DRAFT ATLANTIC TRAWL GEAR TAKE REDUCTION STRATEGY

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December 2008

TABLE OF CONTENTS

I ATLANTIC TRAWL GEAR TAKE REDUCTION STRATEGY

II Introduction

In September 2006, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) convened the Atlantic Trawl Gear Take Reduction Team (ATGTRT) under the Marine Mammal Protection Act (MMPA). The ATGTRT was convened to address incidental mortality and serious injury of long-finned pilot whales (*Globicephala melas*), short-finned pilot whales (*Globicephala macrorhynchus*), common dolphins (*Delphinus delphis*), and Atlantic white-sided dolphins (*Lagenorhynchus acutus*) in several trawl gear fisheries operating in the Atlantic Ocean. These marine mammal species are known to interact with the Mid-Atlantic Mid-Water Trawl, the Mid-Atlantic Bottom Trawl, Northeast Mid-Water Trawl and the Northeast Bottom Trawl fisheries.[1]

Section 118 of the MMPA establishes a method for managing incidental interactions between marine mammals and commercial fisheries. Under section 118, Take Reduction Plans (TRPs) are developed to identify actions necessary to conserve and protect strategic marine mammal stocks[2] that interact with Category I and II fisheries.[3] The immediate goal of a TRP is to reduce, within six months of implementation, the incidental serious injury or mortality of marine mammals from commercial fishing to levels less than PBR. The long-term goal is to reduce, within five years of its implementation, the 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.

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[1] These trawl fisheries are the focus of this Take Reduction Strategy. See Appendix D for brief descriptions of these fisheries.

[2] The MMPA defines the term "strategic stock" to mean a marine mammal stock (A) for which the level of direct human-caused mortality exceeds the potential biological removal level; (B) …..is declining and is likely to be listed as a threatened species under the Endangered Species Act (ESA) of 1973 within the foreseeable future; or (C) ….is listed as a threatened or endangered species under the ESA or is designated as a depleted stock under this Act. The term "potential biological removal level" means 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.

[3] NMFS must publish, at least annually, a List of Fisheries (LOF) that classifies U.S. commercial fisheries into one of three categories, based on the relative frequency of incidental serious injuries and mortalities of marine mammals in each fishery:

- Category I designates fisheries with frequent serious injuries and mortalities incidental to commercial fishing;
- Category II designates fisheries with occasional serious injuries and mortalities;
- Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities.

Take Reduction Teams (TRTs) consisting of representatives from the fishing industry, fishery management councils, state and federal resource management agencies, the scientific community and conservation organizations develops the TRP while NMFS is responsible for its implementation. After a TRP is finalized, the TRT and NMFS meet periodically to monitor implementation of the plan and update as necessary. Take reduction plans must recommend regulatory or voluntary measures for the reduction of incidental mortality and serious injury; and recommend dates for achieving the specific objectives of the plan.

Presently, none of these marine mammal stocks under consideration by the ATGTRT are classified as a strategic stock nor do they currently interact with a Category I fishery. At its first meeting the ATGTRT raised several issues critical to the take reduction planning process and the development of an ATGTRP. The ATGTRT requested clarification of the requirements under the MMPA for development of a take reduction plan for marine mammal stocks that are non strategic and that do not interact with Category I fisheries. Specifically, the ATGTRT wanted to know if the 11 month timeline specified in the MMPA for the development of a TRP and the 5 year timeline for reaching ZMRG apply under the specific circumstances of the ATGTRT. The ATGTRT also requested that NMFS conduct a Tier Analysis for the 2007 annual List of Fisheries to verify whether the Squid, Mackerel Butterfish Fishery (Mid-Atlantic Midwater Trawl Fishery) should remain as a Category I fishery or be reclassified as a Category II fishery.

NOAA GC provided detailed legal guidance regarding the TRP timeline and requirements for development of a TRP for marine mammal stocks that are non-strategic in response to questions raised by the ATGTRT. In short, NOAA's GC legal guidance stated that neither the 11 month timeline for the development of a TRP nor the 5 year goal for reaching ZMRG apply to non-strategic stocks that do not interact with Category I fisheries. The ATGTRT agreed that while a ATGTRP may not be required at this time[4], efforts should be made to identify and conduct research necessary to identify measures to reduce serious injury and mortality of marine mammals in Atlantic trawl fisheries and, ultimately, to achieve the MMPA's ZMRG. This information is captured in the Atlantic Trawl Gear Take Reduction Strategy (ATGTRS).[5]

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[4] At the April 2007 meeting, the ATGTRT tabled the discussion of the NOAA GC's legal guidance without reaching consensus, with some members questioning the conclusions reached by NOAA GC. The ATGTRT agreed to focus on areas of consensus; specifically the need to identify and implement research and education and outreach initiatives to reduce serious injury and mortality of marine mammals in Atlantic trawl fisheries and ultimately to achieve the MMPA goal of reducing marine takes to Zero Mortality Rate Goal (ZMRG).

[5] The Atlantic Trawl Gear Take Reduction Strategy (ATGTRS) identifies informational and research tasks as well as education and outreach needs the ATGTRT believes are necessary to provide the basis for achieving the ultimate MMPA goal of achieving ZMRG. The ATGTRS has identified several potential voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals. The tasks identified by this ATGTRS are necessary to make reasoned management decisions that could provide the basis for any future take reduction plan should it be determined that a TRP is needed.

In addition, the ATGTRT recommended that certain voluntary measures be implemented immediately for the Atlantic trawl fisheries in defined areas. NMFS funded outreach placards highlighting these voluntary measures. The placards were designed in collaboration with Garden State Seafood Association, who is also a member of the ATGTRT.

The ATGTRT recommended that two plans be developed to achieve the overall goal of the Take Reduction Strategy to reduce the incidental take of marine mammals in Atlantic trawl fisheries. These include an Education and Outreach Plan and a Research Plan as part of an overall take reduction strategy. The ATGTRT established two sub-groups to develop the Education and Outreach and Research Plans. The Education and Outreach Plan identifies activities that promote the exchange of information necessary to reduce the bycatch of marine mammals in Atlantic trawl fisheries. The Research Plan identifies information and research needs necessary to improve our understanding of the factors resulting in the bycatch in Atlantic trawl fisheries. The results of the identified research will be used to direct additional research and/or identify measures to reduce the serious injury and mortality of short- and long-finned pilot whales, Atlantic white-sided dolphins, and common dolphins in trawl fisheries to levels approaching the ZMRG. The Plans developed by these subgroups are presented below.

III Background

a) Stock Definition, Distribution and Ecology

Atlantic white-sided dolphin (*Lagenorhynchus acutus*): White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100m (328 ft) depth contour (Waring et al. 2007). The species inhabits waters from central West Greenland to North Carolina (about 35° N. lat.) and perhaps as far east as 43° W. long. (Evans 1987).

Very little is known about the stock structure of white-sided dolphins in the Northwest Atlantic. However, distribution of sightings, strandings and incidental takes suggest the possible existence of three stocks: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka et al. 1997). Evidence for a separation between the southern Gulf of Maine population and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic coast of Nova Scotia (Waring et al. 2007).

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39° N. lat.) on to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy (Waring et al. 2007). Sightings data indicate seasonal shifts in distribution (Northridge et al. 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on Virginia and North Carolina beaches (Waring et al. 2007). From June through September, large numbers of white-sided dolphins are found from

Georges Bank to the lower Bay of Fundy (Waring et al. 2007). From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The waters off Virginia and North Carolina appear to represent the southern extent of the species' range (Waring et al. 2007).

Very little is known about the life history of Atlantic white-sided dolphins (Gannon and McLellan, presentation to ATGTRT 2006). Prior to the 1970s, white-sided dolphins in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf (Waring et al. 2007). During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of changing levels of prey species, with the decrease in herring and increase in sand lance in the continental shelf waters (Kenney et al. 1996).

In New England waters, Atlantic white-sided dolphins are observed in groups ranging from a few animals to around 500 individuals, with an average group size of 40 (Cipriano 2002). Atlantic white-sided dolphins feed on a variety of schooling fish and squid. Major prey items include squids, herring, small mackerel, gadid fishes (e.g., cod, hake, haddock, whiting), sandlance and smelt (Cipriano 2002). Different prey species predominate at different times of year. The Atlantic white-sided dolphin presumably is not a deep diver, as maximum recorded dive times were 4 min, and most dive times were shorter than 1 min in duration (Cipriano 2002). Females reach sexual maturity at 6 to 12 years and reportedly produce a single calf every 2 to 3 years (Cipriano 2002).

Long- and short-finned pilot whale (*Globicephala spp.*): There are two species of pilot whales in the western North Atlantic - the Atlantic, or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus* (Waring et al. 2007). Long-finned pilot whales are distributed world wide in cold temperate waters in both the Northern and Southern Hemispheres. In the North Atlantic, the species is broadly distributed and thought to occur from 40° to 75°N in the eastern North Atlantic and from 35° to 65°N in the western North Atlantic (Abend and Smith 1999). Short-finned pilot whales are also distributed world wide in warm temperate and tropical waters. This species is found in the Gulf of Mexico (GOM) and in the western North Atlantic as far north as the central Mid-Atlantic Bight. Both species tend to favor the continental shelf break and slope, as well as other areas of high relief, but are also present offshore in pelagic environments. In the western North Atlantic, they may be associated with the Gulf Stream north wall and with thermal fronts (Waring et al. 1992).

Long- and short-finned pilot whales are difficult to differentiate from one another at sea; and therefore, reference is often made to the combined species, *Globicephala* spp (Waring et al. 2007). Due to this difficulty, the exact species' boundaries for short-finned and long-finned pilot whales in the western North Atlantic have not been clearly defined. However, their distributions are thought to overlap along the mid-Atlantic coast of the U.S. between 35° and 39°N (Payne and Heinemann 1993, Bernard and Reilly 1999).

To more clearly define the degree of overlap of the two species in the mid-Atlantic, NMFS conducted a genetic analysis on biopsy samples and samples collected from animals incidentally taken by commercial fisheries in the mid-Atlantic region. Long- and short-finned pilot whales show a distinct difference in preference for deep water, which may reflect differences in water temperature preferences. Long-finned pilot whales were found on the continental shelf and especially along the shelf break, but did not show evidence of going deeper than the shelf break. Short-finned pilot whales were present on the shelf, especially south of Cape Hatteras, along the shelf edge and in deeper water east of the shelf break (Rosel, unpublished data). No long-finned pilot whale samples were found south of 38°N except for three strandings in North Carolina. These strandings may represent aberrant animals or animals that floated farther south after dying. However, biopsy samples from the winter are needed to determine the southern limit of long-finned pilot whale's winter distribution in the mid-Atlantic region. No short-finned pilot whales were identified north of 40°N; nor east of 71.5°W in the Mid-Atlantic Bight. Because of fairly complete sampling north of 40°N in winter and summer this may be a fairly good indication that this species is not regularly found north of this latitude. The greatest area of overlap in distribution of the two species seems to be confined to an area along the shelf edge between 38°N and 40°N in the Mid-Atlantic Bight, where long-finned pilot whales are present in winter and summer and short-finned pilot whales are present at least in summer.

