Request for Rulemaking and Letters of Authorization

Under Section 101(a)(5)(A) of the Marine Mammal Protection Act

for the Take of Marine Mammals Incidental to Fisheries Research Activities

conducted by

NOAA Fisheries Southeast Fisheries Science Center

within the

Atlantic Ocean, Gulf of Mexico and Puerto Rico/Virgin Islands Ecosystems

April 2016

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1.0 A DETAILED DESCRIPTION OF THE SPECIFIC ACTIVITY OR CLASS OF ACTIVITIES THAT CAN BE EXPECTED TO RESULT IN INCIDENTAL TAKING OF MARINE MAMMALS

This application, submitted to the National Marine Fisheries Service (NMFS) Office of Protected Resources, requests rulemaking and subsequent letters of authorization under the Marine Mammal Protection Act (MMPA) of 1972 for the incidental take of marine mammals during fisheries surveys and related research activities conducted by the Southeast Fisheries Science Center (SEFSC), National Marine Fisheries Service (NMFS), NOAA. Management of certain protected species falls under the jurisdiction of the NMFS under the MMPA and Endangered Species Act (ESA). Mechanisms exist under both the ESA and MMPA to assess the effect of incidental takings and to authorize appropriate levels of take.

The Federal government has a trust responsibility to protect living marine resources in waters of the United States (U.S.), also referred to as federal waters. These waters generally lie 3-to-200 nautical miles from the shoreline [those waters 3-12 nautical miles offshore comprise territorial waters and those 12-to-200 nautical miles offshore comprise the Exclusive Economic Zone (EEZ)], except where other nations have adjacent territorial claims. The U.S. government has also entered into a number of international agreements and treaties related to the management of living marine resources in international waters outside of the U.S. EEZ (i.e., the high seas). To carry out its responsibilities over federal and international waters, Congress has enacted several statutes authorizing certain federal agencies to administer programs to manage and protect living marine resources. Among these federal agencies, NOAA has the primary responsibility for protecting marine finfish and shellfish species and their habitats. Within NOAA, the NMFS has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources.

The SEFSC conducts fisheries research within the Atlantic Research Area (ARA), the Gulf of Mexico Research Area (GOMRA), and the Caribbean Research Area (CRA). Within the area covered by this MMPA application to incidentally take marine mammals, NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA)[1], the Atlantic Coastal Fisheries Cooperative Management Act (ACA)[2], the Atlantic Striped Bass Conservation Act[3], the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA)[4], and the Atlantic Tuna Conventions Act (ATCA). Accomplishing the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In the NMFS Southeast Region, the entities involved include the Southeast Fisheries Science Center, NMFS Southeast Regional Office, NMFS Headquarters, the South Atlantic, Gulf of Mexico, and Caribbean Fisheries Management Councils, and international fisheries management organizations and commissions.

1.1 Fisheries Science Centers

Six Regional Fisheries Science Centers gather, direct and coordinate the collection of scientific information needed to inform fisheries management decisions[5]. Each Fisheries Science Center is a

1 16 U.S.C. §§ 1801-1884, (MSA 2007).

2 16 U.S.C. 5101-5109, (ACFCMA 1993).

3 16 U.S.C. 5151-5158, (ASBCA1984).

4 16 U.S.C. §1531 et seq.

5 The six Regional Fisheries Science Centers are: 1) Northeast, 2) Southeast, 3) Southwest, 4) Northwest, 5) Alaska, and 6) Pacific Islands.

distinct entity and is the scientific focal point for a particular region (Figure 1-1). The Southeast Fisheries Science Center (SEFSC) conducts research on living marine resources in marine and estuarine habitats of the Atlantic Ocean along the southeastern coast of the U.S., the Gulf of Mexico, and the Caribbean Sea, including marine waters offshore from Puerto Rico and the U.S. Virgin Islands (Figure 1-2). The SEFSC provides fisheries and ecosystem scientific information to resource managers to support Fisheries Management Councils and numerous other domestic and international fisheries management organizations operating throughout these regions. The SEFSC is headquartered in Miami, Florida and also includes six research facilities in: Beaufort, North Carolina; Panama City, Florida; Pascagoula, Mississippi; Stennis, Mississippi; Lafayette, Louisiana; and Galveston, Texas (Figure 1-3).

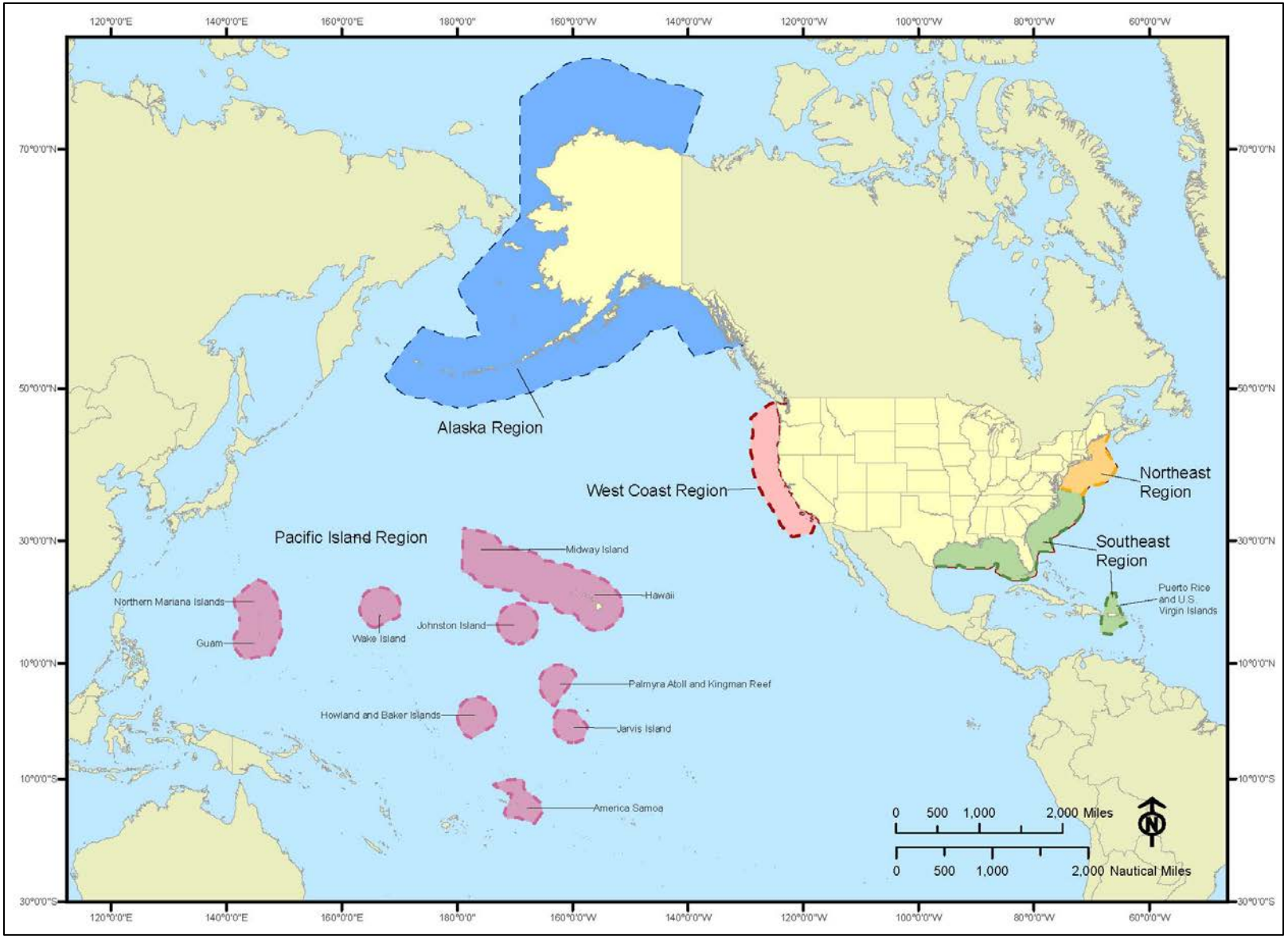

Figure 1-1 National Marine Fisheries Service regions

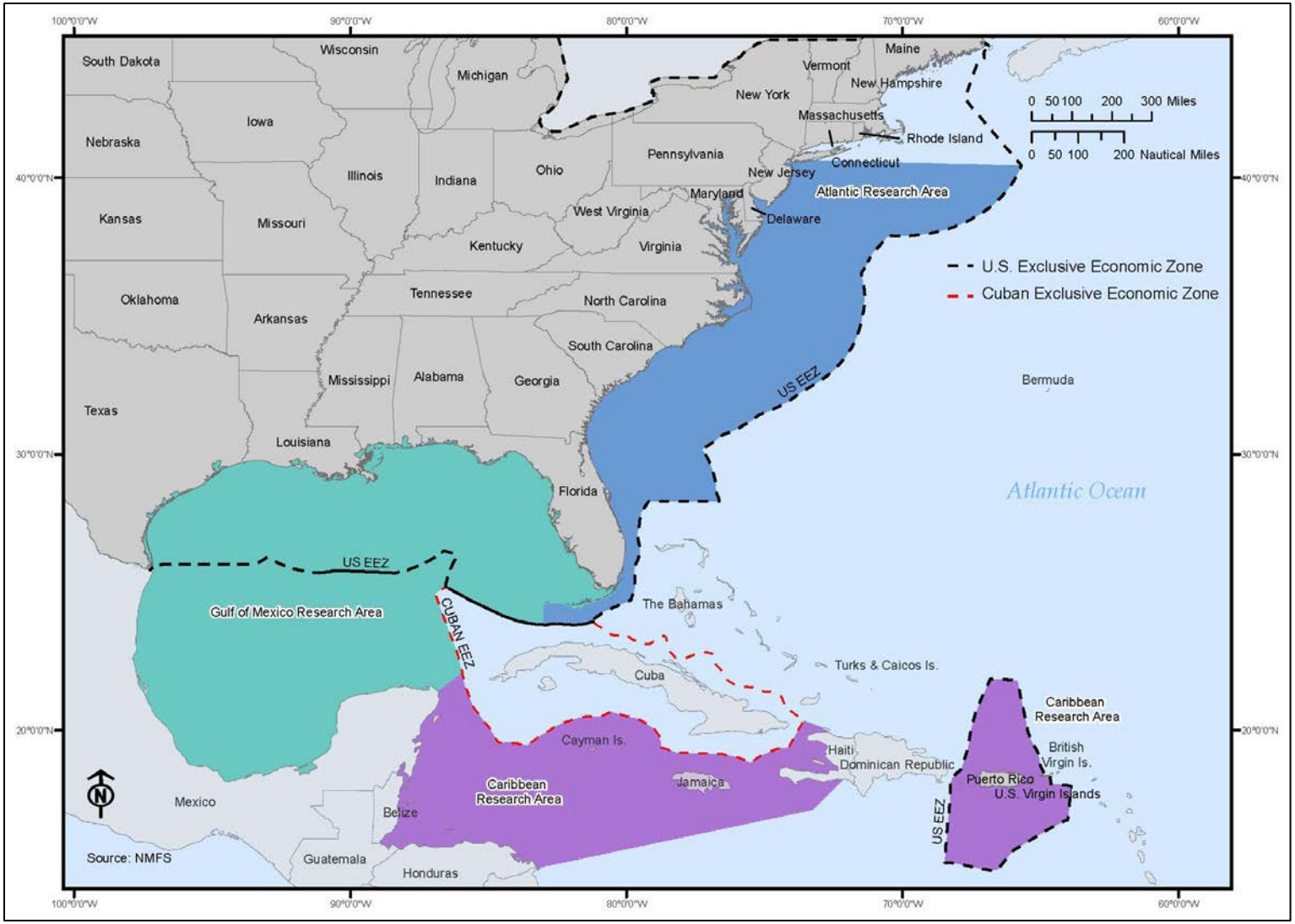

Figure 1-2 SEFSC research areas

All SEFSC fisheries research is conducted south of Virginia. The Marine Mammal and Ecosystem Assessment Survey extends north to New York and periodically outside of the U.S. EEZ in the GOMRA and CRA.

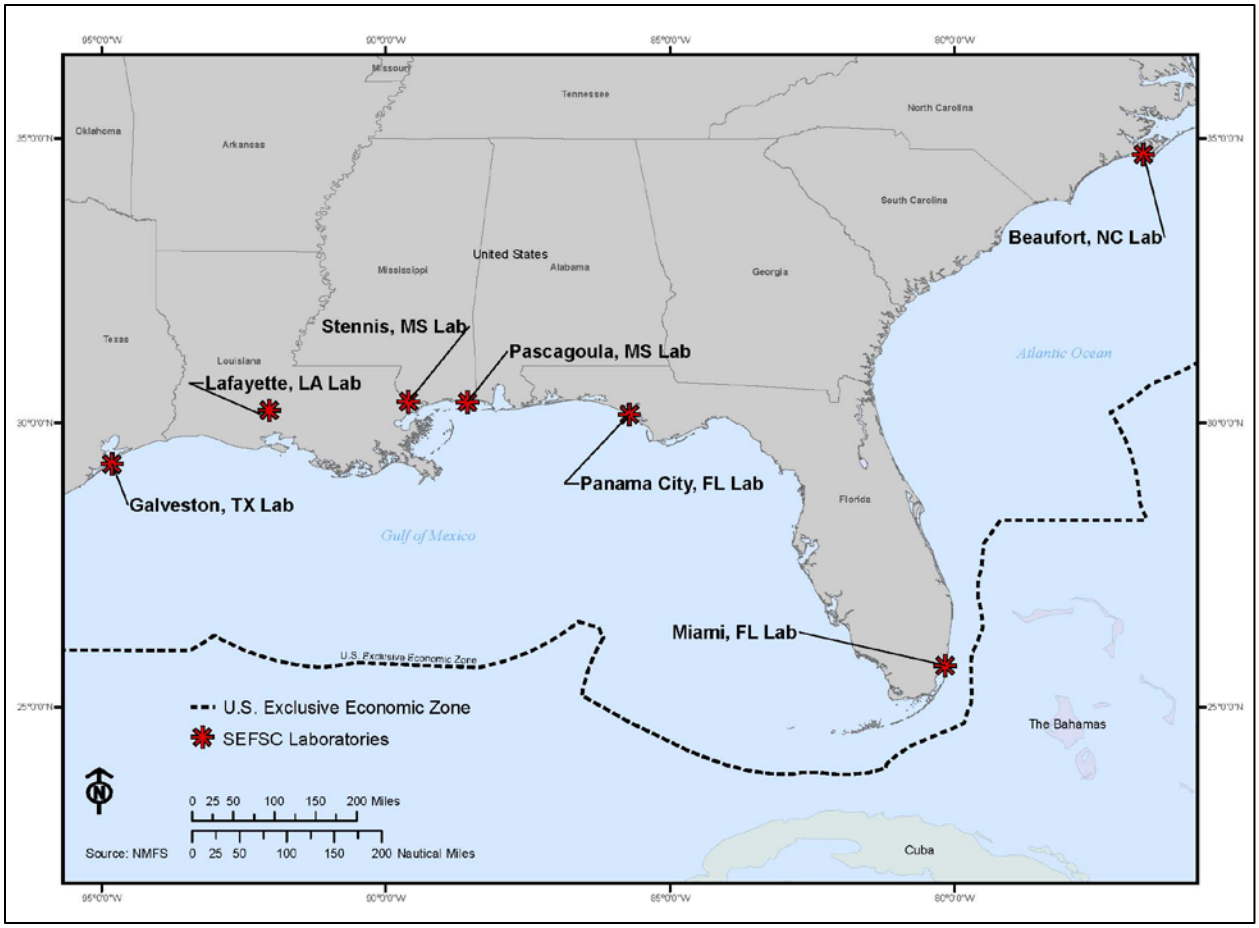

Figure 1-3 SEFSC offices and research facilities

1.2 Fisheries Management Councils

In order to encourage a collaborative approach to fisheries management, the MSA established the nation's eight Regional Fishery Management Councils. The councils, which include fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others, are designed to provide all resource users and managers a voice in the fisheries management process. Under the MSA, the councils are charged with developing Fishery Management Plans (FMPs) and management measures for the fisheries occurring within the EEZ adjacent to their constituent states. Data collected by fisheries science centers are often used to inform FMPs, as well as to inform other policies and decisions promulgated by the Fishery Management Councils. Such policies and decisions sometimes affect areas that span the jurisdictions of several Fisheries Management Councils (Figure 1-4), and make use of data provided by multiple fisheries science centers. Five councils are convened for the Atlantic Ocean (New England, Mid-Atlantic, South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils), incorporating members of their respective states and territories. The South Atlantic Fishery Management Council (SAFMC), the Gulf of Mexico Fishery Management Council (GMFMC), and the Caribbean Fishery Management Council (CFMC) rely primarily on the SEFSC for fisheries independent research data for development of stock assessment reports and other management purposes.

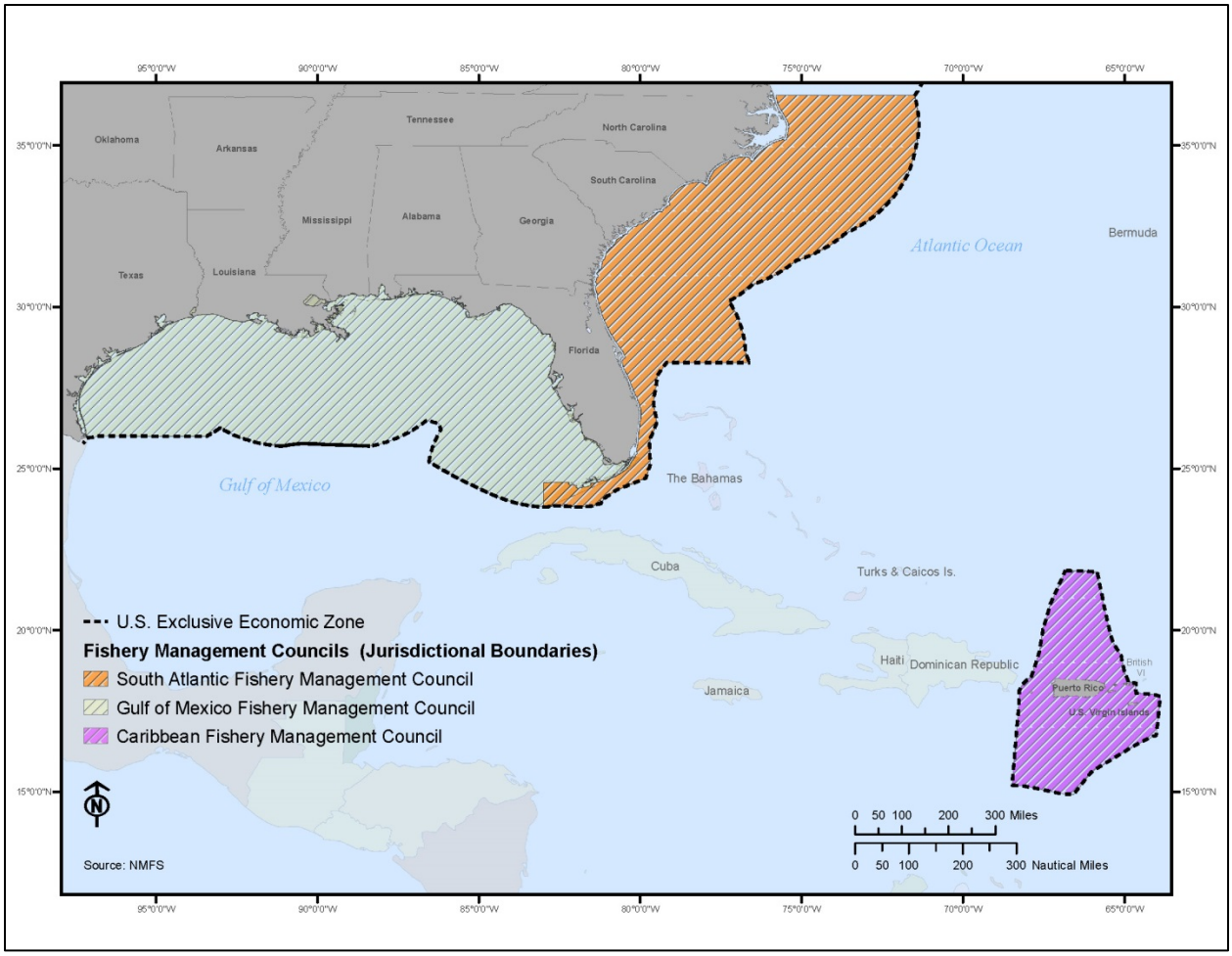

Figure 1-4 Fishery management council jurisdictional boundaries within the NMFS Southeast Region

1.3 Marine Fisheries Commissions

Three Interstate Marine Fisheries Commissions were chartered by Congress in recognition that fish do not adhere to political boundaries. Two of these cover species found in SEFSC research areas, the Atlantic States Marine Fisheries Commission (ASMFC) and the Gulf States Marine Fisheries Commission (GSMFC). The ASMFC was formed by the 15 Atlantic coast states in 1942. It exists to coordinate the conservation and management of nearshore fishery resources shared by member states through the creation of FMPs. For species that have significant fisheries in both state and federal waters (i.e., Atlantic herring, summer flounder, Spanish mackerel), the Commission works cooperatively with the Fishery Management Councils to develop FMPs.

1.4 International Fisheries Management Organizations

In addition to providing information to domestic fisheries management councils, the SEFSC provides scientific advice to support international fisheries councils, commissions, and conventions including the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the International Whaling Commission (IWC).

The ICCAT is an inter-governmental fishery organization responsible for the conservation of approximately 30 tunas and tuna-like species in the Atlantic Ocean and its adjacent seas. The organization was established in 1966 and formally entered into force in 1969. There are currently 48 contracting parties to ICCAT, including the U.S. Research undertaken through ICCAT includes biometry, ecology, and oceanography, with an emphasis on fishing impacts on stock abundance. ICCAT also compiles data on other fish species (mainly sharks) caught as bycatch during tuna fishing in the Convention area, and which are not investigated by other international fishery organizations. The Highly Migratory Species branch of the Sustainable Fisheries Division of the SEFSC participates in Atlantic billfish assessments under the auspices of the ICCAT. The SEFSC staff also coordinates the ICCAT Enhanced Research Program for billfish in the Western Atlantic Ocean and act as tagging coordinators for the U.S. delegation to ICCAT.

The IWC was established in 1946 under the International Convention for the Regulation of Whaling for the purpose of conserving whale populations and managing commercial and subsistence whaling efforts. In addition to its whaling management responsibilities, the IWC encourages, coordinates, funds, and publishes the results of scientific whale research. The IWC Scientific Committee includes many of the world's leading whale biologists and provides advice on management issues based on scientific research.

1.5 Role of Fisheries Research in Federal Fisheries Management

Fisheries managers use a variety of techniques to manage trust resources, a principal one being the development of FMPs. FMPs articulate fishery goals as well as the methods used to achieve those goals, and their development is specifically mandated under the MSA. The SEFSC provides scientific information and advice to assist with the development of FMPs prepared by the SAFMC, GMFMC, CFMC, and other agencies.

Through its Regional Fisheries Science Centers, NMFS conducts both *fisheries-dependent* and *fisheries-independent* research on the status of living marine resources and associated habitats, which aids in the development of FMPs. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals. NMFS role in these activities varies and generally can be described as follows:

- Fishery-independent research directed by SEFSC scientists and conducted on board NOAA-owned and operated vessels (white ships) or NOAA-chartered vessels.
- Fishery-independent research directed by cooperating research partners (other state and federal agencies, academic institutions, and independent researchers) conducted on board non-NOAA vessels. The SEFSC helps fund, staff, or analyze data for these types of research efforts.

In the Southeast Region, the SEFSC also conducts fisheries-dependent research through its Fisheries Statistics Division that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by the SEFSC but researchers collect data directly from the commercial and recreational vessels both in port (via interviews, logbooks, and portside sampling) and at sea (via the Pelagic Observer Program). Incidental takes of marine mammals that occur during commercial fishing are covered under the Magnuson-Steven Act. Only the fishery-independent research activities conducted or funded by the SEFSC are considered in this LOA.

1.6 SEFSC Research Programs

The SEFSC is the research arm of NMFS in the Southeast Region. The SEFSC plans, develops, and manages a multidisciplinary program of basic and applied research to:

- Generate the scientific information necessary for the conservation and management of the region's living marine resources.
- Inform management of the region's marine and anadromous fish and invertebrate populations to ensure they remain at sustainable and healthy levels. Responsibilities include maintaining healthy fish stocks for commercial and recreational fishing; sustaining ecosystem services; and coordinating with domestic and international organizations to implement fishery agreements and treaties.

SEFSC fishery-independent research efforts are divided among two research divisions that are tasked with different roles in collecting scientific information on living marine resources and the ecosystems that sustain them.

1.6.1 Protected Resources Division

The SEFSC's Protected Resources Division receives broad programmatic guidance from the goals and objectives of the NOAA Strategic Plan and the 2007 NOAA Strategic Plan for Fisheries Research to provide scientifically sound information and data sufficient to support ecosystem-based fishery conservation and management, recover and maintain protected species populations, and reduce conflicts that involve protected species. SEFSC scientists conduct research and provide scientific and technical advice to local, state, and federal management organizations, including Fishery Management Councils and the National Marine Sanctuary Program.

The Protected Resources Division develops, coordinates, and monitors marine mammals, sea turtles, early life history dynamics (fish), reef fish (Fisheries Assessment, Monitoring, and Ecology [FAME] Unit), coral (Benthic Ecosystems Assessment Research [BEAR] Unit), and the Ecosystem Investigations Unit. The Division manages research and assessment programs for marine mammals, sea turtles, and other protected marine species to meet agency responsibilities under the MMPA, ESA, and MSA, including monitoring and coordinating data collection from stranded protected species. It also manages biodiversity research programs related to marine community assemblages and management, rebuilding over-utilized and depleted fisheries resources, protecting key habitats, and maintaining marine diversity through, among other things, marine reserves, and sanctuaries.

The research focus of the Protected Resources Division includes marine protected areas, coral reef ecosystems, essential fish habitat, habitat restoration, biological research to support stock assessments and management decisions, and fishery-independent assessments of the status of exploited and non-exploited species with emphasis on non-destructive technology.

1.6.2 Sustainable Fisheries Division

The Sustainable Fisheries Division conducts research to determine the distribution and abundance of living marine resources managed under the MSA and the ATCA. Fishery dependent and independent data are used to produce catch, effort, and life history information; estimate the current status of fishery stocks; provide assessment results to fishery management organizations; and to advise fishery management organizations on potential outcomes of implementing future fishery management options.

The Sustainable Fisheries Division includes the Highly Migratory Species (HMS) Branch and the Gulf of Mexico and Caribbean Species Branch. The HMS Branch is further divided into the HMS Fisheries Assessment Unit and the HMS Biology Unit. The Gulf of Mexico and Caribbean Species Branch includes the Gulf and Caribbean Fisheries Assessments Unit.

1.7 SEFSC Fisheries and Ecosystem Research Activities

The SEFSC conducts fisheries research and funds fisheries research conducted by its research partners that may incidentally take marine mammals. Detailed information describing the time of year projects are conducted, the regions of operations, the gear used, and methodological details of those fisheries research projects anticipated to be conducted for the foreseeable future is presented in Table 1.1. The SEFSC is requesting rulemaking and subsequent Letters of Authorization for these proposed activities. Additional information and detailed descriptions of scientific gears, instruments, and vessels used are contained in Appendix A. Section 11 includes gear-specific descriptions of mitigation measures used during research to minimize risk of marine mammal interactions. In general, all SEFSC surveys are set in an ecological context. That is, the SEFSC conducts concurrent hydrographic, oceanographic, and meteorological sampling in addition to the marine resource surveys. The SEFSC anticipates that these long-term surveys and other fisheries and ecosystem research activities are likely to continue during the next five years, although not necessarily every year.

Table 1-1 Summary description of fisheries and ecosystem research activities conducted or funded by the SEFSC in the proposed action.

See Section 11 for gear-specific descriptions of mitigation measures used to reduce impacts on marine mammals. See Appendix A for descriptions of the different gear types and vessels greater than 65 ft length. Vessels are described under the U.S. Coast Guard (USCG) classification system: USCG Class A: ≤ 16 ft; USCG Class I: 16 to <26 ft; USCG Class II: 26 to <40 ft; USCG Class III: 40 to 65 ft; USCG Small Research Vessel (>65 ft. and <300 gross tons); USCG Research Vessel (>65 ft. and >300 gross tons). Appendix B in the SEFSC Draft Programmatic Environmental Assessment includes figures showing the spatial/temporal distribution of fishing gears used during SEFSC research.

Abbreviations used in the table:	
ACFCMA	Atlantic Coastal Fisheries Cooperative Management Act
ADCP	Acoustic Doppler Current Profiler
BRD	Bycatch Reduction Device
CTD	Conductivity Temperature Depth
DAS	days at sea
EEZ	Exclusive Economic Zone
ft	foot, feet
Gag	Juvenile Grouper
GOM	Gulf of Mexico
GULFSPAN	Gulf of Mexico Shark Pupping & Nursery
HMS	Highly Migratory Species
hr(s)	hour(s)
IBBEAM	Integrated Biscayne Bay Ecological Assessment and Monitoring
in	inch
IJA	Inter-jurisdictional Fisheries Act
kg	kilograms
kHz	kilohertz
kts	knots
L	liter
m	meter
mm	millimeter
m^2	square meter
MARMAP	Marine Resources Monitoring, Assessment, and Prediction
MPA	Marine Protected Area
mi	miles
min	minutes
mm	millimeter
NA	Not Available or Not Applicable
nm	nautical miles
RecFIN	Recreational Fisheries Information Network
ROV	Remotely Operated Vehicle
R/V	Research Vessel
SEFIS	Southeast Fishery-Independent Survey
SEAMAP	Southeast Area Monitoring and Assessment Program
TBD	to be determined
TED	Turtle Excluder Device
U.S.	United States
v	volt
yr	year
~	approximately
Cooperating research partners:	
ADCNR	Alabama Department of Conservation & Natural Resources
FFWCC	Florida Fish & Wildlife Conservation Commission
FSU/CML	Florida State University Coastal & Marine Laboratory
GDNR	Georgia Department of Natural Resources
LDWF	Louisiana Department of Wildlife & Fisheries
MDMR	Mississippi Department of Marine Resources
MML	Mote Marine Laboratory
NCDENR	North Carolina Department of Environmental and Natural Resources
NOAA	National Oceanic and Atmospheric Administration
PR-DNER	Puerto Rico Department of Natural and Environmental Resources
SCDNR	South Carolina Department of Natural Resources
SEFSC	Southeast Fisheries Science Center
TPWD	Texas Parks & Wildlife Department
USA/DISL	University of South Alabama Dauphin Island Sea Laboratory
USFWS	United States Fish and Wildlife Service
USM/GCRL	University of Southern Mississippi Gulf Coast Research Lab
USCG	United States Coast Guard
USVI-DFW	United States Virgin Islands - Division of Fish and Wildlife (Department of Planning and Natural Resources)
UWF	University of West Florida
VIMS	Virginia Institute of Marine Science

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
GULF OF MEXICO RESEARCH AREA							
Surveys Using Gillnet Gear							
HMS–GOM Shark Pupping & Nursery Survey (GULFSPAN), (SEFSC, USM/GCRL, UWF, FSU/CML)	SEFSC component: Midwater and surface gillnet survey designed to monitor juvenile shark populations in the coastal GOM. The intent of this survey is to support stock assessment and continue to describe and refine shark essential fish habitat as mandated by the MSA. The survey is led by the NOAA Fisheries Panama City Laboratory, SEFSC, and has Gulf Coast research institution collaborators in FL and MS.	SEFSC - FL Panhandle in St. Andrew Bay and St. Joseph Bay, 1-10 m depths	Annual Apr-Oct, 30 DAS, (approximately 4 days/month), daytime operations only	USCG Class I: R/V *Mokarran*, R/V *Pristis*	Set gillnet	A single gillnet, 600 feet long and 10 feet deep, consisting of six 100-foot long panels ranging in stretched mesh sizes from 3 to 5.5 inches in 0.5 in increments. The same size net is used for sampling in all areas by all institutions. The six panels are strung together and fished as a single gear (i.e., set); one end of each set is anchored and the opposite end is tied to the boat via a bridle. In depths greater than 10 feet (the depth of the net), the gear acts like a midwater gillnet - the lead line weighs enough to hold the floats under the surface of the water but not enough to sink the net completely. In depths less than 10 feet, the gear fishes the entire water column. Duration: 30-60 min., consistently monitored	SEFSC – 16-20 sets/month, up to 120 sets total
	Survey component conducted by USM/GCRL.	Mississippi Sound, 1-9 m depths	Annual Apr-Oct, 8 DAS (1/month), daytime operations only	USCG Class I: Small vessel	Set gillnet	Same as SEFSC gear	3 sets/month 21 sets total
	Survey component conducted by UWF.	Perdido Bay, Pensacola Bay, Choctawhatchee Bay, and Santa Rosa Sound, 1.5-6 m depths	Annual May-Sep, 10 DAS (2/month), daytime operations only	USCG Class I: State vessel	Set gillnet	Same as SEFSC gear except soak duration is 30 min	10 sets/month 50 sets total
	Survey component conducted by FSU/CML.	Northwest FL state waters, 0.7-7 m depths A) Apalachee Bay B) Alligator Pt.-Anclote Keys	Annual A) Jan-Dec, 12 DAS (1/month) B) June & July, 20 DAS, daytime operations only	USCG Class I: R/V *Naucrates*	Set gillnet	Same as SEFSC gear	74 sets/yr total A) 24 sets B) 50 sets
					Bottom longline	Mainline length: ~1500 m (monofilament); 100 gangions/set; Hook size and type: 25 of each hook size 10/0, 12/0, 14/0, 16/0; Soak time: 1 hr.	74 sets/yr total A) 24 total B) 50 total
	Survey component conducted by MML	State waters of southwest FL within Pine Island Sound in the Charlotte Harbor estuary. Depth ranges 0.6-4.6 m depth.	Annual May-Sep, 15 DAS, daytime operations only	USCG Class I: State vessel	Set gillnet	Two types of gillnets are used: 1) Same net as SEFSC; and 2) monofilament 4.5" stretch mesh, 1200 ft x 10 ft. Both nets are anchored with two 25 lb Danforth anchors; surface floats are attached to the float line at 70 ft intervals terminating with a high flyer at each end.	16 sets/month (within two designated 10 km^2 grids), 80 sets total
IJA Coastal Finfish Gillnet Survey, (MDMR)	To sample and monitor finfish populations in MS waters for management purposes.	Mississippi Sound and estuaries; 0.2-2 m depths	Annual, Jan-Dec, 24 DAS, daytime operations only	USCG Class I: Small vessel	Sinking gillnet, shallow deployment	Single 750 ft long x 6 ft deep gillnet consisting of five 150 ft panels, each with stretch-mesh sizes 2, 2½, 3, 3 ½, and 4 inches, respectively; Duration: 1 hr	8 sets/month, 96 sets total
Smalltooth Sawfish Abundance Survey, (SEFSC)	The completion of the Smalltooth Sawfish Recovery Plan in 2009 brought a new phase of conservation for the U.S. Distinct Population Segment of the smalltooth sawfish, *Prisits pectinata*. This survey monitors the abundance of juvenile smalltooth sawfish in coastal southwest FL, one of the most important regions for juveniles.	Ten Thousand Islands, FL backcountry region, including areas in Everglades National Park and Ten Thousand Island National Wildlife Refuge in 0.2-1.0 m depths.	Annual, Mar-Nov, 56 DAS (6-7 DAS/trip), daytime operations only	USCG Class I: R/V *Pristis*	Set gillnet, shallow deployment	Gillnets are 5 ft deep and either 100 or 200 ft long with mesh sizes either 3 or 4 inches, fished in depths of 0.2-1.0 m. Nets are anchored at both ends, and marked with surface buoys; only one net is fished at a time Duration: 1-4 hrs Permit ESA-17787 outlines that nets are set close to or over shallow muddy mangrove lined shorelines. Nets must be checked every 30 minutes or immediately if any animal (sawfish or bycatch) is observed in the gear.	~20 sets/month, 180-200 sets total

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
Surveys Using Longline Gear							
Pelagic Longline Survey-GOM, (SEFSC) (See also effort conducted in the ARA)	This survey targets pelagic shark and finfish species, results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks on pelagic longline gear, measuring, attaching various tags, and releasing them alive. Random survey site selection based on significant oceanic (Gulf Stream or loop currents), or bathymetric features (continental shelf edge). Fin fish are sampled for otoliths and gonads for biological information.	U.S. GOM	Intermittent, Feb-May, 30 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Oregon II*	Pelagic longline	Mainline length: 5 nm (4.0 mm diameter, 454 kg test monofilament); 100 gangions/set (2.0 mm diameter, 179 kg test); Hook size and type: 18/0 non-offset steel, 0.5 m length multi-strand leader (364 kg test), 50 bullet floats. Bait: Atlantic mackerel; Soak Time: 3 hr.	100-125 sets
					CTD profiler	Duration: 10-20 min	100-125 casts
Shark and Red Snapper Bottom Longline Survey-GOM, (SEFSC) (See also effort conducted in the ARA)	This Gulf-wide survey targets shark and reef fish species, results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks on longline gear, measuring, attaching various tags, and releasing them alive. Fin fish are sampled for otoliths and gonads for biological information.	Randomly selected sites from FL to Brownsville, TX between bottom depths 9 - 366 m	Annually, July-Sep, 60 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Oregon II*, R/V *Gordon Gunter*; USCG Small R/V: R/V *Caretta*, R/V *Gandy*	Bottom longline	Mainline length: 1 nm (4.0 mm diameter, 454 kg test monofilament); 100 gangions/set (3.0 mm diameter, 332 kg test monofilament); Hook size and type: 15/0 circle hook. Bait: Atlantic mackerel; Soak Time: 1 hr.	175 sets
					CTD profiler and rosette water sampler	Duration: 5-15 min	175 casts
					Neuston and bongo effort if needed to augment SEAMAP plankton objectives	Neuston net: 1 x 2 m opening with 0.505 or 0.947 mm mesh; Tow speed: 1-2 kts Bongo towing frame consists of two cylindrical nets, each 61 cm in diameter, fine mesh nets (0.202 or 0.335 mm).	0-20 tows
SEAMAP – GOM Bottom Longline Survey, (ADCNR, USM-GCRL, LDWF, TPWD)	These surveys target inshore shark and fin fish species in state waters of AL, MS, LA, and TX. Surveys follow the same basic protocols but are conducted by state agencies and institutions. Results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about fish biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks and finfish on longline gear, measuring, attaching various tags (if the animal is in good condition), and releasing them alive. Fin fish are sampled for hard parts for biological information.	AL – MS Sound, Mobile Bay, and near Dauphin Island MS – MS Sound, south of the MS Barrier Islands, Chandeleur, and Breton Sound, and the area east of the Chandeleur Islands. LA – LA waters west of the MS River TX – near Aransas Pass and Bolivar Roads Ship Channel	Annually, Apr-May, June-July, Aug-Sep; AL – 8 DAS, day operations only MS – 16 DAS, day operations only LA – 24 DAS, day operations only TX – 10 DAS, day operations only	USCG Class III: R/V *E.O. Wilson*, R/V *Alabama Discovery* , R/V *Defender I*, R/V *Tom McIlwain*, R/V *Nueces*, R/V *SanJacinto;* USCG R/V: R/V *Blazing Seven*	Bottom longline	Mainline length: one nm (4.0 mm diameter, 454 kg test monofilament); 100 gangions/set (3.0 mm diameter, 332 kg test monofilament); Hook size and type: 15/0 circle hook. Bait: Atlantic mackerel; Soak Time: 1 hr.	AL – 32 sets MS – 40 LA – 98 TX – 20
					CTD Profiler	Duration: 5-15 min	AL – 32 casts LA – 40
					Water quality and chemistry (YSI instruments, Niskin bottles, turbidity meter)	Duration: 5-15 min	MS – 40 casts TX – 20
Surveys Using Trawl Gear							
IJA Biloxi Bay Beam Trawl Survey, (MDMR)	Sample post-larval and juvenile fish and invertebrate species.	MS state waters in Biloxi Bay, 1-5 ft depths	Annually, Jan-Dec, 25 DAS, day operations only	USCG Class I: R/V *Grav I*, R/V *Grav II*, R/V *Grav IV*	Modified beam trawl	Net size: 5 ft wide beam trawl pulled by hand from small vessel; Duration: ~20 min at target depth	11 trawls/month, 132 trawls total

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
IJA Inshore Finfish Trawl Survey, (MDMR)	To sample and monitor inshore finfish for management purposes.	MS state waters from Biloxi Back Bay, to approximately 2 miles south of the barrier islands outside of Dog Keys Pass, 5-25 ft depths	Annually, Jan-Dec, 12 DAS, day operations only	USCG Class I: small vessel R/V *Geoship*,	Otter trawl	Net size: 16 ft otter trawl (¾ in stretch nylon multifilament mesh, with a ¼ in mesh cod end); Tow speed 2.5 kts Duration: 10 min at target depth	72 trawls
IJA Open Bay Shellfish Trawl Survey, (TPWD)	Resource assessment survey to determine the status of shellfish populations for better management and harvest in coastal waters. A total of 20 samples are randomly selected and collected each month in four bay systems and 10 samples are collected each month in the lower Laguna Madre. All samples are collected within the bay systems using 20 ft trawls towed for 10 minutes.	TX state waters in Galveston, Matagorda, Aransas, and Corpus Christi Bays and the lower Laguna Madre, 3-30 ft depths	Annually, Jan-Dec, 120 DAS, day operations only	USCG Class I: small vessel USCG Class II: R/V *Trinity Bay*, R/V *Copano Bay*, R/V *RJ Kemp*	Otter trawl	Net size: 20-ft otter shrimp trawl (1½-inch-stretch nylon multifilament mesh), with 48-inch-long and 20-inch-wide trawl doors, constructed of ½-inch plywood with angle iron framework and iron runners; Tow speed 2.5 kts Duration: 10 min at target depth	90 trawls/month, 1080 trawls total
					Water quality and chemistry (YSI instruments, Niskin bottles, turbidity meter)	Duration: 5-15 min	
Oceanic Deep-water Trawl – GOM, (SEFSC)	Survey is conducted to sample mid-water (500-800 m) prey of marine mammals. Conducted in conjunction with Marine Mammal and Ecosystem Assessment Survey-GOM.	U.S. GOM waters >500 m deep	Intermittent due to funding, 20 DAS, 24 hour operations, *conducted in 2009 & 2010 and in the future as funding allows.	USCG R/V: R/V *Gunter*, R/V *Pisces*	High Speed Midwater Trawl, Aleutian Wing Trawl	>10 m opening, 2-3 meter doors, towed at 500-800 m Tow speed: 2-3 knots Duration: 1-3 hours at target depth	60 trawls (2-3 per day)
					CTD profiler and rosette water sampler	Duration: 5-15 min	60 casts Tow speed: 0 Duration: 60-90 min
St. Andrew Bay Juvenile Reef Fish Trawl Survey, (SEFSC)	Examine the variation of snapper and grouper recruitment to seagrass beds in St. Andrew Bay, FL. Benthic trawling is conducted annually from spring through fall to assess changes in snapper and grouper densities over time at four locations within the bay. Targeted species include: lane snapper, gray snapper, and gag grouper and occasionally, red grouper. All fish caught are measured and then released alive. This research is used by the GMFMC to provide early life history information for gag grouper stock assessments, and demonstrates the value of seagrasses as essential fish habitat.	St. Andrew Bay, FL, up to 2 m depths	Annually, May-Nov, 28 DAS, day operations only, (one day/week)	USCG Class I: Boston Whaler	Benthic Trawl	Net size: 1 m wide x 25 cm high metal frame with 2 mm mesh bag; Tow speed: 3.1 kts Duration: 30 sec (measured 50 m distance)	13 trawls per week, 24 weeks, 312 trawls total
Small Pelagics Trawl Survey, (SEFSC)	A resource assessment survey to complement the Fall Shrimp/Groundfish survey, and to monitor the abundance and distribution of small pelagics (scad, herring, butterfish, etc.) in the GOM.	U.S. GOM in depths of 50-500 m	Annually, Oct-Nov, 40 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Gordon Gunter*, R/V *Pisces*	High-opening bottom trawl	Net size: 90 ft high opening, 2-seam, bottom trawl with 2.8 m^2 steel "V" doors; Tow speed: 3.0 kts Duration: 30 min at target depth	150-200 trawls
					Bongo net	Tow speed: 0 Duration: 5-15 min	40-50 tows
					Neuston net	Tow speed: 1-2 kts Duration: 10 min	40-50 tows
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
					ADCP	333 kHz	Continuous
					CTD profiler and rosette water sampler	Duration: 8-20 min	250 casts
SEAMAP-GOM Shrimp/ Groundfish Trawl Survey, (SEFSC, FFWCC, ADCNR, USM/GCRL, LDWF)	A resource assessment survey to monitor the abundance and distribution of benthic fauna in the U.S. GOM in state and federal waters at depths of 30-360 ft. The SEFSC and cooperating partner agencies from the four Gulf Coast states conduct the survey using consistent protocols, although there are some differences in gears and oceanographic instruments used. Sample sites are selected to complement the efforts of cooperating partners. Sampling occurs during day and night hours.	U.S. GOM from FL to Mexico in depths of 30-360 ft	Annually, summer (June & July) and fall (Oct-Nov), effort evenly divided between seasons unless noted; all surveys have 24 hour operations-set/haul anytime day or night; SEFSC – 80 DAS FL – 20 DAS (summer only) AL – 6 DAS MS – 10 DAS LA – 10 DAS	USCG Class II: R/V *Trinity Bay*, R/V *Copano Bay*, R/V *RJ Kemp* USCG Class III: R/V *A.E. Verrill*, R/V *Alabama Discovery*, R/V *Sabine Lake*, R/V *Nueces*, R/V *San Jacinto*, R/V *San Antonio*, R/V *Matagorda Bay* USCG R/V: R/V *Oregon II*, R/V *Tommy Munro*, R/V *Weatherbird II*, R/V *Pelican*, R/V *Blazing Seven* R/V *Point Sur*	Otter trawl	Net size: 42-ft shrimp (otter) trawl (1½-inch-stretch nylon multifilament mesh) with 8 ft by 40 in wooden doors and chain brackets. Tow speed: 2.5 kts Duration: 30 min at target depth	Effort evenly divided between seasons unless noted. SEFSC - 345 trawls (summer), 325 (fall) FL – 160 (summer only) AL – 16-24 MS – 60 LA – 50
					Bongo net	Tow speed: 0 Duration: 5-15 min	SEFSC – 110 tows (summer), 75 (fall) LA – 14 MS - 12
					Neuston net	Tow speed: 1-2 kts Duration: 10 min	SEFSC – 115 tows (summer), 75 (fall) LA – 14 MS - 12
					CTD profiler and rosette water sampler	Duration: 8-20 min	SEFSC – 395 casts (summer), 305 (fall) FL – 200 (summer only) AL – 20 MS – 81 LA – 50
SEFSC BRD Evaluations, (SEFSC)	Gear testing of various BRD designs for the shrimp fishery. Paired comparison conducted aboard a twin rigged shrimp vessel owned and operated by NOAA. Target shrimp catch and bycatch data collected from each net for each comparative tow.	State and federal nearshore and offshore waters off FL, AL, MS, and LA at depths of 10-35 m. Also Mississippi Sound at depths of 3-6 m.	Annually, May & Aug (one week/month), 14 DAS, night operations only	USCG Class III: R/V *Caretta*	Western jib shrimp trawls	Net size: Two 50 ft Western jib shrimp trawls with 8 x 40 in wooden doors; Tow speed: 2.5 kts Duration: 2 hrs or less [A]	20 paired trawls each season, 40 paired trawls total
SEFSC-GOM TED Evaluations, (SEFSC)	Gear testing of various TED designs for the shrimp fishery. Paired comparison conducted aboard a twin rigged shrimp vessel owned and operated by NOAA. TED installed in one trawl while the other is left with no TED. Target shrimp catch and bycatch data collected from each net for each comparative tow.	State and federal nearshore and offshore waters off FL, AL, MS, and LA at depths of 10-35 m. Also Mississippi Sound at depths of 3-6 m.	Annually, May, Aug, & Sep (one week/month), 21 DAS, day operations only	USCG Class I & II: NOAA small boats USCG Class III: R/V *Caretta*	Western jib shrimp trawls	Net size: Two 50 ft Western jib shrimp trawls with 8 x 40 in wooden doors; Tow speed: 2.5 kts Duration: 55 min at target depth	30 paired trawls per season, 90 paired trawls total
SEFSC Skimmer Trawl TED Testing, (SEFSC)	Gear testing of various TED designs for the skimmer trawl shrimp fishery. Paired comparison conducted aboard twin rigged skimmer trawl vessel owned and operated by NOAA. Target shrimp catch and bycatch data collected from each net for each comparative tow.	Conducted in Mississippi Sound, Chandeleur Sound, and Breton Sound at depths of 2-6 m.	Annually until 2016 (tentative depending on funding and need) May-Dec, 5-15 DAS/month, 60 DAS total, 24 hour operations-set/haul anytime day or night	USCG Class III: R/V *Caretta*	Skimmer trawls	Two 19 ft, two seam skimmer trawls capable of fishing depths from 8 to 18 ft Tow speed: 2.5 kts Duration: 55 min	600 paired trawls

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
SEFSC Small Turtle TED Testing and Gear Evaluations, (SEFSC)	Testing various TED designs for the shrimp fishery utilizing the small turtle testing protocol and NOAA working divers. Two year old, hatchery-raised, loggerhead sea turtles are used to evaluate the turtle exclusion rates of control and candidate TEDs.	State waters in St. Andrews Bay	Annually, June, 21 DAS, day operations only	USCG Class III: R/V *Caretta*	Western jib shrimp trawls are utilized during TED evaluations	Net size: Two 50 ft Western jib shrimp trawls with 8 ft by 40 in wooden doors; Tow speed: 2.5-3.5 kts Duration: up to 75 min at target depth [A]	100 paired trawls
Surveys Using Other Gears							
IJA Biloxi Bay Seine Survey, (MDMR)	Conduct monthly seine sampling in Biloxi Bay estuary to provide diversity and abundance data on the juvenile life stage of estuarine-dependent species important to northern GOM fisheries.	MS state waters in Biloxi Bay, 1-5 ft depths	Annually, Jan-Dec, 25 DAS, day operations only	USCG Class I & II: R/V *Grav I*, R/V *Grav II*, R/V *Grav IV*, small vessel	Bag seine	50 ft bag seine with ¼ in bar mesh, 6 ft deep lateral wings and 6 ft wide central bag. Set and pulled by hand Duration: up to 20 min	11 sets/month, 132 sets total
IJA Oyster Dredge Monitoring Survey, (MDMR)	Collect and analyze data on the condition of oyster reefs in MS to determine the number of live, marketable, and spawnable oysters. Evaluate the incidence of predators and competitors. Collect and analyze data on spat density and success in selected areas.	MS state waters, at commercially important oyster reefs: Pass Christian Complex, Pass Marianne Reef, Telegraph Reef and St. Joe Reef, in 5-15 ft depths	Annually, Jan-Dec, 12 DAS, day operations only	USCG Class I: R/V *Rookie* USCG Class II: R/V *Silvership*	Oyster dredge	9-tooth bar is ~ 20 in wide with teeth 4 in long and spaced 2 in apart Tow speed 2-3 kts Duration: 1 min	38 tows
IJA Shoreline Shellfish Bag Seine Survey, (TPWD)	Resource assessment survey to determine the status of shellfish populations for better management and harvest in coastal waters. Twenty samples are randomly selected and collected each month from five selected bay systems.	TX state waters in Galveston, Matagorda, Aransas, and Corpus Christi Bays and the lower Laguna Madre, 0-6 ft depths	Annually, Jan-Dec, 120 DAS, day operations only	N/A	Bag seine	60 ft long bag seine with 6 ft deep lateral wings (½ in stretch nylon multifilament mesh), with 6 ft wide central bag. Samples collected along the shoreline pulling an extended 60 ft bag seine (with an attached 40 ft spacing rope) for 50 ft. Area swept is 300 m^2. Soak time: 2-3 min	100 sets/month, 1200 total
Marine Mammal and Ecosystem Assessment Survey-GOM, (SEFSC)	Observational surveys are conducted to assess all cetacean species in U.S. EEZ waters, or to focus on the ecology of a selected group of species. Sampling protocols include transects to assess the distribution and abundance of cetaceans. Project operates with MMPA section 10 directed research permit for the intentional takes of marine mammals during research. Non-intentional and incidental takes with active acoustic gear or other gear is not covered under the directed research permit. Thus, the request for including the active acoustics associated with this research within the scope of the LOA application.	Northern GOM	Every three years, June-Sep, 60 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Gordon Gunter*	CTD profiler and rosette water sampler	Duration: 30 min	60 casts
					Expendable bathythermographs		300 units
					ADCP	333 kHz	Continuous
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous
					Passive acoustic arrays	Cables extend up to 600 m aft of the stern	Continuous
Northeast GOM MPA Survey, (SEFSC)	The Madison-Swanson, Steamboat Lumps, and The Edges marine reserves on the West Florida Shelf were established to protect spawning aggregations of gag grouper, (*Mycteroperca microlepis*). Objectives are to document the relationship between habitat and species assemblages and track changes in reef fish abundance and distribution over time.	Madison-Swanson, Steamboat Lumps, and The Edges marine reserves on the West Florida Shelf	Annually, Feb-Mar, 60 DAS, day operations only	USCG Class III: R/V *Caretta*	4-camera array	The camera array contains 16 color cameras with paired black-and-white Video stereo cameras and a bait basket. The array is baited with squid, lowered to the bottom and attached to a float by line; Soak time: 30 min	100 – 200 deployments
					CTD Profiler	Duration: 5-20 min	100 – 200 casts

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
Panama City Laboratory Reef Fish (Trap/Video) Survey, (SEFSC)	Objectives include generating age-based annual indices of abundance of reef fishes; examining patterns in community structure, habitat associations, and regional catch, recruitment, demographics, and distribution. Sampling occurs on rocky reefs and live bottom in inner and mid-shelf waters (8-50 m) during daytime from 1 hr. after sunrise until 1 hr. before sunset using a stationary camera array at every site, followed with a chevron trap at every other site.	Destin, FL to Cedar Key, FL	Annually, May-Sep, 40 DAS, day operations only	USCG Class II: R/V *Harold B*, USCG Class III: R/V *Caretta* , R/V *Defender*, R/V *Apalachee*	4-camera array	The camera array contains 16 color cameras with paired black-and-white stereo cameras and a bait basket. The array is baited with Atlantic mackeral, set on bottom, and attached to a float by ½ in line using 2:1 scope Soak time: 30 min	200 deployments
					Chevron fish trap outfitted with one GoPro video camera.	Chevron trap is 6 x 6 ft with single 7.5 x 11.5 in oval opening and a bait basket. Traps are baited, deployed with a rope and attached float and soaked for 90 minutes. A GoPro camera on the trap overlooks the entrance to the funnel.	100 sets
					CTD profiler	Duration: 1-4 min	200 casts
SEAMAP-GOM Finfish Vertical Line Survey, (ADCNR, LDWF, USM/GCRL)	A resource assessment survey to monitor the abundance and distribution of reef fish. Survey component conducted in Alabama waters by ADCNR	State and federal waters off Alabama. Sampling depths 60 to 500 ft. Stations are sampled during daylight hours.	Annually, two intervals: spring (Apr & May) and summer (July-Sep), 10 DAS, day operations only	USCG Class III: R/V *Escape*, R/V *Lady Ann*	Bandit gear	Bandit mainline 300-lb test, attached to end of mainline is a weighted, 24-ft section of 400-lb test clear monofilament ("backbone"); Ten gangions (200-lb test clear monofilament) are attached to the backbone; Hook size and type: one hook (either a 8/0, 11/0 or 15/0 Mustad 39960D) is attached to each gangion; Bait: Atlantic mackerel. Soak time: 5 min.	120 sets per season, 240 sets total
	Survey component conducted in LA waters west of the Mississippi River by LDWF	State and federal waters west of the Mississippi River, across three depth strata (60-120 ft, 120-180 ft, and 180-360 ft). Sampling depths 60 to 360 ft Stations are sampled during daylight hours.	Annually, Quarterly (20 stations sampled/depth strata/quarter), 24 DAS, day operations only	USCG Class III: R/V *Defender I* USCG R/V: R/V *Blazing Seven*,	Bandit gear	Same as ADCNR gear	60 sets per quarter, 240 sets total
	Survey component conducted in waters off of MS by USM/GCRL.	State and federal waters off MS. Sampling depths 5-30 fathoms. Stations are sampled during daylight hours.	Annually, three intervals: Mar-Apr, May-June, and Sep-Oct, 12 DAS (4 days/season), day operations only	USCG Class III: R/V *Tom McIlwain*	Bandit gear	Same as ADCNR gear	15 stations/season - 45 stations total, 3 sets per station, 135 sets total
SEAMAP-GOM Offshore Plankton Survey, (LDWF)	Ichthyoplankton sampling occurs in the spring and fall in federal waters off the coast of LA to collect eggs and larvae. Samples are collected 24 hours a day.	Federal waters off the coast of LA	Annually, May and Sep, 8 DAS (4/season), 24 hour operations	USCG Class III: R/V *Acadiana* USCG R/V: R/V *Blazing Seven* R/V *Point Sur*	Bongo net	Single frame with two 16 in cylindrical-conical nets; Tow speed: 1.5 kts Duration: < 30 min	25 tows
					Neuston net	3 ft x 6 ft opening, very small mesh (microns) Tow speed: 2 kts Duration: 10 min	25 tows
					CTD profiler	Duration: 10 min	20 casts
SEAMAP-GOM Plankton Survey, (ADCNR)	Ichthyoplankton surveys are conducted to collect larvae for red drum, king mackerel and other species.	Three stations in AL state waters out to 360 ft depth. There are 9 fixed stations near Mobile Bay, AL of which three are selected randomly.	Annually, Aug-Sep, 2 DAS, day operations only	USCG Class III: R/V *A.E. Verrill*, R/V *Alabama Discovery*	Bongo net	Single frame with two 16 in cylindrical-conical nets; Tow speed: 1.5 kts Duration: < 30 min	6 tows
					Neuston net	3 ft x 5 ft opening, very small mesh (microns) Tow speed: 2 kts Duration: 10 min	6 tows
					CTD profiler	Duration: 5-20 min	6 casts

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
SEAMAP-GOM Plankton Survey, (ADCNR, LDWF, USM/GCRL)	Plankton sampling occurs in the spring, summer and fall in the waters off LA to collect eggs and larvae.	State and federal waters off the coast of AL, MS, LA, and FL. Three stations in AL state waters out to 360 ft depth. There are 9 fixed stations near Mobile Bay, AL, of which three are selected randomly.	AL: Annually, Aug-Sep, 2 DAS, day operations only LA: Annually, May, June, Sep, Oct, 10 DAS, day operations only MS/FL: Annually, May & Sep, 8 DAS, 24 hour operations	USCG Class III: R/V *A.E. Verrill*, R/V *Alabama Discovery*, R/V *Acadiana* USCG R/V: R/V *Blazing Seven*, R/V *Tommy Munro* R/V *Point Sur*	Bongo net	Single frame with two 16 in cylindrical-conical nets; Tow speed: 1.5 kts Duration: < 30 min	AL: 6 tows LA: 14 tows MS/FL: 20 tows
					Neuston net	3 ft x 6 ft opening, very small mesh (microns) Tow speed: 2 kts Duration: 10 min	AL: 6 tows LA: 14 tows MS/FL: 20 tows
					CTD Profiler	Duration: 5-20 min	AL: 6 casts LA: 50 casts MS/FL: 20 casts
SEAMAP-GOM Plankton Survey, (SEFSC)	Assess the occurrence, abundance and geographical distribution of the early life stages of fishes. Describe the pelagic habitat of fish larvae through measurements of various physical and biological parameters. Map the distribution of fish eggs along the cruise track using a CUFES.	Coastal, shelf and open ocean waters of the GOM	Annually, Feb-Mar (winter), 30 DAS; Apr-May (spring), 60 DAS; Aug-Sep (fall), 36 DAS 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Oregon II*, R/V *Gordon Gunter*, R/V *Pisces*	Bongo net	Single frame with two 61 cm cylindrical-conical nets, 0.202 or 0.335 mm mesh; Tow speed: 1.5 kts Duration: < 30 min	650 tows
					Neuston net	1 m x 2 m opening, 0.505 or 0.947 mm mesh Tow speed: 2 kts Duration: 10 min	650 tows
					MOCNESS	The 1 m x 1 m MOCNESS frame carries sensors and controls 6 to 20 nets. Sensors report conductivity (salinity), temperature, depth and volume filtered. Nets are 0.505 mm mesh. Tow speed: 2 kts Duration: < 60 min	378 tows
					Methot juvenile fish net	2.32 m x 2.24 m rigid aluminum frame outfitted with a 13.1 m long, 3 mm knotless mesh net. Tow speed: 3-4 kts Duration: < 60 min	126 tows
					CTD profiler and rosette water sampler	Duration: 30 min	756 casts
SEAMAP-GOM Reef Fish Monitoring, (FFWCC)	Objectives include monitoring relative indices of abundance of reef fishes, examining patterns in community structure, habitat associations, and regional catch, recruitment, demographics, and distribution through time.	West FL shelf from 26°N to Dry Tortugas, FL	Annual, July-Sep, 50 DAS, daylight hours	USCG Class I & II: R/V *No Frills*, R/V *Gulf Mariner*, R/V *Sonic*, R/V *Johnson*, chartered fishing vessels USCG Small R/V: R/V *Bellows*, R/V *Apalachee* USCG R/V: R/V *Weatherbird*	2-camera array	Array is two Stationary Imaging System (SIS) units inside aluminum housing. Each SIS has one color video camera and two black-and-white stereo still cameras. Array is attached to a float by line; Soak time: 60 min	150 deployments
					Chevron fish trap	Chevron traps are 5.8 x 5 x 2 ft with 11 in diameter opening, 1.5 in vinyl-clad mesh; baited with Atlantic mackerel. Three traps are set at each station and each trap has a single vertical line (~2:1 scope) with a buoy attached Soak time: 90 min	300-450 sets
					CTD profiler	Tow speed: 0 Duration: 5-15 min	300 casts
SEAMAP-GOM Reef Fish Survey, (SEFSC)	This survey targets reef fish species; results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, stock structure and status, and potential vulnerability to fishing pressure. Reef fish are sampled for hard parts for biological information.	Gulf-wide survey from Brownsville, TX to Key West, FL, in depths of 15-500 ft	Annual, Apr-July, 60 DAS, 24 hour operations on large vessels (cameras, traps, bandit – daytime only), 12 hour operations on small vessels (daytime only)	USCG Class III: R/V *Caretta*, R/V *Gandy* USCG R/V: R/V *Pisces*, R/V *Oregon II*	4-camera array	The camera array contains 16 color cameras with paired black-and-white Videre stereo cameras. The array is baited with squid, lowered to the bottom and attached to a float by line (~2:1 scope) with a buoy attached Soak time: 30 min	400-600 deployments
					Chevron trap (discontinued use in 2013)	6 x 6 ft 'chevron' shaped trap with one 4 in entrance portal. Trap baited with squid or mackerel, weighted, submerged and fished on the bottom; Soak time: 1 hr	50-100 sets

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
					CTD Profiler	Duration: 5-20 min	400-600 casts
					Bandit Reels	Vertical mainline with 10 gangions, either deployed or attached to the vessel; Hook size and type: 8/0, 11/0, or 15/0 circle hook; Bait: mackerel; Soak time: 5 min	120 sets
					Acoustic Doppler Current Profiler	333 kHz	Continuous
					Simrad ME70 Multi-beam echosounder	70-120 kHz	Continuous
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous
Surveys Using SCUBA Divers or Remotely Operated Vehicles (ROVs)							
FL/Dry Tortugas Coral Reef Benthic Survey, (SEFSC)	Survey includes scheduled-interval and episodic sampling of coral reef benthos to serve goals of protected species (coral) monitoring, coral reef, and habitat assessment.	Survey area encompasses federal and territorial waters from Dry Tortugas to Martin County, FL	Quarterly-annually, May-Oct, 100 DAS	USCG Class I & II: small vessels	SCUBA divers with measuring devices, cameras, and hand tools	Human divers collect benthic samples (algae and coral biopsies) and assess habitat	300 dives
IJA Oyster Visual Monitoring Survey, (MDMR)	Collect and analyze data on the condition of oyster reefs in MS to determine the number of live, marketable, and spawnable oysters; evaluate the incidence of predators or competitors and summarize the data. Collect and analyze data on spat density and success in selected areas.	MS state waters, 5-15 ft depths	Annually, Sep/Oct to Apr/May of following year, 12 DAS, day operations only	USCG Class I & II: R/V *Silvership*, R/V *Rookie*	SCUBA divers	SCUBA gear, 1 m squares All reef material and marine organisms obtained by sampling are analyzed on the boat and returned to the reef.	20 dives
Reef Fish Visual Census Survey – Dry Tortugas, (SEFSC)	Assess abundance and size of reef fishes, and characterize bottom habitat features	Dry Tortugas area in the GOM, <33m deep	Annually, May-Sept, 25 DAS, day operations only	USCG Class II & III: Chartered dive vessel	SCUBA divers with meter sticks, 30 cm rule and digital camera	Human divers visually collect data on the abundance and size of reef fish, and habitat features at randomly selected 15 m diameter plots	300 dives
Tortugas Ecological Reserve Survey, (SEFSC)	This survey employs scuba divers swimming 30 m replicate underwater transects to identify and count all species of snapper/grouper/other predators seen on the transect swim out, deploying a tape measure as they swim. Species of interest are counted to the limits of visibility.	Tortugas South Ecological Reserve, Florida Keys National Marine Sanctuary	Biennially, summer (June or July), 6 days, day and night 12 hour operations	USCG Class II & III: Chartered vessel	SCUBA divers, transect tape, clipboards/pencils	Human divers identify and count fish species seen on the transect swim	16 stations, each station done 2-3 times
ATLANTIC RESEARCH AREA							
Surveys Using Gillnets, Trammel Nets, or Fyke Nets							
ACFCMA American Eel Fyke Net Survey, (SCDNR)	To monitor the ingress of elvers returning from the Sargasso Sea. This is evaluated by a fishery-independent data collection effort aimed at determining eel utilization and the abundance level of eel/elver recruitment to a single river. Sampling site is inland from the only area where elvers can be harvested commercially.	Goose Creek Reservoir or the Cooper River, near Charleston, SC, 1-7 ft depths	Annually, Feb-Apr, 32 DAS, day operations only	USCG Class A: John Boat - no motor, walk/wade to work net	Fyke net	Wings 18.8 x 9 ft, 19 in diameter hoops, 37.6 ft headrope, 700 micron mesh, 1 in 2 checker board grate over net opening. During the week, the end of the net is tied closed and sampled every 24 hours (i.e., once a day). No sampling occurs during the weekend and the net is untied to allow fish and eels to pass through. Duration: 8 weeks	1 station per day, 40 collections total
					Thermometer		32 casts

