Incidental Harassment Authorization Request for 2013

Marine Corps Air Station, Cherry Point

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1. Description of Activities

The United States Marine Corps (USMC) requests Incidental Harassment Authorization (IHA) for the incidental take of marine mammals, specifically common bottlenose dolphin (*Tursiops truncatus*), during training operations at the Marine Corps Air Station (MCAS) Cherry Point Range Complex (Figure 1-1). Pursuant to National Marine Fisheries Service (NMFS) requirements for an IHA request, MCAS Cherry Point has prepared this report to analyze potential environmental effects associated with military training within the MCAS Cherry Point Range Complex. The report focuses on the potential effects to marine mammals from bombing and target training at the in-water bombing targets (BTs) Brant Island (BT-9) and Rattan Bay (Piney Island Bombing Range, BT-11) located in Pamlico Sound, North Carolina (NC) (Figure 1-1). These bombing targets are under the control and management of MCAS Cherry Point. Activities evaluated in this document can be part of single unit training exercises or larger-scale training events.

This section provides a description of the training activities conducted at the in-water ranges that involve the use of live (explosive) and inert (non-explosive) ordnance, and small boat maneuvers.

1.1 Munitions Firing

Munitions firing training conducted on the water ranges includes air-to-surface (firing from aircraft to surface water targets) and surface-to-surface (firing from ship or boat to surface targets). The number of sorties that conduct these missions may vary from year to year, as shown in Table 1-1. Table 1-2 lists the types of ordnance, or munitions, that can be expended at the Range Complex, including practice bombs, rockets, flares, chaff, gun ammunition, and grenades. Note that deployment of live ordnance is only permitted at BT-9; all munitions fired at BT-11 are inert.

Table 1-1: Aircraft and boat sorties, by mission type, conducted in 2011 and 2012.

Mission Type	BT-9		BT-11	
	2011	2012	2011	2012
Air-to-Surface	1,554		4,251	
Surface-to-Surface	223	322	105	106
Total	1,777		4,356	

MCAS Cherry Point's standard operating procedures set the maximum limit at 100 pounds (lbs) trinitrotoluene (TNT) equivalent for explosive ordnance at BT-9. Net explosive weights (NEW) currently authorized for use at BT-9 range from 0.1019 to 100 lbs. Practice bombs are used at both targets and are inert, although they do contain a small amount of explosive marking charge in a signal cartridge that allows the target hit to be detected by range scorekeepers and the pilot. Explosives in the signal cartridge are less than 1 lb TNT equivalent (USMC 2001b). Note that all ordnance fired on the BT-11 range is inert with the exception of a signal charge in practice bombs.

Every practice and live-fire exercise at the Range Complex is designed and conducted so that all ammunition and other ordnance strike and/or fall within the existing danger zones or restricted areas for each bombing target. A *danger zone* is a defined water area (or areas) used for target practice, bombing, rocket firing or other especially hazardous operations that may be closed to the public on a full-time or intermittent basis (33 CFR 334.2). A *restricted area* is a defined water area for the purpose of prohibiting or limiting public access generally to

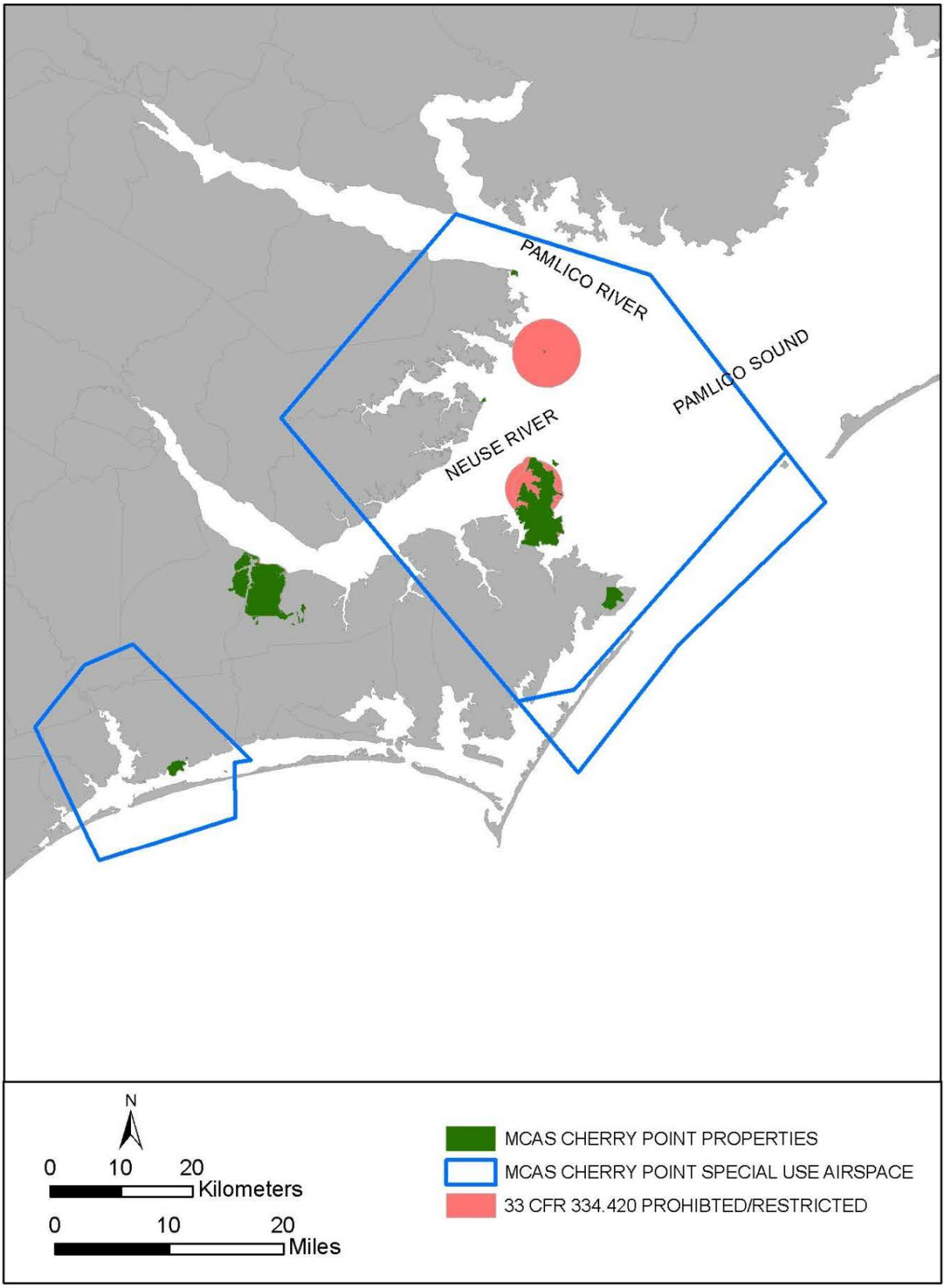

Figure 1.1: MCAS Cherry Point Range Complex.

Table 1-2: Munitions authorized for use at the MCAS Cherry Point Range Complex[1]. Inert ordnance is displayed in plain text; live ordnance is displayed in bold text.

Small Arms	Large Arms	Missiles[2]	Rockets	Bombs	Pyrotechnics
.22 cal	20mm	Hellfire	2.75-in Rocket	Practice Hand Grenade	Chaff
.40 cal	**20mm**	Tube-launched, optically tracked, wire-guided (TOW)	2.75-in Rocket Illumination	Non-Lethal Stun Grenade	LUU-2
.45 cal	25mm		2.75-in Rocket White Phosphorous	Smoke Grenade	LUU-19
.50 cal	30mm		2.75-in Rocket Red Phosphorous	**G911 Grenade**	MI27 A1-Parachute Flare
5.56mm	**30mm**		**2.75-in Rocket**	BA21 0.052 lb	Self Protection Flare
7.62mm	40mm		5-in Rocket	BDU-48 10 lbs	Signal Illuminations
9mm	**40mm**		5-in Rocket White Phosphorous	BDU-33 25 lbs	Simulated Booby Traps
12 Gauge	40mm Illumination		5-in Rocket Red Phosphorous	E976 25 lbs	Smokey Sams
	60mm Illuminations		**5-in Rocket**	MK-76 25 lbs	Artillery Simulator Ground Burst
	60mm Smoke White Phosphorous			LGTR 90 lbs	
	81mm			**MK-81 250 lbs**	
	81mm Illumination			BDU-45 500 lbs	
	81mm Smoke White Phosphorous			BDU-50 500 lbs	
	105mm Target Practice			GBU-12 500 lbs	
	105mm 40lbs			MK-82 500 lbs	
				BDU-38 750 lbs	
				GBU-16 1,000 lbs	
				MK-83 1,000 lbs	
				MK-63 1,061 lbs	

[1]Variants of the listed munitions and newly developed munitions that fall into these categories may be approved for use at the Range Complex as they become available.