Based on available information, serious injury and mortality are applied to a PBR assigned to long- and short-finned pilot whales as if they were one species. Further studies are needed to confirm the exact boundaries in this region, both spatially and temporally, and to determine whether or not there are different stocks of long- and short-finned pilot whales in the North Atlantic.

NMFS is currently conducting research to improve the understanding of the delineation and distribution of short- and long-finned pilot whales. Further sampling will help determine 1) whether short-finned pilot whales are present in this area during winter, and 2) whether long-finned pilot whales are present farther south, and during what periods.

Population structure for neither long-finned nor short-finned pilot whales in the North Atlantic is well known. For short-finned pilot whales, there is no available information on whether the North Atlantic stock is subdivided into smaller populations. Several indirect and directed studies on long-finned pilot whales indicate that there is some degree of population differentiation within the North Atlantic. Mercer (1975) examined population dynamics of long-finned pilot whales in Newfoundland waters and noted that depletion of pilot whales due to the Newfoundland drive fishery in the 1950s did not coincide with any reduction of long-finned pilot whale landings in the drive fishery of the Faroe Islands, suggesting the existence of two or more demographically independent populations in the North Atlantic.

Similarly, Bloch and Lastein (1993) performed a discriminant analysis on morphometric characters measured from long-finned pilot whales collected in Newfoundland and Faroe Islands drive fisheries. Significant differences were found between pilot whales in these

two areas, with pilot whales in Newfoundland having significantly longer skulls and shorter bodies. In addition, Newfoundland male pilot whales had significantly longer flippers. The authors suggested that the thermal front between the North Atlantic-Irminger current and the East Greenland-Labrador current may provide a physical barrier to dispersal, thereby isolating pilot whales in these two areas and allowing differentiation to arise. They further suggested that, since this front reaches and follows the mid-Atlantic ridge southwards, it may segregate long-finned pilot whales on either side of the Atlantic basin.

Abend and Smith (1999) reviewed all available location information (sightings, strandings, bycatch and harvest reports) and inferential data (prey preferences and distributions, oceanographic processes) for long-finned pilot whales in the North Atlantic. Their conclusions regarding the geographic distribution of the species in the North Atlantic support previously published distributions. However, they concluded the distributional data provide evidence neither for nor against a single population in the Atlantic.

Most recently, Fullard et al. (2000) examined eight nuclear microsatellite markers in long-finned pilot whales from Cape Cod, MA, West Greenland, the Faroe Islands and the United Kingdom. Using standard estimates of population subdivision (FST), pairwise comparisons of the Faroe Islands to Cape Cod, the Faroe Islands to West Greenland, and the West Greenland to Cape Cod were all significantly different from each other, revealing significant genetic heterogeneity and some degree of population subdivision within the North Atlantic. Differentiation was highest between West Greenland and the other three sites suggesting that this population may be isolated from the others in the North Atlantic, perhaps due to an ecological difference between cold West Greenland waters and warmer Gulf Stream waters stretching across the Atlantic. It should be noted, that pairwise comparisons of Cape Cod to locations in the eastern Atlantic showed significant differentiation, suggesting that there may be population differentiation across the Atlantic as well. Although genetic and morphometric data, which are perhaps the best indicators of population identity, show population heterogeneity among long-finned pilot whales in the North Atlantic, neither the number of nor the geographic ranges of these smaller populations are known.

The life history of pilot whales is generally the best understood of the four marine mammal species under consideration by the ATGTRT. Pilot whales are highly social, generally found in large groups, or pods, averaging 20-90 individuals (Olson and Reilly 2002). Pilot whales are often observed in association with other marine mammal species, most commonly the common bottlenose dolphin (*Tursiops truncatus*) (Olson and Reilly 2002). Pilot whales also co-occur with Atlantic white-sided dolphins (*Lagenorhynchus acutus*), common dolphin (*Delphinus delphis*), fin whales (*Balaenoptera physalus*), sperm whales (*Physeter macrocephalus*) and minke whales (*Balaenoptera acutorostrata*) (Olson and Reilly 2002).

Pilot whales are long-lived, have delayed age of maturity, different age of maturation for females and males, seasonal mating and produce a single calf in multi-year intervals

(Olson and Reilly 2002). The birth interval of pilot whales is one of the longest of all in cetaceans,[6] with calves produced every 3 to 3.5 years (Olson and Reilly 2002).

Pilot whales reportedly feed primarily at night, with dives reported to depths of between 380 to 648 m shortly after sunset (Baird et al. 2002). Baird et al. (2002) documented deep dives of pilot whales just after sunset, the time that vertically migrating prey may become more readily available as they move closer to the surface. These researchers conclude that pilot whales feed on vertically migrating prey, with deep dives at dusk and dawn and near-surface foraging at night.

The most important prey items in the diet of *G. melas* are the squids *Loligo pealei* and *Illex illecebrosus*. Histioteuthid squids and a few other non-commercial squids are also important (Overholtz and Waring 1991; Gannon et al. 1997). In addition to squid, *G. melas* is known to prey on Atlantic mackerel (*Scomber scombrus*), Atlantic herring (*Clupea harengus*) and sliver hake (*Merluccius bilinearis*).

The diet of *G. macrorhynchus* in the western North Atlantic includes the squids *Brachioteuthis riisei* (an oceanic species), *Taonius pavo*, and *Histioteuthis reversa* (Mintzer et al. 2008). *Scopelogadus beanii* was the most abundant fish in the stomach contents of stranded *G. melas* (Mintzer et al. 2008).

Pilot whales may use echolocation to locate prey and vocalizations to maintain contact between members of the pod (Olson and Reilly 2002). There are significant differences between the vocalizations of long-finned and short-finned pilot whales; with long-finned pilot whales calls occurring at a lower and narrower frequency range than short-finned pilot whales (Olson and Reilly 2002).

Common dolphins (*Delphinus delphis*): The common dolphin may be one of the most widely distributed cetacean species. It is found worldwide in temperate, tropical, and subtropical seas (Waring et al. 2007). There are two species of common dolphin – short-beaked and long-beaked. Only short-beaked dolphins occur in the North Atlantic. Westgate (2005), the only existing study on short-beaked common dolphins in the western North Atlantic, found no significant differences between genetic samples of common dolphins split north and south of 39° N lat. in the northwest Atlantic or those found closer or farther from the shore. However, samples were collected in the north in the summer and in the south in the winter and hence may represent the same stock (i.e., the results could be confounded by seasonal migration). Due to the high genetic diversity of this species, a study with a much larger sample size should be conducted in which samples are collected in both seasons and in both regions. The study did find significant differences between populations in the northeast and northwest Atlantic, indicating that there is stock structure within the species (Waring et al. 2007).

In the North Atlantic, common dolphins appear to be present along the coast over the continental shelf along the 200-2000 m (656-6,561 ft) isobaths or over prominent

[6] Cetaceans are a diverse group of marine mammals that includes some 83 species of whales, dolphins and porpoises.

underwater topography from 50º N. to 40º S. lat. (Evans 1994). The species is less common south of Cape Hatteras, although pods have been reported as far south as eastern Florida (Gaskin 1992). Off the northeastern U.S. coast, common dolphins are distributed along the continental slope (100 to 2000 m; 328-6,561 ft) and are associated with the Gulf Stream (CETAP 1982, Selzer and Payne 1988, Waring et al. 1992). They are widespread from Cape Hatteras northeast to Georges Bank (35° N. to 42° N. lat.) during mid-January to May (Hain et al. 1981, CETAP 1982, Payne et al. 1984). Common dolphins move onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are occasionally found in the Gulf of Maine (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant et al. 1970, Gowans and Whitehead 1995, Waring et al. 2007).

Relatively little is known about the life history of common dolphins.[7] Common dolphins feed on a variety of prey, including squid, small mesopelagic fishes found in the deep-scattering layer and epipelagic schooling fishes such as small scombroids, clupeoids and squids (Evans 1994, Ohizumi el al. 1998). Research has found that common dolphins start to feed at dusk and continue to feed throughout the night off the coast of southern California (Evans 1994). Foraging dives have been recorded to 200 m (656 ft) (Perrin 2002).

b) Marine Mammal Mortality Estimates

Waring et al. (2007b) provides a summary of the total estimated takes of marine mammal mortality in Atlantic trawl fisheries.[8] (see Appendix E also available at: http://www.nefsc.noaa.gov/nefsc/publications/tm/tm201/).

c) Significant Variables Correlated with Bycatch Rate

Bycatch rate models were used to identify variables that are most highly correlated to marine mammal bycatch in the mid-water trawl and bottom trawl fisheries.[9] These variables included spatial, temporal and environmental characteristics in addition to gear characteristics and fishing practices. While the modeling results indicate correlations between some variables and bycatch rates, in reality there may not be a causal link between a particular variable and bycatch rates. The models can also be used to quantify the effect of potential bycatch reduction measures. Observer data can be modified to

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[7] See Westgate A.J. 2005. Population structure and life history of short-beak common dolphins (*Delphinus delphis*) in the North Atlantic. PhD Dissertation, for recent advances.

[8] Observer data were used to calculate the bycatch rate (i.e., the number of dead animals per unit of fishing effort). The bycatch rate was expanded to encompass an entire fishery, to derive the total bycatch estimate. In order to do this, fishing hauls are divided into strata with similar bycatch rates, where the strata are defined by a regression model.

[9] See http://www.nero.noaa.gov/prot_res/atgtrp/presentations/091906/6Palka&Rossman.pdf and http://www.nero.noaa.gov/prot_res/atgtrp/presentations/092006/7Palka%20&%20Rossman.pdf

"simulate" the potential bycatch reduction measure. The predicted number of marine mammal mortalities that might be avoided if potential gear modifications were in place can then be estimated.

i) Mid-water trawl fisheries

The bycatch rate models indicate that the most significant predictors of marine mammal bycatch in mid-water trawl fisheries are the latitude where fishing occurs and depth of the water column. For both single and paired mid-water trawls, total bycatch from 2003 – 2005 was highest in water 51-125 fathoms (306-750 ft; 93-229 m) in depth and at a latitude of 39° N – 40° N lat. Additionally, the highest bycatch rate was found in paired trawls (NEFSC 2007).

For mid-water trawl takes of white-sided dolphins and pilot whales, other variables correlated with bycatch included: temporal variables such as time of the year (i.e., season, month), and time of day (night); spatial variables such as latitude and bottom slope (steep, i.e., ≥0.5°); gear characteristics such as scope, wireout, tow speed and net design; and fishing practices, such as target species (mackerel in mid-Atlantic on the shelf break and herring in the Northeast on the northern edge of George's Bank).

ii) Bottom trawl fisheries

According to the models, the most significant predictors of marine mammal bycatch in bottom trawl fisheries varied among pilot whales, white-sided dolphins and common dolphins. They include statistical area,[10] target fish species, sea surface temperature (SST), bottom depth, bottom slope and vessel horse power (VHP). The most significant factors for predicting bycatch rates for pilot whales, white-sided dolphins, and common dolphins are as follows:

Pilot whales: Mean annual mortality from 2001 to 2005 was highest in the Mid-Atlantic region in areas with shallow slope (<3.9°), by vessels with small VHP (<1,265 hp) targeting squid. This was followed by small VHP vessels fishing in shallow slope waters in Northeast region targeting all species "other" than squid. Several other variables were investigated for correlations with pilot whale bycatch. Some of the variables with the highest correlations included bottom depth, vessel length and gross tons, codend mesh sizes and head rope length.

