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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Northern Migratory Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Rosel *et al.* 2009; Duffield and Wells 2002). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-1988 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (Rosel *et al.* 2009; McLellan *et al.* 2003).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Hoelzel *et al.* 1998; Mead and Potter 1995; Rosel *et al.* 2009). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina, identified 2 concentrations of bottlenose dolphins, 1 inshore of the 25-m isobath and the other offshore of the 50m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters < 25 m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected from large vessel surveys during the summers of 1998 and 1999, from systematic biopsy sampling efforts in nearshore waters from New Jersey to central Florida conducted in the summers of 2001 and 2002, and from winter biopsy collection effort in 2002 and 2003 in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature, and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the 2 morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the 2 morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (< 20 m deep), were of the coastal morphotype, and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the 2 morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, 1 offshore morphotype group was sampled during November just south of Cape Lookout only 7.3 km from shore. Coastal morphotype samples were also collected farther away from shore at 33 m depth and 39 km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the 2 morphotypes. Samples collected in Georgia waters also indicated significant overlap between the 2 morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112 km from shore at a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the 2 morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20 m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20 m and 100 m depth) and overlaps spatially with the offshore morphotype.

Distinction Between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Wells *et al.* 1996; Scott *et al.* 1990; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). The Indian River Lagoon system in central Florida also has a long-term photo-ID study, and this study identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008).

A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters; a study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001; Rosel *et al*. 2009) and animals resident in the Charleston Estuarine System show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al*. 2009). In addition, stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen) in animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March were very low (Cortese 2000). One explanation for this depleted oxygen signature is that a resident group of dolphins in Pamlico Sound moves into nearby nearshore areas in the winter.

Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of the Northern Migratory Coastal Stock

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002), and satellite telemetry (Southeast Fisheries Science Center, unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are 5 coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal stock and a Central Florida Coastal stock.

Among the coastal stocks, the migratory movements and spatial distribution of the Northern Migratory stock are the best understood based on aerial survey data, tag-telemetry studies, photo-ID data and genetic studies. Bottlenose dolphins occur along the North Carolina coast and as far north as Long Island, New York, during summer months (CETAP 1982; Kenney 1990; Garrison *et al.* 2003). During winter months, bottlenose dolphins are rarely observed north of the North Carolina/Virginia border, and their northern distribution appears to be limited by water temperatures < 9.5ºC (Garrison *et al.* 2003). Seasonal variation in the densities of animals observed off Virginia Beach, Virginia, also indicates the seasonal migration of dolphins northward during summer months and then south during winter (Barco and Swingle 1996).

Four dolphins tagged during 2003 and 2004 off the coast of New Jersey in late summer moved south to North Carolina and inhabited waters near and just south of Cape Hatteras during winter months. These animals then moved north to New Jersey again during the following summer (SEFSC, unpublished data). Similarly, dolphins tagged off Virginia Beach, Virginia, during the late summer occupied the area between Cape Hatteras and Cape Lookout

during winter months (NMFS 2001). There is no evidence suggesting that these animals moved farther south than Cape Lookout during winter months (NMFS 2001).

In addition, there are no matches in long term photo-ID studies between sites in New Jersey and those south of Cape Hatteras (Urian *et al.* 1999; NMFS 2001). Genetic analyses also indicated significant differentiation between bottlenose dolphins occupying coastal waters from the North Carolina/Virginia border to New Jersey during summer months and those in southern North Carolina and further south (NMFS 2001; Rosel *et al.* 2009). There was a lack of differentiation in nuclear microsatellite genetic data between animals from Virginia and north and those in southern North Carolina. This is consistent with some degree of seasonal spatial overlap between the Northern Migratory stock and other stocks occupying coastal waters of North Carolina (Rosel *et al.* 2009).

The available data strongly supports the presence of a distinct Northern Migratory stock. However, this stock does overlap spatially with other distinct groups of coastal bottlenose dolphins. During summer months, the degree of overlap with the Southern Migratory stock in coastal waters of northern North Carolina and Virginia is unknown. During winter months, the Northern Migratory stock moves southward to waters from Cape Lookout, North Carolina, to north of Cape Hatteras, North Carolina, based upon tag-telemetry studies. The stock overlaps spatially with the Northern North Carolina Estuarine System stock during this period. These complex seasonal spatial movements and the overlap of coastal and estuarine stocks in the waters of North Carolina greatly limit the ability to fully assess the mortality of each of these stocks.

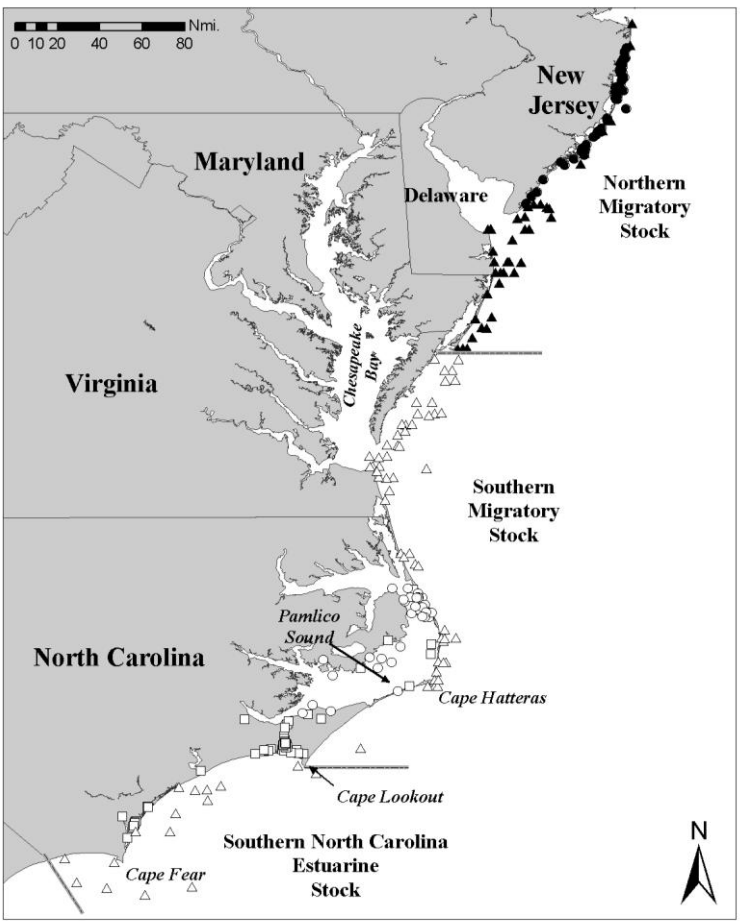

Figure 1. *The summer (July-September) distribution of bottlenose dolphin stocks occupying coastal waters from North Carolina to New Jersey. Locations are shown from aerial surveys (triangles), satellite telemetry (circles), and photo-ID studies (squares). Sightings assigned to the Northern Migratory stock are shown with filled symbols. Photo-ID data are courtesy of Duke University and the University of North Carolina at Wilmington.*

In summary, spatial distribution data, tag-telemetry studies, photo-ID studies and genetic studies demonstrate the existence of a distinct Northern Migratory stock of coastal bottlenose dolphins. During summer months (July-September), this stock occupies coastal waters from the shoreline to approximately the 25m isobath between the Chesapeake Bay mouth and Long Island, New York (Figure 1). During winter months (January-March), the stock moves south to waters of North Carolina and occupies coastal waters from Cape Lookout, North Carolina, to the North Carolina/Virginia border.

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias.

The winter 2002 survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5ºC. During the summer survey, 6,734 km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20 m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia-Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20 m and 20-40 m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189 km of trackline. There were a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457 km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in the Northern Migratory stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003). For the region north of Cape Hatteras, North Carolina, there was complete separation between the coastal and offshore morphotypes, with only coastal animals occupying waters < 20 m deep. Therefore, all animals observed in the 0-20 m depth stratum during surveys of this region were assigned to the coastal morphotype (Garrison *et al.* 2003).

The summer surveys are best for estimating the abundance for both the Northern and Southern Migratory stocks since they overlap least with other stocks during summer months. An analysis of summer survey data from 1995, 2002 and 2004 demonstrated strong inter-annual variation in the spatial distribution of presumed Southern Migratory and Northern Migratory stock animals. Two groups of dolphins in each survey year were identified using a multivariate cluster analysis of sightings based on water temperature, depth and latitude. One group ranged from Cape Lookout, North Carolina, to just north of the Chesapeake Bay mouth, and 1 ranged farther north along the eastern shore of Virginia to New Jersey. The southern group (i.e., the Southern Migratory stock) was found in water temperatures between 26.5 and 28.0°C, and the northern group (i.e., the Northern Migratory stock) occurred in cooler waters between 24.5 and 26.0°C. The spatial distribution of these groups was strongly correlated with water temperatures and varied between years. During the summer of 2004, water temperatures were significantly cooler than those during 2002, and animals from both groups were distributed farther south and overlapped spatially. Very few bottlenose dolphins were observed in waters north of Virginia during the summer 2004 survey.

The best abundance estimate for the Northern Migratory stock is therefore from the summer 2002 survey when there was little overlap and an apparent separation from the Southern Migratory stock at approximately 37.5°N latitude. This boundary is based upon the distribution of the 2 identified clusters of animals, and it likely varies between years as a function of varying water temperatures. Abundance estimates from the summer 2002 survey were derived for these stocks by post-stratifying survey effort and sightings into the identified spatial range of the 2 clusters of animals (Figure 1). The resulting best abundance estimate for the Northern Migratory stock is 9,604 (CV=0.36).

Minimum Population Estimate

The minimum population size (Nmin) was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). The best estimate for the Northern Migratory Coastal stock of bottlenose dolphins is 9,604 (CV=0.36). The resulting minimum population estimate is 7,147.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the Northern Migratory stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Northern Migratory Coastal stock of bottlenose dolphins is 7,147. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is depleted. PBR for this stock of bottlenose dolphins is 71.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

This stock has the potential to interact with the following Category I and II fisheries: (1) mid-Atlantic gillnet; (2) Virginia pound net; (3) mid-Atlantic menhaden; (4) Atlantic blue crab trap/pot, and (5) mid-Atlantic beach/haul seine. The primary known source of fishery mortality is the mid-Atlantic coastal gillnet fishery, which affects the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System stocks of bottlenose dolphin. At certain times of year, it is not possible to definitively assign mortalities observed in that fishery to a specific stock because of the overlap amongst the 4 stocks around North Carolina. Additional fishery interactions have been reported in Virginia pound nets, beach-based gillnet gear, and blue crab or other pot gear. However, none of these fisheries has systematic federal observer coverage, which prevents the estimation of total takes. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III. The total estimated average annual fishery mortality of the Northern Migratory stock ranges between a minimum of 5.92 and a maximum of 8.22 animals per year. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Earlier Interactions

The Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 bottlenose dolphins (NMFS 1991, pp. 5-73). However, no observer data are available, and this information has not been updated for some time.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of coastal morphotype bottlenose dolphins, and the sink gillnet gear in North Carolina is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish or finfish generically (Rossman and Palka 2001). From 2001-2008, 7 additional bottlenose dolphin mortalities were observed in the mid-Atlantic gillnet fishery. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April and 2 occurring off of Virginia during November. Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003, 1 in September 2005, 1 in September 2006 and 1 in October 2006. Because the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign all observed mortalities, or extrapolated bycatch estimates, to a specific stock. In addition, the Bottlenose Dolphin Take

Reduction Plan (BDTRP) was implemented in May 2006 resulting in changes in the gear configurations and other characteristics of the fishery.

To estimate the mortality of bottlenose dolphins in the mid-Atlantic gillnet fishery, the available data were divided into the period from 2002 through April 2006 (pre-BDTRP) and from May 2006-2008 (post-BDTRP). Three alternative approaches were used to estimate bycatch rates. First, a generalized linear model (GLM) approach was used similar to that described in Rossman and Palka (2001). This approach included all observed mortalities from 1995-2008 where the fishing gear was still in use during the period from 2002-2008. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data. Finally, a ratio estimator pooled across years was used to estimate different CPUE values for the pre-BDTRP and post-BDTRP periods. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality, again similar to the approach in Rossman and Palka (2001). To account for the uncertainty in the most appropriate of these 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) are used to estimate the mortality of bottlenose dolphins for this fishery (Table 1).

Table 1. Summary of the 2002-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) in the Northern Migratory stock in the commercial mid-Atlantic gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-BDTRP) and after the implementation of the plan (post-BDTRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data, VMRC landings and NCDMF dealer data. Values in parentheses indicated the CV of the estimate.

Period	Year	Observer Coverage[a]	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-BDTRP	2002	0.01	0	0	24.75 (0.34)	0	0	27.87 (0.33)
	2003	0.01	0	0	11.77 (0.36)	0	0	19.98 (0.30)
	2004	0.02	0	0	14.57 (0.35)	0	0	21.83 (0.33)
	2005	0.03	0	0	14.67 (0.39)	0	0	19.55 (0.32)
	Jan-Apr 2006	0.03	0	0	5.92 (0.37)	0	0	6.50 (0.37)
Annual Avg. pre-BDTRP			Minimum: 4.78 (CV=0.17)			Maximum: 6.38 (CV=0.15)		
post-BDTRP	May-Dec 2006	0.03	0	0	7.99 (0.30)	0	0	9.07 (0.29)
	2007	0.03	0	0	20.66 (0.31)	0	0	24.51 (0.31)
	2008	0.01	0	0	18.75 (0.31)	0	0	20.61 (0.31)
Annual Avg. post-BDTRP			Minimum: 5.27 (CV=0.19)			Maximum: 6.02 (CV=0.19)		

[a] Observer coverage is reported on an annual basis for the entire fishery as a proportion of the reported tons of fish landed.

There have been no observed mortalities in the mid-Atlantic gillnet fishery since 2001 that could potentially be assigned to the Northern Migratory stock. Hence, both the annual and pooled ratio estimators of bycatch rate were equal to zero in both the pre-BDTRP and post-BDTRP periods. Since the GLM approach includes information from prior to 2002, positive bycatch rates for the Northern Migratory stock were estimated (Table 1). Since observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year, the minimum and maximum possible mortality of the Northern Migratory stock are presented for comparison to PBR (Table 1).

Based upon these analyses, the minimum mortality estimate for the Northern Migratory stock for the pre-BDTRP period was 4.78 (CV=0.17) animals per year, and that for the post-BDTRP period was 5.27 (CV=0.19) animals per year. The maximum estimates were 6.38 (CV=0.15) for the pre-BDTRP period and 6.02 (CV=0.19) for the post-BDTRP period (Table 1).

Beach Haul Seine/Beach-based Gillnet Gear

Two coastal bottlenose dolphin takes were observed in beach haul seine gear: 1 in May 1998 and 1 in December 2000. These takes occurred during a striped bass fishery within the spatial and seasonal range of the Northern Migratory stock. Beach-based gillnet gear is now considered part of the Mid-Atlantic gillnet fishery described above; however, it is not included in the observer program or resulting mortality estimates. Data from the Southeast Region Stranding Network from 2002-2008 include 2 confirmed reports of bottlenose dolphin mortalities in beach-based gillnet gear for striped bass during winter months off the coast of northern North Carolina: 1 in December 2002 and 1 in January 2008. A third possible mortality associated with this gear occurred during December 2002 (Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Based upon their location and time of year, these mortalities were most likely animals from the Northern Migratory stock.

Crab Pots and Other Pots

Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that interactions with pot gear are a common occurrence and result in mortalities of coastal morphotype bottlenose dolphins in some regions (Burdett and McFee 2004). Southeast Regional Marine Mammal Stranding Network data (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009) from 2004 through 2008 include 13 reports of interactions between bottlenose dolphins and confirmed blue crab pot gear with the majority of these occurring in waters from Florida to South Carolina. In addition, there were 4 interactions documented with pot gear where the fishery could not be confirmed. In these cases, the gear was confirmed to be associated with a pot or trap, but may have been from a fishery other than blue crab (e.g., whelk fisheries in Virginia). None of these confirmed mortalities could be assigned to the Northern Migratory stock.

Virginia Pound Nets

Historical and recent stranding network data report interactions between bottlenose dolphins and pound nets in Virginia. Stranding data for 2004-2008 indicate 17 cases where bottlenose dolphins were removed from pound net gear, and it was determined that animals were entangled pre-mortem. In each case, the bottlenose dolphin was recovered directly from the fishing gear. Of these 17 cases, 14 were documented mortalities while 3 were released alive (S. Barco, Virginia Aquarium, unpublished data; Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). These interactions occurred primarily inside estuarine waters near the mouth of the Chesapeake Bay and in summer months. Five of these mortalities occurred during May and June when they could have impacted either the Northern Migratory or Southern Migratory stocks.

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies, turtle relocation trawls, and fisheries surveys. From 2002-2008, there have been 15 reported interactions during these activities resulting in 13 documented mortalities of bottlenose dolphins. One mortality in a research beach seine was reported from June 2007 in Northern North Carolina that was consistent with the spatial

range of the Northern Migratory stock, the Southern Migratory stock, or the Northern North Carolina Estuarine System stock. All mortalities from known sources including commercial fisheries and research related mortalities for the stock are summarized in Table 2.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly in estuaries near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004), and in portions of Biscayne Bay, Florida (Litz *et al.* 2007). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins and little study of contaminant loads in migrating coastal dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 2. Summary of annual reported and estimated mortality of bottlenose dolphins from the Northern Migratory stock. Where minimum and maximum values are reported, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. The reported mortalities in Virginia pound net, beach-based gillnet and crab pot fisheries are confirmed reports and are likely an underestimate of total mortalities in these fisheries.

Year	Mid-Atlantic Gillnet	Virginia Pound Net	Beach-based Gillnet Gear	Blue Crab Pot	Other Pot	Fishery Research	Total
2004	Min = 4.9 Max = 7.3	Min = 0 Max = 3	0	0	0	0	Min = 4.9 Max = 10.3
2005	Min = 4.9 Max = 6.5	0	0	0	0	0	Min = 4.9 Max = 6.5
2006	Min = 4.6 Max = 5.2	0	0	0	0	0	Min = 4.6 Max = 5.2
2007	Min = 6.9 Max = 8.2	Min = 0 Max = 2	0	0	0	Min = 0 Max = 1	Min = 6.9 Max = 11.2
2008	Min = 6.3 Max = 6.9	0	1	0	0	0	Min = 7.3 Max = 7.9
Annual Average Mortality (2004-2008)				Minimum Estimated = 5.92 Maximum Estimated = 8.22			

Strandings

Between 2004 and 2008, 484 bottlenose dolphins stranded along the Atlantic coast between North Carolina and New York that could be assigned to the Northern Migratory stock (Table 3; Northeast Regional Marine Mammal Stranding Network; Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). The assignment of animals to a particular stock is impossible in some seasons and regions, particularly in North Carolina, Virginia and Maryland. Therefore, it is likely that the counts below include some animals from either the Southern Migratory or Northern North Carolina Estuarine System stocks. In addition, stranded carcasses are not

routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form. In most cases, it was not possible to determine if a human interaction had occurred due to the decomposition state of the stranded animal. However, in cases where a determination could be made, the incidence of evidence of fisheries interactions was high, particularly in Virginia and North Carolina where the percentages of stranded animals with evidence of fisheries interaction were 57% and 45% respectively when a determination could be made. It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point in the animal's life. Evidence of fishery interaction is by far the most common type of human interaction reported.

Table 3. Strandings of bottlenose dolphins from North Carolina to New York that can possibly be assigned to the Northern Migratory stock. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, in waters of North Carolina, Virginia and Maryland there is likely overlap with other stocks during particular times of year. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009.

State	**2004**			**2005**			**2006**			**2007**			**2008**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
North Carolina[a]	5	2	16	0	2	17	0	3	11	2	2	16	2	2	9
Virginia[b]	15	12	32	9	16	17	10	1	30	6	4	22	9	4	43
Maryland[b]	1	4	3	1	0	1	2	3	6	1	2	6	2	0	1
Delaware	1	11	4	1	1	7	2	0	8	0	0	13	0	0	3
New Jersey	2	11	2	0	7	6	3	9	3	3	5	3	0	8	3
New York	0	0	0	0	0	0	0	4	3	0	6	3	0	0	0
Annual Total	121			85			98			94			86		

[a] Strandings for North Carolina include data for November-April north of Cape Lookout when Northern Migratory animals may be in coastal waters. The stock identity of these strandings is highly uncertain and likely also includes animals from the Northern North Carolina Estuarine System stock.

[b] Strandings from Virginia and Maryland were assigned to stock based upon both location and time of year. Some of the strandings assigned to the Northern Migratory stock could possibly be assigned to the Southern Migratory stock or Northern North Carolina Estuarine System stock.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the WNA, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2009 to recognize resident estuarine stocks and migratory and resident coastal stocks. The total U.S. fishery-related mortality and serious injury for the Northern Migratory stock cannot be directly estimated because of the spatial overlap among the stocks of bottlenose dolphins that occupy waters of North Carolina. In addition, several fisheries are unobserved and the reported mortalities are minimum estimates. The total mortality is therefore unlikely to be less than 10% of the calculated PBR, and thus cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This stock retains the depleted designation as a result of its origins from the coastal migratory stock. The species is not listed as threatened or endangered under the Endangered Species Act, but this is a strategic stock due to the depleted listing under the MMPA.

REFERENCES CITED

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwacke, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin and D. A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10: 157-167.

Barco, S. G. and W. M. Swingle. 1996. Sighting patterns of coastal migratory bottlenose dolphins (*Tursiops truncatus*) in the nearshore waters of Virginia and North Carolina. Final Report to the Virginia Dept. of Environmental Quality, Coastal Resources Management Program through Grant #NA47OZ0287-01 from NOAA, Office of Ocean and Coastal Resource Management. 32 pp.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 pp.

Burdett, L. G. and W. E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorization. J. Cetacean Res. Mange. 6(3): 231-240.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

CETAP (Cetacean and Turtle Assessment Program). 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final Report, Contract AA551- CT8- 48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, D.C. 576 pp.

Duffield, D. A. and R. S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. *In*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.

Garrison, L. P., P. E. Rosel, A. A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., L. H. Schwacke, G. B. Mitchum, A. A. Hohn, R. S. Wells, E. S. Zolman and P. A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Kuehl, D. W., R. Haebler and C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.

Litz, J. A. 2007. Social structure, genetic structure, and persistent organohaline pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, FL. Ph.D. dissertation from University of Miami. 140 pp.

Litz, J. A., L. P. Garrison, L. A. Fieber, A. Martinez, J. P. Contillo and J. R. Kucklick. 2007. Fine-scale spatial variation of persistent organic pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Environ. Sci. Technol. 41: 7222-7228.

Mazzoil, M., J. S. Reif, M. Youngbluth, M. E. Murdoch, S. E. Bechdel, E. Howells, S. D. McCulloch, L. J. Hansen and G. D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

McLellan, W. M., A. S. Friedlaender, J. G. Mead, C. W. Potter and D. A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4: 297-304.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Rossman, M. C. and D. L. Palka. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15. 77 pp.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21: 2752-2764.

Scott, G. P., D. M. Burn and L. J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3: 819-823.

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Stolen, M. K., W. N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45-54.

Speakman, T., E. S. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.

Urian, K. W., A. A. Hohn and L. J. Hansen. 1999. Status of the photo-identification catalog of coastal bottlenose dolphins of the western north Atlantic: Report of a workshop of catalog contributors. NOAA Tech. Memo. NMFS-SEFSC-425. 22pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S., M. D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York. 519 pp.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Mar. Mamm. Sci. 18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Southern Migratory Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Rosel *et al.* 2009; Duffield and Wells 2002). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-1988 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (Rosel *et al.* 2009; McLellan *et al.* 2003).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Hoelzel *et al.* 1998; Mead and Potter 1995; Rosel *et al.* 2009). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina, identified 2 concentrations of bottlenose dolphins, 1 inshore of the 25-m isobath and the other offshore of the 50-m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters < 25 m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected from large vessel surveys during the summers of 1998 and 1999, from systematic biopsy sampling efforts in nearshore waters from New Jersey to central Florida conducted in the summers of 2001 and 2002, and from winter biopsy collection effort in 2002 and 2003 in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature, and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the 2 morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the 2 morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (< 20 m deep), were of the coastal morphotype, and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the 2 morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, 1 offshore morphotype group was sampled during November just south of Cape Lookout only 7.3 km from shore. Coastal morphotype samples were also collected farther away from shore at 33 m depth and 39 km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the 2 morphotypes. Samples collected in Georgia waters also indicated significant overlap between the 2 morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112 km from shore and a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the 2 morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20 m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20 m and 100 m depth) and overlaps spatially with the offshore morphotype.

Distinction Between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Wells *et al.* 1996; Scott *et al.* 1990; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). The Indian River Lagoon system in central Florida also has a long-term photo-ID study, and this study identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008).

A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters; a study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001; Rosel *et al*. 2009), and animals resident in the Charleston Estuarine System show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al*. 2009). In addition, stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen) in animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March were very low (Cortese 2000). One explanation for this depleted oxygen signature is that a resident group of dolphins in Pamlico Sound moves into nearby nearshore areas in the winter.

Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of the Southern Migratory Coastal Stock

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002), and satellite telemetry (Southeast Fisheries Science Center, unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are 5 coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal stock and a Central Florida Coastal stock.

Among the coastal stocks, the migratory movements and spatial distribution of the Southern Migratory stock are the most poorly understood. Stable isotope analysis conducted using biopsy samples from free-ranging animals sampled in estuarine, nearshore coastal and offshore habitats suggests migratory movement of animals in coastal waters between Georgia in the winter and southern North Carolina during the summer and fall. In that study, $^{15}N\backslash^{14}N$, and $^{34}S\backslash^{32}S$ ratios of animals sampled off of Georgia during winter months were similar to those of animals sampled in waters off of southern North Carolina, near Cape Fear, during winter months (Knoff 2004). Satellite tag telemetry studies also provide evidence for a stock of dolphins migrating seasonally along the coast between North Carolina and northern Florida. Two dolphins were tagged during November 2004 just south of Cape Fear, North Carolina. One of these animals remained along the South Carolina and southern North Carolina coasts throughout the winter (January-February) while the other migrated south to Northern Florida through February. In the spring (March-June), these animals moved further north of the tagging site to Cape Hatteras, North Carolina. The tags did not last beyond June, and therefore the distribution of these animals during summer months is unknown (Southeast Fisheries Science Center, unpublished data).

Genetic analyses indicate significant differentiation between bottlenose dolphins occupying coastal waters from the North Carolina/Virginia border to New Jersey during summer months and those in southern North Carolina and further south (Rosel *et al.* 2009). In addition, tagging studies of animals occupying New Jersey waters during the summer indicate that animals from the Northern Migratory stock do not move south of Cape Lookout, North Carolina during winter months. These data demonstrate that the Northern Migratory stock is distinct from the potential Southern Migratory stock. However, there is limited capability to demonstrate genetic differentiation of the Southern Migratory stock from other coastal and estuarine bottlenose dolphin stocks because the Southern Migratory stock overlaps spatially with at least 1 other stock of bottlenose dolphins throughout the year.

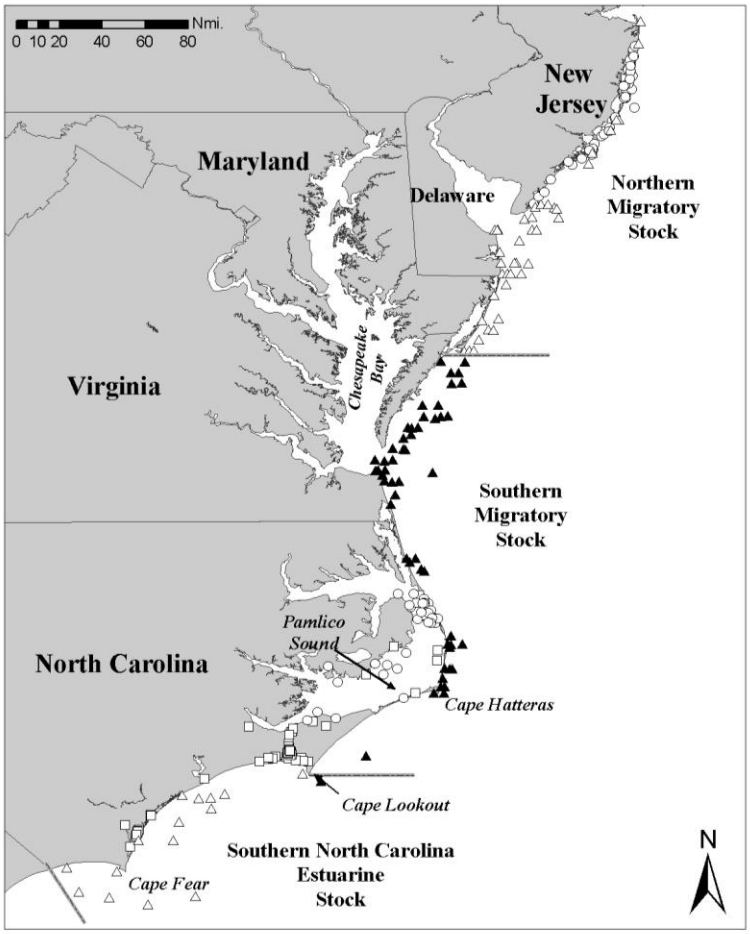

Figure 1. *The summer (July-September) distribution of bottlenose dolphin stocks occupying coastal waters from North Carolina to New Jersey. Locations are shown from aerial surveys (triangles), satellite telemetry (circles), and photo-ID studies (squares). Sightings assigned to the Southern Migratory stock are shown with filled symbols. Photo-ID data are courtesy of Duke University and the University of North Carolina at Wilmington.*

In summary, the limited data available supports the definition of a Southern Migatory stock of coastal morphotype bottlenose dolphins; however, there is a large amount of uncertainty in its spatial movements. The seasonal movements are best described by tag telemetry data. During the fall (October-December), this stock occupies waters of southern North Carolina (South of Cape Lookout) where it overlaps spatially with the Southern North Carolina Estuarine System stock in coastal waters. In winter months (January-March), the Southern Migratory stock moves as far south as northern Florida where it overlaps spatially with the South Carolina/Georgia and Northern Florida Coastal stocks. In spring (April-June), the stock moves north to waters of North Carolina where it overlaps with the Southern North Carolina Estuarine System stock and the Northern North Carolina Estuarine System stock. In summer months (July-September), the stock is presumed to occupy coastal waters north of Cape Lookout, North Carolina, to the eastern shore of Virginia (Figure 1). It is possible that these animals also occur inside the Chesapeake Bay and in nearshore coastal waters where there is evidence that Northern North Carolina Estuarine System stock animals also occur.

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias.

The winter 2002 survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5ºC. During the summer survey, 6,734 km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20 m and 20-40 m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189 km of trackline. There were a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457 km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003). For the region north of Cape Hatteras, North Carolina, there was complete separation between the coastal and offshore morphotypes, with only coastal animals occupying waters < 20 m deep. Therefore, all animals observed in the 0-20 m depth stratum during surveys of this region were assigned to the coastal morphotype (Garrison *et al.* 2003).

The summer surveys are best for estimating the abundance for both the Northern and Southern Migratory stocks since they overlap least with other stocks during summer months. An analysis of summer survey data from 1995, 2002 and 2004 demonstrated strong inter-annual variation in the spatial distribution of presumed Southern Migratory and Northern Migratory stock animals. Two groups of dolphins in each survey year were identified using a multivariate cluster analysis of sightings based on water temperature, depth and latitude. One group ranged from Cape Lookout, North Carolina, to just north of the Chesapeake Bay mouth, and 1 ranged farther north along the eastern shore of Virginia to New Jersey. The southern group (i.e., the Southern Migratory stock) was found in water temperatures between 26.5 and 28.0°C, and the northern group (i.e., the Northern Migratory stock) occurred in cooler waters between 24.5 and 26.0°C. The spatial distribution of these groups was strongly correlated with water temperatures and varied between years. During the summer of 2004, water temperatures were significantly cooler than those during 2002, and animals from both groups were distributed farther south and overlapped spatially. Very few bottlenose dolphins were observed in waters north of Virginia during the summer 2004 survey.

The best abundance estimate for the Southern Migratory stock is therefore from the summer 2002 survey when there was little overlap and an apparent separation from the Northern Migratory stock at approximately 37.5°N latitude. This boundary is based upon the distribution of the 2 identified clusters of animals, and it likely varies between years as a function of varying water temperatures. Abundance estimates from the summer 2002 survey were derived for these stocks by post-stratifying survey effort and sightings into the identified spatial range of the 2 clusters of animals (Figure 1). The resulting best abundance estimate for the Southern Migratory stock is 12,482 (CV=0.32).

Minimum Population Estimate

The minimum population size (Nmin) was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). The best estimate for the Southern Migratory Coastal stock of bottlenose dolphins is 12,482 (CV=0.32). The resulting minimum population estimate is 9,591.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the Southern Migratory stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Southern Migratory Coastal stock of bottlenose dolphins is 9,591. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is depleted. PBR for this stock of bottlenose dolphins is 96.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

This stock has the potential to interact with the following Category I and II fisheries: (1) mid-Atlantic gillnet; (2) Virginia pound net; (3) mid-Atlantic menhaden; (4) Atlantic blue crab trap/pot; (5) mid-Atlantic beach/haul seine; (6) Southeastern U.S. Atlantic shark gillnet; and (7) Southeast Atlantic gillnet. The primary known source of fishery mortality is the mid-Atlantic gillnet fishery, which affects the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System stocks of bottlenose dolphin. At certain times of year, it is not possible to definitively assign mortalities observed in that fishery to a specific stock. Additional commercial fisheries that may impact the Southern Migratory stock are Virginia pound nets, blue crab or other pot fisheries, the shark gillnet and the shrimp trawl fishery. With the exception of the shark gillnet fishery, these fisheries, lack systematic federal observer coverage, which prevents the estimation of total takes. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III. The total estimated average annual fishery mortality of the Southern Migratory stock ranges between a minimum of 24.0 and a maximum of 55.0 animals per year. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Earlier Interactions

The Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 bottlenose dolphins (NMFS 1991, pp. 5-73). However, no observer data are available, and this information has not been updated for some time.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of coastal morphotype bottlenose dolphins, and sink gillnet gear in North Carolina is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish or finfish generically (Rossman and Palka 2001). From 2001-2008, 7 additional bottlenose dolphin mortalities were observed in the mid-Atlantic gillnet fishery. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April and 2 occurring off of Virginia during November. Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003, 1 in September 2005, 1 in September 2006 and 1 in October 2006. Because the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign all observed mortalities, or extrapolated bycatch estimates, to a specific stock. In addition, the Bottlenose Dolphin Take Reduction Plan (BDTRP) was implemented in May 2006 resulting in changes in the gear configurations and other characteristics of the fishery.

To estimate the mortality of bottlenose dolphins in the mid-Atlantic gillnet fishery, the available data were divided into the period from 2002 through April 2006 (pre-BDTRP) and from May 2006 through 2008 (post-BDTRP). Three alternative approaches were used to estimate bycatch rates. First, a generalized linear model (GLM) approach was used similar to that described in Rossman and Palka (2001). This approach included all observed mortalities from 1995-2008 where the fishing gear was still in use during the period from 2002-2008. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data. Finally, a ratio estimator pooled across years was used to estimate different CPUE values for the pre-BDTRP and post-BDTRP periods. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality similar to the approach in Rossman and Palka (2001). To account for the uncertainty in the most appropriate of these 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) are used to estimate the mortality of bottlenose dolphins for this fishery (Table 1).

Table 1. Summary of the 2002-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) in the Southern Migratory stock in commercial mid-Atlantic gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-BDTRP) and after the implementation of the plan (post-BDTRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data, VMRC landings and NCDMF dealer data. Values in parentheses indicated the CV of the estimate.

Period	Year	Observer Coverage[a]	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-BDTRP	2002	0.01	0	29.17 (0.97)	6.71 (0.40)	0	67.83 (0.68)	24.22 (0.45)
	2003	0.01	0	34.77 (0.68)	12.35 (0.36)	63.56 (0.99)	47.08 (0.97)	14.00 (0.40)
	2004	0.02	0	81.52 (0.97)	18.93 (0.39)	0	88.56 (0.68)	31.71 (0.45)
	2005	0.03	114.84 (1)	74.05 (0.68)	19.41 (0.42)	123.18 (1.02)	91.01 (0.97)	26.61 (0.45)
	Jan-Apr 2006	0.03	0	0	0.00	0	0	0.32 (0.42)
Annual Avg. pre-BDTRP			Minimum: 21.81 (CV=0.13)			Maximum: 34.03 (CV=0.12)		
post-BDTRP	May-Dec 2006	0.03	0	0	12.10 (0.48)	174.98 (0.70)	44.29 (0.69)	18.99 (0.51)
	2007	0.03	0	0	10.75 (0.35)	0	36.62 (0.69)	18.33 (0.44)
	2008	0.01	0	0	28.54 (0.51)	0	86.60 (0.69)	36.45 (0.52)
Annual Avg. post-BDTRP			Minimum: 5.71 (CV=0.31)			Maximum: 41.91 (CV=0.14)		

[a] Observer coverage is reported on an annual basis for the entire fishery as a proportion of the reported tons of fish landed.

There have been 4 observed takes in the mid-Atlantic gillnet fishery since 2001 that could potentially be assigned to the Southern Migratory stock. Three of these occurred relatively close to shore and in areas with potential overlap with the Northern North Carolina Estuarine System stock. A fourth occurred several kilometers from shore in northern North Carolina during summer months, and therefore is most likely to be from the Southern Migratory stock. These interactions are reflected in positive values for both the pooled and annual ratio estimators (Table 1). Since observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year, the minimum and maximum possible mortality of the Southern Migratory stock are presented for comparison to PBR (Table 1).

Based upon these analyses, the minimum mortality estimate for the Southern Migratory stock for the pre-BDTRP period was 21.81 (CV=0.13) animals per year, and that for the post-BDTRP period was 5.71 (CV=0.31) animals per year. The maximum estimates were 34.03 (CV=0.12) for the pre-BDTRP period and 41.91 (CV=0.14) for the post-BDTRP period (Table 1).

Crab Pots and Other Pots

Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that interactions with pot gear are a common occurrence and result in mortalities of coastal morphotype bottlenose dolphins in some regions (Burdett and McFee 2004). Southeast Regional Marine Mammal Stranding Network data (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009) from 2004 through 2008 include 13 reports of interactions between bottlenose dolphins and confirmed blue crab pot gear with the majority of these occurring in waters from Florida to South Carolina. In addition, there were 4 interactions documented with pot gear where the fishery could not be confirmed. In these cases, the gear was confirmed to be associated with a pot or trap, but may have been from a fishery other than blue crab (e.g., whelk fisheries in Virginia). There was 1 mortality in pot gear where the fishery type could not be confirmed in Virginia. This mortality was reported in August 2007 and could be assigned to either the Southern Migratory or the NNCES stock.

Virginia Pound Nets

Historical and recent stranding network data report interactions between bottlenose dolphins and pound nets in Virginia. Stranding data for 2004-2008 indicate 17 cases where bottlenose dolphins were removed from pound net gear, and it was determined that animals were entangled pre-mortem. In each case, the bottlenose dolphin was recovered directly from the fishing gear. Of these 17 cases, 14 were documented mortalities while 3 were released alive (S. Barco, Virginia Aquarium, unpublished data; Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). These interactions occurred primarily inside estuarine waters near the mouth of the Chesapeake Bay and in summer months. Five of these mortalities occurred during May and June when they could have impacted either the Northern Migratory or Southern Migratory stocks. The other 9 mortalities occurred during the summer (July-September) when they could have impacted either the Southern Migratory or the Northern North Carolina Estuarine System stocks. The overall impact of the Virginia Pound Net fishery on the Southern Migratory stock is unknown due to the limited information on the stock's movements, particularly whether or not it occurs within waters inside the mouth of the Chesapeake Bay.

Southeastern U.S. Atlantic Shark Gillnet Fishery and Southeast Atlantic Gillnet Fishery

Gillnet fisheries targeting finfish and sharks operate in southeast waters between North Carolina and southern Florida. Historically, a drift net fishery targeting coastal sharks operated in waters in northern Florida during winter months that could have interacted with the Southern Migratory stock. Bottlenose dolphin takes (n=2) in the drift net fisheries in this area were documented in 2002 and 2003 (Garrison 2007). Currently, gillnet fisheries include a number of different fishing methods and gear types including drift nets, "strike" fishing and anchored ("sink") gillnets. The majority of this fishing is reported from waters of North Carolina and central Florida, and very little effort is reported during winter months (January-March) within the range of the Southern Migratory stock. There have been no observed recent bottlenose dolphin takes within the stock boundaries.

Southeastern U.S. Shrimp Trawl Fishery

In August 2002 in Beaufort County, South Carolina, a fisherman self-reported a dolphin entanglement in a commercial shrimp trawl. However, this is outside of the seasonal range of the Southern Migratory stock in these

waters, and there is relatively little effort during winter months when the fishery could possibly interact with this stock. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including directed live capture studies, turtle relocation trawls and fisheries surveys. From 2002-2008, there have been 15 reported interactions during research activities resulting in 13 documented mortalities of bottlenose dolphins. A mortality occurring in a turtle relocation trawl off of North Carolina during March of 2002 could have been attributed to either the Southern Migratory stock or the Northern North Carolina Estuarine System stock. One mortality in a research beach seine was reported from June 2007 in northern North Carolina that was consistent with the spatial range of the Northern Migratory stock, the Southern Migratory stock or the Northern North Carolina Estuarine System stock. All mortalities from known sources including commercial fisheries and research related mortalities for each provisional stock are summarized in Table 2.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly in estuaries near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004), and in portions of Biscayne Bay, Florida (Litz *et al.* 2007). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins and little study of contaminant loads in migrating coastal dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 2. Summary of annual reported and estimated mortality of bottlenose dolphins from the Southern Migratory stock. Where minimum and maximum values are reported, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. The reported mortalities in Virginia pound net and pot fisheries are confirmed reports and are likely an underestimate of total mortalities in these fisheries.

Year	Mid-Atlantic Gillnet	Virginia Pound Net	Blue Crab Pot	Other Pot	Research	Total
2004	Min = 33.5 Max = 40.1	Min = 0 Max = 6	0	0	0	Min = 33.5 Max = 46.1
2005	Min = 69.4 Max = 80.3	Min = 0 Max = 1	0	0	0	Min = 69.4 Max = 81.3
2006	Min = 4.0 Max = 79.5	Min = 0 Max = 2	0	0	0	Min = 4.0 Max = 81.5
2007	Min = 3.6 Max = 18.3	Min = 0 Max = 3	0	Min = 0 Max = 1	Min = 0 Max = 1	Min = 3.6 Max = 23.3
2008	Min = 9.5 Max = 41.0	Min = 0 Max = 2	0	0	0	Min = 9.5 Max = 43.0

Annual Average Mortality (2004-2008)	Minimum Estimated = 24.00 Maximum Estimated = 55.04

Strandings

Between 2004 and 2008, 588 bottlenose dolphins stranded along the Atlantic coast between Florida and Maryland that could potentially be assigned to the Southern Migratory stock (Table 3; Northeast Regional Marine Mammal Stranding Network; Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). The assignment of animals to a particular stock is impossible in some seasons and regions. During spring and summer months in North Carolina, Virginia and Maryland, the stock overlaps with the Northern Migratory, Northern North Carolina Estuarine System and the Southern North Carolina Estuarine System stocks. During fall and winter months, the stock overlaps with the Southern North Carolina Estuarine System stock, the South Carolina/Georgia Coastal stock, and the Northern Florida Coastal stock. Therefore, the counts below include an unknown number of animals from these other stocks. In addition, stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form. In most cases, it was not possible to determine if a human interaction had occurred due to the decomposition state of the stranded animal. However, in cases where a determination could be made, the incidence of evidence of fisheries interactions was high, particularly in Virginia and North Carolina where the percentages of stranded animals with evidence of fisheries interaction were 61% and 44% respectively when a determination could be made. It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point in the animal's life. Evidence of fishery interaction is by far the most common type of human interaction reported.

Table 3. Strandings of bottlenose dolphins from North Carolina to New York that can possibly be assigned to the Northern Migratory stock. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, in waters of North Carolina, Virginia and Maryland there is likely overlap with other stocks during particular times of year. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009.

State	**2004**			**2005**			**2006**			**2007**			**2008**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
Maryland[a]	1	3	1	1	0	3	1	2	4	1	0	3	1	0	0
Virginia[a]	20	12	36	12	18	25	13	4	36	11	5	30	13	4	44
North Carolina[b]	9	10	28	6	7	35	1	4	22	6	8	25	5	5	25
South Carolina[c] (Dec-Mar)	1	3	5	2	6	4	1	2	8	0	8	10	1	1	5
Georgia[d] (Jan-Feb)	0	0	2	0	1	1	0	0	2	1	1	1	0	0	3

Florida[d] (Jan-Feb)	0	2	1	0	0	3	0	0	4	0	0	8	0	0	1
Annual Total	134			124			104			118			108		

[a] Strandings from Virginia and Maryland were assigned to stock based upon location and time of year with most occurring between May and September that could be assigned to the Southern Migratory stock. Some of these strandings could also be assigned to the Northern Migratory stock or Northern North Carolina Estuarine System stock.

[b] Strandings from North Carolina were assigned based on location and time of year. During summer and fall, some of these strandings could also be assigned to the Northern North Carolina Estuarine System or Southern North Carolina Estuarine System stocks.

[c] Strandings in coastal waters from South Carolina during December-March are potentially from the Southern Migratory stock or the South Carolina/Georgia Coastal resident stock.

[d] Strandings in Georgia and northern Florida during January and February could also be assigned to the South Carolina/Georgia or the Northern Florida Coastal resident stocks, respectively.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal morphotype bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2009 to recognize resident estuarine stocks and migratory and resident coastal stocks. The total U.S. fishery-related mortality and serious injury for the Southern Migratory stock cannot be directly estimated because of the spatial overlap among the stocks of bottlenose dolphins that occupy waters of North Carolina. In addition, several fisheries are unobserved and the reported mortalities are minimum estimates. The total mortality is therefore unlikely to be less than 10% of the calculated PBR, and thus cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This stock retains the depleted designation as a result of its origins from the coastal migratory stock. The species is not listed as threatened or endangered under the Endangered Species Act, but this is a strategic stock due to the depleted listing under the MMPA.

REFERENCES CITED

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwacke, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin and D. A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10: 157-167.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 pp.

Burdett, L. G. and W. E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorization. J. Cetacean Res. Mange. 6(3): 231-240.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

CETAP (Cetacean and Turtle Assessment Program). 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final Report, Contract AA551- CT8- 48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, D.C. 576 pp.

Duffield, D. A. and R. S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. *In*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.

Garrison, L. P. 2007. Estimated marine mammal and turtle bycatch in shark gillnet fisheries along the Southeast US Atlantic coast: 2000-2006. NMFS Southeast Fisheries Science Center. PRD Contribution #PRBD-07/08-02. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P., P. E. Rosel, A. A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., L. H. Schwacke, G. B. Mitchum, A. A. Hohn, R. S. Wells, E. S. Zolman and P. A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Knoff, A.J. 2004. Bottlenose dolphin (*Tursiops truncatus*) population structure along the Atlantic coast of the United States: A stable isotope approach. Ph.D. Dissertation, University of Virginia, Charlottesville, VA, 156 pp.

Kuehl, D. W., R. Haebler and C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.

Litz, J. A. 2007. Social structure, genetic structure, and persistent organohaline pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, FL. Ph.D. dissertation from University of Miami. 140 pp.

Litz, J. A., L. P. Garrison, L. A. Fieber, A. Martinez, J. P. Contillo and J. R. Kucklick. 2007. Fine-scale spatial variation of persistent organic pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Environ. Sci. Technol. 41: 7222-7228.

Mazzoil, M., J. S. Reif, M. Youngbluth, M. E. Murdoch, S. E. Bechdel, E. Howells, S. D. McCulloch, L. J. Hansen and G. D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

McLellan, W. M., A. S. Friedlaender, J. G. Mead, C. W. Potter and D. A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4: 297-304.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Rossman, M. C. and D. L. Palka. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15. 77 pp.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21: 2752-2764.

Scott, G. P., D. M. Burn and L. J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3: 819-823.

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Stolen, M. K., W. N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45-54.

Speakman, T., E. S. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S., M. D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York. 519 pp.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Mar. Mamm. Sci. 18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic South Carolina/Georgia Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Duffield and Wells 2002; Rosel *et al.* 2009). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-1988 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (McLellan *et al.* 2003; Rosel *et al.* 2009).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Mead and Potter 1995; Hoelzel *et al.* 1998; Rosel *et al.* 2009). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina, identified 2 concentrations of bottlenose dolphins, 1 inshore of the 25m isobath and the other offshore of the 50m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters <25m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected during large vessel surveys during the summers of 1998 and 1999, during systematic biopsy sampling efforts in nearshore waters from New Jersey to central Florida conducted in the summers of 2001 and 2002, and during winter biopsy collection efforts in 2002 and 2003, in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the 2 morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the 2 morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (<20m deep) were of the coastal morphotype, and all samples collected in deeper waters (>40m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the 2 morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13m, and coastal morphotype dolphins were observed at depths of 31m and 75km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, 1 offshore morphotype group was sampled during November just south of Cape Lookout only 7.3km from shore. Coastal morphotype samples were also collected farther away from shore at 33m depth and 39km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the 2 morphotypes. Samples collected in Georgia waters also indicated significant overlap between the 2 morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112km from shore at a depth of 38 m. An offshore sample was collected in 22m depth at 40km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the 2 morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20m and 100m depth) and overlaps spatially with the offshore morphotype.

Distinction between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Scott *et al.* 1990; Wells *et al.* 1996; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). A long-term photo-ID study in the Indian River Lagoon system in central Florida has also identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008).

A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters. A study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001; Rosel *et al.* 2009) and animals resident in the Charleston estuarine system show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al.* 2009). In addition, stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen) in animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March were very low (Cortese 2000). One explanation for this depleted oxygen signature is that a resident group of dolphins in Pamlico Sound moves into nearby nearshore areas in the winter.

Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of the South Carolina/Georgia Coastal Stock

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002) and satellite telemetry (NMFS unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are 5 coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal stock and a Central Florida Coastal stock.

The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. Migratory movement and spatial distribution of the Northern Migratory stock is best understood based on tag-telemetry, photo-ID and aerial survey data. This stock migrates seasonally between coastal waters of central North Carolina and New Jersey. It is not thought to overlap with the South Carolina/Georgia Coastal stock in any season. The Southern Migratory stock is defined primarily on satellite tag telemetry studies and is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear and as far south as coastal Florida during winter months.

During summer months when the Southern Migratory stock is found in waters north of Cape Fear, North Carolina, bottlenose dolphins are still seen in coastal waters of South Carolina, Georgia and Florida, indicating the presence of additional stocks of coastal animals. Speakman *et al.* (2006) using photo-ID studies documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the estuarine stock. Genetic analyses of samples from northern Florida, Georgia and central South Carolina (primarily the estuaries around Charleston), using both mitochondrial DNA and nuclear microsatellite markers, indicate significant

genetic differences between these areas (NMFS 2001; Rosel *et al*. 2009). This stock assessment report addresses the South Carolina/Georgia Coastal stock, which is present in coastal Atlantic waters from the North Carolina/South Carolina border south to the Georgia/Florida border (Figure 1). There is no obvious boundary defining the offshore extent of this stock. The combined genetic and logistic regression analysis (Garrison 2007) indicated that in waters less than 10m depth, 70% of the bottlenose dolphins were of the coastal morphotype. Between 10 and 20m depth, the percentage of animals of the coastal morphotype dropped precipitously and at depths >40m nearly all (>90%) animals were of the offshore morphotype. However, in winter months, the Southern Migratory stock (also of the coastal morphotype) moves into this region in waters 10-30m depth complicating the ability to define ocean-side boundaries for the South Carolina/Georgia Coastal stock.

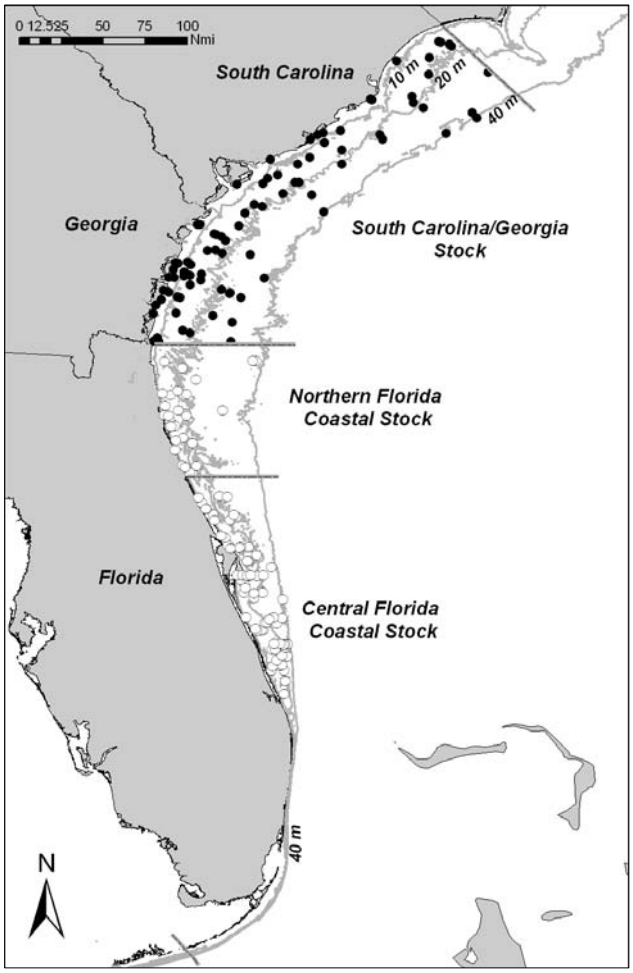

Figure 1. *The South Carolina/Georgia Coastal Stock of bottlenose dolphins (North Carolina/South Carolina border to the Georgia/Florida border). Circles represent all sightings of bottlenose dolphin groups from NMFS 2002 and 2004 aerial surveys; dark circles- groups within the boundaries of this stock. In waters >20m, sightings may include the offshore morphotype of bottlenose dolphins.*

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias.

The winter 2002 survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay where water temperatures were <9.5ºC. During the summer survey, 6,734km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20m and 20-40m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189km of trackline. There were 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in each stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the

direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003).

There is apparent inter-annual variation in the abundance estimates and observed spatial distribution of bottlenose dolphins in this region that may indicate movements of animals in response to environmental variability. However, at this time there is no tag-telemetry or genetic evidence supporting the presence of additional migratory stocks along the southern portion of the survey range.

For the South Carolina/Georgia Coastal stock, the mean of the summer 2002 and 2004 abundance estimates provided the best estimate of abundance. During winter months, this stock overlaps spatially with the Southern Migratory stock and hence winter survey data are inappropriate for estimating abundance of the South Carolina/Georgia Coastal stock. The abundance estimate for this stock from the summer 2002 survey was 8,518 (CV=0.37) and that from summer 2004 was 7,379 (CV=0.29). The best abundance estimate is the inverse-variance weighted average of these 2 surveys and is 7,738 (CV=0.23).

Minimum Population Estimate

The minimum population size (Nmin) for the stock was calculated as the lower bound of the 60% confidence interval for a log-normally distributed mean (Wade and Angliss 1997). The best estimate for the South Carolina/Georgia Coastal stock is 7,738 (CV=0.23). The resulting minimum population estimate is 6,399.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the western North Atlantic coastal morphotype. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the South Carolina/Georgia Coastal stock of bottlenose dolphins is 6,272. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is depleted. PBR for this stock of bottlenose dolphins is 64.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Three Category II fisheries have the potential to interact with the South Carolina/Georgia Coastal stock of bottlenose dolphins – the Southeastern U.S. Atlantic shark gillnet fishery, the Southeast Atlantic gillnet fishery and the Atlantic blue crab/trap pot fishery. In addition, the Southeastern U.S. Atlantic shrimp trawl fishery (Category III) has the potential to interact with this stock. Only limited observer data are available for these and other fisheries that may interact with this stock. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Southeastern U.S. Atlantic Shark Gillnet Fishery and Southeast Atlantic Gillnet Fishery

Gillnet fisheries targeting finfish and sharks operate in southeast waters between North Carolina and southern Florida. These fisheries include a number of different fishing methods and gear types including drift nets, “strike” fishing, and anchored (“sink”) gillnets. The majority of this fishing is reported from waters of North Carolina and central Florida. A small number of trips (average 35 annually from 2004-2008) are reported within the bounds of the South Carolina/Georgia Coastal stock. There has been no observer coverage of sets within the stock boundaries, and therefore there have been no observed takes.

Southeastern U.S. Shrimp Trawl Fishery

In August 2002 in Beaufort County, South Carolina, a fisherman self-reported a dolphin entanglement in a commercial shrimp trawl. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

Atlantic Blue Crab/Trap Pot Fishery

The blue crab trap pot fishery only rarely fishes in coastal waters of South Carolina and Georgia during winter months. Thus coastal dolphins rarely have the opportunity to encounter trap pots. During 2004-2008, no stranded animals assigned to the South Carolina/Georgia Coastal stock showed evidence of entanglement in trap pot gear.

Other Mortality

There were 128 stranded bottlenose dolphins recovered between 2004 and 2008 in the waters of the South Carolina/Georgia Coastal stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). It was not possible to determine whether or not there was evidence of human interaction for 75 of these strandings and for 48 it was determined there was no evidence of human interaction. The remaining 5 showed evidence of human interaction and 1 of those showed evidence of fishery interaction- an animal was found in 2005 with hook and line in the mouth. Two animals had lacerations, again unknown whether ante-mortem or post-mortem, and 1 had human debris in the forestomach. Finally, 1 of the 6 animals with human interaction determinations was caught in a research trawl in 2006, although it is unknown whether the animal was dead prior to being caught in the trawl. It is worth noting that during winter months, the South Carolina/Georgia Coastal stock overlaps with the Southern Migratory stock and it is currently not possible to distinguish between them. Hence during winter months, stranded dolphins could come from either of these 2 stocks.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al.* 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin inhabiting estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2010 to recognize resident estuarine stocks and migratory and resident coastal stocks. This stock retains the depleted designation as a result of its origins from the originally delineated depleted coastal migratory stock. The total U.S. fishery-related mortality and serious injury for the South Carolina/Georgia Coastal stock is unknown. There are several commercial fisheries overlapping with the stock boundaries; however, these have little to no observer coverage. Insufficient information is available to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching a zero mortality and serious injury rate. The species is not listed as threatened or endangered under the Endangered Species Act, but this is a strategic stock due to the depleted listing under the MMPA.

REFERENCES CITED

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwacke, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin and D. A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10: 157-167.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

CETAP (Cetacean and Turtle Assessment Program). 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final Report, Contract AA551- CT8- 48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, D.C. 576 pp.

Duffield, D. A. and R. S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus.* pp. 3-11. *In*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.

Garrison, L. P. 2007. Estimated marine mammal and turtle bycatch in the shark gillnet fisheries along the southeast U.S. Atlantic coast: 2000-2006. Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149. PRD Document #07/08-10, 22 pp.

Garrison, L. P., P. E. Rosel, A. A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., L. H. Schwacke, G. B. Mitchum, A. A. Hohn, R. S. Wells, E. S. Zolman and P. A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Kuehl, D. W., R. Haebler, C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.

Litz, J. A. 2007. Social structure, genetic structure, and persistent organohaline pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, FL. Ph.D. dissertation from University of Miami. 140 pp.

Mazzoil, M., J. S. Reif, M. Youngbluth, M. E. Murdoch, S. E. Bechdel, E. Howells, S. D. McCulloch, L. J. Hansen and G. D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

McLellan, W. M., A. S. Friedlaender, J. G. Mead, C. W. Potter and D. A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4: 297-304.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21: 2752-2764.

Scott, G. P., D. M. Burn and L. J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3: 819-823.

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Stolen, M. K., W. N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45-54.

Speakman, T., E. S. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S., M. D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York. 519 pp.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Mar. Mamm. Sci.18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Northern Florida Coastal Stock

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The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Duffield and Wells 2002; Rosel *et al.* 2009). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-1988 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (McLellan *et al.* 2003; Rosel *et al.* 2009).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Mead and Potter 1995; Hoelzel *et al.* 1998; Rosel *et al.* 2009). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina, identified 2 concentrations of bottlenose dolphins, 1 inshore of the 25m isobath and the other offshore of the 50m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters <25m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected during large vessel surveys during the summers of 1998 and 1999, during systematic biopsy sampling efforts in nearshore waters from New Jersey to central Florida conducted in the summers of 2001 and 2002, and during winter biopsy collection efforts in 2002 and 2003, in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the 2 morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the 2 morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (<20m deep) were of the coastal morphotype, and all samples collected in deeper waters (>40m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the 2 morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13m, and coastal morphotype dolphins were observed at depths of 31m and 75km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, 1 offshore morphotype group was sampled during November just south of Cape Lookout only 7.3km from shore. Coastal morphotype samples were also collected farther away from shore at 33m depth and 39km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the 2 morphotypes. Samples collected in Georgia waters also indicated significant overlap between the 2 morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112km from shore at a depth of 38m. An offshore sample was collected in 22m depth at 40km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the 2 morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20m and 100m depth) and overlaps spatially with the offshore morphotype.

Distinction between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Scott *et al.* 1990; Wells *et al.* 1996; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). A long-term photo-ID study in the Indian River Lagoon system in central Florida has also identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008).

A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters. A study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001; Rosel *et al.* 2009) and animals resident in the Charleston estuarine system show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al.* 2009). In addition, stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen) in animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March were very low (Cortese 2000). One explanation for this depleted oxygen signature is that a resident group of dolphins in Pamlico Sound moves into nearby nearshore areas in the winter.

Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of the Northern Florida Coastal Stock

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002) and satellite telemetry (NMFS unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are 5 coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal stock and a Central Florida Coastal stock.

The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. Migratory movement and spatial distribution of the Northern Migratory stock is best understood based on tag-telemetry, photo-ID and aerial survey data. This stock migrates seasonally between coastal waters of central North Carolina and New Jersey. It is not thought to overlap with the South Carolina/Georgia Coastal stock in any season. The Southern Migratory stock is defined primarily on satellite tag telemetry studies and is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear and as far south as coastal Florida during winter months. While it is possible that this stock overlaps during winter with the northern range of the Northern Florida Coastal stock, more data are needed to confirm this overlap.

During summer months when the Southern Migratory stock is found in waters north of Cape Fear, North Carolina, bottlenose dolphins are still seen in coastal waters of South Carolina, Georgia and Florida, indicating the presence of additional stocks of coastal animals. Speakman *et al.* (2006) using photo-ID studies documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the estuarine

stock. Genetic analyses of samples from northern Florida, Georgia and central South Carolina (primarily the estuaries around Charleston), using both mitochondrial DNA and nuclear microsatellite markers, indicate significant genetic differences between these areas (NMFS 2001; Rosel *et al*. 2009). This stock assessment report addresses the Northern Florida Coastal stock, which is present in coastal Atlantic waters from the Georgia/Florida border south to 29.4°N (Figure 1). There is no obvious boundary defining the offshore extent of this stock. The combined genetic and logistic regression analysis (Garrison *et al.* 2003) indicated that in waters less than 10m depth, 70% of the bottlenose dolphins were of the coastal morphotype. Between 10 and 20m depth, the percentage of animals of the coastal morphotype dropped precipitously and at depths >40m nearly all (>90%) animals were of the offshore morphotype. However, in winter months, the Southern Migratory stock (also of the coastal morphotype) moves into this region in waters 10-30m depth complicating the ability to define ocean-side boundaries for the Northern Florida Coastal stock.

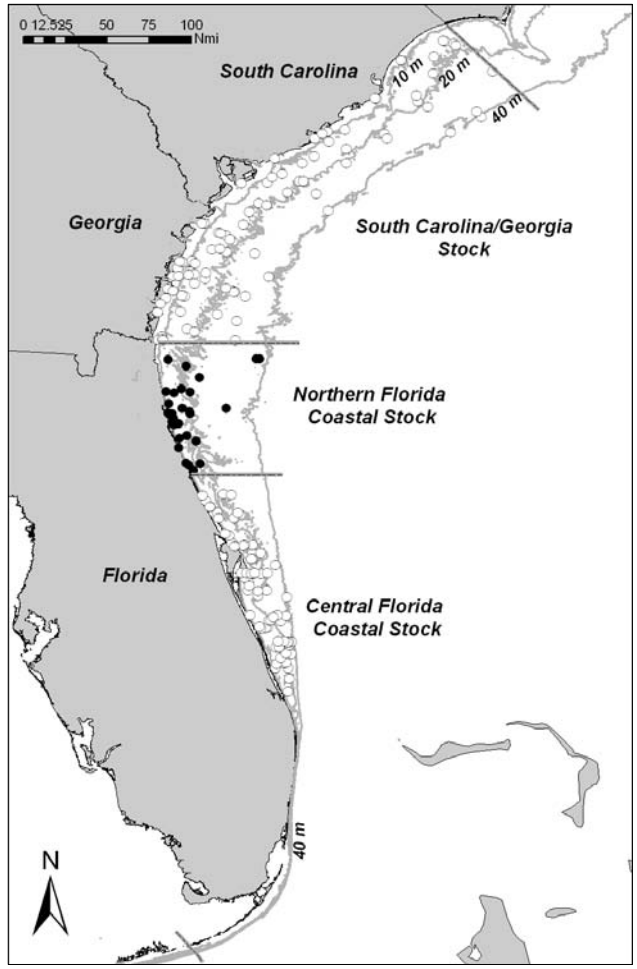

Figure 1. *The Northern Florida Coastal Stock of bottlenose dolphins (Georgia/Florida border to 29.4°N). Circles represent all sightings of bottlenose dolphin groups from NMFS 2002 and 2004 aerial surveys; dark circles- groups within the boundaries of this stock. In waters >20m, sightings may include the offshore morphotype of bottlenose dolphins.*

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias.

The winter 2002 survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay where water temperatures were <9.5ºC. During the summer survey, 6,734km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups was sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20m and 20-40m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189km of trackline. There were 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in each stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability

that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003).

For the Northern Florida Coastal stock, the mean of the summer 2002 and 2004 abundance estimates provided the best estimate of abundance. During winter months, this stock overlaps spatially with the Southern Migratory stock, and hence winter survey data are inappropriate for estimating abundance. There is strong inter-annual variation in the abundance estimates and observed spatial distribution of bottlenose dolphins in this region that may indicate movements of animals in response to environmental variability. The abundance estimate for this stock from the summer 2002 survey was 737 (CV=0.47) and that from summer 2004 was 5,391 (CV=0.27). The best abundance estimate is the unweighted average of these 2 surveys and is 3,064 (CV=0.24). It is unknown why the abundance estimates from 2002 and 2004 differ by nearly an order of magnitude. Survey methodologies did not differ significantly between the years, although a larger amount of survey effort was expended in the Northern Florida and Central Florida strata during 2004 than in 2002. The disparity most likely represents variability in dolphin spatial distribution between those 2 years. Because the 2 abundance estimates differ so dramatically, using an inverse-variance weighted mean when combining the estimates would heavily weight the smaller of the 2 estimates, and therefore would likely introduce negative bias into the estimate of stock size. Therefore, an unweighted mean of the 2002 and 2004 abundance estimates was calculated and used as the best estimate of stock abundance.

Minimum Population Estimate

The minimum population size (Nmin) for the stock was calculated as the lower bound of the 60% confidence interval for a log-normally distributed mean (Wade and Angliss 1997). The best estimate for the Northern Florida Coastal stock is 3,064 (CV=0.24). The resulting minimum population estimate is 2,511.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the western North Atlantic coastal morphotype. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Northern Florida Coastal stock of bottlenose dolphins is 2,502. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is depleted. PBR for this stock of bottlenose dolphins is 25.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Three Category II fisheries have the potential to interact with the Northern Florida Coastal stock of bottlenose dolphins – the Southeastern U.S. Atlantic shark gillnet fishery, the Southeast Atlantic gillnet fishery and the Atlantic blue crab/trap pot fishery. In addition, the Southeastern U.S. Atlantic shrimp trawl fishery (Category III) may interact with this stock. Only limited observer data are available for these and other fisheries that may interact with this stock. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Southeastern U.S. Atlantic Shark Gillnet Fishery and Southeast Atlantic Gillnet Fishery

Gillnet fisheries targeting finfish and sharks operate in southeast waters between North Carolina and southern Florida. Historically, a drift net fishery targeting coastal sharks operated in waters including within the Northern Florida Coastal stock boundaries during winter months. Bottlenose dolphin takes (n=2) in the drift net fisheries were

documented in 2002 and 2003 just south of the range of the Northern Florida Coastal stock (Garrison 2007). Currently, gillnet fisheries include a number of different fishing methods and gear types including drift nets, "strike" fishing, and anchored ("sink") gillnets. The majority of this fishing is reported from waters of North Carolina and central Florida. Gillnet trips (average 211 annually from 2004-2008) are reported within the bounds of the Northern Florida Coastal stock. There have been no observed bottlenose dolphin takes within the stock boundaries, but there was no observer coverage in 2008, so it was not possible to observe any takes (Table 1).

Table 1. Summary of the 2004-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) by stock in the southeast gillnet fisheries in water of the Northern Florida Coastal stock. Data include years sampled (Years), number of vessels reporting effort within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Stock	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northern Florida Coastal	2004-2008		Obs. Data, SEFSC FVL	0.14, 0.09, 0.02, 0.03, 0	0, 0, 0, 0, unk	0, 0, 0, 0, unk	0, 0, 0, 0, NA	NA	0* (*no observer coverage in 2008)

NA = cannot be calculated

[a] Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of reported trips with effort inside the stock boundaries. Reported fishery effort includes a number of different fishing methods and target species that cannot be separated.

[b] Percent observer coverage is reported on a per trip basis as limited by reporting to the FVL. Multiple sets may occur on any given trip.

Atlantic Blue Crab/Trap Pot Fishery

During 2004-2008, no stranded animals assigned to the Northern Florida Coastal stock showed evidence of entanglement in trap pot gear.

Southeastern U.S. Shrimp Trawl Fishery

The shrimp trawl fishery operates in waters off the Florida coast. However, there has been little to no observer coverage of this fishery in the last decade. No other bottlenose dolphin mortality or serious injury related to shrimp trawling along the Florida coast has been reported to NMFS.

Other Mortality

Seventy-eight stranded bottlenose dolphins were recovered between 2004 and 2008 in the waters of the Northern Florida Coastal stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). It was not possible to determine whether or not there was evidence of human interaction for 67 of these strandings, and for 8 it was determined there was no evidence of human interaction. The remaining 3 showed evidence of human interaction but none showed evidence of fishery interaction, although 1 animal had rope marks on the caudal peduncle that may have been from a fishery interaction but it is not possible to determine this without examining the rope, which was not found on the animal at the time of stranding. It is worth noting that during winter months, the Northern Florida Coastal stock likely overlaps with the Southern Migratory stock and it is currently not possible to distinguish between them. Hence during winter months, stranded dolphins could come from either of these 2 stocks.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al.* 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin inhabiting estuaries along the

Atlantic coast and have likewise found evidence of high blubber concentrations, particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2010 to recognize resident estuarine stocks and migratory and resident coastal stocks. The total U.S. fishery-related mortality and serious injury for the Northern Florida Coastal stock likely is less than 10% of the calculated PBR, and thus can be considered to be insignificant and approaching zero mortality and serious injury rate. However, there are commercial fisheries overlapping with this stock that have no observer coverage. This stock retains the depleted designation as a result of its origins from the originally delineated depleted coastal migratory stock. The species is not listed as threatened or endangered under the Endangered Species Act, but this is a strategic stock due to the depleted listing under the MMPA.

REFERENCES CITED

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwacke, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin and D. A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10: 157-167.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

CETAP (Cetacean and Turtle Assessment Program). 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final Report, Contract AA551- CT8- 48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, D.C. 576 pp.

Duffield, D. A. and R. S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. *In*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.

Garrison, L. P. 2007. Estimated marine mammal and turtle bycatch in the shark gillnet fisheries along the southeast U.S. Atlantic coast: 2000-2006. Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149. PRD Document #07/08-10, 22 pp.

Garrison, L. P., P. E. Rosel, A. A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., L. H. Schwacke, G. B. Mitchum, A. A. Hohn, R. S. Wells, E. S. Zolman and P. A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Kuehl, D. W., R. Haebler, C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.

Litz, J. A. 2007. Social structure, genetic structure, and persistent organohaline pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, FL. Ph.D. dissertation from University of Miami. 140 pp.

Mazzoil, M., J. S. Reif, M. Youngbluth, M. E. Murdoch, S. E. Bechdel, E. Howells, S. D. McCulloch, L. J. Hansen and G. D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

McLellan, W. M., A. S. Friedlaender, J. G. Mead, C. W. Potter and D. A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4: 297-304.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21: 2752-2764.

Scott, G. P., D. M. Burn and L. J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3: 819-823.

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Stolen, M. K., W. N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45-54.

Speakman, T., E. S. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S., M. D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York. 519 pp.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Mar. Mamm. Sci.18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Central Florida Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Duffield and Wells 2002; Rosel *et al.* 2009). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-1988 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (McLellan *et al.* 2003; Rosel *et al.* 2009).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Mead and Potter 1995; Hoelzel *et al.* 1998; Rosel *et al.* 2009). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina, identified 2 concentrations of bottlenose dolphins, 1 inshore of the 25m isobath and the other offshore of the 50m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters <25m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected from large vessel surveys during the summers of 1998 and 1999, from systematic biopsy sampling efforts in nearshore waters from New Jersey to central Florida conducted in the summers of 2001 and 2002, and from winter biopsy collection effort in 2002 and 2003, in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the 2 morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the 2 morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (<20m deep) were of the coastal morphotype, and all samples collected in deeper waters (>40m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the 2 morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13m, and coastal morphotype dolphins were observed at depths of 31m and 75km from shore (Garrison *et al.* 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, 1 offshore morphotype group was sampled during November just south of Cape Lookout only 7.3km from shore. Coastal morphotype samples were also collected farther away from shore at 33m depth and 39km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the 2 morphotypes. Samples collected in Georgia waters also indicated significant overlap between the 2 morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112km from shore at a depth of 38m. An offshore sample was collected in 22m depth at 40km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the 2 morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20m and 100m depth) and overlaps spatially with the offshore morphotype.

Distinction between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Scott *et al.* 1990; Wells *et al.* 1996; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). A long-term photo-ID study in the Indian River Lagoon system in central Florida has also identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008).

A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters. A study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001; Rosel *et al.* 2009) and animals resident in the Charleston estuarine system show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al.* 2009). In addition, stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen) in animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March were very low (Cortese 2000). One explanation for this depleted oxygen signature is that a resident group of dolphins in Pamlico Sound moves into nearby nearshore areas in the winter.

Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of the Central Florida Coastal Stock

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002) and satellite telemetry (NMFS unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are 5 coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal stock and a Central Florida Coastal stock.

The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. Migratory movement and spatial distribution of the Northern Migratory stock is best understood based on tag-telemetry, photo-ID and aerial survey data and migrates seasonally between coastal waters of central North Carolina and New Jersey. It is not thought to overlap with the South Carolina/Georgia Coastal stock in any season. The Southern Migratory stock is defined primarily based on satellite tag telemetry studies and is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear and as far south as coastal Florida during winter months. It is unclear whether this stock overlaps with the Central Florida Coastal stock in any season.

During summer months when the Southern Migratory stock is found in waters north of Cape Fear, North Carolina, bottlenose dolphins are still seen in coastal waters of South Carolina, Georgia and Florida, indicating the presence of additional stocks of coastal animals. Speakman *et al.* (2006) using photo-ID studies documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the estuarine stock. Genetic analyses of samples from northern Florida, Georgia and central South Carolina (primarily the

estuaries around Charleston), using both mitochondrial DNA and nuclear microsatellite markers, indicate significant genetic differences between these areas (NMFS 2001; Rosel *et al*. 2009). This stock assessment report addresses the Central Florida Coastal stock, which is present in coastal Atlantic waters from 29.4°N south to the western end of Vaca Key (~24.69°N –81.11°W) where the stock boundary for the Florida Keys stock begins (Figure 1). There has been little study of bottlenose dolphin stock structure in coastal waters of southern Florida, therefore the southern boundary of the Central Florida stock is uncertain. There is no obvious boundary defining the offshore extent of this stock.

The combined genetic and logistic regression analysis (Garrison *et al.* 2003) indicated that in waters less than 10m depth, 70% of the bottlenose dolphins were of the coastal morphotype. Between 10 and 20m depth, the percentage of animals of the coastal morphotype dropped precipitously, and at depths >40m nearly all (>90%) animals were of the offshore morphotype. These spatial patterns may not apply in the Central Florida Coastal stock, as there is a significant change in the bathymetric slope and a close approach of the Gulf Stream to the shoreline south of Cape Canaveral.

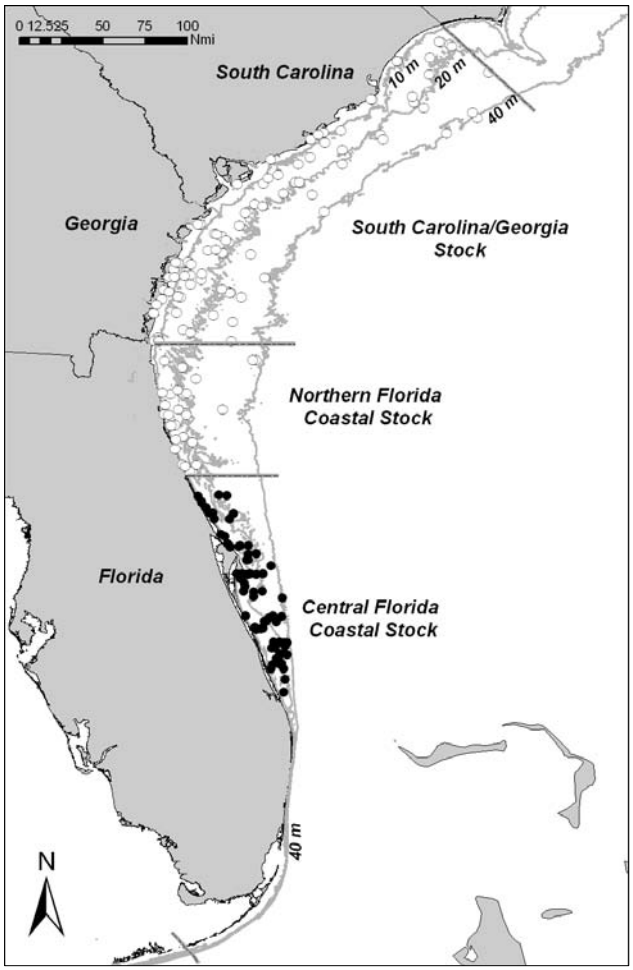

Figure 1. *The Central Florida Coastal stock of bottlenose dolphins (29.4°N to Vaca Key). Circles represent all sightings of bottlenose dolphin groups from NMFS 2002 and 2004 aerial surveys; dark circles- groups within the boundaries of this stock. In waters >20m, sightings may include the offshore morphotype of bottlenose dolphins.*

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias.

The winter survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay where water temperatures were <9.5ºC. During the summer survey, 6,734km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20m and 20-40m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189km of trackline. There was a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in each stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003).

For the Central Florida Coastal stock, the mean of the summer 2002 and 2004 abundance estimates provided the best estimate of abundance. There is strong inter-annual variation in the abundance estimates and observed spatial distribution of bottlenose dolphins in this region that may indicate movements of animals in response to environmental variability. The abundance estimate for this stock from the summer 2002 survey was 718 (CV=0.51) and that from summer 2004 was 11,918 (CV=0.27). The best abundance estimate is the unweighted average of these 2 surveys and is 6,318 (CV=0.26). It is unknown why the abundance estimates from 2002 and 2004 differ by nearly an order of magnitude. Survey methodologies did not differ significantly between the years, although a larger amount of survey effort was expended in the Northern Florida and Central Florida strata during 2004 than in 2002. The disparity most likely represents variability in dolphin spatial distribution between those 2 years. Because the 2 abundance estimates differ so dramatically, using an inverse-variance weighted mean when combining the estimates would heavily weight the smaller of the 2 estimates, and therefore would likely introduce negative bias into the estimate of stock size. Therefore, an unweighted mean of the 2002 and 2004 abundance estimates was calculated and used as the best estimate of stock abundance.

Minimum Population Estimate

The minimum population size (Nmin) for each stock was calculated as the lower bound of the 60% confidence interval for a log-normally distributed mean (Wade and Angliss 1997). The best estimate for the Central Florida Coastal stock is 6,318 (CV=0.26). The resulting minimum population estimate is 5,094.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the western North Atlantic coastal morphotype. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Central Florida Coastal stock of bottlenose dolphins is 5,109. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is depleted. PBR for this stock of bottlenose dolphins is 51.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Three Category II fisheries have the potential to interact with the Central Florida Coastal stock of bottlenose dolphins – the Southeastern U.S. Atlantic shark gillnet fishery, the Southeast Atlantic gillnet fishery and the Atlantic blue crab/trap pot fishery. In addition, the following Category III fisheries may interact with this stock: Southeastern U.S. Atlantic shrimp trawl fishery; Florida spiny lobster trap/pot; and Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot. Only limited observer data are available for these and other fisheries that may interact with this stock. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Southeastern U.S. Atlantic Shark Gillnet Fishery and Southeast Atlantic Gillnet Fishery

Gillnet fisheries targeting finfish and sharks operate in southeast waters between North Carolina and southern Florida. Historically, a drift net fishery targeting coastal sharks operated in waters including within the Central Florida Coastal stock boundaries during winter months. Bottlenose dolphin takes (n=2) were observed in the drift net fisheries targeting sharks in 2002 and 2003 (Garrison 2007). Currently, gillnet fisheries include a number of different fishing methods and gear types including drift nets, "strike" fishing, and anchored ("sink") gillnets. The majority of this fishing is reported from waters of North Carolina and central Florida. However, there has been a significant reduction in the amount of drift gillnet fishing targeting sharks during the last several years. Gillnet trips (average 766 annually from 2004-2008) are reported within the bounds of the Central Florida Coastal stock. There have been no observed bottlenose dolphin takes within the stock boundaries since 2003 (Table 1).

Table 1. Summary of the 2004-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) by stock in the southeast gillnet fisheries in water of the Central Florida Coastal stock. Data include years sampled (Years), number of vessels reporting effort within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Stock	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Central Florida Coastal	2004-2008		Obs. Data, SEFSC FVL	0.07, 0.09, 0.07, 0.02, 0.05	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	NA	0

NA = cannot be calculated

[a] Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of reported trips with effort inside the stock boundaries. Reported fishery effort includes a number of different fishing methods and target species that cannot be separated.

[b] Percent observer coverage is reported on a per trip basis as limited by reporting to the FVL. Multiple sets may occur on any given trip.

Atlantic Blue Crab/Trap Pot Fishery

During 2004-2008, no stranded animals assigned to the Central Florida Coastal stock were confirmed to have been entangled in commercial trap pot gear.

Southeastern U.S. Shrimp Trawl Fishery

The shrimp trawl fishery operates in waters off the Florida coast. However, there has been little to no observer coverage of this fishery in the last decade. No other bottlenose dolphin mortality or serious injury related to shrimp trawling along the Florida coast has been reported to NMFS.

Other Mortality

Eighty-two stranded bottlenose dolphins were recovered between 2004 and 2008 in the waters of the Central Florida Coastal stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). It was not possible to determine whether or not there was evidence of human interaction for 60 of these strandings and for 16 it was determined there was no evidence of human interaction. The remaining 6 showed evidence of human interaction. Three animals were reported entangled in gear consistent with a trap pot fishery, but gear was only recovered for 1 animal, possibly lobster pot gear. One animal was entangled in high test monofilament. The 5th animal had scars consistent with net entanglement and the last an old bullet in the skull. Neither of the last 2 findings was thought to be the cause of the mortality.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al.* 1991). More recent studies

have examined persistent organic pollutant concentrations in bottlenose dolphin inhabiting estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2010 to recognize resident estuarine stocks and migratory and resident coastal stocks. The total U.S. fishery-related mortality and serious injury for the Central Florida Coastal stock likely is less than 10% of the calculated PBR, and thus can be considered to be insignificant and approaching zero mortality and serious injury rate. However, there are commercial fisheries overlapping with this stock that have no observer coverage. This stock retains the depleted designation as a result of its origins from the originally delineated depleted coastal migratory stock. The species is not listed as threatened or endangered under the Endangered Species Act, but this is a strategic stock due to the depleted listing under the MMPA.

REFERENCES CITED

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwacke, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin and D. A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10: 157-167.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

CETAP (Cetacean and Turtle Assessment Program). 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final Report, Contract AA551- CT8- 48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, D.C. 576 pp.

Duffield, D. A. and R. S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. *In*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.

Garrison, L. P. 2007. Estimated marine mammal and turtle bycatch in the shark gillnet fisheries along the southeast U.S. Atlantic coast: 2000-2006. Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149. PRD Document #07/08-10, 22 pp.

Garrison, L. P., P. E. Rosel, A. A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L. P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., L. H. Schwacke, G. B. Mitchum, A. A. Hohn, R. S. Wells, E. S. Zolman and P. A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.

Hoelzel, A. R., C. W. Potter, and P. B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Kuehl, D. W., R. Haebler, C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.

Litz, J. A. 2007. Social structure, genetic structure, and persistent organohaline pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, FL. Ph.D. dissertation from University of Miami. 140 pp.

Mazzoil, M., J. S. Reif, M. Youngbluth, M. E. Murdoch, S. E. Bechdel, E. Howells, S. D. McCulloch, L. J. Hansen and G. D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

McLellan, W. M., A. S. Friedlaender, J. G. Mead, C. W. Potter and D. A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4: 297-304.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21: 2752-2764.

Scott, G. P., D. M. Burn and L. J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3: 819-823.

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Stolen, M. K., W. N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45-54.

Speakman, T., E. S. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S., M. D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York. 519 pp.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Mar. Mamm. Sci.18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Northern North Carolina Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present primarily in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* 2008). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005; Balmer *et al.* 2008).

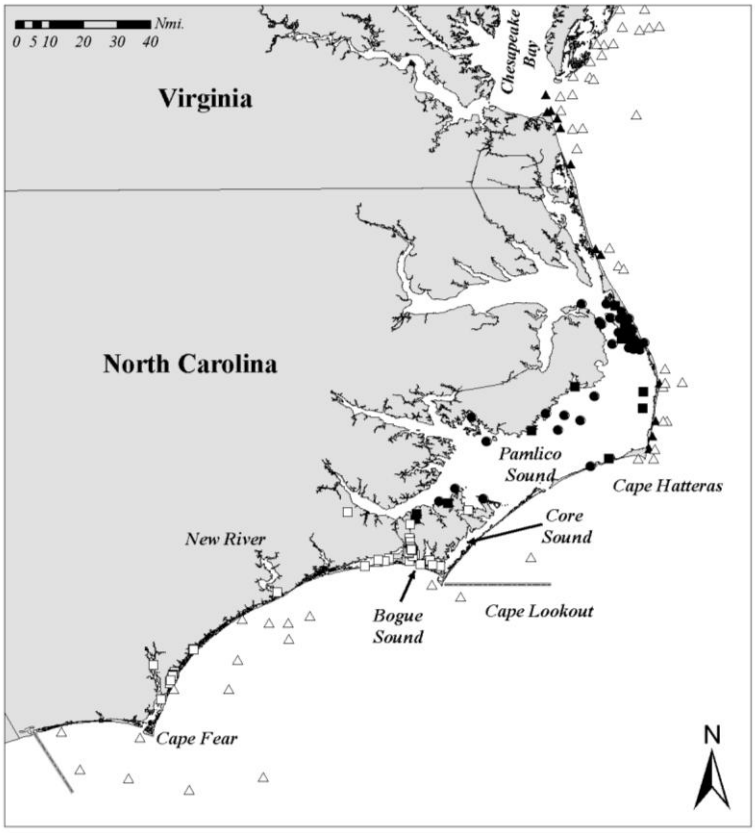

Figure 1. *The summer (July-September) distribution of bottlenose dolphins occupying coastal and estuarine waters in North Carolina and Virginia. Locations are shown from aerial surveys (triangles), satellite telemetry (circles) and photo-identification studies (squares). Sightings assigned to the Northern North Carolina Estuarine System stock are shown with filled symbols. Photo-identification data are courtesy of Duke University and the University of North Carolina at Wilmington.*

The Northern North Carolina Estuarine System (NNCES) stock is defined as animals that occupy estuarine waters of Pamlico Sound during summer months (July-August). The ranging patterns of bottlenose dolphins in photo-ID studies supports the presence of a group of dolphins within these waters that are distinct from both dolphins occupying estuarine and coastal waters in southern North Carolina and animals in the Northern and Southern Migratory stocks that occupy coastal waters of North Carolina at certain times of the year (Read *et al.* 2003; NMFS 2001; NMFS unpublished data). In addition, stable isotope analysis of animals sampled along the beaches of North Carolina between Cape Hatteras and Bogue Inlet during February and March showed very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as "depleted oxygen"; Cortese 2000). One explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby coastal waters in the winter (NMFS 2001). The estuarine waters of Pamlico Sound had previously been included in the abundance estimates and stock assessment reports for the Northern migratory stock and the winter "mixed" North Carolina management unit of coastal bottlenose dolphins (Waring *et al.* 2007). However, they are now recognized as a distinct stock based upon these differences in seasonal ranging patterns and stable isotope signatures.

The seasonal movements of the NNCES stock are best described using a combination of tag telemetry and long-term photo-ID studies. Animals captured and released near Beaufort, North Carolina, were fitted with satellite-

linked transmitters during November 1999 (3 animals), April 2000 (8 animals) and April 2006 (5 animals) (NMFS unpublished data). In addition, long-term photo-ID studies have been conducted in waters of North Carolina that include records of both these tagged animals and animals that were captured and freeze-branded near Beaufort, North Carolina, during summer months (Duke University unpublished data; University of North Carolina at Wilmington unpublished data; NMFS unpublished data). Of these tagged or freeze-branded animals, 18 occupied waters of northern Pamlico Sound during summer months and hence were identified as belonging to the NNCES stock. The NNCES stock occurs primarily within the waters of Pamlico Sound north of Core Sound during summer months (July-August). There is evidence that some of these animals also move into nearshore coastal waters along the northern coast of North Carolina and into coastal waters of Virginia and perhaps into Chesapeake Bay. One animal that was tagged near Virginia Beach in September 1998 was observed to move south into waters of Pamlico Sound and had a photo-ID record within the sound during July (NMFS unpublished data). In addition, there are photo-ID matches between inshore waters of Virginia Beach, Virginia, and Pamlico Sound (Urian, pers. comm.) that also demonstrate movements of NNCES animals between these areas. Therefore, it is presumed that the spatial range of NNCES animals during summer and fall months (July-October) includes Pamlico Sound, nearshore (< 1km from shore) coastal waters of northern North Carolina, and nearshore and estuarine waters of Virginia (Figure 1).

There are fewer tag-telemetry data for assigned NNCES animals during winter months. However, photo-ID studies, available tag data and stable isotope data indicate that the stock moves out of the waters of Pamlico Sound into coastal waters south of Cape Hatteras during late fall and through winter (November-April). Tag telemetry records show that NNCES animals move as far south as the New River during winter months (January-February) (NMFS unpublished data). The Northern Migratory stock also occupies the nearshore coastal waters of North Carolina during these months, and hence there is likely overlap between these stocks, particularly between Cape Hatteras and Cape Lookout.

The movements of animals from the NNCES stock are distinct from those of the Southern North Carolina Estuarine System stock (SNCES). Some of the animals tagged or freeze-branded near Beaufort moved south to Cape Fear and occupied nearshore coastal and estuarine waters during winter months. During summer and fall, these animals moved north and occupied inshore and nearshore coastal waters near Cape Lookout including Bogue Sound and Core Sound. It is probable that there is spatial overlap between these 2 estuarine stocks during late summer and fall in the waters near Beaufort. However, SNCES stock animals were not observed to move north of Cape Lookout in coastal waters nor into the main portion of Pamlico Sound during summer (NMFS unpublished data; Duke University unpublished data; University of North Carolina at Wilmington unpublished data). These movement patterns are consistent with those in resightings of individual dolphins during a photo-ID study that sampled much of the estuarine waters of North Carolina (Read *et al.* 2003). Read *et al.* (2003) suggested that movement patterns, differences in group sizes, and habitats are consistent with 2 stocks of animals occupying estuarine waters of North Carolina. Finally, genetic analysis of samples from animals in waters of southern North Carolina (between Cape Lookout and the North Carolina/South Carolina border) demonstrate significant differentiation from animals occupying waters from Virginia and further north and waters of South Carolina (Rosel *et al.* 2009).

In summary, during summer and fall months (July-October), the NNCES stock occupies waters of Pamlico Sound and nearshore coastal and estuarine waters of northern North Carolina to Virginia Beach (Figure 1). It likely overlaps with animals from the Southern Migratory stock in coastal waters during these months. During late fall and winter (November-March), the NNCES stock moves out of estuarine waters and occupies nearshore coastal waters between the New River and Cape Hatteras. It overlaps with the Northern Migratory stock during this period, particularly between Cape Lookout and Cape Hatteras. It appears that the region near Cape Lookout including Bogue Sound and Core Sound is an area of overlap with the SNCES stock during late summer.

POPULATION SIZE

Read *et al.* (2003) provided the first and only available abundance estimate of bottlenose dolphins that occur within the estuarine portion of the NNCES stock range. This estimate was based on a photo-ID mark-recapture survey of a portion of North Carolina waters inshore of the barrier islands, conducted during July 2000. Because the survey did not sample all of the estuarine waters where dolphins are known to occur, the estimates of abundance may be negatively biased. Read *et al.* (2003) estimated the number of animals in the inshore waters of North Carolina equivalent to that of the NNCES stock to be 919 (95% CI 730 - 1,190, CV=0.13). Gubbins *et al.* (2003) also conducted a photo-ID mark-recapture study and provided an abundance estimate (513, CV=0.13) for inshore and nearshore waters near Beaufort, North Carolina, but this area represented only a small portion of the NNCES stock area and included animals in coastal waters. Goodman *et al.* (2007) conducted seasonal, strip-transect aerial surveys of southwestern Pamlico Sound from July 2004 through April 2006. Their survey area sampled approximately 25% or less of the waters within the NNCES stock boundaries. Mean seasonal abundance estimates

ranged from a low of 54 (CV=0.46) during June-August 2005 (summer), to a high of 426 (CV=0.35) during September-November 2004 (autumn), but seasonal patterns were not consistent among years. For example, the estimate for spring of 2005 was only 71 (CV=0.39) while the estimate for spring of 2006 was 323 (CV=0.35). The abundance estimate from Read *et al.* (2003) is the best abundance estimate for the stock in estuarine waters; however, this estimate is more than 8 years old, and hence cannot be used to calculate N_{min} or PBR.

Since both tag-telemetry studies and photo-ID records indicate that some portion of the NNCES stock occurs in coastal waters between Cape Hatteras, North Carolina, and Virginia during summer months, it is appropriate to include animals from summer aerial surveys of these areas in the abundance estimate. Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias. Abundance estimates were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995).

During the summer survey, 6,734km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20m and 20-40m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189km of trackline. There were a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. During the summer of 2004, water temperatures were significantly cooler than those during 2002 and earlier surveys conducted in 1995, and animals distributed farther south and overlapped spatially. It is probable that both the Northern Migratory and Southern Migratory stocks occurred in waters of northern North Carolina during the summer of 2004.

The best abundance estimate for the Northern North Carolina Estuarine System stock in coastal waters is therefore from the summer 2002 survey when there was less overlap among stocks. Survey data were post-stratified to estimate the abundance of dolphins within a strip extending from the shoreline to 1km from shore between Cape Lookout, North Carolina, and Virginia Beach, Virginia. Tag-telemetry records indicated that NNCES animals rarely ventured further away from shore. However, animals from the Southern Migratory stock do occur within this strip during summer months. Therefore, the estimate of abundance within this strip includes both NNCES animals and Southern Migratory animals and hence overestimates abundance. The resulting best abundance estimate for the NNCES stock in coastal waters is 468 (CV=0.32).

The best available abundance estimate for the NNCES stock is the combined abundance from estuarine and coastal waters. This combined estimate is 1,387 (CV=0.17). However, this estimate includes data that are more than 8 years old from Read *et al.* (2003). Hence, the abundance of the NNCES stock is currently unknown.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). Because the only available comprehensive abundance for this stock is derived from data that are more than 8 years old, they may not be used to calculate the minimum population estimate, and as a result the minimum population estimate for the NNCES stock of bottlenose dolphins is unknown.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

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POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NNCES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The NNCES stock interacts with 3 Category II fisheries: the Atlantic blue crab trap/pot fishery, North Carolina long haul seine fishery and North Carolina inshore gillnet fishery. There is no systematic federal observer coverage of these fisheries by the National Marine Fisheries Service (NMFS), although the North Carolina Division of Marine Fisheries operates systematic coverage of the fall flounder gillnet fishery in Pamlico Sound (Price 2008). As a result, information about interactions with North Carolina inshore fisheries is based solely on stranding data and it is not possible to estimate the annual number of interactions or mortalities in these fisheries. The NNCES stock may also interact with the mid-Atlantic gillnet fishery, the mid-Atlantic haul/beach seine fishery and the Virginia Pound Net fishery. The magnitude of the interaction with each of these fisheries is unknown because of both uncertainty in the movement patterns of the stock and the spatial overlap between the NNCES stock and other bottlenose dolphin stocks in coastal waters. The total estimated average annual fishery mortality on the NNCES stock ranges between a minimum of 4.1 and a maximum of 22.6 animals per year. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of coastal morphotype bottlenose dolphins, and the sink gillnet gear in North Carolina is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish or finfish generically (Rossman and Palka 2001). From 2001-2008, 7 additional bottlenose dolphin mortalities were observed in the mid-Atlantic gillnet fishery. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April and 2 occurring off of Virginia during November. Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003, 1 in September 2005, 1 in September 2006 and 1 in October 2006. Because the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign all observed mortalities, or extrapolated bycatch estimates, to a specific stock. In addition, the Bottlenose Dolphin Take Reduction Plan (BDTRP) was implemented in May 2006 resulting in changes in the gear configurations and other characteristics of the fishery.

To estimate the mortality of bottlenose dolphins in the mid-Atlantic gillnet fishery, the available data were divided into the period from 2002 through April 2006 (pre-BDTRP) and from May 2006–2008 (post-BDTRP). Three alternative approaches were used to estimate bycatch rates. First, a generalized linear model (GLM) approach was used similar to that described in Rossman and Palka (2001). This approach included all observed mortalities from 1995-2008 where the fishing gear was still in use during the period from 2002-2008. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data. Finally, a ratio estimator pooled across years was used to estimate different CPUE values for the pre-BDTRP and post-BDTRP periods. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality, again similar to the approach in Rossman and Palka (2001). To account for the uncertainty in the most appropriate of these 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) are used to estimate the mortality of bottlenose dolphins for this fishery (Table 1). It should be noted that the extrapolated estimates of total mortality include landings from inshore waters where the NNCES stock is likely to occur.

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Table 1. Summary of the 2002-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) in the Northern North Carolina Estuarine System stock in the commercial mid-Atlantic coastal gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-BDTRP) and after the implementation of the plan (post-BDTRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data and NCDMF dealer data. Values in parentheses indicated the CV of the estimate.

Period	Year	Observer Coverage[a]	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-BDTRP	2002	0.01	0	0	15.64 (0.63)	0	39.45 (0.92)	33.69 (0.38)
	2003	0.01	0	0	11.03 (0.58)	49.46 (0.94)	12.77 (0.92)	19.29 (0.36)
	2004	0.02	0	0	12.10 (0.62)	0	28.46 (0.92)	28.42 (0.34)
	2005	0.03	0	0	11.84 (0.60)	0	22.58 (0.92)	23.01 (0.37)
	Jan-Apr 2006	0.03	0	0	1.40 (0.50)	0	0	1.99 (0.37)
Annual Avg. pre-BDTRP			Minimum: 3.47 (CV=0.30)			Maximum: 19.79 (CV=0.11)		
post-BDTRP	May-Dec 2006	0.03	0	0	5.08 (0.42)	73.37 (0.69)	18.84 (0.68)	12.46 (0.36)
	2007	0.03	0	0	8.32 (0.43)	0	24.47 (0.68)	18.77 (0.34)
	2008	0.01	0	0	8.14 (0.42)	0	21.91 (0.68)	16.77 (0.34)
Annual Avg. post-BDTRP			Minimum: 2.39 (CV=0.25)			Maximum: 18.99 (CV=0.11)		

[a] Observer coverage is reported on an annual basis for the entire fishery as a proportion of the reported tons of fish landed.

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There have been 3 observed takes in the mid-Atlantic gillnet fishery since 2001 that could potentially be assigned to the Northern North Carolina Estuarine System stock. However, in each of these cases, the take could potentially be assigned to the Southern Migratory stock since they occurred in near-shore coastal waters of northern North Carolina. Since observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year, the minimum and maximum possible mortality on the NNCES stock are presented for comparison to PBR (Table 1).

Based upon these analyses, the minimum mortality estimate for the NNCES stock for the pre-BDTRP period was 3.47 (CV=0.30) animals per year, and that for the post-BDTRP period was 2.39 (CV=0.25) animals per year. The maximum estimates were 19.79 (CV=0.11) for the pre-BDTRP period and 18.99 (CV=0.11) for the post-BDTRP period (Table 1).

Beach Haul Seine/Beach-based Gillnet Gear

Two coastal bottlenose dolphin takes were observed in beach haul seine gear: 1 in May 1998 and 1 in December 2000. These takes occurred during a striped bass fishery within the spatial and seasonal range of the Northern Migratory stock. Beach-based gillnet gear is now considered part of the mid-Atlantic gillnet fishery described above; however, it is not included in the observer program or resulting mortality estimates. Data from the Southeast Region Stranding Network from 2002 to 2008 include 2 confirmed reports of bottlenose dolphin mortalities in beach-based gillnet gear for striped bass during winter months off the coast of northern North Carolina: 1 in December 2002 and 1 in January 2008. A third possible mortality associated with this gear occurred during December 2002 (Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Based upon their location and time of year, these mortalities were most likely animals from the Northern Migratory stock rather than the NNCES stock since they occurred north of Cape Hatteras in winter months.

Crab Pots and Other Pots

Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that interactions with pot gear are a common occurrence and result in mortalities of coastal morphotype bottlenose dolphins in some regions (Burdett and McFee 2004). Southeast Regional Marine Mammal Stranding Network data (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009) from 2004 through 2008 include 13 reports of interactions between bottlenose dolphins and confirmed blue crab pot gear with the majority of these occurring in waters from Florida to South Carolina. In addition, there were 4 interactions documented with pot gear where the fishery could not be confirmed. In these cases, the gear was confirmed to be associated with a pot or trap, but may have been from a fishery other than blue crab (e.g., whelk fisheries in Virginia). Of the confirmed blue crab pot interactions, there was 1 reported mortality in this 5 year period in waters of Virginia and North Carolina. This case occurred in August 2004 and is most likely assigned to the NNCES stock. There was 1 mortality in pot gear where the fishery type could not be confirmed in Virginia. This mortality was reported in August 2007 and could be assigned to either the Southern Migratory or the NNCES stock.

Virginia and North Carolina Pound Nets

Historical and recent stranding network data report interactions between bottlenose dolphins and pound nets in Virginia. Stranding data for 2004-2008 indicate 17 cases where bottlenose dolphins were removed from pound net gear, and it was determined that animals were entangled pre-mortem. In each case, the bottlenose dolphin was recovered directly from the fishing gear. Of these 17 cases, 14 were documented mortalities while 3 were released alive (S. Barco, Virginia Aquarium, unpublished data; Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). These interactions occurred primarily inside estuarine waters near the mouth of the Chesapeake Bay and in summer months. Nine of these mortalities occurred during the summer (July-September) when they could have impacted either the Southern Migratory or the Northern North Carolina Estuarine System stocks. The overall impact of the Virginia Pound Net fishery on the Northern North Carolina Estuarine System stock is unknown due to the limited information on the stock's movements, particularly whether or not it occurs within waters inside the mouth of the Chesapeake Bay. In addition, 1 bottlenose dolphin was recovered dead from pound net gear in North Carolina during August 2004. This mortality is most likely assigned to the NNCES stock.

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. From 2002 to 2009, there have been 15 reported interactions during research activities resulting in 13 documented mortalities of bottlenose dolphins. A mortality occurring in a turtle relocation trawl off of North Carolina during March 2002 could have been attributed to either the Southern Migratory stock or the NNCES stock. One mortality in a research beach seine was reported from June 2007 in northern North Carolina that was consistent with the spatial range of the Northern Migratory stock, the Southern Migratory stock or the NNCES stock. Finally, a mortality was observed in July 2007 in a research net in the Neuse River that is most likely from the NNCES stock.

Three bottlenose dolphins that were captured, tagged with satellite-linked transmitters, and released near Beaufort, North Carolina, during April 2006 by the NMFS as part of a long-term stock delineation research project were believed to have died shortly thereafter as a result of the capture or tagging (NMFS unpublished data). Two of

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the animals were recovered stranded but because of advanced decomposition of the carcasses cause of death could not be determined. One of these 2 animals was known from long-term photo-ID and was likely of the Southern North Carolina Estuarine System stock. The third animal has not been observed subsequent to release, but patterns in the data received from its satellite tag were similar to that of the other 2 and indicated the fates were similar. These last 2 animals were, based on satellite-derived locations, most likely from the NNCES stock. All known human-caused mortalities including both commercial fisheries and research related mortalities are summarized in Table 2.

This stock inhabits areas with significant drainage from agricultural, industrial and urban sources, and as such is exposed to contaminants in runoff from those sources. The blubber of 47 bottlenose dolphins captured and released in and around Beaufort contained contaminant levels of some level, and 7 had unusually high levels of the pesticide methoxychlor (Hansen *et al.* 2004). While there are no estimates of indirect human-caused mortality from pollution or habitat degradation, Schwacke *et al.* (2002) found that the levels of polychlorinated biphenyls (PCBs) observed in Beaufort female bottlenose dolphins would likely impair reproductive success, especially of primiparous females.

Table 2. Summary of annual reported and estimated mortality of bottlenose dolphins from the Northern North Carolina Estuarine System stock. Where minimum and maximum values are reported, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. The reported mortalities in Virginia Pound Net, beach-based gillnet and crab pot fisheries are confirmed reports and are likely an underestimate of total mortalities in these fisheries.

Year	Mid-Atlantic Gillnet	Virginia Pound Net[a]	Beach-based Gillnet	Blue Crab Pot	Other Pot	Research	Total
2004	Min = 4.0 Max = 18.9	Min = 1 Max = 4	0	1	0	0	Min = 6.0 Max = 23.9
2005	Min = 4.0 Max= 15.2	Min = 0 Max = 1	0	0	0	0	Min = 4.0 Max = 16.2
2006	Min = 2.2 Max = 35.6	Min = 0 Max = 2	0	0	0	2	Min = 4.2 Max = 39.6
2007	Min = 2.8 Max = 14.4	Min = 0 Max = 1	0	0	Min = 0 Max = 1	Min = 1 Max = 2	Min = 3.8 Max = 18.4
2008	Min = 2.7 Max = 12.9	Min = 0 Max = 2	0	0	0	0	Min = 2.7 Max = 14.9
Annual Average Mortality (2004-2008)				Minimum Estimated = 4.1 Maximum Estimated = 22.6			

[a] Pound nets also include a mortality observed in North Carolina in 2004.

Strandings

Between 2004 and 2008, 422 bottlenose dolphins stranded along the Atlantic coast in North Carolina and Virginia that could be assigned to the NNCES stock (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). The assignment of animals to a particular stock is impossible in some seasons and regions, particularly in coastal waters of North Carolina and Virginia. Therefore, it is likely that the counts below include some animals from either the

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Southern Migratory or Northern Migratory stocks. Within estuarine waters of North Carolina, where the probability is very high that strandings are from the NNCES stock, there were a total of 73 strandings in this 5 year period. In addition, stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form. In most cases, it was not possible to determine if a human interaction had occurred due to the decomposition state of the stranded animal. However, in cases where a determination could be made, the incidence of evidence of fisheries interactions was high. In cases where a determination could be made, 65% of stranded animals from Virginia, 41% of cases from coastal waters of North Carolina and 82% (14/17) of cases from North Carolina estuarine waters had evidence of human interaction. It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point in the animal's life. Evidence of fishery interaction is by far the most common type of human interaction reported.

Table 3. Strandings of bottlenose dolphins from North Carolina and Virginia that can possibly be assigned to the Northern North Carolina Estuarine System (NNCES) stock. Strandings observed in North Carolina are separated into those occurring within Pamlico Sound and other estuaries (Estuary) vs. coastal waters. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, particularly in coastal waters, there is likely overlap between the NNCES stock and other bottlenose dolphin stocks. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009.

State	**2004**			**2005**			**2006**			**2007**			**2008**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
North Carolina - Coastal	6	8	25	7	7	41	1	7	25	5	8	26	5	5	28
North Carolina - Estuary	6	1	9	2	0	7	4	2	11	2	0	19	0	0	10
Virginia[a]	13	5	10	7	9	13	9	3	17	6	3	19	8	1	22
Annual Total	83			93			79			88			79		

[a] Strandings from Virginia include primarily waters inside Chesapeake Bay during late summer through fall. It is likely that the NNCES stock overlaps with the Southern migratory stock in this area.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted as a result of the 1987-1988 mortality event. Scott *et al.* (1988) suggested that dolphins residing in the bays, sounds and estuaries adjacent to these coastal waters were not affected by the mortality event, and these animals were explicitly excluded from the depleted listing (Federal Register: 54(195), 41654-41657; 56(158), 40594-40596; 58(64), 17789-17791).

The status of the NNCES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this

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stock. The annual average of human caused mortality for this stock ranges between a minimum of 4.1 and a maximum of 22.6, but this is an underestimate of total mortality associated with commercial fisheries. The most recent abundance estimate is greater than 8 years old, and therefore PBR is undetermined. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. However, the total human-caused mortality and serious injury is most likely greater than 10% of PBR and may approach or exceed PBR. Because the stock size is currently unknown, and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

REFERENCES CITED

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10(2): 157-167.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 pp.

Burdett, L. G. and W. E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorization. J. Cetacean Res. Mange. 6(3): 231-240.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. thesis. University of Miami. 143 pp.

Cortese, N. A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis from University of Virginia, Charlottesville. 118 pp.

Goodman, M.A., J.B. McNeill, E. Davenport and A.A. Hohn 2007. Protected species aerial survey data collection and analysis in waters underlying the R-5306A Airspace: Final report submitted to U.S. Marine Corps, MCAS Cherry Point. NOAA Tech. Memo. NMFS-SEFSC-551, 25 pp.

Gubbins, C. 2002. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquat. Mamm. 28: 24-31.

Gubbins, C.M., M. Caldwell, S.G. Barco, K. Rittmaster, N. Bowles and V. Thayer 2003. Abundance and sighting patterns of bottlenose dolphins (*Tursiops truncatus*) at four northwest Atlantic coastal sites. J. Cetacean Res. Manage. 5(2): 141-147.

Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman and P.A. Fair 2004. Geographic variation in polychlorinated biphenyl and organochlorine pesticide concentrations in the blubber of bottlenose dolphins from the U.S. Atlantic coast. Sci. Total Environ. 319: 147-172.

Litz, J.A. 2007. Social structure, genetic structure, and persistent organohalogen pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Ph.D. thesis. University of Miami. 140 pp.

Mazzoil, M., S.D. McCulloch and R.H. Defran 2005. Observations on the site fidelity of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Fla. Sci. 68(4): 217-226.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

Price, B. 2008. Sea turtle bycatch monitoring of the 2007 fall gillnet fisheries in southeastern Pamlico Sound, North Carolina. Completion report for activities under Endangered Species Act Section 10 Incidental Take Permit # 1528. NC Division of Marine Fisheries, Morehead City, NC, 25 pp.

Read, A.J., K.W. Urian, B. Wilson and D.M. Waples 2003. Abundance of bottlenose dolphins in the bays, sounds, and estuaries of North Carolina. Mar. Mamm. Sci. 19(1): 59-73.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Rossman, M. C. and D. L. Palka. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the

U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15, 77 pp.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21(12): 2752-2764.

Scott, G.P., D.M. Burn and L.J. Hansen 1988. The dolphin dieoff: Long-term effects and recovery of the population. Conference proceedings, Oceans '88. IEEE Cat. No. 88-CH2585-8.

Sellas, A.B., R.S. Wells and P.E. Rosel 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6(5): 715-728.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh and K. Maze-Foley, eds. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2007. NOAA Tech Memo. NMFS-NE-205, 415 pp.

Wells, R.S., M.D. Scott and A.B. Irvine 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In*: H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York.

Zolman, E.S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River estuary, Charleston County, South Carolina, U.S.A. Mar. Mamm. Sci. 18: 879-892.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Southern North Carolina Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Several lines of evidence support a distinction between dolphins inhabiting primarily coastal waters near the shore and those present primarily in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (e.g., Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (e.g., Wells *et al.* 1987). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005; Balmer *et al.* 2008).

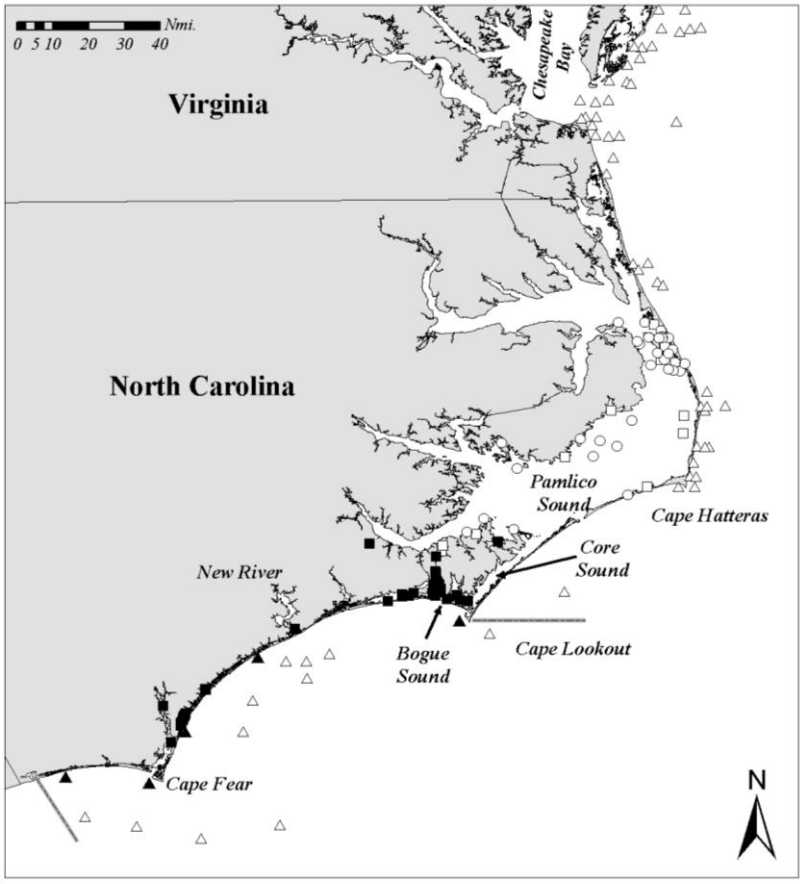

Figure 1. *The summer (July-September) distribution of bottlenose dolphins occupying coastal and estuarine waters in North Carolina and Virginia. Locations are shown from aerial surveys (triangles), satellite telemetry (circles) and photo-identification studies (squares). Sightings assigned to the Southern North Carolina Estuarine System stock are shown with filled symbols. Photo-identification data are courtesy of Duke University and the University of North Carolina at Wilmington.*

The Southern North Carolina Estuarine System (SNCES) stock is defined as animals occupying estuarine and nearshore coastal waters between the North Carolina/South Carolina border and the New River during winter months that do not undertake large scale migratory movements. Their range includes estuarine waters near Cape Fear and inshore waters of the Intracoastal Waterway along the southern North Carolina coast during fall and winter months (November–February). The ranging patterns of bottlenose dolphins in photo-ID studies supports the presence of a group of dolphins within these waters that are distinct from both dolphins occupying estuarine and coastal waters in northern North Carolina and animals from the Northern and Southern Migratory stocks that occupy coastal waters of North Carolina at certain times of the year (Read *et al.* 2003; NMFS 2001; NMFS unpublished data). In addition, genetic analysis of samples from animals in waters of southern North Carolina (between Cape Lookout and the North Carolina/South Carolina border) demonstrate significant differentiation from animals occupying waters from Virginia and further north and waters of South Carolina (NMFS 2001; Rosel *et al.* 2009). In prior stock assessment reports, the animals within this region were referred to as the "Southern North Carolina" coastal stock during summer months, and were part of the winter

"mixed" North Carolina management unit of coastal bottlenose dolphins (Waring *et al.* 2009). However, they are now recognized as a distinct stock based upon these differences in seasonal ranging patterns and genetic analyses.

The seasonal movements of the SNCES stock are best described using a combination of tag telemetry and long-term photo-ID studies. Animals captured and released near Beaufort, North Carolina, were fitted with satellite-linked transmitters during November 1999 (3 animals), April 2000 (8 animals) and April 2006 (5 animals) (NMFS unpublished data). In addition, long-term photo-ID studies have been conducted in waters of North Carolina that include records of both these tagged animals and animals that were captured and freeze-branded near Beaufort, North Carolina, during summer months (Duke University unpublished data; University of North Carolina at Wilmington unpublished data; NMFS unpublished data). Two animals were tagged at Holden Beach, just south of Cape Fear during November 2004, and they remained within waters of North Carolina throughout the 9 month period when their tags were operational (NMFS unpublished data). Of the tagged or freeze-branded animals, 8 occupied estuarine and coastal waters near Cape Fear during winter months (January-February) and hence were identified as belonging to the SNCES stock. The seasonal movements of these animals are presumed to represent the range of the SNCES stock. During winter through late spring (December–May) the SNCES stock occurs primarily within the waters of southern North Carolina south of the New River. This includes both estuarine, Intracoastal Waterway and nearshore coastal waters. During summer through early fall (July-October), the stock moves north along the North Carolina coast and occupies waters of Bogue Sound, Core Sound and southern Pamlico Sound (Figure 1).

The movements of animals from the SNCES stock are distinct from those of the Northern North Carolina Estuarine System stock (NNCES). During summer and fall, NNCES animals occupy waters of northern Pamlico Sound and nearshore coastal waters perhaps as far north as the Chesapeake Bay. It is probable that there is spatial overlap between these 2 estuarine stocks during late summer and fall in the waters near Beaufort. However, SNCES stock animals were not observed to move north of Cape Lookout in coastal waters nor into the main portion of Pamlico Sound during summer (NMFS unpublished data; Duke University unpublished data; University of North Carolina at Wilmington unpublished data). These movement patterns are consistent with those in resights of individual dolphins during a photo-ID study that sampled much of the estuarine waters of North Carolina (Read *et al.* 2003). Read *et al.* (2003) suggested that movement patterns, differences in group sizes, and habitats are consistent with 2 stocks of animals occupying estuarine waters of North Carolina. Finally, genetic analysis of samples from animals in waters of southern North Carolina (between Cape Lookout and the North Carolina/South Carolina border) demonstrate significant differentiation from animals occupying waters from Virginia and further north and waters of South Carolina (Rosel *et al.* 2009).

In summary, during summer and fall months (July-October), the SNCES stock occupies estuarine and nearshore coastal waters (< 3km from shore) between the North Carolina/South Carolina border and Core Sound (Figure 1). It likely overlaps with the Northern North Carolina Estuarine System stock in the northern portion of its range during late summer. During late fall through spring, the SNCES stock moves south to waters near Cape Fear. In coastal waters, it overlaps with the Southern Migratory stock during this period.

Dolphins residing in the estuaries south of this stock between the North Carolina/South Carolina border and the northern boundary of the Charleston Estuarine System stock (CES) are not currently covered in any stock assessment report. There are insufficient data to determine whether animals in this region exhibit affiliation to the CES stock or to the SNCES stock, or if there are 1 or more estuarine stocks in this region. It should be noted, however, that in this intervening region during 2003-2007, there were 11 recorded bottlenose dolphin strandings, 2 of which were confirmed fishery interactions. One of these 2 was entangled in crab pot gear, disentangled and released alive. Of the remaining 9 stranded dolphins, evidence of human interaction could not be determined for 4 and 5 were determined not to have had any human interaction (Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009).

POPULATION SIZE

Read *et al.* (2003) provided the first and only available comprehensive abundance estimate of bottlenose dolphins that occur within the proposed boundaries of the SNCES stock. This estimate is based on a photographic mark-recapture survey of North Carolina waters inshore of the barrier islands, conducted during July 2000. Read *et al.* (2003) estimated the number of animals in the inshore waters of North Carolina equivalent to that of the SNCES stock at 141 (95% CI 112 - 200, CV=0.15). However, this estimate is more than 8 years old, and hence cannot be used to calculate N_{min} or PBR.

Since both tag-telemetry studies and photo-ID records indicate that some portion of the SNCES stock occurs in coastal waters between the North Carolina/South Carolina border and Cape Lookout during summer months, it is

appropriate to include animals from summer aerial surveys of these areas in the abundance estimate. Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias. Abundance estimates were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995).

During the summer survey, 6,734km of trackline were completed between Sandy Hook, New Jersey, and Ft. Pierce, Florida. All tracklines in the 0-20m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia/Florida state line. A total of 185 bottlenose dolphin groups were sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20m and 20-40m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189km of trackline. There were a total of 140 sightings of bottlenose dolphin groups including 3,093 individual animals. During the summer of 2004, water temperatures were significantly cooler than those during 2002 and earlier surveys conducted in 1995, and animals were distributed farther south and overlapped spatially. It is probable that both the Northern Migratory and Southern Migratory stocks occurred in waters of northern North Carolina during the summer of 2004.

The best abundance estimate for the Southern North Carolina Estuarine System stock in coastal waters is therefore from the summer 2002 survey when there was less overlap among stocks. Survey data were post-stratified to estimate the abundance of dolphins within a strip extending from the shoreline to 3km from shore between the North Carolina/South Carolina border and Cape Lookout, North Carolina. Tag-telemetry records indicated that SNCES animals rarely ventured further away from shore. However, animals from the Southern Migratory stock may occur within this strip during summer months. Therefore, the estimate of abundance within this strip likely includes both SNCES animals and Southern Migratory animals and hence overestimates the abundance. The resulting best abundance estimate for the Southern North Carolina Estuarine System stock in coastal waters is 2,454 (CV=0.53).

The best available abundance estimate for the SNCES stock is the combined abundance from estuarine and coastal waters. This combined estimate is 2,595 (CV=0.28). However, this estimate includes data that are more than 8 years old from Read *et al.* (2003). Retaining only the portion of this estimate that is less than 8 years old, the best estimate is the aerial survey from coastal waters only since it accounts for approximately 95% of the stock. Thus, the best estimate of stock abundance is 2,454 (CV=0.53), but this is clearly an underestimate of total abundance since it excludes estuarine waters.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate for the Southern North Carolina Estuarine System stock of bottlenose dolphins is 2,454 (CV=0.53). The resulting minimum population estimate is 1,614.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the SNCES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or

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stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the SNCES stock is therefore 16. However, this is an underestimate since the abundance estimate excludes the estuarine waters occupied by this stock.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The SNCES stock interacts with 3 Category II fisheries: the Atlantic blue crab trap/pot fishery, North Carolina long haul seine fishery and North Carolina inshore gillnet fishery. There is no systematic observer coverage of these fisheries by the National Marine Fisheries Service (NMFS), although the North Carolina Division of Marine Fisheries operates systematic coverage of the fall flounder gillnet fishery in Pamlico Sound (Price 2008). As a result, information about interactions with North Carolina inshore fisheries is based solely on stranding data and it is not possible to estimate the annual number of interactions or mortalities in these fisheries. The SNCES stock may also interact with the mid-Atlantic gillnet fishery. The magnitude of the interaction with this fishery is unknown because of both uncertainty in the movement patterns of the stock and the spatial overlap between the SNCES stock and other bottlenose dolphin stocks in coastal waters. The total estimated average annual fishery mortality on the SNCES stock ranges between a minimum of 0.6 and a maximum of 1.2 animals per year. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of coastal morphotype bottlenose dolphins, and the sink gillnet gear in North Carolina is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish or finfish generically (Rossman and Palka 2001). From 2001 to 2008, 7 additional bottlenose dolphin mortalities were observed in the mid-Atlantic gillnet fishery. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April and 2 occurring off of Virginia during November. Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003, 1 in September 2005, 1 in September 2006 and 1 in October 2006. Because the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System, and Southern North Carolina Estuarine System bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign all observed mortalities, or extrapolated bycatch estimates, to a specific stock. In addition, the Bottlenose Dolphin Take Reduction Plan (BDTRP) was implemented in May 2006 resulting in changes in the gear configurations and other characteristics of the fishery.

