

A photograph of a rocky beach. The ground is covered with small, smooth, multi-colored pebbles in shades of brown, tan, and grey. A long, thin, reddish-brown piece of driftwood lies diagonally across the middle of the frame. In the lower-left quadrant, there is a piece of white, speckled shell. Another smaller piece of shell is visible in the upper-left quadrant. The overall scene is a natural, outdoor setting.

V. STATUS OF HUMAN USE

This section characterizes the primary uses occurring within or near the sanctuary, including some that are ancillary or prohibited by sanctuary regulation. It presents information on type and level of use and associated economic value, when known. The primary uses include commercial and recreational fishing, whale watching and marine transportation.



CONTEXT

The Stellwagen Bank sanctuary attracts extensive commercial, recreational, scientific and educational activities and is heavily utilized throughout all seasons. The many ports, large and small, that rim Massachusetts Bay offer direct access. Located in the backyard of an estimated 4.8 million people living in the greater Boston metropolitan area, the sanctuary is exposed to the environmental stresses of human population and development, including waste disposal and discharge and creeping industrialization along its western boundary. This section characterizes or describes the primary uses occurring within or near the sanctuary, including some that are ancillary or prohibited by sanctuary regulation.

A characterization or *status* of current uses—who, what, where, when and how the resource is affected—is pivotal to understand and evaluate the *pressures* which are applied to sanctuary resources. Some of the questions the sanctuary must address are: what do we know about the pattern and scale of these uses, how are they altering habitat structure and the organization of marine communities, and are the impacts chronic or acute? Ultimately, can we and how do we improve our ability to make human uses compatible with resource protection? Answering these questions requires a substantially improved understanding of the spatial distribution and intensity of major uses in the sanctuary.

The ONMS is mandated by Congress to facilitate uses that are compatible with the primary goal of resource protection. The term “compatible” is articulated as the standard for acceptable use in the National Marine Sanctuaries Act, but the Act does not define or provide the criteria to apply that standard. The resource protection goals articulated in the Act include comprehensive conservation and management to maintain the natural biological communities and to protect, restore and enhance natural habitats, populations and ecological processes. The previous section on Resource States presents cases where uses impact and pressure sanctuary resources.

When available, information on the types and levels of human use of the Stellwagen Bank sanctuary and the associated economic value is presented in this section. In those cases, discussion of economic value is limited to direct sales value of the products or services provided. The total economic impact of these commercial uses (i.e., market value) has not been determined as part of this management plan review process. While other uses occur and are briefly described, the primary uses addressed include commercial and recreational fishing, whale watching and marine transportation. Non-market valuation (e.g., existence value) of sanctuary resources *per se* has not been undertaken. Economic analyses using both market and non-market valuation can help ensure that management actions take into account the full range and value of ecosystem services, even if the goods or services involved are not traded in markets.



COMMERCIAL FISHING

HISTORY IN THE GOM

Commercial fishing was once the most economically important activity directly dependent on the natural resources of the GoM including Stellwagen Bank. The discovery of vast codfish grounds in the northwest Atlantic in the late 1400s by explorer John Cabot was a significant driving force behind the colonization of the New England seaboard. It was cod fishing that brought the first settlers to Gloucester, Marblehead, Salem, Weymouth and Scituate, Massachusetts (McFarland, 1911). In the decade between 1765 and 1775, the business of cod fishing actively involved 20 towns, 605 vessels, 1,475 fishermen and 9,600 others in curing, packaging and shipping (McFarland, 1911). Claesson and Rosenberg (2009) provide a historical narrative of Stellwagen Bank's fisheries and deduce from historical records the prior richness of these resources.

As the consumption of seafood increased and markets expanded, so too did the pressure to extend fishing efforts to offshore locations. The technology of fishing gear advanced rapidly with the mechanization of equipment during the 19th century. Primitive nets evolved into purse seines, otter trawls, gill nets and trap and pound nets. The major advance in the fishing industry during this time was the development and use of diesel-propelled fishing vessels, which replaced steam-driven and sail craft. Fishing gear itself became mechanized, greatly enhancing success. Ice replaced salt as the principal means of preservation and offered consumers a fresh product.