White-sided dolphin: Mean annual mortality from 2001 to 2005 was highest in the Northeast region in deep waters (>142.59 m) with low (<4.44° C) to mid (≥4.44° to 6.49° C) SST. Fishing effort in these areas was dominated by the monkfish fishery. Additionally, a large proportion of white-sided dolphin observed takes occurred in statistical areas 521 and 522 in March and April when effort was highest in the cod, haddock and monkfish fisheries (See Appendix C). Several other variables were investigated for correlations with white-sided dolphin bycatch. Some of the variables with the highest correlations included time of year (month), wire out, area and latitude.

[10] See Appendix C for chart of statistical areas

Common dolphin: Mean annual mortality from 2001 to 2005 was highest in statistical areas 622 and 627 in the Mid-Atlantic region. Fishing effort in these areas where bottom slope was >0.965° (where most of the bycatch was observed) was dominated by *Illex* and *Loligo* squid fisheries. Several other variables were investigated for correlations with common dolphin bycatch. Some of the variables with the highest correlations included target species, latitude, state landed and bottom slope.

IV Observer Sampling Program

The main sources of data estimating mortalities and serious injuries of marine mammals incidental to Atlantic trawl fisheries are the Northeast Fishery Observer Program and fishery logbooks. Incidental bycatch of marine mammals in trawl gear is a rare event. As a result observer data are pooled over years to obtain statistically reliable mortality estimates with low levels of uncertainty. Due to the very large amount of fishing effort in the Northeast and Mid-Atlantic bottom trawl fisheries, a substantial increase in annual sampling coverage is required for monitoring the rare marine mammal bycatch events in these fisheries (Rossman, 2007). Observer coverage increased significantly in 2003-2005 due to increased funding. However, coverage levels are known to fluctuate annually due to changes in Congressional funding levels. Table 1 provides a summary of annual observer coverage, by trawl fishery for the years 2001 to 2005.

Table 1: Summary of Annual Observer Coverage 2001-2005

Fishery	Years	Observer Coverage
Mid-Atlantic Bottom Trawl	01-05	.01, .01, .01, .03, .03
Northeast Bottom Trawl	01-05	.01, .03, .04, .05, .12
Mid-Atlantic Mid-Water Trawl - Including Pair Trawl	01-05	0, .003, .018, .064, .084
Northeast Mid-Water Trawl - Including Pair Trawl	01-05	.001, 0, .031, .126, .199

Source: Waring et al. 2007

Fishery observers collect data on fishing operations, gear and vessel characteristics, retained and discarded catch composition, bycatch of protected species, animal biology and habitat. The biological samples currently collected by at-sea fishery observers from incidentally taken marine mammals include:

- Preliminary species identification
- Description of animals (e.g., distinguishing marks, injuries, etc.)
- Biopsy tissue sample
- Body measurements (e.g., total length, blubber thickness, flipper and fluke length)

- Body temperature
- Sex determination
- Stomach sample
- Internal organ samples
- Tag the animal with carcass tag
- Return carcasses to shore for detailed necropsies

Collection of samples from incidentally caught marine mammals can be difficult for several reasons including, but not limited to: some animals are not brought on board the vessel (e.g., due to the size of the animals, as for pilot whales, or due to lack of room on the vessel); observers do not always reach the animal before they are thrown overboard; and some animals caught are severely decomposed.

V EDUCATION AND OUTREACH PLAN

As noted in the previous section, the ATGTRT established an Education and Outreach Subgroup to develop an outreach plan to promote the exchange of information necessary to reduce the bycatch of marine mammals in Atlantic trawl fisheries. This outreach plan provides the framework within which those actions and activities necessary to achieve the goals of the overall outreach program are identified and implemented. This plan will help ensure that outreach activities and educational materials will promote efforts to achieve the overall goal of reducing marine mammal bycatch in Atlantic trawl fisheries.

The establishment and enhancement of partnerships with various groups, such as regional fishery management councils, states, industry, environmental organizations, and academia offers an opportunity to develop more effective outreach tools to increase communication with constituents. In general, partnerships bring together people with a variety of different backgrounds, experiences and perspectives. These types of partnerships can result in the development of a wide range of options for solutions to complex problems or issues. Public support for management measures can be enhanced through partnerships by increasing the understanding and acceptance of various management actions necessary to reduce interactions of marine mammals in Atlantic trawl fisheries.

Currently, there is a poor understanding of the behavior and mechanisms leading to the bycatch of marine mammals in trawl fisheries. Improving the understanding of how takes occur, including marine mammal behavior and vessel gear and operational practices specific to various trawl fisheries, is necessary to identify effective take reduction measures. The ATGTRT has identified several areas of research needed to improve the understanding of marine mammal behavior that contributes to incidental capture and potential gear modifications to reduce marine mammal interactions. In the interim, the ATGTRT has identified several potential voluntary measures that can be adopted by certain trawl fishing sectors to potentially reduce the incidental capture of marine mammals. The voluntary measures identified by the ATGTRT are as follows:

- reducing the numbers of turns made by the fishing vessel and tow times while fishing at night; and
- increased radio communications between fishing vessels about the presence and/or incidental capture of a marine mammal can alert other fishermen to the potential for additional interactions in the area.[11]

Given the uncertainty surrounding the exact circumstances that result in marine mammal interactions with trawl gear, outreach needs are not yet well defined beyond initial efforts

[11] At the 2nd Meeting of the ATGTRT in April 2007, Industry Representatives proposed several voluntary measures/actions that vessels could take to potentially reduce the potential for interactions with marine mammals. While the ATGTRT recommendation is based on consideration of the data analysis provided by NMFS Northeast Fisheries Science Center scientists, combined with the experience and expertise of fishing industry representatives on the ATGTRT, the exact efficacy of these measures in reducing marine mammal takes in trawl fisheries is uncertain.

identified in this outreach plan. The actions identified by this plan are important steps towards facilitating the exchange of information and increasing collaboration and communication efforts between various constituent groups. This collaboration is necessary to reduce the bycatch of marine mammals in various Atlantic trawl fisheries.

There are a variety of approaches and techniques available for use in public outreach. Potential outreach tools include:

- Brochures
- Informational placards
- Factsheets
- Videos
- Websites
- Direct mailings
- Email
- Displays, exhibits, and posters
- Constituent workshops and meetings
- Conferences
- Demonstrations and presentations.

As recommended research is conducted and new data become available, this new information will be available to the ATGTRT to base future management recommendations. As our understanding of the factors resulting in marine mammal bycatch in trawl fisheries improves and potential take reduction measures are identified, this section of the ATGTRS will be updated to ensure an effective education and outreach program is in place to promote measures to reduce marine mammal bycatch.

a) Goals and Objectives

The primary goals of this outreach plan are to:

1. Promote the exchange of information relevant to reducing the bycatch of marine mammals in various Atlantic trawl fisheries.

2. Increase collaboration and communication between various constituent groups in order to build, improve, and maintain effective long-term partnerships.

b) Education and Outreach Actions

The ATGTRT identified a number of outreach needs and informational materials to promote progress towards reducing the take of marine mammals in trawl gear. These outreach initiatives and materials are important elements of the over all Atlantic Trawl Gear Take Reduction Strategy.

Actions identified to promote the exchange of information necessary to help reduce marine mammal bycatch in trawl fisheries (Goal 1):

1A. Develop and distribute outreach materials to Atlantic trawl fishermen to increase awareness and understanding of current statutory and regulatory requirements related to the protection of marine mammals.
   (i) Develop and distribute fact sheet summaries detailing the requirements of the MMPA.
   (ii) Develop maps from Maine to the North Carolina/South Carolina border that show all of the closure areas and gear modification requirement areas affecting these trawl fisheries (for example, National Marine Sanctuaries and areas developed under the MMPA and the Magnuson-Stevens Fisheries Conservation and Management Act).

1B. Develop and distribute outreach materials to Atlantic trawl fishermen to assist in the identification of marine mammal species and areas where bycatch rates are relatively high.
   (i) Develop species identification placards. These informational placards should include voluntary actions that can be taken in the event of an interaction with a marine mammal and identify potential problem areas. The placards should include charts of the potential problem areas.
   (ii) Purchase and distribute the "Guide to Marine Mammals and Turtles of U.S. Atlantic and Gulf" (URI Sea Grant) to appropriate members of the fishing industry.
   (iii) Communicate the location of "hotspots," or areas where observers have seen elevated interaction with marine mammals (e.g., statistical area, time, season, etc.). This can be done through captain communications or through the distribution of fact sheets.

1C. Maintain an ATGTRT website. This website will provide a venue for providing the ATGTRT as well as other interested parties updates on the results of gear research, status of the stocks, takes of marine mammals in various trawl fisheries, meeting summaries and presentations and other relevant information.

1D. Provide regular updates to the ATGTRT on the status of marine mammal stocks, current research, funding opportunities, and other relevant issues related to the ATGTRT.

1E. Develop outreach materials on NMFS Observer Programs to improve industry understanding of Observer Program duties and data disposition (e.g., marine mammal sampling protocols, use of observer data in take estimates, etc.).

Actions identified to increase collaboration and communication efforts between various constituent groups in order to build, improve, and maintain long-term relationships (Goal 2):

2A. Convene public meetings and forums to facilitate information exchange between various interest groups.
   (i) Convene a trawl fishery characterization workshop to facilitate an understanding of different gear configurations and operational practices that exist in the Atlantic trawl fisheries of concern.
   (ii) Convene a workshop to review ongoing bycatch reduction research and the results of field trials, both domestic and international.

2B. Utilize forums such as large conferences and trade shows (e.g., Maryland Watermen's Show, Maine Fisherman's Forum, Fish Expo, etc.) as venues for education and outreach initiatives to provide information to fishermen and other industry representatives about issues related to the take of marine mammals in Atlantic trawl fisheries as appropriate.

2C. Provide regular updates on the status of research and education and outreach efforts to the members of the ATGTRT and its subgroups.

2D. Provide meeting summaries to the public through various media including press releases, website and other appropriate means.

2E. Coordinate with other federal and state agencies and organizations (e.g., the New England and Mid-Atlantic Fishery Management Councils, the Atlantic States Marine Fisheries Commission and the Marine Mammal Commission) to promote information exchange and cooperation in research and management activities related to the reduction of marine mammal bycatch in Atlantic trawl fisheries.

VI ATLANTIC TRAWL GEAR TAKE REDUCTION RESEARCH PLAN

As noted above, the ATGTRT established a Research Subgroup to develop a Research Plan. This Research Plan identifies information and research needs necessary to develop methods to achieve the goal of reducing the serious injury and mortality of marine mammals in Atlantic trawl fisheries.

a) Goal and Objectives of Research

The goal of this Research Plan is to obtain information necessary to reduce the serious injury and mortality of short- and long-finned pilot whales, Atlantic white-sided dolphins, and common dolphins taken incidental to commercial trawl fisheries operating in the Mid-Atlantic and Northeast regions of the United States to levels ZMRG, as specified in the MMPA. The objectives necessary to achieve this goal include:

- Improve our understanding of interactions between commercial fishing vessels engaged in trawl fisheries and marine mammals that result in serious injury and mortality of these species.
- Identify and develop technologically and economically feasible methods and techniques to minimize the incidental capture of marine mammals in Atlantic trawl fisheries and reduce serious injury and mortality of such interactions when they occur.