[2]Two types on missiles, Hellfire and TOW, were previously approved for use at BT-9 per Air Station Order P3570.2R; however, use of these missiles at MCAS Cherry Point has been cancelled since Fiscal Year (FY) 2005 due to operational limitations imposed by an insufficient weapon danger zone safety footprint at the water range.

provide security for government property and/or protection to the public from the risks of damage or injury arising from the government's use of that area (33 CFR 334.2).

1.1.1 Surface-to-Surface

Gunnery exercise is the only category of surface-to-surface activity currently conducted at BT-9 and BT-11.

- Gunnery Exercise: A small boat, typically operated by Special Boat Team personnel, uses a machine gun to attack a surface target that simulates another ship, boat, swimmer, floating mine or near-shore land targets. Boats conducting surface-to-surface firing activities will typically use 7.62 millimeter (mm) or .50 caliber (cal) machine guns; 40 mm grenade machine guns; or G911 concussion hand grenades. This exercise is usually a live-fire exercise, but blanks may be used so that the boat crews can practice their ship handing skills. BT-9 is the most common target used for gunnery exercises. A target is not used for the gunnery exercises employing the G911 Concussion grenade, as the goal of this specific training is to learn how to throw the grenade into the water.

1.1.2 Air-to-Surface

There are four categories of air-to-surface activities conducted at the MCAS Cherry Point bombing targets: mine laying, bombing, gunnery, and rocket exercises.

- Mine Laying: These activities involve a fixed-wing aircraft deploying inert mine shapes in an offensive or defensive pattern. Mine laying operations are conducted in the waters around BT-9.
- Bombing Exercise: During these exercises, fixed-wing aircraft deliver bombs against surface maritime targets with the goal of destroying or disabling enemy ships or boats. These exercises occur during day and night. Air-to-surface bombing exercises employ either unguided or precision-guided munitions. Unguided munitions include MK-76 and BDU-45 inert training bombs, as well as the MK-80 series of inert bombs (no cluster munitions are authorized). Precision-guided munitions consist of laser-guided bombs (inert) and laser-guided training rounds (inert).
- Gunnery Exercise: Rotary-wing gunnery exercises involve CH-53, UH-1, CH-46, MV-22, or H-60 rotary-wing aircraft with mounted 7.62 mm or .50 cal machine guns. Each gunner expends approximately 800 rounds of 7.62 mm or 200 rounds of .50 cal ammunition per exercise. Fixed-wing gunnery exercises involve two aircraft that begin descent to the target from an altitude of approximately 914 meters (m) (3,000 feet [ft]) while still several miles away. Within a distance of 1,219 m (4,000 ft) from the target, each aircraft fires a burst of approximately 30 rounds before descending to a minimum altitude of 305 m (1,000 ft) and then breaks off and repositions for another strafing run. This continues until each aircraft expends its exercise ordnance allowance of approximately 250 rounds. Typically fixed-wing gunnery exercises involve F/A-18 with Vulcan M61A1/A2, 20 mm cannon, and AV-8 with GAU-12, 25 mm cannon.
- Rocket Exercise: Fixed- and rotary-wing aircraft crews launch rockets at surface maritime targets during rocket exercises with the goal of destroying or disabling enemy ships or boats. Rocket exercises may occur day or night. These operations employ 2.75-inch (in) and 5-in rockets.

1.1.3 Quantity and Accuracy or Ordnance Used

The amount of ordnance to be annually expended at BT-9 and BT-11 under the activity is 1,225,815 and 1,254,684, respectively (Table 2-3 and Table 2-4). The amounts of ordnance expended at the BTs account for all uses of the targets, including use by other services. There are five types of explosive sources used at BT-9: 2.75-in Rocket High Explosives (HE), 5-in Rocket HE, 30 mm HE, 40 mm HE, G911 grenades, Hellfire missiles, and TOW missiles. No high explosive munitions are used at BT-11.

Both bombing targets are located in or near water; therefore, there is potential for rounds that miss the targets to impact or detonate in the water. BT-9 is comprised of two hulls grounded in the water; therefore, as the

target is located in water, the Marine Corps assumes that 100 percent of the ordnance expended at BT-9 would detonate in the water at a depth of approximately 1.2 m (3.9 ft). Three of the targets at BT-11 are located either within or immediately adjacent to Rattan Bay. In addition, the location and use of several other targets at BT-11 cause their associated Safety Danger Zones (SDZs) to extend into the water. At BT-11, thirty-six percent of the composite weapons SDZs fall over water. Based on the location of the SDZs, the USMC conservatively estimates that 36 percent of the total number of rounds expended at BT-11 would impact the water.

Table 1-3: Proposed level of live and inert munitions to be expended at BT-9 in 2013.

Proposed Munitions		Proposed No. of Rounds	Net Explosive Weight (lb)
Small Arms excluding .50 cal		525,610	N/A
.50 cal		568,515	N/A
Large Arms – Live	30mm	0	0.1019
	40mm	5,000	0.1199
Large Arms – Inert		117,051	N/A
Rockets – Live	2.75-in	48	4.8
	5-in	20	15.0
Rockets – Inert		876	N/A
Bombs and Grenades – Live	G911	0	0.5
	100-lbs NEW HE Bomb	0	100
Bombs and Grenades – Inert		4,199	N/A
Missiles	Hellfire	0	34.4
	TOW	0	13.6
Pyrotechnics		4,496	N/A
	Total	1,225,815	N/A

Table 1-4: Proposed level of inert munitions to be expended at BT-11 in 2013.

Proposed Munitions	Proposed No. Rounds
Small Arms excluding .50 cal	610,957
.50 cal	366,775
Large Arms	240,334
Rockets	5,592
Bombs and Grenades	22,114
Pyrotechnics	8,912
Total	1,254,684

1.2 Small Boat Maneuvers

Small boat maneuvers are conducted by Naval Special Warfare teams, Navy Expeditionary Combat Command units (e.g., Naval Coastal Warfare, Inshore Boat Units, Mobile Security Detachments, Explosive Ordnance Disposal, and Riverine Forces), and U.S. Coast Guard units. Boats used by these units include, but are not limited to, small unit river craft, combat rubber raiding craft, rigid hull inflatable boats, and patrol craft. These boats may have either inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion.

The number of sorties conducted at each range may vary from year to year based on training needs and worldwide operational tempo. Boat sortie weapons training at BT-9 includes live fire of 7.62 mm, .50 cal, and 40 mm grenades, as well as use of G911 concussion grenades. Munitions, both live and inert, fired during small boat maneuvers are included in the larger analyses for BT-11 and BT-9 and, therefore, are not broken down here.

2. Dates and Duration of Activity and Geographical Region

Surface-to-surface and air-to-surface munitions firing occurs year-round without seasonal restrictions. The bombing targets are located at the convergence of the Neuse River and Pamlico Sound (Figure 2-1).

The Brant Island Target, also known as Bombing Target-9, is located approximately 52 kilometers (km) (28 nautical miles [nm]) northeast of MCAS Cherry Point in Pamlico Sound, Pamlico County, NC. Brant Island Shoals is located approximately 4.8 km (3 miles [mi]) southeast of Goose Creek Island. Brant Island Shoals is roughly oriented northwest to southeast through the center of the circular target area. The target is defined by a 6 statute-mile (SM) diameter prohibited area having its center on the southern side of Brant Island at latitude 35°12’30”, longitude 76°26’30” (33 CFR 334.420). The area is closed to navigation and personnel at all times, and is delineated by large signs on pilings surrounding the perimeter of BT-9.

Bombing Target-11 is a 50.6 square kilometer (km^2) (19.5 square mile [mi^2]) complex of land- and water-based targets at the Piney Island Bombing Range, and includes all of the island and the surrounding waters in Pamlico Sound. There are two designated danger zones and three restricted areas around the BT-11 target.

3. Species and Numbers of Marine Mammals Likely to be Found within the Activity Area

While there are records showing the occurrence of 40 marine mammal species in the nearshore and offshore waters of North Carolina, the vast majority of these species are oceanic in distribution. Only one marine mammal species—the common bottlenose dolphin (*Tursiops truncatus*)—has been repeatedly sighted in Pamlico Sound, while an additional species—the endangered West Indian manatee (*Trichechus manatus*)—has been rarely sighted (Lefebvre *et al*. 2001; DoN 2003). Due to its rarity, no further information regarding the West Indian manatee will be included in this document.