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
ACFCMA American Shad Drift Gillnet Survey, (SCDNR)	To demonstrate sustainability and determine spawning stock size. Fishery-independent data collection effort aimed at determining abundance and evaluating catch rates of adult American Shad in two major river systems in SC. All specimens are tagged and released.	Santee, Edisto, Waccamaw, Combahee Rivers, SC	Annual, Jan-Apr, (2-3 trips/week), 40 DAS, day operations only	USCG Class I: R/V *Bateau*, R/V *McKee Craft*	Drift gillnet	Single 5 in stretch mesh, no longer than 450 ft and 22 ft depth. The net is set adrift, constantly tended. Soak time: 20 min	4-5 sets/trip, 120 sets total
RecFIN Red Drum Trammel Net Survey, (SCDNR)	This survey targets red drum in SC. Results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. The study continues a long-term randomly stratified trammel net survey of SC estuaries that began in 1990.	Coastal estuaries and rivers of SC in depths of 6 ft or less along shoreline.	Annually, Jan-Dec, 120-144 DAS (14-18 days/month), day operations only	USCG Class I: Florida Mullet Skiffs	Trammel net	183 x 2.1 m trammel net fitted with a polyfoam float line and a lead core bottom line. Inner netting of 63.5 mm stretch-mesh sandwiched between a pair of outer panels of 355.6 mm stretched-mesh. Gear fished for approximately 10 min	1000 sets/ yr covering 225 stations/yr. Operates in 7-9 strata/month
Surveys Using Longline Gear							
HMS Chesapeake Bay and Coastal Virginia Bottom Longline Shark Survey, (VIMS)	Fishery-independent survey designed to monitor the abundances of late-juvenile and adult shark species inhabiting the lower Chesapeake Bay and coastal waters off of Virginia since 1973. The data collected are used to inform a number of stock assessments, the program is considered one of the longest running fishery-independent survey efforts focused on the monitoring of shark abundances.	Chesapeake Bay and state and federal waters off Virginia	Annually, May-Oct (5 days/month), 30 DAS, day operations only	USCG Class III: R/V *Bay Eagle*	Bottom longline	Mainline length: 2,315 m (4.8 mm diameter tarred nylon) (anchored at each end and delineated at ends and every 20 gangions by a Norwegian buoy); 100-120 standard gangions/set; Hook size and type: 9/0 Mustad J-hook or 12/0 circle hook; Bait: Atlantic menhaden Soak time: 4 hrs.	50 sets
					Hydrolab MS5 Sonde	Measures depth, temperature, salinity, dissolved oxygen concentration, and dissolved oxygen percent saturation.	50 casts
MARMAP Reef Fish Long Bottom Longline Survey, (SCDNR)	Bottom long line survey to monitor relative abundance and life history parameters of golden tilefish and other species that occur over soft (muddy) bottom habitat (tilefish grounds) in areas around 100 fathom depths.	South Atlantic Bight (between 27°N and 34°N, but mostly off GA and SC). Sampling occurs in federal waters. Depths from ~500 to 860 ft	Annually 1996-2012*, Aug-Oct, 10-20 DAS, day operations only *Halted in 2012 but will resume annually if funding obtained	USCG Small R/V: R/V *Lady Lisa*	Bottom longline	Mainline length: ~ 5,500 ft (weighted at both ends and a large surface float is attached to one end); 100 gangions/set (2 ft long, 200-lb test monofilament); Hook size and type: Mustad 14/0 non-stainless steel circle hook; Bait: whole squid; Soak time: 90 min	60 sets
					CTD profiler	Duration: 5-15 min	60 casts
MARMAP/SEAMAP-SA Reef Fish Survey, (SCDNR)	The objective is to collect fishery-independent data concerning species relative abundance, distribution, and habitat which provides valuable fishery information to managers, scientists, and students in the South Atlantic Bight region. Multiple gears are used to obtain life history samples of reef fishes (mostly species in the SAFMC snapper-grouper management complex), in particular age, reproductive and diet information. Bottom longlines are used to sample live bottom/reef area with considerable vertical relief, generally in waters deeper than 90 meters. Underwater video cameras investigate and verify bottom habitat.	South Atlantic Bight (between 27°N and 34°N)	Annually, year-round but primarily Apr-Oct, 70-120 DAS, day operations only	USCG R/V: R/V *Palmetto*	Chevron fish trap outfitted with two cameras	Chevron trap (1.7 x 1.5 x 0.6 m) with one video camera and one still camera; Bait: clupeids (e.g., menhaden); Soak time: 90 min	600 sets
					Bottom longline	Mainline length: 84 ft 20 gangions/set (2 ft long., 200-lb test monofilament), Mainline is weighted at both ends and a large surface float is attached to one end; Hook size and type: Mustad 14/0 non-stainless steel circle hook; Bait: whole squid. Soak time: ~90 minutes.	200 sets

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
					Bandit reels	3/0 or 6/0 reels with Electramate motors. (30 lb and 50 lb test monofilament leaders respectively); 3 hooks per line; Hook size and type: non-stainless, non-offset circle hooks sizes 2/0-5/0, occasionally sizes up to 9/0 and non-offset J-hooks are used; Bait: squid and scad (*Decapterus* spp.); Soak times: 1-10 min/drop, with total fishing effort per bandit rig of ~15-90 min	400 sets
					CTD profiler	Duration: 5-15 min	300 casts
Pelagic Longline Survey-SA, (SEFSC) (See also effort conducted in the GOMRA)	This survey targets pelagic shark and fin fish species, results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks on pelagic longline gear, measuring, attaching various tags, and releasing them alive. Random survey site selection based on significant oceanic (Gulf Stream or loop currents), or bathymetric features (continental shelf edge). Fin fish are sampled for hard parts for biological information.	Cape Hatteras, NC to Cape Canaveral, FL	Intermittent, Feb-May, 30 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Oregon II*	Pelagic Longline	Mainline length: 5 nm (4.0 mm diameter, 454 kg test monofilament); 100 gangions/set (2.0 mm diameter, 179 kg test); Hook size and type: 18/0 non-offset steel, 0.5 m length multi-strand leader (364 kg test), 50 bullet floats. Bait: Atlantic mackerel; Soak Time: 3 hr.	100-125 sets
					CTD profiler	Duration: 10-20 min	100-125 casts
Shark and Red Snapper Bottom Longline Survey-SA, (SEFSC) (See also effort conducted in the GOMRA)	This survey targets shark and reef fish species, results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks on longline gear, measuring, attaching various tags, and releasing them alive. Fin fish are sampled for hard parts for biological information.	Cape Hatteras, NC to Cape Canaveral, FL between bottom depths 9 - 183 m	Annually, July-Sep, 60 DAS, 24 hour operations (set/haul anytime day or night)	USCG Class III: R/V *Caretta* USCG R/V: R/V *Oregon II*, R/V *Gordon Gunter*;	Bottom longline	Mainline length: 1 nm (4.0 mm diameter, 454 kg test monofilament); 100 gangions/set (3.0 mm diameter, 332 kg test monofilament); Hook size and type: 15/0 circle hook. Bait: Atlantic mackerel; Soak Time: 1 hr.	70 sets
					CTD profiler and rosette water sampler	Duration: 5-15 min	70 casts
					Neuston and bongo effort if needed to augment SEAMAP plankton objectives	Neuston net: 1 x 2 m opening with 0.505 or 0.947 mm mesh; Bongo towing frame consists of two cylindrical nets, each 61 cm in diameter, fine mesh nets (0.202 or 0.335 mm).	0-20 tows

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
SEAMAP-SA Red Drum Bottom Longline Survey, (NCDNR, SCDNR, GDNR)	Utilize proven fishery-independent methods to sample the adult red drum population to develop a better understanding of abundance, distribution and age composition of the stock, thereby allowing for more effective and responsible management of the stock. Tagging of red drum to gather information on migration and stock identification. A sub-sample of red drum is sacrificed for collection of biological information including age, reproductive activity, genetic composition of the stock, and stomach content analysis. Study conducted by three state cooperating agencies. Results made available to ASMFC, NMFS and members of the Red Drum Stock Assessment Committee for the red drum SEDAR.	NC: Pamlico Sound or in the nearshore waters of Ocracoke Inlet SC: Estuaries out to 10 miles in Winyah Bay, Charleston Harbor, St. Helena Sound, and Port Royal Sound GA: State and federal waters off the coast of GA and NE FL, (~32°05' N latitude to the north, 29°20'N latitude to the south, 80°30'W longitude to the east, and the coastline to the west.)	Annually NC: mid-July to mid-Oct (2 days/ week for 12 weeks), 24 DAS, 24 hour operations, primarily at night SC: Aug-Dec, day operations only 36 DAS GA: Apr-Dec (6 days/month), 54 DAS, day operations only	USCG Class II: 26 ft outboard USCG Class III: R/V *Marguerite,* R/V *Silver Crescent*	Bottom longline	Mainline length: 2,025-4,920 ft (500-660 lb test) (The mainline is weighted at both ends and large surface floats are attached to each end); Gangions 1.5-2 ft length, 200-275 lb test monofilament; NC: 100 hooks/set SC: 40 hooks/set GA: 60 hooks/set; Hook size and type: 15/0 Mustad tuna circle hook (0° offset) (GA may also use 12/0 circle hook, 0° offset, depressed barbs); Bait: readily available baitfish or squid (GA); Soak time: 30 min	NC: 75-100 sets total SC: 360 sets GA: 200-275 sets
					YSI (Dissolved oxygen, salinity, temperature)	Duration: 5-15 min	NC: 75-100 casts SC: 360 casts GA: 200-275 casts
Surveys Using Trawl Gear							
ACFCMA Ecological Monitoring Trawl Survey, (GDNR)	Trawl survey used to develop fishery-independent indices for Georgia's commercially and recreationally important crustaceans and finfish. Sampling occurs monthly year round in six of the nine sound systems and in state territorial waters (0-3 nm.).	Georgia state waters out to three nm, 10-35 ft depths	Annually, Jan-Dec (7 days/month), 84 DAS, day operations only	USCG Class III: R/V *Anna*	Otter trawl	40 ft otter trawl (1 7/8 in stretch mesh), with 5 ft wooden doors and a tickler chain; Tow speed: 2.5 kts Duration: 15 min	42 trawls/month, 504 trawls total
					YSI 85 (Dissolved oxygen, salinity, temperature)	Duration: 5-15 min	504 casts total
ACFCMA Juvenile Stage Trawl Survey, (GDNR)	Trawl survey used to develop fishery-independent juvenile indices for Georgia's commercially and recreationally important crustaceans and finfish.	Creeks and rivers of three Georgia sound systems (Ossabaw, Altamaha, and St. Andrew)	Annually, Dec-Jan (3 days/month), 36 DAS, day operations only	USCG Class I: 19 ft Cape Horn; 25 ft Parker	Otter trawl	20 ft semi-balloon shrimp trawl net (1½ in stretch mesh), with 30 in wooden otter trawl doors and tickler chain; Tow speed: 2.5 kts Duration: 5 min	18 trawls/month, 216 trawls total
					YSI 85 (Dissolved oxygen, salinity, temperature)	Duration: 5-15 min	216 casts total
Atlantic Striped Bass Tagging Bottom Trawl Survey, (USFWS)	Cruise objective is to monitor, tag and release Atlantic migratory striped bass, as part of the ASMFC management program. Secondary objectives include tagging and release of other species: red drum, horseshoe crabs and spiny dogfish and winter skates. And opportunistically tag and release any incidentally encountered Atlantic sturgeon.	North of Cape Hatteras, NC, in state and federal waters, 30-120 ft depths	Annually, Jan-Feb, 14 DAS, 24 hour operations (set/haul anytime day or night)	USCG R/V: R/V *Oregon II*, R/V *Cape Hatteras*, R/V *Savannah*	65 ft high-opening bottom trawls	65 ft trawl net with 3.75 inch stretch nylon multifilament mesh cod end, up to two nets used simultaneously; Towing speed: 3 kts Duration: up to 30 min	200-350 trawls
Juvenile Sport Fish Trawl Monitoring in Florida Bay, (SEFSC)	This project surveys juvenile spotted seatrout and other sport fish as part of a monitoring and assessment program supporting the Comprehensive Everglades Restoration Project.	Florida Bay, FL	Annually, May-Nov, 35 DAS, day operations only	USCG Class I: R/V *Batou*	Otter trawl	11ft head rope; Tow speed: 4 kts; Duration: 2 min	~500 trawls
Oceanic Deep-water Trawl Survey (SEFSC) *Planned but not yet funded	Survey is conducted to sample mid-water (500-800 m) prey of marine mammals	Southeastern U.S. Atlantic waters >500 m deep	Intermittent, 20 DAS	USCG R/V: NOAA ships	High Speed Midwater Trawl, Aleutian Wing Trawl	>10 m opening, 2-3 meter doors, Towing speed: 2-3 knots at 500-800 m depth Duration: ~ 2 hrs to set and haul gear, 1-3 hours at target depth	60 trawls (2-3 per day)

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
SEAMAP-SA NC Pamlico Sound Trawl Survey, (NCDENR)	Trawl survey designed to monitor juvenile fish, shrimp, and crab abundance in Pamlico Sound and its bays and rivers. The survey is conducted to support stock assessments and management of finfish, shrimp, and crab species.	Pamlico Sound and the Pamlico, Pungo, and Neuse rivers in waters ≥6 ft deep	Annually, June & Sep, 20 DAS (10 days/month), day operations only	USCG Class III: R/V *Carolina Coast*	Otter trawl: paired mongoose-type Falcon bottom trawls	120 ft three-lead bridle with 34 ft footrope, 0.1875 in tickler chain, and 4 x 2 ft wooden doors. Codend is #30 twine with 1.5 in stretch mesh. Towing speed: 2.5 kts Duration: 20 min	54 trawls each month, 108 trawls total
					Ponar grab	Stationary sample of bottom sediment	54 casts each month, 108 total
					YSI 556 (Dissolved oxygen, salinity, temperature)	Duration: 5-15 min	54 casts each month, 108 total
					Secchi disk	Stationary soak at surface	54 casts each month, 108 total
SEAMAP-SA Coastal Trawl Survey, (SCDNR)	This survey provides long-term, fishery-independent data on the distribution and relative abundance of resident and transient fishes, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs, and cephalopods that are accessible by high-rise trawls. Additional data recorded for priority species include measurements of length or width for all priority species, sex and individual weights for blue crab, sharks, and horseshoe crabs, and reproductive information on commercially important penaeid shrimp and blue crabs.	Cape Hatteras, NC to Cape Canaveral, FL in nearshore oceanic waters of 15-30 ft depth.	Annually, Apr-May (spring), July-Aug (summer), and Oct-Nov (fall), 60-65 DAS, day operations only	USCG Small R/V: R/V *Lady Lisa*	Otter trawl: paired mongoose-type Falcon bottom trawls	75 ft three-lead bridle with 86 ft head rope, 0.25 in tickler chain, and 10 ft x 40 in wooden chain doors. Codend is #30 twine with 1.625 in stretch mesh; Towing speed: 2.5 kts Duration: 20 min	300-350 trawls total, evenly divided between seasons
					SEABIRD electronic CTD	Duration: <5 min	300-350 casts
SEFSC-SA TED Evaluations, (SEFSC)	Gear testing of various TED designs for the shrimp fishery. Paired comparison conducted aboard a twin rigged shrimp vessel owned and operated by University of Georgia. Directed sea turtle capture rate study with live feed video monitored TEDs installed in each trawl.	State and federal waters off Georgia and eastern FL	Annually, Nov-Apr, 10 DAS, 24 hour operations-set/haul anytime day or night	USCG Class III: R/V *Georgia Bulldog*	Otter trawl: Mongoose shrimp trawls	Two 70 ft Mongoose shrimp trawls with 8 ft x 40 in wooden doors; Tow speed: 2.5 kts; Duration: up to 4 hrs [A]	50 paired trawls
In-Water Sea Turtle Research (SCDNR)	This survey was initiated (permitted and funded) by NMFS in 2000 to conduct annual sampling to monitor the relative abundance, distributional patterns, demographic structure, and health of sea turtles in coastal waters of the SE U.S. Although the biological focus is primarily on sea turtles, all biota collected during the survey are identified and enumerated as appropriate.	Winyah Bay, SC to St. Augustine, FL in water depths of 15-45 ft	Annually, mid-May through late Jul to early Aug, 24-30 DAS, day operations only	USCG Class III: R/V *Georgia Bulldog* USCG Small R/V: R/V *Lady Lisa*	Paired flat net bottom trawls (NMFS Turtle Nets per Dickerson et al. 1995) with tickler chains	60 ft head-rope, 4-seams, 4-legs, and 2 bridles. Net body consisted of 4 in bar and 8 in stretch mesh, with top and sides made of #36 twisted nylon and bottom with #84 braided nylon twine. Cod end consisted of 2 in bar and 4 in stretch mesh. Tow speed: 2.8 kts Duration: 30 min	400-450 total trawls
Surveys Using Other Gears							
ACFCMA American Eel Pot Survey for Yellow-phase Eels, (GADNR)	Survey to monitor abundance of yellow-phase American eels as required under ASMFC's FMP for eels. Survey began in 2013 to replace research conducted by the ACFCMA American Eel Fyke Net Survey, (GDNR)	Georgia state waters in the Altamaha River System. Sampling is conducted during daylight hours. Depth ranges from 2 to 20 ft	Annually. Sampling monthly Nov–Apr. based on water temp. 36 DAS (6 days/month), day operations only	USCG Class I: 19 ft Cape Horn, 18 ft skiff	Eel traps/pots with float	16 in by 20 in by 11in trap with ½ in by 1 in mesh. 3-2" openings to internal funnels. 1/8" inch nylon float line with a single bullet float (12" length). Majority are tied to limbs along river bank using 10-15 ft of float line depending on depth. A few pots (<5) are in the river, attached to up to 30 ft. of float line. Baited with horseshoe crabs and shrimp heads. Duration: 24-48 hrs	30 stations (180 sets/month; 30 traps set each of 6 days)
Beaufort Bridgenet Plankton Survey, (SEFSC)	This is the longest consecutive ichthyoplankton ingress sampling program along the U.S. east coast (26 years). Fall/winter spawned larvae are collected during once-weekly sampling.	Pivers Island Bridge, NOAA Beaufort facility, Beaufort, NC	Annually, Nov-May (some years monthly Jan-Dec), night operations only	None	Plankton net	2 m^2 rectangular plankton net with 1 mm mesh, fitted with a flow meter. Duration: ~ 9 hrs	20-52 tows

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
IBBEAM Project, (SEFSC)	This project surveys fish, epifauna (shrimp, crabs, and small fishes) and water temperature and salinity as part of a monitoring and assessment program supporting the Comprehensive Everglades Restoration Project.	Western shoreline of Biscayne Bay, FL	Annually, May-Oct (wet season) and Nov-Apr (dry season), 14 DAS, day operations only	USCG Class II & III vessels	Human divers	Mask and snorkel surveys along 60 m^2 belt-transects	100 dives
					Throw trap	Open-ended 1 m^2 aluminum box, 45 cm deep.	372 casts
Intraspecific Diversity in Pink Shrimp Survey, (SEFSC)	This project collects young pink shrimp for genetic analysis. Information on habitat and environmental conditions where juveniles are collected also noted. Adult pink shrimp will also be obtained from the Tortugas and Sanibel fisheries. The information will furnish information regarding the use of pink shrimp as an ecological indicator in South Florida ecosystem restoration projects affecting the quantity, quality, and timing of freshwater inflow to estuaries.	Florida Bay, Whitewater Bay, Fakahatchee Bay, Biscayne Bay, Sanibel shrimp fishery, Tortugas shrimp fishery	Annually, June-Aug, 16 DAS, day operations only	USCG Class I: R/V *Privateer*	Miniature roller-frame trawl	0.5 m diameter mouth, 1 mm mesh; Tow speed: 5 kts, Duration: 5 min	40 trawls
					Dip net	19 in. diameter, 0.25 in mesh	40 samples
					Bag seine	Two-part seine (1 mm mesh), main net is 5 x 16.5 ft with 5 ft PVC pole at each end and 4 in floats. Sock, located in center of net, is 9 ft long and tapers from 50-10 in (closed cod end).	40 sets
Marine Mammal and Ecosystem Assessment Survey-SA, (SEFSC)	Observational surveys are conducted to assess all cetacean species in U.S. EEZ waters, or to focus on the ecology of a selected group of species. Sampling protocols include transects to assess the distribution and abundance of cetaceans. Project operates with MMPA section 10 directed research permit for the intentional takes of marine mammals during research. Non-intentional and incidental takes with active acoustic gear or other gear is not covered under the directed research permit. Thus, the request for including the active acoustics associated with this research within the scope of the LOA application.	Southeastern U.S. Atlantic	Every three years, June-Sep, 60 DAS, 24 hour operations	USCG R/V: R/V *Gordon Gunter*	CTD profiler and rosette water sampler	Duration: 30 min	60 casts
					Expendable bathythermographs		300 units
					Acoustic Doppler Current Profiler	333 kHz	Continuous
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous
					Passive acoustic arrays	Cables extend up to 600 m aft of the stern	Continuous
RecFIN Red Drum Electrofishing Survey, (SCDNR)	This survey targets red drum in SC. Results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. The study continues a long-term electrofishing survey of the upper estuaries that began in 2001.	Coastal estuaries and rivers of SC in depths of 6 ft or less in low salinity waters (0-12 ppt)	Annually, Jan-Dec, 60-72 DAS (5-6 days/month), day operations only	USCG Class I: Small vessels	18 ft elecrofishing boat	Electrofishing boat operating at ~3000 W pulsed direct current fishes for 15 minutes, The electric field is less than 20 ft around the electrofishing vessel. The boat drifts with the current or operates at idle speed along the river bank.	360 stations per year (30 sites/month)
St. Lucie Rod-and-Reel Fish Health Study, (SEFSC)	This project samples fish for the prevalence of externally visible abnormalities. Abnormality prevalence is an indicator of fish health and habitat quality. Most fish are released after screening for externally visible abnormalities. A small proportion is retained for histopathology.	Nearshore reef, inlet, and estuary of St. Lucie River, FL inlet system (Jupiter or Ft. Pierce, FL)	Annually, Jan-Dec, weekly, 156 DAS, day operations only	USCG Class I: Small vessels	Rod and reel gear	Hook size and type: 10- or 17-lb test monofilament with a 1-foot monofilament leader and a No.7 Mustad hook; One line with one hook is fished at each station Bait: dead shrimp Soak time: 30 min	468 stations per year: 3/day x 3 day/wk
SEAMAP-SA Gag Ingress Study, (SCDNR)	Objective: to monitor ingress into estuarine nursery areas of juveniles of winter spawning commercially and recreationally important fish species, in particular gag (Mycteroperca microlepis), using juvenile fish collectors (Witham collectors).	In the vicinity of Swansboro, NC; Wilmington, NC; Georgetown, SC; Charleston, SC; Beaufort, SC; Savannah, GA; and Brunswick, GA	Annually, Mar-June, 100 DAS, day operations only	USCG Class I: Small vessels	Witham collectors	Witham collectors consist of air conditioner filter material folded over 18 x18 in PVC frame. Anchored with a single line and floated off the bottom in tidal creeks that are about 1 m deep at low tide. Collectors deployed ~ 100 ft apart.	15 sets (4 collectors at each set), 60 sets total

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
SEFIS, (SEFSC)	Supplements and improves fishery-independent survey efforts for red snapper and other reef fish species in Atlantic waters using underwater video and chevron fish traps. SEFIS was established to work cooperatively with MARMAP/SEAMAP-SA to (1) increase sample sizes, (2) improve spatial coverage for the long-term reef fish trap survey, and (3) address potential gear efficiency limitations.	Cape Hatteras, NC, to St. Lucie Inlet, FL	Annually, Apr-Oct, 30-80 DAS, 24 hour operations (cameras & traps-daytime operations, acoustics-anytime day or night)	USCG R/V: R/V *Nancy Foster*, R/V *Pisces*, R/V *Savannah*	Chevron fish trap outfitted with 2 high-definition video cameras.	6 x 6 ft trap with single 6 x 24 in oval opening; Bait: menhaden; Soak time: 90 min	1200 deployments
					CTD profiler	Duration: 5-15 min	100-200 casts
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous
					Multi-frequency single-beam active acoustics	18, 38, 120, and 200 kHz	Continuous
Surveys Using SCUBA Divers or Remotely Operated Vehicle (ROV)							
U.S. South Atlantic MPA Survey, (SEFSC)	ROV and acoustic mapping survey of five Marine Protected Areas off the southeast coast between Jacksonville, FL and Cape Fear, NC.	Jacksonville, FL to Cape Fear, NC on or near the continental shelf edge at depths between 80 and 600 m.	Annually, May-Aug, 14 DAS, 24 hour operations (ROV daytime operations, acoustics- anytime day or night)	USCG R/V: R/V *Pisces*, R/V *Nancy Foster*, R/V *Spree*	ROV Phantom S2 vehicle with tether attached to CTD cable	Vehicle conducts visual transects over high relief bottom and stays within 5 m of bottom during survey.	10-40 deployments
					CTD profiler	Duration: 5-20 min	28 casts
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Every other night for 6-12 hrs
					EK60 Multi-frequency single-beam active acoustics	18, 38, 120, and 200 kHz	Every other night for 6-12 hrs
Reef Fish Visual Census Survey - Florida Keys/SE Florida Shelf, (SEFSC)	Assess abundance and size of reef fishes, and characterize bottom habitat features.	Florida Keys and SE Florida Shelf, <33 m deep	Annually, May-Sep, 25 DAS, day operations only	USCG Class I: R/V *Aldo Leopold*	SCUBA divers with meter sticks, 30 cm rule and digital camera	Human divers visually collect data on the abundance and size of reef fish, and habitat features at randomly selected 15 m diameter plots.	300 dives

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
CARIBBEAN RESEARCH AREA							
Surveys Using Other Gears							
Caribbean Plankton Recruitment Experiment, (SEFSC)	Develop fisheries-independent larval survey for commercial coral reef fish species in the U.S. Caribbean. Develop larval indices for snapper, parrot fish, and grouper, determine seasonal abundances, and population connections between islands and with the upstream sources.	Caribbean and Mexican waters	Bi-annually, Feb or June, 15 DAS, 24 hour operations, anytime day or night	USCG R/V: R/V *Gordon Gunter*, R/V *Nancy Foster*	Bongo net	Bongo-towing frame consists of two circular frames, each 61 cm in diameter, connected by a central yoke to which the towing wire is attached; frame is fitted with 2 cylindrical-conical fine mesh nets. Tows are conducted from the surface down to 300 ft. with samples collected approximately every 75 ft. Duration: 5-15 min	75 tows
					MOCNESS	The 1 x 1 m MOCNESS holds nine 0.505 mm mesh nets. Conducted at stations >75 m. Duration: 30 min or less	75 tows
					CTD profiler and rosette water sampler	Duration: 30 min	75 casts
Caribbean Reef Fish Survey, (SEFSC)	The objective is to determine the relative abundance of reef fish and elasmobranchs on the shelf waters of Puerto Rico (PR) and U.S. Virgin Islands (USVI). Video cameras, fish traps, vertical lines and bottom longlines will be used during the cruise.	PR and USVI, continental shelf waters	Every two years, Mar-June, 40 DAS, 24 hour operations	USCG R/V: R/V *Pisces*, R/V *Oregon II*	Bandit Reels	Vertical mainline, deployed with buoy or attached to the vessel; 10 gangions/set; Hook size and type: 8/0 or 11/0 circle hook; Bait: mackerel; Soak time: 5-10 min	300 sets
					4-camera array	The camera array contains 16 color cameras with paired black-and-white Videre stereo cameras. The array is baited with squid, lowered to the bottom and attached to a float by line; Soak time: 30 min	150 deployments
					Chevron traps	Chevron trap is 6 x 6 ft with 4 in diameter entrance, weighted, submerged and fished on the bottom: Bait: squid or mackerel; Soak time: 1 hr.	100 sets
					CTD profiler	Duration: 5-15 min	300 casts
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous
					Acoustic Doppler Current Profiler	333 kHz	Continuous
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous
Marine Mammal and Ecosystem Assessment Survey-C, (SEFSC)	Observational surveys are conducted to assess all cetacean species in U.S. EEZ waters, or to focus on the ecology of a selected group of species. Sampling protocols include transects to assess the distribution and abundance of cetaceans. Project operates with MMPA section 10 directed research permit for the intentional takes of marine mammals during research. Non-intentional and incidental takes with active acoustic gear or other gear is not covered under the directed research permit. Thus, the request for including the active acoustics associated with this research within the scope of the LOA application.	U.S. Caribbean Sea	Every three years, June-Sep, 60 DAS, 24 hour operations-acoustics-anytime day or night	USCG R/V: R/V *Gordon Gunter*	CTD profiler and rosette water sampler	Tow speed: 0, Duration: 30 min	60 casts
					Expendable bathythermographs		300 units
					Acoustic Doppler Current Profiler	333 kHz	Continuous
					Simrad ME70 Multi-Beam echosounder	70-120 kHz	Continuous

Survey Name (Research Agency)	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Stations
					EK60 Multi-frequency single-beam active acoustics	18, 38, 70, 120, and 200 kHz	Continuous
					Passive acoustic arrays	Cables extend up to 600m aft of the stern	Continuous
SEAMAP-C Finfish Rod-and-Reel Survey, (PR-DNER)	This survey targets lane snapper in the territorial waters of PR. Results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure.	West and east coasts of PR in territorial and federal waters at 15-300 ft depths	Annually, Jan-Dec, 120 DAS, night operations only	USCG Class I & III: Three chartered vessels	Rod-and-reel gear	Rod-and-reel gear uses 80 lb test monofilament, 3 lines with 3 hooks per line are fished at each station; Hook size and type: #6 Mustad. Bait: squid; Soak time: 4 hrs.	120 stations (360 lines total)
SEAMAP-C Lane Snapper Bottom Longline Survey, (PR-DNER)	This survey targets fin fish in the territorial waters of PR. Results of survey are used for stock assessments and to support FMPs. Information is also obtained about their biology, distribution, movements, stock structure and status and potential vulnerability to fishing pressure.	East, west, and south coasts of PR in territorial and federal waters at depths ranging from 15-300 ft.	Annually beginning July 2015, (summer, winter, fall, spring), 120 DAS (30 days/season), night operations only	USCG Class III: Two chartered vessels	Bottom longline	Mainline length: 300-ft (130-lb test monofilament), The mainline is weighted at both ends, 100 gangions/set (18 in of 20 lb test); Hook size and type: #10 circle hook; Bait: squid; Soak time: 45 min.	45 sets/season, 180 sets total
SEAMAP-C Yellowtail Snapper Rod-and-Reel Survey, (PR-DNER)	This survey targets yellowtail snapper in the territorial waters of PR. Results of survey are used for stock assessments and to support Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure.	East, west, and south coasts of PR in territorial and federal waters at depths ranging from 15-300 ft	Annually beginning 2014, (4 sampling seasons), 120 DAS, night operations only	USCG Class I & III: Three chartered vessels	Rod-and-reel gear	Rod-and-reel gear uses 80 lb test monofilament, 3 lines with one hook per line are fished at each station; Hook size and type: #6 Mustad Bait: sardine; Soak time: 4 hrs	120 stations (360 lines total)
Surveys Using SCUBA Divers							
Caribbean Coral Reef Benthic Survey, (SEFSC)	Survey includes scheduled-interval and episodic sampling of coral reef benthos to serve goals of protected species (coral) monitoring, coral reef, and habitat assessment.	Federal and territorial waters around PR, USVI, and Navassa	Annual to triennial, May-Oct, 30 DAS, day operations only	USCG Class I & II: Small vessel <28 ft	SCUBA divers with measuring devices and hand tools	Human divers collect benthic samples (algae and coral biopsies), transect tapes, measurement rods, photography	300 dives
Reef Fish Visual Census Survey-U.S. Caribbean, (SEFSC)	Assess abundance and size of reef fishes and characterize bottom habitat features	PR and USVI waters < 100 ft deep	Annually, May-Sept, 25 DAS, day operations only	USCG Class I & II: Small vessel <24 ft	SCUBA divers with meter sticks, 30 cm rule and digital camera	Human divers visually collect data on the abundance and size of reef fish and habitat features at randomly selected 15 m diameter plots	300 dives
SEAMAP-C Queen Conch Visual Survey, (PR-DNER, USVI-DFW)	To assess the queen conch, Strombus gigas, resource within the territorial seas of the USVI, PR, and the contiguous EEZ. Results are used to support stock assessment and management of the fishery. Queen conch abundance and density will be estimated by visual census surveys conducted along predetermined compass headings by SCUBA divers using diver propulsion vehicles. There is no extraction and/or collection of queen conch.	PR and USVI territorial waters in 10-90 ft depths, some sampling occurs in federal waters	Annually, PR: July-Nov, 35 DAS USVI: June-Oct, 62 DAS, day operation only	USCG Class I & III: Three chartered vessels	SCUBA divers, SCUBA gear and underwater scooters	Human divers visually collect data on the abundance and density of queen conch.	PR: 100 dives USVI: 62 dives
SEAMAP-C Spiny Lobster Artificial Habitat Survey, (PR-DNER, USVI-DFW)	To assess juvenile spiny lobster, *Panulirus argus*, recruitment to artificial shelters within the territorial sea of the USVI, PR, and the contiguous EEZ. During each survey the number of juvenile lobsters will be counted within each shelter and carapace length will be determined to the nearest millimeter with a handheld caliper. There is no extraction and/or collection of the resource.	PR and USVI territorial waters in 6-90 ft depths	Annually, PR: Jan-Dec, 84 DAS USVI: Jan-Dec, 20 DAS, day operations only	USCG Class I & III: Three chartered vessels	Juvenile lobster artificial shelters	Shelters are composed of 16 cinder or breeze blocks, two levels of 8 blocks.	10 shelters, continuous deployment
					SCUBA divers, SCUBA gear and underwater scooters	Human divers visually collect data on the abundance of juvenile lobsters and measure carapace length.	PR: 60 dives USVI: 20 dives

A - Trawl projects designed to test bycatch reduction devices and TEDs for commercial fishing gear may have longer tow times (up to four hours). These exceptions to the short tow duration protocols are necessary to meet their research objectives. TEDs are used in nets that are towed in excess of 55 minutes as required by 50 CFR 223.206.

2.0 DATES AND DURATION OF SUCH ACTIVITY AND THE SPECIFIC GEOGRAPHIC REGION WHERE IT WILL OCCUR

The dates and duration of the fisheries research activities that would be conducted by the SEFSC during the five year LOA authorization period are summarized in Section 1.7 and Table 1-1. While some surveys are consistently conducted every year, they are often based on randomized sampling designs so the exact location of survey effort varies year to year in the same general area.

Some surveys are only conducted every two or three years or when funding is available. Timing of the surveys is a key element of their design. Oceanic and atmospheric conditions, as well as ship contingencies, often dictate survey schedules even for routinely conducted surveys.

In addition, the cooperative research program is designed to provide flexibility on an annual basis in order to address issues as they arise.

Most cooperative research projects go through an annual competitive selection process to determine which projects should be funded based on proposals developed by many independent researchers and fishing industry participants. Because the need for different kinds of fisheries information changes over time and overall funding levels vary with annual congressional appropriations, the priorities for funding different kinds of projects change regularly, which makes it difficult to know what will be funded in the next several years.

2.1 Specified Geographic Regions Where the Activities Will Occur

SEFSC research activities are conducted in the Southeast Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea. SEFSC research surveys occur both inside and outside the United States Exclusive Economic Zone, and sometimes span across multiple ecological, physical, and political boundaries.

SEFSC fisheries research activities take place within four Large Marine Ecosystems (LMEs): The Northeast U.S. Continental Shelf LME (NE LME), the Southeast U.S. Continental Shelf LME (SE LME), the Gulf of Mexico LME, (GOM LME), and the Caribbean Sea LME (CS LME). Within these LMEs, SEFSC's activities take place in three primary research areas: the Atlantic Research Area (ARA), the Gulf of Mexico Research Area (GOMRA), and the Caribbean Research Area (CRA), which are described in detail in the following sections. The research area boundaries are not the same as the LME boundaries; activities in the ARA occur out to the EEZ line which is beyond the SE LME boundary, while activities in the GOMRA and CRA cover only a portion the GOM and CS LMEs. Figure 2-1 shows the location and boundaries of these three research areas and the LMEs. Additional descriptive material concerning the geology, oceanography, and physical environment influencing species distribution within each of these research areas can be found in chapter 3 of the Draft PEA accompanying this application.

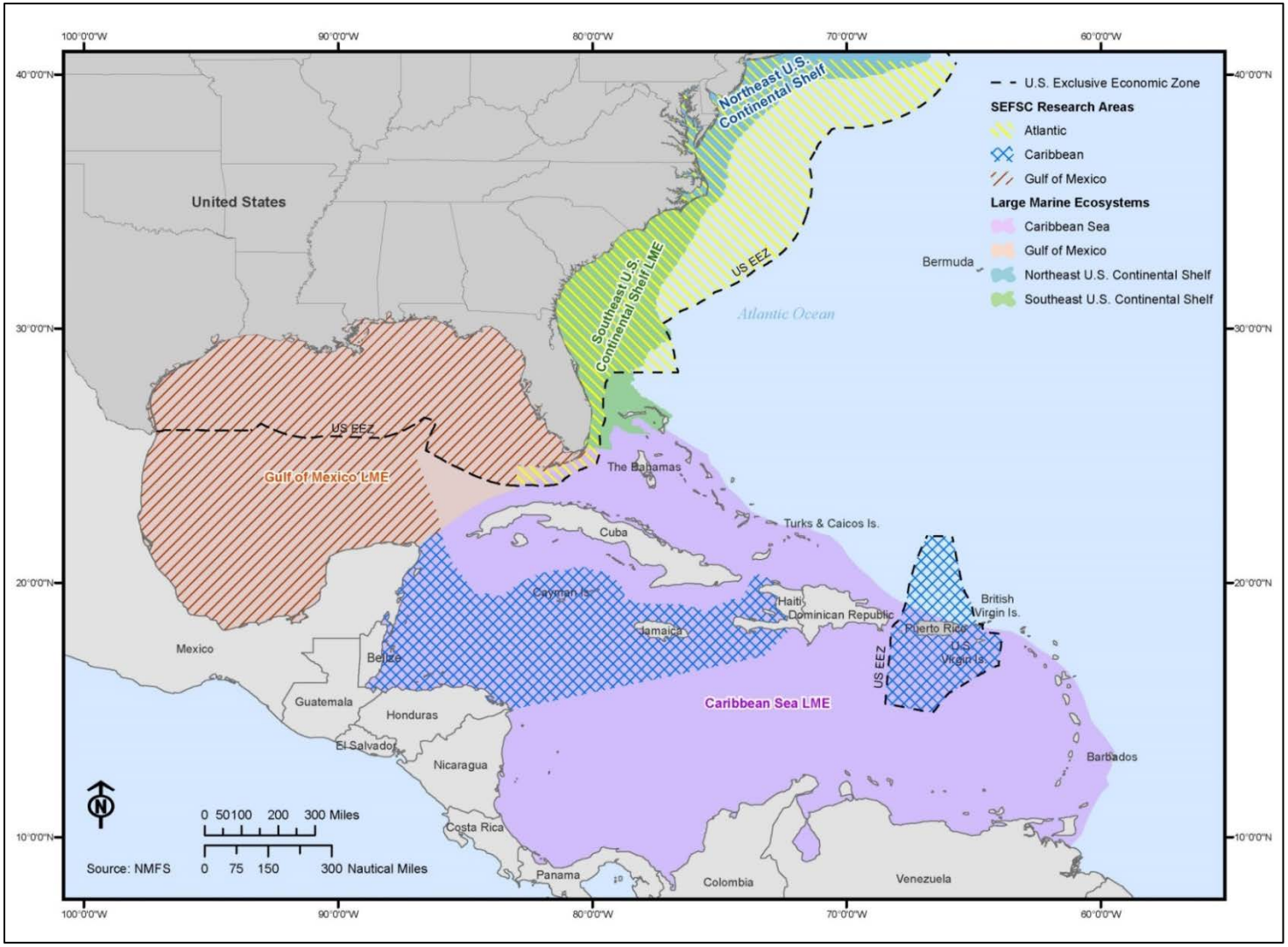

Figure 2-1 Large marine ecosystems and SEFSC research areas

All SEFSC fisheries research is conducted south of Virginia. The Marine Mammal and Ecosystem Assessment Survey extends north to New York and periodically outside of the U.S. EEZ in the GOMRA and CRA. The Caribbean Plankton Recruitment Experiment also periodically extends outside of the U.S. EEZ in the GOMRA and CRA.

2.1.1 Atlantic Research Area

The SEFSC conducts research in the SE LME and NE LME, both inside and outside the LME boundaries, at times beyond the EEZ zone. SEFSC fisheries research is only conducted south of Virginia. The Marine Mammal and Ecosystem Assessment Survey extends north to New York (Figure 2-1).

The SE LME extends from the Straits of Florida to Cape Hatteras, North Carolina in the Atlantic Ocean. It is characterized by its temperate climate. The LME has a surface area of about 300,000 km^2, of which 2.44% is protected. It contains 0.27% of the world's coral reefs and 18 estuaries and river systems (Sea Around Us 2007). It also contains many bays including the Albermale-Pamlico Sound, the second largest estuary in the nation, nearshore and barrier islands, freshwater and estuarine habitats and extensive coastal marshes that provide unique habitats for living marine resources (Aquarone 2009).

Adjacent to this LME, the warm, saline, northward flowing Gulf Stream is bounded by two fronts; the inshore Gulf Stream Front and the offshore Gulf Stream Front (see Figure 2-2). The inshore Gulf Stream Front extends over the upper continental slope and shelf break, approximately aligned with the 50-meter isobath (Atkinson and Menzel 1985), while the offshore Gulf Stream Front runs parallel to it approximately 100 kilometers offshore. The Gulf Stream forms a semi-permanent offshore deflection near a deepwater bank southeast of Charleston, NC, called the 'Charleston Bump' at 31.5 degrees North. The Mid-Shelf Front is aligned approximately with the 35-to-40 meter isobaths. Other shelf fronts separate a mixture of water masses formed by wintertime cold air outbreaks, river discharge, tidal mixing and wind-induced coastal upwelling (Pietrafesa et al. 1985, Belkin et al. 2009).

The NE LME has a total area of approximately 115,831 square miles, and is structurally very complex, with marked temperature changes, winds, river runoff, estuarine exchanges, tides and complex circulation regimes (See Figure 2-3). The Shelf-Slope Front is associated with a southward flow of cold, fresh water from the Labrador Sea. The Mid-Shelf Front follows the 50-m isobath (Ullman and Cornillon 1999). The Nantucket Shoals Front hugs the namesake bank/shaols along 20-30-m isobaths. The Wilkinson Basin Front and Jordan Basin Front separate deep basins from Georges Bank and Browns Bank (Mavor and Bisagni 2001). The Main Coastal Front and Cape Cod Front are seasonal fronts within this LME (Ullman and Cornillon 1999).

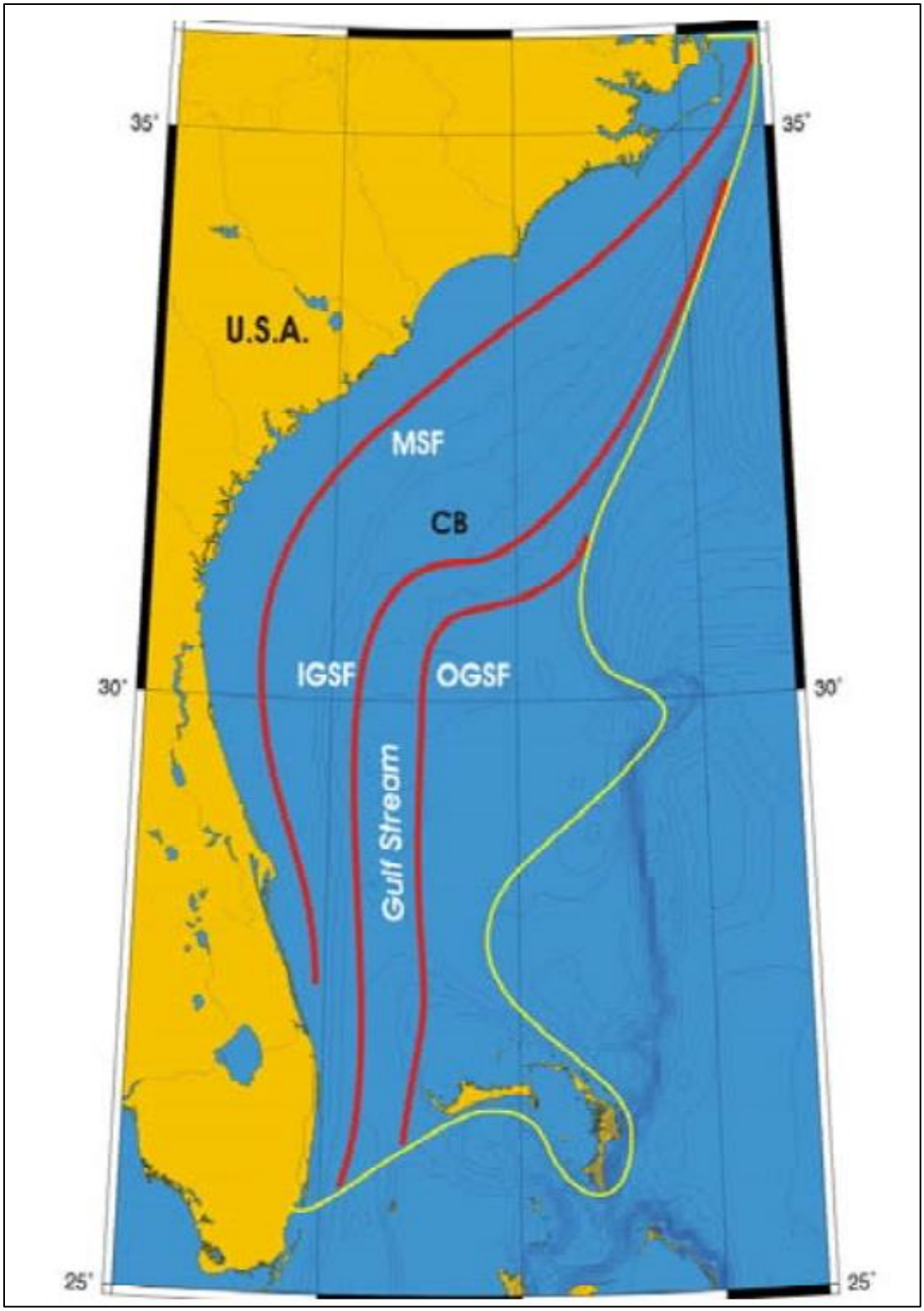

Figure 2-2 Fronts of the Southeast U.S. Continental Shelf LME

Notes: CB=Charleston Bump, IGSF=Inshore Gulf Stream Front, MSF=Mid-Shelf Front, OGSF=Offshore Gulf Stream Front. Yellow line=LME Boundary. After Belkin et al. (2009)

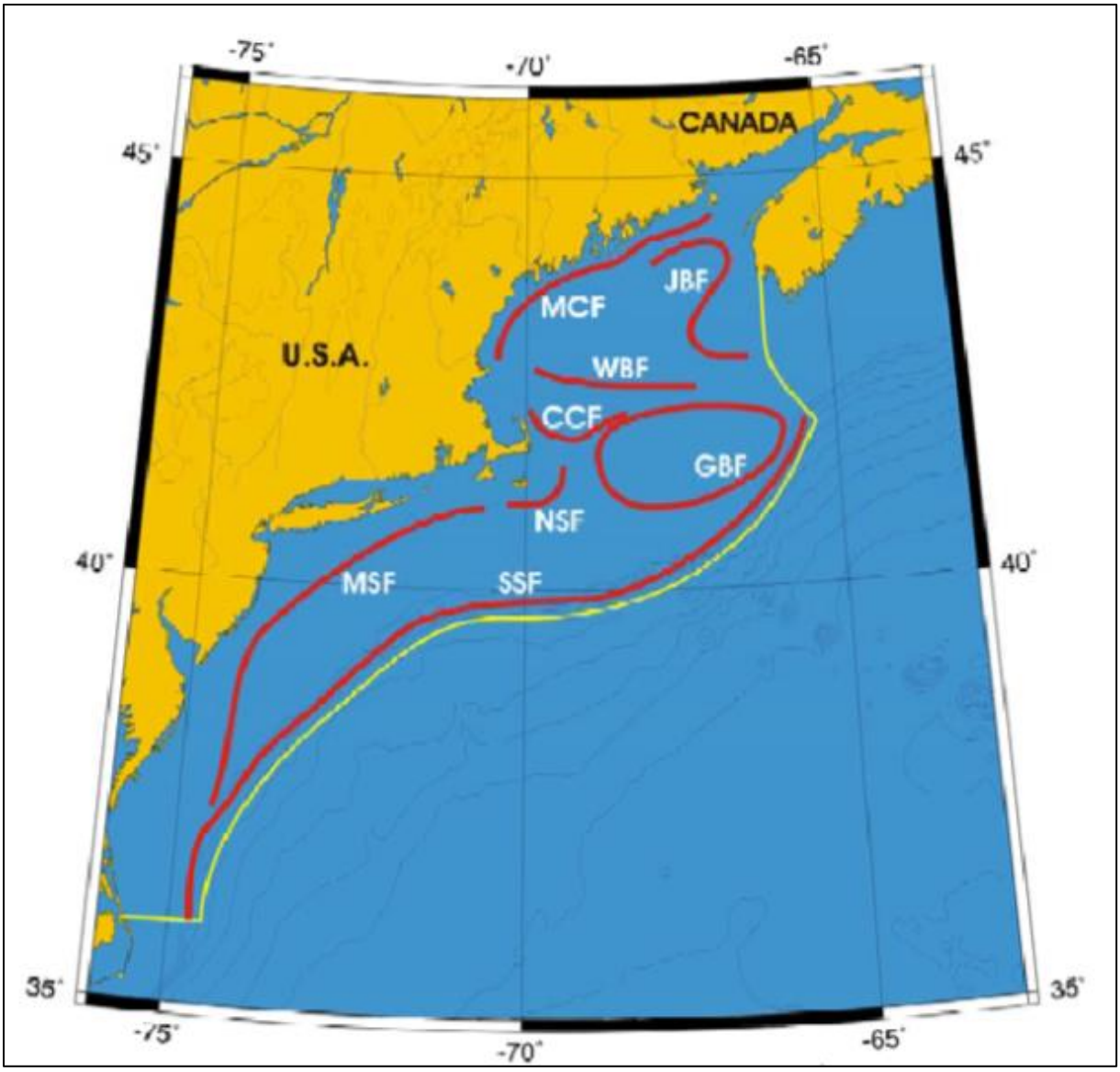

Figure 2-3 Fronts of the Northeast U.S. Continental Shelf LME

Notes: CCF=Cape Cod Front, GBF=Georges Bank Front, MCF=Main Coastal Front, MSF=Mid-Shelf Front, NSF=Nantucket Shoals Front, SSF=Shelf-Slope Front, Yellow line=LME boundary. After Belkin et al. (2009)

2.1.2 Gulf of Mexico Research Area

The SEFSC conducts fisheries research in portions of the GOM LME. The Marine Mammal and Ecosystem Assessment Survey and the Caribbean Plankton Recruitment Experiment periodically extend outside of the U.S. EEZ in the GOMRA (Figure 2-1).

The GOM LME is a deep marginal sea bordered by Cuba, Mexico, and the U.S. It is the largest semi-enclosed coastal sea of the western Atlantic, encompassing more than 1.5 million km^2, of which 1.57% is protected, as well as 0.49% of the world's coral reefs and 0.02% of the world's sea mounts (Sea Around Us 2007). The continental shelf is very extensive, comprising about 30% of the total area, and is topographically very diverse (Heileman and Rabalais 2009). Oceanic water enters this LME from the Yucatan channel and exits through the Straits of Florida, creating the Loop Current, a major oceanographic feature and part of the Gulf Stream System (Lohrenz et al. 1999) (see Figure 2-4). The

LME is strongly influenced by freshwater input from rivers, particularly the Mississippi-Atchafalaya, which accounts for about two-thirds of the flows into the Gulf (Richards & McGowan 1989). Forty-seven major estuaries are found in this LME (Sea Around Us 2007). Important hydrocarbon seeps exist in the southernmost and northern parts of the LME (Richards and McGowan 1989). A major climatological feature is tropical storm activity, including hurricanes.

From December through March, two major oceanic fronts emerge over two shelf areas, the West Florida Shelf (WFS) and Louisiana-Texas Shelf (LTS). The WFS Front extends over the mid-shelf, whereas the LTS Front is located closer to the shelf break. Both fronts form owing to cold air outbreaks (Huh et al. 1978). Huge freshwater discharge from the Mississippi River Estuary and rivers of the Florida Panhandle contribute to the fronts' development and maintenance. Compared to these northern fronts, the Campeche Bank Shelf-Slope Front and Campeche Bank Coastal Front in the south are weak and unstable. The Loop Current Front is always present at the inshore boundary of the namesake front, best defined in winter.

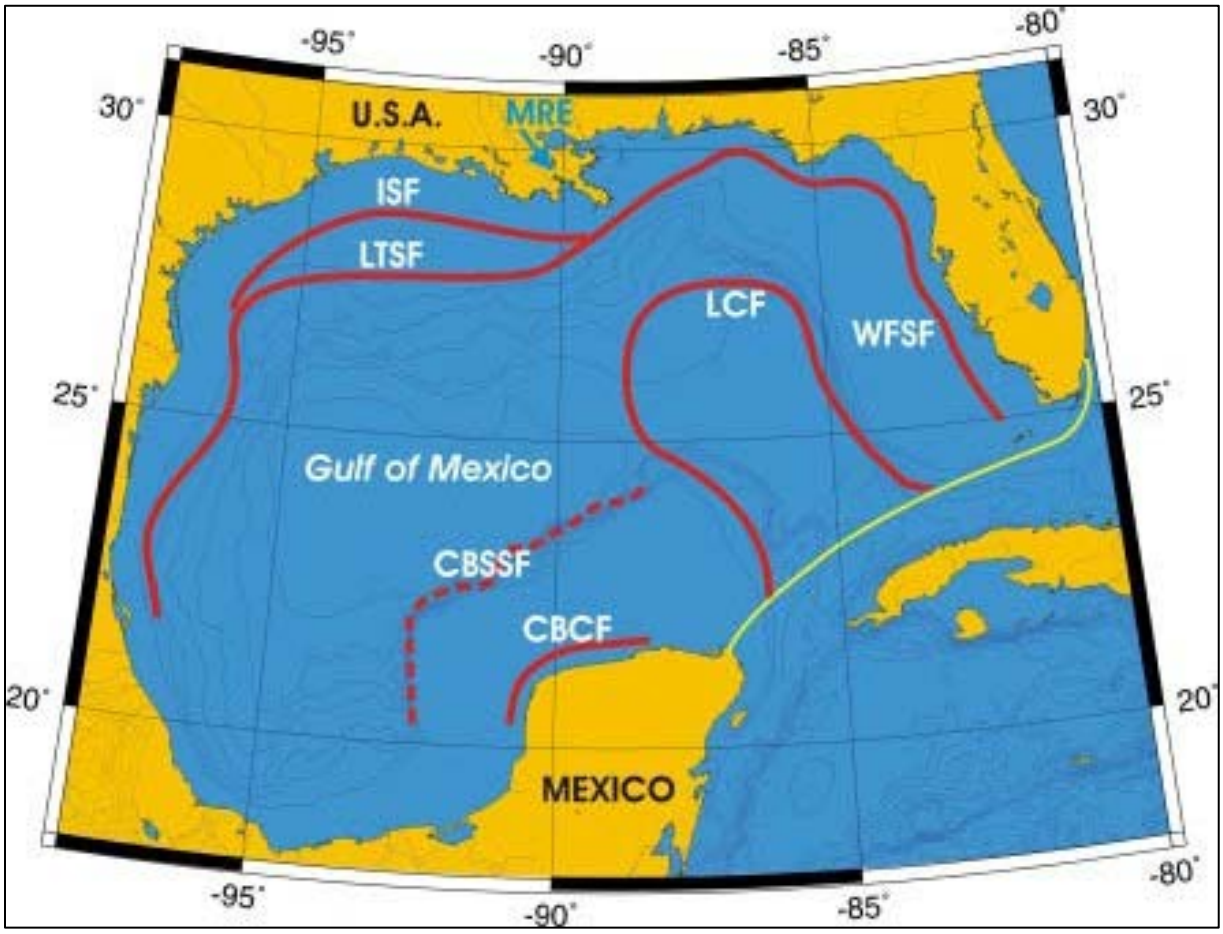

Figure 2-4 Fronts of the Gulf of Mexico LME

Notes: CBCF=Campeche Bank Coastal Front, CBSSF=Campeche Bank Shelf-Slope Front (most probable location), ISF=Inner Shelf Front, LCF=Loop Current Front, LTSF=Louisiana-Texas shelf Front, MRE=Mississippi River Estuary, WFSF=West Florida Shelf Front. Yellow line=LME boundary. After Belkin and Cornillon (2007)

2.1.3 Caribbean Research Area

The SEFSC conducts fisheries research in portions of the Caribbean Sea LME. The Marine Mammal and Ecosystem Assessment Survey and the Caribbean Plankton Recruitment Experiment periodically extend outside of the U.S. EEZ in the CRA (Figure 2-1).

The CS LME is a tropic sea bounded by North America (South Florida), Central and South America, and the Antilles chain of islands. The LME has a surface area of about 3.3 million km^2, of which 3.89% is protected (Heileman and Mahon 2009). It contains 7.09% of the world's coral reefs and 1.35% of the world's sea mounts (Sea Around Us 2007). The average depth is 2,200 meters, with the Cayman Trench being the deepest part at 7,100 meters. Most of the Caribbean islands are influenced by the nutrient-poor North Equatorial Current that enters the Caribbean Sea through the passages between the Lesser Antilles islands. A significant amount of water is transported northwestward by the Caribbean Current through the Caribbean Sea and into the Gulf of Mexico, via the Yucatan Current. Run-off from two of the largest river systems in the world, the Amazon and the Orinoco, as well as numerous other large rivers, dominates the north coast of South America (Muller-Karger 1993).

In the southern Caribbean Sea, oceanic fronts are generated by coastal wind-induced upwelling off of Venezuela and Columbia (see Figure 2-5). A 100-km long front separates the Gulf of Venezuela, likely caused by brackish water outflow from Lake Maracaibo and combined with coastal upwelling. Two shelf-break fronts off Cuba encompass two wide shelf areas off the southern Cuban coast. The Windward Passage Front between Cuba and Hispaniola separates the westward Atlantic inflow waters moving into the Caribbean in the western part of the passage from the Caribbean outflow waters heading eastward in the eastern portion of the passage. A 200-km long front in the Gulf of Honduras peaks during the winter, likely related to a salinity differential between the Gulf's apex and onshore waters caused by high precipitation in southern Belize (Heyman and Kjerfve 1999).

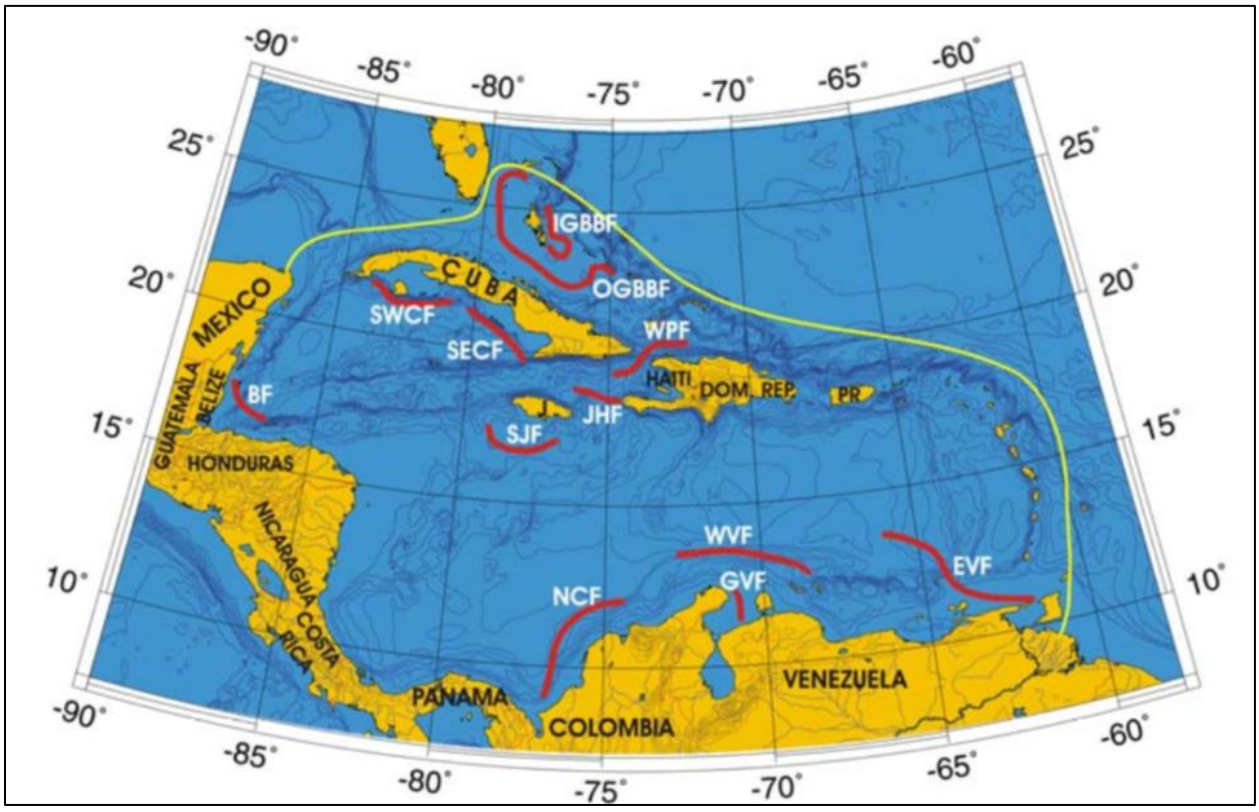

Figure 2-5 Fronts of the Caribbean Sea LME

Notes: BF=Belize Front, DOM.REP=Dominican Republic, EVF=East Venezuela Front, GFV=Gulf of Venezuela Front, IGBBF=Inner Great Bahama Bank Front, JHF=Jamaica-Haiti Front, NCF=North Colombia Front, OGBBF=Outer Great Bahama Bank Front, PR=Puerto Rico (U.S.), SECF=Southeast Cuba Front, SJF=South Jamaica Front, SWCF=Southwest Cuba Front, WPF=Windward Passage Front, WVF=West Venezuela Front, Yellow Line=LME boundary. After Belkin et al. (2009)

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS LIKELY TO BE FOUND WITHIN THE ACTIVITY AREA

Marine mammal abundance estimates in this application represent the total number of individuals that make up a given stock or the total number estimated within a particular study area. NMFS stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. Survey abundance (as compared to stock or species abundance) is the total number of individuals estimated within the survey area, which may or may not align completely with a stock's geographic range as defined in the NMFS Stock Assessment Reports (SARs) (http://www.nmfs.noaa.gov/pr/sars/region.htm). These surveys may also extend beyond U.S. waters. Both stock abundance and survey abundance are used in this application when available to determine a density of marine mammal species within the survey area.

The species and approximate numbers of marine mammals likely to be found in the three SEFSC activity areas are shown in Tables 3-1, 3-2 and 3-3. Extralimital or rarely sighted species are not included. These are species that do not normally occur in the survey area for which there are one or more records that are considered beyond the normal range. These species are not likely to be 'taken' pursuant to the MMPA during survey operations and therefore are not included in the take request. Extralimital or rarely sighted species within the SEFSC's ARA include the North Atlantic bottlenose whale (*Hyperoodon ampullatus*), blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), Bryde's whale (*B. edeni*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), white-beaked dolphins (*Lagenorhynchus albirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), harp seal (*Pagophilus groenlandicus*), and hooded seal (*Cystophora cristata*). Extralimital or rarely sighted species in the GOMRA include the North Atlantic right whale (*Eubalaena glacialis*), blue whale, fin whale (*B. physalus*), sei whale, minke whale (*B. acutorostrata*), humpback whale (*Megaptera novaeangliae*), and Sowerby's beaked whale. In the Puerto Rico/Virgin Islands region extralimital or rarely sighted species include blue whale, fin whale, sei whale, Bryde's whale, minke whale, harbor seal (*Phoca vitulina*), gray seal (*Halichoerus grypus*), harp seal, and hooded seal. Caribbean manatees (*Trichechus manatus*) also occur within the SEFSC survey areas but are under the jurisdiction of the U.S. Fish and Wildlife Service and will not be discussed in this application.

Twenty-seven cetacean species and two pinniped species have been recorded off the southeastern coast of the U.S. Species are seasonally distributed throughout continental shelf and shelf break waters, with some species extending into deeper oceanic waters to the EEZ and beyond (Table 3-1). The federal status and approximate numbers of marine mammals in the area where SEFSC fisheries research is conducted are shown in Tables 3-2 and 3-3. The list includes five cetacean species that are also listed as endangered under the ESA [North Atlantic right whale, humpback whale, fin whale, sei whale (*B. borealis*), and sperm whale (*Physeter macrocephalus*)] and one cetacean designated as depleted under the MMPA [five stocks of bottlenose dolphins (*Tursiops truncatus*)]. Table 3-3 lists the numerous stocks of bottlenose dolphins, recognized by NMFS for management purposes, which occur in the ARA. Some are designated as depleted or strategic under the MMPA.

Twenty one species of cetaceans have been recorded in the Gulf of Mexico (Table 3-1). The list includes the sperm whale that is also listed as endangered under the ESA. Table 3-3 lists the numerous stocks of bottlenose dolphins in the Gulf of Mexico recognized by NMFS for management purposes, some of which are designated as depleted or strategic under the MMPA. As with marine mammals in the ARA off the southeastern U.S., species are distributed throughout continental shelf and shelf break waters, with some species extending into deeper waters to the EEZ and beyond the EEZ.

Twenty one cetacean species have been recorded in the CRA, off Puerto Rico and the U.S. Virgin Islands, including humpback and sperm whales which are listed as endangered under the ESA (Tables 3-1 and 3-2).

SEFSC survey activity occurs during all months of the year; trawl surveys occur during all months, longline surveys occur principally from March – October, and the other gear used in numerous surveys also occurs in all months in most years. Thus both sexes and all age groups of most of the marine mammal species that occur in the three ecosystems where the SEFSC conducts fisheries research may be present when surveys occur.