The ATGTRT has identified a number of collaborative research needs and studies, including research testing potential gear modifications and studying marine mammal behavior around trawl gear, that it believes are necessary to achieve these two objectives.

b) Atlantic Trawl Gear Take Reduction Team Recommendations

As described above, the Observer Program collects biological and fishery related information. This Research Plan has identified several recommendations for the collection of additional information to help guide the overall Take Reduction Strategy. These are as follows:

Recommendation: Fishery observers should characterize marine mammal behavior during fishing vessel operations (e.g., haul back, set, vessel transit etc.) in as much detail as possible.

Recommendation: Increase collection of biopsy samples from incidentally captured marine mammals. This is particularly important to help define stock structure and assign mortality of the long-finned and short-finned pilot whales.

Recommendation: Allocate additional observer coverage to fisheries, regions and seasons as appropriate to obtain more precise bycatch estimates.

The ATGTRT identified and discussed a list of data mining and research needs over the course of the ATGTRT meetings held to date. Among the topics discussed were such things as:

- What was known about vessel activity at the time of interactions?
- What was known about the animal's behavior that resulted in the interaction?
- Where in the trawl gear were incidentally captured animals found?
- What were the age and sex of the animals being taken?

While the answers for many of these questions are not known, relevant information that could inform research may be available in existing data. For example, preliminary indications from a cursory review of observer log notes accompanying biological sampling suggests that many of the pilot whales taken seemed to be smaller in size, potentially juveniles (Van Atten, September 2006 ATGTRT Meeting Summary). This has potential implications for mitigation measures.

Recommendation: Summarize observer log notes on conditions at time of observed marine mammal takes; the location within the trawl where animals were found; sex/age of the animal and animal behavior.

c) Research Needs

There are several general approaches for reducing the incidental capture of marine mammals and mitigating any associated serious injury and mortality due to fishing activity. These include: (1) temporal and/or spatial separation of fishing activity and marine mammals; (2) measures to reduce and/or prevent marine mammals from interacting with fishing gear; (3) gear and operational modifications to exclude and/or release marine mammals while reducing serious injury and mortality in the event interactions occur.

Research is needed to identify effective measures to reduce the incidental take of marine mammals in Atlantic trawl fisheries. Basic questions exist about the precise nature of how takes of marine mammals occur in trawl fisheries. An improved understanding of these uncertainties is vital to the identification and development of effective techniques to reduce and mitigate these interactions. Research is needed to answer fundamental questions about both the biology and behavior of marine mammals that result in their incidental capture by commercial trawl fisheries. Research is also needed to find technologically feasible methods of reducing cetacean bycatch in trawl fisheries, including gear and operational techniques.

Given the number of species and fisheries under consideration by the ATGTRT it is likely that no single method or technique will work for all fisheries and species under consideration. To obtain the best results from research, there should be coordination between researchers, industry representatives, environmental organizations, and federal and state managers.

The research tasks identified below can be grouped as follows:[12] (1) Those that describe /identify the problem (shows how marine mammals and fish react around gear); and (2) Those that address the problem (e.g., deterrents, gear modifications, etc.).

(1) Small Cetacean

Uncertainty remains as to the exact nature, mechanisms and animal behavior that lead to interactions between small cetaceans and trawl fisheries. As discussed above, relatively little is known about the life histories of the marine mammal species under consideration by the ATGTRT, particularly common and white-sided dolphins.

i) Stock Structure

Accurate stock structure delineation allows for accurate abundance estimates and appropriate bycatch limits. If a population is identified as one large stock but is actually two separate stocks, then PBR will be set too high. This can potentially place a heavy burden on one stock and risk the loss of genetic diversity. On the other hand, if two stocks are defined, but they actually constitute one large stock, then regulations on the fisheries could be too restrictive.

As discussed, long-finned pilot whales are found primarily in the northern portion of the North Atlantic and short-finned pilot whales are found primarily in the southern portion, but the two species overlap in the mid-Atlantic. Habitat preferences are perhaps influenced by a preference for water depth or temperature. As noted, genetic studies suggest that the greatest area of overlap occurs between 38°N and 40°N lat., where long-finned pilot whales are present in winter and summer and short-finned pilot whales are present at least in summer. Given the available information, serious injury and mortality are applied to a PBR assigned to long- and short-finned pilot whales as if they were one species. Further studies are needed to confirm the exact boundaries in this region, both spatially and temporally, and to determine whether or not there are different stocks of long- and short-finned pilot whales in the North Atlantic.

NMFS is currently conducting research to improve the understanding of the delineation and distribution of short- and long-finned pilot whales. The results will be useful for defining summer and early fall distributions. However, current research will not be useful for determining the extent of overlap between the two species in the winter in the mid-Atlantic because genetic samples are not available for that season. Accomplishing this requires winter cruises to collect biopsies and habitat data simultaneously so the habitat modeling can occur. Thus, assigning mortalities to a given pilot whale species in late fall and winter will not be possible until this information is available.

[12] Though some research within tier 2 cannot occur until after 1 is completely defined, it is possible to conduct some research tasks within tier 2 immediately because a general idea of the problem is known.

Research Task: Improve abundance estimates for all species affected by the ATGTRT by conducting more surveys in the future, by appropriately incorporating data from multiple years, and by using appropriate stock structure boundaries.

Research Task: Complete genetic analyses necessary to partition takes of short- and long- finned pilot whales in commercial fisheries to species and establish stock specific PBR rates for each species.

Research Task: Conduct winter research cruises to collect biopsy samples and collect habitat data for use in habitat modeling to establish the extent of overlap between the two species of pilot whales in the winter in the mid-Atlantic region.

Atlantic white-sided dolphins (*Lagenorhynchus acutus*) are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100m depth contour (Waring et al. 2006). The species inhabits waters from central West Greenland to North Carolina (about 35° N. lat.) and perhaps as far east as 43° W. long. (Evans 1987).

As noted, very little is known about the stock structure of white-sided dolphins in the Northwest Atlantic. However, distribution of sightings, strandings and incidental takes suggest the possible existence of three stocks: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka et al. 1997). Evidence for a separation between the southern Gulf of Maine population and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic side of Nova Scotia (Waring et al. 2007).

Research surveys have documented relatively large inter-annual variations in population abundance estimates in U.S. waters. This variation may be related to movements of the stock associated with habitat features such as water temperature and prey availability. Research should be conducted to improve our understanding as to whether environmental and biological factors are responsible for the relatively large inter-annual variability in Atlantic white-sided dolphin abundance.

Research Task: Model environmental and biological factors that may be responsible for the large inter-annual variability in abundance estimates for Atlantic white-sided dolphins.

There are two species of common dolphin – short-beaked and longbeaked. Only short-beaked dolphins occur in the north Atlantic. The one existing study (Westgate 2005)[13] did not find significant differences between samples split north and south of 39° N in the northwest Atlantic or those found closer or farther from the shore, but there are

[13] Westgate (2005) tested the proposed one-population-stock model using a molecular analysis of mitochondrial DNA (mtDNA), as well as a morphometric analysis of cranial specimens. Both genetic analysis and skull morphometrics failed to provide evidence of more then a single population in the western North Atlantic, supporting the proposed one stock model.

significant differences between the stocks in the northeast and northwest Atlantic. Due to their high genetic diversity, a study with a much larger sample size should be conducted.

Research Task: Conduct research study utilizing morphometrics and molecular genetic analysis to confirm previous similar research results supporting one stock model of common dolphins in western north Atlantic.

ii) Marine Mammal Behavior that May Result in Fishery Interactions

To reiterate, little is known about the behavior of marine mammals taken incidental to trawl fisheries. The ATGTRT discussed a number of issues related to marine mammal behavior that might result in the incidental take of marine mammals in Atlantic trawl fisheries. These issues included:

- Are the animals just in the wrong place at the wrong time, or are they attracted to the trawls?
- If the animals are attracted to the trawls, what cues do they use to locate the gear?
- If the animals are attracted to the trawls, at what point during fishing do they interact with the gear (e.g., when do interactions occur? during haul back, vessel turns during tows? etc)?

The answers to these questions are complicated by the fact that very little is known about specific cetacean behavior while interacting with trawl gear. An additional complicating factor is that there are four different species and several different trawl fisheries under consideration by the ATGTRT. Different species may react to trawl gear in different ways and the various trawl fisheries use different trawl gear configurations and fishing methods. Consequently, a single type of gear modification or mitigation method is not likely to decrease bycatch for every fishery and marine mammal species.

Marine mammals are often sighted near fishing vessels during normal fishing operations. It is not known if this is when most interactions occur, because recorded sightings are opportunistic rather than systematic and therefore are difficult to quantify or analyze (Van Atten, presentation to ATGTRT 2006).

Marine mammals have been observed actively feeding in the mouth of trawl gear or conducting active forays further into the net. At the present time, it is not known if the cetaceans are feeding on the target species or on prey that slips through the net. Marine mammals have been observed feeding behind trawl gear on discards and fish slipping through the meshes of the net (see Fertl and Leatherwood 1997, Zollett 2005). Conversely, another hypothesis is cetaceans may be playing around the nets rather than feeding in them.

Based on records from observer trips from 2000-2005 where sufficient details were available, white-sided dolphins were mainly trapped in the belly of the trawl and the codend, while common dolphins and pilot whales were mostly caught in the codend. While conducting research to reduce common dolphin bycatch in trawl fisheries in the

United Kingdom (UK), the Sea Mammal Research Unit (SMRU)(University of St. Andrew, Scotland) found that all the captured animals were recovered from the back end of the net's extension piece (MacKay, presentation to ATGTRT 2006).

There are a number of possible reasons and mechanisms drawing the animals to the nets, as well as potential options for deterrence. Sound may be an important cue for attracting marine mammals to the trawls. The open ocean is a good environment for sound transmission. Under favorable conditions, sounds produced by fishing vessels can transmit over distances of several kilometers. Odontocete cetaceans (toothed whales and dolphins) rely heavily on acoustics to sense their environment. They use both passive listening and active sonar (i.e., echolocation). Odontocetes possess excellent hearing. The frequency sensitivity of the auditory system is not well known for either species of pilot whale. However, the most sensitive range of hearing for an animal is often similar to the frequency range of the sounds they produce. In addition to passive hearing, cetaceans have a finely-honed echolocation capacity that allows them to distinguish very small differences between objects. Depending on what the animals are targeting, however, they may not be using echolocation to detect the trawls. There has been significant hearing research conducted primarily with bottlenose dolphins and harbor porpoise but not other species.

Audiograms have been published for both Risso's (*Grampus griseus*) and common (*Delphinus delphis*) dolphins. Nachtigall *et al.* (2005) used auditory evoked potentials (AEP) to measure the hearing thresholds of one stranded infant Risso's dolphin, finding a typical U-shaped audiogram curve with hearing sensitivity sharply declining after 90 kHz. AEP results showed hearing sensitivity for this infant Risso's dolphin between 4 and 150 kHz, with maximum sensitivity ranging widely between 22.5 and 90 kHz. An earlier study by Nachtigall *et al.* (1995) looked at the hearing response of one adult Risso's dolphin using behavioral methods and found that this adult's hearing sensitivity was between 1.6 and 110 kHz, with maximum sensitivity between 8 and 64 kHz. When compared to the hearing of the adult, the infant was found to hear at much higher frequencies. The infant was also found to have lower hearing thresholds at higher frequencies but higher thresholds at lower frequencies than the adult Risso's dolphin.