To estimate the mortality of bottlenose dolphins in the mid-Atlantic gillnet fishery, the available data were divided into the period from 2002 through April 2006 (pre-BDTRP) and from May 2006–2008 (post-BDTRP). Three alternative approaches were used to estimate bycatch rates. First, a generalized linear model (GLM) approach was used similar to that described in Rossman and Palka (2001). This approach included all observed mortalities from 1995 to 2008 where the fishing gear was still in use during the period from 2002 to 2008. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data. Finally, a ratio estimator pooled across years was used to estimate different CPUE values for the pre-BDTRP and post-BDTRP periods. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality, again similar to the approach in Rossman and Palka (2001). To account for the uncertainty in the most appropriate of these 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) are used to estimate the mortality of bottlenose dolphins for this fishery (Table 1).

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Table 1. Summary of the 2002-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus truncatus*) in the Southern North Carolina Estuarine System stock in the commercial mid-Atlantic gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-BDTRP) and after the implementation of the plan (post-BDTRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data and NCDMF dealer data. Values in parentheses indicated the CV of the estimate.

Period	Year	Observer Coverage[a]	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-BDTRP	2002	0.01	0	0	1.77 (0.35)	0	0	4.36 (0.30)
	2003	0.01	0	0	3.12 (0.42)	0	0	4.71 (0.34)
	2004	0.02	0	0	2.77 (0.43)	0	0	6.51 (0.36)
	2005	0.03	0	0	1.43 (0.41)	0	0	2.34 (0.30)
	Jan-Apr 2006	0.03	0	0	0.01 (0.70)	0	0	0.32 (0.42)
Annual Avg. pre-BDTRP			Minimum: 0.61 (CV=0.22)			Maximum: 1.22 (CV=0.18)		
post-BDTRP	May-Dec 2006	0.03	0	0	2.23 (0.51)	0	0	2.83 (0.41)
	2007	0.03	0	0	1.88 (0.52)	0	0	2.88 (0.37)
	2008	0.01	0	0	1.42 (0.48)	0	0	2.56 (0.32)
Annual Avg. post-BDTRP			Minimum: 0.61 (CV=0.30)			Maximum: 0.92 (CV=0.21)		

[a] Observer coverage is reported on an annual basis for the entire fishery as a proportion of the reported tons of fish landed.

There have been no observed mortalities in the mid-Atlantic gillnet fishery since 2001 that could potentially be assigned to the Southern North Carolina Estuarine System stock. Hence, both the annual and pooled ratio estimators of bycatch rate were equal to 0 in both the pre-BDTRP and post-BDTRP periods. Since the GLM approach includes information from prior to 2002, positive bycatch rates for the SNCES stock were estimated (Table 1). Since observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year, the minimum and maximum possible mortality of the SNCES stock are presented for comparison to PBR (Table 1).

Based upon these analyses, the minimum mortality estimate for the SNCES stock for the pre-BDTRP period was 0.61 (CV=0.22) animals per year, and that for the post-BDTRP period was also 0.61 (CV=0.30) animals per year. The maximum estimates were 1.22 (CV=0.18) for the pre-BDTRP period and 0.92 (CV=0.21) for the post-BDTRP period (Table 1).

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Crab Pots and Other Pots

Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that interactions with pot gear are a common occurrence and result in mortalities of coastal morphotype bottlenose dolphins in some regions (Burdett and McFee 2004). Southeast Regional Marine Mammal Stranding Network data (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009) from 2004 through 2008 include 13 reports of interactions between bottlenose dolphins and confirmed blue crab pot gear with the majority of these occurring in waters from Florida to South Carolina. In addition, there were 4 interactions documented with pot gear where the fishery could not be confirmed. In these cases, the gear was confirmed to be associated with a pot or trap, but may have been from a fishery other than blue crab (e.g., whelk fisheries in Virginia). There were no reported interactions that were likely to impact the SNCES stock during 2004-2008.

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including directed live capture studies, turtle relocation trawls and fisheries surveys. From 2002 to 2009, there have been 15 reported interactions during research activities resulting in 13 documented mortalities of bottlenose dolphins. One mortality was reported from October 2006 in a fishery research trawl that was most likely from the SNCES stock.

Three bottlenose dolphins that were captured, tagged with satellite-linked transmitters, and released near Beaufort, North Carolina, during April 2006 by the NMFS as part of a long-term stock delineation research project were believed to have died shortly thereafter as a result of the capture or tagging (NMFS unpublished data). Two of the animals were recovered stranded but because of advanced decomposition of the carcasses cause of death could not be determined. One of these 2 animals was known from long-term photo-ID and was likely of the Southern North Carolina Estuarine System stock. The third animal has not been observed subsequent to release, but patterns in the data received from its satellite tag were similar to that of the other 2 and indicated the fates were similar. These last 2 animals were, based on satellite-derived locations, most likely from the NNCES stock. All known human-caused mortalities including both commercial fisheries and research related mortalities are summarized in Table 2.

This stock inhabits areas with significant drainage from agricultural, industrial and urban sources, and as such is exposed to contaminants in runoff from those sources. The blubber of 47 bottlenose dolphins captured and released in and around Beaufort contained contaminants of some level, and 7 had unusually high levels of the pesticide methoxychlor (Hansen *et al.* 2004). While there are no estimates of indirect human-caused mortality from pollution or habitat degradation, Schwacke *et al.* (2002) found that the levels of polychlorinated biphenyls (PCBs) observed in Beaufort female bottlenose dolphins would likely impair reproductive success, especially of primiparous females.

Table 2. Summary of annual reported and estimated mortality of bottlenose dolphins from the Southern North Carolina Estuarine System stock. Where minimum and maximum values are reported, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. The reported mortalities in crab pot fisheries are confirmed reports and are likely an underestimate of total mortalities in these fisheries.

Year	Mid-Atlantic Gillnet	Blue Crab Pot	Other Pot	Research	Total
2004	Min = 0.9 Max = 2.2	0	0	0	Min = 0.9 Max = 2.2
2005	Min = 0.5 Max = 0.8	0	0	0	Min = 0.5 Max = 0.8
2006	Min = 0.7 Max = 1.1	0	0	2	Min = 0.7 Max = 1.1

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2007	Min = 0.6 Max = 1.0	0	0	0	Min = 0.6 Max = 1.0
2008	Min = 0.5 Max = 0.9	0	0	0	Min = 0.5 Max = 0.9
Annual Average Mortality (2004-2008)			Minimum Estimated = 0.6 Maximum Estimated = 1.2		

Strandings

Between 2004 and 2008, 78 bottlenose dolphins stranded in coastal and estuarine waters of North Carolina that could be assigned to the SNCES stock (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). The assignment of animals to a particular stock is impossible in some seasons and regions. In particular, there is overlap between the SNCES stock and the Southern Migratory stock in coastal waters of southern North Carolina during fall and spring. There is also overlap in southern Pamlico Sound and waters of Bogue Sound with the NNCES stock during late summer and early fall. Therefore, it is likely that the counts below include some animals from either the Southern Migratory or NNCES stock. Within estuarine waters of southern North Carolina, where the probability is very high that strandings are from the SNCES stock, there were a total of 18 strandings in this 5 year period. In addition, stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form. In most cases, it was not possible to determine if a human interaction had occurred due to the decomposition state of the stranded animal. However, in cases where a determination could be made, the incidence of evidence of fisheries interactions was high in coastal waters. In cases where a determination could be made, 47% of cases from coastal waters of North Carolina and 25% (2/8) of cases from North Carolina estuarine waters had evidence of human interaction. It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point in the animal's life. Evidence of fishery interaction is by far the most common type of human interaction reported.

Table 3. Strandings of bottlenose dolphins from North Carolina that can possibly be assigned to the Southern North Carolina Estuarine System stock. Strandings observed in North Carolina are separated into those occurring within estuaries vs. coastal waters. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, particularly in coastal waters, there is likely overlap between the SNCES stock and other bottlenose dolphin stocks. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009.

State	**2004**			**2005**			**2006**			**2007**			**2008**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
North Carolina - Coastal	4	8	10	3	4	4	2	3	2	3	1	5	4	2	5
North Carolina - Estuary	1	1	3	0	0	1	0	4	2	1	1	1	0	0	3

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Annual Total	27	12	13	12	14

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted as a result of the 1987-1988 mortality event. Scott *et al.* (1988) suggested that dolphins residing in the bays, sounds and estuaries adjacent to these coastal waters were not affected by the mortality event and these animals were explicitly excluded from the depleted listing (Federal Register: 54(195), 41654-41657; 56(158), 40594-40596; 58(64), 17789-17791).

The status of the SNCES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. The annual average of human caused mortality for this stock ranges between a minimum of 0.6 and a maximum of 1.2, but this is an underestimate of total mortality associated with commercial fisheries. The most recent abundance estimate is an underestimate of stock size because it excludes estuarine waters. Based upon the available data, it seems unlikely that mortality in commercial fisheries exceeds PBR. However, the total human-caused mortality and serious injury is most likely greater than 10% of PBR. Because of uncertainty in both stock size and mortality and because relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

REFERENCES CITED

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10(2): 157-167.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Andersen, K. P Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 pp.

Burdett, L.G. and W.E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorization. J. Cetacean Res. Mange. 6(3): 231-240.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. thesis. University of Miami. 143 pp.

Gubbins, C. 2002. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquat. Mamm. 28: 24-31.

Gubbins, C.M., M. Caldwell, S.G. Barco, K. Rittmaster, N. Bowles and V. Thayer 2003. Abundance and sighting patterns of bottlenose dolphins (*Tursiops truncatus*) at four northwest Atlantic coastal sites. J. Cetacean Res. Manage. 5(2): 141-147.

Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman and P.A. Fair 2004. Geographic variation in polychlorinated biphenyl and organochlorine pesticide concentrations in the blubber of bottlenose dolphins from the U.S. Atlantic coast. Sci. Total Environ. 319: 147-172.

Litz, J.A. 2007. Social structure, genetic structure, and persistent organohalogen pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Ph.D. thesis. University of Miami. 140 pp.

Mazzoil, M., S.D. McCulloch and R.H. Defran 2005. Observations on the site fidelity of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Fla. Sci. 68(4): 217-226.

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In:* A. Bjørge and G.P. Donovan. Biology of Phocoenids. Rep. Int. Whal. Comm., Special Issue 16, Cambridge, U.K.

DRAFT

Price, B. 2008. Sea turtle bycatch monitoring of the 2007 fall gillnet fisheries in southeastern Pamlico Sound, North Carolina. Completion report for activities under Endangered Species Act Section 10 Incidental Take Permit # 1528. NC Division of Marine Fisheries, Morehead City, NC, 25 pp.

Read, A.J., K.W. Urian, B. Wilson and D.M. Waples 2003. Abundance of bottlenose dolphins in the bays, sounds, and estuaries of North Carolina. Mar. Mamm. Sci. 19(1): 59-73.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18: 5030–5045.

Rossman, M.C. and D.L. Palka. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15, 77 pp.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21(12): 2752-2764.

Scott, G.P., D.M. Burn and L.J. Hansen 1988. The dolphin dieoff: Long-term effects and recovery of the population. Conference proceedings, Oceans '88. IEEE Cat. No. 88-CH2585-8.

Sellas, A.B., R.S. Wells and P.E. Rosel 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6(5): 715-728.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., E. Josephson, C.P. Fairfield and K. Maze-Foley, eds. 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2008. NOAA Tech. Memo. NMFS-NE-210, 440 pp.

Wells, R.S., M.D. Scott and A.B. Irvine 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In*: H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York.

Zolman, E.S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River estuary, Charleston County, South Carolina, U.S.A. Mar. Mamm. Sci. 18: 879-892.

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~~December 2009~~~~January~~March 2010

NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*): Western Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. In addition, recent resightings of photographically identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton *et al.* 2007), ~~and~~ northern Norway (Jacobsen *et al.* 2004), and the Azores (Hamilton *et al.* 2009). The September 1999 Norwegian sighting represents one of only two published sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. The few published records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972) represent either distributional anomalies, normal wanderings of occasional animals, or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. Whatever the case, the location of much of the population is unknown during the winter. Offshore (greater than 30 miles) surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001 had 3 sightings in 1996, 1 in 1997, 13 in 1998, 6 in 1999, 11 in 2000 and 6 in 2001 (within each year, some were repeat sightings of previously recorded individuals). Several of the years that offshore surveys were flown were some of the lowest count years for calves and for numbers of right whales in the Southeast recorded since comprehensive surveys began in the calving grounds. Therefore, the frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear.

Research results suggest the existence of six major habitats or congregation areas for western North Atlantic right whales: the coastal waters of the southeastern United States; the Great South Channel; Georges Bank/Gulf of Maine; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf. However, movements within and between habitats are extensive. In 2000, one whale was photographed in Florida waters on 12 January, then again eleven days later (23 January) in Cape Cod Bay, less than a month later off Georgia (16 February), and back in Cape Cod Bay on 23 March, effectively making the round-trip migration to the Southeast and back at least twice during the winter season (Brown and Marx 2000). Results from satellite tags clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al.* 1997; Baumgartner and Mate 2005). Systematic surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear. Four of the calves were not sighted by surveys conducted further south. One of the cows photographed was new to researchers, having effectively eluded identification over the period of its maturation (McLellan *et al.* 2004).

New England waters are an important feeding habitat for right whales, which feed in this area primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*). Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al.* 1986; 1995). While feeding in the coastal waters off Massachusetts has been better studied than in other areas, right whale feeding has also been observed on the margins of Georges Bank, in the Great South Channel, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The characteristics of acceptable prey distribution in these areas are beginning to emerge (Baumgartner *et al.* 2003; Baumgartner and Mate 2003). NMFS (National Marine Fisheries Service) and Provincetown Center for Coastal Studies aerial surveys during springs of 1999-2006 found right whales along the Northern Edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank and Wilkinson Basin. The consistency with which right whales occur in such locations is relatively high, but these studies also highlight the high interannual variability in right whale use of some habitats.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes in the western North Atlantic right whale (Malik *et al.* 1999). Schaeff *et al.*(1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated by Malik *et al.* (2000). The low diversity in North Atlantic right whales might be indicative of inbreeding, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure, using DNA extracted from museum and archaeological specimens of baleen and bone, has suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 1997; 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggests population subdivision over a protracted (but not evolutionary) timescale. Genetic studies concluded that the principal loss of genetic diversity occurred prior to the 18th century (Waldick *et al.* 2002). However, revised conclusions that nearly all the remains in the North American Basque whaling archaeological sites were Bowhead whales and not right whales (Rastogi *et al.* 2004) contradict the previously held belief that Basque whaling during the 16th and 17th centuries was principally responsible for the loss of genetic diversity.

High-resolution (using 35 microsatellite loci) genetic profiling has been completed for 66% of all identified North Atlantic right whales through 2001. This work has improved our understanding of genetic variability, number of reproductively active individuals, reproductive fitness, parentage and relatedness of individuals (Frasier *et al.* 2007).

One emerging result of the genetic studies is the importance of obtaining biopsy samples from calves on the calving grounds. Only 60% of all known calves are seen with their mothers in summering areas, when their callosity patterns are stable enough to reliably make a photo-ID match later in life. The remaining 40% are not seen on a known summering ground. Because the calf's genetic profile is the only reliable way to establish parentage, if the calf is not sampled when associated with its mother early on, then it is not possible to link it with a calving event or to its mother, and information such as age and familial relationships is lost. From 1980 to 2001, there were 64 calves born that were not sighted later with their mothers and thus unavailable to provide age-specific mortality information (Frasier *et al.* 2007). An additional interpretation of paternity analyses is that the population size may be larger than was previously thought. Fathers for only 45% of known calves have been genetically determined. However, genetic profiles were available for 69% of all photo-identified males (Frasier 2005). The conclusion was that the majority of these calves must have different fathers which cannot be accounted for by the unsampled males and the population of males must be larger (Frasier 2005). This inference of additional animals that have never been captured photographically and/or genetically suggests the existence of habitats of potentially significant use that remain unknown.

POPULATION SIZE

The western North Atlantic minimum stock size is based on a census of individual whales identified using photo-identification techniques. A review of the photo-ID recapture database as it existed on ~~30 May 2007~~24 June 2009 indicated that ~~345~~361 individually recognized whales in the catalog were known to be alive during 2005. This number represents a minimum population size. This count has no associated coefficient of variation.

Previous estimates using the same method with the added assumption that whales seen within the previous seven years were still alive have resulted in counts of 295 animals in 1992 (Knowlton *et al.* 1994) and 299 animals in 1998 (Kraus *et al.* 2001). An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al.* 2001).

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986), however, recent genetic analysis has shown that nearly all of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004; Frasier *et al.* 2007). The stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves *et al.* 2001; Reeves *et al.* 2007). A modest but persistent whaling effort along the coast of the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, Reeves and Mitchell could conclude only that there were at least hundreds of right whales present in the western North Atlantic during the late 1600s. Reeves *et al.* (1992) plotted a series of population trajectories using historical data, assuming a present day population size of 350 animals. The results suggested that there may have

been at least 1,000 right whales in the population during the early to mid-1600s, with the greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves *et al.* 1992; Kenney *et al.* 1995). However, little is known about the population dynamics of right whales in the intervening years.

Minimum Population Estimate

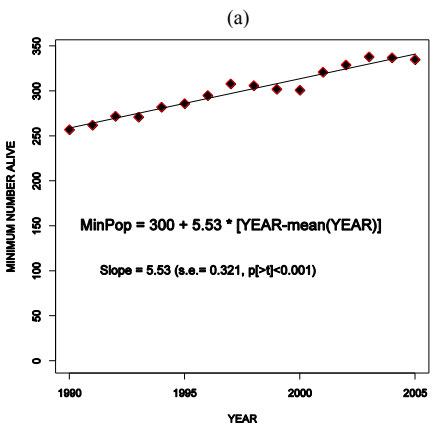
The western North Atlantic population size was estimated to be at least ~~345~~361 individuals in 2005 based on a census of individual whales identified using photo-identification techniques. This value is a minimum and does not include animals that were alive prior to ~~2003~~2005, but not recorded in the individual sightings database as seen during from 1 December ~~2003~~2004 to ~~10 October 2008~~24 June 2009 (note that matching of photos ~~from~~ taken during 2006 ~~and 2007 is~~ 2009 was not complete at the time the data were received). It also does not include some calves known to be born during 2005, or any other individual whale seen during 2005 but not yet entered into the catalog.

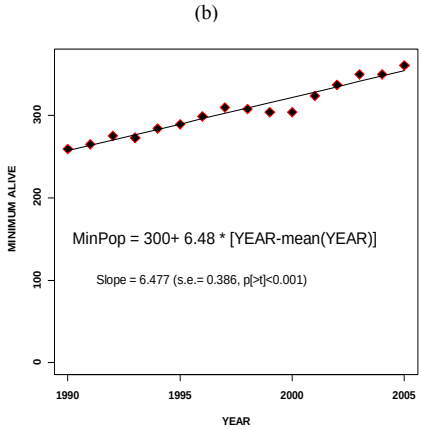
Current Population Trend

The population growth rate reported for the period 1986-1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) suggested that crude survival probability declined from about 0.99 in the early 1980s to about 0.94 in the late 1990s. The decline was statistically significant. Additional work conducted in 1999 was reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop concluded based on several analytical approaches that survival had indeed declined in the 1990s. Although capture heterogeneity could negatively bias survival estimates, the workshop concluded that this factor could not account for the entire observed decline, which appeared to be particularly marked in adult females. Another workshop was convened by NMFS in September 2002, and reached similar conclusions regarding the decline in the population (Clapham 2002).

~~Recent mortalities, including those in the first half of 2005, suggest an~~ An increase in mortality in 2004 and 2005 was cause for serious concern ~~the annual mortality rate~~ (Kraus *et al.* 2005). Calculations based on demographic data through 1999 (Fujiwara and Caswell 2001) indicated that this mortality rate increase would reduce population growth by approximately 10% per year (Kraus *et al.* 2005). Of ~~these~~ those ~~recent~~ mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, losing their complete lifetime reproduction potential.

Despite the preceding, examination of the minimum number alive population index calculated from the individual sightings database, as it existed on ~~10 October 2008~~24 June 2009, for the years 1990-2005 (Figure 1) suggests a positive trend in ~~numbers~~population size. These data reveal a significant increase in the number of catalogued whales alive during this period, but with significant variation due to apparent losses exceeding gains during 1998-99. Mean growth rate for the period was ~~1.8~~2.1%.





(b)

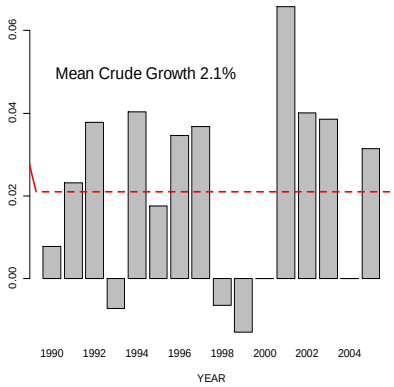


Figure 1. Minimum number alive (a) and crude annual growth rate (b) for cataloged North Atlantic right whales. Minimum number (N) of cataloged individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly catalogued that year. It does not include calves born that year or any other individuals not yet catalogued. Mean crude growth rate (dashed line) is the exponetiated mean of $\log_e[(N_{t+1}-N_t)/N_t]$ *for each year (t).*

The minimum number alive may increase slightly in later years as analysis of the backlog of unmatched but high-quality photographs proceeds. For example, the minimum number alive for 2002 was calculated to be 313 from a 15 June 2006 data set and revised to 325 using the 30 May 2007 data set.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from 5 to 17, with a mean of 11.2 (SE=0.90). The reproductively active female pool was static at approximately 51 individuals during 1987-1992. Mean calving interval, based on 86 records, was 3.67 years. There was an indication that calving intervals may have been increasing over time, although the trend was not statistically significant (P=0.083) (Knowlton *et al.* 1994).

Total reported calf production and calf mortalities from 1993 to ~~2007~~2009 are shown below in Table 1. The mean calf production for this ~~fifteen~~seventeen year period was 17.2 (15.~~6 (13.7-17.7~~3-19.4; 95% C.I.). During the 2004 and 2005 calving seasons three adult females were found dead with ~~near~~ near-term fetuses.

An updated analysis of calving intervals through the 1997/1998 season suggests that the mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This conclusion ~~is~~ was supported by modeling work reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop agreed that calving intervals had indeed increased and further that the reproductive rate was approximately half that reported from studied populations of southern right whales, *E. australis*. A workshop on possible causes of reproductive failure was held in April 2000 (Reeves *et al.* 2001). Factors considered included contaminants, biotoxins, nutrition/food limitation, disease, and inbreeding problems. While no conclusions were reached, a research plan to further investigate this topic was developed. Analyses completed since that workshop found that in the most recent years, calving intervals were closer to three years (Kraus *et al.* 2007).

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Hamilton *et al.* 1998; Best *et al.* 2001), which may reflect lowered recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to an unstable age structure or to reproductive senescence on the part of some females. However, few data are available on either factor and senescence has not been documented for any baleen whale.

Table 1: North Atlantic right whale calf production and mortality, 1993-2007

Year[a]	Reported calf production	Reported calf ~~mortalites~~mortalities
1993	8	2
1994	9	0
1995	7	0
1996	22	3
1997	20	1
1998	6	1
1999	4	0
2000	1	0
2001	31	4
2002	21	2
2003	19	0
2004	17	1
2005	28	0
2006	19	2
2007	23	2
2008	23	2
2009	39	1

a. includes December of the previous year

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). ~~Recent publications report unacceptable levels of mortality (Best *et al.* 2001), and forecast a high probability that North Atlantic right whales will go extinct in 200 years if anthropogenic mortality is not curtailed (Fugiwara and Caswell 2001); therefore, the PBR for this population is set to zero.~~The minimum population size is 361 and the observed net productivity is 0.02. PBR for the Western Atlantic Stock of North Atlantic Right whale is 0.7.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2003~~4~~ through 2008~~7~~, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 2.8~~3.0~~ per year (U.S. waters, 2.2; Canadian waters, 0.6~~8~~). This is derived from two components: 1) incidental fishery entanglement records at 0.8 per year (U.S. waters, 0.6; Canadian waters, 0.2), and

2) ship strike records at 2.0~~2~~ per year (U.S. waters, 1.6; Canadian waters, 0.4~~6~~). Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates of this report to reflect the effective range of this stock. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information (Cole *et al.* 2005). For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries. For more information on determinations for this period, see Glass *et al.* (2010~~09~~).

Background

The details of a particular mortality or serious injury record often require a degree of interpretation. The assigned cause is based on the best judgment of the available data; additional information may result in revisions. When reviewing Table 2 below, several factors should be considered: 1) a ship strike or entanglement may occur at some distance from the reported location; 2) the mortality or injury may involve multiple factors; for example, whales that have been both ship struck and entangled are not uncommon; 3) the actual vessel or gear type/source is often uncertain; and 4) in entanglements, several types of gear may be involved.

The serious injury determinations are susceptible to revision. There are several records where a struck and injured whale was re-sighted later, apparently healthy, or where an entangled or partially disentangled whale was re-sighted later free of gear. The reverse may also be true: a whale initially appearing in good condition after being struck or entangled is later re-sighted and found to have been seriously injured by the event. Entanglements of juvenile whales are typically considered serious injuries because the constriction on the animal is likely to become increasingly lethal as the whale grows (Cole *et al.* 2005; Nelson *et al.* 2007).

A serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited the serious injury designation to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death (Cole *et al.* 2005; Nelson *et al.* 2007; Glass *et al.* 2008; Glass *et al.* ~~2009~~2010). Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury may increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. This conservative approach likely underestimates serious injury rates.

With these caveats, the total minimum detected~~estimated~~ annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) is ~~3~~2.8~~.2~~ right whales per year (U.S. waters 2.2~~4~~; Canadian waters, 0.6~~8~~). As with entanglements, some injury or mortality due to ship strikes is almost certainly undetected, particularly in offshore waters. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent lost data, some of which may relate to human impacts. For these reasons, the estimate of 2.8~~3.2~~ right whales per year must be regarded as derived from ~~a~~ minimum count~~estimate~~ (Glass *et al.* 2010~~09~~).

Further, the small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales. The principal factors believed to be retarding growth and recovery of the population are ship strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities ~~were~~ was recorded (IWC [International Whaling Commission] 1999; Knowlton and Kraus 2001; Glass *et al.* 2009). Of these, 13 (28.9%) were neonates that were believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) resulted from ship strikes, 3 (6.7%) were related to entanglement in fishing gear (in two cases lobster gear, and one gillnet gear), and 13 (28.9%) were of unknown cause. At a minimum, therefore, 42.2% of the observed total for the period and 50% of the 32 non-calf deaths were attributable to human impacts (calves accounted for three deaths from ship strikes). Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990).

Finally, entanglement or minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so that it is more likely to become vulnerable to further injury. Such was apparently the case with the two-year-old right whale killed by a ship off Amelia Island, Florida in March 1991 after having carried gillnet gear wrapped around its tail region since the previous summer (Kenney and Kraus 1993). A similar fate befell right whale #2220, found dead on Cape Cod in 1996.

Fishery-Related Serious Injury and Mortality

Reports of mortality and serious injury relative to PBR as well as total human impacts are contained in records

maintained by the New England Aquarium and the NMFS Northeast and Southeast Regional Offices (Table 2). From ~~2003~~ 2004 through ~~2007~~2008, 4 of ~~15~~ 14 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. For this time frame, the average reported mortality and serious injury to right whales due to fishery entanglement was 0.8 whales per year (U.S. waters, 0.6; Canadian waters, 0.2). Information from an entanglement event often does not include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period 2004~~3~~ through 2008~~7~~, there were at least four documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious-injury determination. ~~An unidentified right whale was disentangled in the Bay of Fundy, Canada on 9 July 2003. The gear was tentatively identified as U.S. lobster gear and other unknown gear.~~ On 6 December 2004, a one-year-old female, #3314, was sighted with line wrapped on both its head and tail which would likely have been fatal. Following more than three weeks of attempts, the constricting fishing gear was removed. On 3 December 2005, #3445—the 2004 calf of #2145—was first sighted off Brunswick, Georgia, with line across its back and around its right flipper. Over 300 feet of trailing line was removed. This whale was resighted on 12 June 2006, apparently gear-free. An adult female, #2029, first sighted in the Great South Channel on 9 March 2007, may have avoided serious injury due to being partially disentangled on 18 September 2007 by researchers in the Bay of Fundy, Canada. On 8 December 2008, Eg number 3294 was successfully disentangled. Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107 was first sighted with gear wrapping its caudal peduncle on 6 July 2002 near Briar Island, Nova Scotia. Although the gear was removed on 1 September by the New England Aquarium disentanglement team, and the animal seen alive on an aerial survey on 1 October, its carcass washed ashore at Nantucket on 12 October, 2002 with deep entanglement injuries on the caudal peduncle. ~~On 8 December 2008, Eg number 3294 was successfully disentangled.~~

In January 1997, NMFS changed the classification of the Gulf of Maine and U.S. mid-Atlantic lobster pot fisheries from Category III to Category I based on examination of stranding and entanglement records of large whales from 1990 to 1994 (62 FR 33, Jan. 2, 1997).

The only bycatch of a right whale observed by the Northeast Fisheries Observer Program was in the pelagic drift gillnet fishery in 1993. No mortalities or serious injuries have been documented in any of the other fisheries monitored by NMFS.

Entanglement records from 1990 through 2008~~7~~ maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included 47~~6~~ confirmed right whale entanglements, including right whales in weirs, gillnets, and trailing line and buoys. Because whales often free themselves of gear following an entanglement event, scarring may be a better indicator of fisheries interaction than entanglement records. In an analysis of the scarification of right whales, 338 of 447 (75.6%) whales examined during 1980-2002 were scarred at least once by fishing gear (Knowlton *et al.* 2005). Further research using the North Atlantic Right Whale Catalogue has indicated that, annually, between 14% and 51% of right whales are involved in entanglements (Knowlton *et al.* 2005). Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada and the U.S. east coast were summarized by Read (1994). In six records of right whales that were entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the whales were either released or escaped on their own, although several whales were observed carrying net or line fragments. A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976.

For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea. The number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001). Records from 2004~~3~~ through 2008~~7~~ have been summarized in Table 2. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes was 2.~~2~~0 whales per year (U.S. waters, 1.6; Canadian waters, 0.4~~6~~).

~~Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2003 through December 2007.~~

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
01/14/03	serious injury	Adult Female #2240 12m (est)	Jacksonville, FL		P	Body condition poor; no gear recovered
10/02/03 –	mortality	Adult Female #2150 15m (est)	Digby, NS	P		Large fracture in skull; subdermal hemorrhage
02/07/04	mortality	Adult Female #1004 16.0m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
09/06/04	mortality	Adult Female #2301 15m (est)	Roseway Basin, NS		P	Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA; gear recovered consists of 10 fathoms of 3/8" & 7/16" rope
11/24/04	mortality	Adult Female #1909 14.9m	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed
01/12/05	mortality	Adult Female #2143 13.1m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
03/10/05	serious injury	Adult Female #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
04/28/05	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
01/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
01/22/06	mortality	Calf Female 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting; no gear present
03/11/06	serious injury	Yearling Male #3522	off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface
07/24/06	mortality	age unknown Female	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs

		~~9.6m~~				
~~08/24/06~~	~~mortality~~	~~Adult Female 14.7m~~	~~Roseway Basin, NS~~	~~P~~		~~16 fractured vertebrae; dorsal blubber bruise from head to genital region~~
~~12/30/06~~	~~mortality~~	~~Yearling Male #3508 12.6m~~	~~off Brunswick, GA~~	~~P~~		~~20 propeller lacerations along right side of head and back with associated hemorrhaging~~
~~03/31/07~~	~~mortality~~	~~Calf Male 7.7 m~~	~~Outer Banks, NC~~		~~P~~	~~Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered~~

~~a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.~~
~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass *et al.* 2009) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.~~

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2004 through December 2008.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
02/07/04	mortality	Adult Female #1004 16.0m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
09/06/04	mortality	Adult Female #2301 15m (est)	Roseway Basin, NS		P	Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA; gear recovered consists of 10 fathoms of 3/8" & 7/16" rope
11/24/04	mortality	Adult Female #1909 14.9m	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed
01/12/05	mortality	Adult Female #2143 13.1m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
03/10/05	serious injury	Adult[c] Female[c] #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; last resighted 9/4/05 in extremely poor condition
04/28/05	mortality	Adult Female #2617	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures

		14.7m				
01/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
01/22/06	mortality	Calf Female[c] 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting; no gear present
03/11/06	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface; not resighted since
07/24/06	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
08/24/06	mortality	Adult Female 14.7m	Roseway Basin, NS	P		16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/06	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P		20 propeller lacerations along right side of head and back with associated hemorrhaging
03/31/07	mortality	Calf Male 7.7 m	Outer Banks, NC		P	Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered
02/03/08	serious injury	Adult Male #1980	Cape Hatteras, NC		P	Embedded wrap in rostrum; decline in health; no gear recovered; last resighted 04/16/2008

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. Additional information that was not included in previous reports.

STATUS OF STOCK

The size of this stock is considered to be extremely low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). A Recovery Plan has been published for the North Atlantic right whale and is in effect (NMFS [National Marine Fisheries Service] 2005). NMFS is presently engaged in evaluating the need for critical habitat designation for the North Atlantic right whale. Under a prior listing as northern right whale, t~~T~~hree critical habitats, Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern U.S. were designated ~~for the Northern right whale~~ by NMFS (59 FR 28793, June 3, 1994). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the North Atlantic right whale (Brown *et al.* 2009). A National Marine Fisheries Service ESA status review in 1996 concluded that the western North Atlantic population remains endangered. This conclusion was reinforced by the International Whaling Commission (Best *et al.* 2001), which expressed grave concern regarding the status of this stock. Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury was a minimum of 3.0 right whales per year from 2004~~3~~ through 2008~~7~~. Given that PBR has been set to ~~zero~~0.7, no mortality

or serious injury for this stock can be considered insignificant. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is an endangered species.

REFERENCES CITED

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales of the North Atlantic. Rep. Int. Whal. Comm. (Special Issue) 10: 191-199.

Angliss, R.P. and D.P. DeMaster 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Tech. Memo. OPR-13.

Baumgartner, M.F., T.V.N. Cole, R.G. Campbell, G.J. Teegarden and E.G. Durbin 2003. Associations between North Atlantic right whales and their prey, *Calanus finmarchicus*, over diel and tidal time scales. Mar. Ecol. Prog. Ser. 264: 155-166.

Baumgartner, M.F. and B.R. Mate 2003. Summertime foraging ecology of North Atlantic right whales. Mar. Ecol. Prog. Ser. 264: 123-135.

Baumgartner, M.F. and B.R. Mate 2005. Summer and fall habitat of North Atlantic right whales (*Eubalaena glacialis*) inferred from satellite telemetry. Can. J. Fish. Aq. Sci. 62: 527-543.

Best, P.B., J.L. Bannister, J. R.L. Brownell and G.P. Donovan, eds. 2001. Right whales: worldwide status. J. Cetacean Res. Manage. (Special Issue) 2: 309.

Brown, M.W., D. Fenton, K. Smedbol, C. Merriman, K. Robichaud-Leblanc and J.D. Conway 2009. Recovery Strategy for the North Atlantic Right Whale (*Eubalaena glacialis*) in Atlantic Canadian Waters [Final]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, vi + 66 pp.

Brown, M.W. and M.K. Marx 2000. Surveillance, monitoring and management of North Atlantic right whales, *Eubalaena glacialis*, in Cape Cod Bay, Massachusetts: January to Mid-May, 2000. Division of Marine Fisheries, Commonwealth of Massachusetts. final report.

Caswell, H., S. Brault and M. Fujiwara 1999. Declining survival probability threatens the North Atlantic right whale. Proc. Natl. Acad. Science USA 96: 3308-3313.

Clapham, P.J., (ed.) 2002. Report of the working group on survival estimation for North Atlantic right whales. Available from the Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.

Clapham, P.J., S.B. Young and R.L. Brownell, Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review 29: 35-60.

Cole, T.V.N., D. Hartley and R.L. Merrick 2005. Methodologies of the NOAA National Marine Fisheries Service aerial survey program for right whales (*Eubalaena glacialis*) in the Northeast U.S., 1998-2006. Northeast Fish. Sci. Cent. Ref. Doc. 05-08.

Frasier, T.R. 2005. Integrating genetic and photo-identification data to assess reproductive success in the North Atlantic right whale (*Eubalaena glacialis*). PhD thesis. McMaster University, Hamilton, Ontario.

Frasier, T.R., B.A. McLeod, R.M. Gillett, M.W. Brown and B.N. White 2007. Right whales past and present as revealed by their genes. Pages 200-231 *in*: S. D. Kraus and R. M. Rolland, (eds.) The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, Massachusetts.

Fujiwara, M. and H. Caswell 2001. Demography of the endangered North Atlantic right whale. Nature 414: 537-41.

Glass, A.H., T.V.N. Cole and M. Garron ~~2009~~2010. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007. Northeast Fish Sci Cent Ref Doc. ~~09-04~~xx-xx. xx~~19~~ pp.

Glass, A.H., T.V.N. Cole, M. Garron, R.L. Merrick and R.M. Pace, III 2008. Mortality and serious injury determinations for baleen whale stocks along the United States Eastern Seaboard and adjacent Canadian Maritimes, 2002-2006. Northeast Fish. Sci. Cent. Ref. Doc. 08-04. 18 pp.

Hain, J.H.W. 1975. The international regulation of whaling. Marine Affairs J. 3: 28-48.

Hamilton, P.K., A.R. Knowlton and M.K. Marx 2007. Right whales tell their own stories: The photo-identification catalog. Pages 75-104 *in*: S. D. Kraus and R. M. Rolland, (eds.) The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, MA.

Hamilton, P.K., A.R. Knowlton, M.K. Marx and S.D. Kraus 1998. Age structure and longevity in North Atlantic right whales *Eubalaena glacialis* and their relation to reproduction. Mar. Ecol. Prog. Ser. 171: 285-292.

Hamilton, P.K., R.D. Kenney and T.V.N. Cole. 2009. Right whale sightings in unusual places. Right Whale News 17(1): 9-10. (journal article in prep. by Mónica Almeida e Silva, Centro do IMAR da Universidade dos Açores, Departamento de Oceanografia e Pescas, Horta, Portugal)

IWC [International Whaling Commission] 1999. Report of the workshop on the comprehensive assessment of right

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whales worldwide. J. Cetacean Res. Manage. 1 (supplement): 119-120.
Jacobsen, K., M. Marx and N. Øien 2004. Two-way trans-Atlantic migration of a north Atlantic right whale (*Eubalaena glacialis*). Mar. Mammal Sci. 20: 161–166.
Kenney, R.D., M.A.M. Hyman, R.E. Owen, G.P. Scott and H.E. Winn 1986. Estimation of prey densities required by western North Atlantic right whales. Mar. Mammal Sci. 2: 1-13.
Kenney, R.D. and S.D. Kraus 1993. Right whale mortality-- a correction and an update. Mar. Mammal Sci. 9: 445-446.
Kenney, R.D., H.E. Winn and M.C. Macaulay 1995. Cetaceans in the Great South Channel, 1979-1989: right whale (*Eubalaena glacialis*). Cont. Shelf Res. 15: 385-414.
Knowlton, A.R. and S.D. Kraus 2001. Mortality and serious injury of North Atlantic right whales (*Eubalaena glacialis*) in the North Atlantic Ocean. J. Cetacean Res. Manage. (Special Issue) 2: 193-208.
Knowlton, A.R., S.D. Kraus and R.D. Kenney 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Can. J. Zool. 72: 1297-1305.
Knowlton, A.R., M.K. Marx, H.M. Pettis, P.K. Hamilton and S.D. Kraus 2005. Analysis of scarring on North Atlantic right whales (*Eubalaena glacialis*): monitoring rates of entanglement interaction 1980-2002. National Marine Fisheries Service. Contract #43EANF030107. Final Report.
Knowlton, A.R., J. Sigurjonsson, J.N. Ciano and S.D. Kraus 1992. Long-distance movements of North Atlantic right whales (*Eubalaena glacialis*). Mar. Mammal Sci. 8: 397-405.
Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales (Eubalaena glacialis). Mar. Mammal Sci. 6: 278-291.
Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.K. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A.Pabst, A.J. Read and R.M. Rolland 2005. North Atlantic right whales in crisis. Science 309(5734): 561-562.
Kraus, S.D., P.K. Hamilton, R.D. Kenney, A. Knowlton and C.K. Slay 2001. Reproductive parameters of the North Atlantic right whale. J. Cetacean Res. Manage. (Special Issue) 2: 231-236.
Kraus, S.D., R.M. Pace and T.R. Frasier 2007. High investment, low return: the strange case of reproduction in *Eubalaena glacialis*. Pages 172- 199 *in*: S. D. Kraus and R. M. Rolland, (eds.) The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, MA.
Malik, S., M.W. Brown, S.D. Kraus, A. Knowlton, P. Hamilton and B.N. White 1999. Assessment of genetic structuring and habitat philopatry in the North Atlantic right whale (Eubalaena glacialis). Can. J. Zool. 77: 1217-1222.
Malik, S., M.W. Brown, S.D. Kraus and B.N. White 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. Mar. Mammal Sci. 16: 545-558.
Mate, B.M., S.L. Nieukirk and S.D. Kraus 1997. Satellite-monitored movements of the northern right whale. J. Wildl. Manage. 61: 1393-1405.
Mayo, C.A. and M.K. Marx 1990. Surface foraging behaviour of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. Can. J. Zool. 68: 2214-2220.
McLellan, W.A., E. Meagher, L. Torres, G. Lovewell, C. Harper, K. Irish, B. Pike and A.D. Pabst 2004. Winter right whale sightings from aerial surveys of the coastal waters of the US Mid-Atlantic. 15th Biennial Conference on the Biology of Marine Mammals.
Moore, J.C. and E. Clark 1963. Discovery of right whales in the Gulf of Mexico. Science 141(3577): 269.
Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole 2007. Mortality and serious injury determinations for large whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2001-2005. Northeast Fish. Sci Cent. Ref. Doc. 07-05. 18 pp.
NMFS [National Marine Fisheries Service] 2005. Recovery plan for the North Atlantic right whale (*Eubalaena glacialis*). National Marine Fisheries Service, Silver Spring, Maryland.
Rastogi, T., M.W. Brown, B.A. McLeod, T.R. Frasier, R.Grenier, S.L. Cumbaa, J. Nadarajah and B.N. White 2004. Genetic analysis of 16th-century whale bones prompts a revision of the impact of Basque whaling on right and bowhead whales in the western North Atlantic. Can. J. Zool. 82: 1647–1654.
Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Pages 133-147 *in*: W. F. Perrin, G. P. Donovan and J. Barlow, (eds.) Gillnets and cetaceans. Rep. Int. Whal. Comm. (Special Issue) 15.
Reeves, R.R., J.M. Breiwick and E. Mitchell 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 5-7 *in*: J. Hain, (ed.) The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fish. Sci. Cent. Ref. Doc. 92-05.

Reeves, R.R., R. Rolland and P. Clapham, (eds.) 2001. Report of the workshop on the causes of reproductive failure in North Atlantic right whales: new avenues of research. Northeast Fish. Sci. Cent. Ref. Doc. 01-16.

Reeves, R.R., T. Smith and E. Josephson 2007. Near-annihilation of a species: Right whaling in the North Atlantic. Pages *in*: S. D. Kraus and R. M. Rolland, (eds.) The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, MA.

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr. and R. DeSalle 1997. An effective method for isolating DNA from non-conventional museum specimens. Molecular Ecol. 6: 677-681.

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr., S. Malik, M.W. Brown, B.N. White, P. Walsh and R. DeSalle 2000. Utility of North Atlantic right whale museum specimens for assessing changes in genetic diversity. Conservation Biology 14: 1837-1842.

Schaeff, C.M., S.D. Kraus, M.W. Brown, J. Perkins, R. Payne and B.N. White 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*) using DNA fingerprinting. Can. J. Zool. 75: 1073-1080.

Schmidly, D.J., C.O. Martin and G.F. Collins 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. Southwest Naturalist 17: 214-215.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waldick, R.C., S.D. Kraus, M. Brown and B.N. White 2002. Evaluating the effects of historic bottleneck events: An assessment of microsatellite variability in the endangered, North Atlantic right whale. Molecular Ecol. 11(11): 2241-2250.

HUMPBACK WHALE (*Megaptera novaeangliae*): Gulf of Maine Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a geographic range encompassing the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al.* 1992; Palsbøll *et al.* 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al.* 1995; Larsen *et al.* 1996). Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Indeed, earlier genetic analyses (Palsbøll *et al.* 1995), based upon relatively small sample sizes, had failed to discriminate among the four western North Atlantic feeding areas. However, genetic analyses often reflect a timescale of thousands of years, well beyond those commonly used by managers. Accordingly, the decision was made to reclassify the Gulf of Maine as a separate feeding stock (Waring *et al.* 2000); this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. This reclassification has subsequently been supported by new genetic analyses based upon a much larger collection of samples than those utilized by Palsbøll *et al.* (1995). These analyses have found significant differences in mtDNA haplotype frequencies among whales sampled in four western feeding areas, including the Gulf of Maine (Palsbøll *et al.* 2001). During the 2002 Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC 2002).

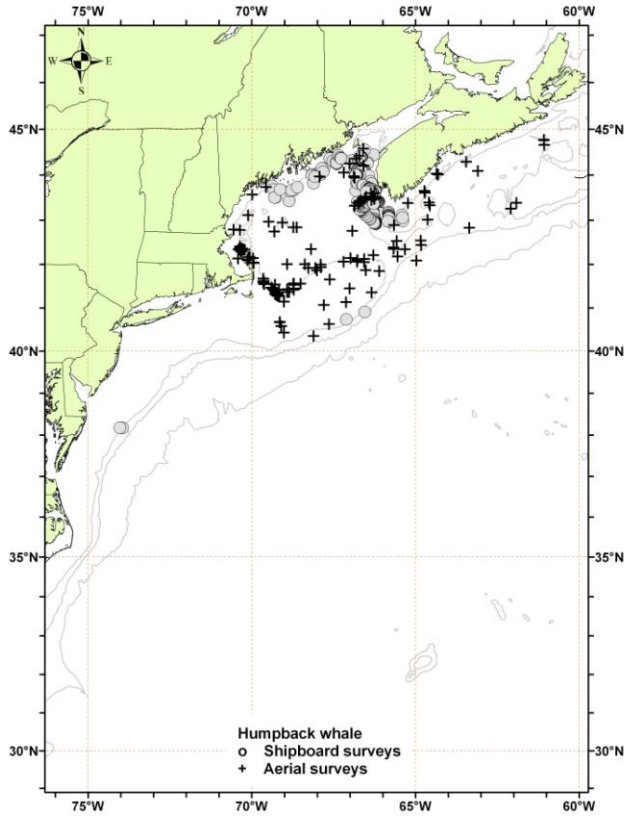

Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 2006, and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys have now been compared to both the overall North Atlantic Humpback Whale Catalogue and a large regional catalogue from the Gulf of Maine (maintained by the College of the Atlantic and the Provincetown Center for Coastal Studies, respectively); this work is summarized in Clapham *et al.* (2003). The match rate between the Scotian Shelf and the Gulf of Maine was 27% (14 of 52 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (28%, n=10 of 36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian

Shelf, despite the additional distance of nearly 100 nautical miles (one whale was observed in both areas). In contrast, all of the 36 humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any other North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling effort in other regions in recent years. Overall, it appears that the northern range of many members of the Gulf of Maine stock does not extend onto the Scotian Shelf.

During winter, whales from most North Atlantic feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among subpopulations occurs (Katona and Beard 1990; Clapham *et al.* 1993; Palsbøll *et al.* 1997; Stevick *et al.* 1998). A few whales of unknown northern origin migrate to the Cape Verde Islands (Reiner *et al.* 1996). In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank and Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Whitehead and Moore 1982; Mattila *et al.* 1989; Mattila *et al.* 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico to the coast of Venezuela (Winn *et al.* 1975; Levenson and Leapley 1978; Price 1985; Mattila and Clapham 1989).

Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported 38 humpback whale strandings occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas were becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data). Whether the increased numbers of sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is unknown.

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (alive or dead) were of sufficient quality to be compared to catalogs from the Gulf of Maine (the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (42.9%) matched to the Gulf of Maine, 4 (19.0%) to Newfoundland and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of recent photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to abundance of prey species, although behavior and bottom topography are factors influencing foraging strategy (Payne *et al.* 1986; 1990). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased markedly during 1992-1993, along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters

of Cultivator Shoal and on the Northeast Peak on Georges Bank and on Jeffreys Ledge; these latter areas are traditional locations of herring occurrence. In 1996 and 1997, sand lance and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Provincetown Center for Coastal Studies and College of the Atlantic).

In early 1992, a major research program known as the Years of the North Atlantic Humpback (YONAH) (Smith *et al.* 1999) was initiated. This was a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results pertaining to the estimation of abundance and to genetic population structure are summarized below.

POPULATION SIZE

North Atlantic Population

The overall North Atlantic population (including the Gulf of Maine), derived from genetic tagging data collected by the YONAH project on the breeding grounds, was estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Because the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed a result of sampling bias, lower rates of migration among females, or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size. Photographic mark-recapture analyses from the YONAH project provided an ocean-basin-wide estimate of 11,570 animals during 1992/1993 (CV=0.068, Stevick *et al.* 2003), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (CV=0.138, 95% CI=8,000 to 13,600) (Smith *et al.* 1999). In the northeastern North Atlantic, Øien (2001) estimated from sighting survey data that there were 889 (CV=0.32) humpback whales in the Barents and Norwegian Seas region.

Gulf of Maine stock - earlier estimates

Please see Appendix IV for earlier estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Gulf of Maine Stock - Recent surveys and abundance estimates

An abundance estimate of 521 (CV=0.67) humpback whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 359 (CV=0.75) humpback whales was obtained from a line-transect sighting survey conducted from 12 June to 4 August 2004 by a ship and plane. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100 m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

An abundance estimate of 847 animals (CV=0.55) was derived from a line-transect sighting survey conducted during August 2006 which covered 10,676 km of trackline from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the Gulf of St. Lawrence. (Table 1; Palka pers. comm.) Some evidence exists to support a 25% exchange rate between Scotian shelf animals and with those in the Gulf of Maine (Clapham *et al.* 2003), which suggest that a 25% correction factor be applied to the humpback population estimate from the Scotian shelf stratum. Because the Scotian shelf was surveyed in only 2006, the 25% correction factor (described above) was applied to only the 2006 abundance estimate.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-

normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 847 animals (CV=0.55). The minimum population estimate for this stock is 549 animals.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales.

Month/Year	Type	N	CV
Aug 2002	S. Gulf of Maine to Maine	521	0.67
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	359	0.75
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	847	0.55

Current Population Trend

As detailed below, current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in size. This is consistent with an estimated average trend of 3.1% (SE=0.005) in the North Atlantic population overall for the period 1979-1993 (Stevick *et al.* 2003), although there are no feeding-area-specific estimates.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Barlow and Clapham (1997) applying an interbirth interval model to photographic mark-recapture data, estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 2000; Clapham *et al.* 2001). For the Gulf of Maine stock, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) give values of 0.96 for survival rate, 6 years as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão *et al.* (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) is close to the maximum for this stock.

Clapham *et al.* (2003) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The population growth estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although confidence limits were not provided (because maturation parameters could not be estimated), both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-1995) in which survival rates declined. It is possible that this shift resulted in calves that were born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling occurred. If the decline is real, it may be related to known high mortality among young-of-the-year whales in the waters off the U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth.

In light of the uncertainty accompanying the more recent estimates of population growth rate for the Gulf of Maine stock, the maximum net productivity rate was assumed to be the default value of 0.04 for cetaceans (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Gulf of Maine stock is 549 whales. The maximum productivity rate is the default value of 0.04. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the Gulf of Maine humpback whale stock is 1.1 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2004~~3~~ through 2008~~7~~, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.6~~4~~ animals per year (U.S. waters, 4.4~~0~~; Canadian waters, 0.2~~4~~). This value includes incidental fishery interaction records, 3.0~~2.8~~ (U.S. waters, 2.8~~4~~; Canadian waters, 0.2~~4~~); and records of vessel collisions, 1.6 (U.S. waters, 1.6; Canadian waters, 0) (Glass *et al.* 2010~~09~~).

In contrast to stock assessment reports before 2007, these averages include humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock. In past reports, only events involving whales confirmed to be members of the Gulf of Maine stock were counted against the PBR. Starting in the 2007 report, we assumed whales were from the Gulf of Maine unless they were identified as members of another stock. At the time of this writing, no whale was identified as a member of another stock. These determinations may change with the availability of new information. Canadian records were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

Serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited serious injury designations to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death. Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury might increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. For these reasons, the human impacts listed in this report represent a minimum estimate.

To better assess human impacts (both vessel collision and gear entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts.

Background

As with right whales, human impacts (vessel collisions and entanglements) may be slowing recovery of the humpback whale population. Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition did not preclude examination for human impacts), Wiley *et al.* (1995) reported that six (30%) had major injuries possibly attributable to ship strikes, and five (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region was produced by Barco *et al.* (2002). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states. Inspection of length data from 48 of these whales (18 females, 22 males, and 8 of unknown sex) suggested that 39 (81.2%) were first-year animals, 7 (14.6%) were immature and 2 (4.2%) were adults. However, sighting histories of five of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the proportion of mature whales in the mid-Atlantic may be higher than suggested by the stranded sample.

Robbins and Mattila (2001) reported that males were more likely to be entangled than females. Their scarring data suggested that yearlings were more likely than other age classes to be involved in entanglements. Finally, female humpbacks showing evidence of prior entanglements produced significantly

fewer calves, suggesting that entanglement may significantly impact reproductive success.

Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of interactions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) was reported annually between 1979 and 1988, and 12 of 66 humpback whales entangled in 1988 died (Lien *et al.* 1988). Two humpbacks were reported entangled in fishing gear in Newfoundland and Labrador waters in 2005. One towed away the gear and was not re-sighted, and the other was released alive (Ledwell and Huntington 2006). Eighty-four humpbacks were reported entangled in fishing gear in Newfoundland and Labrador from 2000~~-~~ to 2006 (W. Ledwell, pers. comm.). Volgenau *et al.* (1995) reported that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

Disturbance by whale watching may be an important issue in some areas of the population's range, notably the coastal waters of New England where the density of whale watching traffic is seasonally high. However, no studies have been conducted to address this question.

As reported by Wiley *et al.* (1995), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2004~~3~~ through 2008~~7~~, ~~11 records had some evidence of a collision with a vessel. Eight~~there are 8 ~~of these were~~ reports of mortalities as a result of ~~the~~ collision with a vessel. No whale involved in the recorded vessel collisions had been identified as a member of a stock other than the Gulf of Maine stock at the time of this writing (Glass *et al.* 2010~~09~~).

Fishery-Related Serious Injuries and Mortalities

A description of Fisheries is provided in Appendix III. Two mortalities were observed in the pelagic drift gillnet fishery, one in 1993 and the other in 1995. In winter 1993, a juvenile humpback was observed entangled and dead in a pelagic drift gillnet along the 200-m isobath northeast of Cape Hatteras. In early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank. Additional reports of mortality and serious injury, as well as description of total human impacts, are contained in records maintained by NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990-1994 period were the basis used to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period 2004~~3~~ through 2008~~7~~ were reviewed. Entanglements accounted for ~~four~~ five mortalities and 10~~ten~~ serious injuries. With no evidence to the contrary, all events were assumed to involve members of the Gulf of Maine stock. While these records are not statistically quantifiable in the same way as observer fishery records, they provide some indication of the frequency of entanglements.

~~Table 2. Confirmed U.S. and Canadian human-caused mortality and serious injury records of North Atlantic humpback whales, January 2003 – December 2007. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. (Glass *et al.* 2009).~~

~~Date[a]~~	~~Report Type[b]~~	~~Age, Sex, ID, Length~~	~~Location[a]~~	~~Assigned Cause: P=primary, S=secondary~~		~~Notes/Observations~~
				~~Ship strike~~	~~Entang./ Fsh.inter~~	
~~06/06/03~~	~~mortality~~	~~Juvenile Female 8.3m~~	~~Chesapeake Bay mouth, VA~~	~~p~~		~~Major trauma to right side of head; hematoma~~

~~07/09/03~~	~~serious injury~~	~~Calf of Shockwave sex unknown~~	~~Bay of Fundy, NS~~		~~P~~	~~Constricting entanglement on a young whale; no gear recovered~~
~~07/12/03~~	~~serious injury~~	~~age & sex unknown~~	~~Oregon Inlet, NC~~		~~P~~	~~Entangled in substantial amount of gear; no gear recovered~~
~~08/15/03~~	~~mortality~~	~~Calf sex unknown 7.3m (est)~~	~~Petit Manan Island, ME~~		~~P~~	~~Floating offshore wrapped in line; gear recovered consists of a small portion of gillnet~~
~~08/16/03~~	~~serious injury~~	~~age & sex unknown~~	~~Cape Cod, MA~~		~~P~~	~~Poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system, surface buoy system and endline~~
~~08/18/03~~	~~serious injury~~	~~age & sex unknown~~	~~Cape Cod, MA~~		~~P~~	~~Extensive entanglement; no gear recovered~~
~~07/11/04~~	~~serious injury~~	~~Juvenile sex unknown "Lucky"~~	~~Briar Island, NS~~		~~P~~	~~Entanglement on a young whale; no gear recovered~~
~~10/03/04~~	~~mortality~~	~~age unknown Male 15m (est)~~	~~Georges Bank, U.S.~~		~~P~~	~~Fresh carcass with entangling line and high flyer; no gear recovered~~
~~12/19/04~~	~~mortality~~	~~Calf Female 8.0m~~	~~Bethany Beach, DE~~	~~P~~		~~Hematoma and skeletal fracturing~~
~~01/09/06~~	~~mortality~~	~~Adult Female #8667 14.0m~~	~~off Charleston, SC~~	~~P~~		~~Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal~~
~~03/17/06~~	~~mortality~~	~~Juvenile Female 10.0m~~	~~Virginia Beach, VA~~	~~P~~		~~Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds~~
~~03/25/06~~	~~serious injury~~	~~Juvenile sex unknown 8m (est)~~	~~Flagler Beach, FL~~		~~P~~	~~Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as lobster pot gear~~
~~08/06/06~~	~~serious injury~~	~~age & sex unknown~~	~~Georges Bank, U.S.~~		~~P~~	~~Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered~~

~~08/23/06~~	~~serious injury~~	~~age & sex unknown 12m (est)~~	~~Great South Channel, U.S.~~		~~P~~	~~Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap~~
~~09/06/06~~	~~mortality~~	~~age & sex unknown~~	~~East of Cape Cod, MA~~		~~P~~	~~Whale entangled through mouth continuing back to multiple wraps around peduncle; no gear recovered~~
~~10/15/06~~	~~mortality~~	~~Juvenile Female 10.1m~~	~~off Fenwick Island, DE~~	~~P~~	~~S~~	~~Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point~~
~~01/27/07~~	~~serious injury~~	~~age & sex unknown~~	~~off Beach Haven, NJ~~		~~P~~	~~Body wrap likely to become constricting; random cyamid patches; thin body condition.; probable flipper wraps; no gear recovered~~
~~05/10/07~~	~~mortality~~	~~Adult Female 12.5m~~	~~off Wachapreague, VA~~	~~P~~		~~Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke~~
~~05/13/07~~	~~mortality~~	~~Juvenile Male 9.3m~~	~~Rockport, MA~~	~~P~~		~~Areas of hemorrhaging indicate major blunt trauma to chest, neck & head~~
~~06/23/07~~	~~serious injury~~	~~age unknown Male "Egg Toss"~~	~~Wildcat Knoll~~		~~P~~	~~Body wrap of gear imbedded; no gear recovered~~
~~06/24/07~~	~~mortality~~	~~Juvenile Female "Tofu" 9.9m~~	~~Stellwagen Bank~~	~~P~~		~~Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla~~
~~12/21/07~~	~~mortality~~	~~age unknown Male 9.4m~~	~~Ocean Sands, NC~~		~~P~~	~~Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel & ventral pleats consistent with gillnet entanglement; animal emaciated; no gear recovered~~

~~a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.~~

~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass *et al.* 2009) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.~~

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2004 - December 2008. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. This is in contrast to prior reports.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
07/11/04	serious injury	Juvenile sex unknown "Lucky"	Briar Island, NS		P	Entanglement on a young whale; no gear recovered
10/03/04	mortality	age unknown Male 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	Calf Female 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing
01/09/06	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
03/17/06	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
03/25/06	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as lobster pot gear
08/06/06	serious injury	age & sex unknown	Georges Bank		P	Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered
08/23/06	serious injury	age & sex unknown 12m (est)	Great South Channel		P	Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap
09/06/06[c]	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth, continuing back to multiple wraps around peduncle; no gear recovered
10/15/06	mortality	Juvenile Female 10.1m	off Fenwick Island, DE	P	S	Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point

01/27/07	serious injury	age & sex unknown	off Beach Haven, NJ		P	Body wrap likely to become constricting; random cyamid patches; thin body condition; probable flipper wraps; no gear recovered
05/10/07	mortality	Adult Female 12.5m	off Wachapreague, VA	P		Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke
05/13/07	mortality	Juvenile Male 9.3m	Rockport, MA	P		Areas of hemorrhaging indicate major blunt trauma to chest, neck & head
06/23/07	serious injury	age unknown "Egg Toss" Male	Wildcat Knoll		P	Body wrap of gear imbedded; no gear recovered
06/24/07	mortality	Juvenile Female "Tofu" 9.9m	Stellwagen Bank	P		Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla
12/21/07	mortality	age unknown Male 9.4m	Ocean Sands, NC		P	Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel & ventral pleats consistent with gillnet entanglement; emaciated; no gear recovered
01/06/08	serious injury	age & sex unknown 10m (est)	off Cape Lookout, NC		P	Constricting line cutting into right flipper in several places; heavy cyamid load; emaciated; no gear recovered
05/30/08	mortality	age & sex unknown	Georges Bank		P	Constricting body wraps, one wrap under lower jaw; open wound on right flipper; no gear recovered
06/09/08	mortality	age & sex unknown	Georges Bank		P	Constricting body wrap; gear analysis pending
07/08/08	serious injury	Adult Female "Estuary"	off Nauset, MA		P	Cuts were made, but no gear was removed; emaciated; moderate cyamid coverage; deep wounds in fluke blades from gear; hunched over position maintained after cuts were made to the gear; gear analysis pending
08/13/08	serious injury	age & sex unknown 10m (est)	off NJ		P	Partial disentanglement; emaciated; lethargic; heavy cyamid load; gear analysis pending
08/21/08	serious injury	age & sex unknown	off Chatham, MA		P	Evidence of decline in health; no gear recovered

11/04/08	mortality	Juvenile Male 10.1m	Assateague, MD	P		Cranial fractures with associated hemorrhaging

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. Record was added after review of carcasses sighted on 08/20/06 and 09/06/06. Previous reports stated these were the same animal. Recent review could not confirm the resight, therefore they are now being treated as two separate events. There was inconclusive evidence with regard to the carcass on 08/20/06 to determine mortality due to entanglement.

Other Mortality

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other unrecorded mortalities occurred during this event. During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales stranded between North Carolina and New Jersey. The significance of these strandings is unknown.

In July 2003, an Unusual Mortality Event (UME) was invoked in offshore waters when an estimated minimum of 12-15 humpback whales died in the vicinity of the Northeast Peak of Georges Bank. Preliminary tests of samples taken from some of these whales were positive for domoic acid at low levels, but it is currently unknown what levels would affect the whales and therefore no definitive conclusions can yet be drawn regarding the cause of this event or its effect on the status of the Gulf of Maine humpback whale population. Seven humpback whales were considered part of a large whale UME in New England in 2005. Twenty-one dead humpback whales found between 10 July and 31 December 2006 triggered a humpback whale UME declaration, still considered ongoing at the end of 2007. Causes of these UME events have not been determined.

STATUS OF STOCK

The status of the North Atlantic humpback whale population was the topic of an International Whaling Commission Comprehensive Assessment in June 2001, and again in May 2002. These meetings conducted a detailed review of all aspects of the population and made recommendations for further research (IWC 2002). Although recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the U.S. Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan was published and is in effect (NMFS 1991). There are insufficient data to reliably determine current population trends for humpback whales in the North Atlantic overall. The average annual rate of population increase was estimated at 3.1% (SE=0.005, Stevick *et al.* 2003). An analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2003) suggested a lower rate of increase than the 6.5% reported by Barlow and Clapham (1997), but results may have been confounded by distribution shifts. The total level of U.S. fishery-caused mortality and serious injury is unknown, but reported levels are more than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant or approaching zero mortality and serious injury rate. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

As part of a large-scale assessment called More of North Atlantic Humpbacks (MoNAH) project, extensive sampling was conducted on humpbacks in the Gulf of Maine/Scotian Shelf region and the primary wintering ground on Silver Bank during 2004-2005. These data are being analyzed along with additional data from the U.S. mid-Atlantic to estimate abundance and refine knowledge of the North Atlantic humpback whales' population structure. The work is intended to update the YONAH population assessment in preparation for a status review under the ESA.

REFERENCES CITED

Angliss, R.P. and D.P. DeMaster 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: Report of the serious injury workshop, 1-2 April 1997, Silver Spring MD. NOAA Tech. Memo. NMFS-OPR-13. 48 pp.

Balcomb, K.C. and G. Nichols 1982. Humpback whale censuses in the West Indies. Rep. Int. Whal. Comm. 32: 401-406.

Barco, S.G., W.A. McLellan, J.M. Allen, R.A. Asmutis-Silvia, R. Mallon-Day, E.M. Meagher, D.A. Pabst, J. Robbins, R.E. Seton, W.M. Swingle, M.T. Weinrich and P.J. Clapham 2002. Population identity of humpback whales (*Megaptera novaeangliae*) in the waters of the U.S. mid-Atlantic states. J. Cetacean Res. Manage. 4(2): 135-141.

Barlow, J. and P.J. Clapham 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78: 535-546.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Brandão, A., D.S. Butterworth and M.R. Brown 2000. Maximum possible humpback whale increase rates as a function of biological parameter values. J. Cetacean Res. Manage. 2 (supplement): 192-193.

Christensen, I., T. Haug and N. Øien 1992. Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (Mysticeti) and sperm whales (*Physeter macrocephalus*) in Norwegian and adjacent waters. ICES J. Mar. Sci. 49: 341-355.

Clapham, P.J., L.S. Baraff, C.A. Carlson, M.A. Christian, D.K. Mattila, C.A. Mayo, M.A. Murphy and S. Pittman 1993. Seasonal occurrence and annual return of humpback whales, *Megaptera novaeangliae*, in the southern Gulf of Maine. Can. J. Zool. 71: 440-443.

Clapham, P.J., J. Barlow, M. Bessinger, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins and R. Seton 2003. Abundance and demographic parameters of humpback whales from the Gulf of Maine, and stock definition relative to the Scotian Shelf. J. Cetacean Res. Manage. 5(1): 13-22.

Clapham, P.J., M.C. Bérubé and D.K. Mattila 1995. Sex ratio of the Gulf of Maine humpback whale population. Mar. Mamm. Sci. 11: 227-231.

Clapham, P.J. and C.A. Mayo 1987. Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. Can. J. Zool. 65: 2853-2863.

Clapham, P.J., J. Robbins, M. Brown, P. Wade and K. Findlay 2001. A note on plausible rates of population growth for humpback whales. J. Cetacean Res. Manage. 3 (suppl.): 196-197

Fogarty, M.J., E.B. Cohen, W.L. Michaels and W.W. Morse 1991. Predation and the regulation of sand lance populations: An exploratory analysis. ICES [Int. Counc. Explor. Sea] Mar. Sci. Symp. 193: 120-124.

Geraci, J.R., D.M. Anderson, R.J. Timperi, D.J.S. Aubin, G.A. Early, J.H. Prescott and C.A. Mayo 1989. Humpback whales (*Megaptera novaeangliae*) fatally poisoned by dinoflagellate toxins. Can. J. Fish. Aquat. Sci 46: 1895-1898.

Glass, A.H., T.V.N. Cole and M. Garron 2009. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007. Northeast Fish Sci Cent Ref Doc. 09-04. 19 pp.

Glass, A.H., T.V.N. Cole, M. Garron, R.L. Merrick and R.M. Pace, III 2008. Mortality and serious injury determinations for baleen whale stocks along the United States Eastern Seaboard and adjacent Canadian Maritimes, 2002-2006. Northeast Fish. Sci. Cent. Ref. Doc. 08-04. 18 pp.

IWC 2002. Report of the Scientific Committee. Annex H: Report of the Sub-committee on the Comprehensive Assessment of North Atlantic humpback whales. J. Cetacean Res. Manage. 4 (supplement): 230-260.

Katona, S.K. and J.A. Beard 1990. Population size, migrations, and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic ocean. Rep. Int. Whal. Comm. (Special Issue) 12(295-306).

Larsen, A.H., J. Sigurjónsson, N. Øien, G. Vikingsson and P.J. Palsbøll 1996. Population genetic analysis of mitochondrial and nuclear genetic loci in skin biopsies collected from central and northeastern North Atlantic humpback whales (*Megaptera novaeangliae*): population identity and migratory

destinations. Proceedings of the Royal Society of London, B 263: 1611-1618.
Ledwell, W. and J. Huntington 2006. Whale, leatherback sea turtles, and basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada 18 pp.
Levenson, C. and W.T. Leapley 1978. Distribution of humpback whales (*Megaptera novaeangliae*) in the Caribbean determined by a rapid acoustic method. J. Fish. Res. Board Can 35: 1150-1152.
Lien, J., W. Ledwell and J. Naven 1988. Incidental entrapment in inshore fishing gear during 1988: A preliminary report to the Newfoundland and Labrador Department of Fisheries and Oceans. 15 pp.
Mattila, D.K. and P.J. Clapham 1989. Humpback whales and other cetaceans on Virgin Bank and in the northern Leeward Islands, 1985 and 1986. Can. J. Zool. 67: 2201-2211.
Mattila, D.K., P.J. Clapham, S.K. Katona and G.S. Stone 1989. Population composition of humpback whales on Silver Bank. Can. J. Zool. 67: 281-285.
Mattila, D.K., P.J. Clapham, O. Vásquez and R. Bowman 1994. Occurrence, population composition and habitat use of humpback whales in Samana Bay, Dominican Republic. Can. J. Zool. 72: 1898-1907.
NMFS 1991. Recovery plan for the humpback whale (*Megaptera novaeangliae*). National Marine Fisheries Service, Silver Spring, Maryland, 105 pp.
Øien, N. 2001. Humpback whales in the Barents and Norwegian Seas. International Whaling Commission Scientific Committee, IWC, 135 Station Road, Impington, Cambridge, UK. SC/53/NAH21.
Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf
Palsbøll, P.J., J. Allen, T.H. Anderson, M. Bérubé, P.J. Clapham, T.P. Feddersen, N. Friday, P. Hammond, H. Jørgensen, S.K. Katona, A.H. Larsen, F. Larsen, J. Lien, D.K. Mattila, F.B. Nygaard, J. Robbins, R. Sponer, R. Sears, J. Sigurjónsson, T.D. Smith, P.T. Stevick, G. Vikingsson and N. Øien 2001. Stock structure and composition of the North Atlantic humpback whale, *Megaptera novaeangliae*. International Whaling Commission Scientific Committee, IWC, 135 Station Road, Impington, Cambridge, UK. SC/53/NAH11.
Palsbøll, P.J., J. Allen, M. Berube, P. Clapham, T. Feddersen, P. Hammond, R. Hudson, H. Jorgensen, S. Katona, A.H. Larsen, F. Larsen, J. Lien, D. Mattila, J. Sigurjonsson, R. Sears, T. Smith, R. Sponer, P. Stevick and N. Oien 1997. Genetic tagging of humpback whales. Nature 388: 767-769.
Palsbøll, P.J., P.J. Clapham, D.K. Mattila, F. Larsen, R. Sears, H.R. Siegismund, J. Sigurjónsson, O. Vásquez and P. Arctander 1995. Distribution of mtDNA haplotypes in North Atlantic humpback whales: the influence of behavior on population structure. Mar. Ecol. Prog. Ser. 116: 1-10.
Paquet, D., C. Haycock and H. Whitehead 1997. Numbers and seasonal occurrence of humpback whales (*Megaptera novaeangliae*) off Brier Island, Nova Scotia. Can. Field-Nat. 111: 548-552.
Payne, P.M., J.R. Nicholas, L. O'Brien and K.D. Powers 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. Fish. Bull. 84: 271-277.
Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham and J.W. Jossi 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88: 687-696.
Price, W.S. 1985. Whaling in the Caribbean: historical perspective and update. Rep. Int. Whal. Comm. 35: 413-420.
Reiner, F., M.E.D. Santos and F.W. Wenzel 1996. Cetaceans of the Cape Verde archipelago. Mar. Mamm. Sci. 12: 434-443.
Robbins, J. and D.K. Mattila 2001. Monitoring entanglements of humpback whales (Megaptera novaeangliae) in the Gulf of Maine on the basis of caudal peduncle scarring. International Whaling Commission Scientific Committee, IWC, 135 Station Road, Impington, Cambridge, UK. SC/53/NAH25.
Smith, T.D., J. Allen, P.J. Clapham, P.S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P.J. Palsboll, J. Sigurjonsson, P.T. Stevick and N. Oien 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (Megaptera novaeangliae). Mar. Mamm. Sci. 15(1): 1-32.
Stevick, P., N. Øien and D.K. Mattila 1998. Migration of a humpback whale between Norway and the West

Indies. Mar. Mamm. Sci. 14: 162-166.

Stevick, P.T., J. Allen, P.J. Clapham, N. Friday, S.K. Katona, F. Larsen, J. Lien, D.K. Mattila, P.J. Palsbøll, J. Sigurjónsson, T.D. Smith, N. Øien and P.S. Hammond 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Mar. Ecol. Prog. Ser. 258: 263-273.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan and D.A. Pabst 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9: 309-315.

Volgenau, L., S.D. Kraus and J. Lien 1995. The impact of entanglements on two substocks of the western North Atlantic humpback whale, *Megaptera novaeangliae*. Can. J. Zool. 73: 1689-1698.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, K.D. Bisack and L.J. Hansen, eds. 1999. U.S. Atlantic marine mammal stock assessments - 1998. NOAA Tech. Memo. NMFS-NE-116. 182 pp.

Waring, G.T., J.M. Quintal and S.L. Swartz, eds. 2000. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments - 2000. NOAA Tech. Memo. NMFS-NE-162. ix +197p. +3 app. pp.

Whitehead, H. and M.J. Moore 1982. Distribution and movements of West Indian humpback whales in winter. Can. J. Zool. 60: 2203-2211.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford and D.P. Gannon 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. 93: 196-205.

Winn, H.E., R.K. Edel and A.G. Taruski 1975. Population estimate of the humpback whale (*Megaptera novaeangliae*) in the West Indies by visual and acoustic techniques. J. Fish. Res. Board Can 32: 499-506.

~~December 2009~~March 2010

FIN WHALE (*Balaenoptera physalus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al.* 1984).

A genetic study conducted by Bérubé *et al.* (1998) using both mitochondrial and nuclear DNA provided strong support for an earlier population model proposed by Kellogg (1929) and others. This postulates the existence of several subpopulations of fin whales in the North Atlantic and Mediterranean with limited gene flow among them. Bérubé *et al.* (1998) also proposed that the North Atlantic population showed recent divergence due to climatic changes (i.e., postglacial expansion), as well as substructuring over even relatively short distances. The genetic data are consistent with the idea that different subpopulations use the same feeding ground, a hypothesis that was also originally proposed by Kellogg (1929).

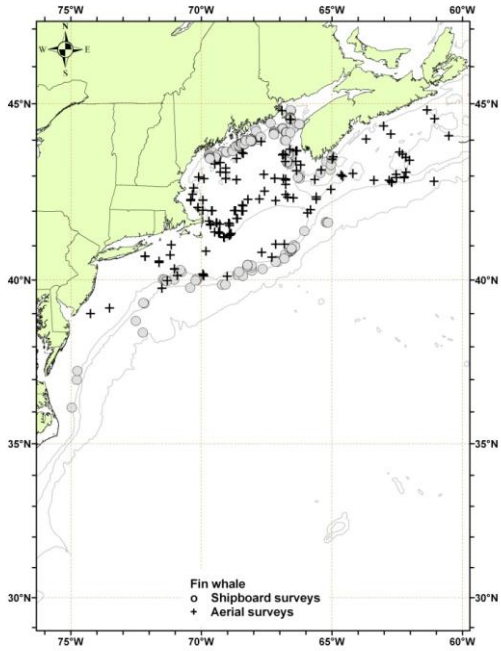

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Fin whales are common in waters of the U. S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are probably the dominant large cetacean species during all seasons, having the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain *et al.* 1992; Kenney *et al.* 1997).

New England waters represent a major feeding ground for fin whales. There is evidence of site fidelity by females, and perhaps some segregation by sexual, maturational or reproductive class in the feeding area (Agler *et al.* 1993). Seipt *et al.* (1990) reported that 49% of fin whales sighted on the Massachusetts Bay area feeding grounds were resighted within the same year, and 45% were resighted in multiple years. The authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that in some respects were similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed ~~maternally-~~maternally-directed site fidelity for fin whales in the Gulf of Maine. Information on life history and vital rates is also available in data from the Canadian

fishery, 1965-1971 (Mitchell 1974). In seven years, 3,528 fin whales were taken at three whaling stations. The station at Blandford, Nova Scotia, took 1,402 fin whales.

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occurs for most of the population. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of fin whale calls found no evidence for large-scale migratory movements (Watkins *et al.* 2000).

POPULATION SIZE

The best abundance estimate available for the western North Atlantic fin whale stock is ~~2,269~~3,985 (CV= 0.~~37~~24). ~~This August 2006 estimate is recent and provides an estimate when the largest portion of the population was within the study area. However, this estimate must be considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas.~~This is the sum of the estimate derived from the August 2006 Gulf of Maine survey and the estimate derived from the July-Aug 2007 northern Labrador to Scotian Shelf survey. The abundance estimates of fin whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified fin whales to the total number of positively identified fin whales and positively identified sei whales.

Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of ~~2,933~~1,716 (CV=0.~~49~~40) fin whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the ~~1000~~-1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled ~~data of~~ 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 1,925 (CV=0.55) fin whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the ~~two~~-two-~~independent~~-independent-team ~~line~~-line-transect method and analyzed using the modified ~~direct~~-direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back ~~line~~-line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled ~~data of~~ 2002, 2004 and 2006 aerial survey data.

An abundance of 2,269 (CV=0.37) fin whales was estimated from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled ~~data of~~ 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 1,~~352~~-716 (~~95%CI=821-2,226~~CV=0.26) fin whales was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009)~~(Lawson and Gosselin 2008)~~.

Table 1. Summary of recent abundance estimates for western North Atlantic fin whales. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	2,933	0.49
Jun-July 2004	Gulf of Maine to lower Bay of Fundy	1,925	0.55
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,269	0.37
July-Aug 2007	N. Labrador to Scotian Shelf	1~~,352~~716	0.26
Aug 2006+Jul-Aug 2007	S. Gulf of Maine to N. Labrador (COMBINED)	3,985	0.24

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for fin whales is ~~2,269~~ 3,985(CV=0.~~37~~24). The minimum population estimate for the western North Atlantic fin whale is ~~1,678~~3,269.

Current Population Trend

There are insufficient data to determine population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Based on photographically identified fin whales, Agler *et al.* (1993) estimated that the gross annual reproduction rate was at 8%, with a mean calving interval of 2.7 years.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~1,678~~3,269. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is ~~3.4~~6.5.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2003~~ 2004 through ~~2007~~2008, the minimum annual rate of human-caused mortality and serious injury to fin whales was 3.2~~2.8~~ per year (U.S. waters, 2.4~~2.0~~; Canadian waters, 0.8). This value includes incidental fishery interaction records, 1.2 (U.S. waters, 1.0; Canadian waters, 0.2); and records of vessel collisions, 2.0~~1.6~~ (U.S. waters, 1.~~2~~4; Canadian waters, 0.6~~4~~)(Glass 2010). Detected mortalities should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured fin whales for the period 2004~~3~~ through 2008~~7~~ on file at NMFS found three records with substantial evidence of

fishery interactions causing mortality, and three records resulting in serious injury (Table 2), which results in an annual rate of serious injury and mortality of 1.2 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observer fishery records, they give a minimum count of entanglements for the species.

~~Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2003 – December 2007.~~

~~Date[a]~~	~~Report Type[b]~~	~~Age, Sex, Length~~	~~Location[a]~~	~~Assigned Cause: P=primary, S=secondary~~		~~Notes/Observations~~
				~~Ship strike~~	~~Entang. / Fsh.inter~~	
~~02/12/04~~	~~serious injury~~	~~age & sex unknown~~	~~Pea Island, NC~~		~~P~~	~~Entangled whale noticeably emaciated; no gear recovered~~
~~02/25/04~~	~~mortality~~	~~Adult Female 16.3m~~	~~Port Elizabeth, NJ~~	~~P~~		~~Displaced vertebrae; ruptured aorta~~
~~06/30/04~~	~~mortality~~	~~age & sex unknown 12m (est)~~	~~Georges Bank~~		~~P~~	~~Freshly dead; heavy line constricting mid-section; no gear recovered~~
~~09/26/04~~	~~mortality~~	~~age & sex unknown 15m (est)~~	~~St. Johns, NB~~	~~P~~		~~Fresh carcass on bow of 293 m cruise ship~~
~~03/26/05~~	~~mortality~~	~~Adult Female 16.3m~~	~~off Virginia Beach, VA~~	~~P~~		~~Extensive hemorrhaging and vertebral fractures~~
~~04/03/05~~	~~mortality~~	~~Adult[c] Female 18.8m~~	~~Southampton, NY~~	~~P~~		~~Subdermal hemorrhaging~~
~~08/23/05~~	~~mortality~~	~~Juvenile Male 13.7m~~	~~Port Elizabeth, NJ~~	~~P~~		~~Brought in on bow of 294 m ship~~

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~~09/11/05~~	~~mortality~~	~~Juvenile Male 11.0m~~	~~Bonne Esperance, QC~~	~~p~~		~~Bottom jaw completely severed/broken~~
~~09/17/06~~	~~serious injury~~	~~age & sex unknown 18m (est)~~	~~off Mt. Desert Rock, ME~~		~~p~~	~~Pale skin overall; cyamid load at point of attachment; emaciated; no gear recovered~~
~~03/25/07~~	~~mortality~~	~~age unknown Female 18.0m~~	~~Norfolk Harbor, VA~~	~~p~~		~~Extensive fracturing of ribs, skull and vertebrae w/ associated hemorrhage & edema~~
~~05/24/07~~	~~mortality~~	~~age unknown Male~~	~~Newark Bay, NJ~~	~~p~~		~~Hemorrhage (epaxial muscle, diaphragm, pleural lining) and multiple fractures of the ribs, vertebrae & sternum and the trailing tissue of the animal was marked by propeller cuts~~
~~06/25/07~~	~~serious injury~~	~~age & sex unknown~~	~~Great South Channel~~		~~p~~	~~Wrap on tail assoc w/ cyamid load; flippers & mouth involved; extremely emaciated; lethargic; no gear recovered~~
~~8/11/07~~	~~mortality~~	~~age & sex unknown~~	~~Cabot Strait, NS~~		~~p~~	~~Constricting wrap around body, between the head and flippers; no gear recovered~~
~~09/26/07~~	~~mortality~~	~~Juvenile Male 13m (est)~~	~~off Martha's Vineyard, MA~~		~~p~~	~~Freshly dead, scavenged carcass with gear present; evidence of multiple body wraps with associated hemorrhaging; no gear recovered~~

~~a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.~~

~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS have been used here. Some assignments may change as new information becomes available and/or when national standards are established.~~

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2004 - December 2008.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	

02/12/04	serious injury	age & sex unknown	Pea Island, NC		P	Emaciated; no gear recovered
02/25/04	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
06/30/04	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting mid-section; no gear recovered
09/26/04	mortality	age & sex unknown 15m (est)	St~~.~~aint John~~s~~, NB	P		Fresh carcass on bow of ship
03/26/05	mortality	Adult[c] Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
04/03/05	mortality	Adult[c] Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
08/23/05	mortality	Juvenile[c] Male 13.7m	Port Elizabeth, NJ	P		Brought in on bow of ship
09/11/05	mortality	Juvenile[c] Male 11.0m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken
09/13/05[d]	mortality	age & sex unknown	Blanc Sablon, Newfoundland	P		Lower jaw broken associated with massive areas of bruising
09/17/06	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated; no gear recovered
03/25/07	mortality	age unknown Female 18.0m	Norfolk Harbor, VA	P		Extensive fracturing of ribs, skull and vertebrae w/ associated hemorrhage & edema
05/24/07	mortality	age unknown Male	Newark Bay, NJ	P		Hemorrhage (epaxial muscle, diaphragm, pleural lining) and multiple fractures of the ribs, vertebrae & sternum and the

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						trailing tissue of the animal was marked by propeller cuts
06/25/07	serious injury	age & sex unknown	Great South Channel		P	Wrap on tail assoc w/ cyamid load; flippers & mouth involved; extremely emaciated; lethargic; no gear recovered
08/11/07	mortality	age & sex unknown	Cabot Strait, Nova Scotia		P	Constricting wrap around body, between the head and flippers; no gear recovered
09/26/07	mortality	Juvenile Male 13m (est)	off Martha's Vineyard, MA		P	Freshly dead, scavenged carcass with gear present; evidence of multiple body wraps with associated hemorrhaging; no gear recovered
07/02/08	mortality	age unknown Male 14.8m	Barnegat Inlet, NJ	P		Vertebral fractures with associated hemorrhaging; hemorrhaging around ball joint of right flipper

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass 2010) ~~(Nelson *et al.* 2007)~~ have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. The gender and length were misreported in the 2006 Stock Assessment Report. This table shows the correct values.
d. Additional record which was not included in previous reports.

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Other Mortality

After reviewing NMFS records for ~~2003~~ 2004 through ~~2007~~2008, ~~eight~~ ten were found that had sufficient information to confirm the cause of death as collisions with vessels ~~(Table 2~~(Table 2;Glass 2010)~~)~~. These records constitute an annual rate of serious injury or mortality of ~~1.6~~2.0 fin whales from vessel collisions. ~~NMFS data include one additional record of fin whale collisions with vessels, but the available supporting documentation is insufficient to determine if the whale sustained mortal injuries from the encounter.~~ The number of fin whales taken at 3 whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974).

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trend for fin whales. The total level of human-caused mortality and serious injury is unknown. NMFS records represent coverage of only a portion of the area surveyed for the population estimate for the stock. The total U.S.

fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. A ~~Draft~~ revised Recovery ~~recovery~~ Plan ~~plan~~ for fin whales has been ~~prepared and is available for review~~published (NMFS 2006).

REFERENCES CITED

Agler, B.A., R.L. Schooley, S.E. Frohock, S.K. Katona and I.E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. J. Mamm. 73(3): 577-587.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Bérubé, M., A.Aguilar, D. Dendanto, F. Larsen, G.N.d. Sciara, R. Sears, J. Sigurjónsson, J. Urban-R. and P.J. Palsbøll. 1998. Population genetic structure of North Atlantic, Mediterranean and Sea of Cortez fin whales, *Balaenoptera physalus* (Linnaeus 1758): analysis of mitochondrial and nuclear loci. Mol. Ecol. 15: 585-599.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, DC. #AA551-CT8-48**:** 576.

Clapham, P.J. and I.E. Seipt. 1991. Resightings of independent fin whales, *Balaenoptera physalus*, on maternal summer ranges. J. Mamm. 72: 788-790.

Clark, C.W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Rep. Int. Whal. Comm. 45: 210-212.

Donovan, G.P. 1991. A review of IWC stock boundaries. Rep. Int. Whal. Comm. (Special Issue) 13: 39-68.

Glass, A. 2010. Mortality and serious injury determinations for baleen whale stocks along the United States Eastern Seaboard and adjacent Canadian Maritimes, 20024-2008. Northeast Fish. Sci. Cent. Ref. Doc.

Hain, J.H.W., M.J. Ratnaswamy, R.D. Kenney and H.E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Rep. Int. Whal. Comm. 42: 653-669.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald and D. G. Robertson, (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam.

Kellogg, R. 1929. What is known of the migration of some of the whalebone whales. Ann. Rep. Smithsonian Inst. 1928: 467-494.

Kenney, R.D., G.P. Scott, T.J. Thompson and H.E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. J. Northwest Fish. Sci. 22: 155-171.

Lawson, J.W. and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 2009/031. 33 pp.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 108-169 *in*: W. E. Schevill, (ed.) The whale problem: A status report. Harvard University Press, Cambridge, MA.

Mizroch, A.A., D.W. Rice and J.M. Breiwick. 1984. The fin whale, *Balaenoptera physalus*. Mar. Fish. Rev. 46: 20-24.

NMFS. 2006. Draft recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. http://www.nmfs.noaa.gov/pr/pdfs/recovery/draft_finwhale.pdf

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (special issue) 16: 27-50.

Palka, D.L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans, European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

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Palka, D.L. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Seipt, I.E., P.J. Clapham, C.A. Mayo and M.P. Hawvermale. 1990. Population characteristics of individually identified fin whales *Balaenoptera physalus* in Massachusetts Bay. Fish. Bull. 88(2): 271-278.

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Watkins, W.A., M.A. Daher, G.M. Reppucci, J.E. George, D.L. Martin, N.A. DiMarzio and D.P. Gannon. 2000. Seasonality and distribution of whale calls in the North Pacific. Oceanography 13: 62-67.

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SEI WHALE (*Balaenoptera borealis borealis*): Nova Scotia Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwest Atlantic sei whales, and suggested two stocks - a Nova Scotia stock and a Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern U.S., and extends northeastward to south of Newfoundland. The Scientific Committee of the International Whaling Committee (IWC), while adopting these general boundaries, noted that the stock identity of sei whales (and indeed all North Atlantic whales) was a major research problem (Donovan 1991). In the absence of evidence to the contrary, the proposed IWC stock definition is provisionally adopted, and the "Nova Scotia stock" is used here as the management unit for this stock assessment. The IWC boundaries for this stock are from the U.S. east coast to Cape Breton, Nova Scotia, thence east to longitude 42° W.

Indications are that, at least during the feeding season, a major portion of the Nova Scotia sei whale stock is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) - the Gulf of Maine and Georges Bank. Spring is the period of greatest abundance in U.S. waters, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys in 1999, 2000 and 2001 found concentrations of sei and right whales along the northern edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al.* 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, in particular south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000-m depth contour than were fin whales.

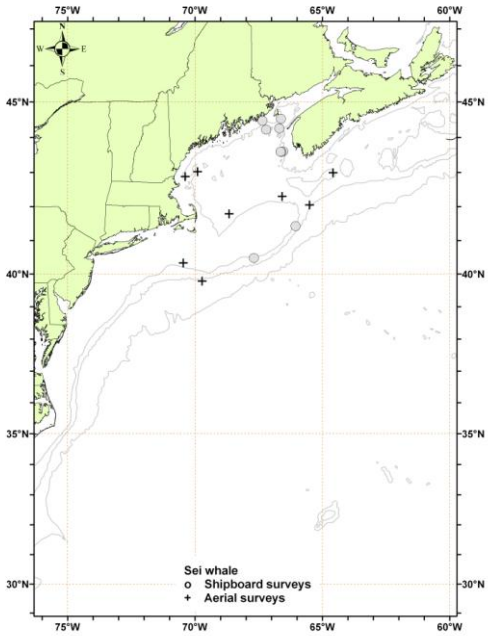

Figure 1. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al.* 2002). A review by prey preferences by Horwood (1987) show that in the N Atlantic sei whales seem to prefer copepods over all other prey species. In Nova Scotia sampled stomachs from captured sei whales showed a clear preference for copepods between June and October and euphasiids were taken only in May and November (Mitchell 1975). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al.* 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling *et al.* 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide (Jonsgård and Darling 1977).

Based on analysis of records from the Blandford, Nova Scotia, whaling station, where 825 sei whales were taken between

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1965 and 1972, Mitchell (1975) described two "runs" of sei whales, in June-July and in September-October. He speculated that the sei whale population migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified.

POPULATION SIZE

The total number of sei whales in the U.S. Atlantic EEZ is unknown. However, five abundance estimates are available for portions of the sei whale habitat: from Nova Scotia during the 1970's, in the U.S. Atlantic EEZ during the springs of 1979-1981, and in the U.S. and Canadian Atlantic EEZ during the summers of 2002, 2004, and 2006. The August 2004 abundance estimate (386) is considered the best available for the Nova Scotia stock of sei whales. However, this estimate must be considered conservative in view of the known range of the sei whale in the entire western North Atlantic, and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. The abundance estimates of sei whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified sei whales to the total of positively identified fin whales and positively identified sei whales.

Earlier abundance estimates

Please see appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 71 (CV=1.01) sei whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 386 (CV=0.85) sei whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN)(Table 1; Palka 2006). There were 6,180 km of trackline within known sei whale habitat, from the 100 m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed. Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 207 (CV=0.62) sei whales was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

Table 1. Summary of recent abundance estimates for Nova Scotia sei whales. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	71	1.01
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	386	0.85
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	207	0.62

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for the Nova Scotia stock sei whales is 386 (CV=0.85). The

minimum population estimate is 208.

Current Population Trend

~~There are insufficient data to determine~~A population ~~trends~~ trend analysis has not been done for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 208. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is 0.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2003~~ 2004 through 2008~~7~~, the minimum annual rate of human-caused mortality and serious injury to sei whales was ~~0.8~~1.0. This value includes incidental fishery interaction records, 0.~~2~~6, and records of vessel collisions, 0.~~6~~ 4 (Glass *et al.* ~~2009~~2010). ~~(2010)~~ Detected mortalities should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured sei whales for the period 2004~~3~~ through 2008~~7~~ on file at NMFS found 3~~one~~ records with substantial evidence of fishery interactions causing serious injury (Table 2), which results in an annual rate of serious injury and mortality of 0.6~~2~~ sei whales from fishery interactions. ~~The fishery entanglement serious injury was discovered on Jeffreys Ledge on 16 September 2006.~~

~~Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2003 – 2007.~~

~~Date[a]~~	~~Report Type[b]~~	~~Age, Sex, Length~~	~~Location[a]~~	~~Assigned Cause: P=primary, S=secondary~~		~~Notes/Observations~~
				~~Ship strike~~	~~Entang./ Fsh inter~~	
~~02/19/03~~	~~mortality~~	~~age unknown Male 11.0m~~	~~Norfolk, VA~~	~~P~~		~~Large gash into muscle, hematoma and abrasions~~
~~04/17/06~~	~~mortality~~	~~Juvenile Male 10.9m~~	~~Baltimore, MD~~	~~P~~		~~Brought in on bow of ship, freshly dead; massive hemorrhaging on right side; large blood clot behind head; several broken ribs~~
~~09/16/06~~	~~serious injury~~	~~age & sex unknown~~	~~Jeffreys Ledge~~		~~P~~	~~Constricting wrap cutting into skin; no gear recovered~~
~~05/30/07~~	~~mortality~~	~~Adult Female~~	~~off Deer Island, MA~~	~~P~~		~~Broken left flipper, 8 vertebral processes, and 4 ribs; right flipper~~

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		~~14.4m~~				~~sheared off; lower jaw dislocated; hemorrhaging and/or edema associated with lower jaw and left flipper region~~

~~a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.~~

~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass *et al.* 2009) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.~~

Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2004 - 2008.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
04/17/06	mortality	Juvenile Male 10.9m	Baltimore, MD	P		Brought in on bow of ship, freshly dead; massive hemorrhaging on right side; large blood clot behind head; several broken ribs
09/16/06	serious injury	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; no gear recovered
05/30/07	mortality	Adult Female 14.4m	off Deer Island, MA	P		Broken left flipper, 8 vertebral processes, and 4 ribs; right flipper sheared off; lower jaw dislocated; hemorrhaging and/or edema associated with lower jaw and left flipper region
04/09/08	serious injury	age & sex unknown	Great South Channel		P	Constricting wrap on fluke; skin sloughing; no gear recovered
06/29/08	mortality	age & sex unknown 15m (est)	Slacks Cove, New Brunswick		P	Extensive entanglement evident; no gear present

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

For the period 2004 through 2008 files at NMFS included 2 records with substantial evidence of vessel collisions causing serious injury or mortality (Table 2). Previous NMFS records of human-caused sei whale mortalities include one from 17 November 1994, when a sei whale carcass was observed on the bow of a container ship as it docked in Boston, Massachusetts, and one from 2 May 2001 when the carcass of a 13 m female sei whale slid off the bow of a ship arriving in New York harbor.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends for sei whales. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the sei whale is listed as an endangered species under the ESA. A Recovery Plan for sei whales has been written and is awaiting legal clearance.

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report. Washington, DC, Bureau of Land Management. #AA551-CT8-48 538 pp.

Donovan, G.P. 1991. A review of IWC stock boundaries. Rep. Int. Whal. Comm. (Special Issue) 13: 39-68.

Flinn, R.D., A.W. Trites and E.J. Gregr 2002. Diets of fin, sei, and sperm whales in British Columbia: An analysis of commercial whaling records, 1963-1967. Mar. Mamm. Sci. 18(3): 663-679.

Glass, A.H., T.V.N. Cole and M. Garron 2009. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007. Northeast Fish Sci Cent Ref Doc. 09-04. 19 pp.

Harwood J. 1987. The Sei Whale: Population Biology, Ecology & Management. Croom Helm, London. 375 pp.

Hain, J.H.W., M.A. Hyman, R.D. Kenney and H.E. Winn 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. Mar. Fish. Rev. 47(1): 13-17.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake *et al.*, (eds.) Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Jonsgård, Å. and K. Darling 1977. On the biology of the Eastern North Atlantic sei whale, *Balaenoptera borealis* Lesson. Rep. Int. Whal. Comm. (Special Issue) 1: 124-129.

Mitchell, E. 1975. Preliminary report on Nova Scotia fishery for sei whales (*Balaenoptera borealis*). Rep. Int. Whal. Comm. 25: 218-225.

Mitchell, E. and D.G. Chapman 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). Rep. Int. Whal. Comm. (Special Issue) 1: 117-120.

Palka, D.L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0), Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans. European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Palka, D.L. and P.S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88: 687-696.

Schilling, M.R., I. Seipt, M.T. Weinrich, S.E. Frohock, A.E. Kuhlberg and P.J. Clapham 1993. Behavior of individually identified sei whales, *Balaenoptera borealis*, during an episodic influx into the southern Gulf of Maine in 1986. Fish. Bull. 90(4): 749-755.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

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~~January~~March 2010~~December 2009~~

MINKE WHALE (*Balaenoptera acutorostrata acutorostrata*): Canadian East Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution~~, being distributed in polar~~in~~,~~ temperate and tropical waters. In the North Atlantic, there are four recognized populations—Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). These divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data and pre-existing ICES boundaries. However, there were very few data from the Canadian East Coast population.

Minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45ºW) to the Gulf of Mexico. The relationship between this stock and the other three stocks is uncertain. It is also uncertain if there are separate sub-stocks within the Canadian East Coast stock.

The minke whale is common and widely distributed within the U.S. Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution. Spring and summer are times of relatively widespread and common occurrence, and when the whales are most abundant in New England waters. In New England waters during fall there are fewer minke whales, while during winter the species appears to be largely absent. Like most other baleen whales, minke whales generally occupy the continental shelf proper, rather than the continental shelf edge region. Records summarized by Mitchell (1991) hint at a possible winter distribution in the West Indies, and in the mid-ocean south and east of Bermuda. As with several other cetacean species, the possibility of a deep-ocean component to the distribution of minke whales exists but remains unconfirmed.

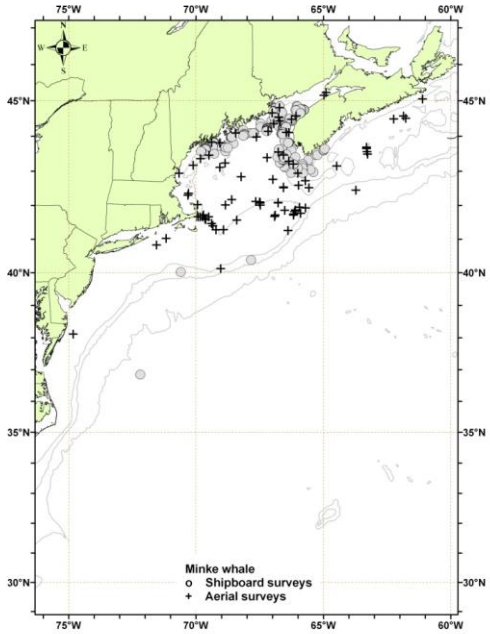

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, eleven estimates are available for portions of the habitat (see Appendix IV for details on these surveys and estimates). ~~The best available current abundance estimate for minke whales, 3,312 (CV=0.74), is obtained from the 2006 aerial survey because this survey is recent and covered the largest portion of the animal's habitat.~~ The best recent abundance estimate for this stock is 8,987 (CV=0.32) (Table 2), which is the sum of the August 2006 U.S. survey (3,312 CV=0.74) and the Jul-Aug 2007 Canadian survey (5,675 CV=0.25).

Earlier estimates

For earlier abundance estimates please see Appendix IV.

Recent surveys and abundance estimates

An abundance estimate of 756 (CV=0.90) minke whales was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the ~~1000~~ 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 600 (CV=0.61) minke whales was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the ~~100~~ 100-m depth contour on ~~the~~ southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1; Palka 2006). Shipboard data were collected using the ~~two~~ two ~~independent~~ independent-team ~~line~~ line-transect method and analyzed using the modified ~~direct~~ direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 3,312 (CV=0.74) minke whales was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the ~~2000~~ 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of ~~3,242~~ 5,675 (95%CI=2,~~051~~214-~~4,845~~6,745) minke whales was generated ~~form~~ from the Canadian ~~Trans~~ Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This survey covered ~~area~~ from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009)~~(Lawson and Gosselin 2008)~~.

Table 1. Summary of abundance estimates for the Canadian east coast stock of minke whales. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	756	0.90
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	600	0.61
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	3,312	0.74
Jul-Aug 2007	N. Labrador to Scotian Shelf	~~3,242~~5,675	0.21-0.27
Aug 2006 + Jul-Aug 2007	S. Gulf of Maine to N. Labrador (COMBINED)	8,987	0.32

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for minke whales is 8,987~~3,312~~ animals (CV=0.~~74~~32). The minimum population estimate for the Canadian East Coast minke whale is 6,909~~1,899~~ animals.

Current Population Trend

~~There are insufficient data to determine population trends for this species.~~A population trend analysis for this species has not been conducted.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity are that females mature between 6~~-~~ and 8 years of age, and pregnancy rates are approximately 0.86 to 0.93. Based on these parameters, the calving interval is between 1 and 2 years. Calves are probably born during October to March after 10 to 11 months gestation and nursing lasts for less than 6 months. Maximum ages are not known, but for Southern Hemisphere minke whales maximum age appears to be about 50 years (IWC 1991; Katona *et al.* 1993).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 6,909~~1,899~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Canadian east coast minke whale is ~~19~~69.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

~~Recent minke whale takes have been observed in – or have been attributed to – the Northeast bottom trawl, Northeast/Mid-Atlantic lobster trap/pot, and unknown fisheries, although not all takes have resulted in mortalities (Tables 2 to 56).~~

~~Data to estimate the mortality and serious injury of minke whales come from the Northeast Fisheries Science Center Observer Program and from records of strandings and entanglements in U.S. waters. For the purposes of this report, only those strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are shown in Tables 3-4 through 5.~~

During 2004~~3~~ to 2008~~7~~, the ~~U.S.~~ total annual minimum detected~~estimated~~ average human-caused mortality and serious injury was ~~32.4~~ 2.8 minke whales per year (CV=unknown). This is derived from three components: ~~0.62 minke whales per year from U.S. fisheries using observer data,~~ 1.~~0~~2~~8~~ minke whales per year (unknown CV) from U.S. fisheries using strandings and entanglement data, 1.42 minke whales per year (unknown CV) from Canadian fisheries using strandings and entanglement data, and 0.4 minke whales per year from U.S. ship strikes (Glass 2010) ~~(Glass *et al.* 2009)~~.

Data to estimate the mortality and serious injury of minke whales come from the Northeast Fisheries Science Center Observer Program and from records of strandings and entanglements in U.S. waters. For the purposes of this report, only those strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are shown in Table 2.

Detected mortalities in the strandings and entanglement data should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate ~~of human-caused mortality~~ which is almost certainly biased low.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Little information is available about fishery interactions that took place before the 1990s. Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976. A minke whale was caught and released alive in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990).

Two minke whales were observed taken in the Northeast sink gillnet fishery ~~between 1989 and the present~~. The take in July 1991, south of Penobscot Bay, Maine was a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge, was released alive.

A minke whale was trapped and released alive from a herring weir off northern Maine in 1990.

Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995; the fishery

closed in 1998.

One minke whale was reported caught in an Atlantic tuna purse seine off Stellwagen Bank in 1991 (D. Beach, NMFS NE Regional Office, pers. comm.) and another in 1996. The minke caught during 1991 was released uninjured after a crew member cut the rope wrapped around the tail. The minke whale caught during 1996 escaped by diving beneath the net.

One minke whale, reported in the strandings and entanglement database maintained by the New England Aquarium and the Northeast Regional Office/NMFS, was taken in a 6-inch gill net on 24 June 1998 off Long Island, New York. This take was assigned to the mid-Atlantic gillnet fishery. No minke whales have been taken in this fishery during observed trips in 1993 to 20087.

The strandings and entanglement database reported 7 minke whale mortalities and serious injuries that were attributed to the Northeast/Mid-Atlantic Lobster Trap/Pot Ffishery during 1990 to 1994; 1 in 1990 (may be serious injury), 2 in 1991 (1 mortality and 1 serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, 2 January 1997). The one confirmed minke whale mortality during 1995 was attributed to the lobster fishery. No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the four confirmed 1997 records, one minke whale mortality was attributed to the lobster trap fishery. In 2002, one minke whale mortality and one live release were attributed to this fishery. The 28 June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery. Annual mortalities due to the Northeast/Mid-Atlantic Lobster Trap/Pot fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to 2001, 1 in 2002, and 0 in 2003 through 2008.

U.S.

Northeast Bottom Trawl

The fishery is active in New England waters in all seasons. Detailed fishery information is reported in Appendix III. One freshly dead minke whale was caught in 2004 on the northeast tip of Georges Bank in US waters (Tables 2 and 45)). Two fresh dead minkes were reported by observers in 2008 but due to scavenging evidence and emaciation not consistent with the length of the tows, these deaths were not attributed to the fishery. During 2004 to 2008, as determined from fishery observer as well as strandings and entanglement records, the minimum detected average annual mortality and serious injury is 0.2 minke whales per year in this fishery (Table 2).

An expanded bycatch estimate has not been generated because with only one observed take, it is not possible to generate an accurate bycatch estimateis being developed for this bycatch. Therefore, this catch is reported as 1, with a resulting 5-year mean annual mortality of 0.2.

Northeast/Mid-Atlantic Lobster Trap/Pot Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 7 minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994; 1 in 1990 (may be serious injury), 2 in 1991 (1 mortality and 1 serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, 2 January 1997). The one confirmed minke whale mortality during 1995 was attributed to the lobster fishery. No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the four confirmed 1997 records, one minke whale mortality was attributed to the lobster trap fishery. In 2002, one minke whale mortality and one live release were attributed to this fishery. The 28 June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery (Table 5). Annual mortalities due to this fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to 2001, 1 in 2002, and 0 in 2003 through 20072008. Estimated average annual mortality related to this fishery during 2003 2004 to 2007 2008 was 0 minke whales per year).

Unknown Fisheries

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, include 36 records of minke whales within U.S. waters for 1975-1992. The gear include unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, which

came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).

The audited NE Regional Office/NMFS entanglement/stranding database contains records of minke whales, of which the confirmed mortalities and serious injuries from the last five years are reported in Table 42~~5~~. Mortalities (and serious injuries) that were likely a result of a U.S. fishery interaction with an unknown fishery include 3 (0) in 1997, 3 (0) in 1999, 1 (1) in 2000, 2 (0) in 2001, 1 (0) in 2002, 5 (0) in 2003, 2 (0) in 2004, 0 (0) in 2005, 0 (0) in 2006, ~~and~~ -1 (1) in 2007, and 1 (0) in 2008 (Table~~s 3 and 4~~ 2). ~~Examination of minke entanglement records from 1997 indicates that 4 out of 4 confirmed records of mortality were likely a result of fishery interactions. One was attributed to the lobster pot fishery (see above), and three were not attributed to any particular fishery because the information from the entanglement event did not contain the necessary details. Of the five mortalities in 1999, two were attributed to an unknown trawl fishery and three to some other fishery. Of the two interactions with an unknown fishery in 2000, one was a mortality and one was a serious injury. In 2001, the two confirmed fishery interactions were both from an unknown fishery. In 2002, there was one mortality in an unknown fishery. In 2003, 5 of 5 confirmed mortalities were due to interactions with an unknown fishery (Tables 3 and 5). In 2004, of the four confirmed mortalities, two were due to an interaction with an unknown fishery. In 2005 and 2006 there were no mortalities attributed to fishery interactions. In 2007 there was one mortality and one serious injury, both attributed to unknown fisheries.~~

~~In general, an entangled or stranded cetacean could be an animal that is part of an expanded bycatch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997 through 2008~~7~~, no minke whale bycatch estimates were generated from observed takes in any fishery observed by the NEFSC Observer Program, therefore, the strandings from those years in which mortalities were attributable to fishery interactions can be added into the human-caused mortality estimate.~~ During 2004~~3~~ to 2008~~7~~, as determined from strandings and entanglement records, the minimum detected~~estimated~~ average annual mortality and serious injury is 1.0~~8~~ minke whales per year in unknown fisheries (Table ~~3~~2).

CANADA

Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

Herring Weirs

During 1980 to 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. During January 1991 to September 2002, 26 minke whales were trapped in herring weirs in the Bay of Fundy. Of these 26, 1 died (H. Koopman, pers. comm.) and several (number unknown) were released alive and unharmed (A. Westgate, pers. comm.).

Other Fisheries

Six minke whales were reported entangled during 1989 in the ~~now non-operational~~ groundfish gillnet fishery in Newfoundland and Labrador (Read 1994). One of these animals escaped and was still towing gear, the remaining five animals died.

Salmon gillnets in Canada, now no longer used, had taken a few minke whales. In Newfoundland in 1979, one minke whale died in a salmon net. In Newfoundland and Labrador, between 1979 and 1990, it was estimated that 15% of the Canadian minke whale takes were in salmon gillnets. A total of 124 minke whale interactions were documented in cod traps, groundfish gillnets, salmon gillnets, other gillnets, and other traps. The salmon gillnet fishery ended in 1993 as a result of an agreement between the fishermen and North Atlantic Salmon Fund (Read 1994).

Five minke whales were entrapped and died in Newfoundland cod traps during 1989. The cod trap fishery closed in Newfoundland in 1993 due to the depleted groundfish resources (Read 1994).

In 2004, two minke whales were reported dead in entangled fishing gear off of Newfoundland and Labrador, one in a blackback flounder net, and one in crab gear (Ledwell and Huntington 2004). ~~(Tables 3 and 4).~~ Only the flounder net animal had enough information to include it as a human-caused mortality. In 2005, four minke whales were reported entangled in fishing gear in Newfoundland and Labrador. Two (entangled in salmon net and mackerel trap gear) were released alive and two (involved with whelk pot and toad crab pot fisheries ~~(Tables 3 and 4)~~) were

dead (Ledwell and Huntington 2006). The whelk pot mortality could not be conclusively attributed to human causes. In 2006, one minke whale was reported dead in a mackerel trap off of Newfoundland (Ledwell and Huntington 2007) (Tables 3 and 4). In 2007, f~~F~~our minke whales in Newfoundlandland and Labrador were reported entangled, but released alive (Ledwell and Huntington 2008)~~in 2007 in Newfoundlandland and Labrador, where a. All were released alive (Ledwell and Huntington 2007)~~. In 2008, four minkes were reported entangled in Newfoundland and Labrador. Two of these were dead (Tables 3 and 4) and two were released alive, though one of the live releases was listed as „condition uncertain" (Ledwell and Huntington 2009). In 2008, one minke was reported dead in an unknown fishery off of New Brunswick (Tables 3 and 4). Mortalities (and serious injuries) that were likely a result of a Canadian fishery interaction with an unknown fishery include 1(0) in 2004, 1(0) in 2005, 1(0) in 2006, 0(0) in 2007, and 3(0) in 2008. During 2004 to 2008, as determined from Canadian strandings and entanglement records, the minimum detected~~estimated~~ average annual mortality ~~i~~was 1.42 minke whales per year in fisheries (Table ~~3~~2).

~~Table 2. Summary of the incidental mortality of minke whales (*Balaenoptera acutorostrata*) by U.S. commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).~~

~~Fishery~~	~~Years~~	~~Vessels~~	~~Data Type [a]~~	~~Observer Coverage[b]~~	~~Observed Mortality~~	~~Estimated Mortality~~	~~Estimated CVs~~	~~Mean Annual Mortality~~
~~Northeast Bottom Trawl~~	~~0304-0708~~	~~unk~~	~~Obs. Data~~	~~.03, .04, .05, .06, .06, 0.08~~	~~0, 1, 0, 0, 0, 2~~	~~1[c]3[c]~~	~~unk[c]~~	~~0.2[c]6[c]~~
~~Total~~								~~0.2[c]6[c]~~

~~Table 3. From strandings and entanglement data, summary of confirmed incidental mortalities and serious injuries of minke whales (*Balaenoptera acutorostrata*) by commercial fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities and serious injuries assigned to this fishery (Assigned Mortality), and mean annual mortality and serious injuries. See Table 45 for details. (NA=Not Available)~~

~~Fishery~~	~~Years~~	~~Vessels~~	~~Data Type~~ [a]	~~Assigned Mortality~~	~~Mean Annual Mortality~~
~~U.S. unknown Fisheries~~	~~043-087~~	~~NA~~	~~Entanglement & Strandings~~ [a]	~~5, 2, 0, 0, 2, 1~~	~~1.08~~
~~Canadian fisheries~~	~~04-08~~	~~NA~~	~~Entanglement & Strandings~~ [b]	~~2, 1, 1, 0, 3~~	~~1.4~~
~~TOTAL~~					~~21.48 (CV=unk)~~

~~a. Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).~~
~~B. Data from records in the entanglement and strandings data base maintained by …~~

~~Table 4. Summary of minke whales (*Balaenoptera acutorostrata*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured). (NA = Not Available)~~

~~Fishery~~	~~Years~~	~~Ratio~~	~~Injured~~	~~Uninjured~~
~~Pelagic longline~~	~~03-07~~	~~0~~	~~0~~	~~1~~ [a]

~~Minke whale released alive from pelagic longline gear in 2003.~~

Table 4~~2~~5. Confirmed U.S. and Canadian human-caused mortality and serious injury records of Canadian East Coast stock of minke whales, January 2004~~3~~ through December 2008~~7~~.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang. / Fsh. Inter.	
~~05/24/03~~	~~mortality~~	~~Adult Male 7.6m~~	~~Gloucester, MA~~		~~P~~	~~Unknown fishery; line marks on head and dorsal fin; no line present; cut across back anterior to dorsal fin; no gear recovered~~

~~05/31/03~~	~~mortality~~	~~Juvenile Female 3.6m (est)~~	~~Martha's Vineyard, MA~~		~~P~~	~~Unknown fishery; whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear~~
~~06/28/03~~	~~mortality~~	~~Yearling Male 5.1m~~	~~Chatham, MA~~		~~P~~	~~Unknown fishery; wrapped in lobster gear; gear not recovered~~
~~08/09/03~~	~~mortality~~	~~Juvenile Female, 3.5m (est)~~	~~Harwich, MA~~		~~P~~	~~Unknown fishery; hemorrhaging in areas with net marks on whale; no gear recovered~~
~~09/13/03~~	~~mortality~~	~~Juvenile Female 6m (est)~~	~~Casco Bay, ME~~		~~P~~	~~Unknown fishery; freshly dead; external chaffing marks and belly slit open; no gear recovered~~
05/06/04	mortality	Adult Female 7.7m	Martha's Vineyard, MA		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam; no gear present
06/01/04	mortality	Juvenile Female 6.5m	Chatham, MA	P		Large area of subdermal hemorrhaging
07/19/04	mortality	Adult Female 7.9m	Eastham, MA		P	Unknown fishery; extensive entanglement markings; no gear recovered
08/04	mortality	age & sex unknown 4m (est)	Georges Bank, USA		P	Northeast Bottom Trawl; fresh dead, rigid, had to cut out of net, rope in mouth; from fisheries observer records
08/09/04[c]	mortality	age & sex unknown	Cape Broyle Head, Newfoundland		P	Blackback flounder net; partial disentanglement; fishermen witnessed death of animal in remaining gear
~~09/07/04[e]~~	~~mortality~~	~~age & sex unknown~~	~~off Square Islands, Labrador~~		~~P~~	~~Crab gear; constricting gear through mouth and around~~
05/23/05	mortality	Juvenile Male 5.9m	Port Elizabeth, NJ	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging
08/24/05[c]	mortality	age & sex unknown	Bridgeport, New World Island, Newfoundland		P	Toad crab pots; constricting gear through mouth with flipper and tail wraps

09/22/06[c]	mortality	age & sex unknown	Woods Cove, Northern Peninsula, Newfoundland		P	Mackerel trap; anchored by tail in doorways of the gear
07/16/07	serious injury	age & sex unknown 10m (est)	Trescott, ME		P	Unknown fishery; wrapped in gear and anchored; no gear recovered
08/05/07	mortality	Juvenile Female 4.3m	Cape Cod Bay, MA		P	Unknown fishery; chronic entanglement with severe emaciation and dehydration and loss of protein; line lacerated blubber layer across back and at flipper insertions; severe hemorrhage and necrosis of blubber at gear entanglement points; gear consists of 11/164" diameter floating rope
06/14/08	mortality	Juvenile Female 4.7m	Orleans, MA		P	Unknown fishery; braided line impressions wrapped the body in 3 places and left a deep, hemorrhaged laceration across the rostrum and blowholes; hemorrhaged abrasions present on roof of mouth; wet, blood-filled lungs indicate drowning; no gear present
07/23/08	mortality	age & sex unknown 7m (est)	Kelligrews, Newfoundland		P	Unknown fishery; constricting wraps of gear on caudal peduncle; 5/8" polypropylene rope
07/26/08	mortality	age & sex unknown	Conception Bay, Newfoundland		P	Blackback flounder net; constricting wraps of gear through mouth and around tail
08/25/08	mortality	age & gender unknown 8m (est)	off Richibucto Cape, New Brunswick		P	Unknown fishery; evidence of constricting body wraps; gear not recovered

			ship strike	entanglement	
5-year totals	**~~serious injury~~US waters**	**serious injury ~~US waters~~**	**0**	**1**	
		mortality ~~Canadian waters~~	**2**	**5**	
	~~mortality~~Canadian	**serious injury ~~US waters~~**	**0**	**0**	

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	waters	**mortality ~~Canadian waters~~**	**0**	**6**	

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass *et al.* 2009; Glass 2010)~~(Glass *et al.* 2009)~~ have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. Additional record which was not included in previous reports.

Other Mortality

Minke whales have been and continue to be hunted in the North Atlantic. From the Canadian East Coast population, documented whaling occurred from 1948 to 1972 with a total kill of 1,103 animals (IWC 1992). Animals from other North Atlantic minke populations are presently still being harvested~~ at low levels~~.

U.S.

Minke whales inhabit coastal waters during much of the year and are thus subject to collision with vessels. According to the NMFS/NER marine mammal entanglement and stranding database, on 7 July 1974, a necropsy of a minke whale suggested a vessel collision; on 15 March 1992, a juvenile female minke whale with propeller scars was found floating east of the St. Johns Channel entrance (R. Bonde, USFWS, Gainesville, FL, pers. comm.); and on 15 July 1996 the captain of a vessel reported hitting a minke whale offshore of Massachusetts. After reviewing this record, it was concluded the animal struck was not a serious injury or mortality. On 12 December 1998, a minke whale was struck and presumed killed by a whale watching vessel in Cape Cod Bay off Massachusetts.

During 1999 to 2003, no minke whale was confirmed struck by a ship. During 2004 and 2005, one minke whale mortality was attributed to ship strike in each year (Table 42~~5~~). During 2006 to~~and~~ 2008~~7~~, no minke whale was confirmed struck by a ship. Thus, during 2004~~3~~ to 2008~~7~~, as determined from stranding and entanglement records, the minimum detected~~estimated~~ annual average was 0.4 minke whales per year struck by ships.

In October 2003, an Unusual Mortality Event was declared involving minke whales and harbor seals along the coast of Maine;~~.~~ ~~sTwo of the seven criteria established to designate such an event were met by these species. Specifically, there was a marked increase in mortalities when compared with historical records, and the mortalities were occurring in a localized area of the Maine coast. From 11-30 September 2003, nine minke whales were reported along the mid-coast to southern Maine. Results from analyses for biotoxins failed to show the presence of either saxitoxin or domoic acid (by ELISA and Receptor Binding Assay). Most whale carcasses that were examined appeared to be in good body condition immediately prior to death. S~~ince then~~October 2003~~, the number of minke whale stranding reports has returned to normal. There were two minke whale stranding mortalities in NC in 2005 but in neither case could cause of death be attributed to human causes (Glass *et al.* 2008). There were 7 minke whale stranding mortalities reported along the US Atlantic coast in 2006. Three were in New Jersey, one in Massachusetts, one in Rhode Island, and two in the EEZ. One of the stranding mortalities from New Jersey was reported with signs of human interaction due to pieces of plastic found in the stomach.

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia between 1991 and 1996 (Hooker *et al.* 1997). Researchers with the Dep~~t~~artment of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. Lucas and Hooker (2000) reported 4 minke whales stranded on Sable Island between 1970 and 1998, 1 in spring 1982, 1 in January 1992, and a mother/calf in December 1998. On the mainland of Nova Scotia, a total of 7 reported minke whales stranded during 1991 to 1996. The 1996 stranded minke whale was released alive off Cape Breton on the Atlantic Ocean side, the rest were found dead. All the minke whales stranded between July and October. One was from the Atlantic Ocean side of Cape Breton, 1 from Minas Basin, 1 was at an unknown location, and the rest stranded in the vicinity of Halifax, Nova Scotia. It is unknown how many of the strandings resulted from fishery interactions.

Whales and dolphins stranded between 1997 and 2008 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows: 4 minke whales stranded

in 1997, 0 documented strandings in 1998 to 2000, 1 in September 2001, 4 in 2002, 2 in 2003, 0 in 2004, 3 in 2005, 8 in 2006, 1 in 2007, and ~~3~~ 4 (~~not~~ including the entangled animal listed in ~~table~~ Table 2) in 2008.

The Whale Release and Strandings program has reported ten minke whale stranding mortalities in Newfoundland and Labrador between 2004 and 2008, ~~seven~~ five of which are included in Table 2 (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009).