A review of the records contained in the North Atlantic Right Whale Database, maintained by the NMFS, shows that no sightings of the endangered North Atlantic right whale (*Eubalaena glacialis*) have ever been recorded within Pamlico Sound or in the vicinity of the bombing targets (Kenney 2006). No suitable North Atlantic right whale habitat exists in the shallow Pamlico Sound, including the vicinity of the BTs; therefore, no further information regarding this species is included in this document. All other marine mammal species potentially occurring in the southwestern portion of Pamlico Sound are considered extralimital.

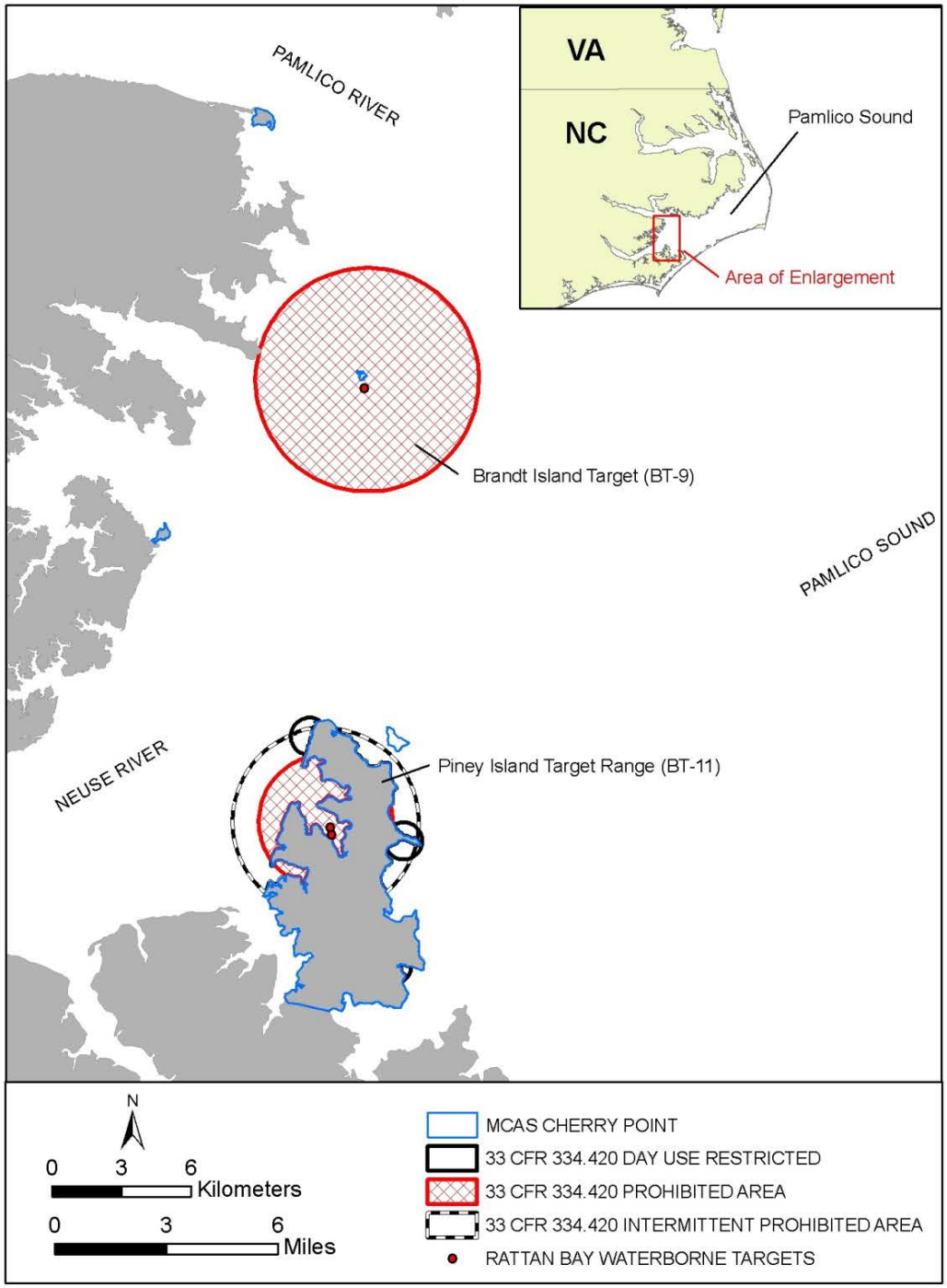

Figure 2-1: MCAS Cherry Point bombing targets Brant Island (BT-9) and Piney Island Bombing Range (BT-11) (33 CFR 334.420; USMC 2001a).

There are two morphotypes of bottlenose dolphins in the western North Atlantic Ocean: coastal and offshore. The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula, and along the Gulf of Mexico. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and western North Atlantic represent separated stocks (Duffield and Wells 2002; Rosel *et al*. 2009). On the Atlantic coast, Scott *et al*. (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality even in 1987-1988 and observed density patterns. However, re-analysis of stranding data (McLellan *et al*. 2003) and extensive analysis of genetic (Rosel *et al*. 2009), photo-identification (photo-ID) (Zolman 2002), and satellite telemetry (Southeast Fishery Science Center, unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks.

Integrated analysis of these multiple lines of evidence suggests that there are five coastal stocks of bottlenose dolphin: the Northern Migratory and Southern Migratory stocks, a South Carolina/Georgia Coastal stock, a Northern Florida Coastal Stock, and a Central Florida Coastal stock. Of these five stocks, only the Northern Migratory and Southern Migratory stocks have been observed in Pamlico Sound, NC.

In addition to inhabiting coastal nearshore waters, the coastal morphotype of bottlenose dolphin inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al*. 1987; Wells *et al*. 1996; Weller 1998; Scott *et al*. 1990; Gubbins 2002; Zollman 2002; Mazzoil *et al*. 2005; Speakman *et al*. 2006; Litz 2007; Stolen *et al*. 2007; Mazzoil *et al*. 2008). There are multiple lines of evidence supporting demographic separation of bottlenose dolphins residing within estuaries along the Atlantic coast. A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters (Cortese 2000; Caldwell 2001; Rosel *et al*. 2009). Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration, and the presence of transient animals (e.g., Speakman *et al*. 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal, or shorter, time scales is poorly understood. Yet for the purposes of the 2010 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, the NMFS considered bottlenose dolphins inhabiting primarily estuarine habitats distinct from those inhabiting coastal habitats (Waring *et al*. 2011). Two estuarine stocks occur in Pamlico Sound, NC: the Northern North Carolina Estuarine System (NNCES) stock and the Southern North Carolina Estuarine System (SNCES) stock.

According to the NMFS U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2010 (Waring *et al*. 2011), the abundance, the abundance estimate for the stocks which may occur in the activity area are listed in Table 3-1.

Table 3-1: Abundance estimates and minimum population estimates for stocks of common bottlenose dolphin that may occur in the activity area of BT-9 and BT-11.

Stock	Abundance Estimate (number of individuals)[1]	Minimum Population Estimate (number of individuals)[1]
Northern Migratory Coastal Stock	9,604	7,147
Southern Migratory Coastal Stock	12,482	9,591
Northern North Carolina Estuarine System Stock	1,387	unknown
Southern North Carolina Estuarine System Stock	2,454[2]	1,614

[1]Source: Waring *et al*. 2011.
[2]Waring *et al*. 2011 acknowledge that this is an underestimate of total abundance because the data excludes estuarine waters.

4. Status, Distribution, and Seasonal Distribution of Affected Species or Stocks of Marine Mammals Likely to be Found in the Activity Area

Marine mammal distribution is affected by demographic, evolutionary, ecological, habitat-related, and anthropogenic factors (Bjørge 2002; Stevick *et al*. 2002). Marine mammal movements are often related to feeding or breeding activity (Stevick et al. 2002). Cetacean movements are often a reflection of the distribution and abundance of prey (Kenney *et al*. 1996). Marine mammal movements have also been linked to environmental parameters indirectly indicative of prey distribution such as temperature variations (oceanic fronts), sea-surface chlorophyll-a concentrations, and bottom depth (Fiedler 2002).

