1. **Cover Page** –

Pilot Project: Evaluating the Effects of Circle Hooks on Catch Rates
within Two Pelagic Longline Time-Area Closures

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2. **Abstract** –

A total of 188 pelagic longline sets were conducted within the South Atlantic Bight and Florida East Coast NOAA pelagic statistical areas to evaluate the catches and catch characteristics. A total of over 3200 individual animals was caught, including 1295 swordfish and 717 tunas. For istiophorid billfishes, 75 blue marlin, 22 white marlin, and 136 sailfish were caught, with only 76 combined billfishes discarded dead. Bycatch of sharks was minimal, and the main bycatch elasmobranch species were tiger, silky, and night sharks. The work interacted with only five sea turtles (three leatherback, two loggerhead), all of which were released alive, and no sea birds or marine mammals. While the results suggest that limited pelagic longline operations could occur within these specific regions of the time-area closures, additional highly-monitored research in targeted regions of these time-area closures and clearly defined bycatch limits would be prerequisites to a public reopening of these areas to commercial operations.

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3. Introduction –

Time-area closures have been used for many years in many fisheries as a management tool by the U.S. National Marine Fisheries Service (NMFS) to reduce levels of bycatch. For the pelagic longline fishery, there is a seasonal closure of some of the offshore waters from the Mid-Atlantic States to reduce the bycatch of bluefin tuna *Thunnus thynnus thynnus*, for example. Large expanses of waters traditionally fished by the U.S. pelagic longline fishery have been closed by NMFS in recent years to protect populations of sea turtles[1] and other bycatch species (Figure 1). For example, the Florida East Coast (FEC) time-area closure was closed in 2000, in large part, to reduce the catch of juvenile swordfish *Xiphias gladius* by the pelagic longline fleet. Other areas closed to pelagic longline operations include the DeSoto Canyon in the Gulf of Mexico (again, due to juvenile swordfish) and the traditional winter fishing grounds of the Windward Passage between Cuba and Haiti and Yucatan Channel between Mexico and Cuba (in part due to geo-political concerns over fishing in foreign Exclusive Economic Zones). However, all of these areas once allowed the U.S. pelagic longline fleet access to some of the most fertile fishing grounds in the western Atlantic Ocean for swordfish and other highly migratory species (HMS) such as yellowfin *Thunnus albacares* and bigeye *T. obesus* tunas.

Closing these areas was compounded with gear restrictions for the fleet, with the result that the U.S. share of the North Atlantic catch of swordfish has dropped from an average of 28.9% of the North Atlantic total harvest between 1985-1994 to only a 22.9% average from 2000-2004 (ICCAT, 2006), or a drop of over half from the catches in the late 1980s.[2] These regulatory actions have also resulted in growing pressure at the International Commission for the Conservation of Atlantic Tunas (ICCAT) from other harvesting nations to revise the U.S. allocation of the total allowable catch of this swordfish stock. While recent ICCAT annual meetings have ended without changing the current U.S. quota on the North

[1] The grouping of "sea turtles" (Superfamily: Chelonioidea) includes the following species: leatherback *Dermochelys coracea*, loggerhead *Caretta caretta*, Kemp's and olive Ridley *Lepidochelys kempii* and *L. olivacea*, green *Chelonia mydas*, and hawksbill *Eretmochelys imbricata*. Leatherback and loggerhead turtles are the most common turtle bycatch species in the pelagic longline fishery.

[2] Although dated, these same trends hold true today. On July 12th, the NOAA HMS Management Division reported that only 18.3% of the annual baseline quota for the U.S. North Atlantic swordfish allocation had been caught during the first half of 2011. Additional information can be obtained on the Atlantic HMS Management Division website (http://www.nmfs.noaa.gov/sfalhms)

Atlantic swordfish stock, such challenges to the U.S. quota share are likely in the future. Recent overtures by other ICCAT members have suggested that continued "underharvesting" by the United States would result in the transfer of this quota to other member states, including those within the Caribbean Basin. Many of these developing-state fisheries continue to use J-style hooks and retain all fishes caught (including the istiophorid billfishes), unlike the U.S. pelagic longline fleet, which is required to use circle hooks, to release all istiophorid billfishes, and use "best practice" release protocols for all bycatch animals. Absent an increase in the domestic harvest levels, the United States will be increasingly unable to prevent such a quota allocation transfer by ICCAT from the United States to developing states where bycatch mortalities of juvenile swordfish, billfish, and other protected species will likely be much greater. Therefore, any changes in the U.S. swordfish fisheries management regime that would enable U.S. vessels to approach or catch its annual international quota of swordfish would also help preserve the important conservation advocacy role of the United States within ICCAT.[3]

Several options have been suggested for how the United States might retain its swordfish quota. One suggestion would be to advocate for recognition of the economic contribution of the recreational fishery, suggesting that the combined economic value of recreational fishing tackle, recreational fishing boats, and so on is at least equivalent to the value of actual swordfish landings by the commercial fishery.[4] Unfortunately, ICCAT has historically rarely considered economic values[5] of recreational fisheries in its management measures, and especially for developing fisheries whose economic values remain unquantified. Another suggestion would be to encourage better reporting of landings in the recreational fishery, including an allowance in the overall U.S. quota to better account for recreationally-released swordfish. However, even a combined approach of increased

[3] This perspective of maintaining domestic harvest allocatiuons as a means of secondarily protecting non-target species has been referred to as a "conservation quota," although prohibited by U.S. and ICCAT policy.
[4] Although there are three main fisheries in the U.S. Atlantic that harvest swordfish commercially – pelagic longline, swordfish buoy gear, and hook-and-line gear (the latter two primarily in the Florida Straits) – the "fishery" term here is a combination of all commercial landing gear types.
[5] Additionally, the basic ICCAT Convention focuses on catch, not value: "The Commission may, on the basis of scientific evidence, make recommendations designed to maintain the populations of tuna and tuna-like fishes that may be taken in the Convention area at levels which will permit the *maximum sustainable catch*." (italics added, Article VIII-1a; http://www.iccat.es/Documents/Commission/BasicTexts.pdf)

recreational fishery reporting rates and a release allowance for this recreational fishery would be unlikely to close the current shortfalls in U.S. annual swordfish harvests.

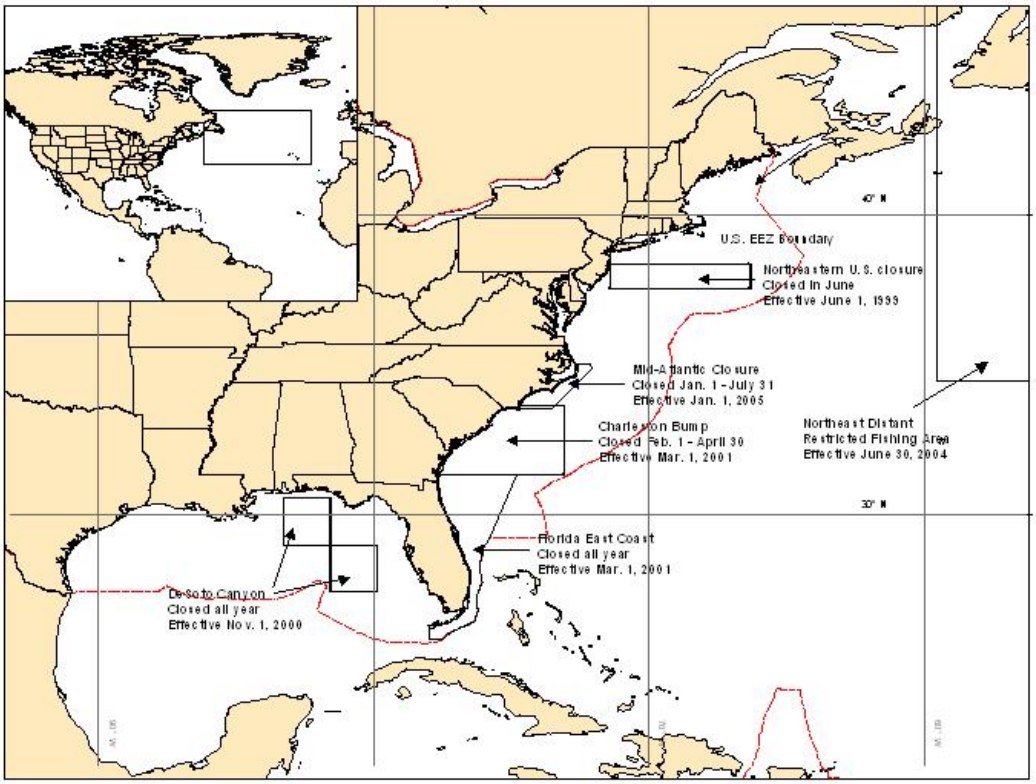

Figure 1. Time-area closures in the Atlantic Ocean and Gulf of Mexico to U.S.-flagged pelagic longline vessels. Inset map shows the extent of the Northeast Distant (NED) time-area closure encompassing much of the traditional Grand Banks seasonal swordfish fishery. (Map from NOAA 2010.)

A different suggestion for increasing the total U.S. harvest of swordfish would be to re-examine the boundaries of the time-area closures impacting the commercial pelagic longline fishery. This rationale posits that if the originally-stated conservation goals of the time-area closures have been achieved, then these closures should be reopened to the fishery. The Charleston Bump and Florida East Coast time-area pelagic longline closures were implemented in 2001 because of specific concerns about the high rates of juvenile swordfish bycatch on a then-overfished stock, with other bycatch species also discussed as additional support for the closures (65 FR 47214; NMFS, 2006; see also Cramer, 2001). The most recent assessment for the North Atlantic swordfish stock now indicates a relative biomass (B_{2009}/B_{MSY}) of 1.05, with overfishing not occurring and the stock not being overfished

(ICCAT, 2009). In its simplest form, the view held by some in the U.S. commercial fishery is that the stock is now recovered, and the utility of these time-area closures has been served in that recovery process; with recovery of the stock should come a reopening of these areas.[6]

The Florida East Coast and Charleston Bump time-area closure areas include some relatively unusual oceanographic features. The Florida Straits is a geographic area of high current, steep topography, and tropical waters bordered by Florida, Cuba (to the south), and the Bahamas (to the east and south, via Cay Sal Bank). As the Gulf Stream exits the Florida Straits at approximately 26°N and begins to broaden out along a northeastern axis, the current slows and begins to meander northward. The Charleston Bump is an oceanographic feature located approximately 80-100 nautical miles southeast of Charleston, South Carolina. Because of the underlying seafloor morphology at this location, the Gulf Stream is deflected upwards, creating a persistent upwelling and the so-called Charleston Gyre warm-core eddy. This combination of biological productivity, seafloor topography, and current patterns attracts both structure-associated reef fishes and upper-level pelagic predators such as marlins and tunas (Sedberry et al., 2001). Electronic tagging data indicate that swordfish there utilize the biological productivity of the Charleston Bump, but are not truly resident fishes (Sedberry and Loefer, 2001). Although conventional tagging data indicate that large swordfish actively enter and exit the Florida Straits, it has not been resolved whether any part of the swordfish stock in the Florida Straits represents a resident or transient population.

In addition to time-area closures reducing the absolute levels of bycatch via a reduction in overall local fishing effort, changes in terminal gear technology have also been implemented to reduce both bycatch rates and bycatch mortality rates. For example, increased attention is being devoted worldwide to the use of "circle" hooks in pelagic longline fisheries (see brief review in Watson and Kerstetter, 2006). In contrast to the familiar J-style hook, the circle hook features a point turned in relative to the eye, resulting in a generally circle-shaped hook. The mechanism of the hooking event also is different. With J-style hooks, the fish takes the bait and a force (either the fish or an angler) is required to impale the point of the hook into the nearest tissue. In contrast, circle hooks rely on the force of the fish as it swims away from the bait to rotate the hook, usually resulting in the eye of

[6] While the concern about juvenile swordfish was the most public justification for the Charleston Bump and Florida East Coast time-area closures, 71 FR 47214 was also explicit in stating the positive benefits of a reduction in sailfish, blue marlin, and white marlin bycatch, as well as bycatch of sea turtles.

the hook exiting the mouth and the then-exposed barb hooking into the jaw (see Cooke and Suski, 2004). This hook type has been in use for hundreds of years, but has been primarily used historically in such commercial fisheries as Pacific halibut *Hippoglossus stenolepis* (Johannes, 1981; Woll et al., 2001). However, the majority of recent circle hook advocates are recreational anglers. Several recreational and commercial fishery studies have all supported the common belief that these hooks reduce post-release mortality by preferentially hooking fish in the jaw rather than deep or foul hooking (e.g., recreational: Prince et al., 2007 and commercial: Kerstetter and Graves, 2006a; Kerstetter et al., 2006; Pacheco et al., 2011).