Navigation capabilities and the power and productivity of fishing improved with the introduction of electronic equipment, such as ship-to-shore telephones, LORAN and Global Positioning System (GPS) plotters, direction finders, depth indicators, the enhanced efficiency of record keeping "fish finders", radar and automatic steering devices. The introduction of synthetics, now used in most fishing gear and equipment, increased durability and cost effectiveness and further improved fishing methods.

The collective effect of these early innovations was an increase in fresh fish landings from shorter trips. As the

demand for fish grew, Boston became the primary fishing port because of its position as the New England marketing and transportation center. Gloucester businesses, suffering from this change of venue and competition from less expensive imports from Norway, Canada and Iceland, prevailed by improving fish processing techniques (notably "quick-freeze") and shipping. These industry advancements enabled the introduction of formally underutilized species to both fresh and frozen fish markets in the eastern and midwestern parts of the country.

Large foreign trawlers began fishing on Georges Bank in 1961, primarily on non-traditional fish species, such as hake, herring and squid. By 1973, approximately 300 vessels from 16 countries were also targeting more traditional domestic species, notably haddock. New England fisheries began to feel the pressure from these foreign vessels. Because there was no effective management of fisheries outside the existing U.S. 12-mile contiguous zone, the Magnuson Fishery Conservation and Management Act (MFCMA) of 1976 was passed to extend U.S. management jurisdiction out to 200 nautical miles. This action reduced the level of foreign fishing in the GoM, and for a while revitalized both New England and U.S. fisheries (MacIassac and Hotz, 1982).

Just as Gloucester is considered America's oldest seaport, Stellwagen Bank (formerly Middle Bank) is listed among the most historic fishing grounds in the GoM, harkening back to early colonial times. Today, the sanctuary area remains one of several areas of concentrated commercial fishing effort in the GoM, in addition to Jeffreys Ledge, Cashes Ledge, Tillies Bank, Brown Bank and the more expansive Georges Bank. Due to this effort, many of the principal GoM groundfish stocks are overfished and rebuilding is proving difficult (<http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0513/>). Several species among these stocks have been added to the Species of Concern List for the Endangered Species Act (<http://www.nmfs.noaa.gov/pr/species/concern/>). The Northwest Atlantic, most of which is outside of the U.S. Exclusive Economic Zone (EEZ) and therefore not subject to U.S. jurisdiction, has become one of the most overfished regions of the world (Essington *et al.*, 2006).

CURRENT TRENDS AND STATUS IN THE SANCTUARY

DATA TYPES AND SOURCES

Commercial fishing in the Stellwagen Bank sanctuary is characterized in the management plan through the use of two primary types of data from different sources: standardized surveys and mandatory Fishing Vessel Trip Reports (VTR). VTR data are used in analyses of spatial distribution of fishing effort and catches in fishery management plans (e.g., NEFMC, 2006). These data types and sources are described and compared below. The data were gathered and/or analyzed to document and typify the spatial distribution, landings value (ex-vessel, dockside sales paid to fishermen) and volume, and species composition representative of commercial fisheries in the sanctuary. Ex-vessel or landings value is the price paid to the fishermen upon direct sale of the fish landed.

The Northeast Vessel Monitoring System (VMS) is a program developed by NOAA Fisheries Service to monitor commercial vessels fishing for permitted species provided in Fisheries Regulations, Code of Federal Regulations, Title 50, Part 648. The VMS system uses specialized VMS computers and integrated Global Positioning Systems (GPS) installed on required vessels to transmit, via satellite, the vessel's identification, the vessel's location and the permit under which the vessel is operating.

VMS data in the sanctuary has limitations over VTR data when analyzing fishing effort spatially. The Northeast VMS program is a relatively new program and is in the process of phasing in more vessels; archived data only includes a fraction of the commercial vessels fishing in the sanctuary. VMS data does not differentiate between a commercial fishing vessel in transit and actively fishing. Vessel locations are transmitted hourly and only contain one location, not the entire vessel track over that hour. The limited spatial and temporal information supplied by the VMS data, as well as the inability to evaluate vessel fishing versus not fishing, render the data unsuitable for characterizing fishing within the sanctuary.