STATUS OF STOCK

The status of minke whales, relative to OSP, in the U.S. Atlantic EEZ is unknown. The minke whale is not listed as endangered under the Endangered Species Act (ESA). The total U.S. fishery-related mortality and serious injury for this stock is ~~not~~ less than 10% of the calculated PBR and, therefore, can~~not~~ be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because estimated human-related mortality and serious injury does not exceed PBR and the minke whale is not listed as a threatened or endangered species under the ESA.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, DC. #AA551-CT8-48: 576.

Donovan, G. P. 1991. A review of IWC stock boundaries. Rep. Int. Whal. Comm. (Special Issue) 13: 39-68.

Glass, A. 2010. Mortality and serious injury determinations for baleen whale stocks along the United States Eastern Seaboard and adjacent Canadian Maritimes, 2004-2008. Northeast Fish. Sci. Cent. Ref. Doc.

Glass, A. H., T. V. N. Cole and M. Garron 2009. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007. Northeast Fish Sci Cent Ref Doc. 09-04. 19 pp.

Glass, A. H., T. V. N. Cole, M. Garron, R. L. Merrick and R. M. Pace, III 2008. Mortality and serious injury determinations for baleen whale stocks along the United States Eastern Seaboard and adjacent Canadian Maritimes, 2002-2006. Northeast Fish. Sci. Cent. Ref. Doc. 08-04. 18 pp.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake. F. J. Manly, L. L. McDonald and D. G. Robertson, (eds.). Marine mammal survey and assessment methods. Balkema, Rotterdam.

Hooker, S. K., R. W. Baird and M. A. Showell 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

IWC 1991. Appendix 11. Biological parameters of North Atlantic minke whales. *In* Annex F, report of the sub-committee on North Atlantic minke whales. Rep. Int. Whal. Comm. 41: 160.

IWC 1992. Annex K. Report of the working group on North Atlantic minke trials. Rep. Int. Whal. Comm. 42: 246-251.

Katona, S. K., V. Rough and D. T. Richardson 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316 pp.

Lawson, J. W. and J.-F. Gosselin 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 2009/031. 33 pp.

Ledwell, W. and J. Huntington 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.

Ledwell, W. and J. Huntington 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and

Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.
Ledwell, W. and J. Huntington 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda, Newfoundland and Labrador region.
Lucas, Z. N. and S. K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.
Mitchell, E. D. 1991. Winter records of the minke whale (*Balaenoptera acutorostrata* Lacepede 1804) in the southern North Atlantic. Rep. Int. Whal. Comm. 41: 455-457.
Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (special issue) 16: 27-50.
Palka, D. L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans, European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.
Palka, D. L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf
Palka, D. L. and P. S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.
Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Comm. (Special Issue) 15: 133-147.
Wade, P. R. and R. P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Waring, G. T., P. Gerrior, P. M. Payne, B. L. Parry and J. R. Nicolas 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull. 88(2): 347-360.

~~January~~ March 2010

BLUE WHALE (*Balaenoptera musculus musculus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the blue whale, *Balaenoptera musculus musculus,* in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence (Sears *et al.* 1987). The species was hunted around Newfoundland in the first half of the 20th century (Sergeant 1966). The present Canadian distribution, broadly described, is spring, summer, and fall in the Gulf of St. Lawrence, especially along the north shore from the St. Lawrence River estuary to the Strait of Belle Isle and off eastern Nova Scotia. The species occurs in winter off southern Newfoundland and also in summer in Davis Strait (Mansfield 1985). Individual identification has confirmed the movement of a blue whale between the Gulf of St. Lawrence and western Greenland (Sears and Larsen 2002), although the extent of exchange between these two areas remains unknown. Similarly, a blue whale photographed by a NMFS large whale survey in August 1999 had previously been observed in the Gulf of St. Lawrence in 1985 (R. Sears and P. Clapham, unpublished data) and there have been additional photographic resightings between the Gulf of Maine, Scotian Shelf and Gulf of St. Lawrence (R. Sears, pers. comm.).

The blue whale is best considered as an occasional visitor in US Atlantic Exclusive Economic Zone (EEZ) waters, which may represent the current southern limit of its feeding range (CETAP 1982; Wenzel *et al.* 1988). All of the five sightings described in the foregoing two references were in August. Yochem and Leatherwood (1985) summarized records that suggested an occurrence of this species south to Florida and the Gulf of Mexico, although the actual southern limit of the species' range is unknown.

Using the U.S. Navy's SOSUS program, blue whales have been detected and tracked acoustically in much of the North Atlantic, including in subtropical waters north of the West Indies and in deep water east of the US Atlantic EEZ, indicating the potential for long~~-~~ distance movements (Clark 1995). Most of the acoustic detections were around the Grand Banks area of Newfoundland and west of the British Isles. Historical blue whale observations collected by Reeves *et al*. ~~(~~(2004)~~)~~ ~~collection of historical blue whales observations~~ show a broad longitudinal distribution in tropical and warm temperate latitudes during the winter months~~-~~, with a narrower, more northerly distribution in summer. Sigurjónsson and Gunnlaugsson (1990) note that North Atlantic blue whales appear to have been depleted by commercial whaling to such an extent that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic.

Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, Newfoundland, Nova Scotia, New England and Greenland all belong to the same stock, while blue whales photographed off Iceland and the Azores appear to be part of a separate population (CETAP 1982; Wenzel *et al.* 1988; Sears and Calambokidis 2002; Sears and Larsen 2002).

POPULATION SIZE

Little is known about the population size of blue whales except for ~~in~~ the Gulf of St. Lawrence area. From 1979 to the summer of 2009, a total of 440 blue whales was~~ere~~ photo-identified mainly in the St. Lawrence estuary and northwestern Gulf of St. Lawrence (R. Sears, pers. comm.). Biopsies were taken on nearly 40% of this population (R. Sears, pers. comm.). Each year, from 20 to 105 blue whales are identified in this region. Approximately 40% of the identified blue whales return frequently ~~return~~ to the study area, the others have been observed during fewer than three seasons between 1979 and 2002, which suggests that these individuals range mostly outside the St. Lawrence, possibly in the waters at the edge of the continental shelf, from the Labrador Sea and Davis Strait in the north, east to the Flemish Cap and south to New England (Sears and Calambokidis 2002). Photo-identification data from outside the estuary and Gulf of St. Lawrence are limited. A few blue whales have been photographed along the coast of Newfoundland, on the Scotian Shelf and in the Gulf of Maine, and some are not included among the 440 blue whales that have been identified in the estuary and northwest of the Gulf of St. Lawrence (Sears and Calambokidis, 2002; J. Lawson, pers. comm.). Ramp *et al.* (2006) estimated the survival rate at 0.975 and the gender ratio of the 139 biopsy sampled individuals at 79 males for 67 females (Sears 2003). Given the small proportion of the distribution range that has been sampled and considering the low number of blue whales encountered and photographed, the current data, based on photo-identification, do~~es~~ not allow for an estimate of abundance of this species in the Northwest Atlantic with a minimum degree of certainty ~~the abundance of this species in the Northwest Atlantic~~ (Sears *et al.* 1987; Hammond *et al.* 1990; Sears *et al.* 1990; Sears and Calambokidis 2002; Fisheries and Oceans Canada 2009). ~~()~~ Mitchell (1974) estimated that the blue whale population in the western North Atlantic may

number only in the low hundreds. R. Sears (pers. comm.) suggests that 400 to 600 individuals may be found in the western North Atlantic.

Minimum Population Estimate

The catalogue count 440of 440 recognizable individuals from the Gulf of St. Lawrence area which were catalogued by Sears *et al*. (1987; 1990; pers. comm.) is considered to be a minimum population estimate for the western North Atlantic stock.

Current Population Trend

There are insufficient data to determine population trends for this species. Off western and southwestern Iceland, an increasing trend of 4.9% a year was reported for the period 1969-1988 (Sigurjonsson and Gunnlaugsson 1990). Pike *et al*. (2009) conducted ship surveys in the Central and Northeast Atlantic in 1987, 1989, 1995 and 2001. Blue whales were most commonly sighted off western Iceland, and to a lesser extent northeast of Iceland. They were very rare or absent in the Northeast Atlantic. Sightings were combined over all surveys to estimate the detection function using standard line- transect methodology, with the addition of a covariate to account for differences between surveys. Total abundance was highest in 1995 (979, 95% CI 137-2,542) and lowest in 1987 (222, 95% CI 115-440). Uncertainty in species identity had little effect on estimates of abundance. There was a significant positive trend in abundance northeast of Iceland and in the total survey area. These estimates should be treated with caution given the effort biases underlying the sightings data on which it was based.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 440. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for stocks which are endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP)or of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.10 because the blue whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Western North Atlantic stock of blue whale is 0.9.However, the minimum population size figure given above is outdated and thus is not usable for the calculation of PBR (see Wade and Angliss 1997). Consequently, no PBR can be calculated for this stock because of lack of any data on current minimum population size.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Threats for North Atlantic blue whales are poorly unknown, but may include ship strikes, pollution, entanglement in fishing gear, and long-term changes in climate (which could affect the abundance of their zooplankton prey). During winter and early spring, ice-related strandings and entrapments have been documented on the southwestern and eastern coasts of Newfoundland (Sears and Calambokidis 2002). There are no recent confirmed records of mortality or serious injury to blue whales in the US Atlantic EEZ. However, in March 1998 a dead 20- m (66-ft) male blue whale was brought into Rhode Island waters on the bow of a tanker. The cause of death was determined to be ship strike. Although it appears likely that the vessel concerned was responsible, the necropsy revealed some injuries that were difficult to explain in this context. The location of the strike was not determined; given the known rarity of blue whales in US Atlantic waters, and the vessel's port of origin (Antwerp), it seems reasonable to suppose that the whale died somewhere to the north or east of the US Atlantic EEZ.

Fishery Information

No fishery information is presented because there are no observed fishery-related mortalities or serious injury.

STATUS OF STOCK

The status of this stock relative to OSP in the US Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends for blue whales. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant and approaching a zero mortality and serious injury rate. This is a strategic stock because the blue whale is listed as an endangered

species under the ESA. A Recovery Plan has been published (Reeves *et al.* 1998) and is in effect.

Field Code Changed

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, DC. #AA551-CT8-48: 576.

Clark, C. W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Rep. Int. Whal. Comm. 45: 210-212.

Fisheries and Oceans Canada 2009. Recovery Strategy for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population, in Canada [PROPOSED]. Ottawa. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada 62 pp.

Hammond, P. S., R. Sears and M. Bérubé 1990. A note on problems in estimating the number of blue whales in the Gulf of St Lawrence from photo-identification data. Rep. Int. Whal. Comm. Special Issue 12: 141-142.

Mansfield, A. W. 1985. Status of the blue whale, *Balaenoptera musculus*, in Canada. Can. Field-Nat. 99(3): 417-420.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 108-169 *in*: W. E. Schevill, (ed.) The whale problem: A status report. Harvard University Press, Cambridge, MA.

Pike, D. G., G. A. Víkingsson, T. Gunnlaugsson and N. Øien 2009. A note on the distribution and abundance of blue whales (*Balaenoptera musculus*) in the Central and Northeast North Atlantic. NAMMCO Sci. Publ. 7: 19-29.

Ramp, C., M. Bérubé, W. Hagen and R. Sears 2006. Survival of adult blue whales *Balaenoptera musculus* in the Gulf of St. Lawrence, Canada. Mar. Ecol. Prog. Ser. 319: 287- 295.

Reeves, R. R., P. J. Clapham, J. R. L. Brownell and G. K. Silber 1998. Recovery Plan for the blue whale (*Balaenoptera musculus*). Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD 39 pp.

Reeves, R. R., T. D. Smith, E. Josephson, P. J. Clapham and G. Woolmer 2004. Historical observations of humpback and blue whales in the North Atlantic Ocean: clues to migratory routes and possibly additional feeding grounds. Mar. Mamm. Sci. 20(4): 774-786.

Sears, R. 2003. Status, knowledge gaps and threats; current research program. Pages 5-7 *in*: V. Lesage and M. Hammill, (eds.) Proceedings of the workshop on the development of research priorities for the northwest Atlantic blue whale population, 20-21 November 2002. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, proceeding series. 2003/031.

Sears, R. and J. Calambokidis 2002. COSEWIC Assessment and update status report on the blue whale *Balaenoptera musculus*, Atlantic population and Pacific poulation, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa 38 pp.

Sears, R. and F. Larsen 2002. Long range movements of a blue whale (*Balaenoptera musculus*) between the Gulf of St. Lawrence and West Greenland. Mar. Mamm. Sci. 18(1): 281-285.

Sears, R., F. Wenzel and J. M. Williamson 1987. The blue whale: a catalog of individuals from the western North Atlantic (Gulf of St. Lawrence). Mingan Island Cetacean Study, St. Lambert, Quebec, Canada. 27 pp.

Sears, R., J. M. Williamson, F. W. Wenzel, M. Berube, D. Gendron and P. Jones 1990. Photographic identification of the blue whale (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada. International Whaling Commission Special Issue Report (SC/A88/ID23).

Sergeant, D. E. 1966. Populations of large whale species in the western North Atlantic with special reference to the fin whale. Fish. Res. Board. Canada. Circular No. 9. 30 pp.

Sigurjonsson, J. and T. Gunnlaugsson 1990. Recent trends in abundance of blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) off west and southwest Iceland, with a note on occurrence of other cetacean species. Rep. Int. Whal. Comm. 40: 537-551.

Wade, P. R. and R. P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Wenzel, F., D. K. Mattila and P. J. Clapham 1988. *Balaenoptera musculus* in the Gulf of Maine. Mar. Mamm. Sci. 4(2): 172-175.

Yochem, P. K. and S. Leatherwood 1985. Blue whale. Pages 193-240 *in*: S. H. Ridgway and R. Harrison, (eds.) Handbook of Marine Mammals, Vol. 3: The Sirenians and Baleen Whales. Academic Press, New York.

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HARBOR SEAL (*Phoca vitulina concolor*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas above about 30ºN (Katona *et al.* 1993). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al.* 1993; Gilbert and Guldager 1998; Baird 2001). Stanley *et al.* (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.* 1991). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

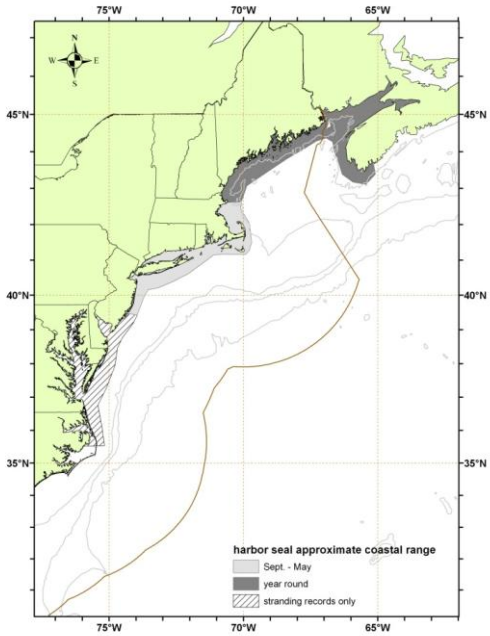

Figure 1. *Approximate coastal range of harbor seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the southern New England, to New Jersey coasts from September through late May (Schneider and Payne 1983; Barlas 1999; Schroeder 2000; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.* 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). While earlier research identified no pupping areas southern New England (Payne and Schneider 1984; Barlas 1999), more recent information suggests that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts (Rubenstein pers. comm.). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

Prior to the spring 2001 live-capture and radio-tagging of adult harbor seals, it was believed that the majority of seals moving into southern New England and mid-Atlantic waters were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the seals tagged in March in Chatham Harbor seals were detected at least once during the

May/June 2001 abundance survey along the Maine coast (Gilbert *et al.* 2005; Waring *et al.* 2006).

POPULATION SIZE

Since passage of the MMPA in 1972, the observed count of seals along the New England coast has been increasing. Coast-wide aerial surveys along the Maine coast were conducted in May/June 1981, 1986, 1993, 1997, and 2001 during pupping (Gilbert and Stein 1981; Gilbert and Wynne 1983; 1984; Kenney 1994; Gilbert and Guldager 1998; Gilbert *et al.* 2005). However, estimates older than eight years are deemed unreliable (Wade and Angliss 1997), and should not be used for PBR determinations. Therefore, there is no current abundance estimate for harbor seals. ~~only the 2001 estimate is useful for population assessment.~~ The 2001 survey, conducted in May/June, included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out. The corrected estimate (pups in parenthesis) for 2001 is 99,340 (23,722). The 2001 observed count of 38,014 is 28.7% greater than the 1997 count. Increased abundance of seals in the Northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989; Rough 1995; Barlas 1999; Schroeder 2000; deHart 2002).

Canadian scientists counted 3,500 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate. The Sable Island population was the largest in eastern Canada in the late 1980's, however recently the number has drastically declined (Baird 2001). Similarly, pup production declined on Sable Island from 600 in 1989 to around a dozen pups or fewer by 2002 (Baird 2001; Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups moving into the older age classes (Bowen et al. 2003). Possible reasons for this decline may be increased use of the island by gray seals and increased predation by sharks (Stobo and Lucas 2000; Bowen *et al.* 2003). Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St Lawrence estuary. In the estuary, surveys were flown in June 1995, 1996, and 1997, and in August 1994, 1995, 1996 and 1997; different portions of the Gulf were surveyed in June 1996 and 2001 (Robillard *et al.* 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than a count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard et al. 2005).

~~Table 1. Summary of abundance estimates for the western Atlantic harbor seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).~~

~~Month/Year~~	~~Area~~	~~N_{best}~~ [a]	~~CV~~
~~May/June 2001~~	~~Maine coast~~	~~99,340 (23,722)~~ [b]	~~CV=.097~~

~~[a] Pup counts are in brackets~~

~~[b] Corrected estimate based on uncorrected count of 38,011 (9,278)~~

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for this stock.

~~The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor seals is 99,340 (CV=.097). The minimum population estimate is 91,546 based on corrected total counts along the Maine coast in 2001.~~

Current Population Trend

There are insufficient data to determine the population trends for this stock.

~~Between 1981 and 2001, the uncorrected counts of seals increased from 10,543 to 38,014, an annual rate of 6.6 percent (Gilbert et al. 2005).~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on

uncorrected haulout counts over the 1981 to 2001 survey period, the harbor seal population was ~~is~~ growing at approximately 6.6% (Gilbert et al. 2005). However, a population grows at the maximum growth rate (R_{max}) only when it is at a very low level; thus the 6.6% growth rate is not considered to be a reliable estimate of (R_{max}). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate (½ of 12%), and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). ~~The minimum population size is 91,546.~~ The recovery factor (F_R) for this stock is 0.5, the value for stocks of unknown status. PBR for the western North Atlantic stock of harbor seals is un~~known~~determined. ~~PBR for U.S. waters is 2,746.~~

ANNUAL HUMAN-CAUSED MORTALITY

For the period 2004-2008 ~~2003-2007~~ the total human caused mortality and serious injury to harbor seals is estimated to be 44~~0~~34 ~~477~~ per year. The average was derived from two components: 1) 43~~1~~25 (CV=0.16) ~~467 (CV=0.14)~~; Table 2) from the 2004-2008 ~~2003-2007~~ observed fishery; and 2) 9.4~~10~~ from average 2004-2008 ~~2003-2007~~ non-fishery related, human interaction stranding mortalities (NMFS unpublished data).

Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurred in the mariculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data). ~~However, no data are available to determine whether shooting still takes place.~~Between 2004 and 2008, there are 6 records of harbors seals and 3 of unidentified seals with evidence of gunshot wounds in the Northeast Regional Office Marine Mammal Stranding Network database.

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Fishery Information

Detailed Fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet:

Annual estimates of harbor seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. The fishery has been observed in the Gulf of Maine and in southern New England (Williams 1999; NMFS unpublished data). There were 560~~551~~ harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2008~~2007~~, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (e.g. less than four years old). Estimated annual mortalities (CV in parentheses) from this fishery were 332 (0.33) in 1998, 1,446 (0.34) in 1999, 917 (0.43) in 2000, 1,471 (0.38) in 2001, 787 (0.32) in 2002, 542 (0.28) in 2003, 792 (0.34) in 2004, 719 (0.20) in 2005, 87 (0.58) in 2006, ~~and~~ 92 in 2007, and 27~~8~~43 (0.41) in 2008 (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were 2, 9, 14, 8, ~~and~~ 14, and 6 unidentified seals observed during 2003-2008~~2007~~, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2003~~4~~-2008~~2007~~ was 3~~93~~87 ~~446~~ harbor seals (CV=0.17~~0.15~~) (Table 2).

Mid-Atlantic Gillnet

No harbor seals were taken in observed trips during 1993-1997, or 1999-2003. Two harbor seals were observed taken in 1998, one in 2004, two in 2005, one in 2006, ~~and~~ none in 2007, and two in 2008. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997 and 1999-2003, 11 in 1998 (0.77), 15 (0.86) in 2004, 63 (0.67) in 2005, 26 (0.98) in 2006, ~~and~~ 0 in 2007, and 88 (0.74) in 2008. Average annual estimated fishery-related mortality attributable to this fishery during 2003~~4~~-2008~~2007~~ was ~~21~~38 (CV = 0.43~~-0.49~~) harbor seals (Table 2).

Northeast Bottom Trawl

Seven harbor seal mortalities were observed between 2001 and 2007, one in 2002, one in 2005, ~~and~~ three in 2007, and none in 2008. (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery has not been generated.

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 11 harbor seals were captured and released alive in 2004 and 4 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004, 2 in 2005, ~~and~~ one in 2007, and one in 2008. This fishery was not observed in 2006.

CANADA

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to a lack of observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994; Cairns *et al.* 2000). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting.

~~Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).~~

~~Fishery~~	~~Years~~	~~Vessels~~	~~Data Type~~[a]	~~Observer Coverage~~[b]	~~Observed Mortality~~	~~Estimated Mortality~~	~~Estimated CVs~~	~~Mean Annual Mortality~~
~~Northeast Sink Gillnet~~[c]	~~03-07~~	~~unk~~[d]	~~Obs. Data, Weighout, Logbooks~~	~~.03, .06, .07, .04, .07~~	~~21, 45, 70, 3, 6~~	~~542, 792, 719, 87, 92~~	~~.28, .34, .20, .58, .48~~	~~446 (0.15)~~
~~Mid-Atlantic Gillnet~~	~~03-07~~	~~unk~~[d]	~~Obs. Data, Weighout~~	~~.01, .02, .03, .04, .05~~	~~0, 1, 2, 1, 0~~	~~0, 15, 63, 26, 0~~	~~0, .86, .67, .98, 0~~	~~21 (0.49)~~[e]
~~Northeast Bottom Trawl~~	~~03-07~~	~~unk~~[d]	~~Obs. Data, Weighout~~	~~.04 .05, .12, .06, .06~~	~~0, 0, 1, 0, 3~~	~~0, 0, unk~~[e]~~, 0, unk~~[e]	~~0, 0, unk~~[e]~~, 0, unk~~[e]	~~unk~~[e]
~~TOTAL~~								~~467 (0.14)~~

~~[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.~~

~~[b] The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the northease bottom trawl are ratios based on trips.~~

~~[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2003 – 2007, respectively, 0, 8, 3, 3, and 2 takes were observed in nets with~~

~~pingers. In 2003 – 2007, respectively, 21, 37, 67, 0, and 4 takes were observed in nets without pingers.~~

[a] ~~Number of vessels is not known.~~

[e] ~~Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years 2003-2007 has not been generated.~~

Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina concolor*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast [c] Sink Gillnet	04-08	Obs. Data, Weighout, Logbooks	.06, .07, .04, .07, .05	45, 70, 3, 6, 9	792, 719, 87, 92, 243	.34, .20, .58, .48, .41	3~~93~~87 (0.17)
Mid-Atlantic Gillnet	04-08	Obs. Data, Weighout	.02, .03, .04, .06, .03	1, 2, 1, 0, 2	15, 63, 26, 0, 88	.86, .67, .98, 0, .74	38 (0.43)
Northeast Bottom Trawl	04-08	Obs. Data, Weighout	.05, .12, .06, .05, .08	0, 1, 0, 3, 0	0, unk [ed], 0, unk [ed], 0	0, unk [ed], 0, unk [ed], 0	unk [ed]
TOTAL							4~~31~~25 (0.16)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

[b] The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the northeast bottom trawl are ratios based on trips.

[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2004 - 2008, respectively, 8, 3, 3, 2, and 0 takes were observed in nets with pingers. In 2004 – 2008, respectively, 37, 67, 0, 4, and 11 takes were observed in nets without pingers.

[d] ~~Number of vessels is not known.~~

[ed] Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years 2004-2008 has not been generated.

Other Mortality

Canada: Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune 2000; Baird 2001). Small numbers of harbor seals are taken in subsistence hunting in northern Canada, and Canada also issues personal hunting licenses which allow the holder to take six seals annually (DFO 2008).

U.S.: Historically, harbor seals were bounty hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona et al. 1993; Lelli *et al.*, 2009). Bounty hunting ended in the mid-1960s.

~~Currently, aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Baird 2001).~~ Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease, and predation (Katona *et al.* 1993; NMFS unpublished data; Jacobs and Terhune 2000). Mortalities caused by human interactions include boat strikes, fishing gear interactions, oil spill/exposure, harassment, and shooting.

Small numbers of harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From 2004 to 2008~~2003 to 2007~~, 1,823~~1871~~ harbor seal stranding mortalities were reported in all states between Maine and Florida (Table 3; NMFS unpublished data). Sixty-eight

~~Seventy three (3.9%)~~ (3.7%) of the seals stranded during this five year period showed signs of human interaction (~~15 in 2003,~~ 15 in 2004, 14 in 2005, 8 in 2006, ~~and~~ 21 in 2007, and 10 in 2008), with 21 ~~24~~ having some sign of fishery interaction ~~8 in 2003,~~ 3 in 2004, 0 in 2005, 8 in 2006, ~~and~~ 5 in 2007, and 5 in 2008). An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters in 2003 and continued into 2004. No consistent cause of death could be determined. The UME was declared over in spring 2005 (MMC [Marine Mammal Commission] 2006). NMFS declared another UME in the Gulf of Maine in autumn 2006 based on infectious disease.

Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994-1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population appears to result from a combination of shark-inflicted mortality, on both pups and adult females and inter-specific competition with the much more abundant gray seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

~~Table 3. Harbor seal (*Phoca vitulina*) stranding mortalities along the U.S. Atlantic coast (2003-2007)[a].~~

~~State~~	~~2003[b]~~	~~2004[b]~~	~~2005~~	~~2006[b]~~	~~2007[b]~~	~~Total~~
~~ME~~	~~169~~	~~348~~	~~121~~	~~371~~	~~106~~	~~1115~~
~~NH~~	~~15~~	~~21~~	~~31~~	~~28~~	~~6~~	~~101~~
~~MA~~	~~88~~	~~150~~	~~101~~	~~94~~	~~51~~	~~484~~
~~RI~~	~~8~~	~~11~~	~~3~~	~~6~~	~~8~~	~~36~~
~~CT~~	~~0~~	~~1~~	~~2~~	~~1~~	~~3~~	~~7~~
~~NY~~	~~7~~	~~12~~	~~22~~	~~11~~	~~11~~	~~63~~
~~NJ~~	~~7~~	~~5~~	~~1~~	~~7~~	~~6~~	~~26~~
~~DE~~	~~1~~	~~0~~	~~3~~	~~2~~	~~0~~	~~6~~
~~MD~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~2~~
~~VA~~	~~0~~	~~2~~	~~3~~	~~2~~	~~0~~	~~7~~
~~NC~~	~~8~~	~~2~~	~~8~~	~~4~~	~~0~~	~~22~~
~~FL~~	~~1~~	~~0~~	~~0~~	~~1~~	~~0~~	~~2~~
~~Total~~	~~304~~	~~552~~	~~297~~	~~527~~	~~191~~	~~1871~~
~~Unspecified seals (all states)~~	~~27~~	~~33~~	~~59~~	~~46~~	~~34~~	~~199~~

~~a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Records of live releases and rehabbed animals have been eliminated. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.~~

~~b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004, and again in 2006-2007.~~

Table 3. Harbor seal (*Phoca vitulina concolor*) stranding mortalities along the U.S. Atlantic coast (2004-2008) with subtotals of animals recorded as pups in parentheses.[a]

State	2004[b]	2005	2006[b]	2007[b]	2008	Total
ME	348	121(94)	371 (220)	106 (80)	178 (152)	1124
NH	21	31 (25)	28 (19)	6 (5)	3 (2)	89
MA	150	101(45)	94 (35)	51 (17)	50 (4)	446
RI	11	3	6 (3)	8 (1)	6 (4)	34
CT	1	2 (1)	1 (1)	3	-	7
NY	12	22 (2)	11	11 (7)	5 (1)	61

NJ	5	1 (1)	7	6	7	26
DE	-	3 (1)	2	-	-	5
MD	-	2	-	-	-	2
VA	2	3	2	-	1	8
NC	2	8 (3)	4	-	6 (2)	20
FL	-	-	1	-	-	1
Total	552	297	527	191	256	1823
Unspecified seals (all states)	33	59	46	34	51	223

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Records of live releases and rehabbed animals have been eliminated. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004, and again in 2006-2007.

STATUS OF STOCK

The status of the western North Atlantic harbor seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. Total fishery-related mortality and serious injury for this stock is believed to be low relative to the population size in U.S. waters but cannot ~~not less than 10% of the calculated PBR and, therefore, cannot~~ be considered to be approaching zero mortality and serious injury rate. Although PBR cannot be determined for this stock, the level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is believed to be low relative to the total stock size; therefore, this is not a strategic stock.~~This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.~~

REFERENCES CITED

Baird, R.W. 2001. Status of harbor seals, *Phoca vitulina*, in Canada. Can. Field-Nat. 115: 663-675.

Barlas, M.E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor)* and gray seals (*Halichoerus grypus*) in southern New England, winter 1998-summer 1999. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 52 pp.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Boulva, J. and I.A. McLaren 1979. Biology of the harbor seal, *Phoca vitulina*, in eastern Canada. Bull. Fish. Res. Bd. Can 200: 1-24.

Bowen, W.D., S.L. Ellis, S.J. Iverson and D.J. Boness 2003. Maternal and newborn life-history traits during periods of contrasting population trends: implications for explaining the decline of harbour sels (*Phoca vitulina*), on Sable Island. J. Zool., London 261: 155-163.

Bravington, M.V. and K.D. Bisack 1996. Estimates of harbour porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. Int. Whal. Comm. 46: 567-574.

Cairns, D.K., D.M. Keen, P-Y. Daoust, D.J. Gillis and M. Hammill 2000. Conflicts between seals and fishing gear on Prince Edward Island. Canadian technical report of fisheries and aquatic sciences. 2333. 39 pp.

DFO. 2008. Atlantic Seal Hunt: 2006-2010 management plan. Department of Fisheries and Oceans. Fisheries Resource Management – Atlantic, Ottawa, Ontario, Canada, K1A 0E6 34 pp. Available at: http://www.dfo-mpo.gc.ca/reports-rapports-eng.htm#n1.

deHart, P.A.P. 2002. The distribution and abundance of harbor seals (*Phoca vitulina concolor)* in the Woods Hole region. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 88 pp.

Gilbert, J.R. and N. Guldager 1998. Status of harbor and gray seal populations in northern New England. NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. NMFS/NER Cooperative Agreement 14-16-009-1557. Final Report

Gilbert, J.R. and J.L. Stein 1981. Harbor seal populations and marine mammal fisheries interactions, 1981. NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. Contract NA-80-FA-C-00029.

Annual report 35 pp.
Gilbert, J.R., G.T. Waring, K.M. Wynne and N. Guldager 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Mar. Mamm. Sci. 21: 519-535.
Gilbert, J.R. and K.M. Wynne 1983. Harbor seal populations and marine mammal-fisheries interactions, 1982. NMFS. NA80FAC00029 43 pp.
Gilbert, J.R. and K.M. Wynne 1984. Harbor seal populations and marine mammal fisheries interactions, 1983. NMFS, Northeast Fisheries Science Center, 166 Water St, Woods Hole, MA. Contract NA-80-FA-C-00029. Third annual report 52 pp.
Jacobs, S.R. and J.M. Terhune 2000. Harbor seal (*Phoca vitulina*) numbers along the New Brunswick coast of the Bay of Fundy in autumn in relation to aquaculture. Northeast. Nat. 7(3): 289-296.
Katona, S.K., V. Rough and D.T. Richardson 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316 pp.
Kenney, M.K. 1994. Harbor seal population trends and habitat use in Maine. M.S. thesis. University of Maine, Orono, ME. 55 pp.
Lelli, B., D.E. Harris, and A-M Aboueissa. 2009. Seal bounties in Maine and Massachusetts, 1888 to 1962. Northeast. Nat. 16(2): 239-254.
Mansfield, A.W. 1967. Distribution of the harbor seal, *Phoca vitulina Linnaeus*, in Canadian Arctic waters. J. Mamm. 48(2): 249-257.
MMC [Marine Mammal Commission] 2006. US Marine Mammal Commission Annual Report to Congress, 2005. M. M. Commission. Bethesda, MD Vi+163 pp. http://www.mmc.gov/reports/annual/pdf/2005annualreport.pdf
Payne, P.M. and D.C. Schneider 1984. Yearly changes in abundance of harbor seals, *Phoca vitulina*, at a winter haul-out site in Massachusetts. Fish. Bull. 82: 440-442.
Payne, P.M. and L.A. Selzer 1989. The distribution, abundance and selected prey of the harbor seal, *Phoca vitulina concolor*, in southern New England. Mar. Mamm. Sci. 5(2): 173-192.
Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Pages 133-147 *in*: W. F. Perrin, G. P. Donovan and J. Barlow, (eds.) Gillnets and cetaceans. Reports of the International Whaling Commission. (Special Issue) 15.
Richardson, D.T. 1976. Assessment of harbor and gray seal populations in Maine 1974-1975. Final report to Marine Mammal Commission. Contract No. MM4AC009.
Robillard, A., V. Lesage and M.O. Hammill 2005. Distribution and abundance of harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in the estuary and Gulf of St Lawrence, 1994-2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613: 152.
Rosenfeld, M., M. George and J.M. Terhune 1988. Evidence of autumnal harbour seal, *Phoca vitulina*, movement from Canada to the United States. Can. Field-Nat. 102(3): 527-529.
Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission. Contract T10155615 28 pp.
Schneider, D.C. and P.M. Payne 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. J. Mamm. 64(3): 518-520.
Schroeder, C.L. 2000. Population status and distribution of the harbor seal in Rhode Island waters. M.S. thesis. University of Rhode Island, Kingston, RI. 197 pp.
Stanley, H.F., S. Casey, J.M. Carnahan, S. Goodman, J. Harwood and R.K. Wayne 1996. Worldwide patterns of mitochondrial DNA differentiation in the harbor seal (*Phoca vitulina*). Mol. Biol. Evol. 13: 368-382.
Stobo, W.T. and G.M. Fowler 1994. Aerial surveys of seals in the Bay of Fundy and off southwest Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 1943: 57.
Stobo, W.T. and Z. Lucas 2000. Shark-inflicted mortality on a population of harbour seals (*Phoca vitulina*) at Sable Island, Nova Scotia. J. Zool., London 252: 405-414.
Temte, J.L., M.A. Bigg and O. Wiig 1991. Clines revisited: the timing of pupping in the harbour seal (*Phoca vitulina*). J. Zool., London 224: 617-632.
Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Waring, G.T., J.R. Gilbert, J. Loftin and N. Cabana 2006. Short-term movements of radio-tagged harbor seals in New England. Northeast. Nat. 13(1): 1–14.
Whitman, A.A. and P.M. Payne 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. Can. Field-Nat. 104(4): 579-582.
Williams, A.S. 1999. Prey selection by harbor seals in relation to fish taken by the Gulf of Maine sink gillnet

fishery. M.S. thesis. University of Maine, Orono, ME. 62 pp.
Wilson, S.C. 1978. Social organization and behavior of harbor seals, *Phoca concolor*, in Maine. Marine Mammal Commission, Washington. contract MM6ACO13, GPO-PB-280-188. Final Report

~~January~~March 2010 ~~December 2009~~

GRAY SEAL (*Halichoerus grypus grypus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New York to Labrador (Davies 1957; Mansfield 1966; Katona *et al.* 1993; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the northeastern Atlantic stock (Bonner 1981; Boskovic *et al.* 1996; Lesage and Hammill 2001). There are two breeding concentrations in eastern Canada; one at Sable Island, and one that breeds on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990) and, for management purposes, they are treated by the Canadian DFO as separate stocks (Mohn and Bowen 1996). In the mid 1980s, small numbers of animals and pupping were observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al.* 1993; J. R. Gilbert, pers. comm., University of Maine, Orono, ME; Rough 1995). In the late 1990's, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (D. Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and adjacent sites in Nantucket Sound, and Green and Seal Islands off the coast of Maine (Wood *et al.* 2007)

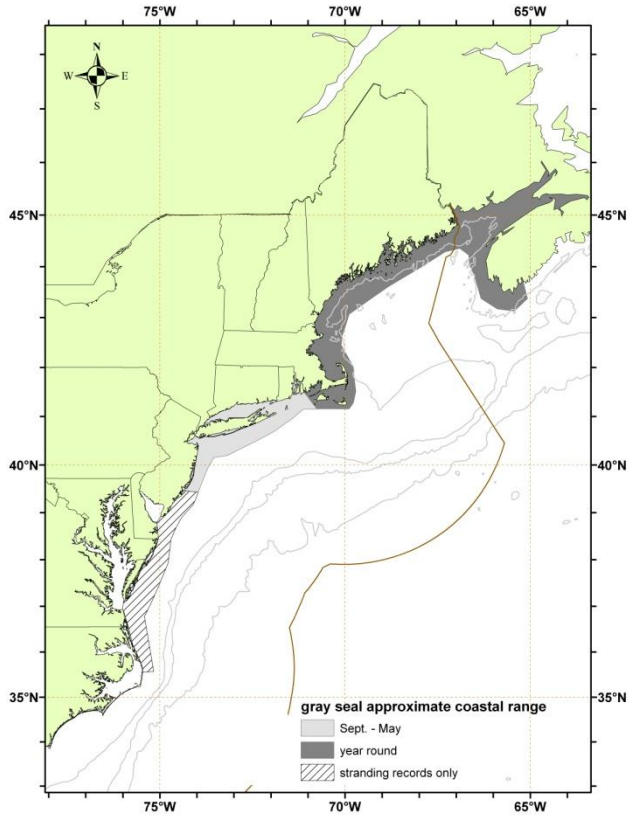

Figure 1. Approximate coastal range of gray seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although estimates of portions of the stock are available for select time periods. The size of the Canadian population from 1993 to 2004 has been estimated from three –surveys. A 1993 survey estimated the population at 144,000 animals (Mohn and Bowen 1996; DFO 2003) a 1997 survey estimated 195,000 (DFO 2003), and a 2004 survey obtained estimates ranging between 208,720 (SE=29,730) and 223,220 (SE=17,376) depending upon the model used (Trzcinski *et al.* 2005). The population at Sable Island had been increasing by approximately 13% per year for nearly 40 years (Bowen *et al.* 2003), but the most recent (2004) survey results indicate this population increase has declined to 7% (Trzcinski *et al.* 2005; Bowen *et al.* 2007). The non-Sable Island (Gulf of St Lawrence and Eastern Shore) abundance has increased from 20,900 (SE=200) in 1970 to 52,500 (SE=7,800) in 2004 (Hammill 2005). ~~The population in US waters is also increasing. Maine coast-wide surveys conducted during summer (all other surveys were conducted January-May) revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005).~~ In U.S. waters, gray seals currently pup at three established colonies: Muskeget Island, MA, Green Island, ME, and Seal Island, ME. They have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid

1990's. Aerial survey data of these sites indicate that pup production is increasing. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) was born in the U.S. in 2008 (Wood LaFond 2009). Table 2 summarizes singe day pup counts from the three U.S. pupping colonies from 2001/2002 to 2007/2008 pupping period. The decrease in pup counts in some years is an artifact of survey date and not indicative of true declines in those years. In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island (MA) and Noman's Land (MA). Some of the local breeders have been observed with brands and tags indicating they had been born on Sable Island, Canada (Rough 1995). The increase in the number of gray seals observed in the U.S. is probably due to both natural increase and immigration.

Gray seals are also observed in New England outside of the pupping season. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). Maine coast-wide surveys conducted during summer revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005). ~~In 2002, the maximum counts of two breeding colonies in Maine, with number of pups in parentheses, were 193 (9) on Seal Island and 74 (31) on Green Island (S. Wood, pers. comm., University of Massachusetts, Boston, MA). Gray seal numbers are increasing in coastal waters between southern Massachusetts and eastern Long Island. Pup counts on Muskeget have increased from 0 in 1989 to 1,023 in 2002 (Rough 1995, S. Wood, pers. comm.). Gray seal numbers increase in this region in the spring (April May) when molting occurs. In April May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995).~~ In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999). No gray seals were recorded at haul out sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently several hundred ~~small numbers of~~ gray seals have been recorded in surveys conducted ~~in~~ off eastern Long Island ~~this region (deHart 2002;~~ (R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY). ~~Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).~~

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	Nbest	CV
~~May 2001[a]~~	~~Maine coast~~	~~1,731~~	~~NA~~
January 2004~~[b]~~[a]	Gulf of St Lawrence + Nova Scotia Eastern Shore	52,500	0.15
January 2004~~[b]~~[a]	Sable Island	208,720 216,490223,220	0.14 0.11 0.08

~~[a] These counts pertain to animals seen in U.S. waters, and the stock relationship to animals in Canadian waters is unknown.~~

~~[b]~~[a]These are model based estimates derived from pup surveys.

Table 2. The number of pups observed on Muskeget, Seal and Green Islands 2002-2008. Data are from aerial surveys. These are single day counts, not an estimate of total pup production. (Wood LaFond 2009)

Pupping Season	Muskeget Island	Seal Island	Green Island
2001-2	883	No data	34
2002-3	509	147	No data
2003-4	824	150	26
2004-5	992	365	33
2005-6	868	239	43
2006-7	1704	364	57
2007-8	2095	466	59

Minimum Population Estimate

Depending on the model used, the N_{min} for the Canadian gray seal population was estimated to range between 125,541 and 169,064 (Trzcinski et al. 2005) Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950s the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades. Pup production on Sable Island, Nova Scotia, has increased exponentially at a rate of 12.8% annually for more than 40 years (Stobo and Zwanenburg 1990; Mohn and Bowen 1996; Bowen *et al.* 2003; Trzcinski *et al.* 2005; Bowen *et al.* 2007), but has declined to 7% in 2004 (Trzcinski *et al.* 2005; Bowen *et al.* 2007). The non Sable Island population increased from 6,900 in the mid-1980s to a peak of 11,100 (SE=1,300) animals in 1996 (Hammill and Gosselin 2005). Pup production declined to 6,100 (SE=900) in 2000, then increased to 15,900 (SE=1,200) in 2004 (Hammill and Gosselin 2005). Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Surveys of ~~W~~winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980's as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994 (Rough 1995). In January 2002, ~~between 900 and 1,000~~ 883 pups were counted on Muskeget Island and surrounding shoals (~~S.~~ Wood Lafond 200~~, pers. comm9.~~). In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island and Nomans Land. These observations continue the increasing trend in pup production reported by Rough (1995). The change in gray seal counts at Muskeget and Monomoy from 2,010 in spring 1994 to 5,611 in spring 1999 represents an annual increase rate of 20.5%, however, it has not been determined what proportion of the increase represents growth or immigration. For example, a few gray seals branded as pups on Sable Island in the 1970s (Stobo and Zwanenburg 1990) are typically sighted in the Cape Cod region during winter.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. A recent study estimated the current annual rate of increase at 7% on Sable Island (Trzcinski *et al.* 2005; Bowen *et al.* 2007), which represents a 45% decline from previous estimates (Mohn and Bowen 1996; Bowen *et al.* 2003). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery

factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but is known to be increasing. PBR for the western North Atlantic gray seals in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2004-2008~~2003-2007~~, the total estimated human caused mortality and serious injury to gray seals was 1,139~~1,160.4~~ per year. The average was derived from three components: 1) 585~~503(CV=0.16)~~ (0.15) (Table ~~2~~3) from the 2004-2008~~2003-2007~~ U.S. observed fishery; 2) ~~2.4~~ 4.8 from average 2004-2008 ~~2003-2007~~ non-fishery related, human interaction stranding mortalities (NMFS unpublished data); and 3) ~~655~~ 549 from average 2004-2008~~2003-2007~~ kill in the Canadian hunt.

Fishery Information

Detailed fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet

Annual estimates of gray seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were 216~~185~~ gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and 2008~~2007~~. Estimated annual mortalities (CV in parentheses) from this fishery were 0 in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), 131 in 1997 (0.50),61 in 1998 (0.98), 155 in 1999 (0.51), 193 in 2000 (0.55), 117 in 2001 (0.59), 0 in 2002, 242 (0.47) in 2003, 504 (0.34) in 2004, 574 (0.44) in 2005, 314 (0.22) in 2006, ~~and~~ 886 (0.24) in 2007, and 6~~43~~18 (0.23) in 200~~7~~8 (Table ~~2~~3). There were 2, 9, 14, 8, ~~and~~ 14, and 6 unidentified seals observed during 2004-2008~~2003-2007~~, respectively. Since 1997 unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2004-2008~~2003-2007~~ was 5~~71~~66~~490~~ gray seals (CV= 0.15~~0.16~~) (Table 3~~2~~). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

No gray seals were taken in observed trips during 1998-2000, 2003, or 2006-2008~~, and 2007~~. One gray seal was observed taken in both 2001and 2004 (Table ~~2~~3). In 2001 the gray seal was taken in April off the coast of New Jersey near Hudson Canyon in 81 m of water. The 2004 take was off Virginia in April. Observed effort was scattered between New Jersey and North Carolina from 1 to 90 km off the beach. In 2002, 65% of sampling was concentrated in one area and not distributed proportionally across the fishery. Therefore, observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2004-2008~~2003-2007~~ was 14~~13~~ gray seals (CV= 0.92~~0.92~~) (Table ~~2~~3).

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003, and was not observed in 2006. No mortalities have been observed, but 15 gray seals were captured and released alive in 2004, 19 in 2005, ~~and~~ 0 in 2007, and 6 in 2008. In addition, 5 seals of unknown species were captured and released alive in 2004, ~~,~~ 2 in 2005, ~~and~~ 1 in 2007, and none in 2008.

Northeast Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management, rather than marine mammal management needs. No mortalities were observed prior to 2005, when four mortalities were attributed to this fishery. No mortalities were observed in 2006. The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004, and for 2006. Nine gray seal mortalities were attributed to this fishery in 2007, and 4 in 2008. Estimates have not been generated for 2005, ~~or~~ 2007 or 2008.

CANADA

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the

1970's and early 1980's on Sable Island (Anonymous 1986).

In 1996, observers recorded 3 gray seals (1 released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens 1997). Seal bycatch occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

~~Table 2. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).~~

~~Fishery~~	~~Years~~	~~Vessels~~	~~Data Type~~ ~~a~~	~~Observer Coverage~~ ~~b~~	~~Observed Mortality~~	~~Estimated Mortality~~	~~Estimated CVs~~	~~Mean Annual Mortality~~
~~Northeast Sink Gillnet~~ ~~e~~	~~03-07~~	~~unk~~	~~Obs. Data, Weighout, Logbooks~~	~~.03, .06, .07, .04, .07~~	~~5, 21, 33, 9, 80~~	~~0, 242, 504, 574, 248, 886~~	~~.47, .34, .44, .47, .24~~	~~490 (0.16)~~
~~Mid-Atlantic Gillnet~~	~~03-07~~	~~unk~~	~~Obs. Data, Weighout~~	~~.01, .02, .03, .04, .05~~	~~0, 1, 0, 0, 0~~	~~0, 69, 0, 0, 0~~	~~0, .92, 0, 0, 0~~	~~13 (0.92)~~
~~Northeast Bottom Trawl~~	~~03-06~~	~~unk~~	~~Obs. Data, Weighout~~	~~.04, .05, .12, .06, .06~~	~~0, 0, 4, 0, 9~~	~~0, 0, 0, unk~~ ~~f~~ ~~, unk~~ ~~f~~	~~0, 0, 0, unk~~ ~~f~~ ~~, unk~~ ~~f~~	~~unk~~ ~~d~~
~~TOTAL~~								~~503 (0.16)~~

~~a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.~~

~~b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed.~~

~~e. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In 2003 - 2007, respectively, 1, 1, 1, , 1 and 8 takes were observed in nets with pingers. In 2003 – 2007, respectively, 0, 4, 20, 32, 8, and 72 takes were observed in nets without pingers.~~

~~d. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated.~~

Table 3. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality

Northeast Sink Gillnet[c]	04-08	Obs. Data, Weighout, Logbooks	.06, .07, .04, .07, .05	21, 33, 9, 80, 31	504, 574, 248, 886, 64~~3~~18	.34, .44, .47, .24, .23	5~~71~~66 (0.15)
Mid-Atlantic Gillnet	04-08	Obs. Data, Weighout	.02, .03, .04, .05, .03	1, 0, 0, 0, 0	69, 0, 0, 0, 0	.92, 0, 0, 0, 0	14 (0.92)
Northeast Bottom Trawl	04-08	Obs. Data, Weighout	.05, .12, .06, .06, .08	0, 4, 0, 9, 4	0, 0, unk[d], unk[d], unk[d]	0, 0, unk[d], unk[d], unk[d]	unk[d]
TOTAL							58~~5~~0 (0.15)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed.

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2004 - 2008, respectively, 1, 1, 1 8, and 4 takes were observed in nets with pingers. In 2004 – 2008, respectively, 4, 20, 32, 8, 72, and 27 takes were observed in nets without pingers.

d. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated.

Other Mortality

Canada: In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Laviguer and Hammill 1993). Between 1999 and 200~~7~~8 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76), 2002 (126), 2003 (6), 2004 (0), 2005 (579), 2006 (1,804) ~~and~~ 2007 (887), ~~and~~ 2008 (1,472), and 259 (2009). (DFO 2003; 2008; 2009; M. Hammill pers. comm.). The traditional hunt of a few hundred animals is expected to continue off the Magdalen Islands and in other areas, except Sable Island where commercial hunting is not permitted (DFO 2003). DFO established a 2008 total allowable catch (TAC) ~~n annual (2006-2010) TAC~~ of 12,000: ~~2,100 gray seals in the Gulf of St. Lawrence, and 8,300 on the Scotian Shelf.~~ 2,000 in the Gulf and 10,000 on the Scotian Shelf. Since 2007, a small commercial hunt has taken place on Hay Island in Nova Scotia (http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/faq-eng.htm)~~–~~. The hunting of gr~~e~~ay seals will continue to be prohibited on Sable Island (http://www.dfo-mpo.gc.ca/seal-phoque/index_e.htm).

Canada also issues personal hunting licenses which allow the holder to take six gray seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

U.S: Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s (Katona, *et al.* 1993; Lelli, *et al.* 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli, *et al.* 2009). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented gray seals entangled in netting or plastic debris around the Cape Cod/Nantucket area, and in recent years have made successful disentanglement attempts.

From 2004-2008 305 ~~2003-2007, 305~~ gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table ~~3~~4; NMFS unpublished data). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Fifty-three ~~Thirty-nine (12.8%)~~ (17.4%) of the total stranding mortalities showed signs of human interaction (~~7 in 2003,~~ 16 in 2004, 3 in 2005, and 5 in 2006, ~~and~~ 8 in 2007, and 21 in 2008), with 29 ~~27~~ having some indication of fishery interaction (~~5 in 2003,~~ 11 in 2004, 1 in 2005, 5 in 2006, ~~and~~ 5 in 2007, and 7 in 2008).

~~Table 3. Gray seal (*Halichoerus grypus*) stranding mortalities along the U.S. Atlantic coast (2003-2007)[a].~~

~~State~~	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~Total~~
~~ME~~	~~2~~	~~3~~	~~4~~	~~3~~	~~5~~	~~17~~
~~NH~~	~~1~~	~~-~~	~~-~~	~~-~~	~~1~~	~~2~~
~~MA~~	~~58~~	~~33~~	~~26~~	~~29~~	~~50~~	~~196~~
~~RI~~	~~6~~	~~8~~	~~2~~	~~2~~	~~5~~	~~23~~
~~CT~~	~~-~~	~~2~~	~~-~~	~~-~~	~~-~~	~~2~~
~~NY~~	~~5~~	~~2~~	~~7~~	~~6~~	~~21~~	~~41~~
~~NJ~~	~~2~~	~~-~~	~~2~~	~~1~~	~~5~~	~~10~~
~~DE~~	~~-~~	~~1~~	~~-~~	~~-~~		~~1~~
~~MD~~	~~-~~	~~1~~	~~3~~	~~-~~	~~1~~	~~5~~
~~VA~~	~~1~~	~~2~~	~~1~~	~~-~~	~~1~~	~~5~~
~~NC~~	~~-~~	~~-~~	~~-~~	~~2~~	~~1~~	~~3~~
~~Total~~	~~75~~	~~52~~	~~45~~	~~43~~	~~90~~	~~305~~
~~Unspecified seals (all states)~~	~~27~~	~~33~~	~~59~~	~~46~~	~~34~~	~~199~~

~~a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.~~

Table 4. Gray seal (*Halichoerus grypus*) stranding mortalities [a] along the U.S. Atlantic coast (2004-2008) with subtotals of animals recorded as pups in parentheses.

State	2004	2005	2006	2007	2008	Total
ME	3 (2)	4 (1)	3	5 (1)	6 (1)	21
NH	-	-	-	1 (1)	-	1
MA	33 (7)	26 (6)	29 (5)	50 (9)	53 (4)	191
RI	8 (3)	2 (1)	2 (2)	5 (1)	7	24
CT	2 (1)	-	-	-	-	2
NY	2 (1)	7	6 (4)	21 (17)	2 (2)	38
NJ	-	2 (2)	1 (1)	5 (2)	3	11
DE	1	-	-		1 (1)	2
MD	1 (1)	3 (2)	-	1	1	6
VA	2	1	-	1	1	5
NC	-	-	2	1 (1)	1 (1)	4
Total	52 (15)	45 (12)	43 (12)	90 (32)	75 (9)	305 (80)
Unspecified seals (all states)	33	59	46	34	51	223

a. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.

STATUS OF STOCK

The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. The species is not listed as threatened or

endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is low relative to the stock size in Canadian and U.S. waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES CITED

Anonymous 1986. Seals and sealing in Canada. Rep. of the Royal Commission on Seals and Sealing, Vol. 1. Canadian Government Publishing Centre, Ottawa, Ontario, Canada, 65 pp.

Barlas, M.E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor)* and gray seals (*Halichoerus grypus*) in southern New England, winter 1998-summer 1999. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 52 pp.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Bonner, W.N. 1981. Grey seal *Halichoerus grypus Fabricus*, 1791. Pages 111-144 *in*: S. H. Ridgway and R. J. Harrison, (eds.) Handbook of marine mammals, Vol. 2: Seals. Academic Press, London.

Boskovic, R., K.M. Kovacs, M.O. Hammill and B.N. White. 1996. Geographic distribution of mitochondrial DNA haplotypes in grey seals (*Halichoerus grypus*). Can. J. Zool. 74: 1787-1796.

Bowen, W.D., J. McMillan and R. Mohn. 2003. Sustained exponential population growth of grey seals at Sable Island, Nova Scotia. ICES J. Mar. Sci. 60: 1265-1274.

Bowen, W.D., J.I. McMillan and W. Blanchard. 2007. Reduced population growth of gray seals at Sable Island: Evidence from pup production and age of primiparity. Mar. Mamm. Sci. 23: 48-64.

Bravington, M.V. and K.D. Bisack. 1996. Estimates of harbour porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. Int. Whal. Comm. 46: 567-574.

Davies, J.L. 1957. The geography of the gray seal. J. Mamm. 38: 297-310.

deHart, P.A.P. 2002. The distribution and abundance of harbor seals (*Phoca vitulina concolor)* in the Woods Hole region. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 88 pp.

DFO. 2003. Atlantic Seal Hunt: 2003-2005 management plan. Department of Fisheries and Oceans. Fisheries Resource Management – Atlantic, Ottawa, Ontario, Canada, K1A 0E6 34 pp.

DFO. 2008. —Atlantic Seal Hunt: 2006-2010 management plan. Department of Fisheries and Oceans. Fisheries Resource Management – Atlantic, Ottawa, Ontario, Canada, K1A 0E6 34 pp. ~~accessed on 17 November, 2008, from~~ Available at: http://www.dfo-mpo.gc.ca/seal-phoque/faq_e.htm#2.

DFO, 2009. Frequently asked questions about Canada's seal hunt. Department of Fisheries and Oceans. Available at: http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/faq-eng.htm

Gilbert, J.R., G.T. Waring, K.M. Wynne and N. Guldager. 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Mar. Mamm. Sci. 21: 519-535.

Hammill, M.O. 2005. Abundance of Northwest Atlantic grey seals in the Gulf of St. Lawrence and along the Nova Scotia Eastern Shore. Canadian Department of Fisheries and Oceans. Ottawa, Ontario. DFO– Research Document 2005/036. 11 pp.
http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_036_e.

Hammill, M.O. and J.F. Gosselin. 2005. Pup production of non-Sable Island grey seals in 2004. Canadian Department of Fisheries and Oceans. Ottawa, Ontario. DFO Research Document 2005/036. 20 pp. http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_033_e.htm

Katona, S.K., V. Rough and D.T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316 pp.

Laviguer, L. and M.O. Hammill. –1993. Distribution and seasonal movements of grey seals, *Halichoerus grypus*, born in the Gulf of St. Lawrence and eastern Nova Scotia shore. Can. Field-Nat. 107: 329-340.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES [Int. Counc. Explor. Sea] C.M. 1997/Q:08:-10.

Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, *Halichoerus grypus*, in the Northwest Atlantic. Can. Field-Nat. 115(4): 653-662.

Lelli, B., D.E. Harris, and A-M Aboueissa. 2009. Seal bounties in Maine and Massachusetts, 1888 to 1962. Northeast. Nat. 16(2): 239-254.

Mansfield, A.W. 1966. The grey seal in eastern Canadian waters. Can. Audubon Mag. 28: 161-166.

Mohn, R. and W.D. Bowen. 1996. Grey seal predation on the eastern Scotian Shelf: Modeling the impact on Atlantic cod. Can. J. Fish. Aquat. Sci 53: 2722-2738.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Pages 133-147 *in*: W. F. Perrin, G. P. Donovan and J. Barlow, (eds.) –Gillnets and cetaceans. Reports of the International Whaling Commission. (Special Issue) 15.

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission. Contract T10155615 28 pp.

Stobo, W.T. and K.C.T. Zwanenburg. 1990. Grey seal (*Halichoerus grypus*) pup production on Sable Island and estimates of recent production in the northwest Atlantic. Pages 171-184 *in*: W. D. Bowen, (ed.) Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. and Aq. Sci. 222.

Trzcinski, M.K., R. Mohn and W.D. Bowen. 2005. Estimation of grey seal population size and trends at Sable Island. Canadian Department of Fisheries and Oceans. Ottowa, Ontario. DFO Research Document 2005/067. 10 pp. http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_067_e.htm

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Wood LaFond, S. 2009. Dynamics of Recolonization: a Study of the Gray Seal (*Halichoerus grypus*) in the Northeast U.S. Ph.D. Dissertation. University of Massachusetts, Boston. 83 p.

Wood, S.A., S. Brault and J.R. Gilbert. 2007. 2002 Aerial survey of grey seals in the Northeastern United States. Pages 117-121 *in*: T. Haug, M. Hammill and D. Ólafsdóttir, (eds.) –Grey seals in the North Atlantic and Baltic. NAMMCO Sci. Pub. 6, Tromsø, Norway.

Zwanenberg, K.C.T. and W.D. Bowen. – 1990. Population trends of the grey seal (*Halichoerus grypus*) in eastern Canada. Pages 185-197 *in*: W. D. Bowen, (ed.) –Population biology of sealworm (Pseudoterranova decipiens) in relation to its intermediate and seal hosts. Can. Bull. Fish. and Aq. Sci. 222.

~~January~~March 2010~~December 2009~~

HARP SEAL (*Pagophilus groenlandicus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988). The world's harp seal population is divided into three separate stocks, each identified with a specific pupping site on the pack ice (Lavigne and Kovacs 1988; Bonner 1990). The largest stock is located off eastern Canada and is divided into two breeding herds. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988), and the third stock breeds on the ice in the White Sea off the coast of Russia. The Front/Gulf stock is equivalent to western North Atlantic stock.

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western North Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring.

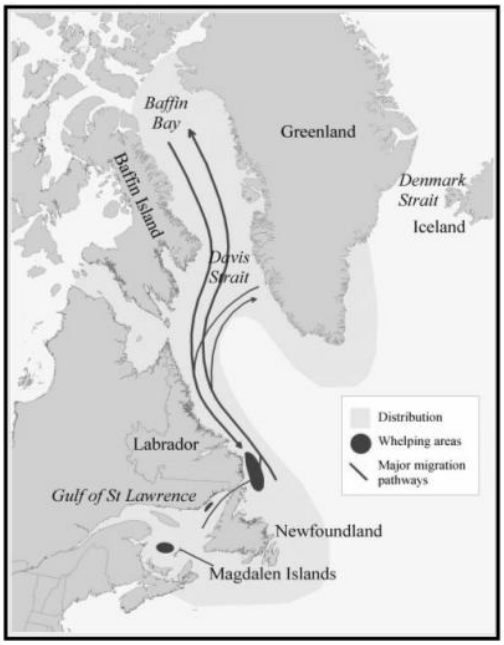

Figure 1: From: *Technical Briefing on the Harp Seal Hunt in Atlantic Canada*
http://www.dfo-mpo.gc.ca/misc/seal_briefing_e.htm

Since the early 1990s, ~~In recent years,~~ numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al.* 1993; Rubinstein 1994; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000). These extralimital appearances usually occur in January-May (Harris *et al.* 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000).

POPULATION SIZE

Abundance estimates for the western North Atlantic stock are available which use a variety of methods including aerial surveys and mark-recapture (Table 1). These methods involve surveying the whelping concentrations and estimating total population adult numbers from pup production. Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total abundance. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). This model has subsequently been updated in Shelton *et al.* (1992), Stenson (1993), Shelton *et al.* (1996), and Warren *et al.* (1997). The revised 2000 population estimate was 5.5 million ~~seals~~ (95% CI= 4.5-6.4 million) harp seals. (Healey and Stenson 2000). The estimate based on the 2004 survey was calculated at 5.82 million (95% CI=4.1-7.6 million;

Hammill and Stenson 2005) but has been subsequently revised to 5.5 million (95% CI=3.8 - 7.1 million; Table 1; DFO 2007). The 2008 and 2009 estimates, respectively, based on the 2008 survey of the Gulf and Front were 6.5 million (95% CI=5.7 to 7.3 million) and 6.9 million (95% CI=6.0 to 7.7 million; Table 1; DFO 2010).

Table 1. Summary of abundance estimates for western North Atlantic harp seals. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and confidence interval (CI).

Month/Year	Area	N_{best}	CI
2004	Front and Gulf	5.5 million	(95% CI 3.8-7.1 million)
2008	Front and Gulf	6.5 million	(95% CI 5.7-7.3 million)
2009	Front and Gulf	6.9 million	(95% CI 6.0-7.7 million)

Minimum population estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for western North Atlantic harp seals is 6.9 million (95% CI 6.0-7.7 million; DFO 2010)~~5.5 million (SE = 856,645; DFO 2007)~~. The minimum population estimate based on the ~~2004~~ 2008 pup survey results is 6.5 million (CV=0.06) ~~288,000~~ seals. Data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

Harp seal pup production in the 1950s was estimated at 645,000, but had decreased to 225,000 by 1970 (Sergeant 1975). Estimated number then began to increase and have continued to increase through the late 1990s, reaching 478,000 in 1979 (Bowen and Sergeant 1983; 1985), 577,900 (CV=0.07) in 1990 (Stenson *et al.* 1993), 708,400 (CV=0.10) in 1994 (Stenson *et al.* 2002), and 998,000 (CV=0.10) in 1999 (Stenson *et al.* 2003). The 2004 estimate of 991,000 pups (CV=0.06) was not significantly different from the 1999 estimate, which ~~suggests~~ suggested that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al.* 2005). The 2008 estimated of 1,076,600 pups (CV=0.06) is based on the visual aerial survey counts (DFO 2010).

The population appears to be increasing in U.S. waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown~~. In Canada the 2004 pup production estimate suggests that the increase in pup production observed throughout the 1990s has likely stopped (Stenson *et al.* 2005).~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size in U.S. waters is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic harp seal in U.S. waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of ~~321,000~~289,220 harp seals. ~~However, Johnston *et al.* (2000) suggests that catch statistics from the Canadian hunt are negatively biased due to under reporting. Because of this, and because of biases in the current abundance estimate, a more conservative F_R of 0.5 may be appropriate. Using the lower F_R results in a "PBR" of 160,000 harp seals. The Canadian model predicts~~

~~replacement yields between 522,000 and 541,000 (Healey and Stenson 2000).~~ However, the PBR for the stock in US waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2004-2008~~2003-2007~~ the total estimated annual human caused mortality and serious injury to harp seals was 500,272~~20433,221~~. This is derived from two components: 1) an average catch of 500,075~~433,221~~ seals from 2004-2008~~2003-2007~~ by Canada (Table 2a); and 2) 197~~5111~~ harp seals (CV=0.20~~0.20~~) from the observed U.S. fisheries (Table 2b. Harp seal harvests are summarized in the table below.

~~Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year.~~

~~Fishery~~	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~Average~~
~~Commercial catches[a]~~	~~289,512~~	~~365,971~~	~~323,826~~	~~354,867~~	~~224,745~~	~~217850 311,881~~
~~Commercial catch struck and lost[b]~~	~~24,084~~	~~31,026~~	~~21,495~~	~~26,674~~	~~14,914~~	~~24,745~~
~~Greenland subsistence catch[c]~~	~~66,149~~	~~70,586~~	~~91,696~~	~~92,210~~	~~82778~~81,447	~~80648~~78,137
~~Canadian Arctic[d]~~	~~1,000~~	~~-~~	~~-~~	~~-~~	~~-~~	~~1000 1,000~~
~~Greenland and Canadian Arctic struck and lost[e]~~	~~67,149~~	~~70,586~~	~~91,696~~	~~92,210~~	~~81,447~~	~~78,470~~
~~Newfoundland lumpfish[f]~~	~~5,367~~	~~12,290~~	~~12,290~~	~~12,290~~	~~12,290~~	~~12290 10,643~~
~~Total~~	~~453,261~~	~~550,458~~	~~541,002~~	~~578,251~~	~~414,842~~	~~504,209~~

~~a. Hammill and Stenson 2003, DFO 2003, DFO 2005; Stenson 2005, Stenson 2008~~

~~b. Struck and lost is calculated for the commercial harvest assuming that the rate is 5% for young of the year, and 50% for animals one year of age and older (DFO 2001, Stenson unpublished data).~~

~~c. ICES 2003, DFO 2005; Stenson unpublished data; 2002-2004 average used for 2005.~~

~~d. Hammill and Stenson 2003; Stenson unpublished data;~~

~~e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data); 2002-2004 average used for 2005.~~

~~f. DFO 2005; Stenson unpublished data; 2001-2004 average used for 2005.~~

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Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year.

Fishery	**2004**	**2005**	**2006**	**2007**	**2008**	**Average**
Commercial catches[a]	365,971	323,826	354,867	224,745	217,850	**297,452**
Commercial catch struck and lost[b]	31,026	21,495	26,674	14,914	11,724	**21,167**
Greenland subsistence catch[c]	70,586	91,696	92,210	82,778	80,648	**83,583**
Canadian Arctic[d]	1,000	1,000	1,000	1,000	1,000	**1,000**
Greenland and Canadian Arctic struck and lost[e]	71,586	92,696	93,210	83,778	81,648	**84,583**
Newfoundland lumpfish[f]	12,290	12,290	12,290	12,290	12,290	**12,290**
Total	**552,458**	**543,002**	**580,251**	**419,505**	**405,160**	**500,075**

a. Hammill and Stenson 2003, DFO 2003, DFO 2005; Stenson unpublished data

b. Struck and lost is calculated for the commercial harvest assuming that the rate is 5% for young of the year, and 50% for animals one year of age and older (DFO 2001, Stenson unpublished data).

c. ICES 2003, DFO 2005; Stenson unpublished data; 2002-2004 average used for 2005.

d. Hammill and Stenson 2003; Stenson unpublished data;~~2002-2004 average for Yr - Yr - check papers for years~~

e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data); 2002-2004 average used for 2005.

f. DFO 2005; Stenson unpublished data; 2001-2004 average used for 2005.

Fishery Information

U.S.

Detailed fishery information is reported in the Appendix III.

Northeast Sink Gillnet:

Annual estimates of harp seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were 168 154 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2008 2007. The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. In addition, bycatch was also observed in shelf and shelf-edge waters southwest of Cape Cod. One observed winter mortality was in waters south of Cape Cod. The stratification design used for this species is the same as that for harbor porpoise (Bravington and Bisack 1996). Estimated annual mortalities (CV in parentheses) from this fishery were: 81 (0.78) in 1999, 24 (1.57) in 2000, 26 (1.04) in 2001, 0 during 2002-2003, 303 (0.30) in 2004, 35 (0.68) in 2005, 65 (0.66) in 2006, and 119 (0.35) in 2007, and 25 0 38 (0.37 8) in 2008 (Table 2b). There were also 2, 9, 14, 8, and 18, and 6 unidentified seals observed during 2004 2003 through 2008 2007 respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2004-2008 2003-2007 was 154 2 104 harp seals (CV= 0.19 0.21) (Table 2b).

Mid-Atlantic Gillnet:

No harp seals were taken in observed trips during 1993-1997, and or 1999-2006. One harp seal was observed taken in both 1998, and and one in 2007, and four were taken in 2008. Observed effort from 1993 to 2008 2007 was scattered between New York and North Carolina from 1 to 9 km off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997, 17 in 1998 (1.02), 0 in 1999-2006 and 38 in 2007, and 176 (0.74) in 2008. In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality attributable to this fishery during 2004-2008 2003-2007 was 43 7 harp seals (CV=).63 0.90) (Table 2b).

Northeast Bottom Trawl

Three mortalities were observed in the Northeast bottom trawl fishery between 2002 and 2008 2007. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 between 1991 and 2000, 49 (CV=1.10) in 2001, and 0 in 2002 - 2004, - and 0 in and 2006 - - 2007 2008. Estimates have not been generated for 2005.

Table 2b. Summary of the incidental mortality of harp seal (*Pagophilus groenlandicus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality [c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality

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~~Northeast Sink Gill net~~	~~03-07~~	~~unk~~	~~Obs. Data, Trip Logbook, Allocated Dealer Data~~	~~.06, .07, .04, .07~~	~~0, 15, 3, 3, 11~~	~~0, 303, 35, 65, 119~~	~~0, .30, .68, .66, .35~~	~~104 (0.21)~~
~~Mid-Atlantic Gill net~~	~~03-07~~							

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~~Northeast Bottom Trawl~~	~~03-07~~	~~unk~~						
~~TOTAL~~								~~111 (0.20)~~

~~a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout) and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.~~

~~b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic coastal sink gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl fishery coverages are ratios based on trips.~~

~~c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2000 - 2007, respectively, 2, 1, 0, 0, 4, 0, 3, and 0 takes were observed in nets with pingers. In 2000 - 2007, respectively, 1, 0, 0, 0, 11, 3, 0, and 12 takes were observed in nets without pingers.~~

~~d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.~~

Table 2b. Summary of the incidental mortality of harp seal (Pagophilus groenlandicus) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	04-08	Obs. Data, Trip Logbook, Allocated Dealer Data	.06, .07, .04, .07, .05	15, 3, 3, 11, 14	303, 35, 65, 119, 238	.30, .68, .66, .35, .38	152 (0.19)

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Mid-Atlantic Gillnet	04-08	Obs. Data, Trip Logbook, Allocated Dealer Data	.02, .03, .04, .05, .03	0, 0, 0, 1, 4	0, 0, 0, 38, 176	0, 0, 0, 0.9, .74	43 (0.63)
Northeast Bottom Trawl	04-08	Obs. Data Weighout	.05, .12, .06, .06, .08	0, 3, 0, 0, 0	0, unk, 0, 0	0, unk, 0, 0, 0	unk
TOTAL							195 (0.20)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout) and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.
b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic coastal sink gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl fishery coverages are ratios based on trips.
c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2000-2008, respectively, 2, 1, 0, 0, 4, 0, 3, 0, and 3 takes were observed in nets with pingers. In 2000-2008, respectively, 1, 0, 0, 0, 11, 3, 0, 12, and 15 takes were observed in nets without pingers.
d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.

Other Mortality

Field Code Changed

Canada: Harp seals have been commercially hunted since the mid-1800s in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at 186,000 seals and remained at this level through 1995 (Stenson 1993; ICES 1998). The TAC was increased to 250,000 and 275,000, respectively, in 1996 and 1997 (ICES 1998). The 1997 TAC remained in effect through 2002. In 2003, a three-year TAC was set at 975,000 with a maximum of 350,000 allowed in the first ~~tow~~ two years (ICES 2008). As a result of catches in the first two years the 2005 TAC was set at 319,517 (ICES 2008). The 2006 TAC was increased to 335,000 (325,000 commercial hunt, 6,000 Aboriginal initiative, and 2,000 allocation each for personal use and Arctic catches). The TAC was reduced to 270,000 in 2007 (263,140 commercial hunt, 4,860 for Aboriginal, and 2,000 for personal use) (ICES 2008). In 2008 the TAC was increased to 275,000 (268,050 commercial hunt, 4,950 for Aboriginal, and 2,000 for personal use). ~~).~~

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U.S.: From 2004 to 2008~~2003 to 2007~~, 541~~469~~ harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). Eighteen~~Seventeen (3.6%)~~ (3.3%) of the mortalities during this five-year period showed signs of human interaction (~~2 in 2003,~~ 2 in 2004, 5 in 2005, 2 in 2006, ~~and~~ 6 in 2007, and 3 in 2008), with ~~2~~3 having some sign of fishery interaction (1each in 2005, 2007 and 2008) ~~and 1 in 2007~~). However, the cause of death of stranded animals is not being evaluated (interactions may be non-fatal or even post-mortem) and is not included in annual human-induced mortality estimates. Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal strandings in the Gulf of Maine is consistent with the species' seasonal migratory patterns in this region.

~~Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities along the U.S. Atlantic coast (2003-2007)[a].~~

~~State~~	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~Total~~
~~ME~~	~~7~~	~~30~~	~~10~~	~~14~~	~~8~~	~~69~~
~~NH~~	~~-~~	~~-~~	~~2~~	~~-~~	~~1~~	~~3~~
~~MA~~	~~23~~	~~85~~	~~44~~	~~24~~	~~51~~	~~227~~

RI	3	7	9	6	2	27
CT	0	2	3	4	1	10
NY	5	20	41	15	19	100
NJ	-	6	12	3	3	24
DE	1	0	2	-	2	5
MD	-	-	2	-	4	6
VA	-	1	4	-	5	10
NC	-	-	-	1	-	1
Total	**37**	**142**	**129**	**65**	**96**	469
Unspecified seals (all states)	27	33	59	46	34	199

a. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities [a] along the U.S. Atlantic coast (2004-2008) with subtotals of animals recorded as pups in parentheses.

State	2004	2005	2006	2007	2008	Total
ME	30	10	14	8	15	77
NH	-	2	-	1	1	4
MA	85	44	24	51 (2)	51	255
RI	7	9	6	2	5	29
CT	2	3	4	1	2	12
NY	20	41	15	19 (1)	8	103
NJ	6	12	3 (1)	3	12	36
DE	0	2 (1)	-	2	-	4
MD	-	2	-	4	1	7
VA	1	4	-	5	3	13
NC	-	-	1	-	-	1
Total	**151**	**129**	**67**	**96**	**98**	**541**
Unspecified seals (all states)	33	59	46	34	51	223

a. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

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STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the stock's abundance appears to have stabilized. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is very low relative to the stock size and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is also low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Bonner, W. N. 1990. The natural history of seals. Facts on File, New York. 196 pp.

Bowen, W. D. and D. E. Sergeant. 1983. Mark-recapture estimates of harp seal pup (*Phoca groenlandica*) production in the northwest Atlantic. Can. J. Fish. Aquat. Sci 40: 728-742.

Bowen, W. D. and D. E. Sergeant. 1985. A mark-recapture estimate of 1983 harp seal pup production in the Northwest Atlantic. NAFO SCR Doc. 85/I/1.

Bravington, M. V. and K. D. Bisack. 1996. Estimates of harbour porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. Int. Whal. Comm. 46: 567-574.

CAFSAC 1992. Update on population estimates of Harp seal in the Northwest Atlantic. Canadian Atlantic Fisheries Scientific Advisory Committee.

DFO 2007. A review of ice conditions and potential impact on harp seal neonatal mortality. Department of Fisheries and Oceans. DFO Can. Sci. Advis. Sec. Sci. Resp. 2007/008. http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ScR-RS/2007/ScR-RS2007_008_E.pdf

DFO 2010. Current status of Northwest Atlantic harp seals, (*Phagophilusa groenlandicus*). Department of Fisheries and Oceans. DFO Can. Sci. Advis. Sec. Sci. Resp. 2009/074.

Hammill, M. O. and G. B. Stenson. 2005. Abundance of Northwest Atlantic harp seals (1960-2005). Can. Sci. Advisory Sec. Res. Doc. 2005/090.

Harris, D. E. and S. Gupta. 2006. GIS-based analysis of ice-breeding seal strandings in the Gulf of Maine. Northeast. Nat. 13: 403-420.

Harris, D. E., B. Lelli and G. Jakush. 2002. Harp seal records from the southern Gulf of Maine: 1997-2001. Northeast. Nat. 9(3): 331-340.

Healey, B. P. and G. B. Stenson. 2000. Estimating pup production and population size of the northwest Atlantic harp seal (*Phoca groenlandica*). Can. Stock Assess. Sec. Res. Doc. 2000/081.

ICES 1998. Report of the joint ICES/NAFO working group on harp and hooded seals, Copenhagen, Denmark, ICES [International Council for the Exploration of the Sea], 28 August-3 September 1997. ICES CM 1998/Assess:3.

ICES 2008. Report of the working group on harp and hooded seals (WGHARP), Tromsø, Norway, ICES [International Council for the Exploration of the Sea], 30 August 2008. ICES CM 2008/ACOM:17.

ICES 2009. Report of the working group on harp and hooded seals (WGHARP), Copenhagen, Denmark [International Council for the Exploration of the Sea], 27 August 2009. ICES CM 2009/ACOM:17.

~~Johnston, D. W., P. Meisenheimer and D. M. Lavigne 2000. An evaluation of management objectives for Canada's commercial harp seal hunt, 1996-1998. Cons. Biol. 14: 729-737.~~

Katona, S. K., V. Rough and D. T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316 pp.

Lacoste, K. N. and G. B. Stenson. 2000. Winter distribution of harp seals (*Phoca groenlandica*) off eastern Newfoundland and southern Labrador. Polar Biol. 23: 805-811.

Lavigne, D. M. and K. M. Kovacs. 1988. Harps and hoods: Ice breeding seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada. 174 pp.

McAlpine, D. F. 1999. Increase in extralimital occurrences of ice-breeding seals in the northern Gulf of Maine region: more seals or fewer fish. Mar. Mamm. Sci. 15: 906-911.

Roff, D. A. and W. D. Bowen. 1983. Population dynamics and management of the Northwest Atlantic harp seal. Can. J. Fish. Aquat. Sci 40: 919-932.

Ronald, K. and P. J. Healey. 1981. Harp Seal. Pages 55-87 *in*: S. H. Ridgway and R. J. Harrison, (eds.) Handbook of marine mammals, Vol. 2: Seals. Academic Press, New York.

Rubinstein, B. 1994. An apparent shift in distrubution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. MA thesis. Department of Biology. Boston, MA, Boston University.

Sergeant, D. E. 1965. Migrations of harp seal *Pagophilus groenlandicus* (Erxleben) in the Northwest Atlantic. J. Fish. Res. Board Can 22: 433-464.

Sergeant, D. E. 1975. Estimating numbers of harp seals. Rapp. P.-v. Reun. Cons. int Explor. Mer. 169(274-280).

Shelton, P. A., N. G. Caddigan and G. B. Stenson. 1992. Model estimates of harp seal population trajectories in the Northwest Atlantic. CAFSAC Res. Doc. 92/89. 23 pp.

Shelton, P. A., G. B. Stenson, B. Sjare and W. G. Warren. 1996. Model estimates of harp seal numbers-at-age for the Northwest Atlantic. NAFO Sci. Coun. Studies 26: 1-14.

Stenson, G. B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.

Stenson, G. B., M. O. Hammill, M. C. S. Kingsley, B. Sjare, W. G. Warren and R. A. Myers. 2002. Is there evidence of increased pup production in northwest Atlantic harp seals, *Pagophilus groenlandicus*? ICES J. Mar. Sci. 59: 81-92.

Stenson, G. B., M. O. Hammill, J. Lawson, J. F. Gosselin and T. Haug. 2005. 2004 pup production of harp seals, *Pagophilus groenlandicus*, in the Northwest Atlantic. Department of Fisheries and Oceans, Canada 34 pp. http://www.dfo-mpo.gc.ca./csas/

Stenson, G. B., R. A. Myers, M. O. Hammill, I.-H. Ni, W. G. Warren and M. S. Kingsley. 1993. Pup production of harp seals, *Phoca groenlandica*, in the Northwest Atlantic. Can. J. Fish. Aquat. Sci 50: 2429-2439.

Stenson, G. B., L. P. Rivest, M. O. Hammill, J. F. Gosselin and B. Sjare 2003. Estimating pup production of harp seals, *Pagophilus groenlandicus*, in the Northwest Atlantic. Mar. Mamm. Sci. 19(1): 141-160.

Stenson, G. B. and B. Sjare. 1997. Seasonal distribution of harp seals, *Phoca groenlandica*, in the Northwest Atlantic. ICES C.M. 1997/CC:10 (Biology and Behavior II). 23 pp.

Stenson, G. B. 2008. Recent catches of harp seals (*Pagophilus groenlandicus*) in the Northwest Atlantic DFO. Can. Sci. Advisory Sec. Res. Doc. 2008/080.

Stevick, P. T. and T. W. Fernald. 1998. Increase in extralimital records of harp seals in Maine. Northeast. Nat. 5(1): 75-82.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Warren, W. G., P. A. Shelton and G. B. Stenson. 1997. Quantifying some of the major sources of uncertainty associated with estimates of harp seal prey consumption. Part 1: Uncertainty in the estimates of harp seal population size. J. Northwest Atl. Fish. Sci. 22: 289-302.

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~~December 2009~~~~January~~March 2010

HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, strandings and takes reported by NMFS observers in the Sea Sampling Program. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al.* 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. However, during the fall, several satellite tagged harbor porpoises did favor the waters around the 92 m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida during the 1980s (Smithsonian strandings database) and one in 2003 (NE Regional Office/NMFS strandings and entanglement database).

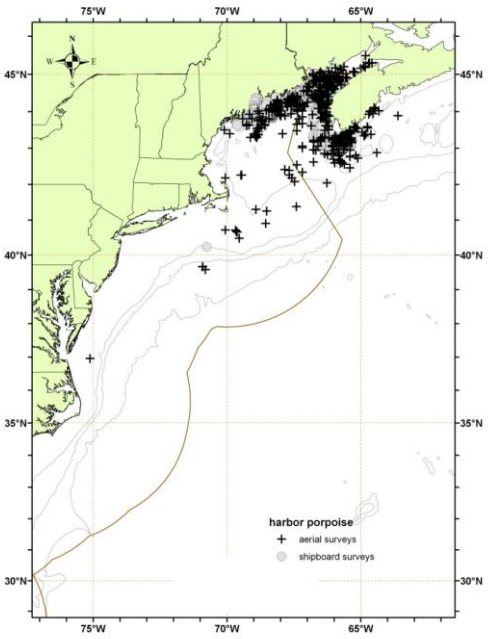

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Gaskin (1984; 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland populations. ~~Recent a~~Analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a; Rosel *et al.* 1999b), organochlorine contaminants (Westgate *et al.* 1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel *et al.* 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Palka *et al.* 1996; Rosel *et al.* 1999a) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Nuclear microsatellite markers have also been applied to samples from these

four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel *et al.* 1999a). These patterns may be indicative of female philopatry coupled with dispersal of males. Both mitochondrial DNA and microsatellite analyses indicate that the Gulf of Maine/Bay of Fundy stock is not the sole contributor to the aggregation of porpoises found in the mid-Atlantic states during winter (Rosel *et al.* 1999a; Hiltunen 2006). Mixed-stock analyses using twelve microsatellite loci in both Bayesian and likelihood frameworks indicate that the Gulf of Maine/Bay of Fundy is the largest contributor (~60%), followed by Newfoundland (~25%) and then the Gulf of St. Lawrence (~12%), with Greenland making a small contribution (<3%). For Greenland, the lower confidence interval of the likelihood analysis includes zero. For the Bayesian analysis, the lower 2.5% posterior quantiles include zero for both Greenland and the Gulf of St. Lawrence. Intervals that reach zero provide the possibility that these populations contribute no animals to the mid-Atlantic aggregation. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland, and Greenland.

POPULATION SIZE

To estimate the population size of harbor porpoises in the Gulf of Maine/Bay of Fundy region, eight line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, 1999, 2002, 2004, 2006, and 2007. The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,054 (CV=0.47), based on the 2006 survey results (Table 1). This is because the 2006 estimate covered the largest portion of the harbor porpoise range.

An abundance estimate of 64,047 (CV=0.48) harbor porpoises was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 51,520 (CV=0.65) harbor porpoises was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct-duplicate method (Palka 1995b) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 89,054 (CV=0.47) harbor porpoises was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

An abundance estimate of 4,862 (95%CI=2,204-8,801) harbor porpoises from the Gulf of Maine/Bay of Fundy, Gulf of ~~Saint~~ St. Lawrence, and Newfoundland stocks was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases. {Lawson, 2009 #1069}

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	64,047	0.48
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	51,520	0.65
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	89,054	0.47
Jul-Aug 2007	Northern Labrador-Scotian Shelf	4,862	0.31

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor porpoises is 89,054 (CV=0.47). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 60,970.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate a likely annual growth rate of 4%. In an attempt to estimate a potential population growth rate that incorporates many of the uncertainties in survivorship and reproduction, Caswell *et al.* (1998) used a Monte Carlo method to calculate a probability distribution of growth rates. The median potential annual rate of increase was approximately 10%, with a 90% confidence interval of 3-15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Moore and Read (2008) conducted a Bayesian population modeling analysis to estimate the potential population growth of harbor porpoise in the absence of bycatch mortality. Their method used fertility data, in combination with age-at-death data from stranded animals and animals taken in gillnets, and was applied under two scenarios to correct for possible data bias associated with observed bycatch of calves. Demographic parameter estimates were ‚model averaged' across these scenarios. The Bayesian posterior median estimate for potential natural growth rate was 0.046. This last, most recent, value will be the one used for the purpose of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 60,970. The maximum productivity rate is 0.046. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 703.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from U.S. and Canadian Sea Sampling Programs, from records of strandings in U.S. and Canadian waters, and from records in the Marine Mammal Authorization Program (MMAP). See Appendix III for details on U.S. fisheries and data sources. Estimates using Sea Sampling Program and MMAP data are discussed by fishery under the Fishery Information section (Table 2). Strandings records are discussed under the Unknown Fishery in the Fishery Information section (Table 3) and under the Other Mortality section (Table 4).

The total annual estimated average human-caused mortality is 9~~40~~28~~860~~+ (CV=0.16~~2~~) harbor porpoises per year. This is derived from four components: 8~~89~~77~~07~~ harbor porpoise per year (CV=0.1~~6~~5~~2~~) from most U.S. fisheries using observer and MMAP data, an unknown number for the Northeast bottom trawl fishery, 45 per year (unknown CV) from Canadian fisheries using observer data, and 6~~7.5~~ per year from unknown U.S. fisheries using strandings data.

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, Northeast bottom trawl and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries (Table 2). Detailed U.S. fishery information is reported in Appendix III.

Earlier Interactions

One harbor porpoise was observed taken from the Atlantic pelagic drift gillnet fishery during 1991-1998; the fishery ended in 1998. This observed bycatch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7.00), 1.7 in 1990 (2.65), 0.7 in 1991 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), 0 during 1994-1996 and 0 in 1998. The fishery was closed during 1997.

U.S.

Northeast Sink Gillnet

In 1984 the Northeast sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal bycatch. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the 11 gillnetters who received permits and logbooks, 30 harbor porpoises were reported caught. It was estimated, using rough estimates of fishing effort, that a maximum of 600 harbor porpoises were killed annually in this fishery (Gilbert and Wynne 1985; Gilbert 1987).

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Estimated annual bycatch (CV in parentheses) from this fishery during 1990-2007 was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), 1,400 in 1993 (0.18) (CUD 1994; Bravington and Bisack 1996), 2,100 in 1994 (0.18), 1,400 in 1995 (0.27) (Bisack 1997), 1,200 in 1996 (0.25), 782 in 1997 (0.22), 332 in 1998 (0.46), 270 in 1999 (0.28) (Rossman and Merrick 1999), 507 in 2000 (0.37), 53 (0.97) in 2001, 444 (0.37) in 2002, 592 (0.33) in 2003, 654 (0.36) in 2004, 630 (0.23) in 2005, 514 (0.31) in 2006, ~~and~~ 395 (0.37) in 2007, and ~~720~~666 (0.48) in 2008 (Table 2). There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990-1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Scientific experiments that demonstrated the effectiveness of pingers in the Gulf of Maine were conducted during 1992 and 1993 (Kraus *et al.* 1997). After the scientific experiments, experimental fisheries were allowed in the general fishery during 1994 to 1997 in various parts of the Gulf of Maine and south of Cape Cod areas. During these experimental fisheries, bycatch rates of harbor porpoises in pingered nets were less than in non-pingered nets.

Average estimated harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery during 1994-1998, before the Take Reduction Plan, was 1,163 (0.11). The average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from 2004~~3~~ to 2008~~7~~ was 5~~8~~372~~57~~ (0.17~~4~~) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995 were from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast sink gillnet fishery (Bravington and Bisack 1996; Bisack 1997). The estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, 572 (0.35) for 1997, 446 (0.36) for 1998, 53 (0.49) for 1999, 21 (0.76) for 2000, 26 (0.95) for 2001, unknown in 2002, 76 (1.13) in 2003, 137 (0.91) in 2004, 470 (0.51) in 2005, 511 (0.32) in 2006, ~~and~~ 58 (1.03) in 2007, and 35~~3~~0 (0.7~~6~~5) in 2008. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic gillnet fishery during 1995 to 1998, before the Take Reduction Plan, was 358 (CV=0.20). The average annual harbor porpoise mortality and serious injury in the mid-Atlantic gillnet fishery from ~~2003~~ 2004 to 20087 was ~~250~~ 30~~6~~5 (0.~~26~~3427) (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. ~~Nineteen~~ Twenty harbor porpoise mortalities were observed in the Northeast bottom trawl fishery between 1989 and ~~2007~~2008, but many of these are not attributable to this fishery. Decomposed animals are presumed to have been dead prior to being taken by the trawl. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003, 4 in 2005, ~~and~~ 1 in 2006, and 1 in 2008. Estimates have not been generated for this fishery.

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27, 113, 79, 122, 118, 174, 73, ~~and~~ 79, and 58 stranded harbor porpoises on U.S. beaches during 1999 to ~~2007~~2008, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1, 3, 2, 9, and 6 stranded harbor porpoises in 1999 to 2004, respectively, were due to unknown fisheries and these animals were in areas and times that were not included in the above

mortality estimate derived from observer program data (Table 3). As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. The ~~two-year average~~ harbor porpoise mortality and serious injury in this unknown fishery category f~~r~~orm ~~2003 to~~ 2004 is 6.0~~7.5~~ (CV is unknown).

CANADA

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. No harbor porpoises were observed taken.

Bay of Fundy Sink Gillnet

During the early 1980s, harbor porpoise bycatch in the Bay of Fundy sink gillnet fishery, based on casual observations and discussions with fishermen, was thought to be low. The estimated harbor porpoise bycatch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). The Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988.

More recently, an observer program implemented in the summer of 1993 provided a total bycatch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, (approximately 11.3% coverage of the Bay of Fundy trips) (Trippel *et al.* 1996). During 1994, the observer program was expanded to cover 49% of the gillnet trips (171 observed trips). The bycatch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), and the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed from July 21 to August 31. During the open fishing period of 1995, 89% of the trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated bycatch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was computed due to lack of coverage in the Wolves fishing grounds. During 1996, the Canadian gillnet fishery was closed during 20-31 July and 16-31 August due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be 20 harbor porpoises (DFO 1998; Trippel *et al.* 1999). Trippel *et al.* (1999) estimated that during 1996, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 68% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. During 1997, the fishery was closed to the majority of the gillnet fleet during 18-31 July and 16-31 August, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during September 1-7. From the 75 monitored trips, 19 harbor porpoises were observed taken. After accounting for total fishing effort, the estimated bycatch in 1997 was 43 animals (DFO 1998). Trippel *et al.* (1999) estimated that during 1997, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 85% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. The number of monitored trips (and observed harbor porpoise mortalities were 111 (5) for 1998, 93 (3) for 1999, 194 (5) for 2000, and 285 (39) for 2001. The estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepherd 2004). Estimates of variance are not available.

There has been no observer program during the summer since 2002 in the Bay of Fundy region, but the fishery was active. Bycatch for these years is unknown. The annual average of most recent five years with available data (1997-2001) was 43 animals, so this value is used to estimate the annual average for more recent years~~2003-2007 removals~~.

Herring Weirs

Harbor porpoises are taken in Canadian herring weirs, but there have been no recent efforts to observe takes in the U.S. component of this fishery. Smith *et al.* (1983) estimated that in the 1980s approximately 70 harbor porpoises became trapped annually and, on average, 27 died annually. In 1990, at least 43 harbor porpoises were trapped in Bay of Fundy weirs (Read *et al.* 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read *et al.* 1994). Between 1992 and 1994, this cooperative program resulted in the live release of 206 of 263 harbor porpoises caught in herring weirs. Mortalities (and releases) were 11 (50) in 1992, 33 (113) in 1993, and 13 (43) in 1994 (Neimanis *et al.* 1995). Since that time, ~~an~~ additional ~~751~~ harbor porpoises have been documented in Canadian herring weirs where the number of ~~, of which 687 were released or escaped, 41 died, and 23 had an unknown status. M~~mortalities (~~and~~ releases, and unknowns) were 5 (60, 0) in 1995; 2 (4, 0) in 1996; 2 (24, 0) in 1997; 2 (26, 0) in 1998; 3 (89, 0) in 1999; 0 (13, 0) in 2000 (A. Read, pers. comm), 14 (296, 0) in 2001, 3 (46, 4) in 2002, 1 (26, 3) in 2003, 4 (53, 2) in 2004; 0 (19, 5) in 2005; 2 (14, 0) in 2006; 3 (9, 3) in 2007 and 0 (8, 6) in 2008 (Neimanis *et al.* 2004; H. Koopman

and A. Westgate, pers. comm.).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 2004~~3~~-2008~~7~~ was 1.8~~2.0~~ (Table 2). An estimate of variance is not possible.

Gulf of St. Lawrence gillnet

This fishery interacts with the Gulf of St. Lawrence harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Using questionnaires to fishermen, Lesage *et al.* (2006) determined a total of 2215 (95% CI 1151-3662) and 2394 (95% CI 1440-3348) harbor porpoises were taken in 2000 and 2001, respectively. The largest takes were in July and August around Miscou and the North Shore of the Gulf of St. Lawrence. According to the returned questionnaires, the fish species most usually associated with incidental takes of harbor porpoises include Atlantic cod, herring and mackerel. An at-sea observer program was also conducted during 2001 and 2002. However, due to low observer coverage that was not representative of the fishing effort, Lesage *et al.* (2006) concluded that resulting bycatch estimates were unreliable.

Newfoundland gillnet

This fishery interacts with the Newfoundland harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Estimates of incidental catch of small cetaceans, where the vast majority are likely harbor porpoises was 862 in 2001, 1,428 in 2002, and 2,228 in 2003 for the Newfoundland nearshore cod and Greenland halibut fisheries, and the Newfoundland offshore fisheries in lumpfish, herring, white hake, monkfish and skate (Benjamins *et al.* 2007) .

Table 2. From observer program data, summary of the incidental mortality of harbor porpoise (*Phocoena phocoena*) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
U.S.							
Northeast Sink Gillnet[c]	~~03~~04-~~07~~08	Obs. Data, Weighout, Trip Logbook	~~.03,~~ .06, .07, .04, .07, .05	~~12[e],~~ 27[e], 51[e], 26, 35, 30	~~592,~~ 654[e], 630[e], 514, 395, ~~720~~666	~~.33,~~ .36, .23, .31, .37, .48	~~557~~58372 (~~0.14~~0.17)
Mid-Atlantic Gillnet	~~03~~04-~~07~~084	Obs. Data Weighout	~~.01,~~ .02, .03, .04, .06, .03	~~1,~~ 2, 15, 20, 1, 9	~~76,~~ 137, 470, 511, 58, 35~~3~~0	~~1.13,~~ .91, .51, .32, 1.03, .76~~5~~	~~250~~3065 (0.~~26~~3427)
Northeast bottom trawl[g]	~~03~~04-~~07~~084	Obs. Data Weighout	~~.04,~~ .05, .12, .06, .06, .08	~~1,~~0,4,1, 0, 1	~~unk[i],~~0,unk[i], unk, 0, unk	~~unk,~~ 0, unk, unk, 0, unk	unk[i,g]
U.S. TOTAL	2004~~3~~-2008~~7~~						8~~89~~77~~07~~ (0.16~~5~~2)
CANADA							
Bay of Fundy Sink Gillnet[d]	1997-2001~~07~~	Can. Trips	unk	19, 5, 3, 5, 39	4~~33~~4, 38, 32, 28, 73	unk	43[f] (unk)
Herring Weir	04~~3~~-08~~7~~	Coop. Data	unk	~~1,~~ 4, 0, 2, 3, 0	~~1,~~ 4, 0, 2, 3, 0	NA	1.8~~2.0~~ (unk)
CANADIAN TOTAL	2004~~3~~-2008~~7~~						45 (unk)
GRAND TOTAL							9~~3~~422~~850~~+ (unk)

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NA = Not available.

a. Observer data (Obs. Data) are used to measure bycatch rates; the U.S. data are collected by the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program, the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. Trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory vessel trip report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery. Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

b. O~~The o~~bserver coverage~~s~~ for the ~~U.S. and Canadian sink gillnet fisheryies~~ is~~are ratios based on trips, and for the~~ U.S. Northeast and mid-Atlantic coastal gillnet fisheries~~y~~, ~~the coverage unit of effort~~ is based on tons of fish landed.

c. During 2002-2008 in the Northeast gillnet fishery~~7~~, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

$$\sum_{i}^{ping,non-ping} \frac{\#\,porpoise_i}{ss landings_i} \cdot \frac{\#\,hauls_i}{total\#\,hauls}$$

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, 4, 12, 2, ~~and~~ 9 and 6 observed harbor porpoise takes on pinger trips from 1992 to 2008~~7~~, respectively, that were included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, 0, 1, 7, 21, 33, 24, ~~and~~ 7, and 13 observed harbor porpoise takes in 1995 to 2008~~7~~, respectively, on trips dedicated to fish sampling versus dedicated to watching for marine mammals; these were also included in the observed mortality column (Bisack 1997).

d. There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

e. There were 22 active weirs around Grand Manan. The number of weirs elsewhere is unknown.

f~~h~~. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery is still active; thus, the bycatch estimate is estimated using past averages.

g~~i~~. Estimates of bycatch mortality attributed to the Northeast bottom trawl fishery have not been generated.

Table 3. From strandings and entanglement data, summary of confirmed incidental mortality of harbor porpoises (*Phocoena phocoena*) by fishery: includes years sampled (Years), ~~number of vessels active within the fishery (Vessels),~~ type of data used (Data Type), mortalities assigned to this fishery (Assigned Mortality), and mean annual mortality.

Fishery	Years	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	~~03~~04-~~07~~08	Entanglement & Strandings	~~9,~~ 6, unk[b], unk[b], unk[b], unk[b]	~~7.5~~6
TOTAL				~~7.5~~6

NA=Not Available.

a Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).

b. As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Thus, the annual mortality is ~~an~~that from ~~average from the years 2003~~ 2004.

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Other Mortality

U.S.

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960s, and the meat was used for human consumption, oil, and fish bait (NMFS 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until media reports in September 1997 depicted a Passamaquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing

legal action in state court.

During 2003, 122 harbor porpoises were reported stranded (Table 4). The number of reported fishery interactions by state are: 1 in Massachusetts (October), 1 in Maryland (March), 6 in Virginia (3 in March, 2 in April, and 1 in May), and 1 in North Carolina (February). Three harbor porpoises were reported mutilated in North Carolina. All of these strandings reported with fishery interactions were in areas and times that were not part of a bycatch estimate derived from the observer data (Table 3).

During 2004, 117 harbor porpoises were reported stranded on Atlantic US beaches. There were 8 reported fishery interactions by state: 1 in Massachusetts (May), 1 in New York (May), and 3 in Virginia (February, March, and April), and 3 in North Carolina (April). In addition, there was 1 mutilation in Delaware during March. Of these 8 fishery interactions, six were in areas and times that were not part of a bycatch estimated derived from the observer data (Table 3).

During 2005, 175 harbor porpoises were reported stranded on Atlantic US beaches. Although 24 animals were classified as having signs of human interaction, and of those 24, 7 showed signs of fishery interaction, in no case was cause of death directly attributable to these interactions. An Unusual Mortality Event was declared for harbor porpoise in North Carolina, as there were 38 stranded in that state between 1 January and 28 March 2005. Most of these were young of the year, and histopathological examinations of 6 of these animals showed no– systemic diseases or common symptoms other than emaciation or any systemic disease (MMC 2006).

During 2006, 73 harbor porpoises were reported stranded on Atlantic US beaches. Eight of these were reported as having signs of human interaction, but in no case was cause of death directly attributable to these interactions. In fact, in three cases the human interaction was post-mortem. One of the human interaction mortalities was classified as a fishery-interaction (with no further detail), one as a boat collision, and one was involved in an oil spill.

During 2007, 79 harbor porpoises were reported stranded on Atlantic US beaches. Of these, six were reported as having signs of human interaction. One of these was classified as a fishery interaction, and one had signs of propeller wounds, although the marks appeared to have been made post-mortem.

During 2008, 58 harbor porpoises were reported stranded on Atlantic US beaches. Of these, four were reported as having signs of human interaction. One of these was classified as a fishery interaction.

As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Using only Averaging 2003 to 2004, it is estimated that there were 7.56 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality (Table 3).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2003-2007.

Area	Year					Total
	2003	2004	2005	2006	2007	
Maine	5	15	9	9	10	**48**
New Hampshire	2	2	0	1	0	**5**
Massachusetts[a]	35	49	55	23	22	**184**
Rhode Island[b]	2	3	6	3	1	**15**
Connecticut	0	0	1	0	0	**1**
New York[c]	8	8	15	11	10	**52**
New Jersey	5	14	17	6	5	**47**
Pennsylvania	0	0	1	0	0	**1**
Delaware	1	1	3	3	3	**11**
Maryland	5	2	4	2	0	**13**
Virginia	19	8	22	9	8	**66**
North Carolina[d]	39	15	42	6	20	**122**

~~Florida~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
~~**TOTAL U.S.**~~	~~**122**~~	~~**117**~~	~~**175**~~	~~**73**~~	~~**79**~~	~~**566**~~
~~Nova Scotia~~	~~3~~	~~4~~	~~6~~	~~4~~	~~4~~	~~21~~
~~**GRAND TOTAL**~~	~~**125**~~	~~**121**~~	~~**181**~~	~~**77**~~	~~**83**~~	~~**587**~~

~~a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007.~~
~~b. In Rhode Island, one animal stranded alive in 2006, and was taken to rehab.~~
~~c. Includes one live animal in 2006 in New York.~~
~~d. In North Carolina, one animal was relocated and released in 2005, and one was taken to rehab in2003 and one in 2006. The 2003 animal was tagged and released (Schofield *et al.* 2008).~~

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2004-2008.

Area	Year					**Total**
	2004	2005	2006	2007	2008	
Maine[a]	15	9	9	10	7	**50**
New Hampshire	2	0	1	0	0	**3**
Massachusetts[ab]	49	55	23	22	25	**174**
Rhode Island[be]	3	6	3	1	1	**14**
Connecticut	0	1	0	0	0	**1**
New York[ce]	8	15	11	10	3	**47**
New Jersey	14	17	6	5	8	**50**
Pennsylvania	0	1	0	0	0	**1**
Delaware	1	3	3	3	0	**10**
Maryland	2	4	2	0	2	**10**
Virginia	8	22	9	8	6	**53**
North Carolina[d]	15	42	6	20	6	**89**
Florida	0	0	0	0	0	**0**
TOTAL U.S.	**117**	**175**	**73**	**79**	**58**	**502**
Nova Scotia	3	5~~4~~	4~~6~~	4	6	~~**16**~~**22**~~**7**~~
Newfoundland and New Brunswick	0	5	0	1	4	**10**
GRAND TOTAL	**120**	**185~~4~~**	**77~~9~~**	**84**	**62**	**5~~28~~34~~9~~**

a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007 and one in 2008.
b. In Rhode Island~~,~~ one animal stranded alive in 2006~~,~~ and was taken to rehab.
c. Includes one live animal in 2006 in New York.
d. In North Carolina, one animal was relocated and released in 2005, ~~and~~ one animal was taken to rehab ~~in2003 and one~~ in 2006, and one animal immediately released in 2008. ~~The 2003 animal was tagged and released (Schofield *et al.* 2008).~~

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded between 1991 and 1996 on the

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coast of Nova Scotia (Hooker *et al.* 1997). Researchers with the Canadian Department~~t~~ of Fisheries and Oceans documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. On the mainland of Nova Scotia, a total of 8 stranded harbor porpoises were recorded between 1991 and 1996: 1 in May 1991, 2 in 1993 (July and September), 1 in August 1994 (released alive), 1 in August 1994, and 3 in 1996 (March, April, and July (released alive)). On Sable Island, 8 stranded dead harbor porpoises were documented, most in January and February; 1 in May 1991, 1 in January 1992, 1 in January 1993, 3 in February 1997, 1 in May 1997, and 1 in June 1997. Two strandings during May-June 1997 were neonates (> 80 cm). The harbor porpoises that stranded in the winter (January-February) were on Sable Island, those in the spring (March to June) were in the Bay of Fundy (2 in Minas Basin and 1 near Yarmouth) and on Sable Island (2), and those in the summer (July to September) were scattered along the coast from the Bay of Fundy to Halifax.

Whales and dolphins stranded between 1997 and ~~2007~~ 2008 on the coast of Nova Scotia as recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network are as follows (Table 4): 3 harbor porpoises stranded in 1997 (1 in April, 1 in June and 1 in July), 2 stranded in June 1998, 1 in March 1999, 3 in 2000 (1 in February, 1 in June, and 1 in August); 2 in 2001 (1 in July and 1 in December), 5 in 2002 (3 in July (1 released alive), 1 in August, and 1 in September (released alive)), 3 in 2003 (2 in May (1 was released alive) and 1 in June (disentangled and released alive)), 4 in 2004 (1 in April, 1 in May, 1 in July (released alive) and 1 in November), 6 in 2005 (1 in April (released alive), 1 in May, 3 in June and 1 in July), 4 in 2006 (1 in June, 1 in August, 1 in September, and 1 in December), ~~and~~ 4 in 2007, and ~~xx~~6 in 2008 (Table 4).

FFive dead stranded harbor porpoises were reported in 200~~8~~5 by the Newfoundland and Labrador Whale Release and Strandings Program, 1 in 2007 and 4 in 2008. (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009~~(Ledwell 2009)~~

USA management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gillnets was published in the Federal Register (63 FR 66464) on 02 December 1998 and became effective 01 January 1999. The Gulf of Maine portion of the plan pertains to all fishing with sink gillnets and other gillnets capable of catching regulated groundfish in New England waters, from Maine through Rhode Island. This portion of the rule includes time and areas closures, some of which are complete closures; others are closed to gillnet fishing unless pingers are used in the prescribed manner. Also, the rule requires those who intend to fish to attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72º30'W longitude to the mid-Atlantic shoreline from New York to North Carolina. This portion of the rule includes time and area closures, some of which are complete closures; others are closed to gillnet fishing unless the gear meets certain restrictions. The MMPA mandates that the take reduction teams that developed the above take reduction measures periodically meet to evaluate the effectiveness of the plan and modify it as necessary. The Harbor Porpoise Take Reduction Team was reconvened in December 2007 to discuss updated harbor porpoise abundance and bycatch information. The Team recommended modifications to the plan to further reduce harbor porpoise bycatch in commercial fisheries. NMFS is currently undertaking rule-making to modify the plan.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On 7 January 1993, the National Marine Fisheries Service (NMFS) proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On 5 January 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 2 August 2001, NMFS made available a review of the biological status of the Gulf of Maine/Bay of Fundy harbor porpoise population. The determination was made that listing under the Endangered Species Act (ESA) was not warranted and this stock was removed from the ESA candidate species list (NMFS 2001). Population trends for this species have not been investigated. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because average annual human-related mortality and serious injury exceeds PBR.

REFERENCES CITED

Barlow, J. and P. Boveng 1991. Modeling age-specific mortality for marine mammal populations. Mar. Mamm. Sci. 7: 50-65.

Benjamins, S., J. Lawson and G. Stenson 2007. Recent harbour porpoise bycatch in gillnet fisheries in Newfoundland and Labrador, Canada. J. Cetacean Res. Manage. 9(3): 189-199.

Bisack, K.D. 1997. Harbor porpoise bycatch estimates in the U.S. New England multispecies sink gillnet fishery: 1994 and 1995. Rep. Int. Whal. Comm. 47: 705-714.

Bravington, M.V. and K.D. Bisack 1996. Estimates of harbour porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. Int. Whal. Comm. 46: 567-574.

Caswell, H., S. Brault, A.J. Read and T.D. Smith 1998. Harbor porpoise and fisheries: An uncertainty analysis of incidental mortality. Ecol. Appl. 8(4): 1226-1238.

CUD 1994. Estimating harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery. Conservation and Utilization Division. Northeast Fish. Sci. Cent. Ref. Doc. 94-24.

DFO 1998. Harbour porpoise bycatch in the lower Bay of Fundy gillnet fishery. DFO Maritimes Regional Fisheries Status Report 98/7E. Available from Department of Fisheries and Oceans, Resource management Branch, P.O. Box 550, Halifax, NS B3J 2S7, Canada.

Gaskin, D.E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969-75. Rep. Int. Whal. Comm. 27: 487-492.

Gaskin, D.E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Comm. 34: 569-586.

Gaskin, D.E. 1992. The status of the harbour porpoise. Can. Field-Nat. 106: 36-54.

Gilbert, J.R. 1987. Marine Mammal Interaction with New England Gillnet Fisheries. NMFS. NA84EAC00070. draft report 21 pp.

Gilbert, J.R. and K.M. Wynne 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. NMFS. NA80FAC00029 and NA84EAC00070 15 pp.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake *et al.*, (eds.) Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Hiltunen, K.H. 2006. Mixed-stock analysis of harbor porpoises (*Phocoena phocoena*) along the U.S. mid-Atlantic coast using microsatellite DNA markers. MS thesis. The College of Charleston.

Hooker, S.K., R.W. Baird and M.A. Showell 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

Johnston, D.W. 1995. Spatial and temporal differences in heavy metal concentrations in the tissues of harbour porpoises (*Phocoena phocoena* L.) from the western North Atlantic. M.S. thesis. University of Guelph, Guelph, Ontario, Canada. 152 pp.

Kraus, S.D., J.H. Prescott and G.S. Stone 1983. Harbor porpoise, *Phocoena phocoena*, in the U.S. coastal waters off the Gulf of Maine: a survey to determine seasonal distribution and abundance. NMFS. NA82FAC00027 22 pp.

Kraus, S.D., A.J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson and J. Williamson 1997. Acoustic alarms reduce porpoise mortality. Nature 388(6642): 525.

Lamb, A. 2000. Patterns of harbor porpoise mortality in two US Atlantic sink gillnet fisheries and changes in life history parameters. M.S. thesis. Boston University, Boston, MA.

Lawson, J.W. and J.-F. Gosselin 2008. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 208/031. 33 pp.

Ledwell, W. and J. Huntington 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.

Ledwell, W. and J. Huntington 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.

Ledwell, W. and J. Huntington 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda,

Newfoundland and Labrador region.

Lesage, V., J. Keays, S. Turgeon and S. Hurtubise 2006. Bycatch of harbour porpoises (*Phocoena phocoena*) in gillnet fisheries of the Estuary and Gulf of St. Lawrence in 2000-2002. J. Cetacean Res. Manage. 8(1): 67-78.

Lucas, Z.N. and S.K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

MMC 2006. US Marine Mammal Commission Annual Report to Congress, 2005. Marine Mammal Commission. Bethesda, MD Vi+163 pp. http://www.mmc.gov/reports/annual/pdf/2005annualreport.pdf

Moore, J.E. and A.J. Read 2008. An uncertainty analysis of cetacean demography and bycatch mortality using carcass data. Ecol. Appl. (in press).

Neimanis, A.S., H.N. Koopman, A.J. Westgate, L.D. Murison and A.J. Read 2004. Entrapment of harbour porpoises (*Phocoena phocoena*) in herring weirs in the Bay of Fundy, Canada. J. Cetacean Res. Manage. 6(1): 7-17.

Neimanis, A.S., A.J. Read, A.J. Westgate, H.N. Koopman, J.Y. Wang, L.D. Murison and D.E. Gaskin 1995. Entrapment of harbour porpoises (*Phocoena phocoena*) in herring weirs in the Bay of Fundy, Canada. International Whaling Commission, Dublin, Ireland., Working paper SC/47/SM18.

NMFS 1992. Harbor porpoise in Eastern North America: Status and Research Needs. Results of a scientific workshop held May 5-8, 1992 at NEFSC, Woods Hole, MA, USA. National Marine Fisheries Service. Northeast Fish. Sci. Cent. Ref. Doc., Silver Spring, Maryland. 92-06. 28 pp.

NMFS 1993. Proposed listing of Gulf of Maine population of harbor porpoises as threatened under the Endangered Species Act. Federal Register 58: 3108-3120.

NMFS 1999. Listing of Gulf of Maine/Bay of Fundy population of harbor porpoise as threatened under the Endangered Species Act. Federal Register 64(2): 465-471.

NMFS 2001. Status review of the Gulf of Maine/Bay of Fundy population of harbor porpoise under the Endangered Species Act (ESA). Federal Register 66(203): 53195-53197.

Palka, D. 1995a. Influences on spatial patterns of Gulf of Maine harbor porpoises. Pages 69-75 *in*: A. S. Blix, L. Walloe and O. Ulltang, (eds.) Whales, Seals, Fish and Man. Elsevier Science.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. Northeast Fish. Sci. Cent. Ref. Doc. 00-07. 29 pp. http://www.nefsc.noaa.gov/psb/pubs/palkalabref00-07.pdf

Palka, D.L. 1995b. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0), Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans. European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. and P.S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Palka, D.L., A.J. Read, A.J. Westgate and D.W. Johnston 1996. Summary of current knowledge of harbour porpoises in US and Canadian Atlantic waters. Rep. Int. Whal. Comm. 46: 559-565.

Polacheck, T. 1989. Harbor porpoises and the gillnet fishery. Oceanus 32(1): 63-70.

Polacheck, T., F.W. Wenzel and G. Early 1995. What do stranding data say about harbor porpoise (*Phocoena phocoena*)? Rep. Int. Whal. Comm. (Special Issue) 16: 169-180.

Read, A.J., J.E. Craddock and D. Gannon 1994. Life history of harbour porpoises and pilot whales taken in commercial fishing operations off the northeastern United States. Final Report, Phase II. 50-EANE-2-00082. final report, phase II.

Read, A.J. and A.A. Hohn 1995. Life in the fast lane: the life history of harbour porpoises from the Gulf of Maine. Mar. Mamm. Sci. 11(4): 423-440.

Read, A.J., J.R. Nicolas and J.E. Craddock 1996. Winter capture of a harbor porpoise in a pelagic drift net off North Carolina. Fish. Bull. 94(2): 381-383.

Read, A.J. and A.J. Westgate 1997. Monitoring the movements of harbour porpoises (*Phocoena phocoena)* with satellite telemetry. Marine Biology 130: 315-22.

Rosel, P.E., S.C. France, J.Y. Wang and T.D. Kocher 1999a. Genetic structure of harbour porpoise *Phocoena phocoena* populations in the northwest Atlantic based on mitochondrial and nuclear markers. Mol. Ecol. 8: S41-S54.

Rosel, P.E., R. Tiedemann and M. Walton 1999b. Genetic evidence for limited trans-Atlantic movements of the harbor porpoise *Phocoena phocoena*. Marine Biology 133: 583-591.

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Rossman, M.C. and R.L. Merrick 1999. Harbor porpoise bycatch in the Northeast Multispecies Sink Gillnet Fishery and the Mid-Atlantic Coastal Gillnet Fishery in 1998 and during January-May 1999. Northeast Fish. Sci. Cent. Ref. Doc. 99-17. 36 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd9917.pdf

Schofield, D.T., G. Early, F.W. Wenzel, K. Matassa, C. Perry, G. Beekman, B. Whitaker, E. Gebhard, W. Walton and M. Swingle 2008. Rehabilitation and Homing Behavior of a Satellite-Tracked Harbor Porpoise (*Phocoena phocoena*). Aquatic Mammals 34(1): 1-8.

Smith, G.J.D., A.J. Read and D.E. Gaskin 1983. Incidental catch of harbor porpoises, *Phocoena phocoena* (L.), in herring weirs in Charlotte County, New Brunswick, Canada. Fish. Bull. 81(3): 660-2.

Trippel, E.A. and T.D. Shepherd 2004. By-catch of harbour porpoise (*Phocoena phocoena*) in the Lower Bay of Fundy gillnet fishery from 1998-2001. Department of Fisheries and Oceans. Ottawa, Ontario. DFO Research Document 2004/2521.

Trippel, E.A., M.B. Strong, J.M. Terhune and J.D. Conway 1999. Mitigation of harbour porpoise (*Phocoena phocoena*) bycatch in the gillnet fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci 56: 113-123.

Trippel, E.A., J.Y. Wang, M.B. Strong, L.S. Carter and J.D. Conway 1996. Incidental mortality of harbour porpoise (*Phocoena phocoena*) by the gill-net fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci 53: 1294-1300.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Wang, J.Y., D.E. Gaskin and B.N. White 1996. Mitochondrial DNA analysis of harbour porpoise, *Phocoena phocoena*, subpopulations in North American waters. Can. J. Fish. Aquat. Sci 53: 1632-45.

Westgate, A.J., D.C.G. Muir, D.E. Gaskin and M.C.S. Kingsley 1997. Concentrations and accumulation patterns of organochlorine contaminants in the blubber of harbour porpoises, *Phocoena phocoena*, from the coast of Newfoundland, the Gulf of St. Lawrence and the Bay of Fundy/Gulf of Maine. Envir. Pollut. 95: 105-119.

Westgate, A.J., A.J. Read, T.M. Cox, T.D. Schofield, B.R. Whitaker and K.E. Anderson 1998. Monitoring a rehabilitated harbor porpoise using satellite telemetry. Mar. Mamm. Sci. 14(3): 599-604.

Westgate, A.J. and K.A. Tolley 1999. Geographical differences in organochlorine contaminants in harbour porpoises *Phocoena phocoena* from the western North Atlantic. Mar. Ecol. Prog. Ser. 177: 255-268.

Woodley, T.H. and A.J. Read 1991. Potential rates of increase of a harbor porpoise (*Phocoena phocoena*) population subjected to incidental mortality in commercial fisheries. Can. J. Fish. Aquat. Sci 48: 2429-35.

~~December 2009~~~~January 2010~~March 2010

LONG-FINNED PILOT WHALE (*Globicephala melas melas*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are ~~two~~2 species of pilot whales in the western Atlantic—the ~~Atlantic or~~ long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the ~~two~~2 stocks in U.S. Atlantic waters is limited. ~~These species are difficult to differentiate at sea; therefore, some of the descriptive material below refers to *Globicephala* sp., and is identified as such.~~ The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Buckland *et al.* 1993; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (ICES 1993; Fullard *et al.* 2000). Morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock structure across the Atlantic (Fullard *et al.* 2000). However, Fullard *et al.* (2000) have proposed a stock structure that is related to sea~~-~~surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream. ~~The species is considered to occur from Canada to Cape Hatteras. NMFS is currently conducting research to improve the understanding of species delineation and distribution.~~

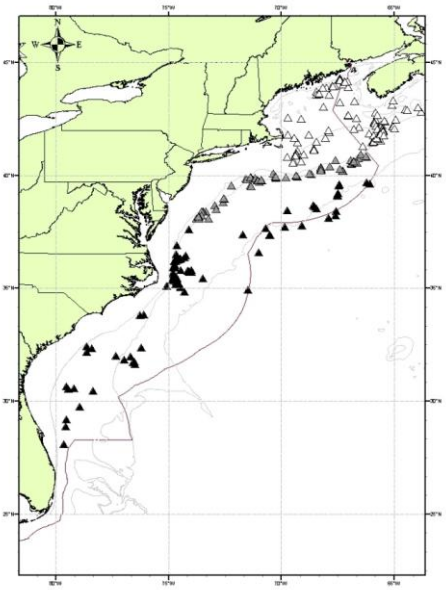

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possible mixed (gray symbols) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are at the 100-m, 1,000-m, and 4,000-m depth contours.*

In U.S. Atlantic waters, p~~P~~ilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeast U.S. coast in winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn (CETAP 1982; Payne and Heinemann 1993). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992; NMFS unpublished data). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey ~~(Payne~~ (Payne and Heinemann 1993;Garrison *et al.* in review).