4.1 Spatial Distribution

Bottlenose dolphins in North Carolina concentrate in shallow water habitats along the shorelines, and few, if any, individuals are present in the central portions of the sounds (Gannon 2003; Read *et al*. 2003a, 2003b). Bottlenose dolphins in the area of the bombing targets select shallow habitats, such as tributary creeks and the edges of the Neuse River, where the bottom depth is less than 3.5 m (11.5 ft) (Gannon 2003). Bottlenose dolphins use the downstream portion of the Neuse River estuary and lateral creeks more than the upstream area, and their density is highest during spring (May and June) and lowest during the summer (July and August) (Gannon 2003). Fine-scale distribution of dolphins seems to relate to the presence of topography or vertical structure, such as the steeply-sloping bottom near the shore and oyster reefs, which may be used to facilitate prey capture (Gannon 2003).

Between 2002 and 2003, researchers from Duke University, on behalf of the USMC, conducted 11 boat-based surveys for bottlenose dolphins in the waters surrounding BT-9 and BT-11. During this time, one sighting in the restricted area surrounding BT-9 and two sightings in proximity of BT-11 were observed in addition to seven sighting in adjacent waters, for a total of 276 bottlenose dolphins sighted (Read *et al*. 2002, 2003b, 2003c). Some large groups of dolphins have been reported in the restricted areas. In October 2002, a sighting of 50 dolphins was made within BT-9, and two months later a group of 70 dolphins moved into the prohibited area of the in-water targets of BT-11 (Read *et al*. 2003b).

From July 2004 through June 2005, the NMFS-Southeast Fisheries Science Center (SEFSC) in Beaufort, NC, aerially surveyed the area of southwestern Pamlico Sound encompassed by the restricted airspace R-5306A. The NMFS-SEFSC conducted 23 aerial surveys of the water beneath the restricted airspace, during which time no

dolphins were observed near BT-9 or BT-11, although a total of 296 bottlenose dolphins were observed in the waters under the restricted airspace (Goodman *et al*. 2004, 2005a, 2005b, 2005c).

4.1.1 Northern Migratory Coastal Stock

Among the coastal stocks, the migratory movements and spatial distribution of the Northern Migratory stock are the best understood (based on aerial survey data, tag-telemetry studies, photo-ID data and genetic studies). During summer months (July-September), this stock occupies coastal waters from the shoreline to approximately the 25-m isobaths between the Chesapeake Bay mouth and Long Island (CETAP 1982; Kenney 1990; Garrison *et al*. 2003). During winter months (January-March), the stock moves south to waters of North Carolina and occupies coastal waters from Cape Lookout, NC to the North Carolina/Virginia border (NMFS 2001).

During summer months, the degree of overlap between the Northern Migratory and the Southern Migratory stocks in coastal waters of northern North Carolina and Virginia is unknown. During winter months, the stock spatially overlaps with the NNCES stock. These complex seasonal spatial movements and the overlap of coastal and estuarine stocks in the waters of North Carolina greatly limit the ability to fully assess the mortality of each of these stocks (Waring *et al*. 2011).

4.1.2 Southern Migratory Coastal Stock

Of the coastal stocks, the migratory movements and spatial distribution of the Southern Migratory stock are most poorly understood. The limited data available supports the definition of a Southern Migratory stock of coastal morphotype bottlenose dolphins; however, there is a large amount of uncertainty in its spatial movements. The seasonal movements are best described by tag telemetry data. During the fall (October-December), this sock occupies waters of southern North Carolina (South of Cape Lookout) where it overlaps spatially with the SNCES stock in coastal waters. In winter months (January-March), the Southern Migratory stock moves as far south as northern Florida where it overlaps spatially with the South Carolina/Georgia and Northern Florida Coastal stocks. In spring (April-June), the stock moves north to waters of North Carolina where it overlaps with the SNCES stock and the NNCES stock. In summer months (July-September), the stock is presumed to occupy coastal waters north of Cape Lookout, NC, to the eastern shore of Virginia. It is possible that these animals also occur inside the Chesapeake Bay and in nearshore coastal waters where there is evidence that NNCES stock animals also occur (Waring *et al* 2011).

Genetic analyses (Rosel *et al*. 2009) and tagging studies demonstrate that the Northern Migratory stock is distinct from the potential Southern Migratory stock. Yet there is limited capability to demonstrate genetic differentiation of the Southern Migratory stock from other coastal and estuarine bottlenose dolphin stocks because the Southern Migratory stock overlaps spatially with at least one other stock of bottlenose dolphins throughout the year (Waring *et al*. 2011).

4.1.3 Northern North Carolina Estuarine System Stock

The Northern North Carolina Estuarine System stock is defined as animals that occupy estuarine waters of Pamlico Sound during summer months (July-August) (Waring *et al*. 2011). The estuarine waters of Pamlico Sound had previously been included in the abundance estimates and stock assessment reports for the Northern Migratory stock and the winter “mixed” North Carolina management unit of coastal bottlenose dolphins (Waring *et al*. 2007). Now they are recognized as a distinct stock based upon these differences in seasonal ranging patterns and stable isotope signatures (Waring *et al*. 2011).

During summer and fall months (July-October), the NNCES stock occupies waters of Pamlico Sound and nearshore coastal and estuarine waters of northern North Carolina to Virginia Beach. It likely overlaps with animals from the Southern Migratory stock in coastal waters during this period. In late fall and winter (November-March), the NNCES stock moves out of estuarine waters and occupies nearshore coastal waters between the New River and Cape Hatteras. The NNCES stock overlaps with the Northern Migratory stock during this period, particularly between Cape Lookout and Cape Hatteras. It appears that the region near Cape Lookout, NC, including Bogue Sound and Core Sound, is an area of overlap with the SNCES stock in late summer (Waring *et al*. 2011).

4.1.4 Southern North Carolina Estuarine System Stock

The Southern North Carolina Estuarine System stock is defined as animals occupying estuarine and nearshore coastal waters between the North Carolina/South Carolina border and the New River during winter months, and that do not undertake large-scale migratory movements (Waring *et al*. 2011). In prior stock assessment reports, the animals within this region were referred to as the "Southern North Carolina" coastal stock during summer months, and were part of the winter "mixed" North Carolina management unit of coastal bottlenose dolphins (Waring *et al*. 2009). They are now recognized as a distinct stock based upon differences in seasonal ranging patterns and genetic analysis (Waring *et al*. 2011).

During summer and fall months (July-October), the SNCES stock occupies estuarine and nearshore coastal waters (<3km from shore) between the North Carolina/South Carolina border and Core Sound. The stock likely overlaps with the NNCES stock in the northern portion of its range during late summer. From late fall through spring, the SNCES stock moves south to waters near Cape Fear. In coastal waters, it overlaps with the Southern Migratory stock during this period (Waring *et al*. 2011).

4.1.5 Density Estimates at the MCAS Cherry Point Range Complex

Aerial surveys conducted specifically for dolphins and turtles were flown in Pamlico and Core sounds from July 2004 to April 2006 (Goodman *et al*. 2007). From these surveys, Goodman *et al*. (2007) created density estimates for bottlenose dolphins in the western portion of Pamlico Sound (including the MCAS Cherry Point Range Complex) ranging from 0.0272/km^2 (0.0105/mi^2) in winter to 0.2158/km^2 (0.0833/mi^2) in autumn. Researchers noted animal counts from aerial surveys would likely be lower than counts from boat-based surveys because during aerial surveys there is a shorter amount of time for observers to make sightings, which would likely result in underestimated densities (Goodman *et al*. 2007). Accordingly, Goodman *et al*. incorporated correction factors for both animals residing at the surface but not sighted during the aerial survey and animals below the surface that were not sighted.

A "mark-and-sight" survey was conducted in the estuaries, bays and sounds of North Carolina by Read *et al*. (2003a) in summer 2000, which yielded a density of 0.183/km^2 (0.071/mi^2) (based on an estimate of 919 dolphins for the northern inshore waters divided by an estimated 5,015 km^2 [1,936 mi^2] survey area) for dolphins in North Carolina's inland waters. Although this density estimate is slightly lower than the highest density estimate from Goodman *et al*. (2007), it is likely more precise and incorporates less bias than estimates derived from aerial surveys and is therefore a more conservative and applicable estimate. Although the surveys by Read *et al*. were only conducted in the summer, there is a resident population in Pamlico Sound that does not likely leave the area; therefore, this density estimate can be applied year-round to the entire MCAS Cherry Point Range Complex.