Standardized Surveys

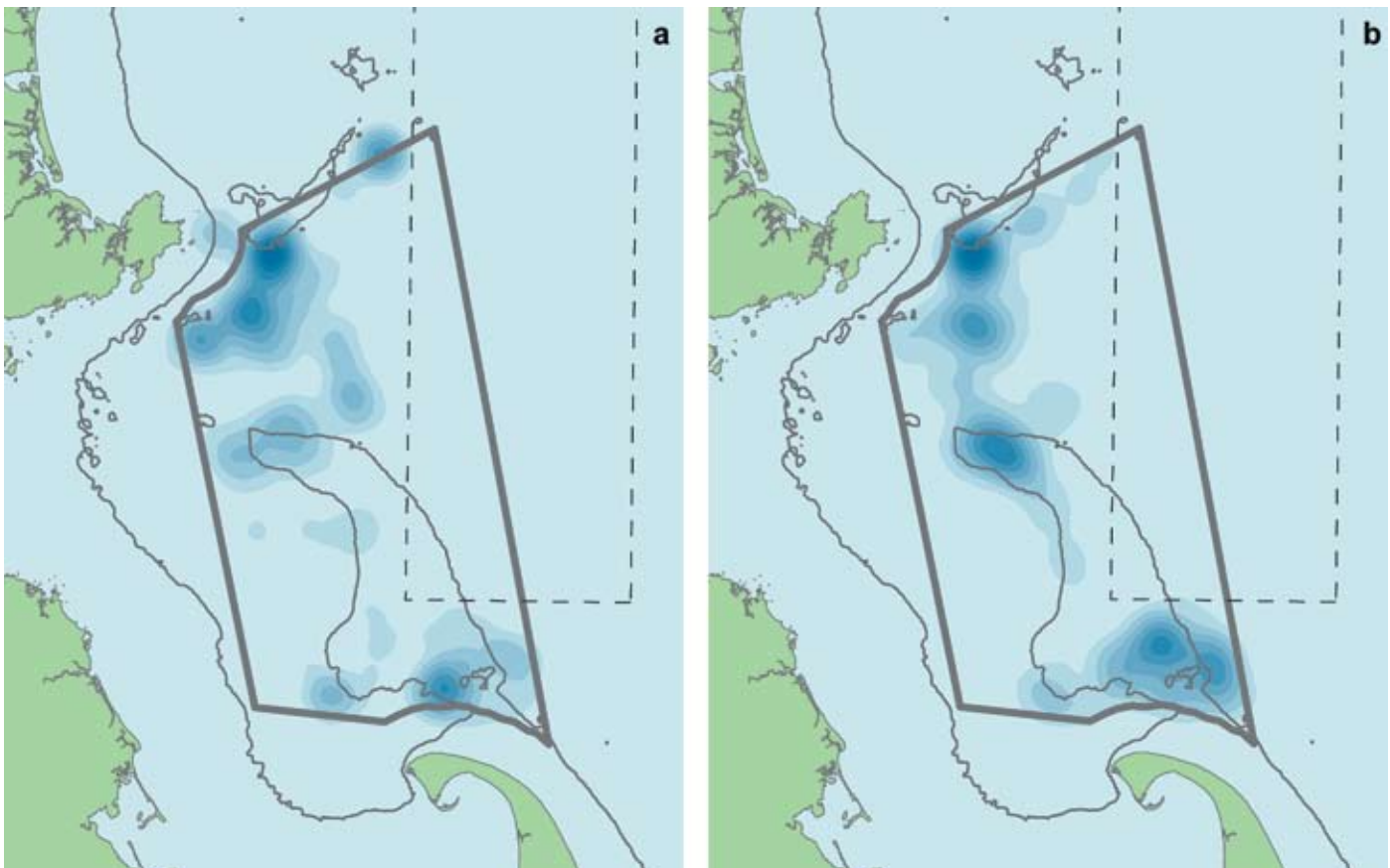
During July 2001–June 2002, a year-long study was undertaken to quantify and map patterns of human and marine mammal use of the sanctuary (Wiley *et al.*, 2003). Each month, sightings data were collected along 15 standardized shipboard survey tracklines that crossed the sanctuary at 5 km (2.5 nm) intervals providing 100 percent coverage. The density and distribution of the data were analyzed with *ArcView's Spatial Analyst* program to develop a "user geography" of the sanctuary based on spatial patterns and intensity of use.