The positive impact of circle hooks in pelagic longline fisheries specifically is increasingly well documented for both target species and bycatch fishes such as marlin. Comparisons of catch rates between hook types indicate that circle hooks catch more fishes in sheer numbers than J-style hooks, especially with large tunas. Hoey (1996) reported 32.9 fish per set for circle hooks, while catching 25.5 fish per set using J-style hooks. Falterman and Graves (2002) found a significantly increased CPUE for circle hooks versus J-style hooks on both yellowfin tuna *T. albacares* and a composite "all fishes" category, even though the low number of fish caught overall prevented comparisons across most other species. Sullivan et al. (1999) also noted increased fishing power using circle hooks in the Pacific halibut *Hippoglossus stenolepis* fishery. Watson et al. (2005) found that circle hooks decreased retained swordfish catch, but increased tuna catch relative to J-style hooks in the Northeast Distant (Grand Banks) swordfish fishery. In the southern Florida Straits, Kerstetter (2004) found no difference in swordfish catch rates, mortality at haulback, or sizes (lengths and weights) between size 16/0 non-offset circle hooks and size 18/0 circle hooks with a 10° offset. Kerstetter and Graves (2006a) found significant catch rate differences between size 9/0 J-style hooks and size 16/0 non-offset circle hooks only for yellowfin tuna (fall fishery) and dolphinfish *Coryphaena hippurus* (spring fishery). More recently, Kerstetter et al. (2006) found both higher swordfish catch rates and rates of external hooking locations with non-offset 18/0 circle hooks versus 9/0 J-style hooks in the northern Brazilian pelagic longline fishery. Circle hooks have also been shown to increase rates of post-release survival versus J-style hooks for white marlin *Tetrapturus albidus* caught by pelagic longline gear (Kerstetter and Graves, 2006b). In recently-concluded research, 15 of 17 sailfish *Istiophorus platypterus* caught by non-offset circle hooks with pelagic longline gear off

Florida survived for at least ten days, an 88.2% post-release survival rate (Kerstetter and Graves, 2006c; Kerstetter and Graves, 2008). Years of cooperative experiments outside of the time-area closures have now demonstrated the positive differences in catch rates, hooking locations, and even post-release survival rates with the use of circle hooks versus J-style hooks with pelagic longline gear (see also Serafy et al., 2008).

Objectives

This project proposed to collect data on pelagic longline catch rates, size of fish, hooking location, mortality at haulback, and bycatch mortality in order to evaluate and compare the fishing efficiency of size 18/0 non-offset circle hooks with whole dead finfish and/or squid bait while targeting swordfish within the parts of the Charleston Bump and Florida East Coast time-area closures included in the recently-denied EFP request from Blue Water Fishermen's Association (72 F.R. 44834; see Fig. 1). The area in question consists of "the waters approximately 40 nautical miles north of Fort Pierce, FL, beginning at 28°N latitude and seaward of the Gulf Stream then continuing north and east seaward of the 100-fathom contour to the northern and eastern boundaries of the Charleston Bump closed area. In the Florida East Coast closed area, the proposed fishing areas include the waters between 28° and 30°N latitude, seaward of the Gulf Stream, out to the boundary of the U.S. Exclusive Economic Zone (EEZ). In the Charleston Bump Closed Area, the proposed fishing activities would take place seaward of the 100-fathom contour to the northern and eastern boundaries of that closure." (72 F.R. 11327) Although the spatial extent of the recreational fishing effort in these two time-area closures was (and remains) unknown, anecdotal information at the time suggested that these areas would have minimal opportunity for possible gear conflicts between the recreational and commercial fisheries.

Both time-area closures to pelagic longline gear originated from a need in part to reduce the bycatch of undersized swordfish to help rebuild the North Atlantic stock in accordance with management guidelines from the International Commission for the Conservation of Atlantic Tunas (ICCAT). The North Atlantic swordfish stock assessment at the time of the area-closure implementation indicated that the stock was moderately overfished, but is currently at a biomass consistent with maximum sustainable yield (ICCAT, 2006). To help guard against additional problems with bycatch, the federal government

mandated specific hook and bait types for the fishery in 2004, as well as safe handing equipment and procedures for bycatch species such as billfishes and sea turtles.

The purpose of this proposed research within the Charleston Bump (February-April) and Florida East Coast time-area closures was to determine the effects on target and bycatch species' catch rates and mortality at haulback for the small-vessel, coastal pelagic longline fishery given the recovery of the overall North Atlantic swordfish stock and the mandatory use of large, non-offset circle hooks. The research project had three overarching goals, with the analyses of these data testing these matching three hypotheses:

1) Comparison of catch rates between open and closed (experimental portions) areas;

> *H_{O1}: There are no statistically significant differences in catch rates within each of the two time-area closures and the open areas of the SAB and FEC NMFS statistical areas by species (including juvenile swordfish).*

2) Comparison of historical and contemporary catch rates between open and closed (experimental portions) areas; and

> *H_{O2}: There are no statistically significant differences between contemporary and historical catch rates within each of the two time-area closures by species (including juvenile swordfish).*

3) Comparison of historical and contemporary catch rates of hooks.

> *H_{O3}: There are no statistically significant differences in mortality (at haulback) between circle hooks (contemporary data) and J-style hooks (historical data) within the two time-area closures and the open areas of the SAB and FEC statistical areas combined by species (including composite values for species groups and juvenile swordfish).*

These three main research goals for the time-area closure project as a whole were then distilled into the following six specific, testable objectives:

- Evaluate the catch rates of target and bycatch species within the Charleston Bump and Florida Coast East time-area closures to PLL gear.
- Evaluate bycatch reduction potential for 18/0 non-offset circle hook on swordfish directed bycatch species.
- Evaluate the effectiveness of line cutters and de-hookers for releasing bycatch species.
- Collect data on the spatial and temporal relationship between target and bycatch species.
- Evaluate "immediate" mortality using non-offset 18/0 circle hooks.
- Evaluate bycatch reduction potential for non-offset 18/0 hook on all swordfish-directed fishery bycatch species.

4. Methods –

Exempted Fishing Permits (EFPs)

The research conducted under this report occurred within the closed period of the Charleston Bump time-area closure and within only a small part of the FCE time-area closure (Figure 2). Discussions relating to this specific proposal were initiated in 2006, and a related proposal from the Blue Water Fishermen's Association involving 13 commercial pelagic longline vessels within the FCE and CB time-area closures was denied an EFP in July 2007. Although the original proposal called for sampling during a one-year period between 1 September 2007 and 1 September 2008 with two small "coastal fleet" pelagic longline vessels, the final work involved several vessels and almost three years of sampling to achieve a substantial number of sets. The HMS Management Division required that no more than three specific vessels be included on the EFP for this research at any one time and had a set of criteria for participation by captains and vessels, such as background checks for prior Notices of Violation and Assessment (NOVAs) and clear title between vessels and owners. As a result of these requirements, several vessels and captains interested in participating with this project were denied inclusion onto the respective EFP.

All participating vessels were also required to carry Pelagic Observer Program staff, Pelagic Observer Program contractor observers, or Pelagic Observer Program-trained fisheries observers during the course of fishing under the EFP. These observers would collect data on all animals caught, including size and weight, as well as time, depth, sea surface temperature, and location information for each set using standard NMFS forms (a full list of data collected by the POP can be found in Beerkircher et al., 2004). The vessel captain and crews were required to use all federally-required "best practice" equipment and techniques for releasing non-retained bycatch animals in a manner maximizing their survival.

In the end, one EFP (HMS-EFP-08-02) was issued to the Principal Investigator in order to conduct this research, although it was subsequently amended four times over the course of the project. (This EFP and amendments are attached as Appendix I.) The final

areas authorized by these EFPs are shown in Figure 2, with two colors showing the original authorized fishing area[7] (pink) and extension (yellow) granted in 2009.

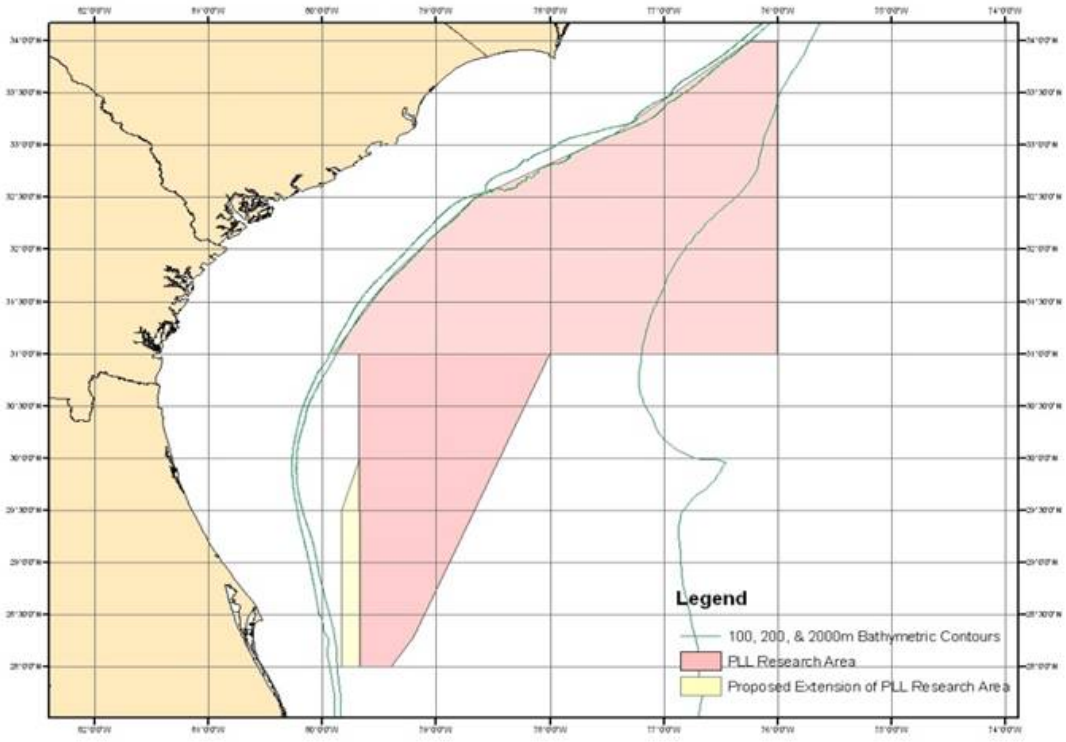

Figure 2. Specific research areas of the Charleston Bump and Florida Coast East time-area closures for pelagic longline research. (Image courtesy of the NOAA Highly Migratory Species Management Division, 2008.)

The total number of proposed sets for this study was 256 for both vessels combined (128 per vessel), which would be distributed equally across the four calendar quarters. To minimize sampling bias to the catch comparisons, each participating vessel would be encouraged to fish an equal number of sets (and approximately equal amounts of the same gear configurations) both inside and outside of the specific time-area closure waters. A "set" would be considered as a deployment of more than 50% of the gear within an area. Participating vessels would not be permitted to deploy gear within any area remaining closed

[7] The fishing area in pink consists of "the waters approximately 40 nautical miles north of Fort Pierce, FL, beginning at 28°N latitude and seaward of the Gulf Stream then continuing north and east seaward of the 100-fathom contour to the northern and eastern boundaries of the Charleston Bump closed area. In the Florida East Coast closed area, the fishing area includes the waters between 28° and 31°N latitude, seaward of the Gulf Stream, out to the boundary of the U.S. Exclusive Economic Zone (EEZ). In the Charleston Bump Closed Area, the fishing area would take place seaward of the 100-fathom contour to the northern and eastern boundaries of that closure." (72 F.R. 11327).

under the EFP, and in the event of the gear drifting toward a closed area, the vessel would be required to immediately begin gear retrieval.