5. Take Authorization Requested

Incidental Harassment Authorization (IHA) is requested for the harassment of marine mammals pursuant to § 101 (a)(5)(A-D) of the Marine Mammal Protection Act, as amended (16 U.S.C. 1317(a)(5)). The request is for the year 2013. The term *harassment*, as defined in §3 (18)(A) (16 U.S.C. 1362) of the MMPA, includes both Level A harassment (potential injury) and Level B harassment (potential disturbance).

The National Defense Authorization Act of Fiscal Year 2004 (Public Law 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with § 104(c)(3) [16 U.S.C. § 1374 (c)(3)]. In the case of a military readiness activity[1], such as the activities described in this request, the term *harassment* means:

> (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or
> (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B harassment].

Actions involving sound in the water include the potential to harass marine animals in the surrounding waters. The NMFS identifies the following activities as those with the greatest potential to harass marine mammals by noise: seismic air guns, ship and aircraft noise, high energy sonar, and explosive detonations.

Modeling results from explosive ordnance use at Brant Island (BT-9) predict MMPA – Level B exposure for up to 23 common bottlenose dolphins. Modeling results for direct strike by ordnance at BT-9 and BT-11 predict a risk of mortality less than 0.5 common bottlenose dolphin, and no MMPA – Level A or Level B exposures. There are no predicted harassment exposures for small boat maneuvers within the MCAS Cherry Point Range Complex. A summary of model results is displayed in Table 5-1. These estimates do not take into account the mitigation measures in Section 9. Given the implementation of those measures, the actual exposures would likely be lower than the anticipated amount.

Table 5-1: Predicted levels of potential take resulting from military readiness activities at BT-9 and BT-11 in 2013.

Activity	Level B (Behavioral + TTS)	Level A	Mortality
Explosive Ordnance Deployment	23.28926	0.25815104	0.02253716
Direct Strike by Inert and Explosive Ordnance Deployment	0	0	0.44541282
Small Boat Maneuvers	0	0	0

[1] The Fiscal Year 2004 National Defense Authorization Act adopted the definition of *military readiness activity* as set forth in Fiscal Year 2003 National Defense Authorization Act (Public Law 107-314). Public Law 107-314 §315(f) defined the term *military readiness activity* to include all training and operations of the Armed Forces that relate to combat; and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability of use.

6. Impacts of Activities on Marine Mammals

6.1 Estimating Marine Mammal Harassment from Explosive Ordnance

6.1.1 Development of Criteria for Impact

For explosions of ordnance planned for use at the MCAS Cherry Point Range Complex, in the absence of any mitigation or monitoring measures, there is a very small chance that a marine mammal could be injured or killed when exposed to the energy generated from an explosive force. Analysis of noise impacts is based on criteria and thresholds initially presented in Final Environmental Impact Statements (FEISs) for ship shock trials of the Seawolf submarine and the *Winston S. Churchill* (DDG 81), and subsequently adopted by the NMFS (DoN 1998, 2001; NOAA 1998).

Non-lethal injurious impacts (Level A harassment) are defined in those documents as tympanic membrane (TM) rupture and the onset of slight lung injury. The threshold for Level A harassment corresponds to a 50-percent rate of TM rupture, which can be stated in terms of an energy flux density (EFD) value of 205 dB re 1 μPa^2-s. TM rupture is well-correlated with permanent hearing impairment. Ketten (1998) indicates a 30-percent incidence of permanent threshold shift (PTS) at the same threshold.

The criteria for onset of slight lung injury were established using partial impulse because the impulse of an underwater blast wave was the parameter that governed damage during a study using mammals, not peak pressure or energy (Yelverton 1981). Goertner (1982) determined a way to calculate impulse values for injury at greater depths, known as the Goertner "modified" impulse pressure. Those values are valid only near the surface because as hydrostatic pressure increases with depth, organs like the lung, filled with air, compress. Therefore the "modified" impulse pressure thresholds vary from the shallow depth starting point as a function of depth.

The shallow depth starting points for calculation of the "modified" impulse pressures are mass-dependent values derived from empirical data for underwater blast injury (Yelverton 1981). During the calculations, the lowest impulse and body mass for which slight, and then extensive, lung injury found during a previous study were used to determine the positive impulse that may cause lung injury. The Goertner model is sensitive to mammal weight such that smaller masses have lower thresholds for positive impulse so injury and harassment will be predicted at greater distances from the source for them. Impulse thresholds of 13.0 and 31.0 psi-ms, found to cause slight and extensive injury in a dolphin calf, were used as thresholds in the analysis contained in this document.

Level B (non-injurious) harassment includes temporary (auditory) threshold shift (TTS), a slight, recoverable loss of hearing sensitivity. One criterion used for TTS, the total energy flux density of the signal, is a threshold of 182 dB re 1 μPa^2-s maximum EFD level in any 1/3-octave (OTO) band above 100 Hertz (Hz) for toothed whales (e.g., dolphins). A second criterion, a maximum allowable peak pressure of 23 psi, has recently been established by the NMFS to provide a more conservative range for TTS when the explosive or animal approaches the sea surface, in which case explosive energy is reduced, but the peak pressure is not. The NMFS applies the more conservative of these two.

For multiple successive explosions, the acoustic criterion for non-TTS behavioral disturbance is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The non-TTS threshold is derived following the approach of the *Churchill* FEIS for

the energy-based TTS threshold. The research on pure-tone exposures reported in Schlundt *et al*. (2000) and Finneran and Schlundt (2004) provided a threshold of 192 dB re 1 μPa^2-s as the lowest TTS value. This value for pure-tone exposures is modified for explosives by (a) interpreting it as an energy metric, (b) reducing it by 10 decibels (dB) to account for the time constant of the mammal ear, and (c) measuring the energy in OTO bands, the natural filter band of the ear. The resulting TTS threshold for explosives is 182 dB re 1 μPa^2-s in any OTO band. As reported by Schlundt *et al*. (2000) and Finneran and Schlundt (2004), instances of altered behavior in the pure-tone research generally began five dB lower than those causing TTS. The non-TTS threshold is therefore derived by subtracting 5 dB from the 182 dB re 1 μPa^2-s in any OTO band threshold, resulting in a 177 dB re 1 μPa^2-s (SEL) non-TTS behavioral disturbance threshold for multiple explosions.

Table 6-1: Explosive threshold levels.

Effect	Threshold Type	Threshold Level	MMPA Harassment Level
Onset Mortality	1% Mortal lung injury (positive impulse)	31 psi-ms	Mortality
Injurious Physiological	50% TM rupture	205 dB re 1 μPa^2-s	Level A
	Slight lung injury (positive impulse)	13 psi-ms	Level A
Non-injurious Physiological	TTS (peak OTO energy)	182 dB re 1 μPa^2-s	Level B
	TTS (peak pressure)	23 psi	Level B
Non-injurious Behavioral	Non-TTS threshold for multiple successive explosions (peak OTO energy)	177 dB re 1 μPa^2-s	Level B

Level A harassment criteria and thresholds under the MMPA are appropriate to apply as *harm* criteria and thresholds under the ESA. Analysis that predicts MMPA – Level A harassment will occur as a result of the proposed action would correspond to harm under the ESA. Level B harassment criteria and thresholds under the MMPA are appropriate to apply as harassment criteria and thresholds under the ESA.

Harm defined under ESA regulations is "…an act which actually kills or injures…" listed species (50 CFR 222.102). *Harassment* is an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

6.1.2 Explosive Acoustic Sources

Acoustic Characteristics of Explosives

The acoustic sources employed at the MCAS Cherry Point BT-9 target area are categorized as broadband explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band. Explosives are impulsive sources that produce a shock wave, which dictates additional pressure-related metrics (i.e., peak pressure and positive impulse).

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive weight accounts for the first two parameters.

NEW is a metric used to describe an explosive; the NEW is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For acoustic sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

For the BT-9 in-water target, the following types of ordnance were modeled: Bomb (GBU, BDU, MK), Hellfire Missile, 2.75-in Rocket HE, 5-in Rocket HE, TOW Missile, G911 Grenades, 30 mm HE, and 40 mm HE.

Animal Harassment Effects of Explosive Acoustic Sources

The harassments expected to result from explosive acoustic sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following. Let A represent the impact area (i.e., the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N explosives is merely NA regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of detonations spaced closely in time, while the energy metrics increase at a rate of $N^{1/2}$ (under spherical spreading loss only) or less.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. For all metrics, the cumulative impact area of an event consisting of N bursts is merely the product of the impact area of a single burst and the number of bursts, as would be the case if the bursts are sufficiently spaced in time or location as to insure that each burst is affecting a different set of marine wildlife.