The 2001–2002 survey was the repeat of a nearly identical year-long study undertaken in the sanctuary by Wiley during May 1994–August 1995, which allows comparison over the two time periods. The 1994–1995 survey covered only the southern two-thirds of the sanctuary prior to creation of the Western GoM Closure Area in 1998. Refer to Wiley *et al.* (2003) for details on the methodologies used.

The standardized survey data, together with the Vessel Trip Report data for the July 2001–June 2002 period, were used for the analyses of spatial distribution and density of fishing in the sanctuary. This base period was chosen based on analysis of the comparability of these data sources as explained below.

FIGURE 99. SPATIAL DENSITY PATTERNS BASED ON FISHING TRIPS FOR TWO TYPES OF BOTTOM MOBILE GEAR (OTTER TRAWLS AND DREDGES COMBINED) IN THE STELLWAGEN BANK SANCTUARY ARE COMPARED USING STANDARDIZED SURVEY DATA (a) AND VESSEL TRIP REPORT (VTR) DATA (b) OVER THE SAME TIME PERIOD (JULY 2001–JUNE 2002).

The patterns are Kriged density plots of information from both data sets using a 5,000 m search radius and analyzed by ESRI ARCGIS. VTR gear codes: DRC, DRS, OTF, OTM, PTM.



Fishing Vessel Trip Reports (VTR)

Since April 1994, fishing vessel trip reporting has been phased in for all NOAA Fisheries Service northeast permitted species as mandated by their corresponding Fishery Management Plans (FMP). In their Vessel Trip Reports (VTR), fishermen are required to report the location of catches using latitude and longitude or LORAN lines. The data series for the sanctuary analyses begins with the year 1996, as there was only partial coverage in 1994 and fleet adjustments to the requirements during 1995. The only NOAA Fisheries Service northeast permitted species that do not have VTR reporting requirements inherent in the FMP are Lobster and Surf Clam/Ocean Quahog (SC/OQ).

The SC/OQ FMP requires vessel owners or operators to maintain an accurate daily fishing log for each trip on forms provided by the NOAA Fisheries Service Regional Administrator. The logbook data indicate that these species were not fished in the sanctuary during 1996-2005. Many lobster vessels have federal permits that require them to report all catches to the VTR system. The Highly Migratory Species Division of NOAA Fisheries Service manages albacore, bluefin tuna, dorado, sharks, swordfish and tropical tuna. These species do not have VTR reporting requirements in

their FMPs, but catches of these species under other federal permits also result in some reporting to the VTR system. As noted below, adjustments are made that consider underrepresentation of lobster and bluefin tuna landings in the VTR data for the sanctuary.