Popov and Klishin (1998) measured auditory brain stem responses (ABR) of a sick male common dolphin and found hearing sensitivity to occur between approximately 10 and 150 kHz, with maximum sensitivity between 60 and 70 kHz. The audiogram most likely would have been U-shaped, but frequencies below 10 kHz were not measured. Similar to the infant Risso's audiogram, this common dolphin's audiogram showed hearing sensitivity sharply declining after approximately 100 kHz.

It is important to note that individual differences in dolphin hearing do exist, as demonstrated by Ridgway and Carder (1997). Thus, caution should be taken when interpreting results from small sample sizes as hearing sensitivities could range between individuals. Ridway and Carder (1997) also showed that high-frequency hearing appears to become less sensitive or even lost as dolphins get older, which may explain the audiogram differences in the adult and infant Risso's dolphins.

In addition to their sensitivity to sound, cetaceans have good vision (Gannon, presentation to ATGTRT 2006). Understanding the visual acuity of marine mammals is an important factor that may provide a means to deter marine mammals or facilitate post-capture release of animals once captured in trawl gear.

Research Task: Use cameras and other technologies to document underwater behavior of cetaceans around and within trawl gear.

Research Task: Photo-document the activity of cetaceans around nets to show the prevalence of marine mammals in close proximity to fishing vessels and the conditions under which interactions occur. These images should be associated with other data collected about environmental conditions and vessel activities (e.g, haul back, setting out, vessel turns).

Research Task: Investigate novel technological techniques to document marine mammal behavior (e.g., use of sonar to document marine mammal behavior around and within trawls).

Research Task: Conduct research into the auditory and visual capacity of cetaceans that may be utilized in the development of potential deterrent and exclusion measures.

iii) Prioritization of Small Cetacean Research Needs

Research is needed to improve our understanding of the marine mammal behaviors that result in interactions with Atlantic trawl fisheries, stock structure and the relationship between PBR and bycatch for each stock. This research is essential to developing measures to reduce the take of marine mammals in Atlantic Trawl fisheries and should be addressed as expeditiously as possible.

The ATGTRT recommends that research to address these uncertainties focus on those marine mammal species closest to their respective PBRs and in fisheries with the highest bycatch rates. The Team recommends a mixed approach of task implementation priority; including consideration of such factors as cost and ease of implementation (i.e., "low hanging fruit") combined with the more difficult research studies that focus on the most critical issues. Prioritization of research should take into consideration the potential of the research to result in measures to reduce bycatch, costs and funding availability, technological and operational feasibility, and the difficulty in acquiring statistically meaningful results given the low probability of interactions.

(2) Marine Mammal Bycatch Mitigation Techniques

As discussed, research is needed to improve our understanding of the exact behavior and mechanisms that result in the capture of marine mammals in trawl fisheries. In addition

the ATGTRT discussed a number of potential factors associated with normal fishing operations that might result in the bycatch of marine mammals. For example, there are a number of vessel operational practices that may result in the capture of marine mammals that are in the vicinity or actively foraging within trawl gear. Fertl and Leatherwood (1997) note that cetaceans actively foraging with trawl gear during the haul may become captured when the boat slows or stops to haul in the catch. Changes in speed or direction of a vessel may contribute to cetacean bycatch due to changes in the size and shape of the net. The profile of the mouth of the net and the net itself may change significantly during different phases of fishing, particularly during haulback and vessel turns (Northridge 1988, see also Zollett 2005).

The ATGTRT has identified several potential methods and techniques that should be investigated to determine their effectiveness in reducing interactions between trawl fisheries and marine mammals. These include the following:

- Use video cameras to examine the behavior of fish and cetaceans in the trawl nets;
- Conduct research into soft V-grids;
- Use a combination of noise or visual deterrents and escape openings designed to alert cetaceans without blocking the net;
- Employ "smart" deterrents, such as pingers;
- Provide a simple opening with no excluder;
- Use flexible grids that may be deployed from net drums more easily; and
- Investigate operational changes such as methods of hauling back, setting, turning the boat during towing operations, and use the acoustics of the boat to alert cetaceans.

i) Fishing Practice and Gear Modification Research Needs

The ATGTRT recommends that a phased research strategy be initiated as a first step in identifying potential gear modifications to reduce bycatch. In the first phase, the fishing industry would utilize video equipment to document gear performance and configuration during normal trawl operations. Video and sonar would be used to document marine mammal interactions with trawl gear. This phase of research would be conducted in consultation with NMFS researchers from Northeast Fisheries Science Center (NEFSC), Southeast Fisheries Science Center (SEFSC), and the Northeast Regional Office (NERO) Gear Team.

In the second phase of research, the fishing industry would conduct field trials with various excluder devices and other gear modifications documenting the performance of various fishing practice modifications. These investigations might include such things as reducing the number of turns by the vessel, tow time, etc. The industry would again work in consultation with NMFS staff including NEFSC and SEFSC's Pascagoula Lab as well as industry consultants.

In the third phase of research, the industry and partners would present the results of its investigations to the ATGTRT for review and discussion. Based on the results, the ATGTRT will discuss potential recommendations for additional research and actions necessary to reduce marine mammal interactions with trawl fisheries.

In summary:

Phase 1

- Industry video of normal trawl operations.
- Industry video and sonar of marine mammals interacting with gear (in consultation with NMFS).

Phase 2

- Field experimentation with various excluder devices and other gear modifications (TBD)(in consultation with NEFSC, SEFSC – Pascagoula Lab, industry consultants, etc.).
- Observations of fishing practice modifications.

Phase 3

- Industry and partners bring results of research to Research Subgroup and the ATGTRT to discuss the information and how to move forward.

Research Task: Conduct research on gear modifications and/or operating procedures to minimize the incidental capture of marine mammals and reduce serious injury and mortality of such interactions when they do occur (e.g., escape panels, exclusion grids, operational effects on gear performance and net profile).

ii) Review Bycatch Techniques Utilized in Other Domestic and International Trawl Fisheries

Research relevant to the development of bycatch reduction strategies for Atlantic trawl fisheries has been conducted both domestically and internationally. A review of such research should be undertaken to identify potential techniques that may be employed in Atlantic trawl fisheries in the United States to reduce the incidental serious injury and mortality of marine mammals.

The results of these research studies should be reviewed as part of efforts to develop Atlantic trawl bycatch reduction techniques and strategies. For example, as discussed above, researchers at the SMRU are conducting ongoing research, mainly focused on exclusion devices, to develop mitigation strategies for common dolphin bycatch incidental to trawl fisheries in the UK. The work was undertaken at the request of fishing industry due to concerns over the high rates of bycatch of common dolphins. Researchers concluded, based on patterns of bycatch that the dolphins seem to be attracted to the nets. However, the animals did not seem to be pursuing the target catch

because the target species was not found in stomach content analysis of bycaught dolphins.

SMRU researchers have tested two types of mitigation devices – acoustic deterrents and exclusion grids. Based on research study results, acoustic deterrence was ineffective (or yielded inconsistent results). Experiments with exclusion grids resulted in significant decreases in bycatch of common dolphins. The use of a live video feed with the exclusion device was essential, allowing researchers to observe the workings of the gear and the behavior of the dolphins, and allowing fishermen to see whether the targeted fish species were escaping (MacKay, presentation to ATGTRT 2006). The researchers tested grids using three types of materials, steel, steel tubes, and flexi, to test whether different materials had varying impacts on common dolphin and target fish escape rates. The SMRU researchers concluded that common dolphins are capable of detecting all three types of exclusion grids used in experimental field trials (i.e., flexi, steel, steel tube) (Mackay, presentation to ATGTRT 2006). Of the steel and flexi grids, the flexi proved easier for the crew to handle. Any differences in fish losses between these two grids were not evident. After the dolphins escaped from the nets in the UK study, researchers observed them swimming strongly. Based on the video footage, the common dolphins always seemed aware of the grid and did not appear to hit the grids when escaping from the nets.

MacKay (2006) noted that, based on the results of research in the UK, the challenge is to design the nets to allow for ease of cetacean escape. Current research involves conducting further trials of the escape hatches. Researchers will explore additional modifications, such as methods for rendering the escape routes more obvious and net designs, that will provide animals with more areas from which to exit the trawl net.

Another example is French researchers experimented with a small panel area made of bungee – some common dolphins escaped, while others failed to find or use the escape route (Mackay, presentation to ATGTRT 2006). The 360-degree bungee panel, which will be tested in the 2006/2007 season, will give the animals alternatives for escape. Observations of dolphins in the net showed that while some tried to go out the sides or bottom, most swam upwards to escape (MacKay, ATGTRT presentation 2006).

Although studies of exclusion grids conducted in New Zealand in the 1990s showed some injuries to escaping animals, the cause was likely caused by some other part of the fishing gear rather than the grid itself, as such injuries were also seen in bycaught seals when a grid was not present (Gibson and Isakssen 1998).

Research Task: Review domestic and international bycatch reduction research related to trawl fisheries to identify potential techniques that may be employed in Atlantic trawl fisheries in the United States to reduce the take of marine mammals.

Research Task: Coordinate with international and domestic researchers in the identification and implementation of marine mammal bycatch reduction research in Atlantic trawl fisheries.

iii) Acoustic and Other Potential Marine Mammal Deterrence/Mitigation Techniques

As discussed above, marine mammals rely heavily on acoustics to sense their environment. Various methods exist that may deter marine mammals from commercial fishing gear. Acoustical pingers have been used in gillnet fisheries to mitigate the incidental bycatch of various species of marine mammals (e.g., harbor porpoise in the Gulf of Maine). Other deterrence methods, such as projecting bright lights or using pingers emitting killer whale sounds, could be investigated to determine their potential to deter and mitigate marine mammal interactions with trawl gear. In addition, research has been conducted to determine whether behavioral modification techniques might be used to reduce marine mammal interactions with commercial fisheries. For example, efforts have been undertaken in longline fisheries to determine whether setting and hauling of unbaited sets might reduce marine mammal predation on target species due to gear deployment and retrieval feeding cues.

Research Task: Investigate the use of acoustical deterrence techniques to reduce bycatch including pingers and predator vocalizations (e.g., killer whale).

Research Task: Investigate the use of visual deterrence techniques to reduce bycatch (e.g., lights, light sticks, reflective twine/rope).

Research Task: Investigate auditory cues such as vessel operational acoustics (e.g., gear deployment, haul back, engine, etc.) that may increase interactions between trawl fisheries and marine mammals.

d) Prioritization of Gear Research Needs

Research should be focused initially on those fisheries with the highest bycatch rates of marine mammal stocks nearest to their respective PBRs. Existing data can be used to identify which trawl fisheries are the highest priority in terms of interactions with marine mammals. For example, the ATGTRT believes that research to address takes of Atlantic white-sided dolphin and pilot whales is currently a higher priority than common dolphin, which is close to its respective ZMRG.