All explosives are modeled as detonating at a 1.2-meter depth. This depth is the same depth used for the 2009 MCAS Cherry Point MMPA compliance report. The NEW for these sources are provided in Table 6-2. Included in this table are the peak OTO source level (SL) and the approximate frequency at which the peak occurs.

Table 6-2: Source weights and peak source levels.

Source Type	NEW (lbs)	Peak OTO SL (dB)	Center Frequency of Peak OTO (Hz)
Bomb (GDU, BDU, MK)	100	237	635
Hellfire Missile	34.4	232	800
5-in Rocket	15.0	229	1008
TOW Missile	13.6	228	1008
2.75-in Rocket	4.8	224	1270
G911 Grenade	0.5	214	2540
40 mm-HE(I)	0.1199	208	4032
30 mm-HE(I)	0.1019	207	4032

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breech the surface with some of the acoustic energy escaping the water column. The source levels presented in the table above have not been adjusted for possible venting nor does the subsequent analysis attempt to take this into account. However, for the source weights and depths involved this is not a significant over-simplification.

6.1.3 Environmental Characterization

Important Environmental Parameters for Estimating Animal Harassment

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular acoustic source activity. In turn, propagation loss as a function of range depends on a number of environmental parameters, including:

- Water depth,
- Sound speed variability throughout the water column,
- Bottom geo-acoustic properties, and
- Surface roughness, as determined by wind speed.

Due to the importance that propagation loss plays in Anti-Submarine Warfare, the Navy has invested heavily in measuring and modeling these environmental parameters. The result of this effort is a collection of global databases containing these environmental parameters, which are accepted as standards for Navy modeling efforts. Table 6-3 contains the version of the databases used in the modeling for this report.

Table 6-3: Navy standard databases used in modeling.

Parameter	Database	Version
Water Depth	Digital Bathymetry Data Base Variable Resolution	DBDBVR 6.0
Sound Speed	Generalized Digital Environmental Model	GDEM 3.0
Bottom Loss <1500 Hz	Low-Frequency Bottom Loss Database with Sediment Thickness	LFBL 11.1
Bottom Loss > 1000 Hz	High-Frequency Bottom Loss Database	HFBL 2.2
Ocean Sediment	Re-packed Bottom Sediment Type	BST 2.0
Wind Speed	Surface Marine Gridded Climatology Database	SMGC 2.0

The sound speed profile directs the sound propagation in the water column. The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. If the sound speed minimum occurs within the water column, more sound energy can travel further without suffering as much loss (ducted propagation). But if the sound speed minimum occurs at the surface or bottom, the propagating sound interacts more with these boundaries and may become attenuated more quickly. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled to demonstrate the extent of the difference.

Losses of propagating sound energy occur at the boundaries. The water-sediment boundary defined by the bathymetry can vary by a large amount. In a deep water environment, the interaction with the bottom may matter very little. In a shallow water environment the opposite is true and the properties of the sediment become very important. The sound propagates through the sediment, as well as being reflected by the interface. Soft (low density) sediment behaves more like water and the sound has relatively more transmission and relatively less reflection than a hard (high density) bottom or thin sediment.

The roughness of the boundary at the water surface depends on the wind speed. Average wind speed can vary seasonally, but could also be the result of local weather. A rough surface scatters the sound energy and increases the transmission loss. Boundary losses affect higher frequency sound energy much more than lower frequencies.

Characterizing the Acoustic Marine Environment

Each environment for modeling impact value is characterized by a fixed water depth, sound velocity profile, and bottom loss type. The bathymetry database is on a grid of variable resolution. In a deep water area, the modeling is done on a grid of depth intervals to capture water depth dependence. In a shallow water area with bathymetric features, the bathymetry values can be averaged over the area of interest.

The sound velocity profile database has a fixed spatial resolution storing temperature and salinity as a function of time and location. The low frequency bottom loss database is organized in provinces with a set of geo-acoustic parameters in each province. The high frequency bottom loss database is globally partitioned into nine classes. The area of interest can be characterized by the appropriate sound speed profile, set of low frequency bottom loss parameters, and high frequency bottom loss class. If the operating area falls across a province boundary, the modeling environment is partitioned into homogenous regions. Partitioning takes account of the fact that the lower frequency acoustic energy (below about 1,000 Hz) is secondary to the higher frequency acoustic energy.

In addition, seasonal variation is sampled by looking at summer and winter cases. The environmental characteristics affecting acoustic propagation that have seasonal variation are the sound speed profile and the wind speed.

ZOI volumes in the operating area are then computed using propagation loss estimates derived for the representative environment. Finally, a weighted average of the ZOI volumes is taken over all representative environments; the weighting factor is proportional to the geographic area spanned by the environmental province.

Description of the Brant Island (BT-9) Target Environment

As described in Section 3.1, BT-9 is in an extremely shallow area with a relatively flat bottom of sandy sediment. There is seasonal variation. For modeling efforts, environmental values were extracted from the Navy standard databases in a radius of 9.3 km (5.8 mi) around the center point (35°12'30"N, 76°26'40"W).

The Navy standard database for bathymetry has a resolution of 0.05 minutes in Pamlico Sound. Values for the bathymetry from the DBDBV in the extracted area were found between approximately 1 m and 8 m. A median depth of 5 m (rounded to the nearest meter) was used as the water depth in the modeling.

The sound speed profile in the area of interest is almost constant because of mixing in the shallow water. The Navy standard GDEM database provided a nearly-isospeed profile for the area. Seasonal changes were captured by modeling the propagation with a winter (February) profile of about 1502 meter per second (m/s) and a summer (August) profile of about 1538 m/s. Although the sound speed is isovelocity with less than 1 m/s of change in the water column, the database profile of the top five meters was used, rather than a single number.

In very shallow water, the bottom loss databases tend to revert to a generic sandy bottom. The sources modeled in the BT-9 area generate peak OTO source levels near 1,000 Hz. At that frequency, a sandy bottom tends to be a relatively low-loss bottom. (Note: This may lead to a somewhat conservative [or over-] estimate of the number of takes.)

The seasonal variability in wind speed was modeled as 12.25 knots in the summer and 13.61 knots in the winter.

6.1.4 Modeling Impact on Marine Mammals

Many underwater actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

In this analysis, estimating the number of animals that may be injured or otherwise harassed entailed the following steps:

- For the relevant environmental acoustic parameters, transmission loss (TL) estimates were computed, sampling the water column over the appropriate depth and range intervals. TL calculations were also made over non-overlapping, OTO bands for a wide range of frequencies.
- The accumulated energy within the waters where the source is "operating" was sampled over a volumetric grid. At each grid point, the received energy from each source emission was modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate metric was similarly modeled for each emission. The maximum value of that metric, over all emissions, was stored at each grid point.
- The impact volume for a given threshold was estimated by summing the incremental volumes represented by each grid point for which the appropriate metric exceeds that threshold.
- Finally, the number of harassments was estimated as the vector product of the animal density depth profile and the impact volume, and scaled by user-specifiable surface animal densities.

Appendix A describes in detail the process of computing impact volumes.

6.1.5 Impacts from Explosive Ordnance

Species densities are usually reported by marine biologists as animals per square kilometer, which is an area metric. This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector specifies the volume of water ensonified above the specified threshold in each depth interval. A corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth.

Impact volumes for all depth intervals are scaled by their respective depth densities, divided by their depth interval widths, summed over the entire water column, and finally converted to square kilometers to create impact areas. Since the impact volume vector is the volume of water at or above a given threshold per unit operation (e.g., per detonation, or clusters of munitions explosions), the final harassment count for each animal is the unit operation harassment count multiplied by the number of units deployed.

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

Model results predict explosive ordnance use at BT-9 at levels identified in Table 1-3 to produce exposure to sound levels that produce a non-injurious behavioral effect (between 177 and 182 dB SEL) and TTS (182 dB SEL or 23 psi) for up to 11 and 13 common bottlenose dolphin, respectively. The sum of these two effects results in a prediction of MMPA – Level B harassment for up to 23 dolphins. Predictions for MMPA – Level A harassment and mortality do not exceed one common bottlenose dolphin. Model results are displayed in Table 6-4.

Table 6-4: Predicted levels of potential take resulting from use of explosive ordnance at BT-9 in 2013.