Table 3-1 Marine mammal species that regularly occur in the SEFSC Atlantic (ARA), Gulf of Mexico (GOMRA), and Caribbean (CRA) Research Areas

Species		ARA	GOMRA	CRA
Common Name	**Scientific Name**			
CETACEANS				
North Atlantic right whale	*Eubalaena glacialis*	X		
Humpback whale	*Megaptera novaeangliae*	X	X	X
Fin whale	*Balaenoptera physalus*	X	X	
Minke whale	*Balaenoptera acutorostrata*	X	X	X
Bryde's whale	*Balaenoptera edeni*		X	
Sperm whale	*Physeter macrocephalus*	X	X	X
Pygmy or dwarf sperm whale	*Kogia breviceps or K. sima*	X	X	X
Killer whale	*Orcinus orca*	X	X	X
Pygmy killer whale	*Feresa attenuata*	X	X	X
False killer whale	*Pseudorca crassidens*	X	X	X
Cuvier's beaked whale	*Ziphius cavirostris*	X	X	X
Mesoplodont beaked whales	*Mesoplodon spp.*	X	X	X
Melon-headed whale	*Peponocephala electra*	X	X	X
Risso's dolphin	*Grampus griseus*	X	X	X
Short-finned pilot whale	*Globicephala macrorhynchus*	X	X	X
Long-finned pilot whale	*Globicephala melas*	X		
Short-beaked common dolphin	*Delphinus delphis*	X		
Atlantic spotted dolphin	*Stenella frontalis*	X	X	X
Pantropical spotted dolphin	*Stenella attenuata*	X	X	X
Striped dolphin	*Stenella coeruleoalba*	X	X	X
Fraser's dolphin	*Lagenodelphis hosei*	X	X	X
Rough-toothed dolphin	*Steno bredanensis*	X	X	X
Clymene dolphin	*Stenella clymene*	X	X	X
Spinner dolphin	*Stenella longirostris*	X	X	X
Bottlenose dolphin (numerous stocks, see Table 3-3)	*Tursiops truncatus*	X	X	X
Harbor porpoise	*Phocoena phocoena*	X		
PINNIPEDS				
Harbor seal	*Phoca vitulina concolor*	X		
Gray seal	*Halichoerus grypus*	X		

Table 3-2 Numbers and federal status of marine mammals that occur in the SEFSC research areas

Common Name (Stock)	Federal ESA/MMPA Status[1]	Estimated [2] Minimum Number (N_{min})	Estimated [2] Best Number (N_{best})
ATLANTIC RESEARCH AREA			
North Atlantic right whale (Western North Atlantic)	Endangered	476	476
Humpback whale [3] (Gulf of Maine)	Endangered	823	823
Fin whale (Western North Atlantic)	Endangered	1,234	1,618
Minke whale (Canadian East Coast)		16,199	20,741
Sperm whale (North Atlantic)	Endangered	1,815	2,288
Pygmy and dwarf sperm whales (Western North Atlantic)		2,598	3,785
Killer whale (Western North Atlantic)		unknown	unknown
Pygmy killer whale (Western North Atlantic)		unknown	unknown
False killer whale (Western North Atlantic)		212	442
Cuvier's beaked whale (Western North Atlantic)		5,021	6,532
Mesoplodon beaked whales: Blainville's, Gervais' and True's (Western North Atlantic)		4,632	7,092
Melon-headed whale (Western North Atlantic)		unknown	unknown
Risso's dolphin (Western North Atlantic)		12,619	18,250
Short-finned pilot whale (Western North Atlantic)		15,913	21,515
Long-finned pilot whale (Western North Atlantic)		3,464	5,636
Short-beaked common dolphin (Western North Atlantic)		112,531	173,486
Atlantic spotted dolphin (Western North Atlantic)		31,610	44,715
Pantropical spotted dolphin (Western North Atlantic)		1,733	3,333
Striped dolphin (Western North Atlantic)		42,804	54,807
Fraser's dolphin (Western North Atlantic)		unknown	unknown
Rough-toothed dolphin (Western North Atlantic)		134	271
Clymene dolphin (Western North Atlantic)		unknown	unknown
Spinner dolphin (Western North Atlantic)		unknown	unknown
Bottlenose dolphin (see Table 3-3)	see Table 3-3	see Table 3-3	see Table 3-3

Common Name (Stock)	Federal ESA/MMPA Status[1]	Estimated [2] Minimum Number (N_{min})	Estimated [2] Best Number (N_{best})
Harbor porpoise (Gulf of Maine/Bay of Fundy)		61,415	79,833
Harbor seal (Western North Atlantic)		66,884	75,834
Gray seal (Western North Atlantic)		unknown	unknown
GULF OF MEXICO RESEARCH AREA			
Humpback whale [3] (Western North Atlantic)	Endangered	unknown	unknown
Fin whale (Western North Atlantic) [4]	Endangered	unknown	unknown
Minke whale (Canadian East Coast) [4]		unknown	unknown
Bryde's whale (Northern Gulf of Mexico)	Strategic	16	33
Sperm whale (Northern Gulf of Mexico)	Endangered	560	763
Pygmy or dwarf sperm whale (Northern Gulf of Mexico)		90	186
Killer whale (Northern Gulf of Mexico)		14	28
Pygmy killer whale (Northern Gulf of Mexico)		75	152
False killer whale (Northern Gulf of Mexico)		unknown	unknown
Cuvier's beaked whale (Northern Gulf of Mexico)		36	74
Mesoplodon beaked whales: Blainville's and Gervais' (Northern Gulf of Mexico)		77	149
Melon-headed whale (Northern Gulf of Mexico)		1,274	2,235
Risso's dolphin (Northern Gulf of Mexico)		1,563	2,442
Short-finned pilot whale (Northern Gulf of Mexico)		1,456	2,415
Atlantic spotted dolphin (Northern Gulf of Mexico)		unknown	unknown
Pantropical spotted dolphin (Northern Gulf of Mexico)		40,699	50,880
Striped dolphin (Northern Gulf of Mexico)		1,041	1,849
Rough-toothed dolphin (Northern Gulf of Mexico)		311	624
Clymene dolphin (Northern Gulf of Mexico)		64	129
Spinner dolphin (Northern Gulf of Mexico)		6,221	11,441
Bottlenose dolphin (see Table 3-3)	see Table 3-3	See Table 3-3	see Table 3-3
CARIBBEAN RESEARCH AREA[5]			

Common Name (Stock)	Federal ESA/MMPA Status[1]	Estimated [2] Minimum Number (N_{min})	Estimated [2] Best Number (N_{best})
Humpback whale (Western North Atlantic) [3]	Endangered	unknown	unknown
Minke whale		unknown	unknown
Sperm whale (Puerto Rico and U.S. Virgin Islands)	Endangered	unknown	unknown
Pygmy or dwarf sperm whale		unknown	unknown
Killer whale		unknown	unknown
False killer whale		unknown	unknown
Pygmy killer whale		unknown	unknown
Cuvier's beaked whale (Puerto Rico and U.S. Virgin Islands)	Strategic	unknown	unknown
Mesoplodont beaked whales		unknown	unknown
Melon-headed whale		unknown	unknown
Risso's dolphin		unknown	unknown
Short-finned pilot whale (Puerto Rico and U.S. Virgin Islands)	Strategic	unknown	unknown
Atlantic spotted dolphin (Puerto Rico and U.S. Virgin Islands)	Strategic	unknown	unknown
Pantropical spotted dolphin		unknown	unknown
Striped dolphin		unknown	unknown
Fraser's dolphin		unknown	unknown
Rough-toothed dolphin		unknown	unknown
Clymene dolphin		unknown	unknown
Spinner dolphin (Puerto Rico and U.S. Virgin Islands)	Strategic	unknown	unknown
Bottlenose dolphin (Puerto Rico and U.S. Virgin Islands)	Strategic	unknown	unknown

1. Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted or strategic. All marine mammal stocks are considered protected under the MMPA. All ESA-listed stocks are also considered depleted and strategic.
2. Waring et al 2007, 2009, 2010, 2011, 2012, 2014, 2015a, 2015b, but see Section 4 below.
3. Humpback whales have been proposed for reclassification; see species account in Section 4. The best available estimate for the entire Western North Atlantic population is 11,570 (Stevick et al. 2003b); estimates of abundance for humpbacks in the GOMRA and CRA are unknown.
4. Estimated abundance of the portion of these stocks in the GOMRA is unknown. See the Atlantic Research Area for total stock estimates.
5. Stock delineations and abundance information for many marine mammal species in the CRA are limited. Until data are available to indicate otherwise, the SEFSC assumes that species in the CRA constitute separate stocks from the ARA and GOMRA. Delineated stocks are included in the table; those lacking stock names are those for which the stock is not yet delineated.

Table 3-3 Stocks of bottlenose dolphins (*Tursiops truncatus*) in the SEFSC research areas

Stock	MMPA Status[1]	N_{min} [2]	N_{best} [2]
ATLANTIC RESEARCH AREA			
Western North Atlantic Offshore	Not Strategic	56,053	77,532

Stock	MMPA Status[1]	N_{min} [2]	N_{best} [2]
Northern Coastal Migratory	Depleted	8,620	11,548
Southern Coastal Migratory	Depleted	6,326	9,173
Coastal, South Carolina & Georgia	Depleted	3,097	4,377
Coastal, Northern Florida	Depleted	730	1,219
Coastal, Central Florida	Depleted	2,851	4,895
Northern North Carolina Estuarine System	Strategic	782	823
Southern North Carolina Estuarine System	Strategic	unknown	unknown
Northern South Carolina Estuarine System	Strategic	unknown	unknown
Charleston Estuarine System	Strategic	unknown	unknown
Northern Georgia/Southern South Carolina Estuarine System	Strategic	unknown	unknown
Central Georgia Estuarine System	Strategic	185	192
Southern Georgia Estuarine System	Strategic	185	194
Jacksonville Estuarine System	Strategic	unknown	unknown
Indian River Lagoon Estuarine System	Strategic	unknown	unknown
Biscayne Bay	Strategic	unknown	unknown
Florida Bay	Not Strategic	unknown	unknown
GULF OF MEXICO RESEARCH AREA			
Oceanic	Not Strategic	4,230	5,806
Continental Shelf	Not Strategic	46,926	51,192
Western Coastal	Not Strategic	17,491	20,161
Northern Coastal	Not Strategic	6,004	7,185
Eastern Coastal	Not Strategic	11,110	12,388
Northern Gulf of Mexico Bay, Sound, and Estuary (31 stocks listed below) [3,4]			
Laguna Madre[3]	Strategic	unknown	unknown
Nueces Bay, Corpus Christi Bay[3]	Strategic	unknown	unknown
Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espirtu Santo Bay[3]	Strategic	unknown	unknown
Matagorda Bay, Tres Palacios Bay, Lavaca Bay[3]	Strategic	unknown	unknown
West Bay[3]	Strategic	unknown	unknown
Galveston Bay, East Bay, Trinity Bay[3]	Strategic	unknown	unknown
Sabine Lake[3]	Strategic	unknown	unknown
Calcasieu Lake[3]	Strategic	unknown	unknown
Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay[3]	Strategic	unknown	unknown
Terrebonne Bay, Timbalier Bay[3]	Strategic	unknown	unknown
Barataria Bay[4]	Strategic	unknown	unknown
Mississippi River Delta[3]	Strategic	170	332

Stock	MMPA Status[1]	N_{min} [2]	N_{best} [2]
Mississippi Sound, Lake Borgne, Bay Boudreau[3]	Strategic	551	901
Mobile Bay, Bonsecour Bay[3]	Strategic	unknown	unknown
Perdido Bay[3]	Strategic	unknown	unknown
Pensacola Bay, East Bay[3]	Strategic	unknown	unknown
Choctawhatchee Bay[4]	Strategic	173	179
St. Joseph Bay[4]	Strategic	142	152
St. Andrews Bay[3]	Strategic	unknown	unknown
St. Vincent Sound, Apalachicola Bay, St. Georges Sound[3]	Strategic	390	439
Apalachee Bay[3]	Strategic	unknown	unknown
Waccasassa Bay, Withlacoochee Bay, Crystal Bay[3]	Strategic	unknown	unknown
St. Joseph Sound, Clearwater Harbor[3]	Strategic	unknown	unknown
Tampa Bay[3]	Strategic	unknown	unknown
Sarasota Bay, Little Sarasota Bay[3]	Strategic	160	160
Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay[3]	Strategic	unknown	unknown
Caloosahatchee River[3]	Strategic	unknown	unknown
Estero Bay[3]	Strategic	unknown	unknown
Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay[3]	Strategic	unknown	unknown
Whitewater Bay[3]	Strategic	unknown	unknown
Florida Keys (Bahia Honda to Key West)[3]	Strategic	unknown	unknown
CARIBBEAN RESEARCH AREA			
Puerto Rico and U.S. Virgin Islands	Strategic	unknown	unknown

1. Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted. All marine mammal stocks are considered protected under the MMPA.
2. Waring et al. 2012, 2013, 2014, 2015a and b
3. NMFS is in the process of writing individual stock assessment reports for each of these Gulf of Mexico bay, sound and estuary (BSE) stocks of bottlenose dolphins.
4. Mississippi River Delta; Mississippi Sound, Lake Borgne, Bay Boudreau; St. Joseph; Choctawhatchee Bay; St. Vincent Sound, Apalachiola Bay, St. George Sound; and Sarasota Bay, Little Sarasota Bay stocks are the only stocks among the 31 BSE stocks for which there are recent estimates.

The SEFSC conducts conducts aerial- and ship-based line-transect surveys to estimate marine mammal abundance and density. In the ARA ship-based surveys are conducted during summer that combined cover the U.S. EEZ from the Maryland-Virginia border south to central Florida. Additional aerial surveys are conducted during summer in the coastal waters north to northern New Jersey. Densities to estimate acoustic takes for each species were estimated for continental shelf and offshore habitats based on these surveys. Bottlenose dolphin abundances for the shelf habitat were based on aerial surveys conducted during 2010 and 2011 (Waring et al. 2015). Bottlenose dolphins and Atlantic spotted dolphins (which generally occur in waters >20 m deep) are not easily differentiated during aerial surveys. There is no recent abundance estimate for Atlantic spotted dolphins in continental shelf waters. Therefore, the best scientific information available for estimating acoustic takes for this species comes from an abundance estimate for continental shelf waters from a 1998 ship survey that included shelf waters (Mullin and

Fulling 2003), which was used to estimate density. Abundances for offshore species were based on a 2011 ship survey similar in methods to Garrison et al. (2010 in Waring et al. 2015).

Other marine mammal species are rarely seen or are seasonal in the ARA. Consequently, there are no stock abundance or density estimates for these species specific to the SEFSC research areas. For the ARA these species include North Atlantic right whale, sei whale, minke whale, humpback whale, melon-headed whale, pygmy killer whale, Fraser's dolphin, long-finned pilot whale, killer whale, spinner dolphin, Clymene dolphin, harbor porpoise, harbor seal and gray seal.

In the GOMRA, the SEFSC conducts seasonal aerial-based line-transect marine mammal abundance surveys of continental shelf waters. To estimate marine mammal abundance in offshore waters, ship-based line-transect surveys are conducted during summer. Combined these efforts cover the U.S. EEZ in the Gulf of Mexico. Estimated densities of these species based on the survey data for continental shelf and offshore habitats was used to estimate acoustic takes. Bottlenose dolphin density in continental shelf waters were based on the inverse-variance weighted average of seasonal abundance estimates from aerial surveys conducted during spring 2011, summer 2011, fall 2011, and winter 2012 (Waring et al. 2015b). Similar to the ARA, there is not a recent abundance estimate for Atlantic spotted dolphins in waters from 20-200 m deep. Rough-toothed dolphins also occasionally inhabit shelf waters in the Gulf of Mexico and there is no recent abundance estimate for shelf waters. The best available scientific information for both species comes from the abundance estimates from 1998-2001 ship surveys of continental shelf waters (Fulling et al. 2003). Abundance estimates for most offshore species were based on line-transect ship survey data from systematic line-transect surveys conducted during summer 2003, spring 2004, and summer 2009 (SEFSC unpublished) and were similar to those reported by Mullin and Fulling (2004). Both beaked whales (*Ziphius cavirostris* and *Mesoplodon* spp.) and the pygmy/dwarf sperm whales are difficult to detect using visual surveys. These species groups are deep divers with long duration dives and are difficult to detect visually when they are at the surface. The available visually-based abundance estimates from the 2003, 2004, and 2009 vessel surveys are therefore severely negatively biased for these species because data are not available to correct for this bias. Passive acoustic monitoring units were deployed during 2010-2011 in the Mississippi Canyon region and analyses were conducted to estimate densities of both beaked whales and *Kogia* spp. based upon detections and identification of echolocation clicks (SEFSC unpublished). These densities were used to estimate acoustic takes in the Gulf of Mexico. Fraser's dolphin occurs in the GOMRA but was rarely seen and there is no abundance estimate.

For completeness and to avoid redundancy, the required information about all marine mammal species and numbers of each (insofar as it is known), are included in Section 4. Because density estimates are most relevant in this application to the determination of the acoustic take request, those values are provided in Section 6.2.5.

4.0 STATUS, DISTRIBUTION AND SEASONAL DISTRIBUTION OF AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS

The following information summarizes data on the affected species, by research area, their status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities, as available in published literature and reports, including marine mammal stock assessment reports. A brief synopsis of marine mammal acoustics and hearing precedes the species descriptions.

Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators. General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au and Hastings (2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). Interfering with these functions through anthropogenic noise could result in potential adverse impacts.

Southall et al. (2007) provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Assignment was based on behavioral psychophysics (the relationship between stimuli and responses to stimuli), evoked potential audiometry, auditory morphology, and, for pinnipeds, whether they were hearing through air or water. Because no direct measurements of hearing exist for baleen whales, hearing sensitivity was estimated from behavioral responses (or lack thereof) to sounds, commonly used vocalization frequencies, body size, ambient noise levels at common vocalization frequencies, and cochlear measurements. NOAA modified the functional hearing groups of Southall et al. (2007) to extend the upper range of low-frequency cetaceans and to divide the pinniped hearing group into Phocid and Otariid hearing groups (NOAA 2015). Detailed descriptions of marine mammal auditory weighting functions and functional hearing groups are available in NOAA (2015). Table 4-1 presents the functional hearing groups and representative species or taxonomic groups for each that occur in SEFSC research areas. Most species found in the SEFSC project areas are in the first two groups, low frequency cetaceans (baleen whales) and mid frequency cetaceans (odontocetes); pinnipeds are rare in SEFSC areas and only retained in the table for information purposes.

Table 4-1 Summary of the five functional hearing groups of marine mammals

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low frequency cetaceans (Mysticetes–Baleen whales)	7 Hz to 25 kHz (best hearing is generally below 1000 Hz, higher frequencies result from humpback whales)	All baleen whales
Middle frequency Cetaceans (Odontocetes)	150 Hz to 160 kHz (best hearing is from approximately 10-120 kHz)	Includes species in the following genera: *Steno*, *Tursiops*, *Stenella*, *Delphinus*, *Lagenodelphis*, *Grampus*, *Peponocephala*, *Feresa*, *Orcinus*, *Globicephala*, *Physeter*, *Ziphius*, *Mesoplodon*
High frequency cetaceans (Odontocetes)	200 Hz to 180 kHz (best hearing is from approximately 10-150 kHz)	Includes species in the genera *Kogia* and *Phocoena*
Phocid pinnipeds (true seals)	75 Hz to 100 kHz (best hearing is from approximately 1-30 kHz)	Includes species in the genera *Phoca* and *Halichoerus*
Otariid pinnipeds (sea lions and fur seals)	100 Hz to 48 kHz (best hearing is from approximately 1-16 kHz)	None occur in SEFSC research areas

All life history and abundance data for the marine mammal species described below is obtained from literature as cited and, where not cited, is from the most recent relevant NMFS Stock Assessment Reports (Waring et al. 2015a,b, and previous). The minimum population size presented in each species account is calculated as the lower 20th percentile of the log-normal distribution of the most recent abundance estimate (Barlow et al. 1995). The potential biological removal (PBR) is calculated as the minimum population size within the U.S. EEZ of the stock's region times one half the default maximum net growth rate for the species, times a recovery factor that varies from 1.0 to 0.1 depending on the status of the stock (Wade and Angliss 1997).

NMFS manages the species described below by designating stocks based on their geographic ranges, habitat use, genetics, and other factors. For the purposes of this LOA application and the corresponding Draft PEA, the geographic research areas within the SEFSC region were broken into the three research areas (ARA, GOMRA, and CRA). The stock structure of many species is unknown or has not been completely determined throughout these research areas; this is particularly true of the CRA. Given these sources of uncertainty regarding stock structures, we have attempted to make clear where each species is known to occur within the context of the three research areas. Source information for data found outside of the Stock Assessment Reports is provided, since not all data is currently published or publically available.

4.1 Cetaceans

4.1.1 North Atlantic Right Whale (*Eubalaena glacialis*) – Western North Atlantic Stock

Description: As summarized in Kenney (2009) right whales have an extremely robust body form with a thick blubber layer and the girth at times exceeding 60% of total body length. The head is relatively large, comprising about one quarter to one third of the body length and the upper jaw is arched. The body is mostly black, sometimes with irregular white ventral patches. There is no dorsal fin and the pectoral flippers are large, broad, and blunt; the flukes are very broad. Baleen plates are relatively narrow and 2-2.8 m long. The most conspicuous external characteristic of right whales are the callosities on the head which are irregular patches of keratinized tissue inhabited by dense populations of specialized amphipod crustaceans, known as cyamids or whale lice. Adults are typically 13-16 m long.

Abundance and Stock Status: The North Atlantic right whale is considered one of the most critically endangered large whales in the world (Clapham et al. 1999, Perry et al. 1999, Kenney 2009). A Recovery Plan, originally published in 1991 and most recently revised in 2005, is currently in effect for this species (NMFS 2005). The small population size leaves this stock vulnerable to anthropogenic impacts throughout much of its range (NMFS 2006a).

The western North Atlantic right whale stock was estimated to include at least 476 individuals in 2011 (Waring et al. 2015b). The estimated population growth rate was 2.5% for the period 1986-1992 (Knowlton et al. 1994). Subsequent analyses suggested declining survival probability in the 1990s (Best et al. 2001, Caswell et al. 1999, Clapham 2002). Recent review of the minimum number alive population index derived from the individual sightings database indicates a positive population trend, with a geometric mean growth rate of 2.8% for the years 1990-2011 (Waring et al. 2015b).

Based on the minimum population size of 476, a recovery factor of 0.1 and a maximum productivity rate of 0.04, the PBR for the Western Atlantic stock of North Atlantic right whales is 1.0. The minimum rate of anthropogenic mortality and serious injury to right whales averaged 4.3 per year, 2009-2013. This includes reported incidental fishery entanglements of 3.4 per year (U.S. waters, 0.2; Canadian waters, 0; unassigned location, first sighting in U.S., 2.05; unassigned location, first sighting in Canada, 1.15) and reported ship strikes of 0.9 per year (U.S. waters, 0.7; Canadian waters, 0; unassigned location, first sighted in U.S., 0.2; unassigned location, first sighting in Canada, 0). All but one of the fishery entanglements resulting in serious injury or mortality reported in U. S. waters during this period occurred

after the Atlantic Large Whale Take Reduction Plan's sinking-groundline rule went into effect in 2009. All of the five reported ship strike serious injury and mortalities in U.S. waters during this time occurred after the speed limit rule went into effect in December 2008, although none occurred in areas with mandated speed restrictions under the rule (Waring et al. 2015b). Given that the species is critically endangered and that the average annual anthropogenic mortality and serious injury exceeds PBR, no mortality or serious injury is considered insignificant (Waring et al. 2015b).

Distribution and Habitat: The western North Atlantic right whale population ranges from wintering and calving grounds in the coastal waters of the southeastern U.S. to summer feeding and nursery grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Cetacean and Turtle Assessment Program [CETAP] 1982, Waring et al. 2015b). The six major congregation areas are: coastal waters of the southeastern U.S. (Georgia-North Florida coast); the Great South Channel; Gulf of Maine/Georges Bank; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf (Waring et al. 2013). The only known calving and nursery grounds are in the coastal waters off the southeastern U.S., from Savannah, Georgia to St. Augustine, Florida, although calf sightings off North Carolina suggest that calving grounds may extend as far north as Cape Fear (McLellan et al. 2004). Sightings in the Gulf of Mexico are rare and are likely either anomalies or in areas that were historically part of the winter range of right whales (Moore and Clark 1963, Schmidly et al. 1972, Ward-Geiger et al. 2011, Waring et al. 2013).

In 1994, NMFS designated critical habitat for the northern right whale in U.S. waters of the North Atlantic (59 FR 28805, June 3, 1994; Figure 4-1). The Cape Cod Bay and Great South Channel Critical Habitat Areas are important feeding and nursery areas off the New England coast. The Southeastern U.S. Critical Habitat Area is located off the coasts of Florida and Georgia and is a primary calving area for this population. On February 20, 2015, NMFS proposed to replace the critical habitat for North Atlantic right whales with two new areas (80 FR 9314). On January 27, 2016 (81 FR 4838), NMFS published a final rule redefining critical habitat for North Atlantic right whales, including calving areas along the U.S. coast from Cape Fear, North Carolina to 28° North latitude, just south of Cape Canaveral, Florida (Figure 4-1). The newly defined critical habitat contains approximately 29,763 sq km of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1) and off the Southeast U.S. coast (Unit 2). The latter area overlaps with the SEFSC ARA.

Behavior and life history: Right whales have a three-year reproductive cycle. DON (2008) summarized the literature on northern right whale foraging behavior. Dives of 5-15 min or longer have been reported, but can be much shorter when feeding. Foraging dives in the known feeding high-use areas are frequently near the bottom and the average depth of a dive was strongly correlated with both the average depth of peak copepod abundance and the average depth of the mixed layer. Right whale feeding dives are characterized by a rapid descent from the surface to a particular depth between 80 and 175 m, remarkable fidelity to that depth for 5 to 14 min, and then rapid ascent back to the surface Longer surface intervals have been observed for reproductively active females and their calves. Killer whales and large sharks are likely predators of right whales, likely focusing on calves or juveniles.

Acoustics and Hearing: Parks et al. (2007) recently developed a preliminary model of the frequency range of hearing for North Atlantic right whales using morphometric analyses of inner ears of stranded whales and a previously established model for marine mammal hearing. The predicted total hearing range was 10 Hz to 22 kHz (Parks et al. 2007). North Atlantic right whales are, thus, in the low-frequency functional hearing group of Southall et al. (2007). Their vocalizations range from 20 Hz to 15 kHz (Department of the Navy [DON] 2008) (Table 4-1).

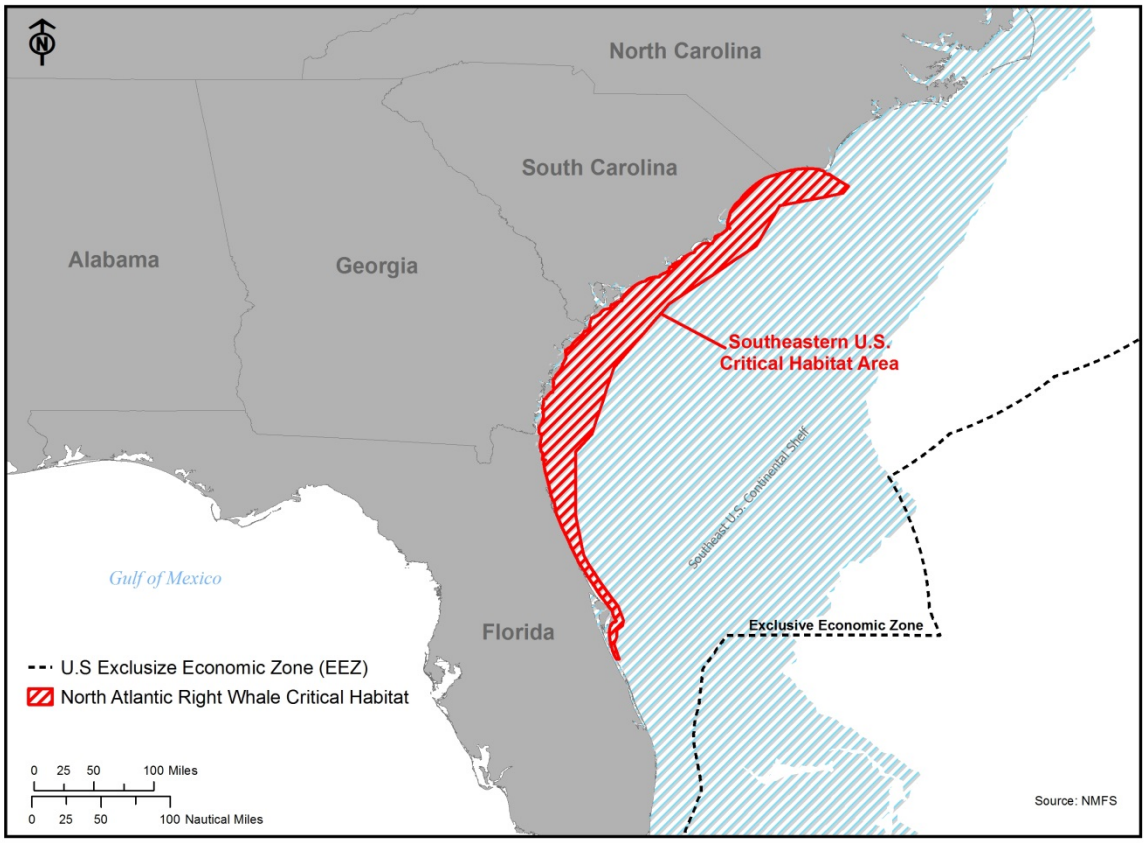

Figure 4-1 Currently designated critical habitat for the North Atlantic right whale in the Southeast Region

4.1.2 Humpback Whale (*Megaptera novaeangliae*) – Western North Atlantic Population and Gulf of Maine Feeding Stock

Description: As summarized by Clapham (2009, and citations therein), humpback whales are large baleen whales with females slightly larger than males. Adult lengths are 16-17 m and calves are about 4 m. Humpback whales are easily recognized at close range by their extremely long flippers, which may be one-third the length of the body. The flippers are white on the bottom and may be white or black on top, depending on the population. The body is black on top with variable coloration ventrally and on the sides. The head and jaws have numerous knobs which are diagnostic for the species. The dorsal fin is small and variable in shape. The underside of the tail exhibits a pattern of white to black that is individually identifiable. The baleen is primarily black and occurs in 270-400 plates on each side of the mouth.

Abundance and Stock Status: The western North Atlantic humpback whale population includes six relatively discrete feeding-area subpopulations: the east coast of the U.S. (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway (Clapham et al. 2003, Katona and Beard 1990, Palsbøll et al. 1997, Waring et al. 2013). The species is listed as endangered throughout its range. Based on genetic analyses, the Gulf of Maine feeding stock is treated as a separate management stock (IWC 2002, Palsbøll et al. 1995). Individuals from all feeding

areas have been identified in the West Indies breeding and calving areas, including Puerto Rico (Stevick et al. 2003a). A Recovery Plan was published and is currently in effect (NMFS 1991).

The best and minimum estimate of abundance for Gulf of Maine humpback whales is 823 animals (Waring et al. 2015b). The average annual rate of increase for the North Atlantic population was estimated at 3.1 percent. The Gulf of Maine stock appears to be steadily increasing, although analysis of demographic parameters suggested a lower rate of increase than previously reported. Results, however, may have been confounded by distribution shifts that coincided with the period of declining survival rates (1992-1995). Calf survival and, presumably, population growth, appear to have increased since 1996 (Waring et al. 2009). PBR for this stock is 2.7 whales (Waring et al. 2015b). The average annual rate of human-caused mortality and serious injury for 2009 to 2013 was 9 Gulf of Maine humpback whales per year. This includes 7.4 entanglements (U.S. waters, 1.8; Canadian waters, 0.35; unassigned location, first sighted in U.S., 4.55; unassigned location, first sighting in Canada, 0.7) and 1.6 vessel collisions, all in U.S. waters (Waring et al. 2015b).No status or trends information are available specific to Puerto Rico and U.S. Virgin Islands waters. Humpback whales sighted in this area are part of the North Atlantic population, only a part of which (Gulf of Maine stock) feeds in U.S. waters. The best available estimate for the entire North Atlantic humpback whale population is 11,570, based on data collected in 1992 and 1993, and the average annual rate of increase was estimated at 3.1 percent (Stevick et al. 2003b). Swartz et al. (2001) provided a provisional estimate of 532 humpback whales on the Puerto Rican-Virgin Islands insular shelf during February/March 2001. PBR and human-caused mortality and serious injury for the CRA are unknown.

In April 2015, NMFS finished a status review of humpback whales and announced a proposal to revise the listing status by splitting the endangered species into 14 DPSs and replacing the current species-level listing with listings by DPS, defined by breeding population (80 FR 22304, April 21, 2015). The result would be two listed as endangered (Cape Verde Islands/Northwest Africa and Arabian Seas DPSs), two as threatened (Western North Pacific and Central America DPSs), and ten not proposed for listing (the West Indies, Hawaii, Mexico, Brazil, Gabon/Southwest Africa, Southeast Africa/Madagascar, West Australia, East Australia, Oceania, and Southeastern Pacific DPSs). Humpback whales in the western North Atlantic, including the Gulf of Maine population, would be included in the West Indies DPS that is not proposed for listing (80 FR 22304, April 21, 2015).

Distribution and Habitat: Humpback whales are found in all oceans of the world and are highly migratory from high latitude feeding grounds to low latitude calving areas. They are typically found in coastal or shelf waters in summer and close to islands and reef systems in winter (Clapham 2009). Humpbacks primarily occur near the edge of the continental slope and deep submarine canyons, where upwelling concentrates zooplankton near the surface for feeding. They often feed in shipping lanes which makes them susceptible to mortality or injury from large ship strikes (Douglas et al. 2008). In the North Atlantic, humpbacks return each spring to specific feeding grounds in the Gulf of Maine, Gulf of St. Lawrence, Newfoundland, Labrador, Greenland, Iceland, and Norway (Clapham 2009).

Most North Atlantic humpback whales migrate to the West Indies during the winter to mate and calve (Katona and Beard 1990, Clapham et al. 1993). Most humpback whales wintering on the breeding and calving areas in the West Indies are found in the waters of the Dominican Republic, with lower densities throughout the remainder of the Antillean Island chain, from Puerto Rico to the coast of Venezuela (Waring et al. 2013 and citations therein). Concentration areas in the latter region include the northwestern coast of Puerto Rico and the northern Virgin Islands (Mignucci-Giannoni 1998).

Not all migrate south, however, as significant numbers occur in mid- and high-latitude regions in winter (Clapham et al. 1993, Swingle et al. 1993). Most of the individually identified whales in this region were from the Gulf of Maine, but some were from Newfoundland and the Gulf of St. Lawrence. The Mid-Atlantic region appears to be a supplemental winter feeding area for humpbacks whales (Barco et al.

2002). Wiley et al. (1995) concluded that these areas were becoming increasingly important habitats for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area.

Behavior and life history: Humpback whales are known for their spectacular aerial behaviors and complex songs of males, the latter of which is presumably to attract females. They breed in warm tropical waters after an 11 month gestation period; calves likely feed independently after 6 months. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009). As summarized in Clapham (2009, and citations therein) and DON (2008, and citations therein), humpback whale dives in summer last less than 5 min; those exceeding 10 min are atypical. In winter (December through March), dives average 10 to 15 min. Although humpback whales have been recorded to dive as deep as about 500 m, on the feeding grounds they spend the majority of their time in the upper 122 m of the water column. On the wintering grounds they dive deeper to 176 m or greater. The humpback whale is a "lunge feeder" taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. They also blow nets, or curtains, of bubbles around or below prey patches to concentrate the prey in one area, then lunge with mouths open through the middle.

Acoustics and Hearing: Humpback whales are in the low-frequency functional hearing group, with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Their vocal repertoire ranges from 20 Hz to greater than 10 kHz (DON 2008) (Table 4-1).

4.1.3 Fin Whale (*Balaenoptera physalus*) – Western North Atlantic Stock

Description: Fin whales are sexually dimorphic with females about 10-15% longer than males; in the Northern Hemisphere female length is about 22.5 m and for males 21 m (Aguilar 2009). Fin whales are slender with a narrow rostrum, a falcate dorsal fin located at 75% of total length; it is higher than the blue whale but lower than the sei whale (ibid). The ventral grooves are numerous and extend from the chin to the umbilicus. The pigmentation of the head region is strikingly asymmetrical whereas the left side, dorsal and ventral, is dark slate and the right side dorsal is light gray and the right ventral is white (ibid). The pigmentation also is shown in the baleen plates which are gray and yellowish.

Abundance and Stock Status: The fin whale is listed as endangered under the ESA. The status of the stock off the U.S. Atlantic coast, relative to OSP is unknown and data are inadequate to determine the population trend for fin whales. A Final Recovery Plan for fin whales was published in 2010 (NMFS 2010a). The best abundance estimate for western North Atlantic fin whales is 1,618 with a minimum population estimate of 1,234 whales. The calculated PBR is 2.5 fin whales (Waring et al. 2015b). From 2009 through 2013, the minimum annual rate of human-caused mortality and serious injury for western North Atlantic fin whales averaged 3.55 whales. This includes 1.75 entanglements (U.S. waters, 0.2; Canadian waters, 0.6; unassigned location, first sighted in U.S., 0.65; unassigned location, first sighting in Canada, 0.3) and 1.8 vessel collisions, in U.S. waters only (Waring et al. 2015b). Total U.S. fishery related mortality and serious injury for this stock is likely biased low and is not less than 10% of PBR, so cannot be considered insignificant and approaching a zero mortality and serious injury rate (Waring et al. 2015b).

Distribution and Habitat: Fin whales are common in waters off the U.S. east coast, principally from Cape Hatteras northward. They are not, however, common in the SEFSC survey areas. New England waters represent a major feeding area for fin whales (Hain et al. 1992, Kenney et al. 1997), with key feeding grounds in the western Gulf of Maine from Stellwagen Bank to Jeffreys Ledge. Calving, mating, or wintering areas are unknown for most of the population, although Hain et al. (1992) suggested calving takes place during October to January off the U.S. Mid-Atlantic region. Fin whales off the U.S. Atlantic coast may migrate into Canadian waters, open-ocean areas, or even subtropical or tropical regions. It is, however, unlikely that fin whales undergo distinct annual migrations (Waring et al. 2015b).

Behavior and life history: Fin whales become sexually mature between six to ten years of age, depending on density-dependent factors. Reproduction occurs primarily in the winter. Gestation lasts about 11

months and nursing occurs for 6 to 11 months (Aguilar 2009). Fin whales typically dive for 5 to 15 min, separated by sequences of 4 to 5 blows at 10 to 20 second intervals. Goldbogen et al. (2006) reported that fin whales off California made foraging dives to a maximum of 228-271 m and dive durations of 6.2-7.0 min. Fin whale dives likely coincide with the diel migration of krill. Fin whales feed on planktonic crustaceans, including euphausiids (krill) and copepods, as well as schooling fish including sand lance, herring, capelin, and mackerel (Aguilar 2009).

Acoustics and hearing: Fin whales are in the low-frequency functional hearing group, with an estimated auditory range of 7 Hz to 22 kHz (Southall et al. 2007). They also vocalize at low frequencies of 15-30 Hz (DON 2008) (Table 4-1).

4.1.4 Minke Whale (*Balaenoptera acutorostrata*) – Canadian East Coast Stock

Description: As summarized by Perrin and Brownell (2009, and citations therein), the North Atlantic minke whale is the second smallest baleen whale with females somewhat larger than males. In the North Atlantic females have been measured at 8.5-8.8 m and males at 7.8- 8.2 m and weigh about 10 tons. The body is dark gray to brownish dorsally and white to cream ventrally; the flipper has a white chevron that is diagnostic. The baleen is white and short and numbers between 230-360 plates; the dorsal fin is relatively tall and falcate and located forward on the posterior one-third of the body. The rostrum is very narrow and pointed (thus the species name acutorostrata).

Abundance and Stock Status: Minke whales off the eastern coast of the U.S. are considered to be part of the Canadian East Coast stock, which inhabits the area from the eastern half of the Davis Strait (45º W) to the Gulf of Mexico (Waring et al. 2015b). The number of minke whales comprising the Canadian East Coast stock is unknown and data are insufficient to calculate population trends. The best available current abundance estimate for the stock (20,741) was derived from the Canadian Trans-North Atlantic Sighting Survey in 2007. Although this survey did not include U.S. waters, it covered more of the minke whale range than have other surveys, so is considered the best available estimate. The minimum estimate is 16,199 and the PBR is 162 minke whales (Waring et al. 2015b). From 2009 through 2013, the minimum average annual human-caused mortality and serious injury of minke whales was 7.7 (0.2 from observed U.S. fisheries, 6.5 from U.S. and Canadian fisheries using stranding and entanglement data, and 1.2 due to ship strikes) (Waring et al. 2015b). Minke whales are not listed as either threatened or endangered under the ESA.

Distribution and Habitat: Minke whales are among the most common and numerous baleen whales found throughout the world. In the North Atlantic Ocean, they range from Baffin Bay, Denmark Strait, Franz Josef Land, and Novaya Zemlya with wintering grounds at least to the Caribbean Sea in the west and the Strait of Gibraltar in the east (Perrin and Brownell 2009). Minke whales are common and widely distributed off the northeast U.S. coast (CETAP 1982, Waring et al. 2011). There appears to be a strong seasonal component to minke whale distribution. They are most abundant, widespread, and common in New England waters in spring and summer (CETAP 1982, Waring et al. 2007). Numbers diminish during fall and, during winter, they are largely absent from the area (Mitchell 1991, Waring et al. 2011). Minke whales generally occupy the continental shelf proper, including bays and estuaries, rather than shelf-edge waters (Mitchell and Kozicki 1975, Hamazaki 2002, Waring et al. 2007).

Behavior and life history: Little is known of the natural history of minke whales. They are assumed to breed in winter in warm waters of low latitudes, give birth to a single calve every other year, and reach sexual maturity when 7-9 m long (Perrin and Brownell 2009). They are largely piscivorous and consume a variety of forage fishes (e.g., Atlantic herring, mackerel, and sand lance). Their dietary composition on the U.S. OCS was estimated as 95% fish and 5% euphausiids (Kenney et al. 1997). There are no data on dive depth for minke whales. Minke whales are predated upon by killer whales.

Acoustics and hearing: Minke whales are in the low-frequency functional hearing group with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Vocalizations range from 60 Hz to 20 kHz (DON 2008) (Table 4-1).

4.1.5 Bryde's Whale (*Balaenoptera edeni*) – Northern Gulf of Mexico Stock

Description: Bryde's whales are among the least well known of the larger baleen whales. They are medium sized balaenopterids that may attain lengths of 15.5 m, although most are smaller. Females are larger than males (Kato and Perrin 2009). Bryde's whales closely resemble, and are often confused with, sei whales. The feature that most readily distinguishes them from other species, including sei whales, is the presence of three prominent ridges on the rostrum. The rostrum is V-shaped and the dorsal fin is strongly falcate. They are dark gray above and white below, although the dark areas extend to the throat grooves and flippers (Kato and Perrin 2009).

Abundance and Stock Status: Bryde's whales in the northern Gulf of Mexico probably constitute a resident stock and are provisionally considered a separate stock (Waring et al. 2013). Genetic analyses indicate that northern Gulf of Mexico Bryde's whales represent an evolutionary lineage distinct from other recognized Bryde's whale subspecies, including those in the southern Caribbean and southwestern Atlantic off Brazil (Rosel and Wilcox 2014). The geographic distribution of this Bryde's whale form is not completely understood. Two strandings from the southeastern U.S. Atlantic coast share the same genetic characteristics with those from the northern Gulf of Mexico but it is unclear whether these are extralimital strays or they indicate the population extends from the northeastern Gulf of Mexico to the Atlantic coast of the southern U.S. (Rosel and Wilcox 2014).

The best available abundance estimate for northern Gulf of Mexico Bryde's whales is 33 individuals, based on a summer 2009 survey that covered waters from the 200 m isobaths offshore to the seaward extent of the U.S. EEZ (Waring et al. 2015b). The minimum population estimate is 16 and the calculated PBR is 0.03 Bryde's whales, the equivalent of one take every 33 years. The minimum annual human-caused mortality and serious injury for this stock of Bryde's whales is 0.2 for 2009 to 2013, based on one ship strike mortality in 2009. Fishery-related mortality and serious injury during this time period for observed fisheries and fisheries-related strandings was zero (Waring et al. 2015b). No abundance information is available for Bryde's whales in either the ARA or CRA.

The species is not listed under the ESA or designated as depleted under the MMPA. The northern Gulf of Mexico stock is, however, considered a strategic stock, since the average annual human-caused mortality and serious injury exceeds PBR.

Distribution and Habitat: Bryde's whales occur throughout tropical and warm temperate waters (16.3° C and warmer) between 40° N and 40° S worldwide. They do not undertake long migrations, but show a general movement toward the equator in winter and toward higher latitudes in summer (Kato and Perrin 2009).

Behavior and life history: Female Bryde's whales attain sexual maturity at approximately 11.6-11.8 m length and males reach sexual maturity at 11.0-11.4 m length. Gestation is approximately 11 months and calves wean at about 6 months of age and the calving interval is 2 years (Kato and Perrin 2009). Similar to other baleen whales, Bryde's whales are often alone or in small groups. They primarily feed on pelagic schooling fishes, such as pilchard, anchovies, sardines, and herring. As opportunistic feeders, however, they also consume krill and copepods, as well as cephalopods and pelagic red crabs (Kato and Perrin 2009).

Acoustics and hearing: Bryde's whales are categorized in the low frequency functional hearing group along with all other baleen whales. The estimated auditory bandwidth is 7 Hz to 22 kHz (Southall et al. 2007) (Table 4-1). Bryde's whales produce low-frequency tonal and swept calls similar to other

balaenopterids (Oleson et al. 2003). Six call types associated with Bryde's whales in the Eastern Tropical Pacific ranged in frequency from 20 to 60 Hz (Oleson et al. 2003).

4.1.6 Sperm Whale (*Physeter macrocephalus*) – North Atlantic, Northern Gulf of Mexico, and Puerto Rico and U.S. Virgin Islands Stocks

Description: The sperm whale is the largest toothed whale species and the most sexually dimorphic cetaceans in body length and weight (Whitehead 2009). Adult females can reach 12 m in length, while adult males measure as much as 18 m in length (Jefferson et al. 1994). The head is large (comprising about one-third of the body length) and squarish. The lower jaw is narrow and under slung. The blowhole is located at the front of the head and is offset to the left. Sperm whales are brownish gray to black in color with white areas around the mouth and often on the belly. The flippers are relatively short, wide, and paddle-shaped. There is a low rounded dorsal hump and a series of bumps on the dorsal ridge of the tailstock and the surface of the body behind the head tends to be wrinkled (Whitehead 2009).

Abundance and Stock Status: Sperm whales are listed as endangered under the ESA. Data are insufficient to assess population trends, and the current abundance estimate was based on surveys of only a fraction of the known stock range (Waring et al. 2015a). A Final Recovery Plan for sperm whales was published and is in effect (NMFS 2010b). Currently, the best population estimate for western North Atlantic sperm whales (2,288) is the sum of estimates from surveys between central Florida and the lower Bay of Fundy in 2011. This is likely an underestimate, as the individual estimates were not corrected for dive times, which average 30 to 60 minutes. The minimum population estimate for the western North Atlantic stock is 1,185 and the PBR, 3.6 (Waring et al. 2015a). Between 2008 and 2012, average annual human-caused mortality was 0.8, based on reports of sperm whales mortalities in 2009 and 2010 in the Canadian Labrador halibut longline fishery, one entanglement mortality in Canadian pot/trap gear, and one vessel strike mortality. There have been no reported entanglements of sperm whales in U.S. Atlantic fisheries. Vessel strike was determined as the cause of death in a sperm whale stranded in Florida in 2012 (Waring et al. 2015a).

Research conducted in the Gulf of Mexico since 2000 indicates that Gulf of Mexico sperm whales constitute a distinct stock, separate from other Atlantic Ocean stocks. This stock delineation is based on genetic analyses, movement patterns, photographic identification, coda vocalizations, and population structure (Jochens et al. 2008, Waring et al. 2013).

The best available abundance estimate for northern Gulf of Mexico sperm whales is 763, derived from an oceanic survey of waters from the 200 m isobath to the seaward extent of the U.S. EEZ in 2009 (Waring et al. 2015b). The minimum population estimate is 560, with a PBR of 1.1 sperm whales. There is insufficient information to determine population trends. Sperm whales occur throughout oceanic waters of the Gulf of Mexico, but 65% of those waters are south of the U.S. EEZ. Surveys limited to U.S. waters are not able to discern shifts in distribution to other areas in the Gulf of Mexico that could account for changes in abundance (Waring et al. 2015b). Total human-caused mortality and serious injury for this stock during 2009-2013 was zero. Total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate (Waring et al. 2015b).

The Puerto Rico and U.S. Virgin Islands sperm whale population is provisionally considered a separate stock for management purposes. Sperm whales are among the most common species to strand in waters of Puerto Rico and the Virgin Islands, but have not been extensively studied there (Waring et al. 2010). Research conducted in the eastern Caribbean Sea (islands of Dominica, Guadeloupe, Grenada, St. Lucia and Martinique) by Gero et al. (2007) suggests that this population of sperm whales was small and isolated. An estimated abundance for the Puerto Rico and U.S. Virgin Islands stock of sperm whales is unknown. Present data are insufficient to calculate a minimum population estimate or to determine population trends for this stock of sperm whales. PBR for this stock is also unknown, as is the level of human-caused mortality and serious injury (Waring et al. 2010). The only documented ship-strike

mortality of a sperm whale off Puerto Rico was caused by a U.S. Navy vessel in 2001 (Jensen and Silber 2003).

Distribution and Habitat: North Atlantic sperm whales are principally distributed along the continental shelf edge, over the continental slope, and into mid-ocean regions (CETAP 1982, Hamazaki 2002, Waring et al. 2001, Waring et al. 2007). Waring et al. (2007) suggest that this offshore distribution is more commonly associated with the Gulf Stream edge and other features. Distribution off the eastern U.S. coast varies seasonally (CETAP 1982, Scott and Sadove 1997). In winter, sperm whales concentrate east and northeast of Cape Hatteras. Distribution shifts northward in spring to east of Delaware and Virginia, and, in summer, to the area east and north of Georges Bank and the continental shelf south of New England (Scott and Sadove 1997, Waring et al. 2001). Sperm whales are abundant on the continental shelf south of New England and along the continental shelf edge in the Mid-Atlantic Bight in fall (Waring et al. 2007).

Sperm whales occur year round in the northern Gulf of Mexico along the continental slope and in oceanic waters; information is limited for the southern Gulf of Mexico (Waring et al. 2013 and citations therein). Satellite-tagging studies showed no discernible seasonal migrations except for Gulf-wide movements particularly along the northern Gulf slope. Mature males appear to move in and out of the Gulf (Englehaupt et al. 2009, Jochens et al. 2008, Waring et al. 2013). Females more frequently occur on the upper continental slope of the northern Gulf of Mexico, while males tend to use regions of deeper water (Jochens et al. 2008).

Sperm whales also inhabit continental slope and oceanic waters surrounding Puerto Rico and the U.S. Virgin Islands. They occur in the northeastern Caribbean from late fall, through winter and early spring. Sightings begin as early as October, increase from November through January, peak in February, and decrease through March. Sperm whales are rarely seen during April through September (Mignucci-Giannoni 1998).

Behavior and Life History: Females reach sexual maturity at about age 9 when roughly 9 m long and they give birth about every 5 years; gestation is 14-16 months (Whitehead 2009). Males are larger during the first 10 years and continue to grow well into their 30s, finally reaching physical maturity at about 16 m (ibid). The sperm whale consumes a wide variety of deep water fish and cephalopods. Sperm whales forage during deep dives that routinely exceed a depth of 400 m and duration of 30 min (Watkins et al. 2002). They are capable of diving to depths of over 2,000 m with durations of over 60 min. Sperm whales spend up to 83 percent of daylight hours underwater. Males do not spend extensive periods of time at the surface, whereas females may spend one to five hours at the surface per day without foraging (Whitehead 2009). An average dive cycle consists of about a 45 min dive with a 9 min surface interval. The average swimming speed is estimated to be 2.5 km/hr.

Acoustics and Hearing: As summarized in DON (2008, and citations therein), sperm whales typically produce short-duration (less than 30 millisecond), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges. When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Whitehead 2009). Codas are shared between individuals of a social unit and are considered to be primarily for intra-group communication. Neonatal clicks are of low directionality, long duration (2 to 12 ms), low frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 μPa-m rms. Source levels from adult sperm whales' highly directional (possible echolocation), short (100 μs) clicks have been estimated up to 236 dB re 1 μPa-m rms. Creaks (rapid sets of clicks) are heard most frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors. In summary, sperm whales are in the mid-frequency functional hearing group, with an estimated auditory

range of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations, including echolocation clicks, range from 100 Hz to 30 kHz (DON 2008) (Table 4-1).

4.1.7 Pygmy Sperm Whale (*Kogia breviceps*) and Dwarf Sperm Whale (*K. sima*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: *Kogia* spp. are porpoise-like and robust with a distinctive under-slung lower jaw. Pygmy sperm whales reach a maximum size of about 3.8 m and weight of 450 kg; dwarf sperm whales are smaller at 2.7 m and 272 kg (McAlpine 2009). Adults of both species are bluish-gray to blackish-brown dorsally and light below (ibid). On the side of the head between the eye and the flipper there is a crescent shaped light colored mark referred to as a "false gill." Both species have the shortest rostrum of any cetacean, and the skull is markedly asymmetrical (ibid).

Abundance and Stock Status: Neither species is listed as either endangered or threatened under the ESA. Dwarf sperm whales (*K. sima*) and pygmy sperm whales (*K. breviceps*) are difficult to distinguish at sea (Jefferson et al. 1994). Sightings are, therefore, generally listed as *Kogia* spp. and abundance estimates are similarly grouped. Distinct morphological characteristics, as well as data obtained from blood and muscle tissues, enable species determination of stranded animals.

Total numbers of dwarf and pygmy sperm whales off the U.S. Atlantic coast are unknown. The best available abundance estimate for *Kogia* spp. is 3,785 animals, derived from combined summer 2011 surveys from central Florida to the lower Bay of Fundy. The central Florida to central Virginia component yielded an estimate of 2,002 *Kogia* spp. The minimum population estimate is 2,598 and PBR is 26 animals. The estimated annual average fishery-related mortality or serious injury was 3.4 *Kogia* spp. from 2007 through 2011 (Waring et al. 2014).

The Gulf of Mexico population is provisionally considered a separate stock for management purposes. There is currently no information to differentiate this stock from the Atlantic Ocean stock(s) (Waring et al. 2013).

The best available population estimate for dwarf and pygmy sperm whales in the northern Gulf of Alaska is 186, derived from a summer 2009 survey that covered waters from the 200 m isobaths to the offshore extent of the U.S. EEZ. The minimum population estimate is 90 and the calculated PBR is 0.9 (Waring et al. 2013). There has been zero fishery-related mortality or serious injury reported for dwarf sperm whales from 1998 to 2010. The estimated annual average fishery-related mortality or serious injury to pygmy sperm whales was 0.3 for 2006-2010 in the pelagic longline fishery (Waring et al. 2013). Total human-caused mortality and serious injury is not known for either species and data are insufficient to determine if total fishery-related mortality and serious injury is insignificant and approaching a zero mortality rate. Neither *Kogia* species is considered strategic; but, with the difficulties in distinguishing between species, there is concern for the possibility of mortalities exceeding PBR (Waring et al. 2013).

No status and trends information is available for *Kogia* spp. within the CRA.

Distribution and Habitat: Pygmy and dwarf sperm whales have a worldwide distribution in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans (McAlpine 2009). Pygmy sperm whales are sighted primarily along the continental shelf edge and over deeper waters off the shelf. Several studies have suggested that pygmy sperm whales live mostly beyond the continental shelf edge.

Sightings of *Kogia* spp. in the northern Gulf of Mexico are primarily in oceanic waters and have been documented during all seasons (Mullin et al. 1991, Mullin and Fulling 2004, Maze-Foley and Mullin 2006, Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: As summarized in DON (2008, and citations therein) pygmy and dwarf sperm whales probably feed on fish and invertebrates that feed on the zooplankton in tropical and temperate waters. Kogia feed on cephalopods and, less often, on deep-sea fishes and shrimps. *Kogia* make dives of up to 25 min. Median dive times of around 11 minutes have been documented. A satellite-tagged pygmy

sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer (Scott et al. 2001). Most sightings are brief; these whales are often difficult to approach and they actively avoid aircraft and vessels. There is no information on the breeding behavior of either species.

Acoustics and Hearing: *Kogia* species are in the high-frequency functional hearing group, with an estimated auditory bandwidth of 200 Hz to 180 kHz (Southall et al. 2007). Vocalizations frequencies range from 13 to 200 kHz (Table 4-1). Recordings of clicks emitted by free-ranging *K. sima* (dwarf sperm whales) in the Lesser Antilles were in the lower end of the range (13-30 kHz). Recordings of stranded pygmy sperm whales were in the 60 to 200 kHz range (DON 2008).

4.1.8 Killer Whale (*Orcinus orca*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: Killer whales are the largest member of the dolphin family attaining maximum body lengths of 9 m for males and 7.7 m for females (Ford 2009). Maximum measured weights for males is 5,568 kg and for females 3,810 kg (Ford 2009). Males develop larger appendages than females including the pectoral fins, tail flukes, and dorsal fin - which is erect in shape and may be as high as 1.8 m in males. Directly behind the dorsal fin is a gray area of variable shape called the saddle patch. Killer whales are generally black dorsally and white ventrally with a conspicuous elliptically shaped white patch behind the eye (post-ocular patch). Considerable variation exists in the shape and color of the post-ocular patch, saddle patch, and the size and shape of the dorsal fin such that these features are used to identify individuals.

Abundance and Stock Status: Killer whales are not listed as either threatened or endangered under the ESA. The stock assessment for western North Atlantic killer whales was last updated in 1995 (Waring et al. 2015a). The number of killer whales off the eastern U.S. coast remains unknown. Consequently, minimum population size, trends in abundance, and PBR are also unknown and indeterminable. There were no observed human-caused serious injuries or mortalities to this stock from 2008 through 2012 (Waring et al. 2015a).

The northern Gulf of Mexico killer whale population is provisionally considered a separate stock for management purposes; adequate information to distinguish this stock from others in the Atlantic is currently lacking (Waring et al. 2013). The best available population estimate for killer whales in the northern Gulf of Mexico is 28, determined from a summer 2009 oceanic survey of a region from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. The minimum population size is 14 and the PBR is 0.1 (Waring et al. 2013). There was no reported fishery-related mortality or serious injury to this stock from 1998 to 2010. Total human-caused mortality and serious injury is unknown and none has been documented. This species is not listed under the ESA as either threatened or endangered, nor is it considered a strategic stock (Waring et al. 2013).

Status and trends information available is not available for killer whales within the CRA.

Distribution and Habitat: Killer whales are found in all oceans and are second only to humans as the most widely spread of all mammals (Ford 2009). They are most commonly found in coastal and temperate waters of high productivity.

Killer whale sightings in the northern Gulf of Mexico primarily occur in oceanic waters of the north-central Gulf. They are rarely seen in shelf waters of the Gulf (Waring et al. 2013 and citations therein).

Behavior and Life History: Killer whales are very social and the basic social unit is based on matrilineal relationships linked by maternal decent. A typical matriline is composed of a female, her sons and daughters, and the offspring of her daughters (Ford 2009). Females may live to 80-90 years so a female's line may contain four living generations. The pod is the next level of organization comprised of a group

of related matrilines with a shared common maternal ancestor. The next level of social structure is the clan, followed by a resident society.

Births may occur in any month but most are in October-March. Females give birth when between 11 and 16 years of age with a five-year interval between births. Gestation is 15-18 months and weaning is about 1-2 years after birth. Males attain sexual maturity at about 15 years of age. Life expectancy for females is about 50 years with a maximum of 80-90; males typically live to about 29 years of age (Ford 2009).

Acoustics and Hearing: Killer whales, like most cetaceans, are highly vocal and use sound for social communication and to find and capture prey. The sounds include a variety of clicks, whistles, and pulsed calls (Ford 2009). As summarized in DON (2008, and citations therein), the peak to peak source levels of echolocation signals range between 195 and 224 dB re 1 µPa-m. The source level of social vocalizations ranges between 137 to 157 dB re 1 µPa-m. Acoustic studies of resident killer whales in British Columbia have found that there are dialects, in their highly stereotyped, repetitive discrete calls, which are group-specific and shared by all group members (Ford 2009). These dialects likely are used to maintain group identity and cohesion, and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford 2009). The killer whale has the lowest frequency of maximum sensitivity and one of the lowest high frequency hearing limits known among toothed whales. The upper limit of hearing is 100 kHz for this species.

4.1.9 Pygmy Killer Whale (*Feresa attenuata*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: Pygmy killer whales have round, blunt heads and lack the characteristic dolphin beak. They have robust bodies that narrow toward the dorsal fin, and long flippers. The back, parts of the sides and belly are dark gray to black, with a pale area often present on the flank. The lips are edged in white. Average length for both sexes is 2.3 m (Donahue and Perryman 2009).

Abundance and Stock Status: The western North Atlantic and Gulf of Mexico populations are provisionally being considered separate stocks for management purposes. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation. This species is not listed as either endangered or threatened under the ESA

Abundance estimates are unavailable for the western North Atlantic stock, as it is rarely seen during surveys (Waring et al. 2007). Although a group of six pygmy killer whales was sighted during a 1992 survey off of Cape Hatteras, North Carolina (Hansen et al. 1994), none were sighted during later surveys (Mullin and Fulling 2003). Abundance could not be estimated from the 1992 data, as the sighting did not occur during line-transect sampling effort. Minimum population estimates, population trends, and PBR are currently indeterminable (Waring et al. 2007).

Currently, the best available population estimate for pygmy killer whales in the northern Gulf of Mexico is 152, derived from a summer 2009 survey that covered waters from the 200 m isobaths to the offshore extent of the U.S. EEZ. The minimum population estimate is 75 and the calculated PBR is 0.8 (Waring et al. 2013). There has been zero fishery-related mortality or serious injury reported for this stock from 1998 to 2010. With no documented human-caused mortality or serious injury of pygmy killer whales in the northern Gulf of Mexico, take is assumed to not exceed PBR and this is, therefore, not considered a strategic stock (Waring et al. 2013).

Status and trends information is not available for pygmy killer whales in the CRA.

Distribution and Habitat: Pygmy killer whales occur in tropical and subtropical waters worldwide and are assumed to be part of the cetacean fauna of the tropical western North Atlantic (Waring et al. 2007). Sightings are more common in warmer coastal waters than offshore (Wade and Gerrodette 1993).

Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin et al. 1994, Mullin and Fulling 2004). Sightings of pygmy killer whales were documented in all seasons during

aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: The feeding behavior of pygmy killer whales is not well known. Remains of cephalopods and small fish have been found in stomachs of stranded and incidentally caught individuals. They may be one of the species of small whales that attack and sometimes eat smaller dolphins caught in the tuna purse-seine fishery (Donahue and Perryman 2009).

Pygmy killer whales generally are observed in small schools of 12-50 animals, although larger schools have been seen as well. They are known to bow ride. Pygmy killer whale life history is poorly understood. *Acoustics and hearing*: Pygmy killer whales are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007) (Table 4-1).

4.1.10 False Killer Whale (*Pseudorca crassidens*) – Western North Atlantic Stock and Northern Gulf of Mexico Stocks

Description: False killer whales are among the larger members of the dolphin family. Adult males may reach lengths of nearly 6 m and females may be 5 m in length. They are mostly dark gray to black in color, with a rounded head, small falcate dorsal fin, and flippers that distinctively bulge on the leading edge. The common name stems from skull morphology similar to killer whales (Baird 2009a).

Abundance and Stock Status: There are no worldwide population estimates for false killer whales that "appear to be naturally uncommon throughout their range" (Baird 2009a). The best abundance estimate for the Western North Atlantic stock is 442 whales, derived from one sighting during summer 2011 surveys from central Florida to the lower Bay of Fundy. The minimum estimate is 212 whales and the PBR is 2.1 whales per year (Waring et al. 2015a).

False killer whales are not listed under the ESA. The western North Atlantic stock is, however, considered strategic due to its small population size and because low levels of mortality or serious injury would exceed PBR (Waring et al. 2015a).

The Gulf of Mexico population of false killer whales is provisionally considered a single stock for management purposes; there is currently no information to distinguish this stock from other Atlantic Ocean stock(s). The current population size is unknown since the most recent survey data are greater than eight years old. The minimum population size is, therefore, unknown and PBR cannot be determined (Waring et al. 2013). Although total human-caused mortality and serious injury is unknown, none was reported during 1998-2010. Because of this lack of documented take, this stock is not considered strategic (Waring et al. 2013).

Distribution and habitat preferences: False killer whales occur throughout tropical and warm temperate waters worldwide. They are largely pelagic, but also occur nearshore and in shallow waters around oceanic islands (Baird 2009a). They have a diverse diet that includes a variety of squid and fish. There is evidence of false killer whales attacking other marine mammals, including a humpback calf and sperm whales (Baird 2009a).

Sightings of false killer whales occur in oceanic waters, primarily in the eastern part of the northern Gulf of Mexico (Mullin and Fulling 2004, Maze-Foley and Mullin 2006). All survey sightings have been in spring or summer (Hansen et al. 1996, Mullin and Hoggard 2000, Mullin and Fulling 2004).

Status and trends information is not available for false killer whales within the CRA.

Behavior and life history: They are very social and are often in groups of 20 - 100 individuals. Not much is known about the diving behavior of false killer whales other than a recorded dive to over 230 m by one tagged animal (Baird 2009a). Both males and females reach sexual maturity between 8 and 14 years. A

calving interval of 7 years was estimated for one population. False killer whales appear long-lived with males living an estimated 57 years and females for 62 years (Baird 2009a).

Acoustics and hearing: False killer whales are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007) (Table 4-1).

4.1.11 Cuvier's Beaked Whale (*Ziphius cavirostris*) – Western North Atlantic, Northern Gulf of Mexico, and Puerto Rico and U.S. Virgin Islands Stocks

Description: Cuvier's beaked whale resembles other beaked whales in that it has a robust, cigar-shaped body with a smallish falcate dorsal fin set about two thirds back; the small flippers fit into a slight depression as with other beaked whales (Heyning and Mead 2009). The head is blunt with a small poorly defined rostrum that grades into a generally sloping melon region (Heyning and Mead 2009). Minimum length at sexual maturity is 5.3 m for females and 5.3 m for males.

Abundance and Stock Status: Several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) are available for specific areas and time periods (Barlow et al. 2006). There are also two estimates of Cuvier's beaked whales alone, with the best (6,532) being the sum of estimates from surveys between central Florida and the lower Bay of Fundy in 2011. The northern survey area (central Virginia to the lower Bay of Fundy) yielded an estimate of 4,962 Cuvier's beaked whales and the southern survey (central Florida to central Virginia) yielded an estimated 1,570 whales (Waring et al. 2014). This joint estimate is considered the best available because together these two surveys have the most complete coverage of the species' habitat. The minimum joint population estimate is 5,021 and the PBR is 50 whales (Waring et al. 2014). The average annual human-caused mortality during 2007 to 2011 was 0.4 animals, based on two stranding records, one with report of a fishery interaction and one record of a vessel strike (Waring et al. 2014). The total fishery mortality and serious injury for this stock is less than 10% of the PBR and thus can be considered to be insignificant and approaching zero

The status of Cuvier's beaked whales in the western North Atlantic relative to OSP is not known, and data are insufficient to evaluate trends in abundance. There are no known habitat issues for this species, although there appears to be increasing evidence of potential effects of human-made sounds on deep-diving cetaceans, such as Cuvier's beaked whales, may be of increasing concern (DeRuiter et al. 2013, Waring et al. 2014). They are not listed as threatened or endangered under the ESA nor as "depleted" under the MMPA (Waring et al. 2014).

Information on stock differentiation is lacking for Cuvier's beaked whales in the Gulf of Mexico and nearby waters. For management purposes, however, the Gulf of Mexico stock is provisionally considered a separate stock. The best abundance estimate available for Cuvier's beaked whales in the northern Gulf of Mexico is 74, based on a summer 2009 survey covering waters from the 200 m isobath to the seaward extent of the U.S. EEZ. This estimate is negatively biased since the only sightings included were of beaked whales positively identified to species. The minimum population estimate is 36 Cuvier's beaked whales and the PBR is 0.4. Total human-caused mortality and serious injury is unknown and none has been documented. In 2007, one unidentified beaked whale was released alive without serious injury after an entanglement interaction with the pelagic longline fishery (Waring et al. 2013 and citations therein). The species is not listed as threatened or endangered under the ESA.

The Puerto Rico and U.S. Virgin Islands population of Cuvier's beaked whales is provisionally considered a separate stock from those in the Atlantic Ocean and Gulf of Mexico (Waring et al. 2012). Estimated abundance is currently unknown and has never been assessed for the northeast Caribbean. Minimum population size is not known and PBR is undetermined. Total human-caused mortality and serious injury is also unknown for this stock (Waring et al. 2012). This is considered a strategic stock because of the combined lack of stock information and the documented interactions between unidentified beaked whales and pelagic longline fisheries between Haiti and Cuba (Waring et al. 2012).

Distribution and Habitat: Cuvier's beaked whale is distributed in all oceans and seas except the high polar regions. Cuvier's beaked whale generally is sighted in waters >200 m deep, and is frequently recorded at depths >1,000 m. They are commonly sighted around seamounts, escarpments, and canyons (Heyning and Mead 2009). As summarized in Waring et al. (2009), Cuvier's beaked whale strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean. Stock structure in the North Atlantic is unknown. Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast; most sightings were in late spring or summer. Waters deeper than 1,000 m are the area of highest utilization for the Cuvier's beaked whale in the Northeast Atlantic while water depths between 500 m and 1,000 m are less utilized. Occurrence in waters shallower than 500 m is rare (DON 2008).