None of the participating vessels received any compensation during this study; vessels had to provide even their own hooks. Vessel operators were required to follow the following general protocols[8] relating to sets conducted during this project:

- •The vessel operator is responsible for all matters relating to safety of personnel, the vessel, and equipment operation.
- •The vessel Captain and crew will work cooperatively with and assist the observer to ensure the fullest potential data collection.
- •Research vessels will adhere to all gear requirements under current HMS regulations.
- •All legally harvested fish catch may be retained by the vessel for sale.
- •Research vessels will take precautions to reduce gear and/or fishing grounds conflicts.
- •All vessels will employ NOAA-specified line cutters, de-hookers, and mouth gags and openers, and must attempt to release alive all non-target bycatch species.
- •The vessel crew will assist the observer in collecting data on section location, water temperature, and time of section set and haul, including positions of beeper buoys and high-flyers.
- •Following each fishing set, the Captain and Observer will determine the accurate number of hooks fished, to be included in the Observer's daily report.
- •The fishery observer or experiment coordinator will be given access to the fish at the point of sale to record weight data by carcass

Vessel operators were also required to follow a set of gear configurations when operating within any of the EFP-authorized time-area closiures:

- •Branch lines must be at least 110% of the float line length.
- •When targeting swordfish, all vessels must:
- — Only non-offset 18/0 circle hooks: either Mustad #39960D or the L-P model
- — Use leaded swivels on every leader, placed 2.5 fathoms above the hook
- — Use 5 hooks between each set of floats
- — No requirement that the first gangion be on the float
- — 7 or 10 fathom drops and 12 fathom leaders, uniform within a set
- •Hook spacing must be uniform within a set, and All float, poly ball, and beeper buoy drops must be consistent within a set.
- •Vessel may deploy up to 500 hooks per set within the closed areas. Vessels may deploy additional hooks at their discretion when fishing outside the closed areas, but must still allow observer access to examine any caught animals.

[8] A full list of the vessel requirements for participation in this time-area closure project, including safety items and cost-sharing details, is included in Appendix II.

Experimental Design

Analysis for Sample Size and Power

Estimates of sample sizes and statistical power[9] for the study were conducted *pre hoc* using G*POWER 3.0.1 (Faul, 2006) and catch rates from historical POP data. Catch rates in the pelagic longline fishery are commonly expressed as catch-per-unit-effort (CPUE) values of number of individuals caught per 1,000 hooks. However, the contemporary CPUEs within the time-area closures remain unknown, so proxy estimates were generated using historical data. For example, in 2000 the POP observed 16 sets in the South Atlantic Bight statistical area during the three-month period that would then be closed in 2001, with the average[10] CPUE for discarded (juvenile) swordfish at 23.3 per 1000 hooks (SD ±21.8). Assume that the CPUE for discarded swordfish outside this time-area closure is 20.0, but inside is 23.3, with the same standard deviation. To detect a significant difference, the G*POWER analysis indicates a minimum of 1592 sets both inside and outside the time-area closure. In contrast, if the assumption is that the CPUE for discarded swordfish inside this time-area closure is 35.0, but outside is only 23.3, with the same standard deviation, the analysis indicates a need of only 128 sets inside and outside the time-area closure to detect a difference at the same significance level. The same type of analysis would also apply to other bycatch species of concern, such as istiophorid billfishes or bluefin tuna. Increasing the α-error probability in these sample size simulations results in a decrease of the required sample sizes (number of sets) for statistical significance. Although a fine-scale (e.g., 1° x 1°) geospatial analysis of historical CPUEs within the current time-area closures was not conducted under the goals of this research project, anecdotal evidence suggests that much of the historical juvenile swordfish bycatch occurred within the times and areas that would remain closed even under

[9] Type I error probability is assessed with statistical significance tests (e.g., the α-values usually seen with statistical testing indicates the likelihood that the test found a true difference with 95% probability), while Type II error probability is assessed with statistical power tests. Statistical power is conventionally expressed as (1-β), and power values of greater than 0.8 are generally considered sufficient to avoid Type II errors.

[10] "Average" CPUE values are actually arithmetic means, which have commonly been used to evaluate catch rates in the pelagic longline fishery. While an unbiased estimator, arithmetic means are sensitive to large range of measurements (e.g., bacterial colony counts, where a measurement series could be 100, 1, 10000). Pelagic longline fishery data often encounter null CPUE values for some rare-event species, such as blue marlin. As recommended by McConnaughey and Conquest (1993), a comparison of the arithmetic means with geometric means for CPUE values found in this work was conducted for all main species.

this research proposal. Data from this project, however, would allow such a geospatial analysis in the future.

Analysis of Catches and Catch Rates.

Catches are simply described in terms of numbers of caught animals and those retained for sale versus released (alive) or discarded (dead or damaged). Due to the economic value of the species and the prior concern regarding catches of undersized animals, swordfish catches are segregated into three categories: all swordfish, kept swordfish, and swordfish released and discarded. Most other retained species (e.g., tunas and dolphin) have a minimum size that is almost always met; any catch is therefore usually retained for sale by the vessel. Thus, only for swordfish are there these three categories.

Catch rates in the pelagic longline fishery are traditionally expressed as catch-per-unit-effort (CPUE) values of number of individuals caught per 1,000 hooks. All CPUEs log-transformed with log(x+1) for normality and assessed for area and quarter effects using PROC GAM in SAS (v. 9.2). Analyses simply compared the catch rates within the time-area closures ("closed") and outside the time-area closures ("open") in areas of the South Atlantic Bight and Florida East Coast NMFS pelagic statistical areas. Specifically, the Charleston Bump time-area closure is only seasonal; therefore, sets in this area during open seasons lumped with rest of open areas for analyses. Statistical power was calculated *post hoc* for all comparisons using Cohen's *d* and G*Power (v.3.1.2). Generally, values of $(1-\beta) > 0.8$ are considered adequate power.

5. Results –

A total of 188[11] research sets were conducted during the study period (Tables 1 and 2). These sets were observed by a number of different POP observers, NSU graduate students, and the project Principal Investigator between 2008 and 2010. As is standard procedure with POP observers, the individual codes by POP number are not identified to person.

[11] At the HMS Advisory Panel meeting presentation by the Principal Investigator in April 2011, it was reported that 192 sets were completed. In a subsequent review of all the set records, four of these 192 sets were conducted in non-closed areas and observed by a non-POP trained NSU graduate student. While no fisheries regulations were broken, these four sets were excluded from the final analyses presented here to maintain standards and consistency regarding such factors as data reporting on POP datasheets.

Five different vessels participated in the time-area closure research, with the vast majority of the sets conducted by the F/V *Kristin Lee* out of Pompano Beach, Florida (Table 3). A number of factors likely combined to preclude additional participation, including the requirement for non-offset, size 18/0 circle hooks and the interest in fishing observed sets both within and outside of the time-area closure boundaries. Additionally, some of these vessels (e.g., the F/V *Shady Lady*) are only seasonal participants in the areas affected by these time-area closures. These points are addressed further in the Discussion section of this final report.

All other federal fishery regulations were observed during this study. During each set, the crew deployed size 18/0 non-offset circle hooks to target swordfish, and each set was of standard overnight duration. The gear configuration used a standard length leader, with five hooks per basket (between floats), and use a standard length of floatline (between the mainline and the surface) that is consistent with lengths currently used outside the time-area closure (for a diagram of the approximate gear configuration used, see Kerstetter and Graves, 2006a). Standard lengths were used within each set, although some variability occurred between sets and trips.

Catches and Catch rates

Of the 188 total observed sets, 10 were not fully observed by the on-board fisheries observer.[12] These were therefore excluded for subsequent catch rate analyses, resulting in a total of 178 sets within the catch rate dataset. The catches (Tables 5-9) and catch rates (Table 10) for all species encountered through this research were generally as expected: swordfish catches were higher within the time-area closure "closed" areas, while tuna catches were higher offshore in the "open" areas. Catch rates were not calculated for sea turtles due to only three catches; any calculated catch rate would be meaningless given the number of potential variables affecting those catches. No sea birds or marine mammals were caught during any of this research.

[12] Incomplete observations of a set can occur for several reasons. For this study, one of these non-observed sets occurred when several datasheets blew overboard in rough seas and high winds. The nine remaining non-observed sets were due to various illnesses by the respective observers.

Table 1. List of observed trips by year and quarter during research in the Florida Coast East and Charleston Bump time-area pelagic longline time-area closures. Values are expressed as two numbers: the trip ID and the number of sets (e.g., "G02004:4" would be trip G02004, which observed four sets).

2008				2009				2010			
Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
D04048:5	D04051:9	U04002:1	C05001:1		C05004:1	C05007:4	C05009:6	U04013:2	U04014:6	N06001:6	
D04049:4	V04001:6	U04003:6	C05003:4		C05005:7	C05008:2	U04011:5		V04003:4	N06002:9	
D04050:6	W04001:3	U04004:8	CO5002:1		C05006:5	U04007:7	U04012:4		Z05001:9	Z05002:4	
S01096:6			MO3001:5		S01109:7	U04008:7					
U04001:3					U04005:5	U04009:4					
					U04006:5	U04010:4					
					V04002:6						

Table 2. Number of trips and sets by observer by year during research in the Florida Coast East and Charleston Bump time-area pelagic longline time-area closures.

	2008		2009		2010		Total	
	SETS	**TRIPS**	**SETS**	**TRIPS**	**SETS**	**TRIPS**	**SETS**	**TRIPS**
U04	18	4	41	8	8	2	67	14
V04	6	1	6	1	4	1	16	3
C05	7	3	25	6			32	9
S01	6	1	7	1			13	2
W04	3	1					3	1
D04	24	4					24	4
M03	5	1					5	1
N06					15	2	15	2
Z05					13	1	13	1

Table 3. Number of trips and sets by vessel by year during research in the Florida Coast East and Charleston Bump time-area pelagic longline time-area closures.

	2008		2009		2010	
	SETS	**TRIPS**	**SETS**	**TRIPS**	**SETS**	**TRIPS**
F/V Kristin Lee	44	10	48	10	36	6
F/V Carol Ann	24	4				
F/V Shady Lady			19	4	4	1
F/V Southern Lady	5	1				
F/V Dakota			12	2		

Tables 4a and 4b. Lengths of buoy drop lines (4a) and types of baits (4b) used during research sets in the Florida Coast East and Charleston Bump time-area pelagic longline time-area closures. For 4a, the values are based on string numbers rather than individual set configurations; therefore, ratios of each gear type within a set may be different. For 4b, the squid percentage is only important for the mixed category, this allows for an average percentage of the number of hooks with squid to be seen. The unknown category accounts for trips that bait information or gear could not be found; this affects the 2008 year with nine trips missing information on gear type used and 12 trips missing information on bait type used. Numbers refer to the number of sets using the drop line configurations (4a) and bait type (4b).

	2008		**2009**		**2010**
7 fa	4	15, 10, and 7 fa	4	15, 13, and 9 fa	4
10 fa	14	12, 10 and 7 fa	6	15 and 10 fa	9
mixed (7 fa and 10 fa)	46	12 fa	5	14 , 10 and 7 fa	6
unknown	9	11 and 7 fa	2	14 and 10 fa	1
		10 and 5 fa	7	12 and 10 fa	1
		10 fa	42	10 and 7 fa	6
		9 and 5 fa	4	10 and 5 fa	4
		9 and 2 fa	3	10 fa	8
		9 fa	1		
		2 fa	5		

	2008			**2009**			**2010**		
	# sets	**# baits**	**% squid**	**# sets**	**# baits**	**% squid**	**# sets**	**# baits**	**% squid**
squid	17	7725	100%	45	20656	100%	4	2155	100%
mackerel	8	3978	0%	0	0	0%	0	0	0%
mix	36	17054	76%	34	16844	56%	36	17307	73%
unknown	12	6610							

Table 5. Catches of tunas during pelagic longline research efforts in the Florida East Coast and South Atlantic Bight NOAA pelagic statistical areas. Numbers are expressed as "X/Y", where X is the number retained by the vessel(s) and Y is the number caught, but discarded dead, released alive, or lost at boatside.