As noted, one set or type of gear modifications is not going to be effective for each fishery under consideration by the ATGTRT. Differentiation of sub-fisheries is probably more important for the bottom trawl groundfish fishery than the mid-water trawl fisheries (e.g., it is important to identify which bottom trawl fishery are in the hotspot areas, such as statistical areas 521 & 522 during March and April because different fisheries utilize distinct techniques).

VII. Convene Bycatch Reduction and Fishery Characterization Workshops

The ATGTRT recommended that at least two workshops be convened to further progress in achieving the overall goal of the ATGTRT.

1) The ATGTRT recommended convening an Industry/NMFS workshop to discuss various trawl fisheries operating in the Mid-Atlantic and Northeastern United States in order to increase understanding of various trawl fisheries. This Workshop would help differentiate the various bottom trawl fisheries in New England and Mid-Atlantic based on fishing practices. This Workshop should include participation of invited participants including ATGTRT members to foster and facilitate a broader understanding of the characteristics and unique features and issues associated with the various trawl fisheries.

Research Task: Convene a Trawl Fishery Characterization Workshop to facilitate an increase understanding of the different gear configuration and operational practices that exist between various Atlantic trawl fisheries interacting with marine mammal species of concern.

2) The ATGTRT recommended convening a workshop that would build on the Cetacean and Sea Turtle Trawl Interaction Mitigation Workshop held in December 2005 in Atlantic City, NJ. The 2005 workshop reviewed the characteristics of trawl fisheries with takes and early field research. The goal of the workshop was to identify potential gear solutions to address the problem cetacean and sea turtle bycatch, to build communication between the industry and NMFS, and to discuss how best to test Bycatch Reduction Technology (BRT). This workshop focused mainly on cetacean bycatch. Workshop participants identified a number of options that should be investigated as part of efforts to reduce cetacean bycatch in trawl fisheries (see page 22 for recommended measures).

Research Task: Convene a workshop to review ongoing bycatch reduction research and results of field trials, both domestic and international and identify measures that warrant additional investigation as potential techniques to reduce marine mammal bycatch in Atlantic trawl fisheries.

VIII. Research and Education and Outreach Funding

The ATGTRT Coordinator shall actively monitor research and education and outreach funding opportunities and provide notification to the ATGTRT as potential funding opportunities and sources arise related to the research tasks and education and outreach needs identified the ATGTRS. The ATGTRT recommends that, when funds become available for various ATGTRT related research, the ATGTRT Research Subgroup be convened to provide guidance on which projects should be funded based on priorities and the amount of funds. The ATGTRT Coordinator will work with all ATGTRT Members to ensure other research tasks related to such issues as marine mammal biology, stock structure and education and outreach initiatives.

IX. Permitting

Prior to conducting various research tasks identified in this plan it will be necessary to obtain all relevant permits and authorizations. The ATGTRT Coordinator shall work with the ATGTRT and other interested parties to obtain all necessary permits and authorizations required by relevant federal and state laws and regulations prior to conducting research identified in this research plan.

X. Next Steps

A. Implementation, Monitoring and Evaluation

The Take Reduction Team agreed to employ an adaptive management approach to achieving the goal of the ATGTRS, to reduce serious injuries and mortalities of pilot whales, Atlantic white-sided dolphins and common dolphins in Atlantic trawl gear fisheries. The NMFS will provide the Team with annual bycatch reports for the marine mammal stocks that are incidentally taken in Atlantic trawl gear fisheries. In conjunction with the receipt of these annual bycatch reports, NMFS and the Team will assess the merits of convening future ATGTRT meetings, either in-person or via teleconferences.

In addition, the ATGTRT has identified a series of steps to monitor and evaluate the implementation of the research and education and outreach tasks recommended by the ATGTRS. The NMFS will provide the Team the following information on an annual basis:

- Status of ATGTRS implementation
- Update on status of research activities and findings
- Updated stock assessment reports
- Updates on NMFS' relevant observer program activities
- Description and status of research and monitoring projects identified by the ATGTRS including a description of key research results to date.
- Update on voluntary efforts being carried out by the Atlantic Trawl Fisheries sectors
- Updates on the modeling of marine mammal takes in Atlantic Tralw Fisheries as new results become available.

This information will assist the ATGTRT and NMFS in: (1) evaluating the status of the implementation of the ATGTRS; (2) adjusting the research program and education and outreach program as appropriate; and (3) analyzing the status of marine mammal stocks of concern, including bycatch and the need for the Team to consider possible future management measures including the development of a TRP should the best available information indicates this is warranted.

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Appendix A: Summary of Plans Recommendations and Tasks

Education and Outreach Tasks

1A. Develop and distribute outreach materials to Atlantic trawl fishermen to increase awareness and understanding of current statutory and regulatory requirements related to the protection of marine mammals.
- (i) Develop and distribute fact sheet summaries detailing the requirements of the MMPA.
- (ii) Develop maps from Maine to the North Carolina/South Carolina border that show all of the closure areas and gear modification requirement areas affecting these trawl fisheries (for example, National Marine Sanctuaries and areas developed under the MMPA and the Magnuson-Stevens Fisheries Conservation and Management Act).

1B. Develop and distribute outreach materials to Atlantic trawl fishermen to assist in the identification of marine mammal species and areas where bycatch rates are relatively high.
- (i) Develop species identification placards. These informational placards should include voluntary actions that can be taken in the event of an interaction with a marine mammal and identify potential problem areas. The placards should include charts of the potential problem areas.
- (ii) Purchase and distribute the "Guide to Marine Mammals and Turtles of U.S. Atlantic and Gulf" (URI Sea Grant) to appropriate members of the fishing industry.
- (iii) Communicate the location of "hotspots," or areas where observers have seen elevated interaction with marine mammals (e.g., statistical area, time, season, etc.). This can be done through captain communications or through the distribution of fact sheets.

1C. Maintain an ATGTRT website. This website will provide a venue for providing the ATGTRT as well as other interested parties updates on the results of gear research, status of the stocks, takes of marine mammals in various trawl fisheries, meeting summaries and presentations and other relevant information.

1D. Provide regular updates to the ATGTRT on the status of marine mammal stocks, current research, funding opportunities, and other relevant issues related to the ATGTRT.

1E. Develop outreach materials on NMFS Observer Programs to improve industry understanding of Observer Program duties and data disposition

(e.g., marine mammal sampling protocols, use of observer data in take estimates, etc.).

2A. Convene public meetings and forums to facilitate information exchange between various interest groups.
   (i) Convene a trawl fishery characterization workshop to facilitate an understanding of different gear configurations and operational practices that exist in the Atlantic trawl fisheries of concern.
   (ii) Convene a workshop to review ongoing bycatch reduction research and the results of field trials, both domestic and international.

2B. Utilize forums such as large conferences and trade shows (e.g., Maryland Watermen's Show, Maine Fisherman's Forum, Fish Expo, etc.) as venues for education and outreach initiatives to provide information to fishermen and other industry representatives about issues related to the take of marine mammals in Atlantic trawl fisheries as appropriate.

2C. Provide regular updates to the members of the ATGTRT and its subgroups on the status of research and education and outreach efforts.

2D. Provide meeting summaries to the public through various media including press releases, website and other appropriate means.

2E. Coordinate with other federal and state agencies and organizations (e.g., the New England and Mid-Atlantic Fishery Management Councils, the Atlantic States Marine Fisheries Commission and the Marine Mammal Commission) to promote information exchange and cooperation in research and management activities related to the reduction of marine mammal bycatch in Atlantic trawl fisheries.

Research Recommendations and Tasks

1. **Recommendation:** Fishery observers should characterize marine mammal behavior during fishing vessel operations (e.g., haul back, set, vessel transit etc.) in as much detail as possible.

2. **Recommendation**: Increase collection of biopsy samples from incidentally captured marine mammals. This is particular important to help define stock structure and assign mortality of the long-finned and short-finned pilot whales.

3. **Recommendation**: Allocate additional observer coverage to fisheries, regions and seasons as appropriate to obtain more precise bycatch estimates.

4. **Recommendation**: Summarize observer log notes on conditions at time of observed marine mammal takes; the location within the trawl where animals were found; sex/age of the animal and animal behavior.

5. **Research Task:** Improve abundance estimates for all species affected by the ATGTRT by conducting more surveys in the future, by appropriately incorporating data from multiple years, and by using appropriate stock structure boundaries.

6. **Research Task**: Complete genetic analyses necessary to partition takes of short- and long-finned pilot whales in commercial fisheries to species and establish stock specific PBR rates for each species.

7. **Research Task**: Conduct winter research cruises to collect biopsy samples and collect habitat data for use in habitat modeling to establish the extent of overlap between the two species of pilot whales in the winter in the mid-Atlantic region

8. **Research Task:** Model environmental and biological factors that may be responsible for the large inter-annual variability in abundance estimates for Atlantic white-sided dolphins.

9. **Research Task:** Conduct research study utilizing morphometrics and molecular genetic analysis to confirm previous similar research results supporting one stock model of common dolphins in western north Atlantic.

10. **Research Task**: Use cameras and other technologies to document underwater behavior of cetaceans around and within trawl gear.

11. **Research Task**: Photo-document the activity of cetaceans around nets to show the prevalence of marine mammals in close proximity to fishing vessels and the conditions under which interactions occur. These images should be associated with other data collected about environmental conditions and vessel activities (e.g, haul back, setting out, vessel turns).

12. **Research Task**: Investigate novel technological techniques to document marine mammal behavior (e.g., use of sonar to document marine mammal behavior around and within trawls).

13. **Research Task**: Conduct research into the auditory and visual capacity of cetaceans that may be utilized in the development of potential deterrent and exclusion measures.

14. **Research Task:** Conduct research on gear modifications and/or operating procedures to minimize the incidental capture of marine mammals and reduce serious injury and mortality of such interactions when they do occur (e.g., escape panels, exclusion grids, operational effects on gear performance and net profile).

15. **Research Task**: Investigate the use of acoustical deterrence techniques to reduce bycatch including pingers and predator vocalizations (e.g., killer whale).

16. **Research Task:** Investigate the use of visual deterrence techniques to reduce bycatch (e.g., lights, light sticks, reflective twine/rope).

17. **Research Task:** Investigate auditory cues such as vessel operational acoustics (e.g., gear deployment, haul back, engine, etc.) that may increase interactions between trawl fisheries and marine mammals.

18. **Research Task**: Review domestic and international bycatch reduction research related to trawl fisheries to identify potential techniques that may be employed in Atlantic trawl fisheries in the United States to reduce the take of marine mammals.

19. **Research Task**: Coordinate with international and domestic researchers in the identification and implementation of marine mammal bycatch reduction research in Atlantic trawl fisheries.

20. **Research Task**: Convene a Trawl Fishery Characterization workshop to facilitate an increase understanding of the different gear configuration and operational practices that exist between various Atlantic trawl fisheries interacting with marine mammal species of concern.

21. **Research Task**: Convene a workshop to review ongoing bycatch reduction research and results of field trials, both domestic and international.