Distribution of Cuvier's beaked whales is known largely from strandings, as species identification can be difficult, particularly from aerial surveys. Strandings have occurred throughout the year in the Gulf of Mexico and aerial surveys indicate beaked whale presence during all seasons. Beaked whale sightings made during vessel surveys show a broad distribution in waters greater than 500m depth. Cuvier's beaked whales likely occur throughout the oceanic Gulf of Mexico (Waring et al. 2013 and citations therein).

Cuvier's beaked whales are sighted throughout the Caribbean Sea and around Puerto Rico and the Virgin Islands. This is one of the most commonly stranded species in the region (Mignucci-Giannoni et al. 1998, Waring et al. 2012).

Behavior and Life History: Little is known of the feeding preferences of Cuvier's beaked whale. They may be mid-water and bottom feeders on cephalopods and, rarely, fish. There is little information on beaked whale reproductive behavior. Recent studies by Baird et al. (2006) show that Cuvier's beaked whales dive deeply (maximum of 1,450 m) and for long periods (maximum dive duration of 68.7 min) but also spend time at shallow depths. Tyack et al. (2006) has also reported deep diving for Cuvier's beaked whales with mean depth of 1,070 m and mean duration of 58 min.

Acoustics and Hearing: Beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication (DON (2008). Cuvier's beaked whales' echolocation clicks were recorded at frequencies from 20 to 70 kHz. There is no information on the hearing abilities of Cuvier's beaked whale. By assumption Cuvier's beaked whales are placed in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DON 2008) (Table 4-1)

4.1.12 Mesoplodon Beaked Whales (*Mesoplodon* spp.) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: At least four species in this genus have been recorded off the U.S. east coast, but due to difficulty distinguishing species at sea, most available information is to the genus level only (Waring et al. 2014). The four species known to occur in this region are: Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), Sowerby's beaked whale (*M. bidens*), and True's beaked whale (*M. mirus*). Insufficient sighting records exist off the U.S. east coast to determine any possible spatial or seasonal patterns in the distribution of mesoplodont beaked whales. Although they are fairly common in some parts of the ocean, because of their shyness around vessels and unobtrusive behavior, they are rarely observed (Pitman 2009). The three species of *Mesoplodon* known to occur in the Gulf of Mexico are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*) and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale is considered extralimital in the Gulf of Mexico. All species of *Mesoplodon* have a single tooth in the front to the middle of each side of the jaw. They are relatively small whales ranging in length from about 4 m to 6.2 m, depending on species (Pitman 2009). The body

is spindle shaped with a small, usually triangular dorsal fin located approximately two-thirds of the way back on the body. The flippers are small and narrow and fit into pigmented depressions in the body.

Abundance and Stock Status: As with Cuvier's beaked whales above, several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) are available for specific areas and time periods (Barlow et al. 2006). There are also two estimates of *Mesoplodon* spp. whales along the U.S. east coast, with the best (7,092) being the sum of estimates from surveys between central Florida and the lower Bay of Fundy in 2011. The northern survey area (central Virginia to the lower Bay of Fundy) yielded an estimate of 5,500 mesoplodont beaked whales and the southern survey (central Florida to central Virginia) yielded an estimated 1,592 animals (Waring et al. 2014). This joint estimate is considered the best available because together these two surveys have the most complete coverage of the species' habitat. The minimum joint population estimate is 4,632 and the PBR is 46 *Mesoplodon* spp. whales. Data are insufficient to determine population trends or to calculate PBR for individual species (Waring et al. 2014). The total average estimated annual mortality of Blainville's beaked whales in observed fisheries in the U.S. Atlantic EEZ during 2007-2011 is 0.2 based on a single stranding in 2007 of an animal apparently killed by fishery entanglement. There were zero fishery-related mortalities of Gervais', Sowerby's, or True's beaked whales during that same time period. Permanent closure of the pelagic drift gillnet fishery removed the primary known source of incidental fishery mortality in these waters (Waring et al. 2014).

Although there is no information to differentiate stocks of *Mesoplodon* spp. whales in the Gulf of Mexico from Atlantic Ocean stock(s), for management purposes, these populations are provisionally considered separate stocks (Waring et al. 2013). The total number of Blainville's beaked whales in the northern Gulf of Mexico is unknown and the best available abundance estimate is for *Mesoplodon* spp., which is a combined estimate for Blainville's and Gervais' beaked whales. The estimate of abundance for *Mesoplodon* spp. in oceanic waters in the Gulf of Mexico is 149, based on a summer 2009 survey. The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 77 and the PBR for is 0.8 (Waring et al. 2013). It is not possible to determine the PBR for individual *Mesoplodon* species. Data are insufficient data to determine the population trends due to uncertainty in at-sea species identification. Total human-caused mortality and serious injury is unknown and none has been documented. In 2007, one unidentified beaked whale was released alive without serious injury after entanglement interaction with the pelagic longline fishery (Waring et al. 2013).

Status and trends information is not available for *Mesoplodon* spp. within the CRA.

Distribution and Habitat: World-wide, beaked whales normally inhabit continental slope and oceanic waters that are deeper than 200 m (Pitman 2009). Occurrence often has been linked to the continental slope, canyons, escarpments, and oceanic islands (MacLeod and D'Amico 2006). Most sightings are in late spring and summer, which corresponds to survey effort. Distribution is otherwise derived from stranding reports (Waring et al. 2009). During spring and summer, *Mesoplodon* spp. beaked whales occupy shelf-edge and deeper oceanic waters (CETAP 1982, Hamazaki 2002, Palka 2006). They are associated with warm waters (20.7° to 24.9° C), Gulf Stream features and warm-core rings, and steep bathymetry (Tove 1995, Hamazaki 2002, Waring et al. 2001, Palka 2006).

Behavior and Life History: *Mesoplodon* spp. occur alone or in groups of up to 15, and probably calve in the summer. They may be both a mid-water and bottom feeder on squid and fish (Pitman 2009). Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 2009). Baird et al. (2006) reported on the diving behavior of four Blaineville's beaked whales (*M. densirostris*) off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (690-3,000 m) with a maximum dive to1,408 m. Dives ranged from at least 13 min to a maximum of 68 min (Baird et al. 2006).

Acoustics and Hearing: *Mesoplodon* spp. beaked whales are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DON 2008) (Table 4-1).

4.1.13 Melon-Headed Whale (*Peponocephala electra*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: The melon-headed whale is predominantly gray with a darker gray dorsal cape and a distinct eye patch. They often have white lips and light coloration on the throat region. This species is hard to distinguish from pygmy killer whales at sea. Length for males is 2.5 m and for females is 2.4 m. There is some sexual dimorphism. Males have longer flippers, taller dorsal fins, broader flukes, and are more robust than females (Perryman 2009).

Abundance and Stock Status: The western North Atlantic population is provisionally considered a separate stock for management purposes, although there is no information available to differentiate this stock from the northern Gulf of Mexico stock. The numbers of melon-headed whales off the U.S. east are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of melon- headed whales was sighted during both a 1999 (20 whales) and 2002 (80 whales) vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina in waters >2500 m deep (Waring et al. 2007).

The best available population estimate for melon-headed whales in the northern Gulf of Mexico is 2,235, derived from a summer 2009 survey that covered waters from the 200 m isobaths to the offshore extent of the U.S. EEZ. The minimum population estimate is 1,274 and the calculated PBR is 13 (Waring et al. 2013). There has been no fishery-related mortality or serious injury reported for this stock from 1998 to 2010. Total human-caused mortality and serious injury is not known, although none has been reported. It is assumed that average annual human-related mortality and serious injury is less than PBR, so this is not considered a strategic stock (Waring et al. 2013).

Status and trends information is not available for Melon-headed whales within the CRA.

This species is not listed under the ESA.

Distribution and Habitat: Melon-headed whales are distributed worldwide in tropical and subtropical waters. They generally occur offshore in deep oceanic waters. Nearshore distribution is generally associated with deep water areas near to the coast (Perryman 2009).

Melon-headed whales in the northern Gulf of Mexico are generally sighted in water depths >800m and west of Mobile Bay, Alabama (Mullin et al. 1994, Mullin and Fulling 2004, Maze-Foley and Mullin 2006). Sightings occurred during in all seasons in the northern Gulf of Mexico (Hansen et al. 1996, Mullin and Hoggard 2000).

Squid appear to be the preferred prey, along with some fish and shrimp (Perryman 2009).

Behavior and Life History: Melon headed whales are often in large schools (mean school size is about 200), including in mixed schools with Fraser's dolphins (Perryman 2009, Wade and Gerrodette 1993). They may also form mixed schools with spinner, bottlenose, and rough-toothed dolphins (Perryman 2009). Females reach sexual maturity at approximately 11.5 years of age and males at about 15 years (Perryman 2009).

Acoustics and Hearing: Melon-headed whales are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007) (Table 4-1).

4.1.14 Risso's Dolphin (*Grampus griseus*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: Risso's dolphins are large dolphins with adults of both sexes reaching up to 4 m in length; there is no evidence of sexual dimorphism (Baird 2009b). The anterior body is robust, tapering to a relatively narrow tail stock with a relatively small dorsal fin. The bulbous head has a distinct vertical crease along the anterior surface of the melon (Baird 2009b). Color patterns change with age; older animals are covered with linear scars and may appear whitish on the dorsal and lateral surfaces. The dorsal fin is falcate and black in color (Baird 2009b). They are often confused with killer whales due to the large size of their dorsal fin.

Abundance and Stock Status: There is no information on Risso's dolphin stock structure in the western North Atlantic. In absence of specific information, the Gulf of Mexico and Atlantic stocks are treated as two separate stocks (Waring et al. 2015b).

Total numbers of Risso's dolphins off the U.S. or Canadian Atlantic coast are unknown, although several abundance estimates exist for select times and places. The best abundance estimate for Risso's dolphins is the sum of the estimates from two 2011 U.S. Atlantic surveys, 18,250, where the estimate from the northern U.S. Atlantic (Virginia to the Bay of Fundy) is 15,197 and from the southern U.S. Atlantic (Florida to Virginia) is 3,053. The combined estimate is considered the best available because these two surveys together have the most complete coverage of the population's habitat. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,619 and PBR is 126 (Waring et al. 2015b). The total annual average estimated fishery mortality and serious injury for this stock for 2009-2013 was 54 dolphins. This is not less than 10 percent of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate (Waring et al.2015b).

The best available abundance estimate available for northern Gulf of Mexico Risso's dolphins is 2,442, based on a summer 2009 survey of waters from the 200-m isobath to the seaward extent of the U.S. EEZ. The minimum population estimate is 1,563 and the calculated PBR is 16 Risso's dolphins (Waring et al. 2015). Estimated annual average fishery-related mortality and serious injury for this stock (7.9 dolphins during 2008 to 2012) is based on observed serious injury and mortality in the Pelagic Longline fishery in 2008, 2011, and 2012. Total fishery-related mortality and serious injury is not less than ten percent of PBR for this stock, so cannot be considered insignificant and approaching a zero mortality rate. Average human-caused mortality and serious injury does not, however, exceed PBR, so this is not considered a strategic stock (Waring et al. 2015a).

Status and trends information is not available for Risso's dolphins within the CRA.

Risso's dolphins are not listed as "threatened" or "endangered" under the ESA nor as "depleted" under the MMPA.

Distribution and Habitat: Risso's dolphins are distributed world-wide in tropical and warm-temperate waters. They occur along the continental shelf edge from Cape Hatteras northward to Georges Bank during the spring, summer, and autumn (CETAP 1982, Payne et al. 1984). In winter, the range begins at the Mid-Atlantic Bight and extends farther offshore into oceanic waters (Payne et al. 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round (Payne et al. 1984). During 1990, 1991, and 1993, spring/summer surveys conducted in continental shelf edge and deeper oceanic waters had sightings of Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring et al. 1992).

Risso's dolphins are found throughout the oceanic waters of the northern Gulf of Mexico, but concentrate along the continental slope (Baumgartner 1997, Maze-Foley and Mullin 2006). They are seen during all seasons (Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: As summarized in Baird (2009b, and citations therein), Risso's dolphins are relatively gregarious, typically travelling in groups of 10-50 individuals; the largest group reported had over 4,000 individuals. They have been observed bow riding in front of gray whales and are often seen surfing in swells. Gestation is 13-14 months and calving intervals are about 2.4 years with peak calving during winter in the eastern North Pacific. Sexual maturity for females is thought to be 8-10 years of age and males 10-12 years of age. They feed almost exclusively on squid, likely at night (Baird 2009b).

Acoustics and Hearing: Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Risso's dolphin vocalizations range from 400 Hz to 65 Hz (DON 2008) (Table 4-1).

4.1.15 Short-Finned Pilot Whale (*Globicephala macrorhynchus*) – Western North Atlantic, Northern Gulf of Mexico, and Puerto Rico and U.S. Virgin Islands Stocks

Description: Short-finned pilot whales appear black or dark gray; the body is robust with a thick tailstock. The melon is exaggerated and bulbous and there is either no beak or a barely discernible one (Olson 2009). They exhibit striking sexual dimorphism with adult males reaching an average length of 6 m and they are larger than females; the broad-based dorsal fin of a male is larger than that of a female (Olson 2009).

Abundance and Stock Status: There are two species of pilot whales in the western Atlantic: the short-finned pilot whale, *G. macrorhynchus* and the long-finned pilot whale, *Globicephala melas*; long-finned pilot whales are discussed below (CETAP 1982, Waring et al. 2011, 2013, 2015b). Neither species is listed as threatened or endangered under the ESA. Because these species are difficult to distinguish at sea, sighting data often are reported as *Globicephala* sp. Survey data are, therefore, combined with the analysis of spatial distribution of the two species based on genetic analyses of biopsy samples to generate individual abundance estimates (Waring et al. 2015b). The abundance of short-finned pilot whales in western North Atlantic appears to be variable and influenced by prevailing oceanographic conditions. Because animals may spend time outside the U.S. EEZ as oceanographic conditions change, a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The best available estimate for short-finned pilot whales in the western North Atlantic is 21,515, derived from summer 2011 surveys from central Florida to the lower Bay of Fundy. A regression model developed to predict the probability of a pilot whale being either long-finned or short-finned as a function of sea surface temperature and water depth was used to partition abundance estimates from the 2011 survey (Waring et al. 2015b). The minimum population estimate is 15,913 and the calculated PBR for short-finnned pilot whales is 159. The total annual estimated average fishery-related mortality and serious injury in the pelagic longline fishery was 148 short-finned pilot whales from 2009 through 2013. The total annual fishery-related mortality and serious injury is not known. In addition to the observed takes in the pelagic longline fishery, there was a self-reported take in the hook and line fishery in 2013 (Waring et al. 2015b). Total U.S. fishery-related mortality and serious injury for the western North Atlantic stock of short-finned pilot whales exceeds 10 percent of PBR and cannot be considered insignificant and approaching zero mortality and injury rate (Waring et al. 2015b).

The Gulf of Mexico population of short-finned pilot whales is considered a separate stock for management purposes. Currently, information to differentiate the stock from Atlantic stocks is not available. The best available abundance estimate for northern Gulf of Mexico short-finned pilot whales is 2,415, based on a summer 2009 survey of waters from the 200-m isobath to the seaward extent of the U.S. EEZ. The minimum population estimate is 1,456 and the calculated PBR is 15 pilot whales (Waring et al. 2015b). The estimated average annual fishery-related mortality and serious injury was 0.5 northern Gulf of Mexico short-finned pilot whales, 2009 to 2013, in the pelagic longline fishery. Total human-caused mortality and serious injury is less than ten percent of PBR for this stock (Waring et al. 2015b).

The Puerto Rico and U.S. Virgin islands stock of short-finned pilot whales are provisionally considered a separate stock from the North Atlantic stock off the east coast of the U.S. and the Gulf of Mexico stock for management purposes. They have not been extensively studied in these waters. Abundance is unknown (best and minimum) and data are insufficient to determine trends and to calculate PBR. Total human-caused mortality and serious injury is unknown and there is not systematic monitoring of all fisheries that may take this stock. Due to these factors and because there are documented interactions between short-finned pilot whales and the pelagic longline fishery in waters off Cuba, this is considered a strategic stock (Waring et al. 2012).

Distribution and Habitat: Short-finned pilot whales occur worldwide in tropical to warm-temperate seas and usually do not range north of 50° N or south of 40° S. They may seasonally extend into shelf-edge waters north of Cape Hatteras (Leatherwood et al.1983). The NEFSC and SEFSC are using genetic and photo-identification data to better define the northern range of this species and habitat overlap with the long-finned pilot whale off the eastern U.S.

Sightings of short-finned pilot whales in the northern Gulf of Mexico are primarily on the continental slope west of 89˚W (Mullin and Fulling 2004, Maze-Foley and Mullin 2006). Short-finned pilot whales are seen throughout the year (Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: Pilot whales are very social and may travel in groups of several to hundreds of animals, often with other cetaceans. They appear to live in relatively stable, female-based groups (DON 2008). Sexual maturity occurs at 9 years for females and 17 years for males. The mean calving interval is 4 to 6 years. Pilot whales are deep divers; the maximum dive depth measured is about 971 m (Baird et al. 2002). Short-finned pilot whales feed on squid and fish, including several deep-water species, such as *Brachioteuthis reversa* and *Scopelagadus beanii* (Mintzer et al. 2008)

Acoustics and Hearing: Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to14 kHz and a source level of 180 dB re 1 µPa-m for whistles (DON 2008). *Globicephala* spp. are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007) (Table 4-1).

4.1.16 Long-Finned Pilot Whale (*Globicephala melas*) – Western North Atlantic Stock

Description: Long-finned pilot whales appear black or dark gray; the body is robust with a thick tailstock. The melon is exaggerated and bulbous and there is either no beak or a barely discernible one (Olson 2009). They exhibit striking sexual dimorphism with adult males reaching an average length of 6 m and they are larger than females; the broad-based dorsal fin of a male is larger than that of a female (Olson 2009). They are very difficult to distinguish from the short-finned pilot whale discussed previously in that the flippers are marginally longer and they exhibit a noticeable ‘elbow’ (Olson 2009).

Abundance and Stock Status: The best estimate of abundance for western North Atlantic long-finned pilot whales is 5,636, derived from summer 2011 surveys from central Virginia to the lower Bay of Fundy. This is considered the best estimate, as it is the most recent, but the 2011 surveys did not include areas of the Scotain Shelf where the highest densities of long-finned pilot whales occurred in 2006. The minimum population estimate is 3,464 whales and the PBR is 35 (Waring et al. 2015b). There are insufficient data to determine population trends. The total annual observed fishery-related mortality or serious injury during 2009 to 2013 averaged 31 long-finned pilot whales. Takes in bottom trawl, mid-water trawl, and gillnet fisheries were examined using model-based predictions and all were assigned as long-finned pilot whales; bycatch of pilot whales in the pelagic longline fishery appears to be restricted to short-finned pilot whales. The total U.S. fishery-related mortality and serious injury for long-finned pilot whales exceeds 10 percent of PBR, so cannot be considered to be insignificant and approaching a zero mortality and serious injury rate (Waring et al. 2015b).

Distribution and Habitat: In U.S. Atlantic waters, Long-finned pilot whales concentrate along the northeast U.S. shelf edge between the 100 m and 1000 m isobaths during mid-winter and early spring (CETAP 1982, Payne and Heinemann 1993, Abend and Smith 1999). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn. Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring et al. 1992). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey. Pilot whales south of Cape Hatteras are expected to be short-finned (Waring et al. 2011).

Behavior and Life History: Pilot whales are very social and may travel in groups of several to hundreds of animals, often with other cetaceans. They appear to live in relatively stable, female-based groups (DON 2008). Sexual maturity occurs at 9 years for females and 17 years for males. The mean calving interval is 4 to 6 years. Pilot whales are deep divers; the maximum dive depth measured is about 971 m (Baird et al. 2002). Pilot whales feed primarily on squid (Sergeant 1962, Mercer 1975, Gannon et al. 1997), but also consume fish (Overholtz and Waring 1991).

Acoustics and hearing: The calls of long-finned pilot whales are of a lower frequency and a narrower frequency range than those of the short-finned pilot whale. The mean frequency for long-finned pilot whales is 4,480 Hz versus 7,870 for short-finned pilot whales (Olson 2009). *Globicephala* spp. are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007) (Table 4-1).

4.1.17 Short-Beaked Common Dolphin (*Delphinus delphis*) – Western North Atlantic Stock

Description: As summarized in DON (2008, and citations therein) and Perrin (2009a), short-beaked common dolphins are slender, moderately robust dolphins, with a moderate length beak, and a tall, slightly falcate dorsal fin. The beak is shorter than in long-beaked common dolphins, and the melon rises from the beak at a steeper angle. Short-beaked common dolphins are distinctively marked with a V-shaped saddle caused by a dip in the cape below the dorsal fin, yielding an hourglass pattern on the side of the body. The back is dark brownish-gray, the belly is white, and the anterior flank patch is tan to cream in color. The lips are dark, and there is a dark stripe from the eye to the apex of the melon and another one from the chin to the flipper (the latter is diagnostic to the genus). There are often variable light patches on the flippers and dorsal fin. Length ranges up to about 2.3 m (females) and 2.6 m (males).

Abundance and Stock Status: Although the common dolphin may be one of the most widely distributed cetacean species, total numbers off the U.S. and Canadian Atlantic coasts is unknown, as is stock status within these waters. Data are also insufficient to determine population trends. Common dolphins are not listed as endangered or threatened under the ESA.

The best abundance estimate for western North Atlantic short-beaked common dolphins (173,486 animals) is derived from the Canadian Trans-North Atlantic Sighting Survey (TNASS) during summer 2007 (Waring et al. 2015b). The most recent estimates of common dolphins in U.S. waters are 67,191 for central Virginia to the lower Bay of Fundy and 2,993 for central Florida to central Virginia, derived from shipboard and aerial surveys during June-August 2011. The minimum population estimate of common dolphins in the western North Atlantic, based on TNASS, is 112,531 and the PBR is 1,125 (Waring et al. 2015b). Total estimated annual average fishery-related mortality and serious injury, 2009 to 2013, was 363 short-beaked common dolphins, with more than half (210.2) taken in the Mid-Atlantic bottom trawl fishery. Total fishery-related mortality and serious injury is not less than 10 percent of PBR, so cannot be considered insignificant and approaching zero mortality and serious injury rate (Waring et al. 2015b).

Distribution and Habitat: Short-beaked common dolphins are the most abundant dolphin in offshore warm-temperate waters in the Atlantic and Pacific (Perrin 2009a). They occur worldwide from about 40-60^{o} N to about 50^{o} S (Perrin 2009a). They tend to prefer cooler water farther offshore than the sympatric

long-beaked common dolphin; they occupy upwelling-modified habitats with less tropical characteristics than surrounding water masses (Perrin 2009a). During summer and fall, short-beaked common dolphins primarily occur along the outer coast in waters deeper than 200 m, south of 42° N and to a lesser extent in water depths between 100 m and 200 m south of 42° N, and seaward of the 100 m water depth north of 42° N. In winter and spring, animals typically stay south of the 13° C isotherm.

Behavior and Life History: Short-beaked common dolphins are usually found in large groups of hundreds to thousands of individuals and are often associated with other marine mammal species. Gestation is 10-11.7 months with a calving interval of 1-3 years, depending on location (Perrin 2009a). Age at sexual maturity varies by region from 3 years to 7-12 years for males and 2-4 and 6-8 years for females. Cooler water populations exhibit more seasonality in reproduction (Perrin 2009a). Diel fluctuations in vocal activity of this species (more vocal activity during late evening and early morning) appear to be linked to feeding on the deep scattering layer as it rises. Foraging dives up to 200 m in depth have been recorded off southern California (DON 2008).

Acoustics and Hearing: As summarized in DON (2008, and citations therein), recorded vocalizations include whistles, chirps, barks, and clicks. Clicks range from 0.2 to 150 kHz with dominant frequencies between 23 and 67 kHz and estimated source levels of 170 dB re 1 μPa. Chirps and barks typically have a frequency range from less than 0.5 to 14 kHz, and whistles range in frequency from 2 to 18 kHz. Maximum source levels are approximately 180 dB 1 μPa-m.

4.1.18 Atlantic Spotted Dolphin (*Stenella frontalis*) – Western North Atlantic Stock, Northern Gulf of Mexico, and Puerto Rico and U.S. Virgin Islands Stocks

Description: There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin, *Stenella frontalis* and the pantropical spotted dolphin, *S. attenuata* (Perrin et al. 1987, see following account). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. This is a large bodied form of spotted dolphin found along the coast on both sides of the Atlantic Ocean. It may be so heavily spotted as to appear white from a distance but not all individuals are spotted (Perrin 2009b). A constant diagnostic external feature is a spinal blaze sweeping up into the dorsal cape; the peduncle does not exhibit the division into darker upper lighter lower halves present in *S. attenuata*, a species for which it may be confused (ibid). The beak is medium length and sharply demarcated from the melon; the dorsal fin is tall and truncated. Adults tange from 1.6 m to 2.3 m in body length and weigh up to 143 kg (ibid).

Abundance and Stock Status: Atlantic spotted dolphins are not listed as threatened or endangered under the ESA. The two forms of Atlantic spotted dolphin may be distinct sub-species: the large, heavily spotted form which occurs on the continental shelf, usually inside of or near to the 200-m isobath; and a smaller, less spotted island and offshore form found in the Atlantic Ocean but not in the Gulf of Mexico. They are difficult to distinguish in areas where they co-occur (Waring et al. 2015b). Prior to 1999, species of spotted dolphins were not differentiated during surveys, resulting in insufficient data to determine the population trends (Waring et al. 2015b).

The best abundance estimate for Atlantic spotted dolphins in the western North Atlantic is 44,715, derived from summer surveys in 2011 that included waters from central Florida to the lower Bay of Fundy. Estimated abundance for central Virginia to the lower Bay of Fundy is 26,798 and is 17,917 for central Florida to central Virginia. These estimates include both ecotypes (forms) combined (Waring et al. 2015b). The minimum estimate is 31,610 and the calculated PBR is 316. The annual estimated average fishery-related mortality or serious injury for this stock was 42 dolphins in the shrimp trawl fishery during 2007-2011; more recent data are not yet available (Waring et al. 2015b).

The population of Atlantic spotted dolphins in the Gulf of Mexico is, for management purposes, considered a separate stock from those in the Atlantic Ocean. The current population size is unknown for Atlantic spotted dolphins in the northern Gulf of Mexico, since the most recent surveys were more than

eight years ago in 2000-2001 and 2003-2004. The current and minimum population estimates and PBR are, therefore, also unknown since these data are greater than eight years old. Total human-caused mortality and serious injury for this stock is unknown (Waring et al. 2015b).

The Puerto Rico and U.S. Virgin Islands population of Atlantic spotted dolphins is provisionally considered a separate stock from the Atlantic Ocean and Gulf of Mexico stocks for management purposes (Waring et al. 2012). The abundance of this stock is unknown and data are insufficient for determining minimum population size, population trends, or for determining PBR (Waring et al. 2012). Estimates of human-caused mortality and serious injury are unknown for this stock and systematic monitoring of fisheries with which this stock may interact is lacking. This stock is considered strategic due to this lack of information (Waring et al. 2012).

Distribution and Habitat: Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al. 1976). The species is endemic to the tropical and warm-temperate Atlantic (Perrin 2009b). The range extends from about 50^{o} N to about 25^{o} S and in the western Atlantic the heavily spotted form inhabits shallow, gently sloping waters off the continental shelf usually within the 200-m curve (Perrin 2009b). They extend south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood et al. 1976, Perrin et al. 1994). They regularly occur in the inshore waters south of Chesapeake Bay and near the continental shelf edge and continental slope waters north of this region (Payne et al. 1984, Mullin and Fulling 2003). Atlantic spotted dolphins north of Cape Hatteras also associate with the north wall of the Gulf Stream and warm-core rings (Waring et al. 1992).

Atlantic spotted dolphins are seen year round in the Gulf of Mexico, where they occur primarily in continental shelf (10-200 m deep) to slope (<500m deep) waters (Fulling et al. 2003, Mullin and Fulling 2004, Maze-Foley and Mullin 2006, Hansen et al. 1996, Mullin and Hoggard 2000).

NMFS surveys during the winters of 1995, 2000 and 2001 sighted Atlantic spotted dolphins in continental slope and oceanic waters of Puerto Rico and the U.S. Virgin Islands and surrounding areas. Stranding records indicate that Atlantic spotted dolphins are among the most common species to strand in Puerto Rico and the Virgin Islands (Waring et al. 2012 and citations therein).

Behavior and Life History: Atlantic spotted dolphins have a maximum age of about 23 years with age at sexual maturity estimated at 8-15 years for females (Perrin 2009b). Average calving interval is about 3 years. In the Bahamas they typically inhabit shallow water and consume a variety of prey including small-to-large epipelagic and mesopelagic fishes and squid. Sharks are the only known predator, but they may also be preyed on by killer whales (Ibid). Dives to 40-60 m and lasting up to 6 minutes have been recorded. They often associate with bottlenose dolphins while foraging and traveling in the Bahamas; in the Azores they join large temporary mixed-species feeding aggregations with tuna, other cetaceans, and seabirds (Perrin 2009b).

Acoustics and Hearing: Atlantic spotted dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations similarly range from 100 Hz to 130 kHz (DON 2008) (Table 4-1).

4.1.19 Pantropical Spotted Dolphin (*Stenella attenuata*) – Western North Atlantic Stock and Northern Gulf of Mexico Stocks

Description: Spotted dolphins are characterized by a long, clearly defined beak, prominent falcate dorsal fin, slender body and spots on adults. The larger coastal spotted dolphin is heavily spotted. Adults can be 1.7-2.6 m long and weigh up to 119 kg, with a great deal of geographic variation (Perrin 2009c).

Abundance and Stock Status: The two spotted dolphin species in the Atlantic -- *S. frontalis* and *S. attenuata* – can be difficult to differentiate at sea, so abundance estimates prior to 1999 included both species combined. More recent estimates are species-specific, as species can be confidently identified south of Cape Hatteras. The current best abundance estimate for pantropical spotted dolphins is 3,333,

based on 2011 summer surveys from central Florida to the lower Bay of Fundy. All sightings of this species occurred in waters between central Florida and Central Virginia. The minimum estimate is 1,733 and the calculated PBR is 17. There were zero reported fishery-related mortalities or serious injuries to this stock from 2007 to 2011 (Waring et al. 2014). The western North Atlantic pantropical spotted dolphin population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s).

The best currently available population estimate for pantropical spotted dolphins in the northern Gulf of Mexico is 50,880 from a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ from Texas to Florida. The minimum population estimate is 40,699 and the PBR is 407 (Waring et al. 2015b). The estimated average annual fishery-related mortality and serious injury for this stock during 2009-2013 was 3.8, based on takes of pantropical spotted dolphins in the pelagic longline fishery. Additional mean annual mortality and serious injury due to non-SEFSC associated fishery research was 0.6, for a total mean annual human-caused mortality and serious injury for this stock during 2009-2013 of 4.4. Total fishery-related mortality and serious injury for this stock is less than 10 percent of PBR and can be considered to be insignificant and approaching a zero mortality and serious injury rate (Waring et al. 2015b) This is not considered a strategic stock since the average annual human-related mortality and serious injury does not exceed PBR (Waring et al. 2015b).

Status and trends information is not available for pantropical spotted dolphins within the CRA.

This species is not listed as threatened or endangered under the ESA.

Distribution and Habitat: The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin 2009c). Pantropical spotted dolphins are seen year round in the northern Gulf of Mexico, where they occur primarily in oceanic waters (Mullin and Fulling 2004, Maze-Foley and Mullin 2006, Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: Pantropical spotted dolphins often occur in large multi-species schools, particularly with spinner dolphins (Perrin 2009c). In 2006, >50% of the offshore spotted dolphins recorded were in mixed species schools (Jackson et al. 2008). Females become sexually mature at 9-11 years old and males at 12-15 years of age. The calving interval is approximately 2-3 years. Gestation ranges from 11.2-11.5 months and weaning occurs between 9 months and 2 years (Perrin 2009c).

Acoustics and hearing: Spotted dolphins are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007) (Table 4-1).

4.1.20 Striped Dolphin (*Stenella coeruleoalba*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: The striped dolphin is uniquely marked with black lateral stripes from eye to flipper and eye to anus. There is also a white V-shaped "spinal blaze" originating above and behind the eye and narrowing to a point below and behind the dorsal fin (Archer 2009). There is a dark cape and white belly; the lateral field is usually darker than the ventral. This is a relatively robust dolphin with a long, slender beak and prominent dorsal fin. The longest specimen was 2.56 m and the heaviest was 156 kg but mean maximum body length in the western pacific is 2.4 m for males and 2.2 m for females (Archer 2009).

Abundance and Stock Status: Striped dolphins in the western North Atlantic are not listed as either threatened or endangered under the ESA. The best abundance estimate for striped dolphins is the sum of summer 2011 survey estimates – 54,807 dolphins. The estimate for waters off central Virginia to the lower Bay of Fundy is 46,882 and for central Florida to central Virginia, it is 7,925 (Waring et al. 2014). The minimum population estimate is 42,804 and the calculated PBR is 428 striped dolphins. Total annual average fishery-related mortality of this stock was zero for the period 2007 to 2011 (Waring et al. 2014).

The Gulf of Mexico population is provisionally considered a separate stock from Atlantic Ocean stocks for management purposes; adequate information to distinguish this stock from others in the Atlantic is

currently lacking (Waring et al. 2013). The best currently available population estimate for striped dolphins in the northern Gulf of Mexico is 1,849 from a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. The minimum population estimate is 1,041 and the PBR is 10 (Waring et al. 2013). There has been no reported fishery-related mortality or serious injury to this stock from 1998 to 2010 and total human-caused mortality and serious injury is unknown. This is not considered a strategic stock since it is unlikely that the average human-caused mortality and serious injury exceeds PBR (Waring et al. 2013).

Status and trends information is not available for striped dolphins within the CRA.

This species is not listed under the ESA as either threatened or endangered.

Distribution and Habitat: Striped dolphins are distributed worldwide in warm-temperate to tropical zones. In the western North Atlantic, they range from Nova Scotia to, at least, Jamaica and into the Gulf of Mexico (Waring et al. 2014 and citations therein). Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling. Off the northeastern U.S. striped dolphins distribute along the continental shelf edge from Cape Hatteras to the southern edge of Georges Bank and offshore over the continental slope and rise (CETAP 1982, Mullin and Fulling 2003).

Striped dolphins are seen year round in the northern Gulf of Mexico, where they occur primarily in oceanic waters (Mullin and Fulling 2004, Maze-Foley and Mullin 2006, Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: As summarized from Archer (2009, and references therein), mating is seasonal and gestation lasts 12-13 months. Females become sexually mature between 5 and 13 years of age and between 7 and 15 years of age for males. Striped dolphins are acrobatic and perform a variety of aerial behaviors but they do not commonly bow ride. They often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m to reach potential prey. Striped dolphins may feed at night in order to take advantage of the deep scattering layer's diurnal vertical movements (Archer 2009).

Acoustics and hearing: Striped dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 6 to > 24 kHz (DON 2008) (Table 4-1).

4.1.21 Fraser's Dolphin (*Lagenodelphis hosei*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: Fraser's dolphins are stocky dolphins with a short beak, small triangular to falcate dorsal fin, small flukes and flippers and striking black head stripe that is prominent in adult males, variable in adult females and absent in calves. The back is brownish gray, the lower body cream colored and the belly pink or white. The largest male recorded was 2.7 m and the largest female 2.6 m. Large males could weigh up to 210 kg (Dolar 2009).

Abundance and Stock Status: Fraser's dolphins are not often seen in the western North Atlantic, which may be due to naturally low abundance relative to other cetaceans. For management purposes, the western North Atlantic population is provisionally considered a separate stock from the northern Gulf of Mexico stock. Due to the rarity of sightings, the number of Fraser's dolphins off the U.S. Atlantic coast is unknown and seasonal abundance estimates are not available. Consequently, a minimum population estimate, population trends, and PBR are also unknown for this stock (Waring et al. 2007). There are no reports of fishery-related mortality or serious injury to the western North Atlantic stock of Fraser's dolphins during 2001 to 2005, the last time period for which this stock was assessed (Waring et al. 2007).

The Gulf of Mexico population of Fraser's dolphins is provisionally considered a single stock for management purposes; adequate information to distinguish this stock from others in the Atlantic is currently lacking (Waring et al. 2013). The best currently available population estimate for Fraser's dolphins in the northern Gulf of Mexico is unknown, as none were seen during a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. Small numbers of Fraser's dolphins likely inhabit the northern Gulf of Mexico, as they have been consistently seen every few years since the early 1900s (Waring et al. 2013). The minimum population size is unknown and the PBR is indeterminable. There was no reported fishery-related mortality or serious injury to this stock from 1998 to 2010. Total human-caused mortality and serious injury is unknown; none has been documented. This is not considered a strategic stock (Waring et al. 2013).

Status and trends information is not available for Fraser's dolphins within the CRA.

This species is not listed as either threatened or endangered under the ESA.

Distribution and Habitat: Fraser's dolphins are distributed worldwide in tropical waters (Dolar 2009), generally between 30° N and 30° S (Dolar 2009). They are typically oceanic and commonly occur in water depths of 1500-2500 m. They prey primarily on mesopelagic fish, cephalopods, and crustaceans and (Dolar 2009).

Fraser's dolphins in the northern Gulf of Mexico are found in oceanic waters (>200 m) during all seasons (Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: Fraser's dolphins often occur in tightly grouped, fast moving schools of 100-1,000 individuals. They commonly occur in large mixed-species schools with melon-headed whales in the ETP (Dolar 2009, Wade and Gerrodette 1993). They prey primarily on mesopelagic fish, cephalopods, and crustaceans and, in the ETP, are thought to feed between 250 to 500 m depth (Dolar 2009). They are deep divers and capable of diving to >600 m (Dolar 2009). Life history data is available for Fraser's dolphins off Japan. The age of sexual maturity appears to be 7-10 years for males and 5-8 years for females (Dolar 2009).

Acoustics and Hearing: Fraser's dolphins are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007) (Table 4-1).

4.1.22 Rough-toothed Dolphin (*Steno bredanensis*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: The rough toothed dolphin is so named because of unique vertical ridges on the teeth. They are distinctive in appearance, with a smooth sloping forehead and long beak, tall dorsal fin, and long flippers. They are generally darkly colored, with a white belly and dark gray to black back. The mouth area and lower sides often have white spots or patches. They can weigh up to 155 kg and be up to 2.6 m in length. Males are larger than females (Jefferson 2009a).

Abundance and Stock Status: Rough-toothed dolphins off the U.S. Atlantic coast are, for management purposes, provisionally considered a separate stock from those in the northern Gulf of Mexico. Additional data are needed to adequately delineate stocks. Currently, the best population estimate available for the western North Atlantic stock (271) is from summer 2011 surveys of waters from central Florida to the lower Bay of Fundy. All of the sightings were in the central Florida to central Virginia survey area. The minimum population estimate is 134 and the calculated PBR is 1.3. Data are insufficient to assess trends. There were zero reported fishery-related mortalities or serious injuries to rough toothed dolphins during 2007 to 2011 (Waring et al. 2014).

The Gulf of Mexico population is provisionally considered a separate stock from Atlantic Ocean stocks for management purposes; adequate information to distinguish this stock from others in the Atlantic or to determine if there are multiple stocks in the Gulf of Mexico is currently lacking (Waring et al. 2013). The best currently available population estimate for rough-toothed dolphins in the northern Gulf of Mexico is

624 from a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. The minimum population estimate is 311 and the PBR is 3.1 (Waring et al. 2013). There has been no reported fishery-related mortality or serious injury to this stock from 1992 to 2010 and total human-caused mortality and serious injury is unknown. This stock is not considered strategic since it is unlikely that the average human-caused mortality and serious injury exceeds PBR (Waring et al. 2013).

Status and trends information is not available for Rough-toothed dolphins within the CRA.

This species is not listed under the ESA as either threatened or endangered.

Distribution and Habitat: Rough-toothed dolphins are a tropical to warm temperate species found in oceanic waters worldwide, as well as over continental shelf and coastal waters in some areas (Jefferson 2009a, May-Collado et al. 2005). Rehabilitated and tagged rough-toothed dolphins in the western North Atlantic traveled through water depths averaging greater than 100 m, although each tagged dolphin also transited through very shallow waters at some point. These tagged rough-toothed dolphins moved through waters with temperatures averaging 21° to 30°C (Waring et al. 2014 and citations therein).

Rough-toothed dolphins have been seen in all seasons in the northern Gulf of Mexico, where they occur primarily in oceanic, but also in continental shelf, waters (Fulling et al. 2003, Mullin and Fulling 2004, Maze-Foley and Mullin 2006, Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: School size is variable, but commonly in the range of 10-20 (Jefferson 2009a). Rough-toothed dolphins commonly occur in mixed schools with other delphinids in the Eastern Tropical Pacific. They have also been observed associating with flotsam (Jefferson 2009a). They feed on a variety of fish and cephalopods but their general ecology is poorly studied. They may stay submerged for up to 15 min and are known to dive as deep as 150 m (Jefferson 2009a). The only life history information available is from Japan, where males reach sexual maturity at about 14 years of age and females at about 10 years old. The maximum recorded age was 32-36 years (Jefferson 2009a).

Acoustics and Hearing: As summarized in DON (2008), the rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz. Whistles have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range. They are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007) (Table 4-1).

4.1.23 Clymene Dolphin (*Stenella clymene*) – Western North Atlantic and Northern Gulf of Mexico Stocks

Description: This dolphin is small but stocky with a moderately long beak, separated from the melon by a distinct crease (Jefferson 2009b). The dorsal fin is tall and nearly triangular and the flippers and fluke are typical dolphin-type. The color pattern is distinctly tripartite, with a white belly, light gray flanks, and dark cape (ibid). There is an eye stripe that runs forward to the upper beak and connects with a dark gray stripe running the length of the upper beak (ibid). Few specimens have been measured but they probably do not exceed 2.0 m in length with males somewhat larger than females; maximum known weight is 80 kg (ibid).

Abundance and Stock Status: The western North Atlantic stock of Clymene dolphins is considered a separate stock from those in the northern Gulf of Mexico for management purposes. Sightings of this species are rare off the U.S. Atlantic coast and only one population estimate has been calculated based on survey data from 1998 (Waring et al. 2014). This "best" estimate of abundance available for the Clymene dolphin in the U.S. Atlantic EEZ is 6,086 (Mullin and Fulling 2003). No minimum population estimate is available and there are insufficient data to determine population trends or PBR for this stock. There were

zero fishery-related mortalities or serious injuries to this stock reported during 2007-2011 (Waring et al. 2014).

The best currently available population estimate for Clymene dolphins in the northern Gulf of Mexico is 129 from a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. The minimum population estimate is 64 and the PBR is 0.6 (Waring et al. 2013). There was no reported fishery-related mortality or serious injury to this stock from 1998 to 2010. Total human-caused mortality and serious injury is unknown, as none has been documented. This is not considered a strategic stock (Waring et al. 2013).

Status and trends information is not available for Clymene dolphins within the CRA.

This species is not listed under the ESA as either threatened or endangered.

Distribution and Habitat: Clymene dolphins are found only in the Atlantic Ocean in tropical to warm-temperate waters; the exact range is not well understood (Jefferson 2009b). Most sightings have been in deep, offshore waters, but may be seen near shore when deep water approaches the coast (ibid). It likely feeds on mesopelagic fishes and squid. They are known to associate with spinner dolphins.

Clymene dolphin sightings in the northern Gulf of Mexico generally occur over deeper waters off the continental shelf, primarily west of the Mississippi River (Mullin et al. 1994). They have been seen during winter, spring, and summer aerial surveys (Hansen et al. 1996, Mullin and Hoggard 2000).

Behavior and Life History: Little is known of the behavior and life history of this species. School size is generally of moderate size of a few hundred individuals with school size in the Gulf of Mexico averaging 42 individuals (Mullen et al. 1994). They are active bow riders and acrobatic. They likely feed mostly on mesopelagic fishes and squids.

Acoustics and Hearing: There has been little work done on the acoustic behavior of these animals but they appear to be quite vocal with whistles in the frequency range 0f 6-19 kHz (Jefferson 2009b). It is assumed that they are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007) (Table 4-1).

4.1.24 Spinner Dolphin (*Stenella longirostris*) – Northern Gulf of Mexico and Puerto Rico and Virgin Islands Stocks

Description: Spinner dolphins are readily identifiable by their external features and highly acrobatic "spinning" behavior. They have long slender beaks, tipped with black or dark gray, a dark gray cape, light gray sides, light belly, and a dark band that goes from the eye to the flipper. In the North Atlantic, Gulf of Mexico, and Puerto Rico/Virgin Islands areas there are no recognized subspecies (Perrin 2009d). Adults are 1.3-2.4 m long and weigh 23-80 kg. Males are larger than females (ibid).

Abundance and Stock Status: The Gulf of Mexico population is provisionally considered a separate stock from Atlantic Ocean stocks for management purposes; adequate information to distinguish this stock from others in the Atlantic is currently lacking (Waring et al. 2013). The best currently available population estimate for spinner dolphins in the northern Gulf of Mexico is 11,441 from a summer 2009 oceanic survey that included waters from the 200 m isobath offshore to the seaward extent of the U.S. EEZ. The minimum population estimate is 6,221 and the PBR is 62 (Waring et al. 2013). There has been no reported fishery-related mortality or serious injury to this stock from 1998 to 2010 and total human-caused mortality and serious injury is unknown. This is not considered a strategic stock since it is unlikely that the average human-caused mortality and serious injury exceeds PBR (Waring et al. 2013).

The Puerto Rico and U.S. Virgin Islands spinner dolphin population is provisionally considered a separate stock from the Atlantic Ocean and Gulf of Mexico stocks for management purposes. Abundance of the Puerto Rico and U.S. Virgin Islands stock of spinner dolphins is unknown and minimum population estimate, population trends, and PBR cannot be determined. Total human-caused mortality and serious

injury is unknown for this stock and systematic monitoring of fisheries with which this stock may interact is lacking. This stock is being considered strategic due to this lack of information (Waring et al. 2012).

This species is not listed under the ESA as either threatened or endangered.

Distribution and Habitat: Spinner dolphins occur in tropical and most sub-tropical waters between 30-40^{o} N and 20-40^{o} S latitude, generally in areas with a shallow mixed layer, shallow and steep thermocline, and little variation in surface temperatures (Perrin 2009d). Spinner dolphins in the northern Gulf of Mexico occur in oceanic waters, typically east of the Mississippi River and have been seen during all seasons (Hansen et al. 1996, Mullin and Hoggard 2000).

Spinner dolphins have been sighted in waters of Puerto Rico and the U.S. Virgin Islands, as well as other areas of the Caribbean Sea. They occur year round, although sightings appear fewer in the summer and fall. Most sightings are on continental shelf waters, but occur in deeper waters, as well (Mignucci-Giannoni 1998, Waring et al. 2012 and citations therein).

Behavior and Life History: A rationale for the most conspicuous behavior of the spinner dolphin – the spinning for which the species is named – remains a mystery. Theories as to why spinners spin include communication, play, and knocking off remoras (Perrin 2009d). School size varies from a few animals to over a thousand. Mixed schools with other species, particularly pantropical spotted dolphins, are common (Perrin 2009a). Mating appears to be promiscuous. Gestation is about 10 months and breeding is seasonal. Females reach sexual maturity at 4-7 years, and males at 7-10 years. Calving interval is 3 years and calves nurse for 1-2 years (Perrin 2009d).

Acoustics and Hearing: Spinner dolphins produce an array of whistles and burst pulses that vary by activity and geographically (Perrin 2009d). Spinner dolphins are in the mid-frequency functional hearing group of Southall et al. (2007), with an estimated auditory bandwidth of 150 Hz to 160 kHz (Table 4-1).

4.1.25 Bottlenose Dolphin (*Tursiops truncatus*) – Numerous Stocks

Description: Bottlenose dolphins are large and robust, varying in color from light gray to charcoal. The bottlenose dolphin is characterized by a medium-length stocky beak that is clearly distinct from the melon (Jefferson et al. 2008). The dorsal fin is tall sand falcate. There are striking regional variations in body size, with adult lengths from 1.9 to 3.8 m (Wells and Scott 2009).

Abundance and Stock Status: Two morphologically and genetically distinct morphotypes of bottlenose dolphins—the coastal and offshore forms--inhabit waters along the U.S. Atlantic and Gulf of Mexico coasts (Curry and Smith 1997, Duffield et al. 1983, Duffield 1986, Hersh and Duffield 1990, Mead and Potter 1995). These forms are further divided into one offshore and 16 coastal and estuarine system stocks within the ARA (Table 3-3, Figure 4-2).

The NMFS recognized only one migratory stock of coastal bottlenose dolphins in the western North Atlantic from 1995 to 2001; the entire stock was listed as depleted under the MMPA. Individual coastal stocks retained the depleted status when stock structure was revised in 2002 to recognize multiple stocks and seasonal management units (Table 3-3). Further revisions in 2008 and 2009 recognized resident estuarine stocks and migratory and resident coastal stocks (Waring et al. 2015b). The migratory and coastal stocks retained the depleted status and most estuarine stocks are strategic. The species is not listed as threatened or endangered under the ESA (Waring et al. 2015b).

Best and minimum abundance estimates for the western North Atlantic migratory coastal stocks, resident coastal stocks, and numerous resident estuarine system stocks are listed in Table 3-3. Population size is unknown for eight of these stocks. The estuarine system stocks, for which estimates exist, generally number in the hundreds and are much smaller than the coastal stocks that range in size from approximately 1,200 to over 11,500 individuals. PBR calculations, shown in parentheses, are available for stocks for which there are population estimates: northern coastal migratory (86), southern coastal migratory (63), South Carolina/Georgia coastal (31), northern Florida coastal (7), central Florida coastal

(29), northern North Carolina estuarine (7.8), central Georgia estuarine system (1.9), and the southern Georgia estuarine system (1.9). The estimated average annual human-caused serious injury and mortality levels during 2009-2013 are known for eleven of the coastal and estuarine stocks in the ARA: northern coastal migratory (1-7.5), southern coastal migratory (1-12), South Carolina/Georgia coastal stock (1.2-1.6), northern Florida coastal stock (0.4), central Florida coastal stock (0.2), northern North Carolina estuarine system (1-16.7), southern North Carolina estuarine system (0-0.4), northern South Carolina estuarine system (0.2), northernGeorgia/southern South Carolina estuarine system (1.4), Jacksonville estuarine system (1.2), and the Indian River Lagoon estuarine system stock (4.4) (Waring et al. 2015b).

The western North Atlantic offshore bottlenose dolphin is not listed as depleted under the MMPA, or as threatened or endangered under the ESA. The best available abundance estimate for offshore morphotype bottlenose dolphins (77,532) is from summer 2011 surveys that covered waters from central Florida to the lower Bay of Fundy. The estimate for the southern survey area from central Florida to central Virginia is 50,766 and, for the northern area from central Virginia to the lower Bay of Fundy, it is 26,766 dolphins. The minimum estimated population size for the entire survey area is 56,053 and the calculated PBR is 561. A trend analysis has not been conducted (Waring et al. 2015b). Total estimated mean annual mortality and serious injury of western North Atlantic offshore bottlenose dolphins from commercial fisheries during 2009-2013 was 43.9, with takes in the Northeast sink gillnet (5.2), Northeast bottom trawl (6.4),Mid-Atlantic bottom trawl (18.2), and pelagic longline (14.1) fisheries (Waring et al. 2015b).

There are thirty-six stocks of bottlenose dolphins delimited in the northern Gulf of Mexico (Table 3-3, Figure 4-3). These include 31 bay, sound, and estuary stocks in the inshore waters, three coastal stocks (western, northern, and eastern) in coastal waters out to the 20 m isobath, the northern Gulf of Mexico continental shelf stock in waters from 20 to 200 m depth, and the northern Gulf of Mexico oceanic stock in waters offshore of the 200 m isobath (Waring et al. 2015b).

Best and minimum abundance estimates for all stocks for which these data are available are listed in Table 3-3. Estimates are unknown for most of stocks. NMFS is in the process of writing individual stock assessments for each of the 31bay, sound, and estuary stocks, although, as of 2015, only those for Barataria Bay; St. Joseph Bay; Choctawatchee Bay; and Mississippi Sound, Lake Borgne, Bay Boudreau were finalized (Waring et al. 2015b). Gulf of Mexico bottlenose dolphin stocks with recent estimates include the eastern coastal; northern coastal; oceanic; Mississippi River Delta; Mississippi Sound, Lake Borgne, Bay Boudreau; St. Joseph; Choctawhatchee Bay; St. Vincent Sound, Apalachiola Bay, St. George Sound; and Sarasota Bay, Little Sarasota Bay stocks.. PBR calculations, shown in parentheses, are available for the following Gulf of Mexico stocks: continental shelf (469); the eastern coastal (111); northern coastal (60); western coastal (175); oceanic (42); Mississippi River Delta (1.7); Mississippi Sound, Lake Borgne, Bay Boudreau (5.6); St. Joseph (1.4); Choctawhatchee Bay (1.7); St. Vincent Sound, Apalachiola Bay, St. George Sound (3.9); and Sarasota Bay, Little Sarasota Bay (1.6) (Waring et al. 2015b). Minimum average annual fishery-related mortality and serious injury information (excluding data from the shrimp trawl fishery) is available for the following northern Gulf of Mexico stocks for 2009-2013: the continental shelf (0.6); eastern coastal (1.6); northern coastal (0.4); western coastal (0.6); Barataria Bay (0.8); Mississippi Sound, Lake Borgne, Bay Boudreau (1.6); and Choctawhatchee Bay (0.4) stocks (Waring et al. 2015b). Total annual human-caused mortality and serious injury levels are unknown for the coastal and BSE stocks for 2009-2013, as these stocks are known to interact with unobserved fisheries and because the most current observer data for the shrimp trawl fishery are for 2007-2011 (Waring et al. 2015b). The northern Gulf of Mexico oceanic stock's known and reported fishery-related mortality and serious injury averaged 6.5 per year for 2008-2012 in the Gulf of Mexico pelagic longline fishery (Waring et al. 2015a). The levels of take are not less than 10 percent of PBR for the oceanic; Mississippi Sound, Lake Borgne, Bay Boudreau; and Choctawhatchee Bay stocks, so cannot be considered insignificant and approaching zero mortality and serious injury rate for those stocks (Waring et al. 2015a, b). The Gulf of Mexico bay, sound, and estuary stocks are listed as strategic due to largely

unknown, but likely small, stock sizes and low numbers of mortalities and serious injuries would exceed PBR (Waring et al. 2015b).

The Puerto Rico and U.S. Virgin Islands population of bottlenose dolphins may consist of multiple stocks and is provisionally considered a single separate stock from the Atlantic Ocean and Gulf of Mexico stocks for management purposes (Waring et al. 2012). The abundance of this stock is unknown and data are insufficient for determining minimum population size, population trends, or for determining PBR (Waring et al. 2012). Total human-caused mortality and serious injury is unknown for this stock and systematic monitoring of fisheries with which this stock may interact is lacking. In the absence of this information, this stock is considered strategic (Waring et al. 2012).

Distribution and Habitat: The coastal form is continuously distributed along the Atlantic coast south of Long Island, New York to Florida and into the Gulf of Mexico. The offshore form occurs primarily along the outer continental shelf and continental slope from Georges Bank to the Florida Keys (CETAP 1982, Kenney 1990). North of Cape Hatteras, the two forms separate along bathymetric lines during summer months. Aerial survey data indicated that bottlenose dolphins in waters < 25 m deep corresponded with the coastal morphotype and those along the shelf break corresponded with the offshore form (CETAP 1982, Kenney 1990). Biopsy tissue sampling and genetic analysis corroborated this by showing that bottlenose dolphins concentrated in nearshore waters (< 20 m deep) were of the coastal form and those in waters > 40 m depth were from the offshore form (Garrison 2003). Torres et al. (2003) found that the offshore form was found exclusively seaward of 21 miles (34 km) and that all bottlenose dolphins within 4 miles (7.5 km) of shore were of the coastal form. During winter months south of Cape Hatteras, the rnages of the two forms may overlap. The estuarine stocks are believed to stay in nearshore waters within 1.8 miles of the coast, where they may overlap with coastal stocks (Waring et al. 2015b and citations therein). Figures 4-1 and 4-2 depict the distribution of bottlenose dolphin stocks within the Atlantic and Gulf of Mexico research areas used by the SEFSC.

Bottlenose dolphins are among the most commonly sighted cetaceans in waters near Puerto Rico, the U.S. Virgin Islands, and in the northeastern Caribbean Sea. They occur throughout the area, primarily over the shelf or shelf-edge habitats (Mignucci-Giannoni 1998, Waring et al. 2012 and citations therein).

Behavior and Life History: Births have been reported from all seasons with peaks during spring-summer months. Females may give birth as late as their 48th year. A large variety of fish and squid forms most of the diet and varies by region, although they do seem to prefer sciaenids, scombrids, and mugilids (Wells and Scott 2009). Most consumed fish are bottom dwellers. Sharks are probably the most important predators on bottlenose dolphins. As summarized in DON (2008, and citations therein), dive durations as long as 15 min are recorded for trained individuals but typical dives are more shallow and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths and can last longer than 5 minutes during deep offshore dives. Offshore bottlenose dolphins regularly dive to 450 m and possibly as deep as 700 m.

Acoustics and Hearing: Coastal and offshore stocks of bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DON 2008) (Table 4-1).

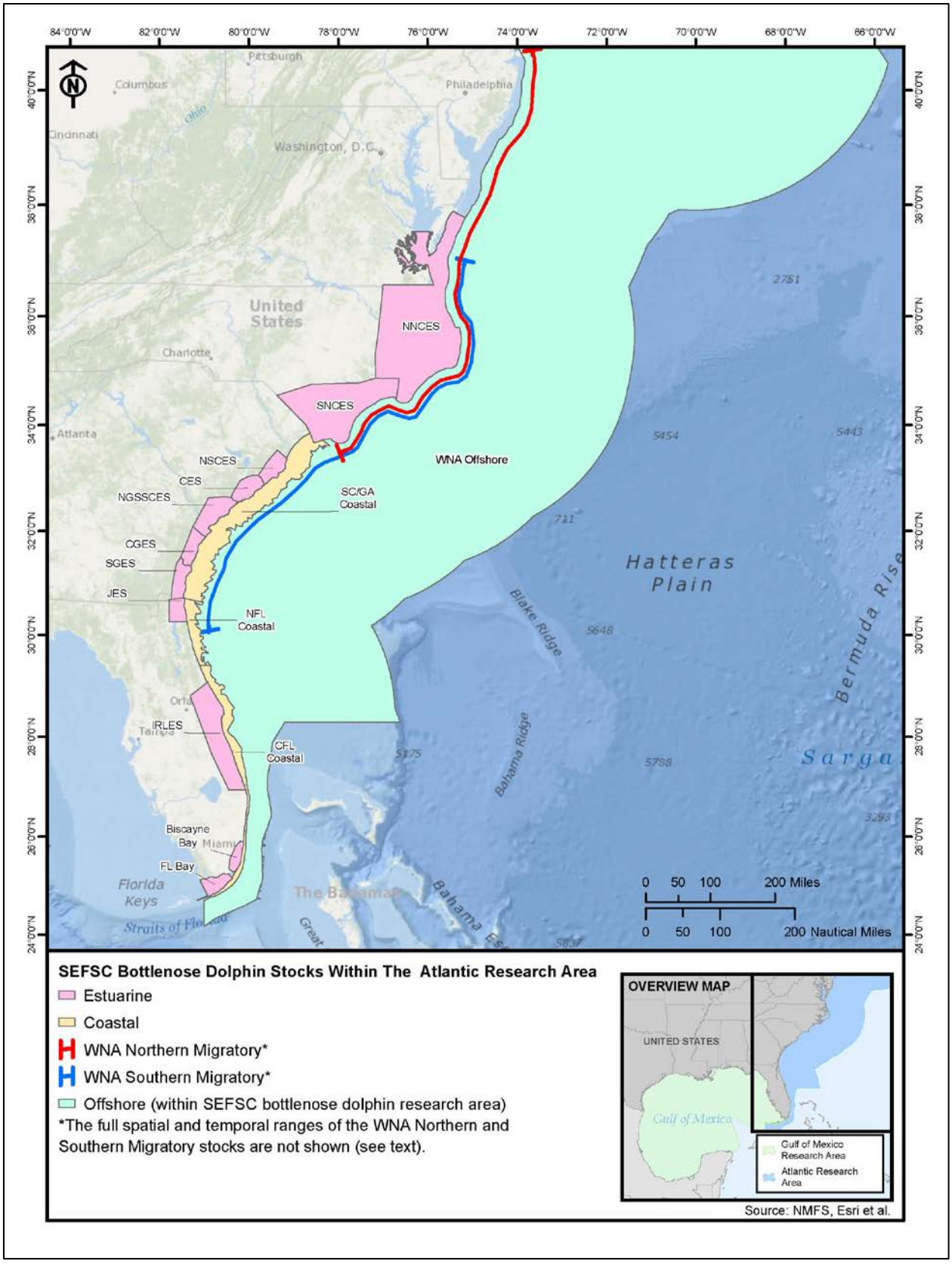

Figure 4-2 Bottlenose dolphin stocks within the SEFSC Atlantic Research Area

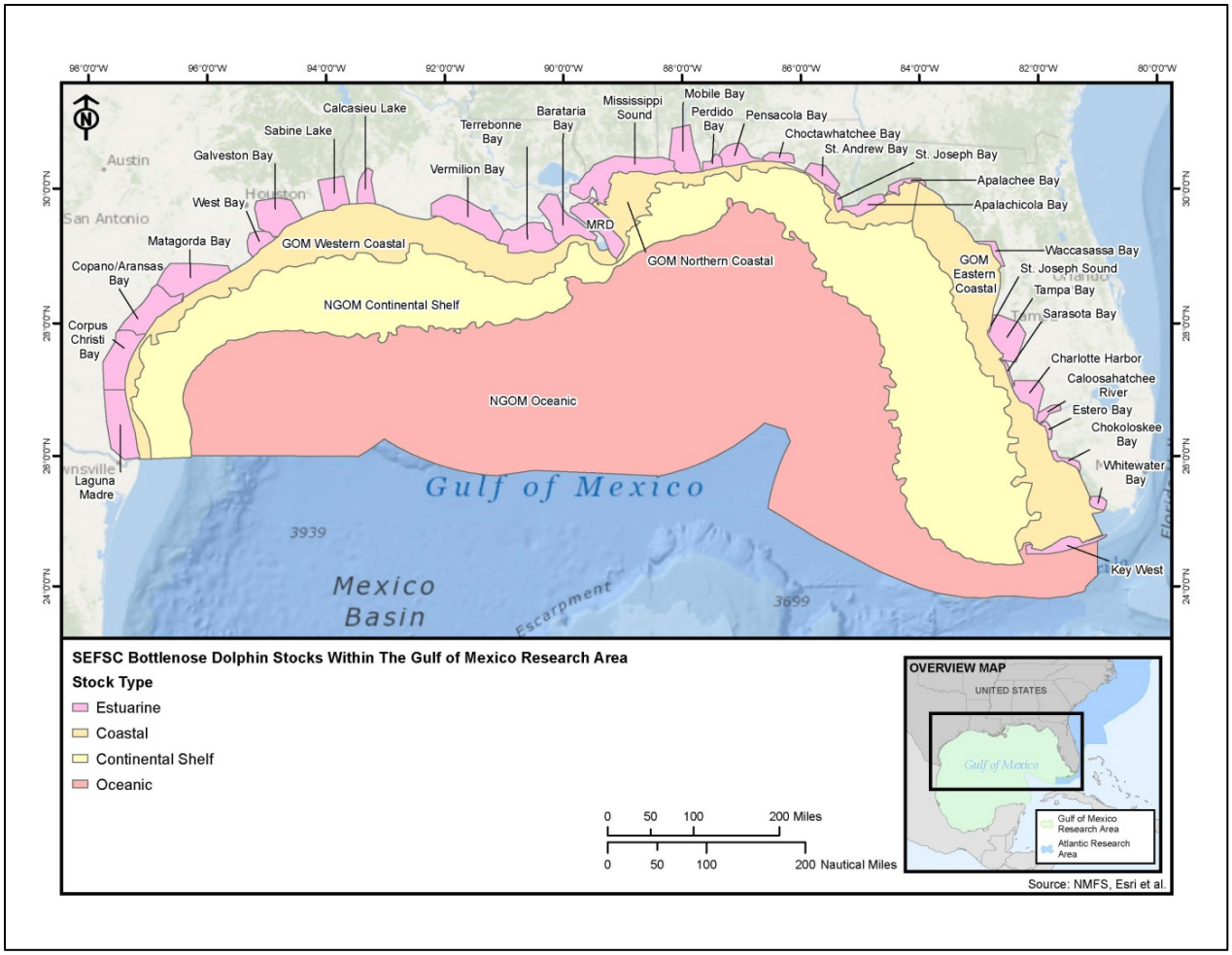

Figure 4-3 Bottlenose dolphin stocks within the SEFSC Gulf of Mexico Research Area

4.1.26 Harbor Porpoise (*Phocoena phocoena*) – Gulf of Maine/Bay of Fundy Stock

Description: Harbor porpoises are one of the smaller porpoises and have a short, stocky body. On average females reach 1.6 m in length and 60 kg while males reach 1.4 m and 50 kg (Bjørge and Tolley 2009). The body is dark gray dorsally with the chin and ventral surfaces a contrasting white that sweeps up the mid flanks (ibid). They have a small triangular dorsal fin that facilitates recognition when swimming but are also known to lie on the surface (ibid). Harbor porpoise tend to avoid ships and rarely bow ride.

Abundance and Stock Status: The stock of harbor porpoise found in U.S. and Canadian Atlantic waters is the Gulf of Maine/Bay of Fundy stock (Waring et al. 2015b). This stock is currently not listed under the ESA. Population trends for this species are unknown. The best, and most recent, population estimate for this stock is 79,833, based on 2011 survey results. The minimum estimated population size is 61,415 and the PBR is 706 (Waring et al. 2015b). The total estimated average annual human-caused mortality and serious injury is 564 porpoises (521 from U.S. fisheries and 43 from Canadian fisheries). Most (385.5) were taken in the Northeast sink gillnet fishery, followed by 133 takes in the mid-Atlantic sink gillnet fishery between 2009 and 2013. Since total U.S. fishery-related mortality and serious injury exceeds ten percent of PBR for this stock, it cannot be considered to be insignificant and approaching a zero mortality and serious injury rate (Waring et al. 2015b). Harbor porpoise are reported stranded along the U.S. coast from Maine to North Carolina, with 515 strandings from 2009 to 2013, 69 of which were in North Carolina (Waring et al. 2015b).

Distribution and Habitat: Gulf of Maine/Bay of Fundy harbor porpoises typically occupy cooler (< 17° C) and relatively shallow (< 200 m) coastal waters off the Northeast U.S., Bay of Fundy, and southwest Nova Scotia, Canada (Gaskin 1984, Palka et al. 1996, Read 1999). Harbor porpoises exhibit strong seasonal distribution patterns. During summer (July to September), they concentrate in the northern Gulf of Maine and southern Bay of Fundy region. During fall (October-December) and spring (April-June), they widely disperse from New Jersey to Maine, with lower densities farther north and south. During winter (January to March), intermediate densities of harbor porpoises occur from New Jersey to North Carolina, with lower densities off New York to New Brunswick, Canada (Waring et al. 2015b and citations therein). Habitat use is believed to be associated with prey, particularly Atlantic herring (Recchia and Read 1989, Palka 1995, Gannon et al. 1998).