		2008			2009			2010		
		Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed
albacore	Q1	7/4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	2/1	0/0	0/0	0/0	1/0	1/0	2/0	0/0	0/0
	Q3	6/1	1/0	0/0	0/1	0/0	0/0	3/0	1/0	0/0
	Q4	4/0	0/0	0/0	1/0	0/0	0/0	0/0	0/0	0/0
bigeye	Q1	25/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	35/4	0/0	0/0	0/0	2/1	0/1	21/0	1/0	1/0
	Q3	95/4	13/0	0/0	51/5	2/0	0/0	28/4	7/1	0/0
	Q4	36/3	0/0	0/0	5/2	2/1	0/0	0/0	0/0	0/0
blackfin	Q1	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/0	2/0	3/0	0/0
	Q3	0/0	0/0	0/0	2/0	0/0	0/0	2/2	3/4	0/0
	Q4	0/1	0/0	0/0	0/2	0/0	0/0	0/0	0/0	0/0
bluefin	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/0	1/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
skipjack	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/1	0/1	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/1	0/0	0/0	0/0	0/0
yellowfin	Q1	14/2	5/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	2/0	0/0	0/1	0/0	2/0	2/0	11/0	1/0	0/0
	Q3	5/0	1/0	0/0	13/1	1/0	0/0	15/2	7/0	0/0
	Q4	10/1	8/1	0/0	8/0	1/0	0/0	0/0	0/0	0/0

Table 6. Catches of billfish and swordfish during pelagic longline research efforts in the FEC and SAB pelagic statistical areas. Numbers are expressed as "X/Y", where X is the number retained by the vessel(s) and Y is the number caught, but discarded dead, released alive, or lost at boatside.

		2008			2009			2010		
		Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed
blue marlin	**Q1**	0/2	0/1	0/0	0/0	0/0	0/0	0/0	0/1	0/0
	Q2	0/9	0/0	0/2	0/0	0/3	0/5	0/1	0/1	0/1
	Q3	0/8	0/0	0/0	0/5	0/17	0/0	0/7	0/4	0/0
	Q4	0/4	0/1	0/0	0/2	0/1	0/0	0/0	0/0	0/0
sailfish	**Q1**	0/2	0/1	0/0	0/0	0/0	0/0	0/0	0/4	0/0
	Q2	1/5	0/3	0/0	0/0	0/6	1/0	0/0	0/4	0/3
	Q3	0/10	0/1	0/0	0/12	3/35	0/0	0/6	0/32	0/0
	Q4	0/5	0/0	0/0	0/2	0/3	0/0	0/0	0/0	0/0
spearfish	**Q1**	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
(SPF, SPG, SPX)	**Q2**	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
white marlin	**Q1**	0/3	0/0	0/0	0/0	0/0	0/3	0/0	0/0	0/0
(WHM, WHX)	**Q2**	0/9	0/1	0/2	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/2	0/0	0/0	0/0	0/2	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
unknown billfish	**Q1**	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
(BIL)	**Q2**	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
swordfish	**Q1**	57/12	24/15	142/101	0/0	0/0	0/0	0/0	24/3	-
	Q2	39/9	7/6	96/66	1/0	54/5	330/109	24/0	56/15	93/25
	Q3	61/24	16/11	0/0	30/11	282/59	0/0	25/7	102/25	-
	Q4	53/29	33/20	0/0	18/3	119/54	0/0	0/0	0/0	-

Table 7. Catches of pelagic sharks during pelagic longline research efforts in the FEC and SAB pelagic statistical areas. Numbers are expressed as "X/Y", where X is the number retained by the vessel(s) and Y is the number caught, but discarded dead, released alive, or lost at boatside.

		2008			2009			2010		
		Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed
blue	Q1	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/1	0/0
	Q2	0/8	0/0	0/1	0/1	0/1	0/15	0/12	0/1	0/2
	Q3	0/1	0/0	0/0	0/1	0/1	0/0	0/1	0/2	0/0
	Q4	0/0	0/0	0/0	0/1	0/0	0/0	0/0	0/0	0/0
common thresher	Q1	0/0	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/1	0/0	0/0	1/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
oceanic whitetip	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/1	0/0
	Q2	0/1	0/0	0/0	0/0	0/1	0/1	0/0	0/0	0/0
	Q3	0/1	0/0	0/0	0/2	0/0	0/0	0/1	0/6	0/0
	Q4	0/2	0/1	0/0	0/1	0/0	0/0	0/0	0/0	0/0
shortfin mako	Q1	1/0	0/0	1/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	1/0	0/0	0/0	2/0	4/1	4/1	4/1	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	3/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table 8. Catches of large coastal sharks during pelagic longline research efforts in the FEC and SAB pelagic statistical areas. Numbers are expressed as "X/Y", where X is the number retained by the vessel(s) and Y is the number caught, but discarded dead, released alive, or lost at boatside.

		2008			2009			2010		
		Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed
blacktip	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
bull	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
silky	Q1	0/10	0/37	0/22	0/0	0/0	0/0	0/0	0/5	0/0
	Q2	1/12	0/8	4/26	0/2	0/3	18/75	0/0	2/35	0/11
	Q3	1/1	1/4	0/0	0/9	0/18	0/0	0/1	0/17	0/0
	Q4	0/0	0/1	0/0	0/1	0/8	0/0	0/0	0/0	0/0
hammerheads	Q1	0/0	0/1	0/0	0/0	0/0	0/0	0/0	0/2	0/0
(all species)	Q2	0/0	0/0	0/0	0/0	0/1	1/0	0/0	0/0	0/1
	Q3	0/0	0/0	0/0	0/0	0/1	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/1	0/0	0/0	0/0	0/0
tiger	Q1	0/11	0/18	0/2	0/0	0/0	0/0	0/0	0/6	0/0
	Q2	0/4	0/1	0/8	0/0	0/6	0/14	0/3	0/13	0/3
	Q3	0/6	0/2	0/0	0/6	0/21	0/0	0/7	0/8	0/0
	Q4	0/6	0/4	0/0	0/1	0/10	0/0	0/0	0/0	0/0

Table 9. Catches of prohibited sharks during pelagic longline research efforts in the FEC and SAB pelagic statistical areas. Numbers are expressed as "X/Y", where X is the number retained by the vessel(s) and Y is the number caught, but discarded dead, released alive, or lost at boatside.

		2008			2009			2010		
		Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed	Open	FEC Closed	CB Closed
bigeye thresher	Q1	0/1	0/0	0/2	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/2	0/0	0/1	0/0	0/0	0/5	0/1	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/2	0/0	0/0	0/0	0/0
	Q4	0/2	0/0	0/0	0/1	0/0	0/0	0/0	0/0	0/0
dusky	Q1	0/0	0/4	0/1	0/1	0/0	0/0	0/0	0/0	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/3	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/1	0/0	0/0	2/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
longfin mako	Q1	0/2	0/0	0/0	0/0	0/0	0/0	0/0	0/1	0/0
	Q2	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
night	Q1	0/2	0/0	0/101	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/1	0/0	0/51	0/0	0/28	0/112	0/1	0/19	0/5
	Q3	0/0	0/0	0/0	0/1	0/8	0/0	0/1	0/2	0/0
	Q4	0/0	0/4	0/0	0/2	0/0	0/0	0/0	0/0	0/0
sandbar	Q1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q2	0/2	0/1	0/1	0/0	0/2	0/0	0/0	0/2	0/
	Q3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Q4	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Table 10. Catch rates of pelagic fishes encountered during pelagic longline research efforts in the FEC and SAB pelagic statistical areas. Values are presented in two formats: the normal font is geometric mean, while the italicized font is the arithmetic mean. Significance is indicated as "*" for p<0.05 and "**" for p<0.001.

	CPUE Comparison				
	Open	Closed	Significant Difference?	Statistical Power	GLM Significant Terms
Swordfish					
All	6.767	17.907	**	1.00	A
	11.135	*33.404*			
Retained Only	10.108	10.852	**	0.559	A*Q
	20.876	*24.379*			
Discarded/Released Only	0.231	0.695	**	0.979	A, Q
	5.815	*9.025*			
Tunas					
Bigeye	0.082	< 0.0001	**	1.00	A, Q, A*Q
	8.926	*0.605*			
Yellowfin	< 0.0001	< 0.0001	**	0.999	A
	5.481	*0.582*			
Albacore	< 0.0001	< 0.0001	**	0.999	A, Q, A*Q
	8.684	*0.074*			
Blackfin	< 0.0001	< 0.0001	*	0.811	A, Q
	0.678	*0.214*			
Dolphinfish	< 0.0001	< 0.0001	**	0.991	A, Q, A*Q
	4.144	*12.82*			
Billfishes					
White Marlin	< 0.0001	< 0.0001	*	0.549	A, Q, A*Q
	0.35	*0.141*			
Sailfish	< 0.0001	< 0.0001	**	0.24	Q, A*Q
	1.193	*2.448*			
Blue Marlin	< 0.0001	< 0.0001	*	0.475	A, Q
	1.061	*0.663*			
Sharks					
Tiger	< 0.0001	< 0.0001		0.679	A
	1.185	*2.093*			
Silky	< 0.0001	< 0.0001	**	0.999	A, Q
	1.046	*5.17*			
Dusky	none	< 0.0001	*	na	Q
	none	*0.155*			
Night	< 0.0001	< 0.0001	**	0.999	A, Q, A*Q
	0.201	*6.028*			
Shortfin Mako	< 0.0001	< 0.0001		0.085	none
	0.175	*0.244*			

Analysis of catch composition, including bycatch and incidental catch.

Of the 188 total sets, four were incomplete and thus excluded from analyses; therefore these results are for 184 total sets.

Boarding Status: The boarding status – i.e., alive versus dead at the side of the vessel during gear retrieval – was calculated and assessed for six tuna species, four billfishes, and swordfish (see Table 11). For white marlin, totals included both species code "WHM" (white marlin) and "WHX" (white marlin or roundscale spearfish). For spearfish, totals include species codes "SPF" (longbill spearfish), "SPG" (roundscale spearfish), and "SPX" (unknown spearfish). Swordfish results are presented in three categories: all swordfish combined, kept swordfish only, and swordfish either released alive or discarded dead. The results were mixed for tunas, with yellowfin and bigeye being significantly more often alive at haulback, but albacore and blackfin being significantly more often dead. Billfishes were more frequently alive at haulback, although this was only significant for blue marlin and sailfish. All three categories of swordfish were significantly more often dead at haulback.

The boarding status was also calculated and assessed for 14 shark species, separated into pelagic sharks, large coastal sharks, and prohibited species (see Table 12). The pelagic species (with the exception of the common thresher) were all significantly more often alive at haulback. For the large coastal species, only the tiger shark was more likely alive at haulback, with this species being very rarely found dead on the gear. The results for the prohibited species are more mixed, likely resulting from this being a management unit rather than a phylogenetic (physiological) one. Only the night shark was significantly more likely alive at haulback, although both longfin mako and sandbar sharks only had alive individuals found on the gear.

Table 11. Analysis of status for caught tunas, billfishes, and swordfish at haulback ("boarding status"), defined as alive versus dead by the NMFS Pelagic Observer Program protocols. Results do not include animals with status "3" (unknown) or generic species categories (e.g., "BIL" for unknown billfish and "TUN" for unknown tuna). Significance is indicated as "*" for $p<0.05$ and "**" for $p<0.001$.

	Open Areas	Closed FEC	Closed CB	Total	% Alive	Significant
Tunas						
Bluefin	1/0	none	none	1/0	100.0	
Yellowfin	58/24	15/5	2/0	75/29	72.1	**
Bigeye	169/131	16/5	1/1	186/137	57.9	*
Albacore	2/21	0/2	na	2/23	8.0	**
Blackfin	7/22	1/7	1/0	9/29	23.7	*
Skipjack	0/1	0/1	0/1	0/3	0.0	
Billfishes						
Blue Marlin	33/9	23/6	9/0	65/15	81.2	**
White Marlin	7/6	3/0	3/0	13/6	68.4	
Sailfish	28/16	100/36	2/0	130/52	71.4	**
Spearfish	2/3	none	none	2/3	66.7	
Swordfish						
All	118/258	175/720	328/526	621/1504	29.2	**
Kept Only	82/211	109/581	207/433	398/1225	24.5	**
Rel/Disc Only	33/43	60/117	115/91	208/251	45.3	*

Table 12. Analysis of status for caught sharks at haulback ("boarding status"), defined as alive versus dead by the NMFS Pelagic Observer Program protocols. Results do not include animals with status "3" (unknown) or generic species categories (e.g., "SHX" for unknown shark and "SRQ" for unknown requiem shark). Significance is indicated as "*" for $p<0.05$ and "**" for $p<0.001$.