~~The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea . The stock structure of the North Atlantic population is uncertain . Morphometric and genetic studies have provided little support for stock structure across the Atlantic . However, Fullard *et al.* have proposed a stock structure that is related to sea-surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream.~~

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sighting~~s~~ data are reported as *Globicephala* sp.~~—~~. ~~S~~Sightings from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1)~~—~~. Combined abundance estimates for the ~~two~~2 species have previously been derived from line~~-~~-transect surveys~~—~~. The best available abundance estimates are from surveys conducted during the summer of 2004~~—~~. These survey data have been combined with an analysis of the spatial distribution of the ~~two~~2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison *et al.*, in prep)~~—~~. The resulting abundance estimate for long-finned pilot whales in U.S. waters is 12,619 (CV~~=~~0.37)~~—~~. ~~Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to distinguish at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 + 15,411 = 31,139 whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.~~

Earlier estimates

Please see appendix IV for earlier estimates and descriptions of abundance surveys~~—~~. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 which covered 7,465~~-~~km of trackline over waters from the 1000~~-~~m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)*~~,~~, the probability of detecting a group on the track line, used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761~~-~~km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the ~~two~~two-independent-team line-transect method and analyzed using the modified direct duplicate-method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*. Aerial data were collected using the Hiby circle-back line~~-~~transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50~~-~~m) between Florida and Maryland (27.5~~-~~ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed ~~two~~2 independent visual teams searching with 25× bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the ~~M~~mid-Atlantic. The survey included 5,659 ~~-~~km of trackline, and collected a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina, along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was ~~15,411~~21,056 animals (CV~~=~~0.~~43~~54; Garrison *et al.*, in review).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 which covered 10,676 ~~-~~km of trackline in the region from the 2000~~-~~m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 6,134 (95% CI=2,774-10,573) pilot whales was ~~generated~~ generated from the Canadian Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to the Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	~~15,411~~21,056	0.~~43~~54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	~~31,139~~36,784	0.~~27~~34
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35
July-Aug 2007	N. Labrador to Scotian Shelf	6,134	0.28

Spatial Distribution and Abundance Estimates for *Globicephala melas*

Biopsy samples from pilot whales were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007~~.~~. These samples were identified to species using genetic analysis of mitochondrial DNA sequences~~.~~. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes~~.~~. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples (Garrison *et al.*, in prep)~~.~~. Based upon the date and location of sample collection, the probability of a sample being from a long-finned (or short-finned) pilot whale was evaluated as a function of sea-surface temperature and water depth using logistic regression~~.~~. This analysis indicated that at water temperatures ~~less than~~< 22°C, the probability of a sample coming from a long-finned pilot whale~~s~~ was near 1, and at temperatures >25°C, this probability was near 0~~.~~. The probability of a long-finned pilot whale also decreased with increasing water depth~~.~~. Spatially, during summer months, this habitat model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales~~.~~. The area of overlap between the ~~two~~2 species occurred primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude~~.~~. This habitat model was used to partition the abundance estimates from surveys conducted during the summer of 2004~~.~~. The survey covering waters from Florida to Maryland was predicted to consist entirely of short-finned pilot whales~~.~~. The aerial portion of the northeast survey covering the Gulf of Maine~~,~~ and the Bay of Fundy and surveys conducted in Canadian waters ~~a~~were predicted to consist entirely of long-finned pilot whales~~.~~. The vessel portion of the northeast survey contained a mix of both species, with the sightings in offshore waters near the Gulf Stream predicted to consist of short-finned pilot whales~~.~~. The best abundance estimate for long-finned pilot whales is thus the sum of the northeast aerial survey estimate (11,038 [CV~~=~~0.40], Palka 2006) and the estimated number of long-finned pilot whales from the northeast vessel survey (1,581 [CV =0.86])~~.~~. The best available abundance estimate is thus 12,619 (CV~~=~~0.37) (Palka 2006; ~~,~~Garrison *et al.*, in review)~~.~~.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for ~~*Globicephala* sp.~~western North Atlantic long-finned pilot whales is ~~31,139~~12,619 animals (CV~~=~~0.~~27~~37)~~ derived from the 2004 surveys.~~. This reflects only the portion of the long-finned pilot whale population occupying U.S. waters~~.~~. This is consistent with guidelines for assessment of trans-boundary stocks since the available mortality estimates are also restricted to U.S. waters. The minimum population estimate for ~~*Globicephala* sp. is 24,86~~long-finned pilot whales is 9,333.~~6~~.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala* ~~sp.~~ *melas melas.*

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth of 177-cm; mean length at sexual maturity of 490-cm for males and 356-cm for females; age at sexual maturity of 12 years for males and 6 years for females; mean adult length of 557-cm for males and 448 cm for females; and maximum age of 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch *et al.* 1993; Desportes *et al.* 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and different analytical techniques.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a ~~"r~~ecovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for ~~*Globicephala* sp.~~long-finned pilot whales is 9,333~~24,866~~. The maximum productivity rate is 0.04, the default value for cetaceans. The ~~"r~~ecovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic ~~*Globicephala* sp. is 249. It is not possible to determine the PBR for only~~ long-finned pilot whale~~s~~ is 93~~.~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human caused mortality of long-finned pilot whales cannot be determined~~—~~. The highest bycatch rates in the pelagic longline fishery area were observed during September – October ~~majority of observed mortality and serious injury to pilot whales is observed during October-November~~ along the mid-Atlantic coast (Garrison 2007)~~—~~. In bottom trawls, most mortalities were observed in the same area between July and November~~;~~ (Rossman 2009). The model used to derive abundance estimates uses data restricted to the warmest months of the year (June-August), ~~,~~and there is currently very little data available for the potential area of overlap during the fall~~-~~. T~~t~~herefore, it is not possible to partition mortality estimates between the ~~two~~2 species because there are very few available genetic samples from the area of overlap and season where most mortality occurs~~—~~. Mortality and serious injury estimates are thus presented only for the ~~two~~2 species combined~~—~~. Total annual estimated average fishery-related mortality or serious injury during 2004-2008 was 17~~5~~6 pilot whales (CV=0.14; Table 2)~~—~~. Of this, it is most likely that the mortality due to the pelagic longline fishery, the N~~n~~ortheast midwater trawl fishery, and the N~~n~~ortheast groundfish fishery have the most direct impact on long-finned pilot whales.

~~Total annual estimated average fishery related mortality or serious injury to this stock during 2003-2007 was 166 pilot whales (CV=0.14); Table 2).~~

Fishery Information

Detailed fishery information is reported in Appendix III~~—~~.

~~—~~Total fishery-related mortality and serious injury cannot be estimated separately for the ~~two~~2 species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities

(Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) was taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0).

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In ~~one~~1 interaction, the net was pursed around ~~one~~1 pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001, with no marine mammals observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and~~, 0~~ none were observed taken during 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 (CV=1.10) in 1998.

One pilot whale take was observed in the *Illex* squid portion of the Southern New England/~~M~~mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the Southern New England/~~M~~mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998, and 49 in 1999 (CV=0.97). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was ~~one~~1 observed take in the Southern New England/mid-Atlantic Bottom Trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 in 1996-1998, and 228 (CV=~~-~~1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was ~~from~~ rec~~ro~~orded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and ~~2007~~2008, ~~136~~ 154 pilot whales ~~(including 2 identified as short-finned pilot whales)~~ were released alive, including ~~78~~ 83 that were considered seriously injured, ~~(of which 1 was identified as a short-finned pilot whale),~~ and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms deep during April-June. During the July-September

period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20- and 50-fathom isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, 16 (CV=1.00) in 2006 and 0 in 2007. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995 including 37 estimated short-finned pilot whales (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 51 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 (CV=0.21) in 2005, 169 (CV=0.47) in 2006, 57 (CV=0.47) in 2007, and 98 (CV=0.42) in 2008. The average combined' annual mortality in 2004-2008 was 122 pilot whales (CV=0.19) (Table 2). The average combined' annual mortality in 2003-2007 was 110 pilot whales (CV=0.20) (Table 2).

An experimental fishery was conducted on 6six vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques with standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" fishing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including one1 which was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the Mmid-Atlantic bottom trawl in 2000, four4 in 2005, one1 in 2006, and zero0 in 2007, and zero0 in 2008. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38(CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, 37 (CV=0.34) in 2006, and 36 (CV=0.38) in 2007, and 24 (CV=0.36) in 2008. The 2004-2008 average mortality attributed to the Mmid-Atlantic bottom trawl was 34 animals (CV=0.13).
. The 2003-2007 average mortality attributed to the Mid-Atlantic bottom trawl was 34 animals (CV=0.15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, four4 in 2005, one1 in 2006, and four4 in 2007, and 5 in 2008. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, and 12 (CV=0.35) in 2007 and 10 (CV=0.34) in 2008. The 2004-2008 average mortality attributed to the northeast bottom trawl was 15 animals (CV=0.13). The 2003-2007 average mortality attributed to the northeast bottom trawl was 15 animals (CV=0.13).

Northeast Mid-Water Trawl (Including Pair Trawl)

In Sept 2004 aA pilot whale was observed taken in the pairedsingle mid-water trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. In April 2008, six pilot whale takes were observed in the single mid-water trawl fishery in hauls targeting mackerel and located on the southern edge of Georges Bank. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed takes per observed hours the gear was in the water) for each year, where the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and Northeast and Mmid-Atlantic mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort. The VTR data were used to estimate the total effort (Palka, pers. comm.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth, as significant explanatory variables, where soak duration was the unit of effort. Estimated annual fishery-related mortalities were: unknown in 2001-2002, 1.9 (CV=0.56)0 in 2003, and 5.361.4 (CV=0.9825 8) in 2004, 1.1 (CV=0.68)0 in 2005 to, 0 in 2006, and 0 in 2007, and 6.513.1 16 (CV=0.6010.56) in 2008. (Table 2; Palka pers. comm.). The average annual estimated mortality during 2004-2008 was 3.714.3.8 (CV=0.5107).(Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2003-2007 was 1 (CV=0.35).

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)

In March 2007 aNo pilot whales wasere observed bycaught in the single mid-wateris fishery between 2002 and

2006, or in 2008, though because of data pooling, estimates were still generated for some years in a haul targeting herring that was south of Rhode Island. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effortthe bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. comm.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. Estimated annual fishery-related mortalities were unknown in 2002, 0 in3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, 7.5 (CV=0.76) in 2005, 0 in to 2006, and 11.2412.1.9 (CV=0.701.020.99) in 2007, and 0 in 2008 (Table 2; Palka pers. com.). The average annual estimated mortality during 2004-2008 was 2.244 (CV=0.1.020.994) (Table 2; Palka pers. comm.). The average annual estimated fishery related mortality during 2003-2007 was 5 (CV=0.31).

CANADA

An unknown number of long-finned pilot whales have also been taken in Newfoundland, Labrador, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches were recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100 ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (see Figure 3, Hooker *et al.* 1997). During the 1991-1996 period, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker *et al.* 1997).

There was one1 record of incidental catch in the offshore Greenland halibut fishery that involved one1 long-finned pilot whale in 2001; no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala sp.*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[d]	03-07	unk	Obs. Data Dealer	.01, .03, .03, .02, .03	0, 0, 0, 0, 0	0, 0, 4, 1, 0	0, 0, 0, 0, 0	31, 35, 31, 37, 36	31, 35, 31, 37, 36	.31, .33, .31, .34, .38	34 (.15)
Northeast Bottom Trawl[d]	03-07	unk	Obs. Data Dealer Data VTR Data	04, .05, .12, .06, .06	0, 0, 0, 0, 0	0, 0, 2, 4, 1, 4	0, 0, 0, 0, 0	20, 15, 15, 14, 12	20, 15, 15, 14, 12	, .26, .29, .30, .28, .35	15 (.13)

~~Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[c]~~	~~03-07~~	~~23, 25, 31, 23, 14~~	~~Obs. Data Dealer Data VTR Data~~	~~.018, .064, .084, .089, .039~~	~~0, 0, 0, 0, 0~~	~~0, 0, 0, 0, 1~~	~~0, 0, 0, 0, 0~~	~~3.9, 8.1, 7.5, 0, 4.9~~	~~3.9, 8.1, 7.5, 0, 4.9~~	~~.46, .38, .76, 0, .70~~	~~5 (.31)~~
~~Northeast Mid-Water Trawl - Including Pair Trawl[e]~~	~~03-07~~	~~28, 22, 25, 25, 7~~	~~Obs. Data Dealer Data VTR Data~~	~~.031, .126, .199, .031, .08~~	~~0, 0, 0, 0, 0~~	~~0, 1, 0, 0, 0~~	~~0, 0, 0, 0, 0~~	~~1.9, 1.4, 1.1, 0, 0~~	~~unk, 1.9, 1.4, 1.1, 0, 0~~	~~.56, .58, .68, 0, 0~~	~~1 (.35)~~
~~Pelagic Longline (excluding NED-E)[f]~~	~~03-07~~	~~63, 60, 60, 63, 62~~	~~Obs. Data Logbook~~	~~.09, .09, .06, .07, .08~~	~~2, 6, 9, 12, 5~~	~~0, 0, 0, 1, 0~~	~~21, 74, 212, 169, 57~~	~~0, 0, 0, 16, 0~~	~~21, 74, 212, 185, 57~~	~~.77, .42, .21, .47, .65~~	~~110 (.20)~~
~~2005 Pelagic Longline experimental fishery[g]~~	~~05~~	~~6~~	~~Obs. Data~~	~~1~~	~~1~~	~~0~~	~~1~~	~~0~~	~~1~~	~~1.00~~	~~1(1.00)~~
~~TOTAL~~											~~166 (.14)~~

~~a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.~~

~~b. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).~~

~~c. Observer coverage of the Mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.~~

~~d. NE and MA bottom trawl mortality estimates reported for 2007 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 effort. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in early 2009. e. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.~~

~~f. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).~~

~~g. A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield-Walsh and Garrison 2006).~~

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala* sp.) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[c]	04-08	Obs. Data Dealer	.03, .03, .02, .03, .03	0, 0, 0, 0, 0	0, 4, 1, 0, 0	0, 0, 0, 0, 0	35, 31, 37, 36, 24	35, 31, 37, 36, 24	.33, .31, .34, .38, .36	33 (.13)
Northeast Bottom Trawl[e]	04-08	Obs. Data Dealer Data VTR Data	.05, .12, .06, .06, .08	0, 0, 0, 0, 0	0, 2, 4, 1, 4, 5	0, 0, 0, 0, 0	15, 15, 14, 12, 10	15, 15, 14, 12, 10	.29, .30, .28, .35, .34	13 (.12)

Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[d]	04-08	Obs. Data Dealer Data VTR Data	.064, .084, .089, .0439, .131	0, 0, 0, 0, 0	0, 0, 0, 1, 0	0, 0, 0, 0, 0	8.1, 7.5, 0, 0, 0, 11.212 4.9, 0	0, 0, 0, 11.212, 08.1, 7.5, 0, 4.9, 0	.38, .76, 0, 0, 0, .71020.99, 0	42.24 (.141.020.99)
Northeast Mid-Water Trawl - Including Pair Trawl[d]	04-08	Obs. Data Dealer Data VTR Data	.1326, .20199, .031, .08, .208	0, 0, 0, 0, 0	1, 0, 0, 0, 63	0, 0, 0, 0, 0	1.4, 1.1, 0, 0, 6.55.3, 0, 0, 0, 13.116	5.3, 0, 0, 0, 13.1161.4, 1.1, 0, 0, 6.5	.58, .68, 0, 0, .560.982, 0, 0, 0, .601,	3.71.84.3 (.0751)
Pelagic Longline	04-08	Obs. Data Logbook	.09, .06, .07, .07, .07	6, 9, 12, 5, 5	0, 0, 1, 0, 0	74, 212, 169, 57, 98	0, 0, 16, 0, 0	74, 212, 185, 57, 98	.42, .21, .47, .65, .42	122 (.19)
2005 Pelagic Longline experimental fishery[e]	05	Obs. Data	1	1	0	1	0	1	1.00	1(1.00)
TOTAL										1756 (.14)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

[b] Observer coverage of the Mmid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

[c] NE and MA bottom trawl mortality estimates reported for 2007 and 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 and 2008 effort. Complete documentation of methods used to estimate cetacean bycatch mortality are described in Rossman (2009).

[d] Within each of the fisheries (Northeast and Mid-Atlantic), tThe paired and single trawl data were pooled. used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one1 data set and assumed to represent average fishing practices during the time period. Ratio estimation methods were used within each fishery and year to estimate the total the annual bycatch. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one1 given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

[e] A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield- Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC) 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2004- to 2008, 44 short-finned pilot whales (*Globicephala macrorhynchus*), 68 long-finned pilot whales (*Globicephala melas melas*), and 11 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). From 2003 to 2007, 72 short-finned pilot whales (*Globicephala macrorhynchus*), 78 long-finned pilot whales (*Globicephala melas*), and 8 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3).This includes one1 mass stranding of 18 long-finned pilot whales (including one1 pregnant female) as part of a multi-species mass stranding in Barnstable County, Massachusetts, on 10 December 2005. This includes several mass strandings as follows: 57 long finned pilot whales mass stranded in 2002 in Dennis, Massachusetts, and 18 in Brewster, Massachusetts in 2005; 28 short-finned pilot whales stranded in Content Passage, Monroe County, Florida (Atlantic side) on 18 April 2003, and 31 short-finned pilot whales stranded on the Outer Banks of North Carolina on 15-16 January 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released . Both

~~animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently, animals that are returned to the water swim away and strand someplace else~~ (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980)

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale~~. A final report on this UME is pending (Barco, in prep.)~~.

An Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale ~~(*Globicephala macrorhynchus*)~~ was involved in this UME.

A UME mass stranding of ~~thirty-three~~33 short-finned pilot whales, including 5~~five~~ pregnant females, near Cape Hatteras, North Carolina, occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006),~~ though~~ but no single cause for the UME was determined. ~~Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known.~~

Short-finned pilot whales strandings ~~(*Globicephala macrorhynchus*)~~ have been reported stranded as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales ~~(*Globicephala melas*)~~ have been reported stranded as far south as Florida, when 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate~~—~~. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

~~Between~~During ~~2003 and~~2004~~-2007~~2008, several human and/or fishery interactions were documented in stranded pilot whales. ~~Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida.~~ During a UME in Dare, North Carolina, in January 2005, ~~six~~6 of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, ~~one~~1 with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, ~~two~~2 were reported as exhibiting signs of human interaction, ~~one~~1 in Massachusetts and ~~one~~1 in Virginia. In 2008, ~~one~~1 Massachusetts stranding mortality was deemed a fishery interaction due to line markings and cut flukes. The ~~two~~2 New York strandings of long-finned pilot whales were classified as human interactions.

~~Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2003-2007. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.~~

~~STATE~~	~~2003~~			~~2004~~			~~2005~~			~~2006~~			~~2007~~			~~TOTALS~~		
~~-~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~
~~Nova Scotia[a]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~12~~
~~Maine~~	~~0~~	~~1~~	~~0~~	~~0~~	~~4~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1[b]~~	~~0~~	~~0~~	~~9~~	~~0~~
~~New Hampshire~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~

Massachusetts	0	5	0	0	1	0	0	22[m]	0	0	2	0	0	6[e]	0	0	36	0
Rhode Island	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	0	0	3	0	0	1	0	0	0	0	0	2	0	0	6	0
New Jersey	0	6[d]	0	0	0	0	0	0	2	1	0	0	0	1	0	1	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4	0
Virginia	0	3	0	0	0	1[e]	0	4[n]	0	0	2	0	0	0	0	0	9	1
North Carolina	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	0	0	0	38	2	5
South Carolina	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	31	18	1	5	10	2	35	35	4	1	6	1	0	10	0	72	78	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Long-finned pilot whale stranded in Maine in 2007 released alive.
c. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water.
d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
f. One short-finned pilot whale (September) and one pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
g. Only moderate confidence on species identification as long-finned pilot whale.
h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on 19 April 2003 – 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August 2003.
i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
j. One long-finned pilot whale floating dead on Georges Bank offshore.
k. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.
l. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005.
n. Sign of human interaction (a line on the flukes) observed on 2 animals, and one animal was a pregnant female.

Table 3. Pilot whale (*Globicephala macrorhynchus* ([SF]), *Globicephala melas melas* ([LF]) *and Globicephala* sp. ([Sp])) strandings along the Atlantic coast, 2004-2008. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2004			2005			2006			2007			2008			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp

Nova Scotia[a]	0	0	3	0	0	2	0	0	3	0	0	2	0	0	0	0	0	10
Newfoundland and Labrador[b]	0	2	0	0	2	0	0	0	3	0	0	1	0	0	2	0	4	6
Maine[c]	0	4	0	0	2	0	0	1	0	0	1	0	0	1	1	0	9	1
New Hampshire	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Massachusetts[d]	0	1	0	0	22	0	0	2	0	0	6	0	0	1	1	0	32	1
Rhode Island	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0
New York	0	3	0	0	1	0	0	0	0	0	2	0	0	2	0	0	8	0
New Jersey	0	0	0	0	0	2	1	0	0	0	1	0	0	1	0	1	2	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0
Virginia[e]	0	0	1	0	4	0	0	2	0	0	0	0	0	0	0	0	6	1
North Carolina[f]	1	1	1	35	1	2	0	0	1	0	0	0	3	0	1	39	2	5
South Carolina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Florida	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
EEZ	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS - U.S., Puerto Rico, & EEZ	5	10	2	35	35	4	1	6	1	0	10	0	3	7	4	44	68	11

[a] Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
[b] (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009).
[c] Long-finned pilot whale stranded in Maine in 2007 released alive.
[d] Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water.
[e] One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated). Sign of human interaction (a line on the flukes) observed on 2 animals in 2005, and 1 animal was a pregnant female.
[f] In 2004, 1 short-finned pilot whale (September) and 1 pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in February, not related to any UME. 2005 includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death. Signs of fishery interaction observed on a short-finned pilot whale stranded in May 2005.

In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia, from 1970 to 1998 (Lucas and Hooker 2000). This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in 1991-1996 (Hooker *et al.* 1997). Several mass live strandings occurred in Nova Scotia recently. ~~-- 14~~Fourteen pilot whales live mass stranded in 2000, ~~and~~ 3 in 2001 in Judique, Inverness County, and 4 pilot whales live mass stranded at Point Tupper, Inverness County, in 2002, though no specification to species was made.

Mass strandings of long-finned pilot whales were more frequent several decades ago in Newfoundland when this species was more abundant (Table 4). Recent Newfoundland and Labrador strandings are reported in Table 3. ~~With the collapse of the squid stocks on the Grand Banks, pilot whale numbers in the area declined and there have been few or no strandings in recent years (Lawson, DFO, pers. comm.).~~

Table 4~~—~~ Pilot whale mass strandings along the Newfoundland, Canada coast.

Year	Date	Number of Pilot Whales Stranded	Place in Newfoundland
1979	July 14	135	Pt. au Gaul
1980	October 19	70	Pt. Leamington

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	October 25	18	Grand Beach
1982	July 27 August 18	23 3	Grand Bank Bonavista
1983	early January	10	Piccadilly
1984	July 15	5	Middle Cove
1990	December 14	4	St. Anthony

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for long-finned pilot whales is unknown, since it is not possible to partition mortality estimates between the ~~two~~2 species~~—~~. However, it is most likely not less than 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate~~—~~. The total fishery mortality may exceed PBR; however, it is unknown to what extent the pelagic longline fishery in particular impacts this stock~~—~~. Due to the possibility of exceeding PBR, ~~this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. t~~~~T~~his should be considered a~~is not a~~ strategic stock~~ because the 2003~~2004 ~~2007 ~~2008 estimated average annual human-related mortality does not exceed PBR~~. However, the inability to partition mortality estimates between the species limits the ability to adequately assess the status of this stock.~~However, the continuing inability to distinguish between species of pilot whales, and the fact that PBR and abundance estimates are not available for the individual stocks, raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.~~

REFERENCES CITED

Abend, A. 1993. Long-finned pilot whales distribution and diet as determined from stable carbon and nitrogen ratio isotope tracers. M.S. thesis, University of Massachusetts, Amherst, MA. 147 pp.

Abend, A.G. and T.D. Smith. 1999. Review of distribution of the long-finned pilot whale (*Globicephala melas*) in the North Atlantic and Mediterranean. NOAA Tech. Memo. NMFS-NE-117. 22 pp.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Benjamins, S., J. Lawson and G. Stenson. 2007. Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage. 9(3): 189-200.

Bloch, D. and L. Lastein. 1993. Morphometric segregation of long-finned pilot whales in eastern and western North Atlantic. Ophelia 38: 55-68.

Bloch, D., M. Zachariassen and P. Zachariassen. 1993. Some external characters of the long-finned pilot whale off Faroe Island and a comparison with the short-finned pilot whale. Rep. Int. Whal. Comm. (Special Issue) 14: 117-135.

Buckland, S.T., D.R. Andersen, K.P. Burnham and J.L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York. 446 pp.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S.

outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, DC. #AA551-CT8-48**:** 576.

Dam, M. and D. Bloch. 2000. Screening of mercury and persistent organochlorine pollutants in long-finned pilot whale (*Globicephala melas*) in the Faroe Islands. Mar. Poll. Bull. 40: 1090-1099.

Desportes, G., M. Saboureau and A. Lacroix. 1993. Reproductive maturity and seasonality of male pilot long-finned whales off the Faroe Islands. Rep. Int. Whal. Comm. (Special Issue) 14: 233-262.

Fairfield, C.P. and L.P. Garrison. 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NOAA NMFS-SEFSC-572. 62 pp.

Fairfield Walsh, C. and L.P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NMFS-SEFSC-539. 52 pp.

Fairfield Walsh, C. and L.P. Garrison. 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NMFS-SEFSC-560. 54 pp.

Fehring, W.K. and R.S. Wells. 1976. A series of strandings by a single herd of pilot whales on the west coast of Florida. J. Mamm. 57(1): 191-194.

Fullard, K.J., G. Early, M.P. Heide-Jorgensen, D. Bloch, A. Rosing-Asvid and W. Amos. 2000. Population structure of long-finned pilot whales in the North Atlantic: a correlation with sea surface temperature? Mol. Ecol. 9: 949-958.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.

Garrison, L.P. 2007. Estimated marine mammal and turtle bycatch in the shark gillnet fisheries along the Southeast U.S. Atlantic coast: 2000-2006. NMFS, Southeast Fisheries Science Center, Protected Resources and Biodiversity Division. PRD-07/08-02. 22 pp.

Garrison, L.P., A. Martinez and K.M. Foley. in prep. Habitat and abundance of marine mammals in Atlantic Ocean continental slope waters off the eastern U.S. . J. Cetacean Res. Manage.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527. 57 pp.

Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, No. Carolina, USA to Nova Scotia, Canada). Mar. Mamm. Sci. 18(4): 920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald and D. G. Robertson, (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam.

Hohn, A.A., D.S. Rotstein, C.A. Harms and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. NOAA Tech. Memo. NMFS-SEFSC-537. 222 pp.

Hooker, S.K., R.W. Baird and M.A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

ICES. 1993. Report of the study group on long-finned pilot whales, Copenhagen, Denmark, ICES [International Council for the Exploration of the Sea], 30 August - 3 September 1993. CM 1993/N:5.

Irvine, A.B., M.D. Scott, R.S. Wells and J.G. Mead. 1979. Stranding of the pilot whale, *Globicephala macrorhynchus*, in Florida and South Carolina. Fish. Bull. 77(2): 511-513.

Johnson, D.R., C.A. Brown and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. NOAA Tech. Memo. NMFS- SEFSC-418. 70 pp.

Kasuya, T., D.E. Sergeant and K. Tanaka. 1988. Re-examination of life history parameters of long-finned pilot whales in the Newfoundland waters. Sci. Rep. Whales Res. Inst. 39: 103-119.

Lawson, J.W. and J.-F. Gosselin. 2008. Distribution and preliminary abundance estimates for cetaceans seen during Canada‘s Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 208/031. 33 pp.

Leatherwood, S., D.K. Caldwell and H.E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396. 176 pp.

Ledwell, W. and J. Huntington. 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington. 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.

Ledwell, W. and J. Huntington. 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington. 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.

Ledwell, W. and J. Huntington. 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda, Newfoundland and Labrador region.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES [Int. Counc. Explor. Sea] C.M. 1997/Q:08: 10.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

Martin, A.R. and P. Rothery. 1993. Reproductive parameters of female long-finned pilot whales (*Globicephala melas*) around the Faroe Islands. Rep. Int. Whal. Comm. (Special Issue) 14: 263-304.

Muir, D.C.G., R. Wagemann, N.P. Grift, R.J. Norstrom, M. Simon and J. Lien. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland, Canada. Arch. Environ. Contam. Toxicol. 17(5): 613-629.

Nielsen, J.B., F. Nielsen, P.-J. Jorgensen and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). Mar. Poll. Bull. 40: 348-35.

NMFS. 1993. Status of fishery resources off the northeastern United States for 1993. National Marine Fisheries Service. NOAA Tech. Memo. NMFS-F/NEC-101. 140 pp.

Odell, D.K., E.D. Asper, J. Baucom and L.H. Cornell. 1980. A recurrent mass stranding of the false killer whale, *Pseudorca crassidens*, in Florida. Fish. Bull. 78(1): 171-177.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (special issue) 16: 27-50.

Palka, D.L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans, European Cetacean Society‘s 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Palka, D.L. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Payne, P.M. and D.W. Heinemann. 1993. The distribution of pilot whales (*Globicephala* sp.) in shelf/shelf edge and slope waters of the northeastern United States, 1978-1988. Rep. Int. Whal. Comm. (Special Issue) 14: 51-68.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Comm. (Special Issue) 15: 133-147.

Rossman, M.C. 2009. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000-2005. J. Northwest Fish. Sci. 42: 77-101.

Sergeant, D.E. 1962. The biology of the pilot or pothead whale (*Globicephala melaena* (Traill)) in Newfoundland waters. Bull. Fish. Res. Bd. Can 132: 1-84.

Siemann, L. 1994. Mitochondrial DNA sequence variation in North Atlantic long-finned pilot whales, *Globicephala melas*. Ph.D. thesis, Massachusetts Institute of Technology/ Woods Hole Oceanographic Institution.

Taruski, A.G., C.E. Olney and H.E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. J. Fish. Res. Board Can 32(11): 2205-2209.

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waring, G.T. 1995. Fishery and ecological interactions for selected cetaceans off the Northeast USA. Ph.D. thesis, University of Massachusetts, Amherst, MA. 260 pp.

Waring, G.T., C.P. Fairfield, C.M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream Features off the Northeastern USA Shelf. ICES [Int. Counc. Explor. Sea] C.M. 1992/N:12.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull. 88(2): 347-360.

Waring, G.T., E. Josephson, C.P. Fairfield and K. Maze-Foley, eds. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201.

Weisbrod, A.V., D. Shea, M.J. Moore and J.J. Stegeman. 2000. Bioaccumulation patterns of polychlorinated biphenyls and chlorinated pesticides in northwest Atlantic pilot whales. Environ. Toxicol. Chem. 19: 667-677.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo. NMFS-SEFSC-467. 43 pp.

~~December 2009~~~~January~~

March 2010

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Western North Atlantic Stock

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STOCK DEFINITION AND GEOGRAPHIC RANGE

~~The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters .~~ There are 2~~two~~ species of pilot whales in the western North Atlantic - the ~~Atlantic or~~ long-finned pilot whale, *Globicephala melas,* and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, ~~much of the descriptive material below refers to *Globicephala* sp. and is identi~~the ability to separately assess the 2~~two~~ stocks in U.S. Atlantic waters is limited. ~~fied as such.~~ Sightings of ~~these~~ pilot whales (*Globicephala sp.*) ~~animals~~ in the ~~U.S. Atlantic EEZ~~western North Atlantic occur ~~in oceanic waters~~ primarily near the continental shelf break ranging from Florida to the Nova Scotian Shelf (Mullin and Fulling 2003). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey (Payne and Heinemann 1993; Garrison *et al.*, in review). In addition, short-finned pilot whales are documented ~~and~~ along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2003), and they are also known from the wider Caribbean. Studies are currently being conducted at the Southeast Fisheries Science Center to evaluate genetic population structure in short-finned pilot whales. ~~. Information on stock differentiation for the Atlantic population based on morphological, genetic, and/or behavioral data is in progress.~~ Pending these results, the ~~western North Atlantic~~ *Globicephala* ~~sp~~ *macrorhynchus*~~.~~ ~~Population~~population occupying U.S. Atlantic waters~~(s)~~ is ~~provisionally being~~ considered ~~a~~ separate ~~stock~~ from both the northern Gulf of Mexico stock and short-finned pilot whales occupying Caribbean waters~~(s)~~.

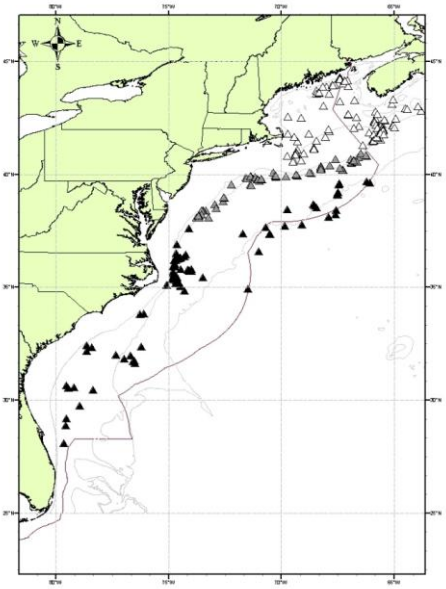

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. The inferred distribution of the two species is preliminary and is valid for June-August only. –Isobaths are at the 100-m, 1,000-m, and 4,000-m depth contours.*

POPULATION SIZE

The total number of short-finned pilot whales off the eastern U.S. ~~and Canadian~~ Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as *Globicephala sp*. ~~Sightings~~ ~~s~~Sightings ~~were~~ from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1). Combined abundance estimates for the ~~two~~2 species have previously been derived from line transect surveys. The best available abundance estimates are from surveys conducted during the summer of 2004 because these are the most recent surveys covering the full range of pilot whales in U.S. Atlantic waters. These survey data have been combined with an analysis of the spatial distribution of the ~~two~~2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison *et al.*, in ~~prep~~review). The resulting

abundance estimate for short-finned pilot whales is 24,674 (CV~~=~~ 0.45). ~~almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 + 15,411 = 31,139 whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.~~

Earlier Estimates

Please see appendix IV for earlier estimates and descriptions of abundance surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 ~~which covered~~covering 7,465 ~~-~~km of trackline ~~over~~ in U.S. waters from the 1,000~~–~~-m depth contour on the southern edge of Georges Bank north to the Gulf of ~~to~~ Maine (Table 1; Palka 2006). The value of *g(0),* the probability of detecting a group on the track line,~~,~~ used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 ~~-~~km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the ~~two~~2~~-~~ independent-team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*. Aerial data were collected using the Hiby circle-back line~~-~~ transect~~s~~ method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5°N and 38ºN latitude) was conducted during June-August 2004. The survey employed ~~two~~2 independent visual teams searching with 25× bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the ~~M~~mid-Atlantic. The survey included 5,659 ~~-~~km of trackline, and collected a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina, along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was ~~15,411~~21,056 animals (CV ~~-~~=0.~~43~~54;~~)~~. Garrison *et al.*, in review).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 ~~which~~ that covered 10,676 ~~-~~km of trackline in the region from the 2,000~~-~~-m depth contour on the southern edge of Georges Bank north to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence~~-~~ (Table 1; Palka pers. comm.).

An abundance estimate of 6,134 (95% CI=2,774-10,573) pilot whales was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases~~-~~ (Lawson and Gosselin 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	~~15,411~~21,056	0.~~43~~54

Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	~~31,139~~36,784	0.~~27~~34
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35
July-Aug 2007	N. Labrador to Scotian Shelf	6,134	0.28

Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*

Biopsy samples from pilot whales were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples. Based upon the date and location of sample collection, the probability of a sample being from a short-finned (or long-finned) pilot whale was evaluated as a function of sea surface temperature and water depth using logistic regression. This analysis indicated that at water temperatures ~~less than~~< 22°C, the probability of a sample coming from a short-finned pilot whales was near ~~zero~~0, and at temperatures >25°C, this probability was near 1. The probability of a short-finned pilot whale also increased with increasing water depth. Spatially, during summer months, this habitat model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. ~~-~~The area of overlap between the ~~two~~2 species occurred primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude. This habitat model was used to partition the abundance estimates from surveys conducted during the summer of 2004. The survey covering waters from Florida to Maryland was predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast survey covering the Gulf of Maine and~~,~~ the Bay of Fundy and surveys conducted in Canadian waters ~~a~~were predicted to consist entirely of long-finned pilot whales. The vessel portion of the northeast survey contained a mix of both species, with the sightings in offshore waters near the Gulf Stream predicted to consist of short-finned pilot whales. The best abundance estimate for short-finned pilot whales is thus the sum of the southeast survey estimate (21,056 [CV=~~-~~0.54]) and the estimated number of short-finned pilot whales from the northeast vessel survey (3,618 [CV=0.50]). The best available abundance estimate is thus 24,674 (CV=~~-~~0.45) (Garrison *et al.*, in review~~,~~; Garrison *et al.*, in prep.).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic *Globicephala~~a~~* ~~sp~~ *macrorhynchus*~~.~~ is ~~31,139~~24,674 animals (CV=0.~~27~~45)~~, derived from the 2004 survey.~~ ~~s.~~ The minimum population estimate ~~for *Globicephala* sp.~~ is ~~24,866~~17,190.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala* ~~*sp.*~~*macrorhynchus.*

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from ~~long~~short-finned pilot whales taken in ~~the Newfoundland drive fishery include~~fisheries off the Pacific coast of Japan. In this region, there are ~~two~~2 distinct stocks of short-finned pilot whales described as "northern" and "southern" types. There were demonstrable differences in the demographic parameters of these ~~two~~2 forms perhaps related to habitat differences (Kasuya and Tai~~,~~ 1993). The northern form ~~were~~as generally larger and had a later age at sexual maturity than the southern form. The ranges of values for demographic parameters for both stocks are: calving interval ~~3.3~~5.1 – 7.8 years; lactation period about ~~21-22~~2.0 - 2.78 years ~~months~~; gestation period ~~12~~ approximately 15 months;~~ births mainly from June to November~~; length at birth ~~of 177~~ 140 - 185 cm; mean length at sexual maturity of ~~490~~ 420 ~~–~~ 560 cm for males and ~~356~~ 316-400 cm for females; mean age at sexual maturity of ~~12~~ 17 years for males and ~~6~~ 8 - 9 years for females; ~~mean adult length of 557 cm for males and 448 cm for females;~~ and maximum age of ~~40~~ 45 for males and ~~50~~ 62 for females (Kasuya and

Tai 1993). ~~Analysis of data from animals taken in the Faroe Islands drive fishery for long-finned pilot whales produced higher values for all parameters . These differences are likely related, at least in part, to larger sample sizes and different analytical techniques.~~

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for ~~*Globicephala* sp.~~short-finned pilot whales is 17,190~~24,866~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic ~~Globicephala sp.~~short-finned pilot whale~~s~~ is ~~249~~172.~~. It is not possible to determine the PBR for only short-finned pilot whales.~~

ANNUAL HUMAN-CAUSED MORTALITY

The total annual human caused mortality of short-finned pilot whales cannot be determined. The highest bycatch rates in the pelagic longline fishery area were observed during September – October along the mid-Atlantic coast (Garrison 2007). In bottom trawls, most mortalities were observed in the same area between July and November (Rossman 2006~~9~~). The model used to derive abundance estimates uses data restricted to the warmest months of the year (June-August), and there is currently very little data available for the potential area of overlap during the fall. ~~The majority of observed mortality and serious injury to pilot whales is observed during October-November along the mid-Atlantic coast (Garrison 2007;Rossman 2006). The habitat model described above is valid only for summer months, and t~~Therefore it is not possible to partition mortality estimates between the ~~two~~2 species because there are very few available genetic samples from the area of overlap and season where most mortality occurs. Mortality and serious injury estimates are thus presented only for the ~~two~~2 species combined. Total annual estimated average fishery-related mortality or serious injury ~~to this stock~~ during ~~2003~~2004-~~2007~~ 2008 was ~~166~~ 176 pilot whales (CV=0.14; Table 2). Of this, it is most likely that the mortality due to the pelagic longline fishery, the mid-Atlantic midwater trawl fishery, and the mid-Atlantic groundfish fishery have the most direct impact on short-finned pilot whales.

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the ~~two~~2 species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) were taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0).

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the

Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In ~~one~~1 interaction, the net was pursed around ~~one~~1 pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001 with no marine mammals ~~were~~ observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none were observed taken from 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 in 1998 (CV=1.10).

One pilot whale take was observed in the *Illex* squid portion of the Southern New England/~~M~~mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the Southern New England/~~M~~mid-Atlantic Squid, Mackerel, and Butterfish Trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998 and 49 in 1999 (CV=0.97). These estimates should, however, be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was ~~one~~1 observed take in the Southern New England/mid-Atlantic Bottom Trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 from 1996-1998, and 228 (CV= 1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on the earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.~~-~~S. Pela~~l~~gic Longline Fishery was ~~from~~ recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008)~~-~~. Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and ~~2006~~2008, ~~128~~ 154 pilot whales were observed released alive, including ~~73~~ 83 that were considered seriously injured, and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009)~~-~~. January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms deep during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20- and 50~~-~~fathom isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, 16 (CV~~=~~1.00) in 2006, and 0 in 2007. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995, (includes 37 estimated short-finned pilot whales in 1995 (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV~~=~~0.58), 51 in 2002 (CV~~=~~0.48), 21 in 2003 (CV~~=~~ 0.78), 74 in 2004 (CV=0.42), 212 in 2005 (CV=0.21), 169 in 2006 (CV~~=~~0.31), ~~and~~ 57 (CV=0.47) in 2007, and 98 (CV=0.42) in 2008. The average „combined' annual mortality and serious injury in ~~2003~~2004-~~2007~~ 2008 was

122~~110~~ pilot whales (CV=0.~~20~~19) (Table 2).

An experimental fishery was conducted on 6~~six~~ vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques with standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" sighing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including ~~one~~1 which was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the ~~M~~mid-Atlantic bottom trawl in 2000, ~~four~~4 in 2005, ~~one~~1 in 2006, ~~and zero~~0 in 2007, and ~~zero~~0 in 2008. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38 (CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, 37 (CV=0.34) in 2006, ~~and~~ 37 (CV=0.38) in 2007, and 24 (CV=0.36) in 2008. The ~~2003~~2004-~~2007~~ 2008 average mortality attributed to the ~~M~~mid-Atlantic bottom trawl was ~~3~~34 animals (CV=0.~~15~~13).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, ~~four~~4 in 2005, ~~one~~1 in 2006, ~~and four~~4 in 2007, and five in 2008. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, ~~and~~ 12 (CV=0.35) in 2007, and 10 (CV=0.34) in 2008. The ~~2003~~2004-~~2007~~ 2008 average mortality attributed to the northeast bottom trawl was 15 animals (CV=0.13).

Northeast Mid-Water Trawl – Including Pair Trawl

In Sept 2004 a~~A~~ pilot whale was observed taken in the paired~~single~~ mid-water trawl fishery on the northern edge of Georges Bank (off ~~of~~ Massachusetts) in a haul that was targeting (and primarily caught) herring ~~in 2004~~. In April 2008, six pilot whale takes were observed in the single mid-water trawl fishery in hauls targeting mackerel and located on the southern edge of Georges Bank. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the ~~bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including~~ paired and single~~, and~~ Northeast ~~and Mmid-Atlantic~~ mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel~~. The VTR~~ data were used to estimate the total effort (Palka, pers. comm.). ~~The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth, as significant explanatory variables, where soak duration was the unit of effort.~~ Estimated annual fishery-related mortalities were: unknown in 2001-2002, ~~1.9 (CV=0.56)~~0 in 2003, and 5~~.~~ ~~36~~1.4 (CV=0.9~~82~~58) in 2004, ~~1.1 (CV=0.68)~~0 in 2005 to~~, 0 in 2006,~~ ~~and 0 in~~ 2007~~-~~, and ~~6.5~~13.~~1~~16 (CV=0.6~~0~~1~~0.56~~) in 2008~~.~~ (Table 2; Palka pers. comm.). The average annual estimated mortality during 2004-2008 was ~~3.71.84~~.3 (CV=0.51~~07~~).~~(Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2003-2007 was 1 (CV=0.35).~~

~~A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and Northeast and Mmid-Atlantic mid-water trawls (Palka, pers. comm.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. Estimated annual fishery-related mortalities were: unknown in 2001-2002, 1.9 (CV=0.56) in 2003, 1.4 (CV=0.58) in 2004, 1.1(CV=.68) in 2005, 0 in 2006, and 0 in 2007. (Table 2; Palka, pers. comm.). The average annual estimated fishery-related mortality during 2003-2007 was 1 (CV=0.35).~~

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)

In March 2007 a~~No~~ pilot whale~~s~~ was~~ere~~ observed bycaught in the single mid-water~~is~~ fishery ~~between 2002 and 2006, or in 2008, though because of data pooling, estimates were still generated for some years~~ in a haul targeting herring that was south of Rhode Island. Due to small sample sizes, the ratio method was used to estimate the bycatch

rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort~~the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls~~ (Palka, pers. comm.). ~~The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort.~~ Estimated annual fishery-related mortalities were unknown in 2002, 0 in~~3.9 (CV=0.46) in~~ 2003 ~~, 8.1 (CV=0.38) in 2004, 7.5 (CV=0.76) in 2005, 0 in~~ to 2006, ~~and~~ ~~11.24.9~~12.1 (CV=~~0.70~~1.~~02~~0.99) in 2007~~-~~, and 0 in 2008 (Table 2; Palka pers. com.). The average annual estimated mortality during 2004-2008 was 2.~~24~~4 (CV=~~0.1.02~~0.99~~4~~).~~(Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2003-2007 was 5 (CV=0.31).~~

~~No pilot whales were observed bycaught in this fishery between 2002 and 2006, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. comm.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. Estimated annual fishery-related mortalities were unknown in 2001-2002, 3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, 7.5 (CV=.76) in 2005, 0 in 2006, and 4.9 (CV=0.70) in 2007 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2003-2007 was 5 (CV=0.31).~~

CANADA

An unknown number of long-finned pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches were recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100 ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (Hooker *et al.* 1997). During the 1991-1996 periods, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker *et al.* 1997).

There was ~~one~~1 record of incidental catch in the offshore Greenland halibut fishery that involved ~~one~~1 long-finned pilot whale in 2001 although no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala* sp.) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Data Type ~~b~~a	Observer ~~Coverage~~ c Coverage b	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality

Mid-Atlantic Bottom ~~Trawl[d]~~Trawl[c]	~~03~~04-~~07~~08	Obs. Data Dealer	~~.01,~~ .03, .03, .02, .03, .03	0, 0, 0, 0, 0	~~0,~~ 0, 4, 1, 0, 0	0, 0, 0, 0, 0	~~31,~~ 35, 31, 37, 36, 24	~~31,~~ 35, 31, 37, 36, 24	~~.31,~~ .33, .31, .34, .38, .36	~~34~~ 33 (~~.15~~13)
Northeast Bottom ~~Trawl[d]~~ Trawl[c]	~~03~~04-~~07~~08	Obs. Data Dealer Data VTR Data	~~04,~~ .05, .12, .06, .06, .08	0, 0, 0, 0, 0	~~0,~~ 0, 2, 4, 1, 4, 5	0, 0, 0, 0, 0	~~20,~~ 15, 15, 14, 12, 10	~~20,~~ 15, 15, 14, 12, 10	~~.26,~~ .29, .30, .28, .35, .34	~~15~~ 13 (~~.13~~12)
Mid-Altlantic Mid-Water Trawl - Including Pair ~~Trawl[e]~~Trawl[d]	~~03~~04-~~07~~08	Obs. Data Dealer Data VTR Data	.06, .08, .09, .04, ~~.13.018, .064, .084, .089, .039~~	0, 0, 0, 0, ~~00, 0, 0, 0, 0~~	0, 0, 0, 1, ~~09, 0, 0, 0~~	0, 0, 0, 0, ~~00, 0, 0, 0, 0~~	0, 0, 0, ~~11.2~~12, ~~03.9, 8.1, 7.5, 0, 4.9~~	0, 0, 0, ~~11.2~~12 ~~.03.9, 8.1, 7.5, 0, 4.9~~	.0, 0, 0, ~~1.02~~0 .99, ~~0.46, .38, .76, 0, .70~~	2 ~~.24~~ (~~1.02~~0.99) ~~5 (.31)~~
Northeast Mid-Water Trawl - Including Pair Trawl [e][d]	~~03~~04-~~07~~08	Obs. Data Dealer Data VTR Data	.13, .20, .03, .08, ~~.20.031, .126, .199, .031, .08~~	0, 0, 0, 0, ~~00, 0, 0, 0, 0~~	1, 0, 0, 0, ~~60, 1, 0, 0, 0~~	0, 0, 0, 0, ~~00, 0, 0, 0, 0~~	5.3, 0, 0, 0, ~~13.116~~1.9, ~~1.4, 1.1, 0, 0~~	5.3, 0, 0, 0, ~~13.116~~1.9, ~~1.4, 1.1, 0, 0~~	0.9~~8~~2, 0, 0, 0, ~~.60~~1, ~~.5 6, .58, .68, 0, 0~~	~~3.74~~.3 (.51)~~1 (.35)~~
Pelagic Longline ~~(excluding NED-E)[f]~~	~~03~~04-~~07~~08	Obs. Data Logbook	~~.09,~~ .09, .06, .07, ~~.0807, .22~~.07	~~2,~~ 6, 9, 12, 5, 5	~~0,~~ 0, 0, 1, 0, 0	~~21,~~ 74, 212, 169, 57, 98	~~0,~~ 0, 0, 16, 0, 0	~~21,~~ 74, 212, 185, 57, 98	~~.77,~~ .42, .21, .47, .65, .42	~~110~~122 (.~~20~~19)
2005 Pelagic Longline experimental ~~fishery[g]~~fishery[f]	05	Obs. Data	1	1	0	1	0	1	1.00	1(1.00)
TOTAL										~~166~~ 17~~56~~ (.14)

~~[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.~~

[~~b~~a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

[~~c~~b] Observer coverage of the ~~M~~mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

[~~d~~c] NE and MA bottom trawl mortality estimates reported for 2007 and 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 and 2008 effort. Complete documentation of methods used to estimate cetacean bycatch mortality are described in ~~'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in early 2009~~Rossman (2009).

[~~e~~d] Within each of the fisheries (Northeast and Mid-Atlantic), the paired and single trawl data were pooled. Ratio estimation methods were used within each fishery and year to estimate the total the annual bycatch.

~~f. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).~~

[~~g~~f] ~~e~~ A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield- Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC)~~(NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC)~~. From ~~2003~~2004-

~~2007~~2008, ~~72~~ 44 short-finned pilot whales (*Globicephala macrorhynchus*) ~~(*Globicephala macrorhynchus*)~~, ~~78~~ 68 long-finned pilot whales (*Globicephala melas melas*), and ~~8~~ 11 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes ~~several one~~1 mass strandin~~gs as follows: 57 long-finned pilot whales stranded in 2002 in Dennis, Massachusetts; 28 short-finned pilot whales stranded in Content Passage, Monroe County, Florida (Atlantic side) on 18 April 2003; and~~ g of 18 long-finned pilot whales (including ~~one~~1 pregnant female) as part of a multi-species mass stranding in Barnstable County, Massachusetts, on 10 December 2005. ~~Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et al.* 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals, when known, is footnoted in Table 3.~~

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale. A final report on this UME is pending (Barco, in prep.).

An Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale ~~(*Globicephala macrorhynchus*)~~ was involved in this UME.

A UME mass stranding of 33~~thirty-three~~ short-finned pilot whales, including ~~five~~5 pregnant females, occurred near Cape Hatteras, North Carolina, from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006)~~(Hohn *et al.* 2006)~~, ~~though~~ but no single cause for the UME was determined.

~~Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known.~~

~~Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2003-2007. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.~~

~~STATE~~	~~2003~~			~~2004~~			~~2005~~			~~2006~~			~~2007~~			~~TOTALS~~		
-	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~
~~Nova Scotia[a]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~12~~
~~Maine~~	~~0~~	~~1~~	~~0~~	~~0~~	~~4~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1[b]~~	~~0~~	~~0~~	~~9~~	~~0~~
~~New Hampshire~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~
~~Massachusetts~~	~~0~~	~~5~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~22[m]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~6[e]~~	~~0~~	~~0~~	~~36~~	~~0~~
~~Rhode Island~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~2~~	~~0~~
~~Connecticut~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~New York~~	~~0~~	~~0~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~6~~	~~0~~
~~New Jersey~~	~~0~~	~~6[d]~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~2~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~	~~6~~	~~2~~
~~Delaware~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Maryland~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~4~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~4~~	~~0~~
~~Virginia~~	~~0~~	~~3~~	~~0~~	~~0~~	~~0~~	~~1[e]~~	~~0~~	~~4[n]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~9~~	~~1~~

North Carolina	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	0	0	0	38	2	5
South Carolina	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	31	18	1	5	10	2	35	35	4	1	6	1	0	10	0	72	78	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Long-finned pilot whale stranded in Maine in 2007 released alive.
c. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water.
d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
f. One short-finned pilot whale (September) and one pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
g. Only moderate confidence on species identification as long-finned pilot whale.
h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on 19 April 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August 2003.
i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
j. One long-finned pilot whale floating dead on Georges Bank offshore.
k. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.
l. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005.
n. Sign of human interaction (a line on the flukes) observed on 2 animals, and one animal was a pregnant female.

Table 3. Pilot whale (*Globicephala macrorhynchus* ([SF)], *Globicephala melas_melas* ([LF)] *and Globicephala* sp. ([Sp)]) strandings along the Atlantic coast, 2004-2008. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2004			2005			2006			2007			2008			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	3	0	0	2	0	0	3	0	0	2	0	0	0	0	0	10
Newfoundland and Labrador[b]	0	2	0	0	2	0	0	0	3	0	0	1	0	0	2	0	4	6
Maine[c]	0	4	0	0	2	0	0	1	0	0	1	0	0	1	1	0	9	1
New Hampshire	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Massachusetts[d]	0	1	0	0	22	0	0	2	0	0	6	0	0	1	1	0	32	1
Rhode Island	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0
New York	0	3	0	0	1	0	0	0	0	0	2	0	0	2	0	0	8	0

New Jersey	0	0	0	0	0	2	1	0	0	0	1	0	0	1	0	1	2	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0
Virginia[e]	0	0	1	0	4	0	0	2	0	0	0	0	0	0	0	0	6	1
North Carolina[f]	1	1	1	35	1	2	0	0	1	0	0	0	3	0	1	39	2	5
South Carolina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Florida	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
EEZ	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS - U.S., Puerto Rico, & EEZ	5	10	2	35	35	4	1	6	1	0	10	0	3	7	4	44	68	11

[a] Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
[b] (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009).
[c] Long-finned pilot whale stranded in Maine in 2007 released alive.
[d] Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water.
[e] One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated). Sign of human interaction (a line on the flukes) observed on 2 animals in 2005, and ~~one~~1 animal was a pregnant female.
[f] In 2004, ~~one~~1 short-finned pilot whale (September) and ~~one~~1 pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in February, not related to any UME. 2005 includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death. Signs of fishery interaction observed on a short-finned pilot whale stranded in May 2005.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales (*Globicephala melas*) have been reported stranded as far south as Florida, when 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3). ~~Between~~During ~~2003~~2004-~~2007~~2008, several human and/or fishery interactions were documented in stranded pilot whales. ~~Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida.~~ During a UME in Dare, North Carolina, in January 2005, ~~six~~6 of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. ~~Two long-finned pilot whales stranded in Virginia in April 2005, one with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, two were reported as exhibiting signs of human interaction, one in Massachusetts and one in Virginia. In 2007, signs of human interaction were reported for one long-finned pilot whale stranded in Massachusetts, after an unsuccessful attempt was made to herd the animal to deeper water. In 2008, one Massachusetts stranding mortality was deemed a fishery interaction due to line markings and cut flukes. The two New York strandings of long-finned pilot whales were classified as human interactions.~~

~~In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia from 1970 to 1998 . This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in~~

~~1991-1996 . Several mass live strandings occurred in Nova Scotia recently - 14 pilot whales live mass stranded in 2000 and 3 in 2001 in Judique, Inverness County and 4 pilot whales live mass stranded at Point Tupper, Inverness County, in 2002, though no specification to species was made.~~

~~Mass strandings of long-finned pilot whales were more frequent several decades ago in Newfoundland when this species was more abundant (Table 4). With the collapse of the squid stocks on the Grand Banks, pilot whale numbers in the area declined and there have been few or no strandings in recent years (Lawson, DFO, pers. comm.).Recent Newfoundland and Labrador strandings are reported in Table 3.~~

~~Table 4. Pilot whale mass strandings along the Newfoundland, Canada coast~~

~~Year~~	~~Date~~	~~Number of Pilot Whales Stranded~~	~~Place in Newfoundland~~
~~1979~~	~~July 14~~	~~135~~	~~Pt. au Gaul~~
~~1980~~	~~October 19~~ ~~October 25~~	~~70~~ ~~18~~	~~Pt. Leamington~~ ~~Grand Beach~~
~~1982~~	~~July 27~~ ~~August 18~~	~~23~~ ~~3~~	~~Grand Bank~~ ~~Bonavista~~
~~1983~~	~~early January~~	~~10~~	~~Piccadilly~~
~~1984~~	~~July 15~~	~~5~~	~~Middle Cove~~
~~1990~~	~~December 14~~	~~4~~	~~St. Anthony~~

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of short-finned pilot whales relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for ~~*Globicephala* sp.~~short-finned pilot whales is unknown, since it is not possible to partition mortality estimates between the ~~two~~2 species. However, it is most likely not less than 10% of the calculated PBR~~,~~ and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The total fishery mortality is unlikely to exceed PBR, since some portion of the mortality impacts long-finned pilot whales, and therefore t~~T~~his is not a strategic stock~~ because the 2003-2007 estimated average annual human-related mortality does not exceed PBR.~~. ~~-~~However, ~~the continuing inability to distinguish between species of pilot whales, and the fact that PBR and abundance estimates are not available for the individual stocks, raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.~~ the inability to partition mortality estimates between the species limits the ability to adequately assess the status of this stock.

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Benjamins, S., J. Lawson and G. Stenson. 2007. Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage. 9(3): 189-200.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

Dam, M. and D. Bloch. 2000. Screening of mercury and persistent organochlorine pollutants in long-finned pilot whale (*Globicephala melas*) in the Faroe Islands. Mar. Poll. Bull. 40: 1090-1099.

Fairfield , C.P. and L.P. Garrison. 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NMFS-SEFSC-572. 62 pp.
Fairfield Walsh, C. and L.P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NMFS-SEFSC-539. 52 pp.
Fairfield Walsh, C. and L.P. Garrison. 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NMFS-SEFSC-560. 54 pp.
Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.
Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.
Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527. 57 pp.
Hansen, L.J., K.D. Mullin, T.A. Jefferson and G.P. Scott. 1996. Visual surveys aboard ships and aircraft. Pages 55-132 *in*: R. W. Davis and G. S. Fargion, (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. .
Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald and D. G. Robertson, (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam.
Hohn, A.A., D.S. Rotstein, C.A. Harms and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. NOAA Tech. Memo. NMFS-SEFSC-537. 222 pp.
Hooker, S.K., R.W. Baird and M.A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.
Johnson, D.R., C.A. Brown and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. NOAA Tech. Memo. NMFS- SEFSC-418. 70 pp.
Kasuya, T.and Tai, S. (1993) Life history of short-finned pilot whale stocks off Japan and a description of the fishery. Reports of the International Whale Commission. Special Issue 14: 439-473.
Lawson, J.W. and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 208/031. 33 pp.
Ledwell, W. and J. Huntington. 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.
Ledwell, W. and J. Huntington. 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.
Ledwell, W. and J. Huntington. 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.
Ledwell, W. and J. Huntington. 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.
Ledwell, W. and J. Huntington. 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda, Newfoundland and Labrador region.
Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES [Int. Counc. Explor. Sea] C.M. 1997/Q:08: 10.
Muir, D.C.G., R. Wagemann, N.P. Grift, R.J. Norstrom, M. Simon and J. Lien. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland, Canada. Arch. Environ. Contam. Toxicol. 17(5): 613-629.

Mullin, K.D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101: 603-613.

Mullin, K.D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172 *in*: R. W. Davis, W. E. Evans and B. Würsig, (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. OCS Study MMS 96-0027.

Nielsen, J.B., F. Nielsen, P.-J. Jorgensen and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). Mar. Poll. Bull. 40: 348-35.

NMFS. 1993. Status of fishery resources off the northeastern United States for 1993. National Marine Fisheries Service. NOAA Tech. Memo. NMFS-F/NEC-101. 140 pp.

Payne, P.M. and D.W. Heinemann. 1993. The distribution of pilot whales (*Globicephala* sp.) in shelf/shelf edge and slope waters of the northeastern United States, 1978-1988. Rep. Int. Whal. Comm. (Special Issue) 14: 51-68.

Palka, D.L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 2005. Shipboard surveys in the northwest Atlantic: estimation of g(0). Pages 32-37 *in*: F. Thomsen, F. Ugarte and P. G. H. Evans, (eds.) Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans. European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Palka, D.L. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Comm. (Special Issue) 15: 133-147.

Rossman, M. C. 2009. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000-2005. J. Northwest Fish. Sci. 42: 77-101.

Sergeant, D.E. 1962. The biology of the pilot or pothead whale (*Globicephala melaena* (Traill)) in Newfoundland waters. Bull. Fish. Res. Bd. Can 132: 1-84.

Taruski, A.G., C.E. Olney and H.E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. J. Fish. Res. Board Can 32(11): 2205-2209.

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waring, G.T. 1995. Fishery and ecological interactions for selected cetaceans off the Northeast USA. Ph.D. thesis, University of Massachusetts, Amherst, MA. 260 pp.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull. 88(2): 347-360.

Waring, G.T., E. Josephson, C.P. Fairfield and K. Maze-Foley, eds. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201.

Weisbrod, A.V., D. Shea, M.J. Moore and J.J. Stegeman. 2000. Bioaccumulation patterns of polychlorinated biphenyls and chlorinated pesticides in northwest Atlantic pilot whales. Environ. Toxicol. Chem. 19: 667-677.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo. NMFS-SEFSC-467. 43 pp.

~~1 January~~March 2010~~September 2009~~

ATLANTIC WHITE-SIDED DOLPHIN (*Lagenorhynchus acutus*):Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour. ~~The~~ In the western North Atlantic the species inhabits waters from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as ~~43~~29˚W in the vicinity of the mid-Atlantic Ridge (Evans 1987; Hamazaki 2002; Doksaeter *et al.* 2008; Waring *et al.* 2008). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stock units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records, and was obvious during abundance surveys conducted in the summers of 1995 and 1999 which covered waters from Virginia to the Gulf of St. Lawrence and during the Canadian component of the TNASS survey in the summer of 2007 (Lawson and Gosselin 2009). White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a few sightings were recorded between these two regions.

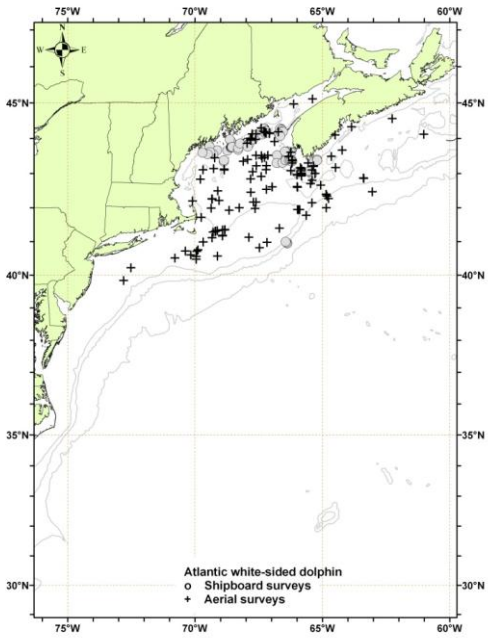

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004,2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) on to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range during the winter months.

~~Prior to the 1970s, white-sided dolphins in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona *et al.* 1993; Kenney *et al.* 1996).~~ Recent stomach content analysis of both stranded and incidental caught white-sided dolphins in U.S. waters, determined the most

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predominant prey were silver hake (*Merluccius bilinearis*), spoonarm octopus (*Bathypolypus bairdii*), and haddock (*Melanogrammus aeglefinus*). Sand lances (*Ammodytes* spp.) were only found in the stomach of one stranded *L. acutus*. Seasonal variation in diet was indicated; pelagic Atlantic herring (*Clupea harengus*) was the most important prey in summer, but was rare in winter (Craddock *et al.* 2009).

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although eight estimates from select regions are available from: 1) spring, summer and autumn 1978-1982; 2) July-September 1991-1992; 3) June-July 1993; 4) July-September 1995; 5) July-August 1999; 6) August 2002; 7) June-July 2004; and 8) August 2006. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 63,368 (CV=0.27), an average of the surveys conducted in August within the last 8 years (2002 and 2006). An average is used to account for the large inter-annual variability of the abundance estimates for this species. This variability may be associated with the water temperature and prey patterns.

An abundance estimate of 109,141 (CV=0.30) white-sided dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the ~~1000~~ 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial surveys ~~data~~.

An abundance estimate of 2,330 (CV=0.80) white-sided dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the ~~two~~ two-~~independent~~ independent-team ~~line~~ line-transect method and analyzed using the modified ~~direct~~ direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line- transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of aerial g(0) was derived from the pooled data of 2002, 2004 and 2006 aerial survey ~~data~~s.

An abundance estimate of 17,594 (CV=0.30) white-sided dolphins was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. Data were collected using the Hiby circle-back ~~line~~ line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of g(0) was derived from the pooled data of 2002, 2004 and 2006 aerial survey ~~data~~s (Table 1; Palka pers. comm.).

An abundance estimate of 5,796 (95%CI=2,681-13,088) white-sided dolphins was generated from the Canadian ~~Trans~~ Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Table 1. Summary of recent abundance estimates for western North Atlantic stock of white-sided dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	109,141	0.30
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	2,330	0.80
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	17,594	0.30
Jul~~y~~-Aug 2007	N. Labrador to Scotian Shelf	5,796	0.43

2002 and 2006	Average of abundance estimates from 2 August surveys	63,368	0.27

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for the western North Atlantic stock of white-sided dolphins is 63,368 (CV=0.27). The minimum population estimate for these white-sided dolphins is 50,883.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: calving interval is 2-3 years; lactation period is 18 months; gestation period is 10-12 months and births occur from May to early August, mainly in June and July; length at birth is 110 cm; length at sexual maturity is 230-240 cm for males, and 201-222 cm for females; age at sexual maturity is 8-9 years for males and 6-8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 50,883. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of white-sided dolphin is 509.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2003~~2004-~~2007~~ 2008 was ~~328~~ 266~~301~~ (CV=0.~~09~~13) white-sided dolphins (Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III

Earlier Interactions

NMFS observers in the Atlantic foreign mackerel fishery reported 44 takes of Atlantic white-sided dolphins incidental to fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al.* 1990; NMFS unpublished data). Of these animals, 96% were taken in the Atlantic mackerel fishery. This total includes 9 documented takes by U.S. vessels involved in joint-venture (JV) fishing operations in which U.S. captains transfer their catches to foreign processing vessels. No incidental takes of white-sided dolphins were observed in the Atlantic mackerel JV fishery when it was observed in 1998.

During 1991 to 1998, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery, both in 1993. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 (.71) in 1989, 6.8 (.71) in 1990, 0.9 (.71) in 1991, 0.8 (.71) in 1992, 2.7 (0.17) in 1993 and 0 in 1994, 1995, 1996, and 1998. There was no fishery during 1997 and the fishery was permanently closed in 1999.

A U.S. ~~joint venture (~~JV~~)~~ mid-water (pelagic) trawl fishery was conducted during 2001 on Georges Bank from August to December. No white-sided dolphins were incidentally captured. Two white-sided dolphins were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF). During TALFF fishing operations all nets fished by the foreign vessel are observed. The total mortality attributed to the Atlantic herring JV

and TALFF mid-water trawl fisheries in 2001 was 2 animals.

The mid-Atlantic gillnet fishery occurs year round from New York to North Carolina and has been observed since 1993. One white-sided dolphin was observed taken in this fishery during 1997. None were observed taken in other years. The estimated annual mortality (CV in parentheses) attributed to this fishery was 0 for 1993 to 1996, 45 (0.82) for 1997, 0 for 1998 to 2001, unknown in 2002 and 0 in 2003-~~2007~~2008.

U.S.

Northeast Sink Gillnet

This fishery occurs year round from in ~~the~~ Gulf of Maine, Georges Bank and ~~in~~ southern New England waters. Between 1990 and 2007 there were ~~56~~ 60 white-sided dolphin mortalities observed in the Northeast sink gillnet fishery. Most were taken in waters south of Cape Ann during April to December. In recent years, the majority of the takes have been east and south of Cape Cod. During 2002, one of the takes was off Maine in the fall Mid-coast Closure Area in a pingered net. Estimated annual fishery-related mortalities (CV in parentheses) were 49 (0.46) in 1991, 154 (0.35) in 1992, 205 (0.31) in 1993, 240 (0.51) in 1994, 80 (1.16) in 1995, 114 (0.61) in 1996 (Bisack 1997), 140 (0.61) in 1997, 34 (0.92) in 1998, 69 (0.70) in 1999, 26 (1.00) in 2000, 26 (1.00) in 2001, 30 (0.74) in 2002, 31 (0.93) in 2003, 7 (0.98) in 2004, 59 (0.49) in 2005, 41 (0.71) in 2006, ~~and~~ 0 in 2007, and 8~~2~~1 (0.5~~6~~7) in 2008. Average annual estimated fishery-related mortality during ~~2003~~2004-~~2007~~ 2008 was ~~35~~ 38 white-sided dolphins per year (0.~~37~~~~41~~33; Table 2).

Northeast Bottom Trawl

Fifty mortalities were documented between 1991 and 2007 in the Northeast bottom trawl fishery; 1 during 1992, 0 in 1993, 2 in 1994, 0 in 1995-2001, 1 in 2002, 12 in 2003, 16 in 2004, 47 in 2005, 4 in 2006 and 1 in 2007. Estimated annual fishery-related mortalities (CV in parentheses) were 110 (0.97) in 1992, 0 in 1993, 182 (0.71) in 1994, 0 in 1995-1999, 137 (0.34) in 2000, 161 (0.34) in 2001, 70 (0.32) in 2002, 216 (0.27) in 2003, 200 (0.30) in 2004, 213 (0.28) in 2005, 164 (0.34) in 2006, ~~and~~ 147 (0.35) in 2007, and 147 (0.32) in 2008. The ~~2003~~2004-~~2007~~ 2008 average mortality attributed to the ~~northeast~~ Northeast bottom trawl was ~~188~~ 174 animals (0.12; Table 2).

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

In July 2003 a~~A~~ white-sided dolphin was observed taken in the single trawl fishery on the northern edge of Georges Bank (off ~~of~~ Massachusetts) ~~during July 2003~~ in a haul that was targeting (and primarily caught) herring. I~~, and~~ n September 2005 three~~3~~ white-sided dolphins were observed taken ~~in 2005~~ in paired trawls targeting herring that were located near Jefferys Bank (off Maine). Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed white-sided dolphin takes per observed hours the gear was in the water) for each year, where the paired and single Northeast mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort~~Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data from paired and single northeast and mid-Atlantic mid-water trawls~~ (Palka, pers. comm.). ~~The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort.~~ Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 2~~2~~4 (0.97~~56~~) in 2003, ~~19 (0.58)~~0 in 2004, ~~15~~9.4 (~~0.31~~1.03) in 2005, and 0~~19 (0.44) in~~ in 2006 to~~, and 0 in 2007, and 5.6 (0.52) in~~ 2008 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2003~~2004-~~2007~~ 2007 was 15 (0.26; Table 2).

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)

In February 2004 a~~A~~ white-sided dolphin was observed taken in the pair trawl fishery near Hudson Canyon (off New Jersey) ~~during February 2004~~ in a haul that was targeting mackerel. In March 2005 f~~F~~ive white-sided dolphins were observed taken in paired trawls targeting mackerel that were off Virginia. ~~in 2005~~. In February 2006, ~~and~~ three animals were observed taken ~~in 2006~~in mackerel paired mid-water trawls north of Hudson Canyon. In March 2007, an animal was observed taken in a mackerel single mid-water trawl near Hudson Canyon. In January and February 2008 three animals were observed in herring single mid-water trawls north of Hudson Canyon. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed white-sided dolphin takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort~~Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and northeast and mid-Atlantic mid-water trawls~~ (Palka, pers. comm.). ~~The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as~~

~~significant explanatory variables, where soak duration was the unit of effort.~~ Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 0~~51 (0.46)~~ in 2003, ~~105~~22 (0.~~38~~99) in 2004, ~~97~~58 (~~0.36~~1.02) in 2005, ~~54~~29 (0.~~5~~74) in 2006, ~~and 3.2~~12 (0.~~70~~98) in 2007, and ~~3.7~~15 (0.743) in 2008 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2003~~2004-~~2007~~ 2008 was ~~62~~27 (0.~~21~~50; Table 2).

Mid-Atlantic Bottom Trawl Fishery

One white-sided dolphin incidental take was observed in 1997, resulting in a mortality estimate of 161 (CV=1.58) animals. No takes were observed from 1998 through 2004 or in 2006 or 2008, one take was observed in 2005 and 2 in 2007. Estimated annual fishery-related mortalities (CV in parentheses) were 27 (0.17) in 2000, 27 (0.19) in 2001, 25 (0.17) in 2002, 31 (0.25) in 2003, 26 (0.20) in 2004, 38 (0.29) in 2005, 26 (0.25) in 2006, ~~and~~ 21 (0.24) in 2007, and 16 (0.18) in 2008. The ~~2003~~2004-~~2007~~ 2008 average mortality attributed to the mid-Atlantic bottom trawl was ~~28~~ 25 animals (0.~~11~~10; Table 2).

Table 2. Summary of the incidental mortality of white-sided dolphins (*Lagenorhynchus acutus*) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[d]	~~03~~04-~~07~~08	Obs. Data Weighout Trip Logbook	~~.03,~~ .06, .07, .04, .07, .05	~~1,~~ 1, 5, 2, 0, 4	~~31,~~ 7, 59 , 41, 0, 8~~2~~1	~~.93,~~ .98, .49 , .71, 0, .5~~6~~7	~~35~~ 38 (0.37~~41~~33)
Northeast Bottom Trawl[c]	~~03~~04-~~07~~08	Obs. Data Weighout	~~.04,~~ .05, .12, .06, .06, .08	~~12,~~ 16, 47, 4, 1, 3	~~216,~~ 200, 213, 164, 147, 147	~~.27,~~ .30, .28, .34, .35, .32	~~188~~ 174 (0.12)
Northeast Mid-water Trawl - Including Pair Trawl	~~03~~04-~~07~~08	Obs. Data Weighout Trip Logbook	~~.031,~~ .126, .199, .031, .08, .199	~~1,~~ 0, 3, 0, 0, 0	~~24, 19, 15, 19, 0, 5.60, 0, 9.4, 0,~~ 0	~~.56, .58, .31, .44, 0, .52~~0, 0, 1.03, 0, 0	~~15~~1.92 (1.03~~(0.26~~18)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	~~03~~04-~~07~~08	Obs. Data Weighout Trip Logbook	~~.018,~~ .064, .084, .089, .039, .133	~~0,~~ 1, 5, 3, 1, ~~32~~	~~51, 105, 97, 54, 3.2, 3.7~~22, 58, 29, 12, 15	~~.46, .38, .36, .57, .70, .43~~.99, 1.02, .74, .98, .73	~~62~~2752 (0.~~21~~50~~16~~)
Mid-Atlantic Bottom Trawl[c]	~~03~~04-~~07~~08	Obs. Data Weighout Trip Logbook	~~.01,~~ .03, .03, .02, .03, .03	~~0,~~ 0, 1, 0, 2, 0	~~31,~~ 26, 38, 26, 21, 16	~~.25,~~ .20, .29, .25, .24, .18	~~28~~ 25 (.~~11~~10)
Total							~~32~~8266~~301~~ (0.~~09~~13)

a Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program. NEFSC collects landings data (Weighout) that are used as a measure of total effort in the Northeast gillnet fishery. Mandatory Vessel Trip Report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the sink gillnet fishery and in the two mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (soak duration) in the mid-water and bottom trawl fisheries.

b Observer coverages for the Northeast sink gillnet are ratios based on metric tons of fish landed. Observer coverages of the trawl fisheries are ratios based on trips.

c A new method was used to develop preliminary estimates of mortality for the mid-Atlantic and Northeast trawl fisheries during 2003-2007. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates from 2003 and afterwards. NE and MA bottom trawl mortality estimates reported for 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2008 effort (Rossman 2009).~~(Rossman 2010).~~

d After 1998, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within the stratum

where white-sided dolphins were observed taken. During the years 1997, 1999, 2001, 2002, and 2004, respectively, there were 2, 1, 1, 1, and 1 observed white-sided dolphins taken on pingered trips. No takes were observed on pinger trips during 1995, 1996, 1998, 2000, 2005 through 2007. Three of the 2008 takes were on non-pingered hauls and the fourth take was recorded as pinger condition unknown.

CANADA

There is little information available that quantifies fishery interactions involving white-sided dolphins in Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnet sets in the Bay of Fundy during 1985 to 1989, and 9 were reported taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960's in the now non-operational Newfoundland and Labrador groundfish gillnets. A few (number not specified) were taken in an experimental drift gillnet fishery for salmon off West Greenland which took place from 1965 to 1982 (Read 1994).

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. Bycaught marine mammals were noted as weight in kilos rather than by the numbers of animals caught. Thus the number of individuals was estimated by dividing the total weight per species per trip by the maximum recorded weight of each species. During 1991 through 1996, an estimated 6 white-sided dolphins were observed taken. One animal was from a longline trip south of the Grand Banks (43º 10'N 53º 08'W) in November 1996 and the other 5 were taken in the bottom trawl fishery off Nova Scotia in the Atlantic Ocean; 1 in July 1991, 1 in April 1992, 1 in May 1992, 1 in April 1993, 1 in June 1993 and 0 in 1994 to 1996.

Estimation of small cetacean bycatch for Newfoundland fisheries using data collected during 2001 to 2003 (Benjamins *et al.* 2007) indicated that, while most of the estimated 862 to 2,228 animals caught were harbor porpoises, a few were white-sided dolphins caught in the Newfoundland nearshore gillnet fishery and offshore monkfish/skate gillnet fisheries.

Herring Weirs

During the last several years, one white-sided dolphin was released alive and unharmed from a herring weir in the Bay of Fundy (A. Westgate, pers. comm.). Due to the formation of a cooperative program between Canadian fishermen and biologists, it is expected that most dolphins and whales will be able to be released alive. Fishery information is available in Appendix III.

Other Mortality

U.S.

During ~~2003~~2004-~~2007~~ 2008 there were ~~288~~ 264 documented Atlantic white-sided dolphin strandings on the US Atlantic coast (Table 3). Twenty-~~seven~~ nine of these animals were released alive. Human interaction was indicated in ~~8~~ 10 records during this period. Of these, ~~4~~ two were classified as fishery interactions.

Mass strandings involving up to a hundred or more animals at one time are common for this species. The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

CANADA

Small numbers of white-sided dolphins have been taken off southwestern Greenland and they have been taken deliberately by shooting elsewhere in Canada (Reeves *et al.* 1999). The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia during 1991 to 1996 (Hooker *et al.* 1997). Researchers with Dept. of Fisheries and Oceans (DFO), Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. White-sided dolphins stranded at nearly all times of the year on the mainland and on Sable Island. On the mainland of Nova Scotia, a total of 34 stranded white-sided dolphins was recorded between 1991 and 1996: 2 in 1991 (August and October), 26 in July 1992, 1 in Nov 1993, 2 in 1994 (February and November), 2 in 1995 (April and August)

and 2 in 1996 (October and December). During July 1992, 26 white-sided dolphins stranded on the Atlantic side of Cape Breton. Of these, 11 were released alive and the rest were found dead. Among the rest of the Nova Scotia strandings, 1 was found in Minas Basin, 2 near Yarmouth and the rest near Halifax. On Sable Island, 10 stranded white-sided dolphins were documented between 1991 and 1998; all were males, 7 were young males (< 200 cm), 1 in January 1993, 5 in March 1993, 1 in August 1995, 1 in December 1996, 1 in April 1997 and 1 in February 1998.

Whales and dolphins stranded between 1997 and ~~2007~~ 2008 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows (Table 3): 0 white-sided dolphins stranded in 1997 to 2000, 3 in September 2001 (released alive), 5 in November 2002 (4 were released alive), 0 in 2003, 19-24 in 2004 (15-20 in October (some (unspecified) were released alive) and 4 in November were released alive), 0 in 2005, and 1 in 2006, ~~and~~ 8-10 in 2007 (all but 3 released alive), and 3 (one released alive) in 2008 (T. Wimmer, pers. comm.).

White-sided dolphins recorded by the Whale Release and Strandings Program in Newfoundland and Labrador are as follows: 1 animal (released alive) in 2004, 1 in 2005 (dead), 3 in 2006 (all dead), 1 in 2007 (released alive) and 2 in 2008 (one released alive and one dead) (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009).

~~Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2003~~2004~~-2008~~7.

~~Area~~	~~-~~				~~-~~	~~**Total**~~
	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	
~~Maine~~	~~2~~	~~10~~	~~3~~	~~3~~	~~1~~	~~19~~
~~New Hampshire~~	~~-~~	~~-~~	~~1~~	~~-~~	~~-~~	~~1~~
~~Massachusetts[a,b]~~	~~59~~	~~34~~	~~60~~	~~49~~	~~18~~	~~220~~
~~Rhode Island~~	~~-~~	~~-~~	~~2~~	~~4~~	~~-~~	~~6~~
~~Connecticut~~	~~1~~	~~-~~	~~-~~	~~-~~	~~-~~	~~1~~
~~New York[c]~~	~~2~~	~~1~~	~~-~~	~~3~~	~~5~~	~~11~~
~~New Jersey~~	~~1~~	~~1~~	~~6~~	~~1~~	~~-~~	~~9~~
~~Delaware~~	~~-~~	~~-~~	~~-~~	~~1~~	~~-~~	~~1~~
~~Maryland[b]~~	~~-~~	~~-~~	~~1~~	~~1~~	~~-~~	~~2~~
~~Virginia[b]~~	~~-~~	~~4~~	~~3~~	~~3~~	~~-~~	~~10~~
~~North Carolina~~	~~1~~	~~2~~	~~3~~	~~1~~	~~1~~	~~8~~
~~**TOTAL US**~~	~~**66**~~	~~**52**~~	~~**79**~~	~~**66**~~	~~**25**~~	~~288~~
~~Nova Scotia~~	~~-~~	~~2~~	~~-~~	~~1~~	~~9~~	~~12~~
~~GRAND TOTAL~~	~~66~~	~~54~~	~~79~~	~~67~~	~~34~~	~~300~~

~~[a] Records of mass strandings in Massachusetts during this period are: January 2003 - 4 animals; April 2003 - 28 animals; November 2003 - 4 animals; February 2005 - 8 animals (3 released alive); April 2005 - 6 animals (all released alive); May 2005 strandings of 2 animals (both released alive but one died later); 3 animals (one released alive) and 5 animals; December 2005 - 2 animals; and January 2006 4 separate events involving 23 white-sided dolphins (5 released alive); February 2006 2 events involving 1 and 5 animals; and July 2006 - 9 animals (7 released alive); January 2007 - 9 animals (3 released alive); and September 2007 - 3 animals.~~

[b] ~~Strandings that appear to involve a human interaction are: 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus. In 2005, 5 animals had signs of human interaction (in Massachusetts, Maryland and Virginia) but in no case was the human interaction able to be determined to be the cause of death. In 2006, 1 animal from Massachusetts was classified as having signs of fishery interaction.~~

[e] ~~Records of mass strandings in New York during this period are: September 2007 - 3 animals~~

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2004-2008.

Area						**Total**
	2004	2005	2006	2007	2008	
Maine	10	3	3	1	1	18
New Hampshire	-	1	-	-	-	1
Massachusetts[a,b]	34	60	49	18	33	194
Rhode Island	-	2	4	-	-	6
Connecticut	-	-	-	-	1	1
New York[c]	1	-	3	5	1	10
New Jersey	1	6	1	-	-	8
Delaware	-	-	1	-	-	1
Maryland	-	1	1	-	1	3
Virginia[b]	4	3	3	-	1	11
North Carolina	2	3	1	1	3	10
South Carolina	-	-	-	-	1	1
TOTAL US	**52**	**79**	**66**	**25**	**42**	**264**
Nova Scotia	2	-	1	9	3	15
Newfoundland and Labrador	1	1	3	1	2	8
GRAND TOTAL	55	80	70	35	47	287

[a] Records of mass strandings in Massachusetts during this period are: February 2005 - 8 animals (3 released alive); April 2005 - 6 animals (all released alive); May 2005 strandings of 2 animals (both released alive but one died later); 3 animals (one released alive) and 5 animals; December 2005 - 2 animals; January 2006 - 4 separate events involving 23 white-sided dolphins (5 released alive); February 2006 - 2 events involving 1 and 5 animals; July 2006 - 9 animals (7 released alive); January 2007 - 9 animals (3 released alive); September 2007 - 3 animals; January 2008 -17animals, February 2008 3 animals (2 released alive).

[b] Strandings that appear to involve a human interaction are: 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus. In 2005, 5 animals had signs of human interaction but in no case was the human interaction able to be determined to

be the cause of death. In 2006, 1 animal from Massachusetts was classified as having signs of fishery interaction. In 2008 2 animals from Massachusetts and one from South Carolina were classified as human interactions.
[c] Records of mass strandings in New York during this period are: September 2007 - 3 animals.

STATUS OF STOCK

The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. A trend analysis has not been conducted for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a non-strategic stock because the ~~2003~~2004-~~2007~~ 2008 estimated average annual human related mortality does not exceed PBR.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Benjamins, S., J. Lawson and G. Stenson 2007. Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage. 9(3): 189-200.

Bisack, K. D. 1997. Marine mammal bycatch estimates and their sampling distribution characteristics in the U.S. New England Multispecies Sink Gillnet, Pelagic pair trawl, pelagic drift gillnet and North Atlantic bottom trawl fisheries: 1994 and 1995. International Whaling Commission. SC/49/sm35**:** 12.

Craddock, J. E., P. T. Polloni, B. Hayward and F. Wenzel 2009. Food habits of Atlantic white-sided dolphins (*Lagenorhynchus acutus*) off the coast of New England. Fish. Bull. 107: 384-394.

Doksaeter, L., E. Olsen, L. Nottestad and A. Ferno 2008. Distribution and feeding ecology of dolphins along the Mid-Atlantic Ridge between Iceland and the Azores. Deep Sea Research II 55: 243-253.

Evans, P. G. H. 1987. The natural history of whales and dolphins. Facts on File Publications, New York. 343 pp.

Gaskin, D. E. 1992. Status of Atlantic white-sided dolphin, *Lagenorhynchus acutus*, in Canada. Can. Field-Nat. 106: 64-72.

Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, No. Carolina, USA to Nova Scotia, Canada). Mar. Mamm. Sci. 18(4): 920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake~~et~~ , B. F. J. Manly, L. L. McDonald and D. G. Robertson, (eds.)~~al, (eds.)~~. Marine mammal survey and assessment methods. Balkema, Rotterdam.

Hooker, S. K., R. W. Baird and M. A. Showell 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

~~Katona, S. K., V. Rough and D. T. Richardson 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC.-316 pp.~~

~~Kenney, R. D., P. M. Payne, D. W. Heinemann and H. E. Winn 1996. Shifts in Northeast shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. Pages 169-196 *in*: K. Sherman, N. A. Jaworski and T. Smayda, (eds.) The northeast shelf ecosystem: assessment, sustainability, and management. Blackwell Science, Cambridge, MA.~~

Lawson, J. W. and J.-F. Gosselin 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 2009/031. 33 pp.

Ledwell, W. and J. Huntington 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.

Ledwell, W. and J. Huntington 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3

pp.
Ledwell, W. and J. Huntington 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.
Ledwell, W. and J. Huntington 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda, Newfoundland and Labrador region.
Lucas, Z. N. and S. K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.
Northridge, S., M. Tasker, A. Webb, K. Camphuysen and M. Leopold 1997. White-beaked *Lagenorhynchus albirostris* and Atlantic white-sided dolphin *L. acutus* distributions in northwest European and U.S. North Atlantic waters. Rep. Int. Whal. Comm. 47: 797-805.
Palka, D., A. Read and C. Potter 1997. Summary of knowledge of white-sided dolphins (*Lagenorhynchus acutus*) from U.S. and Canadian Atlantic waters. Rep. Int. Whal. Comm. 47: 729-734.
Palka, D. L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.
Palka, D. L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans, European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.
Palka, D. L. and P. S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.
Payne, M. and D. W. Heinemann 1990. A distributional assessment of cetaceans in the shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to NMFS. [Available from National Marine Fisheries Science Center, 166 Water St., Woods Hole, MA 02543], 108 pp.
Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Comm. (Special Issue) 15: 133-147.
Reeves, R. R., C. Smeenk, J. R. L. Brownell and C. C. Kinze 1999. Atlantic white-sided dolphin *Lagenorhynchus acutus* (Gray, 1828). Pages 31-56 *in*: S. H. Ridgway and S. R. Harrison, (eds.) Handbook of marine mammals. Vol. 6: The second book of dolphins and the porpoises. Academic Press, San Diego, CA. .
Rossman, M. C. 2009. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000-2005. J. Northwest Fish. Sci. 42: 77-101.
Sergeant, D. E., D. J. St. Aubin and J. R. Geraci 1980. Life history and northwest Atlantic status of the Atlantic white-sided dolphin, *Lagenorhynchus acutus*. Cetology 37: 1-12.
Wade, P. R. and R. P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Waring, G. T., P. Gerrior, P. M. Payne, B. L. Parry and J. R. Nicolas 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull. 88(2): 347-360.
Waring, G. T., L. Nøttestad, E. Olsen, H. Skov and G. Vikingsson 2008. Distribution and density estimates of cetaceans along the mid-Atlantic Ridge during summer 2004. J. Cetacean Res. Manage. 10(2): 137-146.

SHORT-BEAKED COMMON DOLPHIN (*Delphinus delphis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate~~, tropical,~~ and subtropical seas. In the North Atlantic, common dolphins occur over the continental shelf along the ~~200~~100-2000-m isobaths and over prominent underwater topography and east as to the mid-Atlantic Ridge (29˚W) (Doksaeter *et al.* 2008; Waring *et al.* 2008)~~ from 50º N to 40º S latitude (Evans 1994)~~. The species is less common south of Cape Hatteras, although schools have been reported as far south as the Georgia/South Carolina border (32º N) (Jefferson *et al.* 2009). ~~eastern Florida (Gaskin 1992).~~ In waters off the northeastern USA coast common dolphins are distributed along the continental slope ~~(100 to 2,000 m)~~ and are associated with Gulf Stream features (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992; Hamazaki 2002). They occur from Cape Hatteras northeast to Georges Bank (35˚ to 42˚N) during mid-January to May (Hain *et al.* 1981; CETAP 1982; Payne *et al.* 1984). Common dolphins move onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are occasionally found in the Gulf of Maine (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

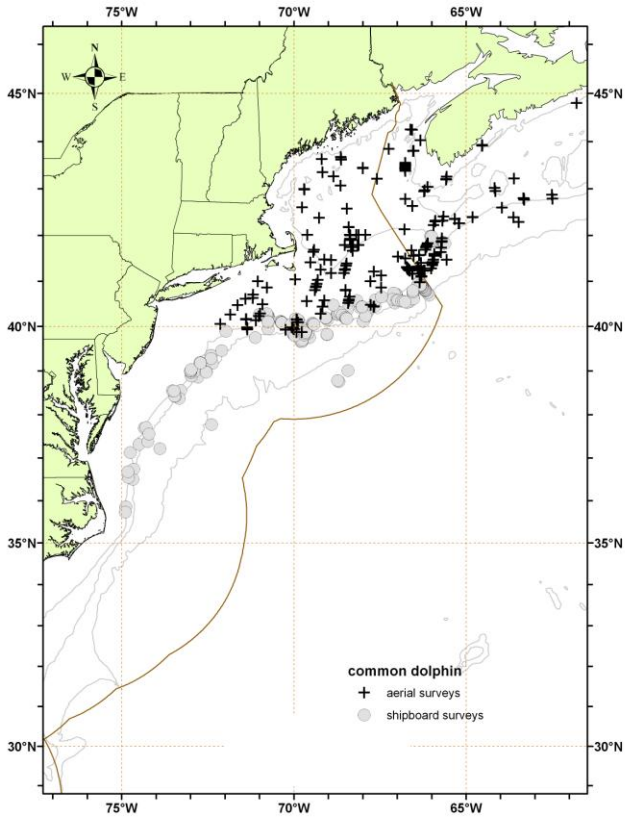

Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Westgate (2005) tested the proposed one-population-stock model using a molecular analysis of mitochondrial DNA (mtDNA), as well as a morphometric analysis of cranial specimens. Both genetic analysis and skull morphometrics failed to provide evidence ($p>0.05$) of more then a single population in the western North Atlantic, supporting the proposed one stock model. However, when western and eastern North Atlantic common dolphin mtDNA and skull morphology were compared, both the cranial and mtDNA results showed evidence of restricted gene flow ($p<0.05$) indicating that these two areas are not panmictic. Cranial specimens from the two sides of the North Atlantic differed primarily in elements associated with the rostrum. These results suggest that common dolphins in the western North Atlantic are composed of a single panmictic group whereas gene flow between the western and eastern North Atlantic is limited (Westgate 2005; 2007).

There is also a peak in parturition during July and August with an average birth day of July 28th. Gestation lasts about 11.7 months and lactation lasts at least a year. Given these results western North Atlantic female common dolphins are likely on a 2-3 year calving interval. Females become sexually mature earlier (8.3 years and 200 cm) than males (9.5 years and 215 cm) as males continue to increase in size and mass. There is significant sexual dimorphism present with males being on average about 9% larger in body length (Westgate 2005; Westgate and Read 2007).

POPULATION SIZE

The total number of common dolphins off the U.S. or Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for selected time periods. The best abundance estimate for common dolphins is 120,743 animals (CV = 0.23). This is the sum of the estimates from two 2004 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 90,547 (CV= 0.24), and from the southern U.S. Atlantic is 30,196 (CV =0.54). This joint estimate is considered best because these two surveys have the most complete coverage of the species' habitat (Table 1).

An abundance estimate of 6,460 (CV=0.74) common dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1: Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 90,547 (CV= 0.244) common dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the ~~two~~ two-~~independent~~ independent-team line transect method and analyzed using the modified ~~direct~~ direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line- transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 30,196 (CV=0.537) common dolphins was derived from a shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50m) between Florida and Maryland (27.5 and 38º N latitude) conducted during June-August, 2004 (Table 1). The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias (*g(0)*) and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001; Palka 2006).

An abundance estimate of 84,000 (CV=0.36) common dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the ~~2000~~ 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 53,625 (95%CI=35,179-81,773) common dolphins was generated ~~form~~ from the Canadian Trans North Atlantic Sighting Survey (TNASS)~~Canadian TNASS~~ ~~aerial survey~~ in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Please see appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Table 1. Summary of abundance estimates for western North Atlantic short-beaked common dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	6,460	0.74
Jun-Aug 2004	Maryland to Bay of Fundy	90,547	0.24
Jun-Aug 2004	Florida to Maryland	30,196	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	120,743	0.23
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St.	84,000	0.36

	Lawrence		
July-Aug 2007	N. Labrador to Scotian Shelf	53,625	0.22

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for common dolphins is 120,743 animals (CV=0.23) derived from the 2004 surveys. The minimum population estimate for the western North Atlantic common dolphin is 99,975.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 99,975 animals. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor is 0.5, the default value for stocks of unknown status relative to optimum sustainable population (OSP), and because the CV of the average mortality estimate is less than 0.3~~The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3~~ (Wade and Angliss 1997). PBR for the western North Atlantic stock of common dolphin is 1,000.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2003~~2004-~~2007~~ 2008 was ~~160~~ 167 (CV=0.~~10~~11) common dolphins (Table 2).

Fishery information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

For more details on the historical fishery interactions prior to 1999 see Waring *et al.* (2007).

In the Atlantic pelagic longline fishery between 1990 and 2007, 20 common dolphins were observed hooked and released alive.

The estimated fishery-related mortality of common dolphins attributable to the *Loligo* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries was 0 between 1997-1998 and 49 in 1999 (CV=0.97). After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

In the Atlantic mackerel portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries, the estimated fishery-related mortality was 161 (CV=0.49) animals in 1997 and 0 in 1998 and 1999. However, the estimates in both the mackerel and *Loligo* fisheries should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl and mid-Atlantic mid-water trawl fisheries.

There was one observed take in the Southern New England/mid-Atlantic Bottom Trawl fishery reported in 1997. The estimated fishery-related mortality for common dolphins attributable to this fishery was 93 (CV= 1.06) in 1997 and 0 in 1998 and 1999. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

Northeast Sink Gillnet

Four common dolphins were observed taken in northeast sink gillnet fisheries in 2005, one in 2006 and 1 in 2007. The estimated annual fishery-related mortality and serious injury attributable to the northeast sink gillnet fishery (CV in parentheses) was 0 in 1995, 63 in 1996 (1.39), 0 in 1997, 0 in 1998, 146 in 1999 (0.97), 0 in 2000-2004, 5 (0.80) in 2005, 20 (1.05) in 2006, and 11 (1.08) in 2007. The 2003-2007 average annual mortality attributed to the northeast sink gillnet was 11 animals (CV=0.54). This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized.

Mid-Atlantic Gillnet

One common dolphin was taken in an observed trip during 2006. Two common dolphins were observed taken in 1995, 1996 and 1997, and no takes were observed from 1998 to 2005, or in 2007 - 2008. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (0.69), 43 in 1996 (0.79), 16 in 1997 (0.53), and 0 in 1998-2005, 11 (1.03) in 2006, ~~and~~ 0 in 2007, and 0 in 2008. Average annual estimated fishery-related mortality attributable to this fishery during ~~2003~~2004-~~2007~~ 2008 was 2 (CV = 1.03) common dolphins (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. One common dolphin was observed taken in 2002, ~~three~~ 3 in 2004, ~~five~~ 5 in 2005, 1 in 2006, ~~and~~ 3 in 2007, and 1 in 2008. (Table2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 27 in 2000 (0.29), 30 (0.30) in 2001, 26 (0.29) in 2002, 26 (0.29) in 2003, 26 (0.29) in 2004, 32 (0.28) in 2005, 25 in 2006, ~~and~~ 24 (0.28) in 2007, and 17 (0.29) in 2008. The ~~2003~~2004-~~2007~~ 2008 average annual mortality attributed to the northeast bottom trawl was ~~27~~ 25 animals (CV=0.~~12~~13).

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, ~~two~~ 2 in 2001, ~~nine~~ 9 in 2004, 15 in 2005, 14 in 2006, ~~and~~ 0 in 2007, and 1 in 2008 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 93 in 2000 (0.26), 103 (0.27) in 2001, 87 (0.27) in 2002, 99 (0.28) in 2003, 159 (0.30) in 2004, 141 (0.29) in 2005, 131 (0.28) in 2006, ~~and~~ 66 (0.27) in 2007, and 108 (0.28) in 2008. The ~~2003~~2004-~~2007~~ 2008 average annual mortality attributed to the mid-Atlantic bottom trawl was ~~119~~ 121 animals (CV=0.~~12~~13).

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)

2007 was the first year a short-beaked common dolphin mortality had been observed in this fishery. This animal was taken in the same haul as an Atlantic white-sided dolphin. Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. The resultant estimated annual fishery-related mortality and serious injury (CV in parentheses) was 3.2 (0.70) for 2007. The ~~2003~~2004-~~2007~~ 2008 average annual mortality attributed to the mid-Atlantic mid-water trawl was 1 (0.70) animal.

Table 2. Summary of the incidental mortality of short-beaked common dolphins (*Delphinus delphis delphis*) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery [a]	Years	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	~~03~~04-~~07~~08	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.03,~~ .06, .07, .04, .07, .05	0, 0, 0, 0, 0	~~0,~~ 0, 4, 1, 1, 2	0, 0, 0, 0, 0	~~0,~~ 0, 26, 20, 11, 3~~5~~3	~~0,~~ 0, 26, 20, 11, 3~~5~~3	~~0,~~ 0, .8, 1.05, 1.08, .77	~~11~~ 18 (0.~~54~~45)
Mid-Atlantic Gillnet	~~03~~04-~~07~~08	Obs. Data, Trip Logbook, Allocated Dealer Data	.01, .02, .03, .04, .~~06~~03	0, 0, 0, 0, 0	~~0,~~ 0, 0, 1, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 0, 11, 0, 0	~~0,~~ 0, 0, 11, 0, 0	~~0,~~ 0, 0, 1.03, 0, 0	2 (1.03)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	~~20~~03~~4~~-~~20~~07~~8~~	Obs. Data Weighout Trip Logbook	~~.018,~~ .064, .084, .089, .039, .13	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 1, 0	0, 0, 0, 0, 0,	~~0,~~ 0, 0, 0, 3.2, 0	~~0,~~ 0, 0, 0, 3.2, 0	~~0,~~ 0, 0, 0, 0, .70, 0	1 (.70)
Northeast Bottom Trawl [d]	~~03~~04-~~07~~08	Obs. Data Dealer Data VTR Data	~~.04,~~ .05, .12, .06, .06, .08	0, 0, 0, 0, 0	~~0,~~ 3, 5, 1, 3, 1	0, 0, 0, 0, 0	~~26,~~ 26, 32, 25, 24, 17	~~26,~~ 26, 32, 25, 24, 17	~~.29,~~ .29, .28, .28, .28, .29	~~27~~ 25 (.~~12~~13)
Mid-Atlantic Bottom Trawl [d]	~~03~~04-~~07~~08	Obs. Data Dealer	~~.01,~~ .03 , .03, .02, .03, .03	0, 0, 0, 0 , 0	~~0,~~ 9, 15, 14, 0, 1	0, 0, 0, 0, 0	~~99,~~ 159, 141, 131, 66, 108	~~99,~~ 159, 141, 131, 66, 108	~~.28,~~ .30, .20, .28, .27, .28	~~119~~ 121 (.~~12~~13)
TOTAL										~~160~~ 167 (.~~10~~11)

a. The fisheries listed in Table 2~~.~~ reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The „North Atlantic bottom trawl' fishery is now referred to as the „Northeast bottom trawl. The Illex, Loligo and Mackerel fisheries are now part of the ‚mid-Atlantic bottom trawl' and 'mid-Atlantic midwater trawl' fisheries.

b. Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Dealer reported data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) that are used to determine the spatial distribution of landings and fishing effort.

c. The observer coverages for the Northeast sink gillnet fishery are ratios based on tons of fish landed. North Atlantic bottom trawl mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips.

d. NE and MA bottom trawl mortality estimates reported for 2007 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 effort. ~~Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in early 2009.~~ NE and MA bottom trawl mortality estimates reported for 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2008 effort (Rossman 2009). Because of this pooling, years with no observed mortality may still have a calculated estimate.~~(Rossman in press).~~

CANADA

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997)~~(Lens 1997)~~. A total of 47 incidental catches were recorded, which included one common dolphin. The incidental mortality rate for common dolphins was 0.007/set.

Other Mortality

From ~~2003~~ 2004 to ~~2007~~2008, ~~407~~ 414 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during 2004 (one event of 6 animals and one of 3 animals), 2005 (a total of 43 in 4 separate events), 2006 (a total of 65 in 10 events), ~~and~~ 2007 (a total of 23 in 5 separate events) and 2008 (one event of 5 animals and one of 2 animals). Five of the 2005 Massachusetts stranded animals, 18 animals in 2006, ~~and~~ 2 animals in 2007, and 2 animals in 2008 were released alive. Common dolphins were included in the UME (unusual mortality event) declared for Virginia in 2004 (MMC 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved. Human interactions were indicated on one of the 2004 Virginia common dolphin mortality records, one of the 2005 and one of the 2007 New York mortality records and one of the 2006 Virginia mortality records. In 2008, seven common dolphins had indications of human interactions, four which were fishery interactions.

Four common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; 2000). One common dolphin was reported stranded in Halifax County, Nova Scotia in 2005 and one was reported stranded in 2008 (Tonya Wimmer, pers. comm.).

~~Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2003-2007.~~

~~STATE~~	~~2003~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~TOTALS~~
~~Maine~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~
~~Massachusetts[a]~~	~~22~~	~~26~~	~~64~~	~~100~~	~~65~~	~~277~~
~~Rhode Island~~	~~2~~	~~1~~	~~0~~	~~2~~	~~4~~	~~9~~
~~Connecticut~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~New York[b, c]~~	~~11~~	~~3~~	~~4~~	~~3~~	~~23~~	~~44~~
~~New Jersey~~	~~6~~	~~17~~	~~4~~	~~2~~	~~4~~	~~33~~
~~Delaware~~	~~1~~	~~2~~	~~1~~	~~0~~	~~0~~	~~4~~
~~Maryland~~	~~0~~	~~5~~	~~0~~	~~0~~	~~0~~	~~5~~
~~Virginia[b, c]~~	~~4~~	~~8~~	~~2~~	~~1~~	~~4~~	~~19~~
~~North Carolina~~	~~7~~	~~4~~	~~1~~	~~2~~	~~0~~	~~14~~
~~Georgia~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Florida~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~EZ~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~
~~TOTALS~~	~~53~~	~~67~~	~~76~~	~~110~~	~~101~~	~~407~~

~~a. Massachusetts mass strandings (2004 - 6 and 3; 2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14; 2007 - 9,2,4,6,2).~~

~~b. Virginia reports 1 common dolphin found in a pound net in 2004. One common dolphin was released alive from a pound net in 2006 in NY. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals involved in a mass stranding in Suffolk county in 2007.~~

~~c. One 2005 and one 2007 mortality in New York reported as having human interactions and one in VA in 2006.~~

Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2004-2008.

STATE	2004	2005	2006	2007	2008	TOTALS
Maine	0	0	0	1	0	1
Massachusetts[a]	26	64	100	65	19	274
Rhode Island	1	0	2	4	3	10
New York [b, c]	3	4	3	23	2	35
New Jersey	17	4	2	4	9	36
Delaware[c]	2	1	0	0	2	5
Maryland	5	0	0	0	2	7
Virginia[b, c]	8	2	1	4	22	37
North Carolina[c]	4	1	2	0	1	8
EZ	1	0	0	0	0	1
TOTALS	67	76	110	101	60	414

a. Massachusetts mass strandings (2004 - 6 and 3; 2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14; 2007 - 9,2,4,6,2; 2008 - 5 and 2).

b. Virginia reports 1 common dolphin found in a pound net in 2004. One common dolphin was released alive from a pound net in 2006 in NY. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals involved in a mass stranding in Suffolk county in 2007. Seven animals involved in 2 mass stranding events in March 2009 (six euthanized, 1 died at site, 2 had signs of fishery interation). In addition, in 2009 3 animals were relocated from the Nansemond River.

c. One 2005 mortality in New York reported as having human interaction and one in VA in 2006. Seven records with signs of human interaction in 2009 - 3 from Virginia, 1 from Massachuisetts, one from North Carolina, and one from Delaware. Of these, 4 were fishery interactions.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of short-beaked common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The ~~2002~~2004-~~2006~~ 2008 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer

continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, DC. #AA551-CT8-48**:** 576.

Doksaeter, L., E. Olsen, L. Nottestad and A. Ferno. 2008 Distribution and feeding ecology of dolphins along the Mid-Atlantic Ridge between Iceland and the Azores. Deep Sea Research II 55:243-253.

~~Evans, W. E. 1994. Common dolphin, white bellied porpoise. Pages 191-224 *in*: S. H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, San Diego, CA.~~

~~Gaskin, D. E. 1992. The status of the harbour porpoise. Can. Field-Nat. 106: 36-54.~~

Gowans, S. and H. Whitehead 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. Can. J. Zool. 73: 1599-1608.

Hain, J. H. W., R. K. Edel, H. E. Hays, S. K. Katona and J. D. Roanowicz 1981. General distribution of cetaceans in the continental shelf waters of the northeastern United States. *In:* A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the US outer continental shelf. BLM. AA551-CT8-48**:** 1-345.

Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, No. Carolina, USA to Nova Scotia, Canada). Mar. Mamm. Sci. 18(4): 920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laakeet al, (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam.

Jefferson, T.A., D. Fertl, J. Bolanos-Jimenez and A.N. Zerbini. 2009. Distribution of common dolphins (*Delphinus* spp.) in the western North Atlantic: a critical re-examination. Marine Biology 156:1109-1124.

Lawson, J. W. and J.-F. Gosselin 2008. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 208/nnn. 33 pp.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES [Int. Counc. Explor. Sea] C.M. 1997/Q:08: 10.

Lucas, Z. N. and S. K. Hooker 1997. Cetacean strandings on Sable Island, Nova Scotia, 1990-1996. Paper SC/49/06 presented to the IWC Scientific Committee, September 1997.

Lucas, Z. N. and S. K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

MMC 2005. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda, MD. 171 pp. http://www.mmc.gov/reports/annual/pdf/2004annualreport.pdf

Palka, D. L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D. L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans, European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D. L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Palka, D. L. and P. S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Payne, P. M., L. A. Selzer. and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles and seabirds in the shelf waters of the northeast U.S., June 1980 - Dec. 1983, based on shipboard observations. National Marine Fisheries Service, Woods Hole. NA81FAC00023**:** 245.

Rossman, M. C. 2009. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000-2005. J. Northwest Fish. Sci. 42: 77-101.

Selzer, L. A. and P. M. Payne 1988. The distribution of white-sided (*Lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the northeastern United States. Mar. Mamm. Sci. 4(2): 141-153.

Sergeant, D. E., A. W. Mansfield and B. Beck 1970. Inshore records of cetacea for eastern Canada, 1949-68. J. Fish. Res. Board Can 27: 1903-1915.

Wade, P. R. and R. P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano 1992. Cetaceans associated with Gulf Stream Features off the Northeastern USA Shelf. ICES [Int. Counc. Explor. Sea] C.M. 1992/N:12.

Waring, G. T., E. Josephson, C. P. Fairfield and K. Maze-Foley, eds. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201.

Waring, G.T., Nottestad, L., Olsen, E., Skov, H. and G. Vikingsson. 2008. Distribution and density estimates of cetaceans along the mid-Atlantic Ridge during summer 2004. Journal of Cetacean Research and Management. 10(2):137-146.

Westgate, A. J. 2005. Population structure and life history of short-beaked common dolphins (*Delphinus delphis*) in the North Atlantic. Ph.D thesis. Nicholas School of the Environment and Earth Sciences. Beaufort, NC, Duke University.

Westgate, A. J. 2007. Geographic variation in cranial morphology of short-beaked common dolphins (*Delphinus delphis*) from the North Atlantic. J. Mamm. 88(3): 678-688.

Westgate, A. J. and A. J. Read 2007. Reproduction in short-beaked common dolphins (*Delphinus delphis*) from the western North Atlantic. Marine Biology 150: 1011-1024.

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~~December 2009~~~~January~~March 2010

HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, strandings and takes reported by NMFS observers in the Sea Sampling Program. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al.* 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. However, during the fall, several satellite tagged harbor porpoises did favor the waters around the 92 m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida during the 1980s (Smithsonian strandings database) and one in 2003 (NE Regional Office/NMFS strandings and entanglement database).

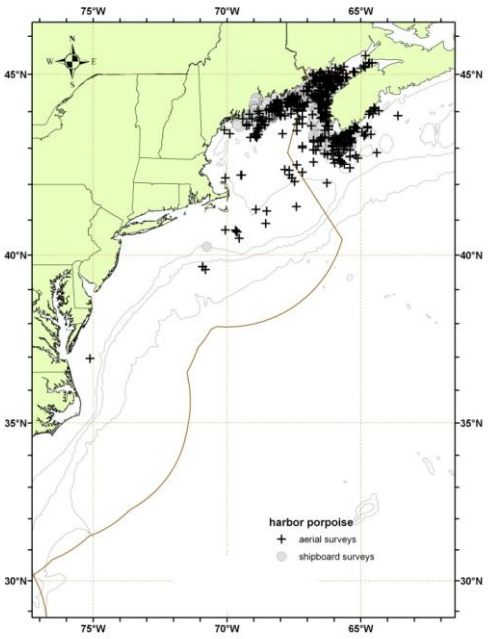

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Gaskin (1984; 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland populations. ~~Recent a~~Analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a; Rosel *et al.* 1999b), organochlorine contaminants (Westgate *et al.* 1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel *et al.* 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Palka *et al.* 1996; Rosel *et al.* 1999a) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Nuclear microsatellite markers have also been applied to samples from these

four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel *et al.* 1999a). These patterns may be indicative of female philopatry coupled with dispersal of males. Both mitochondrial DNA and microsatellite analyses indicate that the Gulf of Maine/Bay of Fundy stock is not the sole contributor to the aggregation of porpoises found in the mid-Atlantic states during winter (Rosel *et al.* 1999a; Hiltunen 2006). Mixed-stock analyses using twelve microsatellite loci in both Bayesian and likelihood frameworks indicate that the Gulf of Maine/Bay of Fundy is the largest contributor (~60%), followed by Newfoundland (~25%) and then the Gulf of St. Lawrence (~12%), with Greenland making a small contribution (<3%). For Greenland, the lower confidence interval of the likelihood analysis includes zero. For the Bayesian analysis, the lower 2.5% posterior quantiles include zero for both Greenland and the Gulf of St. Lawrence. Intervals that reach zero provide the possibility that these populations contribute no animals to the mid-Atlantic aggregation. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland, and Greenland.

POPULATION SIZE

To estimate the population size of harbor porpoises in the Gulf of Maine/Bay of Fundy region, eight line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, 1999, 2002, 2004, 2006, and 2007. The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,054 (CV=0.47), based on the 2006 survey results (Table 1). This is because the 2006 estimate covered the largest portion of the harbor porpoise range.

An abundance estimate of 64,047 (CV=0.48) harbor porpoises was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 51,520 (CV=0.65) harbor porpoises was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct-duplicate method (Palka 1995b) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 89,054 (CV=0.47) harbor porpoises was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

An abundance estimate of 4,862 (95%CI=2,204-8,801) harbor porpoises from the Gulf of Maine/Bay of Fundy, Gulf of ~~Saint~~ St. Lawrence, and Newfoundland stocks was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases. {Lawson, 2009 #1069}

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	64,047	0.48
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	51,520	0.65
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	89,054	0.47
Jul-Aug 2007	Northern Labrador-Scotian Shelf	4,862	0.31

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor porpoises is 89,054 (CV=0.47). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 60,970.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate a likely annual growth rate of 4%. In an attempt to estimate a potential population growth rate that incorporates many of the uncertainties in survivorship and reproduction, Caswell *et al.* (1998) used a Monte Carlo method to calculate a probability distribution of growth rates. The median potential annual rate of increase was approximately 10%, with a 90% confidence interval of 3-15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Moore and Read (2008) conducted a Bayesian population modeling analysis to estimate the potential population growth of harbor porpoise in the absence of bycatch mortality. Their method used fertility data, in combination with age-at-death data from stranded animals and animals taken in gillnets, and was applied under two scenarios to correct for possible data bias associated with observed bycatch of calves. Demographic parameter estimates were ‚model averaged' across these scenarios. The Bayesian posterior median estimate for potential natural growth rate was 0.046. This last, most recent, value will be the one used for the purpose of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 60,970. The maximum productivity rate is 0.046. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 703.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from U.S. and Canadian Sea Sampling Programs, from records of strandings in U.S. and Canadian waters, and from records in the Marine Mammal Authorization Program (MMAP). See Appendix III for details on U.S. fisheries and data sources. Estimates using Sea Sampling Program and MMAP data are discussed by fishery under the Fishery Information section (Table 2). Strandings records are discussed under the Unknown Fishery in the Fishery Information section (Table 3) and under the Other Mortality section (Table 4).

The total annual estimated average human-caused mortality is 9~~40~~28~~860~~+ (CV=0.16~~2~~) harbor porpoises per year. This is derived from four components: 8~~89~~77~~07~~ harbor porpoise per year (CV=0.1~~6~~5~~2~~) from most U.S. fisheries using observer and MMAP data, an unknown number for the Northeast bottom trawl fishery, 45 per year (unknown CV) from Canadian fisheries using observer data, and 6~~7.5~~ per year from unknown U.S. fisheries using strandings data.

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, Northeast bottom trawl and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries (Table 2). Detailed U.S. fishery information is reported in Appendix III.

Earlier Interactions

One harbor porpoise was observed taken from the Atlantic pelagic drift gillnet fishery during 1991-1998; the fishery ended in 1998. This observed bycatch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7.00), 1.7 in 1990 (2.65), 0.7 in 1991 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), 0 during 1994-1996 and 0 in 1998. The fishery was closed during 1997.

U.S.

Northeast Sink Gillnet

In 1984 the Northeast sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal bycatch. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the 11 gillnetters who received permits and logbooks, 30 harbor porpoises were reported caught. It was estimated, using rough estimates of fishing effort, that a maximum of 600 harbor porpoises were killed annually in this fishery (Gilbert and Wynne 1985; Gilbert 1987).

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Estimated annual bycatch (CV in parentheses) from this fishery during 1990-2007 was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), 1,400 in 1993 (0.18) (CUD 1994; Bravington and Bisack 1996), 2,100 in 1994 (0.18), 1,400 in 1995 (0.27) (Bisack 1997), 1,200 in 1996 (0.25), 782 in 1997 (0.22), 332 in 1998 (0.46), 270 in 1999 (0.28) (Rossman and Merrick 1999), 507 in 2000 (0.37), 53 (0.97) in 2001, 444 (0.37) in 2002, 592 (0.33) in 2003, 654 (0.36) in 2004, 630 (0.23) in 2005, 514 (0.31) in 2006, ~~and~~ 395 (0.37) in 2007, and ~~720~~666 (0.48) in 2008 (Table 2). There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990-1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Scientific experiments that demonstrated the effectiveness of pingers in the Gulf of Maine were conducted during 1992 and 1993 (Kraus *et al.* 1997). After the scientific experiments, experimental fisheries were allowed in the general fishery during 1994 to 1997 in various parts of the Gulf of Maine and south of Cape Cod areas. During these experimental fisheries, bycatch rates of harbor porpoises in pingered nets were less than in non-pingered nets.

Average estimated harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery during 1994-1998, before the Take Reduction Plan, was 1,163 (0.11). The average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from 2004~~3~~ to 2008~~7~~ was 5~~8~~372~~57~~ (0.17~~4~~) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995 were from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast sink gillnet fishery (Bravington and Bisack 1996; Bisack 1997). The estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, 572 (0.35) for 1997, 446 (0.36) for 1998, 53 (0.49) for 1999, 21 (0.76) for 2000, 26 (0.95) for 2001, unknown in 2002, 76 (1.13) in 2003, 137 (0.91) in 2004, 470 (0.51) in 2005, 511 (0.32) in 2006, ~~and~~ 58 (1.03) in 2007, and 35~~3~~0 (0.7~~6~~5) in 2008. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic gillnet fishery during 1995 to 1998, before the Take Reduction Plan, was 358 (CV=0.20). The average annual harbor porpoise mortality and serious injury in the mid-Atlantic gillnet fishery from ~~2003~~ 2004 to 20087 was ~~250~~ 30~~6~~5 (0.~~26~~3427) (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. ~~Nineteen~~ Twenty harbor porpoise mortalities were observed in the Northeast bottom trawl fishery between 1989 and ~~2007~~2008, but many of these are not attributable to this fishery. Decomposed animals are presumed to have been dead prior to being taken by the trawl. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003, 4 in 2005, ~~and~~ 1 in 2006, and 1 in 2008. Estimates have not been generated for this fishery.

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27, 113, 79, 122, 118, 174, 73, ~~and~~ 79, and 58 stranded harbor porpoises on U.S. beaches during 1999 to ~~2007~~2008, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1, 3, 2, 9, and 6 stranded harbor porpoises in 1999 to 2004, respectively, were due to unknown fisheries and these animals were in areas and times that were not included in the above

mortality estimate derived from observer program data (Table 3). As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. The ~~two-year average~~ harbor porpoise mortality and serious injury in this unknown fishery category f~~r~~orm ~~2003 to~~ 2004 is 6.0~~7.5~~ (CV is unknown).

CANADA

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. No harbor porpoises were observed taken.

Bay of Fundy Sink Gillnet

During the early 1980s, harbor porpoise bycatch in the Bay of Fundy sink gillnet fishery, based on casual observations and discussions with fishermen, was thought to be low. The estimated harbor porpoise bycatch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). The Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988.

More recently, an observer program implemented in the summer of 1993 provided a total bycatch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, (approximately 11.3% coverage of the Bay of Fundy trips) (Trippel *et al.* 1996). During 1994, the observer program was expanded to cover 49% of the gillnet trips (171 observed trips). The bycatch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), and the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed from July 21 to August 31. During the open fishing period of 1995, 89% of the trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated bycatch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was computed due to lack of coverage in the Wolves fishing grounds. During 1996, the Canadian gillnet fishery was closed during 20-31 July and 16-31 August due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be 20 harbor porpoises (DFO 1998; Trippel *et al.* 1999). Trippel *et al.* (1999) estimated that during 1996, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 68% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. During 1997, the fishery was closed to the majority of the gillnet fleet during 18-31 July and 16-31 August, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during September 1-7. From the 75 monitored trips, 19 harbor porpoises were observed taken. After accounting for total fishing effort, the estimated bycatch in 1997 was 43 animals (DFO 1998). Trippel *et al.* (1999) estimated that during 1997, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 85% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. The number of monitored trips (and observed harbor porpoise mortalities were 111 (5) for 1998, 93 (3) for 1999, 194 (5) for 2000, and 285 (39) for 2001. The estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepherd 2004). Estimates of variance are not available.

There has been no observer program during the summer since 2002 in the Bay of Fundy region, but the fishery was active. Bycatch for these years is unknown. The annual average of most recent five years with available data (1997-2001) was 43 animals, so this value is used to estimate the annual average for more recent years~~2003-2007 removals~~.

Herring Weirs

Harbor porpoises are taken in Canadian herring weirs, but there have been no recent efforts to observe takes in the U.S. component of this fishery. Smith *et al.* (1983) estimated that in the 1980s approximately 70 harbor porpoises became trapped annually and, on average, 27 died annually. In 1990, at least 43 harbor porpoises were trapped in Bay of Fundy weirs (Read *et al.* 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read *et al.* 1994). Between 1992 and 1994, this cooperative program resulted in the live release of 206 of 263 harbor porpoises caught in herring weirs. Mortalities (and releases) were 11 (50) in 1992, 33 (113) in 1993, and 13 (43) in 1994 (Neimanis *et al.* 1995). Since that time, ~~an~~ additional ~~751~~ harbor porpoises have been documented in Canadian herring weirs where the number of ~~, of which 687 were released or escaped, 41 died, and 23 had an unknown status. M~~mortalities (~~and~~ releases, and unknowns) were 5 (60, 0) in 1995; 2 (4, 0) in 1996; 2 (24, 0) in 1997; 2 (26, 0) in 1998; 3 (89, 0) in 1999; 0 (13, 0) in 2000 (A. Read, pers. comm), 14 (296, 0) in 2001, 3 (46, 4) in 2002, 1 (26, 3) in 2003, 4 (53, 2) in 2004; 0 (19, 5) in 2005; 2 (14, 0) in 2006; 3 (9, 3) in 2007 and 0 (8, 6) in 2008 (Neimanis *et al.* 2004; H. Koopman

and A. Westgate, pers. comm.).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 2004~~3~~-2008~~7~~ was 1.8~~2.0~~ (Table 2). An estimate of variance is not possible.

Gulf of St. Lawrence gillnet

This fishery interacts with the Gulf of St. Lawrence harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Using questionnaires to fishermen, Lesage *et al.* (2006) determined a total of 2215 (95% CI 1151-3662) and 2394 (95% CI 1440-3348) harbor porpoises were taken in 2000 and 2001, respectively. The largest takes were in July and August around Miscou and the North Shore of the Gulf of St. Lawrence. According to the returned questionnaires, the fish species most usually associated with incidental takes of harbor porpoises include Atlantic cod, herring and mackerel. An at-sea observer program was also conducted during 2001 and 2002. However, due to low observer coverage that was not representative of the fishing effort, Lesage *et al.* (2006) concluded that resulting bycatch estimates were unreliable.

Newfoundland gillnet

This fishery interacts with the Newfoundland harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Estimates of incidental catch of small cetaceans, where the vast majority are likely harbor porpoises was 862 in 2001, 1,428 in 2002, and 2,228 in 2003 for the Newfoundland nearshore cod and Greenland halibut fisheries, and the Newfoundland offshore fisheries in lumpfish, herring, white hake, monkfish and skate (Benjamins *et al.* 2007) .