Appendix B: Education and Outreach and Research Subgroups

Education and Outreach Subgroup

David Beutel, University of Rhode Island Fisheries Center
Erin Burke - Massachusetts Division of Marine Fisheries
Glenn Delaney – Northeast Seafood Coalition
Greg DiDomenico, Garden State Seafood Association
Pat Fiorelli – New England Fishery Management Council
Glenn Goodwin - Seafreeze, Ltd
Elizabeth Griffin, Oceana
Jeff Kaelin - F/V Providian, Resource Associates
Rick Marks - Roberston, Monagle & Eastaugh
Kerri Lynn Miller - Oceana
Rich Seagraves – Mid-Atlantic Fishery Management Council

NMFS Staff

Melissa Andersen - Office of Protected Resources
Ellen Keane – Northeast Regional Office
Mark Minton – Northeast Regional Office
Allison Rosner – Northeast Regional Office
Glenn Salvador – Northeast Regional Office, Gear Team
Amy Van Atten - - Northeast Fisheries Science Center

Research and Gear Mitigation Subgroup[14]

David Beutel, University of Rhode Island Fisheries Center
Erin Burke - Massachusetts Division of Marine Fisheries
Glenn Delaney – Northeast Seafood Coalition

[14] Lynne Williams, Duke University Marine Laboratory provided assistance to the Team on delphinid acoustics

Greg DiDomenico, Garden State Seafood Association

Pat Fiorelli – New England Fishery Management Council

Glenn Goodwin - Seafreeze, Ltd

Elizabeth Griffin, Oceana

Shaun Heena, Swan Net

Jeff Kaelin - F/V Providian, Resource Associates

Rick Marks - Roberston, Monagle & Eastaugh

Bill McLellan - University of North Carolina, Wilmington

Rich Seagraves, Mid-Atlantic Fishery Management Council

Terry Stockwell - Department of Marine Resources

Sharon Young, Humane Society of the United States

NMFS Staff:

Melissa Andersen - Office of Protected Resources

John Higgins – Northeast Regional Office, Gear Team

John Kenney - Northeast Regional Office, Gear Team

Henry Milliken – Northeast Fisheries Science Center

Mark Minton – Northeast Regional Office

Dr. Debra Palka – Northeast Fisheries Science Center

Patty Rosel – Southeast Fisheries Science Center

Marjorie Rossman - Northeast Fisheries Science Center

Glenn Salvador - Northeast Regional Office, Gear Team

Amy Van Atten - Northeast Fisheries Science Center

ATLANTIC TRAWL TEAM TAKE REDUCTION TEAM

Members and Alternates

Melissa Andersen - National Marine Fisheries Service, Office of Protected Resources

Regina A. Asmutis-Silvia - Whale and Dolphin Conservation Society

Susan G. Barco - Virginia Aquarium and Marine Science Center, Stranding Program

David Beutel - University of Rhode Island Fisheries Center

William Bright - Loper-Bright Enterprises, F/V Retriever

Erin Burke - Massachusetts Division of Marine Fisheries

Brendan Cummings - Center for Biological Diversity

Glenn Delaney - Northeast Seafood Coalition

Gregory DiDomenico - Garden State Seafood Association

Patricia Fiorelli - New England Fishery Management Council

Damon Gannon – Bowdoin College, Kent Island field research station

Glen Goodwin - Seafreeze, Ltd., F/V Relentless

Elizabeth Griffin – Oceana

Shaun Heena - Swan Net East Coast Services

Nick Jenkins – F/V

Jeff Kaelin - F/V Providian, Resource Associates

Jessica Koelsch - The Ocean Conservancy

Robert Lane – F/Vs Isabel S. & Melissa Jayne

Stephen Lee - F/V Kirsten Lee

Jim Lovgren - F/V Sea Dragon

Kerri Lynn - Oceana

Rick Marks - Roberston, Monagle & Eastaugh

Mark Minton - National Marine Fisheries Service

Dan McKiernan - Massachusetts Division of Marine Fisheries

William McLellan - University of North Carolina, Wilmington

Peter Moore - American Pelagic Association

Jackie Odell - Northeast Seafood Coalition

Gerry O'Neill - F/Vs Voyager, Challenger, & Endeavor

Ryan Raber - F/V Providian

Eoin Rochford - Norpel

Jim Ruhle - F/V Darana R

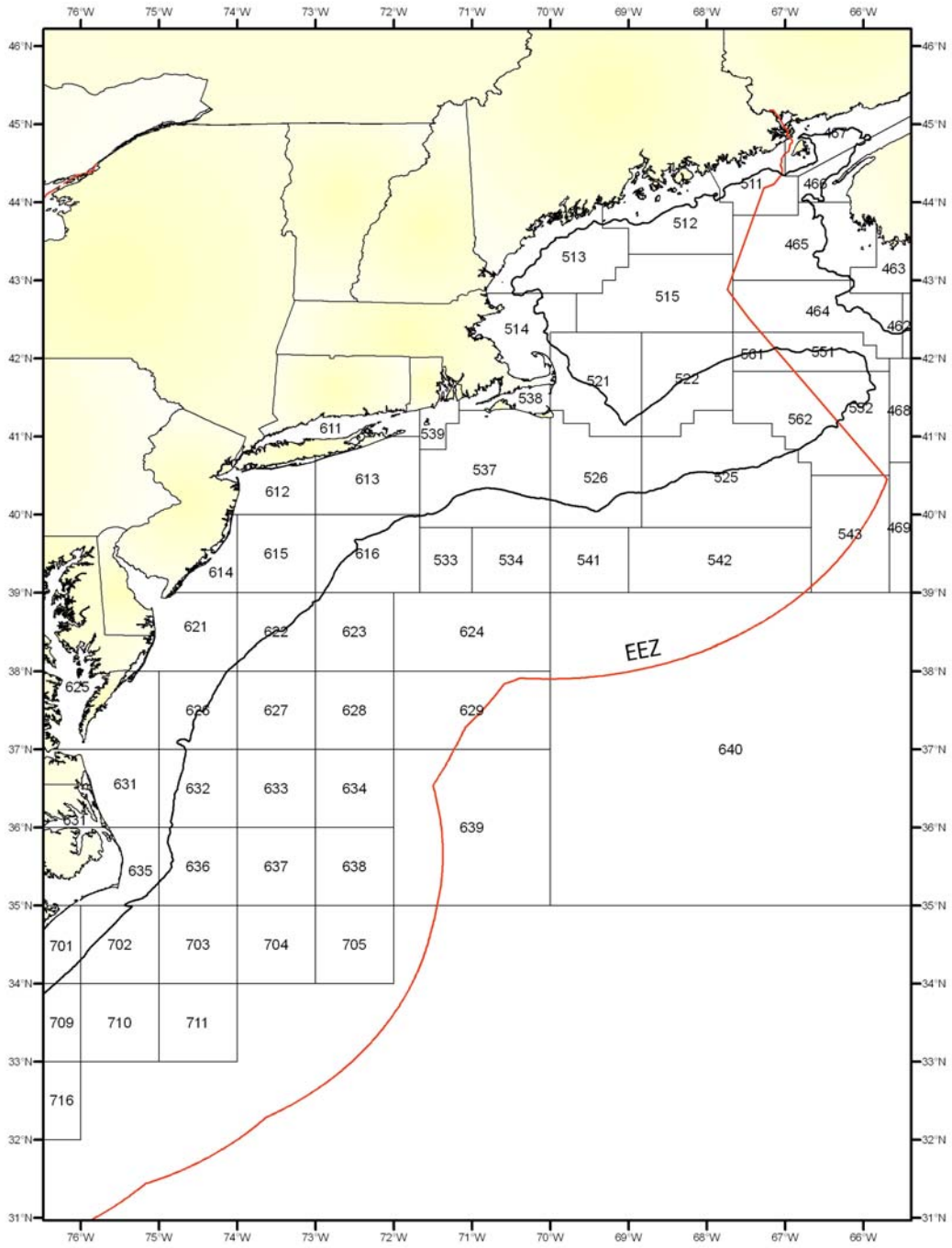
Rich Seagraves - Mid-Atlantic Fishery Management Council

Michael Simpkins - Marine Mammal Commission

Terry Stockwell - Maine Department of Marine Resources

Sharon Young - Humane Society of the United States

APPENDIX C: Statistical Areas



Appendix D: Fishery Descriptions[15]

Mid-Atlantic Bottom Trawl

Target Species: Include, but are not limited to: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny and Smooth Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, Scup, Black Sea Bass, Skate spp, Atlantic Mackerel, *Loligo* Squid, *Illex* Squid, and Atlantic Butterfish.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: To Be Determined

Mixed Groundfish Bottom Trawl Total Effort: Total effort, measured in trips, for the Mixed Groundfish Trawl from 1998 to 2004 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725 and 22,303, respectively (NMFS). The number of days absent from port, or days at sea, is yet to be determined.

Squid, Mackerel, Butterfish Bottom Trawl Total Effort: Total effort, measured in trips, for the domestic Atlantic Mackerel Fishery in the Mid-Atlantic Region (bottom trawl only) from 1997 to 2004 were 373, 278, 262, 102, 175, 310, 238, and 231, respectively (NMFS). Total effort, measured in trips, for the *Illex* Squid Fishery from 1998 to 2004 were 412, 141, 108, 51, 39, 103, and 445, respectively (NMFS). Total effort, measured in trips, for the *Loligo* Squid Fishery from 1998 to 2004 were 1,048, 495, 529, 413, 3,585, 1,848, and 1,124, respectively (NMFS). Atlantic Butterfish is a bycatch (non-directed) fishery, therefore effort on this species will not be reported. The number of days absent from port, or days at sea, is yet to be determined.

Temporal and Spatial Distribution: The Mixed Groundfish Fishery occurs year-round from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Because of spatial and temporal differences in the harvesting of *Illex* and *Loligo* Squid and Atlantic Mackerel, each one of these sub-fisheries is described separately.

***Illex* Squid**

The U.S. domestic fishery for *Illex* Squid, ranging from Southern New England to Cape Hatteras, North Carolina, reflects patterns in the seasonal distribution of *Illex* Squid (*Illex illecebrosus*). *Illex* is harvested offshore (along or outside of the 100m isobath), mainly by small-mesh otter trawlers, when the Squid are distributed in continental shelf and slope waters during the summer months (June-September) (Clark 1998).

[15] Source: Waring et al 2007

***Loligo* Squid**
The U.S. domestic fishery for *Loligo* Squid (*Loligo pealeii*) occurs mainly in Southern New England and mid-Atlantic waters. Fishery patterns reflect *Loligo* seasonal distribution, therefore most effort is directed offshore near the edge of the continental shelf during the fall and winter months (October-March) and inshore during the spring and summer months (April-September) (Clark 1998).

Atlantic Mackerel
The U.S. domestic fishery for Atlantic Mackerel (*Scomber scombrus*) occurs primarily in the Southern New England and mid-Atlantic waters between the months of January and May (Clark 1998). An Atlantic Mackerel Trawl Fishery also occurs in the Gulf of Maine during the summer and fall months (May-December) (Clark 1998).

Atlantic Butterfish
Atlantic Butterfish (*Peprilus triacanthus*) undergo a northerly inshore migration during the summer months, a southerly 334 offshore migration during the winter months, and are mainly caught as bycatch to the directed Squid and Mackerel Fisheries. Fishery Observers suggest that a significant amount of Atlantic Butterfish discarding occurs at sea.