Activity	Level B (Behavioral + TTS)	Behavioral (Between 177 and 182 dB SEL)	TTS	Level A	Mortality
Explosive Ordnance Deployment	23.28926	10.5821671	12.7070929	0.25815104	0.02253716

6.2 Impacts from Inert Ordnance

The potential threats to marine mammals from inert, or non-explosive, ordnance in the absence of conservation measures are noise and direct strike. Estimates of noise fields generated in the water by the impact of non-explosive ordnance indicate that the energy radiated is about 1 to 2 percent of the total kinetic energy of the impact. This energy level (and likely the peak pressure levels) is well below the impact threshold, even at a 1-m distance from the impact location. Therefore, the noise generated by the in-water impact of inert ordnance will not pose a risk to marine life.

The potential risk of a direct hit to an animal in the target area is estimated to be so low it is discountable. The MCAS Cherry Point Range Air Installation Compatible Use Zone study generated the surface area, or footprints, of weapon impact areas associated with air-to-ground ordnance delivery (USMC 2001b); statistically, a weapon

safety footprint describes the area needed to contain 99.99 percent of initial and ricochet impacts at the 95 percent confidence interval for each type of aircraft and the ordnance utilized at the BTs. Therefore, at both BT-9 and BT-11, the probability of deployed ordnance landing in the impact footprint is essentially 1.0. At BT-11 only 36 percent of the weapons footprint is over water, so the likelihood of a weapon striking an animal at that BT is 64 percent less. Water depths in Rattan Bay (the in-water portion of BT-11) range from 0.5 m (1.6 ft) to 3 m (10 ft), meaning that nearly the entire impact footprint in Rattan Bay is suitable for marine mammal use.

The probability of hitting a bottlenose dolphin at the BTs can be derived by:

Probability = (dolphin's dorsal surface area) x (density of dolphins)

Example: Probability for BT-9 = 1.425 m^2 x 0.183/km^2 = 2.61×10^{-7}

The estimate of the dorsal surface area of a bottlenose dolphin is assumed to be 1.425 square meter (m^2) (average length 2.85 m and average both width 0.5 m). Thus, using Read *et al*.'s (2003d) density estimates (0.183/km^2), the probability of a dolphin being hit in the waters of BT-9 is 2.61×10^{-7} and of BT-11 is 9.4×10^{-8}. Using the proposed levels of ordnance expenditures, excluding pyrotechnics, at each in-water BT (Tables 2-3 and 2-4) and taking into account that only 36 percent of ordnance deployed at BT-11 is over water, the estimated potential number of ordnance strikes on a marine mammal per year is estimated as 0.327472524 at BT-9 and 0.117940296 at BT-11 (Table 6-5). Pyrotechnics are not included in these analyses, because these types of ordnance do not strike land/surface with any velocity.

Table 6-5: Estimated potential number of strikes on common bottlenose dolphin by inert ordnance fired at the bombing targets in 2012.

Bombing Target	Ordnance Levels*	Probability of Striking a Dolphin/Ordnance Deployment	Estimated Number of Ordnance Strikes per Year
Brant Island (BT-9)	1,254,684	2.61×10^{-7}	0.327472524
Piney Island (BT-11)	1,254,684[‡]	9.4×10^{-8}	0.117940296

*Excludes pyrotechnics.
[‡]Calculations are based on 36% of this figure, accounting for the fact that only this percentage of ordnance is deployed over water at BT-11.

6.3 Impacts from Small Boat Maneuvers

The bottlenose dolphin is the most common marine mammal in the MCAS Cherry Point Range Complex. Small boats operating at high speeds have the potential to strike a bottlenose dolphin, though Wells and Scott (1999) note that in the busy boating waters of Sarasota Bay, Florida, bottlenose dolphins suffer few injuries from boat traffic. Still, boat and dolphin collisions can occur. Wells and Scott (1999) have documented a few injuries and note that mothers with calves and unhealthy dolphins may be particularly susceptible to injury by boat as their movements are limited. Wells and Scott (1999) also noted obvious propeller-caused injuries to dolphins in Sarasota Bay during times of high recreational usage and high speed powerboat races, though they did not correlate boat races or a particular boat speed with dolphin injury.

Small military boats operating within the MCAS Cherry Point Range Complex water ranges may travel at speeds up to 74 km per hour (40 knots). It still remains that the bottlenose dolphin is less susceptible to serious injury from vessels because of its swimming speed and its ability to maneuver around moving vessels. Based on the

limited number of small boat maneuvers, low concentrations of common bottlenose dolphins, and the low likelihood of serious injury, Level A harassment is unlikely to result from such activity.

Beyond direct vessel strikes, the presence of boats can result in disturbance, causing dolphins to alter their swimming patterns and behaviors. Impacts of such a disturbance are difficult to assess given the affinity this species has to bowride in front of moving vessels. Some researchers have noted changes in behavior of bottlenose dolphins at a distance of 100 m (328 ft) from moving vessels. These alterations include changes in direction, changes in breathing rate, and decreased spacing between dolphins traveling in the same group (Lemon *et al*. 2006). While the effects caused by the presence of small boat maneuvers cannot be directly assessed, there may be a short-term effect on dolphins at the location, but no adverse effect is expected.

6.4 Indirect Impacts

Explosive ordnance may have an impact not only on marine mammals but also on other species and the habitat at BT-9. Physical effects associated with pressure waves generated by underwater detonations of explosives might affect fish species within the vicinity of BT-9. In particular, the rapid oscillation between high- and low-pressure peaks has the potential to burst the swim bladders and other gas-containing organs of fishes (Keevin and Hempen 1997). Sub-lethal effects, such as changes in behavior, have been observed on several occasions as a result of noise produced by explosives (Wright 1982; National Resource Council 2003). The abundances of various fish species and invertebrates near the detonation point could be altered for a few hours before repopulation occurs. As a result, a short-term and localized effect on prey availability may be expected in the vicinity of BT-9, but no adverse effect is expected on the trophic regime or ecosystem at BT-9.

The likelihood of any permanent ecosystem impact at BT-11 due to inert ordnance use is extremely unlikely. Effects on habitat are further discussed in Section 8.

7. Impacts upon the Species or Stock

Approximately 2.5% of the North Carolina Coastal Estuarine stock could be exposed to Level B (Behavioral and TTS) harassment. Based upon the limited amount of take predicted as a result of military training activities within the MCAS Cherry Point Range Complex, there is no reason to anticipate any long-term harmful impacts to the species as a whole or the North Carolina Coastal Estuarine Stock.

8. Impacts on Subsistence Use

None of the marine mammal species discussed in this document is sought for subsistence use in the United States. Therefore, these activities would not effect on the availability of subsistence use species or stocks as identified in MMPA Section 101(a)(5)(A)(i).

9. Impacts to Marine Mammal Habitat and Habitat Restoration

Potential impacts to marine mammal habitat within the MCAS Cherry Point Range Complex have previously been evaluated during a Section 7 consultation with the NMFS (USMC 2001b) and were determined to be minimal (NMFS 2002). Delivery of explosive and inert ordnance may involve a temporary disturbance to the substrate (sediments) and a subsequent increase in localized turbidity, as may the actions of target replacement or routine equipment/system maintenance.

Natural fluctuations in turbidity are driven by rainfall, wind, tides, and season. It is difficult to predict the amount of disturbance that would occur immediately after ordnance hits the substrate. The amount of

sediment disturbance will be influenced by whether or not the ordnance hits the target first before hitting the substrate, as well as the orientation of the ordnance (i.e., whether it lands upright or on its side) upon impact with the sediments (USMC 2001b). The substrates at the bombing target sites are primarily soft sediments such as sand and mud, which should experience only minimal disturbance and quickly resettle. Impacts to the substrate are considered temporary and negligible with no adverse or long-term effects anticipated. Water quality studies of BT-9 and BT-11 compared samples taken directly following ordnance deployment with those taken from control sites, and found that turbidity levels at both sites were low and within North Carolina Division of Water Quality standards (Sirrine Environmental Consultants 1991). Impacts to turbidity caused by ordnance deployment are not likely to disturb the feeding or transiting behavior of bottlenose dolphins in the vicinity of the bombing targets as the species does not depend up vision for either behavior, and as turbidity changes caused by deployment of ordnance is within the range of acceptable levels.

Chemical by-products from use of explosive ordnance during training are considered to have negligible effects here, as they did during the shock trial of the *Winston S. Churchill* (DoN 2001). Initial concentrations of the chemical by-products of ordnance detonations are not hazardous to marine life (DoN 2001). Water quality parameters at BT-9 and BT-11 are all within the limits set by the North Carolina Water Quality Standards for Saltwater Classifications (for those parameters with standards) (Sirrine Environmental Consultants 1991). Neither elevated aluminum concentrations nor visual signs of chaff were detected in the water or sediment samples from the sampled areas (USMC 2001b).