Table 2. From observer program data, summary of the incidental mortality of harbor porpoise (*Phocoena phocoena*) by commercial fishery including the years sampled (Years), ~~the number of vessels active within the fishery (Vessels),~~ the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
U.S.							
Northeast Sink Gillnet[c]	~~03~~04-~~07~~08	Obs. Data, Weighout, Trip Logbook	~~.03,~~ .06, .07, .04, .07, .05	~~12[e],~~ 27[e], 51[e], 26, 35, 30	~~592,~~ 654[e], 630[e], 514, 395, ~~720~~666	~~.33,~~ .36, .23, .31, .37, .48	~~557~~58372 (~~0.14~~0.17)
Mid-Atlantic Gillnet	~~03~~04-~~07~~084	Obs. Data Weighout	~~.01,~~ .02, .03, .04, .06, .03	~~1,~~ 2, 15, 20, 1, 9	~~76,~~ 137, 470, 511, 58, 35~~3~~0	~~1.13,~~ .91, .51, .32, 1.03, .76~~5~~	~~250~~3065 (0.~~26~~3427)
Northeast bottom trawl[g]	~~03~~04-~~07~~084	Obs. Data Weighout	~~.04,~~ .05, .12, .06, .06, .08	~~1,~~0,4,1, 0, 1	~~unk[i],~~0,unk[i], unk, 0, unk	~~unk,~~ 0, unk, unk, 0, unk	unk[i,g]
U.S. TOTAL	2004~~3~~-2008~~7~~						8~~89~~77~~07~~ (0.16~~5~~2)
CANADA							
Bay of Fundy Sink Gillnet[d]	1997-2001~~07~~	Can. Trips	unk	19, 5, 3, 5, 39	4~~33~~4, 38, 32, 28, 73	unk	43[f] (unk)
Herring Weir	04~~3~~-08~~7~~	Coop. Data	unk	~~1,~~ 4, 0, 2, 3, 0	~~1,~~ 4, 0, 2, 3, 0	NA	1.8~~2.0~~ (unk)
CANADIAN TOTAL	2004~~3~~-2008~~7~~						45 (unk)
GRAND TOTAL							9~~3~~422~~850~~+ (unk)

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NA = Not available.

a. Observer data (Obs. Data) are used to measure bycatch rates; the U.S. data are collected by the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program, the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. Trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory vessel trip report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery. Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

b. O~~The o~~bserver coverage~~s~~ for the ~~U.S. and Canadian sink gillnet fisheryies~~ is~~are ratios based on trips, and for the~~ U.S. Northeast and mid-Atlantic coastal gillnet fisheries~~y~~, ~~the coverage unit of effort~~ is based on tons of fish landed.

c. During 2002-2008 in the Northeast gillnet fishery~~7~~, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

$$\sum_{i}^{ping,non-ping} \frac{\#\,porpoise_i}{ss landings_i} \cdot \frac{\#\,hauls_i}{total\#\,hauls}$$

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, 4, 12, 2, ~~and~~ 9 and 6 observed harbor porpoise takes on pinger trips from 1992 to 2008~~7~~, respectively, that were included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, 0, 1, 7, 21, 33, 24, ~~and~~ 7, and 13 observed harbor porpoise takes in 1995 to 2008~~7~~, respectively, on trips dedicated to fish sampling versus dedicated to watching for marine mammals; these were also included in the observed mortality column (Bisack 1997).

d. There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

e. There were 22 active weirs around Grand Manan. The number of weirs elsewhere is unknown.

f~~h~~. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery is still active; thus, the bycatch estimate is estimated using past averages.

g~~i~~. Estimates of bycatch mortality attributed to the Northeast bottom trawl fishery have not been generated.

Table 3. From strandings and entanglement data, summary of confirmed incidental mortality of harbor porpoises (*Phocoena phocoena*) by fishery: includes years sampled (Years), ~~number of vessels active within the fishery (Vessels),~~ type of data used (Data Type), mortalities assigned to this fishery (Assigned Mortality), and mean annual mortality.

Fishery	Years	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	~~03~~04-~~07~~08	Entanglement & Strandings	~~9,~~ 6, unk[b], unk[b], unk[b], unk[b]	~~7.5~~6
TOTAL				~~7.5~~6

NA=Not Available.

a Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).

b. As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Thus, the annual mortality is ~~an~~that from ~~average from the years 2003~~ 2004.

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Other Mortality

U.S.

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960s, and the meat was used for human consumption, oil, and fish bait (NMFS 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until media reports in September 1997 depicted a Passamaquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing

legal action in state court.

During 2003, 122 harbor porpoises were reported stranded (Table 4). The number of reported fishery interactions by state are: 1 in Massachusetts (October), 1 in Maryland (March), 6 in Virginia (3 in March, 2 in April, and 1 in May), and 1 in North Carolina (February). Three harbor porpoises were reported mutilated in North Carolina. All of these strandings reported with fishery interactions were in areas and times that were not part of a bycatch estimate derived from the observer data (Table 3).

During 2004, 117 harbor porpoises were reported stranded on Atlantic US beaches. There were 8 reported fishery interactions by state: 1 in Massachusetts (May), 1 in New York (May), and 3 in Virginia (February, March, and April), and 3 in North Carolina (April). In addition, there was 1 mutilation in Delaware during March. Of these 8 fishery interactions, six were in areas and times that were not part of a bycatch estimated derived from the observer data (Table 3).

During 2005, 175 harbor porpoises were reported stranded on Atlantic US beaches. Although 24 animals were classified as having signs of human interaction, and of those 24, 7 showed signs of fishery interaction, in no case was cause of death directly attributable to these interactions. An Unusual Mortality Event was declared for harbor porpoise in North Carolina, as there were 38 stranded in that state between 1 January and 28 March 2005. Most of these were young of the year, and histopathological examinations of 6 of these animals showed no– systemic diseases or common symptoms other than emaciation or any systemic disease (MMC 2006).

During 2006, 73 harbor porpoises were reported stranded on Atlantic US beaches. Eight of these were reported as having signs of human interaction, but in no case was cause of death directly attributable to these interactions. In fact, in three cases the human interaction was post-mortem. One of the human interaction mortalities was classified as a fishery-interaction (with no further detail), one as a boat collision, and one was involved in an oil spill.

During 2007, 79 harbor porpoises were reported stranded on Atlantic US beaches. Of these, six were reported as having signs of human interaction. One of these was classified as a fishery interaction, and one had signs of propeller wounds, although the marks appeared to have been made post-mortem.

During 2008, 58 harbor porpoises were reported stranded on Atlantic US beaches. Of these, four were reported as having signs of human interaction. One of these was classified as a fishery interaction.

As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Using only Averaging 2003 to 2004, it is estimated that there were 7.56 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality (Table 3).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2003-2007.

Area	Year					Total
	2003	2004	2005	2006	2007	
Maine	5	15	9	9	10	**48**
New Hampshire	2	2	0	1	0	**5**
Massachusetts[a]	35	49	55	23	22	**184**
Rhode Island[b]	2	3	6	3	1	**15**
Connecticut	0	0	1	0	0	**1**
New York[c]	8	8	15	11	10	**52**
New Jersey	5	14	17	6	5	**47**
Pennsylvania	0	0	1	0	0	**1**
Delaware	1	1	3	3	3	**11**
Maryland	5	2	4	2	0	**13**
Virginia	19	8	22	9	8	**66**
North Carolina[d]	39	15	42	6	20	**122**

~~Florida~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
~~**TOTAL U.S.**~~	~~**122**~~	~~**117**~~	~~**175**~~	~~**73**~~	~~**79**~~	~~**566**~~
~~Nova Scotia~~	~~3~~	~~4~~	~~6~~	~~4~~	~~4~~	~~21~~
~~**GRAND TOTAL**~~	~~**125**~~	~~**121**~~	~~**181**~~	~~**77**~~	~~**83**~~	~~**587**~~

~~a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007.~~
~~b. In Rhode Island, one animal stranded alive in 2006, and was taken to rehab.~~
~~c. Includes one live animal in 2006 in New York.~~
~~d. In North Carolina, one animal was relocated and released in 2005, and one was taken to rehab in2003 and one in 2006. The 2003 animal was tagged and released (Schofield *et al.* 2008).~~

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2004-2008.

Area	Year					**Total**
	2004	2005	2006	2007	2008	
Maine[a]	15	9	9	10	7	**50**
New Hampshire	2	0	1	0	0	**3**
Massachusetts[ab]	49	55	23	22	25	**174**
Rhode Island[be]	3	6	3	1	1	**14**
Connecticut	0	1	0	0	0	**1**
New York[ce]	8	15	11	10	3	**47**
New Jersey	14	17	6	5	8	**50**
Pennsylvania	0	1	0	0	0	**1**
Delaware	1	3	3	3	0	**10**
Maryland	2	4	2	0	2	**10**
Virginia	8	22	9	8	6	**53**
North Carolina[d]	15	42	6	20	6	**89**
Florida	0	0	0	0	0	**0**
TOTAL U.S.	**117**	**175**	**73**	**79**	**58**	**502**
Nova Scotia	3	5~~4~~	4~~6~~	4	6	~~**16**~~**22**~~**7**~~
Newfoundland and New Brunswick	0	5	0	1	4	**10**
GRAND TOTAL	**120**	**185~~4~~**	**77~~9~~**	**84**	**62**	**5~~28~~34~~9~~**

a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007 and one in 2008.
b. In Rhode Island~~,~~ one animal stranded alive in 2006~~,~~ and was taken to rehab.
c. Includes one live animal in 2006 in New York.
d. In North Carolina, one animal was relocated and released in 2005, ~~and~~ one animal was taken to rehab ~~in2003 and one~~ in 2006, and one animal immediately released in 2008. ~~The 2003 animal was tagged and released (Schofield *et al.* 2008).~~

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded between 1991 and 1996 on the

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coast of Nova Scotia (Hooker *et al.* 1997). Researchers with the Canadian Department~~t~~ of Fisheries and Oceans documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. On the mainland of Nova Scotia, a total of 8 stranded harbor porpoises were recorded between 1991 and 1996: 1 in May 1991, 2 in 1993 (July and September), 1 in August 1994 (released alive), 1 in August 1994, and 3 in 1996 (March, April, and July (released alive)). On Sable Island, 8 stranded dead harbor porpoises were documented, most in January and February; 1 in May 1991, 1 in January 1992, 1 in January 1993, 3 in February 1997, 1 in May 1997, and 1 in June 1997. Two strandings during May-June 1997 were neonates (> 80 cm). The harbor porpoises that stranded in the winter (January-February) were on Sable Island, those in the spring (March to June) were in the Bay of Fundy (2 in Minas Basin and 1 near Yarmouth) and on Sable Island (2), and those in the summer (July to September) were scattered along the coast from the Bay of Fundy to Halifax.

Whales and dolphins stranded between 1997 and ~~2007~~ 2008 on the coast of Nova Scotia as recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network are as follows (Table 4): 3 harbor porpoises stranded in 1997 (1 in April, 1 in June and 1 in July), 2 stranded in June 1998, 1 in March 1999, 3 in 2000 (1 in February, 1 in June, and 1 in August); 2 in 2001 (1 in July and 1 in December), 5 in 2002 (3 in July (1 released alive), 1 in August, and 1 in September (released alive)), 3 in 2003 (2 in May (1 was released alive) and 1 in June (disentangled and released alive)), 4 in 2004 (1 in April, 1 in May, 1 in July (released alive) and 1 in November), 6 in 2005 (1 in April (released alive), 1 in May, 3 in June and 1 in July), 4 in 2006 (1 in June, 1 in August, 1 in September, and 1 in December), ~~and~~ 4 in 2007, and ~~xx~~6 in 2008 (Table 4).

FFive dead stranded harbor porpoises were reported in 200~~8~~5 by the Newfoundland and Labrador Whale Release and Strandings Program, 1 in 2007 and 4 in 2008. (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009~~(Ledwell 2009)~~

USA management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gillnets was published in the Federal Register (63 FR 66464) on 02 December 1998 and became effective 01 January 1999. The Gulf of Maine portion of the plan pertains to all fishing with sink gillnets and other gillnets capable of catching regulated groundfish in New England waters, from Maine through Rhode Island. This portion of the rule includes time and areas closures, some of which are complete closures; others are closed to gillnet fishing unless pingers are used in the prescribed manner. Also, the rule requires those who intend to fish to attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72º30'W longitude to the mid-Atlantic shoreline from New York to North Carolina. This portion of the rule includes time and area closures, some of which are complete closures; others are closed to gillnet fishing unless the gear meets certain restrictions. The MMPA mandates that the take reduction teams that developed the above take reduction measures periodically meet to evaluate the effectiveness of the plan and modify it as necessary. The Harbor Porpoise Take Reduction Team was reconvened in December 2007 to discuss updated harbor porpoise abundance and bycatch information. The Team recommended modifications to the plan to further reduce harbor porpoise bycatch in commercial fisheries. NMFS is currently undertaking rule-making to modify the plan.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On 7 January 1993, the National Marine Fisheries Service (NMFS) proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On 5 January 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 2 August 2001, NMFS made available a review of the biological status of the Gulf of Maine/Bay of Fundy harbor porpoise population. The determination was made that listing under the Endangered Species Act (ESA) was not warranted and this stock was removed from the ESA candidate species list (NMFS 2001). Population trends for this species have not been investigated. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because average annual human-related mortality and serious injury exceeds PBR.

REFERENCES CITED

Barlow, J. and P. Boveng 1991. Modeling age-specific mortality for marine mammal populations. Mar. Mamm. Sci. 7: 50-65.

Benjamins, S., J. Lawson and G. Stenson 2007. Recent harbour porpoise bycatch in gillnet fisheries in Newfoundland and Labrador, Canada. J. Cetacean Res. Manage. 9(3): 189-199.

Bisack, K.D. 1997. Harbor porpoise bycatch estimates in the U.S. New England multispecies sink gillnet fishery: 1994 and 1995. Rep. Int. Whal. Comm. 47: 705-714.

Bravington, M.V. and K.D. Bisack 1996. Estimates of harbour porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. Int. Whal. Comm. 46: 567-574.

Caswell, H., S. Brault, A.J. Read and T.D. Smith 1998. Harbor porpoise and fisheries: An uncertainty analysis of incidental mortality. Ecol. Appl. 8(4): 1226-1238.

CUD 1994. Estimating harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery. Conservation and Utilization Division. Northeast Fish. Sci. Cent. Ref. Doc. 94-24.

DFO 1998. Harbour porpoise bycatch in the lower Bay of Fundy gillnet fishery. DFO Maritimes Regional Fisheries Status Report 98/7E. Available from Department of Fisheries and Oceans, Resource management Branch, P.O. Box 550, Halifax, NS B3J 2S7, Canada.

Gaskin, D.E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969-75. Rep. Int. Whal. Comm. 27: 487-492.

Gaskin, D.E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Comm. 34: 569-586.

Gaskin, D.E. 1992. The status of the harbour porpoise. Can. Field-Nat. 106: 36-54.

Gilbert, J.R. 1987. Marine Mammal Interaction with New England Gillnet Fisheries. NMFS. NA84EAC00070. draft report 21 pp.

Gilbert, J.R. and K.M. Wynne 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. NMFS. NA80FAC00029 and NA84EAC00070 15 pp.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake *et al.*, (eds.) Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Hiltunen, K.H. 2006. Mixed-stock analysis of harbor porpoises (*Phocoena phocoena*) along the U.S. mid-Atlantic coast using microsatellite DNA markers. MS thesis. The College of Charleston.

Hooker, S.K., R.W. Baird and M.A. Showell 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

Johnston, D.W. 1995. Spatial and temporal differences in heavy metal concentrations in the tissues of harbour porpoises (*Phocoena phocoena* L.) from the western North Atlantic. M.S. thesis. University of Guelph, Guelph, Ontario, Canada. 152 pp.

Kraus, S.D., J.H. Prescott and G.S. Stone 1983. Harbor porpoise, *Phocoena phocoena*, in the U.S. coastal waters off the Gulf of Maine: a survey to determine seasonal distribution and abundance. NMFS. NA82FAC00027 22 pp.

Kraus, S.D., A.J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson and J. Williamson 1997. Acoustic alarms reduce porpoise mortality. Nature 388(6642): 525.

Lamb, A. 2000. Patterns of harbor porpoise mortality in two US Atlantic sink gillnet fisheries and changes in life history parameters. M.S. thesis. Boston University, Boston, MA.

Lawson, J.W. and J.-F. Gosselin 2008. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. 208/031. 33 pp.

Ledwell, W. and J. Huntington 2004. Marine animal entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2004. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 18 pp.

Ledwell, W. and J. Huntington 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.

Ledwell, W. and J. Huntington 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region.

Ledwell, W. and J. Huntington 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Cananda,

Newfoundland and Labrador region.

Lesage, V., J. Keays, S. Turgeon and S. Hurtubise 2006. Bycatch of harbour porpoises (*Phocoena phocoena*) in gillnet fisheries of the Estuary and Gulf of St. Lawrence in 2000-2002. J. Cetacean Res. Manage. 8(1): 67-78.

Lucas, Z.N. and S.K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

MMC 2006. US Marine Mammal Commission Annual Report to Congress, 2005. Marine Mammal Commission. Bethesda, MD Vi+163 pp. http://www.mmc.gov/reports/annual/pdf/2005annualreport.pdf

Moore, J.E. and A.J. Read 2008. An uncertainty analysis of cetacean demography and bycatch mortality using carcass data. Ecol. Appl. (in press).

Neimanis, A.S., H.N. Koopman, A.J. Westgate, L.D. Murison and A.J. Read 2004. Entrapment of harbour porpoises (*Phocoena phocoena*) in herring weirs in the Bay of Fundy, Canada. J. Cetacean Res. Manage. 6(1): 7-17.

Neimanis, A.S., A.J. Read, A.J. Westgate, H.N. Koopman, J.Y. Wang, L.D. Murison and D.E. Gaskin 1995. Entrapment of harbour porpoises (*Phocoena phocoena*) in herring weirs in the Bay of Fundy, Canada. International Whaling Commission, Dublin, Ireland., Working paper SC/47/SM18.

NMFS 1992. Harbor porpoise in Eastern North America: Status and Research Needs. Results of a scientific workshop held May 5-8, 1992 at NEFSC, Woods Hole, MA, USA. National Marine Fisheries Service. Northeast Fish. Sci. Cent. Ref. Doc., Silver Spring, Maryland. 92-06. 28 pp.

NMFS 1993. Proposed listing of Gulf of Maine population of harbor porpoises as threatened under the Endangered Species Act. Federal Register 58: 3108-3120.

NMFS 1999. Listing of Gulf of Maine/Bay of Fundy population of harbor porpoise as threatened under the Endangered Species Act. Federal Register 64(2): 465-471.

NMFS 2001. Status review of the Gulf of Maine/Bay of Fundy population of harbor porpoise under the Endangered Species Act (ESA). Federal Register 66(203): 53195-53197.

Palka, D. 1995a. Influences on spatial patterns of Gulf of Maine harbor porpoises. Pages 69-75 *in*: A. S. Blix, L. Walloe and O. Ulltang, (eds.) Whales, Seals, Fish and Man. Elsevier Science.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. Northeast Fish. Sci. Cent. Ref. Doc. 00-07. 29 pp. http://www.nefsc.noaa.gov/psb/pubs/palkalabref00-07.pdf

Palka, D.L. 1995b. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0), Proceedings of a Workshop on Estimation of g(0) in Line-Transect Surveys of Cetaceans. European Cetacean Society's 18th Annual Conference; Kolmården, Sweden; Mar. 28, 2004.

Palka, D.L. and P.S. Hammond 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci 58: 777-787.

Palka, D.L., A.J. Read, A.J. Westgate and D.W. Johnston 1996. Summary of current knowledge of harbour porpoises in US and Canadian Atlantic waters. Rep. Int. Whal. Comm. 46: 559-565.

Polacheck, T. 1989. Harbor porpoises and the gillnet fishery. Oceanus 32(1): 63-70.

Polacheck, T., F.W. Wenzel and G. Early 1995. What do stranding data say about harbor porpoise (*Phocoena phocoena*)? Rep. Int. Whal. Comm. (Special Issue) 16: 169-180.

Read, A.J., J.E. Craddock and D. Gannon 1994. Life history of harbour porpoises and pilot whales taken in commercial fishing operations off the northeastern United States. Final Report, Phase II. 50-EANE-2-00082. final report, phase II.

Read, A.J. and A.A. Hohn 1995. Life in the fast lane: the life history of harbour porpoises from the Gulf of Maine. Mar. Mamm. Sci. 11(4): 423-440.

Read, A.J., J.R. Nicolas and J.E. Craddock 1996. Winter capture of a harbor porpoise in a pelagic drift net off North Carolina. Fish. Bull. 94(2): 381-383.

Read, A.J. and A.J. Westgate 1997. Monitoring the movements of harbour porpoises (*Phocoena phocoena)* with satellite telemetry. Marine Biology 130: 315-22.

Rosel, P.E., S.C. France, J.Y. Wang and T.D. Kocher 1999a. Genetic structure of harbour porpoise *Phocoena phocoena* populations in the northwest Atlantic based on mitochondrial and nuclear markers. Mol. Ecol. 8: S41-S54.

Rosel, P.E., R. Tiedemann and M. Walton 1999b. Genetic evidence for limited trans-Atlantic movements of the harbor porpoise *Phocoena phocoena*. Marine Biology 133: 583-591.

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Rossman, M.C. and R.L. Merrick 1999. Harbor porpoise bycatch in the Northeast Multispecies Sink Gillnet Fishery and the Mid-Atlantic Coastal Gillnet Fishery in 1998 and during January-May 1999. Northeast Fish. Sci. Cent. Ref. Doc. 99-17. 36 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd9917.pdf

Schofield, D.T., G. Early, F.W. Wenzel, K. Matassa, C. Perry, G. Beekman, B. Whitaker, E. Gebhard, W. Walton and M. Swingle 2008. Rehabilitation and Homing Behavior of a Satellite-Tracked Harbor Porpoise (*Phocoena phocoena*). Aquatic Mammals 34(1): 1-8.

Smith, G.J.D., A.J. Read and D.E. Gaskin 1983. Incidental catch of harbor porpoises, *Phocoena phocoena* (L.), in herring weirs in Charlotte County, New Brunswick, Canada. Fish. Bull. 81(3): 660-2.

Trippel, E.A. and T.D. Shepherd 2004. By-catch of harbour porpoise (*Phocoena phocoena*) in the Lower Bay of Fundy gillnet fishery from 1998-2001. Department of Fisheries and Oceans. Ottawa, Ontario. DFO Research Document 2004/2521.

Trippel, E.A., M.B. Strong, J.M. Terhune and J.D. Conway 1999. Mitigation of harbour porpoise (*Phocoena phocoena*) bycatch in the gillnet fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci 56: 113-123.

Trippel, E.A., J.Y. Wang, M.B. Strong, L.S. Carter and J.D. Conway 1996. Incidental mortality of harbour porpoise (*Phocoena phocoena*) by the gill-net fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci 53: 1294-1300.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Wang, J.Y., D.E. Gaskin and B.N. White 1996. Mitochondrial DNA analysis of harbour porpoise, *Phocoena phocoena*, subpopulations in North American waters. Can. J. Fish. Aquat. Sci 53: 1632-45.

Westgate, A.J., D.C.G. Muir, D.E. Gaskin and M.C.S. Kingsley 1997. Concentrations and accumulation patterns of organochlorine contaminants in the blubber of harbour porpoises, *Phocoena phocoena*, from the coast of Newfoundland, the Gulf of St. Lawrence and the Bay of Fundy/Gulf of Maine. Envir. Pollut. 95: 105-119.

Westgate, A.J., A.J. Read, T.M. Cox, T.D. Schofield, B.R. Whitaker and K.E. Anderson 1998. Monitoring a rehabilitated harbor porpoise using satellite telemetry. Mar. Mamm. Sci. 14(3): 599-604.

Westgate, A.J. and K.A. Tolley 1999. Geographical differences in organochlorine contaminants in harbour porpoises *Phocoena phocoena* from the western North Atlantic. Mar. Ecol. Prog. Ser. 177: 255-268.

Woodley, T.H. and A.J. Read 1991. Potential rates of increase of a harbor porpoise (*Phocoena phocoena*) population subjected to incidental mortality in commercial fisheries. Can. J. Fish. Aquat. Sci 48: 2429-35.

December 2009

BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Northern Gulf of Mexico Bay, Sound, and Estuarine Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are provisionally identified in each of ~~33~~32 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Table 1, based on descriptions of relatively discrete dolphin "communities" in some of these areas). A "community" includes resident dolphins that regularly share large portions of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than with dolphins in adjacent waters. The term, as adapted from Wells *et al.*(1987), emphasizes geographic, genetic and social relationships of dolphins. Bottlenose dolphin communities do not constitute closed demographic populations, as individuals from adjacent communities are known to interbreed. Nevertheless, the geographic nature of these areas and long-term, multi-generational stability of residency patterns suggest that many of these communities exist as functioning units of their ecosystems, and under the Marine Mammal Protection Act must be maintained as such. Also, the stable patterns of residency observed within communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. Thus, in the absence of information supporting management on a larger scale, it is appropriate to adopt a risk-averse approach and focus management efforts at the level of the community rather than at some larger demographic scale. Biological support for this risk-averse approach derives from several sources. Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification or tagging studies have been conducted in the Gulf of Mexico. In Texas, some of the dolphins in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994) have been reported as long-term residents. Hubard *et al.*(2004) reported sightings of dolphins tagged 12-15 years previously in Mississippi Sound. In Florida, long-term residency has been reported from Choctawhatchee Bay (1989-1993), Tampa Bay (Wells 1986a; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986a; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a) and Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 1997; Shane 2004). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. In many cases, residents emphasize use of the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; 1990; Gruber 1981; Irvine *et al.* 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006)~~ 1977, 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006)~~. These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998).

Genetic data also support the concept of relatively discrete bay, sound and estuary stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, Matagorda Bay, Texas, dolphins appear to be a localized population, and differences in haplotype frequencies distinguish between adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991; 2002). Examination of protein electrophoretic data resulted in similar conclusions for the Florida dolphins (Duffield and Wells 1986). Additionally, Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine communities from those occurring in adjacent Gulf coastal waters.

The long-term structure and stability of at least some of these communities is exemplified by the residents of Sarasota Bay, Florida. This community has been observed since 1970 (Irvine and Wells 1972; Scott *et al.* 1990; Wells 1991; 2003). At least 5 generations of identifiable residents currently inhabit the region, including ~~one third~~some of those first identified in 1970. Maximum immigration and emigration rates of about 2-3% have been estimated (Wells and Scott 1990).

Genetic exchange occurs between resident communities; hence the application of the demographically and behaviorally-based term "community" rather than "population" (Wells 1986a; Sellas *et al.* 2005). Some of the calves in

Sarasota Bay apparently have been sired by non-residents (Duffield and Wells 2002). A variety of potential exchange mechanisms occur in the Gulf. Small numbers of inshore dolphins traveling between regions have been reported, with patterns ranging from traveling through adjacent communities (Wells 1986b; Wells *et al.* 1996a; Wells *et al.* 1996b) to movements over distances of several hundred km in Texas waters (Gruber 1981; Lynn and Würsig 2002). In many areas year-round residents co-occur with non-resident dolphins, providing potential opportunities for genetic exchange. About 14-17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Similar mixing of inshore residents and non-residents ~~is~~has been seen off San Luis Pass, Texas (Maze and Würsig 1999), Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of patterns, ranging from apparent nomadism recorded as transience in a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, several communities mix at the mouth of Tampa Bay, Florida (Wells 1986a), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries provide additional opportunities for genetic exchange with residents, and complicate the identification of stocks in coastal and inshore waters. In small bay systems such as Sarasota Bay, Florida, and San Luis Pass, Texas, residents move into Gulf coastal waters in fall/winter, and return inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). In larger bay systems, seasonal changes in abundance suggest possible migrations, with increases in more northerly bay systems in summer, and in more southerly systems in winter. Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and Charlotte Harbor/Pine Island Sound (Thompson 1981; Scott *et al.* 1989), and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida, where recent mark-recapture photo-identification surveys and 2 NOAA-sponsored health assessments were conducted during 2005-2006. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Table 1; Balmer *et al.* ~~in press~~2008). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer *et al.* ~~in press~~2008).

Much uncertainty remains regarding the structure of bottlenose dolphin stocks in many of the Gulf of Mexico bays, sounds and estuaries. Given the apparent co-occurrence of resident and non-resident dolphins in these areas, and the demonstrated variations in abundance, it appears that consideration should be given to the existence of a complex of stocks, and to the roles of bays, sounds and estuaries for stocks emphasizing Gulf of Mexico coastal waters. A starting point for management strategy should be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic and social stability. These localized units would be at greatest risk from geographically-localized impacts. Complete characterization of many of these basic units would benefit from additional photo-identification, telemetry and genetic research (Wells 1994).

The current provisional stocks follow the designations in Table 1., ~~with a few revisions.~~ ~~Available~~As information becomes available, combination or division of these provisional stocks may be warranted. For example, unpublished research ~~information~~ suggests that ~~Block B35, Little Sarasota Bay, can be subsumed under Sarasota Bay,~~ Block B-21, Lemon Bay, can be subsumed under Charlotte Harbor, and B36, Caloosahatchee River, can be considered a part of Pine Island Sound. ~~As more information becomes available, additional combination or division may be warranted. For example,~~Additionally, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remain undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; Wells *et al.* 1996b; Wells *et al.* 1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) recently described fine-scale population structuring into 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among populations of bottlenose dolphins in the southeast U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

Understanding the full complement of the stock complex using the bay, sound and estuarine waters of the Gulf of Mexico will require much additional information. The development of biologically-based criteria to better define and manage stocks in this region should integrate multiple approaches, including studies of ranging patterns, genetics,

morphology, social patterns, distribution, life history, stomach contents, isozyme analyses and contaminant concentrations. Spatially-explicit population modeling could aid in evaluating the implications of community-based stock definition. As these studies provide new information on what constitutes a bottlenose dolphin "biological stock," current provisional definitions will likely need to be revised. As stocks are more clearly identified, it will be possible to conduct abundance estimates using standardized methodology across sites (thereby avoiding some of the previous problems of mixing results of aerial and boat-based surveys), identify fisheries and other human impacts relative to specific stocks and perform individual stock assessments. As recommended by the Atlantic Scientific Review Group (November 1998, Portland, Maine), an expert panel reviewed the stock structure for bottlenose dolphins in the Gulf of Mexico during a workshop in March 2000 (Hubard and Swartz 2002). The panel sought to describe the scope of risks faced by bottlenose dolphins in the Gulf of Mexico, and outline an approach by which the stock structure could most efficiently be investigated and integrated with data from previous and ongoing studies. The panel agreed that it was appropriate to use the precautionary approach and retain the stocks currently named until further studies are conducted, and made a variety of recommendations for future research (Hubard and Swartz 2002). As a result of this, efforts are being made to conduct research in new locations, such as the central Gulf, in addition to the ongoing studies in Texas and Florida.

Table 1. Most recent bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV) and minimum population estimate (N_{MIN}) in northern Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown or undetermined for management purposes. Blocks refer to ~~33~~ aerial survey blocks illustrated in Figure 1. PBR - Potential Biological Removal; UNK - unknown; UND - undetermined.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	UNK	UND	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	UNK	UND	1992	A
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	UNK	UND	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	UNK	UND	1992	A
B55	West Bay	32	0.15	UNK	UND	2000	E
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	UNK	UND	1992	A
B57	Sabine Lake	0[a]	-		UND	1992	A
B58	Calcasieu Lake	0[a]	-		UND	1992	A
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	-		UND	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	UNK	UND	1993	A
B61	Barataria Bay	138	0.08	~~129~~UNK	~~1.3~~UND	2001	D
B30	Mississippi River Delta	0[a]	-		UND	1993	A
B02-05, 29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	UNK	UND	1993	A
B06	Mobile Bay, Bonsecour Bay	122	0.34	UNK	UND	1993	A
B07	Perdido Bay	0[a]	-		UND	1993	A
B08	Pensacola Bay, East Bay	33	0.80	UNK	UND	1993	A
B09	Choctawhatchee Bay	242	0.31	UNK	UND	1993	A
B10	St. Andrew Bay	124	0.57	UNK	UND	1993	A
B11	St. Joseph Bay	81	0.14	72	0.7	2005-06	F
B12-13	St. Vincent Sound, Apalachicola Bay, St. George Sound	537	0.09	498	5.0	2008	G
B14-15	Apalachee Bay	491	0.39	UNK	UND	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	UNK	UND	1994	A
B17	St. Joseph Sound, Clearwater Harbor	37	1.06	UNK	UND	1994	A
B32-34	Tampa Bay	559	0.24	UNK	UND	1994	A
B20,35	Sarasota Bay, Little Sarasota Bay	~~97~~160	na[c]	~~UNK~~160	~~UND~~1.6	~~1992~~2007	B
~~B35~~	~~Little Sarasota Bay~~	~~2[b]~~	~~0.24~~	~~UNK~~	~~UND~~	~~1985~~	~~C~~
B21	Lemon Bay	0[a]	-		UND	1994	A
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	UNK	UND	1994	A

B36	Caloosahatchee River	0[a,b]	-		UND	1985	C
B24	Estero Bay	104	0.67	UNK	UND	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	UNK	UND	1994	A
B27	Whitewater Bay	242	0.37	UNK	UND	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	UNK	UND	1994	A

References: A- (Blaylock and Hoggard 1994); B- (Wells 2009~~1992~~); C- (Scott *et al.* 1989); D- (Miller 2003); E- (Irwin and Würsig 2004); F- (Balmer *et al.* ~~in press~~2008); G - (Tyson 2008)

Notes:

[a] During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0-2 (CV= 0.38); B58, 0-6 (0.34); B59, 0-0; B30, 0-182(0.14); B07, 0-0; B21, 0-15(0.43); and B36, 0-0.

[b] Block not surveyed during surveys reported in Blaylock and Hoggard (1994).

[c] No CV because NBEST was a direct count of known individuals.

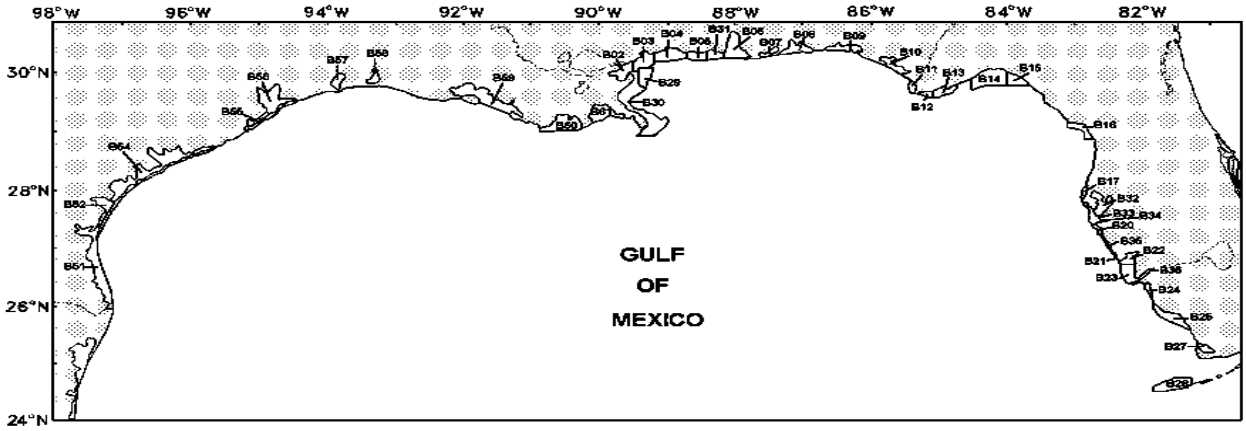

Figure 1. *Northern Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to 1 of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each stock is considered unknown (Wade and Angliss 1997). Recent mark-recapture population size estimates are available for ~~West Bay, Texas, Barataria Bay, Louisiana, and~~ St. Joseph Bay, Florida, and Apalachicola Bay, Florida, and a direct count is available for Sarasota Bay, Florida (Table 1). Previous population size for most other stocks (Table 1) was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana; in September-October 1993 in Louisiana, Mississippi, Alabama and the Florida Panhandle (Blaylock and Hoggard 1994); and in September-November 1994 along the west coast of Florida (NMFS unpublished data). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used~~. Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992).~~. Analyses are currently underway that should provide updated abundance estimates for ~~Sarasota Bay,~~ Lemon Bay, Gasparilla Sound, Charlotte Harbor, and Pine Island Sound during 2010~~2008~~ (Wells, pers. comm.).

Minimum Population Estimate

The population size for all but 3 stocks is currently unknown and the minimum population estimates are given for those 3 stocks in Table 1. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate was calculated for each block from the

estimated population size and its associated coefficient of variation. Where the population size resulted from a direct count of known individuals, the minimum population size was identical to the estimated population size.

Current Population Trend

The data are insufficient to determine population trends for all of the Gulf of Mexico bay, sound and estuary bottlenose dolphin communities. Eleven anomalous mortality events have occurred among portions of these dolphin communities between 1990 and 2008; however, it is not possible to accurately partition the mortalities between bay and coastal stocks, thus the impact of these mortality events on communities is not known.

For Barataria Bay, Louisiana, Miller (2003) estimated a population size ranging from 138 to 238 bottlenose dolphins (95% CI = 128-297) using mark-recapture techniques with data collected from June 1999 to May 2002. The previous estimate for Barataria Bay from 1994, 219 dolphins, falls at the high end of this range. Irwin and Würsig (2004) estimated annual population sizes ranging from 28 to 38 dolphins during 1997-2001 for the San Luis Pass/Chocolate Bay portion of West Bay, Texas, where the previous estimate from 1992 was 29 dolphins.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the dolphin communities that comprise these stocks. While productivity rates may be estimated for individual females within communities, such estimates are confounded at the stock level due to the influx of dolphins from adjacent areas which balance losses, and the unexplained loss of some individuals which offset births and recruitment (Wells 1998). Continued monitoring and expanded survey coverage will be required to address and develop estimates of productivity for these dolphin communities. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is undetermined for most stocks because the population size estimate is more than 8 years old. PBR is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The "recovery" factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because these stocks are of unknown status. PBR for those stocks with population size estimates less than 8 years old is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for these stocks during 2004-2008 is unknown.

Some of the bay, sound and estuarine communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades ending in 1989 (NMFS unpublished data). During the period 1972-1989, 490 bottlenose dolphins, an average of 29 dolphins annually, were removed from a few locations in the Gulf of Mexico, including the Florida Keys, Charlotte Harbor, Tampa Bay~~,~~ and elsewhere. Mississippi Sound sustained the highest level of removals with 202 dolphins taken from this stock during this period, representing 41% of the total and an annual average of 12 dolphins (compared to a previous PBR of 13). The annual average number of removals never exceeded previous PBR levels, but it may be biologically significant that 73% of the dolphins removed during 1982-1988 were females. The impact of those removals on the stocks is unknown.

~~One research-related mortality occurred during November 2002 in Sarasota Bay, Florida. The animal was a 35-year-old male, and it died in a health assessment research project. The histopathology report stated that drowning was the cause of death. However, the necropsy revealed that the animal was in poor condition as follows: anemic, thin (ribs evident, blubber thin and grossly lacking lipid), no food in the stomach and little evidence of recent feeding in the digestive tract, vertebral fractures with muscle atrophy, with additional conditions present. This has been the only such loss during capture/release research conducted over a 38-year period on Florida's central west coast. Another research-related mortality occurred during July 2006 in St. Joseph Bay, near Panama City, Florida, during a NMFS health assessment research project to investigate a series of Unusual Mortality Events in the region. The animal became entangled deep in the capture net and was found dead during extrication of other animals from the net. The cause of death was determined to be asphyxiation.~~

~~As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. Five incidents have been documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. Four of the incidents were mortalities, and 1 occurred during each of the following years: 2003, 2005, 2006 and 2007. An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally.~~

~~Four mortalities resulted from gillnet entanglements in research gear off Texas and Louisiana during 2003, 2004, 2006 and 2007. Three of the mortalities were a result of fisheries sampling and research in Texas, and 1 mortality (2006)~~

~~occurred during a gulf sturgeon research project in Louisiana.~~

~~Two bottlenose dolphin mortalities were observed in the shrimp trawl fishery. A mortality occurred in 2007 off the coast of Louisiana in the vicinity of Atchafalaya Bay, and 1 mortality occurred in 2003 off the coast of Alabama near Mobile Bay. Each of these animals could have belonged to either a coastal stock or to a bay, sound and estuarine stock.~~

~~Fishery Information~~

~~The commercial fisheries which potentially could interact with these stocks in the Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine and gillnet fisheries (Appendix I). Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Two bottlenose dolphin mortalities were observed during 2003 and 2007 which could have belonged to either a coastal or a bay, sound and estuarine stock. During 1992-2007 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to a bay, sound and estuarine stock; however, given the water depths at which the takes occurred, it is more likely the unidentified dolphins belonged to a bottlenose dolphin coastal stock, the bottlenose dolphin continental shelf stock, or possibly to the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and W. Brooks 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. In 2002 there was a calf stranded near Clearwater, Florida, with crab trap line wrapped around its rostrum, through its mouth and looped around its tail. There was an additional unconfirmed report to the stranding network in 2002 of a dolphin entangled in a stone crab trap with the buoy still attached. The animal was reportedly cut loose from the trap and slowly swam off with line and buoy still wrapped around it (NMFS unpublished data). The blue crab fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery. There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery: 2 takes of single bottlenose dolphins were reported in Louisiana waters during 2005 (1 of the animals may have been dead prior to capture); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004; 2 takes of single unidentified dolphins were reported during 2002 (1 in Mississippi and 1 in Louisiana waters); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001; and 3 takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentifed) in Louisiana waters and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters. The menhaden purse seine fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken. No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.~~

~~The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuarine waters. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. A commercial fishermen was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida.~~

Fishery Information

The commercial fisheries which potentially could interact with these stocks in the Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, and gillnet fisheries (Appendix III).

Shrimp Trawl Fishery

Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. A voluntary observer program for the shrimp trawl fishery began in 1992 and became

mandatory in 2007. Three bottlenose dolphin mortalities were observed in the shrimp trawl fishery. One mortality occurred in 2008 off the coast of Texas in the vicinity of Laguna Madre, 1 mortality occurred in 2007 off the coast of Louisiana in the vicinity of Atchafalaya Bay, and 1 mortality occurred in 2003 off the coast of Alabama near Mobile Bay. The Texas 2008 mortality could have belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock. The Louisiana 2007 mortality could have belonged to the Western Coastal stock or a bay, sound and estuarine stock. The Alabama 2003 mortality could have belonged to the Northern Coastal stock or a bay, sound and estuarine stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that 3-4 of the animals belonged to the continental shelf stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. This cannot be confirmed without a necropsy. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock, or possibly to the Atlantic spotted dolphin stock.

Blue and Stone Crab Trap/Pot Fisheries

Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. In 2002 there was a calf stranded near Clearwater, Florida, with crab trap line wrapped around its rostrum, through its mouth and looped around its tail. There was an additional unconfirmed report to the stranding network in 2002 of a dolphin entangled in a stone crab trap with the buoy still attached. The animal was reportedly cut loose from the trap and slowly swam off with line and buoy still wrapped around it (NMFS unpublished data). In 2008, a dolphin was disentangled from crab trap gear in Texas from a concerned citizen and swam away with no reported injuries. Also in 2008, another dolphin off Florida, reportedly half the size of an adult, was disentangled by a county marine officer from a crab pot line and swam away with no reported injuries (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery: 2 takes of single bottlenose dolphins were reported in Louisiana waters during 2005 (1 of the animals may have been dead prior to capture); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004; 2 takes of single unidentified dolphins were reported during 2002 (1 in Mississippi and 1 in Louisiana waters); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001; and 3 takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters. The menhaden purse seine fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana and an additional research gillnet entanglement occurred during 2008 in Texas (see “Other Mortality” below for details). In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

~~Other Mortality~~Strandings

A total of ~~1,425~~641 bottlenose dolphins were found stranded in ~~the~~bays, sounds and estuaries of the northern Gulf of Mexico from 200~~3~~4 through 200~~7~~8 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed ~~16 September 2008~~21 September 2009 and 18 November 2009). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for ~~82~~55 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby coastal stock; however, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcasses originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

Since 1990, there have been 11 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas; about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 an UME of bottlenose dolphins likely caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 an UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 106 bottlenose dolphins and ~~one~~1 unidentified dolphin stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses. 8) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The event has been closed, however, the investigation is ongoing.

Table 2. Bottlenose dolphin strandings occurring in bays, sounds and estuaries in the northern Gulf of Mexico from 2004 to 2008, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 21 September 2009 and 18 November 2009). Please note human interaction does not necessarily

mean the interaction caused the animal's death. Please also note that strandings in bay, sound and estuarine waters have been reported separately from strandings in coastal waters; therefore, the annual totals below will differ from those reported previously.

Stock	Category	2004	2005	2006	2007	2008	Total
Bay, Sound and Estuarine	Total Stranded	187	138	163[a]	76	77	641
	Human Interaction	10	4	23	10	8	55
	---Fishery Interaction	5	3	10	5	8	31
	---Other	5	1	13	5	0	24
	No Human Interaction	43	31	36	15	16	141
	CBD	134	103	104	51	53	445

[a] Includes 2 mass stranding events (2 animals in July 2006, 3 animals in November 2006)

Other Mortality

Two dolphin research-related mortalities have occurred. During November 2002 in Sarasota Bay, Florida, a 35-year-old male died in a health assessment research project. The histopathology report stated that drowning was the cause of death. However, the necropsy revealed that the animal was in poor condition as follows: anemic, thin (ribs evident, blubber thin and grossly lacking lipid), no food in the stomach and little evidence of recent feeding in the digestive tract, vertebral fractures with muscle atrophy, with additional conditions present. This has been the only such loss during capture/release research conducted over a 39-year period on Florida's central west coast. Another research-related mortality occurred during July 2006 in St. Joseph Bay, near Panama City, Florida, during a NMFS health assessment research project to investigate a series of Unusual Mortality Events in the region. The animal became entangled deep in the capture net and was found dead during extrication of other animals from the net. The cause of death was determined to be asphyxiation.

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. Five incidents have been documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. Four of the incidents were mortalities, and 1 occurred during each of the following years: 2003, 2005, 2006 and 2007. It is likely that 2 of these animals belonged to the Western Coastal stock (2005, 2007) and 2 animals belonged to bay, sound and estuarine stocks (2003, 2006). An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally. It is likely this animal belonged to a bay, sound and estuarine stock. All of the mortalities were included in the stranding database and the 3 most recent are included in the appropriate stranding tables under "Other" Human Interaction.

Four mortalities resulted from gillnet entanglements in research gear off Texas and Louisiana during 2003, 2004, 2006 and 2007. Three of the mortalities were a result of fisheries sampling and research in Texas, and 1 mortality (2006) occurred during a gulf sturgeon research project in Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. The floatline was wrapped around the dolphin's tail; the net released itself upon retrieval and the dolphin appeared in good condition as it swam away. All of these animals likely belonged to bay, sound and estuarine stocks. The mortalities were included in the stranding database and the 3 most recent are included in Table 2 under "Other" Human Interaction.

The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuarine waters. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning~~, and swimming with~~ of wild bottlenose dolphins ~~have~~has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells, in press), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of „take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, ~~Samuels and Bejder (2004) observed~~ a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and ~~Cunningham-Smith *et al.* (2006) have observed~~ provisioning has been observed south of Sarasota Bay ~~continuing~~ since 1990 (Cunningham-Smith *et*

al. 2006; Powell and Wells, in press). ~~The effects of swim-with activities on dolphins and their legality under the MMPA are less clear and are currently under review. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning.~~ There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells, ~~pers. comm.)~~in press). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

As noted previously, bottlenose dolphins are known to be struck by vessels (Wells and Scott 1997). During 200~~3~~4-200~~7~~8, ~~12~~7 stranded bottlenose dolphins (of ~~1425~~637 total strandings) showed signs of a boat collision (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). In some instances, the propeller scars were well-healed and were not suspected as a cause of stranding or death, and it is possible some of the instances were post-mortem collisions. In addition to vessel collisions, the presence of vessels may also impact bottlenose dolphin behavior in bays, sounds and estuaries. Nowacek *et al.* (2001) reported that boats pass within 100m of each bottlenose dolphin in Sarasota Bay once every 6 minutes on average, leading to changes in dive patterns and group cohesion. Buckstaff (2004) noted changes in communication patterns of Sarasota Bay dolphins when boats approached. Miller *et al.* (2008) investigated the immediate responses of bottlenose dolphins to "high-speed personal watercraft" (i.e., boats) in Mississippi Sound. They found an immediate impact on dolphin behavior demonstrated by an increase in traveling behavior and dive duration, and a decrease in feeding behavior for non-traveling groups. The findings suggested dolphins attempted to avoid high-speed personal watercraft. It is unclear whether short-term effects will result in long-term consequences like reduced health and viability of ~~Mississippi Sound~~ dolphins. Further studies are needed to determine the impacts ~~on this stock as well as other stocks~~ throughout the Gulf of Mexico.

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population, and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990 and found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations found in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring, and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCKS

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 11 anomalous mortality events among bottlenose dolphins along the northern Gulf of Mexico coast since 1990 (NMFS unpublished data) is cause for concern; however, the effects of the mortality events on stock abundance have not yet been determined.

The relatively high number of bottlenose dolphin deaths which occurred during the mortality events since 1990 suggests that some of these stocks may be stressed. Human-caused mortality and serious injury for each of these stocks is not known, but considering the evidence from stranding data (Table 2), the total fishery-related mortality and serious injury exceeds 10% of the total known PBR or previous PBR, and, therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. Because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, NMFS considers that each of these stocks is a strategic stock.

REFERENCES CITED

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst. ~~in press~~2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J.

Cetacean Res. Manage. 10(2): 157-167.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Barros, N.B. and R.S. Wells 1998. Prey and feeding patterns of resident bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. J. Mamm. 79(3): 1045-1059.

Blaylock, R.A. and W. Hoggard 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356. 10 pp.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Mar. Mamm. Sci. 9: 434-440.

Bräger, S., B. Würsig, A. Acevedo and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. J. Mamm. 75(2): 431-437.

Bryant, L. 1994. Report to Congress on results of feeding wild dolphins: 1989-1994. National Marine Fisheries Service, Office of Protected Resources, 23 pp.

Buckland, S.T., D.R. Andersen, K.P. Burnham and J.L. Laake 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York. 446 pp.

Buckstaff, K.C. 2004. Effects of watercraft noise on the acoustic behavior of bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. Mar. Mamm. Sci. 20:709-725.

Cunningham-Smith, P., D.E. Colbert, R.S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat~~ic~~. Mamm. 32(3): 346-356.

Duffield, D.A. and R.S. Wells 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Report to National Marine Fisheries Service, Southeast Fisheries Center 16 pp.

Duffield, D.A. and R.S. Wells 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. Pages 155-169 *in*: A. R. Hoelzel, (ed.) Genetic Ecology of Whales and Dolphins. Rep. Int. Whal. Comm., Cambridge, U.K. Special Issue 13.

Duffield, D.A. and R.S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. Pages 3-11 *in*: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL.

Fazioli, K.L., S. Hofmann and R.S. Wells 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat~~ic~~. Mamm~~als~~. 32(2): 212-222.

Fertl, D.C. 1994. Occurrence patterns and behavior of bottlenose dolphins (*Tursiops truncatus*) in the Galveston ship channel. Texas J. Sci. 46: 299-317.

Flewelling, L.J., J.P. Naar, J. P. Abbott, D.G. Baden, N.B. Barros, G.D. Bossart, M.D. Bottein, D.G. Hammond, E.M. Haubold, C.A. Heil, M.S. Henry, H.M. Jacocks, T.A. Leighfield, R.H. Pierce, T.D. Pitchford, S.A. Rommel, P.S. Scott, K.A. Steidinger, E.W. Truby, F.M.V. Dolah and J.H. Landsberg 2005. Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. Nature 435: 755-756.

Gorzelany, J.F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-617.

Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M~~asters~~. Sc. thesis. Texas A&M University, College Station. 182 pp.

Hansen, L.J., (ed.) 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21.(Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149).

Henningsen, T. 1991. Zur Verbreitung und Ökologie des Großen Tümmlers (*Tursiops truncatus*) in Galveston, Texas. Diplom thesis. Christian-Albrechts-Universität, Kiel, Germany. 80 pp.

Henningsen, T. and B. Würsig 1991. Bottle-nosed dolphins in Galveston Bay, Texas: Numbers and activities. European research on cetaceans - 5. Proceedings of the Fifth Annual Conference of the European Cetacean Society, Sandefjord, Norway, Cambridge, UK, 21-23 February, 1991. 36-38 pp.

Hubard, C.W., K. Maze-Foley, K.D. Mullin and W.W. Schroeder 2004. Seasonal abundance and site fidelity of bottlenose dolphins (*Tursiops truncatus*) in Mississippi Sound. Aquat~~ic~~. Mamm~~als~~. 30: 299-310.

Hubard, C.W. and S.L. Swartz 2002. Gulf of Mexico bottlenose dolphin stock identification workshop: 14-15 March 2000, Sarasota, Florida. NOAA Tech. Memo. NMFS-SEFSC-473. 50 pp.

Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. 79: 671-688.

Irvine, B. and R.S. Wells 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). Cetology 13(1-5).

Irwin, L.J. and B. Würsig 2004. A small resident community of bottlenose dolphins, *Tursiops truncatus*, in Texas: Monitoring recommendations. G~~ulf~~, ~~of~~ Mex.~~ico~~ Sci~~ence~~, 22(1): 13-21.

Laake, J.L., S.T. Buckland, D.R. Anderson and K.P. Burnham 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, CO, 72 pp.

Lipscomb, T.P. 1993. Some answers to questions about morbillivirus. Pages 4-5 *in*: R. A. Blaylock, B. Mase and D. K. Odell, (eds.) Strandings. SEFSC Miami Laboratory, Miami, Florida. Vol. 2, No. 3.

Lipscomb, T.P., S. Kennedy, D. Moffet and B.K. Ford 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J~~ournal~~, ~~of~~ Wildl~~ife~~, Dis~~ease~~, 30(4): 572-576.

Lynn, S.K. and B. Würsig 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G~~ulf~~, ~~of~~ Mex~~ico~~, Sci~~ence~~, 20(1): 25-37.

Maze, K.S. and B. Würsig 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. Aquat~~ic~~, Mamm~~als~~, 25: 91-103.

McFee, W.E. and J. W. Brooks 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: a summary. U.S. Fish and Wildlife Service. Unpublished Report.

Miller, C. 2003. Abundance trends and environmental habitat usage patterns of bottlenose dolphins (*Tursiops truncatus*) in lower Barataria and Caminada Bays, Louisiana. Ph.D. thesis. Louisiana State University, Baton Rouge. 125 pp.

Miller, L.J., M. Solangi and S.A. Kuczaj, II 2008. Immediate response of Atlantic bottlenose dolphins to high-speed personal watercraft in the Mississippi Sound. J. Mar. Biol. Assoc. U. K. 88(6): 1139-1143.

Mullin, K.D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph. D. thesis. Mississippi State University, Starkville. 135 pp.

NMFS 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NMFS 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149, 35 pp.

Nowacek, S.M., R.S. Wells and A.R. Solow. 2001. Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. Mar. Mamm. Sci. 17:673-688.

Powell, J. R. and R. S. Wells. In press. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci.

Quintana-Rizzo, E. and R.S. Wells. 2001. Resighting and association patterns of bottlenose dolphins (*Tursiops truncatus*) in the Cedar Keys, Florida: Insights into social organization. Can. J. Zool. 79:447-456.

Reynolds, J.E., III 1985. Evaluation of the nature and magnitude of interactions between bottlenose dolphins, *Tursiops truncatus*, and fisheries and other human activities in coastal areas of the southeastern United States. National Technical Information Service PB86-162203, U.S. Department of Commerce, Springfield, VA 22161.

Samuels, A. and L. Bejder 2004. Chronic interactions between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21(12): 2752-2764.

Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD 88/89-07. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Scott, M.D., R.S. Wells and A.B. Irvine 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 *in*: S. Leatherwood and R. R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

Sellas, A.B., R.S. Wells and P.E. Rosel 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6(5): 715-728.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, *Tursiops truncatus*, in the Aransas

Pass area of Texas. M. Sc.~~asters~~ thesis. Texas A&M University, College Station. 238 pp.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245-265 *in*: S. Leatherwood and R. R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

Shane, S.H. 2004. Residence patterns, group characteristics, and association patterns of bottlenose dolphins near Sanibel Island, Florida. G~~ulf~~. Mex. Sci~~ence~~. 22(1): 1-12.

Shane, S.H., R.S. Wells and B. Würsig 1986. Ecology, behavior, and social organization of the bottlenose dolphin: A review. Mar. Mamm. Sci. 2(1): 34-63.

Thompson, N.B. 1981. Estimates of abundance of *Tursiops truncatus* in Charlotte Harbor, Florida. NOAA/NMFS/SEFSC/Miami Laboratory, Fishery Data Analysis Technical Report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Tyson, R.B. 2008. Abundance of bottlenose dolphins (*Tursiops truncatus*) in the Big Bend of Florida, St. Vincent Sound to Alligator Harbor. M. Sc. thesis. Florida State University, Tallahassee. 65 + ix pp.

Urian, K.W. 2002. Community structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida, USA. M.Sc. thesis. University of North Carolina, Wilmington. 26 pp.

Urian, K.W., D.A. Duffield, A.J. Read, R.S. Wells and D.D. Shell 1996. Seasonality of reproduction in bottlenose dolphins, *Tursiops truncatus*. J. Mamm. 77: 394-403.

Urian, K.W., S. Hofmann, R.S. Wells and A.J. Read. 2009. Fine-scale population structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida. Mar. Mamm. Sci. 25(9): 619-638.

Varanasi, U., K.L. Tilbury, D.W. Brown, M.M. Krahn, C.A. Wigren, R.C. Clark and S.L. Chan 1992. Chemical contaminants in bottlenose dolphins stranded along the Gulf of Mexico during 1990. Pages 56-86 *in*: L. J. Hansen, (ed.) Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. Southeast Fisheries Science Center Contribution MIA-92/93-21.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph. D. thesis. Texas A&M University, College Station. 142 pp.

Wells, R.S. 1986a. Population structure of bottlenose dolphins: Behavioral studies along the central west coast of Florida. Contract report to NMFS, SEFSC. Contract No. 45-WCNF-5-00366. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149 58 pp.

Wells, R.S. 1986b. Structural aspects of dolphin societies. Ph. D. thesis. University of California, Santa Cruz. 234 pp.

Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pages 199-225 *in*: K. Pryor and K. S. Norris, (eds.) Dolphin societies: Discoveries and puzzles. University of California Press, Berkeley.

Wells, R.S. 1993. The marine mammals of Sarasota Bay. Chapter 9. pp. 9.1-9.23. *In:* P. Roat, C. Cicicolella, H. Smith and D. Tomasko (eds.) Sarasota Bay: 1992 Framework for Action. Sarasota Bay National Estuary Program, 5333 N. Tamiami Trail, Sarasota, FL 34234.

~~Wells, R.S. 1992. The marine mammals of Sarasota Bay. Pages 9.1-9.23 – Sarasota Bay: Framework for action. Sarasota Bay National Estuary Program, Sarasota, FL.~~

Wells, R.S. 1994. Determination of bottlenose dolphin stock discreteness: Application of a combined behavioral and genetic approach. K. R. Wang, P. M. Payne and V.G. Thayer (compilers). Coastal stock(s) of Atlantic bottlenose dolphin: Status review and management. Proceedings and recommendations from a workshop held in Beaufort, NC, 13-14 September 1993. NOAA Tech. Memo. NMFS-OPR-4. 16-20 pp.

Wells, R.S. 1998. Progress report: Sarasota long-term bottlenose dolphin research. Unpublished contract report to the U.S. Department of Commerce, NOAA Fisheries, Southeast Fisheries Science Center, Miami, FL 5 pp.

Wells, R.S. 2003. Dolphin social complexity: Lessons from long-term study and life history. Pages 32-56 *in*: F. B. M. de Waal and P. L. Tyack, (eds.) Animal social complexity: Intelligence, culture, and individualized societies. Harvard University Press, Cambridge, MA.

Wells, R.S. 2009. Learning from nature: Bottlenose dolphin care and husbandry. Zoo Biol. 28: 1-17.

Wells, R.S., J.B. Allen, S. Hoffman, K. Bassos-Hull, D.A. Fauquier, N.B. Barros, R.E. DeLynn, G. Sutton, V. Socha and M.D. Scott 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774-794.

Wells, R.S., M.K. Bassos, K.W. Urian, W.J. Carr and M.D. Scott 1996a. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. NOAA Tech. Memo. NMFS-SEFSC-384. 36 pp.

Wells, R.S., M.K. Bassos, K.W. Urian, S.H. Shane, E.C.G. Owen, C.F. Weiss, W.J. Carr and M.D. Scott 1997.

Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. Contract report to National Marine Fisheries Service, Southeast Fisheries Center Contribution No. 40-WCNF601958. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Wells, R.S., S. Hofmann and T.L. Moors 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.

Wells, R.S. and M.D. Scott 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. Pages 407-415 *in*: P. S. Hammond, S. A. Mizroch and G. P. Donovan, (eds.) Individual recognition of cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rep. Int. Whal. Comm., Cambridge, U.K. Special Issue 12.

Wells, R.S. and M.D. Scott 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. Pages 629 *in*: W. F. Perrin, G. P. Donovan and J. Barlow, (eds.) Gillnets and cetaceans. Rep. Int. Whal. Comm. Special Issue 15.

Wells, R.S. and M.D. Scott 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.

Wells, R.S. and M.D. Scott 1999. Bottlenose dolphins. Pages 137-182 *in*: S. H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals. Vol. 6: The second book of dolphins and the porpoises. Academic Press, San Diego, CA.

Wells, R.S., M.D. Scott and A.B. Irvine 1987. The social structure of free ranging bottlenose dolphins. Pages 247-305 *in*: H. Genoways, (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York.

Wells, R.S., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn and J.C. Sweeney 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci~~ence~~. ~~of the~~ Total Environ~~ment~~. 349: 106-119.

Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott 1996b. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC-385. 25 pp.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Gulf of Mexico Eastern Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Mullin *et al.* 1990). Northern Gulf of Mexico coastal waters have been divided for management purposes into 3 bottlenose dolphin stocks: eastern, northern and western. As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climatic, coastal and oceanographic characteristics might be restricted in their movements between habitats, and thus constitute separate stocks. Coastal waters are defined as those from shore, barrier islands or presumed bay boundaries to the 20-m isobath (Figure 1). The Eastern Coastal bottlenose dolphin stock area extends from 84°W longitude to Key West, Florida; the Northern Coastal bottlenose dolphin stock area from 84°W longitude to the Mississippi River Delta; and the Western Coastal bottlenose dolphin stock area from the Mississippi River Delta to the Texas-Mexico border. The Eastern Coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. It is bordered on the north by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The Northern Coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of freshwater input. The Western Coastal stock area is characterized by an arid to temperate climate, sand beaches in southern Texas, extensive coastal marshes in northern Texas and Louisiana, and low to high levels of freshwater input.

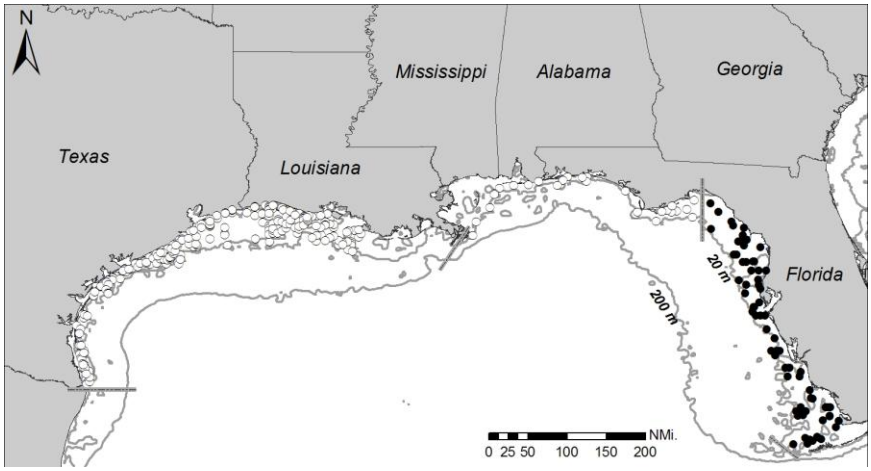

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal stock area in 1992 and 1996, and in the Northern Coastal stock and Eastern Coastal stock areas in 2007. Dark circles indicate groups within the boundaries of the Eastern Coastal stock. The 20- and 200-m isobaths are shown.*

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico continental shelf stock and bay, sound and estuarine stocks, and the Western Coastal stock is trans-boundary with Mexico. The seaward boundary for coastal stocks, the 20-m isobath, generally corresponds to survey strata (Scott 1990; Blaylock and Hoggard 1994; Fulling *et al.* 2003), and thus represents a management boundary rather than an ecological boundary. Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998), and both could potentially occur in coastal waters. The offshore and coastal ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 km from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34m. Within 7.5 km of shore, all animals were of the coastal ecotype. The distance of the 20-m isobath ranges from 4 to 90 km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

Research on coastal stocks is limited. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound over 14 months. They found coastal waters were inhabited by both „inshore' and „Gulf' dolphins but that the 2 types used coastal waters differently. Dolphins from the inshore communities were observed occasionally in Gulf near-shore waters adjacent to their inshore range, whereas „Gulf' dolphins were found primarily in open Gulf of Mexico waters with some displaying seasonal variations in their use of the study area. The „Gulf' dolphins did not show a preference for waters near

passes as was seen for „inshore' dolphins, but moved throughout the study area and made greater use of waters offshore of waters used by „inshore' dolphins. During winter months abundance of „Gulf' groups decreased while abundance for „inshore' groups increased. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by Sarasota Bay dolphins in winter. Seasonal movements of identified individuals and abundance indices suggest that part of the „Gulf" dolphin community moves out of the study area during winter, but their destination is unknown. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

Off Galveston, Texas, Beier (2001) reported an open population of individual dolphins in coastal waters, but several individual dolphins had been sighted previously by other researchers over a 10-year period. Some coastal animals may move relatively long distances alongshore. Two bottlenose dolphins previously seen in the South Padre Island area in Texas were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

The best abundance estimate available for the northern Gulf of Mexico Eastern Coastal stock of bottlenose dolphins is 7,702 (CV=0.19).

Earlier abundance estimates

Previous estimates of abundance were derived using distance sampling analysis (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) with sighting data collected during aerial line-transect surveys conducted during autumn from 1992-1994 (Blaylock and Hoggard 1994; NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18-m isobath. Approximately 5% of the total survey area was visually searched. The previous bottlenose dolphin abundance estimate for the Eastern Coastal stock based on the 1994 survey was 9,912 (CV=0.12).

Recent surveys and abundance estimates

Abundance estimates for the Northern and Eastern Coastal stocks were derived from aerial surveys conducted during 17 July to 8 August 2007. Survey effort covered waters from the shoreline to 200 m depth and was stratified such that the majority of effort was expended in the 0-20 m depth range of the coastal stocks. The survey team consisted of an observer stationed at each of two forward bubble windows and a third observer stationed at a belly window that monitored the trackline. Surveys were typically flown during favorable sighting conditions at Beaufort sea state less than or equal to 3 (surface winds <10 knots). Abundance estimates were derived using distance analysis including environmental covariates that had a significant influence on sighting probability (Buckland *et al.*, 2001), but these estimates were not corrected for *g(0)* and are thus negatively biased. The resulting abundance estimate for the eastern stock was 7,702 animals (CV=0.19).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Eastern Coastal stock of bottlenose dolphins is 7,702 (CV=0.19). The minimum population estimate for the northern Gulf of Mexico Eastern Coastal stock is 6,551 bottlenose dolphins.

Current Population Trend

There are insufficient data to determine population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The minimum population size is 6,551. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Eastern Coastal stock of bottlenose dolphin is 66.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Eastern Coastal stock of bottlenose dolphins during 2004-2008 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Eastern Coastal stock in the northern Gulf of Mexico are the shark bottom longline, shrimp trawl, blue crab trap/pot and stone crab trap/pot fisheries (Appendix III).

Shark Bottom Longline Fishery

The shark bottom longline fishery has been observed since 1994, and 3 interactions with bottlenose dolphins have been recorded. The incidents include 1 mortality (2003) and 2 hooked animals that escaped at the vessels (1999, 2002; Burgess and Morgan 2003a,b). Based on the water depths of the interactions (~12-60m), they likely involved animals from the Eastern Coastal and continental shelf stocks. No interactions were observed during 2004-2008 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009). For the shark bottom longline fishery in the Gulf of Mexico, Richards (2007) estimated bottlenose dolphin mortalities of 58 (CV=0.99), 0 and 0 for 2003, 2004 and 2005, respectively.

Shrimp Trawl Fishery

Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Three bottlenose dolphin mortalities were observed during 2003, 2007 and 2008 which could have belonged to bay, sound and estuarine stocks, the Western Coastal stock, the Northern Coastal stock and the continental shelf stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that 3-4 of the animals belonged to the continental shelf stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. This cannot be confirmed without a necropsy. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock, or possibly to the Atlantic spotted dolphin stock.

Blue and Stone Crab Trap/Pot Fisheries

Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. In 2002 there was a calf stranded near Clearwater, Florida, with crab trap line wrapped around its rostrum, through its mouth and looped around its tail. There was an additional unconfirmed report to the stranding network in 2002 of a dolphin entangled in a stone crab trap with the buoy still attached. The animal was reportedly cut loose from the trap and slowly swam off with line and buoy still wrapped around it (NMFS unpublished data). In 2008, a dolphin was disentangled from crab trap gear in Texas from a concerned citizen and swam away with no reported injuries. Also in 2008, a dolphin off Florida, reportedly half the size of an adult, was disentangled by a county marine officer from a crab pot line and swam away with no reported injuries (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Strandings

A total of 86 bottlenose dolphins were found stranded in Eastern Coastal waters of the northern Gulf of Mexico from 2004 through 2008 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 5 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby bay, sound and estuarine stock; however, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of human-related mortality and serious injury because not all of the dolphins which die or are seriously injured due to human interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of fishery-interaction or other human interactions. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

Since 1990, there have been 11 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas, about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 an UME of bottlenose dolphins likely caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 an UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 106 bottlenose dolphins and 1 unidentified dolphin stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses. 8) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The event has been closed, however, the investigation is ongoing.

Table 1. Bottlenose dolphin strandings occurring in Eastern Coastal stock waters of the northern Gulf of Mexico from 2004 to 2008, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 21 September 2009 and 18 November 2009). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuarine stocks; therefore, the annual totals below will differ from those reported previously.

Stock	Category	2004	2005	2006	2007	2008	Total
Eastern Coastal Stock	Total Stranded	8	36	31	4	7	86
	Human Interaction	0	1	2	0	2	5
	---Fishery Interaction	-	0	2	-	2	4
	---Other	-	1	0	-	0	1
	No Human Interaction	2	9	5	1	1	18
	CBD	6	26	24	3	4	63

Other Mortality

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells, in press), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of „take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells, in press). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells, in press). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

The nearshore habitat occupied by the 3 coastal stocks is adjacent to areas of high human population and in some areas, such as Tampa Bay, Florida, Galveston, Texas, and Mobile, Alabama, is highly industrialized. Concentrations of anthropogenic chemicals such PCBs and DDT and its metabolites vary from site to site, and can reach levels of concern for bottlenose dolphin health and reproduction in the southeastern U.S. (Schwacke *et al.* 2002). PCB concentrations in 3 stranded dolphins sampled from the Eastern Coastal stock area ranged from 16-46µg/g wet weight. Two stranded dolphins from the Northern Coastal stock area had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with a 1990 mortality investigation conducted by NMFS (Varanasi *et al.* 1992). The significance of these findings is unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins (Lahvis *et al.* 1995), or impact reproduction through increased first-born calf mortality (Wells *et al.* 2005). Concentrations of chlorinated hydrocarbons and metals were relatively low in most of the bottlenose dolphins examined in conjunction with an anomalous mortality event in Texas bays in 1990; however, some had

concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). Agricultural runoff following periods of high rainfall in 1992 was implicated in a high level of bottlenose dolphin mortalities in Matagorda Bay, which is adjacent to the Western Coastal stock area (NMFS unpublished data).

STATUS OF STOCK

The status of the Eastern Coastal stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. Additionally, there is no systematic monitoring of all fisheries that may take this stock. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Beier, A. G. 2001. Occurrence, distribution, and movement patterns of outer coastline bottlenose dolphins off Galveston, Texas. Master's thesis from Texas A&M University. 97 pp.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo NMFS-SEFSC-356, 10 pp.

Bryant, L. 1994. Report to Congress on results of feeding wild dolphins: 1989-1994. National Marine Fisheries Service, Office of Protected Resources, 23 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London. 446 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford, UK.

Burgess, G. and A. Morgan. 2003a. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and South Atlantic: 1999 fishing season. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA97FF0041.

Burgess, G. and A. Morgan. 2003b. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and the south Atlantic: 2002(2) and 2003(1) fishing seasons. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA16FM0598.

Cunningham-Smith, P., D. E. Colbert, R. S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat. Mamm. 32(3):346-356.

Fazioli, K. L., S. Hofmann and R. S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2): 212-222.

Flewelling, L. J., J. P. Naar, J. P. Abbott, D. G. Baden, N. B. Barros, G. D. Bossart, M. D. Bottein, D. G. Hammond, E. M. Haubold, C. A. Heil, M. S. Henry, H. M. Jacocks, T. A. Leighfield, R. H. Pierce, T. D. Pitchford, S. A. Rommel, P. S. Scott, K. A. Steidinger, E. W. Truby, F. M. Van Dolah and J. H. Landsberg. 2005. Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. Nature 435: 755-756.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Gorzelany, J. F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-617.

Hale, L. F. and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2005-2006. NOAA Tech. Memo. NMFS-SEFSC-554, 28 pp.

Hale, L. F., L. D. Hollensead and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2007. NOAA Tech. Memo. NMFS-SEFSC-564, 25 pp.

Hale, L. F., S. J. B. Gulak and J. K. Carlson. 2009. Characterization of the shark bottom longline fishery, 2008.

NOAA Tech. Memo. NMFS-SEFSC-586, 23 pp.
Hansen, L. J. (ed.). 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
Hersh, S. L. and D. A. Duffield. 1990. Distinction between Northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. pp. 129-139. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.
Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric „nearshore' and „offshore' populations of bottlenose dolphins. Proc. R. Soc. Lond., Ser. B: Biol. Sci. 265: 1177-1183.
Irvine, A. B., M. D. Scott, R. S. Wells and J. H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. U.S.79: 671-688.
Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins. 72 pp.
Lahvis, G. P., R. S. Wells, D. W. Kuehl, J. L. Stewart, H. L. Rhinehart and C. S. Via. 1995. Decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCB's and DDT in peripheral blood. Environ. Health Perspect. 103: 67-72.
LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. Int. Whal. Commn. 47: 393.
Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. pp. 4-5. *In:* R. A. Blaylock, B. Mase and D. K. Odell (eds.) Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.
Lipscomb, T. P., S. Kennedy, D. Moffet and B. K. Ford. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4): 572-576.
Lynn, S. K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1): 25-37.
McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: A summary. U.S. Fish and Wildlife Service unpublished report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
Mullin, K. D., R. R. Lohoefener, W. Hoggard, C. L. Roden and C. M Rogers. 1990. Abundance of bottlenose dolphins, *Tursiops truncatus*, in the coastal Gulf of Mexico. Northeast Gulf Sci. 11(2): 113-122.
NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
NMFS. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
Powell, J. R. and R. S. Wells. In press. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci.
Richards, P. M. 2007. Estimated takes of protected species in the commercial directed shark bottom longline fishery 2003, 2004, and 2005. NMFS SEFSC Contribution PRD-06/07-08, June 2007, 21 pp.
Samuels, A. and L. Bejder. 2004. Chronic interactions between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.
Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the Southeast United States coast. Environ. Toxicol. Chem. 21: 2752–2764.
Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. pp. 623-639. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.
Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.
Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.
Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark and S. L. Chan. 1992. pp. 56-86. *In:* L. J. Hansen (ed.) Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.
Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS

Workshop April 3-5, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.
Wells, R. S. 1986. Structural aspects of dolphin societies. Ph.D. dissertation from University of California, Santa Cruz. 234 pp.
Wells, R. S. and M. D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. p. 629. *In:* W. F. Perrin, G. P. Donovan and J. Barlow (eds.) Gillnets and cetaceans. Rep. Int. Whal. Commn., Special Issue 15.
Wells, R. S. and M. D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.
Wells, R. S., S. Hofmann and T. L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.
Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.
Wells, R. S., J. B. Allen, S. Hoffman, K. Bassos-Hull, D. A. Fauquier, N. B. Barros, R. E. DeLynn, G. Sutton, V. Socha and M. D. Scott. 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774-794.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Gulf of Mexico Northern Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Mullin *et al.* 1990). Northern Gulf of Mexico coastal waters have been divided for management purposes into 3 bottlenose dolphin stocks: eastern, northern and western. As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climatic, coastal and oceanographic characteristics might be restricted in their movements between habitats, and thus constitute separate stocks. Coastal waters are defined as those from shore, barrier islands or presumed bay boundaries to the 20-m isobath (Figure 1). The Eastern Coastal bottlenose dolphin stock area extends from 84°W longitude to Key West, Florida; the Northern Coastal bottlenose dolphin stock area from 84°W longitude to the Mississippi River Delta; and the Western Coastal bottlenose dolphin stock area from the Mississippi River Delta to the Texas-Mexico border. The Eastern Coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. The Northern Coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of freshwater input. It is bordered on the east by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The Western Coastal stock area is characterized by an arid to temperate climate, sand beaches in southern Texas, extensive coastal marshes in northern Texas and Louisiana, and low to high levels of freshwater input.

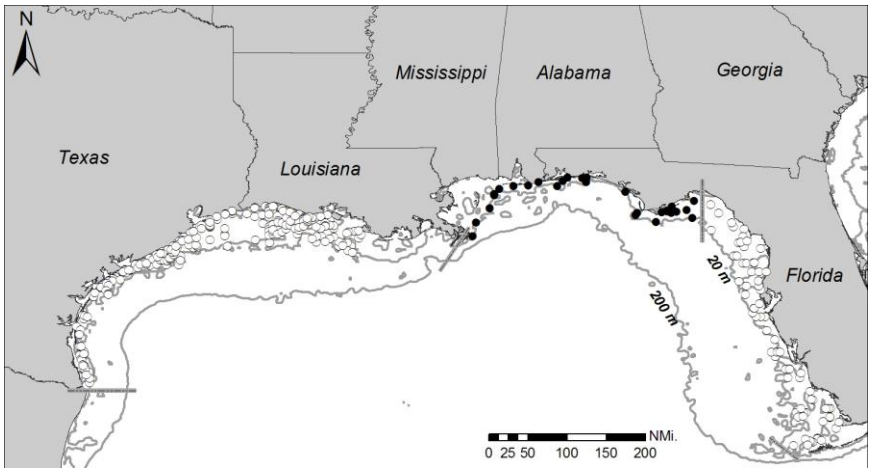

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal stock area in 1992 and 1996, and in the Northern Coastal stock and Eastern Coastal stock areas in 2007. Dark circles indicate groups within the boundaries of the Northern Coastal Stock. The 20- and 200-m isobaths are shown.*

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico continental shelf stock and bay, sound and estuarine stocks, and the Western Coastal stock is trans-boundary with Mexico. The seaward boundary for coastal stocks, the 20-m isobath, generally corresponds to survey strata (Scott 1990; Blaylock and Hoggard 1994; Fulling *et al.* 2003), and thus represents a management boundary rather than an ecological boundary. Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998), and both could potentially occur in coastal waters. The offshore and coastal ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 km from shore. The offshore ecotype was found exclusively seaward of 34km and in waters deeper than 34m. Within 7.5 km of shore, all animals were of the coastal ecotype. The distance of the 20-m isobath ranges from 4 to 90 km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

Research on coastal stocks is limited. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound over 14 months. They found coastal waters were inhabited by both „inshore' and „Gulf' dolphins but that the 2 types used coastal waters differently. Dolphins from the inshore communities were observed occasionally in Gulf near-shore waters adjacent to their inshore range, whereas „Gulf' dolphins were found primarily in open Gulf of Mexico waters with some displaying seasonal variations in their use of the study area. The „Gulf' dolphins did not show a preference for waters near

passes as was seen for „inshore' dolphins, but moved throughout the study area and made greater use of waters offshore of waters used by „inshore' dolphins. During winter months abundance of „Gulf' groups decreased while abundance for „inshore' groups increased. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by Sarasota Bay dolphins in winter. Seasonal movements of identified individuals and abundance indices suggest that part of the „Gulf" dolphin community moves out of the study area during winter, but their destination is unknown. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

Off Galveston, Texas, Beier (2001) reported an open population of individual dolphins in coastal waters, but several individual dolphins had been sighted previously by other researchers over a 10-year period. Some coastal animals may move relatively long distances alongshore. Two bottlenose dolphins previously seen in the South Padre Island area in Texas were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

The best abundance estimate available for the northern Gulf of Mexico Northern Coastal stock of bottlenose dolphins is 2,473 (CV=0.25).

Earlier abundance estimates

Previous estimates of abundance were derived using distance sampling analysis (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) with sighting data collected during aerial line-transect surveys conducted during autumn from 1992-1994 (Blaylock and Hoggard 1994; NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18-m isobath. Approximately 5% of the total survey area was visually searched. The previous bottlenose dolphin abundance estimate for the Northern Coastal stock based on the 1993 survey was 4,191 (CV=0.21).

Recent surveys and abundance estimates

Abundance estimates for the Northern and Eastern Coastal stocks were derived from aerial surveys conducted during 17 July to 8 August 2007. Survey effort covered waters from the shoreline to 200 m depth and was stratified such that the majority of effort was expended in the 0-20 m depth range of the coastal stocks. The survey team consisted of an observer stationed at each of two forward bubble windows and a third observer stationed at a belly window that monitored the trackline. Surveys were typically flown during favorable sighting conditions at Beaufort sea state less than or equal to 3 (surface winds <10 knots). Abundance estimates were derived using Distance analysis including environmental covariates that had a significant influence on sighting probability (Buckland *et al.*, 2001), but these estimates were not corrected for *g(0)* and are thus negatively biased. The resulting abundance estimate for the Northern Coastal stock was 2,473 (CV = 0.25).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Northern Coastal stock of bottlenose dolphins is 2,473 (CV=0.25). The minimum population estimate for the Northern Coastal stock is 2,004 bottlenose dolphins.

Current Population Trend

There are insufficient data to determine population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The minimum population size is 2,004. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Northern Coastal stock of bottlenose dolphin is 20.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Northern Coastal stock of bottlenose dolphins during 2004-2008 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Northern Coastal stock in the northern Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, gillnet, and shark bottom longline fisheries (Appendix III).

Shrimp Trawl Fishery

Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Three bottlenose dolphin mortalities were observed in the shrimp trawl fishery. One mortality occurred in 2008 off the coast of Texas in the vicinity of Laguna Madre, 1 mortality occurred in 2007 off the coast of Louisiana in the vicinity of Atchafalaya Bay, and 1 mortality occurred in 2003 off the coast of Alabama near Mobile Bay. The Texas 2008 mortality could have belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock. The Louisiana 2007 mortality could have belonged to the Western Coastal stock or a bay, sound and estuarine stock. The Alabama 2003 mortality could have belonged to the Northern Coastal stock or a bay, sound and estuarine stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that 3-4 of the animals belonged to the continental shelf stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. This cannot be confirmed without a necropsy. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock, or possibly to the Atlantic spotted dolphin stock.

Blue and Stone Crab Trap/Pot Fisheries

Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. In 2002 there was a calf stranded near Clearwater, Florida, with crab trap line wrapped around its rostrum, through its mouth and looped around its tail. There was an additional unconfirmed report to the stranding network in 2002 of a dolphin entangled in a stone crab trap with the buoy still attached. The animal was reportedly cut loose from the trap and slowly swam off with line and buoy still wrapped around it (NMFS unpublished data). In 2008, a dolphin was disentangled from crab trap gear in Texas from a concerned citizen and swam away with no reported injuries. Also in 2008, a dolphin off Florida, reportedly half the size of an adult, was disentangled by a county marine officer from a crab pot line and swam away with no reported injuries (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery: 2 takes of single bottlenose dolphins were reported in Louisiana waters during 2005 (1 of the animals may have been dead prior to

capture); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004; 2 takes of single unidentified dolphins were reported during 2002 (1 in Mississippi and 1 in Louisiana waters); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001; and 3 takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters. The menhaden purse seine fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. The floatline was wrapped around the dolphin's tail; the net released itself upon retrieval and the dolphin appeared in good condition as it swam away. All of these animals likely belonged to bay, sound and estuarine stocks. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

Shark Bottom Longline Fishery

The shark bottom longline fishery has been observed since 1994, and 3 interactions with bottlenose dolphins have been recorded. The incidents include 1 mortality (2003) and 2 hooked animals that escaped at the vessels (1999, 2002; Burgess and Morgan 2003a,b). Based on the water depths of the interactions (~12-60m), they likely involved animals from the Eastern Coastal and continental shelf stocks. No interactions were observed during 2004-2008 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009). For the shark bottom longline fishery in the Gulf of Mexico, Richards (2007) estimated bottlenose dolphin mortalities of 58 (CV=0.99), 0 and 0 for 2003, 2004 and 2005, respectively.

Strandings

A total of 139 bottlenose dolphins were found stranded in Northern Coastal waters of the Gulf of Mexico from 2004 through 2008 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 3 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby bay, sound and estuarine stock; however, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of human-related mortality and serious injury because not all of the dolphins which die or are seriously injured due to human interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of fishery-interaction or other human interactions. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

Since 1990, there have been 11 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas, about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 an UME of bottlenose dolphins likely caused by morbillivirus started in the

Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 an UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 106 bottlenose dolphins and 1 unidentified dolphin stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses. 8) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The event has been closed, however, the investigation is ongoing.

Table 1. Bottlenose dolphin strandings occurring in Northern Coastal stock waters of the northern Gulf of Mexico from 2004 to 2008, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 21 September 2009 and 18 November 2009). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuarine stocks; therefore, the annual totals below will differ from those reported previously.

Stock	Category	2004	2005	2006	2007	2008	Total
Northern Coastal Stock	Total Stranded	59	21	32	19	8	139
	Human Interaction	0	1	1	1	0	3
	---Fishery Interaction	-	1	0	0	-	1
	---Other	-	0	1	1	-	2
	No Human Interaction	12	3	3	3	1	22
	CBD	47	17	28	15	7	114

Other Mortality

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama

City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells, in press), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of „take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells, in press). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells, in press). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

The nearshore habitat occupied by the 3 coastal stocks is adjacent to areas of high human population and in some areas, such as Tampa Bay, Florida, Galveston, Texas, and Mobile, Alabama, is highly industrialized. Concentrations of anthropogenic chemicals such PCBs and DDT and its metabolites vary from site to site, and can reach levels of concern for bottlenose dolphin health and reproduction in the southeastern U.S. (Schwacke *et al.* 2002). PCB concentrations in 3 stranded dolphins sampled from the Eastern Coastal stock area ranged from 16-46µg/g wet weight. Two stranded dolphins from the Northern Coastal stock area had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with a 1990 mortality investigation conducted by NMFS (Varanasi *et al.* 1992). The significance of these findings is unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins (Lahvis *et al.* 1995), or impact reproduction through increased first-born calf mortality (Wells *et al.* 2005). Concentrations of chlorinated hydrocarbons and metals were relatively low in most of the bottlenose dolphins examined in conjunction with an anomalous mortality event in Texas bays in 1990; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). Agricultural runoff following periods of high rainfall in 1992 was implicated in a high level of bottlenose dolphin mortalities in Matagorda Bay, which is adjacent to the Western Coastal stock area (NMFS unpublished data).

The Mississippi River, which drains about two-thirds of the continental U.S., flows into the north-central Gulf of Mexico and deposits its nutrient load which is linked to the formation of one of the world's largest areas of seasonal hypoxia (Rabalais *et al.* 1999). This area is located in Louisiana coastal waters west of the Mississippi River delta. How it affects bottlenose dolphins is not known.

STATUS OF STOCK

The status of the Northern Coastal stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. Additionally, there is no systematic monitoring of all fisheries that may take this stock. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Beier, A. G. 2001. Occurrence, distribution, and movement patterns of outer coastline bottlenose dolphins off Galveston, Texas. Master's thesis from Texas A&M University. 97 pp.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo NMFS-SEFSC-356, 10 pp.

Bryant, L. 1994. Report to Congress on results of feeding wild dolphins: 1989-1994. National Marine Fisheries Service, Office of Protected Resources, 23 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London. 446 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to

distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford, UK. 432pp.

Burgess, G. and A. Morgan. 2003a. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and South Atlantic: 1999 fishing season. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA97FF0041.

Burgess, G. and A. Morgan. 2003b. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and the south Atlantic: 2002(2) and 2003(1) fishing seasons. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA16FM0598.

Cunningham-Smith, P., D. E. Colbert, R. S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat. Mamm. 32(3):346-356.

Fazioli, K. L., S. Hofmann and R. S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2): 212-222.

Flewelling, L. J., J. P. Naar, J. P. Abbott, D. G. Baden, N. B. Barros, G. D. Bossart, M. D. Bottein, D. G. Hammond, E. M. Haubold, C. A. Heil, M. S. Henry, H. M. Jacocks, T. A. Leighfield, R. H. Pierce, T. D. Pitchford, S. A. Rommel, P. S. Scott, K. A. Steidinger, E. W. Truby, F. M. Van Dolah and J. H. Landsberg. 2005. Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. Nature 435: 755-756.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Gorzelany, J. F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-617.

Hale, L. F. and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2005-2006. NOAA Tech. Memo. NMFS-SEFSC-554, 28 pp.

Hale, L. F., L. D. Hollensead and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2007. NOAA Tech. Memo. NMFS-SEFSC-564, 25 pp.

Hale, L. F., S. J. B. Gulak and J. K. Carlson. 2009. Characterization of the shark bottom longline fishery, 2008. NOAA Tech. Memo. NMFS-SEFSC-586, 23 pp.

Hansen, L. J. (ed.). 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between Northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. pp. 129-139. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric „nearshore' and „offshore' populations of bottlenose dolphins. Proc. R. Soc. Lond., Ser. B: Biol. Sci. 265: 1177-1183.

Irvine, A. B., M. D. Scott, R. S. Wells and J. H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. U.S.79: 671-688.

Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins. 72 pp.

Lahvis, G. P., R. S. Wells, D. W. Kuehl, J. L. Stewart, H. L. Rhinehart and C. S. Via. 1995. Decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCB's and DDT in peripheral blood. Environ. Health Perspect. 103: 67-72.

LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. Int. Whal. Commn. 47: 393.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. pp. 4-5. *In:* R. A. Blaylock, B. Mase and D. K. Odell (eds.) Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.

Lipscomb, T. P., S. Kennedy, D. Moffet and B. K. Ford. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4): 572-576.

Lynn, S. K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1): 25-37.

McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: A summary. U.S. Fish and Wildlife Service unpublished report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Mullin, K. D., R. R. Lohoefener, W. Hoggard, C. L. Roden and C. M Rogers. 1990. Abundance of bottlenose dolphins, *Tursiops truncatus*, in the coastal Gulf of Mexico. Northeast Gulf Sci. 11(2): 113-122.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NMFS. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Powell, J. R. and R. S. Wells. In press. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci.

Rabalais, N. N., R. E. Turner and W. J. Wiseman, Jr. 1999. Hypoxia in the northern Gulf of Mexico: Linkage with the Mississippi River. pp. 297-322. *In:* H. Kumpf, K. Steidinger and K. Sherman (eds.) The Gulf of Mexico large marine ecosystem. Blackwell Science, Oxford, UK.

Reynolds, J. E., III. 1985. Evaluation of the nature and magnitude of interactions between bottlenose dolphins, *Tursiops truncatus*, and fisheries and other human activities in coastal areas of the southeastern United States. National Technical Information Service PB86-162203, U.S. Dep. Commer., Springfield, VA 22161.

Richards, P. M. 2007. Estimated takes of protected species in the commercial directed shark bottom longline fishery 2003, 2004, and 2005. NMFS SEFSC Contribution PRD-06/07-08, June 2007, 21 pp.

Samuels, A. and L. Bejder. 2004. Chronic interactions between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the Southeast United States coast. Environ. Toxicol. Chem. 21: 2752–2764.

Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. pp. 623-639. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark and S. L. Chan. 1992. pp. 56-86. *In:* L. J. Hansen (ed.) Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Wells, R. S. 1986. Structural aspects of dolphin societies. Ph.D. dissertation from University of California, Santa Cruz. 234 pp.

Wells, R. S. and M. D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. p. 629. *In:* W. F. Perrin, G. P. Donovan and J. Barlow (eds.) Gillnets and cetaceans. Rep. Int. Whal. Commn., Special Issue 15.

Wells, R. S. and M. D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.

Wells, R. S., S. Hofmann and T. L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., J. B. Allen, S. Hoffman, K. Bassos-Hull, D. A. Fauquier, N. B. Barros, R. E. DeLynn, G. Sutton, V. Socha and M. D. Scott. 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774-794.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Gulf of Mexico Western Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Mullin *et al.* 1990). Northern Gulf of Mexico coastal waters have been divided for management purposes into 3 bottlenose dolphin stocks: eastern, northern and western. As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climatic, coastal and oceanographic characteristics might be restricted in their movements between habitats, and thus constitute separate stocks. Coastal waters are defined as those from shore, barrier islands or presumed bay boundaries to the 20-m isobath (Figure 1). The Eastern Coastal bottlenose dolphin stock area extends from 84°W longitude to Key West, Florida; the Northern Coastal bottlenose dolphin stock area from 84°W longitude to the Mississippi River Delta; and the Western Coastal bottlenose dolphin stock area from the Mississippi River Delta to the Texas-Mexico border. The Eastern Coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. The Northern Coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of freshwater input. The Western Coastal stock area is characterized by an arid to temperate climate, sand beaches in southern Texas, extensive coastal marshes in northern Texas and Louisiana, and low to high levels of freshwater input.

The Western Coastal stock is trans-boundary with Mexico; however, there is no information available for abundance estimation, nor for estimating fishery-related mortality in Mexican waters.

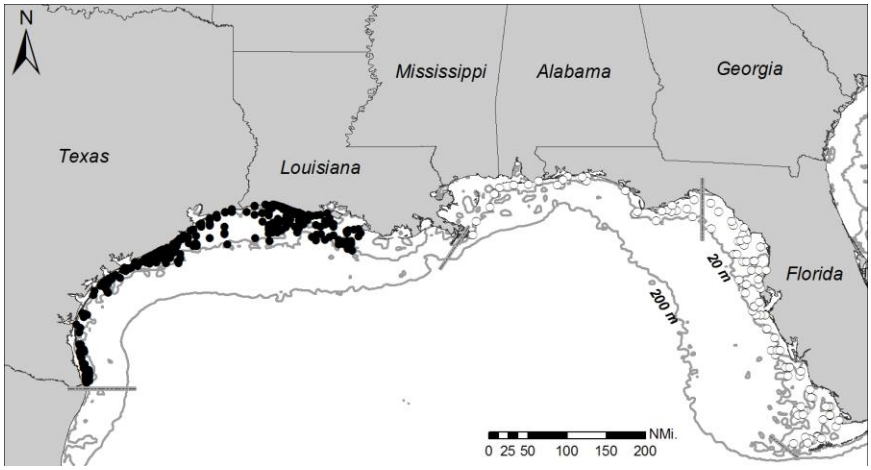

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal stock area in 1992 and 1996, and in the Northern Coastal stock and Eastern Coastal stock areas in 2007. Dark circles indicate groups within the boundaries of the Western Coastal stock. The 20- and 200-m isobaths are shown.*

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico continental shelf stock and bay, sound and estuarine stocks. The seaward boundary for coastal stocks, the 20m -, generally corresponds to survey strata (Scott 1990; Blaylock and Hoggard 1994; Fulling *et al.* 2003), and thus represents a management boundary rather than an ecological boundary. Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998), and both could potentially occur in coastal waters. The offshore and coastal ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 m from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal ecotype. The distance of the 20-m isobath ranges from 4 to 90 km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

Research on coastal stocks is limited. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound over 14 months. They found coastal waters were inhabited by both „inshore' and „Gulf' dolphins but that the 2 types used coastal waters differently. Dolphins from the inshore communities were observed occasionally in Gulf near-shore waters adjacent to their inshore range, whereas „Gulf' dolphins were found primarily in open Gulf of Mexico waters with some displaying seasonal variations in their use of the study area. The „Gulf' dolphins did not show a preference for waters near

passes as was seen for „inshore' dolphins, but moved throughout the study area and made greater use of waters offshore of waters used by „inshore' dolphins. During winter months abundance of „Gulf' groups decreased while abundance for „inshore' groups increased. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by Sarasota Bay dolphins in winter. Seasonal movements of identified individuals and abundance indices suggest that part of the „Gulf" dolphin community moves out of the study area during winter, but their destination is unknown. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

Off Galveston, Texas, Beier (2001) reported an open population of individual dolphins in coastal waters, but several individual dolphins had been sighted previously by other researchers over a 10-year period. Some coastal animals may move relatively long distances alongshore. Two bottlenose dolphins previously seen in the South Padre Island area in Texas were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997).

Earlier abundance estimates

Previous estimates of abundance were derived using distance sampling analysis (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) with sighting data collected during aerial line-transect surveys conducted during autumn from 1992-1994 (Blaylock and Hoggard 1994; NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18m -. Approximately 5% of the total survey area was visually searched. The previous bottlenose dolphin abundance estimate for the Western Coastal stock based on the 1992 survey was 3,499 (CV=0.21).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Western Coastal stock of bottlenose dolphins is unknown. Therefore, the minimum population estimate for the northern Gulf of Mexico Western Coastal stock is unknown.

Current Population Trend

There are insufficient data to determine population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Western Coastal stock of bottlenose dolphin is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Western Coastal stock of bottlenose dolphins during 2004-2008 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Western Coastal stock in the northern Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, gillnet, and shark bottom longline fisheries (Appendix III).

Shrimp Trawl Fishery

Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Three bottlenose dolphin mortalities were observed in the shrimp trawl fishery. One mortality occurred in 2008 off the coast of Texas in the vicinity of Laguna Madre, 1 mortality occurred in 2007 off the coast of Louisiana in the vicinity of Atchafalaya Bay, and 1 mortality occurred in 2003 off the coast of Alabama near Mobile Bay. The Texas 2008 mortality could have belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock. The Louisiana 2007 mortality could have belonged to the Western Coastal stock or a bay, sound and estuarine stock. The Alabama 2003 mortality could have belonged to the Northern Coastal stock or a bay, sound and estuarine stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that 3-4 of the animals belonged to the continental shelf stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. This cannot be confirmed without a necropsy. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal stock or continental shelf stock, or possibly to the Atlantic spotted dolphin stock.

Blue and Stone Crab Trap/Pot Fisheries

Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. In 2002 there was a calf stranded near Clearwater, Florida, with crab trap line wrapped around its rostrum, through its mouth and looped around its tail. There was an additional unconfirmed report to the stranding network in 2002 of a dolphin entangled in a stone crab trap with the buoy still attached. The animal was reportedly cut loose from the trap and slowly swam off with line and buoy still wrapped around it (NMFS unpublished data). In 2008, a dolphin was disentangled from crab trap gear in Texas from a concerned citizen and swam away with no reported injuries. Also in 2008, a dolphin off Florida, reportedly half the size of an adult, was disentangled by a county marine officer from a crab pot line and swam away with no reported injuries (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery: 2 takes of single bottlenose dolphins were reported in Louisiana waters during 2005 (1 of the animals may have been dead prior to capture); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004; 2 takes of single unidentified dolphins were reported during 2002 (1 in Mississippi and 1 in Louisiana waters); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001; and 3 takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters. The menhaden purse seine fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. The floatline was wrapped around the dolphin's tail; the net released itself upon retrieval and the dolphin appeared in good condition as it swam away. All of these animals likely belonged to bay, sound and estuarine stocks. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

Shark Bottom Longline Fishery

The shark bottom longline fishery has been observed since 1994, and 3 interactions with bottlenose dolphins have been recorded. The incidents include 1 mortality (2003) and 2 hooked animals that escaped at the vessels (1999, 2002; Burgess and Morgan 2003a,b). Based on the water depths of the interactions (~12-60m), they likely involved animals from the Eastern Coastal and continental shelf stocks. No interactions were observed during 2004-2008 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009). For the shark bottom longline fishery in the Gulf of Mexico, Richards (2007) estimated bottlenose dolphin mortalities of 58 (CV=0.99), 0 and 0 for 2003, 2004 and 2005, respectively.

Strandings

A total of 526 bottlenose dolphins were found stranded in Western Coastal waters of the northern Gulf of Mexico from 2004 through 2008 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 20 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby bay, sound and estuary stock; however, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of human-related mortality and serious injury because not all of the dolphins which die or are seriously injured due to human interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of fishery-interaction or other human interactions. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

Since 1990, there have been 11 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas, about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 an UME of bottlenose dolphins likely caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 an UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 106 bottlenose dolphins and 1 unidentified dolphin stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive

red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses. 8) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The event has been closed, however, the investigation is ongoing.

Table 1. Bottlenose dolphin strandings occurring in Western Coastal stock waters of the northern Gulf of Mexico from 2004 to 2008, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 21 September 2009 and 18 November 2009). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuarine stocks; therefore, the annual totals below will differ from those reported previously.

Stock	**Category**	**2004**	**2005**	**2006**	**2007**	**2008**	**Total**
Western Coastal Stock	Total Stranded	96	88	79	112	151[a]	526
	Human Interaction	9	2	3	5	1	20
	---Fishery Interaction	1	0	2	0	1	4
	---Other	8	2	1	5	0	16
	No Human Interaction	14	29	15	27	28	113
	CBD	73	57	61	80	122	393

[a] Includes 1 mass stranding event (2 animals in August 2008)

Other Mortality

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. Five incidents have been documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. Four of the incidents were mortalities, and 1 occurred during each of the following years: 2003, 2005, 2006, and 2007. It is likely 2 of these animals belonged to the Western Coastal stock (2005, 2007) and 2 belonged to bay, sound and estuarine stocks (2003, 2006). An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally. It is likely this animal belonged to a bay, sound and estuarine stock. All of the mortalities were included in the stranding database and the 3 most recent are included in the appropriate stranding tables under "Other" Human Interaction.

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006;

Powell and Wells, in press), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of „take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells, in press). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells, in press). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

The nearshore habitat occupied by the 3 coastal stocks is adjacent to areas of high human population and in some areas, such as Tampa Bay, Florida, Galveston, Texas, and Mobile, Alabama, is highly industrialized. Concentrations of anthropogenic chemicals such PCBs and DDT and its metabolites vary from site to site, and can reach levels of concern for bottlenose dolphin health and reproduction in the southeastern U.S. (Schwacke *et al.* 2002). PCB concentrations in 3 stranded dolphins sampled from the Eastern Coastal stock area ranged from 16-46µg/g wet weight. Two stranded dolphins from the Northern Coastal stock area had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with a 1990 mortality investigation conducted by NMFS (Varanasi *et al.* 1992). The significance of these findings is unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins (Lahvis *et al.* 1995), or impact reproduction through increased first-born calf mortality (Wells *et al.* 2005). Concentrations of chlorinated hydrocarbons and metals were relatively low in most of the bottlenose dolphins examined in conjunction with an anomalous mortality event in Texas bays in 1990; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). Agricultural runoff following periods of high rainfall in 1992 was implicated in a high level of bottlenose dolphin mortalities in Matagorda Bay, which is adjacent to the Western Coastal stock area (NMFS unpublished data).

The Mississippi River, which drains about two-thirds of the continental U.S., flows into the north-central Gulf of Mexico and deposits its nutrient load which is linked to the formation of one of the world's largest areas of seasonal hypoxia (Rabalais *et al.* 1999). This area is located in Louisiana coastal waters west of the Mississippi River delta. How it affects bottlenose dolphins is not known.

STATUS OF STOCK

The status of the Western Coastal stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. Because the stock size is currently unknown and PBR undetermined, and because there are documented cases of human-related mortality from a number of sources, this stock is a strategic stock. Additionally, there is no systematic monitoring of all fisheries that may take this stock. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background and a summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Beier, A. G. 2001. Occurrence, distribution, and movement patterns of outer coastline bottlenose dolphins off Galveston, Texas. Master's thesis from Texas A&M University. 97 pp.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo NMFS-SEFSC-356, 10 pp.

Bryant, L. 1994. Report to Congress on results of feeding wild dolphins: 1989-1994. National Marine Fisheries Service, Office of Protected Resources, 23 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London. 446 pp.

Burgess, G. and A. Morgan. 2003a. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and South Atlantic: 1999 fishing

season. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA97FF0041.

Burgess, G. and A. Morgan. 2003b. Commercial shark fishery observer program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and the south Atlantic: 2002(2) and 2003(1) fishing seasons. Final Report, U.S. National Marine Fisheries Service, Highly Migratory Species Management Division Award NA16FM0598.

Cunningham-Smith, P., D. E. Colbert, R. S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat. Mamm. 32(3):346-356.

Fazioli, K. L., S. Hofmann and R. S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2): 212-222.

Flewelling, L. J., J. P. Naar, J. P. Abbott, D. G. Baden, N. B. Barros, G. D. Bossart, M. D. Bottein, D. G. Hammond, E. M. Haubold, C. A. Heil, M. S. Henry, H. M. Jacocks, T. A. Leighfield, R. H. Pierce, T. D. Pitchford, S. A. Rommel, P. S. Scott, K. A. Steidinger, E. W. Truby, F. M. Van Dolah and J. H. Landsberg. 2005. Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. Nature 435: 755-756.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Gorzelany, J. F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-617.

Hale, L. F. and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2005-2006. NOAA Tech. Memo. NMFS-SEFSC-554, 28 pp.

Hale, L. F., L. D. Hollensead and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery: 2007. NOAA Tech. Memo. NMFS-SEFSC-564, 25 pp.

Hale, L. F., S. J. B. Gulak and J. K. Carlson. 2009. Characterization of the shark bottom longline fishery, 2008. NOAA Tech. Memo. NMFS-SEFSC-586, 23 pp.

Hansen, L. J. (ed.). 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between Northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. pp. 129-139. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric „nearshore' and „offshore' populations of bottlenose dolphins. Proc. R. Soc. Lond., Ser. B: Biol. Sci. 265: 1177-1183.

Irvine, A. B., M. D. Scott, R. S. Wells and J. H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. U.S.79: 671-688.

Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins. 72 pp.

Lahvis, G. P., R. S. Wells, D. W. Kuehl, J. L. Stewart, H. L. Rhinehart and C. S. Via. 1995. Decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCB's and DDT in peripheral blood. Environ. Health Perspect. 103: 67-72.

LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. Int. Whal. Commn. 47: 393.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. pp. 4-5. *In:* R. A. Blaylock, B. Mase and D. K. Odell (eds.) Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.

Lipscomb, T. P., S. Kennedy, D. Moffet and B. K. Ford. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4): 572-576.

Lynn, S. K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1): 25-37.

McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: A summary. U.S. Fish and Wildlife Service unpublished report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Mullin, K. D., R. R. Lohoefener, W. Hoggard, C. L. Roden and C. M Rogers. 1990. Abundance of bottlenose dolphins, *Tursiops truncatus*, in the coastal Gulf of Mexico. Northeast Gulf Sci. 11(2): 113-122.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from:

NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NMFS. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Powell, J. R. and R. S. Wells. In press. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci.

Rabalais, N. N., R. E. Turner and W. J. Wiseman, Jr. 1999. Hypoxia in the northern Gulf of Mexico: Linkage with the Mississippi River. pp. 297-322. *In:* H. Kumpf, K. Steidinger and K. Sherman (eds.) The Gulf of Mexico large marine ecosystem. Blackwell Science, Oxford, UK.

Reynolds, J. E., III. 1985. Evaluation of the nature and magnitude of interactions between bottlenose dolphins, *Tursiops truncatus*, and fisheries and other human activities in coastal areas of the southeastern United States. National Technical Information Service PB86-162203, U.S. Dep. Commer., Springfield, VA 22161.

Richards, P. M. 2007. Estimated takes of protected species in the commercial directed shark bottom longline fishery 2003, 2004, and 2005. NMFS SEFSC Contribution PRD-06/07-08, June 2007, 21 pp.

Samuels, A. and L. Bejder. 2004. Chronic interactions between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the Southeast United States coast. Environ. Toxicol. Chem. 21: 2752–2764.

Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. pp. 623-639. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark and S. L. Chan. 1992. pp. 56-86. *In:* L. J. Hansen (ed.) Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Wells, R. S. 1986. Structural aspects of dolphin societies. Ph.D. dissertation from University of California, Santa Cruz. 234 pp.

Wells, R. S. and M. D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. p. 629. *In:* W. F. Perrin, G. P. Donovan and J. Barlow (eds.) Gillnets and cetaceans. Rep. Int. Whal. Commn., Special Issue 15.

Wells, R. S. and M. D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.

Wells, R. S., S. Hofmann and T. L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349: 106-119.

Wells, R. S., J. B. Allen, S. Hoffman, K. Bassos-Hull, D. A. Fauquier, N. B. Barros, R. E. DeLynn, G. Sutton, V. Socha and M. D. Scott. 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774-794.

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KILLER WHALE (*Orcinus orca*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The killer whale is distributed worldwide from tropical to polar regions (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) during 19~~5~~21-1995 occurred primarily in oceanic waters ranging from 256 to 2,652 m (averaging 1,242~~-~~m) in the north-central Gulf of Mexico (O'Sullivan and Mullin 1997). More recent sightings from NMFS vessel surveys have also occurred in oceanic waters of the north-central Gulf (Figure 1). Despite extensive shelf surveys (O'Sullivan and Mullin 1997), no killer whales have been reported on the Gulf of Mexico shelf waters other than those reported in 1921, 1985 and 1987 by Katona *et al.* (1988). Killer whales were seen only in the summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000), were reported from May through June during vessel surveys (Mullin and Fulling 2004; Maze-Foley and Mullin 2006) and recorded in May, August, September and November by earlier opportunistic ship-based sources (O'Sullivan and Mullin 1997).

Different stocks were identified in the northeastern Pacific based on morphological, behavioral and genetic characteristics (Bigg *et al.* 1990; Hoelzel 1991). There is no information on stock differentiation for the Atlantic Ocean population, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that whales from these areas may represent different stocks (Moore *et al.* 1988). Thirty-two individuals have been photographically identified to date in the northern Gulf of Mexico, with 6 individuals having been sighted over a 5 year period, and 1 whale resighted over 10 years. Three animals have been sighted over a range of more than 1,100km (O'Sullivan and Mullin 1997). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico killer whales is 49 (CV=0.77) (Mullin 2007; Table 1). This estimate is pooled from summer 2003 and spring 2004 oceanic surveys covering waters from the 200 m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ).

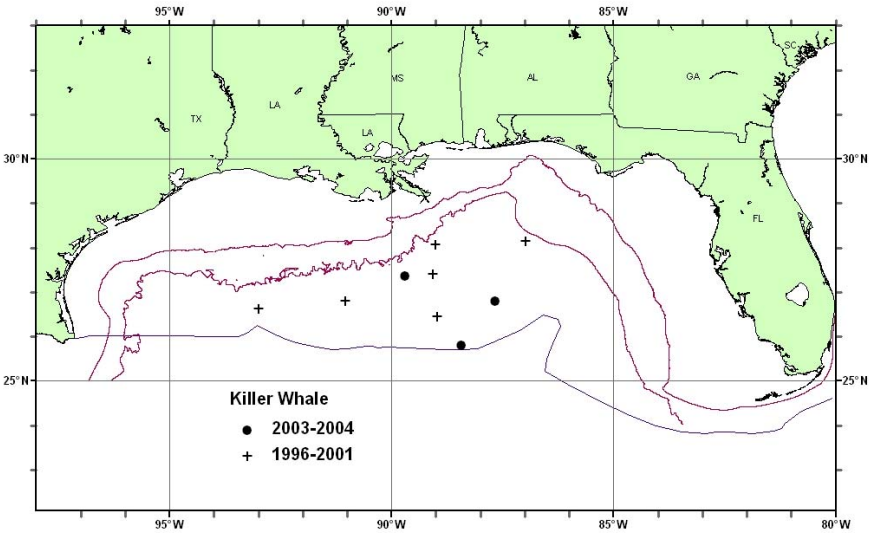

Figure 1. *Distribution of killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during summer in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. EEZ (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of killer whales for all surveys combined was 277 (CV=0.42) (Hansen *et al.* 1995; ~~Table 1~~Appendix IV). Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of

Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for killer whales in oceanic waters, pooled from 1996 to 2001, was 133 (CV=0.49) (Mullin and Fulling 2004; ~~Table 1~~Appendix IV).

Recent surveys and abundance estimates

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for killer whales in oceanic waters, pooled from 2003 to 2004, was 49 (CV=0.77) (Mullin 2007; Table 1), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Table 1. Summary of recent abundance estimate~~s~~ for northern Gulf of Mexico killer whales. Month, year and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Apr-Jun 1991-1994~~	~~Oceanic waters~~	~~277~~	~~0.42~~
~~Apr-Jun 1996-2001 (excluding 1998)~~	~~Oceanic waters~~	~~133~~	~~0.49~~
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	49	0.77

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for killer whales is 49 (CV=0.77). The minimum population estimate for the northern Gulf of Mexico is 28 killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 49 (CV=0.77) and that for 1996-2001 of 133 (CV=0.49) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 277 (CV=0.42). The large relative changes in the total abundances of killer whales are probably due to a number of factors. The killer whale is most certainly a resident species in the Gulf of Mexico but probably occurs in low numbers and the survey effort is not sufficient to estimate the abundance of uncommon or rare species with precision. Also, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of killer whale abundance. The killer whale, like all the other oceanic cetacean species in the Gulf, is a mobile predator and this stock is most likely a transboundary stock. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum

population size is 28. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico killer whale is 0.3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a killer whale during 1998-200~~7~~8 ~~(Yeung~~ (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009). However, during 2008 there was 1 killer whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009).

Fisheries Information

The level of past or current, direct, human-caused mortality of killer whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to killer whales by this fishery. However, on 17 May 2008 there was 1 killer whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009). This was the second observed interaction between a killer whale and this fishery and the first observed interaction within the Gulf of Mexico. During 15 April – 15 June 2008 observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area is dramatically higher than typical for previous years (Garrison *et al.* 2009).

Other Mortality

There were no reported strandings of killer whales in the Gulf of Mexico during ~~1999~~2004-200~~7~~8 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 September 2008 and 21 September 2009). Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of killer whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Bigg, M.A., P.F. Olesiuk, G.M. Ellis, J.K.B. Ford and K.C. Balcomb 1990. Social organization and genealogy of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Pages 383-405 *in*: P. S. Hammond, S. A. Mizroch and G. P. Donovan, (eds.) Individual recognition of cetaceans: Use of photoidentification and other techniques to estimate population parameters. Rep. Int. Whal. Comm., Cambridge. Special Issue 12.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

Fairfield-Walsh, C. and L.P. Garrison 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NOAA NMFS-SEFSC-560. 54 pp.

Fairfield, C.P. and L.P. Garrison 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic

pelagic longline fleet during 2007. NOAA Tech. Memo. NOAA NMFS-SEFSC-572. 62 pp.
Fairfield Walsh, C. and L.P. Garrison 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539. 52 pp.
Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.
Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.
Garrison, L.P. and P.M. Richards 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527. 57 pp.
Garrison, L. P., L. Stokes and C. Fairfield. 2009. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591, 63 pp.
Hansen, L.J., K.D. Mullin, T.A. Jefferson and G.P. Scott 1996. Visual surveys aboard ships and aircraft. Pages 55-132 *in*: R. W. Davis and G. S. Fargion, (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. .
Hansen, L.J., K.D. Mullin and C.L. Roden 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami, FL. Contribution No. MIA-94/95-25. 9 pp.
Hoelzel, A.R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale; Implications for conservation. Pages 225-233 *in*: A. R. Hoelzel, (ed.) Genetic ecology of whales and dolphins. Rep. Int. Whal. Comm., Cambridge. Special Issue 13.
Katona, S.K.J.A.B., P.E. Girton and F. Wenzel 1988. Killer whales (*Orcinus orca*) from the Bay of Fundy to the equator, including the Gulf of Mexico. Rit Fiskideild 11: 205-224.
Leatherwood, S. and R.R. Reeves 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco. 302 pp.
Maze-Foley, K. and K.D. Mullin 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2): 203-213.
Moore, S.E., J.K. Francine, A.E. Bowles and K.B. Ford 1988. Analysis of calls of killer whales, *Orcinus orca*, from Iceland and Norway. Rit. Fiskideild 11: 225-250.
Mullin, K.D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568, 26 pp.
Mullin, K.D. and G.L. Fulling 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.
Mullin, K.D. and W. Hoggard 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172 *in*: R. W. Davis, W. E. Evans and B. Würsig, (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. OCS Study MMS 96-0027.
O'Sullivan, S. and K.D. Mullin 1997. Killer whales (Orcinus orca) in the northern Gulf of Mexico. Mar. Mamm. Sci. 13(1): 141-147.
Thomas, L., J.L. Laake, J.F. Derry, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, S. Strindberg, S.L. Hedley, F.F.C. Marques, J.H. Pollard and R.M. Fewster 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.
Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Tech. Memo. NMFS-SEFSC-430. 26 pp.
Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo., NMFS, Southeast Fisheries Science Center, Miami, FL. NMFS-SEFSC-467. 43 pp.

December 2009

RISSO'S DOLPHIN (*Grampus griseus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Risso's dolphins in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) occur throughout oceanic waters but are concentrated in continental slope waters (Figure 1; Baumgartner 1997; Maze-Foley and Mullin 2006). Risso's dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently little information to differentiate this stock from the Atlantic Ocean stock(s). In 2006, a Risso's dolphin that stranded on the Florida Gulf Coast was rehabilitated, satellite tagged and released into the Gulf southwest of Tampa Bay. Over a 23-day period the Risso's dolphin moved from the Gulf release site into the Atlantic Ocean and north to just off of Delaware (Wells *et al.* ~~In press~~2009). During September 2007 – January 2008, tracking of an adult female Risso's dolphin that had been rehabilitated and released by Mote Marine Laboratory after stranding on the southwest coast of Florida documented movements throughout the northern Gulf of Mexico. The dolphin, released with its young calf, traveled as far as Bahia de Campeche, Mexico, and waters off Texas and Louisiana before returning to the shelf edge southwest of its stranding site off Florida (Wells *et al.* 2008a). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico Risso's dolphins is 1,589 (CV=0.27) (Mullin 2007; Table 1). This estimate is pooled from summer 2003 and spring 2004 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ).

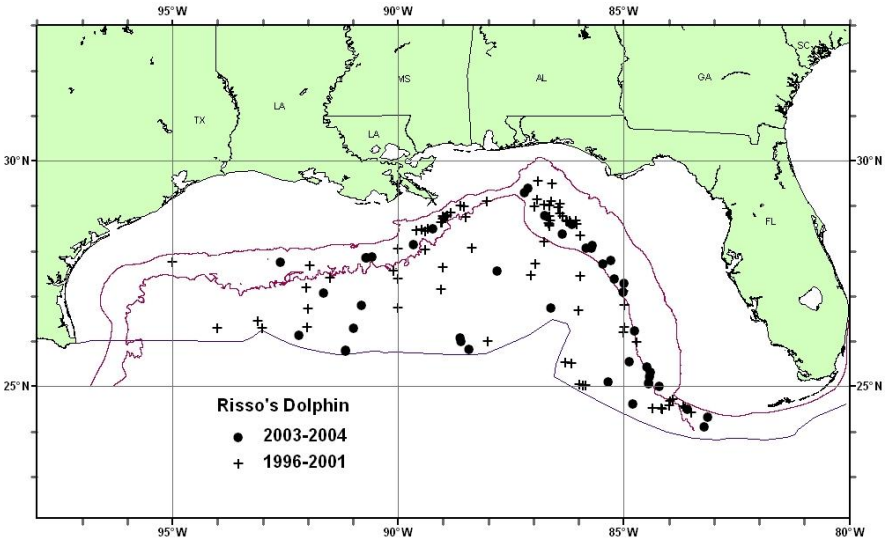

Figure 1. *Distribution of Risso's dolphin sightings from SEFSC vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. EEZ (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Risso's dolphins for all surveys combined was 2,749 (CV=0.27) (Hansen *et al.* 1995; ~~Table 1~~Appendix IV). Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 1996 to 2001, was 2,169 (CV=0.32) (Mullin and Fulling 2004;

~~Table 1~~Appendix IV).

Recent surveys and abundance estimates

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 2003 to 2004, was 1,589 (CV=0.27) (Mullin 2007; Table 1), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Table 1. Summary of recent abundance estimate~~s~~ for northern Gulf of Mexico Risso's dolphins. Month, year and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Apr-Jun 1991-1994~~	~~Oceanic waters~~	~~2,749~~	~~0.27~~
~~Apr-Jun 1996-2001 (excluding 1998)~~	~~Oceanic waters~~	~~2,169~~	~~0.32~~
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,589	0.27

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 1,589 (CV=0.27). The minimum population estimate for the northern Gulf of Mexico is 1,271 Risso's dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,589 (CV=0.27) and that for 1996-2001 of 1,777 (CV=0.34) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low. These estimates are generally similar to that for 1991-1994 of 2,749 (CV=0.27). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Risso's dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The 2 cases of satellite-linked tracking of Risso's dolphins in the Gulf of Mexico both showed movements out of the U.S. Gulf of Mexico EEZ (Wells *et al.* 2008a, 2009). The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,271. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern

Gulf of Mexico Risso's dolphin is 13.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There was 1 reported fishing-related mortality and 2 serious injuries of Risso's dolphins during 2008 (Garrison *et al.* 2009). The mortality and serious injuries were the result of entanglement interactions with the pelagic longline fishery. There ~~has been~~was no reported fishing-related mortality of a Risso's dolphin during 1998-2007 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008). ~~However, d~~During 2005 there was 1 Risso's dolphin released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Risso's dolphins in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. pelagic longline fishery in the northern Gulf of Mexico and in the U.S. Atlantic (Lee *et al.* 1994). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico (see Appendix III for a description of the large pelagics longline fishery). During 2008, 1 mortality and 2 serious injuries occurred due to entanglement interactions with the pelagic longline fishery. Estimated annual mortality attributable to the pelagic longline fishery in the northern Gulf of Mexico during 2008 was 4.4 (CV=1.00) Risso's dolphins and estimated annual serious injury was 3.9 (CV=0.72) Risso's dolphins (Garrison *et al.* 2009). Observer coverage during quarter 1 when the mortality was observed was 21.6%, and coverage during quarter 2 when the serious injuries were observed was 58.2%. Overall percentage observer coverage for the Gulf of Mexico during 2008 was 27.0% (Garrison *et al.* 2009). During 15 April – 15 June 2008 observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area is dramatically higher than typical for previous years. There were no reports of mortality or serious injury to Risso's dolphins in the northern Gulf of Mexico by this fishery during 1998-2007 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008). However, during 2005, 1 Risso's dolphin was observed entangled and released alive in the northern Gulf of Mexico. The animal was not hooked, but was tangled with mainline and leader around its flukes. All gear was removed and the animal dove immediately. It is presumed to have not been seriously injured (Fairfield Walsh and Garrison 2006). One Risso's dolphin was observed taken and released alive during 1992; the extent of injury to the animal was unknown (SEFSC, unpublished data). One lethal take of a Risso's dolphin by the fishery was observed in the northern Gulf of Mexico during 1993 (SEFSC, unpublished data). Estimated average annual fishery-related mortality and serious injury attributable to the pelagic longline fishery in the northern Gulf of Mexico during 1992-1993 was 19 Risso's dolphins (CV=0.20). There is a high likelihood that releases of dolphins that have ingested gear or with multi-wrap entanglements of appendages near their insertions will lead to mortality (Wells *et al.* 2008b).

Other Mortality

There were 14~~6~~ reported strandings of Risso's dolphin in the Gulf of Mexico during 2004-2008~~1999-2007 (13 in Florida, 3 in Texas;~~ (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 September 2008 and 21 September 2009~~; see Table 2 for 2003-2007 data~~). This includes 1 mass stranding of 5 animals in Florida during July 2005 (1 was rehabilitated and released by Mote Marine Laboratory), and 1 mass stranding of 4 animals in Florida during May 2007 (2 were rehabilitated and released by Mote Marine Laboratory). No evidence of human interactions was detected for any of the stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 UMEs have been declared in the Gulf of Mexico, and 1 of these included a Risso's dolphin. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *Karenia brevis* blooms and fish kills in the Florida Panhandle. Additional strandings included 3

Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins.