Behavior and Life History: Harbor porpoises calve and breed throughout the range, and they generally give birth in summer from May through July. Calves remain dependent for at least six months (Leatherwood et al. 1982). Harbor porpoise are usually shy and avoid vessels; thus, they are difficult to approach. Harbor porpoise often feed near bottom in waters less than 200 m deep on bottom-dwelling fishes and small pelagic schooling fishes with high lipid content (Bjørge and Tolley 2009, Leatherwood and Reeves 1986).

Acoustics and Hearing: Harbor porpoise are in the high-frequency functional hearing group, whose estimated auditory bandwidth is 200 Hz to 180 kHz (Southall et al. 2007). Their vocalizations range from 110 to 150 kHz (DON 2008) (Table 4.1).

4.2 Pinnipeds

4.2.1 Harbor Seal (*Phoca vitulina concolor*) – Western North Atlantic Stock

Description: Harbor seals are relatively small pinnipeds. Males tend to be slightly larger than females. Both sexes weigh about 90-120 kg but can be as large as 180 kg and can be 1.2-1.8 m long (Burns 2009). They are covered with short, stiff hair with variable color pattern and two basic color phases. Background color ranges from yellowish (light phase) to black (dark phase), which is then covered with dark spots, and light rings (Burns 2009).

Abundance and Stock Status: The stock structure of the western North Atlantic population of harbor seals is unknown, although those found along the eastern U.S. and Canadian coasts are thought to represent one population (Temte et al. 1991). The most recent coast-wide survey of the Maine coast in 2012 resulted in a corrected estimate of 75,834 seals. The minimum population estimate is 66,884 and the calculated PBR is 2,006 seals (Waring et al. 2015b). The estimated annual average human-caused mortality and serious injury to harbor seals was 420 for 2009-2013. Most (408) were from observed fisheries and twelve were non-fishery-related, human-interaction strandings or direct interactions. The Northeast sink gillnet fishery was responsible for 358 of the fishery-related mortalities (Waring et al. 2015b). Harbor seals are not considered threatened or endangered under the ESA.

Distribution and Habitat: Harbor seals occupy all nearshore waters of the Atlantic Ocean and adjoining seas above about 30º N (Katona et al. 1993). In the western North Atlantic, they range from the eastern Canadian Arctic and Greenland to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967, Boulva and McLaren 1979, Katona et al. 1993, Gilbert and Guldager 1998, Baird 2001). Breeding and pupping in U.S. waters generally occurs along the coast of Maine from mid-May through June. Harbor seals occur year-round in coastal waters of eastern Canada and Maine (Katona et al. 1993) and along the southern New England and New York coasts from September through late May (Schneider and Payne 1983). In recent years, a small number (<50) of harbor seals established a winter haul-out site near Oregon Inlet, North Carolina (Waring et al. 2015b). Scattered sightings and strandings have been recorded as far south as Florida. Of the 1,318 harbor seal stranding mortalities reported in

2009-2013, 24 were in North Carolina and one was in South Carolina (NMFS unpublished data cited in Waring et al. 2015b).

Behavior and Life History: Harbor seals use a variety of terrestrial and aquatic habitats. Their activities are influenced by regional topography, life history requirements, environmental parameters, anthropogenic activities, prey distribution, and, possibly, inter-specific competition with gray seals (Richardson 1976, Gilbert and Stein 1981, Schneider and Payne 1983, Payne and Selzer 1989, Barlas 1999, Lucas and Stobo 2000, Schroeder 2000, deHart 2002, Bowen et al. 2003, Renner 2005, Robillard et al. 2005). Harbor seals are opportunistic predators and the diet composition exhibits temporal and spatial preferences (Selzer and Payne 1989, Williams 1999, Craddock and Polloni 2006).

Acoustics and Hearing: Harbor seals are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 25 Hz to 4 kHz (DON 2008) (Table 4.1).

4.2.2 Gray Seal (*Halichoerus grypus*) – Western North Atlantic Stock

Description: Gray seals are the only members of the genus *Halichoerus*, which means sea pig in Greek. The species name, *grypus*, means hook nosed and refers to the Roman nose profile of adults. Males are larger than females, weighing over 400 kg compared to 250 kg for females (Hall and Thompson 2009). Both sexes have the convex (Roman) nose, although it is more pronounced in males. Pelage patterns vary. Females are more slate-colored, with a lighter underside and dark blotches, while mature males are more uniformly dark (Hall and Thompson 2009).

Abundance and Stock Status: The western North Atlantic stock of gray seals, also known as the eastern Canada population, ranges from New England to Labrador (Mansfield 1966, Katona et al. 1993, Davies 1957, Lesage and Hammill 2001). Over half of the western North Atlantic population breeds and pups on Sable Island, off Nova Scotia, Canada. Current estimates of the total western North Atlantic gray seal population are unavailable; estimates are available for portions of the stock for select time periods. The species is not listed as threatened or endangered under the ESA (Waring et al. 2015b). The total combined population estimate for three principal Canadian breeding and pupping sites (Gulf of St. Lawrence, Nova Scotia Eastern Shore, and Sable Island) for 2014 was 505,000. The minimum population size and PBR for western North Atlantic gray seals in U.S. waters are unknown. Total estimated human-caused mortality and serious injury to gray seals from 2009 to 2013 averaged 5,004 per year, with 1,193.4 from U.S. observed fisheries (1,076 in the Northeast sink gillnet fishery), 7.6 from non-fishery human-interaction strandings, 172 from the Canadian hunt, 82 from Canada's Department of Fisheries and Oceans scientific collections, and 3,549 removals of nuisance animals in Canada (Waring et al. 2015b).

The population in U.S. waters is increasing due to a combination of recolonization by Canadian gray seals and increased pupping. Gray seal breeding colonies in New England include Muskget Island and Monomoy Island in Massachusetts and Green and Seal Islands in Maine, where a combined minimum of 2,620 pups were born in 2008 (Wood Lafond 2009). A minimum of 2,750 and 3,037 pups were counted on Muskeget Island in 2013 and 2014, respectively (Waring et al. 2015b). Pups have been seen on Matinicus Rock, Maine (Waring et al. 2013). Gray seals are also observed in New England outside of the pupping season. A maximum count of 15,756 gray seals was made in southeastern Massachusetts coastal waters in March 2011 (Waring et al. 2015b). Gray seals have also recently been recorded in surveys off eastern Long Island (Waring et al. 2015b). Strandings have been reported as far south as North Carolina, with four stranding mortalities between 2009 and 2013 (Waring et al. 2015b).

Distribution and Habitat: Gray seals occur on both sides of the North Atlantic, with three major populations in eastern Canada, northwestern Europe and the Baltic Sea (Katona et al. 1993). Tagging studies in Atlantic Canada and New England have also documented trans-boundary movements of gray seals (Wood LaFond 2009, NMFS/NEFSC, unpublished data). In U.S. waters, gray seals currently pup at Muskeget Island, Massachusetts, and Green Island, Seal Island, Matinicus Rock, and Mount Desert Rock,

Maine. Gray seals have been using the historic pupping site on Muskeget Island since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid-1990s (Waring et al. 2015b).

Behavior and Life History: Gray seals use a variety of terrestrial and aquatic habitats in U.S. waters. Topography, life history requirements, environmental parameters, anthropogenic activities, prey distribution, and, perhaps, competition with harbor seals influence their activities (Lucas and Stobo 2000, Robillard et al. 2005, Murray 2009). Pupping and breeding take place during the winter months (January-February) with peak pupping in Canada and on Muskeget Island in January (Hall and Thompson 2009, Wood et al. 2007). Gray seals are opportunistic predators and diet composition reflects temporal and spatial prey preferences (Rough 1995, Craddock and Polloni 2006, Ampela 2009).

Acoustics and Hearing: Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DON 2008) (Table 4.1).

5.0 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED AND THE METHOD OF INCIDENTAL TAKING

The promulgation of regulations and subsequent issuance of annual Letters of Authorization (LOA) for the incidental taking of marine mammals is requested pursuant to Section 101 (a)(5)(A) of the Marine Mammal Protection Act (MMPA). The request is for a five-year period commencing upon issuance of the permit.

The term "take", as defined in Section 3 (16 U.S. Code [U.S.C.] 1362 of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of harassment, Level A (potential injury) and Level B (potential disturbance).

The SEFSC requests promulgation of regulations and subsequent issuance of LOAs to authorize potential lethal and non-lethal incidental takes during its planned scientific operations. The requested numbers of authorized lethal and serious injury takes and non-serious injury "Level A" and "Level B" harassment takes per year are discussed in Section 6. Although mortality and serious injury are anticipated to be rare during SEFSC research activities, the SEFSC requests that the LOA authorize a small number of incidental, non-intentional, lethal or serious injury takes of marine mammals in the event that they might occur, and in spite of the monitoring and mitigation efforts described in Sections 11, 13, and 14.

Potential "Level A" harassment/mortality and serious injury takes: As discussed in Section 1, SEFSC surveys involve the use of gear that has the potential to take marine mammals. This gear includes trawl nets in the ARA and GOMRA, hook-and-line gear (longlines, bandit reel, and rod and reel deployments) in all three research areas, trammel nets in the ARA, and gillnets and seine nets in the GOMRA. The SEFSC also uses other research gears for which takes are not requested (see Section 6.1.7). Before any of these gears are deployed, researchers conduct visual monitoring to assess whether marine mammals are present in the area and take action to avoid interactions (see Section 11 for description of monitoring and mitigation procedures).

"Level B" harassment takes: The "Level B" take by harassment may occur as the result of active acoustic sources used during survey operations in all areas surveyed by the SEFSC. The 'take' may be manifested as a temporary threshold shift (Southall et al. 2007) within the zone of audibility where the received levels of sound exposure are high enough that a marine mammal can hear it, or in the zone of responsiveness where the received level is such that the animal responds by causing behavioral modifications (Holt 2008). No hearing loss or physiological damage (permanent threshold shift, Southall et al. 2007) is expected to occur to marine mammals by the acoustic sources used during SEFSC surveys in any of the three research areas.

6.0 THE NUMBER OF MARINE MAMMALS THAT MAY BE TAKEN BY EACH TYPE OF TAKING, AND THE NUMBER OF TIMES SUCH TAKINGS BY EACH TYPE OF TAKING ARE LIKELY TO OCCUR

6.1 Estimated Number of Potential Marine Mammal Takes by Mortality/Serious Injury or 'Level A' Harassment and Derivation of the Number of Potential Takes

6.1.1 Introduction

As stated in the response to Question 5, potential take during SEFSC surveys using trawl nets, gillnets, trammel nets, and several hook-and-line gears (see Table 1-1), may occur in two forms: (1) take by accidental entanglement/hooking that may cause mortality and serious injury, and (2) take by accidental entanglement/hooking that may cause non-serious injury ("Level A" harassment take). Incidental take resulting in mortality and serious injury and "Level A" harassment may occur during trawl surveys sampling shrimp, groundfish, finfish and squids or testing TEDs (Turtle Excluder Device); by hook-and-line gear sampling pelagic sharks, coastal sharks, reef fish, and other finfish; by gillnets sampling coastal sharks, and other finfish; and by trammel nets sampling red drum. The justification for potential take of these species and the estimated mortalities and injuries is discussed in the following sections.

The bottlenose dolphin is the only species that has been historically caught by the SEFSC in fisheries research gear. (One Atlantic spotted dolphin was taken during SEFSC research due to a ship strike; see below.) Additionally, all bottlenose dolphin takes have been in coastal and bay, sound and estuarine (BSE) stocks. Briefly, in the ARA, there are 11 BSE and five coastal stocks and in the GOMRA, 31 BSE and three coastal stocks (Table 3-3). The CRA has one shelf/offshore bottlenose dolphin stock. The coastal and BSE bottlenose dolphins are of the coastal morphotype of bottlenose dolphins. As summarized in Section 4.1.25, bottlenose dolphins are common and widely distributed in all marine waters of the Southeastern U.S. and both sexes and all age classes occur in all seasons. It is assumed that both sexes and all age groups have similar distributions and/or vulnerabilities to SEFSC research activities, so it follows that multiple age classes of these species could be susceptible to take during these activities. Where research has been conducted, in most cases, bottlenose dolphins from BSE stocks may also occur in coastal waters within three km of the coast and coastal dolphins may be temporally transient in BSE stock areas so there is some uncertainty regarding the actual identity of the stock from which the take may occur. If an incidental take were to occur, the SEFSC would initiate genetic analysis to facilitate identification of the coastal/estuarine stock from which the take occurred.

Bottlenose dolphins are the only small cetacean species to routinely inhabit coastal and BSE waters in both the ARA and GOMRA; Atlantic spotted dolphins commonly occur in coastal/shelf waters in both of these areas. Over 20 cetacean species inhabit outer shelf/offshore habitats (including the coastal and offshore bottlenose dolphin morphotypes) in the three SEFSC research areas. Currently, in the outer shelf/offshore habitats one stock per species is designated in each of the three research areas. Due to differences in stock structure, size, and distribution, the take requests for bottlenose dolphins in coastal/BSE habitats and the species in outer shelf/offshore habitats will be made differently.

6.1.2 Use of Historical Interactions as a Basis for Take Estimates

It is anticipated that all species with historic interactions with SEFSC survey gears could potentially be taken in the future. For the duration of the regulations, we estimated the numbers of marine mammals that may be caught during SEFSC surveys based on historic interactions data for a species. Historical interactions with marine mammals during SEFSC surveys (Table 6-1, Figure 6-1) were taken from NOAA's Protected Species Incidental Take (PSIT) database, a real-time internal monitoring tool for reporting interactions with protected species that occur during SEFSC-directed or SEFSC-funded fisheries research surveys including partner or contracted surveys. The discussion below describes how

the SEFSC estimated potential encounters with survey gear based on the historical interactions of various research gears. Records for SEFSC and partner projects date back to 1972 but the first documented interactions did not occur until 2002. The estimates are based on the assumption that annual effort (e.g., total annual trawl tow time) over the requested five-year authorization period would be similar to the annual effort during the 2002-2015 period.

Table 6-1 Historical takes of marine mammals during SEFSC surveys, 2002-2015[1]

Survey Name	Protected Species Taken	Gear Type	Date (Time) Taken	# Killed	# Released Alive [2]	Total Taken
ATLANTIC RESEARCH AREA						
2014						
SEAMAP-SA Coastal Trawl Survey_Spring (SCDNR)	Bottlenose dolphin (Northern Florida Coastal)	Bottom trawl	11 April (4:07 pm)	1	0	1
2012						
SEAMAP-SA Coastal Trawl Survey_Summer (SCDNR)	Bottlenose dolphin (SC/GA Coastal)	Bottom trawl	2 August (11:54 am)	1	0	1
SEAMAP-SA Coastal Trawl Survey_Summer (SCDNR)	Bottlenose dolphin (SC/GA Coastal)	Bottom trawl	11 July (2:30 pm)	0	1	1
2006						
SEAMAP-SA Coastal Trawl Survey_Fall (SCDNR)	Bottlenose dolphin (Southern Migratory)	Bottom trawl	5 October (1:29 pm)	1	0	1
SEAMAP-SA Coastal Trawl Survey_Summer (SCDNR)	Bottlenose dolphin (SC/GA Coastal)	Bottom trawl	28 July (9:18 am)	1	0	1
2002						
RecFIN Red Drum Trammel Net Survey (SCDNR)	Bottlenose dolphin (Charleston Estuarine System)	Trammel net	22 August (10:00 am)	2	0	2
			ARA TOTAL	**6**	**1**	**7**
GULF OF MEXICO RESEARCH AREA						
2014						
SEFSC Skimmer Trawl TED Testing	Bottlenose dolphin (MS Sound, Lake Borgne, Bay Boudreau)	Skimmer trawl	1 October (5:53 am)	1	0	1
2013						
SEFSC Skimmer Trawl TED Testing	Bottlenose dolphin (MS Sound, Lake Borgne, Bay Boudreau)	Skimmer trawl	13 October (6:50 pm)	0	1	1
SEAMAP-GOM Bottom Longline Survey	Bottlenose dolphin (Mobile Bay,	Bottom longline	6 August (4:10:00 pm)	0	1	1

Survey Name	Protected Species Taken	Gear Type	Date (Time) Taken	# Killed	# Released Alive [2]	Total Taken
(ADCNR)	Bonsecour Bay)					
2011						
Gulf of Mexico Shark Pupping and Nursery GULFSPAN (USA/DISL)	Bottlenose dolphin (MS Sound, Lake Borgne, Bay Boudreau)	Gillnet	18 April (2:20 am)	1	0	1
GOMRA TOTAL				**2**	**2**	**4**
TOTAL ALL AREAS [3]						
				8	**3**	**11**

1. No takes have been recorded in 2016 through March.
2. Serious injury determinations were not previously made for animals released alive, but are now part of standard protocols for released animals and will be reported in Stock Assessment Reports.
3. There have been no historical takes in the CRA.

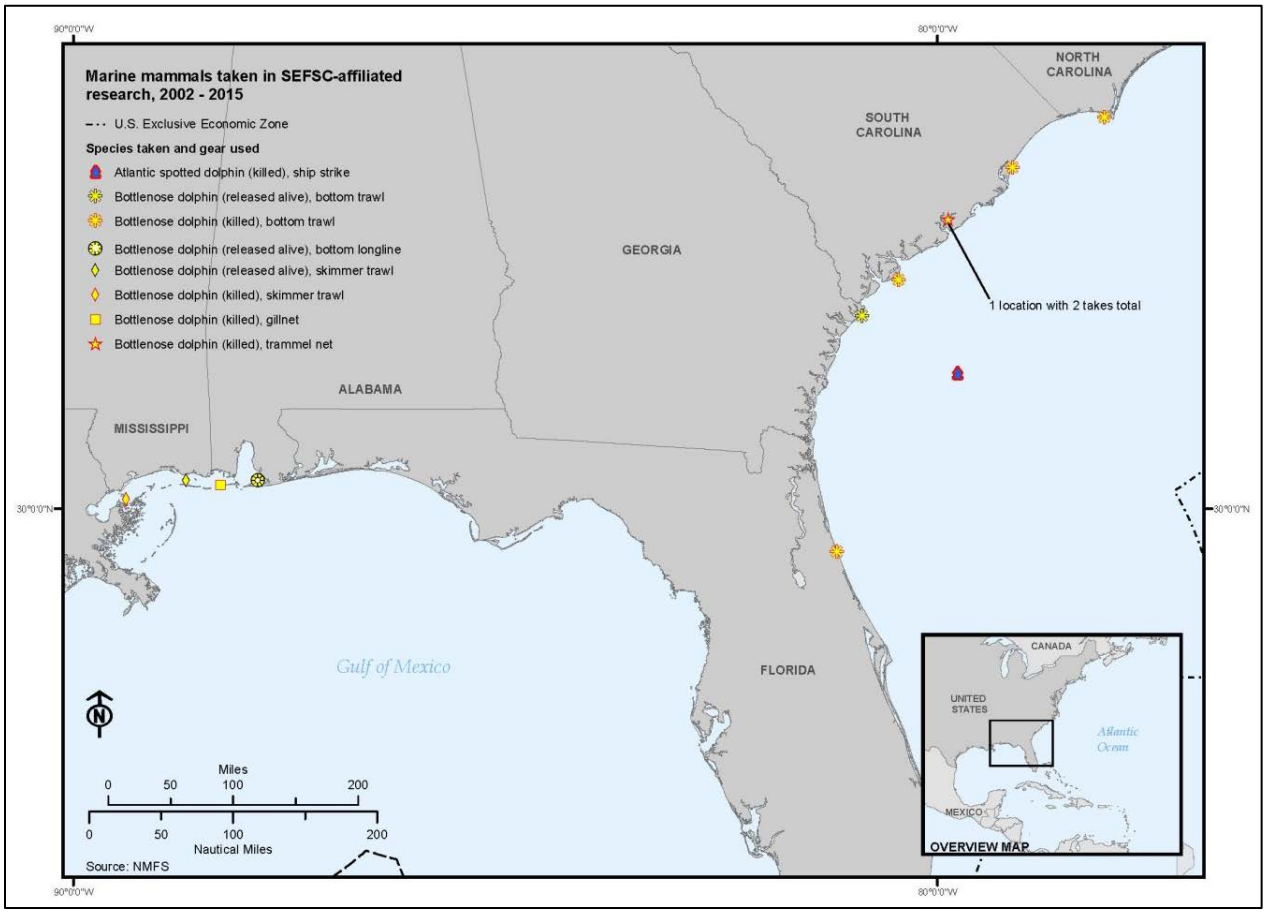

Figure 6-1 Location of marine mammal takes during SEFSC research from 2002 through 2015

Historical Interaction: Summary of Trawl Survey Interactions

Marine mammals have been caught in otter trawls sampling finfish and benthic fauna and skimmer trawl conducting TED testing and sampling shrimp.

In the ARA from 2002-2015, five bottlenose dolphins were taken during SEAMAP, South Carolina Department of Natural Resources bottom trawl surveys as follows: Northern Florida Coastal Stock – one mortality; Southern Migratory Stock – one mortality; South Carolina/Georgia Coastal Stock – two mortalities and one released alive. In the GOMRA, two bottlenose dolphins were taken in skimmer trawls within the identified boundaries of the "Mississippi Sound" Stock – one mortality and one released alive.

Historical Interaction: Summary of Gillnet Survey Interactions

The GULFSPAN gillnet survey caught and killed one bottlenose dolphin in 2011 while a cooperating institution was conducting the survey in Alabama within the identified boundaries of the Mississippi Sound, Lake Borgne, Bay Boudreau Estuarine Stock in the GOMRA. This was the only occurrence of incidental take in these surveys.

Historical Interaction: Summary of Trammel Net Interactions

The RecFIN South Carolina Department of Natural Resources trammel net survey caught two bottlenose dolphins in one set in 2002 within the identified boundaries of the Charleston Estuarine System Stock in the South ARA. One dolphin was killed and the other was released but was a serious injury and therefore listed as a mortality in Table 6-1.

Historical Interaction: Summary of Bottom Longline Interactions

One bottlenose dolphin was hooked and released alive with line trailing during a SEAMAP Alabama Department of Conservation of Natural Resources bottom longline survey in 2013 with in the identified boundaries of the Mobile Bay, Bonsecour Bay Estuarine Stock in the GOMRA.

Historical Interaction: Ship Strike

One Atlantic spotted dolphin calf was killed by the propeller of the ship during SEFSC research in 2011 after a group of Atlantic spotted dolphins were riding the bow of the ship. This occurred in the Western North Atlantic Stock in the ARA. No such future take is requested as it is assumed that this was a rare occurrence that is very unlikely to occur in the next five years.

6.1.3 Approach for Estimating Takes of Species Captured Historically by the SEFSC and Research Partners

For purposes of estimating potential mortality/serious injury (M&SI) takes and Level A harassment takes (Tables 6-2 and 6-3) for the ARA and GOMRA, the SEFSC calculated the average number of reported interactions for bottlenose dolphins in all gear types deployed for each research area during 2002-2015. Bottlenose dolphins have been taken in the course of SEFSC fisheries research in bottom trawls, trammel nets, skimmer trawls, longline gear, and gillnets. Take requests specified by each gear-type for each coastal and BSE stock would lead to an overestimate of the number of takes anticipated based on historical takes. Therefore, the overall SEFSC take request for coastal and BSE bottlenose dolphins is for all gear-types combined. The SEFSC take estimates (for M&SI and Level A harassment) for historically captured bottlenose dolphins for this request was determined by rounding the annual average take of bottlenose dolphins for all gear interactions and stocks combined (ARA = 0.6, GOMRA = 0.3) up to the nearest whole number and multiplying by five to account for the five-year authorization period. The

SEFSC and its research partners have a record of infrequent takes of bottlenose dolphins in fisheries research, such that the annual average take for the 2002-2015 period is well below one animal per year. Nevertheless, the historical record indicates that the potential exists to incidentally take a bottlenose dolphin in any of the previously listed gears in any given year. Therefore, the SEFSC estimates that at least one bottlenose dolphin could be taken in any given year and the take could occur in any of the gears.

While it is not expected based on historical takes, bottlenose dolphins occur in groups and it is possible that a take request for only a small number of takes (e.g., five) could be exceeded in one or two trawl tows, trammel net sets, or gillnet sets if multiple animals were taken in a single set. Therefore, because of bottlenose dolphin propensity to travel in groups, the SEFSC increased the estimate to 10 (Tables 6-2 and 6-3) for both the ARA and GOMRA in the event of multiple takes during one event. That is, 10 takes requested for the ARA and 10 takes requested for the GOMRA for all coastal/BSE stocks; however, the potential takes requested for each stock will be restricted on a stock-by-stock basis (see below). Based on past experience, the SEFSC expects there to be some variability in the actual number of annual gear interactions. By using an average based approach, it is expected to capture the variability that may occur on an annual basis over the five-year period of this requested authorization. Furthermore, mitigation measures have been developed and implemented subsequent to some of the years upon which the take estimates are based. These measures further reduce the likelihood that these estimates would be exceeded. Because there is a very fine line between the two take categories (M&SI and Level A harassment), the SEFSC believes it would be unjustified to estimate potential takes in each category based only on historic interactions in that category; a Level A harassment take could easily have been a serious injury or mortality under a slightly different set of circumstances and vice versa. Thus, the potential take estimates encompass both M&SI and Level A harassment.

Regardless of gear type, for the five-year authorization period, the SEFSC requests a total of 10 coastal and BSE bottlenose dolphin takes for the ARA and 10 for the GOMRA. For each research area in Tables 6-2 and 6-3, the maximum number of potential takes requested for each stock are indicated (not to exceed 10 total takes for all stocks in each research area) as well as information on stock status, stock size, potential biological removal (PBR) and the percent PBR for a range of 0–3 takes. These potential takes are based on: (1) information on stock size – Stocks with a larger dolphin population (>1000 dolphins) may have a higher probability of a take; stocks with no current (i.e., last 8 years) stock size information are assumed to have small stock sizes (<1000 dolphins); (2) proximity of SEFSC-funded research; and (3) history of takes documented in PSIT, which is a real-time internal monitoring tool for reporting interactions with protected species. Based on the location of stock ranges and SEFSC research efforts in the last five years, the stocks with overlaps of SEFSC research within their ranges (Figures 6-2 and 6-3) are assumed to have a higher probability of takes. Additionally, in some cases BSE stocks include a strip of coastal waters up to 3 km wide. When BSE stocks are studied, the BSE dolphins are usually found to use a narrow strip of coastal waters; therefore, research that occurs in coastal waters very close to the boundary of a BSE stock area has the potential to impact that stock.

For each stock, the maximum number of takes requested to be authorized ranges from 0–3 dolphins over the five-year authorization period:

- 0 take request stocks - These are all BSE stock areas with both no historical or anticipated occurrences of SEFSC research in the next five years within the current boundary of the BSE stock or in the coastal waters adjacent to the BSE (i.e., <3 km) (Figures 6-2 and 6-3);
- 1 potential take request stocks - With the exception of the Mississippi Sound stock (see below), these are all BSE stock areas with SEFSC research activities within the BSE boundary or in coastal waters adjacent to the BSE (i.e., < 3 km). The stock size for BSE stocks is either unknown or <1000 dolphins. Of these, the Charleston Estuarine System and the Mobile Bay stocks are the only stocks with any history of SEFSC research takes documented in the PSIT;

- 3 potential takes request stocks - These are all coastal, migratory, and offshore (includes continental shelf and ocean water) stocks (stock sizes >1000 dolphins), and the Mississippi Sound BSE stock (stock size >900 dolphins). Four of these stocks have a history of research takes documented in the PSIT.

Although the SEFSC take estimates for species captured historically are based on an average take during 2002-2015, it should be emphasized that there is still an inherent level of uncertainty in estimating potential take both in terms of numbers and species of marine mammals that may actually be taken. Further, the SEFSC continues to invest significant resources in better understanding the factors that contribute to interactions and developing mitigation measures and evaluating its operations to minimize these occurrences in the future.

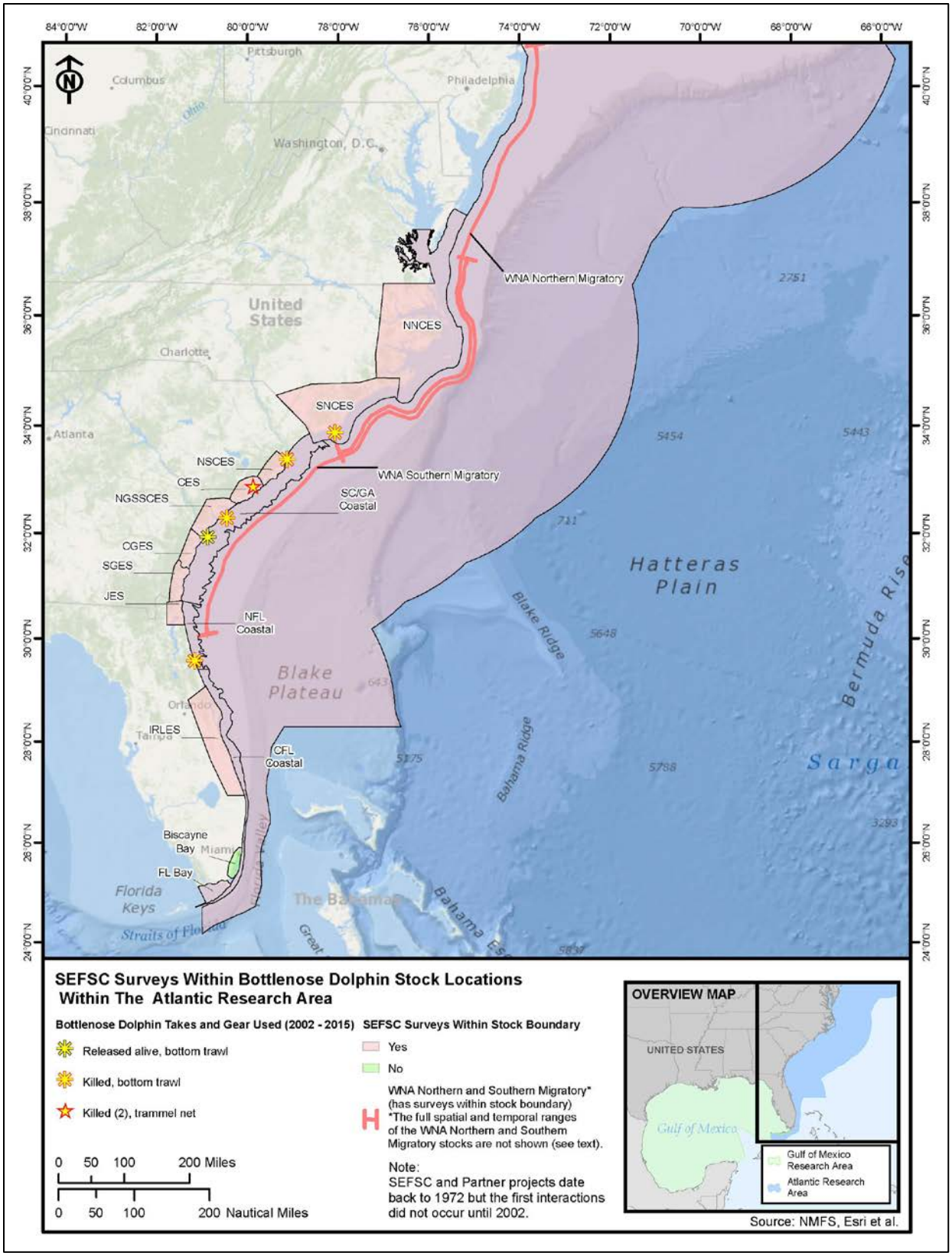

Figure 6-2 SEFSC surveys within bottlenose dolphin stock boundaries within the Atlantic Research Area

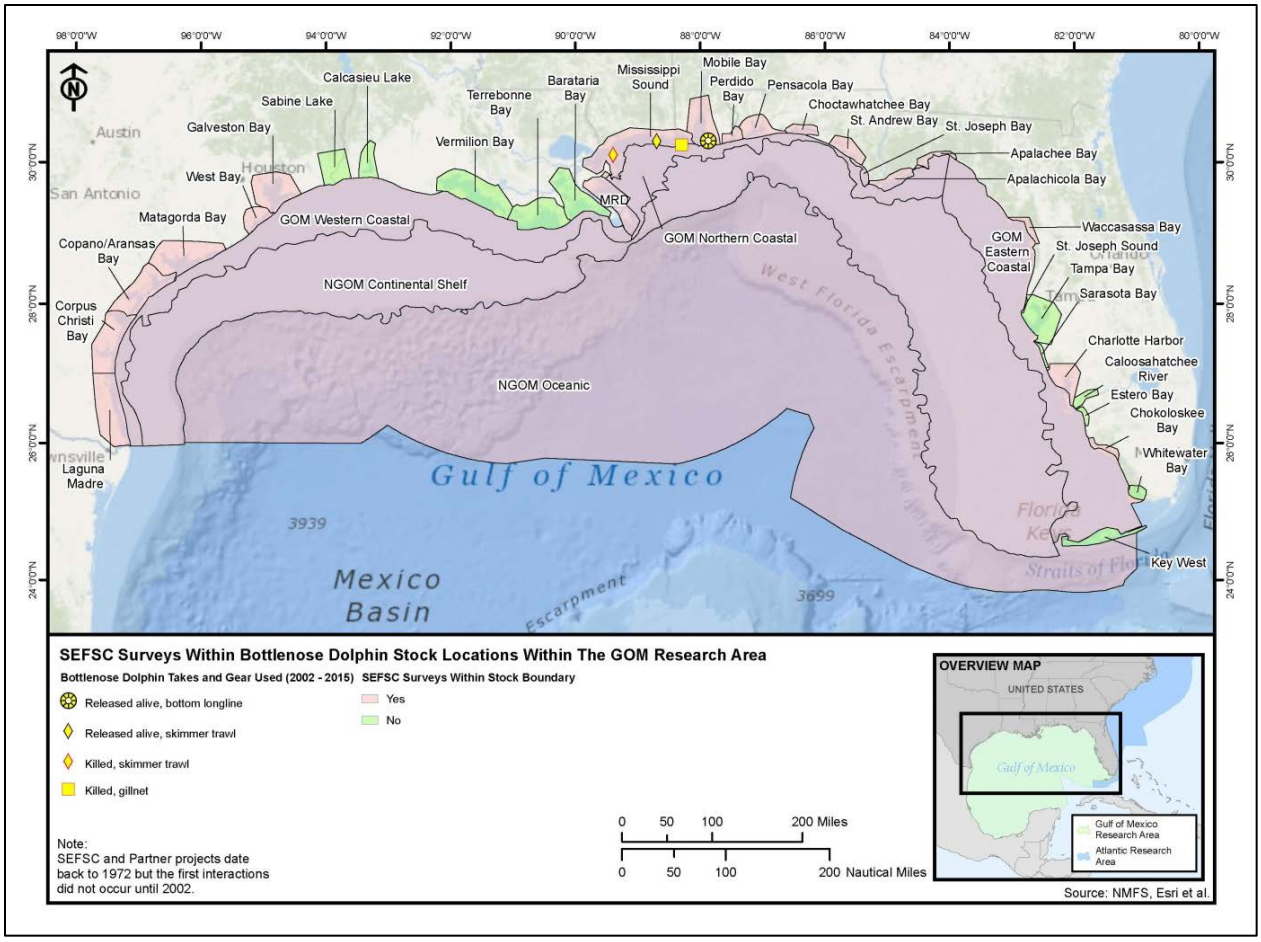

Figure 6-3 SEFSC surveys within bottlenose dolphin stock boundaries within the Gulf of Mexico Research Area

Table 6-2 Requested number of bottlenose dolphin takes from coastal and bay, sound, and estuarine stocks in the ARA

This table summarizes the combined requested takes of bottlenose dolphin stocks by Mortality and Serious Injury (M&SI) and Level A harassment over a five-year period for all gear types combined. The gear types for which bottlenose dolphin stocks are requested include trawls, gillnets, trammel nets, longlines, bandit gear, and rod and reel. The table shows all stocks in the ARA but the SEFSC did not request takes from the Biscayne Bay stock due to the lack of fisheries research in that area. Although potential take for each requested stock is either one or three over the five-year period and, if simply added, would equal 25 takes over that period, the maximum requested take, for all gear types combined, is 10 bottlenose dolphins in the ARA over the five-year authorization period.

Stock	Total SEFSC Takes 2002-2015	M&SI and Level A Take Request Total for 5 Years (all gear types combined)	Average Annual Requested Take (animals per year)
Northern North Carolina Estuarine System Stock		1	0.2
Southern North Carolina Estuarine System Stock		1	0.2
Northern South Carolina Estuarine System Stock		1	0.2

Stock	Total SEFSC Takes 2002-2015	M&SI and Level A Take Request Total for 5 Years (all gear types combined)	Average Annual Requested Take (animals per year)
Charleston Estuarine System Stock	2	1	0.2
Northern Georgia/Southern South Carolina Estuarine System Stock		1	0.2
Central Georgia Estuarine System Stock		1	0.2
Southern Georgia Estuarine System Stock		1	0.2
Jacksonville Estuarine System Stock		1	0.2
Indian River Lagoon Estuarine System Stock		1	0.2
Biscayne Bay Stock		0	0
Florida Bay Stock		1	0.2
Western North Atlantic South Carolina & Georgia Coastal Stock	3	3	0.6
Western North Atlantic Northern Florida Coastal Stock	1	3	0.6
Western North Atlantic Central Florida Coastal Stock		3	0.6
Western North Atlantic Northern Migratory Coastal Stock		3	0.6
Western North Atlantic Southern Migratory Coastal Stock	1	3	0.6

Table 6-3 Requested number of bottlenose dolphin takes from coastal and bay, sound, and estuarine stocks in the GOMRA

This table summarizes the combined potential takes of bottlenose dolphin stocks by M&SI and Level A harassment over a five-year period for all gear types combined. The gear types for which bottlenose dolphin stocks are requested include trawls, gillnets, trammel nets, longlines, bandit gear, and rod and reel. The table shows all stocks in the GOMRA but the SEFSC did not request takes from all stocks due to the lack of fisheries research in those areas. Although potential take for each requested stock is either one or three over the five-year period and, if simply added, would equal 33 takes over that period, the maximum requested take, for all gear types combined, is 10 bottlenose dolphins in the GOMRA over the five-year authorization period.

Stock	Total SEFSC Takes 2002-2015	Potential M&SI and Level A Take Request Total for 5 Years (all gear types combined)	Average Annual Requested Take (animals per year)
Northern Gulf of Mexico Western Coastal Stock		3	0.6
Northern Gulf of Mexico Northern Coastal Stock		3	0.6
Northern Gulf of Mexico Eastern Coastal Stock		3	0.6
Northern Gulf of Mexico Bay, Sound, and Estuarine Stocks (31 stocks below)			
Laguna Madre		1	0.2
Nueces Bay, Corpus Christi Bay		1	0.2

Stock	Total SEFSC Takes 2002-2015	Potential M&SI and Level A Take Request Total for 5 Years (all gear types combined)	Average Annual Requested Take (animals per year)
Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espirtu Santo Bay		1	0.2
Matagorda Bay, Tres Palacios Bay, Lavaca Bay		1	0.2
West Bay		1	0.2
Galveston Bay, East Bay, Trinity Bay		1	0.2
Sabine Lake [1]		1	0.2
Calcasieu Lake		0	0
Atchalfalaya Bay, Vermilion Bay, West Cote Blanche Bay		0	0
Terrabonne Bay, Timbalier Bay [1]		1	0.2
Barataria Bay Estuarine System [1]		1	0.2
Mississippi River Delta		1	0.2
Mississippi Sound, Lake Bornge, Bay Boudreau	3	3	0.6
Mobile Bay, Bonsecour Bay	1	1	0.2
Perdido Bay		1	0.2
Pensacola Bay, East Bay		1	0.2
Choctwhatchee Bay		1	0.2
St. Andrew Bay		1	0.2
St. Joseph Bay		1	0.2
St. Vincent Sound, Apalachiola Bay, St. George Sound		1	0.2
Apalachee Bay		1	0.2
Waccasassa Bay, Withlacoochee Bay, Crystal Bay		1	0.2
St. Joseph Sound, Clearwater Harbor		0	0
Tampa Bay		0	0
Sarasota Bay, Little Sarasota Bay		0	0
Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay		1	0.2
Caloosahatchee River		0	0
Estero Bay		0	0
Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay		1	0.2
Whitewater Bay		0	0
Florida Keys-Bahia Honda to Key West		0	0

1. One take each is requested from the Sabine, Terrebonne, and Barataria Bay stocks, where currently there is no SEFSC or partner research occurring. Research does occur within 3 km of these Gulf BSE stock boundaries. If a take occurred in the adjacent Coastal stock range within 3 km of the BSE stock boundary, stock determination may not be possible. Therefore, the take may be assigned to both stocks as a precautionary measure.

6.1.4 Approach for Estimating Take of "Analogous" Species (i.e., Those Not Historically Taken by the SEFSC)

In addition to the coastal and BSE bottlenose dolphin stocks which have directly interacted with SEFSC research fishing gear over the 14-year period (2002-2015), the SEFSC believes it is appropriate to include estimates for future incidental takes of marine mammals in the ARA, GOMRA, and CRA that have not been taken historically by research activities but inhabit the same areas and show similar types of behaviors and vulnerabilities to such gear used in other contexts (e.g., commercial fisheries and non-SEFSC research) that has taken the "reference" species in the past. In short, while they have not been taken historically, there is some risk that they could be taken in the future. While acknowledging this risk, the approach also recognizes that, absent significant range shifts or changes in habitat usage, such events would likely remain rare occurrences given the lack of SEFSC-related research takes over the past 14 years. Recognizing these uncertainties, additional mitigation measures may be implemented if future take exceeds the maximum number estimated per year, such that it appears that the total estimated take over the five-year authorization period may be exceeded.

Requests Made by Analogy with Species Taken in Non-SEFSC Research Activities

Vulnerability of analogous species to different gear types is informed by the record of interactions species with commercial fisheries and non-SEFSC research fisheries using gear types similar to those used in SEFSC research. The SEFSC request reflects: (1) concern that some species with which we have not had historical interactions may interact with these gears, (2) acknowledgment of variation between sets, and (3) understanding that many marine mammals are not solitary so if a set results in take, the take could be greater than one animal. In these particular instances, the SEFSC estimates the annual take of these 'analogous' species to be equal to the maximum interactions per any given set of a similar species that was historically taken during 2002-2015.

Thus, to estimate the requested taking of analogous species, the SEFSC identified species in the ARA, GOMRA, and CRA which may have vulnerability to research-based trawls. Non-SEFSC affiliated research trawls in the Gulf of Mexico and other parts of the U.S. have taken pelagic marine mammals. (For example a mid-water research trawl conducted to monitor the effects of the Deepwater Horizon oil spill in the Gulf of Mexico took 3 pantropical spotted dolphins in one trawl in 2012. Additionally, an Atlantic spotted dolphin was taken in non-SEFSC research bottom trawl in 2014.) Therefore, because some species exhibit similar behavior, distribution, abundance, and vulnerability to research trawl gear, the SEFSC requests 3 potential takes of the most common dolphin and small whale species in trawl gears over the five-year authorization period for the ARA and GOMRA (Tables 6-4 and 6-5). The SEFSC does not use trawl gear in the CRA and therefore does not request takes with trawl gear in the CRA.

Requests Made by Analogy with Species Taken in Commercial Fisheries

It is well documented that marine mammal species are taken in commercial longline fisheries. The 2015 List of Fisheries classifies commercial fisheries based on prior interactions with marine mammals. Although the SEFSC used this information to help make an informed decision on the probability of specific cetacean and large whale interactions with longline gear and other hook-and-line gear, many other factors were also taken into account (e.g., relative survey effort, survey location, similarity in gear type, animal behavior, prior history of SEFSC interactions with longline gear etc.). Therefore, there are several species that have been shown to interact with commercial longline fisheries but for which SEFSC is not requesting take. For example, the SEFSC is not requesting take of large whales in longline gear. Although large whale species could become entangled in longline gear, the probability of interaction with SEFSC longline gear is extremely low considering a far lower level of survey effort relative to that of commercial fisheries, much shorter set durations, and mitigation measures implemented by the SEFSC. Although data on commercial fishing efforts comparable to the known SEFSC research protocols (net

size, tow duration and speed, and total number of tows) are not publically available, based on the amount of fish caught by commercial fisheries versus SEFSC fisheries research, the "footprint" of research effort compared to commercial fisheries is very small (see Section 9).

Species that were previously caught (as outlined in the 2015 List of Fisheries) in analogous commercial fisheries were considered to have a higher probability of take but not all were included for potential take by the SEFSC because of time, space, and technique dissimilarities between research activities and prosecution of various fisheries. However, research longline gear could be considered analogous to some commercial longline surveys that may be conducted elsewhere (e.g., Garrison 2007, Roche et al. 2007, Straley et al. 2014) so there is some risk of incidental take in research gear. Therefore the SEFSC requests one potential take in hook-and-line gear over the five-year LOA authorization period for species that have been commonly caught in commercial longline fisheries historically in each of the three research areas (Tables 6-4, 6-5, and 6-6).

6.1.5 Estimating Take of Species Listed Under the ESA

Historically, the SEFSC has not interacted with ESA-listed marine mammals. Further, the SEFSC is very concerned about the prospect of taking ESA-listed marine mammals, and it seeks to develop sampling protocols that include mitigation measures designed to minimize the risk of taking any marine mammal species (see Section 11.11). However, for purposes of estimating potential take, the SEFSC did not differentiate between ESA-listed or non-listed marine mammals. The primary factor in estimating potential takes was whether a marine mammal species or stock – regardless of ESA-listing status – was deemed to have a similar vulnerability to gear(s) as those species that have historically interacted with SEFSC fisheries research.

6.1.6 Undetermined Delphinid Species

There are situations with hook-and-line fisheries research gear when a caught animal cannot be identified to species with certainty. This might occur when a hooked or entangled dolphin frees itself before being identified or when concerns over crew safety, weather, or sea state conditions necessitate quickly releasing the animal before identification is possible. The top priority for live animals is to release them as quickly and safely as possible. The SEFSC ship's crew and research personnel make concerted efforts to identify animals incidentally caught in research gear whenever crew and vessel safety are not jeopardized. To account for situations when species identification is not possible, the SEFSC requests one undetermined delphinid take in hook-and-line gear from each of the ARA, GOMRA, and CRA during the effective period of these regulations and subsequent LOAs (Tables 6-4, 6-5, and 6-6). Only those delphinid species that are considered to be at risk of take in hook-and-line gear, i.e., those for which specific take requests in that gear are made, are considered likely to be included in the "undetermined" category.

Table 6-4 Requested number of marine mammal takes from "analogous" stocks in the ARA

This table summarizes the combined potential take request by Mortality and Serious Injury (M&SI) and Level A harassment over a five-year period using trawls and hook-and-line gears gear (longline, bandit reel, and rod-and-reel deployments). Species included in this table are either analogous to historically taken species (bottlenose dolphins) or have known takes in analogous gear used in commercial fisheries; none have been taken previously in SEFSC fisheries research. The requested takes for the five-year period have been averaged for an annual take estimate that can be compared with PBR.

Species (Stock)	M&SI and Level A Take Request for Five-Year Authorization Period		Total Take Request for All Gears Combined	Average Annual Requested Take (animals per year)
	Trawl	Hook-and-line		
Risso's dolphin (Western North Atlantic)	0	1	1	0.2
Short-finned pilot whale (Western North Atlantic)	0	1	1	0.2
Long-finned pilot whale (Western North Atlantic)	0	1	1	0.2
Short-beaked common dolphin	3	1	4	0.8
Atlantic spotted dolphin (Western North Atlantic)	3	1	4	0.8
Pantropical spotted dolphin (Western North Atlantic)	0	1	1	0.2
Striped dolphin (Western North Atlantic)	3	0	3	0.6
Bottlenose dolphin (Western North Atlantic Offshore)	3	1	4	0.8
Harbor porpoise (Gulf of Maine/Bay of Fundy)	1	0	1	0.2
Undetermined delphinid	0	1	1	0.2
Harbor seal (Western North Atlantic)	1	0	1	0.2
Gray seal (Western North Atlantic)	1	0	1	0.2

Table 6-5 Requested number of marine mammal takes from "analogous" stocks in the GOMRA

This table summarizes the combined potential take request by M&SI and Level A harassment over a five-year period using trawls and hook-and-line gears gear (longline, bandit reel, and rod-and-reel deployments). Species included in this table are either analogous to historically taken species (bottlenose dolphins) or have known takes in analogous gear used in commercial fisheries; none have been taken previously in SEFSC fisheries research. The requested takes for the five-year period have been averaged for an annual take estimate that can be compared with PBR.

Species (Stock)	M&SI and Level A Take Request for Five-Year Authorization Period		Total Take Request for All Gears Combined	Average Annual Requested Take (animals per year)
	Trawl	Hook-and-line		
Melon-headed whale (Northern Gulf of Mexico)	3	0	3	0.6
Risso's dolphin (Northern Gulf of Mexico)	0	1	1	0.2
Short-finned pilot whale (Northern Gulf of Mexico)	0	1	1	0.2
Atlantic spotted dolphin (Northern Gulf of Mexico)	3	1	4	0.8

Species (Stock)	M&SI and Level A Take Request for Five-Year Authorization Period		Total Take Request for All Gears Combined	Average Annual Requested Take (animals per year)
	Trawl	Hook-and-line		
Pantropical spotted dolphin (Northern Gulf of Mexico)	3	1	4	0.8
Striped dolphin (Northern Gulf of Mexico)	3	0	3	0.6
Rough-toothed dolphin (Northern Gulf of Mexico)	0	1	1	0.2
Spinner dolphin (Northern Gulf of Mexico)	3	0	3	0.6
Bottlenose dolphin (Northern Gulf of Mexico Continental Shelf)	3	1	4	0.8
Bottlenose dolphin (Northern Gulf of Mexico Oceanic)	3	1	4	0.8
Undetermined delphinid	0	1	1	0.2

Table 6-6 Requested number of marine mammal takes from "analogous" stocks in the CRA

This table summarizes the combined potential take request by M&SI and Level A harassment over a five-year period using trawls and hook-and-line gears gear (longline, bandit reel, and rod-and- reel deployments). Species included in this table are either analogous to historically taken species (bottlenose dolphins) or have known takes in analogous gear used in commercial fisheries; none have been taken previously in SEFSC fisheries research. The requested takes for the five-year period have been averaged for an annual take estimate that can be compared with PBR.

Species (Stock)	M&SI and Level A Take Request for Five-Year Authorization Period	Average Annual Requested Take (animals per year)
	Hook-and-line	
Risso's dolphin (Puerto Rico & U.S.V.I.)	1	0.2
Short-finned pilot whale (Puerto Rico & U.S.V.I.)	1	0.2
Atlantic spotted dolphin (Puerto Rico & U.S.V.I.)	1	0.2
Pantropical spotted dolphin (Puerto Rico & U.S.V.I.)	1	0.2
Bottlenose dolphin (Puerto Rico & U.S.V.I.)	1	0.2
Undetermined delphinid	1	0.2

6.1.7 Survey Gears for which No Take of Marine Mammals by Mortality or Serious Injury or By Non-Serious Injury (Level A Harassment) is Being Requested

The SEFSC uses a variety of research gears and instruments that have no history of takes of marine mammals and which are not anticipated to result in takes in the future. These gears include various plankton nets (bongo, Neuston, etc.), CTDs and water samplers, bag seines, dip nets, oyster dredges, Ponar grabs, camera arrays, fish traps/pots/cages, Witham collectors, SCUBA divers with hand gear and instruments, ROVs, and electrofishing gear. Refer to Table 1.1 and Appendix A for a full list and descriptions of their use. All the gears listed in this section are not considered to have the potential to take marine mammals given their physical characteristics, how they are fished in fisheries research contexts, and the environments where they are used. For example, some commercial trap/pot fisheries, such as the blue crab trap fishery, have a history of taking marine mammals by entanglement in commercial trap/pot gear. However, commercial fisheries often involve hundreds of unattended traps that are located on a

semi-permanent basis, usually with long, loose float lines, close to shore where dolphin densities are the highest. In contrast, SEFSC research gear is fished in deeper waters where dolphin density is low and typically only one pot is fished at a time and monitored continuously for short soak times (e.g., one hour). These differences in deployment mean that the risk of entanglement in SEFSC fisheries research gear is extremely low.

There have been no marine mammal mortalities, serious injuries, or other Level A takes associated with SEFSC fisheries research with any of these gear types. Because of this and other factors, the SEFSC is not requesting marine mammal take for these gears, and as such they are not expected to result in take of marine mammal stocks in the SEFSC research areas.

6.1.8 Mitigation and Minimization of Takes

Because of the suite of mitigation measures SEFSC has implemented and is proposing to add in the future (see Section 11), it expects the total number of marine mammals taken in these gears to decrease in the future and be substantially less than the estimated level of take when summed across all species or stocks. Current and proposed additional mitigation protocols are described later in this application, so they are just mentioned briefly here: limits on trawl tow times and longline set times, marine mammal watches prior to setting gear, and a "move-on" rule if marine mammals are sighted prior to deploying gear. The SEFSC will continue to look for additional ways to minimize marine mammal takes during the course of its fisheries research (e.g., developing new sampling methods that eliminate the possibility of marine mammal mortalities such as video and acoustic sampling). The results of these studies are expected to influence future sampling protocols and gear development.

6.1.9 Conclusion

The SEFSC has used its historical interactions with bottlenose dolphins in fisheries research surveys as a basis for estimating potential takes of these species and of other species it has not interacted with, but which it believes shares similar vulnerabilities to gillnet, longline, trammel net, and trawl gears. Because of the low level of historical interactions, as well as the small number of predicted takes (M&SI and Level A) relative to population size for shelf and oceanic species, and BSE bottlenose dolphin and other species and stocks, respectively, and that harassment will likely be avoided through implementation of the SEFSC's mitigation measures, the SEFSC believes that its activities: (1) will have a minimal to moderate impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival). The basis for this statement is discussed in greater detail in Section 7 of this application.

Further, the SEFSC notes that despite its best efforts to estimate realistic potential marine mammal takes it believes actual takes would be substantially lower than its take estimates, and many of the species/stocks for which it estimated take would not be taken. There is substantial inherent uncertainty in estimating numbers and species/stocks that could be potentially taken, and the SEFSC's take estimates reflect this uncertainty. Our understanding of the potential effects of SEFSC activities on marine mammals is continually evolving. Reflecting this, the SEFSC proposes to include an adaptive management component within the application (see Section 13 of this application). This allows the SEFSC, in concert with NMFS, to consider, on a case-by-case basis, new data to determine whether mitigation and monitoring measures should be modified.

6.2 Estimated Level B Harassment of Marine Mammals due to Acoustic Sources and Derivation of the Estimate

Estimating sound exposures leading to behavioral and physical effects of intermittent high frequency sounds from active acoustic devices used in fisheries research is challenging for a variety of reasons. Among these are the wide variety of operating characteristics of these devices, variability in sound

propagation conditions throughout the typically large areas in which they are operated, uneven (and often poorly understood) distribution of marine species, differential (and often poorly understood) hearing capabilities in marine species, and the uncertainty in the potential for effects from different acoustic systems on different species. The SEFSC took a two-depth-zone approach in assessing the impacts of high-frequency active acoustic sources used in fisheries research in the three different research areas where it operates these devices: continental shelf waters (<200 meter depth) and offshore deep waters (>200 meter depth). The GOMRA and ARA include both shelf and offshore depth zones but the CRA includes only an offshore zone due to the rapid drop-off in water depth around Puerto Rico and the U.S. Virgin Islands (no shelf in this area).

The first step was a qualitative assessment of potential impacts across species and sound types. This analysis considers a number of relevant biological and practical aspects of how marine species likely receive and may be impacted by these kinds of sources. This assessment (described in greater detail in Section 7.2 below) considered the best available current scientific information on the impacts of noise exposure on marine life and the potential for the types of acoustic sources used in SEFSC surveys to have behavioral and physiological effects. The results indicate that a subset of the sound sources used are likely to be entirely inaudible to all marine species, that some of the lower frequency and higher power systems will be detectable over moderate ranges for some species (although this depends strongly on inter-specific differences in hearing capabilities). As discussed in more detail (see Section 7.2), current scientific information supports the conclusion that direct physiological harm is quite unlikely but behavioral avoidance may occur to varying degrees in different species. Consequently, any potential direct injury (as defined by NMFS relative to the U.S. Marine Mammal Protection Act as Level A harassment and currently estimated as 180 and 190 dB RMS received levels respectively for cetaceans and pinnipeds) from these fisheries acoustic sound sources was deemed highly unlikely and were not directly calculated.

Building on this assessment to attempt to quantify behavioral impacts, an analytical framework was derived and applied to estimate potential Level B harassment by acoustic sources (as defined relative to the MMPA). This analysis used characteristics of active acoustic systems, their expected patterns of use in each of the three SEFSC research areas, and characteristics of the marine mammal species that may interact with them to estimate Level B harassment of marine mammals. This approach is relatively straightforward and (although certain adaptations enable a more realistic spatial depiction of exposed animals in the water column) relies on average density values of marine species. While the SEFSC believes this quantitative assessment benefits from its simplicity and consistency with the current NMFS guidelines regarding estimates of Level B harassment by acoustic sources, based on a number of deliberately precautionary assumptions, the resulting take estimates should be seen as a very likely substantial overestimate of behavioral harassment from the operation of these systems. Additional details on the approach used and the assumptions made that result in a conservative estimate (i.e., higher numbers of exposures at received levels identified as Level B harassment) are described below.

6.2.1 Framework for Quantitative Estimation of Potential Acoustic Harassment Takes

The discussion in Section 7.2 considers the differential frequency bands of hearing in marine animals in deriving a qualitative assessment of the probable risk of particular acoustic impacts from general categories of active acoustic sources, and is likely a more appropriate means of assessing their overall impact from a limited set of deployments given the level of scientific uncertainty in a variety of areas. However, in order to meet the compliance requirements for assessing the potential environmental impact of SEFSC operations, in this case acoustic impacts, a quantitative estimate of individual Level B harassment was required.

Different sound exposure criteria are typically used for impulsive and continuous sources (Southall et al. 2007). Under the current NMFS guidelines for calculating Level B harassment, an animal is taken if it is exposed to continuous sounds at a received level of 120 dB root mean square (RMS) or impulsive sounds at a received level of 160 dB RMS. These are simple step-function thresholds that do not consider the

repetition or sustained presence of a sound source nor does it account for the known differential hearing capabilities between species. Sound produced by the fisheries acoustic sources here are very short in duration (typically on the order of milliseconds), intermittent, have high rise times, and are operated from moving platforms. They are consequently considered impulsive sources, which would be subject to the 160 dB RMS criterion. A mathematical method for estimating Level B harassment according to this step-function was derived and applied in each of the SEFSC ecosystem areas of operation where active acoustic gear is used – Gulf of Mexico, Continental Shelf and Offshore; Atlantic, Continental Shelf and Offshore; and Caribbean Offshore.

The assessment paradigm for active acoustic sources used in SEFSC fisheries research is relatively straightforward and has a number of key simplifying assumptions, most of which are deliberately precautionary given the known areas of uncertainty. These underlying assumptions (described in greater detail below) very likely lead to an overestimate of the number of animals that may be exposed at the 160 dB RMS level in any one year on average for each area. Conceptually, Level B harassment may occur when a marine mammal interacts with an acoustic signal. Estimating the number of exposures at the specified received level requires several determinations, each of which is described sequentially below:

1. A detailed characterization of the acoustic characteristics of the effective sound source or sources in operation;
2. The operational areas exposed to levels at or above those associated with Level B harassment when these sources are in operation;
3. A method for quantifying the resulting sound fields around these sources; and
4. An estimate of the average density for marine mammal species in each ecosystem area of operation

Quantifying the spatial and temporal dimensions of the sound exposure footprint of the active acoustic devices in operation on moving vessels and their relationship to the average density of marine mammals enables a quantitative estimate of the number of individuals for which sound levels exceed NMFS' Level B Harassment threshold for each area. The number of Level B harassment events is ultimately estimated as the product of the volume of water insonified at 160 dB RMS or higher and the volumetric density of animals determined from simple assumptions about their vertical stratification in the water column. Specifically, reasonable assumptions based on what is known about diving behavior across different marine mammal species were made to segregate those that predominately remain in the upper 200 m versus those that regularly dive deeper during foraging and transit. Methods for estimating each of these calculations are described in greater detail in the following sections, along with the simplifying assumptions made, and followed by the take estimates for each region.

6.2.2 SEFSC Sound Source Characteristics

An initial characterization of the general source parameters for the primary SEFSC vessels operating active acoustic sources was conducted (Table 6-7). This process enabled a full assessment of all sound sources, including those within the category 1 sources (identified in Section 7.2 below) that are entirely outside the range of marine mammal hearing (not shown here). This auditing of the active sources also enabled a determination of the predominant sources that, when operated, would have sound footprints exceeding those from any other simultaneously used sources. These sources were effectively those used directly in acoustic propagation modeling to estimate the zones within which the 160 dB RMS received level would occur.

The full range of sound sources used in fisheries acoustic surveys were considered (Table 6-7). Many of these sources can be operated in different modes and with different output parameters. In modeling their potential impact areas for these vessels when used and also when they are operated from non-NOAA vessels used for SEFSC survey operations, those features among those given below that would lead to the

most precautionary estimate of maximum received level ranges (i.e. largest insonified area) were used (i.e., lowest operating frequency and highest power output utilized). These operating characteristics of each of the predominant sound sources were used in the calculation of effective line km (Section 6.2.3) and area of exposure (Section 6.2.4) for each source in each survey.

Sources operating at frequencies above the functional hearing range of any marine mammal (typically above 180 kHz; see Section 7.2) were excluded from quantitative analysis. Among those operating within the audible band of marine mammal hearing, five predominant sources were identified as having the largest potential impact zones during operations, based on their relatively lower output frequency, higher output power, and their operational pattern of use (Table 6-7). The hearing range of baleen whales is generally considered to be between 7-25 kHz (Southall et al. 2007). Because the operating frequencies of most SEFSC sources are above this range, baleen whales would not be expected to perceive signals from most SEFSC active acoustic sources and we would not expect any exposures to these signals to result in behavioral harassment. The one exception to this is for those species occurring in areas where the SEFSC ocassionally operates the EK60 at 18 kHz and density estimates are available; in these cases estimated takes have been calculated.

In determining the effective line km for each of these predominant sources (Tables 6-8a and 6-8b) the operational patterns of use relative to one another were further applied to determine which source was the predominant one operating at any point in time for each survey. When multiple sound sources were used simultaneously, the one with the largest potential impact zone in each relevant depth strata was used in calculating takes. For example, when species (e.g., sperm whales) regularly dive deeper than 200 m, the largest potential impact zone was calculated for both depth strata and in some cases resulted in a different source being predominant in either depth strata. This enabled a more comprehensive way of accounting for maximum exposures for animals diving in a complex sound field resulting from simultaneous sources with different spatial profiles. This overall process effectively resulted in three sound sources (EK60, ME70, and EQ50) comprising the total effective line km, their relative proportions depending on the nature of each survey in each region (see Tables 6-8a and 6-8b).

Table 6-7 Output characteristics for predominant SEFSC acoustic sources

Acoustic system	Operating frequencies (kHz)	Source level (dB re: 1 µPa at 1 m)	Nominal beam width (deg)	Effective exposure area: sea surface to 200 m depth (km^2)	Effective exposure area: sea surface to depth at which sound is attenuated to 160 dB SPL (km^2)
Simrad EK60 Scientific Echo Sounder (surrogate for ES60)	18, 38, 70, 120, 200, 333	224	11@18kHz; 7@38kHz	0.0142	0.1411
Simrad ME70 Multi-Beam Echo Sounder	70-120	205	140	0.0201	0.0201
Teledyne RD Instruments Acoustic Doppler Current Profiler (ADCP), Ocean Surveyor	75	223.6	N/A	0.008600	0.018700
Simrad EQ50	50, 200	210	16-50kHz; 7-200kHz	0.0075	0.008
Simrad ITI trawl	27-33 kHz	<200	40 x 100	0.0032	0.0032

Acoustic system	Operating frequencies (kHz)	Source level (dB re: 1 µPa at 1 m)	Nominal beam width (deg)	Effective exposure area: sea surface to 200 m depth (km^2)	Effective exposure area: sea surface to depth at which sound is attenuated to 160 dB SPL (km^2)
monitoring system					

6.2.3 Calculating Effective Line Kilometers for Each NOAA Vessel

An estimated volume of water insonified to the 160 dB RMS received level was determined based on the operating parameters for each source type. In all cases where multiple sources are operated simultaneously, the one with the largest estimated acoustic footprint (and thus leading to higher estimated Level B harassment) was used as the effective source. Two depth zones were defined for each research area: a Continental Shelf Region defined by having bathymetry 0-200 m and an Offshore Region with bathymetry >200 m. Effective line distance and volume insonified was calculated for each depth stratum (0-200 m and > 200 m), where appropriate (i.e. in the Continental Shelf region, where depth is <200 m, only the exposure area for the 0-200 m depth stratumwas calculated). In some cases, this resulted in different sources being predominant in each depth stratum for all line km when multiple sources were in operation; this was accounted for in estimating overall exposures for species that utilize both depth strata (deep divers). For each ecosystem area, the total number of line km that would be surveyed was determined, as was the relative percentage of surveyed linear km associated with each source. The total line km for each vessel, the effective portions associated with each of the dominant sound types, and the effective total km for operation for each sound type is given in Tables 6-8a and 6-8b.

Table 6-8a Annual linear survey distance for each NOAA vessel and its dominant sources within two depth strata over continental shelf regions of the SEFSC research areas

Only sound sources that were the dominant sources of sound during SEFSC research are shown. Due to the steep bathymetry around PR/USVI, only offshore calculations were conducted in the CRA.

Vessel	Line/km	Source	% Time source dominant (0-200 m)	Line km/ dominant source (0-200 m)	Volume insonified at 0-200 m depth (km^3)
ATLANTIC RESEARCH AREA					
NOAA Ship *Gordon Gunter*	1449	EK60	100%	1449	20.6
NOAA Ship *Pisces*	2842	EK60	70%	1989	28.2
		ME70	30%	853	17.1
NOAA Ship *Oregon II*	3352	EK60	10%	335	4.8
		EQ50	20%	670	5.0
GULF OF MEXICO RESEARCH AREA					
Gordon Gunter	16,797	EK60	100%	16,797	238.5
Pisces	4309	EK60	70%	3016	42.8
		ME70	30%	1293	26.0
Oregon II	30,416	EK60	10%	3042	43.2
		EQ50	20%	6083	45.6

Table 6-8b Annual linear survey distance for each NOAA vessel and its predominant sources within two depth strata over offshore deepwater regions of the SEFSC research areas

Only sound sources that were the dominant sources of sound during SEFSC research are shown.