	Open Areas	Closed FEC	Closed CB	Total	% Alive	Significant
Pelagics						
Blue	17/1	5/3	15/1	37/5	88.1	**
Common Thresher	0/1	none	1/1	1/2	33.3	
Oceanic Whitetip	7/1	18/6	1/0	26/7	78.8	**
Shortfin Mako	5/2	3/2	6/1	14/5	73.7	*
Large Coastals						
Blacktip	none	none	none	na	na	
Bull	none	none	none	na	na	
Silky	16/18	78/82	72/79	166/179	48.1	
Hammerheads (all)	none	6/3	4/13	10/16	38.5	
Tiger	43/0	90/3	23/0	156/3	98.1	**
Prohibited						
Bigeye Thresher	3/3	1/2	4/5	8/10	44.4	
Dusky	na	5/0	1/3	6/3	66.7	
Longfin Mako	1/0	1/0	none	2/0	100.0	
Night	9/1	39/39	148/104	196/144	57.6	*
Sandbar	2/0	4/0	1/0	7/0	100.0	

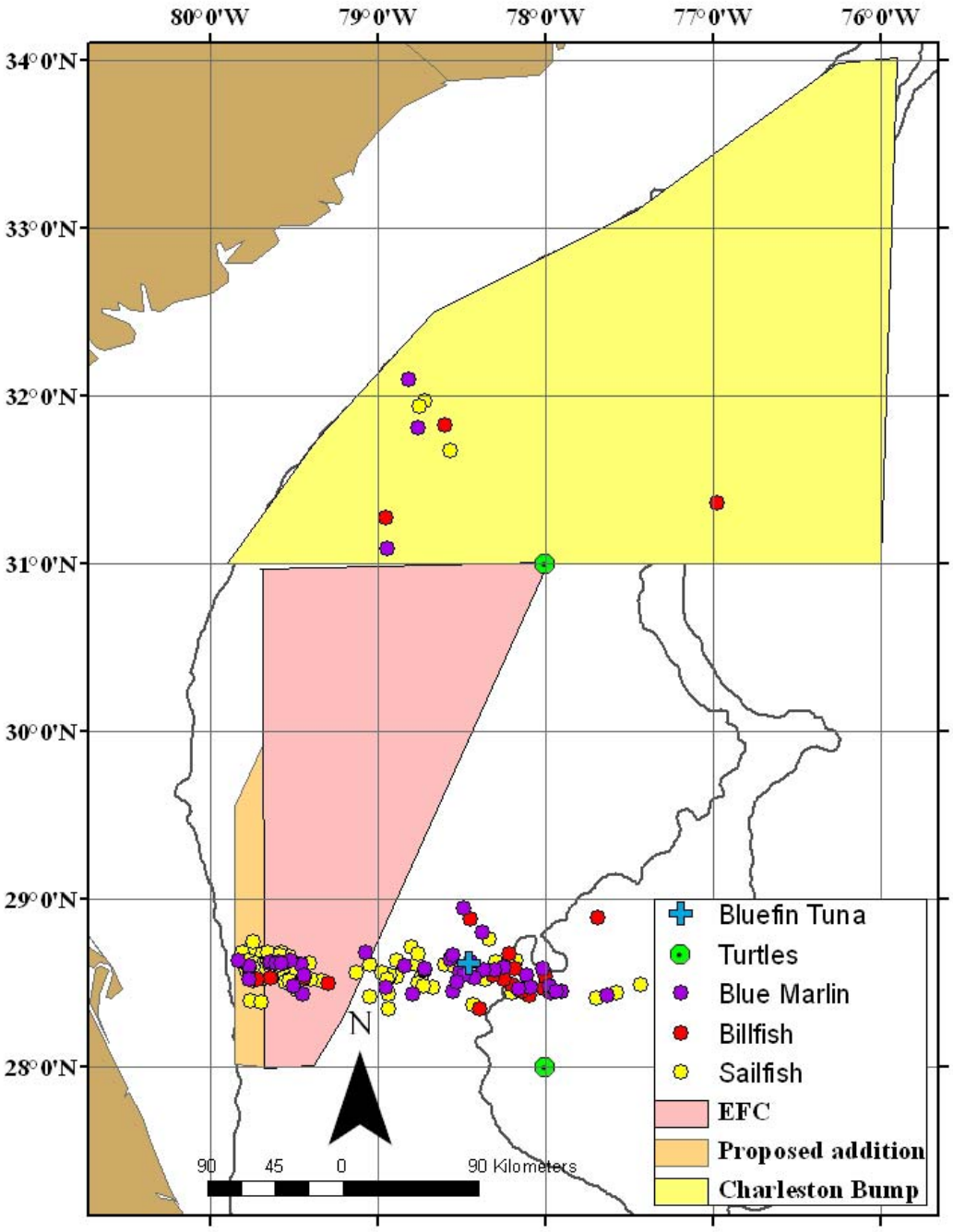

Figure 3. Locations of bycatch species catches during pelagic longline research within the Charleston Bump and Florida Coast East time-area closures, 2008-2010. (Figure by C. Cross, NSU Oceanographic Center.)

6. Discussion –

Catch and Catch Composition

As previously noted, there were no surprising results encountered during this research project. Swordfish catches were higher inside the time-area closures, both for all individuals and for retained fish. Tunas were more commonly caught offshore, within the otherwise open areas. For billfish, sailfish tended to be caught more inshore, within the time-area closure (and especially the Florida East Coast closure). The only possible exception would be that large numbers of night sharks were caught during the Charleston Bump time-area closure period in the spring, with almost none being caught during other periods and other areas. During this three year period, only five interactions with sea turtles occurred: three leatherbacks and two loggerheads. All five were released alive without trailing fishing gear. (Additional information on these five interactions is available from the NOAA Pelagic Observer Program office.) No seabird interactions occurred during any part of this study.

The change in stock abundance for swordfish and other species, and an unavailability of comparative hook performance in these two time-area closures, precludes a quantitative comparison of the experimental fishing activities with historical catch records. However, in a qualitative sense, the contemporary catch rates within these time-area closures begin to approximate historical catch rates. Perhaps because the sets occurred in the northern parts of the Florida Straits, juvenile swordfish bycatch was lower than the historical average within the Florida East Coast statistical area as a whole, while being offshore likely reduced sailfish bycatch from historical levels. The differences between contemporary (non-offset size 18/0 circle hooks) and historical (J hooks) hook performance by species (including composite values for species groups and juvenile swordfish) in the pelagic longline fishery within these two time-area closures is a much more difficult comparison, although the non-offset nature of these large circle hooks likely resulted in both a size-selectivity effect for larger individuals of all species and a reduction in mortality at haulback by decreasing the number of gut-hooked individuals.

Significantly greater CPUEs were observed for juvenile swordfish within the time-area closures than outside them. However, the extremely small swordfish (<65 cm LJFL) occasionally seen caught by pelagic longline gear off the southern Florida Straits (e.g.,

Miami) were not seen during this work. Although a fine-scale (e.g., 1° x 1°) geospatial analysis of historical CPUEs within the current time-area closures has not yet been conducted, anecdotal evidence suggests that much of the historical juvenile swordfish bycatch occurred within the times and areas that would remain closed even under this research proposal.

Practical Aspects of Research Proposal

Vessel Participation: The planned research protocols generally worked as expected. The only substantial problem encountered during this project regarded fishing effort. As previously described within this report, the requirements for inclusion on the EFP by the HMS Management Division resulted in many more vessels being willing to participate in this research than were actually allowed to participate via inclusion on the required EFP. In addition, there was a general unwillingness to fish in the Charleston Bump time-area closure throughout the course of the year, as opposed to just during the closed period.

Recreational Interactions: As hoped, the western boundaries of the allowable fishing areas under the EFPs appear to have adequately separated the commercial and recreational fisheries of these areas: none of the commercial vessels during any part of this study had interactions with a recreational vessel while on the fishing grounds. The increasing cost of fuel and lack of hard targets (e.g., seamounts) within the easily-accessible regions of the South Atlantic Bight and Florida East Coast time-area closures suggests that any further commercial pelagic longline effort within the authorized fishing areas would similarly avoid interactions with the recreational fishery.

Data Recording and Data Access: Standard non-experimental POP observer data collection protocols only record data on animal disposition (e.g., alive versus dead). The results of this study would encourage the revision of the standard non-experimental POP protocols to include such potentially useful information as hooking location using the standard experimental protocols. In addition, this project used the POP datasheets for experimental work that allowed for the recording of the positions of all radio beeper buoys and high-flyers at the end of each section of gear. The adoption of these two additional data streams within the POP datasets would allow for future comparative research.

In general, the POP (and pelagic logbook reporting) datasets have been tightly controlled since 2006, with NOAA only granting limited access to non-NOAA personnel as needed. The inability to get even aggregated data has resulted in a dearth of missing analyses, such as on hook type comparisons. While some of these datasets were analyzed and presented at the recent International Circle Hook Symposium in Miami, there remains much data still unavailable for external researchers (e.g., experimental pelagic longline sets conducted during the Northeast Distant (NED) research from 2001-2002 and the Fisheries Research Institute (FRI) cooperative research program from 2005-2006).

Several management considerations remain, many of which were initially discussed in April 2011 at the HMS Advisory Panel meeting in Silver Spring, Maryland. The two main ones during this discussion were:

•Locations of target and bycatch species catches might allow more specific area targeting of closed areas, and

•Significant interaction effects of area*quarter in most species-level analyses might allow more time-specific targeting of closed areas

The ultimate discussion was driven by the idea that these results may allow future research within these time-area closures under specific, controlled conditions. However, both suggestions are under the presumption that neither alternative strategy would increase bycatch (including sea turtles) nor result in any other undesirable outcome.

7. Impacts and Benefits –

There are two possible benefit streams from this research. In the short-term, these two pelagic longline vessels would benefit from this project both commercially by an extended harvest season and with regards to safety by being able to fish in an area closer to the shore. In a long-term perspective, if this work shows progress in the efforts by the fleet to control bycatch through gear modifications and techniques, NMFS would benefit by having an experimental comparison methodology for re-evaluating existing time-area closures for pelagic longline fishing gear. (There is currently no agreed-upon methodology for determining how or under what conditions the agency could proceed with this re-evaluation.) This proposed work would compare the circle hook gear efficiencies within and outside the

closed time-area, which would allow the agency to develop a set of guidelines that could be potentially exported to other domestic time-area closures.

Ultimately, the United States will need to defend its current level of international swordfish quota in negotiations at the 2008 ICCAT annual meeting, whether this defense is achieved through increased domestic harvests or by other means. Any loss of the current U.S. quota share of the ICCAT North Atlantic swordfish stock is likely to benefit a number of countries in close proximity to the U.S. Exclusive Economic Zone, most of which use less environmentally-friendly harvesting methods than the current U.S. pelagic longline fleet. Many of these countries also fish in areas that are well-known seasonal migratory pathways for swordfish, tunas, and billfish migrating into U.S. waters. The impact of increasing harvest in these foreign fisheries could reduce the amount of swordfish available to U.S. recreational anglers both inside and outside the pelagic longline time-area closures.

8. Extension and Presentation of Results –

The North Atlantic swordfish stock remains a very important source of revenue for the U.S. domestic pelagic fishery, despite the pelagic longline gear type being currently excluded from several of the historically productive fishing grounds in the Florida Straits for this species. The domestic management measures implemented as closed areas to the longline fishery were originally intended to reduce the bycatch mortality of juvenile swordfish and this justification was later extended to include an intended reduction of bycatch mortality for the istiophorid billfishes. These closures have also had the effect of making it difficult for the United States to collectively harvest its annual swordfish quota from ICCAT, whether from commercial or recreational sectors of the fishery.

The results of this study suggest that at least some regions of the current time-area closures see infrequent levels of bycatch, whether of istiophorid billfishes, undersized swordfish, or sea turtles. With increasing resolution of data on specific catches within these areas, future analyses may allow for some limited and specific temporal and spatial reopening of the current time-area closures for the pelagic longline fishery. However, these suggestions are under the clear understanding that targeted reopening would not increase an undesirable or unallowable increase in bycatch species.

The preliminary results of the partial data in this study were presented at the April 2011 spring meeting of the HMS Advisory Panel in Silver Spring, Maryland. A copy of that presentation ("Comparison of Swordfish Buoy Gear and Its Catch in the Florida Straits") was provided to the HMS Management Division shortly following the meeting and is also attached to this report as Appendix I.