Gear Characteristics: The Mixed Groundfish Bottom Trawl Fishery gear characteristics have not yet been determined or summarized. The *Illex* and *Loligo* Squid Fisheries are dominated by small-mesh otter trawls, but substantial landings of *Loligo* Squid are also taken by inshore pound nets and fish traps during the spring and summer months (Clark 1998). The Atlantic Mackerel Fishery is prosecuted by both mid-water (pelagic) and bottom trawls.

Management and Regulations: The Mid-Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). There are at least 2 distinct components to this fishery. One is the mixed groundfish bottom trawl fishery. It is managed by several federal and state FMPs that range from Massachusetts to North Carolina. The relevant FMPs include, but may not be limited to, Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup, and Black Sea Bass (FR 68(1), 50 CFR part 648); and Northeast Skate Complex (FR 68(160), 50 CFR part 648). The second major component is the squid, mackerel, butterfish fishery. This component is managed by the federal Squid, Mackerel, Butterfish FMP. The *Illex* and *Loligo* Squid Fisheries are managed by moratorium permits, gear and area restrictions, quotas, and trip limits. The Atlantic Mackerel and Atlantic Butterfish Fisheries are managed by an annual quota system.

Observer Coverage: During the period 1996-2004, estimated observer coverage (measured in trips) for the Mixed Groundfish Bottom Trawl Fishery was 0.24%, 0.22%, 0.15%, 0.14%,1%, 1%, 1%, 1%, and 3%, respectively.

During the period 1996-2004, estimated observer coverage (trips) in the *Illex* Fishery was 3.7%, 6.21%, 0.97%, 2.84%, 11.11%, 0.00%, 0.00%, 8.74% and 5.07%, respectively.

During the period 1996-2004, estimated observer coverage (trips) of the *Loligo* Fishery was 0.37%, 1.07%, 0.72%, 0.69%, 0.61%, 0.95%, 0.42%, 0.65% and 5.07%, respectively. During the period 1997-2004, estimated observer coverage (trips) of the domestic Atlantic Mackerel Fishery was 0.81%, 0.00%, 1.14%, 4.90%, 3.43%, 0.97%, 5.04% and 18.61%, respectively. Mandatory 100% observer coverage is required on any Joint Venture (JV) fishing operation. The most recent Atlantic Mackerel JV fishing activity occurred in 1998 and 2002 where 152 and 62 transfers from USA vessels were observed respectively. Only the net transfer operations from the USA vessel to the foreign processing vessel are observed. The actual net towing and hauling operations conducted on the USA vessel are not observed.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of scup. The GRAs are spread out in time and space along the edge of the Southern New England and Mid-Atlantic Continental Shelf Region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. Access to the GRAs to harvest non-exempt species (*Loligo* Squid, Black Sea Bass, and Silver Hake) can be granted by a special permit. For detailed information regarding GRAs refer to (FR 70(2), (50 CFR Part 648.122 parts A and B)).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Long-finned Pilot Whale, Short-finned Pilot Whale, Harbor Seal, Gray Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Bottom Trawl

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, and Skate spp.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: In 2002 there were 803 active federal permits reported in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total effort, measured in trips, for the North Atlantic Bottom Trawl Fishery from 1998 to 2004 was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577 and 10,354, respectively (NMFS). An average mean of 970 (CV=0.04) vessels (full 335 and part time) participated annually in the fishery during 1989-1993. The number of days absent from port, or days at sea, is yet to be determined.

Temporal and Spatial Distribution: Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf and is distributed throughout the Gulf of Maine, Georges Bank and Southern New England Regions.

Gear Characteristics: To Be Determined

Management and Regulations: The North Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). This gear is managed by several federal and state FMPs that range from Maine to Connecticut. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648); Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648); Atlantic Bluefish (FR 68(91), 50 CFR Part 648); and Northeast Skate Complex (FR 68(160), 50 CFR part 648). These fisheries are primarily managed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1994-2005, estimated observer coverage (measured in trips) was 0.4%, 1.1%, 0.2%, 0.2%, 0.1%, 0.3%, 1%, 1%, 3%, 4%, 5%, and 12%, respectively. Vessels in the Northeast bottom Trawl Fishery, a Category II fishery under the MMPA, were observed in order to meet fishery management needs rather than monitoring for bycatch of marine mammals.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Harbor Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Herring and miscellaneous pelagic species.

Gear Characteristics: Historically, the Atlantic Herring resource was harvested by the Distant Water Fleet (DWF) until the fishery collapsed in the late 1970's. There has been no DWF since then. A domestic fleet has been harvesting the Atlantic Herring resource utilizing both fixed and mobile gears. Only a small percentage of the resource is currently harvested by fixed gear due to a combination of reduced availability and less

use of fixed gear (Clark 1998). The majority of the resource is currently harvested by domestic mid-water (pelagic) trawls (single and paired).

Management and Regulations: The Northeast Mid-Water Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). Atlantic herring are managed jointly by the MAFMC and ASMFC as one migratory stock complex. There has been a domestic resurgence in a directed fishery on the adult stock due to the recovery of the adult stock biomass.

Temporal and Spatial Distribution: The current fishery occurs during the summer months when the resource is distributed throughout the Gulf of Maine and Georges Bank regions. The stock continues on a southerly migration into mid-Atlantic waters during the winter months.

Total Effort: Total effort, measured in trips, for the Northeast Mid-Water Trawl Fishery (across all gear types) from 1997 to 2004 was578, 289, 553, 1,312, 2,404, 1,736, 2,158, and 1,564, respectively (NMFS). 336 Observer Coverage: During the period 1997-2004, estimated observer coverage (trips) was 0.00%, 0.00%, 0.73%, 0.46%, 0.06%, 0.00% , 2.25% and 11.48%, respectively. A U.S. JV Mid-Water (pelagic) Trawl Fishery was conducted on Georges Bank from August to December 2001. A total allowable landings of foreign fishery (TALFF) was also granted during the same time period. Ten vessels (3 foreign and 7 American), fishing both single and paired mid-water trawls, participated in the 2001 Atlantic Herring JV Fishery. Two out of the three foreign vessels also participated in the 2001 TALFF and fished with paired mid-water trawls. The NMFS maintained 74% observer coverage (243 hauls) on the JV transfers and 100% observer coverage (114 hauls) on the foreign vessels granted a TALFF.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B)

Protected Species Interactions: Documented interaction with White-sided Dolphin and Long-finned Pilot Whale. There were no marine mammal takes observed from the domestic Mid-Water Trawl Fishery trips during the period 1997-2002. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Mackerel, Chub Mackerel and other miscellaneous pelagic species.

Gear Characteristics: To be determined.

Management and Regulations: The Mid-Atlantic Mid-Water Trawl Fishery has been defined as a Category I fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Temporal and Spatial Distribution: To be determined.

Total Effort: Total effort, measured in trips, for the mid-Atlantic Mid-Water Trawl Fishery (across all gear types) from 1997 to 2004 was 331, 223, 374, 166, 408, 261, 428, and 360, respectively (NMFS).

Observer Coverage: During the period 1997-2004, estimated observer coverage (trips) was 0.00%, 0.00%, 1.01%, 8.43%, 0.00%, 0.77% , 3.5%, and 12.16%, respectively.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: Documented interaction with White sided dolphins and Pilot Whale spp. Not mentioned here are possible interactions with sea turtles and sea birds.

Appendix E: Estimated Serious Injury and Mortality (2001-2005)

Estimated serious injury and mortality (SI&M) of Western North Atlantic marine mammals listed by U.S. observed fisheries for 2001-2005 (Source Waring et al. 2007b).

Category, Fishery (estimated # of vessels/persons), Species	Yrs. observed	% observer coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY I						
Gillnet Fisheries: Northeast gillnet (unk)						
White sided dolphin	2001-2005	.04, .02, .03, .06. .07		26 (1.0), 30 (.74), 31 (.93), 7(.98), 59(.49)	31 (.35)	509
Common dolphin	2001-2005	.04, .02, .03, .06, .07		0, 0, 0, 0, 26	5 (.8)	1,000
Longline Fisheries: Pelagic longline (excluding NED-E)						
Long and short-finned pilot whale	2001-2005	.04, .05, .09, .09, .06	50(.58), 52(.48), 21(.49), 74(.42), 212(.21)	20 (1.0), 2 (1.0), 0, 0, 0	86 (.16)	249
CATEGORY II						
Mid-Atlantic Mid-Water Trawl – Including Pair Trawl						
White-sided dolphin	2001-2005	0, .003, .018, .064, .084	0, 0, 0, 0, 0	unk, unk, 51(.46), 105(.38), 97(.76)	84(.34)	509
Long and short-finned pilot whale	2001-2005	0, .003, .018, .064, .084	0, 0, 0, 0, 0	unk, unk, 3.9(.46), 8.1(.38), 7.5(.76)	7(.34)	249
Trawl Fisheries: Gulf of Maine/Georges Bank herring mid-water trawl - JV and TALFF						
Long and short-finned pilot whale (JV and TALFF)	2001	1.00		11 (n/a)	11 (n/a)	249
White-sided dolphin (TALFF)	2001			2 (0)	2 (0)	509
Trawl Fisheries:Northeast bottom trawl (unk)						
Harp seals	2001-2005	.01, .03, .04, .05, .12		49(1.10), 0, 0, 0, unk	unk	n/a
Harbor seals	2001-2005	.01, .03, .04, .05, .12		0, unk, 0, 0, unk	unk	2,746
Long and short-finned pilot whale	2001-2005	.01, .03, .04, .05, .12	0, 0, 0, 0, 0	21(.27), 22(.26), 21(.26), 15.29(.50), 15(.30)	19 (0.12)	249
Common Dolphin	2001-2005	.01, .03, .04, .05, .12	0, 0, 0, 0, 0	30(.30), 26(.29), 26(.29), 26(.29), 32(.28)	28 (.13)	1,000

White-sided dolphin	2001-2005	.01, .03, .04, .05, .12		161(.34), 170(.32), 216(.27), 200(.30), 213(.28)	192 (0.13)	509
Minke whale	2001-2005	.01, .03, .04, .05, .12		unk	unk	19
Harbor Porpoise	2001-2005	.01, .03, .04, .05, .12		0, 0, unk, 0, unk	unk	610
Mid-Atlantic Bottom Trawl						
White-sided dolphin	2001-2005	.01, .01, .01, .03, .03		27(.19), 25(.17), 31(.25), 26(.20), 38(.29)	29 (.11)	509
Long and short-finned pilot whale	2001-2005	.01, .01, .01, .03, .03	0, 0, 0, 0, 0	39(.31), 38(.36), 31(.31), 35(.33), 31(.31)	38(.15)	249
Common Dolphin	2001-2005	.01, .01, .01, .03, .03	0, 0, 0, 0, 0	103(.27), 87(.27), 99(.28), 159(.30), 141(.29)	118 (.13)	1,000
Northeast Mid-Water Trawl Including Pair Trawl						
Long and short-finned pilot whale	2001-2005	.001, 0, .031, .126, .199	0, 0, 0, 0,0	unk, unk, 1.9(.56), 1.4(.58), 1.1(.68)	1(.35)	249
White-sided dolphin	2001-2005	.001, 0, .031, .126, .199	0, 0, 0,0 ,0	unk, unk, 24(.56), 19(.58), 15(.58)	19(.35)	509