Vessel	Line/ km	Source	% Time source dominant (0-200 m)	Line km/ dominant source (0-200 m)	Volume insonified at 0-200 m depth (km^3)	% Time source dominant[1] (>200 m)	Line km/ dominant source (>200 m)	Volume insonified at >200 m depth (km^3)
ATLANTIC RESEARCH AREA								
Gordon Gunter	3402	EK60	100%	3402	43.8	100%	3402	431.7
Pisces	1097	EK60	70%	768	10.9	100%	1097	139.2
		ME70	30%	329	6.6			
Oregon II	1563	EK60	10%	156	2.2	10%	156	19.8
		EQ50	20%	313	2.3	20%	313	0.2
GULF OF MEXICO RESEARCH AREA								
Gordon Gunter	21,774	EK60	100%	21,774	309.2	100%	21,774	2763.1
Pisces	5980	EK60	70%	4186	59.4	100%	5980	758.9
		ME70	30%	1794	36.1			
Oregon II	8,932	EK60	10%	893	12.7	10%	893	113.3
		EQ50	20%	1786	13.4	20%	1786	0.9
CARIBBEAN RESEARCH AREA								
Gordon Gunter	2958	EK60	100%	2958	42.0	100%	2958	375.4
Pisces	175	EK60	70%	123	1.7	100%	175	22.2
		ME70	30%	53	1.1			
Oregon II	322	EK60	10%	32	0.5	10%	32	4.1
		EQ50	20%	64	0.5	20%	64	0.0

1 The deep water percentages total less than 100% because only portions of surveys are over deep water.

6.2.4 Calculating Volume of Water Insonified to 160 dB RMS Received Level

The cross-sectional area of water insonified to 160+ dB RMS received level was calculated using a simple model of sound propagation loss, which accounts for the loss of sound energy over increasing range. We used a spherical spreading model (where propagation loss = 20 x log (range) - such that there would be 60 dB of attenuation over 1000 m). This is a reasonable assumption even in relatively shallow waters since, taking into account the beam angle, the reflected energy from the seafloor will be much weaker than the direct source and the volume influenced by the reflected acoustic energy would be much smaller over the relatively short ranges involved. The spherical spreading model accounted for the frequency dependent absorption coefficient and the highly directional beam pattern of most of these sound sources. For absorption coefficients, the most commonly used formulas given by Francios and Garrison (1982) were used. The lowest frequency was used for systems that are operated over a range of frequencies. The vertical extent of this area is calculated for two depth strata (surface to 200 m, and for

deep water operations > 200 m, surface to range at which the on-axis received level reaches 160 dB RMS). This was applied differentially based on the typical vertical stratification of marine mammals (see Tables 6-9 and 6-10). A simple visualization of a 2-dimensional slice of modeled sound propagation is shown below to illustrate the predicted area insonified to the 160 dB level by an EK-60 operated at 18 kHz.

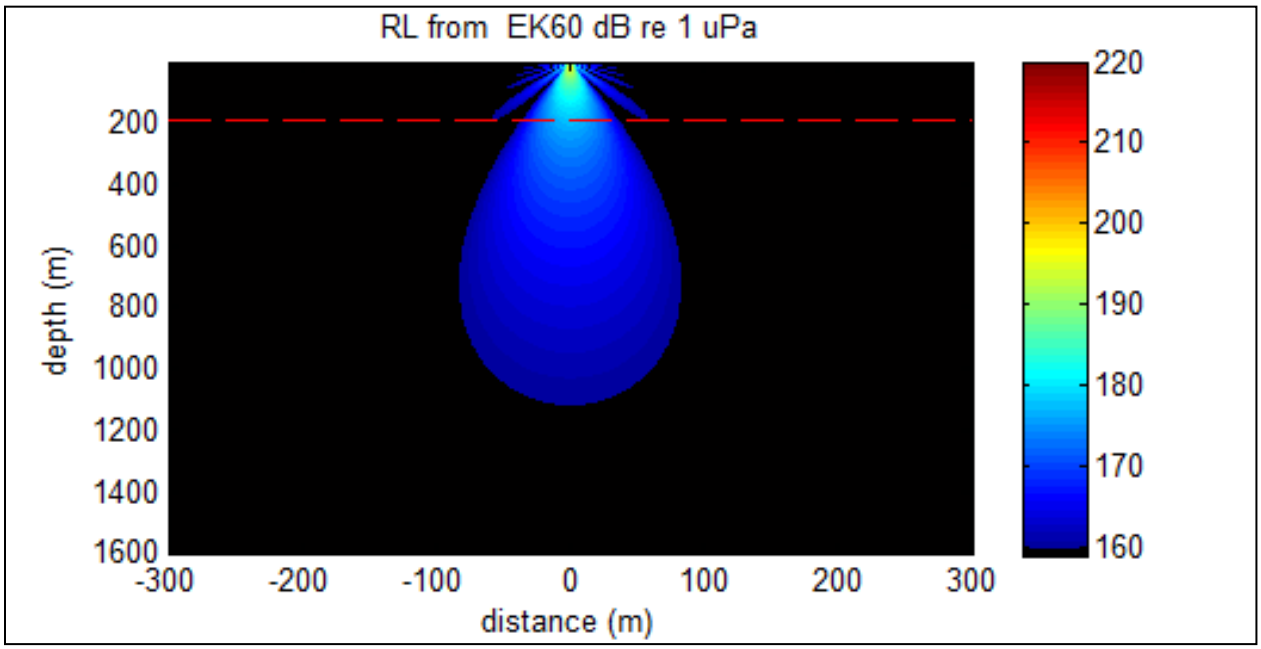

Figure 6-4 Visualization of a two-dimensional slice of modeled sound propagation to illustrate the predicted area ensonified to the 160 dB level by an EK-60 operated at 18 kHz

The dashed red line marks the transition between the two depth strata (0-200 m and >200 m)

Following the determination of effective sound exposure area for transmissions considered in two dimensions, the next step was to determine the effective volume of water insonified >160 dB RMS for the entirety of each survey in each region. For each of the three predominant sound sources, the volume of water insonified is estimated as the athwartship cross-sectional area (in km^2) of sound above 160 dB RMS (as shown in the figure above) multiplied by the total distance traveled by the ship. Where different sources operating simultaneously would be predominant in each different depth strata (e.g. ME70 and EK60 operating simultaneously in deep water may be predominant in the shallow and deeper bins respectively), the resulting cross sectional area calculated took this into account. Specifically, for shallow-diving species this cross-sectional area was determined for whichever was predominant in the shallow strata whereas for deeper diving species in deeper water this area was calculated from the combined effects of the predominant source in the shallow strata and the (sometimes different) source predominating in the deeper strata. This creates an effective total volume characterizing the area insonified when each predominant source is operated and accounts for the fact that deeper diving species may encounter a complex sound field in different portion of the water column.

6.2.5 Species-specific Marine Mammal Densities

One of the primary limitations to traditional estimates of behavioral harassment takes from acoustic exposure is the assumption that animals are uniformly distributed in time and space across very large geographical areas, such as those being considered here. There is ample evidence that this is in fact not the case and marine species are highly heterogeneous in terms of their spatial distribution, largely as a result of species-typical utilization of heterogeneous ecosystem features. Some more sophisticated

modeling efforts have attempted to include the typical behavioral patterns and diving parameters of a species in movement models that more adequately assess the spatial and temporal aspects of distribution and thus exposure to sound. While simulated movement models were not used to mimic individual diving or aggregation parameters in the determination of animal density in this estimation, the vertical stratification of marine mammals based on known or reasonably assumed diving behavior was integrated into the density estimates used.

To estimate takes from active acoustic sources on research ships, the SEFSC first estimated marine mammal densities (animals per km^2) by dividing abundance estimates by the area surveyed for each stock (Table 6-9). The marine mammal abundance estimates used for the ARA and GOM were obtained from Stock Assessment Reports for the Atlantic and the Gulf of Mexico ecosystem areas (Waring et al. 2012, 2013, 2014, and 2015) and the best scientific information available to SEFSC staff. Density estimates in areas where a species is known to occur (Table 3-1), but where published density data is absent were calculated based on values published for the species in adjacent regions by analogy and SEFSC expertise (Tables 3-2 and 6-9). For example, in the CRA there are records of marine mammal species occurrence (e.g., Mignucci-Giannoni 1998, Roden and Mullin 2000); however, area specific abundance estimates are unavailable so the density estimates for the GOMRA were used as proxies where appropriate to estimate acoustic take in the CRA. There are a number of caveats associated with these estimates:

- They are often calculated using visual sighting data collected during one season rather than throughout the year. The time of year when data were collected and from which densities were estimated may not always overlap with the timing of SEFSC fisheries surveys see Section 1.6 or Table 1-1a, b for survey dates).
- Marine mammal survey areas do not necessarily coincide spatially with the entire SEFSC research area boundaries. Estimated densities from the survey areas are assumed to apply to the entire research area.
- The densities used for purposes of estimating acoustic harassment takes do not take into account the patchy distributions of marine mammals in an ecosystem, at least on the moderate to fine scales over which they are known to occur. Instead, animals are considered evenly distributed throughout the assessed area and seasonal movement patterns are not taken into account.

For the ARA and GOMRA marine mammal density estimates were split into two habitats based on known species composition and the distribution of SEFSC research ship activities with active acoustic sources: the continental shelf (depth < 200 m) and offshore (depth > 200 m). The continental shelf in the CRA is extremely narrow, therefore only the offshore habitat was considered. In both ARA and GOMRA, the bottlenose dolphin and the Atlantic spotted dolphin are the primary species that occur in continental shelf waters whereas the offshore is inhabited by 20 or more cetacean species in both research areas. Additionally, in the GOMRA about 40 percent or more of the research ship activity occurs on an annual basis in the shelf habitat compared to the offshore.

To account for at least some coarse differences in marine mammal diving behavior and the effect this has on their likely exposure to these kinds of sometimes highly directional sound sources, a volumetric density of marine mammals of each species was determined. This value is estimated as the two-dimensional density multiplied by the vertical range of typical habitat for the population. Habitat ranges were categorized in two generalized depth strata (0-200 m, and 0 to >200 m) based on gross differences between known generally surface-associated and typically deep-diving marine mammals (Reynolds and Rommel 1999, Perrin et al. 2009). Animals in the shallow diving strata were reasonably estimated, based on empirical measurements of diving with monitoring tags and reasonable assumptions of behavior based on other indicators to spend a large majority of their lives (>75%) at depths of 200 m or shallower (Stewart 2009, Berta et al. 2015). Their volumetric density and thus exposure to sound is thus limited by this depth boundary. In contrast, species in the deeper diving strata were reasonably estimated to regularly dive deeper than 200 m and spend significant time at these greater depths. Their volumetric density and

thus potential exposure to sounds up to the 160 dB RMS level is extended from the surface to the depth at which this received level condition occurs and/or the water depth in the region of interest (e.g. the Continental Shelf region was generally considered to be comprised of water no deeper than 200 m).

The volumetric densities are estimates of the three-dimensional distribution of animals in their typical depth strata. For shallow diving species the volumetric density is the area density divided by 0.2 km (i.e., 200 m). For deeper diving species, the volumetric density is the area density divided by the depth of the area insonified to 160 dB RMS. The two-dimensional and resulting three-dimensional (volumetric) densities for each species in each ecosystem area are shown in the Table 6-9.

Table 6-9 Volumetric densities calculated for each species in SEFSC research areas used in take estimation

Abbreviations: unk=unknown, na=not applicable.

Species [A]	Typical Dive Depth Strata		Continental shelf area [B] density (#/km^2)	Offshore area [C] density (#/km^2)	Continental shelf area volumetric density (#/km^3)	Offshore area volumetric density (#/km^3)
	0-200 m	>200 m				
ATLANTIC RESEARCH AREA						
Fin whale	X			0.00005		0.00025
Sperm whale		X		0.00148		0.00296
Pygmy/dwarf sperm whales		X		0.00426		0.00852
False killer whale	X			0.00094		0.00470
Mesoplodont beaked whales		X		0.00673		0.01346
Risso's dolphin	X			0.00650		0.03248
Short-finned pilot whale		X		0.03610		0.07219
Short-beaked common dolphin	X			0.00637		0.03184
Atlantic spotted dolphin	X		0.39209	0.03812	1.96043	0.19062
Pantropical spotted dolphin	X			0.00709		0.03546
Striped dolphin	X			0.01686		0.08431
Rough-toothed dolphin	X			0.00058		0.00288
Bottlenose dolphin	X		0.25006	0.10802	1.25028	0.54010
GULF OF MEXICO RESEARCH AREA						
Bryde's whale	X			0.00011		0.00054
Sperm whale		X		0.00438		0.00876
Pygmy/dwarf sperm whales		X		0.01857		0.03715
Pygmy killer whale	X			0.00080		0.00400
False killer whale	X			0.00086		0.00432

Species [A]	Typical Dive Depth Strata		Continental shelf area [B] density (#/km^2)	Offshore area [C] density (#/km^2)	Continental shelf area volumetric density (#/km^3)	Offshore area volumetric density (#/km^3)
	0-200 m	>200 m				
Mesoplodont beaked whales		X		0.00925		0.01849
Melon-headed whale	X			0.00487		0.02434
Risso's dolphin	X			0.00523		0.02613
Short-finned pilot whale		X		0.00463		0.00925
Atlantic spotted dolphin	X		0.09971	unk	0.49854	unk
Pantropical spotted dolphin	X			0.09412		0.47062
Striped dolphin	X			0.00735		0.03677
Rough-toothed dolphin	X		0.00401	0.00664	0.02006	0.03322
Clymene dolphin	X			0.00907		0.04537
Spinner dolphin	X			0.01888		0.09439
Bottlenose dolphin	X		0.29462	0.02347	1.47311	0.11735
CARIBBEAN RESEARCH AREA [D]						
Sperm whale		X	na	0.00438	na	0.008761
Pygmy/dwarf sperm whales		X	na	0.01857	na	0.037148
Killer whale	X		na	0.00000	na	0
Pygmy killer whale	X		na	0.00080	na	0.003998
False killer whale	X		na	0.00086	na	0.004324
Mesoplodont beaked whales		X	na	0.00925	na	0.018493
Melon-headed whale	X		na	0.00487	na	0.024343
Risso's dolphin	X		na	0.00523	na	0.026132
Short-finned pilot whale		X	na	0.00463	na	0.009255
Pantropical spotted dolphin	X		na	0.09412	na	0.470615
Striped dolphin	X		na	0.00735	na	0.036771
Fraser's dolphin	X		na	0.00000	na	0
Rough-toothed dolphin	X		na	0.00664	na	0.03322
Clymene dolphin	X		na	0.00907	na	0.045365
Spinner dolphin	X		na	0.01888	na	0.094389
Bottlenose dolphin	X		na	0.02347	na	0.117349

A - Those species known to occur in the ARA and GOMRA with unknown volumetric densities have been omitted from this table. Those omitted include: for the ARA – North Atlantic right whale, minke whale, humpback whale, melon-headed whale, pygmy killer whale, long-finned pilot whale, Fraser's dolphin, spinner dolphin, Clymene dolphin, harbor porpoise, gray seal, and harbor seal; for the GOMRA – killer whale and Fraser's dolphin.

B - continental shelf area, 0-200 m bottom depth

C - offshore area, >200 m bottom depth

Species [A]	Typical Dive Depth Strata		Continental shelf area [B] density (#/km^2)	Offshore area [C] density (#/km^2)	Continental shelf area volumetric density (#/km^3)	Offshore area volumetric density (#/km^3)
	0-200 m	>200 m				

D - Estimates for the CRA are based on proxy values taken from the GOMRA where available and appropriate. Species omitted due to lack of data were humpback whale, minke whale, Bryde's whale, and Atlantic spotted dolphin.

6.2.6 Using Areas Insonified and Volumetric Density to Calculate Acoustic Takes

Level B harassment by acoustic sources, according to current NMFS guidelines, could be calculated for each area by using (1) the combined results from output characteristics of each source and identification of the predominant sources in terms of usage and acoustic output (Section 6.2.2); (2) their relative annual usage patterns for each operational area (Section 6.2.3); (3) a source-specific determination made of the area of water associated with received sounds at either the extent of a depth boundary or the 160 dB RMS received sound level (Section 6.2.4); and (4) determination of a biologically-relevant volumetric density of marine mammal species in each area (Section 6.2.5).These estimated takes are the product of the volume of water insonified at 160 dB RMS or higher for the predominant sound source for each portion of the total line km for which it is used and the volumetric density of animals for each species. These annual take estimates are given in Table 6-10.

Table 6-10 Estimated annual acoustic takes (Level B harassment) by sound type for each marine mammal species in the SEFSC research areas

The volume of water insonified to 160 dB by each sound source and depth strata is shown in Table 6-8a and 6-8b. The number of Level B takes for each species is derived by multiplying the volume of insonified water for each sound source by the volumetric density for each species. Total take requests are rounded up to the nearest whole number.

Species	Volumetric density (#/km^3)	Estimated Level B harassment (#s of animals) in 0-200 m dive depth stratum			Estimated Level B harassment in >200 m dive depth stratum		Total take request (rounded up)
		EK60	ME70	EQ50	EK60	EQ50	
ATLANTIC CONTINENTAL SHELF							
Atlantic spotted dolphin	1.96043	105.05	33.60	9.86	0.00	0.00	149
Bottlenose dolphin	1.25028	67.00	21.43	6.29	0.00	0.00	95
ATLANTIC OFFSHORE							
Fin whale	0.00024	0.02	0.00	0.00	0.00	0.00	1
Sperm whale	0.00296	0.18	0.02	0.01	1.75	0.00	2
Pygmy/dwarf sperm whales	0.00852	0.52	0.06	0.02	5.03	0.00	6
False killer whale	0.00470	0.29	0.03	0.01	0.00	0.00	1
Mesoplodont beaked whales	0.01346	0.83	0.09	0.03	7.95	0.00	9
Risso's dolphin	0.03248	2.00	0.21	0.08	0.00	0.00	3
Short-finned pilot whale	0.07219	4.43	0.48	0.17	42.65	0.00	48
Short-beaked common dolphin	0.03184	1.96	0.21	0.07	0.00	0.00	3

Species	Volumetric density (#/km^3)	Estimated Level B harassment (#s of animals) in 0-200 m dive depth stratum			Estimated Level B harassment in >200 m dive depth stratum		Total take request (rounded up)
		EK60	ME70	EQ50	EK60	EQ50	
Atlantic spotted dolphin	0.19062	11.71	1.26	0.45	0.00	0.00	14
Pantropical spotted dolphin	0.03546	2.18	0.23	0.08	0.00	0.00	3
Striped dolphin	0.08431	5.18	0.56	0.20	0.00	0.00	6
Rough-toothed dolphin	0.00288	0.18	0.02	0.01	0.00	0.00	1
Bottlenose dolphin	0.54010	33.18	3.57	1.27	0.00	0.00	39
GULF OF MEXICO CONTINENTAL SHELF							
Atlantic spotted dolphin	0.49854	161.80	12.95	22.75	0.00	0.00	198
Rough-toothed dolphin	0.02006	6.51	0.52	0.92	0.00	0.00	8
Bottlenose dolphin	1.47311	478.08	38.28	67.21	0.00	0.00	584
GULF OF MEXICO OFFSHORE							
Bryde's whale	0.00054	0.28	0.02	0.00	0.00	0.00	1
Sperm whale	0.00876	3.34	0.32	0.12	31.85	0.01	36
Pygmy/dwarf sperm whales	0.03715	14.17	1.34	0.5	135.05	0.03	152
Pygmy killer whale	0.004	1.52	0.14	0.05	0.00	0.00	2
False killer whale	0.00432	1.65	0.16	0.06	0.00	0.00	2
Mesoplodont beaked whales	0.01849	7.05	0.67	0.25	67.23	0.02	76
Melon-headed whale	0.02434	9.28	0.88	0.33	0.00	0.00	11
Risso's dolphin	0.02613	9.96	0.94	0.35	0.00	0.00	12
Short-finned pilot whale	0.00925	3.53	0.33	0.12	0.00	0.00	4
Pantropical spotted dolphin	0.47062	179.45	16.97	6.31	0.00	0.00	203
Striped dolphin	0.03677	14.02	1.33	0.49	0.00	0.00	16
Rough-toothed dolphin	0.03322	12.67	1.2	0.45	0.00	0.00	15
Clymene dolphin	0.04536	17.3	1.64	0.61	0.00	0.00	20
Spinner dolphin	0.09439	35.99	3.4	1.26	0.00	0.00	41
Bottlenose dolphin	0.11735	44.75	4.23	1.57	0.00	0.00	51
CARIBBEAN OFFSHORE							
Sperm whale	0.00876	0.39	0.01	0.00	3.52	0.00	4
Pygmy/dwarf sperm whales	0.03715	1.64	0.04	0.02	14.92	0.00	17
Pygmy killer whale	0.00400	0.18	0.00	0.00	0.00	0.00	1
False killer whale	0.00432	0.19	0.00	0.00	0.00	0.00	1
Mesoplodont beaked whales	0.01849	0.82	0.02	0.01	7.43	0.00	9

Species	Volumetric density (#/km^3)	Estimated Level B harassment (#s of animals) in 0-200 m dive depth stratum			Estimated Level B harassment in >200 m dive depth stratum		Total take request (rounded up)
		EK60	ME70	EQ50	EK60	EQ50	
Melon-headed whale	0.02434	1.08	0.03	0.01	0.00	0.00	2
Risso's dolphin	0.02613	1.16	0.03	0.01	0.00	0.00	2
Short-finned pilot whale	0.00925	0.41	0.01	0.00	0.00	0.00	1
Pantropical spotted dolphin	0.47062	20.80	0.50	0.23	0.00	0.00	22
Striped dolphin	0.03677	1.63	0.04	0.02	0.00	0.00	2
Rough-toothed dolphin	0.03322	1.47	0.04	0.02	0.00	0.00	2
Clymene dolphin	0.04536	2.01	0.05	0.02	0.00	0.00	3
Spinner dolphin	0.09439	4.17	0.10	0.05	0.00	0.00	5
Bottlenose dolphin	0.11735	5.19	0.12	0.06	0.00	0.00	6

6.2.7 Conclusion Regarding Total Estimates of Level B Harassment Due to Acoustic Sources

The results given in Table 6-10 are based on the approach taken here to estimate marine mammal Level B harassment takes under the MMPA and should be interpreted with considerable caution. This method is prescribed by the current definition of Level B harassment given in NMFS policy guidelines for acoustic impacts with several modifications specific to the directional nature of high-frequency fisheries acoustic sources and the vertical stratification of marine species applied. Given the simplistic step-function approach and lack of species-specific hearing parameters inherent in the NMFS prescribed approach, significant uncertainty in some areas, and a number of underlying assumptions based on how these sources may be used variably in the field, this approach should be considered to result in a highly precautionary estimate of impact (e.g., higher estimated "takes" than are in fact likely). Factors believed to result in the estimated Level B harassment by acoustic sources being conservative (i.e., higher than what may actually occur in situ) include the following:

- While the hearing ranges of the functional hearing groups (see Section 7.2 below and Southall et al. 2007) are accounted for in a straightforward manner in these calculations (i.e. sources are considered unlikely to lead to any Level B harassment if they are above or below functional hearing cut-offs), the known differences in hearing sensitivities between different marine mammal species, and within a functional hearing range (e.g., as reflected in auditory weighting functions), are not considered in estimates of Level B harassment by acoustic sources. All species are assumed to be equally sensitive to acoustic systems operating within their functional hearing range.
- Other known aspects of hearing as they relate to transient sounds (specifically auditory integration times) are also not taken into account in this estimation. Specifically, sounds associated with these fisheries acoustic sources are typically repetitive and quite brief in duration. All Sound Pressure Levels (SPLs) are calculated by assuming a continuous transmission, without taking into account the duty cycle, i.e. the ratio of pulse duration to ping interval. While some animals may potentially hear these signals well (e.g. odontocete cetaceans), for other animals, the perceived sound loudness may be considerably reduced based on their brief nature and the fact that auditory integration times in many species likely exceed the duration of individual signals.

More research is needed, however, in order to be able to quantify any potential reduction in perceived received level due to the brief nature of the sounds and to determine to which species this applies.

- Several other precautionary assumptions are made, including the use of the lowest frequencies and highest output power levels utilized (with greatest potential propagation to higher received levels) in cases where source operational parameters may be varied (Table 6-3).
- It should be recognized that the estimates of acoustic takes consider that more than one animal could be insonified several times and the total estimated take cannot be directly compared to the total number of animals in any particular population stock.

In conclusion, the estimated Level B harassment due to insonification from a variety of acoustic sources likely overestimates the actual magnitude of behavioral impacts of these operations for the reasons given above. This approach is deemed appropriate despite some of the uncertainties in terms of response thresholds to these types of sounds, overall density estimates, and other complicating factors.

7.0 ANTICIPATED IMPACT ON SPECIES OR STOCKS

The SEFSC anticipates that the specified activities could impact the species or stocks of marine mammals by causing mortality, serious injury, and/or Level A (non-serious injury) harassment (through gear interaction) or by causing Level B (behavioral) harassment (through use of active acoustic sources). These could occur through the following:

- Entanglement in nets or longlines;
- Accidental hooking; and
- Alterations in behavior caused by acoustics sources.

Other potential effects of the activity could include hearing impairment, masking, or non-auditory physiological effects, such as stress responses, resonance, and other types of organ or tissue damage related to the use of active acoustics. However, for reasons described below, we do not expect that these effects would occur. In addition, we do not expect that the anticipated impact of the activity upon the species or stocks is likely to include potential effects on marine mammals from ship collision or vessel strike (see 7.4 Collision and Ship Strike for details).

The SEFSC does not expect its survey operations or its cooperative surveys with other research entities would cause the marine mammal populations in the western North Atlantic Ocean, Gulf of Mexico, or Caribbean research areas to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild. Although these surveys have the potential to adversely impact the health and condition of an individual marine mammal, we anticipate no adverse effects on annual rates of recruitment or survival of the affected marine mammal species or stocks. The SEFSC notes, however, that marine mammal distribution and abundance is not uniform in all parts of the study area, and varies substantially in different seasons. Most marine mammal surveys are conducted during the summer and fall; however, density information is not available for every season in all the study regions. But the SEFSC believes that the direct effects on species or stocks are minor since over the course of the operations during the past 14 years just 11 marine mammals have been incidentally caught (three released alive).

While there are different approaches that could be taken to evaluating the significance of anticipated interactions with marine mammals during the course of fisheries research, the Potential Biological Removal (PBR) level used in classifying commercial fisheries is well established and applicable to removals of marine mammals in fisheries research activities, as well. PBR is defined by the MMPA as the maximum number of animals that may be removed from a marine mammal stock, not including natural mortalities, while allowing that stock to reach or maintain its optimum sustainable population. The PBR level is the product of the minimum population estimate of the stock, one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size, and a recovery factor of between 0.1 and 1.0.

In using PBR to evaluate the impact of SEFSC fisheries research activities on affected marine mammal stocks, two assumptions should be noted. First, as described in Section 6 of this application, SEFSC has requested a single number of takes in each gear for each stock in a combined category that includes Level A injury, serious injury and mortality. It is possible that some marine mammals that interact with SEFSC research gears will experience only non-serious injuries. However, for purposes of evaluating the significance of the SEFSC take request relative to PBR we assume the worst-case outcome that all animals in this combined category will be seriously injured or killed. The rationale for this binning of Level A injury, serious injury and mortality takes is described in greater detail in Section 6 of this application.

Second, SEFSC is assuming its anticipated take will equal its actual take of marine mammals in fisheries research activities. PBR was developed as a tool to evaluate actual human-caused removals from a

population, not anticipated future removals. Nonetheless, the take request described in Section 6 is based on comparisons to historical interactions, and as such SEFSC believes its request is a reasonable approximation of the number of takes that may occur in the future. Clearly, the actual number of serious injuries and mortalities that result from SEFSC research will need to be evaluated to understand the significance of these activities. As described in Section 13 of this application, SEFSC plans to implement an adaptive management approach to evaluating its actual takes and continuing to revisit its mitigation measures in light of take events to ensure they are appropriate.

7.1 Interactions with Fishing Gear

The SEFSC incidentally caught 11 bottlenose dolphins from assorted stocks during fisheries related research activities from 2002-2015 (Table 6-1). These incidental take events occurred during surveys using bottom trawl gear (5), trammel net (2), skimmer trawl gear (2), gillnet (1), and bottom longline gear (1); of these, one dolphin was released alive from each of a bottom trawl, a skimmer trawl, and a bottom longline.

Several gear types used during SEFSC fisheries research surveys, including those used by cooperative research partners, are similar to those used in commercial fishing operations in the western North Atlantic Ocean, Gulf of Mexico, and Caribbean. Included are trawls, longlines, rod-and-reel gear, and gillnets. However, it is important to note that even though SEFSC uses similar types of gear as that used in commercial fisheries, the size, configuration, and methods of use of this gear during SEFSC research surveys differs significantly than that used in commercial operations thereby reducing or eliminating the likelihood of incidental catch of marine mammals. For example, the annual spring and autumn trawl surveys are based on a stratified random sampling design and covers a broad area in the SEFSC research areas. Tows are of short duration (~20-30 min), multiple tows are not made in the same location, and the survey does not deliberately target important fishing grounds, which may also have higher concentrations of marine mammals. Figure 6-1 shows the spatial distribution of marine mammals that have been taken in SEFSC surveys from 2002-2015. These historical takes are dispersed fairly widely and, aside from those takes along the interface between estuarine and coastal regions, there does not appear to be any spatial pattern of high risk areas (i.e., “hot spots” for marine mammal takes) or any temporal pattern with regard to seasons or times of day.

The SEFSC has made a concerted effort to develop and implement mitigation measures to reduce the risk of such takes. These mitigation measures are part of the proposed action (continuing fisheries research program) and are described in Section 11. Most of the mitigation measures rely on visual monitoring and detection of marine mammals near the vessel or fishing gear. There are many variables that influence the effectiveness of visual monitoring at any one time, including the lighting and sea state, and the capabilities of the person(s) assigned to watch, so it is impossible to determine an overall measure of effectiveness, such as how many animals may have been avoided with visual monitoring compared to having no monitors. The value of implementing some mitigation measures is therefore based on general principles and best available information even if their effectiveness at reducing takes has not been scientifically demonstrated or quantified.

Because of the low level of historical takes by various gear types used during SEFSC fisheries research surveys, as well as the low level of predicted future takes associated with the use of such gear in research activities in the three research areas, the SEFSC believes that the surveys described below: (1) will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and (2) will not have an immitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

7.1.1 Anticipated Impact of SEFSC Fisheries Research Activities in the ARA, GOMRA, and CRA on Marine Mammal Stocks

Marine mammals have been caught during SEFSC-affiliated research using bottom trawls, trammel nets, skimmer trawls, bottom longlines, and gillnets. No marine mammals have been caught during SEFSC research using other research gears. For detailed descriptions of research efforts using these gears, see Table 1-1. For descriptions of various research gears and instruments used by the SEFSC, see Appendix A. Most of the mitigation measures rely on visual monitoring and detection of marine mammals near the vessel or fishing gear. Mitigation measures also include a move-on rule to minimize chances for gear to be deployed with marine mammals nearby and modified net retrieval procedures if marine mammals are sighted while gear is in the water (see Section 11 for additional information on mitigation and Section 13 for information on monitoring and reporting interactions).

As described in Section 6, SEFSC relied on historic marine mammal interactions by other NMFS science centers, commercial fisheries and other relevant information in developing its take request. Tables 7-1 through 7-5 compare the SEFSC take request for all gears used in its fisheries research relative to each stock's PBR. SEFSC relied heavily on its historic marine mammal interactions with its trawl surveys and other gear and used other relevant information in developing its take request. This section examines the impact of those potential takes relative to the status of each stock.

The impact criteria the SEFSC used to assess the magnitude of research effects on marine mammals have been developed in the context of two important factors derived from the MMPA. The first factor is the calculation of Potential Biological Removal (PBR) for each marine mammal stock. The MMPA defined PBR at 16 U.S.C. § 1362(20) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for anthropogenic mortality for each stock. Calculations of PBR are stock-specific and include estimates of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the Endangered Species Act (ESA) or depleted under the MMPA). NMFS and USFWS are required to calculate PBR (if possible) for each stock of marine mammals they have jurisdiction over and to report PBR in the annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many commercial fisheries involving mortality and serious injury (M&SI) and is a recognized and acceptable metric used by NMFS Office of Protected Resources in the evaluation of commercial fisheries incidental takes of marine mammals in U.S. waters as well as for other sources of mortality such as ship strikes.

The second factor is the categorization of commercial fisheries with respect to their adverse interactions with marine mammals. Under Section 118 of the MMPA, NMFS must classify all U.S. commercial fisheries into one of three categories based on the level of marine mammal M&SI that occurs incidental to each fishery, which it does in the List of Fisheries (LOF) published annually. Category III fisheries are considered to have a remote likelihood of or no known incidental M&SI of marine mammals. Category II fisheries are those that have occasional incidental M&SI of marine mammals. Category I fisheries are those that have frequent incidental M&SI of marine mammals. A two-tiered classification system is used to develop the LOF, with different thresholds of incidental M&SI compared to the PBR of a given marine mammal stock.

However, the LOF criteria is primarily used for managing commercial fisheries based on their actual levels of marine mammal M&SI and is not necessarily designed to assess impacts of projected takes on a given marine mammal stock. Because the analysis of impacts of SEFSC research on marine mammals in this document is based on projected takes rather than actual takes, we use a similar but not identical model to the LOF criteria.

In spite of some fundamental differences between most SEFSC research activities and commercial fishing practices, it is appropriate to assess the impacts of incidental takes due to research in a manner similar to what is done for commercial fisheries for two reasons:

- SEFSC research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- SEFSC research plays a key role in supporting commercial fisheries.

For the purposes of assessing the impact of requested marine mammal takes (combined Level A Harassment and M&SI) on the respective stocks, if the projected annual M&SI of a marine mammal stock from all SEFSC research activities is less than or equal to 10 percent of PBR for that stock, the effect would be considered minor in magnitude for the marine mammal stock, similar to the LOF's Category III fisheries that have a remote likelihood of M&SI with marine mammals with no measurable population change. Projected annual gear takes from SEFSC research activities between 10 and 50 percent of PBR for that stock would be considered moderate in magnitude for the marine mammal stock, similar to the LOF's Category II fisheries that have occasional M&SI with marine mammals where population effects may be measurable. Projected annual gear takes from SEFSC research activities greater than or equal to 50 percent of PBR would be major in magnitude for the marine mammal stock, similar to the LOF's Category I fisheries that have frequent M&SI with marine mammals which measurably affect a marine mammal stock's population trend

7.1.2 Anticipated Impact of SEFSC Fisheries Research Activities in the ARA

Tables 7-1 and 7-2 compare the SEFSC take request in the ARA relative to each stock's PBR. The take request is based on a five-year authorization period, not an annual basis, so the total take request for all gears was divided by five to provide an annual average take for each species/stock with which to compare to the annual PBR values.

For all of the non-bottlenose dolphin stocks for which take is requested in the ARA, the average annual take in all gear types combined is well below 10 percent of PBR (Table 7-1). This level of mortality, if it occurred, would be unlikely to affect the survival or reproductive success of any of these species and would be considered minor. For these species, the SEFSC take request for the ARA also includes one "undetermined delphinid" take over the five-year authorization period in hook-and-line gear to account for rare cases when an animal may be hooked or entangled but escape or be released before it could be identified. For impact analysis purposes, this undetermined take is assigned to each delphind stock considered susceptible to hook-and-line gear, i.e., those species for which specific takes were requested in hook-and-line gear. This results in the addition of 0.2 average annual takes to each of those delphind stocks (Table 7-1). Even with the addition of these "undetermined" takes, the combined take request would still be well below 10 percent of PBR for all of these stocks and would be considered minor on the population level.

Table 7-1 Stocks for which SEFSC is requesting incidental take from the ARA and evaluation of impact relative to PBR

The gear types for which these species are requested include trawls and hook-and-line gear (longlines, bandit gear, and rod-and-reel).

Species (Stock)	Average annual take request in trawls and hook-and-line gears	PBR	% of PBR requested	Total annual take request with undetermined delphinids	Total annual take request with undetermined delphinids as % of PBR
Risso's dolphin (Western North Atlantic)	0.2	126	0.2%	0.4	0.3%

Species (Stock)	Average annual take request in trawls and hook-and-line gears	PBR	% of PBR requested	Total annual take request with undetermined delphinids	Total annual take request with undetermined delphinids as % of PBR
Short-finned pilot whale (Western North Atlantic)	0.2	159	0.1%	0.4	0.3%
Long-finned pilot whale (Western North Atlantic)	0.2	199	0.1%	0.4	0.2%
Short-beaked common dolphin	0.8	1,125	<0.1%	1.0	0.1%
Atlantic spotted dolphin (Western North Atlantic)	0.8	316	0.1%	1.0	0.3%
Pantropical spotted dolphin (Western North Atlantic)	0.2	17	1.2%	0.4	2.4%
Striped dolphin (Western North Atlantic)	0.6	428	0.1%	0.6	0.1%
Bottlenose dolphin (Western North Atlantic Offshore)	0.8	561	0.1%	1.0	0.2%
Harbor porpoise (Gulf of Maine/Bay of Fundy)	0.2	706	<0.1%	0.2	<0.1%
Undetermined delphinid	0.2		NA		
Harbor seal (Western North Atlantic)	0.2	2,006	<0.1%	0.2	<0.1%
Gray seal (Western North Atlantic)	0.2	undetermined	NA	0.2	NA

The SEFSC request for bottlenose dolphins in the ARA is for 10 animals over a five-year period; however, the potential takes for each stock will be restricted on a stock-by-stock basis (see Table 7-2). Six of the estuarine stocks of bottlenose dolphins in the ARA for which takes are requested have an undetermined PBR due to limitations in population assessment research (Table 7-2). For most of the bottlenose dolphin stocks in the ARA for which take is requested and PBR is known, the average annual take represents less than 10 percent of PBR and, if it occurred, would be considered minor to each stock on the population level. For two stocks of bottlenose dolphins in the ARA for which PBR is known (Central Georgia Estuarine stock and Southern Georgia Estuarine stock), the requested take of one animal over the five-year authorization period, if it actually occurred, would be between 10 percent and 20 percent (10.5%) of that stock's PBR and would be considered a moderate impact on the population level. Given the fact that neither of these stocks have ever been taken historically by the SEFSC, the limited scope of SEFSC research efforts within the ranges of these stocks, and the mitigation measures that are implemented during research (see Section 11), the SEFSC does not expect this level of take to actually occur. The SEFSC considers any potential effects of SEFSC research on these stocks to be unlikely, but moderate in magnitude if they occurred. The six estuarine stocks with undetermined PBR are also probably small and, if their populations were determined, would also likely have small PBRs and the take request could be a similar percentage of their respective PBRs as the stocks with a calculated PBR and impacts ranging from minor to moderate.

As described above, the population size and status of many bottlenose dolphins stocks in the SEFSC research areas are poorly known, resulting in undetermined PBR values for these stocks. The lack of any recent population information for these stocks prevents the SEFSC from providing a quantitative assessment with up-to-date information on the potential impacts of the requested takes of animals from these stocks in SEFSC fisheries and ecosystem research gear. The resulting uncertainty regarding the potential effects on these populations could only be addressed with new field and laboratory research on these stocks. Given the large number of stocks that overlap with SEFSC research activities and the huge geographic area in which they occur, such a research program to better define the populations of this species would be a very large and expensive operation. It is not clear what the prospect is that such a comprehensive research program would be funded in the future but it would likely take years to conduct the research, analyze the data, and incorporate the information into the SARs. This LOA application is based on the best, currently available information but if new population estimates for one or more stocks of bottlenose dolphins are developed in the future, NMFS will consider the potential impacts of its ongoing fisheries research program and requested take authorizations on an adaptive management basis, including the potential for additional mitigation measures as necessary.

At the requested level of takes for stocks of unknown size, one animal over the five- year authorization period, or 0.2 animals/year, the impact of a take on survival or reproductive success of the stock is unknown. However, the potential impacts can be placed in perspective. From a population dynamics perspective, the sex and age of the animal taken is important where the removal of a reproductive female would have the largest impact on the reproductive success of the stock. If takes were purely random from a sex/age perspective, the probability of a reproductive female being taken is less than 50 percent. The impact of the removal of a reproductive female depends on the size of the population which is taken into account with the PBR perspective. From a PBR perspective, the stock size would have to be 30 individuals or fewer for the requested take to exceed PBR over five years. While again unknown, the likelihood that many stocks, if any, are comprised of 30 individuals or fewer is very remote. Also, the level of taking would have to exceed PBR over an extended period of time to impact the survival of the stock. That is, one instance of one take over five years that exceeds PBR would not in isolation impact the survival of the stock.

Table 7-2 Evaluation of impact relative to PBR for all ARA coastal and estuarine stocks of bottlenose dolphins based on the average annual requested take for all gears

The gear types for which most bottlenose dolphin stocks are requested include trawls, gillnets, trammel nets, longlines, bandit gear, and rod and reel.

Stock	Average annual take request for all gear types	PBR	% of PBR requested
Coastal, South Carolina & Georgia	0.6	31	1.9%
Coastal, Northern Florida	0.6	7	8.6%
Coastal, Central Florida	0.6	29	2.1%
Coastal, Northern Migratory	0.6	86	0.7%
Coastal, Southern Migratory	0.6	63	0.9%
Northern North Carolina Estuarine System	0.2	7.8	2.6%
Southern North Carolina Estuarine System	0.2	undetermined	NA
Northern South Carolina Estuarine System	0.2	undetermined	NA
Charleston Estuarine System	0.2	undetermined	NA
Northern Georgia/Southern South Carolina	0.2	undetermined	NA

Stock	Average annual take request for all gear types	PBR	% of PBR requested
Estuarine System			
Central Georgia Estuarine System	0.2	1.9	10.5%
Southern Georgia Estuarine System	0.2	1.9	10.5%
Jacksonville Estuarine System	0.2	undetermined	NA
Indian River Lagoon Estuarine System	0.2	undetermined	NA
Biscayne Bay	0.0	undetermined	0%
Florida Bay	0.2	undetermined	NA

7.1.3 Anticipated Impact of SEFSC Fisheries Research Activities in the GOMRA

Tables 7-3 and 7-4 compare the SEFSC take request in the GOMRA relative to each stock's PBR. The take request is based on a five-year authorization period, not an annual basis, so the total take request for all gears was divided by five to provide an annual average take for each stock with which to compare to the annual PBR values.

Excluding coastal and BSE bottlenose dolphins, the SEFSC take request includes ten species or stocks; all of which are requested at an annual level well below 10 percent of PBR (Table 7-3). This level of mortality, if it occurred, would be unlikely to affect the survival or reproductive success of any of these species and would be considered minor. For these species and stocks, the SEFSC take request for the GOMRA also includes one "undetermined delphinid" take over the five-year authorization period in hook-and-line gear. As in the ARA, this request is to account for rare cases when an animal may be hooked or entangled but escapes or is released before it could be identified. For impact analysis purposes, this undetermined take is assigned to each delphind stock in the GOMRA considered susceptible to hook-and-line gear, i.e., those species for which specific takes were requested in hook-and-line gear. This results in the addition of 0.2 average annual takes to each of those delphind stocks (Table 7-3). Even with the addition of these "undetermined" takes, the combined take request would still be below 10 percent of PBR for almost all of these stocks (except rough-toothed dolphin) and would be considered minor on the population level. For rough-toothed dolphin, the combined take request, if it occurred, would be between 10 percent and 20 percent (13.3%) of that stock's PBR and would be considered moderate on the population level. Given the fact that this species has never been taken historically by the SEFSC, the scope of SEFSC research efforts within the range of this stock, and the mitigation measures that are implemented during research, the SEFSC does not expect this level of take to actually occur.

Table 7-3 Stocks for which SEFSC is requesting annual take from the GOMRA and evaluation of impact relative to PBR

The gear types for which these species are requested include trawls, longlines, bandit gear, and rod and reel.

Species (Stock)	Average annual take request in trawls and hook-and-line gears	PBR	% of PBR requested	Total annual take request with undetermined delphinids	Total annual take request with undetermined delphinids as % of PBR
Melon-headed whale (Northern Gulf of Mexico)	0.6	13	4.6%	0.6	4.6%

Species (Stock)	Average annual take request in trawls and hook-and-line gears	PBR	% of PBR requested	Total annual take request with undetermined delphinids	Total annual take request with undetermined delphinids as % of PBR
Risso's dolphin (Northern Gulf of Mexico)	0.2	16	1.3%	0.4	2.5%
Short-finned pilot whale (Northern Gulf of Mexico)	0.2	15	1.3%	0.4	2.7%
Atlantic spotted dolphin (Northern Gulf of Mexico)	0.8	undetermined	NA	1.0	NA
Pantropical spotted dolphin (Northern Gulf of Mexico)	0.8	407	0.2%	1.0	0.2%
Striped dolphin (Northern Gulf of Mexico)	0.6	10	6.0%	0.6	6.0%
Rough-toothed dolphin (Northern Gulf of Mexico)	0.2	3	6.7%	0.4	13.3%
Spinner dolphin (Northern Gulf of Mexico)	0.6	62	1.0%	0.6	1.0%
Bottlenose dolphin (Northern Gulf of Mexico Continental Shelf)	0.8	469	0.2%	1.0	0.2%
Bottlenose dolphin (Northern Gulf of Mexico Oceanic)	0.8	42	1.9%	1.0	2.4%
Undetermined delphinid	0.2		NA		

The SEFSC request for coastal, bay, sound, or estuarine system bottlenose dolphins in the GOMRA is for 10 animals over a five year period; however, the potential takes for each stock will be restricted on a stock-by-stock basis (see Table 7-4). Of the 31 Northern Gulf of Mexico Bay, Sound, and Estuarine Stock complexes, the SEFSC and its research partners conduct research within the ranges of 19 stocks and within 3 km of the range boundaries of three stocks (Sabine, Terrebonne, and Barataria Bay). Seventeen of these 22 stocks have an undetermined PBR due to limitations in population assessment research (Table 7-4). For all but one of these 22 stocks the SEFSC is requesting one take over the five-year period. The exception is the Mississippi Sound/Lake Borngе/Bay Boudreau stock, for which three takes are requested over the five-year authorization period. For four of the five stocks for which PBR has been determined (Mississippi River Delta stock, St. Joseph Bay stock, and Mississippi Sound/Lake Borngе/Bay Boudreau stock, and Choctwhatchee Bay stock), PBR is small and the average annual take request (0.2/yr) would be between 10 percent and 20 percent of PBR. This level of take, if it occurred, would be considered to be a moderate magnitude of impact on these stocks. For the St. Vincent Sound/Apalachiola Bay/St. George Sound stock, the average annual take request (0.2/yr) would be less than 10 percent of PBR and would be considered a minor magnitude of impact on the stock. Many of the stocks with undetermined PBR are also small and, if their populations were determined, would also likely have small PBRs and the take request could be a similar percentage of their respective PBRs as the five stocks with a calculated PBR, with minor to moderate magnitudes of impact.

As described above for ARA stocks with undetermined PBRs, the lack of any recent population information for these stocks in the GOMRA prohibit the SEFSC from providing a quantitative assessment with up-to-date information on the potential impacts of the requested takes of animals from these stocks.

If new population estimates for one or more stocks of bottlenose dolphins in the GOMRA are developed in the future, NMFS will consider the potential impacts of its ongoing fisheries research program and requested take authorizations on an adaptive management basis, including the potential for additional mitigation measures as necessary.

Of the Northern Gulf of Mexico Bay, Sound, and Estuarine Stocks, SEFSC research has historically taken bottlenose dolphins only from the Mobile Bay/Bonsecour Bay and the Mississippi Sound/ Lake Bornge/ Bay Boudreau stocks: two takes occurred in the SEFSC TED testing research in skimmer trawls (one released alive), one bottlenose dolphin was caught and released from a bottom longline in the SEAMAP-GOM survey, and one was died after being caught in a gillnet used in the Gulf of Mexico Shark Pupping and Nursery project. This past history of takes from the Mississippi Sound/ Lake Bornge/ Bay Boudreau stock is one reason the requested take is higher for this stock than any of the other Bay, Sound, and Estuary stocks. Given that there have been only three takes over 14 years of research within this stock's range, the SEFSC believes there is a low potential for actually exceeding the three requested takes for this stock over the five-year authorization period. Also, given the lack of historical takes of most other stocks, the relatively small amount of research within their ranges, and the implementation of mitigation measures as described in this LOA application, the SEFSC believes it is unlikely to exceed the one take per five-year authorization period for any of the other requested Bay, Sound, and Estuary stocks or the total combined take of ten coastal or BSE dolphins over the five-year period.

In addition to these stocks, the SEFSC is requesting three takes each over the five-year authorization period for three Northen Gulf of Mexico coastal stocks of bottlenose dolphins, the Northern Gulf of Mexico Continental Shelf Stock, and the Northern Gulf of Mexico Oceanic Stock. This level of take, if it occurred from any of these bottlenose dolphin stocks, would be much less than 10 percent of PBR and would be unlikely to affect the survival or reproductive success of any of these stocks and would be considered minor.

Table 7-4 Evaluation of impact relative to PBR for all GOMRA coastal, bay, sound, and estuarine stocks of bottlenose dolphins based on the average annual requested take for all gear

The gear types for which most bottlenose dolphin stocks are requested include trawls, gillnets, trammel nets, longlines, bandit gear, and rod and reel.

Stock	Average annual take request for all gears	PBR	% of PBR requested
Northern Gulf of Mexico Western Coastal Stock	0.6	175	0.3%
Northern Gulf of Mexico Northern Coastal Stock	0.6	60	1.0%
Northern Gulf of Mexico Eastern Coastal Stock	0.6	111	0.5%
Northern Gulf of Mexico Bay, Sound, and Estuarine Stocks (31 stocks below)			
Laguna Madre	0.2	undetermined	NA
Nueces Bay, Corpus Christi Bay	0.2	undetermined	NA
Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espirtu Santo Bay	0.2	undetermined	NA
Matagorda Bay, Tres Palacios Bay, Lavaca Bay	0.2	undetermined	NA
West Bay	0.2	undetermined	NA
Galveston Bay, East Bay, Trinity Bay	0.2	undetermined	NA
Sabine Lake	0.2	undetermined	NA
Calcasieu Lake	0	undetermined	0%

Stock	Average annual take request for all gears	PBR	% of PBR requested
Atchalfalaya Bay, Vermilion Bay, West Cote Blanche Bay	0	undetermined	0%
Terrabonne Bay, Timbalier Bay	0.2	undetermined	NA
Barataria Bay Estuarine System	0.2	undetermined	NA
Mississippi River Delta	0.2	1.7	11.8%
Mississippi Sound, Lake Bornge, Bay Boudreau	0.6	5.6	10.7%
Mobile Bay, Bonsecour Bay	0.2	undetermined	NA
Perdido Bay	0.2	undetermined	NA
Pensacola Bay, East Bay	0.2	undetermined	NA
Choctwhatchee Bay	0.2	1.7	11.8%
St. Andrew Bay	0.2	undetermined	NA
St. Joseph Bay	0.2	1.4	14.3%
St. Vincent Sound, Apalachiola Bay, St. George Sound	0.2	3.9	5.1%
Apalachee Bay	0.2	undetermined	NA
Waccasassa Bay, Withlacoochee Bay, Crystal Bay	0.2	undetermined	NA
St. Joseph Sound, Clearwater Harbor	0	undetermined	0%
Tampa Bay	0	undetermined	0%
Sarasota Bay, Little Sarasota Bay	0	1.6	0%
Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	0.2	undetermined	NA
Caloosahatchee River	0	undetermined	0%
Estero Bay	0	undetermined	0%
Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	0.2	undetermined	NA
Whitewater Bay	0	undetermined	0%
Florida Keys-Bahia Honda to Key West	0	undetermined	0%

7.1.4 Anticipated Impact of SEFSC Fisheries Research Activities in the CRA

The SEFSC has not taken marine mammals in the CRA in the course of its research. However, because it has been documented that some marine mammal species may be taken in commercial fisheries in this region, the SEFSC has made an informed decision that there is some probability of specific interactions between commercial fisheries gear analogous to that used in fisheries research. Therefore, the SEFSC is requesting minimal levels of taking five species from CRA waters in hook-and-line gear (Table 7-5). In all cases, due largely to the lack of population assessment studies in the region, no PBRs have been determined for any of these species. Because there has never been an interaction with SEFSC research activities in the region, fisheries research effort is minimal in the area, and the mitigation measures implemented during research, the SEFSC believes that the requested level of take associated with their fisheries research activities is a precautionary level and unlikely to occur.

Table 7-5 Stocks for which SEFSC is requesting annual take from the CRA and evaluation of impact relative to PBR

The gear types for which these species are requested include longlines, bandit gear, and rod and reel.

Species	Average annual M&SI and Level A take request (animals per year)	PBR	% of PBR requested
Risso's dolphin	0.2	undetermined	NA
Short-finned pilot whale	0.2	undetermined	NA
Atlantic spotted dolphin	0.2	undetermined	NA
Pantropical spotted dolphin	0.2	undetermined	NA
Bottlenose dolphin (Puerto Rico & U.S.V.I stock)	0.2	undetermined	NA
Undetermined delphinid	0.2		

7.1.5 Synopsis of the Anticipated Impact of SEFSC Fisheries Research Activities

Our analysis of the effects of research is limited by the extent of knowledge for many of the species and stocks occurring within the vast geographic region served by SEFSC. It is likely that there are as yet to be described stocks for some species and for species to occur within regions where they have yet to be reported. Our knowledge is most complete for the ARA and the GOMRA and thus our assessment of the impact of taking is largely based on what is known from, or adjacent to, these regions. Using the best scientific information available, SEFSC has integrated the following underlying factors into this evaluation of the area-wide impact of SEFSC fisheries research activities:

- There is much remaining to be discovered about marine mammal distribution, abundance and stock structure for the vast area where SEFSC fisheries and ecosystem research activities are conducted. These surveys are time consuming and expensive and take many years to conduct, analyze and to assess trends.
- The gear types used by SEFSC are relatively small in scale and scope; specific locations are visited infrequently.
- There are similarities between the ARA and GOMRA that provide insight into and inform how fisheries research and local stocks are likely to interact in the CRA.
- For species in the CRA, our evaluation of impacts from the requested takes is limited by the fact that there may be undefined stocks in these areas. There may also be instances where a species/stock occur in a given region but has yet to be reported as present. Even so, the levels of take requested for species and stocks within the CRA are low (one animal/species over the five-year authorization period, Table 7-5) and, if they occurred, would likely be distributed across this vast area over time.

Acknowledging these limitations and recognizing the lack of historical interactions, as well as the low level of predicted future takes (mortality, serious injury, and Level A harassment) associated with SEFSC fisheries and ecosystem research activities, SEFSC believes that their research activities will not affect annual rates of recruitment or survival or the health and condition of the species or stock of the requested species. The average annual human-caused mortality for these species is generally, with few exceptions, estimated to be less than the PBR, as discussed above in the species accounts. Except for the Florida Bay stock, all of the coastal and BSE stocks of bottlenose dolphins in the ARA and in the GOMRA, and the short-finned pilot whale, Atlantic spotted dolphin, and bottlenose dolphin stocks in the CRA are classified

as strategic stocks, largely due to small or unknown population sizes. None of the other species or stocks for which takes are requested is considered strategic. Most of the requested takes of species or stocks with known PBRs would equal less than ten percent of PBR and be considered of minor magnitude. Stocks with requested takes between ten and 20 percent of PBR could experience a moderate impact, although most of the takes, if they were to occur, would be at the low end of the range that defines this level of impact. Additionally, takes herein requested are precautionary and most are unlikely to occur, given the infrequency of historical interactions and the implementation of mitigation measures described in Section 11. Based on this SEFSC believes that its activities:

1. Will have a minimal impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and
2. Will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

7.2 Disturbance and Behavioral Changes Due to Noise (Level B harassment)

Characteristics of hearing and the effects of noise on marine life have been reviewed extensively (Richardson et al. 1995, Wartzok and Ketten 1999, Nowacek et al. 2007, Southall et al. 2007, Au and Hastings 2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). General characteristics of hearing in marine mammals is described briefly here primarily for the purposes of categorization with regard to the potential impacts of high frequency active acoustic sources, as well as current information regarding sound exposures that may be detectable, disturbing, or injurious to marine mammals.

7.2.1 Hearing in Marine Mammals

Within marine taxa, there is probably the most known about the hearing capabilities of marine mammals. However many species and in fact entire taxa (e.g., large whales) have not been measured directly in controlled/laboratory settings. Current knowledge is based on direct measurements (using behavioral testing methods with trained animals and electrophysiological measurements of neural responses to sound production), as well as various ways of predicting hearing sensitivity using ranges of vocalization, morphology, observed behavior, and/or taxonomic relatedness to known species (e.g., Ketten 1997, Houser et al. 2001). While less than a third of the >120 marine mammal species have been tested directly, sufficient data exist to indicate general similarities and differences within taxa (e.g., Richardson et al. 1995, Wartzok and Ketten 1999, Au and Hastings 2008) and reasonably assign marine mammal species into functional hearing groups (as in Southall et al. 2007). NOAA modified the functional hearing groups of Southall et al. (2007) to extend the upper range of low-frequency cetaceans and to divide pinnipeds into Phocids and Otariids (NOAA 2015). Detailed descriptions of marine mammal auditory weighting functions and functional hearing groups are available in NOAA (2015). Based on these functional hearing groupings, conclusions may be made about marine mammal hearing, as described below.

No direct measurements of hearing exist in large whales, primarily because of their sheer size and the resulting difficulties in housing and testing them in normal captive settings. Conclusions about their hearing capabilities must be considered somewhat speculative, but some general conclusions and predictions are possible (Richardson et al. 1995, Ketten 1997, Wartzok and Ketten 1999, Houser et al. 2001, Erbe 2002, Clark and Ellison 2004). The thirteen species of baleen whales have been determined to comprise a low frequency cetacean functional hearing group with estimated functional hearing between 7 Hz and 30 kHz (NOAA 2015, Southall et al. 2007, Figure 7-1). Humpback whales produce sounds with some energy above 24 kHz (Au et al. 2006), so it is possible that functional hearing could extend slightly higher in this group. Empirical measurements of Frankel (2005) in demonstrating minor avoidance behavior in gray whales to 21-25 kHz sounds and the anatomical predictions of Parks et al. (2007) are

consistent with the interpretation of a slightly higher upper frequency hearing cut-off in mysticetes, perhaps extending close to 30 kHz in some species.

Odontocetes are segregated into two functional hearing groups based on their relative specialization (or lack thereof) to detect very high frequency sounds (Table 4-1). Southall et al. (2007) distinguished these into the mid-frequency cetaceans including 32 species and subspecies of "dolphins", 6 species of larger toothed whales, and 19 species of beaked and bottlenose whales. These species are determined, based on direct behavioral and electrophysiological methods, to have functional hearing between approximately 150 Hz and 160 kHz (see references in Southall et al. 2007).

High frequency cetaceans include eight species and subspecies of true porpoises, six species and subspecies of river dolphins plus the Franciscana (*Pontoporia blainvillei*), *Kogia*, and four species of cephalorhynchids and have functional hearing between 200 Hz and 180 kHz (Southall et al. 2007, and citations therein).

The pinnipeds (seals) function in both air and water and have functional hearing in each media. Only underwater hearing is considered here, given that the active acoustic sources associated with SEFSC research vessels are operated in water. In the ARA only, this group includes two species (harbor seals and gray seals) that occur on a regular basis. Based on the existing empirical data on hearing in laboratory individuals of nine pinniped species, Southall et al. (2007) estimated functional underwater hearing sensitivity in this group to be between 75 Hz and 75 kHz, but noted that there is considerable evidence that phocid seals have a broader range of hearing sensitivity than the otariids. To account for this, modified functional hearing groups divide pinnipeds into Phocids and Otariids, with estimated auditory bandwidths of 75 Hz to 100 kHz and 100 Hz to 40 kHz, respectively (NOAA 2015).

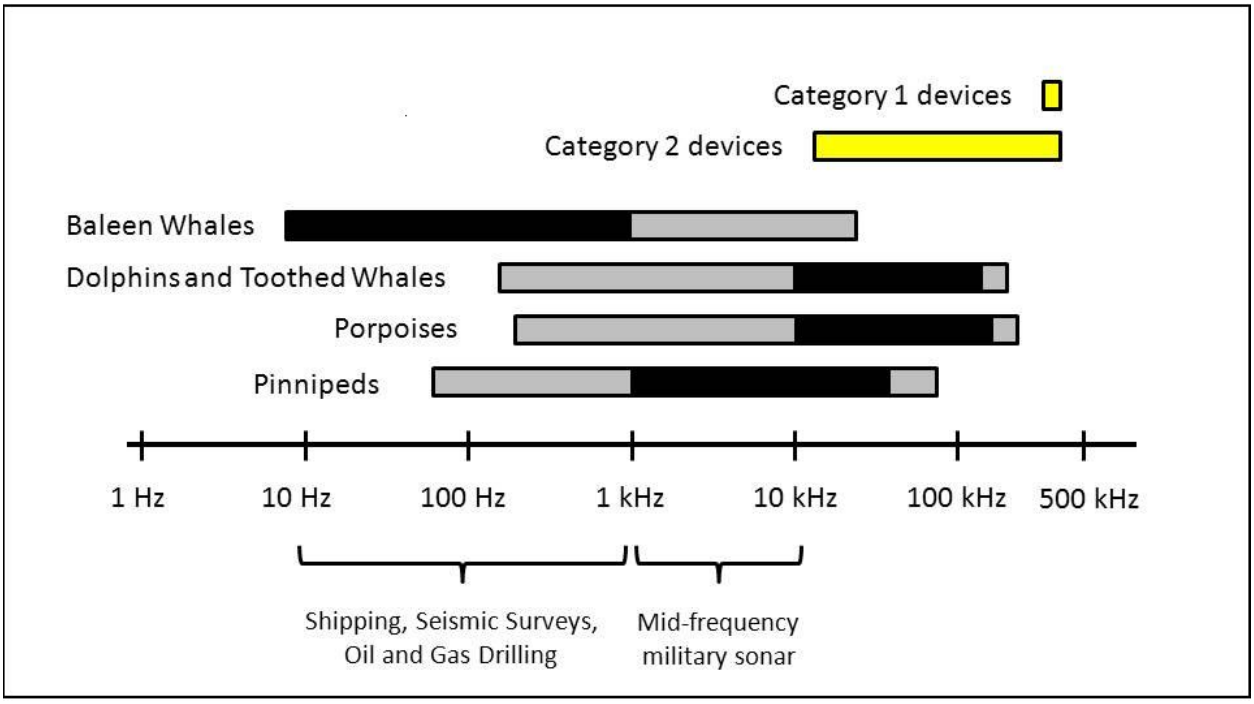

Figure 7-1 Typical frequency ranges of hearing in marine animals shown relative to various underwater sound sources, particularly high frequency active acoustic source

Figure 7-1 shows hearing ranges for different marine mammal groups (gray and black bars) relative to the frequency outputs of the two categories of acoustic devices used in SEFSC research (yellow bars), as identified in Section 6.2. Black bars indicate the most sensitive hearing ranges of different marine mammals. Brackets indicate frequency

ranges of several industrial sound sources as well as U.S. Navy mid-frequency active sonar for comparison. Data on hearing ranges is from Southall et al. (2007) and modified from DON (2008).

7.2.2 Effects of Anthropogenic Noise on Marine Mammals

Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of impacts on marine life, from no or minor responses to potentially severe, depending on received levels, behavioral context and various other factors. Many of the kinds of sources that have been investigated included sounds that are either much lower frequency and/or higher total energy (considering output sound levels and signal duration) than the high frequency mapping and fish-finding sonars used by the SEFSC . These include low- and mid-frequency military sonars, seismic airguns used in geophysical research, pile-driving sounds associated with marine construction, and low- and mid- frequency sounds associated with vessel operations (NRC 1994, 2000, 2003, 2005; Nowacek et al. 2007, Southall et al. 2007, Popper and Hastings 2009). Other than the Navy's studies on the High-Frequency Marine Mammal Monitoring (HF/M3) active sonar system since 2001, there has been relatively little attention given to the potential impacts of high-frequency sonar systems on marine life, largely because their combination of high output frequency and relatively low output power is likely to render them less likely to impact many marine species than some of the other acoustic sources. However, it should be noted that some species of marine animals do hear and produce sounds at some of the frequencies used in these sources and ambient noise is much lower at high frequencies, increasing the relative probability of their detection relative to other sounds in the environment.

Sounds must presumably be audible to be detected and the known or estimated functional hearing capabilities for different species are indicated in Figure 7-1. Additionally, Southall et al. (2007) provided a recent and extensive review on the effects of noise on marine mammal hearing and behavior.

The results of that review indicate that relatively high levels of sound are likely required to cause temporary hearing threshold shifts (TTS) in most pinnipeds and odontocete cetaceans species (e.g., Schlundt et al. 2000, Finneran et al. 2002, 2005, 2007, 2010a and b, Kastak et al. 1999, 2005,2007). The exposures required are often measured with a variety of sound exposure metrics related to level (e.g., RMS, peak, or peak-peak sound pressure level) or sound energy (e.g., sound exposure level that considers level as well as exposure duration). While clearly dependent on sound exposure frequency, level, and duration, based on the results of these studies, for the kinds of relatively brief exposures associated with transient sounds such as the active acoustic sources usd by the SEFSC, RMS sound pressure levels in the range of approximately 180-220 dB re: 1µPa are required to induce onset TTS levels for most species (Chapter 3 in Southall et al. 2007). Recently, Lucke et al. (2009) found a TTS onset in a harbor porpoise exposed to airgun noise at much lower (>20 dB) levels than reported by Finneran et al. (2002) for belugas using a similar impulse noise source; Kastelein (unpubl. data) has similarly observed increased sensitivity in this species. Additionally, Finneran and Schlundt (2010) indicate relatively lower TTS onset levels for higher sound exposure frequencies (20 kHz) than for lower frequencies (3 kHz) in some cetaceans. However, for these animals, which are better able to hear higher frequencies and may be more sensitive to higher frequencies, exposures on the order of ~170 dB RMS or higher for brief transient signals are likely required for even temporary (recoverable) changes in hearing sensitivity that would likely not be categorized as physiologically damaging. The corresponding estimates for permanent threshold shift (PTS), which would be considered injurious, would still be at quite high received sound pressure levels that would rarely be experienced in practice.

Southall et al. (2007) provided a number of extrapolations to assess the potential for permanent hearing damage (permanent threshold shift or PTS) from discrete sound exposures and concluded that very high levels (exceeding 200 dB re: 1µPa received sound pressure levels) would be required; typically quite large TTS is required (~40 dB) to result in PTS from a single exposure. Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups, which essentially account for the fact that impacts of noise on hearing depends in large part on the frequency overlap

between noise and hearing. Based on the Southall et al. (2007) results, Lurton and DeRuiter (2011) modeled the potential impacts (PTS and behavioral reaction) of conventional echosounders on marine mammals. They estimated PTS onset at typical distances of 10s to 100m for the kinds of sources in the fisheries surveys considered here. They also emphasized that these effects would very likely only occur in the cone ensonified below the ship and that animal responses to the vessel at these extremely close ranges would very likely influence their probability of being exposed to these levels. For certain species (e.g., odontocete cetaceans and especially harbor porpoises), these ranges may be somewhat greater based on more recent data (Lucke et al. 2009, Finneran and Schlundt 2010), although they are likely still on the order of hundreds of meters for most fisheries acoustic sources. The overall conclusion here is that the available information on hearing and potential auditory effects in marine mammals would suggest that the high frequency cetacean species would be the most likely to have temporary (not permanent) hearing losses from a vessel operating high frequency sonar sources, but that even for these species, individuals would have to either be very close to and also remain very close to vessels operating these sources for multiple exposures at relatively high levels. Given the moving nature of vessels in fisheries research surveys, the likelihood that animals may avoid the vessel to some extent based on either its physical presence or active acoustic sources, and the intermittent nature of many of these sources, the potential for TTS is probably low for high frequency cetaceans and very low to zero for other species. In addition, the behavioral responses that typically occur (described below) further reduce this already low likelihood that an animal may approach close enough for any type of hearing loss to occur.

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Behavioral responses of marine mammals are extremely variable depending on a host of exposure factors, including exposure level, behavioral context and other factors. The most common type of behavioral response seen across studies is behavioral avoidance of areas around sound sources. These are typically the types of responses seen in species that do clearly respond, such as harbor porpoises, around temporary/mobile higher frequency sound sources in both the field (e.g., Culik et al. 2001, Johnston 2002) and in the laboratory settings (e.g., Kastelein et al. 2000, 2005, 2008a and b). However, what appears to be more sustained avoidance of areas where high frequency sound sources have been deployed for long durations has also been documented in some odontocete cetaceans, particularly those like porpoises and beaked whales that seem to be particularly behaviorally sensitive (e.g., Olesiuk et al. 2002, Carretta et al. 2008, Southall et al. 2007). While low frequency cetaceans and pinnipeds have been observed to respond behaviorally to low- and mid-frequency sounds, there is little evidence of behavioral responses in these species to high frequency sound exposure (see e.g., Jacobs and Terhune 2002, Kastelein et al. 2006).