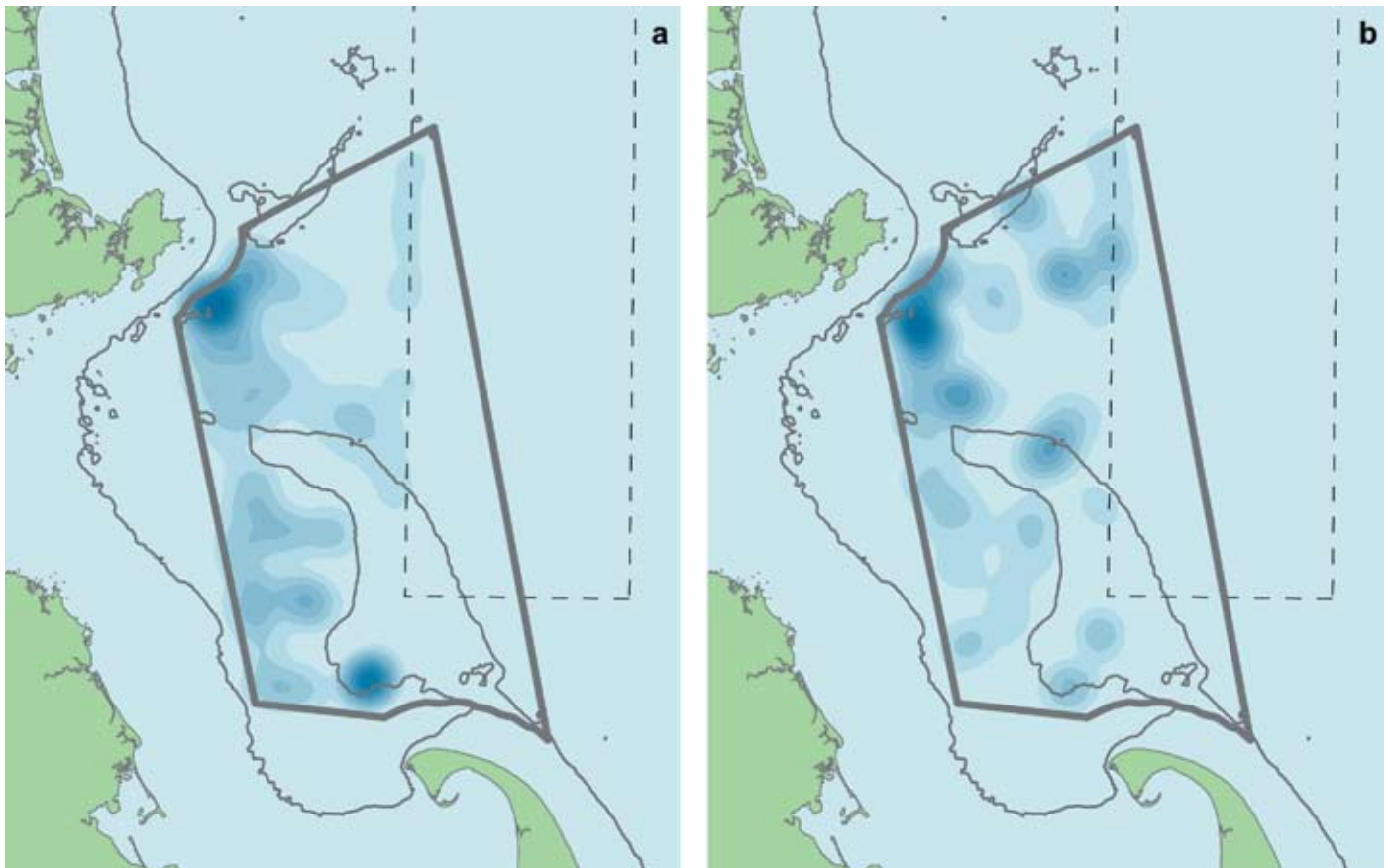
The VTR database was integrated with vessel number and home port-of-registry information to better describe fleet characteristics. This integration provided information about the state from which each vessel hailed as well as the respective port(s) which received each vessel's landings. The integrated VTR database was also used to determine the ex-vessel value and volume of landings from the sanctuary as well as the related attributes involving species and gear.

Comparability of Data Sources

The distribution of the 2001-2002 standardized survey and 2001-2002 VTR data for the same period exhibit consistent spatial patterns when comparable categories of fishing activity are mapped and analyzed using identical methodologies. For example, Figure 99 compares the distribution and density of two categories of mobile gear fishing in the sanctuary, trawling and scallop dredging, using data from the standardized surveys and the VTR information. Similarly, Figure 100 presents comparisons of the distribution and density of fixed

FIGURE 100. SPATIAL DENSITY PATTERNS BASED ON FISHING TRIPS USING FIXED GEAR (E.G., LOBSTER TRAPS, SINK GILLNETS AND LONGLINES) IN THE STELLWAGEN BANK SANCTUARY ARE COMPARED USING STANDARDIZED SURVEY DATA (a) AND VESSEL TRIP REPORT (VTR) DATA (b) OVER THE SAME TIME PERIOD (JULY 2001–JUNE 2002).

Survey data calculations were based on sightings of surface buoys. The patterns are Kriged density plots of information from both data sets using a 5,000m search radius and analyzed by ESRI ARCGIS. VTR gear codes: GNS, LLB, PTC, PTH, PTL.



gear fishing in the sanctuary, e.g., lobster traps, sink gillnets and longlines, using data from the two sources.

Qualitatively, there is a high degree of correlation between the results from the two data set analyses. Given this corroboration, the 2001-2002 timeframe is the period chosen to typify the spatial distribution and density of fishing in the sanctuary. By this standard, the VTR data are considered a reliable estimator of commercial fishing activity at the spatial scale of the sanctuary. A related but independent analysis of commercial fishing in the sanctuary area also concluded that the VTR data, once aggregated and processed via GIS, was a good predictor of broad categories of fishing activities and the locales at sea where the activities occurred (Martin and Hall-Arbor, 2006).