While debris associated with ordnance delivery occurs at the bombing targets (e.g., parachutes, strands of chaff, ordnance remains), no reports of ingestion of debris have been reported nor have any stranded animals been reported with such contents in their stomachs (MCAS Cherry Point 2009). It is most likely that ordnance debris will sink to the bottom and become incorporated into the sediments, thus is not likely to be ingested by marine mammals.

Target establishment and maintenance occurs infrequently (i.e., every five years). MCAS Cherry Point personnel are required to ensure that new targets are free of environmental contaminants prior to placing them in the water for use. Small boat operations or target replacement activities may also occasionally result in temporary and infrequent sediment disturbance, resulting in effects on sediments and turbidity similar to those caused by ordnance deployment.

10. Impact of Marine Mammal Habitat Loss and Modification

As described in Section 9 above, habitat impacts on from military training and testing capabilities were not deemed significant for any species of wildlife that may occur within the MCAS Cherry Point Range Complex. Any modification of habitat would be of short duration and would not impact the availability of habitat within Pamlico Sound or estuarine areas for bottlenose dolphins.

11. Means of Effecting the Least Practicable Adverse Impact

11.1 Mitigation Measures

MCAS Cherry Point incorporates procedures into their operations which help to minimize, or mitigate, the potential adverse effects of activities at the Range Complex on marine mammals (USMC 2001b; NMFS 2002). Protective measures are, and will continue to be, implemented to ensure the least practicable adverse impacts to marine mammals, and in particular common bottlenose dolphins. As discussed in Section 4, bottlenose

dolphins in Pamlico Sound, to include the waters of the MCAS Cherry Point Range Complex, prefer habitats close to shore and have most often been sighted in waters with depths less than 2 m (6.6 ft) (Read *et al*. 2003b, 2003c, 2003d). Therefore, most protective measures will be tailored to focus on areas where this species is known to commonly occur. Adherence to protective measures listed below greatly diminishes the potential impacts on marine mammals:

- Visual Surveys: Range operators will conduct or direct visual surveys to monitor the target areas for unauthorized civilian vessels or persons and protected species pre- and post-exercise. They will use either (1) real-time passive acoustic monitoring via sonobuoy or hydrophones; (2) active acoustic detection; or (3) remotely operated, high-resolution cameras with night vision capabilities to identify animals at the surface or breaking the surface.
- Cold Pass: Pilots will perform a visual check, known as a *cold pass*, of the target area where they will fly low over the target (no ordnance delivered). The visual check serves to determine the presence or absence of unauthorized civilian vessels or persons and protected species. No ordnance may be delivered during the cold pass. The Range Controller may grant the aircrew a *first hot pass* (use of ordnance) after their visual check (see above) and the cold pass, as conditions warrant.
- Search and Rescue Aircraft Range Sweeps: MCAS Cherry Point personnel will conduct search and rescue sweeps with a HH-46D helicopter, known as PEDRO, weekday morning prior to the commencement of the day's range operations. The aircrew aboard PEDRO are trained in search and rescue and are experts at spotting objects in the water. The primary goal of the sweep is to ensure that the bombing target area is clear of unauthorized vessels or persons, but it also includes a visual inspection of the waters for protected species. Sweeps are flown at 30.5 to 91.4 m (100-300 ft) above the surface at speeds of 60 to 100 knots. The helicopter crews can communicate directly with range operators, allowing immediate notification if the target area is not clear.
- Small Boat Visual Checks: Operators of small boats will be knowledgeable of marine mammals, protected species, and visual clues related to the presence of marine mammals and protected species. All members of small boat crews shall be required to take the Marine Species Awareness Training maintained and promoted by the Department of the Navy.
- Closing Targets: Range operators will declare a target *foul* (i.e., close the target) if a protected species is either sighted within 3,000 ft of the bombing targets or sighted within Rattan Bay (BT-11). Exercises may not recommence until the animal(s) has moved outside of the target area.

Further descriptions of these mitigation activities can be found in the USMC Cherry Point Range Complex Marine Mammal Monitoring and Protected Species Plan (Appendix B) and the real-time acoustic monitoring pre-proposal (Appendix C).

11.2 Additional Measures Considered

Other mitigation alternatives considered during development of the protective measures but dismissed because of their negative impact to military readiness include:

- Time or seasonal restrictions: The MCAS Cherry Point Range Complex operates continuously and the common bottlenose dolphin population in Pamlico Sound is largely resident and the density is presumed constant throughout the year. Therefore, time and seasonal restrictions are of no benefit to the species, and are considered impracticable and unwarranted. Such restrictions would severely compromise training flexibility, which is an important asset to the Marine Corps as squadrons regularly rotate between deployments and training.
- Visual monitoring by boat or vessel: Visual monitoring of the impact area by boat or vessel would not be possible due to concerns for personnel safety. Persons or vessels are not permitted within danger zones or impact areas due to safety concerns.

12. Impacts on Subsistence Use in the Arctic

This section intentionally left blank as it is not applicable.

13. Monitoring and Reporting

As described in the previous section, the Marine Corps monitors the bombing targets for marine mammals when the MCAS Cherry Point Range Complex is operating. Range operators keep records of all protected species sightings, to include data on the number of animals, their location, the weather, and other ancillary information. MCAS Cherry Point is implementing an online data registry for marine mammal sighting reporting that employs Microsoft SharePoint as its platform. Range Management officials will use the registry site to input data on marine mammal sightings to include (1) location (either an approximate location or latitude and longitude); (2) the platform that sighted the animal; (3) date and time; (4) species; (5) number of animals; (6) the animals' direction of travel and/or behavior; and (7) weather. Monthly, the Environmental Affairs Department will pull data from the registry to monitor sightings and for data quality control. Data collected in this database will be included in the annual reporting to the National Marine Fisheries Service, as required by NMFS.

Any observation of stranded or injured marine mammals in the vicinity of the MCAS Cherry Point Range Complex will be immediately reported to the NMFS Marine Mammal Stranding Network. MCAS Cherry Point personnel are responsible for ensuring the MCAS Cherry Point Chain of Command and the Marine Corps Installation-East Command are notified of such observations.

14. Research Efforts

MCAS Cherry Point has made significant effort to improve the availability of data on the abundance and seasonal distribution of marine mammals in the vicinity of the MCAS Cherry Point Range Complex. Specifically, MCAS Cherry Point has funded surveys performed by Duke University researchers and provided financial support to augment surveys conducted by the NMFS Southeast Fisheries Science Center. Information and knowledge gained from the MCAS Cherry Point-funded research has contributed significantly to the understanding of bottlenose dolphin stocks, including their distribution and movement, in Pamlico Sound, NC.

The following are highlights of research on bottlenose dolphin that was wholly or partially funded by MCAS Cherry Point:

- Duke University researchers performed boat-based sighting surveys that targeted common bottlenose dolphin from July 2002 to July 2003. Their work also involved photo identification of the sighted dolphins, and compilation and cataloguing the IDs (Read *et al*. 2002, 2003b, 2003c, 2003d).
- Researchers with Duke University conducted acoustic monitoring studies of common bottlenose dolphin at BT-9 and BT-11. Since August 2005, two pop-up hydrophone buoys have been deployed for use at BT-9 and one has been deployed for use in Rattan Bay (BT-11) (Urian 2005a, 2005b).
- NMFS Southeast Fisheries Science Center researchers have conducted aerial surveys within the R-5306A restricted airspace, which encompasses portions of Pamlico and Core sounds (Goodman *et al*. 2005a, 2005b, 2005c, 2004). Previously access to this airspace had been restricted. Conducted over a 16-month period, the aerial surveys were designed to document abundance and seasonal distribution of sea turtles and marine mammals. The survey results were used to develop an index of abundance by season. Additionally, the aerial surveys were used to train MCAS Cherry Point personnel to be marine mammal observers—a skill which is employed during pre- and post-exercise visual checks.

MCAS Cherry Point has contracted Duke University to develop and test a real-time passive acoustic monitoring system that will allow automated detection of bottlenose dolphin whistles (Appendix C). The work has been

performed in two phases. Phase I was the development of an automated signal detector (a software program) to recognize the whistles of dolphins at BT-9 and BT-11. Phase II, currently in progress, is the assembly and deployment of a prototype real-time monitoring unit on one of the towers in the BT-9 range. The success of this effort will help direct future monitoring initiatives and activities within the MCAS Cherry Point Range Complex.

As funding becomes available and research opportunities arise, MCAS Cherry Point will continue to fund and participate in studies that will enhance the Marine Corps' understanding of marine mammals in Pamlico Sound.

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