7.2.3 Active Acoustic Sources Used by the SEFSC and Their Effect on Marine Mammals

A brief discussion of the general characteristics of high frequency acoustic sources associated with fisheries research activities is given below, followed by a qualitative assessment of how those sources may affect marine life. Marine mammals, as opposed to marine fish and sea turtles, are the focus of this

assessment given their overlapping hearing capabilities (Figure 7-1) with the sounds produced by high frequency sound sources.

The high frequency transient sound sources operated by the SEFSC are used for a wide variety of environmental and remote-object sensing in the marine environment. They include various echosounders (e.g., multibeam systems), scientific sonar systems, positional sonars (e.g., net sounders for determining trawl position), and environmental sensors (e.g., current profilers). The specific acoustic sources used in SEFSC active acoustic surveys, are described in Section 6.2. As a general categorization, however, the types of active sources employed in fisheries acoustic research and monitoring may be considered in two broad categories here, based largely on their respective operating frequency (e.g., within or outside the known audible range of marine species) and other output characteristics (e.g., signal duration, directivity). As described below, these operating characteristics result in differing potential for acoustic impacts on marine mammals and other protected species.

Category 1 Active Acoustic Sources

Certain active fisheries acoustic sources (e.g., short range echosounders, acoustic Doppler current profilers) are distinguished by having very high output frequencies (>180 kHz) and generally short duration signals and highly directional beam patterns. Based on the frequency band of transmissions relative to the functional hearing capabilities of marine species, they are not expected to have any negative effect on marine life. They are thus not considered explicitly in the qualitative assessment below (or in the quantitative analysis conducted in Section 6.2). Additionally, passive listening sensors which are sometimes described as elements of fisheries acoustic systems that exist on many oceanographic research vessels have no potential impact on marine life because they are remotely and passively detecting sound rather than producing it.

These sources are determined to have essentially no probability of being detected by or resulting in any potential adverse impacts on marine species. This conclusion is based on the relative output frequencies (> 180 kHz) and the fact that this is above the known hearing capabilities of any marine species (as described above). Sounds that are above the functional hearing range of marine animals may be audible if sufficiently loud (e.g., see Møhl, 1968). However, the relative output levels of these sources and the levels that would likely be required for animals to detect them would be on the order of a few meters. The probability for injury or disturbance from these sources is essentially zero. In fact, NOAA does not regulate or require take assessments for acoustic sources with source frequencies at or above 180 kHz because they are above the functional hearing range of any known marine animal (including high frequency odontocete cetaceans, such as harbor porpoises; Deng et al. 2014, Hastie et al. 2014).

Category 2 Active Acoustic Sources

These acoustic sources, which are present on most SEFSC fishery research vessels, include a variety of single, dual, and multi-beam echosounders (many with a variety of modes), sources used to determine the orientation of trawl nets, and several current profilers with slightly lower output frequencies than category 1 sources. Category 2 active acoustic sources have moderate to very high output frequencies (10 to 180 kHz), generally short ping durations, and are typically focused (highly directional) to serve their intended purpose of mapping specific objects, depths, or environmental features. A number of these sources, particularly those with relatively lower sound frequencies coupled with higher output levels can be operated in different output modes (e.g., energy can be distributed among multiple output beams) that may lessen the likelihood of perception by and potential impact on marine life.

Category 2 active acoustic sources are likely to be audible to some marine mammal species. Among the marine mammals, most of these sources are unlikely to be audible to whales and most pinnipeds, whereas they may be detected by odontocete cetaceans (and particularly high frequency specialists such as harbor porpoise). There is relatively little direct information about behavioral responses of marine mammals,

including the odontocete cetaceans, but the responses that have been measured in a variety of species to audible sounds (see Nowacek et al. 2007, Southall et al. 2007 for reviews) suggest that the most likely behavioral responses (if any) would be short-term avoidance behavior of the active acoustic sources.

The potential for direct physical injury from these types of active sources is low, but there is a low probability of temporary changes in hearing (masking and even temporary threshold shift) from some of the more intense sources in this category. Recent measurements by Finneran and Schlundt (2010) of TTS in mid-frequency cetaceans from high frequency sound stimuli indicate a higher probability of TTS in marine mammals for sounds within their region of best sensitivity; the TTS onset values estimated by Southall et al. (2007) were calculated with values available at that time and were from lower frequency sources. Thus, there is a potential for TTS from some of the category 2 active sources, particularly for mid- and high-frequency cetaceans. However, even given the more recent data, animals would have to be either very close (few hundreds of meters) and remain near sources for many repeated pings to receive overall exposures sufficient to cause TTS onset (Lucke et al. 2009, Finneran and Schlundt 2010). If behavioral responses typically include the temporary avoidance that might be expected (see above), the potential for auditory effects considered physiological damage (injury) is considered extremely low so as to be negligible in relation to realistic operations of these devices.

7.2.4 Acoustic Summary

Based on current scientific understanding and knowledge of the kinds of sources used in field operations, many of the high frequency, directional, and transient active acoustic sources used in SEFSC fisheries research operations are unlikely to be audible to and thus have no adverse impacts on most marine mammals. Sources operating at lower output frequencies, higher output levels, more continuous types of operation and with less directed acoustic energy are more likely to be audible to and affect more marine species.

Among the marine mammals, the whales and pinnipeds are the least likely to detect and be affected by these sounds. The most likely taxa to hear and react would be the odontocete cetaceans (and especially the high frequency specialized and relatively behaviorally sensitive harbor porpoises), who have specialized echolocation systems and associated high frequency hearing and excellent temporal processing of short-duration signals. The current NMFS acoustic step-function threshold of (160 dB RMS received level, irrespective of sound frequency,) is applied in the quantitative assessment in Section 6.2 because this is the current requirement. However, for many marine mammal species with reduced functional hearing at the higher frequencies produced by category 2 active sources (e.g., 40-180 kHz), based purely on their auditory abilities, the potential impacts are likely much less (or non-existent) than might be calculated in the quantitative assessment since these relevant factors are not taken into account.

For species that can detect sounds associated with high frequency active sources, based on the limited observational and experimental data on these and similar sound sources, the most likely impacts would be localized and temporary behavioral avoidance. These kinds of reactions, depending on their relative duration and severity, have been considered relatively low to moderately significant behavioral responses in the severity scaling assessment for marine mammals by Southall et al. (2007).

There is a low probability of some temporary hearing impacts and an even lower probability of direct physical harm for odontocete cetaceans to the loudest kinds of these high frequency sources over very localized areas (tens of meters) around the source. However, recent analysis of a mass stranding of 100 typically oceanic melon-headed whales (*Peponocephala electra*) in a shallow estuarine area in Madagascar in 2008 implicate a mapping survey using a high-powered 12 kHz multi-beam echosounder (MBES) as a likely trigger for this event. Although the cause is equivocal and other environmental, social, or anthropogenic factors may have facilitated the strandings, the authors determined the MBES the most plausible factor initiating the stranding response, suggesting that avoidance behavior may have led the pelagic whales into shallow, unfamiliar waters (Southall et al. 2013).

As a general conclusion, while some of the active acoustic sources used in SEFSC active acoustics during fisheries research surveys are likely to be detected by some marine species (particularly phocid pinnipeds and odontocete cetaceans), the potential for direct injury or hearing impairment is extremely low and the most likely responses involve temporary avoidance behavior. Consequently, and in a manner consistent with the current NMFS acoustic guidelines for defining level B takes of marine mammals from impulse noise sources, a quantitative framework was developed (Section 6.2) for assessing the potential impacts of SEFSC active acoustic sources used in fisheries research.

7.3 Surveys Conducted by the SEFSC that may Take Marine Mammals by Level B Harassment using Category 2 Acoustic Sources

Current NMFS practice regarding exposure of marine mammals to sound is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB RMS or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 160 dB RMS or impulse sounds (e.g., impact pile driving) and 120 dB RMS for continuous noise (e.g., vibratory pile driving), but below injurious thresholds. For airborne noise, pinniped disturbance from haul-outs has been documented at 100 dB for pinnipeds in general, and at 90 dB for harbor seals. NMFS uses these levels as guidelines to estimate when harassment may occur.

Level B harassment take associated with use of active acoustics equipment may occur in SEFSC fisheries surveys as described in Section 1.6 and Table 1-1. As determined in Section 6.2, the level of requested Level B acoustic harassment taking is listed in Table 6-10. The SEFSC believes that these activities will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival).

7.4 Vessel Strikes

Collisions with vessels, or ship strikes, threaten numerous marine animals and are of great concern for endangered large whales, particularly right whales. Ship strikes with marine mammals can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Knowlton and Kraus 2001). Large whales, such as fin whales, are occasionally found draped across the bulbous bow of large ships upon arriving in port. Massive propeller wounds can be immediately fatal. If more superficial, the whales may survive the collisions (Silber et al. 2009). Jensen and Silber (2003) summarized large whale ship strikes world-wide from 1975 to 2003 and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (3%), and one collision (0.75%) was reported for a research boat, pilot boat, whale catcher boat, and dredge boat.

In an analysis of the probability of lethal mortality of large whales at a given speed, results of a study using a logistic regression model showed that the greatest rate of change in the probability of a lethal injury to a large whale, as a function of vessel speed, occurs between vessel speeds of 8.6 and 15 knots (Vanderlaan and Taggart, 2007). Across this speed range, they found that the chances of a lethal injury decline from approximately 80% at 15 knots to approximately 20% at 8.6 knots. Notably, it is only at speeds below 11.8 knots that the chances of lethal injury drop below 50% and above 15 knots the chances asymptotically increase toward 100%.

Injuries and death to marine mammals resulting from ship collisions caused by vessels during SEFSC fisheries research are not likely to occur given the slow research vessel speeds. However, one Atlantic spotted dolphin calf was killed by the prop of the ship during SEFSC research in 2011 after a group of Atlantic spotted dolphins were riding the bow of the ship. This occurred in the Western North Atlantic Stock in the South Atlantic Research Area. However, no such future take is requested by this application as it is assumed that this was a very rare occurrence that is very unlikely occur in the next five years.

Therefore the SEFSC has concluded the probability of vessel and marine mammal interactions occurring during SEFSC operations is negligible due to the vessel's slow operational speed, which is typically four knots or less during sampling and average about 10 knots while in transit, which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist et al. 2001).

Even though the likelihood of a ship strike is very small, we reviewed the available literature to assess the possible impact of ship strike as it applies to SEFSC survey vessels. Williams and O'Hara (2009) summarized their modeling efforts to characterize ship strikes of large cetaceans in British Columbia. Their information on ship strikes was based on ship activity provided to them by the Canadian Coast Guard. Spatially-explicit statistical modeling and Geographic Information System visualization techniques identified areas of overlap between shipping activity and waters used by humpback, fin and killer whales. Areas of highest risk were far removed from areas with high concentrations of people, suggesting that many beach-cast carcasses could go undetected. With few exceptions, high-risk areas were found in geographic bottlenecks, such as narrow straits and passageways. Although not included in the geographic area of the Williams and O'Hara study, the SEFSC survey area is such an area where large numbers of cargo ships transit the area each year, yet evidence for ship collisions are rare. Williams and O'Hara (2009) state that their risk assessments illustrate where ship strikes are most likely to occur, but cannot estimate how many strikes might occur. Propeller wounds on live killer whales were common in their study region, and fatal collisions have been reported in B.C. for all three species

Ship strikes are a major cause of mortality and serious injury in right whales, accounting for 35 percent of deaths from 1970-1999 (Knowlton and Kraus 2001). Average annual reported mortality and serious injury from ship strikes, 2009-2013, was 0.9 right whales (Waring et al. 2015b). Ship strikes occur more frequently with humpbacks (1.6/year, 2009-2013) and fin whales (1.8/year, 2009-2013) (Waring et al. 2015b).

Several mitigation measures, to which NOAA vessels adhere, were implemented to minimize the risk of vessel collisions with right whales. Other species also benefit. The compliance guide for the right whale ship strike reduction rule (NMFS 2008) states that all vessels 19.8 m in overall length or greater must slow to speeds of 10 knots or less in seasonal management areas. When SEFSC vessels are operating in right whale SMAs, DMAs, or at times and locations when whales are otherwise known to be present, they operate at speeds no greater than 10 knots.

SEFSC vessel captains and bridge crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them, but there are no dedicated Marine Mammal Observers (MMOs) aboard the vessels.

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the SEFSC. That, combined with adherence to the above mentioned mitigation measures, indicate that vessel collisions are possible, but unlikely to occur, and anticipated impacts to most species would be negligible to minor. The exception to this determination is right whales. Although it is highly unlikely that a SEFSC fisheries research vessel would strike a right whale, doing so, especially if fatal, would be considered a substantial impact for this small population of endangered whales and would result in the re-initiation of ESA section 7 consultation.

7.5 Conclusions Regarding Impacts of SEFSC Fisheries Research Activities on Marine Mammal Species and Stocks

As outlined in this and previous sections, there are several SEFSC fisheries research activities that have the potential to cause Level B harassment, Level A injury, and serious injury or mortality of marine mammals in the ARA, GOMRA, and CRA. However, because of the low level of historical interactions relative to the abundance of affected populations, as well as the low level of predicted future takes

associated with SEFSC surveys, the SEFSC believes its activities will not affect annual rates of recruitment or survival or the health and condition of the species or stock of the requested species.

- As discussed earlier in this Section, the requested annual takes associated with entanglement or hooking in SEFSC fisheries research surveys over the five-year authorization period would be only a small fraction of stock's PBR.
- For those stocks where the requested take may exceed 10% of PBR, the SEFSC believes estimates of the requested take numbers are largely overestimates of the likely eventual take due to restricted nature of research, the lack of historic research taking, implementation of migitation and avoidance measures, and likely minimal estimates of some population stock sizes due to a lack of the necessary marine mammal research surveys. As a result the requested levels of take are anticipated to be precautionary and are expected to range from minor to moderate in intensity.
- SEFSC surveys use a variety of active acoustic systems in the ARA, GOMRA, and CRA. These are expected to result in Level B harassment for marine mammals in close proximity to the survey vessel and its active acoustic systems. However, exposure to active acoustics used on SEFSC fisheries research surveys is not expected to result in injury to animals and behavioral disturbance is expected to be temporary and not result in population level impacts.

Based on this information the SEFSC believes that its activities will have a minimal impact on the affected species or stocks of marine mammals based on the likelihood that the activities will not affect annual rates of recruitment or survival.

8.0 ANTICIPATED IMPACT OF THE ACTIVITY ON THE AVAILABILITY OF THE SPECIES OR STOCKS OF MARINE MAMMALS FOR SUBSISTENCE USES

Potential impacts resulting from the proposed action would be limited to individuals of marine mammal species located off the East Coast of the U.S., and would not affect Arctic marine mammals that are harvested for subsistence use. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action as identified in MMPA Section 101(a)(5)(A)(i).

9.0 ANTICIPATED IMPACT OF THE ACTIVITY UPON THE HABITAT OF THE MARINE MAMMAL POPULATIONS, AND THE LIKELIHOOD OF RESTORATION OF THE AFFECTED HABITAT

The fisheries research activities conducted by the SEFSC take place primarily in the Southeast Continental Shelf LME, the southern portion of the NE LME, the Gulf of Mexico, and Puerto Rico/Virgin Islands. The proposed activities will not result in any permanent impact on habitats used by marine mammals or to the food resources that they utilize and thus will not affect marine mammal stocks, populations or species within the SEFSC survey areas. Modifications to the water column are expected to be short-term in nature while modifications to the sea floor from bottom-contact sampling gear (e.g., bottom trawls) may be longer-term. Expected modifications to the sea floor due to SEFSC fisheries research activites are minor relative to current and projected future levels of commercial fisheries activity. The levels of removals of finfish and invertebrates relative to overall population sizes was evaluated in the DPEA supporting this LOA application and found to be minor for all common prey items of marine mammals. Potential impacts to marine mammal habitat are not anticipated to alter the function of the habitat and, therefore, will have little to no impact on marine mammal stocks or species.

9.1 Changes in Food Availability

SEFSC fisheries research removals of species commonly utilized by marine mammals are relatively low. Prey of right whales, sei whales, and fin whales are primarily zooplankton, which are sampled in very small quantities by SEFSC fisheries research, so the likelihood of research activities changing prey availability is low and impact negligible to none. There is some overlap in prey of baleen whales, odontocetes, and pinnipeds with finfish and shrimp. The removal by SEFSC fisheries research, regardless of season and location is, however, minor relative to that taken through commercial fisheries and is an even smaller percentage of biomass available (see DPEA Sections 4.2.3 and 4.2.7). Impacts of prey removal may be further reduced by spatial dispersion, since the stratification of the bottom trawl surveys disperses catch over the entire shelf, whereas marine mammals may concentrate feeding in localized areas. SEFSC fisheries research catch levels are unlikely to affect changes in prey type or quantity available to any marine mammals. The resulting impact of the catch level on prey resources would, therefore, be negligible.

Protecting marine ecosystems and accounting for predator consumption are considered when determining Annual Catch Limits and Optimum Yield of commercially harvested fish species. This is particularly relevant for forage fish, such as herring, that are important prey for several marine mammal species. Beginning in around 2008, marine mammal consumption became a specific Term of Reference for all fish stock assessments conducted by the SEFSC.

9.2 Physical Damage to Benthic (Seafloor) Habitat

The potential effects of SEFSC fishery research activities on the physical environment vary depending on the survey gear and other equipment used but generally includes:

- Physical damage to benthic (seafloor) habitat
- Biological damage to infauna and epifauna
- Alteration of the turbidity and geochemistry of the water column.

Fishing gear that contacts the seafloor can alter and/or physically damage seafloor habitat. Physical damage includes furrowing and smoothing of the seafloor as well as the displacement of rocks and boulders as fishing gear is towed across the bottom (Morgan and Chuenpagdee 2003). Physical damage to the seafloor can increase with multiple tows in the same area (Stevenson et al. 2004).

The impacts are primarily caused by bottom trawling and dredging equipment as it comes in contact with the seafloor (Morgan and Chuenpagdee 2003). Bottom contact fishing gear used in SEFSC fishery research activities and funded fishery research activities include several types of shrimp trawls (otter, western jib, mongoose, Falcon), high-opening bottom trawls, flat net bottom trawls, and oyster dredges (see Table 1-1 and Appendix A). Other fishing gear that contacts the seafloor, such as bottom longline, pots, and traps, can cause physical damage but the impacts are localized and minimal as these types of gear are generally not dragged along the bottom.

In general, physical damage to the seafloor recovers within 1.5 years through water currents and natural sedimentation with the exception of rocks and boulders which may be permanently displaced (Stevenson et al. 2004). The majority of the seafloor in the northwestern North Atlantic and Gulf of Mexico is made of a number of sediment types including silt, sand, clay, gravel and boulders. Therefore any physical damage caused by SEFSC surveys and funded fishery research activities would be expected to recover within 1.5 years.

The geographical area directly affected by SEFSC and research partner bottom-contact gear averages about 17.5 square miles per year in the ARA and 122 square miles per year in the GOMRA. The area affected by research each year is much less than 0.1 percent of the total area involved in survey efforts (see DPEA, Section 4.2.1). Given the small magnitude of area affected by research and the short-term nature of physical damage effects, these impacts are considered minor or negligible to marine mammal habitat.

9.3 Physical Damage to Infauna and Epifauna

Infauna are animals that live in the seafloor or within structures that are on the seafloor. Infauna usually construct tubes or burrows and are commonly found in deeper and subtidal waters. Clams, tubeworms, and burrowing crabs are infaunal animals. Epifauna live on the surface of the seafloor or on structures on the seafloor such as rocks, pilings, or vegetation. Epifauna may attach themselves to such surfaces or range freely over them, as by crawling or swimming. Mussels, crabs, starfish, and flounder are epifaunal animals. Fishing gear that contact the seafloor can disturb infauna and epifauna by crushing them, burying them or exposing them to predators (Morgan and Chuenpagdee 2003). The level of biological damage to infauna and epifauna can vary from very minimal to more severe particularly with repeated disturbance in the same areas (Stevenson et al. 2004).

The recovery time for damage to infauna and epifauna varies based on the type of fishing gear used, the type of seafloor surface (i.e., mud, sand, gravel, mixed substrate), and the level of repeated disturbances. In general, biological damage from a single disturbance is 1-18 months, and up to 3 years from repeated disturbances (Stevenson et al. 2004). Because research surveys are conducted in the same areas but not in the exact same locations they are expected to cause single rather than repeated disturbances in any one area. Therefore any physical damage caused by SEFSC surveys and funded fishery research activities would be expected to recover within 1-18 months. Given the small magnitude of area affected by research and the short-term nature of physical damage effects, these impacts are considered minor or negligible to marine mammal habitat.

9.4 Alteration of the Turbidity and Geochemistry of the Water Column

Fishing gear that contacts the seafloor can increase the turbidity of the water by the suspension of fine sediments and benthic algae. Suspension of fine sediments and turnover of sediment can also alter the geochemistry of the seafloor and the water column (Stevenson et al. 2004).

The impacts of alteration of turbidity and geochemistry in the water column are not very well understood (Stevenson et al. 2004). However, these types of effects from fisheries research activities would be periodic, temporary, and localized and are therefore considered negligible to marine mammal habitat.

10.0 ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF THE HABITAT ON MARINE MAMMAL POPULATIONS INVOLVED

Critical habitat has been established for one species listed under the ESA addressed by this application: the North Atlantic right whale. No critical habitat has been designated for any of the stocks of listed blue, fin, sei, humpback, or sperm whales within the regions of SEFSC fisheries research. The evaluation of the effects of the actions requested by this application to listed species and their critical habitat will be the subject of a separate Biological Opinion under section 7 of the ESA conducted by the Southeast Regional Office Protected Resources Division.

As stated in response to Question 9 above, the proposed activities are not anticipated to result in impacts to marine mammal habitats or to the food resources on which they depend. Modifications to the water column are expected to be short-term in nature while modifications to the sea floor from actively sampling gear (bottom trawls, longlines, gillnets) may be longer-term. Expected modifications to the sea floor are insignificant relative to the current and projected future levels of commercial fishing activity. The levels of removals of finfish and invertebrates relative to overall population sizes was evaluated through the supporting DPEA and found to be minor for all common prey items of marine mammals. Potential impacts to marine mammal habitat are not anticipated to alter the function of the habitat and, therefore, will have little to no impact on marine mammal species.

11.0 THE AVAILABILITY AND FEASIBILITY (ECONOMIC AND TECHNOLOGICAL) OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING SUCH ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACT UPON THE AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON THEIR AVAILABILITY FOR SUBSISTENCE USES, PAYING PARTICULAR ATTENTION TO ROOKERIES, MATING GROUNDS, AND AREAS OF SIMILAR SIGNIFICANCE

The following suite of mitigation measures will be employed by the SEFSC and its cooperating research partners during fisheries and ecosystem research. These procedures are the same whether the survey is conducted on board a NOAA vessel, vessel chartered by NOAA, or partner survey vessels. The procedures described are based on protocols used during previous research surveys and/or best practices developed for commercial fisheries using similar gear. The SEFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its on-going survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to marine mammals but any such measures must also pass safety considerations and allow survey results to remain consistent with previous data sets. Additional mitigation measures may be considered and developed further and may be implemented by the SEFSC during the five-year life of the permit.

11.1 Vessel Strike Avoidance

SEFSC-affiliated research vessels (NOAA vessels, NOAA chartered vessels, and research partner vessels) operating in the Atlantic adhere to several mitigation measures which were implemented to minimize the risk of vessel collisions with North Atlantic right whales. Other species also benefit from these measures. The compliance guide for the right whale ship strike reduction rule (NMFS 2008) states that all vessels 65 feet in overall length or greater must slow to speeds of 10 knots or less in Seasonal Management Areas (SMAs). The Southeast U.S. SMA for right whale calving and nursery grounds ranges from southern Georgia to northern Florida in an area bounded to the north by latitude 31°27’N and by 29°45’N to the south and east to 80°51’36”W from November 15 through April 15. Mid-Atlantic SMAs include several port or bay entrances from northern Georgia to Rhode Island between November 1 and April 30. Dynamic Management Areas (DMAs) are temporary areas created around right whale sightings, the size of which depends on the number of whales sighted. Voluntary speed reductions may apply when no SMA is in effect.

When research vessels are actively sampling, cruise speeds are typically less than five knots, a speed at which the probability of collision and serious injury or mortality of large whales is low. When transiting between sampling stations, research vessels can travel at speeds of up to 14 knots but average 10 knots. However, when SEFSC vessels are operating in right whale SMAs, DMAs, or at times and locations when whales are otherwise known to be present, they operate at speeds no greater than 10 knots. In addition, SEFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. There are currently no Marine Mammal Observers (MMOs) aboard the vessels dedicated to watching for marine mammals to minimize the risk of collisions, although the large NOAA vessels (e.g., NOAA Ship *Pisces*) operated by the NOAA Office of Marine and Aviation Operations (OMAO) include one bridge crew dedicated to watching for obstacles at all times, including marine mammals. At any time during a survey or in transit, any bridge personnel that sights marine mammals that may intersect with the vessel course immediately communicates their presence to the helm for appropriate course alteration or speed reduction as soon as possible to avoid incidental collisions, particularly with large whales (e.g., North Atlantic right whales).

The Right Whale Early Warning System is a multi-agency effort that includes the SEFSC, the Florida Fish and Wildlife Conservation Commission (FWC), U.S. Coast Guard, U.S. Navy, and volunteer

observers. Sightings of the critically endangered North Atlantic right whale are reported from aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources (U.S. Coast Guard, commercial ships, fishing vessels, and the general public). Whale sightings are reported in real time to the Right Whale Early Warning System network and information is disseminated to mariners within a half hour of a sighting. The program was designed to reduce collisions between ships and North Atlantic right whales by alerting mariners to the presence of the whales in near real time. All NOAA research vessels operating in North Atlantic right whale habitat participate in the Right Whale Early Warning System.

11.2 Take Reduction Plans

Incidental take of marine mammals in commercial fisheries has been and continues to be a serious issue in the Southeast region. In compliance with section 118 of the MMPA, NMFS has developed and implemented several Take Reduction Plans (TRP) to reduce serious injuries and mortality of strategic marine mammal stocks that interact with certain commercial fisheries. Strategic stocks are those species listed as threatened or endangered under the ESA, those species listed as depleted under the MMPA, and those species with human-caused mortality that exceeds the Potential Biological Removal (PBR) for the species. The immediate goal of TRPs is to reduce serious injury and mortality for each species below PBR within six months of the TRP's implementation. The long-term goal is to reduce incidental serious injury and mortality of marine mammals from commercial fishing operations to insignificant levels approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans. All SEFSC and partner surveys adhere to the relevant TRP requirements that are applicable to our research. Due to substantial differences between SEFSC research fishing practices (smaller gear size, spacial and temporal differences) and differences between scientific survey methodologies versus commercial fishing practices, the majority of SEFSC and partner scientific surveys fall below the requirements necessary to implement TRP regulations. Only the SEFSC MARMAP/SEAMAP-SA Reef Fish Survey (SCDNR) and SEFIS (SEFSC) surveys meet the requirements necessary to implement TRP regulations; both surveys abide by all the Atlantic Large Whale Take Reduction Plan (ALWTRP) requirements. If new surveys are added in the future, the SEFSC fisheries research programs would comply with the gear requirements and operational limits consistent with the TRPs.

The ALWTRP was developed to reduce serious injury and mortality of North Atlantic right, humpback, fin, and minke whales from Northeast/Mid-Atlantic lobster trap/pot, Atlantic blue crab trap/pot, Atlantic mixed species trap/pot, Northeast sink gillnet, Northeast anchored float gillnet, Northeast drift gillnet, Mid-Atlantic gillnet fishery, Southeastern U.S. Atlantic shark gillnet, and Southeastern Atlantic gillnet fisheries (NMFS 2010c). A final rule was published in 1999 (64 FR 7529) and numerous amendments and revisions have been made since. The ALWTRP is continually evolving as more is learned about why whales become entangled and how fishing practices can be modified to reduce entanglement risks (NMFS 2013). The most recent revisions were finalized in May 2015 (80 FR 30367). Gear requirements vary by geographic area and date. Universal gear modification requirements and restrictions apply to all traps/pots and anchored gillnets, including: no floating buoy line at the surface; no wet storage of gear (all gear must be hauled out of the water at least once every 30 days); fishermen are encouraged, but not required, to maintain knot-free buoy lines; and all groundlines must be made of sinking line. Additional gear modification requirements and restrictions vary by location, date, and gear type. Additional requirements may include the use of weak links, and gear marking and configuration specifications. Detailed requirements may be found in the regional guides to gillnet and pot/trap gear fisheries available at http://www.nero.noaa.gov/Protected/whaletrp/.

The intent of the Bottlenose Dolphin Take Reduction Plan (BDTRP) is to reduce serious injuries and mortalities of coastal bottlenose dolphins incidental to 13 Cateogy I and II commercial fisheries, including gillnets, crab trap/pots, haul/beach seines, pound nets, stop net, and purse seine gear (50 CFR 229.35). The following general requirements were implemented: spatial/temporal gillnet restrictions, gear

proximity (fishermen must stay within a set distance of gear), gear modifications for gillnets and Virginia pound nets, non-regulatory gear modifications for crab pots, and other non-regulatory conservation measures (71 FR 24776, April 26, 2006; 77 FR 45268, July 31, 2012; and 80 FR 6925, February 9, 2015). Currently, the SEFSC and research partners do not have any surveys that meet the requirements necessary to implement BDTRP regulations.

The Pelagic Longline Take Reduction Plan (PLTRP) addresses incidental serious injury and mortality of long-finned and short-finned pilot whales and Risso's dolphins in commercial pelagic longline fishing gear in the Atlantic. Regulatory measures include limiting mainline length to 20 nautical miles or less within the Mid-Atlantic Bight (MAB) and posting an informational placard on careful handling and release of marine mammals in the wheelhouse and on working decks of the vessel (NMFS 2009). Currently, the SEFSC uses gear that is only 5 nautical miles long and per PLTRP, uses the Pelagic Longline Marine Mammal Handling and Release Guidelines for any pelagic longline sets made within the Atlantic EEZ.

11.3 Mitigation Measures for Marine Mammals during Research with Bottom Trawl Gear

The SEFSC and research partners use a variety of bottom trawl gears for different research purposes and These trawl types include various shrimp trawls (otter, western jib, mongoose, Falcon), high-opening bottom trawls, and flat net bottom trawls (see Table 1-1 and Appendix A). All research activities conducted with these trawl gears follow the protocols described below. The SEFSC and its research partners also use modified beam trawls and benthic trawls pulled by hand that are not considered to pose a risk to marine mammals due to their small size and very short tow durations (see Section 11.9).

11.3.1 Monitoring Methods

Prior to arrival on station, during operations, and during retrieval, the officer, crew members, and scientific party on watch visually scan for marine mammals (and other protected species) during all daytime operations. Binoculars are used as necessary to survey the area while approaching and upon arrival at the station, during visual and sonar reconnaissance of the trawl line to look for potential hazards (e.g., commercial fishing gear, unsuitable bottom for trawling, etc.), while the gear is deployed, and during haulback. If possible, trawl sampling is conducted prior to any other sampling (e.g., water quality, environmental parameters). However, some survey protocols require environmental data to be collected prior to deployment of the trawl. When that is the case, scientists and crew operating the CTD are also scanning the peripheral sampling area around the vessel for the presence of marine mammals. Monitoring occurs for approximately 15 minutes during the CTD cast. Once the CTD is complete, the trawl is deployed. If marine mammals are sighted prior to setting the trawl gear or at any time the gear is in the water, the bridge crew and Scientific Watch Leader (SWL) are alerted immediately. Environmental conditions (lighting, sea state, precipitation, fog, etc.) often limit the distance for effective visual monitoring of marine mammals.

11.3.2 Operational Procedures

"Move-on" Rule. If marine mammals (or other protected species) are sighted around the vessel before gear deployment, gear is not deployed unless those animals do not appear to be in danger of interactions with the gear (e.g., moving away from deployment site), as determined by the judgment of the Field Party Chief (FPC) or SWL. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. The

FPC or SWL may also elect to stay at the station site and monitor the area to see if the marine mammals leave the site. This decision is made at the FPC or SWL disgression and often depends on the number of marine mammals present, distance to the next station, and environmental conditions.

If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations only when these species have not been sighted within 15 minutes or otherwise determined to no longer be at risk. This decision is at the discretion of the FPC or SWL and is dependent on the situation.

Once the trawl net is in the water, if marine mammals are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the FPC or SWL in consultation with the officer on watch. These judgments take into consideration the species, numbers, and behavior of the animals, the location of animals relative to the gear,the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. In some situations, risk of adverse interactions may be diminished by continuing to trawl with the net at depth until the marine mammals have left the area before beginning haul-back operations. In other situations, swift retrieval of the net may be the best course of action. The appropriate course of action to minimize the risk of incidental take of marine mammals is determined by the professional judgment of the FPC or SWL based on all situational variables, even if the choices compromise the value of the data collected at the station.

Care is taken when emptying the trawl, including opening the cod end as close as possible to the deck of the checker (or sorting table) in order to avoid damage to marine mammals that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not marine mammals are present.

11.3.3 Tow Duration

In 2008, standard tow durations for bottom trawl surveys (Table 1-1) were reduced from 55 minutes to 30 minutes or less at targeted depth, excluding deployment and retrieval time. These short tow durations decrease the opportunity for curious marine mammals to find the vessel and investigate. Tow times are less than the 55 minute tow time restriction required for commercial shrimp trawlers not using turtle excluder devices (TEDs) (50 CFR 223.206). The resulting tow distances are typically one to two nautical miles or less, depending on the survey and trawl speed.

11.4 Mitigation Measures for Protected Species during SEFSC Conservation Engineering Trawl Research

Conservation engineering research conducted by the SEFSC is primarily carried out by the Harvesting Systems Unit at Mississippi Labs in Pascagoula, Mississippi. Independent research is conducted aboard NOAA small vessels, contracted state vessels, or contracted commercial vessels. The primary focus of the research is the development of sea turtle and finfish bycatch mitigation measures for commercial trawl fisheries. The majority of the work focuses on shrimp trawls with a variety of trawl designs used to conduct this research. This research is covered under a Section 10(a)(1)(A) permit for sea turtles; incidental captures are authorized for smalltooth sawfish (three over the five-year permit period) and Atlantic sturgeon (four per year).

11.4.1 Monitoring Methods

Conservation engineering trawl research surveys occur on small vessels with a limited number of scientists and crew. Before the net is set, while the net is being deployed, during the soak, and during haulback the scientists and crew monitor the waters around the vessel and maintain a lookout for marine mammals, sea turtles and other protected species.

11.4.2 Operational Procedures

"Move-on" Rule. If marine mammals are sighted around the vessel before gear deployment, gear is not deployed unless those animals do not appear to be in danger of interactions with the gear, as determined by the judgment of the FPC or SWL. The vessel may be moved or gear deployment may be delayed until the animals no longer appear to be at risk of interaction with the gear.

If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations only when they have not been recently sighted or otherwise determined to no longer be at risk. This decision is at the discretion of the FPC or SWL and is dependent on the situation.

Once the trawl net is in the water, if marine mammals are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the FPC or SWL in consultation with the vessel operator. These judgments take into consideration the species, numbers, and behavior of the animals, the location of animals relative to the gear, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. In some situations, risk of adverse interactions may be diminished by continuing to trawl with the net at depth until the marine mammals have left the area before beginning haul-back operations. In other situations, swift retrieval of the net may be the best course of action. The appropriate course of action to minimize the risk of incidental take of marine mammals is determined by the professional judgment of the FPC or SWL based on all situational variables, even if the choices compromise the value of the data collected at the station.

Care is taken when emptying the trawl, including opening the cod end as close as possible to the deck of the checker (or sorting table) in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not marine mammals are present.

11.4.3 Tow Duration

Trawl projects designed to test bycatch reduction devices (BRDs) and TEDs for commercial fishing gear may have longer tow times (up to four hours). These exceptions to the short tow duration protocols are necessary to meet research objectives. TEDs are used in nets that are towed in excess of 55 minutes as required by 50 CFR 223.206. When research objectives prevent the installation of TEDs in all trawls used, tows will be no longer than 30 minutes unless specific fisheries regulations exist requiring tow time limits in lieu of TEDs. In these cases, tow time limits will match those set by regulations such as the skimmer trawl fishery which has a 55 min tow time limit.

11.4.4 Turtle Excluder Devices

SEFSC BRD Evaluations and SEFSC-SA TED Evaluations install TEDs in each trawl to mitigate for sea turtle interactions and any potential sturgeon or sawfish interactions.

SEFSC-GOM TED Evaluations and SEFSC Skimmer Trawl TED Testing use TEDs in one net and have 55 minute tow times. The SEFSC Small Turtle TED Testing and Gear Evaluations either use TEDs or leave the tailbag untied so that captured animals are able to escape.

11.4.5 Live Feed Video/Sonar Trawl Monitoring

In some cases live feed video or sonar monitoring of the trawl is used in lieu of tow time limits. This mitigation measure is also used in addition to TEDs during some projects. Video or sonar feeds are monitored for the duration of the tow. If a TED is not installed in the trawl and a protected species is observed in the trawl then the tow is immediately terminated. If a TED is installed and a protected species (excluding marine mammals) is observed in the trawl then the individual is monitored for exclusion from the trawl through the TED. If the species observed is a marine mammal or the individual has trouble

escaping through the TED opening, or the individual is lost from the video or sonar feed then the tow is immediately terminated.

11.4.6 Diver Monitored Trawls

During diver assisted gear evaluations (SEFSC Small Turtle TED Testing and Gear Evaluations), dive teams are deployed on the trawls while they are being towed. During this research, divers actively monitor the gear for protected species interactions and use emergency signal floats to notify the vessel if an interaction occurs. When the signal float is deployed the vessel terminates the tow and slows the gear down to a minimal forward speed of less than 0.5 knots, which allows divers to assist the protected species escape.

11.4.7 Skimmer Trawls

The SEFSC began using skimmer trawls in their TED testing in 2012. Skimmer trawls differ from most other trawls in that vessels push nets in shallow, nearshore waters as opposed to otter trawls that pull the nets and are not as limited by water depth. A skimmer trawl consists of an L-shaped frame constructed from metal pipe, which keeps the trawl mouth open. Skimmer frames keep the net on the bottom but are flexible to glide over obstacles. Skimmer trawls are fished from booms on either side of the vessel. Nets remain in the water in the fishing configuration while the codend is emptied; allowing fishers to more quickly retrieve the catch. Interactions with bottlenose dolphins in 2013 and 2014 resulted in additional mitigation measures required for skimmer trawls.

- Additional mitigation measures are implemented to reduce bottlenose dolphin takes for TED testing in skimmer trawls (Permit No. 16253-01; modified in October 2014).
- Trawling must not be initiated when marine mammals, except dolphins or porpoises, are observed within the vicinity of the research, and the marine mammals must be allowed to either leave or pass through the area safely before trawling is initiated.
- Researchers must make every effort to prevent interactions with marine mammals. Researchers must be aware of the presence and location of these animals at all times as they conduct trawling activities.
- During skimmer trawl surveys, a minimum of two staff, one on each side (port/starboard) of the vessel, must inspect the gear every five minutes to monitor for the presence of marine mammals.
- Prior to retrieving the skimmer trawl tail bags, the vessel must be slowed from the active towing speed to 0.5-1.0 knots.
- If a marine mammal enters the net, becomes entangled or dies, researchers must:
    - Stop trawling activities and immediately free the animal
    - Notify the appropriate NMFS Regional Stranding Coordinator as soon as possible
    - Report the incident as specified in Condition E.2.
    - Permitted skimmer trawling activities will be suspended until the Permits Division has granted approval to continue research per Condition E.2.

11.5 Mitigation Measures for Marine Mammals during Research with Oceanic Deep-water Trawl Gear (500-800 m deep)

11.5.1 Monitoring Methods

Additional mitigation measures are imposed on Oceanic Deep-water Trawl surveys due to the known potential for lethal interactions with mid-water trawl gear. Deep-water trawls also occur in oceanic waters where marine mammal species diversity is greatly increased. Oceanic species often travel in very large groups and are less likely to have prior encounters and experience with trawl gear than inshore bottlenose dolphins. Prior to arrival on station, during operations, and during retrieval, the officer, crew members, and scientific party on watch visually scan for marine mammals during all daytime trawling operations. Bridge binoculars are used as necessary to survey the area as far as environmental conditions (lighting, sea state, precipitation, fog, etc.) will allow. Additionally, at least 30 minutes prior to the planned start of putting the trawl net into the water, a scientist that is a trained marine mammal observer visually scans the waters surrounding the vessel for marine mammals. Designated crew also monitor for marine mammals while the gear is deployed. If marine mammals are sighted by the bridge or deck crew prior to or after setting the gear, the bridge crew and/or FPC aand SWL are alerted as soon as possible. Environmental conditions (lighting, sea state, precipitation, fog, etc.) often limit the distance for effective visual monitoring of marine mammals.

11.5.2 Operational Procedures

"Move-on" Rule. If marine mammals are sighted anywhere around the vessel (within two nautical miles) in the 30 minutes before gear deployment, gear is not deployed unless those animals do not appear to be in danger of interactions with the gear, as determined by the judgment of the FPC or SWL. The vessel may be moved or gear deployment may be delayed until the animals no longer appear to be at risk of interaction with the gear. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals are still visible from the vessel and appear to be at risk, the officer on watch may decide to move again or to skip the station. The officer on watch will consult with the FPC or SWL to determine the best strategy to avoid potential takes of these species. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in the previous 30 minutes unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the FPC or SWL in consultation with the officer on watch. The efficacy of the "move-on" rule is limited during night time or other periods of limited visibility; research gear is deployed as necessary when visibility is poor, although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval.

During oceanic deep-water trawl surveys, trawl operations are usually the first activity undertaken upon arrival at a new station in order to reduce the opportunity to attract marine mammals and other marine mammals to the vessel. The order of gear deployment is determined on a case-by-case basis by the FPC or SWL based on environmental conditions and sonar information at the sampling site. Other activities, such as water sampling or plankton tows, are conducted in conjunction with, or upon completion of, trawl activities.

Once the trawl net is in the water, the officer on watch, FPC or SWL, and/or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammals as far away as environmental conditions allow (as noted previously, visibility can be limited for various reasons). If

these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the FPC or SWL, in consultation with the officer on watch. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Most marine mammals have been caught during haul-back operations, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. In some situations, risk of adverse interactions may be diminished by continuing to trawl with the net at depth until the marine mammals have left the area before beginning haul-back operations. In other situations, swift retrieval of the net may be the best course of action. The appropriate course of action to minimize the risk of incidental take of marine mammals is determined by the professional judgment of the FPC or SWL based on all situation variables, even if the choices compromise the value of the data collected at the station.

If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations (when practicable) only when these animalss have not been sighted within 30 minutes or are determined to no longer be at risk (e.g., moving away from deployment site). This decision is at the discretion of the FPC or SWL and is dependent on the situation.

Care is taken when emptying the trawl, including opening the cod end as close as possible to the deck of the checker (or sorting table) in order to avoid damage to marine mammals that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not marine mammals are present.

11.6 Mitigation Measures for Marine Mammals during Research with Bottom and Pelagic Longline Gear

11.6.1 Monitoring Methods

Prior to arrival on station, during operations, and during retrieval of the gear, the officer, crew members, and scientific party on watch visually scan for marine mammals during daytime operations. Binoculars are used as necessary to survey the area while approaching and upon arrival at the station, while the gear is deployed, and during haulback. Additional monitoring is conducted 15 minutes prior to setting the longline gear by members of the scientific crew that monitor from the back deck while baiting hooks. If marine mammals are sighted prior to setting the gear or at any time the gear is in the water, the bridge crew and SWL are alerted immediately. Environmental conditions (e.g., lighting, sea state, precipitation, fog, etc.) often limit the distance for effective visual monitoring of marine mammals. Additional monitoring, beginning 30 minutes prior to the arrival on station, occurs on pelagic longline surveys due to the known potential for leathal interactions with gear.

11.6.2 Operational Procedures

“Move-on” Rule. If marine mammals are sighted around the vessel before gear deployment, gear is not deployed unless those animals do not appear to be in danger of interactions with the gear, as determined by the judgment of the FPC or SWL. The vessel may be moved or gear deployment may be delayed until the animals no longer appear to be at risk of interaction with the gear. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. The FPC or SWL may also elect to stay at the station site and monitor the area to see if the marine mammals leave the site. This decision is made at the FPC or SWL

disgression and often depends on the number of marine mammals present, distance to the next station and environmental conditions.

If longline operations have been delayed because of the presence of marine mammals, the vessel resumes longline operations only when these species have not been sighted within 15 minutes or otherwise determined to no longer be at risk. This decision is at the discretion of the FPC or SWL and is dependent on the situation.

Longline gear is always the first equipment or fishing gear to be deployed when the vessel arrives on station. Longline gear is set immediately upon arrival at each station.

If marine mammals are detected during setting operations or while the gear is in the water and are considered to be at risk (e.g., moving towards deployment site, displaying behaviors of potential interacting with gear, etc.), the FPC or SWL in conjunction with the officer on watch exercise professional judgment and discretion to avoid incidental take of these species with longline gear as described for trawl gear. Halting the setting operations and retrieval of set gear may be warranted. Haul-back may be postponed if the marine mammals are considered to be at risk. The species, number, and behavior of the marine mammals are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The FPC or the SWL uses professional judgment and discretion to minimize the risk of potentially adverse interactions with marine mammals during all aspects of longline survey activities.

All SEFSC bottom and pelagic longline sets are conducted with gear marked at both ends with buoys (Appendix A). Soak time is defined as the time the last highflyer enters the water to the time the first highflyer is retrieved. Setting and hauling the gear is not included in the soak time. Bottom longline sets have a one hour soak time while pelagic sets typically have a three hour soak time, with the following exceptions:

- The HMS Chesapeake Bay and Coastal Virginia Bottom Longline Shark Survey (VIMS) standard soak time has been four hours since its inception in 1973.
- The MARMAP Reef Fish Long Bottom Longline Survey (SCDNR) and MARMAP/SEAMAP-SA Reef Fish Survey (SCDNR) longline gear is buoyed to the surface with a line and buoy on only one end. Bottom longline sets have a 90 minute soak time which was established in 1972.
- The SEAMAP-SA Red Drum Bottom Longline Survey (SCDNR) has a 30 minute soak time to keep red drum and coastal sharks in good condition for tag and release procedures.

In all pelagic longline sets, gear configuration allows a potentially hooked sea turtle or marine mammal the ability to reach the surface (i.e., gangions are 110 percent as long as the drop line depth).

SEFSC longline protocols specifically prohibit chumming (releasing additional bait to attract target species to the gear).

Per PLTRP, the SEFSC pelagic longline survey uses the Pelagic Longline Marine Mammal Handling and Release Guidelines for any pelagic longline sets made within the Atlantic EEZ.

11.7 Mitigation Measures for Marine Mammals during Research with Other Hook-and-Line Gear (Bandit Reel/Vertical Line and Rod and Reel Deployments)

11.7.1 Monitoring Methods

Many hook-and-line surveys occur in conjunction with video monitoring surveys. When this occurs, the camera array is deployed first and soaks for 60 minutes. Scientists on duty monitor the site for protected species 15 minutes prior to deploying the bandit gear, while the gear is in the water, and during haulback. On dedicated hook-and-line only surveys, the officer, crew members, and scientific party on watch

visually scan for marine mammals during all daytime operations. Binoculars are used as necessary to survey the area while approaching and upon arrival at the station, while the gear is deployed, during soak time, and during haulback. If marine mammals are sighted by the scientific, bridge, or deck crew prior to setting the gear or at any time the gear is in the water, the bridge crew and FPC are alerted immediately. Environmental conditions (lighting, sea state, precipitation, fog, etc.) often limit the distance for effective visual monitoring of marine mammals.

11.7.2 Operational Procedures

"Move-on" Rule. If marine mammals are sighted around the vessel before gear deployment, gear is not deployed unless those animals do not appear to be in danger of interactions with the gear, as determined by the judgment of the FPC or SWL. The vessel may be moved or gear deployment may be delayed until the animals no longer appear to be at risk of interaction with the gear. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel.

Soak time is standardized to 5-10 minutes per gear deployment. Leftover bait is not discarded overboard while actively fishing. Tackle is inspected daily to avoid unwanted line breaks.

If marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or halting the setting operations may be warranted, as determined by the judgment of the FPC or SWL.

On the SEAMAP-GOM Reef Fish Survey (NMFS), if setting operations have been halted due to the presence of marine mammals, setting does not resume. The SEAMAP vertical line survey is piggy-backed onto the SEAMAP reef fish video survey, and only 50 percent of those video sites are subsampled, therefore the vessel simply moves to the next site rather than waiting.

On all other vertical line surveys if setting operations have been halted due to the presence of marine mammals, setting may or may not resume. In some cases fishing operations are delayed and the vessel resumes operations when animal(s) have not been sighted within 15 minutes or are determined to no longer be at risk. In other instances, the station is dropped or moved. This decision is at the discretion of the FPC or SWL and is dependent on the situation.

11.8 Mitigation Measures for Marine Mammals during Research with Gillnet and Trammel Net Gear

11.8.1 Monitoring Methods

Gillnet and trammel net research activities occur on small vessels with a limited number of scientists. Monitoring begins 15 minutes prior to deploying the gear. Before the net is set, while the net is being deployed, during the soak, and during haulback, the scientists continuously monitor the net and waters around the net and maintain a lookout for marine mammals.

11.8.2 Operational Procedures

Gear is fished in daylight hours only, primarily in shallow water. The RecFIN Red Drum Trammel Net Survey (SCDNR) is fished exclusively in shallow water.

Prior to setting the net, scientific crew members conduct a 360° visual scan of the peripheral sampling area for the presence of marine mammals. Gillnets and trammel nets are not deployed if marine mammals have been sighted on arrival at the sample site. The exception is for animals that, because of their

behavior, travel vector or other factors, do not appear to be at risk of interaction with the gillnet/trammel net gear. For instance, a dolphin transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or a possible cancellation of the station. If marine mammals are observed in the vicinity of the vessel, deployment of sampling gear does not occur until the animal(s) have not been sighted within 15 minutes or are determined to no longer be at risk.

If marine mammals are not present, the gear is set and continuously monitored during the soak. If marine mammals are sighted during the soak and appear to be at risk of interaction with the gear, then the gear is hauled immediately. If fishing operations are halted, operations resume when animal(s) have not been sighted within 15 minutes or are determined to no longer be at risk, as determined by the judgment of the FPC or SWL. In other instances, the station is moved or cancelled.

Nets are checked for large holes and repaired regularly. Scientists use the minimum amount of line necessary to set the gear to ensure that there is limited floating line in the water which could entangle marine mammals.

On GULFSPAN and IJA Coastal Finfish (MDMR) gillnet surveys, gear soak time does not exceed one hour, excluding setting and hauling of gear. The net is monitored continuously and checked immediately if any disturbance is observed in the gear. If marine mammals are sighted during the soak and appear to be at risk of interaction with the gear, then the gear is pulled immediately. The site is then monitored for 15 minutes and the gear is set again if the animal(s) no longer appear at risk. This decision is at the discretion of the FPC and is dependent on the situation.

Smalltooth Sawfish Abundance Survey (SEFSC) has a one to four-hour soak time. Following protected species permit No. 17787, the net is monitored continuously and checked for catch every 30 minutes or immediately if any disturbance is observed in the gear. The RecFIN Red Drum Trammel Net Survey (SCDNR) uses a soak time of approximately 10 minutes, excluding setting and hauling of gear.

11.9 Mitigation Measures for Marine Mammals during Research with Electrofishing Gear

11.9.1 Monitoring Methods

Electrofishing surveys occur on small vessels with a limited number of scientists. Before the electrofishing vessel begins operating and while the vessel is electrofishing the scientific party monitors the waters around the vessel and maintains a lookout for marine mammals.

If marine mammals are seen within 50 meters of the station before electrofishing begins, electrofishing is delayed until the animal(s) moves out of the area. If the marine mammal does not move, the station is moved.

11.9.2 Operational Procedures

Electrofishing vessel operates with a 3000 watt pulsed direct current for 15 minutes. The electric field is less than 20 feet around the electrofishing vessel.

If marine mammals are seen within 50 meters of the vessel while it is electrofishing, electricity to the water is immediately turned off. No electrofishing is resumed until the animal has moved away. If it remains in the vicinity, the boat moves to a different location.

Once samples are processed, they are retained onboard until after all electrofishing is completed and discarded overboard between stations to avoid attracting protected species.

11.10 Survey Specific Mitigation Measures

The SEAMAP-SA Coastal Trawl Survey conducted by the South Carolina Department of Natural Resources was responsible for five of the eleven marine mammal takes reported by the SEFSC. The SEFSC will form a working group consisting of SEFSC Harvesting Branch gear experts, SCDNR scientists, and SEFSC scientists to evaluate the survey's methodology and fishing gear to determine if additional mitigation measures could be implemented to reduced marine mammal interactions. One specific mitigation measure which will be evaluated is the modification of the current lazy line to a line that is stiffer or thicker to reduce the possibility of marine mammal entanglements in the line.

11.11 Plankton Nets, Fyke Nets, Bag Seines, Small-mesh Towed Nets, Oyster Dredges, Fish Traps, Oceanographic Sampling Devices, Video Cameras, Remotely Operated Vessel (ROV) Deployments, and Chevron Traps

The SEFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, and ROVs. These types of gear are not considered to pose any risk to protected species because of their small size, slow deployment speeds, and/or structural details of the gear and are therefore not subject to specific mitigation measures. However, the officer on watch and crew monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to marine mammals during deployment of all research equipment.

11.12 Improved Implementation of Existing Mitigation Measures

To date, the specific conditions for implementing these mitigation measures in all situations have not been formalized or widely discussed among all scientific parties and vessel operators. The SEFSC therefore will be implementing a series of internal actions to improve its marine mammal training, awareness, and reporting procedures. Additional mitigation measures will be considered for specific surveys. The SEFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described in Sections 11.1 through 11.9.

11.12.1 Judgment Consistency

The SEFSC acknowledges that some mitigation measures require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Officers on deck, FPCs, and SWLs are charged with making those judgments at sea; they are experienced professionals, however, there may be inconsistencies across the range of research surveys conducted and funded by the SEFSC in how those judgments are made. In addition, some of the mitigation measures could also be considered "best practices" for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered in this LOA application, especially those conducted by cooperative research partners, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species have not been formalized and clearly communicated with all scientific parties and vessel operators.

As part of its continuing research program, the SEFSC will initiate a process for its FPCs, SWLs, scientists, and vessel captains and crew to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. There are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions before and during the time research gear is in the water. The intent of this new training program would be to draw on the collective

experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The SEFSC would coordinate not only among its staff and vessel captains and crew but also with those from other fisheries science centers, the Southeast Regional Office, and other institutions with similar experience.

11.12.2 Protected Species Training

Formalized training has not been required under the status quo conditions for all SEFSC researchers and partners. All OMAO officers and SEFSC scientists are knowledgeable about the mitigation requirements of all take reduction and ship strike avoidance plans as well as general mitigation measures to avoid marine mammal incidental take. Safety placards are posted on research vessels. Many scientists have also received varying levels of training through formal workshops and in-house presentations. In an effort to help standardize and further emphasize the importance of protected species information, the SEFSC will require that at a minimum, two members of the scientific party participating on each field survey (both SEFSC and research partner), have received, and will continue to receive, formal training through NMFS Highly Migratory Species/Protected Species Safe Handling, Release, and Identification Workshops (http://www.nmfs.noaa.gov/sfa/hms/compliance/workshops/protected_species_workshop/index.html) or other similar workshops. This workshop is designed to teach protected species identification as well as proper techniques for safe handling and release of entangled or hooked protected species, such as sea turtles, marine mammals, and smalltooth sawfish.

The SEFSC will implement the use of a Protected Species Safe Handling and Release Manual (Appendix D in the supporting DPEA). The manual includes topics such as current mitigation measures, decision-making factors for avoiding take, procedures for handling and releasing marine mammals caught in research gear, and reporting requirements. Review and discussion of the manual would be conducted by the SEFSC on a regular basis and updates would be distributed to SEFSC and partner scientists.

11.12.3 Written Protocols

For all SEFSC and partner research projects, mitigation measures are included in the written cruise instructions. In addition, informational placards and reporting procedures will be reviewed and updated as necessary for consistency and accuracy. Many research cruises already include pre-sail review of marine mammal protocols for participating scientists and crew but the SEFSC will require pre-sail briefings to be conducted before all research cruises, including those conducted by research partners.

11.12.4 Contract Language

The SEFSC will incorporate specific language into its contracts that specifies training requirements, operating procedures, and reporting requirements for marine mammals that will be required for all surveys conducted by research partners, including those conducted on chartered vessels.

11.13 Handling Procedures for Incidentally Captured Marine Mammals

Live or injured marine mammals are released from research gear and returned to the water as soon as possible with no gear or as little gear remaining on the animal as possible. Animals are released without removing them from the water if possible. Data collection is conducted in such a manner as not to delay release of the animal(s). If the safety of the crew and captured animal will not be compromised, the scientific party will attempt to collect biological information from captured, live marine mammals before they are released, including species identification, sex identification if genital region is visible, estimated length, disposition prior to release (e.g., describe how the animal was entangled/hooked in gear), and disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.)

and photographs. Photos of dead marine mammals (and live if possible), should include an image of the left and right side of the dorsal fin to help determine stock ID and a picture of the nature of gear entanglement. Information should also describe whether the animal was seen prior to the entanglement, a description of its behavior, and any mitigation measures used and/or discretionary decisions made by the FPC or SWL, including a rationale for those decisions. This information will be recorded on standardized PSIT forms developed for this purpose. The FPC or crew collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it is released as quickly as possible. If personnel or animal safety would be compromised by data collection efforts, the animal is released as quickly as possible. In addition to gathering data on incidentally caught marine mammals, the FPC or trained scientists would be required to remove as much gear as possible from the animal before release. Gear remaining on an animal has the potential to cause future entanglements and generally increases the chances that an injury will be serious. Human safety is paramount when considering whether and how to disentangle or dehook a marine mammal.

SEFSC staff will submit data on all captured animals to protected species experts at the appropriate NMFS Science Center who will use specific criteria to determine whether the injury is considered serious (i.e., more likely than not to result in mortality). If insufficient data has been collected for any reason, the experts may not be able to determine the severity of the injury. Therefore, it is important to train the FPC, SWL, and other designated scientists on all information necessary to make injury determinations that should be recorded on the PSIT form.

If a large whale is alive and entangled in fishing gear, the vessel will immediately call the U.S. Coast Guard (USCG) at VHF Ch. 16 and/or the appropriate Marine Mammal Health and Stranding Response Network for instructions. All entanglements (live or dead) and vessel strikes must be reported immediately to the NOAA Fisheries Marine Mammal Stranding Hotline at 1-877-433-8299. Additional response, handling, and sampling protocols are found in Appendix D of the DPEA supporting this LOA application.

12.0 WHERE THE PROPOSED ACTIVITY WOULD TAKE PLACE IN OR NEAR A TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND/OR MAY AFFECT THE AVAILABILITY OF A SPECIES OR STOCK OF MARINE MAMMAL FOR ARCTIC SUBSISTENCE USES, THE APPLICANT MUST SUBMIT EITHER A "PLAN OF COOPERATION" (POC) OR INFORMATION THAT IDENTIFIES WHAT MEASURES HAVE BEEN TAKEN AND/OR WILL BE TAKEN TO MINIMIZE ANY ADVERSE EFFECTS ON THE AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE USE

Not applicable. The proposed activity will take place in the Atlantic Ocean along the southeastern coast of the U.S., the Gulf of Mexico, and the Caribbean Sea, including marine waters offshore from Puerto Rico and the U.S. Virgin Islands as discussed in Section 1.2, and no activities will take place in or near a traditional Arctic subsistence hunting area. There are no relevant subsistence uses of marine mammals implicated by this action.

13.0 MONITORING AND REPORTING PLAN

13.1 Monitoring

Monitoring for marine mammals is now a standard part of conducting SEFSC fisheries research activities, particularly those that use gears (i.e., hook-and-line gear, longlines, trawls, and gillnet/trammel net gear) that are known to interact with marine mammals or that we believe have a reasonable likelihood of doing so in the future. As described in Section 11, if marine mammals are sighted in the area and are considered to be at risk of interaction with the research gear then the sampling station is delayed, moved, or canceled. NOAA vessels are required to monitor interactions with marine mammals and report interactions to the Center Director. Similarly, there is a condition of grant and contract awards for monitoring of marine mammal takes.

13.2 Reporting

NOAA Fisheries has established a formal incidental take reporting system, the Protected Species Incidental Take (PSIT) database, requiring that incidental takes of protected species be reported within 48 hours of the occurrence. The PSIT generates automated messages to agency leadership and other relevant staff to alert them of the event and to notify them that updated information describing the circumstances of the event has been inputted into the database. The SEFSC will develop a PSIT reporting form and instructions for use during all of its fisheries and ecosystem research activities and require all SEFSC and research partners to use this form for reporting incidental takes of all marine mammals (and other protected species). The form will include information about the interaction, biological information, gear and any mitigation measures in place. The information collected can then be reviewed and used to determine if additional mitigation measures are necessary for that survey or gear type.

The SEFSC will coordinate with the local Southeast Regional Stranding Coordinator and the NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that are encountered during field research activities. In addition, SEFSC staff provide reports to SEFSC leadership and to the Office of Protected Resources by event, survey leg and cruise. As a result, when marine mammals interact with the gear, whether killed or released alive, a report provided by the FPC or SWL will fully describe any observations of the animals, the context (vessel and conditions), decisions made and rationale for decisions made in vessel and gear handling. This report and any associated photographs from the incident will also be uploaded to the PSIT database. The PSIT and FPC or SWL reports represent not only valuable real-time reporting and information dissemination tools, but also serve as an archive of information that could be mined at later points in time to study why takes occur, by species, gear, etc. The circumstances of these events are critical in enabling SEFSC and the Office of Protected Resources to better evaluate the conditions under which takes are most likely to occur. We believe in the long term this will allow us to avoid some of these situations in the future.

14.0 SUGGESTED MEANS OF LEARNING OF, ENCOURAGING, AND COORDINATING RESEARCH OPPORTUNITIES, PLANS, AND ACTIVITIES RELATING TO REDUCING SUCH INCIDENTAL TAKING AND EVALUATING ITS EFFECTS.

NOAA Fisheries and the SEFSC provide a significant amount of funding and support to marine research. Specifically, NOAA Fisheries provides significant funding annually to universities, research institutions, Federal laboratories, private companies, and independent researchers around the world to study marine mammals. The SEFSC actively participates on Take Reduction Teams and in Take Reduction Planning and it conducts a variety of studies, convenes workshops and engages in other activities aimed at developing effective bycatch reduction technologies, gears and practices. For example, the SEFSC has an active conservation engineering program designed to reduce takes of marine mammals, turtles, and other listed species in fisheries. The SEFSC will continue to foster this research to further reduce takes of marine mammals in both its operations and in commercial fisheries to the lowest practicable levels.

Following the first year of implementation of the LOA the SEFSC will convene a workshop with SERO Protected Species, SEFSC fishery scientists, NOAA research vessel personnel, and other NMFS staff as appropriate to review data collection, marine mammal interactions, and refine data collection and mitigation protocols, as required.

The SEFSC has a keen awareness that an increase in fisheries research effort could result in more marine mammal takes over time. For this reason and because of resource limitations, the SEFSC maximizes efficient use of the charter and NOAA ship time it can attain. We also engage in operational plans with the NEFSC in order to clearly delineate our respective research responsibilities and to ensure we avoid research gaps and duplication of effort between Centers. In short, the SEFSC is on the water conducting fisheries research activities no more often than is necessary to fulfill its responsibilities to provide scientific advice to the Southeast Regional Office and other relevant domestic and international management bodies.

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Request for Rulemaking and Letters of Authorization

Under Section 101(a)(5)(A) of the Marine Mammal Protection Act

for the Take of Marine Mammals Incidental to Fisheries Research Activities conducted by

NOAA Fisheries Southeast Fisheries Science Center

within the Atlantic Ocean, Gulf of Mexico and Puerto Rico/Virgin Islands Ecosystems

April 2016

Appendix A

SEFSC Research Gear and Vessel Descriptions

Prepared for the National Marine Fisheries Service by:

URS Group
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Anchorage, Alaska 99501

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Table A-1 Output characteristics for SEFSC active acoustic sources A-22

1 Trawl Nets

A trawl is a funnel-shaped net towed behind a boat to capture fish. The cod end, or 'bag,' is the fine-meshed portion of the net most distant from the towing vessel where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture market-sized fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish stocks in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so that they can be collected in the codend. The opening of the net, called the 'mouth', is extended horizontally by large panels of wide mesh called 'wings.' The mouth of the net is held open (horizontally and vertically) by the hydrodynamic force exerted on the trawl doors attached to the wings of the net, floats placed on the headrope, and the net itself as the vessel moves forward.

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or 'warps,' to winches on the deck of the vessel. The cables are played out until the net reaches the fishing depth. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. At the end of the tow, the net is retrieved and the contents of the cod end are emptied onto the deck or sorting table. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow for meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into some research vessels and trawl gear may be used to monitor the position and status of the net, speed of the tow, and other variables important to the research design.

SEFSC research trawling activities use both 'pelagic' (surface or mid-water) trawls, which are designed to operate at various depths within the water column, as well as 'bottom' trawls, which are designed to capture target species at or near the seafloor. Bottom trawls may have sweeps to collect marine animals as they lay on the bottom or gather before the trawl opening. The trawl gear may be constructed and rigged for various target species and to operate over different types of bottom surfaces.

Aleutian Wing Trawl

The SEFSC uses an Aleutian Wing Trawl to sample mid-water prey (500-800 m) of marine mammals in the Gulf of Mexico and Atlantic Research Areas. Aleutian Wing Trawls are high speed mid-water trawls and they tend to be larger than bottom trawls with ropes that herd the shoals of fish towards the main body of the trawl (Figure A-1). The Aleutian Wing Trawl used by the SEFSC has a 10-meter (m) wide mouth opening and 2 x 3 m doors and is towed for 1-3 hours at target depth.

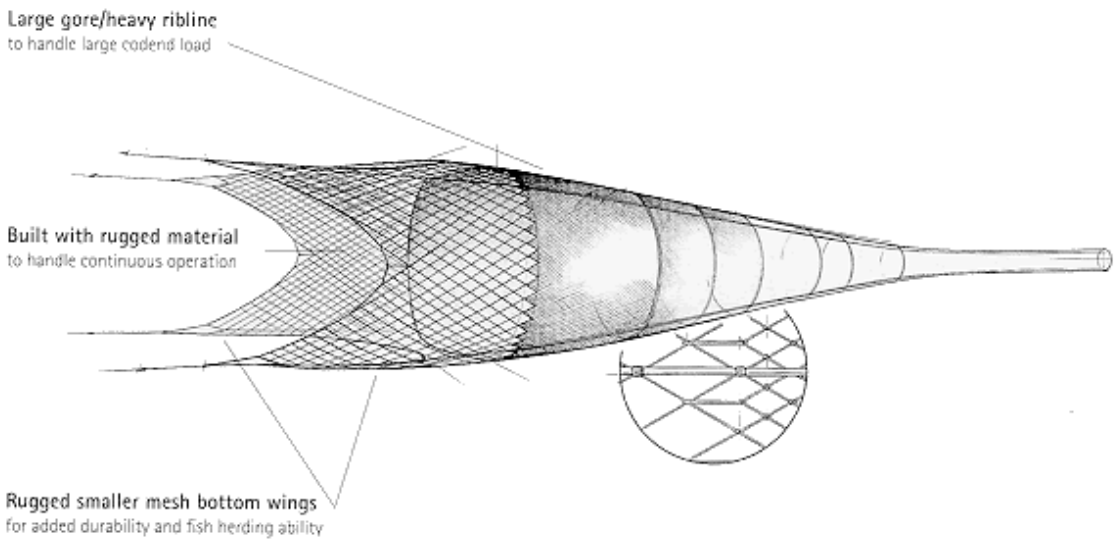

Figure A-1. Aleutian wing trawl illustration

Otter Trawl

The otter trawl with various modifications, is the dominant gear used in SEFSC surveys. A basic otter trawl consists of a heavy mesh bag with wings on each side designed to funnel shrimp and fish into the cod end. A pair of otter boards or trawl doors positioned at the end of each wing hold the mouth of the net open by exerting a hydrodynamic downward and outward force at towing speed.