Conversion to 2005 Constant Dollars

To normalize dollar value for comparison of fishery landings over the decade 1996–2005, ex-vessel revenues (direct sales) were converted to 2005 constant dollars using the Boston Consumer Price Index (CPI-U). Inflation exerts an effect on the value of a dollar and, in most cases, a dollar today can't buy the same amount of goods or services it did in the past. To account for such price changes, it is appropriate to analyze financial data that have been “deflated” to produce a more consistent time series. Accordingly, financial data can be adjusted for inflation using the CPI prepared by the US Bureau of Labor Statistics. The CPI-U tracks changes in the prices paid by urban consumers based on a U.S. city average for a representative lot of goods and services through an annual survey of retailers, landlords and consumers.

DESCRIPTION OF FISHING GEAR

As will be shown, the majority of fish and invertebrates caught in the sanctuary are captured by two types of fixed (stationary) fishing gear, lobster traps and sink gillnets, and by two types of mobile fishing gear, otter trawls and scallop dredges. The Sidebar presents detailed descriptions and

information on these principal gear types as excerpted from Wiley *et al.*, 2003. The most important gear types used in the sanctuary during 1996-2005, based on volume of landings (greater than 1,000 lbs/yr) and their respective VTR gear codes, are listed in Table 11. A more detailed description of these fishing gears is provided in Mooney-Seus and Dianto (2000).

SPATIAL DISTRIBUTION AND DENSITY

Fishing using fixed (stationary) gear was the dominant human use of the sanctuary in 2001–2002 and occurred throughout the sanctuary as determined by the standardized surveys (Figure 101). Density surfaces for the survey data ranged from a high of 1.73–1.92 surface buoys/km²/month around the southwest corner of Stellwagen Bank and the northwest section of the sanctuary off Cape Ann, to lows of 0.0–0.19 surface buoys/km²/month, primarily in the southeastern section of the sanctuary. The dense areas coincided with the presence of trap fishing vessels, indicating concentrations of fishing gear targeting lobsters or, in some cases, crabs. This conclusion is corroborated by the distribution of the catch of lobster in the sanctuary revealed by spatial analysis of the VTR landings data for 1994–2002 (not shown).

In general, the density of fixed fishing gear was greatest in the western portions of the sanctuary and diminished to the east. While the level of fixed fishing activity decreased to the east, substantial levels of use still occurred there. These levels were highest (approximately 0.2–0.6 surface buoys/km²/month) in an area northeast of Stellwagen Bank and along a line delineating the Western GoM Closed Area (WGoMCA), an area closed to groundfishing. These areas coincided with the presence of gillnet fishing vessels, indicating that this fishery occurred primarily in the eastern and northern portions of the sanctuary. Subsequent analyses utilizing VTR data indicate that some of that fixed gear was bottom longline as well as gillnet. With the exception of the southwest corner, there was a tendency for fixed gear not to be associated with the shoal water of Stellwagen Bank itself.

There were two major concentrations of mobile fishing vessels in 2001–2002 as determined by the standardized surveys (Figure 102). The densest aggregation (0.048–0.052 vessels/km²/month) occurred in the southeast section of the sanctuary. The primary vessels associated with that area were scallop dredges, although substantial numbers of stern and eastern rig trawlers also worked the area. A second aggregation occurred over a broad area covering the sanctuary's northwest quarter and consisted primarily of stern and eastern rig trawlers. Monthly densities in this region ranged up to 0.036 vessels/km²/month. With the exception of the heavily used portion in the southeast corner, mobile vessels

TABLE 11. PRINCIPAL GEAR TYPES FISHED IN THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

The respective Vessel Trip Report (VTR) gear codes are included in parentheses.