Finally, it is expected that the results from this study will be converted into a scientific manuscript for submission to a peer-reviewed journal within the next six months. Upon publication, a copy of the paper will be shared with the HMS Management Division.

Conventional Tagging

The at-sea time provided by this time-area closure research provided an opportunity to deploy conventional tags on several pelagic species. Tagging of pelagic teleosts occurred in collaboration with the NMFS Cooperative Tagging Center at the NMFS Southeast Fisheries Science Center in Miami, Florida. The tagging of pelagic elasmobranchs occurred in collaboration with the NMFS Apex Predators Program at the Narragansett Laboratory of the NMFS Northeast Fisheries Science Center. Overall, this research resulted in the conventional tagging of 29 swordfish, 11 blue and white marlin, 19 sailfish, and 74 various pelagic sharks. Notably, two of these tagged sharks (one night and one shortfin mako) were recaptured and reported, providing the Apex Predators Program additional information on the movements of these two species.

Submission of Final Data and Data Storage

Both hard-copy and electronic versions of this final report were sent to the NMFS Southeast Regional Office and the Highly Migratory Species Management Division. The raw data are all in the Pelagic Observer Program final at-sea records from the trips/sets described within this report. Therefore, NOAA (via the POP) already has the data associated within this project. However, if there are any other raw data NOAA would request from this project, please let the Principal Investigator know as soon as possible. Copies of field data sheets are also archived at the NSU Oceanographic Center Fisheries Laboratory.

All biological samples (e.g., gonads and muscle tissue) from pelagic and mesopelagic fishes not otherwise already consumed during normal processing procedures are archived at

the NSU Oceanographic Center Fisheries Laboratory. Information on these samples can be provided to any interested researcher through contact with the Principal Investigator.

9. **Students** –

Two graduate students were financially supported under this project. Cheryl Cross successfully defended her thesis in May 2011 and Heidi Keller (*nee* Da Silva) is scheduled to defend her thesis in July 2011. Several other NSU Oceanographic Center graduate students in the Fisheries Laboratory participated in this project by volunteering to serve as a fisheries observer after completing the NMFS Pelagic Observer Program. These students included: Shannon Bayse,, Michael Tousignant, Sohail Khamesi, and Matthew Dancho.

10. Acknowledgements –

- NSU OC graduate student fisheries observers: Shannon Bayse, Cheryl Cross, Heidi (DaSilva) Keller, Mike Tousignant, Matt Dancho, and Sohail Khamesi
- Matt Dancho, Rachel Hickey, and Sohail Khamesi for species-level data assistance
- Cheryl Cross for ArcGIS assistance
- NMFS POP staff for student observer training and support
- NMFS HMS staff for EFP assistance
- BWFA for support and vessel assistance
- Vessels, crews, and captains of the F/V *Carol Ann*, F/V *Kristin Lee*, F/V *Shady Lady*, F/V *Southern Lady*, and F/V *Dakota*

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12. Appendices –

Appendix Ia-e: Exempted Fishing Permits (EFPs) – the original and four subsequent amendments – issued by the NOAA Fisheries Service Highly Migratory Species Management Division for the time-area closure research.

Appendix II: Excerpt from contract between Nova Southeastern University and ERT regarding the extensive vessel requirements for participation within this project.

Appendix III: "South Atlantic Bight and Florida East Coast Pelagic Longline Time-Area Closure Research: 2008-2010" (Presentation at the spring meeting of the HMS Advisory Panel, held April 2011 in Silver Spring, Maryland)

Appendix 1a:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

National Marine Fisheries Service
Highly Migratory Species Management Division

Permit Number: HMS-EFP-08-02 **Effective Dates**: Date of Issuance through February 28, 2010

Authorized Activity/ Purpose of Exempted Activity: This exempted fishing permit extends the currently authorized scientific research project to evaluate pelagic longline catches and catch rates of target and non-target species within sections of the Charleston Bump and East Florida Coast (EFC) Pelagic Longline (PLL) fishery time-area closures using commercial pelagic longline vessels and specific fishing gear and techniques through February 28, 2010. Vessels are subject to 100 percent observer coverage, and observers or research staff will collect data that includes, but is not limited to, catch per unit effort (CPUE) for target and bycatch species; discard rates; interaction rates with protected species; size of target species; hooking location; mortality at haul back; bycatch mortality; and if possible, an evaluation of the condition of fish at haul back to allow post-release mortality estimates.

Authorized Sampler(s): Dr. David Kerstetter, Shannon Bayse, Bryan Armstrong, Cheryl Cross, Heidi Da Silva, or any NMFS or NMFS-approved observer

Authorized Vessel(s): For PLL fishing: F/V Carol Ann, Captain Greg O'Neill (USCG #609121) F/V Kristin Lee, Captain Alfred (Ally) Mercier (USCG #656259); F/V Southern Lady, Captain Richard (Rick) Ross (USCG #690722). An authorized sampler, and a copy of this EFP, must be on board the vessel during all exempted activities.

Authorized Area(s)/Timing of Exempted Activity: This scientific research is authorized to occur in the East Florida Coast (EFC) and Charleston Bump closed areas of the Atlantic Ocean over a 12 month period beginning in early 2009 and continuing through February 28, 2010, or until the total authorized number of sets has been completed. The latitude and longitude coordinates of the specific areas for which scientific research is authorized are provided in Figure 1. In the EFC, they include waters north of Fort Pierce, FL, beginning at 28 degrees N Latitude and 79 degrees 50 minutes W Longitude and proceeding north, shoreward of the axis of the Gulf Stream to 29 degrees 30 minutes N Latitude, then proceeding diagonally from 29 degrees 30 minutes N Latitude and 79 degrees 40 minutes W Longitude, from there to the northern boundary of the EFC closed area at 31 degrees north latitude. The extended research area is highlighted in Figure 1. In the Charleston Bump, the research area is north of 31 degrees north latitude and follows the 200 meter isobath (~100 fathom contour) to the northern and eastern boundaries of the Charleston Bump closed area.

Authorized Gear(s)/Amount of Gear: NMFS authorizes a total of 145 sets inside the EFC and Charleston Bump closed areas in the specific locations described above. Each set shall consist of 500 18/0 non-offset circle hooks with whole dead finfish bait and/or squid bait. Of the remaining sets to be made in the southern portion of the research area no more than two sections of gear (70 hooks each for a total of 140 hooks) may be set in the extended 10 nautical mile area from 79 degrees 40 minutes to 79 degrees 50 minutes.

Authorized Species/Numbers of Fish: All targeted catch (tunas, swordfish, and sharks) that can be legally landed may be harvested and sold by the vessel owners. All bycatch of unregulated and/or non-target species not intended to be kept and sampled by approved observers must be released using NMFS-approved dehooking equipment and appropriate safe handling and release protocols. Incidental catch of bluefin tuna may be landed consistent with existing regulations. Any mortality of tunas, swordfish, or sharks shall be counted against the appropriate quotas. Any non-target species, prohibited species, or undersized target species that are dead at haul back are authorized to be retained for scientific purposes. Any protected resources shall be tagged and released alive, consistent with requirements of the Terms and Conditions of the 2004 Biological Opinion issued for the fishery.

Regulatory Exemptions: This exempted fishing permit is issued by the Director, Office of Sustainable Fisheries, National Marine Fisheries Service under authority of 50 CFR 635.32 and consistent with 50 CFR 600.745. The specific regulations from which the authorized samplers will be exempted from are: billfish reporting (50 CFR 635.5(c)(2)), highly migratory species (HMS) size limits (50 CFR 635.20 (d) (1-3) and 635.71 (c) (5)), retention by commercial longline vessels (50 CFR 635.21(e)(2) and 635.71 (c) (1)), possession of HMS in a form other than

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regulations in 50 CFR Part 635 including, but not limited to sea turtle bycatch mitigation measures as listed in 50 CFR 635.21 paragraph (c), which apply to gear operation and deployment restrictions for pelagic longline fisheries. This EFP does not exempt the authorized vessels used for collection from acquiring the appropriate HMS permit.

Quota Requirements/Notes: NMFS will track all tuna, swordfish, billfish, and shark mortality incurred under this authorized activity and will utilize all associated mortality in future stock assessments. Billfish caught on commercial longline vessels will be reported as dead discards and included in pelagic longline logbooks.

Terms and Conditions:

Please note that this permit does not confer any right to collect/harvest species in waters under state jurisdiction or the jurisdiction of any other country. The appropriate state fish and wildlife agency must be contacted regarding any collection in state waters, as separate state permits may be required for collection/harvest in state waters.

- ***Limitations on Collection/Harvest***
  Collections/Harvests are authorized only where authorized samplers (listed above) are present on the authorized vessels (listed above). No third-party collectors are authorized under this permit. A copy of this permit must be available for inspection aboard the authorized vessel while conducting the authorized activity.

- ***EFP Reporting Requirements***
  Any mortality of Atlantic billfish caught on PLL gear must be reported to the Chief, Highly Migratory Species Management Division, within 5 days of the conclusion of the fishing trip during which they were caught. HMS mortality as a result of interaction with pelagic longline gear is authorized under this permit and will be reported in commercial logbooks. If excessive mortalities are encountered, NMFS reserves the right to suspend further research operations conducted under this permit.

  For all species caught, including target and incidental catch, an Interim Report form must be filled out with the information specified and mailed within 5 days of the conclusion of the fishing trip during which they were caught to the HMS Management Division. This permit expiration date is February 28, 2010. An annual year-end report for fishing in calendar year 2008 and 2009 is required within 30 days of December 31, 2009. All fishing under the auspices of this EFP in 2009 should be included in an additional annual year-end report within 30 days of December 31, 2009. Copies of both the Interim and Annual Report Forms are enclosed for your use in meeting these reporting requirements (electronic forms may be requested). *Please do not submit your own form to meet these reporting requirements.* Reports must be submitted to the Highly Migratory Species Management Division, National Marine Fisheries Service, F/SF1, 1315 East-West Highway, Silver Spring, Maryland 20910. This information will be incorporated into future stock assessments.
- ***Sea Turtle Safe Handling/Release/Resuscitation Requirements***
  All authorized samplers and vessels (listed above) must comply with Sea Turtle Safe Handling and Release Guidelines as published in the Federal Register (69 FR 40734) on July 6, 2004. A placard that outlines these guidelines must be posted in the wheelhouse of the authorized vessel. If additional placards are required, please call (301) 713-2347 to request them. Resuscitation requirements for sea turtles must also be followed when conducting the authorized activity and these requirements are outlined in 50 CFR 223.206.

Informational Contact(s):

Applicant: David Kerstetter, CIMAS, (305) 361-4242
NMFS Staff Contact: Chris Rilling, (301) 713-2347x113

Emily Menashes for Alan Risenhoover
Office of Sustainable Fisheries

2/17/2009
Date

Appendix 1b:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

EXEMPTED FISHING PERMIT HMS-EFP-08-02 AMENDMENT 1

Pursuant to 50 CFR 635.32 and consistent with 50 CFR 600.745, the Director, Office of Sustainable Fisheries, National Marine Fisheries Service authorizes the amendment of HMS-EFP-08-02. The Exempted Fishing Permit (EFP), HMS-EFP-08-02, was issued to Dr. David Kerstetter to evaluate pelagic longline catches and catch rates of target and non-target species within sections of the East Florida Coast (EFC) and Charleston Bump closed areas. Vessels are subject to 100 percent observer coverage, and observers or research staff will collect data that includes, but is not limited to, catch per unit effort (CPUE) for target and bycatch species; discard rates; interaction rates with protected species; size of target species; hooking locations; mortality at haul back; bycatch mortality; and if possible, an evaluation of the condition of fish at haul back to allow post-release mortality estimates.

The following vessels and Captains are to be removed from the EFP:

F/V Carol Ann (USCG #609121), Captain Greg O'Neill
F/V Southern Lady (USCG #690722), Captain Richard Ross

The following vessels and Captains are to be added to the EFP:

F/V Dakota (USCG # 956008), Captain Robert Scott Rucky
F/V Shady Lady (USCG #908223), Captain Bill McIntyre

This action does not change any other of the requirements, intent or substance of the original Authorization, which remain in effect.