Table 2. Risso's dolphin (*Grampus griseus*) strandings along the northern Gulf of Mexico coast, 200~~3~~4-200~~7~~8.

STATE	2004	2005	2006	2007	2008	TOTAL
Alabama	0	0	0	0	0	0
Florida	1	5[a]	0	6[b]	0	12
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	1	1	0	0	0	2
TOTAL	2	6	0	6	0	14

[a] Florida mass stranding of 5 animals in July 2005
[b] Includes Florida mass stranding of 4 animals in May 2007

STATUS OF STOCK

The status of Risso's dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

REFERENCES CITED

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Baumgartner, M. F. 1997. The distribution of Risso's dolphin (*Grampus griseus*) with respect to physiography in the northern Gulf of Mexico. Mar. Mamm. Sci. 13: 614-638.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

Fairfield-Walsh, C. and L. P. Garrison 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NOAA NMFS-SEFSC-560. 54 pp.

Fairfield, C. P. and L. P. Garrison 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NOAA NMFS-SEFSC-572. 62 pp.

Fairfield Walsh, C. and L. P. Garrison 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539. 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.

Garrison, L. P. and P. M. Richards 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527. 57 pp.

Garrison, L. P., L. Stokes and C. Fairfield. 2009. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591, 63 pp.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott 1996. Visual surveys aboard ships and aircraft. Pages 55-132 *in*: R. W. Davis and G. S. Fargion, (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. .

Hansen, L. J., K. D. Mullin and C. L. Roden 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami, FL. Contribution No. MIA-94/95-25. 9 pp.

Leatherwood, S. and R. R. Reeves 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San

Francisco. 302 pp.

Lee, D. W., C. J. Brown, A. J. Catalano, J. R. Grubich, T. W. Greig, R. J. Miller and M. T. Judge 1994. SEFSC pelagic longline observer program data summary for 1992-1993. NOAA Tech. Memo. NMFS-SEFSC-347. 19 pp.

Maze-Foley, K. and K. D. Mullin 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2): 203-213.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568, 26 pp.

Mullin, K. D. and G. L. Fulling 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172 *in*: R. W. Davis, W. E. Evans and B. Würsig, (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. OCS Study MMS 96-0027.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

Wade, P. R. and R. P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

~~Wells, R.S., G.A. Early, J.G. Gannon, R.G. Lingenfelser and P. Sweeney In press. Tagging and tracking of rough-toothed dolphins (*Steno bredanensis*) from the March 2005 mass stranding in the Florida Keys. S. F. S. C. Available from NMFS, 75 Virginia Beach Road, Miami, FL 33149. NOAA Tech. Memo. NMFS-SEFSC-XXX, XX~~

Wells, R. S., C. A. Manire and J. Whaley. 2008a. Travels with Betty: A Risso's dolphin tour of the Gulf of Mexico. Strandings: Newsletter of the Southeast United States Marine Mammal Health and Stranding Network. National Marine Fisheries Service Southeast Regional Office and Southeast Fisheries Science Center. Winter, Spring, Summer, Fall 2007: 1-4.

Wells, R. S., J. B. Allen, S. Hofmann, K. Bassos-Hull, D. A. Fauquier, N. B. Barros, R. E. DeLynn, G. Sutton, V. Socha and M. D. Scott. 2008b. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Marine Mammal Science 24:774-794.

Wells, R. S., C. A. Manire, L. Byrd, D. R. Smith, J. G. Gannon, D. Fauquier and K. D. Mullin 200~~8~~9. Movements and dive patterns of a rehabilitated Risso's dolphin, *Grampus griseus*, in the Gulf of Mexico and Atlantic Ocean. Mar. Mamm. Sci. 25(2): 420-429.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Tech. Memo. NMFS-SEFSC-430. 26 pp.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo., NMFS, Southeast Fisheries Science Center, Miami, FL. NMFS-SEFSC-467. 43 pp.

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SPERM WHALE (*Physeter macrocephalus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found throughout the world's oceans in deep waters to the edge of the ice at both poles (Leatherwood and Reeves 1983; Rice 1989; Whitehead 2002). Sperm whales were commercially hunted in the Gulf of Mexico by American whalers from sailing vessels until the early 1900s (Townsend 1935). In the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) systematic aerial and ship surveys indicate that sperm whales inhabit continental slope and oceanic waters where they are widely distributed (Figure 1; Fulling *et al.* 2003; Mullin and Fulling 2004; Mullin *et al.* 2004; Maze-Foley and Mullin 2006; Mullin 2007). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Mullin *et al.* 1994; Hansen *et al.* 1996; Mullin and Hoggard 2000). The information for southern Gulf of Mexico waters is more limited, but there are sighting and stranding records from each season with sightings widely distributed in continental slope waters of the western Bay of Campeche (Ortega-Ortiz 2002).

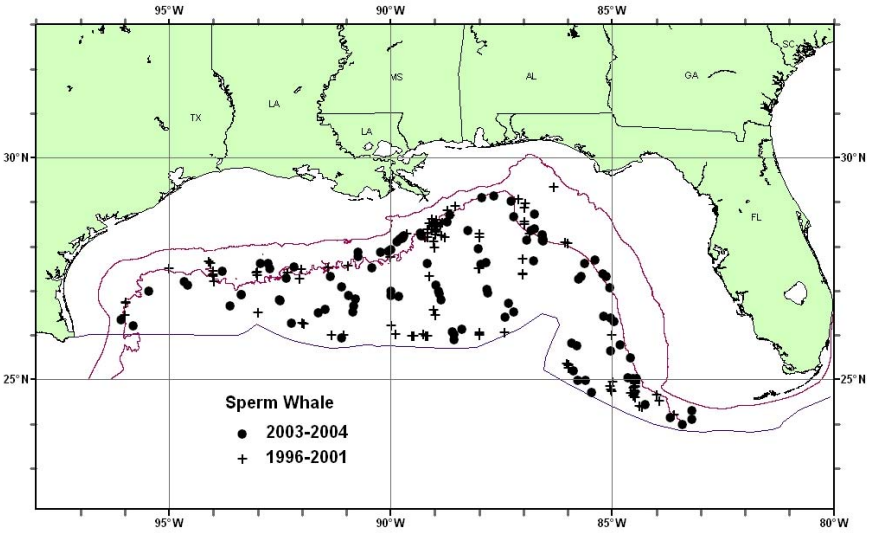

Figure 1. *Distribution of sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Sperm whales throughout the world exhibit a geographic social structure where females and juveniles of both sexes occur in mixed groups and inhabit tropical and subtropical waters. Males, as they mature, initially form bachelor groups but eventually become more socially isolated and more wide-ranging, inhabiting temperate and polar waters as well (Whitehead 2003). While this pattern also applies to the Gulf of Mexico, results of multi-disciplinary research conducted in the Gulf since 2000 confirms speculation by Schmidly (1981) and indicates clearly that Gulf of Mexico sperm whales constitute a stock that is distinct from other Atlantic Ocean stocks(s) (Mullin *et al.* 2003; Jaquet 2006; Jochens *et al.* 2008). The following summarizes the most significant stock structure-related findings from the Sperm Whale Seismic Study (Jochens *et al.* ~~(~~2008) and associated projects. Measurements of the total length of Gulf of Mexico sperm whales indicate that they are 1.5-2.0m smaller on average compared to whales measured in other areas. Female/immature group size in the Gulf ~~(9-11 whales)~~ is about one-third to one-fourth that found ~~elsewhere~~in the Pacific Ocean but more similar to group sizes in the Caribbean (Richter *et al.* 2008; Jaquet and Gendron 2009). Tracks from 39 whales satellite tagged in the northern Gulf were monitored for up to 607 days. No discernable seasonal migrations were made, but Gulf-wide movements primarily along the northern Gulf slope did occur. The tracks showed that whales exhibit a range of movement patterns within the Gulf, including movement into the southern Gulf in a few cases, but that only 1 whale (a male) left the Gulf of Mexico. This animal moved into the North Atlantic and then back into the Gulf after about 2 months. Additionally, no matches were found when 285 individual whales photo-identified from the Gulf and about 2500 from the North Atlantic and Mediterranean Sea were compared. Engelhaupt *et al.* (2009) conducted ~~A~~an analysis of matrilineally inherited mtDNA and found~~revealed~~ a significant genetic differentiation between animals from the northern Gulf of Mexico compared to those from the western North Atlantic Ocean, North Sea and Mediterranean Sea. Analysis of biparentally inherited nuclear DNA showed no significant difference between whales sampled in the Gulf and those from the other areas of the North Atlantic, indicating that mature males move

in and out of the Gulf. Sperm whales make vocalizations used in a social context called "codas" that have distinct patterns that are apparently culturally transmitted (Watkins and Schevill 1977; Whitehead and Weilgart 1991; Rendell and Whitehead 2001), and based on degree of social affiliation, mixed groups of sperm whales worldwide can be placed in recognizable acoustic clans (Rendell and Whitehead 2003). Recordings from mixed groups in the Gulf of Mexico compared to those from other areas of the Atlantic indicated that Gulf sperm whales constitute a distinct acoustic clan that is rarely encountered outside of the Gulf. It is assumed from this that groups from other clans enter the northern Gulf only infrequently. (Gordon *et al.* 2008). Antunes (2009) used additional data to further examine variation in sperm whale coda repertoires in the North Atlantic Ocean, and found that variation in the North Atlantic is mostly geographically structured based on findings of coda patterns unique to certain regions and a significant negative correlation between coda repertoire similarities and geographic distance. His work also suggested sperm whale coda differentiation of the Gulf of Mexico from the North Atlantic.

Additional research by Gero *et al.* (2007) suggested that movements of sperm whales between the adjacent areas of the Caribbean Sea, Gulf of Mexico and Atlantic may not be common. No matches were made from animals photo-identified in the eastern Caribbean Sea (islands of Dominica, Guadeloupe, Grenada, St. Lucia and Martinique) with either animals from the Sargasso Sea or the Gulf of Mexico.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico sperm whales is 1,665 (CV=0.20) (Mullin 2007:; Table 1). This estimate is pooled from summer 2003 and spring 2004 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ).

Earlier abundance estimates

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. EEZ (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of sperm whales for all surveys combined was 530 (CV=0.31) (Hansen *et al.* 1995; Table 1Appendix IV). Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for sperm whales in oceanic waters, pooled from 1996 to 2001, is 1,349 (CV=0.23) (Mullin and Fulling 2004; Table 1Appendix IV).

Recent surveys and abundance estimates

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for sperm whales in oceanic waters, pooled from 2003 to 2004, was 1,665 (CV=0.20) (Mullin 2007; Table 1), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Table 1. Summary of recent abundance estimates for northern Gulf of Mexico sperm whales. Month, year and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Apr-Jun 1991-1994	Oceanic waters	530	0.31
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	1,349	0.23
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,665	0.20

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for sperm whales is 1,665 (CV=0.20). The minimum population estimate for the northern Gulf of Mexico is 1,409 sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,665 (CV=0.20) and that for 1996-2001 of 1,349 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low. These estimates are 2-3 times larger than that for 1991-1994 of 530 (CV=0.31). The 2003-2004 estimates were based on less negatively biased estimates of sperm whale group size and may account for part of the difference. Nevertheless, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of sperm whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,409. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.1 because the sperm whale is an endangered species. PBR for the northern Gulf of Mexico sperm whale is 2.8.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a sperm whale during 1998-200~~7~~8 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield~~-~~-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009). However, during 2008 there was 1 sperm whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009).

Fisheries Information

The level of past or current, direct, human-caused mortality of sperm whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to sperm whales by this fishery. However, on 2 June 2008 there was 1 sperm whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009). The whale was entangled in mainline and other gear and was accompanied by a calf. The mainline broke when the whale dove and gear remained on the animal; however, since it was a large whale it was not considered seriously injured (Garrison and Stokes 2008). This was the first observed interaction between a sperm whale and this fishery. During 15 April – 15 June 2008 observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area is dramatically higher than typical for previous years (Garrison *et al.* 2009).

A commercial fishery for sperm whales operated in the Gulf of Mexico in deep waters between the Mississippi River delta and DeSoto Canyon during the late 1700s to the early 1900s (Mullin *et al.* 1991), but the exact number of whales taken is not known (Townsend 1935; Lowery 1974). Townsend (1935) reported many records of sperm whales from April through July in the north-central Gulf (Petersen and Hoggard 1996).

Other Mortality

Three sperm whale strandings were documented during 2008 (1 in Florida, 2 in Texas), and ~~Two~~2 sperm whale~~s~~ strandings were documented during 2007 (1 in Florida, 1 in Texas). No sperm whale strandings were documented during 2004-2006~~. A total of 9 sperm whale strandings were documented in the northern Gulf of Mexico during 1999-2003~~ (~~Table 2;~~ NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 September 2008 and 21 September 2009). No evidence of human interactions was detected for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Seismic vessel operations in the Gulf of Mexico (commercial and academic) now operate with marine mammal observers as part of required mitigation measures. There have been no reported seismic-related or industry ship-related mortalities or injuries to sperm whales. However, disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities and/or where shipping activity is high. Results from very limited studies of northern Gulf of Mexico sperm whale responses to seismic exploration indicate that sperm whales do not appear to exhibit horizontal avoidance of seismic survey activities. Data did suggest that there may be some decrease in foraging effort during exposure to full-array airgun firing, at least for some individuals. Further study is needed as samples sizes are insufficient at this time (~~Jochens *et al.* 2008~~Miller *et al.* 2009).

Ship strikes to whales occur world-wide and are a source of injury and mortality. One possible sperm whale mortality due to a vessel strike has been documented for the Gulf of Mexico. The incident occurred in 1990 in the vicinity of Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the ship strike was probably pre-mortem (Jensen and Silber 2004).

The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

~~Table 2. Sperm whale (*Physeter macrocephalus*) strandings along the northern Gulf of Mexico coast, 1999-2003. No sperm whale strandings were documented during 2004-2006.~~

~~**STATE**~~	~~**1999**~~	~~**2000**~~	~~**2001**~~	~~**2002**~~	~~**2003**~~	~~**TOTAL**~~
~~Alabama~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Florida~~	~~1~~	~~2~~	~~1~~	~~1~~	~~1~~	~~6~~
~~Louisiana~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~	~~2~~
~~Mississippi~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Texas~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~
~~**TOTAL**~~	~~2~~	~~3~~	~~1~~	~~1~~	~~2~~	~~9~~

STATUS OF STOCK

The status of sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown. This species is listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine the population trends for this species. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because the sperm whale is listed as an endangered species under the ESA.

REFERENCES CITED

Antunes, R. 2009. Variation in sperm whale (*Physeter macrocephalus*) coda vocalizations and social structure in the North Atlantic Ocean. Ph.D. dissertation from University of St. Andrews, U.K. 123 + xi pp.

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6.

73 pp.
Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.
Engelhaupt, D., A. R. Hoelzel, C. Nicholson, A. Frantzis, S. Mesnick, S. Gero, H. Whitehead, L. Rendell, P. Miller, R. De Stefanis, A. Cañadas, S. Airoldi and A. A. Mignucci-Giannoni. 2009. Female philopatry in coastal basins and male dispersion across the North Atlantic in a highly mobile marine species, the sperm whale (*Physeter macrocephalus*). Mol. Ecol. 18: 4193-4205.
Fairfield-, C.P. and L.P. Garrison 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NOAA NMFS-SEFSC-572. 62 pp.
Fairfield Walsh, C. and L.P. Garrison 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539. 52 pp.
Fairfield--Walsh, C. and L.P. Garrison 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NOAA NMFS-SEFSC-560. 54 pp.
Fulling, G.L., K.D. Mullin and C.W. Hubard 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.
Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.
Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.
Garrison, L.P. and P.M. Richards 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527. 57 pp.
Garrison, L.P. and L. Stokes. 2008. Preliminary estimates of protected species bycatch rates in the U.S. Atlantic pelagic longline fishery between 1 April and 30 June, 2008. Southeast Fisheries Sciences Center, PRD Contribution # PRD-07/08-14, 19 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
Garrison, L.P., L. Stokes and C. Fairfield. 2009. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591, 63 pp.
Gero, S., J. Gordon, C. Carlson, P. Evans and H. Whitehead. 2007. Population estimate and inter-island movement of sperm whales, *Physeter macrocephalus*, in the Eastern Caribbean Sea. J. Cetacean Res. Manage. 9(2): 143-150.
Gordon, J., L. Rendell, R. Antunes, N. Jaquet, C. Richter and B. Würsig. 2008. Analysis of codas from the Gulf of Mexico and implications for management. pp. 201-213. *In:* Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack and B Würsig. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006, 341 pp.
Hansen, L.J., K.D. Mullin, T.A. Jefferson and G.P. Scott 1996. Visual surveys aboard ships and aircraft. Pages 55-132 *in*: R. W. Davis and G. S. Fargion, (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. .
Hansen, L.J., K.D. Mullin and C.L. Roden 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami, FL. Contribution No. MIA-94/95-25. 9 pp.
Jaquet, N. 2006. A simple photogrammetric technique to measure sperm whales at sea. Mar. Mamm. Sci. 22(4): 862-879.
Jaquet, N. and D. Gendron. 2009. The social organization of sperm whales in the Gulf of California and comparisons with other populations. J. Mar. Biol. Assoc. U,K. 89(5): 975-983.
Jensen, A. S. and G. K. Silber. 2004. Large whale ship strike database. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-OPR-25, 37 pp.
Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006. 341 pp.
Leatherwood, S. and R.R. Reeves 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco. 302 pp.
Lowery, G.H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton

Rouge. 565 pp.
Maze-Foley, K. and K.D. Mullin 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2): 203-213.
Miller, P. J. O., M. P. Johnson, P. T. Madsen, N. Biassoni, M. Quero and P. L. Tyack. 2009. Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. Deep-Sea Res. I 56: 1168-1181.
Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dep. Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA 108 pp.
Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart 1994. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. Fish. Bull. 92: 773-786.
Mullin, K.D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568, 26 pp.
Mullin, K.D., D. Engelhaupt, C.E. Cates and N.B. Barros 2003. Sperm whale research in the Gulf of Mexico. International Whaling Commission Working Paper SC/55/O15. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.
Mullin, K.D. and G.L. Fulling 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.
Mullin, K.D. and W. Hoggard 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172 *in*: R. W. Davis, W. E. Evans and B. Würsig, (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. OCS Study MMS 96-0027.
Mullin, K.D., W. Hoggard and L.J. Hansen 2004. Abundance and seasonal occurrence of cetaceans in outer continental shelf and slope waters of the north-central and northwestern Gulf of Mexico. Gulf of Mexico Science 2004(1): 62-73.
Ortega-Ortiz, J.G. 2002. Multiscale analysis of cetacean distribution in the Gulf of Mexico. Ph.D. thesis. Texas A&M University. 170 pp.
Petersen, J.C. and W. Hoggard 1996. First sperm whale (*Physeter macrocephalus*) record in Mississippi. Gulf Research Reports 9(3): 215-217.
Rendell, L. E. and H. Whitehead. 2001. Culture in whales and dolphins. Behav. Brain Sci. 24: 309-382.
Rendell, L. and H. Whitehead. 2003. Vocal clans in sperm whales (*Physeter macrocephalus*). Proc. R. Soc. Lond. (Biol) 270:225-231.
Rice, D.W. 1989. Sperm whale, *Physeter macrocephalus* Linnaeus, 1758. Pages 177-233 *in*: S. H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London.
Richter, C., J. Gordon, N. Jaquet and B. Würsig. 2008. Social structure of sperm whales in the northern Gulf of Mexico. Gulf Mex. Sci. 26(2): 118-123.
Schmidly, D.J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-80/41. 165 pp.
Thomas, L., J.L. Laake, J.F. Derry, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, S. Strindberg, S.L. Hedley, F.F.C. Marques, J.H. Pollard and R.M. Fewster 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.
Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whale ships. Zoologica 19: 1-50.
Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Watkins, W. A. and W. E. Schevill. 1977. Sperm whale codas. J. Acoust. Soc. Am. 62: 1486-1490.
Whitehead, H. 2002. Estimates of the current global population size and historical trajectory for sperm whales. Mar. Ecol. Prog. Ser. 242: 295-304.
Whitehead, H. 2003. Sperm whales: Social evolution in the ocean. The University of Chicago Press, Chicago, IL. 431 pp.
Whitehead, H. and L. Weilgart. 1991. Patterns of visually observable behaviour and vocalizations in groups of female sperm whales. Behaviour 118: 275-296.
Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Tech. Memo. NMFS-SEFSC-430. 26 pp.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo., NMFS, Southeast Fisheries Science Center, Miami, FL. NMFS-SEFSC-467. 43 pp.

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SPERM WHALE (*Physeter macrocephalus*): Puerto Rico and U.S. Virgin Islands Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found throughout the world's oceans in deep waters to the edge of the ice at both poles (Leatherwood and Reeves 1983; Rice 1989; Whitehead 2002). Sperm whales throughout the world exhibit a geographic social structure where females and juveniles of both sexes occur in mixed groups and inhabit tropical and subtropical waters. Males, as they mature, initially form bachelor groups but eventually become more socially isolated and more wide-ranging, inhabiting temperate and polar waters as well (Whitehead 2003).

Sperm whales were commercially hunted in the Caribbean Sea by American whalers from sailing vessels until the early 1900s (Townsend 1935). Reeves *et al.* (2001) noted that it was not unusual for nineteenth century American whalers to go to Hispaniola, Puerto Rico or the Bahamas to hunt sperm whales on their way north following humpback whaling voyages to the Grenadines. In waters surrounding Puerto Rico and the U.S. Virgin Islands, NMFS winter ship surveys indicate that sperm whales inhabit continental slope and oceanic waters (Figure 1; Roden and Mullin 2000; Swartz and Burks 2000; Swartz *et al.* 2002). Earlier sightings from the northeastern Caribbean have been reported by Erdman (1970), Erdman *et al.* (1973) and Taruski and Winn (1976), and these and other sightings from Puerto Rican waters are summarized by Mignucci-Giannoni (1988). Mignucci-Giannoni (1998) found 43 records for sperm whales up to 1989 for waters of Puerto Rico, U.S. Virgin Islands and British Virgin Islands, and suggested they occur from late fall through winter and early spring but are rare from April to September. In addition, sperm whales are one of the most common species to strand in waters of Puerto Rico and the Virgin Islands (Mignucci-Giannoni *et al.* 1999).

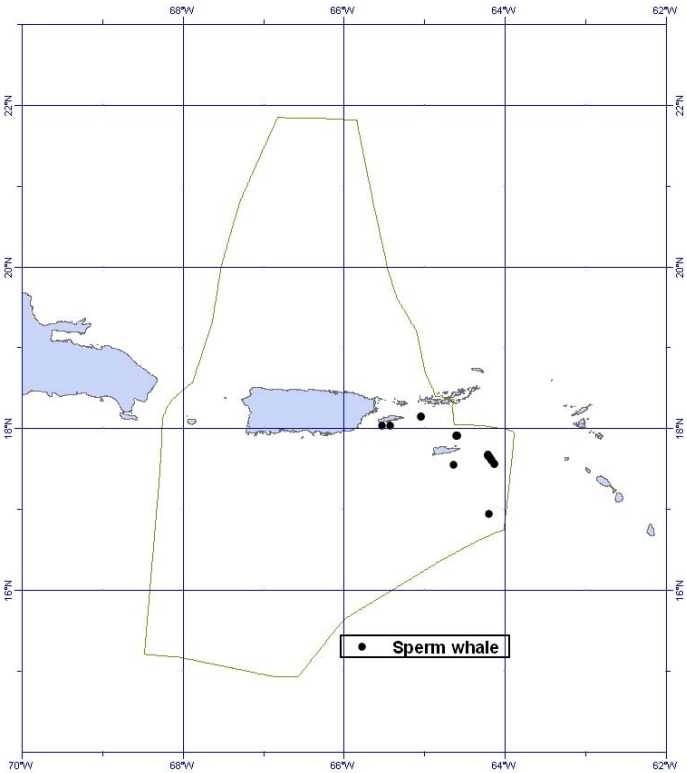

Figure 1. *Distribution of sperm whale sightings from SEFSC vessel surveys during winters of 1995, 2000 and 2001. The solid line indicates the boundary of the U.S. EEZ.*

Sperm whales have not been studied extensively in the waters around Puerto Rico and the U.S. Virgin Islands. However, research has been conducted in the eastern Caribbean Sea (islands of Dominica, Guadeloupe, Grenada, St. Lucia and Martinique) by Gero *et al.* (2007), who found that the population of sperm whales was small and quite isolated as evidenced by high regional resighting rates of photo-identified whales. Additionally, no matches were made from animals photo-identified in the eastern Caribbean Sea with either animals from the Sargasso Sea or the Gulf of Mexico. Gero *et al.* (2007) suggested that movements of sperm whales between the adjacent areas of the Caribbean Sea, Gulf of Mexico and Atlantic may not be common. Gero *et al.* (2009) also found differences in some aspects of the social organization of sperm whales in the eastern Caribbean compared to the Sargasso Sea. For example, group size estimates for the Sargasso Sea were almost twice as large as those for the Caribbean. Clusters containing calves were also significantly larger in the Sargasso Sea compared to the Caribbean. The system of alloparental caregiving to calves differed between the Sargasso and Caribbean Seas as well. Generally, in the Sargasso Sea calves were escorted by 2 individuals whereas only 1 escort was present in the Caribbean. In the Caribbean 1 female provided most of the allocare but did not nurse the calf. In the Sargasso multiple females provided care for and nursed calves.

Sperm whales make vocalizations used in a social context called "codas" that have distinct patterns and are apparently culturally transmitted (Watkins and Schevill 1977; Whitehead and Weilgart 1991; Rendell and Whitehead 2001), and based on degree of social affiliation, mixed groups of sperm whales worldwide can be placed in recognizable acoustic clans (Rendell and Whitehead 2003). Antunes (2009) examined variation in sperm whale coda repertoires in the North Atlantic Ocean, including the Azores, Sargasso Sea, Iceland, Dominica, Panama and Gulf of Mexico. He found that variation in the Gulf of Mexico and North Atlantic basins is mostly geographic. His work suggested sperm whale coda differentiation of the Gulf of Mexico from the North Atlantic, and weak but detectable spatial variation in the North Atlantic. Two coda repertoires from Dominica were more similar to each other than to any other repertoire, and they were more similar to coda repertoires of the North Atlantic basin than to the Gulf of Mexico.

The Puerto Rico and U.S. Virgin Islands sperm whale population is provisionally being considered a separate stock for management purposes, although there is currently limited information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation. Engelhaupt *et al.* (2009) included 15 genetic samples from the Caribbean in their analyses of female philopatry in coastal basins and male dispersion across the North Atlantic. Three samples were from Puerto Rico and the remaining samples were from Dominica (Engelhaupt, pers. comm.). Additional genetic samples from the U.S. Caribbean and surrounding areas are needed. Sperm whales of this stock are likely trans-boundary with, at a minimum, waters near adjacent Caribbean islands and are not likely to occur exclusively within the bounds of the U.S. EEZ.

POPULATION SIZE

The best abundance estimate available for the Puerto Rico and U.S. Virgin Islands stock of sperm whales is unknown. A line-transect survey was conducted during January-March 1995 on NOAA Ship *Oregon II*, and was designed to cover a wide range of water depths surrounding Puerto Rico and the Virgin Islands. However, due to the bottom topography of the region and the size of the vessel, most waters surveyed were >200m deep. Eight sightings of sperm whales were made, 6 of which occurred in and near U.S. waters (Roden and Mullin 2000). Another line-transect survey for humpback whales was conducted during February-March 2000 aboard NOAA Ship Gordon Gunter in the eastern and southern Caribbean Sea. A portion of the survey effort occurred in U.S. waters during transit, and 8 sightings of sperm whales were made in and near U.S. waters. During February-March 2001 a line-transect survey was conducted in waters of the eastern Bahamas, eastern Dominican Republic, Puerto Rico and Virgin Islands. Five sightings of sperm whales were made near Puerto Rico and the Virgin Islands (in and near U.S. waters). It was not possible to estimate abundance from these surveys using line-transect methods due to so few sightings.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for this stock of sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate is assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.1 because the sperm whale is an endangered species. PBR for this stock of sperm whales is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock.

Fisheries Information

The level of past or current, direct, human-caused mortality of sperm whales in Puerto Rico and the U.S. Virgin Islands is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the Caribbean Sea. There has been no reported fishing-related mortality of a sperm whale during 1998-2008 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009).

A commercial fishery for sperm whales operated in the Caribbean Sea during the late 1700's to the early 1900's, but the exact number of whales taken is not known (Townsend 1935).

Other Mortality

A total of 2 sperm whales were found stranded in U.S. waters of the Caribbean Sea from 2004 through 2008 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 September 2008 and 21 September 2009). No evidence of human interactions was detected for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

Ship strikes to whales occur world-wide and are a source of injury and mortality. One sperm whale mortality due to a vessel strike has been documented for Puerto Rico. The incident occurred in 2001 when a 154m U.S. Navy vessel struck and killed a sperm whale 20 miles south of Puerto Rico (Jensen and Silber 2003).

In the past U.S. Navy activity in the area of Puerto Rico was commonplace. The U.S. Navy and the U.S. Marine Corps used the Atlantic Fleet Weapons Training Facility operated out of Vieques Island, Puerto Rico, from 1948 to 2003, including the training of pilots for live ordnance delivery and amphibious assault landings by the Marine Corps. The naval station at Roosevelt Roads in Puerto Rico operated from 1943 to 2004 (between 1943 and 1957 it was opened and closed multiple times). It operated as a major training site for fleet exercises.

STATUS OF STOCK

The status of sperm whales in Puerto Rico and the U.S. Virgin Islands, relative to OSP, is unknown. This species is listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine the population trends for this species. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because the sperm whale is listed as an endangered species under the ESA.

REFERENCES

Antunes, R. 2009. Variation in sperm whale (*Physeter macrocephalus*) coda vocalizations and social structure in the North Atlantic Ocean. Ph.D. dissertation from University of St. Andrews, U.K. 123 + xi pp.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Engelhaupt, D., A. R. Hoelzel, C. Nicholson, A. Frantzis, S. Mesnick, S. Gero, H. Whitehead, L. Rendell, P. Miller, R. De Stefanis, A. Cañadas, S. Airoldi and A. A. Mignucci-Giannoni. 2009. Female philopatry in coastal basins and male dispersion across the North Atlantic in a highly mobile marine species, the sperm whale (*Physeter macrocephalus*). Mol. Ecol. 18: 4193-4205.

Erdman, D. S. 1970. Marine mammals from Puerto Rico to Antigua. J. Mammal. 51: 636-639.

Erdman, D. S., J. Harms and M. Marcial-Flores. 1973. Cetacean records from the northeastern Caribbean region. Cetology 17: 1-14.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Fairfield-Walsh, C. and L. P. Garrison. 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NOAA NMFS-SEFSC-560, 54 pp.

Fairfield, C. P. and L. P. Garrison. 2008. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NOAA NMFS-SEFSC-572, 62 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Garrison, L. P., L. Stokes and C. Fairfield. 2009. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591, 63 pp.

Gero, S., J. Gordon, C. Carlson, P. Evans and H. Whitehead. 2007. Population estimate and inter-island movement of sperm whales, *Physeter macrocephalus*, in the Eastern Caribbean Sea. J. Cetacean Res. Manage. 9(2): 143-150.

Gero, S., D. Engelhaupt, L. Rendell and H. Whitehead. 2009. Who Cares? Between-group variation in alloparental caregiving in sperm whales. Behav. Ecol. 20: 838-843.

Jensen, A. S. and G. K. Silber. 2003. Large whale ship strike database. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-OPR-25, 37 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, CA. 302 pp.

Mignucci Giannoni, A. A. 1988. A stranded sperm whale, *Physeter catodon*, at Cayo Santiago, Puerto Rico. Carib. J. Sci. 24(3-4): 213-215.

Mignucci-Giannoni, A. A. 1998. Zoogeography of cetaceans off Puerto Rico and the Virgin Islands. Carib. J. Sci. 34 (3-4): 173-190.

Mignucci-Giannoni, A. A., B. Pinto-Rodriguez, R. A. Montoya-Ospina, N. M. Jimenez-Marrero, M. A. Rodriguez-Lopez, E. H. Williams, Jr., and D. K. Odell. 1999. Cetacean strandings in Puerto Rico and the Virgin Islands. J. Cetacean Res. Manage. 1(2): 191-198.

Reeves, R. R., S. L. Swartz, S. E. Wetmore and P. J. Clapham. 2001. Historical occurrence and distribution of humpback whales in the eastern and southern Caribbean Sea, based on data from American whaling logbooks. J. Cetacean Res. Manage. 3(2): 117-129.

Rendell, L. E. and H. Whitehead. 2001. Culture in whales and dolphins. Behav. Brain Sci. 24: 309-382.

Rendell, L. and H. Whitehead. 2003. Vocal clans in sperm whales (*Physeter macrocephalus*). Proc. R. Soc. Lond. (Biol) 270:225-231.

Rice, D. W. 1989. Sperm whale, *Physeter macrocephalus* Linnaeus, 1758. pp. 177-233. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London. 442 pp.

Roden, C. L. and K. D. Mullin. 2000. Sightings of cetaceans in the northern Caribbean Sea and adjacent waters, winter 1995. Carib. J. Sci. 36(3-4): 280-288.

Swartz, S. L. and C. Burks. 2000. Cruise results: Windwards humpback survey. NOAA Tech. Memo. NMFS-SEFSC-438.

Swartz, S. L., A. Martinez, J. Stamates, C. Burks and A. A. Mignucci-Giannoni. 2002. Acoustic and visual survey of cetaceans in the waters of Puerto Rico and the Virgin Islands: February-March 2001. NOAA Tech. Memo. NMFS-SEFSC-463.

Taruski, A. G. and H. E. Winn. 1976. Winter sightings of odontocetes in the West Indies. Cetology 22: 1-12.

Townsend, C. H. 1935. The distribution of certain whales as shown by logbook records of American whale ships. Zoologica 19: 1-50.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, WA. U.S. Dep. Commer., NOAA Tech Memo. NMFS-OPR-12, 93 pp.

Watkins, W. A. and W. E. Schevill. 1977. Sperm whale codas. J. Acoust. Soc. Am. 62: 1486-1490.

Whitehead, H. 2002. Estimates of the current global population size and historical trajectory for sperm whales. Mar. Ecol. Prog. Ser. 242: 295-304.

Whitehead, H. 2003. Sperm whales: Social evolution in the ocean. The University of Chicago Press, Chicago, IL. 431 pp.

Whitehead, H. and L. Weilgart. 1991. Patterns of visually observable behaviour and vocalizations in groups of female sperm whales. Behaviour 118: 275-296.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp.

APPENDIX I. Estimated serious injury and mortality (SI&M) of Western North Atlantic marine mammals listed by U.S. observed fisheries for ~~2003~~2004-~~2007~~2008. Marine mammal species with zero (0) observed SI&M during ~~2003~~ 2004 to ~~2007~~ 2008 are not shown in this table.

(tbd = to be determined; n/a = not available; unk = unknown; JV = Joint Venture).

Category, Fishery (estimated # of vessels/persons), Species	Yrs. observed	observer coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY I						
Gillnet Fisheries: Northeast gillnet (unk)						
Harbor porpoise - after Take Reduction Plan	~~2003~~2004-~~2007~~2008	~~03,~~ .06, .07, .04, .07, .05		~~592 (.33),~~ 654(.36), 630(.23), 514(.31), 395(.37), 666 (.48)	~~557~~ 572 (0.~~14~~17)	703
Atlantic white sided dolphin	~~2003~~2004-~~2007~~2008	~~.03,~~ .06. .07, .04, .07, .05		~~31 (.93),~~ 7(.98), 59(.49), 41(.71), 0, 82(.57)	~~35~~38(.~~37~~33)	509
Short-beaked common dolphin	~~2003~~2004-~~2007~~2008	~~.03,~~ .06, .07, .04, .07, .05		~~0, 0,~~ 0, 26(.8), 20(1.05), 11(1.08), 33(.77)	~~11~~ 18 (.~~54~~45)	1,000
Risso's dolphin	~~2003~~2004-~~2007~~2008	~~.03,~~ .06, .07, .04, .07, .05		~~0,~~ 0, 15 (.93), 0, 0, 0	3(.93)	129
Bottlenose dolphin (offshore)	2002-2006	.02, .03, .06, .07, .04		0, 0, 0, unk, unk	unk	566
Harbor seal	~~2003~~2004-~~2007~~2008	~~.03,~~ .06, .07, .04, .07, .05		~~542 (.28),~~ 792(.34), 719(.20), 87(.58), 92 (.48), 243(.41)	~~446~~387(.~~15~~17)	~~2,746~~ und et.
Gray seal	~~2003~~2004-~~2007~~2008	~~.03,~~ .06, .07, .04, .07, .05		~~242 (.47),~~ 504(.34), 574(.44), 248(.47), 886(0.24), 618(.23)	566 (0.15)~~490 (0.16)~~	n/a
Harp seal	~~2003~~2004-~~2007~~2008	~~.03,~~ .06, .07, .04, .07, .05		~~0,~~ 303(.30), 35(.68), 65(.66), 119(.35), 250(.37)	~~104~~154(0.~~21~~19)	n/a
Hooded seal	2001-2005	.04, .02, .03, .06, .07		82(1.14), 0, 0, 43(.95), 0	25(.82)	n/a
Gillnet Fisheries:US Mid-Atlantic gillnet (unk)						
Harbor porpoise - after Take Reduction Plan	~~2003~~2004-~~2007~~2008	~~.01,~~ .02, .03, .04, .06, .03		~~76 (1.13),~~ 137(.91), 470(.23), 511(.52), 58(1.03), 350(.75)	~~250~~305(~~0~~.~~26~~27)	703
Bottlenose dolphin (offshore)	2002-2006	.01, .01, .02, .03, .04		unk, 0, 0, unk, unk	unk	566
Short-beaked common dolphin	~~2003~~2004-~~2007~~2008	~~.01,~~ .02, .03, .04, .06, .03		~~0,~~ 0, 0, 11, 0, 0	2(1.03)	1,000
Harbor seal	~~2003~~2004-~~2007~~2008	~~.01,~~ .02, .03, .04, .06, .03		~~0,~~ 15(.86), 63(.67), 26 (.98), 0, 88(.74)	~~21~~ 38 (.~~49~~43)	~~2,746~~ und et.
Harp Seal	2004-2008	.02, .03, .04, .06, .03		0, 0, 0, 38(.9), 176(.74)	43 (0.63)	n/a
Gray seal	~~2003~~2004-~~2007~~2008	~~.01,~~ .02, .03, .04, .06, .03		~~0,~~ 69(.92), 0, 0, 0, 0	14 (0.92)~~13~~	n/a

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					(.92)	
Longline Fisheries: Pelagic longline (excluding NED-E)[a]						
Risso's dolphin	2003-2007 2004-2008	.09, .09, .06, .07, .08, ??	40(.63), 28(.72), 3(1.0), 0, 9 (.65), 17(.73)	0, 0, 0, 0, 0	16 11 (.41 43)	129
Long and short-finned pilot whale	2003-2007 2004-2008	.09, .09, .06, .07, .08, ??	21(.49), 74(.42), 212(.21), 169(.50), 57(.65), 98(.42)	0, 0, 0, 16 (1.0), 0, 0	110 122 (.50 .19)	249 172/93[c]
Unidentified beaked whale	2003-2007	.09, .09, .06, .07, .08	5.3(1.0), 0, 0, 0, 0	0, 0, 0, 0, 0	1(1.0)	17
Longline Fisheries: Pelagic longline (NED-E area only)[a]						
Risso's dolphin	2003	1.0	0	1 (0)	1 (0)	129
CATEGORY II						
Mid-Atlantic Mid-Water Trawl – Including Pair Trawl (26)						
Risso's dolphin	2004-2008	.064, .084, .089, .039, .13	0, 0, 0, 0, 0	0, 0, 0, 0, unk	unk	
White-sided dolphin	2003-2007 2004-2008	.018, .064, .084, .089, .039, .13	0, 0, 0, 0, 0	51(.46), 105(.38), 97(.76), 54(.57), 3.2 (.70), 3.7(.43)	62 52(.21 16)	509
Short-beaked common dolphin	2003-2007 2004-2008	.018, .064, .084, .089, .039, .13	0, 0, 0, 0, 0	0, 0, 0, 0, 3.2(.70), 0	1 (.70)	1,000
Long and short-finned pilot whale	2003-2007 2004-2008	.018, .064, .084, .089, .039, .13	0, 0, 0, 0, 0	3.9(.46), 8.1(.38), 7.5(.76), 0, 4.9 (.70), 0	54(.31 14)	172/93[c] 2 49
Trawl Fisheries:Northeast bottom trawl (unk)						
Harp seal	2003-2007 2004-2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	0, 0, unk, 0, 0, 0	unk	n/a
Harbor seal	2003-2007 2004-2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	0, 0, unk, 0, unk, 0	unk	2,746 und et.
Gray Seal	2003-2007 2004-2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	0, 0, unk, 0, unk, unk	unk	n/a
Long and short-finned pilot whale [b]	2003-2007 2004-2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	20(.26), 15(29) 15(.30), 14(.28), 12 (.35), 10(.34)	15 13(0.1 3 12)	172/93[c] 2 49
Short-beaked common dolphin [b]	2004 3-2007 2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	26(.29), 26(.29), 32(.28), 25(.28), 24(.28), 17(.29)	27 25 (.12 13)	1,000
Atlantic white-sided dolphin [b]	2003-2007 2004-2008	.04, .05, .12, .06, .06, .08	0, 0, 0, 0, 0	216(.27), 200(.30), 213(.28), 164(.35), 147(.35), 147(.32)	188 174 (0.12)	509
Minke whale	2003-2007	.04, .05, .12, .06,	0, 0, 0, 0, 0	unk	unk	19 69

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Harbor porpoise	~~2003~~2004-~~2007~~2008	~~.04,~~ .05, .12, .06, .06, .08	0, 0, 0, 0, 0	~~unk,~~ 0, unk, unk, 0, unk	unk	703
Mid-Atlantic Bottom Trawl						
Atlantic white-sided dolphin [b]	~~2003~~2004-~~2007~~2008	~~.01,~~ .03, .03, .02, .03, .03	0, 0, 0, 0, 0	~~31(.25),~~ 26(.20), 38(.29), 26(.25), 21(.24), 16(.18)	~~28~~ 25 (.1~~0~~1)	509
Long and short-finned pilot whale [b]	~~2003~~2004-~~2007~~2008	~~.01,~~ .03, .03, .02, .03, .03	0, 0, 0, 0, 0	~~31(.31),~~ 35(.33), 31(.31), 37(.34), 36(.38), 24(.36)	34(.15)	172/ 93[c]~~2~~ ~~49~~
Short-beaked common dolphin	200~~4~~3-~~2007~~2008	~~.01,~~ .03, .03, .02, .03, .03	0, 0, 0, 0, 0	~~99(.28),~~ 159(.30), 141(.29), 131(.28), 66(.27), 108(.28)	~~123~~ 121 (.~~12~~13)	1,000
Northeast Mid-Water Trawl Including Pair Trawl (~~25~~17)						
Long and short-finned pilot whale	~~2003~~2004-~~2007~~2008	~~.031,~~ .126, .199, .031, .08, .20	0, 0, 0, 0,0	~~1.9(.56),~~ 1.4(.58), 1.1(.68), 0, 0, 6.5(.56)	1.8(.~~35~~07)	172/ 93[c]~~2~~ ~~49~~
White-sided dolphin	~~2003~~2004-~~2007~~2008	~~.031,~~ .126, .199, .031, .08, .20	0, 0, 0,0 ,0	~~24(.56),~~ 19(.58), 15(.31), 19(.44), 0, 5.6(.52)	~~15~~12(.~~26~~ 18)	509
Gillnet Fisheries:SE U.S. Atlantic shark gillnet (12)						
Bottlenose dolphin (Central Florida, coastal)	2002-2006	1, .34, .43, 1, 1	0, 0, 0, 0, 0,	1(0), 2(.64), 1(.64), 0, 0	0.8(.36)	n/a

NOTES: The estimated number of vessels/participants is expressed in terms of the number of active participants in the fishery, when possible. If this information is not available, the estimated number of vessels or persons licensed for a particular fishery is provided. Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates to reflect the effective range of this stock.

a. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001 - December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison, 2003; Garrison and Richard, 2004).

b. A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries for pilot whales, common dolphins and white-sided dolphins during 2000-2007. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2007.

c. As of 2010, the PBR for pilot whales has been split. Short-finned pilot whale PBR is 172 and long-finned pilot whale is 93.

APPENDIX II. Summary of the confirmed human-caused mortality and serious injury (SI) events involving baleen whale stocks along the Gulf of Mexico coast, U.S. East coast and adjacent Canadian Maritimes, 2004 - 2008, with number of events attributed to entanglements or vessel collisions by year.

Stock	Mean annual mortality and SI rate (PBR for reference)	Entanglements			Vessel Collisions		
		Annual rate (US waters / Canadian waters)	Confirmed mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed SI's (2004, 2005, 2006, 2007, 2008)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed SI's (2004, 2005, 2006, 2007, 2008)
Western North Atlantic right whale	**2.8** (0.7)	**0.8** (0.6/ 0.2)	(1, 0, 1, 1, 0)	(0, 0, 0, 0, 1)	**2.0** (1.6 / 0.4)	(2, 2, 4, 0, 0)	(0, 1, 1, 0, 0)
Gulf of Maine humpback whale[1]	**4.6** (1.1)	**3.0** (2.6 / 0.4)	(1, 0, 1, 1, 2)	(1, 0, 3, 2, 4)	**1.6** (1.6 / 0)	(1, 0, 3, 3, 1)	**0**
Western North Atlantic fin whale	**3.2** (~~3.4~~6.5)	**1.2** (1.0 / 0.2)	(1, 0, 0, 2, 0)	(1, 0, 1, 1, 0)	**2.0** (1.4 / 0.6)	(2, 5, 0, 2, 1)	**0**
Nova Scotian sei whale	**1.0** (0.4)	**0.6** (0.4 / 0.2)	(0, 0, 0, 0, 1)	(0, 0, 1, 0, 1)	**0.4** (0.4 / 0)	(0, 0, 1, 1, 0)	**0**
Western North Atlantic blue whale[2]	**0** (–)	**0**	**0**	**0**	**0**	**0**	**0**
Canadian East Coast minke whale	**~~3.0~~2.8** (~~19~~69)	**2.~~6~~ 4** (1.2 / 1.~~4~~2)	(~~5~~4, 1, 1, 1, 4)	(0, 0, 0, 1, 0)	**0.4** (0.4 / 0)	(1, 1, 0, 0, 0)	**0**
Western North Atlantic Bryde's whale	**0** (0.1)	**0**	**0**	**0**	**0**	**0**	**0**

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock.

[2] Stock abundance estimates outdated; no PBR established for this stock.

Appendix III
Fishery Descriptions

This appendix is broken into two parts: Part A describes commercial fisheries that have documented interactions with marine mammals in the Atlantic Ocean; and Part B describes commercial fisheries that have documented interactions with marine mammals in the Gulf of Mexico. A complete list of all known fisheries for both oceanic regions, the ~~2008~~ 2010 List of Fisheries, is published in the *Federal Register*, (74 FR 58859, November 16, 2009) ~~(72 FR 66048, November 27, 2007)~~. Each part of this appendix contains three sections: I. data sources used to document marine mammal mortality/entanglements and commercial fishing effort trip locations, II. fishery descriptions for Category I, II and III fisheries that have documented interactions with marine mammals and their historical level of observer coverage, and III. historical fishery descriptions.

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Part A. Description of U.S Atlantic Commercial Fisheries

I. Data Sources

Items 1-5 describe sources of marine mammal mortality, serious injury or entanglement data; items 6-8 describe the sources of commercial fishing effort data used to summarize different components of each fishery (i.e. active number of permit holders, total effort, temporal and spatial distribution) and generate maps depicting the location and amount of fishing effort.

1. Northeast Region Fisheries Observer Program (NEFOP)

In 1989 a Fisheries Observer Program was implemented in the Northeast Region (Maine-Rhode Island) to document incidental bycatch of marine mammals in the Northeast Region Multi-species Gillnet Fishery. In 1993 sampling was expanded to observe bycatch of marine mammals in Gillnet Fisheries in the Mid-Atlantic Region (New York-North Carolina). The Northeast Fisheries Observer Program (NEFOP) has since been expanded to sample multiple gear types in both the Northeast and Mid-Atlantic Regions for documenting and monitoring interactions of marine mammals, sea turtles and finfish bycatch attributed to commercial fishing operations. At sea observers onboard commercial fishing vessels collect data on fishing operations, gear and vessel characteristics, kept and discarded catch composition, bycatch of protected species, animal biology, and habitat (NMFS-NEFSC 2003).

2. Southeast Region Fishery Observer Programs

Three Fishery Observer Programs are managed by the Southeast Fisheries Science Center (SEFSC) that observe commercial fishery activity in U.S. Atlantic waters. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992 and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species Fisheries Management Plan (HMS FMP, 50 CFR Part 635). The second program is the Shark Gillnet Observer Program that observes the Southeastern U.S. Atlantic Shark Gillnet Fishery. The Observer Program is mandated under the HMS FMP, the Atlantic Large Whale Take Reduction Plan (ALWTRP) (50 CFR Part 229.32), and the Biological Opinion under Section 7 of the Endangered Species Act. Observers are deployed on any active fishing vessel reporting shark drift gillnet effort. In 2005, this program also began to observe sink gillnet fishing for sharks along the southeastern U.S. coast. The observed fleet includes vessels with an active directed shark permit and fish with sink gillnet gear (Carlson and Bethea 2007). The third program is the Southeastern Shrimp Otter Trawl Fishery Observer Program. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. The total level of observer coverage for this program is approximately 1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the

number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught.

3. Regional Marine Mammal Stranding Networks

The Northeast and Southeast Region Stranding Networks are components of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). Since 1997, the Northeast Region Marine Mammal Stranding Network has been collecting and storing data on marine mammal strandings and entanglements that occur ~~between the states~~ from~~of~~ Maine ~~and~~ through Virginia. The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the Atlantic coast from North Carolina to Florida, along the U.S. Gulf of Mexico coast from Florida through Texas, and in the U.S. Virgin Islands and Puerto Rico. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement, collect data on stranded animals that include: species; event date and location; details of the event (i.e., signs of human interaction) and determination on cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

4. Marine Mammal Authorization Program

Commercial fishing vessels engaging in Category I or II fisheries are required to register under the Marine Mammal Authorization Program (MMAP) in order to lawfully capture a non-endangered/threatened marine mammal incidental to fishing operations. All vessel owners, regardless of the category of fishery they are operating in, are required to report all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions.

5. Other Data Sources for Protected Species Interactions/Entanglements/Ship Strikes

In addition to the above, data on fishery interactions/entanglements and vessel collisions with large cetaceans are reported from a variety of other sources including the New England Aquarium (Boston, Massachusetts); Provincetown Center for Coastal Studies (Provincetown, Massachusetts); U.S. Coast Guard; whale watch vessels; ~~and~~ Canadian Department of Fisheries and Oceans (DFO);); and members of the Atlantic Large Whale Disentanglement Network.. These data, photographs, etc. are maintained by the Protected Species Division at the Northeast Regional Office (NERO), the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) and the SEFSC.

6. Northeast Region Vessel Trip Reports

The Northeast Region Vessel Trip Report Data Collection System is a mandatory, but self-reported, commercial fishing effort database (Wigley *et al.* 1998). The data collected include: species kept and discarded; gear types used; trip location; trip departure and landing dates; port; and vessel and gear characteristics. The reporting of these data is mandatory only for vessels fishing under a federal permit. Vessels fishing under a federal permit are required to report in the Vessel Trip Report even when they are fishing within state waters.

7. Southeast Region Fisheries Logbook System

The Fisheries Logbook System (FLS) is maintained at the SEFSC and manages data submitted from mandatory Fishing Vessel Logbook Programs under several FMPs. In 1986 a comprehensive logbook program was initiated for the Large Pelagics Longline Fishery and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g.,

gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

8. Northeast Region Dealer Reported Data

The Northeast Region Dealer Database houses trip level fishery statistics on fish species landed by market category, vessel ID, permit number, port location and date of landing, and gear type utilized. The data are collected by both federally permitted seafood dealers and NMFS port agents. Data are considered to represent a census of both vessels actively fishing with a federal permit and total fish landings. It also includes vessels that fish with a state permit (excluding the state of North Carolina) that land a federally managed species. Some states submit the same trip level data to the Northeast Region, but contrary to the data submitted by federally permitted seafood dealers, the trip level data reported by individual states does not include unique vessel and permit information. Therefore, the estimated number of active permit holders reported within this appendix should be considered a minimum estimate. It is important to note that dealers were previously required to report weekly in a dealer call in system. However, in recent years the NER regional dealer reporting system has instituted a daily electronic reporting system. Although the initial reports generated from this new system did experience some initial reporting problems, these problems have been addressed and the new daily electronic reporting system is providing better real time information to managers.

II. U.S Atlantic Commercial Fisheries

Northeast Sink Gillnet (text includes descriptions of Northeast anchored float and Northeast drift gillnets)

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Windowpane Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, and Skate spp.

Number of Permit Holders: In 2008~~7~~, 2,040~~101~~ federal northeast permit holders identified sink gillnet as a potential gear type.

Number of Active Permit Holders: In 2007~~8~~, ~~318~~ 277 federal northeast permit holders reported the use of sink gillnets in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total metric tons of fish landed from 1998 to ~~2007~~ 2008 were 22,933, 18,681, 14,487, 14, 634, 15,201, 17,680, 19,080, 15.390, 14,950, ~~and~~ 15,808, and ~~9,449~~18,808 respectively (NMFS). Data on total quantity of gear fished (i.e., number of sets) have not been reported consistently among commercial gillnet fishermen on vessel logbooks, and therefore will not be reported here.

Temporal and Spatial Distribution: Effort is distributed throughout the Gulf of Maine, Georges Bank, and Southern New England Regions. Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf region in depths ranging from 30 to 750 feet. Some nets are set in water depths greater than 800 feet. Figures 1-5 document the distribution of sets and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~2008, respectively.

Gear Characteristics: The Northeast Sink Gillnet Fishery is dominated by a bottom-tending (sink) net. Less than 1% of the fishery utilizes a gillnet that either is anchored floating or drift (i.e. Northeast anchored float and Northeast drift gillnet fisheries). Monofilament is the dominant material used with stretched mesh sizes ranging from 6 to 12 inches. String lengths range from 600 to 10,500 feet long. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Northeast Sink Gillnet Fishery has been defined as a Category I fishery,

and both the Northeast anchored float and Northeast drift gillnet fisheries as Category II fisheries, in the 2010~~09~~ List of Fisheries (74~~3~~ FR ~~73065~~58859, ~~December~~ November 16, 2008~~9~~, 50 CFR Part 229). This gear is addressed by several federal and state FMPs that range North and East of the 72 degree 30 min line; ~~and~~ the Atlantic Large Whale Take Reduction Plan (ALWTRP) and Harbor Porpoise Take Reduction Plan (HPTRP). This fishery operates from the U.S./Canada border to Long Island, NY, at 72º 30' W long. south to 36º 33.03'N lat. and east to the eastern edge of the EEZ, not including Long Island Sound or other waters where gillnet fisheries are listed as Category II or III. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648.80 through 648.97); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). These fisheries are primarily managed by total allowable catch (TACs); individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1990-~~2007~~2008, estimated percent observer coverage (number of trips observed/total commercial trips reported) was 1, 6, 7, 5, 7, 5, 4, 6, 5, 6, 6, 4, 2, 3, 6, 7, 4, ~~and~~ 7, and 5 respectively.

Comments: Effort patterns in this fishery are heavily influenced by fish time/area closures, and gear restrictions due to fish conservation measures, time/area closures and gear restrictions under the ALWTRP, and pinger requirements and time/area closures under the ~~Harbor Porpoise Take Reduction Plan (~~HPTRP~~)~~.

Protected Species Interactions: Documented interaction with harbor porpoise, white-sided dolphin, harbor seal, gray seal, harp seal, hooded seal, long-finned pilot whale, offshore bottlenose dolphin, Risso's dolphin, and common dolphin were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Sink Gillnet

Target Species: Atlantic cod and other groundfish.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: To Be Determined

Total Effort: To Be Determined

Temporal and Spatial Distribution: In Canadian waters the Gillnet Fishery occurs during the summer and early autumn months mostly in the western portion of the Bay of Fundy.

Gear Characteristics: Typical gillnet strings are 300 m long (three 100 m panels), 4 m deep, with stretched mesh size of 15 cm, strand diameter of 0.57-0.60mm, and are usually set at a depth of about 100 m for 24 hours.

Management and Regulations: To Be Determined

Observer Coverage: During the period 1994 to 2001, the estimated percent observer coverage of the Grand Manan portion of the sink gillnet fishery was 49, 89, 80, 80, 24, 11, 41, and 56. The fishery was not observed during 2002 and 2003.

Comments: Marine mammals in Canadian waters are regulated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). DFO Maritimes Region has developed a Harbour Porpoise Conservation Strategy that has set a maximum take of 110 Harbor Porpoise per year in the Bay of Fundy. Bycatch mitigation measures include acoustic pingers and nylon barium-sulphate netting that target cetacean and sea bird bycatch reduction goals, and fishery effort restrictions that target fish management goals.

Protected Species Interactions: Documented interactions with bottlenose dolphin, common dolphin, fin whale, gray seal, harbor porpoise, harbor seal, harp seal, hooded seal, humpback whale, minke whale, North Atlantic right whale, Risso's dolphin, white-sided dolphin and sea birds were reported in this fishery.

Mid-Atlantic Gillnet

Target Species: Monkfish, Spiny and Smooth Dogfish, Bluefish, Weakfish, Menhaden, Spot, Croaker, Striped Bass, Coastal Sharks, Spanish Mackerel, King Mackerel, American Shad, Black Drum, Skate spp., Yellow perch, White Perch, Herring, Scup, Kingfish, Spotted Seatrout, and Butterfish.

Number of Permit Holders: In 200~~7~~8, ~~approximately 650~~ 641 federal mid-Atlantic permit holders identified sink gillnet as a potential gear type.

Number of Active Permit Holders: In 200~~7~~8, approximately ~~178~~ 1~~2~~682 federal mid-Atlantic permit holders reported the use of sink gillnets in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total metric tons of fish landed from 1998 to ~~2007~~ 2008 were 15,494, 19,130, 16,333, 14,855, 13,389, 13,107, 15,124, 12, 994, 8,755, ~~and~~ 9,359~~7,659~~ and ~~18,808~~8,622 respectively (NMFS). Data on total quantity of gear fished (i.e. number of sets) have not been reported consistently among commercial gillnet fishermen on vessel logbooks, therefore will not be reported here. ~~During 1998 it was estimated that 302 full- and part-time sink gillnet vessels and an undetermined number of drift gillnet vessels participated in this fishery. This is the number of unique vessels in the Commercial Landings Database (Weighout) that reported catch from this fishery during 1998 from the states of Connecticut to North Carolina. This does not include a small percentage of records where the vessel number was missing.~~

Temporal and Spatial Distribution: This fishery operates year-round, extending from New York to North Carolina. It is comprised of a combination of small vessels that target a variety of fish species. This fishery can be prosecuted right off the beach (6 feet) or in nearshore coastal waters to offshore waters (250 feet). Figures 6-10 document the distribution of sets and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~ 2008 respectively.

Gear Characteristics: The Mid-Atlantic Gillnet Fishery utilizes both drift and sink gillnets, including nets set in a sink, stab, set, strike, or drift fashion. These nets are most frequently attached to the bottom, although unanchored drift or sink nets are also utilized to target specific species. Monofilament twine is the dominant material used with stretched mesh sizes ranging from 2.5 to 12 inches. String lengths range from 150 to 8,400 feet. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Mid-Atlantic Gillnet Fishery has been defined as a Category I fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73065, December 1, 2008~~74 FR 58859, November 16, 2009, 50 CFR Part 229). This gear is addressed by several federal FMPs, Inter-State Fishery Management Plans (ISFMP's) managed by the Atlantic States Marine Fisheries Commission (ASMFC), ~~the Atlantic Large Whale TRP~~ALWTRP, the ~~Harbor Porpoise TRP~~HPTRP, and the Bottlenose Dolphin TRP (BDTRP). The eastern boundary of this fishery is a line drawn at 72° 30' W long. from Long Island south to 36º 33.03' N lat., then east to the EEZ, and then south to the North Carolina/South Carolina border. The area does not include waters where Category II and III inshore gillnet fisheries operate in bays, estuaries, and rivers. The relevant FMPs include, but may not be limited to: Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); Weakfish (FR 68(191), 50 CFR 697.7); Shad and River Herring (ASMFC ISFMP 2002); Striped Bass (FR68(202), 50 CFR part 697.7); Spanish Mackerel (FR 65(92), 50 CFR 622.1 through 622.48); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.273); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322); and Atlantic Coastal Sharks (FR 68(247), 50 CFR 600-635). These fisheries are primarily managed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

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Observer Coverage: During the period 1995-2007 2008, the estimated percent observer coverage was 5, 4, 3, 5, 2, 2, 2, 1, 1, 2, 3, 4, and 5 4, and 3 respectively.

Comments: Effort patterns in this fishery are heavily influenced by marine mammal time/area closures and /or gear restrictions under the ALWTRP, HPTRP, and BDTRP; and gear restrictions due to fish conservation measures.

Protected Species Interactions: Documented interaction with harbor porpoise, white-sided dolphin, harbor seal, gray seal, harp seal, coastal bottlenose dolphin, offshore bottlenose dolphin, common dolphin, minke whale (Canadian East Coast stock), humpback whale (Gulf of Maine stock), and long-finned and short-finned pilot whale were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Bottom Trawl

Target Species: Include, but are not limited to: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny and Smooth Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, Scup, Black Sea Bass, Skate spp, Atlantic Mackerel, *Loligo* Squid, *Illex* Squid, and Atlantic Butterfish.

Number of Permit Holders: In 2007,8, approximately 7345 50 federal mid-Atlantic permit holders identified bottom trawl (including beam, bottom fish, bottom shrimp, and bottom scallop trawls) as a potential gear type.

Number of Active Permit Holders: In 20087, approximately 252 227 federal mid-Atlantic permit holders reported the use of bottom trawls in the Northeast Region Dealer Reported Landings Database.

Mixed Groundfish Bottom Trawl Total Effort: Total effort, measured in trips, for the Mixed Groundfish Trawl from 1998 to 2007 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725, 22,303, 15,070, 12,457, and 11,279 respectively (NMFS). The number of days absent from port, or days at sea, is yet to be determined.

Squid, Mackerel, Butterfish Bottom Trawl Total Effort: Total effort, measured in trips, for the domestic Atlantic Mackerel Fishery in the Mid-Atlantic Region (bottom trawl only) from 1997 to 2007 were 373, 278, 262, 102, 175, 310, 238, 231, 0, 117, and 88 respectively (NMFS). Total effort, measured in trips, for the *Illex* Squid Fishery from 1998 to 2007 were 412, 141, 108, 51, 39, 103, 445, 181, 159, and 103 respectively (NMFS). Total effort, measured in trips, for the *Loligo* Squid Fishery from 1998 to 2007 were 1,048, 495, 529, 413, 3,585, 1,848, 1,124, 1,845, 3,058, and 2,127 respectively (NMFS). Atlantic Butterfish is a bycatch (non-directed) fishery, therefore effort on this species will not be reported. The number of days absent from port, or days at sea, is yet to be determined.

Temporal and Spatial Distribution: The Mixed Groundfish Fishery occurs year-round from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Because of spatial and temporal differences in the harvesting of *Illex* and *Loligo* Squid and Atlantic Mackerel, each one of these sub-fisheries is described separately. Figures 11-15 document the distribution of tows and marine mammal interactions observed from 2003 2004 to2007 to 2008 respectively.

***Illex* Squid**

The U.S. domestic fishery for *Illex* Squid, ranging from Southern New England to Cape Hatteras, North Carolina, reflects patterns in the seasonal distribution of *Illex* Squid (*Illex illecebrosus*). *Illex* is harvested offshore (along or outside of the 100-m isobath), mainly by small-mesh otter trawlers, when the Squid are distributed in continental shelf and slope waters during the summer months (June-September) (Clark 1998).

***Loligo* Squid**

The U.S. domestic fishery for *Loligo* Squid (*Loligo pealeii*) occurs mainly in Southern New England and mid-Atlantic waters. Fishery patterns reflect *Loligo* seasonal distribution, therefore most effort is directed offshore near the edge of the continental shelf during the fall and winter months (October-

March) and inshore during the spring and summer months (April-September) (Clark 1998).

Atlantic Mackerel

The U.S. domestic fishery for Atlantic Mackerel (*Scomber scombrus*) occurs primarily in the Southern New England and mid-Atlantic waters between the months of January and May (Clark 1998). An Atlantic Mackerel Trawl Fishery also occurs in the Gulf of Maine during the summer and fall months (May-December) (Clark 1998).

Atlantic Butterfish

Atlantic Butterfish (*Peprilus triacanthus*) undergo a northerly inshore migration during the summer months, a southerly offshore migration during the winter months, and are mainly caught as bycatch to the directed Squid and Mackerel Fisheries. Fishery Observers suggest that a significant amount of Atlantic Butterfish discarding occurs at sea.

Gear Characteristics: The Mixed Groundfish Bottom Trawl Fishery gear characteristics have not yet been determined or summarized. The *Illex* and *Loligo* Squid Fisheries are dominated by small-mesh otter trawls, but substantial landings of *Loligo* Squid are also taken by inshore pound nets and fish traps during the spring and summer months (Clark 1998). The Atlantic Mackerel Fishery is prosecuted by both mid-water (pelagic) and bottom trawls.

Management and Regulations: The Mid-Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009). There are at least 2 distinct components to this fishery. One is the mixed groundfish bottom trawl fishery. It is managed by several federal and state FMPs that range from Massachusetts to North Carolina. The relevant FMPs include, but may not be limited to, Monkfish (FR 68(81), 50 CFR Part 648.648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup, and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). The second major component is the squid, mackerel, butterfish fishery. This component is managed by the federal Squid, Mackerel, Butterfish FMP (50 CFR Part 648.20 through 648.24). The *Illex* and *Loligo* Squid Fisheries are managed by moratorium permits, gear and area restrictions, quotas, and trip limits. The Atlantic Mackerel and Atlantic Butterfish Fisheries are managed by an annual quota system. Mid-Atlantic Bottom Trawl Fisheries are all included in~~addressed by~~ the Atlantic Trawl Gear Take Reduction Strategy~~Team.~~

Observer Coverage: During the period 1996-~~2007~~2008, estimated percent observer coverage (measured in trips) for the Mixed Groundfish Bottom Trawl Fishery was 0.24~~%~~, 0.22~~%~~, 0.15~~%~~, 0.14~~%~~,1~~%~~, 1~~%~~, 1~~%~~, 1~~%~~, 3~~%~~, 3~~%~~, 2~~%~~, ~~and~~ 3~~%~~, and 3 respectively.

During the period 1996-~~2007~~2008, estimated percent observer coverage (trips) in the *Illex* Fishery was 3.7, 6.21, 0.97, 2.84, 11.11, 0, 0, 8.74, 5.07, 6, 15, 14 and 5 respectively. During the period 1996-~~2007~~2008, estimated percent observer coverage (trips) of the *Loligo* Fishery was 0.37, 1.07, 0.72, 0.69, 0.61, 0.95, 0.42, 0.65, 5.07, 4~~.00~~, 3~~.00~~, ~~and~~ 2~~.00~~ and 2 respectively. During the period 1997-~~2007~~2008, estimated percent observer coverage (trips) of the domestic Atlantic Mackerel Fishery was 0.81, 0, 1.14, 4.90, 3.43, 0.97, 5.04, 18.61, 0, 3~~.00~~, ~~and~~ 2~~.00~~ and 0 respectively. Mandatory 100% observer coverage is required on any Joint Venture (JV) fishing operation. The most recent Atlantic Mackerel JV fishing activity occurred in 1998 and 2002 where 152 and 62 transfers from USA vessels were observed respectively. Only the net transfer operations from the USA vessel to the foreign processing vessel are observed. The actual net towing and hauling operations conducted on the USA vessel are not observed.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of scup. The GRAs are spread out in time and space along the edge of the Southern New England and Mid-Atlantic Continental Shelf Region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. Access to the GRAs to harvest non-exempt species (*Loligo* Squid, Black Sea Bass, and Silver Hake) can be granted by a special permit. For detailed information regarding GRAs refer to (FR 70(2), (50 CFR Part 648.122 parts A and B)).

Protected Species Interactions: Documented interaction with common dolphin, long-finned pilot whale, short-finned pilot whale and white-sided dolphin were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Bottom Trawl

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, *Loligo* squid and Skate spp.

Number of Permit Holders: In 2008~~7~~, ~~2,274~~2,208 federal northeast permit holders identified bottom trawl (including beam, bottom fish, bottom shrimp, and bottom scallop trawls) as a potential gear type.

Number of Active Permit Holders: In 2008~~7~~, ~~568~~ 509 federal northeast permit holders reported the use of bottom trawls in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total effort, measured in trips, for the North~~ Atlantic~~east Bottom Trawl Fishery from 1998 to ~~2007~~ 2008 was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577, 10,354, 10,803, ~~and~~ 8,~~603~~ 603, and 8,950 respectively (NMFS). ~~An average mean of 970 (CV=0.04) vessels (full- and part-time) participated annually in the fishery during 1989-1993. The number of days absent from port, or days at sea, is yet to be determined.~~

Temporal and Spatial Distribution: Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf and is distributed throughout the Gulf of Maine, Georges Bank and Southern New England Regions. Figures 16-20 document the distribution of tows and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~ 2008 respectively .

Gear Characteristics: The average footrope length for the bottom trawl fleet was about 84 feet from 1996 – 1999; in 2000 there was a sharp increase to almost 88 feet followed by a steady decline to 85 feet in 2004. Seasonality was evident, with larger footrope lengths in the first quarter, which drop sharply from March to the low in May, and followed by a steady increase in size until December. There are some differences in mean gear size between species. Compared to other species, gear size was smaller for trips that caught winter flounder, cod, yellowtail flounder, fluke, skate, dogfish, and Atlantic herring. Trips that caught haddock, *Illex* squid, and monkfish tended to have larger gear. For most species, seasonal variation was limited. Seasonality was evident for witch flounder, American plaice, scup, butterfish, both squid species, and monkfish. F~~(f~~urther characterization of the Northeast and Mid-Atlantic bottom and mid-water trawl fisheries based on Vessel Trip Report (VTR) data can be found at http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0715/).

Management and Regulations: The Northeast Bottom Trawl Fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009). This gear is managed by several federal and state FMPs that range from Maine to Connecticut -and included in~~by~~ the Atlantic Trawl Gear Take Reduction Strategy~~Team~~. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). These fisheries are primarily addressed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1994-2007, estimated percent observer coverage (measured in trips) was 0.4, 1.1, 0.2, 0.2, 0.1, 0.3, 1.0, 1.0, 3.~~0~~, 4.~~0~~, 5.~~0~~, 12.~~0~~, 6.~~0~~, ~~and~~ 6.~~0~~ and 8 respectively.

Vessels in the Northeast B~~b~~ottom Trawl Fishery, a Category II fishery under the MMPA, were observed in order to meet fishery management needs rather than monitoring for bycatch of marine mammals.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: Documented interaction with common dolphin, harbor porpoise, harbor seal, harp seal, long-finned pilot whale, short-finned pilot whale and white-sided dolphin were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Herring and miscellaneous pelagic species.

Number of Permit Holders: In 2008~~76~~, 1,~~285~~ 270 federal Northeast permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 200~~7~~8, ~~approximately~~ 16 federal northeast permit holders reported the use of mid-water trawls in the Northeast Region Dealer Reported Landings Database.

Gear Characteristics: Historically, the Atlantic Herring resource was harvested by the Distant Water Fleet (DWF) until the fishery collapsed in the late 1970's. There has been no DWF since then. A domestic fleet has been harvesting the Atlantic Herring resource utilizing both fixed and mobile gears. Only a small percentage of the resource is currently harvested by fixed gear due to a combination of reduced availability and less use of fixed gear (Clark 1998). The majority of the resource is currently harvested by domestic mid-water (pelagic) trawls (single and paired).

Management and Regulations: The Northeast Mid-Water Trawl Fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009). Atlantic herring are managed jointly by the MAFMC and ASMFC as one migratory stock complex, and by the Atlantic Trawl Gear Take Reduction Team. There has been a domestic resurgence in a directed fishery on the adult stock due to the recovery of the adult stock biomass. Northeast Mid-Water Trawl Fishery is included in the Atlantic Trawl Gear Take Reduction Strategy.

Temporal and Spatial Distribution: The current fishery occurs during the summer months when the resource is distributed throughout the Gulf of Maine and Georges Bank regions. The stock continues on a southerly migration into mid-Atlantic waters during the winter months. Figures 21-25 document the distribution of tows and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~ 2008 respectively.

Total Effort: Total effort, measured in trips, for the Northeast Mid-Water Trawl Fishery (across all gear types) from 1997 to ~~2007~~ 2008 was 578, 289, 553, 1,312, 2,404, 1,736, 2,158, 1,564, 717, 590, ~~and~~ 286, and 236 respectively (NMFS).

Observer Coverage: During the period 1997-~~2007~~2008, estimated percent observer coverage (trips) was 0, 0, 0.73, 0.46, 0.06, 0, 2.25, 11.48, 19.9, 3.1, ~~and~~ 8.04 and 19.92 respectively. A U.S. JV Mid-Water (pelagic) Trawl Fishery was conducted on Georges Bank from August to December 2001. A total allowable landings of foreign fishery (TALFF) was also granted during the same time period. Ten vessels (3 foreign and 7 American), fishing both single and paired mid-water trawls, participated in the 2001 Atlantic Herring JV Fishery. Two out of the three foreign vessels also participated in the 2001 TALFF and fished with paired mid-water trawls. The NMFS maintained 74% observer coverage (243 hauls) on the JV transfers and 100% observer coverage (114 hauls) on the foreign vessels granted a TALFF.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in

November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B)

Protected Species Interactions: Documented interaction with harbor seal, long-finned pilot whale, short-finned pilot whale and white-sided dolphin were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Mackerel, Chub Mackerel and other miscellaneous pelagic species.

Number of Permit Holders: In 200~~7~~8, ~~360~~ 365 federal mid-Atlantic permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 2008~~7~~, 4~~3~~ federal mid-Atlantic permit holders reported the use of mid-water trawls in the Northeast Region Dealer Reported Landings Database.

Management and Regulations: The Mid-Atlantic Mid-Water Trawl Fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009). This fishery is included in the Atlantic Trawl Gear Take Reduction Strategy.

Temporal and Spatial Distribution: To be determined. Figures 26-30 document the distribution of tows and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~ 2008 respectively.

Total Effort:. Total effort, measured in trips, for the M~~m~~id-Atlantic Mid-Water Trawl Fishery (across ~~all~~ both gear types) from 1997 to ~~2007~~ 2008 was 331, 223, 374, 166, 408, 261, 428, 360, 359, 405, ~~and~~ 312, and 255 respectively (NMFS).

Observer Coverage:. During the period 1997~~-2007~~2008, estimated percent observer coverage (trips) was 0, 0, 1.01, 8.43, 0, 0.77, 3.50, 12.16, 8.40~~-and~~, 8.90, ~~and~~ 3.85, and 13.33 respectively.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: . Documented interaction with bottlenose dolphin, common dolphin, long-finned pilot whale, Risso's dolphin, short-finned pilot whale and white-sided dolphin were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Herring Weir

Target Species: Atlantic Herring

Number of Permit Holders: According to Canadian DFO officials, for 1998 there were 225 licenses for herring weirs on the New Brunswick and Nova Scotia sides of the Bay of Fundy (60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from the East Charlotte area, and 5 from the Saint John area). The number of licenses has been fairly consistent since 1985 (Ed Trippel, pers. comm.)

Number of Active Permit Holders: In 2002 around Grand Manan Island, the only area surveyed for active weirs, there were 22 active weirs. In 2003 the number of active weirs included: 20 around Grand Manan Island, 9 around the Wolves Islands, 10 around Campobello Island, 2 at Deer Island, and 43 in Passamaquoddy Bay and the western Bay of Fundy. The numbers in the eastern Bay of Fundy are unknown, but some do exist.

Total Effort: Effort is difficult to measure. Weirs may or may not have twine (i.e., be actively fishing) on them in a given year and the amount of time the twine is up varies from year to year. Most weirs tend to fish (i.e., have twine on them) during July, August, and September. Some fishermen keep their twine on longer, into October and November, if it is a good year or there haven't been any storms providing incentive to take the twine down. Effort cannot simply be measured by multiplying the number of weirs with twine times the average number of fishing days (this will provide a very generous estimation of effort) because if a weir fills up with fish the fisherman will pull up the drop (close the net at the mouth) which prevents loss of fish, but also means no new fish can get in, therefore the weir is not actively fishing during that period.

Temporal and Spatial Distribution: In Canadian waters, the Herring Weir Fishery occurs from May to October along the southwestern shore of the Bay of Fundy, and is scattered along the coasts of western Nova Scotia.

Gear Characteristics: Weirs are large, heart-shaped structures (roughly 100 feet across) consisting of long wooden stakes (50-80 feet) pounded 3-6 feet into the sea floor and surrounded by a mesh net (the "twine") of about ¾ inch stretch mesh. Weirs are typically located within 100-400 feet of shore. The twine runs from the sea floor to the surface, and the only opening (the "mouth") is positioned close to shore. Herring swimming along the shore at night, encounter a fence (net of the same twine from sea floor to surface) that runs from the weir to the shoreline and directs the fish into the weir. At dawn, the weir fisherman tends the weir and if Herring are present, he/she may close off the weir until the fish can be harvested. Harvesting takes place when the tidal current is the slackest, usually just before low tide. A large net ("seine") is deployed inside the weir, and, much like a purse seine, it is drawn up to the surface so that the fish become concentrated. They are then pumped out with a vacuum hose into the waiting carrier for transport to the processing plant.

Management and Regulations: To Be Determined

Observer Coverage: From mid-July to early September, on a daily basis, scientists from the Grand Manan Whale & Seabird Research Station check only the weirs around Grand Manan Island for the presence of cetaceans.

Comments: Marine mammals occasionally swim into weirs, in which they can breathe and move about. Marine mammals are vulnerable during the harvesting/seining process where they can become tangled in the seine and suffocate if care is not taken to remove them from the net or to remove them from the weir prior to the onset of the seining process. Small marine mammals, like porpoises, can be removed from the net, lifted into small boats, and taken out of the weir for release without interrupting the seining process. Larger marine mammals, such as whales, must be removed from the weir either through the creation of a large enough escape hole in the back of the weir (taking down the twine and removing some poles) or sometimes by sweeping them out with a specialized mammal net, although this approach carries with it a few more risks to the animal than the "escape hole" technique.

Through the cooperation of weir fishermen and the Grand Manan Whale & Seabird Research Station, weir-associated mortality of cetaceans is relatively low. Over 91% of all entrapped porpoises, dolphins and whales are successfully released from weirs around Grand Manan Island. Thus the total number of entrapments (which can vary annually from 6 to 312) is in no way reflective or indicative of cetacean mortality caused by this fishery.

Protected Species Interactions: Documented interactions with harbor porpoise and minke whales were reported in this fishery. Right whales are also vulnerable to entrapment, though very rarely. The last two

minke whales in a Grand Manan weir were safely released, unharmed, through the partial disassembly of the weir.

Gulf Of Maine Atlantic Herring Purse Seine Fishery

Target Species: Atlantic Herring.

Number of Active Permit Holders: The Atlantic Herring FMP distinguishes between vessels catching herring incidentally while pursuing other species and those targeting herring by defining vessels that average less than 1 metric tons of herring caught per trip (in all areas) as incidental herring vessels. In 2008~~7~~ there were ~~11~~ 6 active federal permits reported in the Northeast Region Dealer Reported Landings Database.

Gear Characteristics: The purse seine is a deep nylon mesh net with floats on the top and lead weights on the bottom. Rings are fastened at intervals to the lead line and a purse line runs completely around the net through the rings (www.gma.org, Gulf of Maine Research Institute, GOMRI). One end of the net remains in the vessel and the other end is attached to a power skiff or "bug boat" that is deployed from the stern of the vessel and remains in place while the vessel encircles a school of fish with the net. Then the net is pursed and brought back aboard the vessel through a hydraulic power block. Purse seines vary in size according to the size of the vessel and the depth to be fished. Most purse seines used in the New England Herring Fishery range from 30 to 50 meters deep (100-165 ft) (NMFS 2005). Purse seining is a year round pursuit in the Gulf of Maine, but is most active in the summer when herring are more abundant in coastal waters and are mostly utilized at night, when herring are feeding near the surface. This fishing technique is less successful when fish remain in deeper water and when they do not form "tight" schools.

Management and Regulations: The Gulf Of Maine Atlantic Herring Purse Seine Fishery has been defined as a Category III fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009~~(73 FR 73070, December 1, 2008~~).fishery. This gear is managed by federal and state FMPs that range from Maine to North Carolina. The relevant FMPs include, but may not be limited to the Atlantic Herring FMP (FR 70(19), 50 CFR Part 648.200 through 648.207) and the Northeast Multi-species (FR 67, CFR Part 648.80 through 648.97). This fishery is primarily managed by total allowable catch (TACs).

Temporal and Spatial Distribution: Most U.S. Atlantic herring catches occur between May and October in the Gulf of Maine, consistent with the peak season for the lobster fishery. The connection between the herring and lobster fisheries is the reliance of the lobster industry on herring for bait. In addition, there is a relatively substantial winter fishery in southern New England, and catches from Georges Bank have increased somewhat in recent years. There is a very small recreational fishery for Atlantic herring that generally occurs from early spring to late fall, and herring is caught by tuna boats with gillnets for use as live bait in the recreational tuna fisheries. In addition, there is a Canadian fishery for Atlantic herring from New Brunswick to the Gulf of St. Lawrence, which primarily utilizes fixed gear. Fish caught in the New Brunswick (NB) weir fishery are assumed to come from the same stock (inshore component) as that targeted by U.S. fishermen (http://www.nefmc.org/herring/index.html, Northeast Fisheries Management Council, NEFMC). Figures 31-35 document the distribution of sets and marine mammal interactions observed from ~~2003~~ 2004 to ~~2007~~2008, respectively.

Total Effort: Total metric tons of fish landed from 1998 to ~~2007~~ 2008 were 24,256, 39,866, 29,609, 20,691, 20,096, 17,939, 19,958, 16,306, d 18,700, ~~and~~ 31,019, and 27,327 respectively (NMFS, Unpbl.). Total effort, measured in trips, for the Gulf of Maine Atlantic Herring Purse Seine Fishery from 2002 to 2006 was 343, 339, 276, 202, ~~and~~ 173, and 249 respectively (NMFS, Unpbl.).

Observer Coverage: During the period 1994 to 2002, estimated observer coverage (number of trips observed/total commercial trips reported) was 0~~%~~. From 2003 to ~~2007~~2008, percent observer coverage was 0.34~~%~~, 9.8~~%~~, 0.27~~%~~, 0~~% and~~, 3.2~~%~~ and 11.2 respectively. The coverage in 2004 may be considered a ‚pilot' program, as sampling priorities and data collection methods were refined over the course of the year.

Protected Species Interactions: Documented interactions with humpback whale, fin/sei whale, minke whale, harbor porpoise, harbor seal, gray seal~~s~~ and white-sided dolphin were reported in this fishery.

Northeast/Mid-Atlantic American Lobster Trap/Pot

In the United States (US), the American lobster, *Homarus americanus*, is distributed from Maine to North Carolina and is most abundant in relatively shallow coastal zones. Inshore landings have increased since the 1970's. Fishing effort is intense and increasing throughout the range of the resource. Approximately 80% of lobster landings are derived from state waters which occur from 0-3 miles from shore. There are three distinctly identified stock areas for the American lobster: 1) Gulf of Maine, 2) Southern New England, and 3) Georges Bank. A cooperative state and Federal management plan is in place to manage the lobster resource and the plan is administered under the authority of the Atlantic Coastal Act, with oversight provided by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC's role is to develop coastal fishery management programs, oversee state implementation of the coastal measures in state waters, and provide recommendations for the Federal government to implement complementary regulations in Federal waters. States implement management measures from 0-3 miles within their respective jurisdictions in compliance with the measures adopted in the management plan. The National Marine Fisheries Service is obliged to enact measures that support the plan in Federal waters, from 3-200 miles from shore, codified under 50 CFR 697.

American lobster is the most valuable fishery in the eastern US, with total landings of 87.8 million lbs. valued at $327.6 million in 2008. Combined landings from Maine and Massachusetts vessels comprised 90.5% of the landings for 2008, with Maine landing nearly 69 million lbs. in 2008. In 2008, approximately 3,216 vessels held permits to fish for and harvest lobsters in Federal waters, which does not include the several thousand vessels coastwide authorized to harvest lobster in state water.~~American lobster is the most valuable fishery in the eastern US, with total landings of 83.27.8 million lbs. valued at $384327.6 million in 20078. Combined landings from Maine and Massachusetts vessels comprised 90% of the landings for 20076, with Maine landing nearly 65 million lbs. in 2007. In 2007, approximately 3,223 vessels held permits to fish for and harvest lobsters in Federal waters, which does not include the several thousand vessels coastwide authorized to harvest lobster in state waters.~~ The majority of vessels harvest lobster with traps, with about 2-3% of the harvest taken by mobile gear (trawlers and dredges). The offshore fishery in Federal waters has developed in the past 15 years, largely due to technological improvements in equipment and lower competition in the offshore areas.

In January 1997, NMFS changed the classification of the Gulf of Maine and Mid-Atlantic Lobster Pot Fisheries from Category III to Category I (1997 List of Fisheries 62 FR 33, January 2, 1997) based on examination of 1990 to 1994 stranding and entanglement records of large whales (including Right, Humpback and Minke whales). Both the EEZ and state fishery are operating under Federal regulations from the ALWTRP (50 CFR 229.32). Documented interaction with minke whales were reported in this fishery.

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Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of fishing vessels in the Pelagic Longline Fishery has been declining since a peak number of 361 vessels reporting longline effort during 1995. Over the period between 1995 and 2000, the mean number of vessels reporting effort for the entire Atlantic Ocean not including the Gulf of Mexico was 163. This declined to an annual average of 72 for the period between 2001 and ~~2006~~2007. Seventy-~~four~~ seven vessels reported pelagic longline effort in the Atlantic during ~~2007~~2008. It is likely that some of these vessels also reported effort in the Gulf of Mexico.

Total Effort: The total fishing effort in the Atlantic component of the Pelagic Longline Fishery has been declining since a peak reported effort of 12,318 sets (7.41 million hooks) during 1995. The mean effort reported to the Fisheries Logbook System between 1995 and 2000 was 9,370 sets (5.62 million hooks). Between 2001 and ~~2006~~2007, a mean of 4,~~475~~ 551 sets (3.~~15~~ 19 million hooks) was reported each year. During ~~2007~~2008, the total reported fishing effort in the Atlantic Ocean component of the fishery was ~~4,839~~5,684 sets and ~~3.37~~4.16 million hooks (~~Fairfield Walsh and~~ Garrison *et al.* ~~2007~~2009).

Temporal and Spatial Distribution: Fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. The "Atlantic" component of the fleet operates both in coastal and continental shelf waters along the U.S. Atlantic coast from Florida to Massachusetts. The fleet also operates in distant waters of the Atlantic including the central equatorial Atlantic Ocean and the Canadian Grand Banks. Fishing effort is reported in 11 defined fishing areas including the Gulf of Mexico. During ~~2007~~2008, the majority of fishing effort in the Atlantic was reported in the Mid-Atlantic Bight (Virginia to New Jersey, 1,~~887~~ 911 sets) and the South Atlantic Bight (Georgia to North Carolina, 1,~~070~~ 126 sets) fishing areas (~~Fairfield Walsh and~~ Garrison *et al.* 2009~~2007~~).

Gear Characteristics: The pelagic longline gear consists of a mainline of >700-lb test monofilament typically ranging between 10 and 45 miles long. At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by "high-flyers" or radio beacons. Suspended from the mainline are long gangion lines of 200 to 400-lb test monofilament that are typically 100 to 200 feet in length. Fishing depths are most typically between 40 and 120 feet. Hooks of various sizes are attached by a steel swivel leader. Longline sets targeting tunas are typically set at dawn and soak throughout the day with recovery near dusk. Those sets targeting swordfish are more typically night sets. The total amount of time the gear remains in the water including set, soak, and haul times is typically 10-14 hours. As a result of a recent Biological Opinion on interactions between Atlantic longline gear targeting Tunas and Swordfish and endangered sea turtles, a comprehensive change in the fishing gear occurred in the longline fishery. After August 2004, only circle shaped hooks of 16/0 or 18/0 size can be used throughout the fishery.

Management and Regulations: The Large Pelagics Longline Fishery is listed as a Category I fishery under the MMPA due to frequently observed interactions with marine mammals (73 CFR 73066, December 1, 2008). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP, 50 CFR Part 635) and the Pelagic Longline Take Reduction Plan. ~~Team.~~ The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the HMS FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, reopened the Northeast Distant Water fishing area, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and ~~2006~~2007, observer coverage as a percentage of reported sets in the Atlantic component of the fishery was 4~~%~~, 4~~%~~, 4~~%~~, 7~~%~~, 9~~%~~, 6~~%~~, 7, and 7~~%~~. The observer coverage during 2007 was 7% of reported sets; however, coverage was often >10% in some areas and seasons (~~Fairfield Walsh and~~ Garrison *et al.* 2009~~2007~~). These values do not include the experimental portion of the fishery in the Northeast Distant Water (NED) area, which was 100% of sets during 2001-2003. Observed longline sets and marine mammal interactions are shown for ~~2003~~2004-~~2007~~ 2008 in Figures 36 through 40.

Comments: This fishery has been the subject of numerous management actions since 2000 associated with bycatch of both billfish and sea turtles. These changes have resulted in a reduction of overall fishery effort

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and changes in the behaviors of the fishery. The most significant change was the closure of the NED area off the Canadian Grand Banks and near the Azores as of June 1, 2001 (50 CFR Part 635). An experimental fishery was conducted in this area during both 2001 and 2002 to evaluate gear characteristics and fishing practices that increase the bycatch rate of sea turtles. Several marine mammals, primarily Risso's Dolphins, were seriously injured during this experimental fishery. In addition, there have been a number of time-area closures since late 2000 including year-round closures in the DeSoto Canyon area in the Gulf of Mexico and the Florida East Coast area; and additional seasonal closures in the Charleston Bump area and off of New Jersey (NMFS 2003). Additionally, a ban on the use of live fish bait was initiated in 1999 due to concerns over billfish bycatch. The June 2004 Biological Opinion has resulted in a significant change in the gear and fishing practices of this fishery that will likely impact marine mammal bycatch. The majority of interactions with marine mammals in this fishery have been with Pilot Whales and Risso's Dolphin. These interactions primarily occurred along the shelf break in the Mid-Atlantic Bight region during the third and fourth quarters (Garrison 2003; 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007, Garrison *et al*. 2009). The Pelagic Longline Take Reduction Team was convened during 2005 to develop approaches to reduce the serious injury of pilot whales in the mid-Atlantic, and the resulting take reduction plan is currently being implemented by NOAA Fisheries.

Protected Species Interactions: Documented interactions with Risso's dolphin, long-finned pilot whale, short-finned pilot whale, common dolphin, Atlantic ~~ppotted~~ spotted dolphin, pantropical spotted dolphin, bottlenose dolphin, Cuvier's beaked whale, Mesoplodon beaked whale~~-~~, and northern bottlenose whale were reported in this fishery. Not mentioned here are documented interactions with sea turtles and sea birds.

Southeastern U.S. Atlantic Shark Gillnet

Target Species: Large and small coastal sharks including: Blacktip, Blacknose, Finetooth, Bonnethead, and Sharpnose Sharks

Number of Permit Holders: ~30

Number of Active Permit Holders: ~30

Total Effort: Gillnets targeting sharks in the southeastern U.S. Atlantic are fished in a variety of configurations including long soak drift sets, short soak encircling strike sets, and short duration sink sets. In addition, sink gillnets are used to target other finfish species. The same fishing vessels will fish the different types of sets. It is difficult to identify these different gear types and distinguish sets targeting sharks from those targeting finfish in the reported logbook data. The total amount of effort was therefore estimated based upon observer data and reported fishing gear and catch characteristics (Garrison 2007). Between 2001 and 2005, an annual average of 74 drift sets, 40 strike sets, and 241 sink sets targeting sharks were reported and/or observed. The number of drift sets has been declining steadily while the number of strike sets has been increasing. During 2006, there were 8 drift sets, 40 strike sets, and 301 sink sets targeting sharks reported or observed (Garrison 2007). However, there is direct evidence of under-reporting as some observed sets were not reported to the FLS system, and the total effort remains highly uncertain.~~.~~ In 2007, a total of 85 drift net sets were observed with 4 of those targeting sharks and the remainder Spanish mackerel. A total of 112 sink net sets were observed, with 60 of those targeting sharks and the remainder targeting various fish species (Baremore *et al.* 2007). During 2008, there was very limited targeted fishing for sharks off the coast of Florida due to the closure of the large coastal shark fishery during the first half of the year, and there were no strike sets observed targeting sharks and only a few sink sets (Passerotti and Carlson 2009).~~No strike sets were observed in 2007.~~

Temporal and Spatial Distribution: The Shark Gillnet fleet operates primarily in the coastal waters of Florida and Georgia, but sink sets targeting sharks are reported as far north as Cape Hatteras, NC (Carlson and Bethea 2007; Garrison 2007). Prior to 2007, shark drift gillnet fishing was restricted under the ALWTRP off the coast of Georgia (from 32° N latitude) and Florida to 27° 51' N latitude between 15

November to 31 March. Outside of this season, the drift and strike fishing vessels operated primarily north of Cape Canaveral, Florida, and along the Georgia coast. In 2007, the restricted area was expanded under the ALWTRP to include the area between 32° N latitude west of 80° W longitude and within 35 nautical miles of the South Carolina coast (Southeast U.S. Restricted Area North) with a closure to all gillnet gear from November 15 to April 15. The area between 29° N latitude and 27° 51' N latitude west of 80° W longitude (Southeast U.S. Restricted Area South) is also closed to gillnetting from December 1 through March 31, but fishing for shark is permitted with limited exemptions if special provisions are met (72 FR 34632, June 25, 2007).

Gear Characteristics: ~~Drift~~ Historically, shark drift gillnet fishing ~~is~~ was characterized by large-mesh (5-10 inches) nets that are typically greater than 1500 feet long and have long, night-time soak durations exceeding 10 hours. However, in recent years, an increasing proportion of the fishing effort consists of "strike sets" in which schools of sharks are targeted and encircled. Strike sets are of much shorter duration (typically < 1 hour) than drift sets, have large mesh sizes, and use deep fishing nets (Carlson and Bethea 2007). Sink nets typically use smaller mesh sizes than strike nets, the nets are shallower and shorter, and the soak duration average approximately 2 hours (Garrison 2007). Likewise, large mesh, long soak-time drift net fishing has largely ended. Drift gillnets targeting sharks (observed off the coast of North Carolina) are of much shorter duration with total fishing times averaging less than 3 hours (Passerotti and Carlson 2009).

Management and Regulations: The Southeastern U.S. Atlantic Shark Gillnet Fishery is listed as a Category II fishery under the MMPA due to occasional interactions with marine mammals (74 FR 58859, November 16, 2009)~~(73 FR 73066, December 1, 2008)~~. The directed fishery effort is managed under an amendment to the HMS FMP (50 CFR Part 635, 66 FR 17370 March 30, 2001) that mandates observer coverage outside of the season, defined by the ALWTRP, at levels sufficient to achieve precise estimates (coefficient of variation < 0.3) of marine mammal and sea turtle bycatch. The fishery is also managed under the ALWTRP (50 CFR Part 229.32) and the Bottlenose Dolphin Take Reduction Plan. The ALWTRP includes seasonal restriction of gillnet fishing in the Southeast U.S. Restricted Area North, special provisions for shark gillnet gear in the Southeast U.S. Restricted Area South, including 100% observer coverage, and the use of Vessel Monitoring Systems (VMS) in lieu of 100% observer coverage for shark gillnets with webbing of 5" or greater stretched mesh in the newly created Southeast U.S. Monitoring Area (~~*~~72 FR 57104, October 5, 2007) , and restrictions on setting shark gillnets with webbing of 5" or greater stretched mesh 3 nm from large whales in the newly created Other Southeast Gillnet Waters~~-~~. Similar provisions are also included in the Biological Opinion on the fishery under section 7 of the Endangered Species Act.

Observer Coverage: A dedicated observer program for the Shark Drift Gillnet Fishery has been in place since 1998. Due to the provisions of the ALWTRP, observer coverage has been high during winter months since 2000. However, due to limits on available resources, observer coverage outside of this period was generally low (< 5%) prior to 2000 but has been increasing during the last several years. In 2005, the observer program was expanded to include a limited number of sink gillnets targeting both fish and sharks (Carlson and Bethea 2007). Due to the difficulties in identifying the reported effort, the percentage of observer coverage by gear type is difficult to quantify. From 2001 to 2006, the percent annual observer coverage of the drift gillnet fishery was 68~~%~~, 85~~%~~, 50~~%~~, 66~~%~~, 58~~%~~, and 48~~%~~, respectively. The percent annual coverage of the strike component from 2001 to 2006 was 63~~%~~, 86~~%~~, 72~~%~~, 81~~%~~, and 84~~%~~, respectively. The sink component of the fishery was observed in 2005 and 2006 with coverage levels of 10% and 22%, respectively. However, given the uncertainties surrounding the level of reported effort in the FLS, these estimates of observer coverage are highly uncertain (Garrison 2007). Due to these uncertainties, and continuing changes in the execution and observer coverage of the fishery, effort levels for the fishery and estimated observer coverage for 2007 and 2008 are not available. The locations of observed strike, drift, and sink sets ~~and marine mammal interactions~~ in the shark gillnet fishery are shown in Figures 41-45. There have been no observed marine mammal interactions since 2003.

Comments: There is a significant level of uncertainty surrounding estimating the total level of effort in this fishery. There is direct evidence of inconsistency in reporting. It is not possible to reliably distinguish trips targeting sharks from those targeting other fish species, and it is not possible to distinguish different types

of sets in the logbook data. However, the overall marine mammal and sea turtle bycatch rate is very low, therefore it is unlikely that even severe biases would result in large increases in the estimated total protected species bycatch in this fishery. In addition to marine mammal interactions, this fishery has been the subject of management concern due to recent interactions with endangered sea turtles including Leatherback and Loggerhead Turtles.

Protected Species Interactions: Documented interactions with coastal bottlenose dolphin and Atlantic spotted dolphin were reported in this fishery. There are two documented cases of possible interactions between North Atlantic right whales and the shark drift gillnet fishery off the Florida coast.

Atlantic Blue Crab Trap/Pot

The Blue Crab Trap/Pot Fishery is broadly distributed in estuarine and nearshore coastal waters throughout the mid and south Atlantic. The fishery is estimated to have >16,000 participants deploying gear on a year-round basis. Pots are baited with fish or poultry and are typically set in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. In recent years, reports of strandings with evidence of interactions between bottlenose dolphins and both recreational and commercial crab pot fisheries have been increasing in the Southeast region (McFee and Brooks 1998; Burdett and McFee 2004). Interactions with crab pots appear to generally involve a dolphin becoming wrapped in the buoy line. The total number of these interactions and associated mortality rates has not been documented, but from 2002-2007, SEFSC stranding data show 5 confirmed bottlenose dolphin mortalities due to interactions with blue crab pot gear and 11 bottlenose dolphin disentanglements with live releases. There are also documented interactions with the West Indian manatee, Florida stock. The fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009). It is managed under the Bottlenose Dolphin Take Reduction Plan and the Atlantic Large Whale Take Reduction Plan.

Mid-Atlantic Haul/Beach Seine

This beach-based fishery operates primarily along North Carolina's Outer Banks using small and large mesh gillnets. Small mesh gillnets are generally used in the spring and fall to target gray trout (weakfish), speckled trout, spot, kingfish (sea mullet), bluefish, and harvest fish (star butters). Large mesh gillnets are used to target Atlantic striped bass during the winter and are regulated via North Carolina Fisheries rules and proclamations. Small mesh nets are generally constructed in the manner of a beach seine, although the net material is a combination of multifilament and monofilament. The beach seine system uses a bunt and a wash net that is attached to the beach and fished in the surf (Steve *et al.* 2001). Conversely, large mesh nets are constructed of all monofilament material and generally used to fish during the Atlantic Ocean striped bass beach seine fishery. Although construction and characteristics of large and small mesh nets differ, they are set and hauled similarly. Nets are deployed out of the stern of the surf dories and set perpendicular to the shoreline. A truck is generally used to haul the net ashore by attaching one end of the net to the truck and pulling it ashore while the other end remains fixed until the end of the haul. North Carolina Division of Marine Fisheries (NCDMF) finalized regulations in October 2008 requiring fishermen participating in the Atlantic Ocean striped bass beach seine fishery to use nets constructed of all multifilament material (NCDMF Proclamation FF–51–2008), thereby moving closer to the traditional manner of beach seine fishing for large mesh nets. Small mesh nets are not included under NCDMF's regulations for the Atlantic Ocean striped bass beach seine fishery, and therefore, still operate more in the manner of gillnets rather than beach seines because of their construction with monofilament material and fishing practices. Subsequently, they are listed as a Category I Mid-Atlantic Gillnet fishery in the ~~2009~~ 2010 List of Fisheries (74 FR 58859, November 16, 2009~~73 FR 73054, December 1, 2008~~). Therefore, the Atlantic Ocean striped bass beach seine fishery using large mesh gillnets is now the only fishery included under the Mid-Atlantic Haul/Beach Seine Fishery for North Carolina. The Mid-Atlantic Haul/ Beach Seine Fishery (NC only) is listed as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009~~73 FR 73054, December 1, 2008~~). North Carolina beach-based fishing has been observed since April 7, 1998 by the NMFS Fisheries Sampling Program (Observer Program) based at the NEFSC. ~~Through 2001, there were 101 sets observed during the winter season (Nov-Apr) and 65 sets observed during the summer season (May-Oct)~~The numbers of observed beach seine sets from 1998 to 2008 were

63, 60, 52, 12, 6, 23, 36, 29, 9, 27, and 39. ~~There were no sets observed during the summer of 2001.~~ This fishery has observed interactions with coastal bottlenose dolphin and is managed under the Bottlenose Dolphin Take Reduction Plan .

North Carolina Long Haul Seine

The Long Haul Seine is an estuarine fishery operating in North Carolina waters with 10-15 participants statewide. The seine consists of a 1000-1200 yard long net pulled by two boats for distances of 1-2 nautical miles (Steve *et al.* 2001). Fish are encircled by pulling the net around a fixed stake. The fishery targets Weakfish, Spot, Croaker, Menhaden, Bluefish, Spotted Seatrout, and Hagfish, and operates in Pamlico and Core sounds and tributaries. The fishery operates primarily between June and October. Occasional interactions with ~~Coastal~~ coastal ~~Bottlenose~~ bottlenose ~~Dolphins~~ dolphins have been reported. The fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009) and is managed under the Bottlenose Dolphin Take Reduction Plan.

North Carolina Roe Mullet Stop Net

The Stop Net Fishery is unique to Bogue Banks, North Carolina. The gear consists of a stationary, multi-filament anchored net extended perpendicular to the beach to stop the alongshore migration of Striped Mullet. Once the catch accumulates near the end of the stop net, a beach haul seine is used to capture fish and bring them ashore. The stop net is traditionally left in the water for 1 to 5 days during the fishery season from October to November, but can be left as long as 15 days (Steve *et al.* 2001). Interactions between this fishery and ~~Coastal~~ coastal ~~Bottlenose~~ bottlenose ~~Dolphins~~ dolphins have been reported; however, the total number of interactions has not been estimated. The fishery has been defined as a Category II fishery in the 2010 ~~09~~List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009) and is managed under the Bottlenose Dolphin Take Reduction Plan.

Virginia Pound Net

Pound Nets are a stationary gear fished in nearshore coastal and estuarine waters of Virginia. The gear consists of a large mesh lead posted perpendicular to the shoreline extending outward to the corral, or "heart", where the catch accumulates. Target species included Weakfish, Spot, Spanish mackerel, Bluefish and Croaker. The NEFOP began observing effort in this fishery in 2001. In 2004 and 2005 an experimental fishery was conducted in an area of the Chesapeake Bay that was closed to commercial pound net fishing effort from May to July for sea turtle conservation ~~measures~~. The results from these studies determined a modified pound net leader could be used for pound net fishing while providing sea turtle conservation benefits. Occasional interactions with ~~Coastal~~ coastal ~~Bottlenose~~ bottlenose ~~Dolphins~~ dolphins have been observed while monitoring for sea turtle interactions in both the commercial and experimental fisheries. Three takes of coastal bottlenose dolphins were observed in 2003, 2004, and 2009. Stranded bottlenose dolphins have also shown evidence of interactions with pound nets. From 2002 to 2009, 21 bottlenose dolphins were removed dead from Virginia pound nets, and 4 dolphins were disentangled alive (Sue Barco, Virginia Aquarium). ~~In some cases it is not clear whether pound nets were the cause of death due to entanglement in other gear (monofilament).~~ Data from the Chesapeake Bay suggest that the likelihood of Bottlenose Dolphin entanglement in pound net leads may be affected by the mesh size of the lead net (Bellmund *et al.* 1997), but the information is not conclusive. A recent study conducted by Barco et al. in 2009 examined the use of modified pound net leaders adopted for sea turtle conservation because they believed it would also be effective in reducing bottlenose dolphin interactions in pound net leads. The study took place in the lower Chesapeake Bay and evaluated the effect of modified pound net leaders on finfish bycatch to ensure it maintained catch efficiency. Results show modified pound net leader had similar or greater catches of finfish compared to traditional leaders (e.g., leaders that were not modified for sea turtle conservation). ~~Stranded Bottlenose Dolphins have also shown evidence of interactions with pound nets. From 2002 to 2007, 20 bottlenose dolphins were removed dead from Virginia pound nets, and at least 3 dolphins were disentangled and released alive (Sue Barco, Virginia Aquarium).~~ The fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009)~~73 FR 73068, December 1, 2008).~~

Mid-Atlantic Menhaden Purse Seine

Between 1994 and 1997, about 18-20 menhaden purse-seine vessels for reduction operated out of two processing facilities in Chesapeake Bay at Reedville, Virginia. Another fleet of vessels 2-5 vessels operated out of a smaller processing facility at Beaufort, North Carolina. Since 1998, only one plant has been operational in Virginia with a total fleet of about 10 vessels. Between 1998 and 2004 the factory at Beaufort operated with 2-3 vessels. After the 2004 fishing season, the factory at Beaufort closed permanently. A majority of the fishing effort by the Virginia fleet occurs in the Virginia portion of Chesapeake Bay, and along the ocean beaches of Eastern Shore Virginia. Most sets in Chesapeake Bay are in the main stem of the Bay, greater than one mile from shore. In summer, the Virginia fleet occasionally ranges as far north as northern New Jersey. Purse-seining for reduction purposes is prohibited by state law in Maryland, Delaware, and New Jersey; hence, purse-seine sets in the ocean off Delmarva and New Jersey are by definition greater than 3 miles from shore. The Virginia fleet ranges south into NC coastal waters during November and December, but this segment of the fishery is highly weather-dependent. Large vessels (up to 200 ft) carrying two small purse seine boats are used for fishing effort, with some smaller vessels (called snapper rigs) about 6-75 feet in length. Schools of menhaden are generally spotted from larger vessels and/or spotter planes. The purse seine is deployed over the school vertically from the large vessel or the two smaller boats. The net floatline and leadline has a series of rings threaded with a purse line that is winched closed around the school, and the net is retrieved by power block. The purse seine net is made of nylon fiber with a bar mesh from ¾ to 7/8 inch (about 1-3/4 inch stretched mesh). Net length ranges from 1,000-1,400 feet, with a net dept averaging 65-90 feet. Occasional interactions with ~~Coastal~~ coastal ~~Bottlenose~~ bottlenose ~~Dolphins~~ dolphins have been recorded historically in this fishery. In 2008 and 2009, there was very limited observer coverage; however, there was no systematic coverage prior to these years ~~However, there is no observer coverage in this fishery,~~ and the level of incidental interactions with marine mammals is undocumented. The Mid-Atlantic Menhaden Purse Seine Fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009) and will be managed under the Bottlenose Dolphin Take Reduction Plan..

Southeastern U.S. Atlantic/Gulf of Mexico Shrimp Trawl

The Shrimp Trawl Fishery operates from North Carolina through the Texas coast~~northern Florida~~ virtually year-round, moving seasonally up and down the coast. A recent estimate of fishing effort based upon state dealer trip reports included approximately 23,000 shrimping trips (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Effort occurs in both estuarine and nearshore coastal waters. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Observer coverage ~~is typically~~was historically very sparse and non-systematic. However, in 2007, the observer coverage expanded and became mandatory for fishing vessels to take an observer if selected. Observer coverage currently averages about 1% of the total fishery effort. Occasional interactions with ~~Bottlenose~~ bottlenose ~~Dolphins~~ dolphins have been observed in the Atlantic and Gulf of Mexico, and there is infrequent evidence of interactions from stranded animals. During 1993-2008, 6 unidentified dolphins and two bottlenose dolphin were observed dead in shrimp fishery vessels. The animals were caught in water depths between 7 and 87 m. The unidentified animals were likely either bottlenose dolphins or Atlantic spotted dolphins based upon location and depth. Additionally, in 2002, a fisherman self-reported a take of an unidentified dolphin. The Shrimp Trawl fishery has been defined as a Category III fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009~~73 FR 73068, December 1, 2008~~).

III. Historical Fishery Descriptions

Atlantic Foreign Mackerel

Prior to 1977, there was no documentation of marine mammal bycatch in DWF activities off the Northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in that year, an Observer Program was established which recorded fishery data and information on incidental bycatch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA had been directed primarily towards Atlantic Mackerel and Squid. From 1977 through 1982, an average mean of 120 different foreign vessels per year (range 102-161) operated within the U.S. Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese Tuna longline vessels operating along the U.S. east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1991, the numbers of foreign vessels operating within the U.S. Atlantic EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9 respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8 respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-1982, and increased to 58%, 86%, 95% and 98%, respectively, in 1983-1986. One hundred percent observer coverage was maintained during 1987-1991. Foreign fishing operations for Squid ceased at the end of the 1986 fishing season and for Mackerel at the end of the 1991 season. Documented interactions with white sided dolphins were reported in this fishery.

Pelagic Drift Gillnet

In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery operated during 1998. Then, in January 1999 NMFS issued a Final Rule to prohibit the use of drift net gear in the North Atlantic Swordfish Fishery (50 CFR Part 630). In 1986, NMFS established a mandatory self-reported fisheries information system for Large Pelagic Fisheries. Data files are maintained at the SEFSC. The estimated total number of hauls in the Atlantic Pelagic Drift Gillnet Fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls from 1991 to 1996 was 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998 there were 11, 12, 10, 0, and 11 vessels, respectively, in the fishery. Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996, no fishery in 1997, and 99% coverage during 1998. Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras, North Carolina. Examination of the species composition of the catch and locations of the fishery throughout the year suggest that the Drift Gillnet Fishery was stratified into two strata: a southern, or winter, stratum and a northern, or summer, stratum. Documented interactions with North Atlantic right whales, humpback whales, sperm whales, pilot whale spp., Mesoplodon spp., Risso's dolphins, common dolphins, striped dolphins and white sided dolphins were reported in this fishery.

Atlantic Tuna Purse Seine

The Tuna Purse Seine Fishery occurring between the Gulf of Maine and Cape Hatteras, North Carolina is directed at large medium and giant Bluefin Tuna (BFT). Spotter aircraft are typically used to locate fish schools. The official start date, set by regulation, is 15 July of each year. Individual Vessel Quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates for large medium and giant Tuna can be high and consequently, the season can last only a few weeks, however, over the last number of years, effort expended by this sector of the BFT fishery has diminished dramatically due to the unavailability of BFT on the fishing grounds.

The regulations allocate approximately 18.6% of the U.S. BFT quota to this sector of the fishery (5 IVQs) with a tolerance limit established for large medium BFT (15% by weight of the total amount of giant BFT landed.

Limited observer data is available for the Atlantic Tuna Purse Seine Fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets

were observed. A total of 136 days were covered. No trips were observed during 1997 through 1999. Two trips (seven hauls) were observed in October 2000 in the Great South Channel Region. Four trips were observed in September 2001. No marine mammals were observed taken during these trips. Documented interactions with pilot whale spp. were reported in this fishery.

Atlantic Tuna Pelagic Pair Trawl

The Pelagic Pair Trawl Fishery operated as an experimental fishery from 1991 to 1995, with an estimated 171 hauls in 1991, 536 in 1992, 586 in 1993, 407 in 1994, and 440 in 1995. This fishery ceased operations in 1996 when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in the Atlantic Tuna Fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 and 1995. Sea sampling began in October of 1992 (Gerrior *et al.* 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. Nineteen vessels have operated in this fishery. The fishery operated in the area between 35°N to 41°N and 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39°N, 72°W, around Hudson Canyon, from 1991 to 1993. Examination of the 1991-1993 locations and species composition of the bycatch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge 1996). During the 1994 and 1995 Experimental Pelagic Pair Trawl Fishing Seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudy 1995; 1996), but the results were inconclusive. Documented interactions with pilot whale spp., Risso's dolphin and common dolphins were reported in this fishery.

Part B. Description of U.S. Gulf of Mexico Fisheries

I. Data Sources

Items 1 and 2 describe sources of marine mammal mortality, serious injury or entanglement data, and item 3 describes the source of commercial fishing effort data used to generate maps depicting the location and amount of fishing effort and the numbers of active permit holders. In general, commercial fisheries in the Gulf of Mexico have had little directed observer coverage and the level of fishing effort for most fisheries that may interact with marine mammals is either not reported or highly uncertain. With the exception of the Large Pelagics Longline Fishery, no incidental take estimates are possible for Gulf of Mexico commercial fisheries.

1. Southeast Region Fishery Observer Programs

Two fishery observer programs are managed by the SEFSC that observe commercial fishery activity in the U.S. Gulf of Mexico. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992, and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species FMP (HMS FMP, 50 CFR Part 635). The second is the Southeastern Shrimp Otter Trawl Fishery Observer Program. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. The total level of observer coverage for this program is ~ 1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught. In each Observer Program the observers record information on the total target species catch, the number and type of interactions with protected species including both marine mammals and sea turtles, and biological information on species caught.

2. Regional Marine Mammal Stranding Networks

The Southeast Regional Stranding Network is a component of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the U.S. Gulf of Mexico coast from Florida through Texas. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement with NOAA Fisheries, collect data on stranded animals that include: species; event date and location; details of the event including evidence of human interactions; determinations of the cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

3. Southeast Region Fisheries Logbook System

The FLS is maintained at the SEFSC and manages data submitted from mandatory fishing vessel logbook programs under several FMPs. In 1986, a comprehensive logbook program was initiated for the Large Pelagics Longline Fisheries, and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

4. Marine Mammal Authorization Program

Commercial fishing vessels engaging in Category I or II fisheries are required to register under the Marine Mammal Authorization Program (MMAP) in order to lawfully capture a marine mammal incidental to fishing operations. All vessel owners, regardless of the category of fishery they are operating in, are required to report all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions.

II. Gulf of Mexico Commercial Fisheries

Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of active fishing vessels in the pelagic longline fishery has been declining since a peak number of 361 vessels reporting longline effort during 1995. Over the period between 1995 and 2000, the mean number of vessels reporting effort to the FLS in the Gulf of Mexico was 112. This declined to an annual average of ~~66~~ 64 for the period between 2001 and ~~2006~~2007. The total number of fishing vessels reporting effort in the Gulf of Mexico during ~~2006~~ 2008 was ~~55~~53, though some of these vessels likely also reported fishing effort in other areas.

Total Effort: The total fishing effort in the Gulf of Mexico component of the Pelagic Longline Fishery has ranged between 2.5 and 4.1 million hooks since 1992. The mean effort reported to the FLS between 1995 and 2000 was 4,545 sets and 3.32 million hooks. Between 2001 and 2007, a mean of 4,522 sets (3.40 million hooks) was reported each year. During 2008, the total reported fishing effort in the Gulf of Mexico component of the fishery was 3,246 sets and 2.39 million hooks (Garrison *et al.* 2009).~~During 2007, the total reported fishing effort in the Gulf of Mexico component of the fishery was 3,956 sets and 2.91 million hooks (Fairfield Walsh and Garrison 2007).~~

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Temporal and Spatial Distribution: Fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. The Gulf of Mexico component of the fleet operates both in continental shelf and deep continental slope waters from Florida to Texas.

Gear Characteristics: The pelagic longline gear consists of a mainline of >700-lb test monofilament typically ranging between 10 and 45 miles long. At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by "high-flyers" or radio beacons. Suspended from the mainline are long gangion lines of 200 to 400-lb test monofilament that are typically 100 to 200 feet in length. Fishing depths are most typically between 40 and 120 feet. Hooks of various sizes are attached by a steel swivel leader. Longline sets targeting tunas are typically set at dawn and soak throughout the day with recovery near dusk. Those sets targeting swordfish are more typically night sets. The total amount of time the gear remains in the water including set, soak, and haul times is typically 10-14 hours. As a result of a recent Biological Opinion on interactions between Atlantic longline gear targeting Tunas and Swordfish and endangered sea turtles, a comprehensive change in the fishing gear occurred in the longline fishery. After August 2004, only circle shaped hooks of 16/0 or 18/0 size can be used throughout the fishery.

Management and Regulations: The Large Pelagics Longline Fishery is listed as a Category I fishery under the MMPA's 2009 LOF due to frequently observed interactions with marine mammals (73 FR 73066, December 1, 2008). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (Highly Migratory Species FMP, 50 CFR Part 635) and the Pelagic Longline Take Reduction Plan implementing regulations (74 FR 23349, May 19, 2009) ~~Team~~. The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the Highly Migratory Species FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with endangered sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and ~~2006~~2007, percent observer coverage of reported sets in the Gulf of Mexico component of the fishery was 4~~%~~, 4~~%~~, 3~~%~~, 5~~%~~, 5~~%~~, 7~~%~~, ~~and~~ 8~~%~~, and 16. Observer coverage in the Gulf of Mexico during ~~2007~~ 2008 was ~~15.5~~24.8% of reported sets. This high coverage rate reflects significantly elevated coverage during the second quarter (~~51.6~~58.2%) associated with increased observer effort to document bluefin tuna interactions (~~(Fairfield Walsh and~~ Garrison ~~2007~~*et al.* 2009). Observed longline sets and marine mammal interactions in the Gulf of Mexico are shown for ~~2003~~2004~~-2007~~-2008 in Figures 46 through 50. ~~Only two marine mammal interactions, one with an unidentified dolphin and one with a pilot whale, have been observed during this period.~~

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Comments: This fishery has been the subject of numerous management actions over the last four years associated with bycatch of both billfish and sea turtles. These changes have resulted in a reduction of overall fishery effort and in the behaviors of the fishery. The most significant change was the closure of the Northeast Distant Water Area off the Canadian Grand Banks and near the Azores as of June 1, 2001 (50 CFR Part 635). In the Gulf of Mexico, a year round closure was implemented in two areas in DeSoto Canyon (NMFS 2003). Additionally, a ban on the use of live fish bait was initiated in 1999 due to concerns over billfish bycatch. The June 2004 Biological Opinion has resulted in a significant change in the gear and fishing practices of this fishery that will likely impact marine mammal bycatch. The majority of interactions with marine mammals in this fishery in the Gulf of Mexico have been with Risso's Dolphin (Garrison 2003a)~~; ~~. There have been more interactions with marine mammals observed recently in association with the very high observer coverage between April and June.
~~however, there have been very few interactions with marine mammals observed in the last five years.~~

Protected Species Interactions: Gulf of Mexico stocks of Risso's dolphin, pantropical spotted dolphin, Atlantic spotted dolphin, pilot whales, unidentified beaked whales, sperm whales, killer whales, and offshore bottlenose dolphin.

Gulf of Mexico Shrimp Trawl

The Shrimp Trawl Fishery operates along the Gulf coast of the U.S. virtually year round. Hundreds of thousands of fishing trips are reported annually in the Gulf of Mexico with effort occurring in estuarine, nearshore coastal, and offshore continental shelf waters (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Observer coverage is typically very sparse and is not systematic; however, the program has become mandatory and increased observer coverage beginning in 2007. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Occasional interactions with Bottlenose Dolphins have been observed in both the Gulf and Atlantic components of this fishery, and there is infrequent evidence of interactions from stranded animals. During 1993~~-2007~~2008, ~~4~~ 6 un-identified dolphins and ~~one~~ two bottlenose dolphin were observed dead in shrimp fishery vessels. The animals were caught in water depths between 7 and 87 m. The unidentified animals were likely either bottlenose dolphins or Atlantic spotted dolphins based upon location and depth. Additionally, in 2002, a fisherman self-reported an take of an unidentified dolphin.~~In 2007, a bottlenose dolphin was observed killed in the shrimp fishery in 7m of water in the western Gulf of Mexico~~. The Shrimp Trawl Fishery is listed as a Category III fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009~~73 FR 73068, December 1, 2008~~).

Protected Species Interactions: Gulf of Mexico stocks of coastal and continental shelf bottlenose dolphin and Atlantic spotted dolphin.

Gulf of Mexico Blue Crab Trap/Pot Fisheries

The Blue Crab Trap/Pot Fishery is broadly distributed in estuarine and nearshore coastal waters along the Gulf coast. The fishery is estimated to have approximately 4,000 participants deploying gear on a year-round basis. Pots are baited with fish or poultry and are typically set in rows in shallow water. Pot position is marked by either a floating or sinking buoy line attached to a surface buoy. In recent years, reports of strandings in the Atlantic with evidence of interactions between bottlenose dolphins and both recreational and commercial crab pot fisheries have been increasing in the Southeast region (McFee and Brooks 1998). Interactions have also been reported in the Gulf, including both stranding mortalities and entanglements/live releases. Interactions with crab pots appear to generally involve a dolphin becoming wrapped in the buoy line. The total number of these interactions and associated mortality rates has not been documented; although, Southeast Fishery Science Center stranding data document one bottlenose dolphin interaction in 2002 and one in 2003 . The fishery has been defined as a Category III fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73~~ 74 FR 73069, November 16, 2009~~December 1, 2008~~).

Gulf of Mexico Menhaden Purse Seine Fishery

This fishery operates in coastal waters along the Gulf coast, with the majority of fishing effort concentrated off Louisiana and Mississippi. Fishing effort occurs both in bays, sounds, and in nearshore coastal waters. Between 1994 and 1998, fishery effort averaged approximately 23,000 sets annually (Smith *et al.* 2002). No observer data is available for the Gulf of Mexico Menhaden Fishery; however, recent interactions with coastal bottlenose dolphins have been reported through the MMAP and historically through an observer program carried out by Louisiana State University from 1994 to 1996. The fishery has been defined as a Category II fishery in the ~~2009 List of Fisheries~~2010 List of Fisheries (~~73 FR 73067, December 1, 2008~~74 FR 58859, November 16, 2009).