An otter trawl is a cone-shaped net consisting of a body (made from two, four, and sometimes more panels) and narrowing to one or two codends. Lateral mesh wings extend forward from the opening and lead to two otter boards which force the wings open by the hydrodynamic force imposed when the vessel moves forward. A boat can be rigged to tow a single or two parallel trawls from the stern or from the side on outriggers. Otter trawls usually have an extended top panel (square) to prevent fish from escaping upwards over the top of the net. The mouth of the trawl is framed by a headrope (also called a headline) with floats to open the trawl vertically and the footrope with rollers or other groundgear designed for particular sea floor conditions to maximize the capture of target species living close to the bottom and minimize damage to the gear while moving across uneven surfaces (Figures A-2 and A-3).

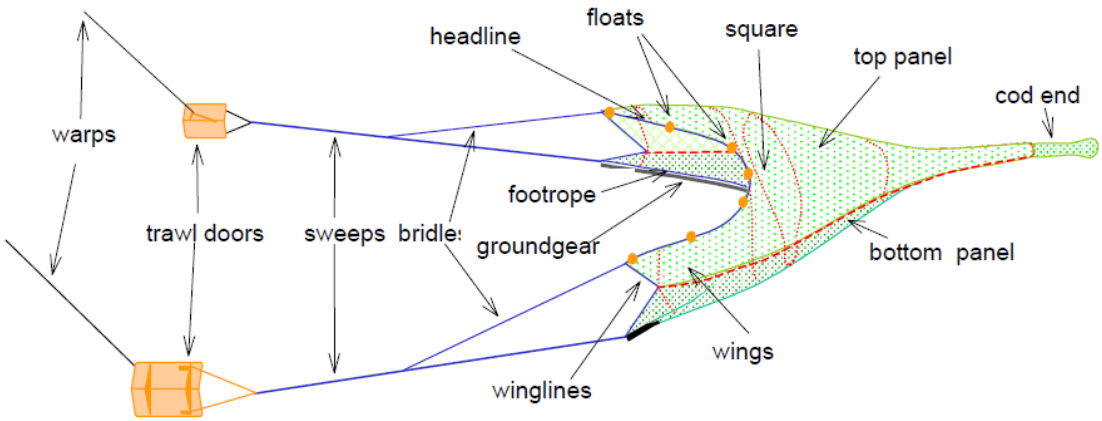

Figure A-2. Otter bottom trawl illustration

Figure A-3. Otter trawl being hauled onboard

Semi-balloon Shrimp Trawl

The semi-balloon shrimp trawl is a modified version of an otter trawl (Figure A-4). The semi-balloon shrimp trawl used by the SEFSC consists of a 20 ft trawl net (1 ½ in stretch mesh), with 30 in wooden otter trawl doors and a tickler chain. It is used in estuaries of the Georgia Sound system that includes the Ossabaw, Altamaha, and St. Andrew rivers to develop indices for recreationally important crustaceans and finfish.

Figure A-4. Semi-ballon shrimp trawl being deployed

Western Jib Shrimp Trawl

The western jib shrimp trawl is another variation of an otter trawl and is used by the SEFSC for gear testing of various Turtle Excluder Devices (TEDs). The western jib shrimp trawl is 50 feet in length with 8 foot by 40 inch wooden doors.

Mongoose-type Falcon Bottom Trawls

The mongoose trawl is a variation of the otter trawl (Figure A-2). The mongoose design incorporates a triangular tongue of additional webbing attached to the middle of the headrope pulled by a center towing cable, in addition to the two cables pulling the doors. This configuration allows the net to spread wider and higher than the conventional otter trawl. The paired (towed by two vessels) mongoose-type Falcon bottom trawl (manufactured by Beaufort Marine Supply) is used during the SEAMAP-SA North Carolina Pamlico Sound Trawl Survey to monitor juvenile fish, shrimp, and crab abundance. This trawl is 120 ft wide with a three-lead bride, 34 ft footrope, 0.1875-inch tickler chain, and 4 x 2 ft wooden doors. A pair of 75-ft mongoose-type Falcon trawl nets are also employed by the SEAMAP-SA Coastal Trawl Survey but the paired trawl is accomplished by towing the two nets on outriggers on either side of the same vessel. This trawl has a three-lead bridle, 89-ft foot-rope, 0.25-inch tickler chain, and 10 ft x 40 inch wooden chain doors.

Skimmer Shrimp Trawl

A skimmer trawl (Figure A-5) extends from the outrigger of a vessel with a cable and a lead weight which hold the trawl mouth open (instead of floats and chains). Skimmers are only used in shallow waters because of the way they are constructed.

The skimmer trawl is held in place by the frame on three sides and mounted on the vessel just behind the bow. Skimmer trawls are pushed through the water instead of towed behind the vessel like otter trawls. The frame is rigid enough to keep the net on the bottom but flexible enough to glide over obstacles along the bottom. This allows the skimmer vessel to continue to move while the cod end of the trawl is retrieved and emptied. This may be done as often as every 30 minutes. The skimmer trawl illustrated below includes a TED and Bycatch Reduction Device (BRD).

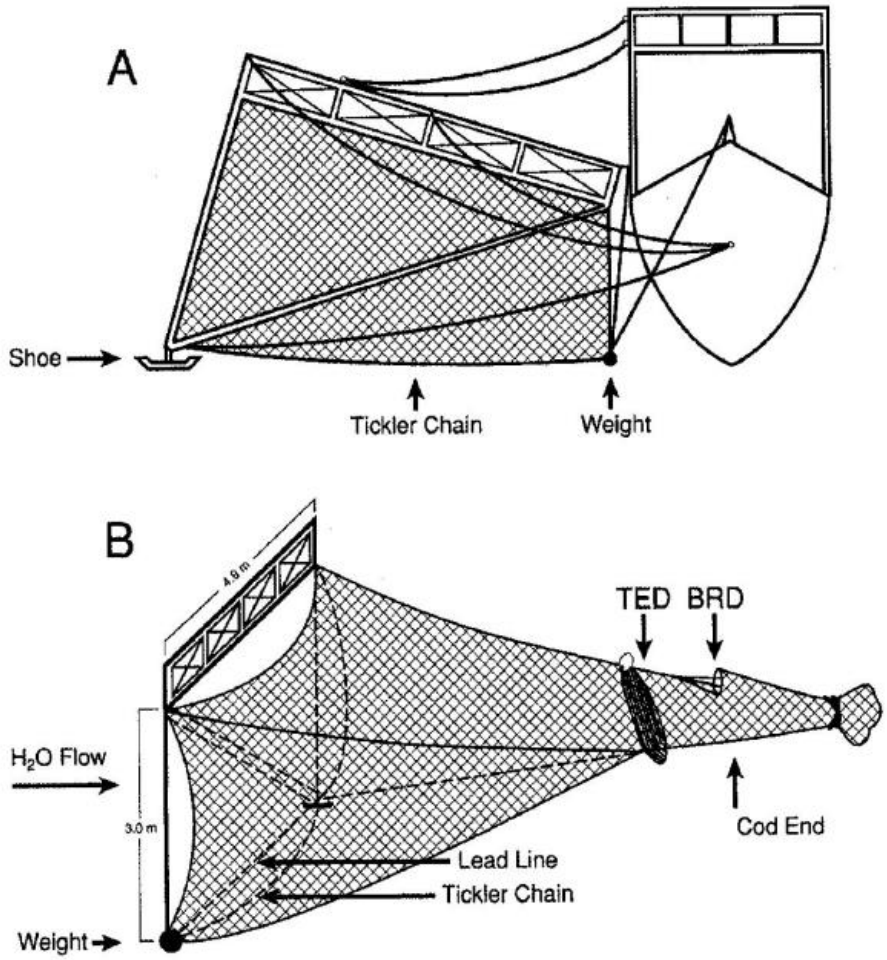

Figure A-5. Skimmer trawl schematic

Miniature Roller Frame Trawl

The roller frame trawl (Figure A-6) has a rectangular rigid frame, usually metal, to keep the mouth of the net open. The interior of the frame contains a grid of vertical bars shielding the net opening, while the bottom of the frame has rollers which allow the apparatus to roll over the seabed. The beam length of the frame is not more than 16 feet and the vertical bars in the frame are no more than 3 inches apart. The SEFSC uses a miniature roller frame trawl with a 0.5 m diameter mouth and 1 mm mesh to collect pink shrimp for comparison of survival and growth.

Figure A-6. Roller frame trawl

Modified Beam Trawl

A beam trawl (Figures A-7 and A-8) is a type of bottom trawl that uses a wood or metal beam to hold the net open as it is towed along the sea floor. The beam holds open the mouth of the net so that no trawl doors are needed. Beam trawls are generally smaller than other types of bottom trawls. Commercial beam trawls have beams of up to 12 meters, while beam trawls for research purposes typically use beams of two to four meters. The beam trawl used by the SEFSC for post-larval, juvenile fish, and invertebrate surveys is a modified version that is constructed with a beam of 1.5 meters and could be pulled by hand.

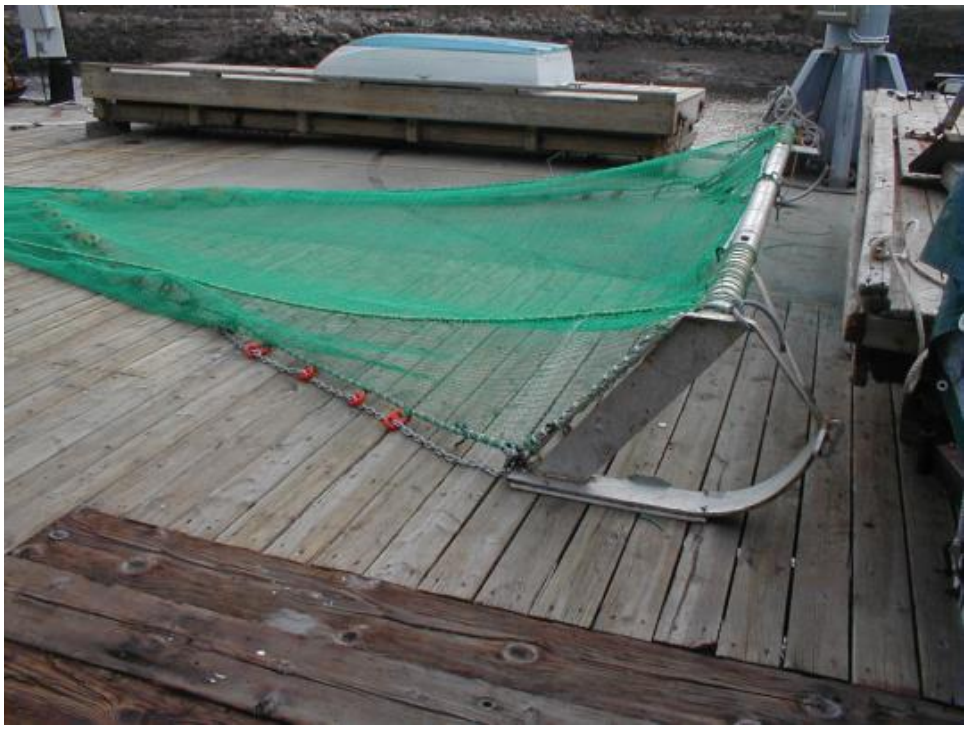

Figure A-7. Beam trawl on deck

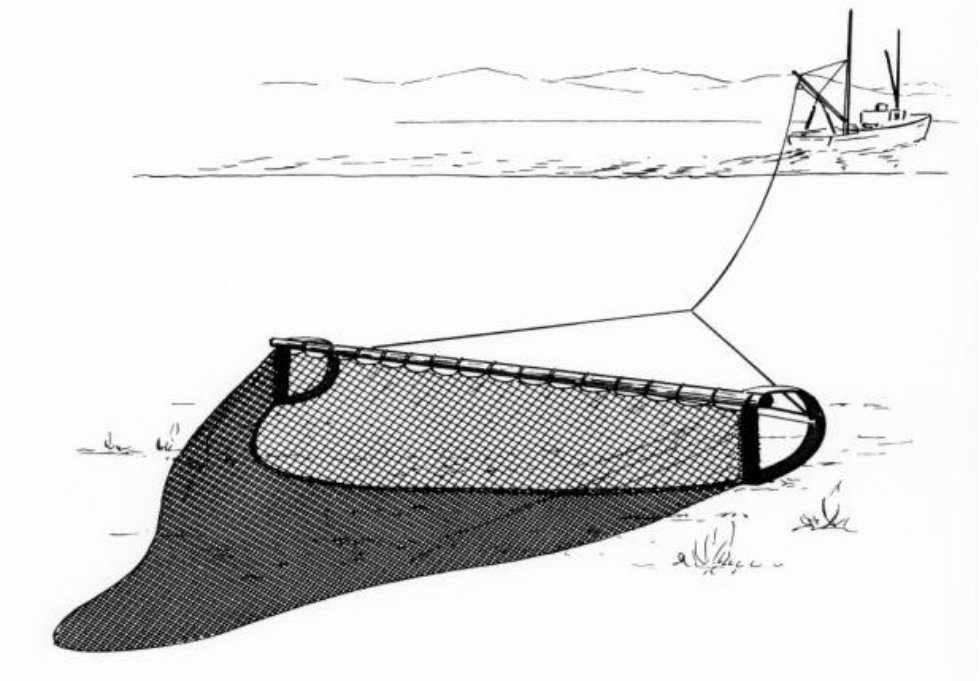

Figure A-8. Beam trawl illustration

2 Oyster Dredge

Oyster dredges (Figure A-9) are constructed from a metal frame with metal chain netting. Along the front edge of the dredge is a long bar with teeth that are dragged on the seafloor to pick up oysters and deposit them into the chain mesh netting. The oyster dredge used for the Mississippi Department of Marine Resource Oyster surveys consists of a nine-tooth bar about 20 inches wide with teeth 4 inches long and spaced 2 inches apart.

Figure A-9. Oyster dredge

3 Hook-and-Line Gear

A variety of SEFSC surveys use hook-and-line gears to sample fish either in the water column or in benthic environments. These gear types include baited hooks deployed on longlines as well as rod-and-reel and bandit gear deployments.

Longline vessels fish with baited hooks attached to a mainline or 'groundline'. The length of the longline and the number of hooks depend on the species targeted, the size of the vessel, and the purpose of the research. Hooks are attached to the mainline by another thinner monofilament line called a 'gangion'. The length of the gangion and the distance between gangions depends on the purpose of the research. The longlines used by the SEFSC for research typically have 100 gangions, each with one baited hook.

Pelagic Longline

Buoys are used to keep pelagic longline gear suspended near the surface of the water, and flag buoys (or 'high flyers') equipped with radar reflectors, radio transmitters, and/or flashing lights are attached to each end of the mainline to enable the crew to find the line for retrieval (Figure A-10). Target species for pelagic longline surveys conducted by the SEFSC are pelagic sharks and finfish species These pelagic

longline protocols have a five-nautical mile mainline with 100 gangions. The time period between completing deployment and starting retrieval of the longline gear is the 'soak time.' Soak time is an important parameter for calculating fishing effort and is typically three hours for SEFSC surveys. Short soak times can help reduce longline interactions with sea turtles and marine mammals.

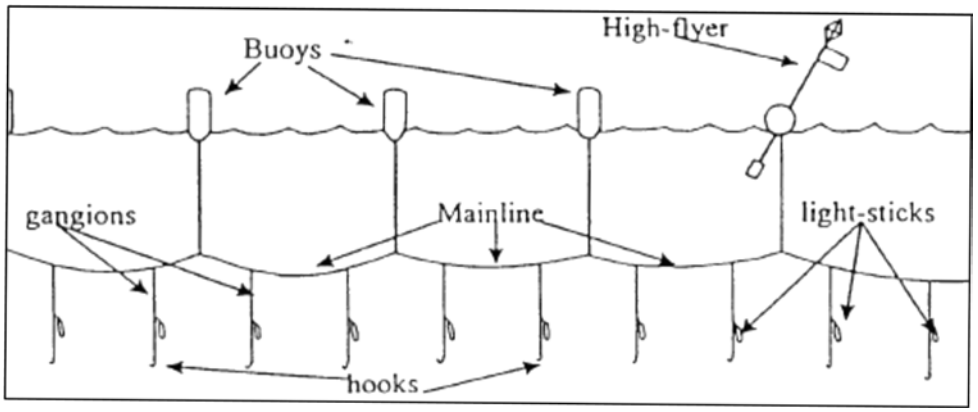

Figure A-10. Pelagic longline schematic

Bottom Longline

Bottom longlines used by the SEFSC to survey species in deeper water, including sablefish, have a one-mile long monofilament mainline that is anchored on the seafloor with weights at the mid-point and ends. The line is marked at the surface by radar high flyers (Figure A-11).

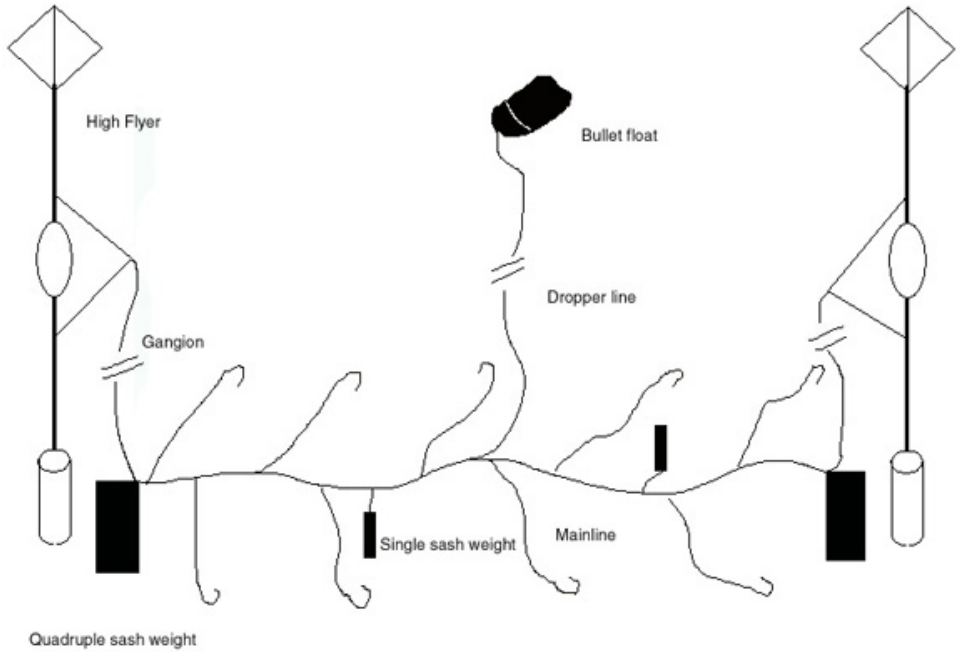

Figure A-11. Bottom longline schematic

Rod and Reel

This gear is a standard fishing pole with a reel attached near the base. These are used by the SEFSC to sample fish in the nearshore reef inlet and estuary of the St. Lucie River, FL.

Bandit Reels

Bandit reels are heavy duty fishing reels that are used for deep sea fishing (Figure A-12). The SEFSC uses a bandit reel with a vertical mainline and 10 gangions that is either deployed from the vessel and marked at the surface by a buoy or is fished while maintaining an attachment to the reel. The hook sizes used are 8/0, 11/0, or 15/0 circle hooks with 0 offset.

Figure A-12. Bandit reel

4 Plankton Nets

SEFSC research activities include the use of several plankton sampling nets that employ very small mesh to sample plankton from various parts of the water column. Plankton sampling nets usually consist of fine mesh attached to a weighted frame. The frame spreads the mouth of the net to cover a known surface area.

Bongo Nets

Bongo nets are used by the SEFSC during various plankton surveys conducted throughout the three research areas. Bongo nets are also used to collect additional data during shark and finfish surveys. Bongo nets consist of two cylindrical nets that come in various diameters and fine mesh sizes (Figure A-13). The bongo nets are towed through the water at an oblique angle to sample plankton over a range of depths. During each plankton tow, the bongo nets are deployed to a depth of approximately 210 m and are then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In

shallow areas, the sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the end of the net, is used to contain the plankton sample. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Some bongo nets can be opened and closed using remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site. Bongo nets are generally used to collect zooplankton for research purposes, and are not used for commercial harvest.

Figure A-13. Bongo net

Neuston Nets

Neuston nets are used to collect zooplankton that lives in the top few centimeters of the sea surface (the neuston layer). This specialized net has a rectangular mouth opening (usually 2 or 3 times as wide as deep, i.e. 60 cm by 20 cm). They are generally towed half submerged at 1-2 kts from the side of the vessel on a boom to avoid the ship's wake.

Figure A-14. Neuston net

Methot Juvenile Fish Net

A Methot net is used to sample juvenile fish, shrimp, and other larger plankton (4 millimeters and larger). It is a single net with a large square opening and is towed behind the vessel. A flowmeter suspended in the mouth of the net measures the flow of water moving through the net and allows for calculation of the volume of water sampled.

MOCNESS

The Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) uses a stepping motor to sequentially control the opening and closing of individual nets to obtain discrete depth tow data (Figure A-15). The MOCNESS uses underwater and shipboard electronics for controlling the device. The electronics system continuously monitors the functioning of the nets, frame angle, horizontal velocity, vertical velocity, volume filtered, and selected environmental parameters such as salinity and temperature. The SEFSC uses the MOCNESS to develop larval indices for snapper, parrot fish, and grouper, as well as to determine seasonal abundances, and population connections between islands and upstream sources.

Figure A-15. MOCNESS

5 Other Nets

Bag Seine

A bag seine is a seine net operated from the shore (Figure A-16). The gear is composed of a bunt (bag or lose netting) and long wings often lengthened with long ropes for towing the seine to the beach. The headrope of the net stays at the surface of the water with float attachments and the footrope maintains contact with the bottom, creating an effective barrier for fish. The SEFSC uses bag seines with a central cod end to survey shrimp, shellfish and estuary fish populations.

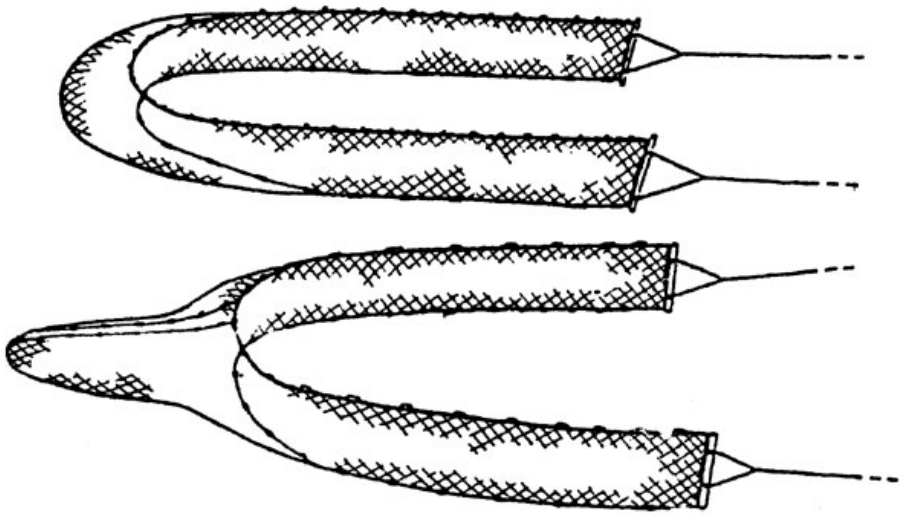

Figure A-16. Bag seine illustration with and without a central codend

Set Gillnets

Set gillnets (Figure A-17) consist of vertical netting held in place, either near the surface or lower in the water column, by floats and weights to selectively target fish of a particular size range depending on the netting size (Walden 1996). Typical gillnets are made of monofilament, multi-monofilament, or multifilament nylon constructed of paneling of varying mesh sizes depending on their use and target species (Hovgård and Lassen 2000). The SEFSC uses gillnets of various sizes, ranging from 1 to 5½ inches stretched mesh, and total net lengths from 100 to 750 feet. Gillnets are used in finfish, smalltooth sawfish, and juvenile shark population surveys in the Gulf of Mexico and Atlantic.

Two SEFSC surveys have shallow water deployments in depths from 0.2 to 2 m. A single 750 ft long x 6 ft deep gillnet consisting of five 150 ft panels, each with stretch-mesh sizes 2, 2½, 3, 3 ½, and 4 inches, respectively, is used for the IJA Coastal Finfish Gillnet Survey. The Smalltooth Sawfish Abundance Survey uses gillnets that are 5 ft deep and either 100 or 200 ft long with mesh sizes either 3 or 4 inches, fished in depths of 0.2-1.0 m. Nets are anchored at both ends, and marked with surface buoys; only one net is fished at a time.

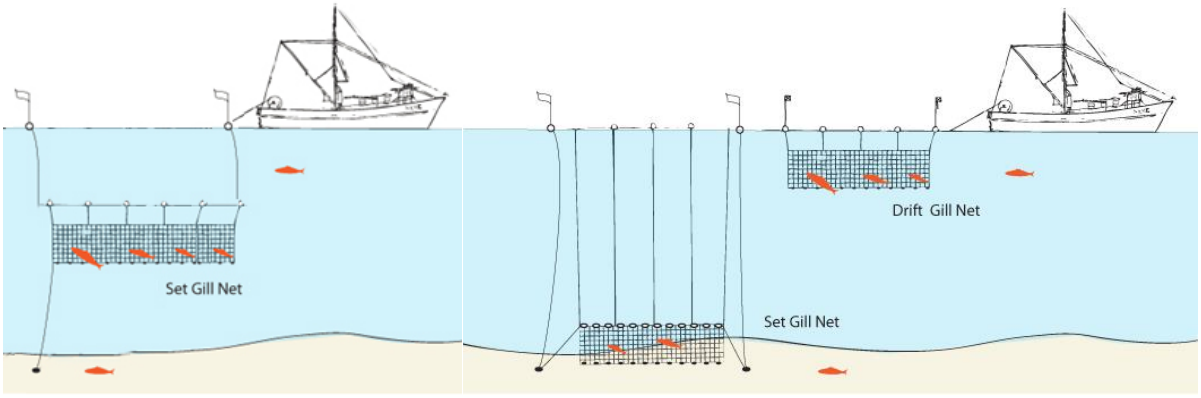

Figure A-17. Diagram of different gillnet deployments

Midwater Set Gillnet

All research institutions participating in the GULFSPAN survey use a midwater monofilament set gillnet consisting of six different stretched-mesh size panels for sampling in all areas. Stretched-mesh sizes range from 3 inches to 5½ inches in ½ inch steps. Each panel is 10 feet deep and 100 feet long. Other panel specifics can be found in Baremore et al. (2012). The six panels are strung together and fished as a single gear (i.e., set); one end of each set is anchored and the opposite end is tied to the boat via a bridle.

Individual sampling strategies may differ between research institutions; however, in general, sets are chosen randomly and the gear is fished either perpendicular to shore or with the wind. It is the aim of the study to have half of the sets made in depths less than 5 meters (16 feet) and half in depths greater than 5 meters. In depths greater than 10 feet (the depth of the net), the gear acts like a midwater gillnet - the lead line weighs enough to hold the floats under the surface of the water but not enough to sink the net completely. In depth less than 10 feet, the gear fishes the entire water column. For all net configurations, the hanging ratio (length to height ratio of the meshes) is 0.5, leadline weight is 4.5 kilograms, 2.3 kilograms of buoyancy is used, and panel length is 100 feet.

Set soak time is defined from the time the gear enters the water to the time the gear is removed completely from the water. Haul back typically starts one half to one hour after the gear first enters the water. After haul back, the gear is moved to a different location, beginning a new set.

Drift Gillnet

The ACFCMA American Shad Drift Gillnet Survey, conducted by the South Carolina Department of Natural Resources, uses drift gillnets (Figure A-17) in several SC river systems to catch, tag, and release adult shad. They use a single 5 inch mesh net which is up to 450 ft in length and 22 ft depth. The net is set adrift for 20 minutes and constantly monitored for catch.

Trammel Net

The trammel net is a variation on the gillnet that consists of three layers of net (Figure A-18). A slack, small mesh, inner panel of netting is sandwiched between two outer layers of netting, which are taut and have a larger mesh size. The inner panel may be made of twisted monofilament or twisted nylon filament. Trammel nets are held vertically in the water by weights on the bottom (lead line), and floats on the top (float line). According to their design, ballasting and buoyancy, these nets may be used to fish near the surface, in mid-water or at the bottom, either in estuarine or marine waters.

The SEFSC uses trammel nets during the red drum stock assessment surveys in South Carolina. This trammel net is 183 meters by 2.1 meters and is fitted with a polyfoam float line and lead core bottom line.

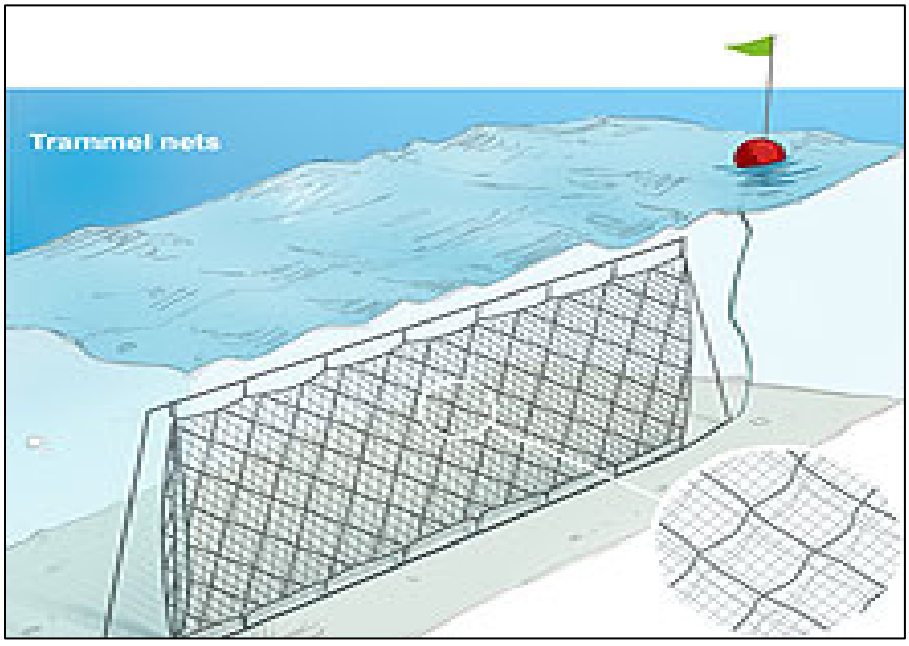

Figure A-18. Trammel net diagram

6 Traps/Pots

Fyke Nets

A fyke net is a fish trap that consists of cylindrical or cone-shaped netting bags that are mounted on rings or other rigid structures and fixed on the bottom by anchors, ballast or stakes (Figure A-19). Fyke traps are often outfitted with wings and/or leaders to guide fish towards the entrance of the bags. The Fyke nets used by the SEFSC are constructed with wings that are 18.8 x 9 feet and bag netting of 700 micron mesh.

Figure A-19. Fyke net diagram

Shrimp Cages

Shrimp cages come in various shapes and are typically constructed of mesh or metal netting and a metal or PVC frame (Figure A-20). They work by being lowered from a vessel or shore onto the bottom of the sea floor where they are baited and left for a certain amount of time and then later retrieved. Shrimp cages are used by the SEFSC during their research on shrimp survival of two different populations. The SEFSC shrimp cages are constructed of 1-inch PVC poles that were oriented vertically attached to two fiberglass hoops and wrapped in 2mm mesh netting.

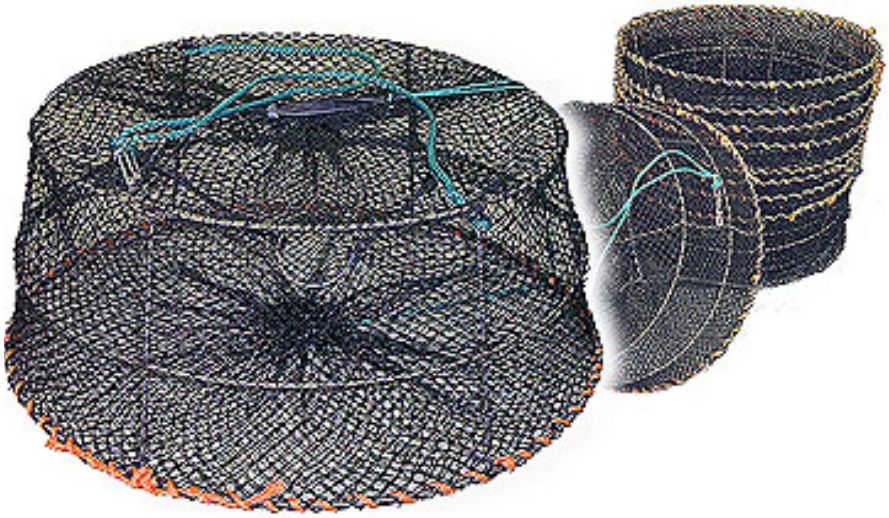

Figure A-20. Shrimp cage

Eel Traps/Pots

Eel traps (Figure A-21) and pots are portable metal traps that can be constructed of wood or metal and come in various shapes. The SEFSC uses a 16 x 20 x 11 inch trap with ½-inch metal mesh. The openings for the internal funnels are 2 x 3 inches and the trap is baited with horseshoe crabs and shrimp heads.

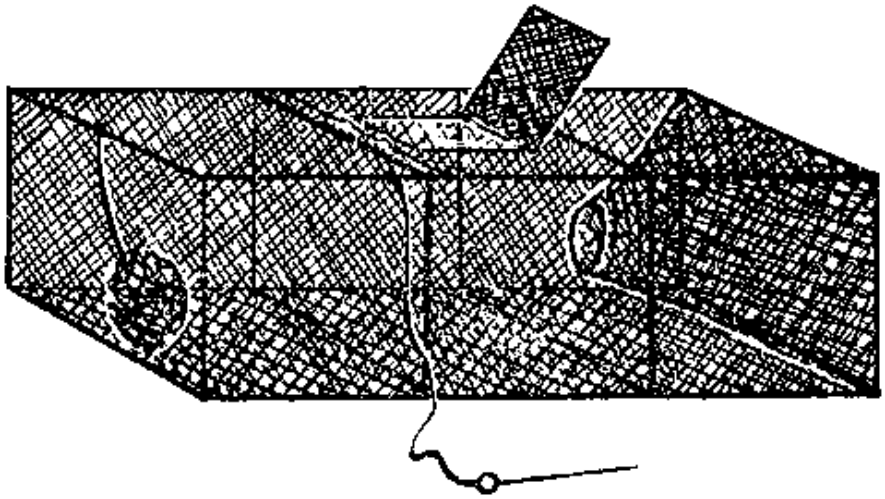

Figure A-21. Simple eel trap

Throw Trap

Throw traps (Figure A-22) are open ended boxes that are tossed into the environment that is being surveyed to randomly discern a survey area. The vegetation and fauna contained in the trap are then measured and assessed. Throw traps can be made of various types of materials depending on the intended use. A throw trap is used during the SEFSC Integrated Biscayne Bay Ecological Assessment and Monitoring Project to survey epifauna and small fish in the Everglades. The throw trap is constructed of aluminum with 1 m^2 walls and a depth of 45 cm.

Figure A-22. Throw trap

Chevron Fish Trap

Chevron fish traps are wire mesh fish cages that are used to sample fish populations (Figure A-23). The SEFSC uses several different chevron fish traps of various dimensions that are baited to attract target species.

Figure A-23. Chevron trap

7 Oceanographic Instruments

Conductivity, Temperature, and Depth (CTD) and Water Samples

A CTD profiler measures these parameters and is the primary research tool for determining chemical and physical properties of seawater. A CTD profiler may be a fairly small device (image on the left in Figure A-24) or it may be deployed with a variety of other oceanographic sensors and water sampling devices (e.g., Niskin or go-flo bottles) in a large (1 to 2 meter diameter) metal rosette wheel (image on the right in Figure A-23). The CTD profiler is lowered through the water column on a cable, and CTD data are collected either within the device or via a cable connecting to the ship. Water sampling devices range from a bucket dropped over the side of a small boat to Niskin bottles that are triggered at discrete depths to collect a suite of water samples throughout the water column. A CTD cast takes from minutes to hours to complete depending on water depth (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.

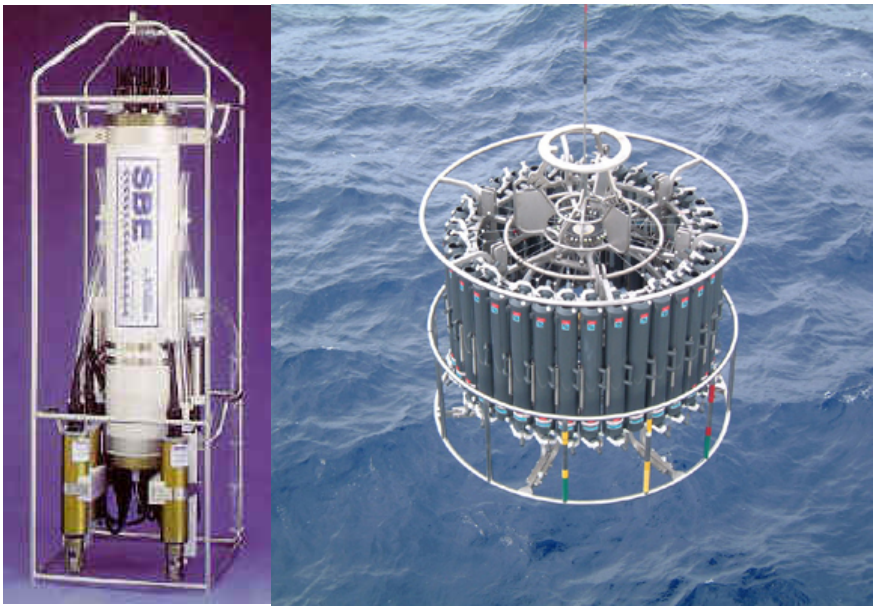

Figure A-24. Sea-Bird 911 and CTD profiler deployment on a sampling rosette with Niskin bottles

Credit: Sea-Bird Electronics, Bellevue WA

Secchi Disk

A secchi disk is a round disk with alternating black and white segments that is used to measure water turbidity and transparency (Figure A-25). Typically the secchi disk is attached to a line that is marked at certain lengths to allow for depth measurement as the disk is lowered. The user lowers the secchi disk into the water until the black and white segments are indiscernible.

Figure A-25. Secchi disk

8 Remotely Operated Vehicles

THE ROV Super Phantom S2

The Super Phantom S2 (Figure A-26) is a powerful, versatile remotely operated vehicle (ROV) with high reliability and mobility. This light weight system can be deployed by two operators and is designed as an underwater platform which provides support services including color video, digital still photography, navigation instruments, laser scaling device, lights, position information of the ROV and support ship, vehicle heading, vehicle depth, and a powered tilt platform.

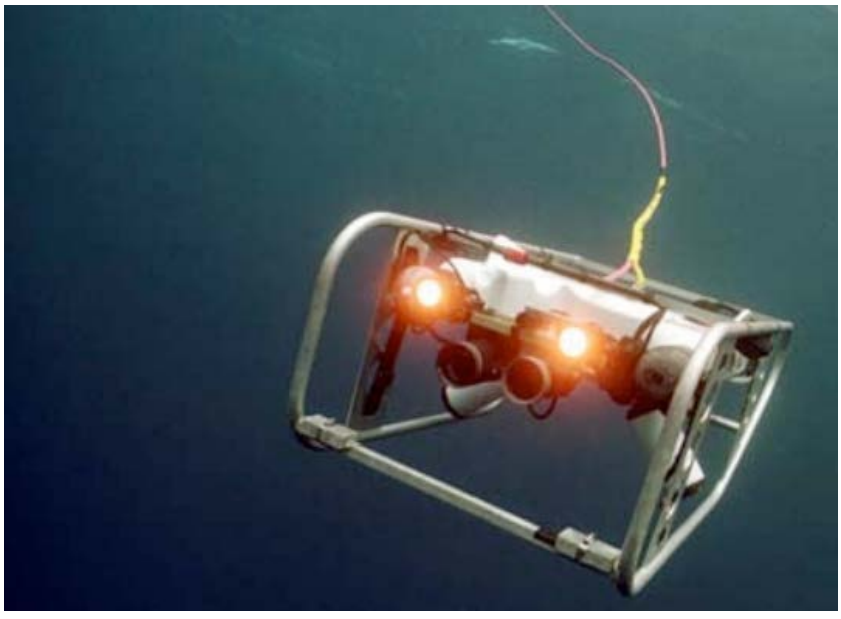

Figure A-26. ROV Super Phantom

MINI ROV

The Mini ROV is used during the SEFSC Panama City Reef Fish survey to help conduct line surveys and identify cryptic and rare fish species in the Gulf of Florida. The mini ROV is equipped with color video cameras and scaling lasers.

Underwater Scooters

Underwater scooters (Figure A-27) are used for both SEAMAP-C Queen Conch and Spiny Lobster surveys in order to help mobilize scuba divers while collecting data**.**

Figure A-27. Underwater scooter

9 Active Acoustic Sources

A wide range of active acoustic sources are used in SEFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Table A-1 shows important characteristics of these sources used on NOAA research vessels conducting SEFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output characteristics for SEFSC active acoustic sources

Acoustic system	Operating frequencies (kHz)	Maximum source level (dB re 1 µPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 38, 70, 120, 200, 333	224	1 ms @ 1 Hz	Downward looking	11°@18kHz; 7°@38kHz
Simrad ME70 multibeam echosounder	70-120	205	2 ms @ 1 Hz	Downward looking	140°
Simrad MS70 multibeam echosounder	70-120	206	2 ms @ 1 Hz	Downward side-looking	0° tilt angle from vertical (horizontal looking)
Simrad SX90 omni-directional multibeam sonar	70-120	206	2 ms @ 1 Hz	Downward omni-directional	0°-90° tilt angle from vertical (average)
ADCP Ocean Surveyor	75	223.6	External trigger	Downward looking (30° tilt)	N/A
Simrad ITI trawl monitoring system	27-33	<200	0.05-0.5 Hz repetition rate	Downward looking	40° x 100°

Multi-frequency Narrow Beam Scientific Echo Sounders (Simrad EK60)

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from survey vessels for a variety of purposes: to acoustically map the distributions of many types of fish, estimate their abundances and biomasses, characterize their biotic and abiotic environments, investigate ecological linkages, and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The SWFSC uses devices that transmit and receive at six frequencies (18, 38, 70, 120, 200, and 333 kHz).

Multi-beam Echosounders (Simrad ME70, MS70, SX90)

Multi-beam echosounders and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal (Figure A-28). The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path. The use of multiple acoustic ‘beams’ allows coverage of a greater area compared to single beam sonar. The sensor arrays for multi-beam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multi-beam echosounders and

sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The multi-beam echosounders used by the SEFSC emit frequencies in the 70-120 kHz range.

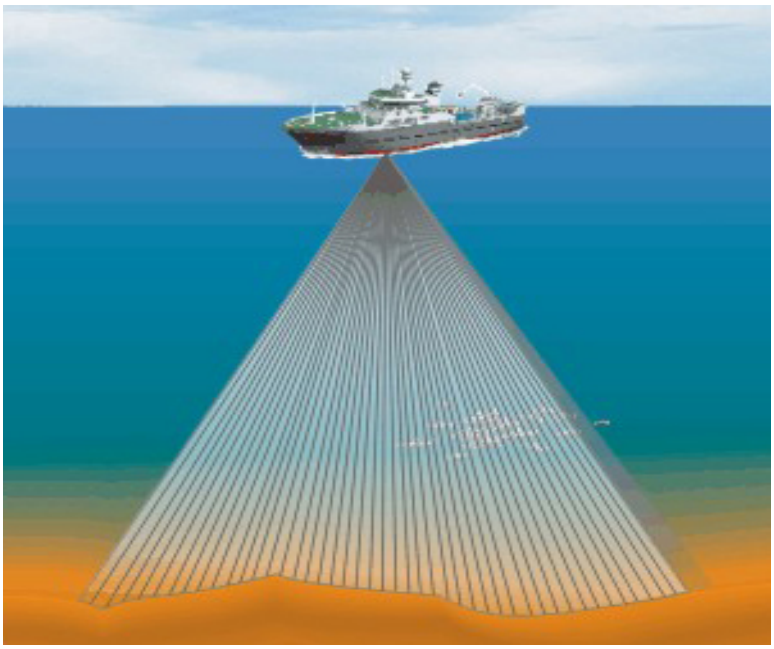

Figure A-28. Conceptual image of a multi-beam echosounder

Acoustic Doppler Current Profiler

An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. An ADCP instrument can be mounted to a mooring or to the bottom of a boat Figure A-29). The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings (WHOI 2011).

Figure A-29. ADCP pre-deployment

Trawl Monitoring Systems (Simrad ITI and FS70)

Trawl monitoring systems allow continuous monitoring of net dimensions during towing to assess consistency, maintain quality control, and provide swept area for biomass calculations. Transponders are typically located in various positions on the trawl or cables connecting the trawl to the ship. Data are monitored in real time to make adjustments in ship speed or depth of trawl to meet survey protocols.

10 Passive Acoustic Arrays

Passive Acoustic Monitoring is conducted by SEFSC during marine mammal surveys using two different towed hydrophone arrays. One is a hand-deployed two-element hydrophone array that is towed 200 meters behind the ship; the second is a five-element hydrophone array that can be towed up to 600 meters behind the ship (Figure A-30). The data collected can be used to determine population abundance and density of cetacean species.

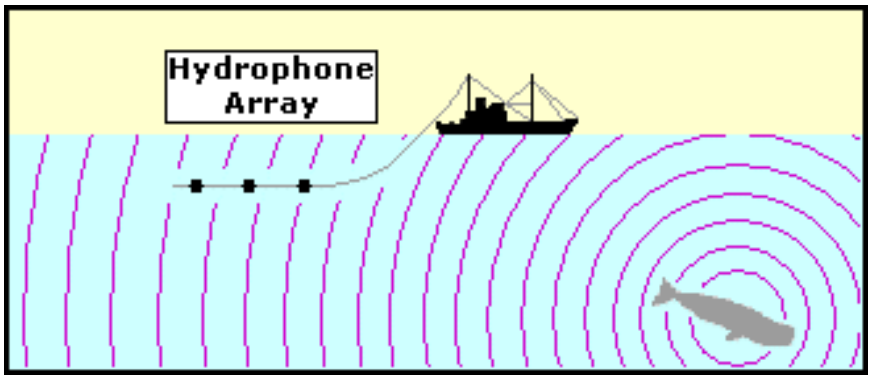

Figure A-30. Passive acoustic array towed behind vessel

11 Other Equipment Used

Expendable Bathythermographs

The SEFSC uses an Expendable Bathythermograph (XBT) to provide ocean temperature versus depth profiles. A standard XBT system consists of an expendable probe, a data processing/recording system, and a launcher (Figure A-31). The XBT probes consist of a metal weight surrounding a temperature probe, attached to a copper wire that conducts the signal to the vessel. Probes are generally launched from the leeward side of the vessel and as far out as possible. Launching from these locations helps obtain high reliability and minimizes the chances that the fine copper probe wire will come in contact with the ship's hull which may cause spikes in the data or a catastrophic wire break. A portable shipboard data acquisition system records, processes, and interprets the data the probes collect. The XBT probes are expendable; they are not retrieved and are left on the seafloor after data collection.

Figure A-31. Expendable XBT probe on the left; hand-held launcher on the right

Handheld Instruments

YSI instruments are handheld devices (several models are used) that measure dissolved oxygen, conductivity, salinity and temperature (Figure A-32). The various models consist of a micro-processor based, digital meter with an attached YSI combination conductivity and dissolved oxygen probe.

Figure A-32. YSI 85

Witham Collectors

Witham collectors are used to monitor the presence of juvenile fish in estuarine nursery areas, in particular gag (*Mycteroperca microlepis*). Witham collectors consist of air conditioner filter material folded over an 18 by 18 inch PVC frame (Figure A-33). They are anchored with a single line and floated off the bottom in tidal creeks that are about 1 m deep at low tide.

Figure A-33. Whitham collectors

Juvenile Lobster Artificial Shelters

Juvenile lobster shelters are used to collect specimens in shallow marine and estuarine areas. They consist of two tiers of eight concrete blocks (Figure A-34) and have been established in seagrass blowout areas (minimum of 2 to 3 meter water depth) in close proximity to fringing mangroves.

Figure A-34. Juvenile lobster shelter

Ponar Dredge

A ponar dredge is used to sample materials on the sea floor. The dredge consists of two opposing semi-circular jaws that are normally held open by a trigger mechanism. The sampler is lowered to the bottom where contact with the bottom sets off the trigger and a strong spring snaps the jaws shut trapping a sample (Figure A-35).

Figure A-35. Ponar dredge

12 Cameras

Go Pro Video Camera

Go Pro video cameras are portable and durable cameras that are easily mounted to objects in order to record things in unusual places. The SEFSC uses Go Pro cameras to document fish species during various studies by attaching them to fish traps.

Underwater Camera Sled

The first generation of underwater camera sled or Towed Optical Assessment Device (TOAD) used for the collection of optical validation data was a MiniBAT 8820 manufactured by Guideline Instruments (Figure A-36). The MiniBAT is a sled designed to be towed at 3–10 knots while being remotely guided by an operator on the towing vessel to keep it close to the seafloor. This iteration of TOAD is configured with a single Sony DCR-PC110 Digital Video Camera in a modified Gates underwater housing. It also features a Canon Power Shot G1 Still Camera (modified by SEFSC engineers) in an Ikelite housing rated to 60 meter depth. Illumination is provided by two 500-watt underwater lights.

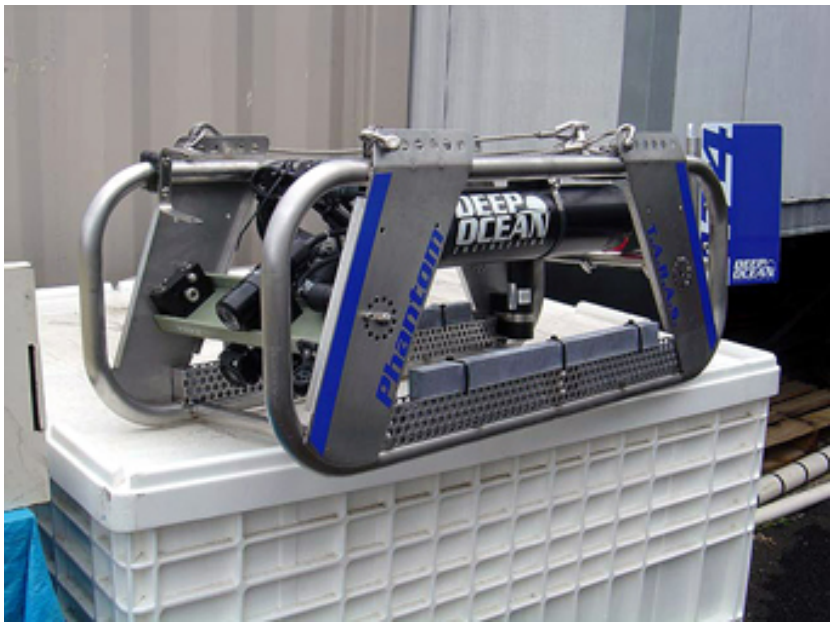

Figure A-36. Camera sled

4-Camera Array and 2-Camera Array

The 4- and 2-camera arrays used by the SEFSC consist of color cameras paired with black-and-white stereo cameras set inside an aluminum housing (Figure A-37). Before being lowered from the boat the arrays are baited with squid and then attached to a float by a line.

Figure A-37. Camera array

13 SEFSC Vessels Used for Survey Activities

The SEFSC and its research partners use a variety of different types and sizes of vessels to meet their needs and objectives. Vessels are also sometimes chartered from the commercial industry or other institutions/agencies. Vessels vary in size from small fishing vessels (U.S. Coast Guard [USCG] Class A – up to 16 ft. and Class I – 16 to <26 ft.), medium vessels (USCG Class II – 26 to <40 ft. and Class III – 40 to 65 ft.), USCG Small Research Vessel (R/V) (>65 ft. and <300 gross tons) and USCG Research Vessel (R/V) (>65 ft. and >300 gross tons). Several Motor Vessels (M/V) >65 feet and USCG Research Vessels are also chartered and used by partner agencies. Since the actual vessel can change frequently, especially for small vessels, only vessels >65 ft used by the SEFSC and partners and named NOAA vessels are described here.

R/V *Georgia Bulldog*

The University of Georgia research vessel R/V *Georgia Bulldog* (Figure A-38) was built in 1977 in St. Augustine Florida and is currently used for research on improving trawl gear as well as sea turtle research. The R/V *Georgia Bulldog* is rigged for various types of fishing that includes: shrimp trawlers, bottom trawl, longline, handline, dredges and traps. The vessel is 72-ft wooden-hull boat that is powered by a 6-cylinder Caterpillar 335 hp diesel engine. It can sleep a total of eight people. Special research equipment aboard the R/V *Georgia Bulldog* includes depth recorders, surface water temperature gauge, three VHF radios, two GPS units, plotter for navigation, color fish finding depth recorder, two radars, automatic pilot, real-time underwater video system, and two computers. The homeport for the R/V *Georgia Bulldog* is Brunswick, Georgia.

Figure A-38. R/V *Georgia Bulldog*

R/V *Lady Lisa*

The R/V *Lady Lisa* is a research vessel operated by the South Carolina Department of Natural Resources (Figure A-39). The R/V *Lady Lisa* is 75 feet in length with a wooden hull and was built in 1980. It is powered by a 415 HP, 12 cylinder Caterpillar engine and is capable of towing two 80-ft trawls. The vessel has accommodations for three crew members and eight scientists as well as dry storage space for gear and cold storage space for samples. The R/V *Lady Lisa* is the primary sampling platform for several state and federal projects, working mostly in near coastal waters between Cape Hatteras, NC and Cape Canaveral, Florida.

Figure A-39. R/V *Lady Lisa*

NOAA Ship *Gordon Gunter*

The *Gordon Gunter* (Figure A-40) primarily serves the NMFS Pascagoula Laboratory in Mississippi. The *Gordon Gunter* is a 224-ft. multi-use platform. It is equipped with a thermosalinograph, CTD, fluorometer, and other oceanographic instruments that monitor atmospheric and oceanic conditions while traveling. A variety of research gears are deployed from the vessel including stern trawling, longlining, plankton tows, and dredging. The *Gordon Gunter* operates in all three SEFSC research areas.

Figure A-40. NOAA Ship *Gordon Gunter*

NOAA Ship *Nancy Foster*

The *Nancy Foster* (Figure A-41) is a 187-ft research vessel that operates in all three SEFSC research areas. The *Nancy Foster* is used in habitat and fauna characterization in the nation's National Marine Sanctuaries as well as pollution assessments, bathymetric surveys, physical and chemical oceanography studies, maritime heritage surveys, and pollution assessments. On board equipment includes two cranes, A-frame, J-frame and two winches. Special research equipment includes wet and dry laboratories, computers for data acquisition and analysis, and instruments for obtaining oceanographic and atmospheric data. The ship also carries four different launches, ranging from 17-ft rigid hull inflatable boats to a 23-ft aluminum boat for diving and oceanographic operations in shallow water.

Figure A-41. NOAA Ship *Nancy Foster*

NOAA Ship *Oregon II*

The *Oregon II* is a 170-ft NOAA research vessel that is used for living marine resource studies in support of the SEFSC Pascagoula Laboratory (Figure A-42). The vessel is operated in all three SEFSC research areas and has several types of fishing and research gear used on board that includes: a double-rigged shrimp trawl, longline winch, fish trap, dredge, electronic fish detection equipment, environmental sensors, and electronics equipment.

Figure A-42. NOAA Ship *Oregon II*

NOAA Ship *Pisces*

The *Pisces* is a 208-ft NOAA research vessel capable of carrying a crew of 21 and up to 15 scientists (Figure A-43). The *Pisces* is a newly constructed fisheries research vessel launched in 2007 and commissioned in 2008. The vessel is operated in all three SEFSC research areas and has multiple types of fishing and research gear available. A special feature of the new ship is its quiet hull design that minimizes the sound transmitted underwater, making this ship ideal for surveying marine life.

Figure A-43. NOAA Ship *Pisces*

NOAA Ship *Thomas Jefferson*

The *Thomas Jefferson* is a 208-ft research vessel that is operated in all three SEFSC research areas (Figure A-44). The vessel is equipped with surveying gear such as GPS, side-scan and multibeam sonar-imaging, and state-of-the-art computers. On-board equipment is used to conduct hydrographic surveys for udpdating NOAA's nautical charts.

Figure A-44. NOAA Ship *Thomas Jefferson*

NOAA Vessel R/V *Harold B*

The R/V *Harold B* (Figure A-45) is a 36-foot ex-Navy aluminum hulled dive boat stationed at the NOAA Fisheries Panama City Laboratory for use in the coastal waters of northwest Florida. The vessel is a 1988 heavily built Munson hull in good condition powered by two John Deere 225 hp diesel engines, vessel also has a Kohler 8EOZ generator. The vessel can operate in inshore and offshore waters no greater than 125 miles from the nearest land. The vessel can, and will, carry up to eight persons, including the vessel operator for voyages up to 12 hours away from port. The vessel is configured for fishing operations, traps, longlines, diving, use of remotely operated vehicles (ROV). Deck modifications include the addition of a davit and hydraulic pot hauler on the aft deck to be used for lifting traps and sampling gear. The vessel is restricted to day time operations only and is restricted from performing restricted ability to maneuver operations at night and during periods of limited visibility. Special Equipment includes GPS (2), Fish/Depth finder (2), Radar, DSC VHF (2), SSB (1), EPIRB, SART and an on board computer w/ Nobeltec navigation software.

Figure A-45. NOAA Vessel R/V *Harold B*

UNOLS R/V *Savannah*

The R/V *Savannah* (Figure A-46) is a multi-use 92' oceanographic and fisheries research vessel operated by the Skidaway Institute of Oceanography, homeported in Savannah, Georgia, and is a member of the University National Oceanographic Laboratory System (UNOLS) fleet. The R/V *Savannah* can sleep a total of 20 people and is used for biological, chemical, physical, and geological oceanographic studies in estuarine and continental shelf waters throughout the southeastern US Atlantic and Gulf Coasts. It can deploy trawls, longlines, handlines, dredges, traps, buoys, landers, and autonomous underwater vehicles, and is equipped with motion-compensated depth recorders, an acoustic doppler current profiler, CTD, crane, A-frame, pot hauler, flow-through systems, and a network of on-board ship sensors.

Figure A-46. UNOLS R/V *Savannah*

R/V *Tommy Munro*

The R/V *Tommy Munro* (Figure A-47) is a 97.5-ft research vessel owned and operated by the University of Southern Mississippi's Gulf Coast Research Laboratory. It has a range of 2,500 nautical miles and berthing for ten scientists and six crew. The vessel is driven by twin GM V12-71 engines each capable of 300 hp @ 1,800 RPM. Electrical power is provided by 2 GM-4-71 diesel-powered generators supplying 50 kw (208/120V AC). Hydraulic power is obtained from one 15 GPM @ 2000 psi system and one 6 GPM @ 2,000 psi system. The vessel is capable of a multitude of scientific collection applications, including trawling, long-lining, plankton sampling, water collection and CTD profiles, benthic grabs, fish/crab trap deployment/retrieval, sensor deployment/retrieval, and mapping.

Figure A-47. R/V *Tommy Munro*

NOAA Vessel R/V *Mokarran* F2504

The Research Vessel *Mokarran* F2504 (Figure A-48) is a 25 foot Boston Whaler with a fiberglass hull that is used for the GULFSPAN Survey and dive operations in support of the SEFSC Panama City Laboratory. It is currently configured for in- and nearshore fishing operations, including gillnetting and longlining. The vessel can carry up to 5 people, including the vessel operator, and operates in Florida state waters no greater than 2 miles from shore. The vessel has been modified from its original design by the addition of a permanent aluminum frame and canvas top. It is equipped with a depth recorder, surface water temperature gauge, GPS plotter for navigation, electronic fish detection equipment, VHS, and an auto-release EPIRB. The home port for the R/V *Mokarran* is Panama City, Florida.

Figure A-48. NOAA Vessel R/V *Mokarran* F2504

NOAA Vessel R/V *Caretta*

The R/V *Caretta* is a 58 ft steel-hull NOAA research vessel that is used for living marine resource studies in support of the SEFSC Pascagoula Laboratory (Figure A-49). The vessel can sleep a total of six people. A variety of research gear deployed from the vessel includes: shrimp trawls with otter boards or skimmers, longlines, handlines, bandit reels, traps, CTD'S, camera arrays, It is equipped with depth recorders, surface water temperature gauge, and plotter for navigation, CTD winch, small crane. The homeport for the R/V *Caretta* is Pascagoula, MS. The R/V *Caretta* operates in state and federal waters from western Louisiana through the west Coast of Florida.

Figure A-49. NOAA Vessel R/V *Caretta*

R/V *Bellows*

The R/V *Bellows* (Figure A-50) is owned by the State of Florida and is operated by the Florida Institute of Oceanography on behalf of the State University System. It is designated and certified as an Oceanographic Research Vessel by the US Coast Guard. The R/V *Bellows* is 71-ft long and has a 20-ft beam. The vessel can accommodate 10 scientists and there is 275 sq. ft of deck space and a 185 sq. ft wetlab/drylab air conditioned area. The vessel is equipped with hydraulic winches to operate CTDs, small trawls or bottom dredges. The vessel is operated out of St. Petersburg, FL.

Figure A-50. R/V *Bellows*

R/V *Weatherbird II*

The R/V *Weatherbird II* (Figure A-51) is owned by the University of South Florida for use through the Florida Institute of Oceanography. The vessel was built in 1982, by Bosarge Marine in Bayou La Batre, AL. This vessel is equipped with advanced laboratories, oceanographic devices and sensor technology designed to enable scientists and students to study and learn about various aspects of the ocean's biological, chemical, geological and physical characteristics. The R/V *Weatherbird II* is 115-ft long and has a 28-ft beam and cruises at 10kts. The vessel can accommodate 13 scientists and 6 crew. There is 780 sq. ft. deck space and a 200 sq. ft wetlab. The vessel is equipped with hydraulic winches for CTDs and trawls. The vessel is operated out of St. Petersburg, FL.

Figure A-51. R/V *Weatherbird II*

R/V *Apalachee*

The R/V *Apalachee* (Figure A-52) is owned and operated by the Florida State University Coastal and Marine Laboratory. The vessel was built by Geo Shipyard, Inc. in New Iberia, LA in 2013. It was designed to work in coastal and offshore waters, allowing scientists and students to conduct research on the ocean's biological, chemical, geological and physical characteristics that affect global and coastal oceans. The R/V *Apalachee* is 65-ft. long and has a 22-ft beam and cruises at 12 – 16kts. The vessel can accommodate 4 – 6 scientists and 2 crew. There is 780 sq. ft deck space and 200 sq. ft wetlab and 200 sq. ft. drylab space. The vessel has a winch and A-frame on the stern and can operate small trawls. The vessel is operated out of St. Teresa, FL.

Figure A-52. R/V *Apalachee*

R/V *Palmetto*

The 110 foot R/V *Palmetto* is South Carolina Department of Natural Resources' offshore research vessel (Figure A-53). Made of steel and powered by twin 550 HP diesel engines, the vessel generally conducts scientific research from Cape Lookout, NC to Palm Beach, Florida and out to over 200 miles. The vessel operates around the clock for up to 10 days at sea with a crew of 6, and has berthing for 9 scientists. Bridge electronics include GPS integrated into computerized navigation software, satellite communications including email capabilities, as well as standard radar, radios, depth-sounders, air and sea temperature sensors, etc. The air-conditioned wet lab has its own navigation electronics and computer facilities. On deck equipment include a seawater ice maker, marine crane, A-frame, winch, and hydraulic pot hauler allowing deployment and retrieval of a wide variety of research instruments and sampling gears. (https://www.dnr.sc.gov/marine/mrri/vessels/palmetto.html)

Figure A-53. R/V *Palmetto*

R/V *Cape Hatteras*

The R/V *Cape Hatteras* is a 135 foot steel-hull research vessel owned and operated by Cape Fear Community College (Figure A-54). The vessel was built in 1981 by Atlantic Marine Ship Builders, Fort George Island. FL and is available for oceanographic research use through charters by outside agencies. The vessel is capable of carrying a crew of 8 and up to 19 scientists and can endure 25 days at sea. The vessel has multiple types of fishing and research gear available including a trawl winch, CTD winch, Markey portable electric winch, J-frame and stern A-frame.

Figure A-54. R/V *Cape Hatteras*

M/V *Spree*

The M/V *Spree* (Figure A-55) is a 100 foot aluminum crew boat refit for open-ocean diving owned and operated by Spree Expeditions Inc. The vessel is capable of carrying 22 passengers, 2 trip leaders, and up to 8 boat crew, for a maximum of 32 people aboard and can endure 25 days at sea. The M/V *Spree* is powered by three 12V71 Detroit Diesel engines and runs at a top speed of approximately 16 knots. The vessel has multiple types of fishing and research gear available including a lifting Davit 500 lb. capacity, towing Davit 1,000 lb. capacity, pot Hauler 800 lb. capacity, Hydraulic Crane 7,000 lb. capacity, NAVTEX Furuno NX-300, autopilot Simrad AP-45, and Satellite: Thrane and Thrane VOIP.

Figure A-55. M/V *Spree*

R/V *Pelican*

The 116 ft. R/V *Pelican* (Figure A-56) was designed and outfitted to conduct a variety of oceanographic research missions. The R/V *Pelican* successfully conducts scientific trawling, MOCNESS trawls, large box core sampling, thirty-foot piston cores, shallow seismic surveys, current meter array and benthic boundary array deployment and recovery. The R/V *Pelican* has also successfully conducted plankton sampling, hydrographic casts with CTD-rosette system, ADCP sampling and underway collection sampling (SCS) and with towed water sampling systems. The vessel is owned by the State of Louisiana, operated by Louisiana Universities Marine Consortium (LUMCON) and homeported in Cocodrie, Louisiana. The vessel is operated as an Research Vessel as designated by the USCG. The vessel is available for legitimate research and education programs of Consortium members, state and federal agencies, other nonprofit groups, and oceanographic industries. The R/V *Pelican* operates primarily in the Gulf of Mexico but has been conducting research as far north as Canada and as far south as Trinidad.

Figure A-56. R/V *Pelican*

R/V *Point Sur*

The 135 ft. R/V *Point Sur* (Figure A-57) was also designed, built and outfitted in 1980 to conduct a variety of oceanographic research missions. The vessel is owned by the University of Southern Mississippi and is managed and operated by LUMCON. The R/V *Point Sur* successfully conducts scientific trawling, MOCNESS trawls, large box core sampling, shallow seismic surveys, current meter array and benthic boundary array deployment and recovery. The vessel has also successfully conducted multiple types of mooring operations, plankton sampling, ADCP sampling, hydrographic casts with CTD-rosette system and underway water collecting sampling systems (SCS). The vessel is homeported in Gulfport, Mississippi at the Port of Gulfport. The vessel is operated as an Research Vessel as designated by the USCG. The vessel is available for legitimate research and education programs of LUMCON and USM members, state and federal agencies, other nonprofit groups, and oceanographic industries.

Figure A-57. R/V *Point Sur*

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