MAR 1 3 2009

Alan Risenhoover, Director
Office of Sustainable Fisheries

Date

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Appendix 1c:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

EXEMPTED FISHING PERMIT HMS-EFP-08-02 AMENDMENT 2

Pursuant to 50 CFR 635.32 and consistent with 50 CFR 600.745, the Director, Office of Sustainable Fisheries, National Marine Fisheries Service authorizes the amendment of HMS-EFP-08-02. The Exempted Fishing Permit (EFP), HMS-EFP-08-02, was issued to Dr. David Kerstetter to evaluate pelagic longline catches and catch rates of target and non-target species within sections of the East Florida Coast (EFC) and Charleston Bump closed areas. Vessels are subject to 100 percent observer coverage, and observers or research staff will collect data that includes, but is not limited to, catch per unit effort (CPUE) for target and bycatch species; discard rates; interaction rates with protected species; size of target species; hooking locations; mortality at haul back; bycatch mortality; and if possible, an evaluation of the condition of fish at haul back to allow post-release mortality estimates.

HMS-EFP-08-02 is hereby amended to include the authorized sampler Tiffany Weidner.

This action does not change any other of the requirements, intent or substance of the original Authorization, which remain in effect.

Emily Menashes

DEC 0 7 2009

per Alan Risenhoover, Director
Office of Sustainable Fisheries

Date

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Appendix 1d:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

EXEMPTED FISHING PERMIT HMS-EFP-08-02 AMENDMENT 3

Pursuant to 50 CFR 635.32 and consistent with 50 CFR 600.745, the Director, Office of Sustainable Fisheries, National Marine Fisheries Service authorizes the amendment of HMS-EFP-08-02. The Exempted Fishing Permit (EFP), HMS-EFP-08-02, was issued to Dr. David Kerstetter to evaluate pelagic longline catches and catch rates of target and non-target species within sections of the East Florida Coast (EFC) and Charleston Bump closed areas. Vessels are subject to 100 percent observer coverage, and observers or research staff will collect data that includes, but is not limited to, catch per unit effort (CPUE) for target and bycatch species; discard rates; interaction rates with protected species; size of target species; hooking locations; mortality at haul back; bycatch mortality; and if possible, an evaluation of the condition of fish at haul back to allow post-release mortality estimates.

HMS-EFP-08-02 is hereby amended to extend the expiration date from February 28, 2010, until September 30, 2010.

This action does not change any other of the requirements, intent or substance of the original Authorization, which remain in effect.

James P. Burgess

MAR - 1 2010

for Alan Risenhoover, Director
Office of Sustainable Fisheries

Date

Appendix 1e:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

EXEMPTED FISHING PERMIT HMS-EFP-08-02 AMENDMENT 4

Pursuant to 50 CFR 635.32 and consistent with 50 CFR 600.745, the Director, Office of Sustainable Fisheries, National Marine Fisheries Service authorizes the amendment of HMS-EFP-08-02. The Exempted Fishing Permit (EFP), HMS-EFP-08-02, was issued to Dr. David Kerstetter to evaluate pelagic longline catches and catch rates of target and non-target species within sections of the East Florida Coast (EFC) and Charleston Bump closed areas. Vessels are subject to 100 percent observer coverage, and observers or research staff will collect data that includes, but is not limited to, catch-per-unit-effort (CPUE) for target and bycatch species; discard rates; interaction rates with protected species; size of target species; hooking locations; mortality at haul back; bycatch mortality; and if possible, an evaluation of the condition of fish at haul back to allow post-release mortality estimates.

HMS-EFP-08-02 is hereby amended to include the authorized samplers Matthew Dancho and Sohail Khamesi, graduate students who will help conduct the research.

This action does not change any other of the requirements, intent or substance of the original Authorization, which remain in effect.

Emily Menashes, ActingDirector
Office of Sustainable Fisheries

6/15/2013
Date

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Appendix II:

C.8 VESSEL REQUIREMENTS:

Vessels participating in the study must submit to and pass an enforcement background check.

Vessels must comply with all applicable vessel monitoring and reporting requirements (e.g. vessel monitoring systems, logbooks) as specified in 50 CFR 635.

All fishing activities must be in compliance with the applicable regulations at 50 CFR part 635, except as modified by the terms and conditions of the Exempted Fishing Permit to be issued under the authority of 50 CFR 635.32.

To be eligible to fish under the EFP, vessels must hold currently valid limited access permits for Atlantic Tunas Longline, Atlantic Swordfish (Directed), and Atlantic Sharks (Directed or Incidental) or be a *bona fide* research vessel. *Bona fide* research vessels would be issued a fish under a Scientific Research Permit, not an EFP.

Also to be eligible, vessels must be capable of embarking a fisheries observer to be designated by NMFS and, when embarking the fisheries observer, must meet the vessel safety requirements at 50 CFR 600.746(c) and the accommodation and access requirements at 50 CFR 635.7(e).

Participating vessels shall furnish all equipment, materials, food, personnel, and services needed to perform the work described in this statement, including longline fishing gear, bait, fuel, and insurance for the vessel and the ship's personnel, including the fisheries observer or PI, unless noted otherwise. The standard practice of the NMFS Atlantic Longline Observer Program has been for NMFS to provide Protection and Indemnity (P&I) insurance.

Vessel owners and operators must possess and utilize all required bycatch/bycatch mortality mitigation gears, protocols, and techniques and be in compliance with all applicable workshop and certification requirements as specified in 50 CFR 635.8.

All participating vessels must carry fisheries observers or the PI, as assigned, during all EFP fishing operations. The fisheries observers will be employed or contracted by NMFS primarily to oversee that the fishing operations are conducted in accordance with research protocols, to observe the results, and to record the data.

Participating vessels must provide the fisheries observer or PI with a bunk in the living quarters comparable to crew members, and provide the same meals, snacks, and amenities as are normally provided to other vessel personnel.

The vessel operator shall not forcibly assault, harass, or sexually harass, intimidate or attempt to influence the fisheries observer, interfere or impede with their data collection, tagging, or other duties, or allow crew members to do the same.

SAFETY

The vessel must have all required United States Coast Guard (USCG) Safety Inspections, as well as having all approved safety, navigation and communication devices in proper working order.

The vessel operator is responsible for all matters relating to safety of personnel, the vessel, and equipment operation. The vessel operator will adhere at all times to Navigational Rules and to Rules of the Road, whether it be while setting, transiting, drifting, hauling, or at anchor. The vessel operator shall review safety procedures and equipment with the fisheries observer or PI at the beginning of the cruise.

If appropriate, the vessel operator shall provide U.S. Coast Guard (USCG) approved survival suits for all vessel personnel. The fisheries observer will provide his/her own USCG approved survival suit. Adequate, dry, top-side storage for all survival suits shall be provided.

The vessel operator shall provide USCG approved life jackets for all personnel aboard. Fisheries observers will supply their own first-aid kit. The vessel operator will provide a completely stocked first-aid kit as required by the USCG.

The vessel must pass a USCG safety examination or inspection. A vessel that has passed a USCG safety examination or inspection must display one of the following:

(i) A current Commercial Fishing Vessel Safety Examination decal, issued within the last 2 years, that certifies compliance with regulations found in 33 CFR, chapter 1 and 46 CFR, chapter 1;

(ii) A certificate of compliance issued pursuant to 46 CFR 28.710; or

(iii) A valid certificate of inspection pursuant to 46 U.S.C. 3311.

Fisheries observers may refuse to board vessels that they deem to be unsafe. Should a dispute arise between the fisheries observer and the vessel operator on safety issues, the fisheries observer will contact NMFS for instructions, and the participating vessel shall not conduct any fishing operations.

VESSEL COMPENSATION

The costs associated with the research platforms, captain and crew salaries, fuel, and all other fishing related and operational expenses will be absorbed by the participating vessels. Participating vessels may retain all legally caught fish and may sell them through normal channels. All proceeds from the sale of catches will be the property of the vessels.

Appendix III:

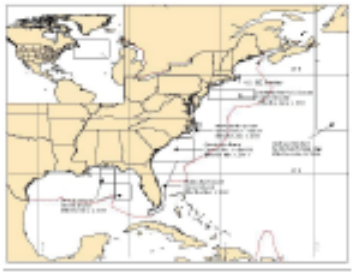
South Atlantic Bight and Florida East Coast Pelagic Longline Time-Area Closure Research: 2008-2010

David Kerstetter
Nova Southeastern University Oceanographic Center

Presentation to the HMS Advisory Panel
April 6, 2011

1

Current Time-Area Closures



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Research Project History

- Original discussions for such a project began in 2006
- Bluewater Fishermen's Association proposed to allow 13 vessels into time-area closures, but opposition eventually resulted in denial of EFP request in July 2007
- Discussion continued with resulting smaller-scale proposal of two vessels, with Federal Register publication of Environmental Assessment by NOAA in November 2007

3

Research Project Goals

1) **Comparison of catch rates between open and closed (experimental portions) areas;**

2) *Comparison of historical and contemporary catch rates between open and closed (experimental portions) areas; and*

3) *Comparison of historical and contemporary catch rates of hooks*

4

Research Project Objectives

- Evaluate the catch rates of target and bycatch species within the Charleston Bump and Florida Coast East time-area closures to PLL gear.
- Evaluate bycatch reduction potential for 18/0 non-offset circle hook on swordfish directed bycatch species.
- Evaluate the effectiveness of line cutters and de-hookers for releasing bycatch species.
- Collect data on the spatial and temporal relationship between target and bycatch species.
- Evaluate "immediate" mortality using non-offset 18/0 circle hooks.
- Evaluate bycatch reduction potential for non-offset 18/0 hook on all swordfish-directed fishery bycatch species.

5

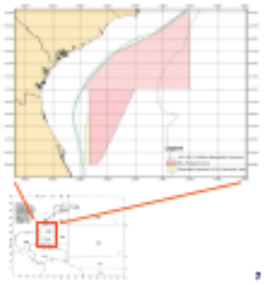
Project EFP Details

- Vessels and captains required to go through (thorough) background check for prior NOVAs – several interested vessels/captains/owners did not pass
- Original proposal by BWFA called for 13 vessels, but NMFS limited participation to three on the EFP at any one time, and no more than two fishing simultaneously
- All vessels carried NMFS POP, POP contractor, or POP-trained fisheries observer for standardized data collection – most sets by NSU OC graduate students

6

Project EFP Details: Area

- Original experimental areas in pink
- Based on concerns that the lower part of the EFC closure could not be adequately fished, a small experimental area in southern end was extended (yellow) in 2009 EFP renewal



Project Methods

- Ports included Dania (FL), Pompano Beach (FL), Cape Canaveral (FL), and Cherry Point (SC)
- Project did not include any compensation to any participating vessel; even hooks had to be provided by the vessel

Project Methods: Operations

- The vessel operator is responsible for all matters relating to safety of personnel, the vessel, and equipment operation.
- The vessel Captain and crew will work cooperatively with and assist the observer to ensure the fullest potential data collection.
- Research vessels will adhere to all gear requirements under current HMS regulations.
- All legally harvested fish catch may be retained by the vessel for sale.
- Research vessels will take precautions to reduce gear and/or fishing grounds conflicts.

Project Methods: Gear Configurations

- Branch lines must be at least 110% of the float line length.
- Hook spacing must be uniform within a set.
- Vessel may deploy up to 500 hooks per set within the closed areas. Vessels may deploy additional hooks at their discretion when fishing outside the closed areas, but must still allow observer access to examine any caught animals.
- All vessels will employ NOAA-specified line cutters, de-hookers, and mouth gags and openers, and must attempt to release alive all non-target bycatch species.

Project Methods: Gear Configurations

When targeting swordfish, all vessels must:

- — Only non-offset 18/0 circle hooks: either Mustad #39960D or the L-P model
- — Use leaded swivels on every leader, placed 2.5 fathoms above the hook
- — Use 5 hooks between each set of floats
- — No requirement that the first gangion be on the float
- — 7 or 10 fathom drops and 12 fathom leaders, uniform within a set

All float, poly ball, and beeper buoy drops must be consistent within a set.