Gulf of Mexico Gillnet Fishery

The Gulf of Mexico gillnet fishery uses strike and straight gillnets to target a wide variety of species including, but not limited to, black drum, sheepshead, weakfish, mullet, spot, croaker, king mackerel, Spanish mackerel, Florida pompano, flounder, shark, menhaden, bluefish, blue runner, ladyfish, spotted seatrout, croaker, kingfish, and red drum. This fishery operates year-round in waters north of the U.S.-Mexico border and west of the fishery management council demarcation line between the Atlantic Ocean and the Gulf of Mexico. Gillnets are not used in Texas, and large gillnets were excluded from Florida state waters after July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. In the Gulf of Mexico, coastal migratory pelagic resources are the only federally managed species for which gillnet gear is authorized, and only run-around gillnetting for these species allowed (CMPR FMP). In state waters, state and Gulf States Marine Fisheries Commission (GSMFC) Interstate FMPs apply. No marine mammal mortalities associated with commercial gillnet fisheries have been reported in these states, but stranding data suggest that marine mammal interactions with gillnets do occur, causing mortality and serious injury. There are no effort or observer data available for these fisheries. Four mortalities of bottlenose dolphins resulted from gillnet entanglements in Texas and Louisiana during 2003, 2004, 2006, and 2007. The 3 Texas mortalities were a result of fisheries sampling and research by Texas Parks and Wildlife, and the Louisiana mortality (2006) occurred during a gulf sturgeon research project for the Army Corps of Engineers. The Gulf of Mexico Gillnet Fisheries are listed as Category II fisheries in the ~~2009 List of Fisheries~~2010 List of Fisheries (74 FR 58859, November 16, 2009~~73 FR 73066, December 1, 2008~~).

LITERATURE CITED

Barco, S.G, L.R D'Eri, J.J. Schaffler, and W.M. Swingle. 2009. Do alternative leaders affect fish catch at the mouth of the Chesapeake Bay? Final Report to NC Sea Grant Bycatch Marine Mammal Program, Sub-Award #2005-2042-04; Sea Grant #08-DMM-03. VAQF Scientific Report 2009-04. Virginia Beach, VA. 18pp.

Baremore, I.E., J.K. Carlson, L.D. Hollensead and D.M. Bethea 2007. Catch and bycatch in the U.S. southeast gillnet fisheries, 2007. NOAA Tech. Memo. NMFS-SEFSC-565. 19 pp.

Becker, P.R., D. Wilkinson and T. Lillestolen 1994. Marine Mammal Health and Stranding Response Program: Program Development Plan. NOAA Tech. Memo. NMFS-OPR-94-2. 35 pp.

Bellmund, S.A., J.A. Musick, R.C. Klinger, R.A. Byles, J.A. Keinath and D.E. Barnard 1997. Ecology of sea turtles in Virginia, final report to National Marine Fisheries Service Northeast Region. Virginia Institute of Marine Science, Gloucester Point, Virginia. Contract number NA80FAC-00004.

Burdett, L.G. and W.E. McFee 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorisation. J. Cetacean Res. Manage. 6: 231-240.

Carlson, J.K. and D.M. Bethea 2007. Catch and bycatch in the shark gillnet fishery: 2005-2006. NOAA Tech. Memo. NMFS-SEFSC-552. 26 pp.

Clark, S.H. 1998. Status of Fishery Resources off the Northeastern United States for 1998. NOAA Tech. Memo. NMFS-NE-115. 160 pp.

Epperly, S.L., L.P. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton and C. Yeung 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. NOAA Tech. Memo. NMFS-SEFSC-490. 88 pp.

Fairfield Walsh, C. and L.P. Garrison 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539. 52 pp.

Fairfield Walsh, C. and L.P. Garrison 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NOAA NMFS-SEFSC-560. 54 pp.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531. 57 pp.

Garrison, L.P. 2007. Estimated marine mammal and turtle bycatch in the shark gillnet fisheries along the Southeast U.S. Atlantic coast: 2000-2006. NMFS, Southeast Fisheries Science Center, Protected Resources and Biodiversity Division. PRD-07/08-02. 22 pp.

Garrison, L.P., Stokes, L., Fairfield, C.P. 2009. Estimated bycatch o marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591. 63pp.

Gerrior, P., A.S. Williams and D.J. Christensen 1994. Observations of the 1992 U.S. pelagic pair trawl fishery in the Northwest Atlantic. Mar. Fish. Rev. 56(3): 24-27.

Goudy, C.A. 1995. The 1994 experimental pair trawl fishery for tuna in the Northwest Atlantic. Massachusetts Institute of Technology, Sea Grant, Cambridge, MA. MITSWG 95-6 10 pp.

Goudy, C.A. 1996. The 1995 experimental pair trawl fishery for tuna in the Northwest Atlantic. Massachusetts Institute of Technology, Sea Grant, Cambridge, MA MITSG 96-17: 13.

McFee, W.E. and W. Brooks, Jr., 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: a summary. U.S. Fish and Wildlife Service. Unpublished Report.

NMFS-NEFSC. 2003. Fishery Sampling Branch. National Marine Fisheries Service-Northeast Fisheries Science Center, accessed on 11/05/2003, from http://www.nefsc.noaa.gov/fsb/.

NMFS-OPR 2003. Marine Mammal Authorization Program. National Marine Fisheries Service-Office of Protected Resources. http://www.nmfs.noaa.gov/prot_res/PR2/Fisheries_Interactions/MMAP.html. accessed on 11/05/2003

NMFS 2003. Guide for complying with the regulations for Atlantic tunas, swordfish, sharks, and billfish. National Marine Fisheries Service. September 2003. http://www.nmfs.noaa.gov/sfa/hms/2003_ComplianceGuide.pdf

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna driftnet and pair trawl fisheries. NMFS. 40ENNF500160 21 pp.

Smith, J.W., E.A. Hall, N.A. McNeil and W.B. O'Bier 2002. The distribution of purse-seine sets and catches in the Gulf Menhaden fishery in the Northern Gulf of Mexico, 1994-1998. Gulf of Mexico Science 20: 12-24.

Passerotti, M.S. and J.K. Carlson. Catch and bycatch in U.S. southeast gillnet fisheries, 2008. NOAA Tech. Memo. NMFS-SEFSC-583, 19 pp.

Steve, C., J. Gearhart, D. Borggaard, L. Sabo and A.A. Hohn 2001. Characterization of North Carolina Commercial Fisheries with Occasional Interactions with Marine Mammals. NOAA Tech. Memo. NMFS-SEFSC-458. 60 pp.

Wigley, S., M. Terceiro, A. Delong and K. Sosebee 1998. Proration of 1994-96 USA Commercial Landings of Atlantic Cod, Haddock and Yellowtail Flounder to Unit Stock Areas. Northeast Fish. Sci. Cent. Ref. Doc. 98-02.

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Appendix III: Fishery Descriptions - List of Figures

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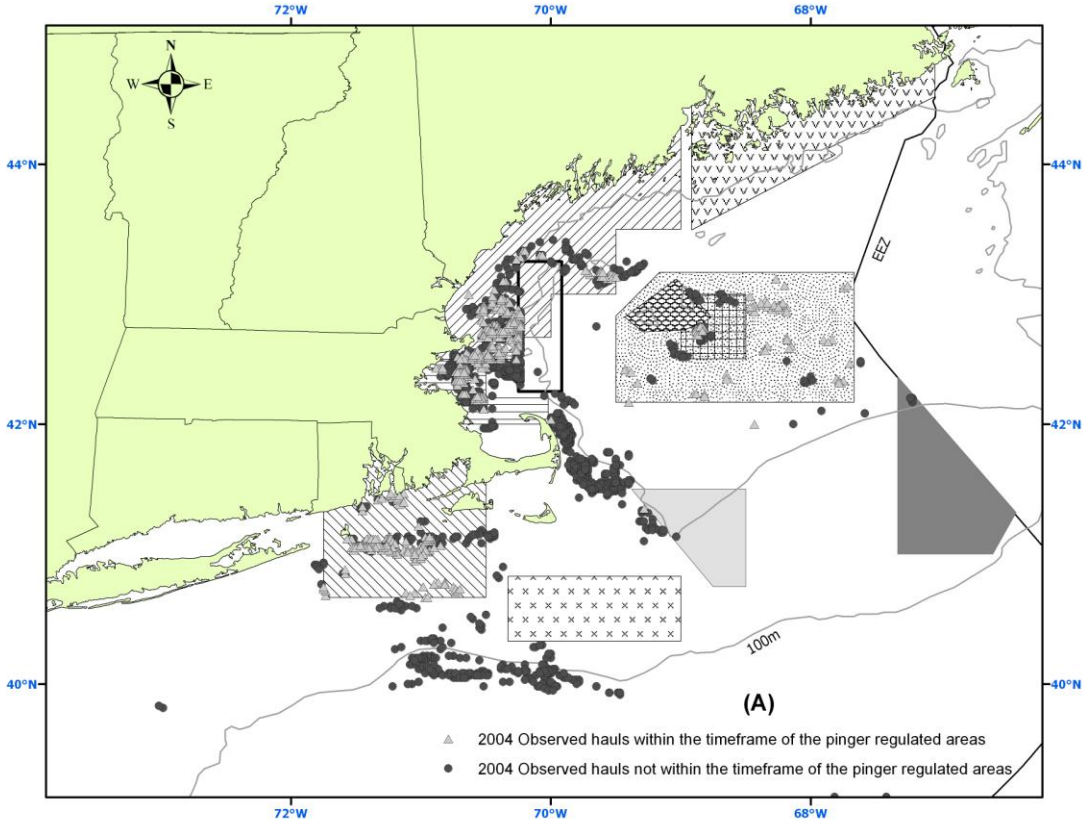
Figure 50. 2008 Observed sets and marine mammal interactions in the pelagic longline fishery - Gulf of Mexico.

Figure 1. 2004 Northeast sink gillnet observed hauls (A) and observed takes (B).

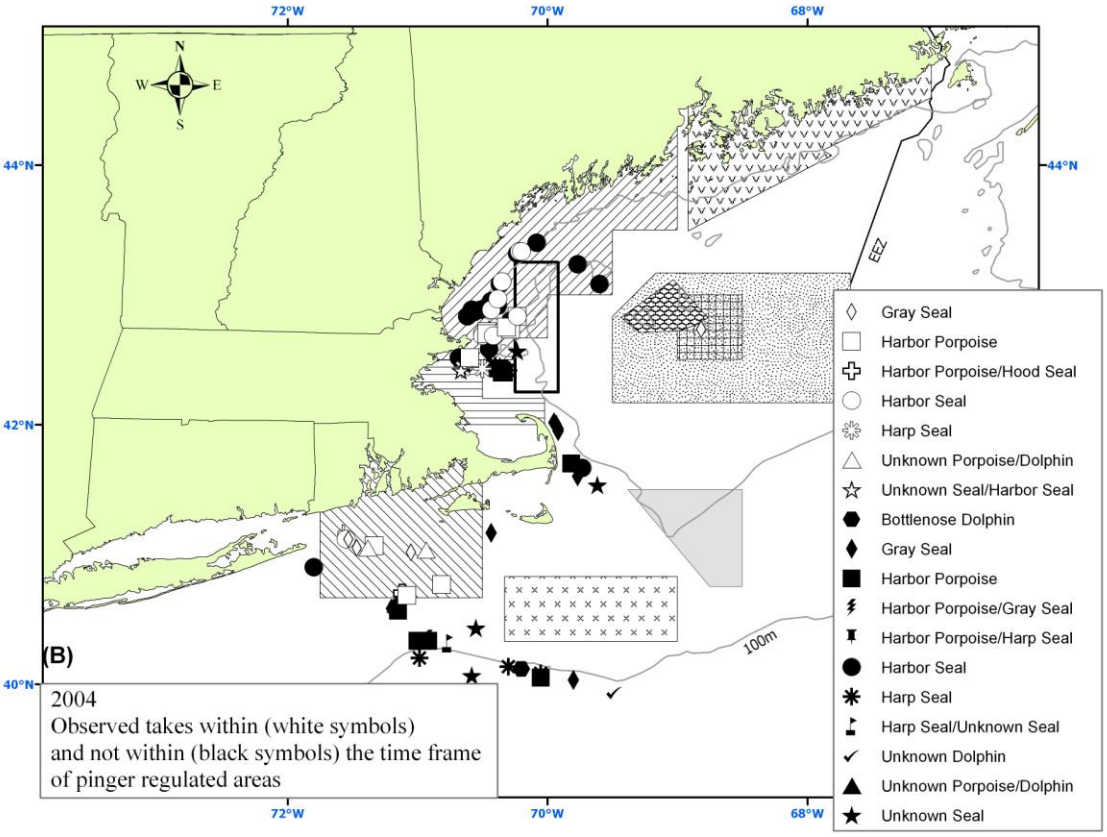


Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure (FMP)

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure



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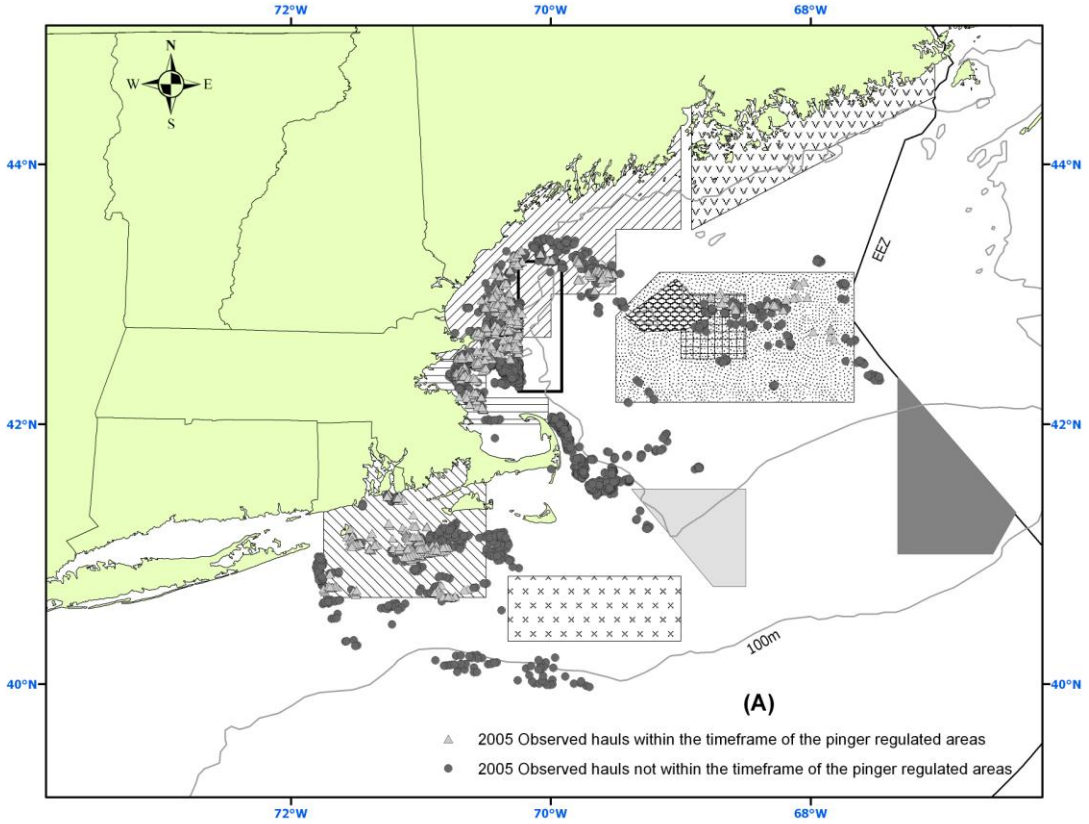

Multispecies Fisheries Management Plan year-round closures:

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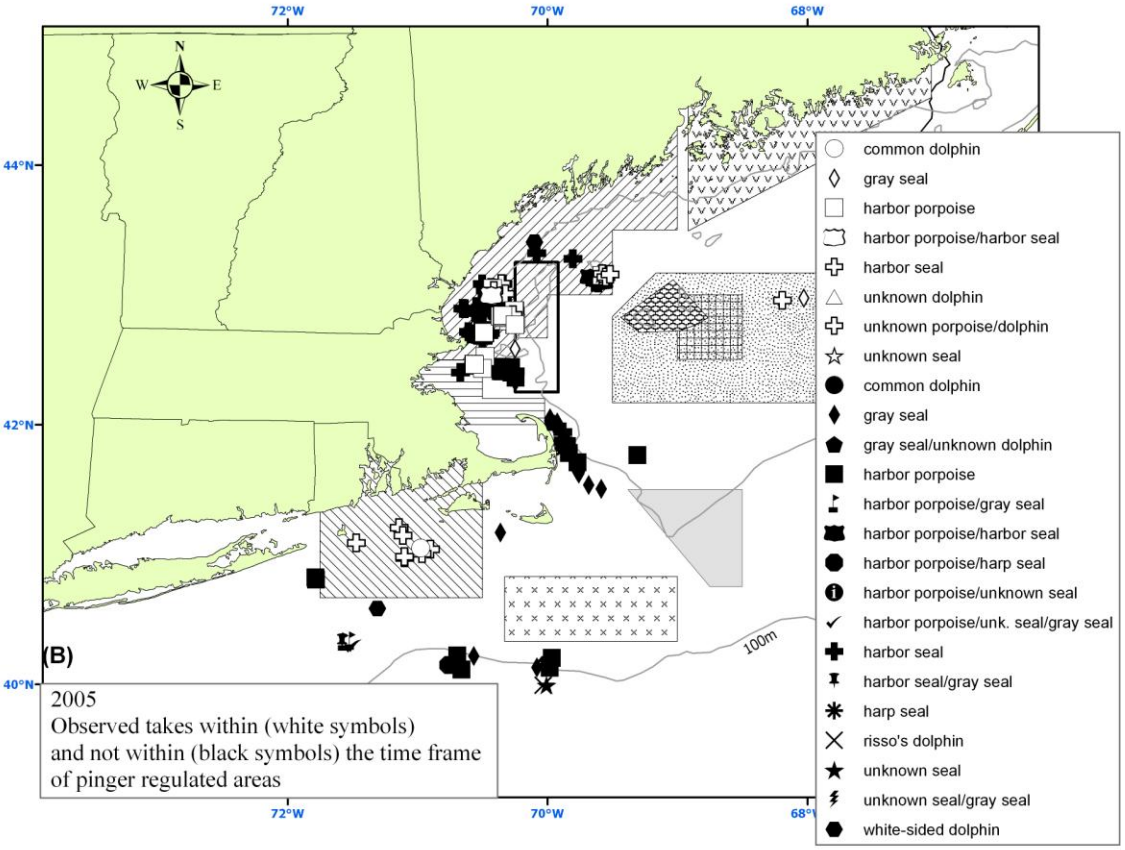
Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure



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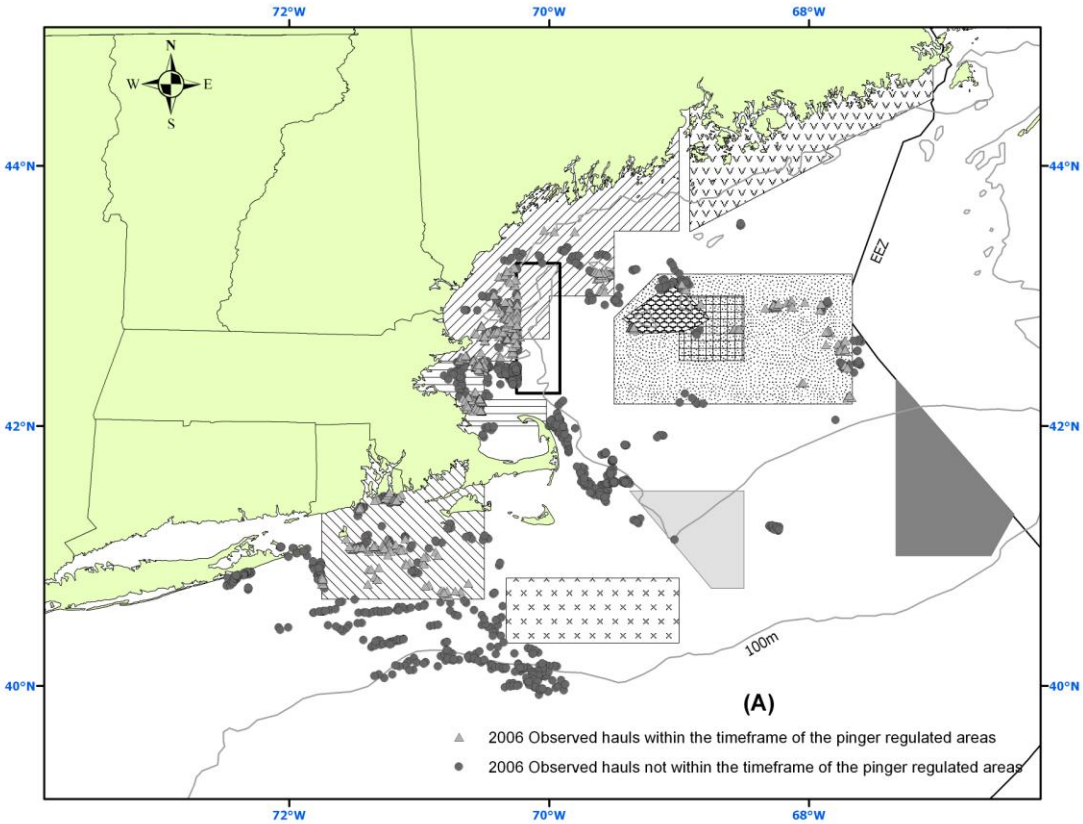
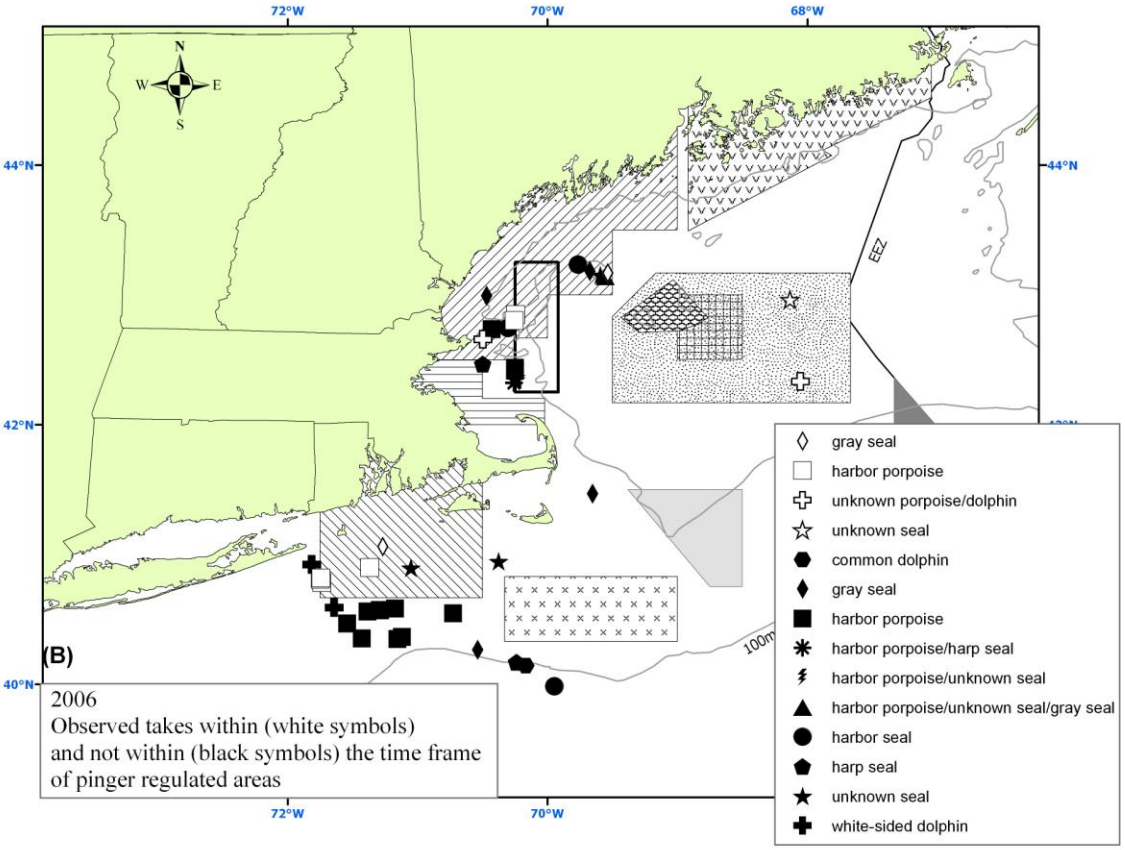


Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure (FMP)

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure



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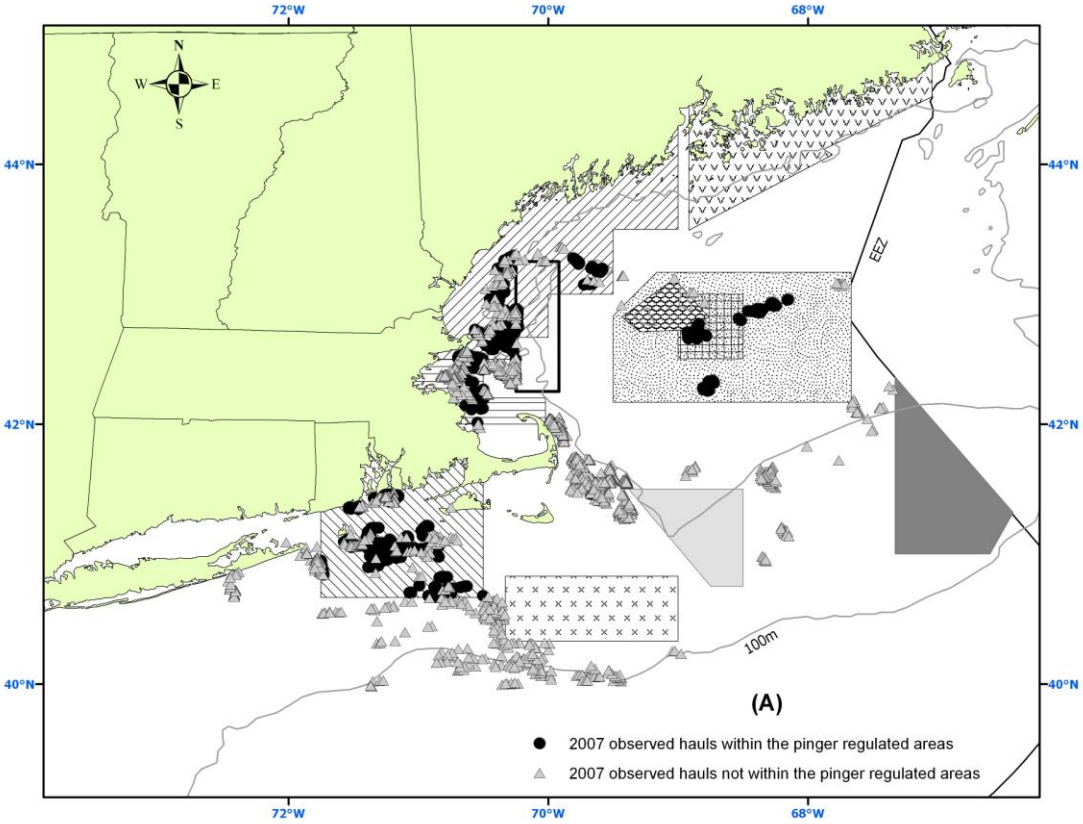


Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure (FMP)

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

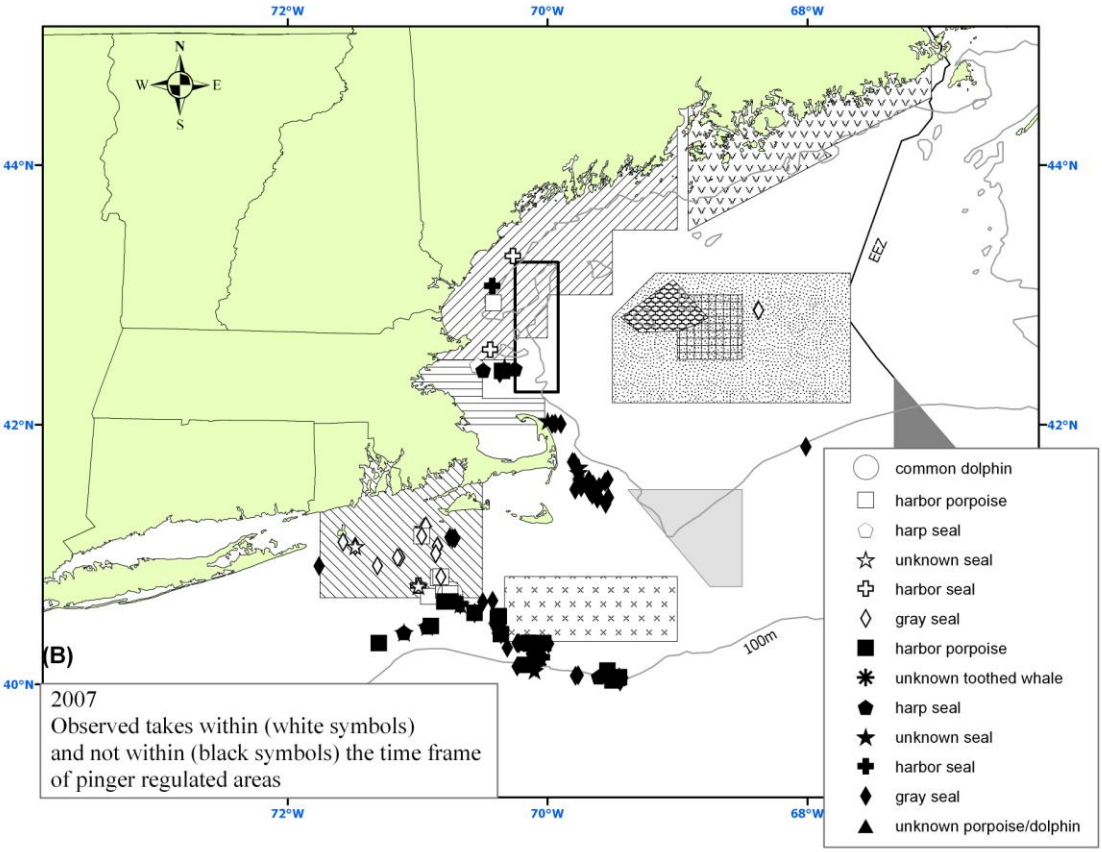
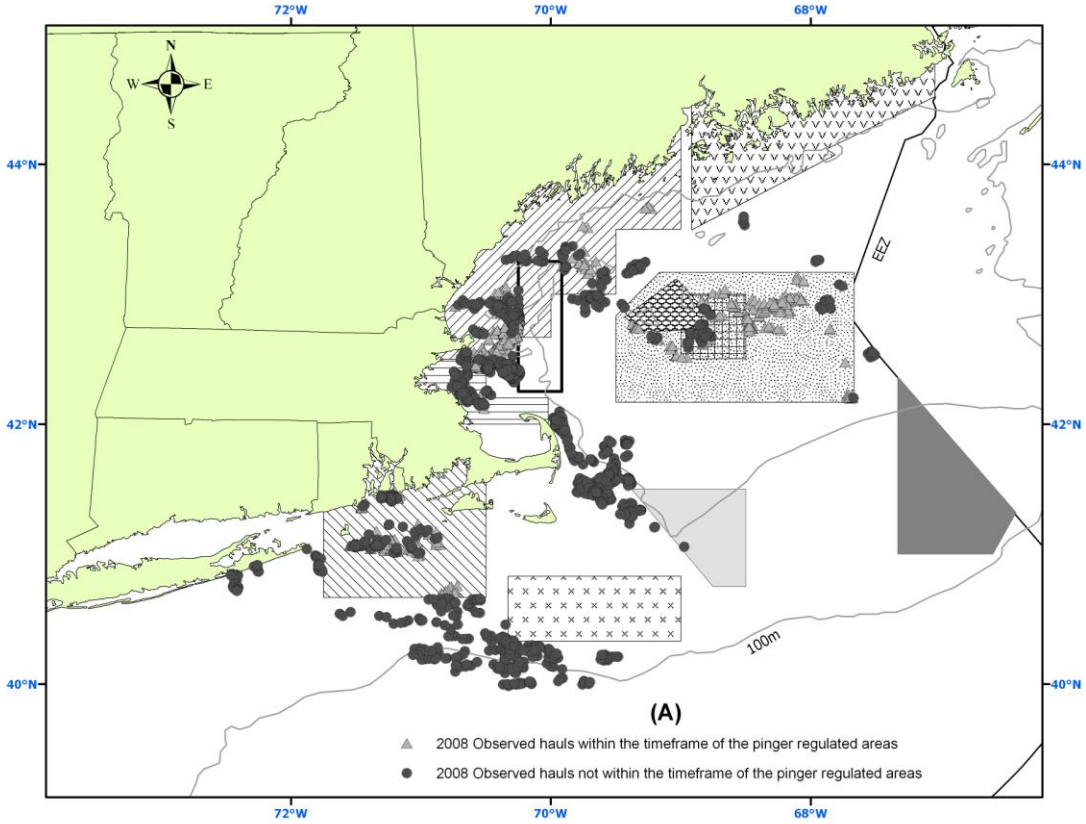


Figure 5. 2008 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure (FMP)

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

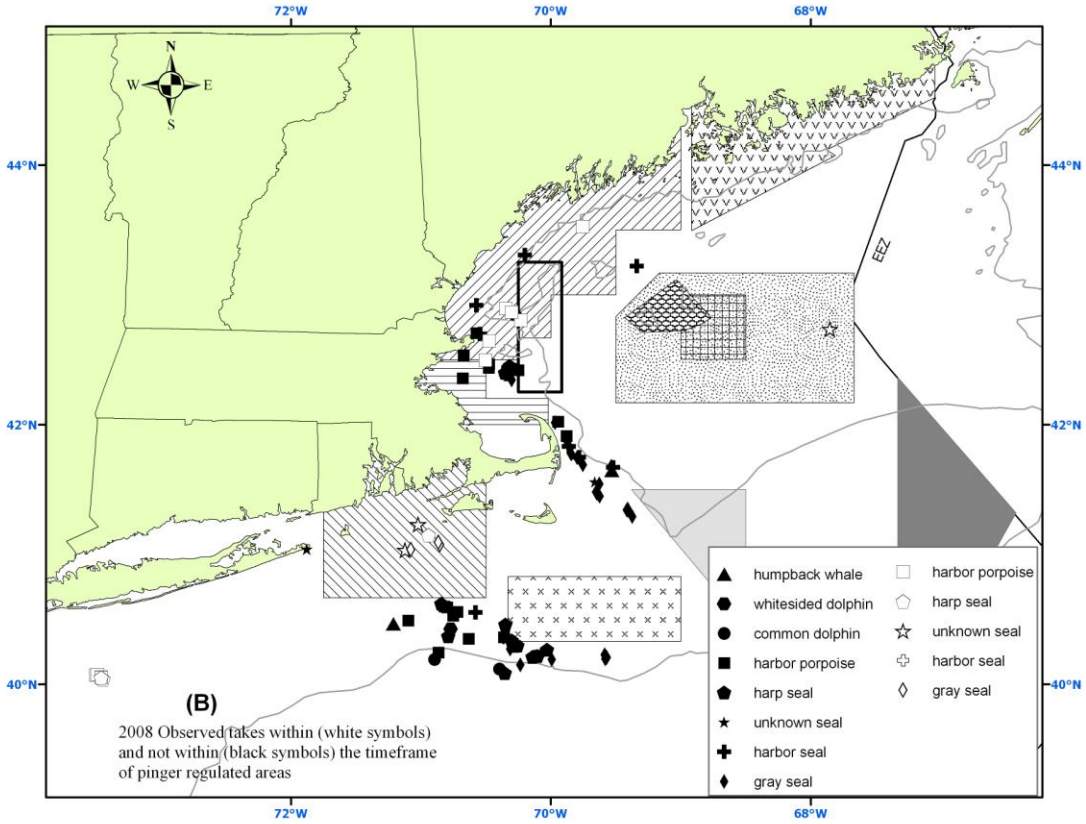
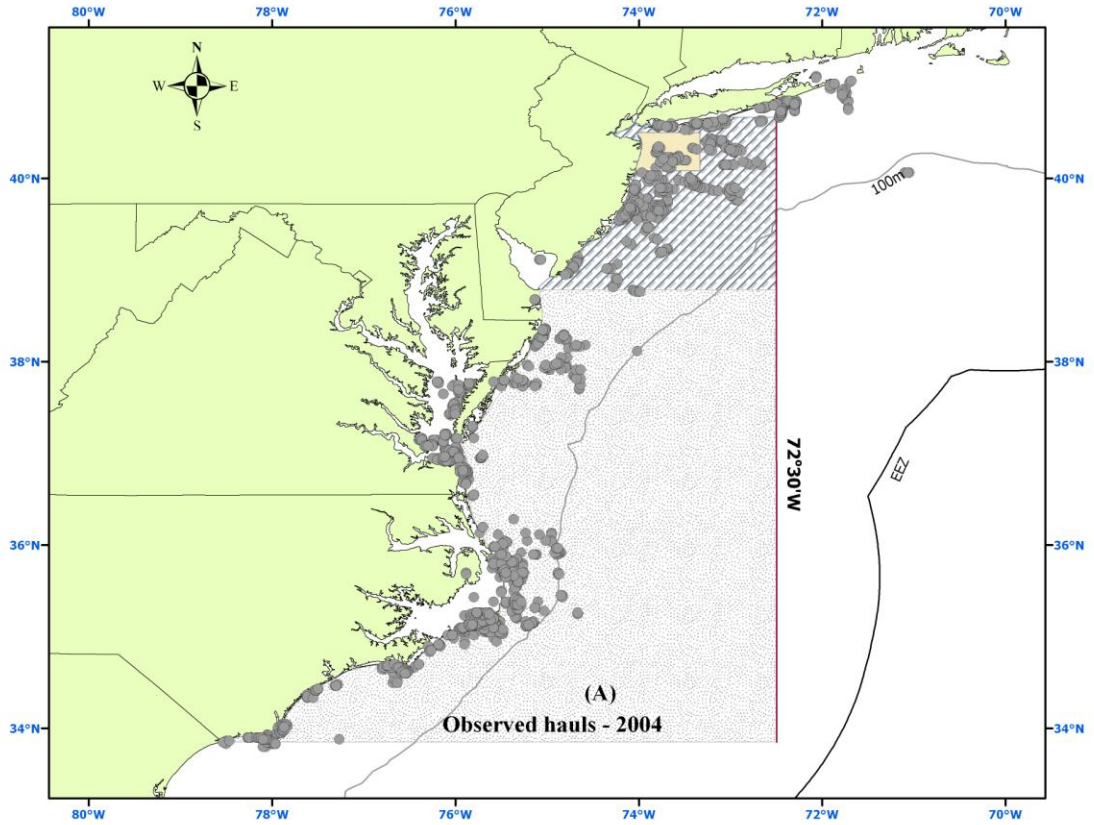


Figure 6. 2004 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

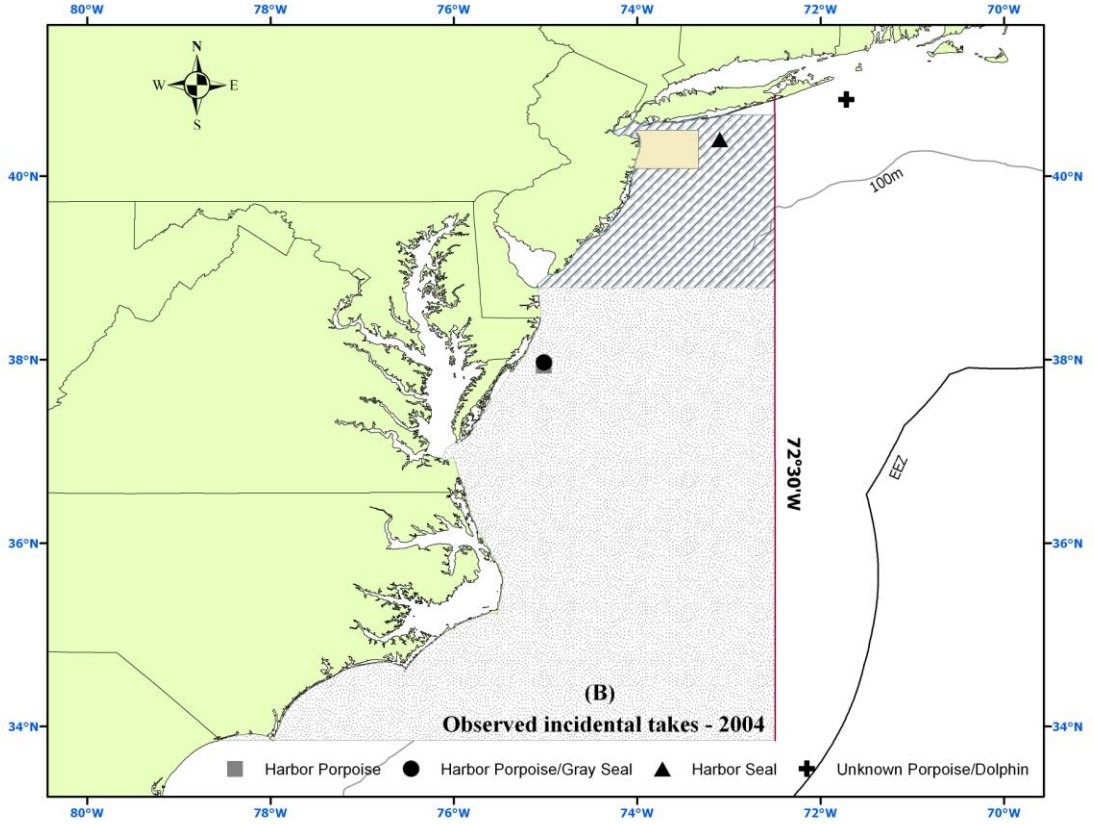
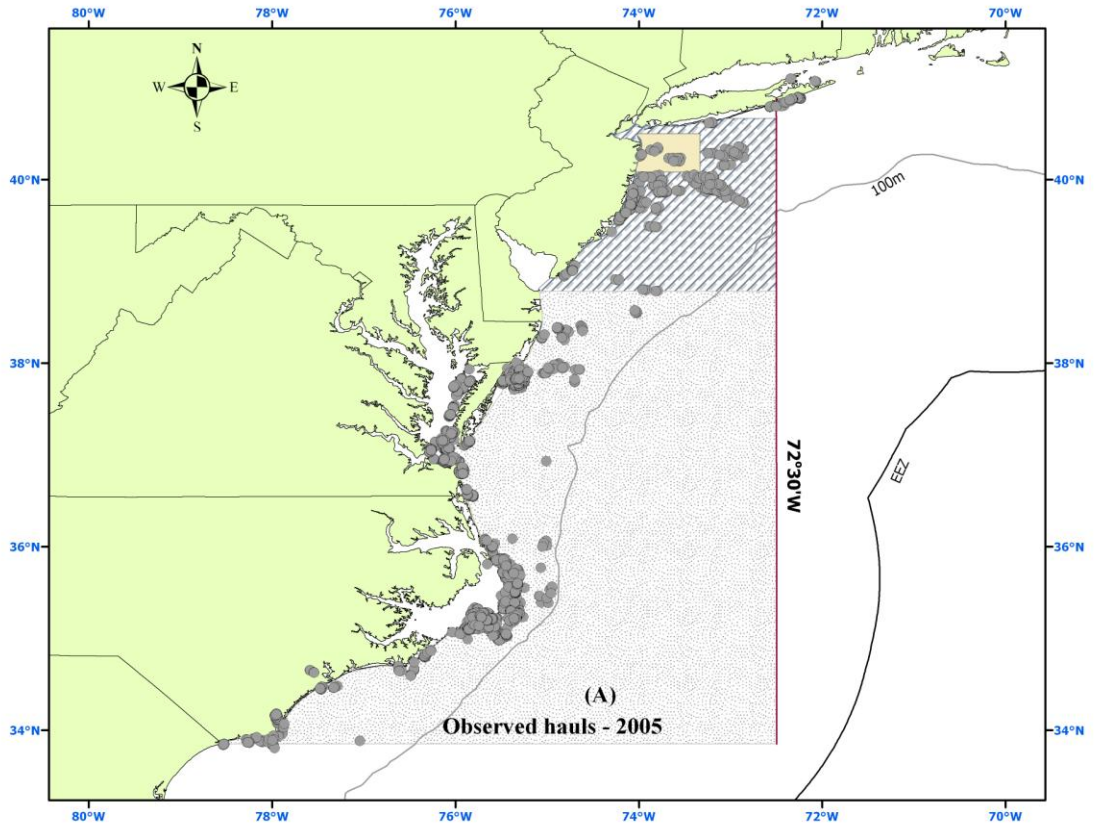


Figure 7. 2005 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

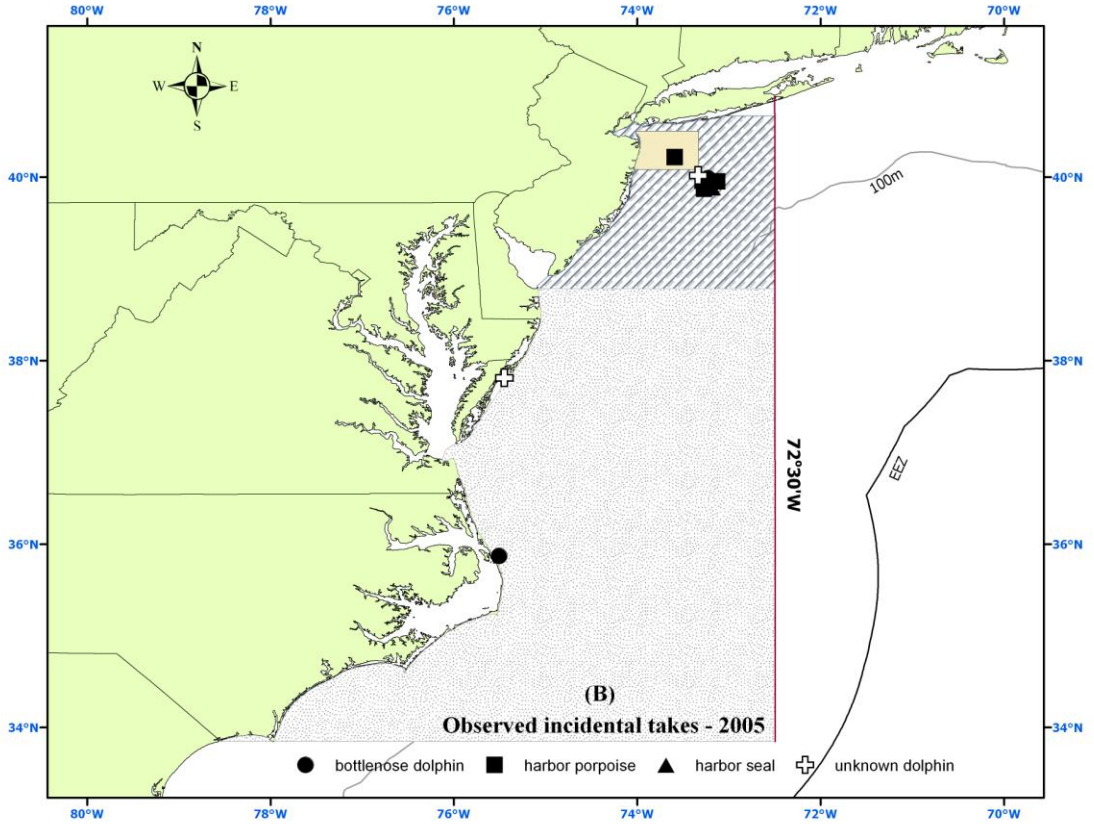
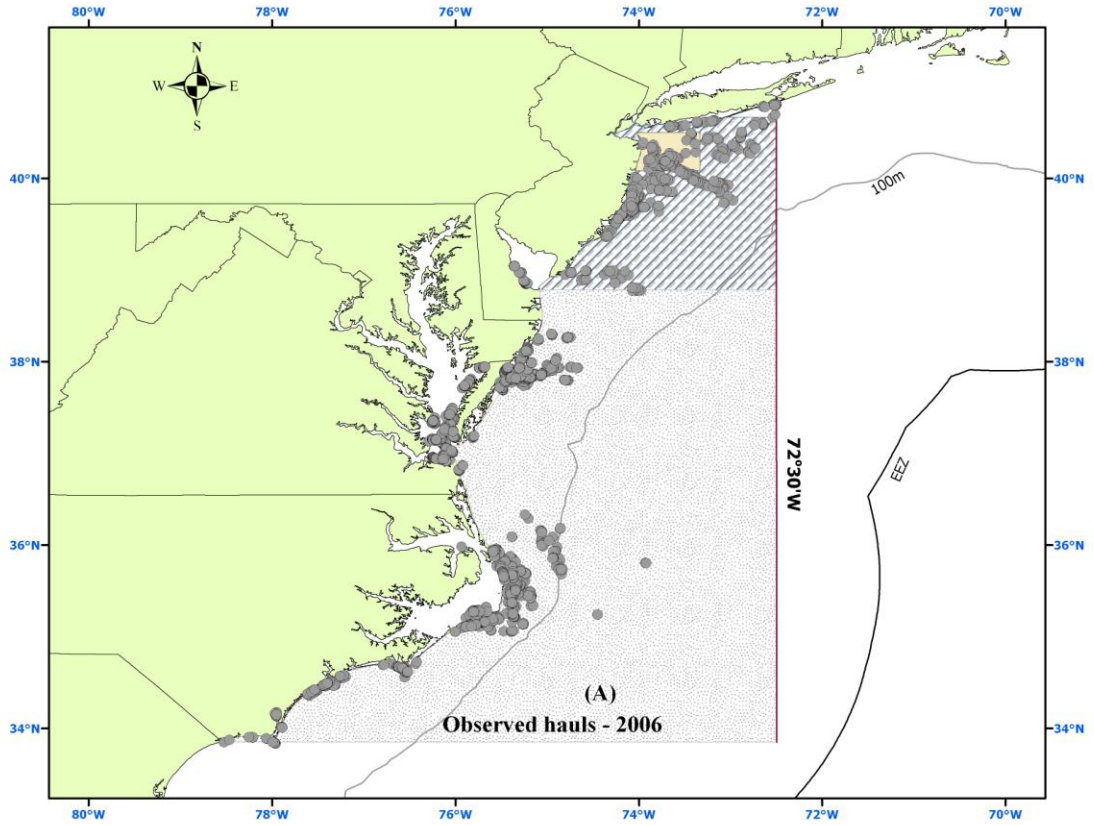


Figure 8. 2006 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

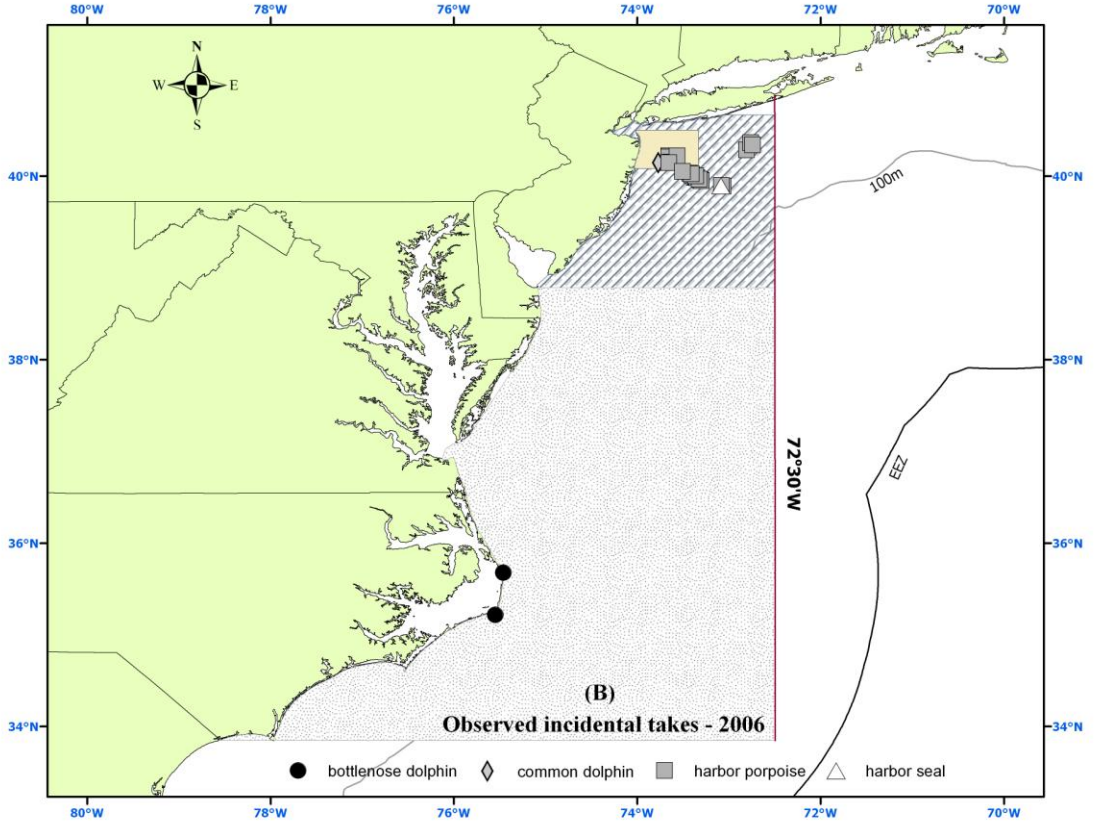
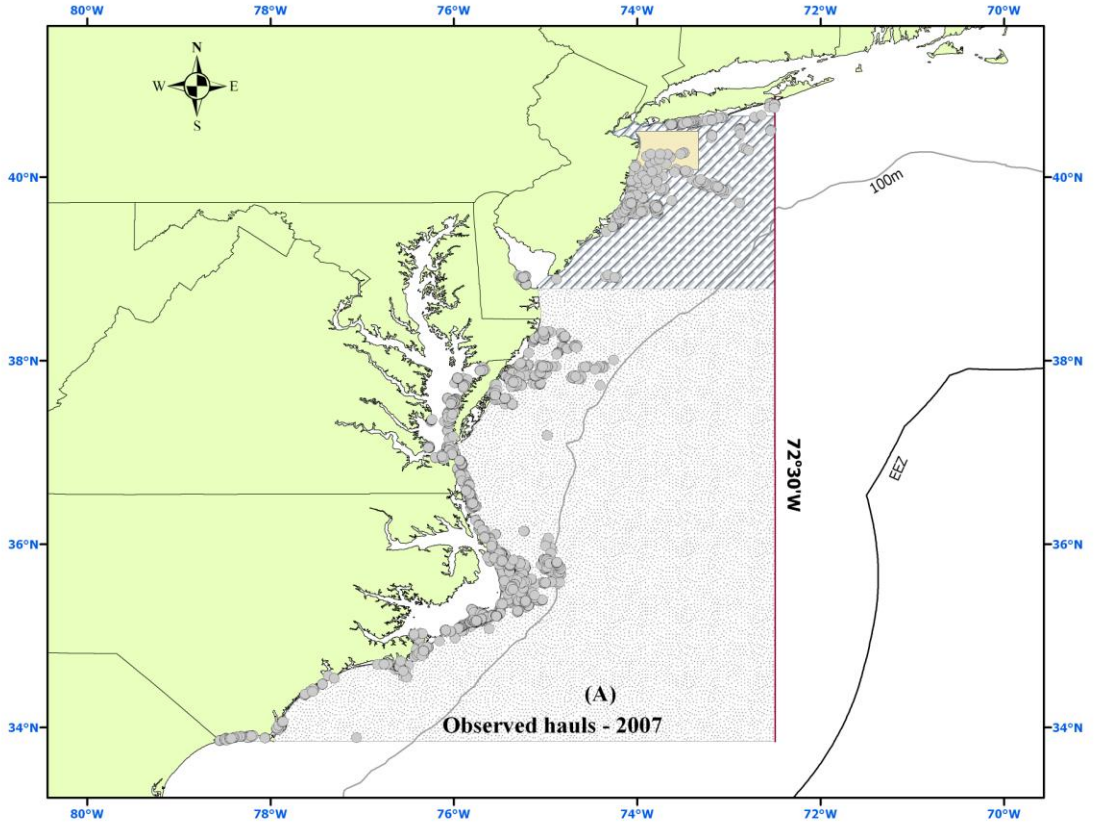


Figure 9. 2007 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

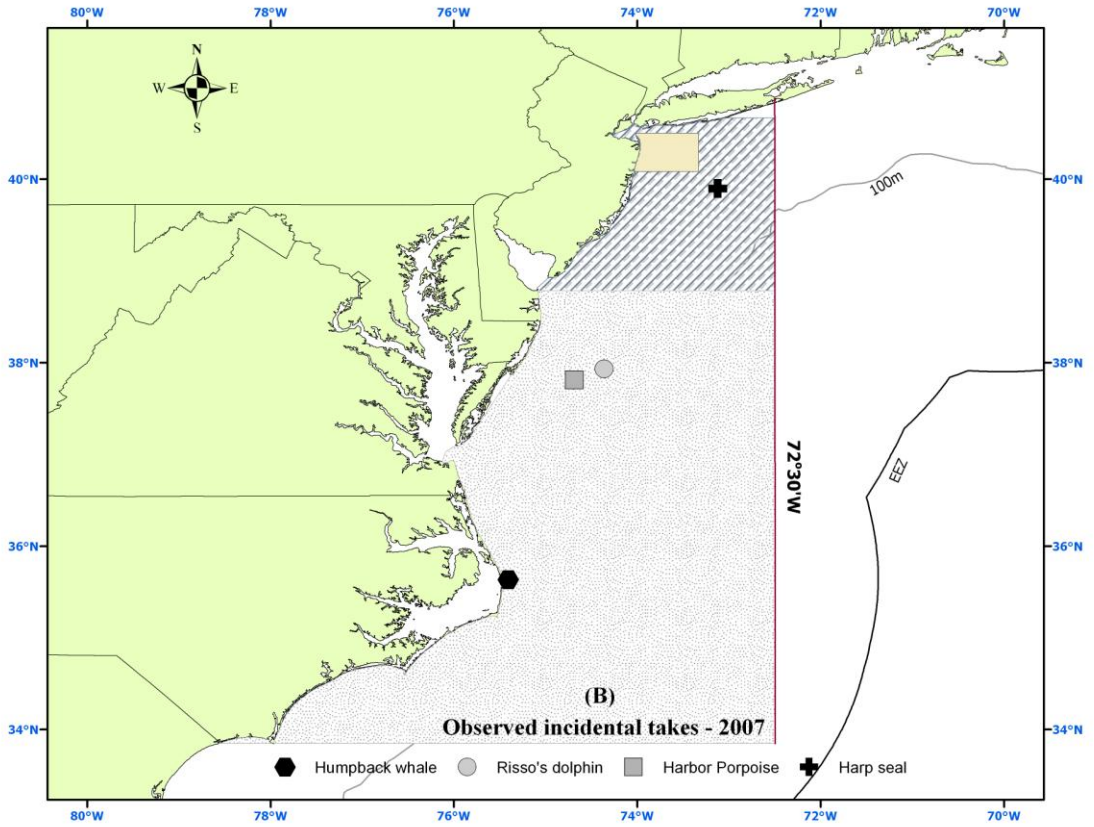
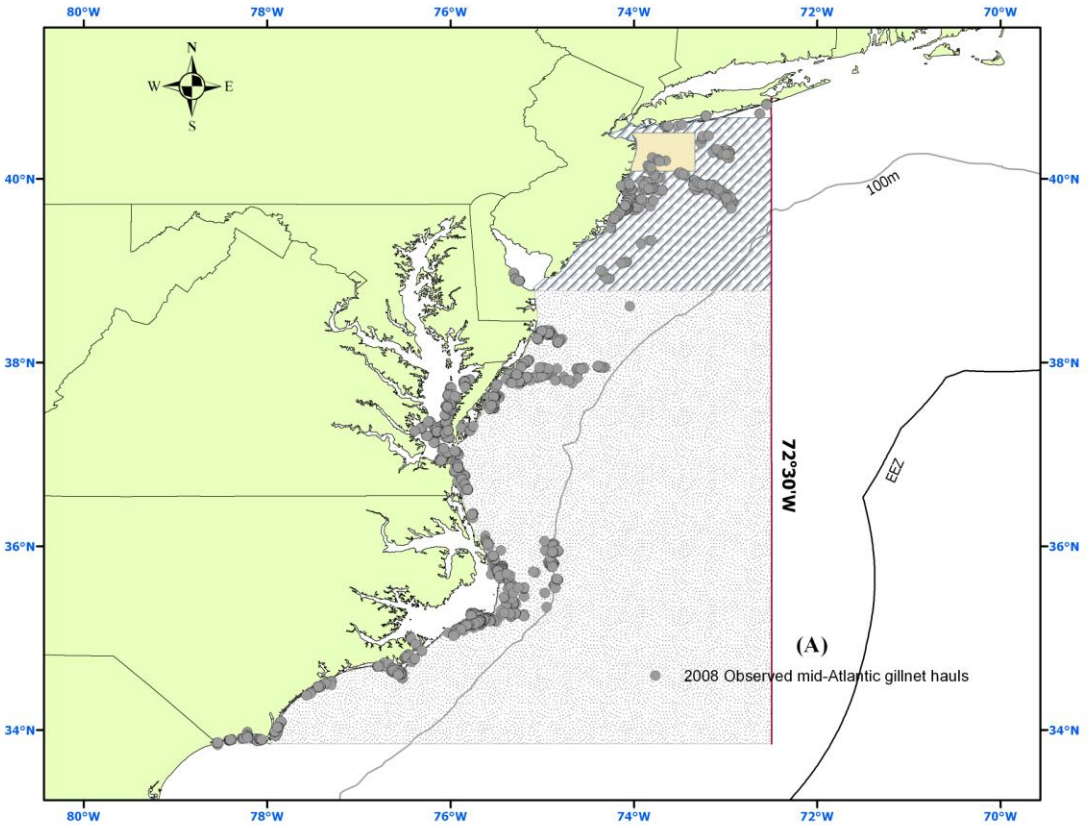


Figure 10. 2008 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

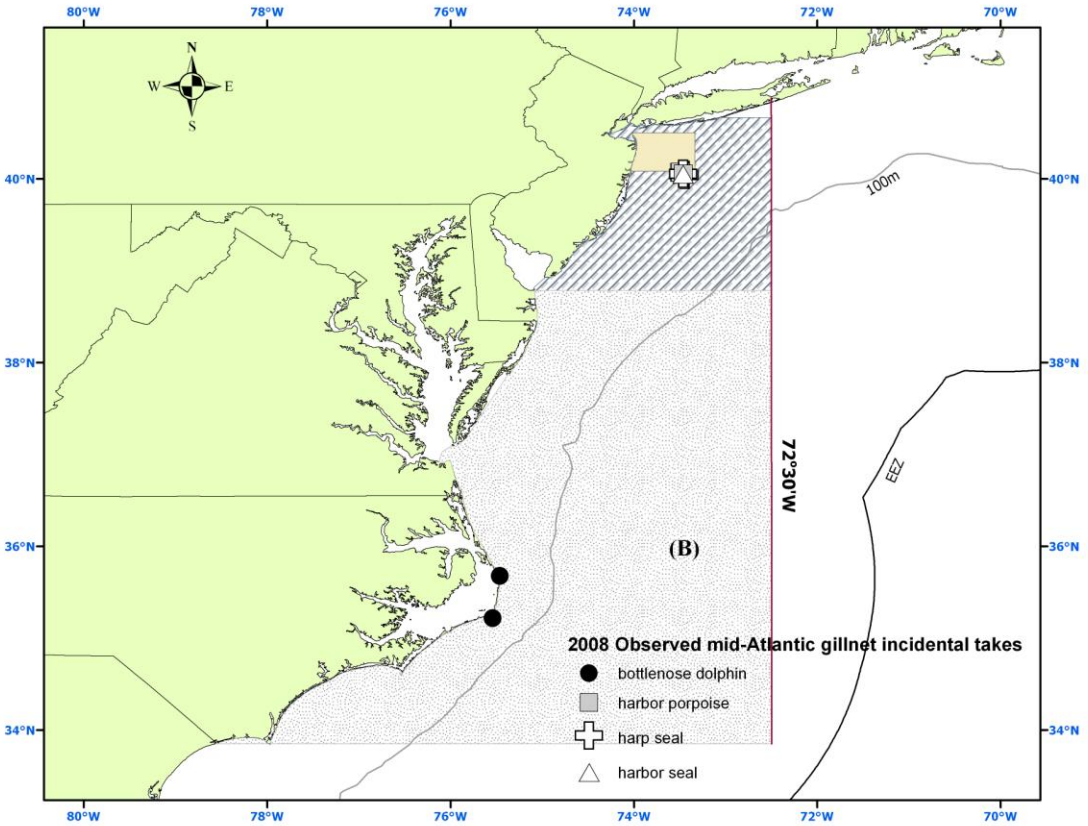


Figure 11. 2004 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

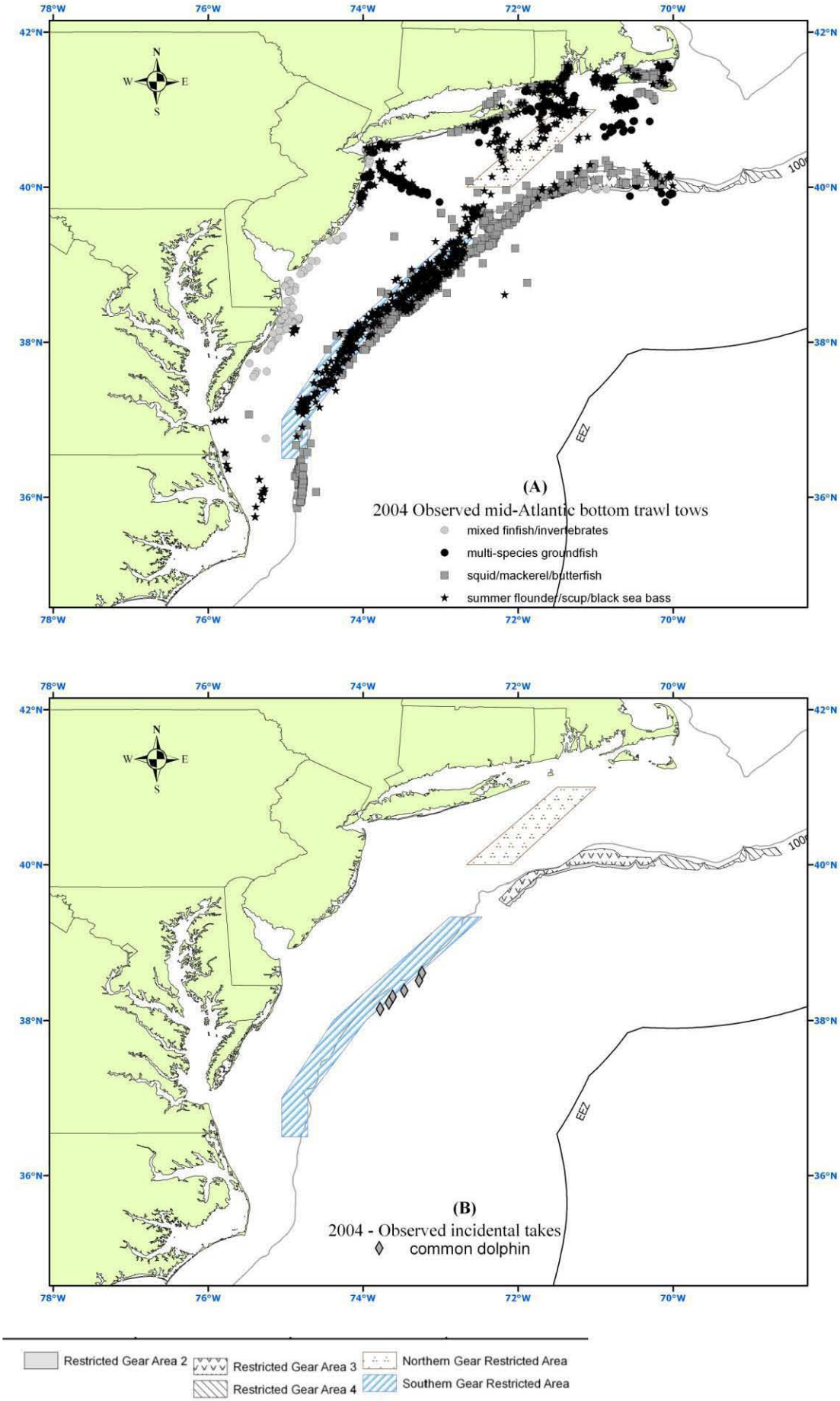


Figure 12. 2005 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

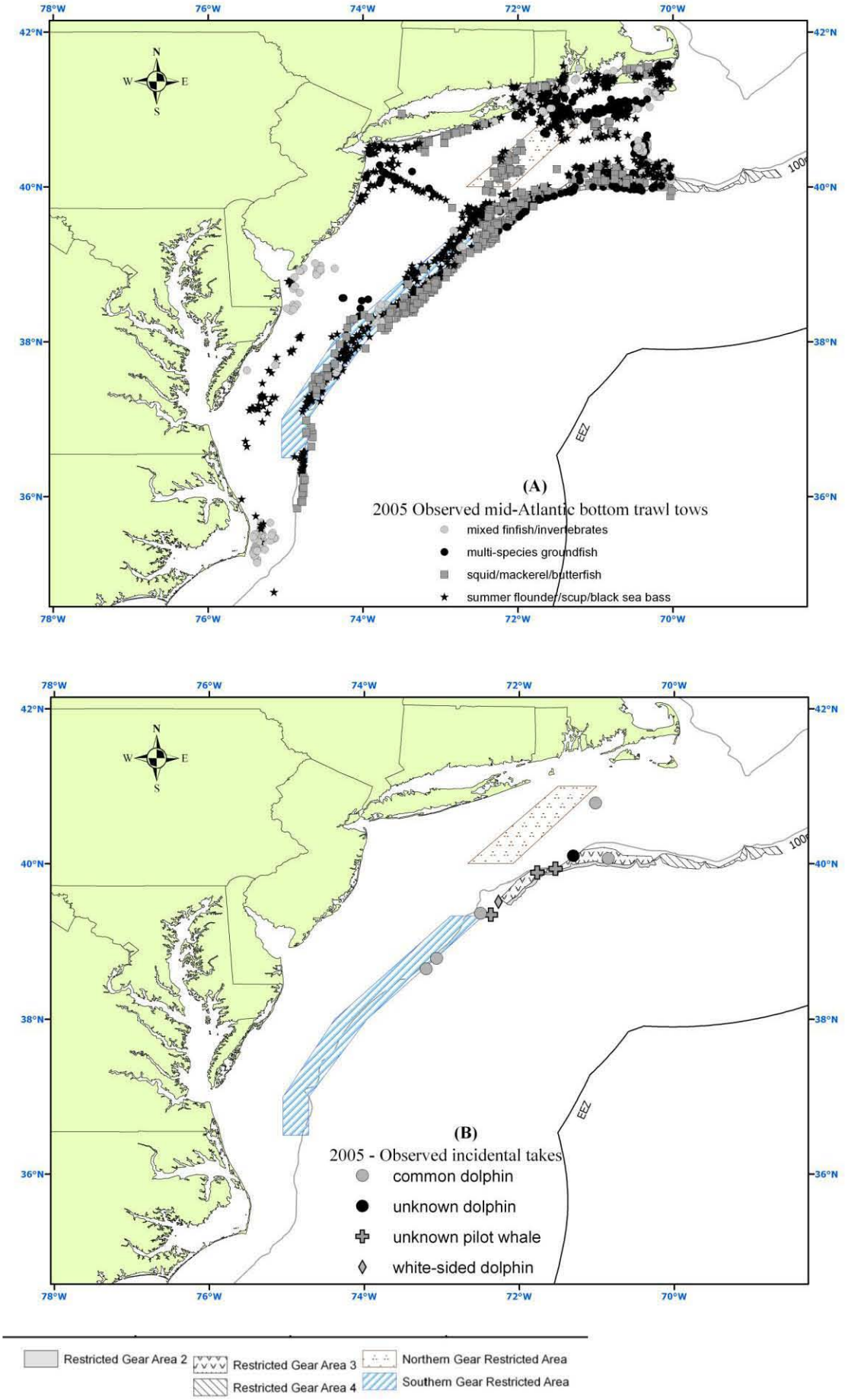


Figure 13. 2006 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

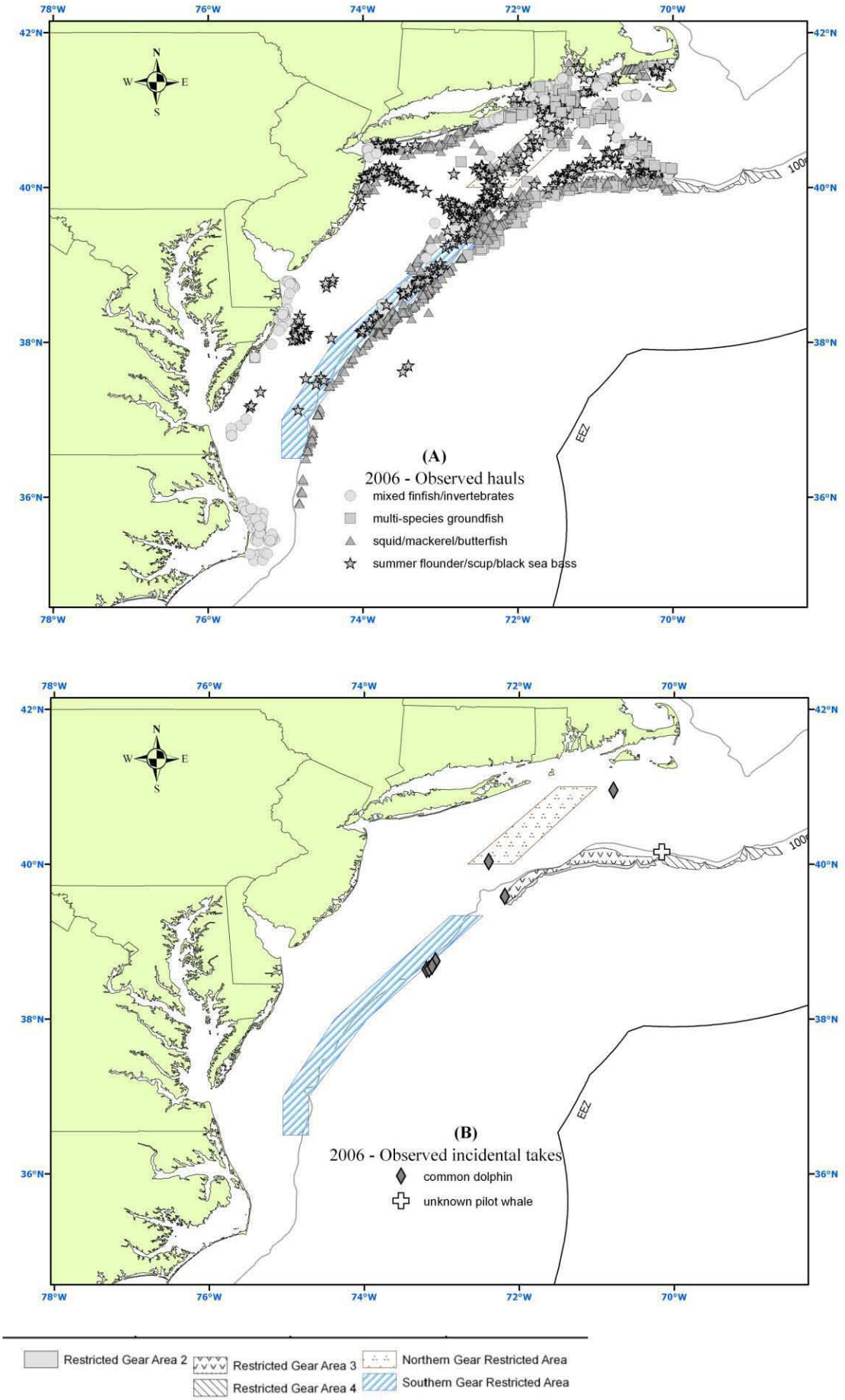


Figure 14. 2007 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

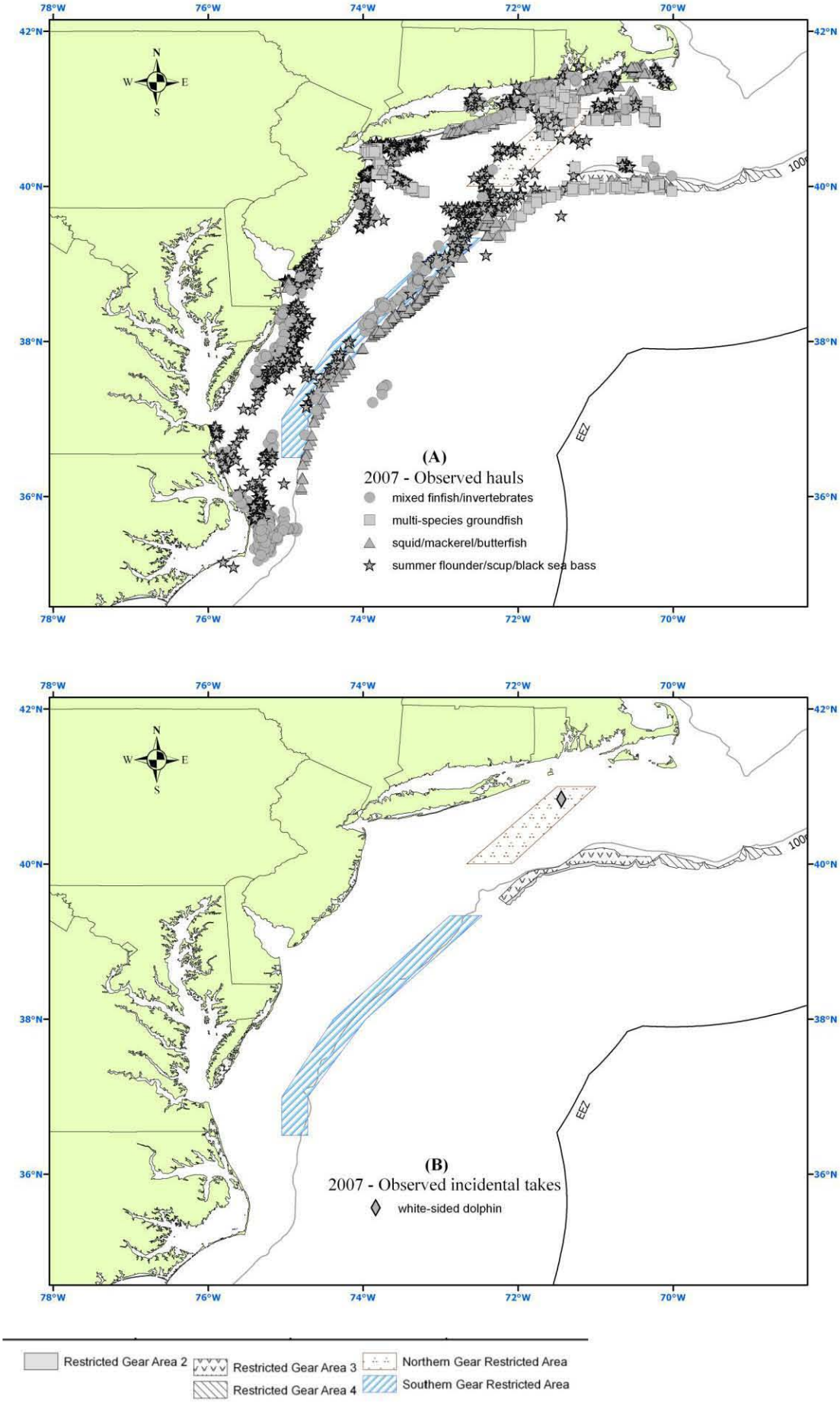


Figure 15. 2008 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

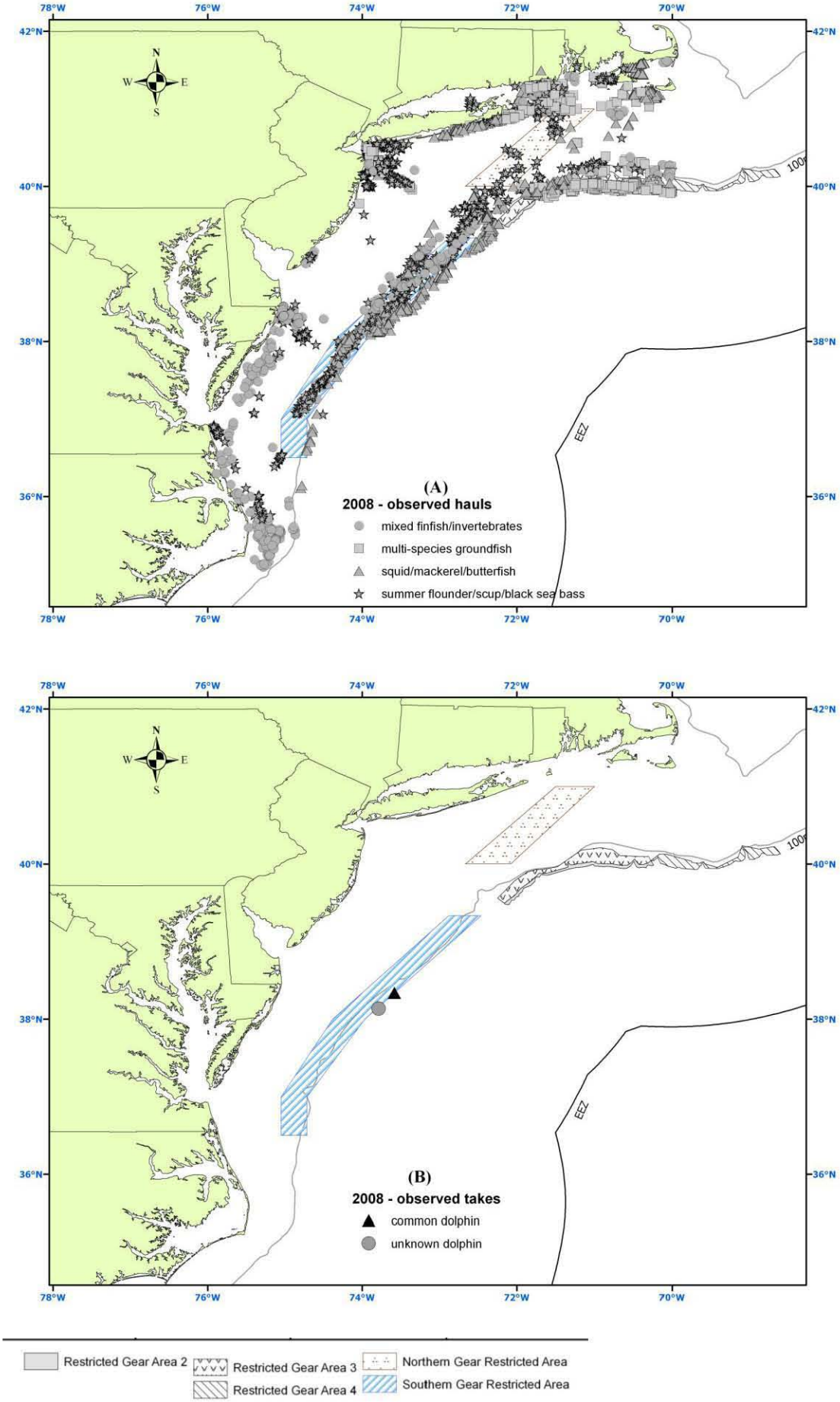


Figure 16. 2004 Northeast bottom trawl observed tows (A) and observed takes (B).

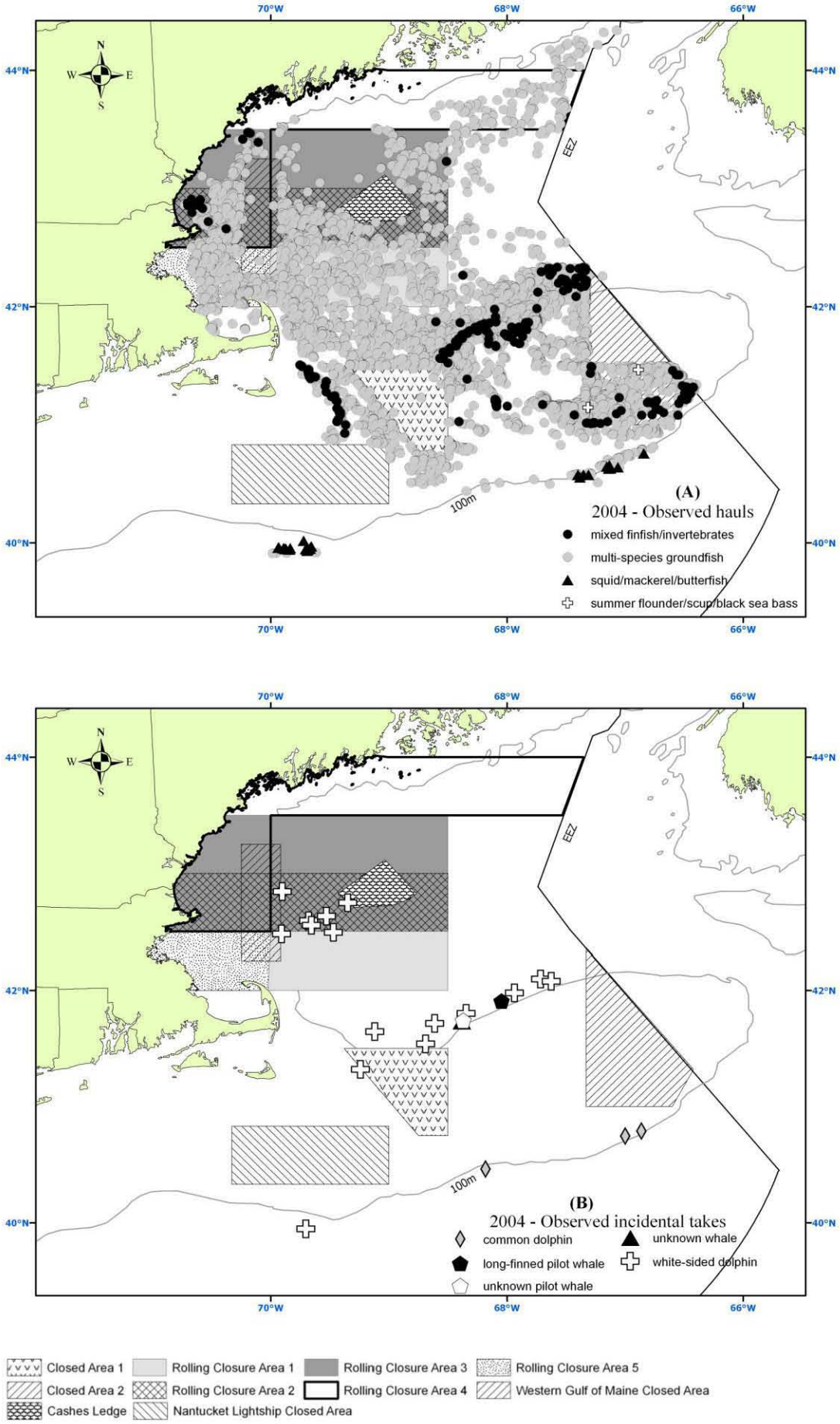


Figure 17. 2005 Northeast bottom trawl observed tows (A) and observed takes (B).

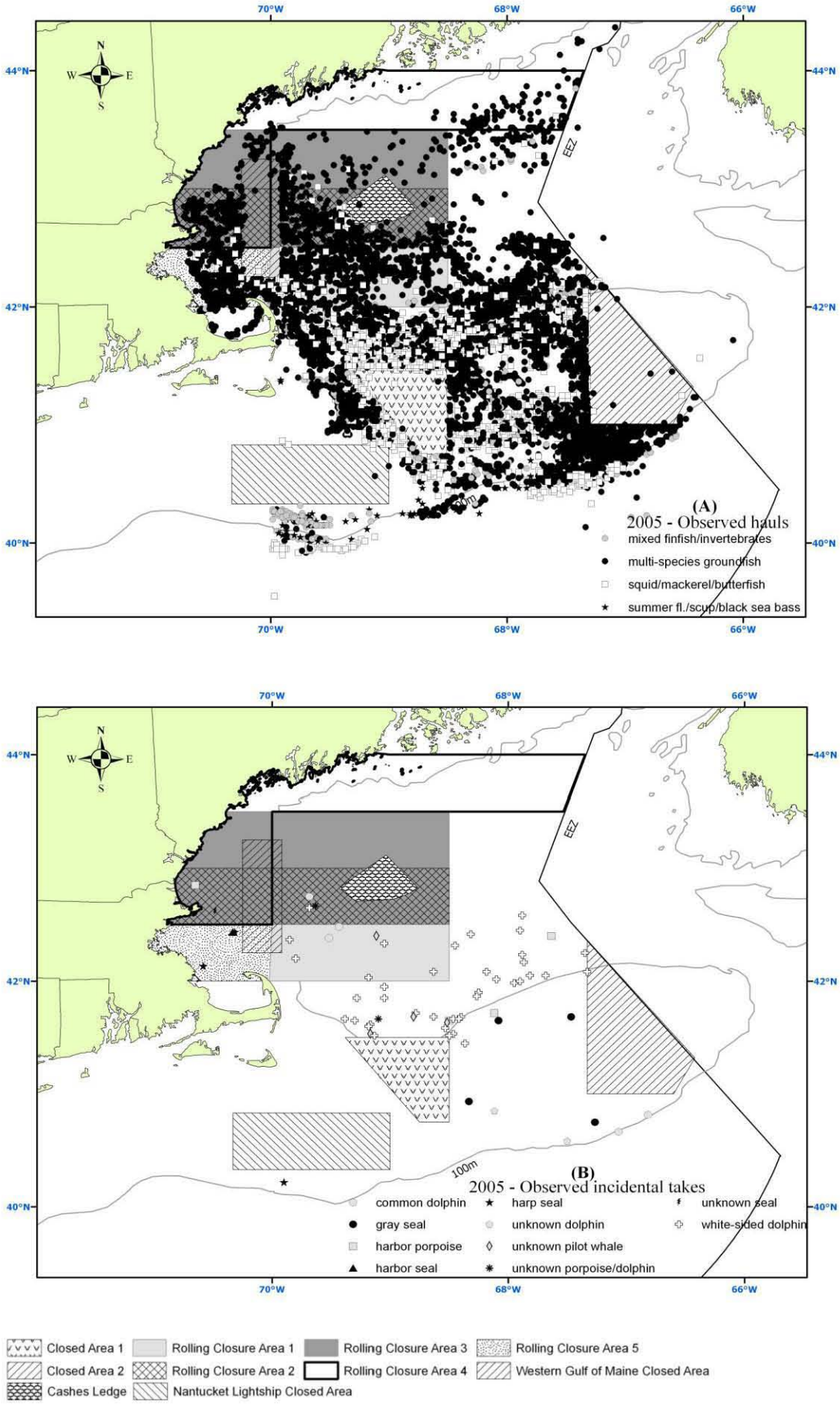


Figure 18. 2006 Northeast bottom trawl observed tows (A) and observed takes (B).

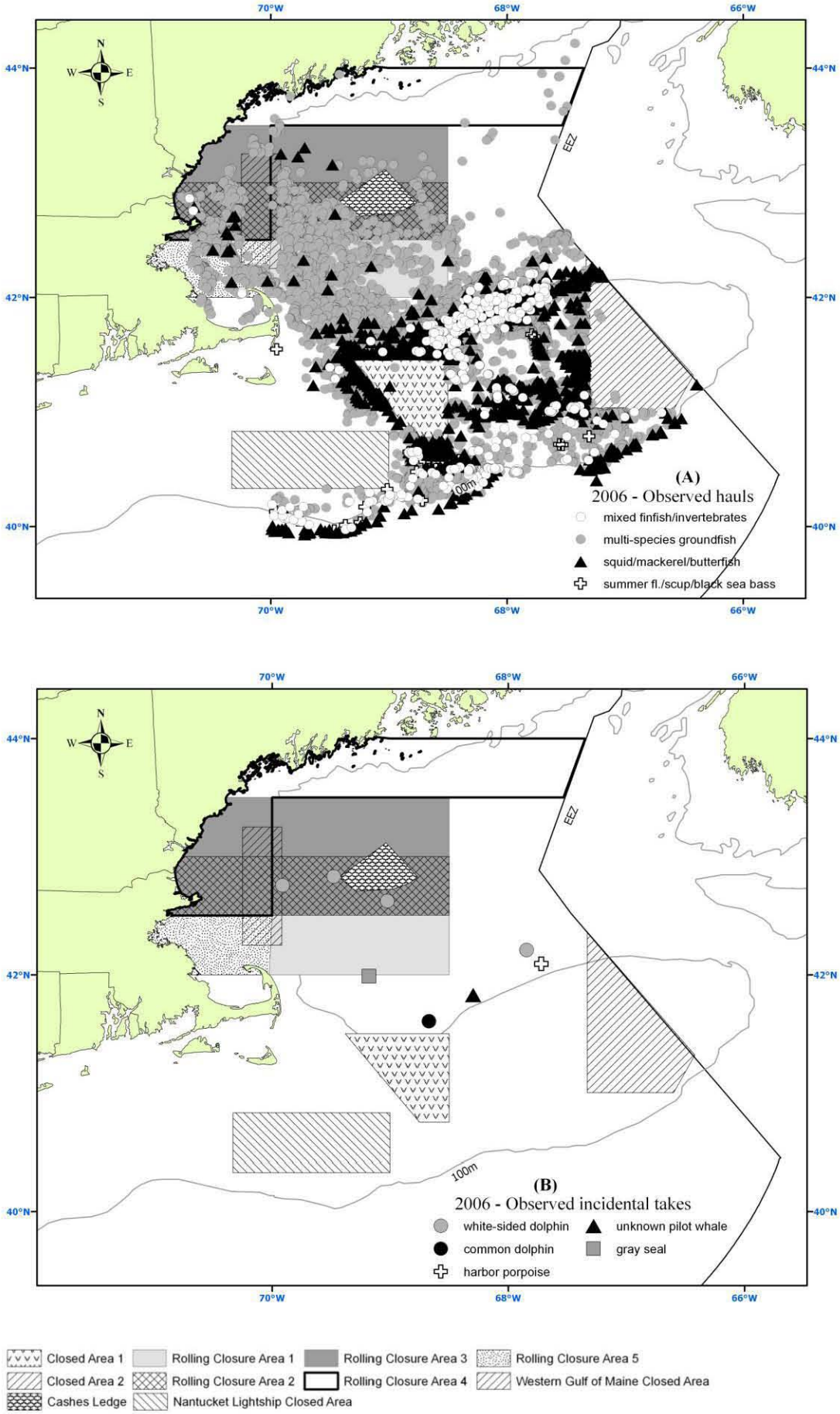


Figure 19. 2007 Northeast bottom trawl observed tows (A) and observed takes (B).

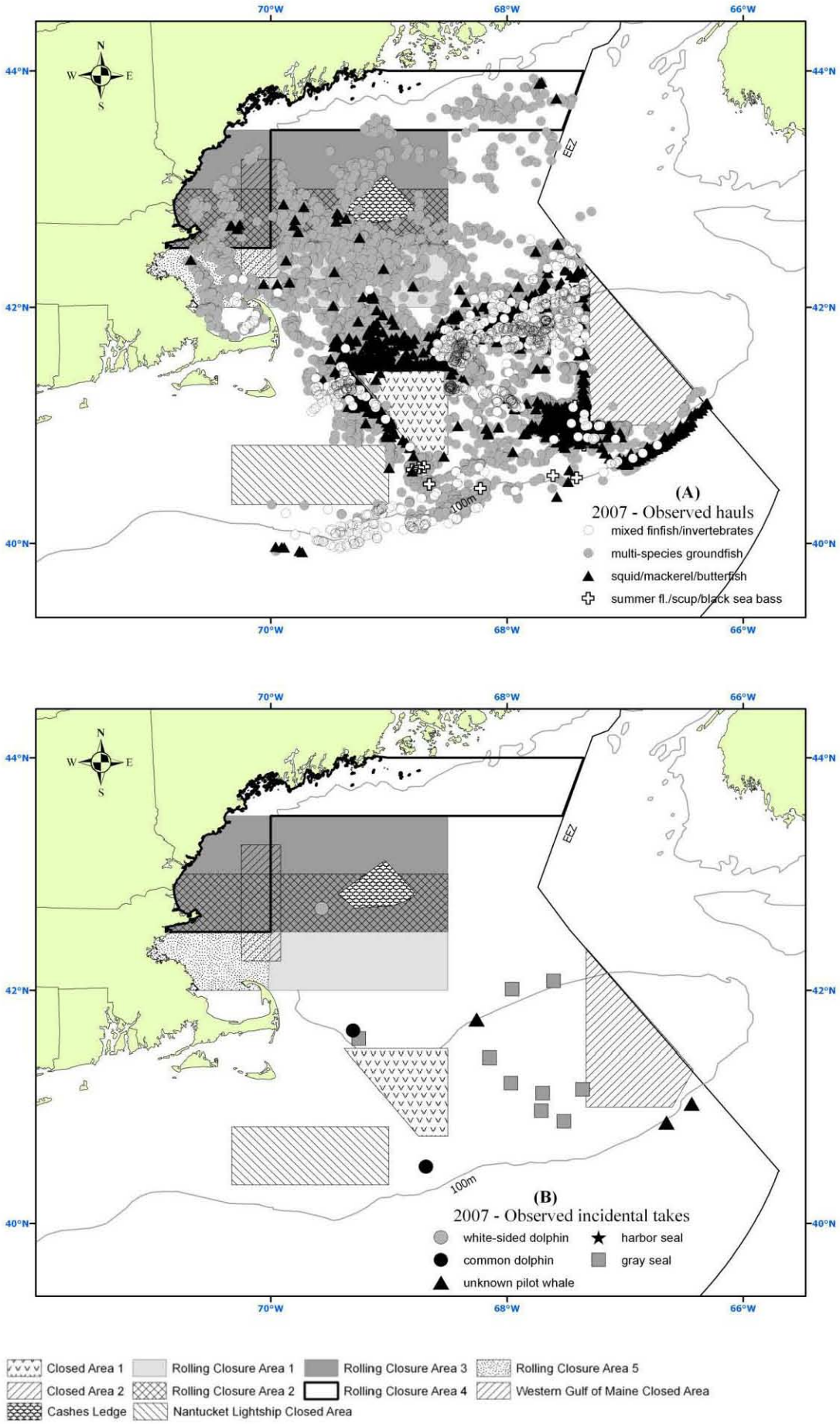


Figure 20. 2008 Northeast bottom trawl observed tows (A) and observed takes (B).

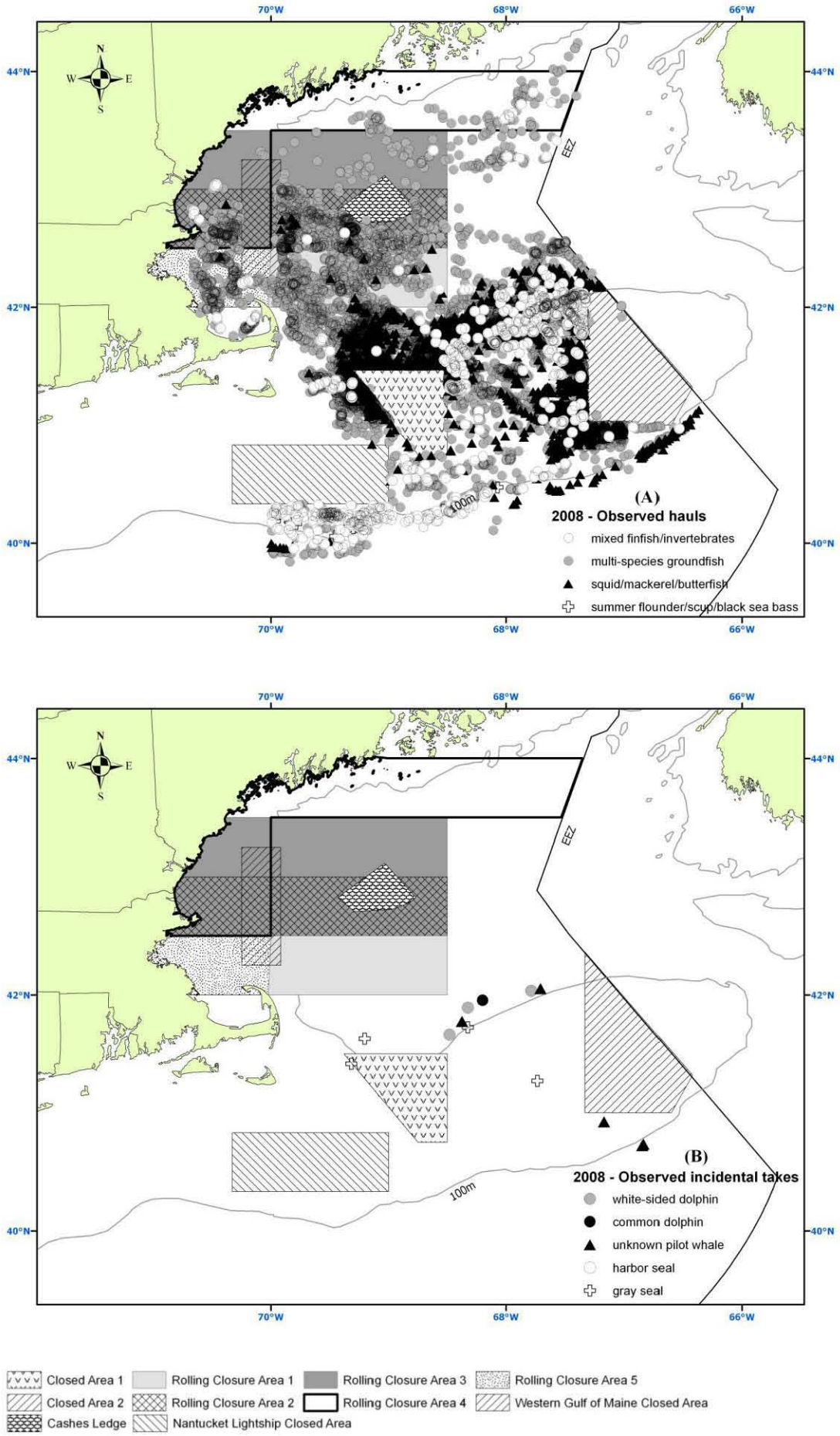
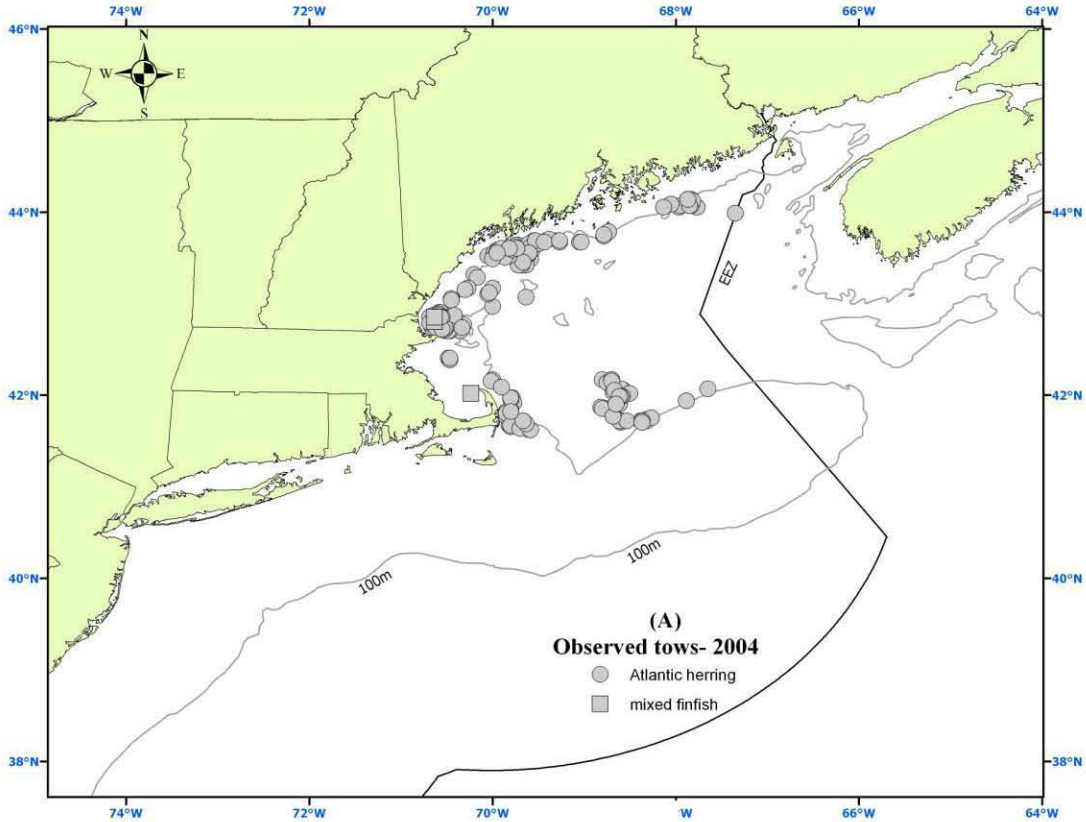


Figure 21. 2004 Northeast mid-water trawl observed tows (A) and observed takes (B).



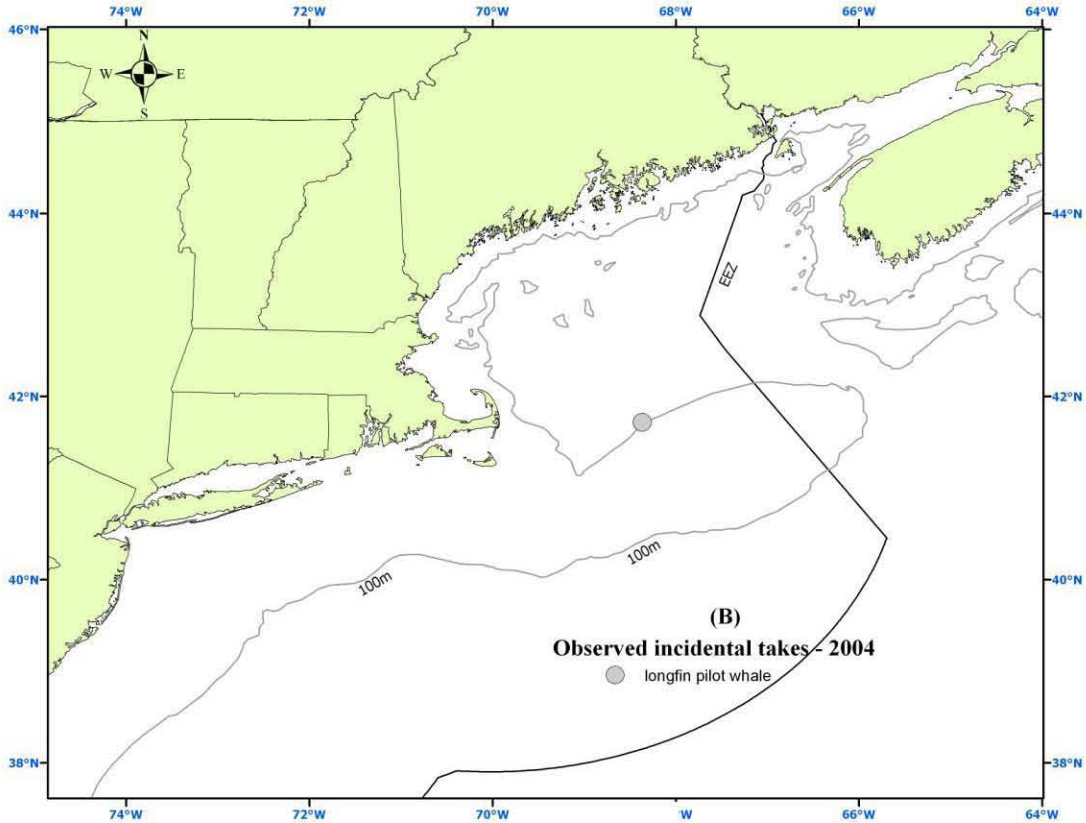
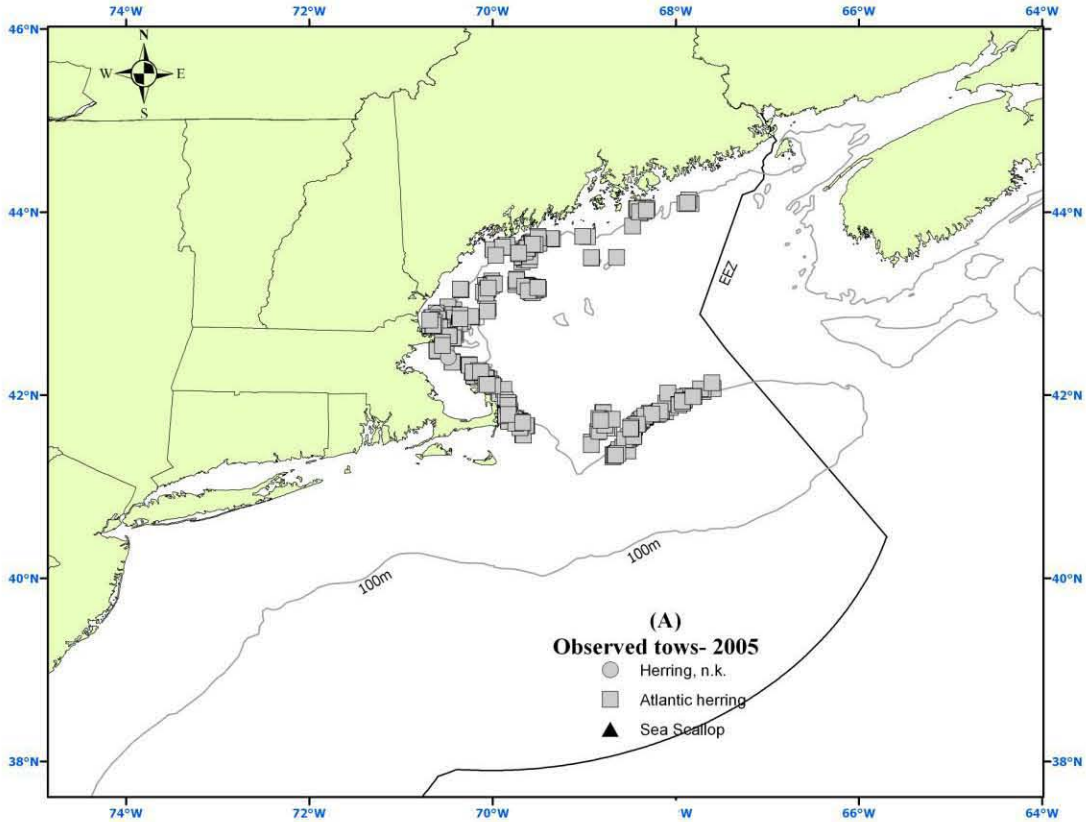


Figure 22. 2005 Northeast mid-water trawl observed tows (A) and observed takes (B).



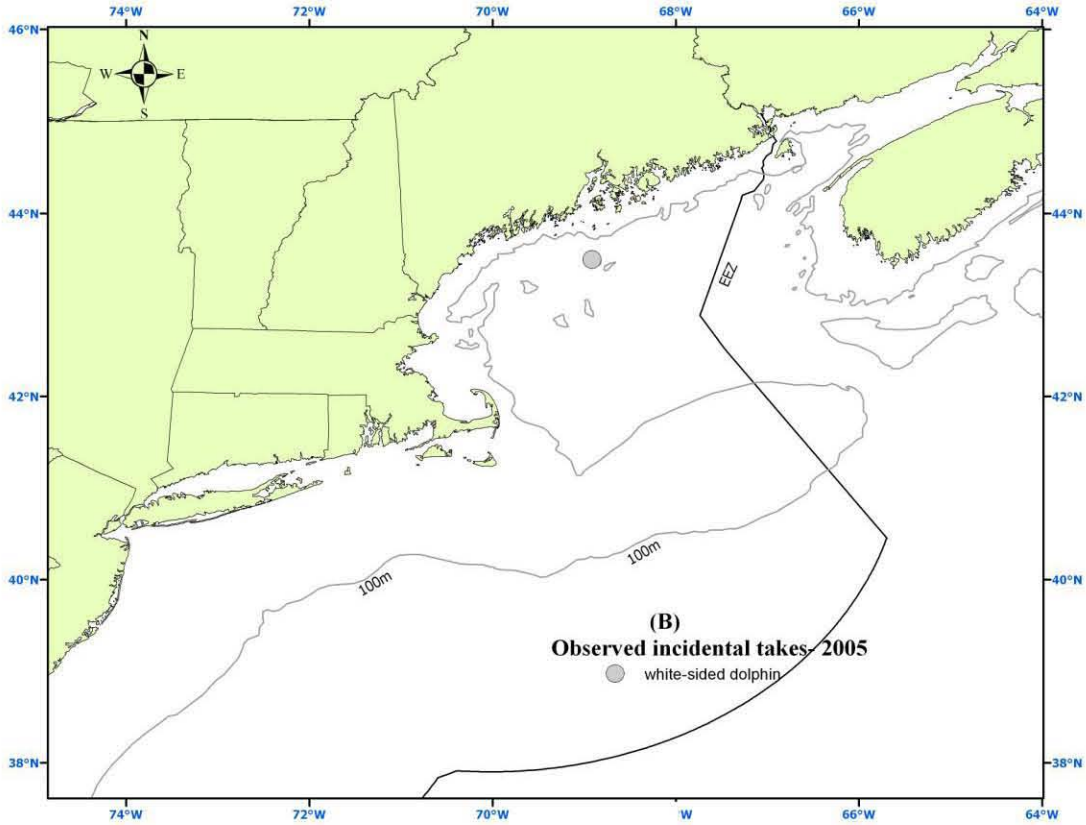
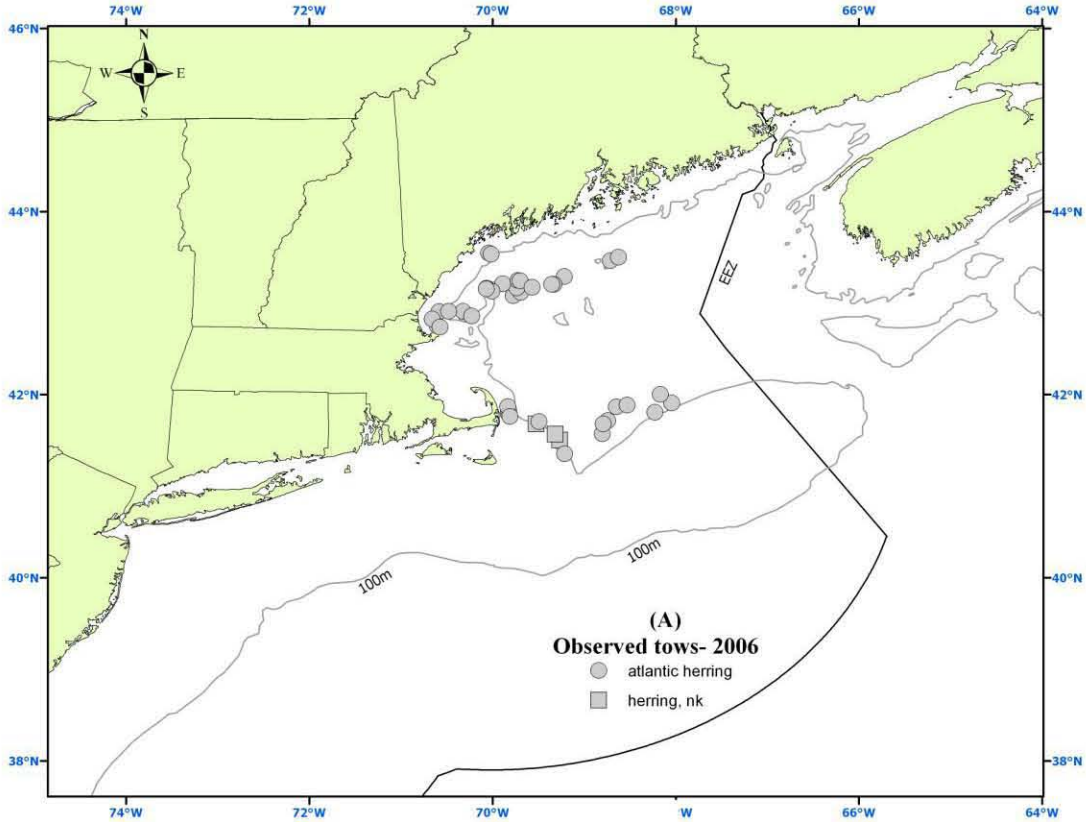


Figure 23. 2006 Northeast mid-water trawl observed tows (A) and observed takes (B).



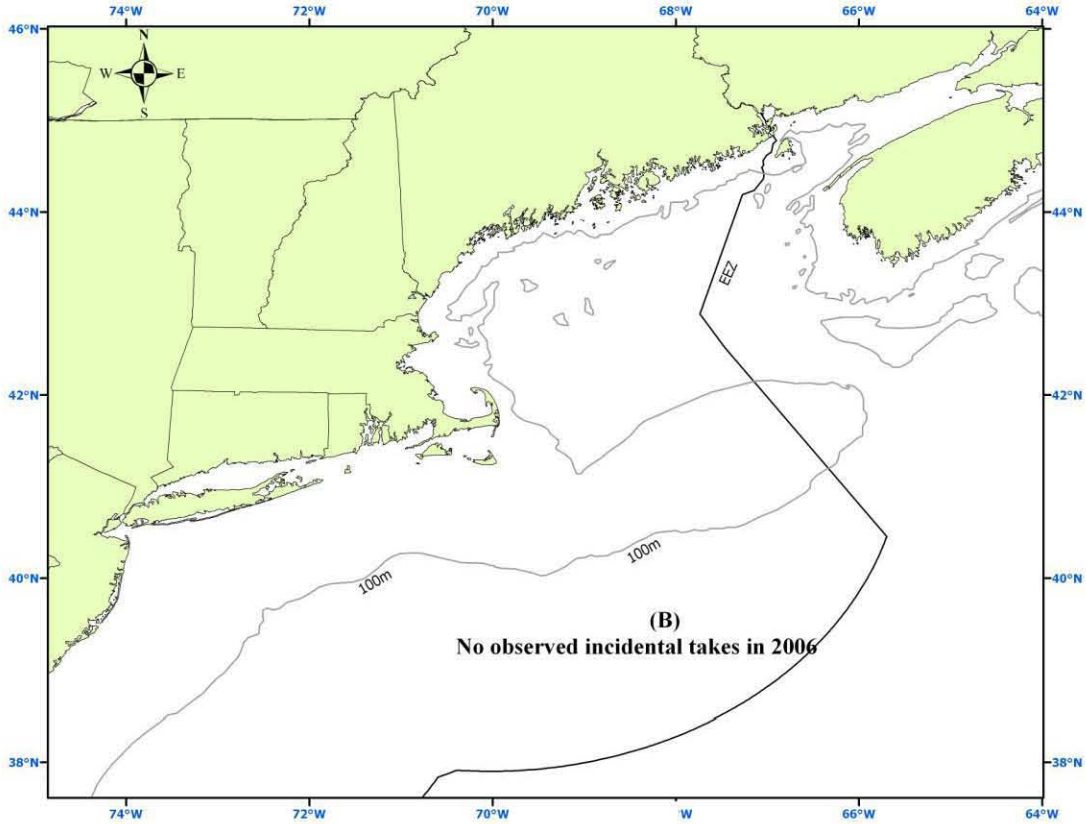


Figure 24. 2007 Northeast mid-water trawl observed tows (A) and observed takes (B).

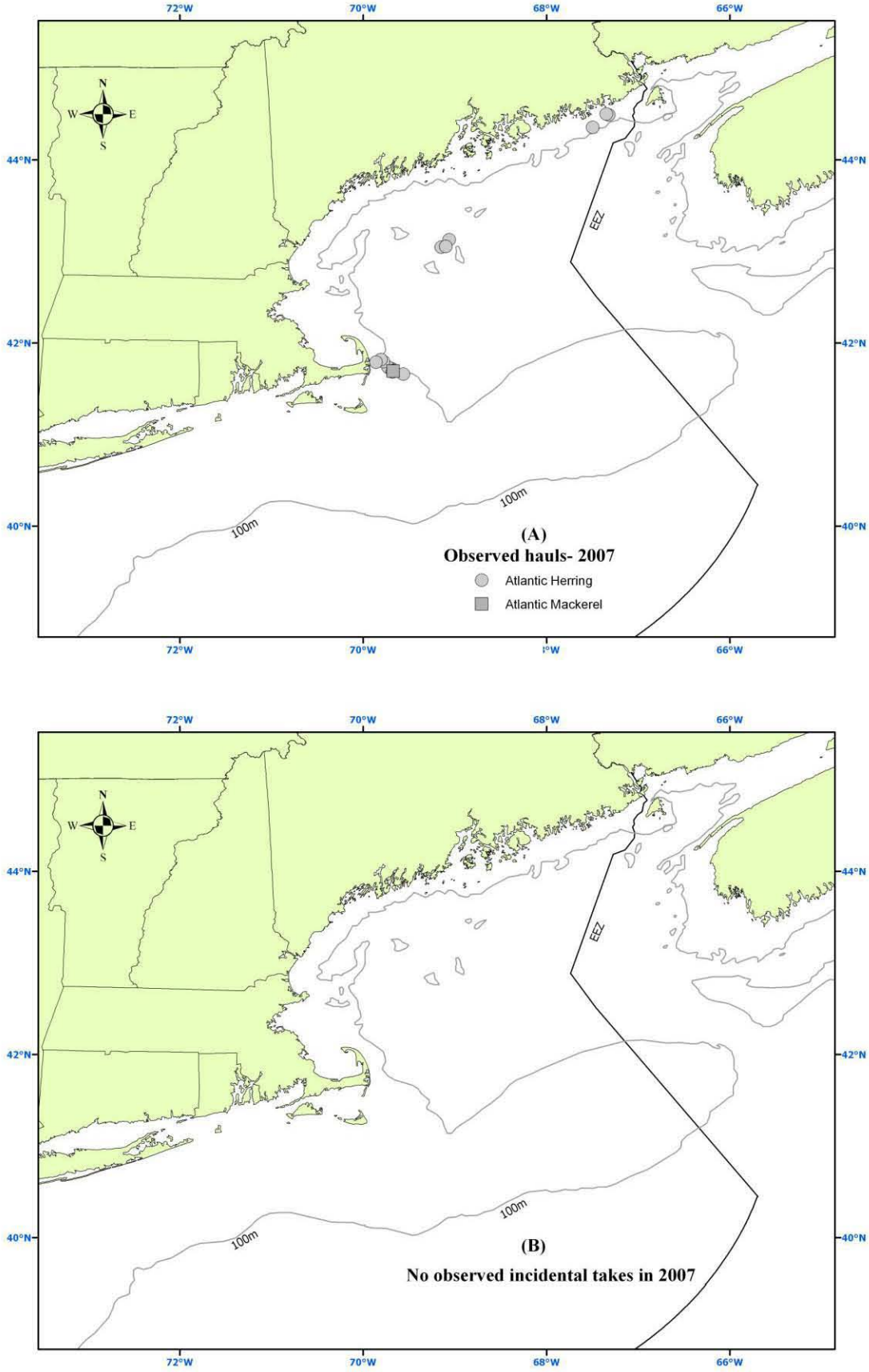


Figure 25. 2008 Northeast mid-water trawl observed tows (A) and observed takes (B).

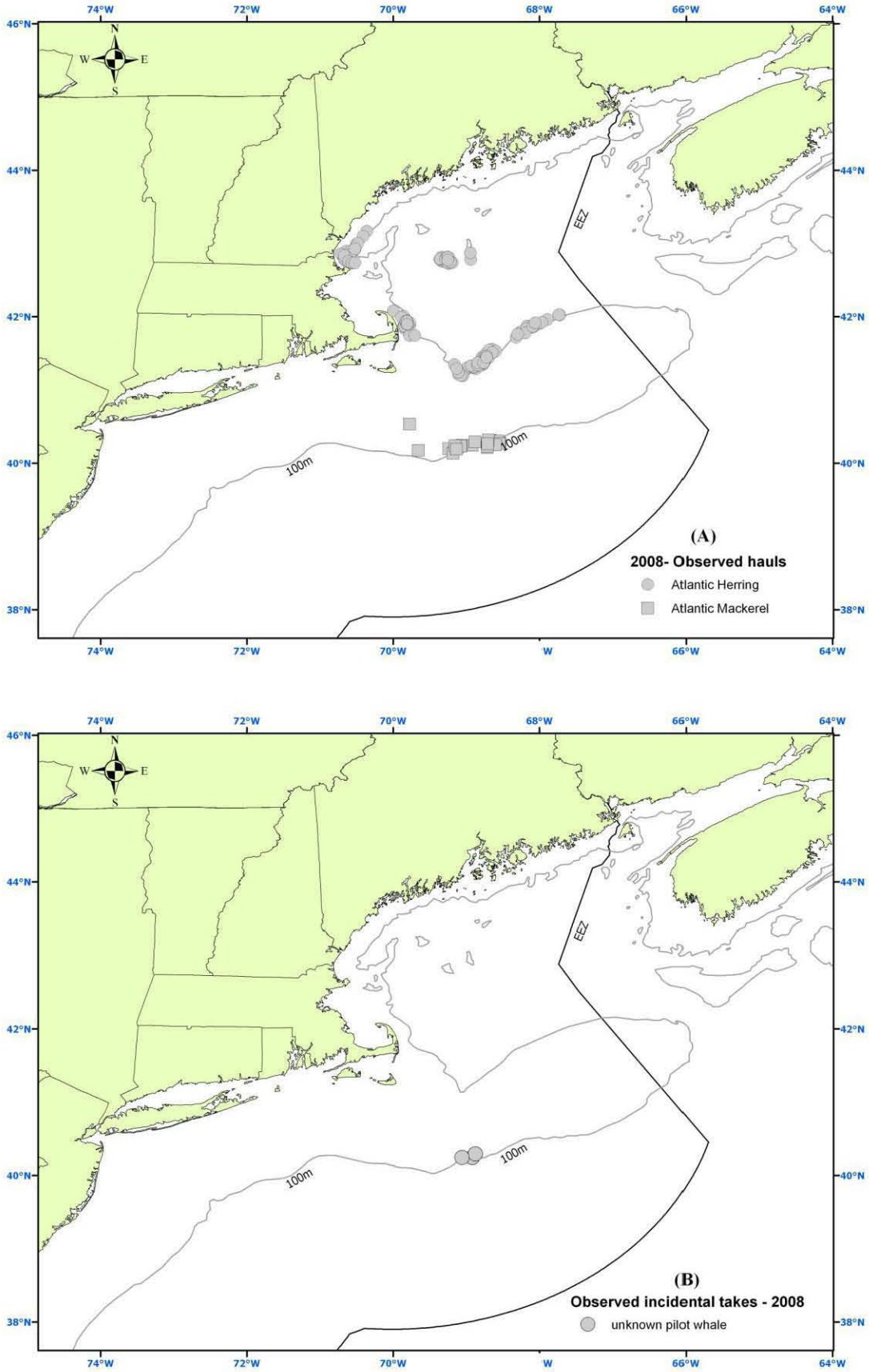


Figure 26. 2004 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

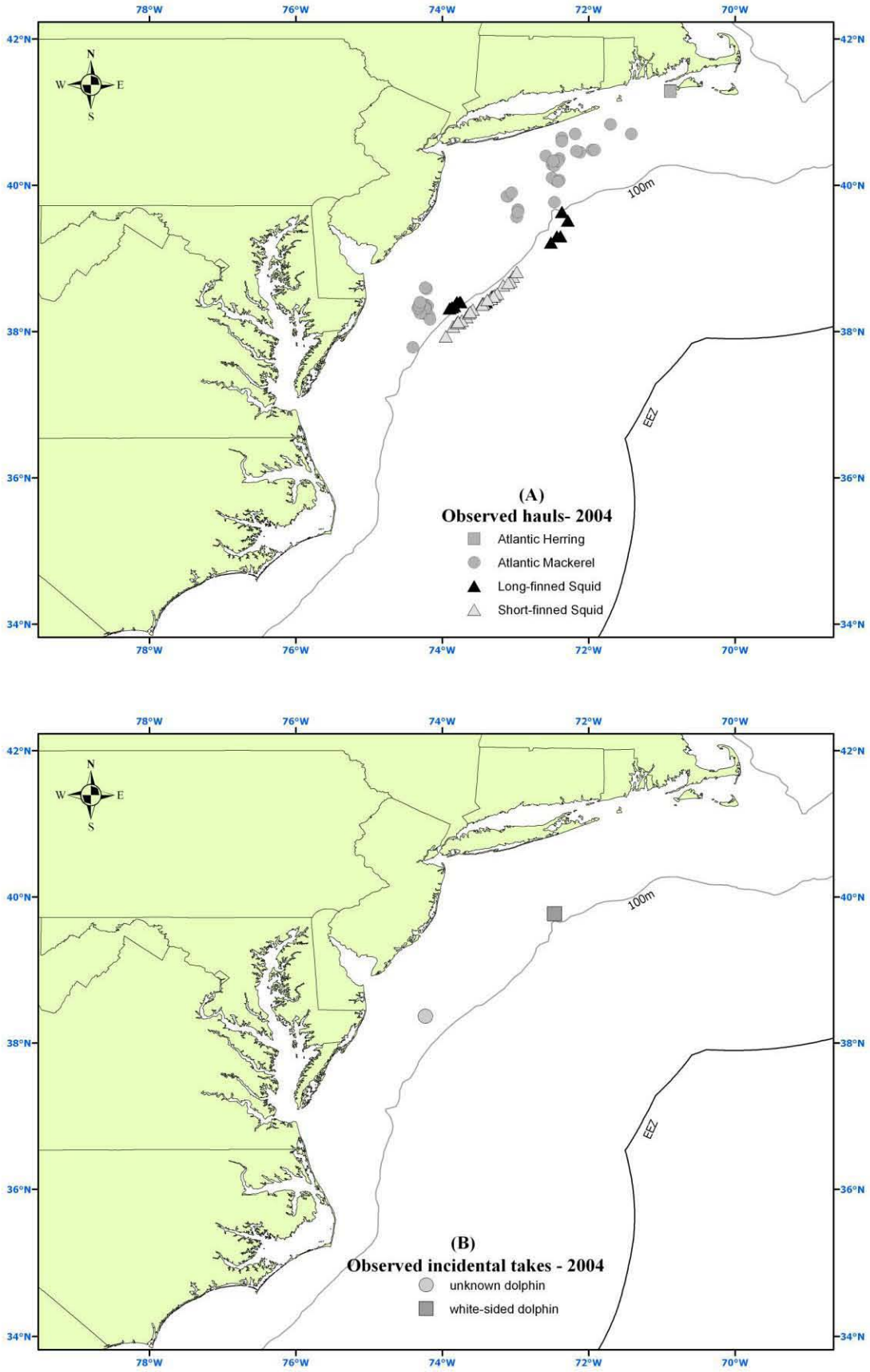


Figure 27. 2005 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

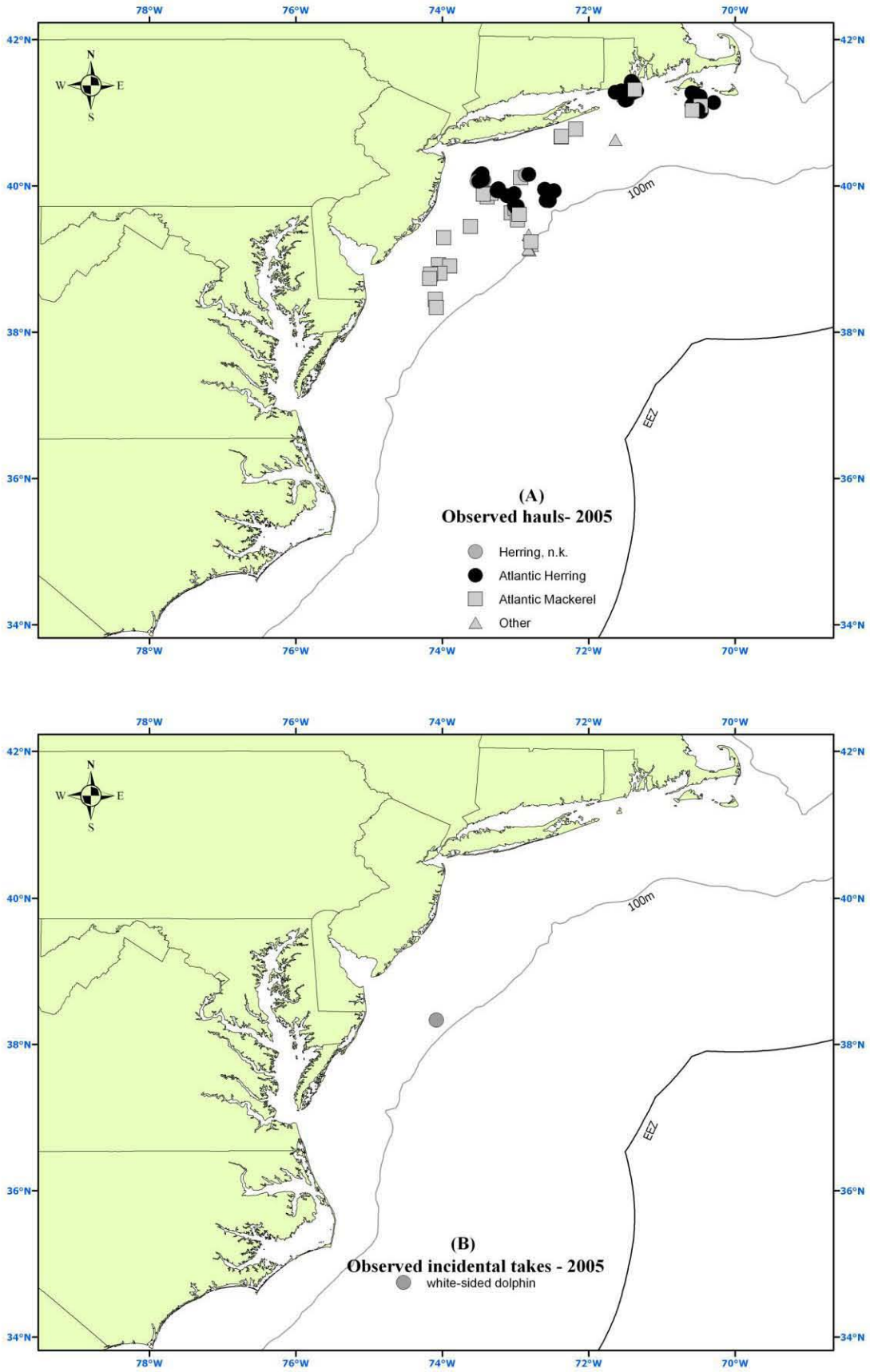


Figure 28. 2006 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

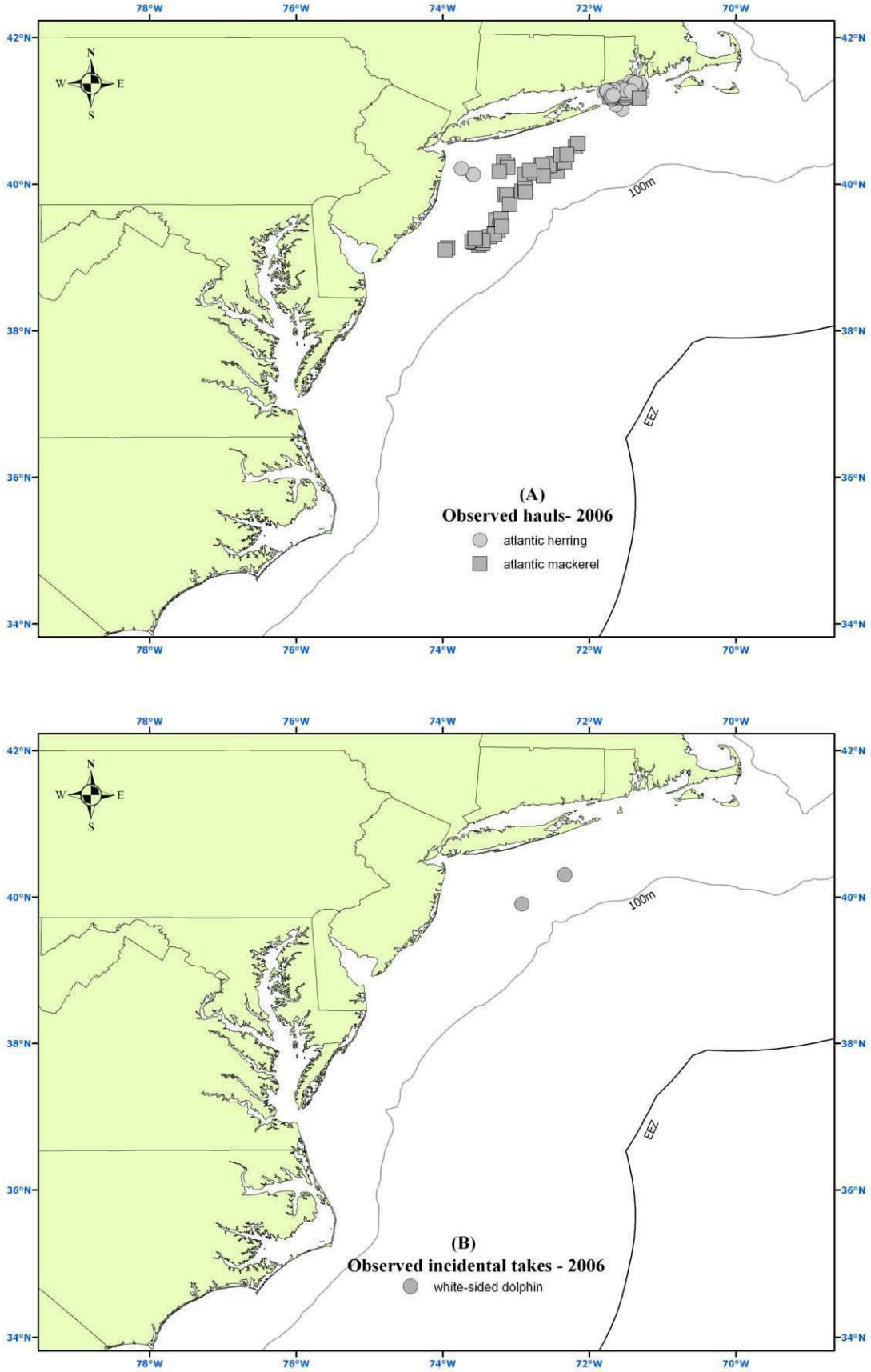


Figure 29. 2007 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

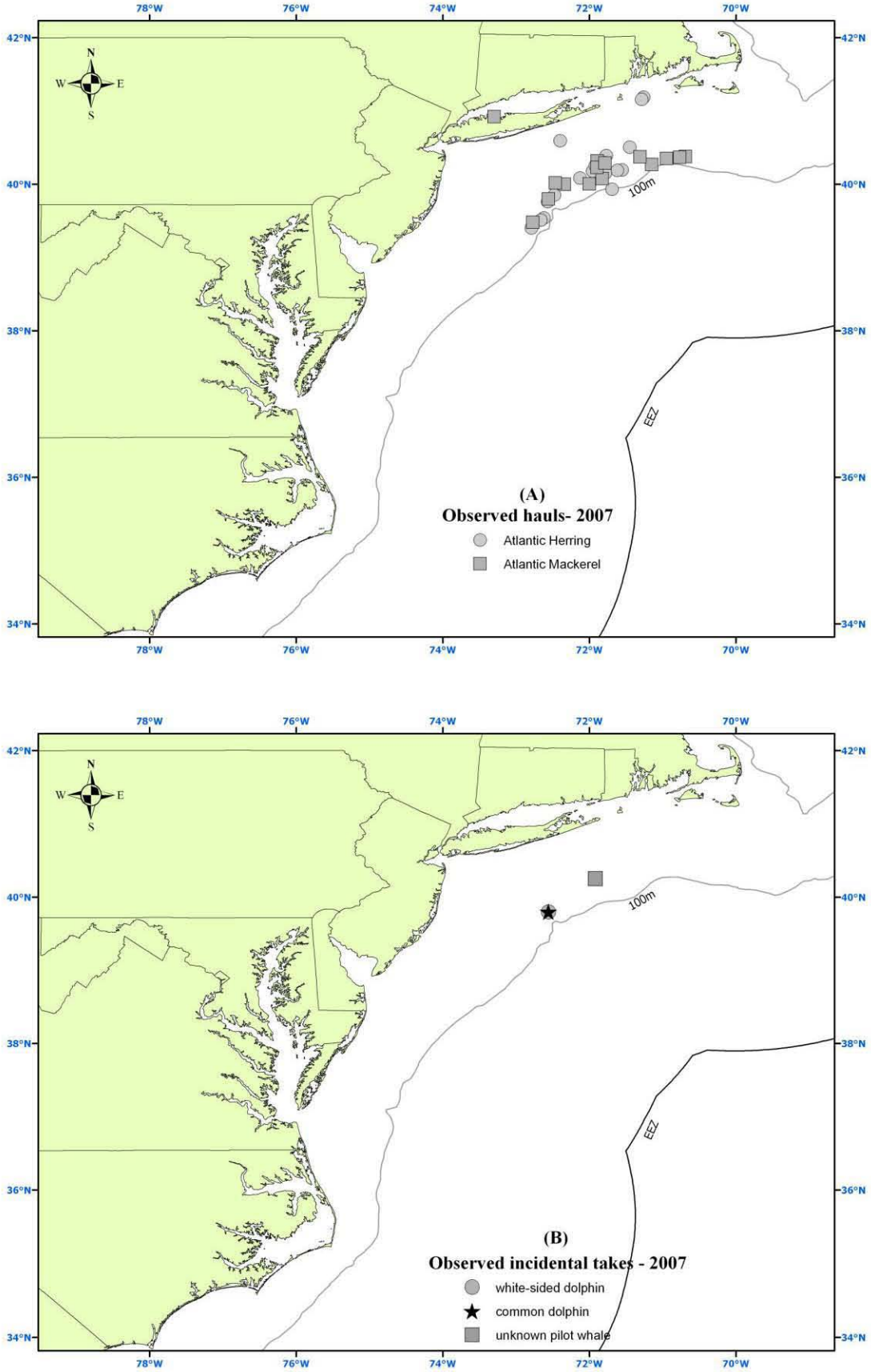


Figure 30. 2008 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

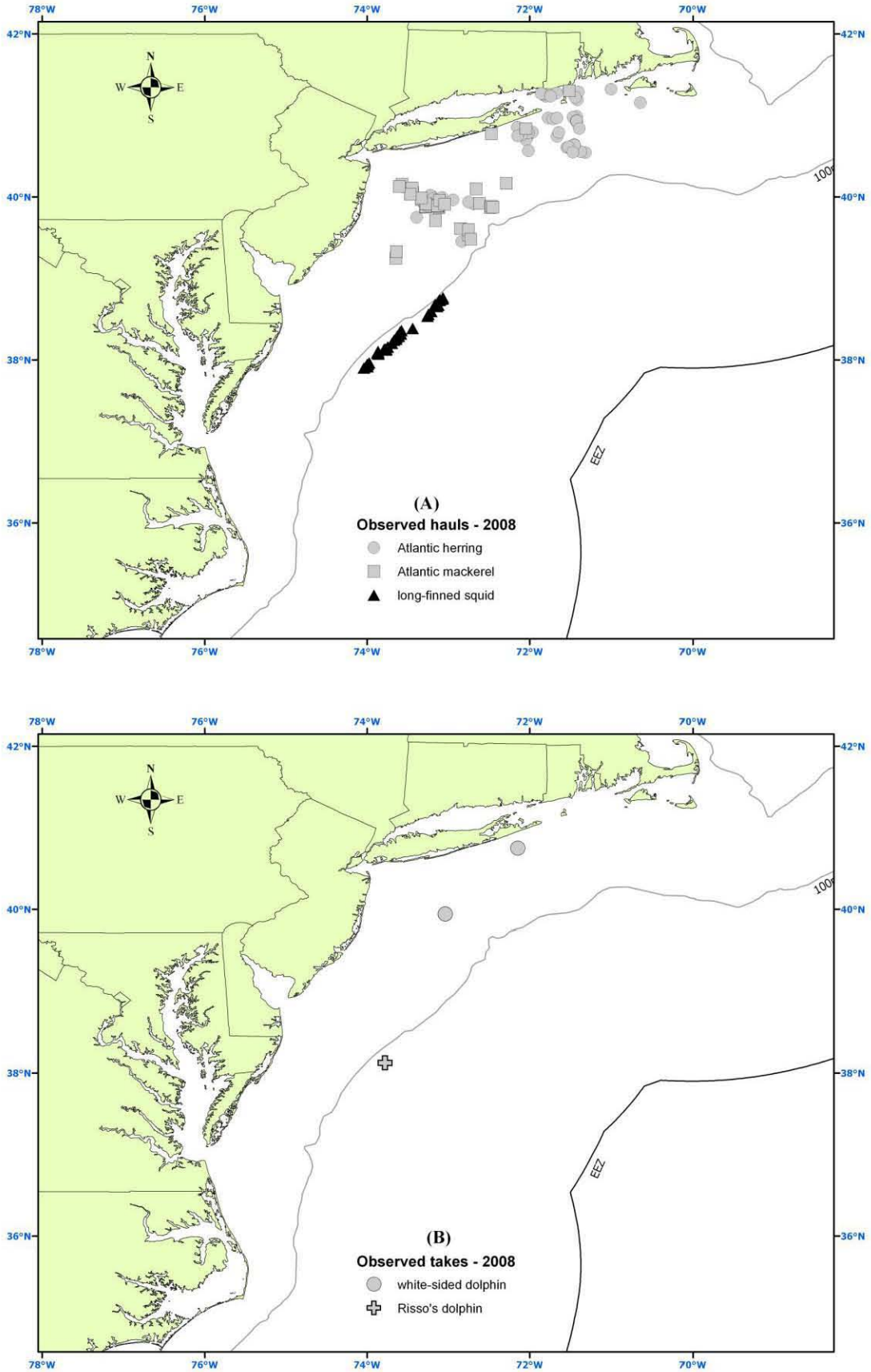
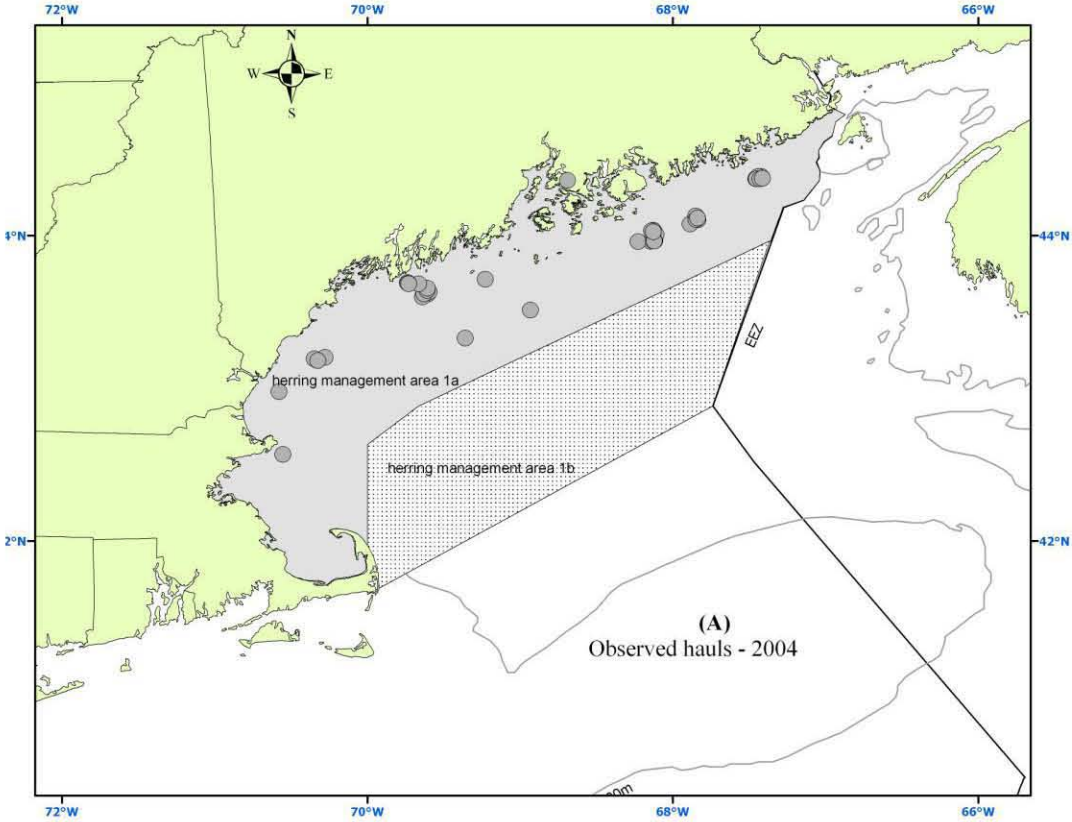


Figure 31. 2004 Herring Purse Seine observed hauls (A) and observed takes (B).



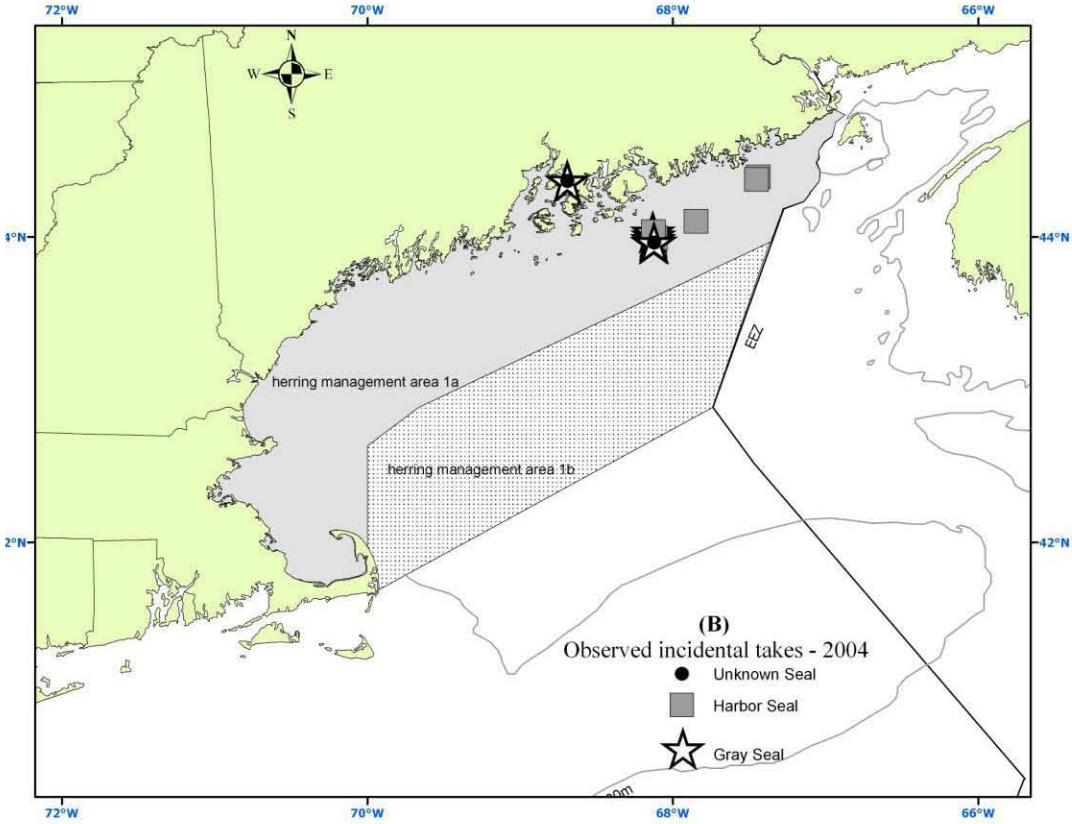
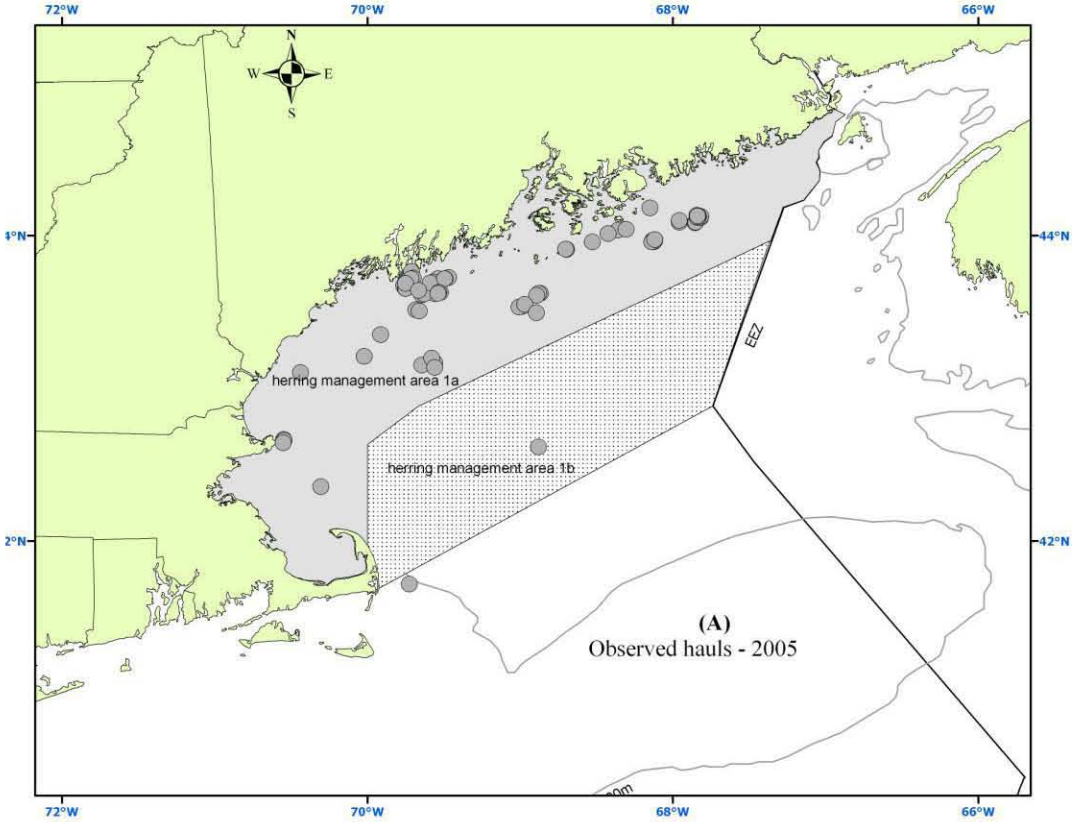


Figure 32. 2005 Herring Purse Seine observed hauls (A) and observed takes (B).



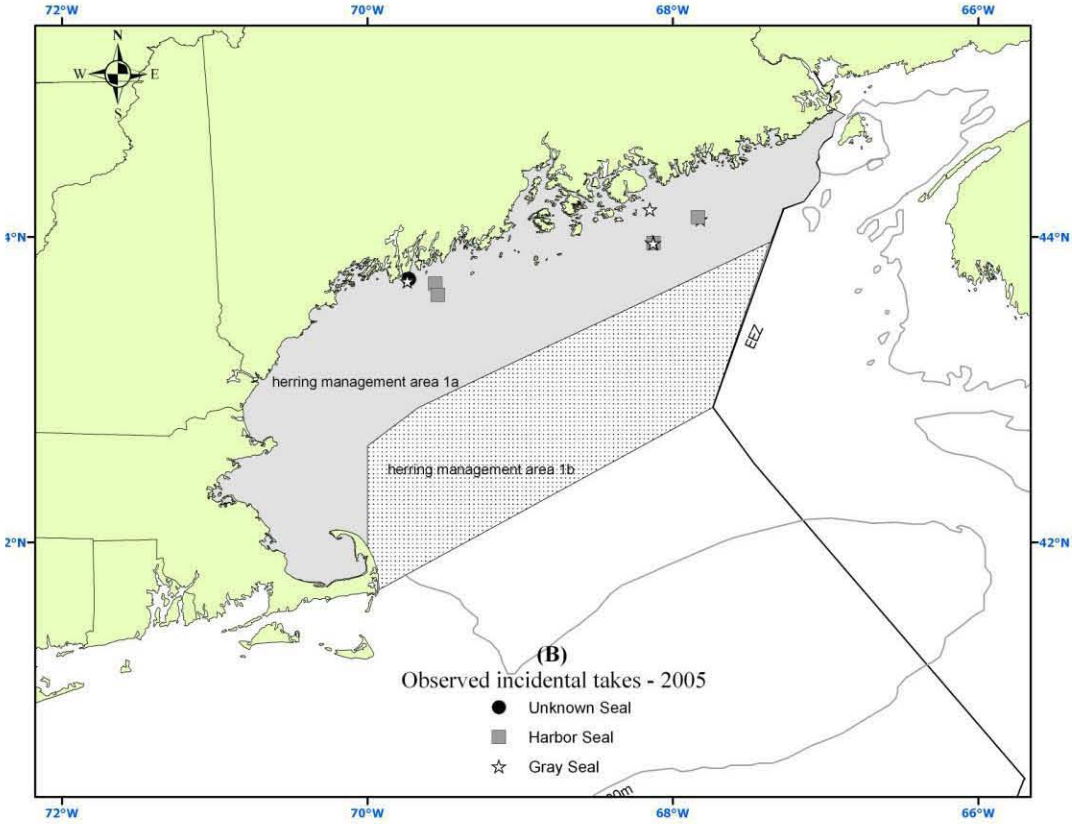
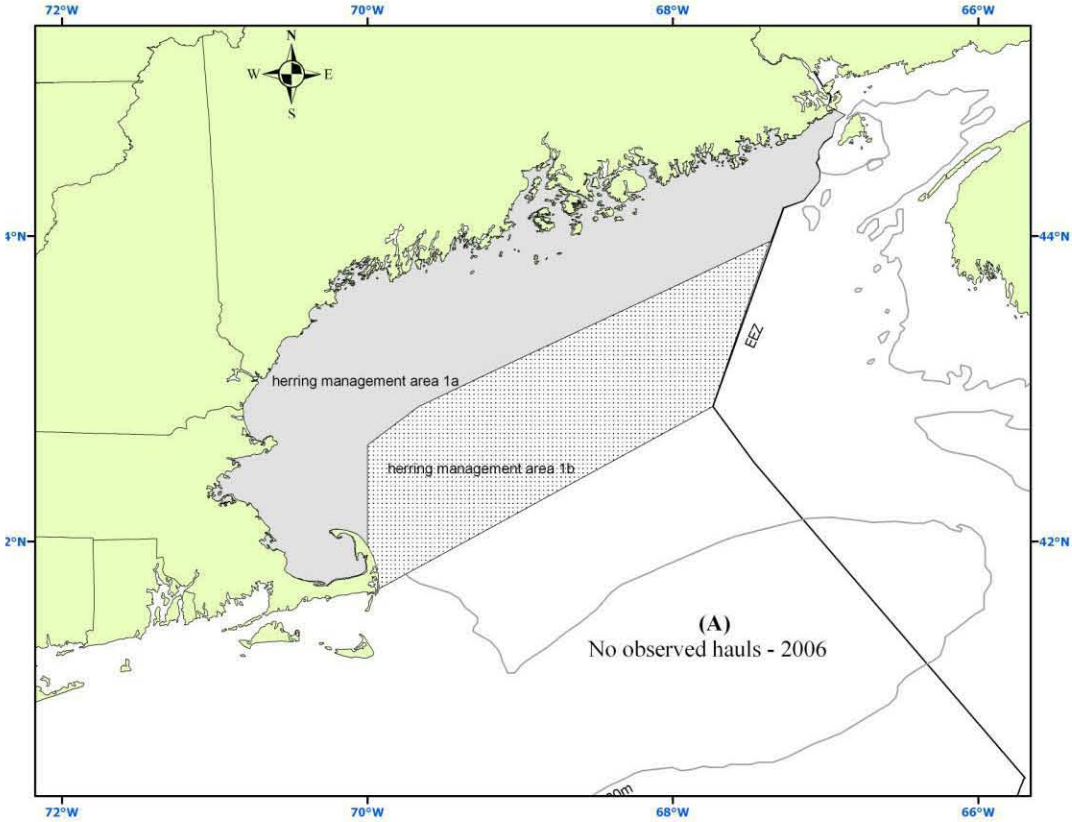


Figure 33. 2006 Herring Purse Seine observed hauls (A) and observed takes (B).



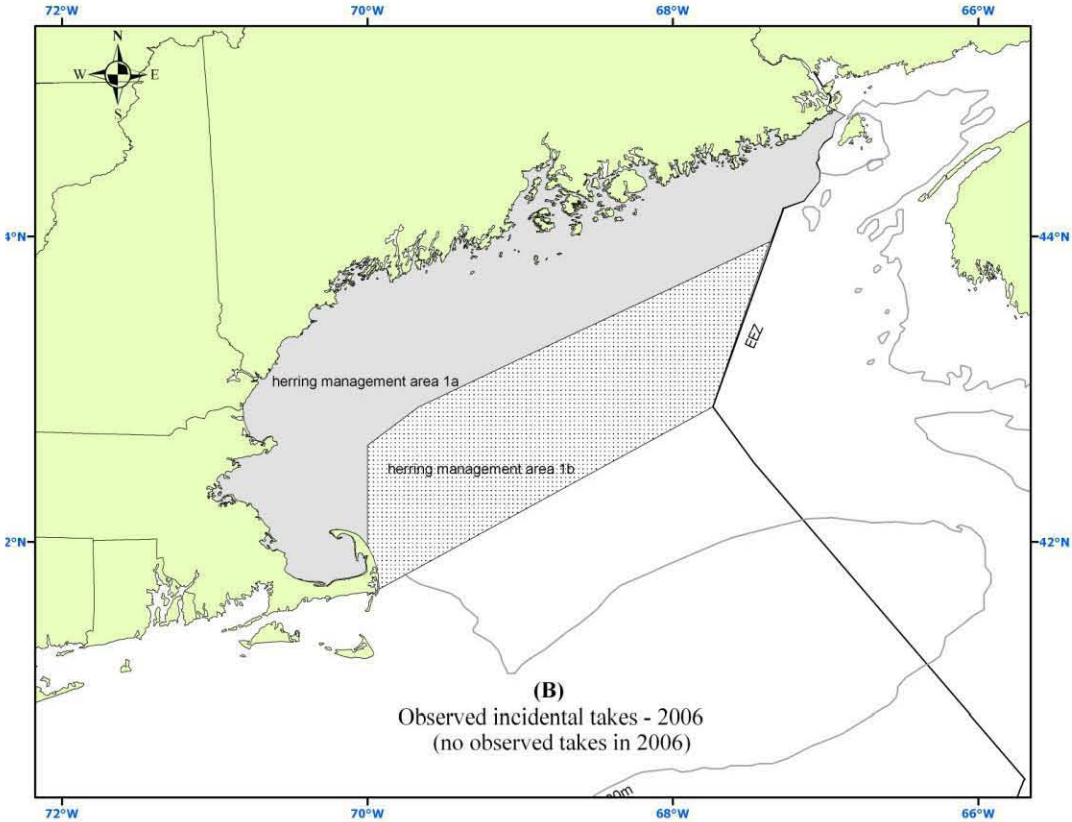
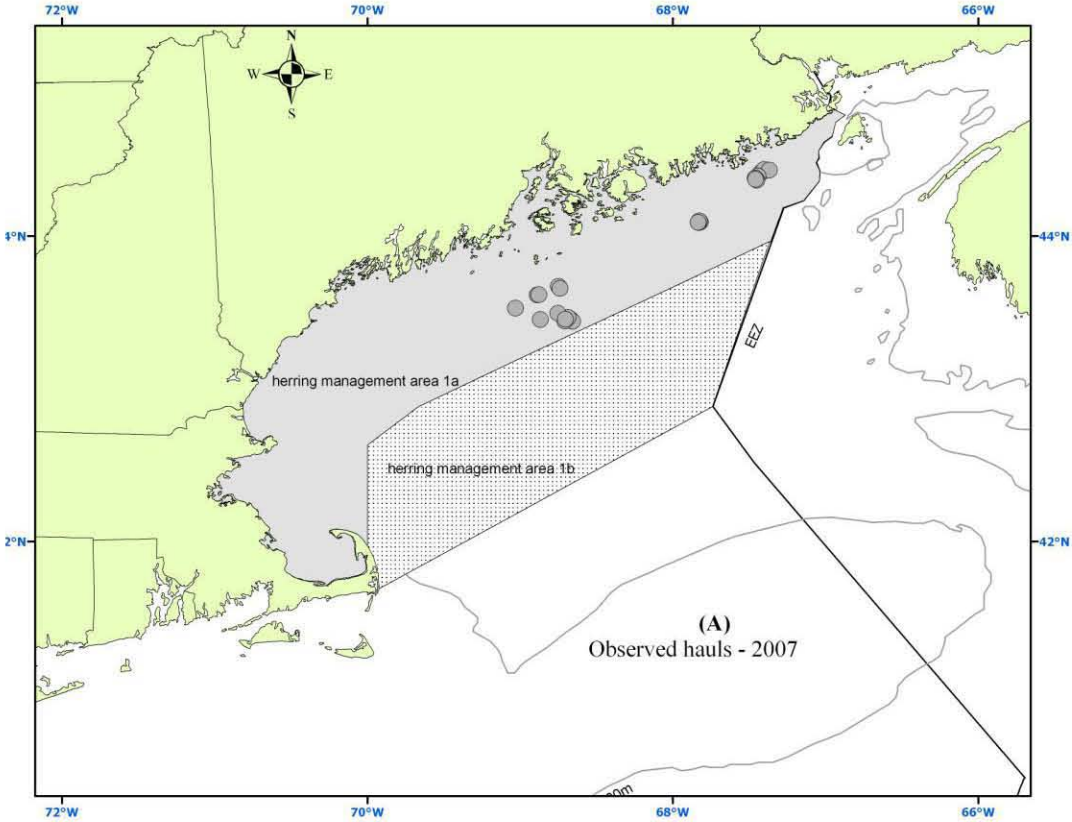


Figure 34. 2007 Herring Purse Seine observed hauls (A) and observed takes (B).



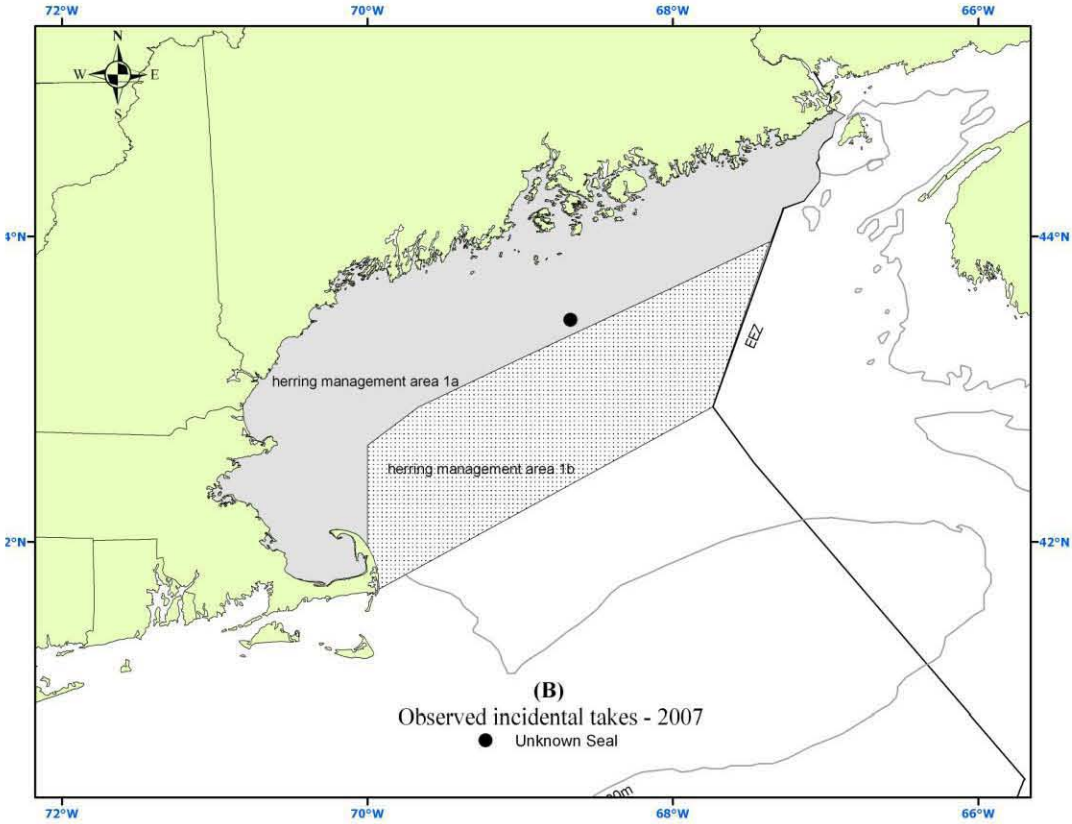


Figure 35. 2008 Herring Purse Seine observed hauls (A) and observed takes (B).

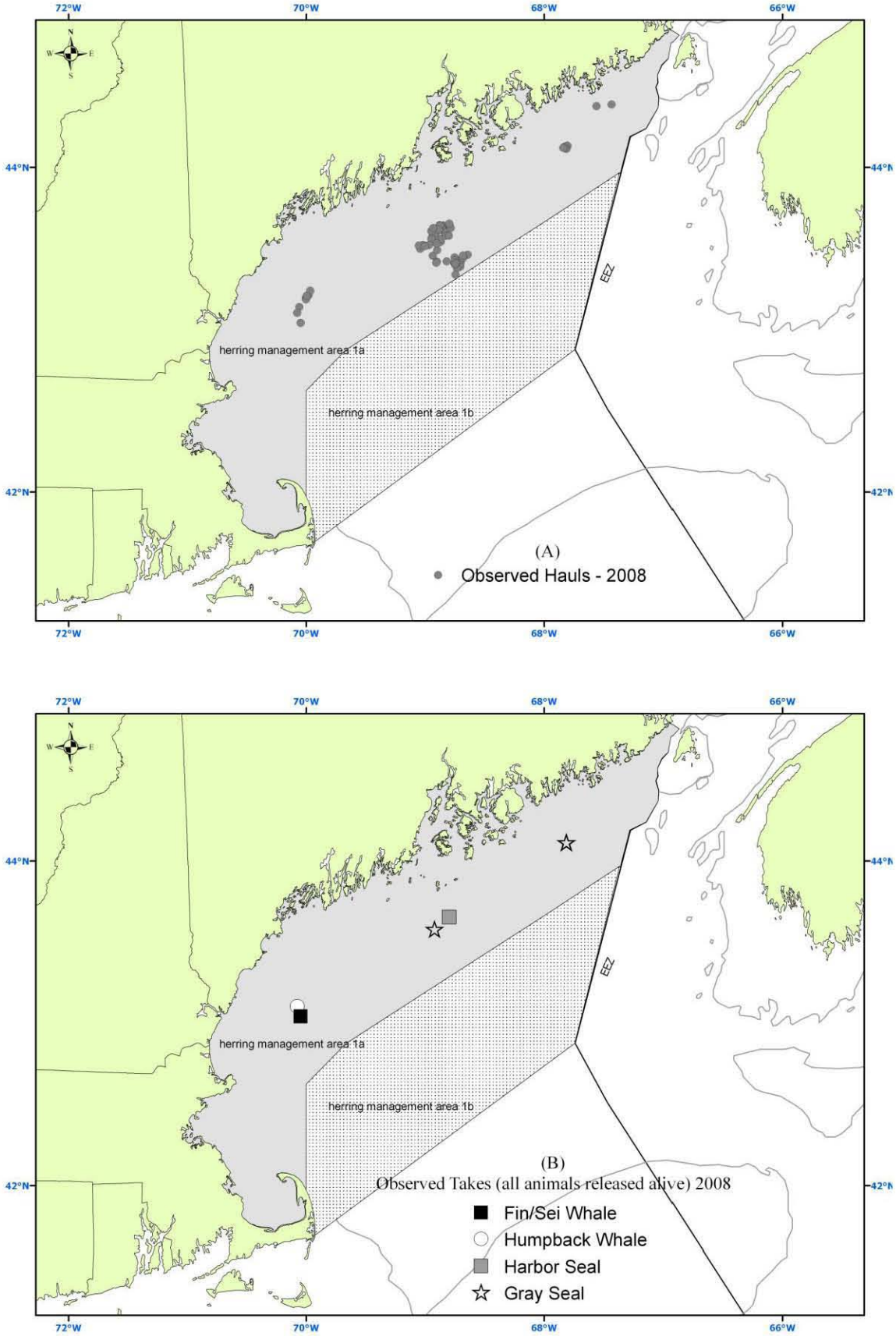


Figure 36. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2004. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

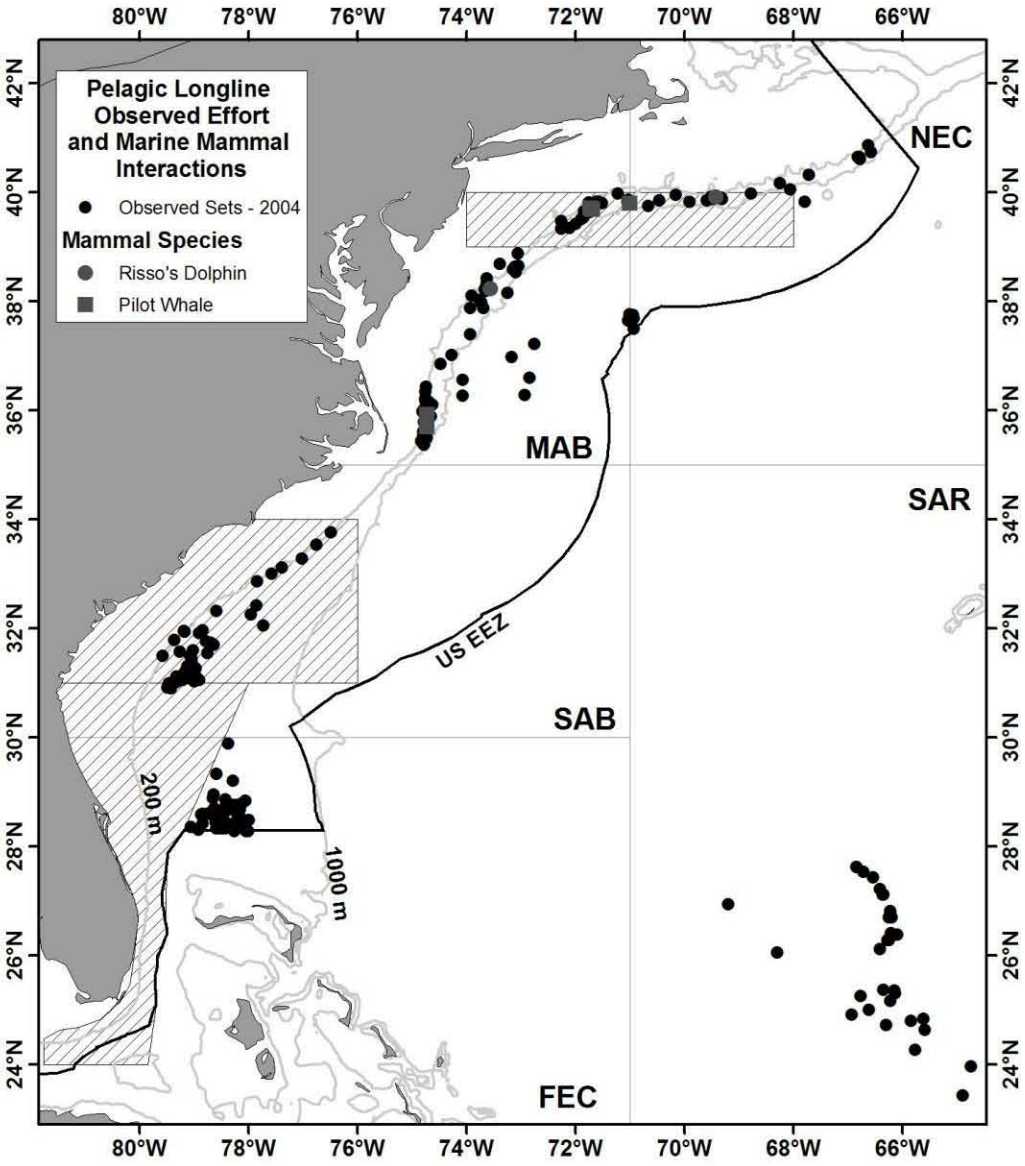


Figure 37. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2005. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

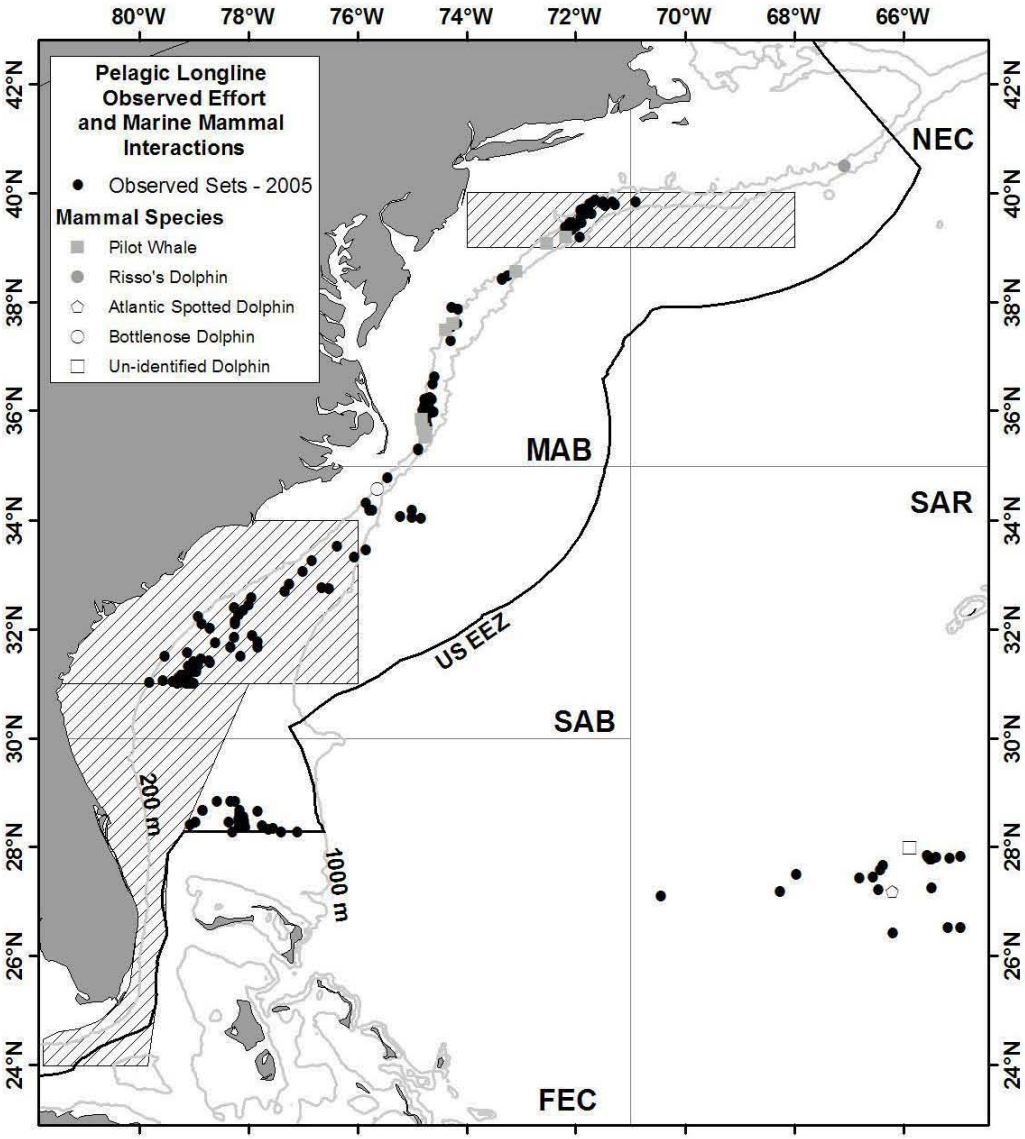


Figure 38. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2006. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

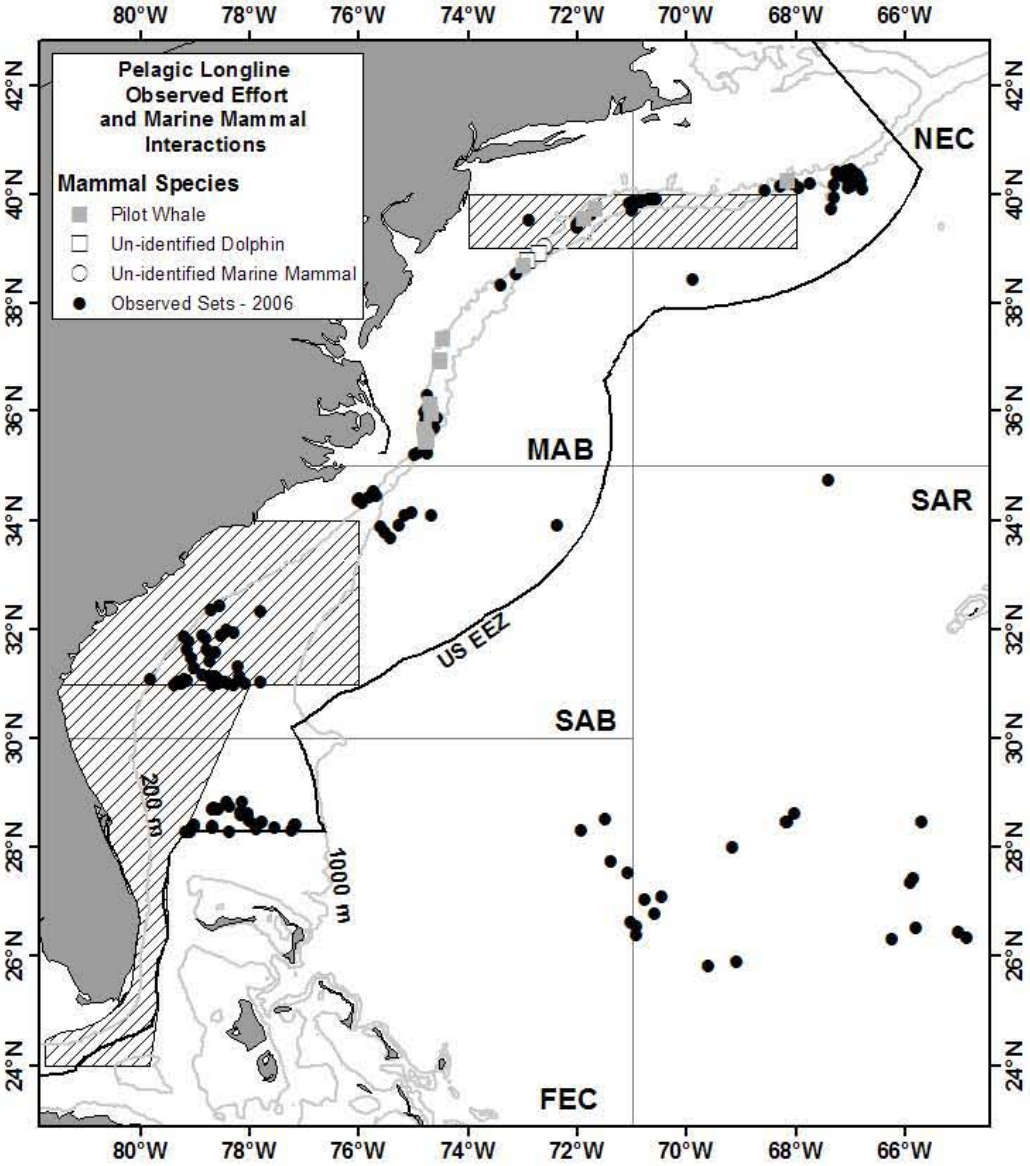


Figure 39. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2007. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

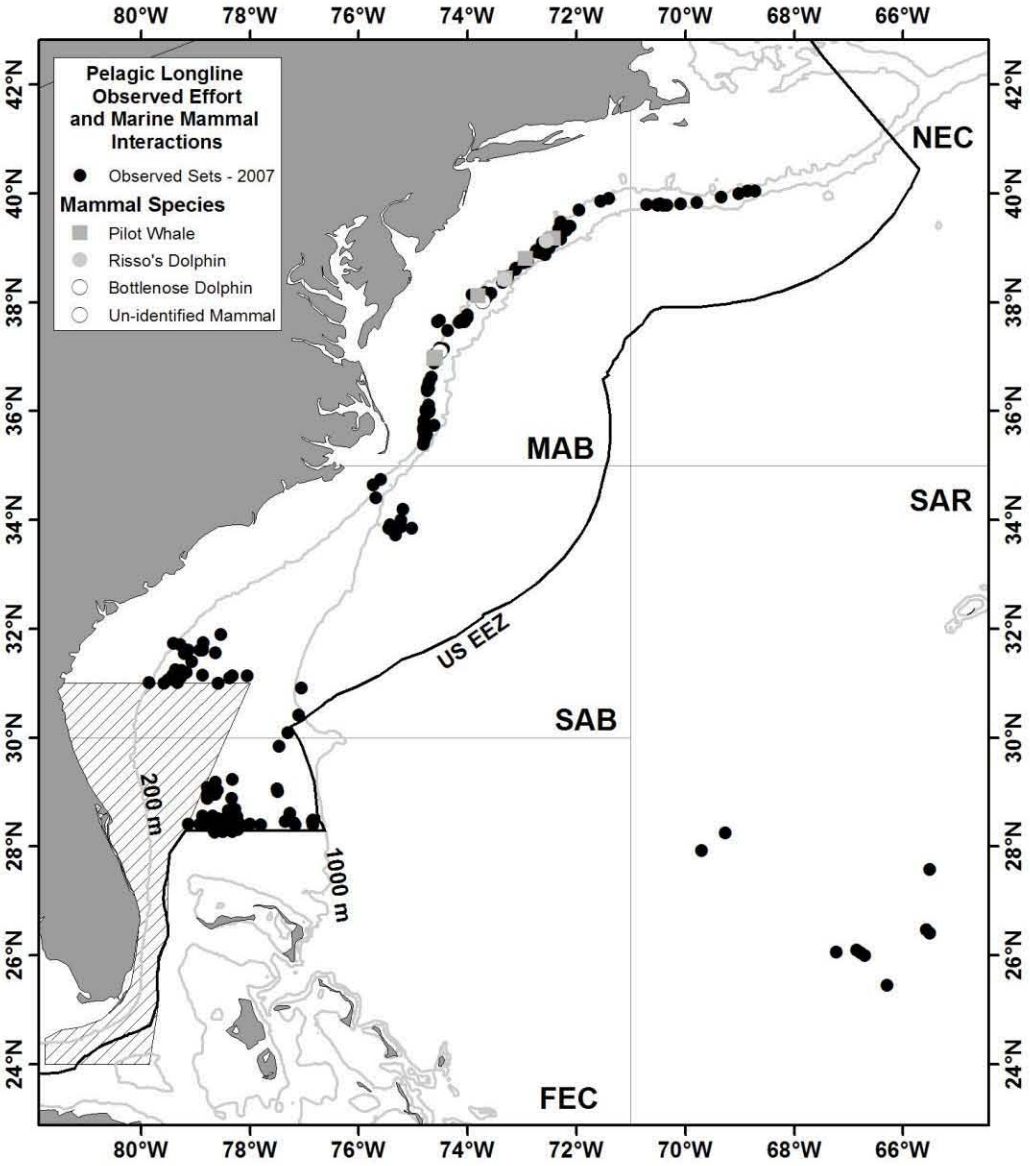


Figure 40. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2008. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

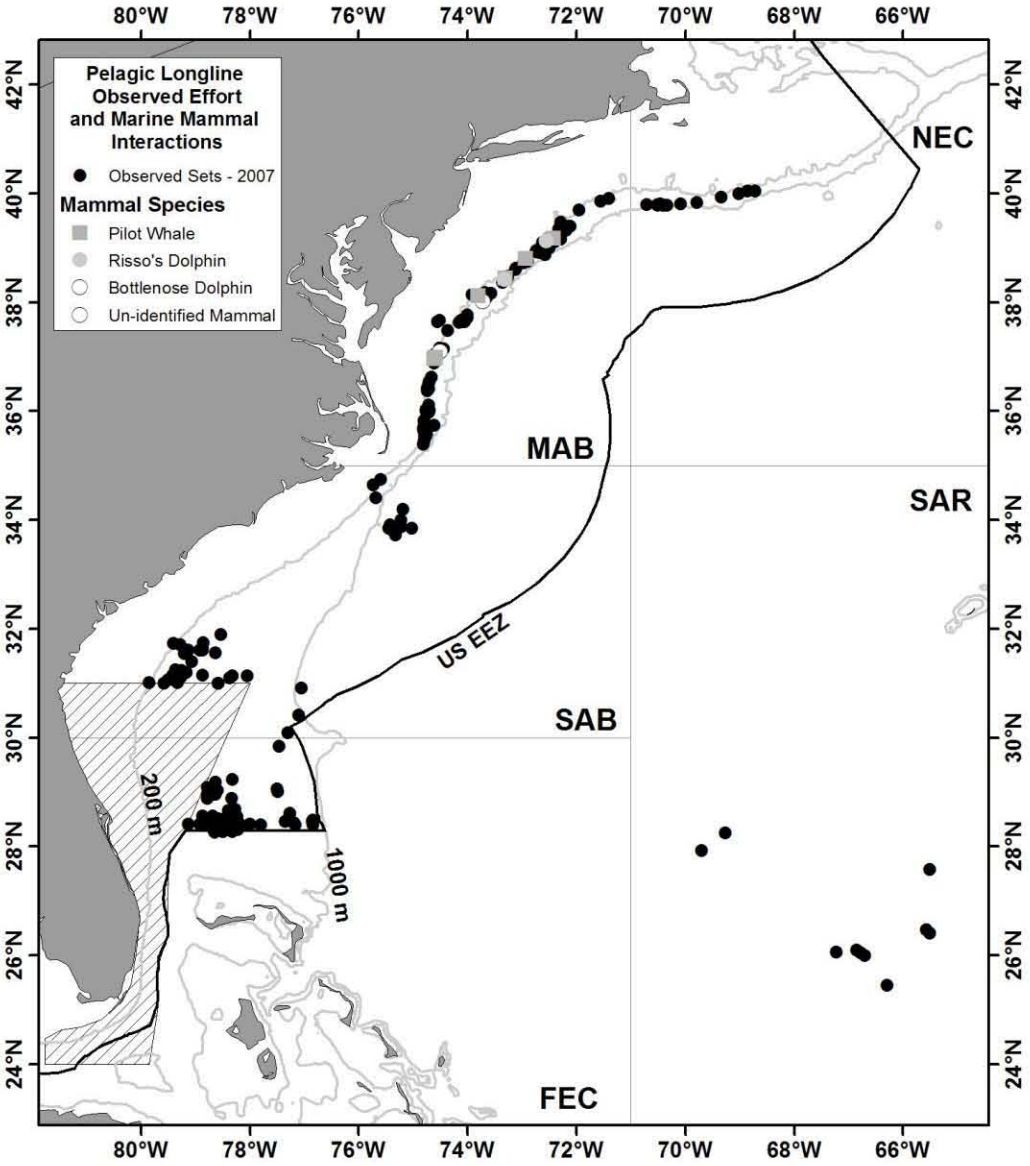


Figure 41. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2004. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.

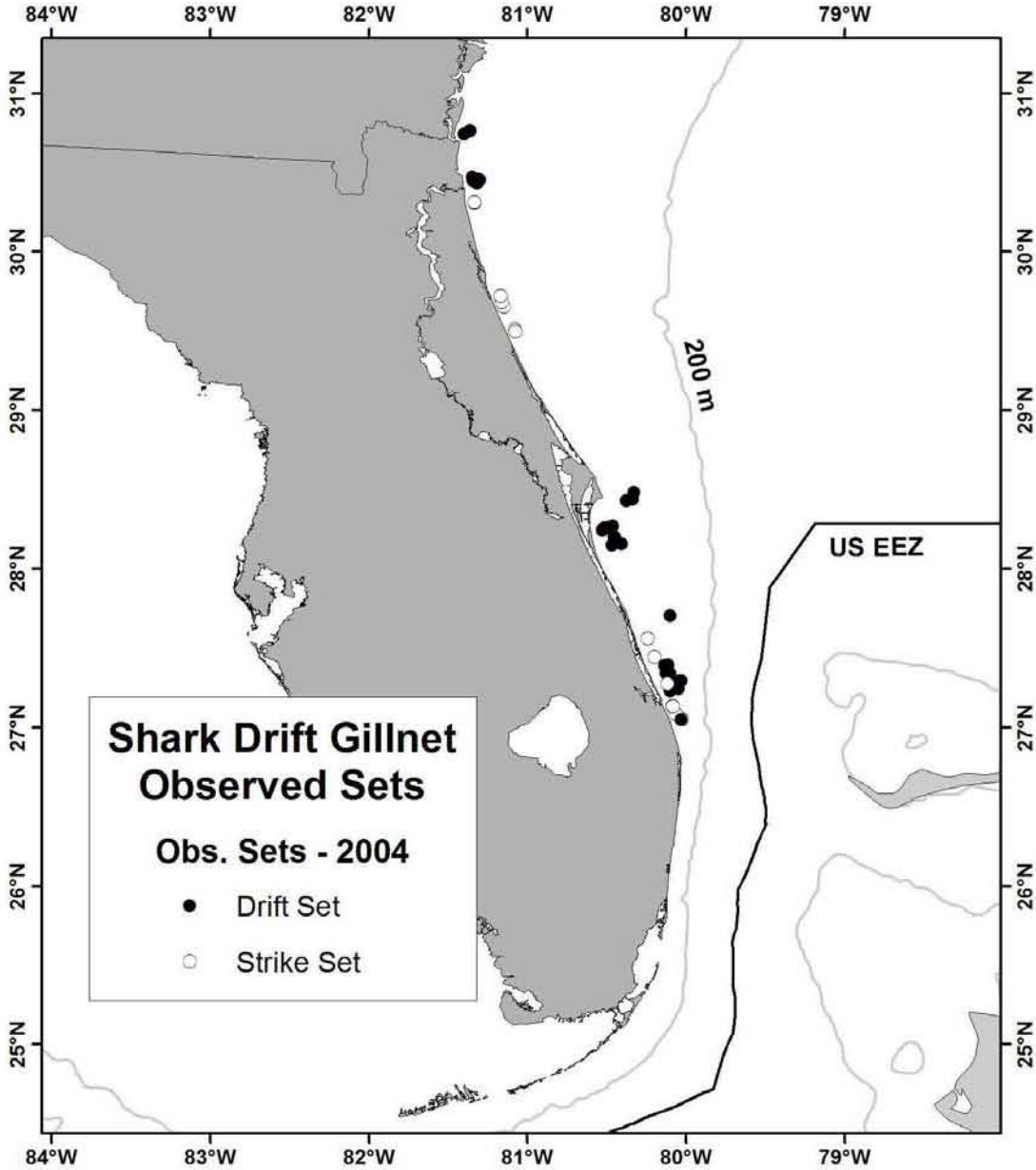


Figure 42. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2005. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.

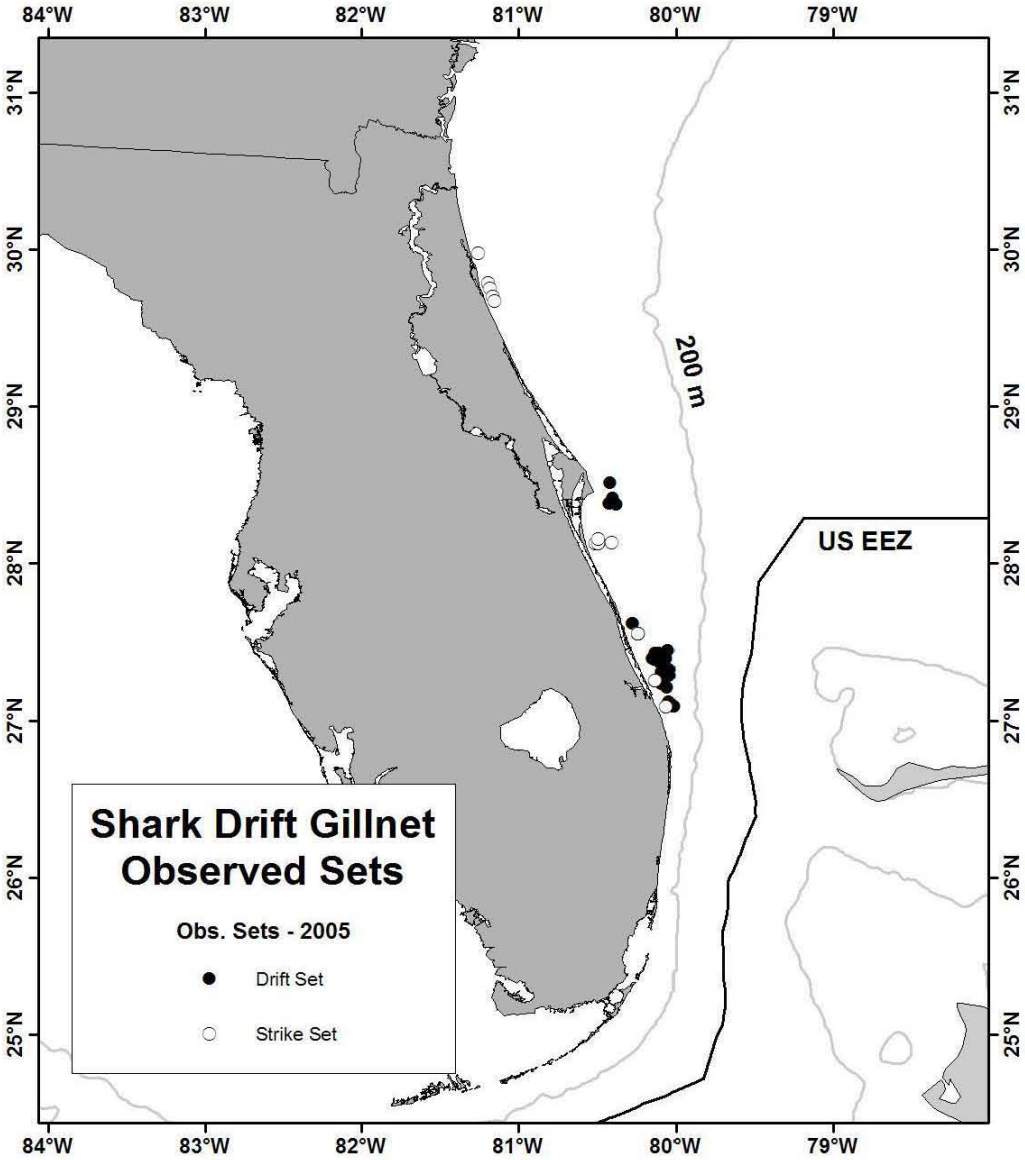


Figure 43. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2006. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Drift, strike, and sink gillnet sets by observed vessels are shown. No interactions with marine mammals were observed.

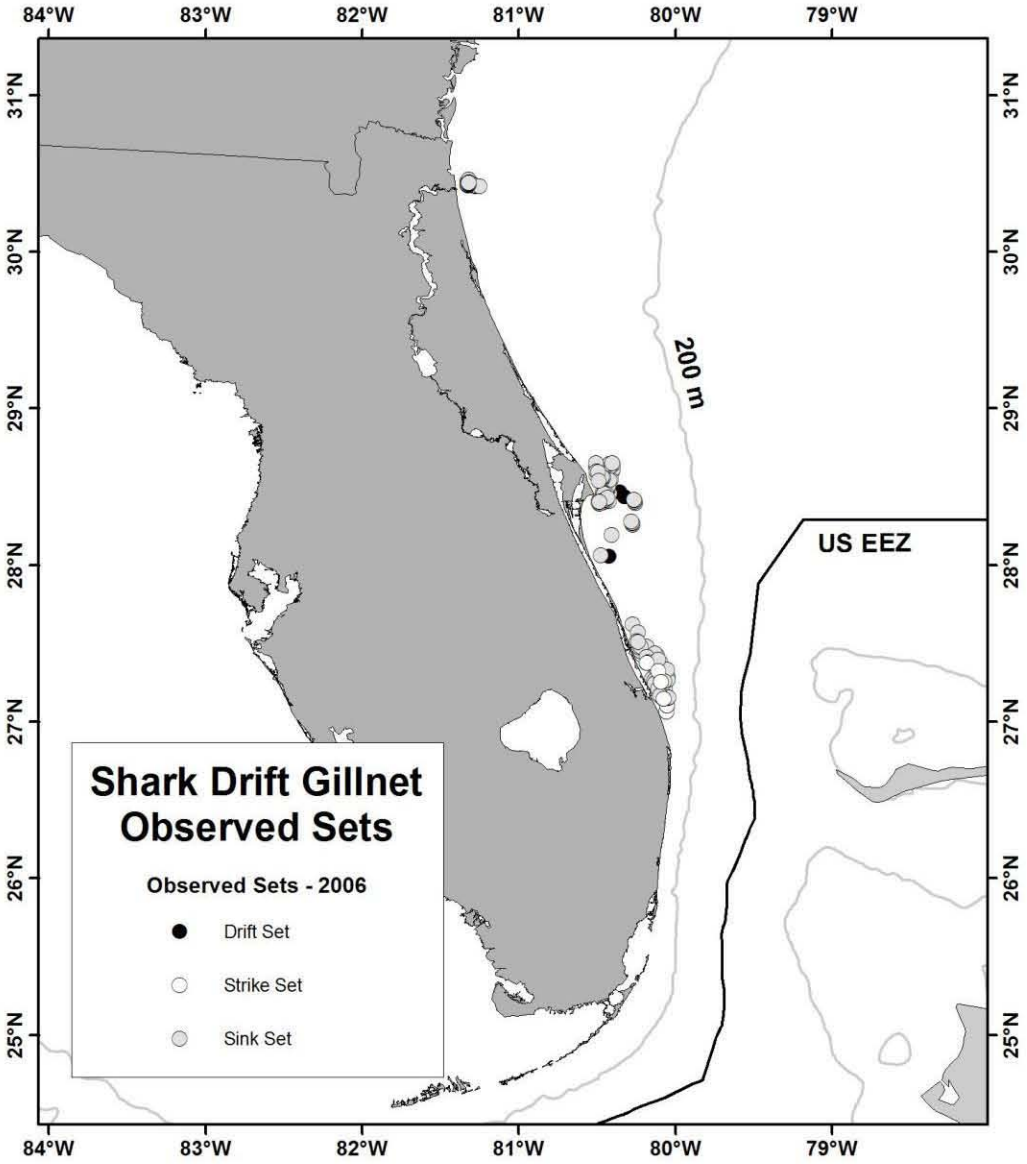


Figure 44. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2007. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Drift, strike, and sink gillnet sets by observed vessels are shown. No interactions with marine mammals were observed.

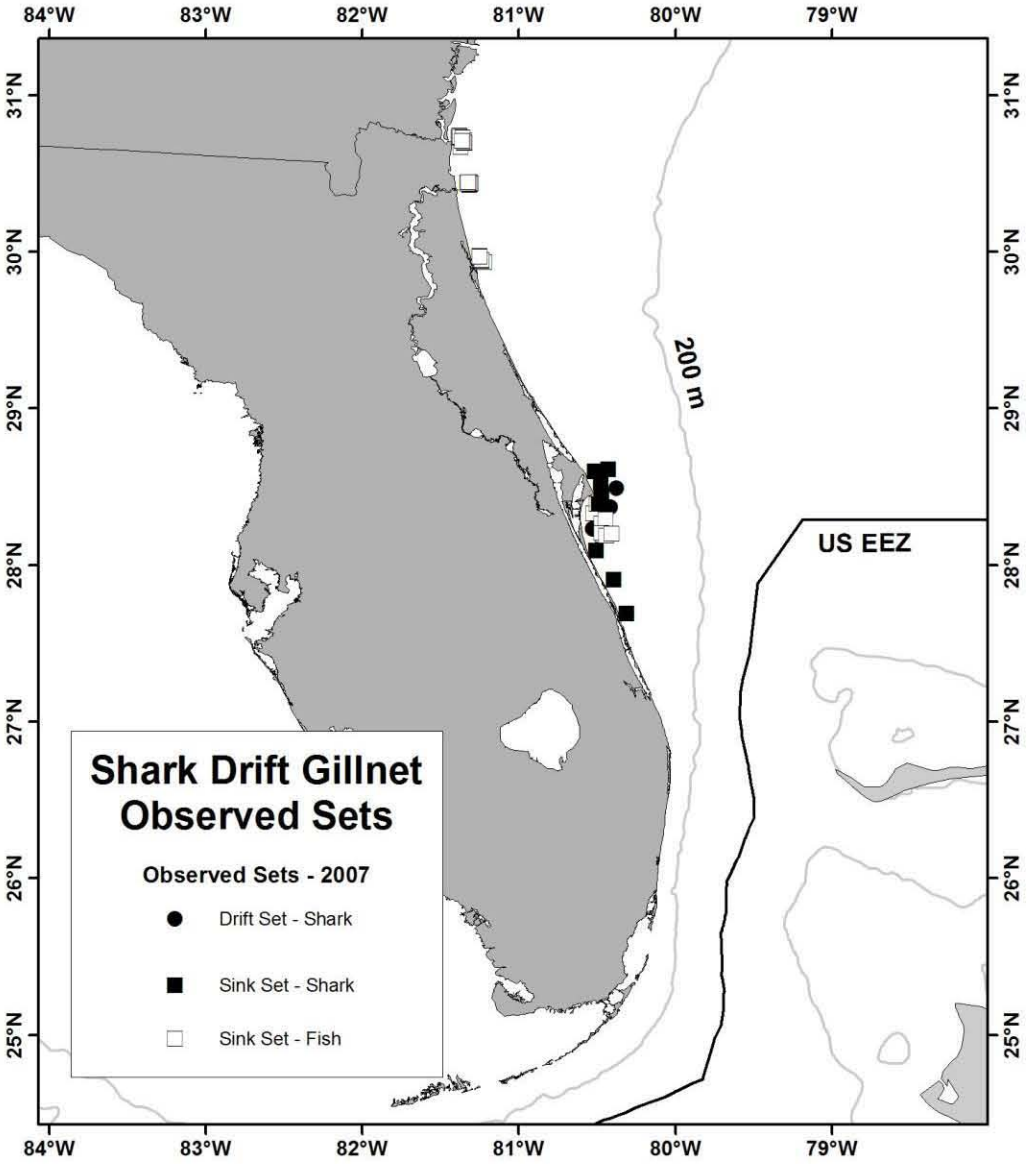


Figure 45. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2008. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Drift, strike, and sink gillnet sets by observed vessels are shown. No interactions with marine mammals were observed.

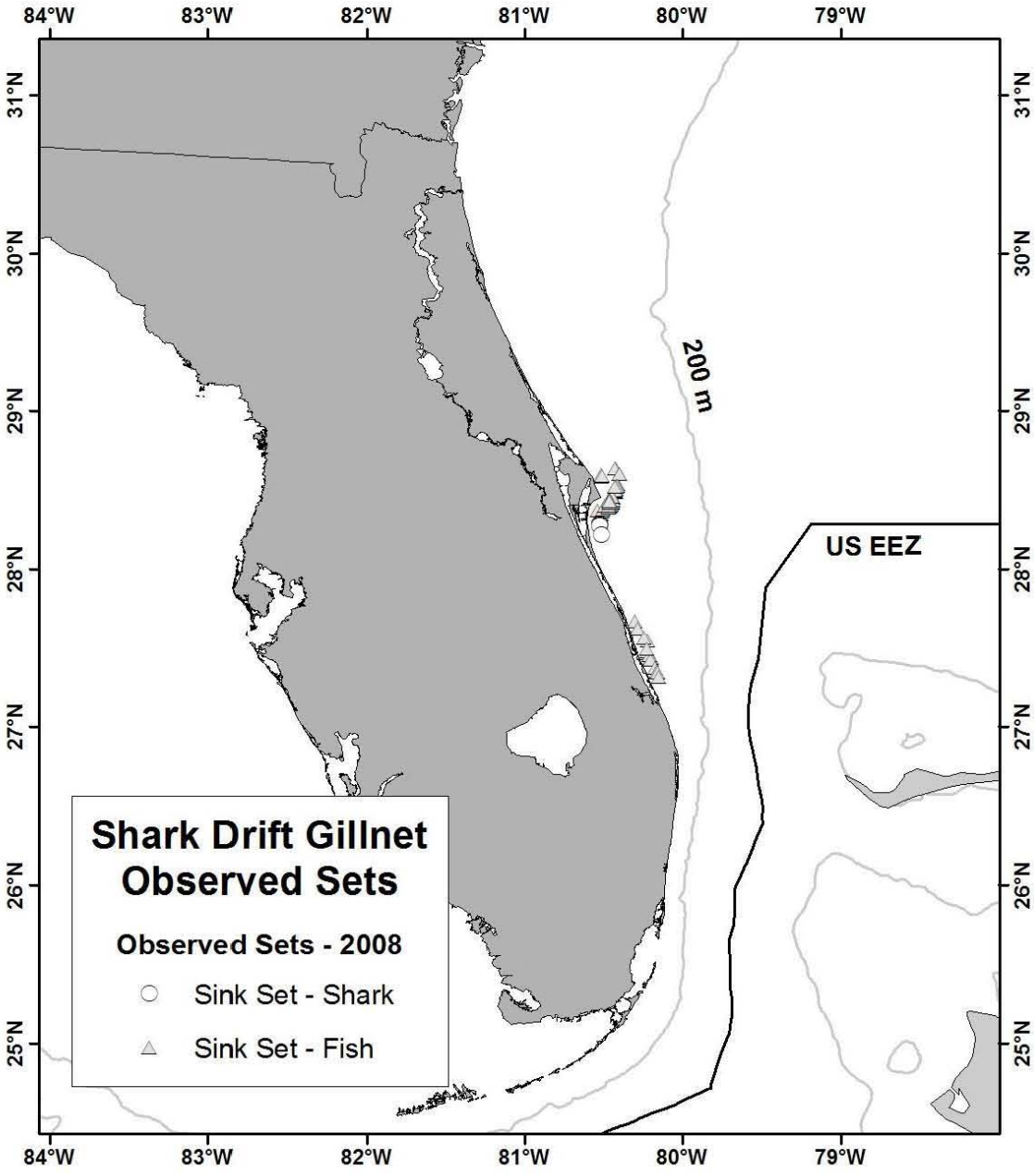


Figure 46. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2004. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

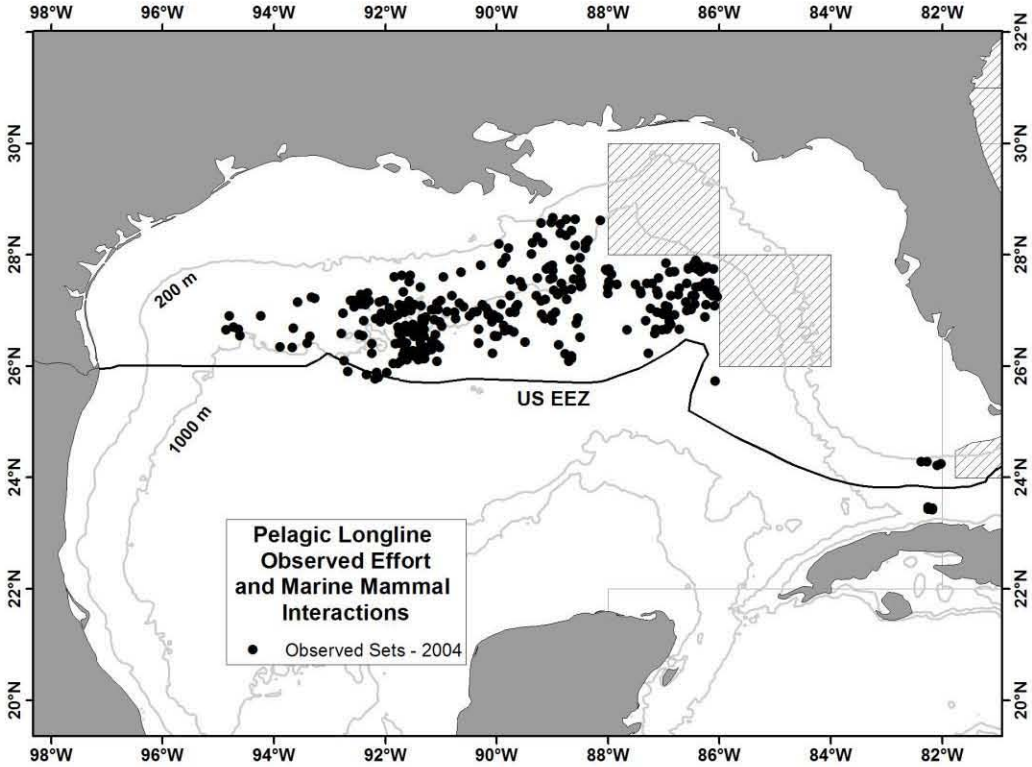


Figure 47. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2005. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

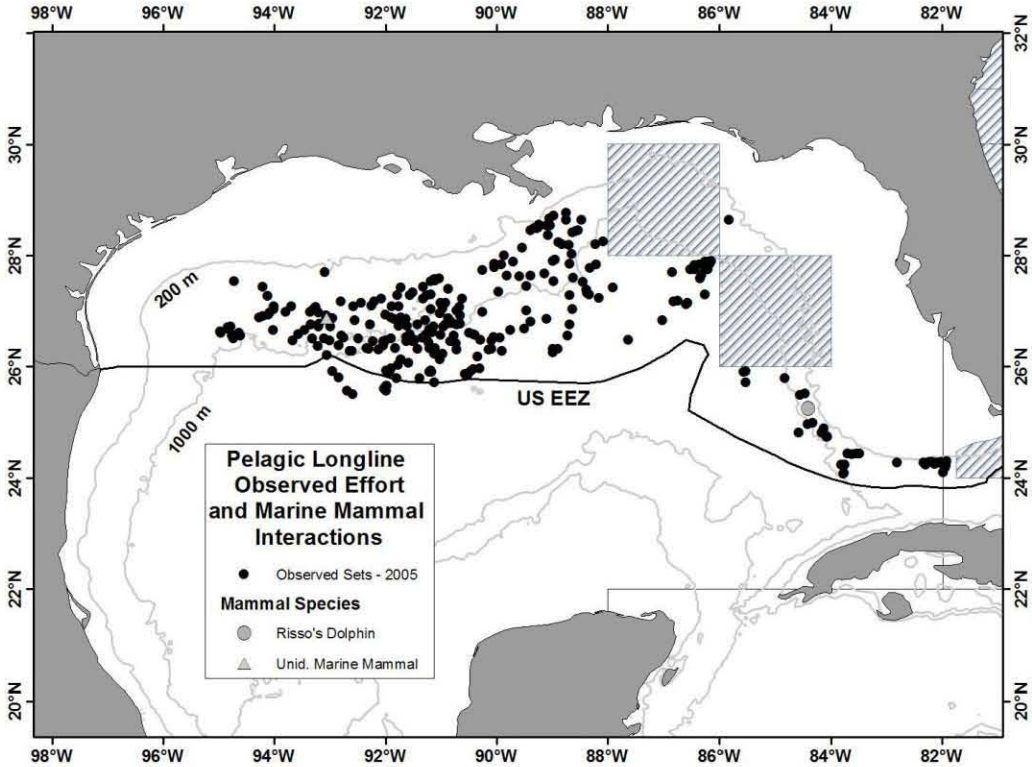


Figure 48. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2006. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

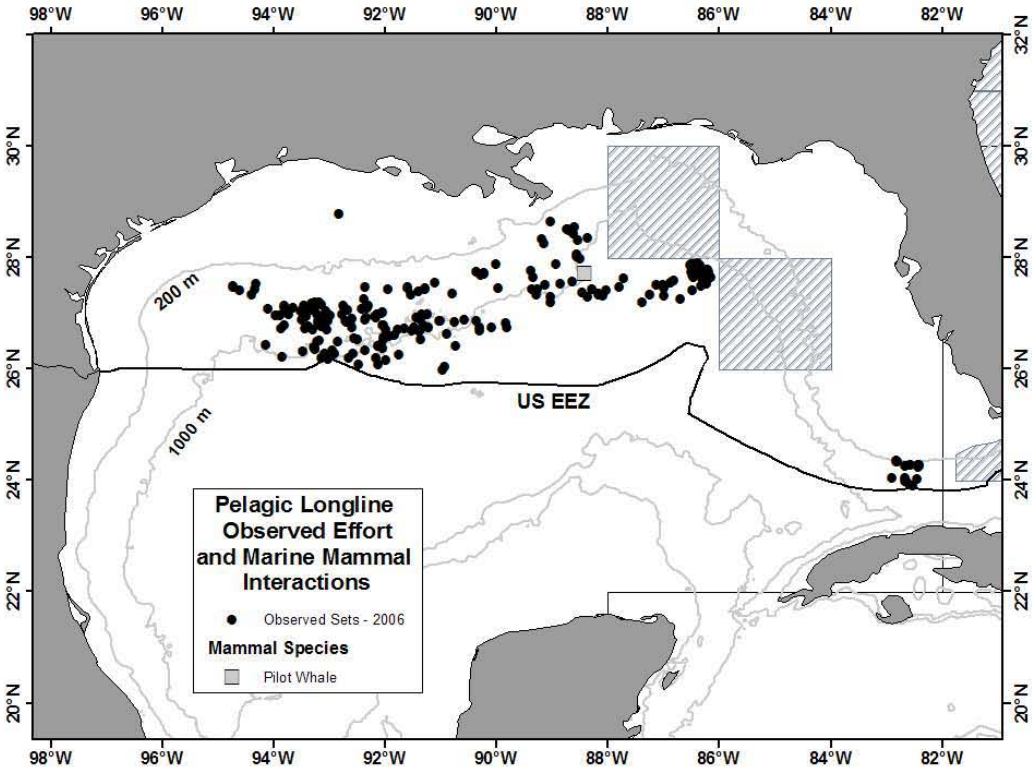


Figure 49. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2007. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

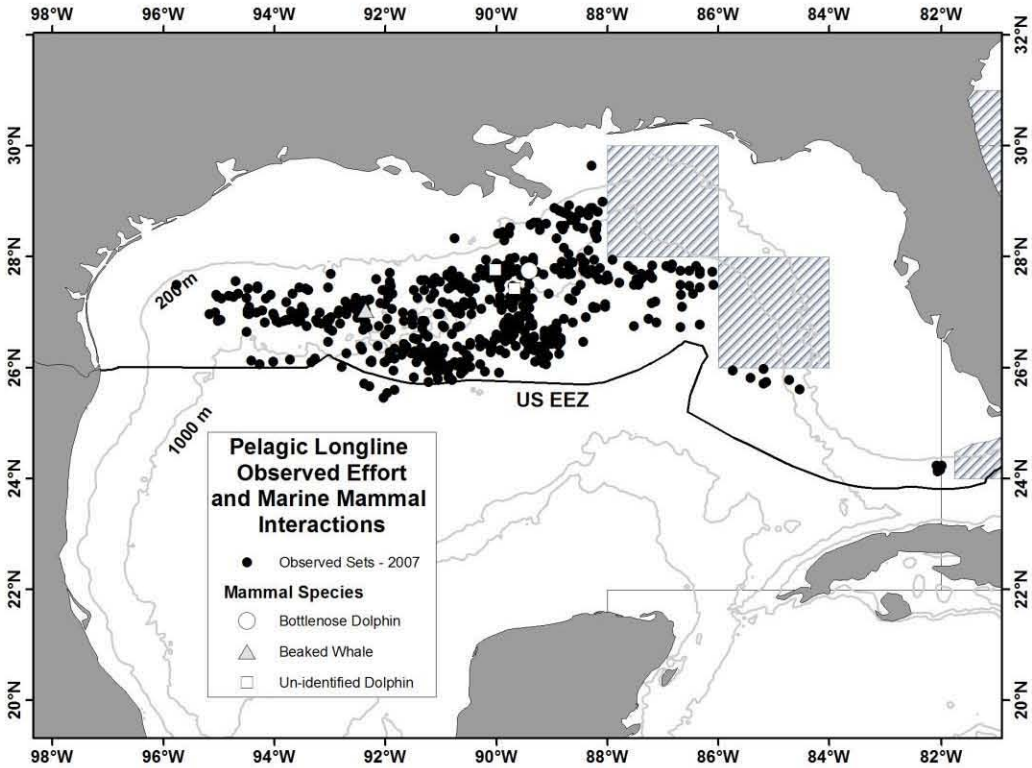
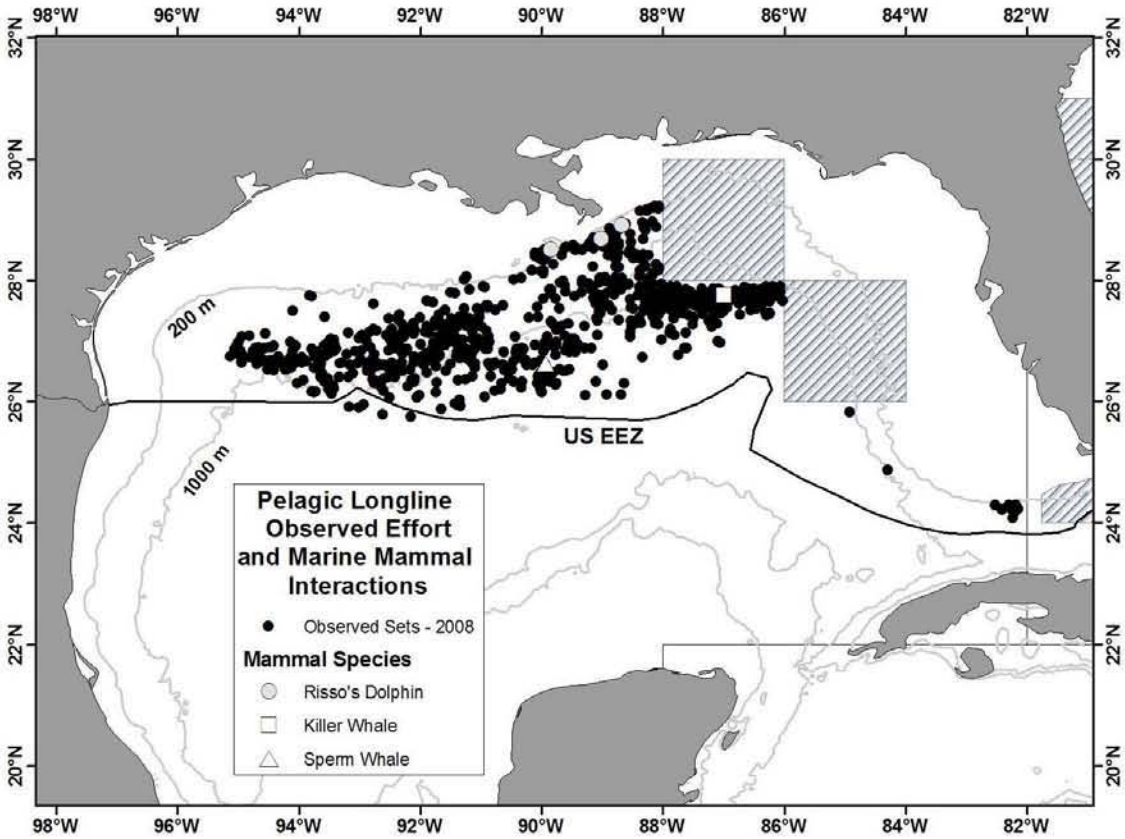


Figure 50. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2008. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.



APPENDIX IV: Table A. Surveys

Survey Number	Year	Season	Platform	Track line length (km)	Area	Agency/Program	Analysis	Corrected for g(0)	Reference
1	1982	year-round	plane (AT-11; 1978-1982)	211,585	Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	CETAP	Line transect analyses of distance data	N	(CETAP 1982)
2	1990	Aug	ship (Chapman)	2,067	Cape Hatteras, NC to Southern New England, North wall of the Gulf Stream	NEC	One team data analyzed by DISTANCE.	N	(NMFS 1990)
3	1991	Jul-Aug	ship (Abel-J)	1,962	Gulf of Maine, lower Bay of Fundy, southern Scotian Shelf	NEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Palka 1995)
4	1991	Aug	boat (Sneak Attack)	640	inshore bays of Maine	NEC	One team data analyzed by DISTANCE.	Y	(Palka 1995)
5	1991	Aug-Sep	plane 1(AT-11)	9,663	Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	NEC/SEC	One team data analyzed by DISTANCE.	N	(NMFS 1991)
6	1991	Aug-Sep	plane 2 (Twin Otter)		Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	NEC/SEC	One team data analyzed by DISTANCE.	N	(NMFS 1991)
7	1991	Jun-Jul	ship (Chapman)	4,032	Cape Hatteras to Georges Bank, between 200 and 2,000m isobaths	NEC	One team data analyzed by DISTANCE.	N	(Waring *et al.* 1992; Waring 1998)
8	1992	Jul-Sep	ship (Abel-J)	3,710	N. Gulf of Maine and lower Bay of Fundy	NEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Smith *et al.* 1993)
9	1993	Jun-Jul	ship (Delaware II)	1,874	S. edge of Georges Bank, across the Northeast Channel, to the SE. edge of the Scotian Shelf	NEC	One team data analyzed by DISTANCE.		(NMFS 1993)

10	1994	Aug-Sep	ship (Relentless)	534	shelf edge and slope waters of Georges Bank	NEC	One team data analyzed by DISTANCE.	N	(NMFS 1994)
11	1995	Aug-Sep	plane (Skymaster)	8,427	Gulf of St. Lawrence	DFO	One team data analyzed using quenouille's jackknife bias reduction procedure that modeled the left truncated sighting curve	N	(Kingsley and Reeves 1998)
12	1995	Jul-Sep	2 ships (Abel-J and Pelican) and plane (Twin Otter)	32,600	Virginia to the mouth of the Gulf of St. Lawrence	NEC	Ship: two independent team data analyzed with modified direct duplicate method. Plane: one team data analyzed by DISTANCE.	Ship: Y. Plane: Y (only harbor porpoise) N (rest of species)	(Palka 1996)
13	1996	Jul-Aug	plane	3,993	Northern Gulf of St. Lawrence	DFO	Quenouille's jackknife bias reduction procedure on line transect methods that modeled the left truncated sighting curve	N	(Kingsley and Reeves 1998)
14	1998	Jul-Aug	ship	4,163	south of Maryland	SEC	One team data analyzed by DISTANCE.	N	(Mullin and Fulling 2003)
15	1998	Aug-Sep	plane (1995 and 1998)		Gulf of St. Lawrence	DFO			(Kingsley and Reeves 1998)
16	1998	Jul-Sep	ship (Abel-J) and plane (Twin Otter)	15,900	north of Maryland	NEC	Ship: two independent team data analyzed with the modifed direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement.	Y	

							Plane: one team data analyzed by DISTANCE.		
17	1999	Jul-Aug	ship (Abel-J) and plane (Twin Otter)	6,123	south of Cape Cod to mouth of Gulf of St. Lawrence	NEC	Ship: two independent team data analyzed with modified direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement. Plane: circle-back data pooled with aerial data collected in 1999, 2002, 2004, 2006, 2007, and 2008 to calculate pooled g(0)'s and year-species specific abundance estimates for all years except 2008.	Y	
18	2002	Jul-Aug	plane (Twin Otter)	7,465	Georges Bank to Maine	NEC	Same as for plane in survey 15.	Y	(Palka 2006)
19	2002	Feb-Apr	ship (Gunter)	4,592	SE US continental shelf Delaware - Florida	SEC	One team data analyzed by DISTANCE.	N	(Garrison *et al.* 2003)
20	2002	Jun-Jul	plane	6,734	Florida to New Jersey	SEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Garrison 2003)
21	2004	Jun-Aug	ship (Gunter)	5,659	Florida to Maryland	SEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Garrison et al. in prep)

22	2004	Jun-Aug	ship (Endeavor) and plane (Twin Otter)	10,761	Maryland to Bay of Fundy	NEC	Same methods used in survey 15.	Y	(Palka 2006)
23	2006	Aug	plane (Twin Otter)	10,676	Georges Bank to Bay of Fundy	NEC	Same as for plane in survey 15.	Y	Palka (in prep)
24	2007	Aug	ship (Bigelow) and plane (Twin Otter)	8,195	Georges Bank to Bay of Fundy	NEC	Ship: Tracker data analyzed by DISTANCE. Plane: same as for plane in survey 15.	Y	Palka (in prep)
25	2007	July-Aug	plane	46,804	Canadian waters from Nova Scotia to Newfoundland	DFO	uncorrected counts	N	(Lawson and Gosselin 2009)
26	2008	Aug	plane (Twin Otter)	6,267	NY to Maine in US waters	NEC	Same as for plane in survey 15.	Y	Palka (in prep)
27	2001	May-June	plane	na	Maine coast	NEC/UM	corrected counts	N	(Gilbert *et al.* 2005)
28	1999	March	plane	na	Cape Cod	NEC	uncorrected counts	N	(Barlas 1999)
29	1983 - 1986	1983 (Fall) 1984 (Winter, Spring, Summer) 1985 (Summer, Fall) 1986 (Winter)	plane (Beechcraft D-18S modified with a bubblenose)	103,490 total 25,627 (bays and sounds) 36,685 (coastal) 41,178 (outer continental shelf, OCS)	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 183-m isobath	SEC	One team data analyzed with Line-transect theory	N	(Scott *et al.* 1989)
30	1991-1994	Apr- June	ship (Oregon II)	22,041	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Hansen *et al.* 1995)
31	1992-1993	Sep-Oct	plane (Twin Otter)	5,578 (bays and sounds) 4,806 (coastal) 7,678 (outer continental shelf, OCS)	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 18-3m isobath	GOMEX92 GOMEX93	One team data analyzed by DISTANCE	N	(Blaylock and Hoggard 1994)
32	1994	Sep-Nov	plane (Twin Otter)	1,155 (bays and sounds) 1,953 (coastal) 1,879 (outer continental shelf, OCS)	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3	GOMEX94	One team data analyzed by DISTANCE	N	NMFS unpub. data

					km past the ~~183m~~ 18-m isobath				
33	1996-1997, 1999-2001	Apr-June	ship (Oregon II and Gunter)	12,162	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Mullin and Fulling 2004)
34	1998-2001	end Aug-early Oct	ship (Gunter and Oregon II)	2,196	northern Gulf of Mexico outer continental shelf (OCS, 20-200 m)	SEC	One team data analyzed by DISTANCE	N	(Fulling *et al.* 2003)
35	2003-2004	Jun-Aug (2003) Apr-Jun (2004)	ship (Gunter)	10,933	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Mullin 2007)
36	2004	12-13 Jan	helicopter		Sable Island	DFO	Pup count	na	(Bowen *et al.* 2007)
37	2004		plane		Gulf of St Lawrence and Nova Scotia Eastern Shore	DFO	Pup count		(Hammill 2005)
38	2009	10 June – 13 August	ship	4,600	northern Gulf of Mexico from 200m to U.S. EEZ	SEC			

APPENDIX IV: Table B. Abundance estimates – "Survey Number" refers to surveys described in Table A. "Best" estimate for each species in bold font.

Species	Stock	Year	Nbest	CV	Survey Number	Notes
Humpback Whale	Gulf of Maine	1992	501			minimum pop'n size estimated from photo-ID data
		1993	652	0.29		YONAH sampling (Clapham *et al.* 2003)
		1997	497			minimum pop'n size estimated from photo-ID data
		1999	902	0.45	17	
		2002	521	0.67	18	
		2004	359	0.75	22	
		2006	**847**	**0.55**	**23**	
Fin Whale	Western North Atlantic	1995	2,200	0.24	12	
		1999	2,814	0.21	18	
		2002	2,933	0.49	18	
		2004	1,925	0.55	22	
		2006	2,269	0.37	23	
		2007	1,352	0.26	25	
		2007	**3,985**	**0.24**	**23+25**	
Sei Whale	Nova Scotia	1977	1,393-2,248			based on tag-recapture data (Mitchell and Chapman 1977)
		1977	870			based on census data (Mitchell and Chapman 1977)

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		1982	280		1	
		2002	71	1.01	21	
		2004	**386**	**0.85**	**23**	
		2006	207	0.62	24	
Minke Whale	Canadian East Coast	1982	320	0.23	1	
		1992	2,650	0.31	3+8	
		1993	330	0.66	9	
		1995	2,790	0.32	12	
		1995	1,020	0.27	11	
		1996	620	0.52	13	
		1999	2,998	0.19	17	
		2002	756	0.9	18	
		2004	600	0.61	22	
		2006	**3,312**	**0.74**	**23**	
		2007	3,242		25	
		~~2008~~2007	5,675		~~26~~38	
		2007	8,987	0.32	23+25	
Sperm Whale	North Atlantic	1982	219	0.36	1	
		1990	338	0.31	2	
		1991	736	0.33	7	
		1991	705	0.66	6	
		1991	337	0.5	5	
		1993	116	0.4	9	
		1994	623	0.52	10	
		1995	2,698	0.67	12	
		1998	2,848	0.49	16	
		1998	1,181	0.51	14	
		2004	2,607	0.57	22	
		2004	2,197	0.47	21	
		2004	**4,804**	**0.38**	**21+22**	**Estimate summed from north and south surveys**
Kogia spp.	Western North Atlantic	1998	115	0.61	16	
		1998	580	0.57	14	
		2004	358	0.44	22	
		2004	37	0.75	21	
		2004	**395**	**0.4**	**21+22**	**Estimate summed from north and south surveys**
Beaked Whales	Western North Atlantic	1982	120	0.71	1	
		1990	442	0.51	2	
		1991	262	0.99	7	
		1991	370	0.65	6	
		1991	612	0.73	5	
		1993	330	0.66	9	
		1994	99	0.64	10	
		1995	1,519	0.69	12	
		1998	2,600	0.4	16	
		1998	541	0.55	14	
		2004	2,839	0.78	22	

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		2004	674	0.36	21	
		2004	**3,513**	**0.63**	**21+22**	**Estimate summed from north and south surveys**
		2006	922	1.47	23	
Risso's Dolphin	Western North Atlantic	1982	4,980	0.34	1	
		1991	11,017	0.58	7	
		1991	6,496	0.74	5	
		1991	16,818	0.52	6	
		1993	212	0.62	9	
		1995	5,587	1.16	12	
		1998	18,631	0.35	17	
		1998	9,533	0.5	15	
		1998	28,164	0.29	15+17	Estimate summed from north and south surveys
		2002	69,311	0.76	18	
		2004	15,053	0.78	21	
		2004	5,426	0.54	22	
		2004	**20,479**	**0.59**	**21+22**	**Estimate summed from north and south surveys**
		2006	14,408	0.38	23	
Pilot Whale	Western North Atlantic	1951	50,000			Derived from catch data from 1951-1961 drive fishery (Mitchell 1974)
		1975	43,000-96,000			Derived from population models (Mercer 1975)
		1982	11,120	0.29	1	
		1991	3,636	0.36	7	
		1991	3,368	0.28	5	
		1991	5,377	0.53	6	
		1993	668	0.55	9	
		1995	8,176	0.65	12	
		1995	9,776	0.55	12+16	Sum of US (#12) and Canadian (#16) surveys
		1998	1,600	0.65	16	
		1998	9,800	0.34	17	
		1998	5,109	0.41	15	
		2002	5,408	0.56	18	
		2004	15,728	0.34	22	
		2004	15,411	0.43	21	
		2004	**31,139**	**0.27**	**21+22**	**Estimate summed from north and south surveys**
		2006	26,535	0.35	23	
		2007	6,134		25	
Atlantic white-sided Dolphin	Western North Atlantic	1982	28,600	0.21	1	
		1992	20,400	0.63	2+7	
		1993	729	0.47	9	
		1995	27,200	0.43	12	
		1995	11,750	0.47	11	
		1996	560	0.89	13	
		1999	51,640	0.38	17	
		2002	109,141	0.3	18	
		2004	2,330	0.8	22	
		2006	17,594	0.3	23	
		2006	**63,368**	**0.27**	**(18+23)/2**	**average of #18 and #23**

		2007	5,796	0.43	25	
White-beaked Dolphin	Western North Atlantic	1982	573	0.69	1	
			5,500			(Alling and Whitehead 1987)
		1982	3,486	0.22		(Alling and Whitehead 1987)
		2006	**2,003**	**0.94**	**23**	
		2007	1,1842		25	
		2008			26	
Common Dolphin	Western North Atlantic	1982	29,610	0.39	1	
		1991	22,215	0.4	7	
		1993	1,645	0.47	9	
		1995	6,741	0.69	12	
		1998	30,768	0.32	17	
		1998	0		15	
		2002	6,460	0.74	21	
		2004	90,547	0.24	22	
		2004	30,196	0.54	21	
		2004	**120,743**	**0.23**	**21+22**	**Estimate summed from north and south surveys**
		2006	84,000	0.36	24	
		2007	53,625	0.22	25	
Altantic Spotted Dolphin	Western North Atlantic	1982	6,107	0.27	1	
		1995	4,772	1.27	12	
		1998	32,043	1.39	16	
		1998	14,438	0.63	14	
		2004	3,578	0.48	22	
		2004	47,400	0.45	21	
		2004	**50,978**	**0.42**	**21+22**	**Estimate summed from north and south surveys**
Pantropical Spotted Dolphin	Western North Atlantic	1982	6,107	0.27	1	
		1995	4,772	1.27	12	
		1998	343	1.03	16	
		1998	12,747	0.56	14	
		2004	0		22	
		2004	4,439	0.49	21	
		2004	**4,439**	**0.49**	**21+22**	**Estimate summed from north and south surveys**
Striped Dolphin	Western North Atlantic	1982	36,780	0.27	1	
		1995	31,669	0.73	12	
		1998	39,720	0.45	16	
		1998	10,225	0.91	14	
		2004	52,055	0.57	22	
		2004	42,407	0.53	21	
		2004	**94,462**	**0.4**	**21+22**	**Estimate summed from north and south surveys**
Bottlenose Dolphin	Western North Atlantic Offshore	1998	16,689	0.32	16	
		1998	13,085	0.4	14	
		2002	26,849	0.19	20	
		2002	5,100	0.41	18	
		2004	9,786	0.56	22	
		2004	44,953	0.26	21	

		2004	**81,588**	**0.17**	**20+21+22**	**Estimate summed from north and south surveys and 2002 survey**
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1991	37,500	0.29	3	
		1992	67,500	0.23	8	
		1995	74,000	0.2	12	
		1995	12,100	0.26	11	
		1996	21,700	0.38	14	
		1999	89,700	0.22	18	survey discovered portions of the range not previously surveyed
		2002	64,047	0.48	21	
		2004	51,520	0.65	23	
		2006	**89,054**	**0.47**	**24**	
		2007	4,862	0.31	25	
		~~2008~~	-	-	~~26~~	
Harbor Seal	Western North Atlantic	2001	99,340	0.097	27	
Gray Seal	Western North Atlantic	1999	5,611		28	
		2001	1,731		27	
		2004	52,500	0.15	37	Gulf of St Lawrence and Nova Scotia Eastern Shore
			208,720	0.14		
			216,490	0.11		
		2004	223,220	0.08	36	Sable Island
Bryde's Whale	Northern Gulf of Mexico	1991-1994	35	1.10	30	
		1996-2001	40	0.61	33	
		2003-2004	**15**	**1.98**	35	
Sperm Whale	Northern Gulf of Mexico	1991-1994	530	0.31	30	
		1996-2001	1,349	0.23	33	
		2003-2004	**1,665**	**0.20**	35	
Kogia spp.	Northern Gulf of Mexico	1991-1994	547	0.28	30	
		1996-2001	742	0.29	33	
		2003-2004	**453**	**0.35**	35	
Cuvier's Beaked Whale	Northern Gulf of Mexico	1991-1994	30	0.50	30	
		1996-2001	95	0.47	33	
		2003-2004	**65**	**0.67**	35	
Mesoplodon spp.	Northern Gulf of Mexico	1996-2001	106	0.41	33	
		2003-2004	**57**	**1.40**	35	
Killer Whale	Northern Gulf of Mexico	1991-1994	277	0.42	30	
		1996-2001	133	0.49	33	
		2003-2004	**49**	**0.77**	35	
False killer Whale	Northern Gulf of Mexico	1991-1994	381	0.62	30	
		1996-2001	1,038	0.71	33	
		2003-2004	**777**	**0.56**	35	
Short-finned Pilot Whale	Northern Gulf of Mexico	1991-1994	353	0.89	30	
		1996-2001	2,388	0.48	33	
		2003-2004	**716**	**0.34**	35	
Melon-headed Whale	Northern Gulf of Mexico	1991-1994	3,965	0.39	30	
		1996-2001	3,451	0.55	33	
		2003-2004	2,283	0.76	35	
Pygmy Killer	Northern	1991-1994	518	0.81	30	

Whale	Gulf of Mexico	1996-2001	408	0.60	33	
		2003-2004	**323**	**0.60**	35	
Risso's Dolphin	Northern Gulf of Mexico	1991-1994	2,749	0.27	30	
		1996-2001	2,169	0.32	33	
		2003-2004	**1,589**	**0.27**	35	
Pantropical Spotted Dolphin	Northern Gulf of Mexico	1991-1994	31,320	0.20	30	
		1996-2001	91,321	0.16	33	
		2003-2004	**34,067**	**0.18**	35	
Striped Dolphin	Northern Gulf of Mexico	1991-1994	4,858	0.44	30	
		1996-2001	6,505	0.43	33	
		2003-2004	**3,325**	**0.48**	35	
Spinner Dolphin	Northern Gulf of Mexico	1991-1994	6,316	0.43	30	
		1996-2001	11,971	0.71	33	
		2003-2004	**1,989**	**0.48**	35	
Clymene Dolphin	Northern Gulf of Mexico	1991-1994	5,571	0.37	30	
		1996-2001	17,355	0.65	33	
		2003-2004	**6,575**	**0.36**	35	
Atlantic Spotted Dolphin	Northern Gulf of Mexico	1991-1994 oceanic	3,213	0.44	30	
		1996-2001 oceanic	175	0.84	33	
		1998-2001 OCS	37,611	0.28	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		2003-2004 oceanic	0	-	35	
Fraser's Dolphin	Northern Gulf of Mexico	1991-1994	127	0.90	30	
		1996-2001	726	0.70	33	
		2003-2004	0	-	35	Current best population size estimate is unknown.
Rough-toothed Dolphin	Northern Gulf of Mexico	1991-1994 oceanic	852	0.31	30	
		1996-2001 oceanic	985	0.44	33	
		1998-2001 OCS	1,145	0.83	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		2003-2004 oceanic	1,508	0.39	35	
Bottlenose Dolphin	Northern Gulf of Mexico Oceanic	1996-2001	2,239	0.41	33	
		2003-2004	**3,708**	**0.42**	35	
Bottlenose Dolphin	Northern Gulf of Mexico Continental Shelf	1998-2001	17,777	0.32	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf are more than 8 years old.
Bottlenose Dolphin	Northern Gulf of Mexico Coastal (3 stocks)	Eastern 1994	9,912	0.12	32	
		Northern 1993	4,191	0.21	31	
		Western 1992	3,499	0.21	31	Current best population size estimate for each of these 3 stocks is unknown because data are more than 8 years old.
Bottlenose Dolphin	Northern Gulf of Mexico Bay, Sound	~~Barataria Bay, 2001~~	~~138~~	~~0.08~~		~~(Miller 2003)~~
		St. Joseph Bay, 2005-	81	0.14		(Balmer *et al.* 2008)

	and Estuarine (33 stocks)	2006				
		St. Vincent Sound, Apalachicola Bay, St. George Sound, 2008	537	0.09		(Tyson 2008)
		Remaining ~~30~~ 31 stocks	unknown	undetermined	31	Current best population size estimate for each of these 30 stocks is unknown because data are more than 8 years old.

REFERENCES CITED

Alling, A.K. and H.P. Whitehead 1987. A preliminary study of the status of white-beaked dolphins, *Lagenorhynchus albirostris*, and other small cetaceans off the coast of Labrador. Can. Field-Nat. 101(1): 131-135.

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10(2): 157-167.

Barlas, M.E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor)* and gray seals (*Halichoerus grypus*) in southern New England, winter 1998-summer 1999. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 52 pp.

Blaylock, R.A. and W. Hoggard 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356. 10 pp.

Bowen, W.D., J.I. McMillan and W. Blanchard 2007. Reduced population growth of gray seals at Sable Island: Evidence from pup production and age of primiparity. Mar. Mamm. Sci. 23: 48-64.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report. Washington, DC, Bureau of Land Management. #AA551-CT8-48 538 pp.

Clapham, P.J., J. Barlow, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins and R. Seton 2003. Stock definition, abundance and demographic parameters of humpback whales from the Gulf of Maine. J. Cetacean Res. Manage. 5(13-22).

Fulling, G.L., K.D. Mullin and C.W. Hubard 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515. 52 pp.

Garrison, L.P., S.L. Swartz, A. Martinez, C. Burks and J. Stamates 2003. A marine mammal assessment survey of the Southeast US continental shelf, February-April 2002. NOAA Tech. Memo. NMFS-SEFSC-492.

Gilbert, J.R., G.T. Waring, K.M. Wynne and N. Guldager 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Mar. Mamm. Sci. 21: 519-535.

Hammill, M.O. 2005. Abundance of Northwest Atlantic grey seals in the Gulf of St. Lawrence and along the Nova Scotia Eastern Shore. Canadian Department of Fisheries and Oceans. Ottawa, Ontario. DFO Research Document 2005/036. 11 pp. http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_036_e.

Hansen, L.J., K.D. Mullin and C.L. Roden 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami, FL. Contribution No. MIA-94/95-25. 9 pp.

Kingsley, M.C.S. and R.R. Reeves 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76: 1529-1550.

Lawson, J.W. and J.-F. Gosselin ~~2008~~2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. Can. Sci. Advisory Sec. Res. Doc. ~~208~~2009/~~nnn~~031. 33 pp.

Mercer, M.C. 1975. Modified Leslie-DeLury population models of the long-finned pilot whale (*Globicephala melaena*) and annual production of the short-finned squid (*Illex illecebrosus*) based upon their interactions at Newfoundland. J. Fish. Res. Board Can 32(7): 1145-1154.

Miller, C. 2003. Abundance trends and environmental habitat usage patterns of bottlenose dolphins (*Tursiops truncatus*) in lower Barataria and Caminada Bays, Louisiana. Ph.D. thesis. Louisiana State University, Baton Rouge. 125 pp.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 108-169 *in*: W. E. Schevill, (ed.) The whale problem: A status report. Harvard University Press, Cambridge, MA.

Mitchell, E. and D.G. Chapman 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). Rep. Int. Whal. Comm. (Special Issue) 1: 117-120.

Mullin, K.D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568, 26 pp.

Mullin, K.D. and G.L. Fulling 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101: 603-613.

Mullin, K.D. and G.L. Fulling 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

NMFS 1990. Cruise results, NOAA Ship CHAPMAN, Cruise No. 90-05. Marine Mammal Sighting Survey. National Marine Fisheries Service. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. 5 pp.

NMFS 1991. Northeast cetacean aerial survey and inter-platform study. National Marine Fisheries Service. NOAA-NMFS-SEFSC and NEFSC. 4 pp.

NMFS 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. National Marine Fisheries Service. NOAA NMFS NEFSC, Woods Hole Laboratory, Woods Hole, MA, 5 pp.

NMFS 1994. Cruise results, NOAA ship RELENTLESS, Cruise No. RS 9402, Marine Mammal Survey/Warm Core Ring Study. National Marine Fisheries Service. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-102. 8 pp.

Palka, D.L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. Northeast Fish. Sci. Cent. Ref. Doc. 96-04. 35 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd9604.pdf

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD 88/89-07. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Smith, T., D. Palka and K. Bisack 1993. Biological significance of by-catch of harbor porpoise in the Gulf of Maine Demersal Gillnet Fishery. Northeast Fish. Sci. Cent. Ref. Doc. 93-23. 15 pp.

Tyson, R.B. 2008. Abundance of bottlenose dolphins (*Tursiops truncatus*) in the Big Bend of Florida, St. Vincent Sound to Alligator Harbor. M. Sc. thesis. Florida State University, Tallahassee. 65 + ix pp.

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. Northeast Fish. Sci. Cent. Ref. Doc. 98-09. 21 pp.

Waring, G.T., C.P. Fairfield, C.M. Ruhsam and M. Sano 1992. Cetaceans associated with Gulf Stream Features off the Northeastern USA Shelf. ICES [Int. Counc. Explor. Sea] C.M. 1992/N:12.