Project Methods: Gear Operations

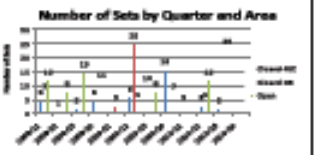
- The vessel crew will assist the observer in collecting data on section location, water temperature, and time of section set and haul, including positions of beeper buoys and high-flyers.
- Following each fishing set, the Captain and Observer will determine the accurate number of hooks fished, to be included in the Observer's daily report.
- The fishery observer or experiment coordinator will be given access to the fish at the point of sale to record weight data by carcass

Project Methods: Gear Operations

- Vessels will conduct normal longline fishing operations inside and outside of each time-area closure
- "Outside" the closure area includes areas within the SAB area (Charleston Bump) and FEC area (East Florida Closure), even outside the U.S. EEZ
- Vessels will attempt – as much as practicable – to divide fishing effort on each trip equally between both sides of the closure lines

Total Effort: Vessels

- 34 trips completed: 14 in 2008; 13 in 2009; 7 in 2010
- 192 sets completed: 39 in CB (seasonal) closed area; 53 in FEC closed area; 100 in open areas
- 5 participating vessels; however, 73% of all sets aboard F/V *Kristin Lee*

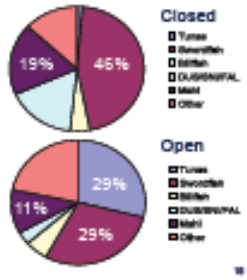


Total Effort: Individual Research Sets

		Q1	Q2	Q3	Q4	
2008	open	17	11	10	6	50
	closed	7	7	–	4	18
2009	open	–	8	25	17	50
	closed	–	32	–	1	33
2010	open	9	12	11	na	32
	closed	–	7	2	na	9
		27	74	53	28	192

- Original proposal called for 256 experimental sets over one, 12-month period – using statistical power estimation tools and historical CPUE data, such work would have provided a minimum power of (1-β)=0.90
- Final sets totalled 192, with 60 within the closed area(s) and the remainder in open areas and/or open seasons – 10 sets not fully observed, so not included in catch rate analyses

Total Catches: All Species



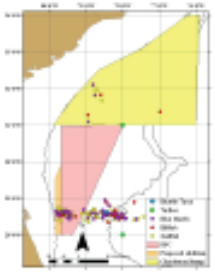
Catches: Swordfish Lengths

- **Total swordfish (both TAC combined):**
  - 1156 open: 141.0 cm±31.3; 994 closed: 135.8 cm ±26.1
  - t=4.23; Pr>|t| < 0.0001**

Catches: Tunas and Mahi Lengths

- **Bigeye tuna:**
  - 310 open: 108.6 cm±20.5; 16 closed: 94.8 cm±14.4
  - t=2.66; Pr>|t| = 0.0082*
- **Yellowfin tuna:**
  - 97 open: 122.2 cm±20.6; 10 closed: 100.3 cm±12.6
  - t=3.05; Pr>|t| = 0.0029*
- **Bluefin tuna:** only one caught, in open area during 2010
- **Mahi:**
  - 116 open: 110.9 cm±17.9; 731 closed: 98.5 cm±14.9
  - t=7.07; Pr>|t| < 0.0001** (Satterthwaite for uneq. var.)

Catches: Bycatch Species Mortality

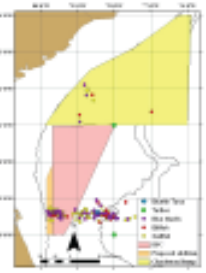


Billfish:

- **Blue marlin: 84 total (14 dead, 10 alive predicted)**
  - **19 dead, 65 alive**
  - **χ^2=25.19, Pr: <0.0001*****
- **White marlin: 11 total (13 dead, 9 alive predicted)**
  - **4 dead, 7 alive**
  - **χ^2=0.82, Pr: 0.3657**
- **Sailfish: 187 total (11 dead, 20 alive predicted)**
  - **56 dead, 131 alive**
  - **χ^2=30.08, Pr <0.0001*****

Predicted values from Table 4-4 in 2007 EA (www.sfp-hms.com)

Catches: Bycatch Species Mortality



Sea Turtles:

- **Under "worst-case" scenario published in FR notice, 2 leatherback and 6 loggerhead turtle interactions would result**
- **Actual results were 3 leatherbacks and 2 loggerheads, all released alive without trailing fishing gear**

No seabird interactions occurred during any part of this study.

Catches: Bycatch Species Mortality

Silky Shark

- 377 total: 175 dead, 201 alive; χ^2=1.79, Pr: 0.1800

Night Shark

- 595 total: 394 dead, 196 alive; χ^2=66.45, Pr: <0.0001***

Tiger Shark

- 160 total: 3 dead, 156 alive; χ^2=147.22, Pr: <0.0001***

Note: "dead" included dead and damaged, while total included individuals with unreported condition.

Testing for Scientific Error

In a hypothetical example of a patient being tested for HIV, statisticians approach it like this: Begin with the null hypothesis, that the patient *does not* have the disease; the alternative hypothesis is that HIV is present. If the null hypothesis is rejected when it is in fact true (the patient tests positive for infection when the patient is well), this is a Type I error or "false positive." If the null hypothesis is not rejected when it is in fact false (the patient tests negative when the patient is infected), this is a Type II error or "false negative."

Type I error probability is assessed with statistical significance tests.
Type II error probability is assessed with statistical power tests.

Statistical power is conventionally expressed as (1-β), and power values of greater than 0.8 are generally considered sufficient to avoid Type II errors.

http://en.wikipedia.org/wiki/Type_I_and_type_II_errors

Catch Rate Comparisons

- CPUEs expressed as: [catch] per 1000 hooks
- All CPUEs log-transformed with log(x+1) for normality and assessed for area and quarter effects using PROC GAM in SAS (v. 9.2)
- Statistical power calculated *post hoc* for all comparisons using Cohen's *d* and G*Power (v.3.1.2). Generally, values of (1-β) > 0.8 are considered adequate power.

Note: Charleston Bump time-area closure is only seasonal; therefore, sets in this area during open seasons lumped with rest of open areas for analyses

Catch Rates: All Swordfish

- **All years, all quarters:**
  - **closed: mean=38.8±29.2 (range: 0-112)**
  - **open: mean=18.77±15.2 (range: 0-84.4)**
- **GLM results: All swordfish**
  - **area: F=12.36, Pr>F 0.0006***
  - **quarter: F=1.91, Pr>F 0.1288**
  - **area*quarter: F=4.72, Pr>F 0.0034***

Power (1-β) = 0.8844

Catch Rates: Retained Swordfish

- All years, all quarters:
  - closed: mean=25.4±18.9 (range: 0-72)
  - open: mean=15.3±12.3 (range: 0-86.3)
- GLM results: Retained Swordfish Only
  - area: F=2.18, Pr>F 0.1411
  - quarter: F=1.02, Pr>F 0.3832
  - area*quarter: F=3.57, Pr>F 0.0152*

Power (1-β) = 0.8931

Catch Rates: Swordfish Discards

- All years, all quarters:
  - closed: mean=11.1±11.5 (range: 0-44)
  - open: mean=4.3±4.8 (range: 0-24.4)
- GLM results: Discarded Swordfish Only
  - area: F=19.18, Pr>F <0.0001**
  - quarter: F=4.60, Pr>F 0.0039*
  - area*quarter: F=4.74, Pr>F 0.0033*

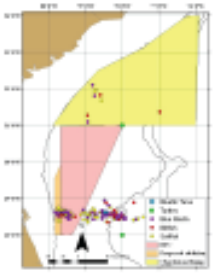
Power (1-β) = 0.9674

Catch Rates: Billfish Bycatch

Blue Marlin

- All years, all quarters:
  - closed: mean=0.69±0.18 (range: 0-0.69)
  - open: mean=0.18±0.27 (range: 0-1.07)
- GLM results:
  - area: F=0.30, Pr>F 0.5872
  - quarter: F=0.34, Pr>F 0.7963
  - area*quarter: F=0.63, Pr>F 0.5937

Power (1-β) = 0.0873

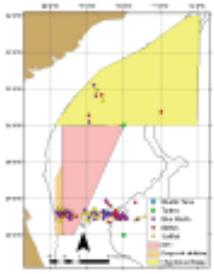


Catch Rates: Billfish Bycatch

Sailfish

- All years, all quarters:
  - closed: mean=0.04±0.14 (range: 0-0.69)
  - open: mean=0.37±0.40 (range: 0-1.33)
- GLM results:
  - area: F=18.27, Pr>F <0.0001**
  - quarter: F=9.89, Pr>F <0.0001**
  - area*quarter: F=2.05, Pr>F 0.1068

Power (1-β) = 0.8644

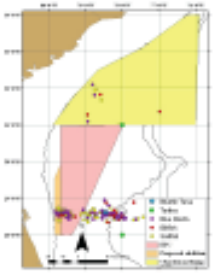


Catch Rates: Billfish Bycatch

All Billfish Combined

- All years, all quarters:
  - closed: mean=0.15±0.26 (range: 0-0.71)
  - open: mean=0.50±0.45 (range: 0-1.47)
- GLM results:
  - area: F=43.57, Pr>F <0.0001**
  - quarter: F=19.75, Pr>F <0.0001*
  - area*quarter: F=1.74, Pr>F 0.1613

Power (1-β) = 0.8906



Catch Rates: Shark Bycatch

Silky Shark

- All years, all quarters:
  - closed: mean=38.17±97.86 (range: 0-582.5)
  - open: mean=1.31±2.81 (range: 0-22.22)
- GLM results:
  - area: F=50.97, Pr>F <0.0001**
  - quarter: F=8.22, Pr>F <0.0001**
  - area*quarter: F=9.98, Pr>F <0.0001**

Power (1-β) = 0.9966

Night Shark

- All years, all quarters:
  - closed: mean=7.84±13.01 (range: 0-64.0)
  - open: mean=0.51±1.47 (range: 0-8.33)
- GLM results:
  - area: F=60.43, Pr>F <0.0001**
  - quarter: F=3.48, Pr>F 0.0172*
  - area*quarter: F=16.01, Pr>F <0.0001**

Power (1-β) = 0.9999

Conclusions: Project

- Requirements for EFP resulted in few participating vessels – many more were willing, but did not qualify
- Unwillingness (or inability, due to EFP requirements) for vessels to conduct year-round sampling in CB
- Zero interactions with any recreational vessel

Conclusions: Catches

- Overall billfish mortality* minimal, as was sea turtle bycatch and bluefin tuna incidental catch
- Significantly higher catch rates of all swordfish and swordfish discards within closed areas
- Unknown effects of using non-offset 18/0 circle hooks versus fleet-standard offset 18/0 circle hooks or non-offset size 16/0 circle hooks

* Defined as "mortality at haulback"

Last Project Steps?

- Completing comparisons of historical and contemporary catch rates (Goal #2); however, some issues:
  - "apples and oranges" comparison question between hook types and changes in baseline CPUE?
  - available data are on basis of single hook types within a set; i.e., not standard, paired-hook scientific comparisons
  - also, standard POP observer protocol is only to record animal disposition (alive or dead), not other, potentially useful data such as hooking location

Next Steps?

- Need to do comparisons of hook types, but little data available for public use (e.g., FRI project and NED project data are still not publicly available). However, some of these data are scheduled to be presented (Congress-willing!) at the upcoming Circle Hook Symposium next month in Miami.

Management Considerations?

- Locations of target and bycatch species catches might allow more specific area targeting of closed areas
- Significant interaction effects of area*quarter in most species-level analyses might allow more time-specific targeting of closed areas

However, both suggestions are under the presumption that neither alternative strategy would increase bycatch nor result in any other undesirable outcome.

Other Research?

- Swordfish diet in FL Straits
- Mesopelagic teleost life-history
- Pelagic stingray life-history
- Cetacean habitat modeling
- Conventional tagging!
  - 29 swordfish
  - 11 blue and white marlin
  - 19 sailfish
  - 74 various sharks, with two tag recoveries (night, sf mako)

Work and results are not to be cited, reproduced, or published without prior permission of the author.

Acknowledgements

- NSU OC graduate student fisheries observers: Shannon Bayse, Cheryl Cross, Heidi (DaSilva) Keller, Mike Tousignant, Matt Dancho, and Sohail Khamesi
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- NMFS HMS staff for EFP assistance
- BWFA for support and vessel assistance
- Vessels, crews, and captains of the F/V *Carol Ann*, F/V *Kristin Lee*, F/V *Shady Lady*, F/V *Southern Lady*, and F/V *Dakota*