Trawls	Hook and Line
Otter Trawl, Bottom, Fish (OTF)	Longline/Tub Trawl, Bottom (LLB)
Otter Trawl, Midwater (OTM)	Longline, Pelagic (LLP)
Otter Trawl, Bottom, Scallop (OTC)	Hand Line/Rod & Reel (HND)
Otter Trawl, Shrimp (OTS)	Pots and Traps
Pair Trawl, Midwater (PTM)	Pot, Crab (PTC)
Purse Seine (PUR)	Pot, Fish (Sea Bass, etc.) (PTF)
Gillnets	Pot, Barrels (Hag) (PTH)
Gillnet, Sink (GNS)	Pot, Lobster (PTL)
Dredges	Other
Dredge, Ocean Quahog/Surf Clam (DRC)	Harpoon (HRP)
Dredge, Scallop (DRS)	

() = Vessel Trip Report Gear Codes

made less use of the sanctuary's eastern section and the shallower area on top of Stellwagen Bank proper.

Comparison of results from the two survey periods between 1994–1995 and 2001–2001 indicates that the area fished by fixed gear in the sanctuary greatly expanded during the interim (Figure 101). Eastward expansion in the lobster fishery since the early-mid 1990s is due to declining recruitment occurring in shoaling waters and/or competition among fishermen for territory (Estrella and Glenn, 2004). Over the same time-frame, the area covered by draggers in the sanctuary contracted, while scallop dredge fishing increased, the latter most notably on the southeast corner of Stellwagen Bank (Figure 102). The timeframe during which the two surveys occurred corresponds to when regulatory changes imposed by NOAA Fisheries Service resulted in fishing effort being redirected from groundfish species, as well as when many boats converted to lobstering. Unless indicated otherwise, the following assessments are based on the VTR data.

FLEET CHARACTERISTICS

Commercial fishing in the sanctuary is conducted by vessels primarily from home ports in several New England states, but especially from the Commonwealth of Massachusetts. Between 1996 and 2005, an average of 327 (range 262–386) boats fished in the sanctuary each year (Table 12). These boats came from home ports in six states, but four states accounted for 98.6% of the total number of vessels. These four states and their percentages were: Massachusetts (85.0%), New Hampshire (6.2%), Maine (5.7%) and Rhode Island (1.7%). The two other states were New York and New Jersey.

The total number of vessels fishing the sanctuary and those from home ports in Massachusetts decreased over this decade. The number of boats from Maine, New Hampshire and Rhode Island fishing the sanctuary varied year-to-year but remained at more or less the same level.

DESCRIPTION OF PRINCIPAL GEAR TYPES

Fixed Gear

Trap Fishery. Trap fisheries employ a passive methodology where traps sit on the seabed and use bait (usually dead fish) to attract lobsters, and to a lesser extent crabs, to the traps. Traps are wire or wooden cages that typically measure 91 cm by 53 cm by 34 cm (36 in by 21 in by 13.5 in), although some can be larger. Traps are often fished in “trawls” consisting of a number of traps leading off a common “ground line.” In the area around the sanctuary, trawls typically consist of approximately 25 traps spaced 30–55 m (100–180 ft) apart (W. Hoffman, Massachusetts Division of Marine Fisheries, Boston, MA, Pers. Comm.). Therefore, a single trawl can be over 1,219 m (4,000 ft) in length. Ground lines along the length of the trawl characteristically consist of buoyant polypropylene line that can float more than 5 m (16 ft) above the bottom (McKiernan *et al.*, 2002). On each end of a trawl, a “buoy line” runs from the gear to a buoy visible at the surface (i.e., the surface buoy). As described above, two surface buoys might indicate the presence of over 1,219 m (4000 ft) of lobster gear.

Gillnet Fishery. Gillnets are comprised of thin, transparent, monofilament webbing stretched between a buoyant “float line” running along the top of the net and a heavy “lead line” running along the bottom. Tension between the buoyant float line and the heavy lead line causes the webbing to rise from the seabed to a height of 2.5 to 3.6 m (8 to 12 ft). If flatfish (e.g., flounder) are targeted, the float line and lead line are tied together, limiting the height to ~ 1 m (3 ft). A single net is ~ 91 m (300 ft) long and nets are joined together into “strings”. In the GoM, net strings range between 458 m (1500 ft) and 2,292 m (7,500 ft) in length (Read, 1994). Each end of a string is marked on the surface with a buoy (usually a “high flyer”) that is attached to the gear by a line also used for hauling. Strings of gillnets are often set in a zigzag or even circular pattern, with small weights along the lead line acting as pivot points. As with the trap fishery, it is important to note that an observation of two surface buoys can indicate the presence of hundreds or thousands of meters of netting on the seafloor below them.

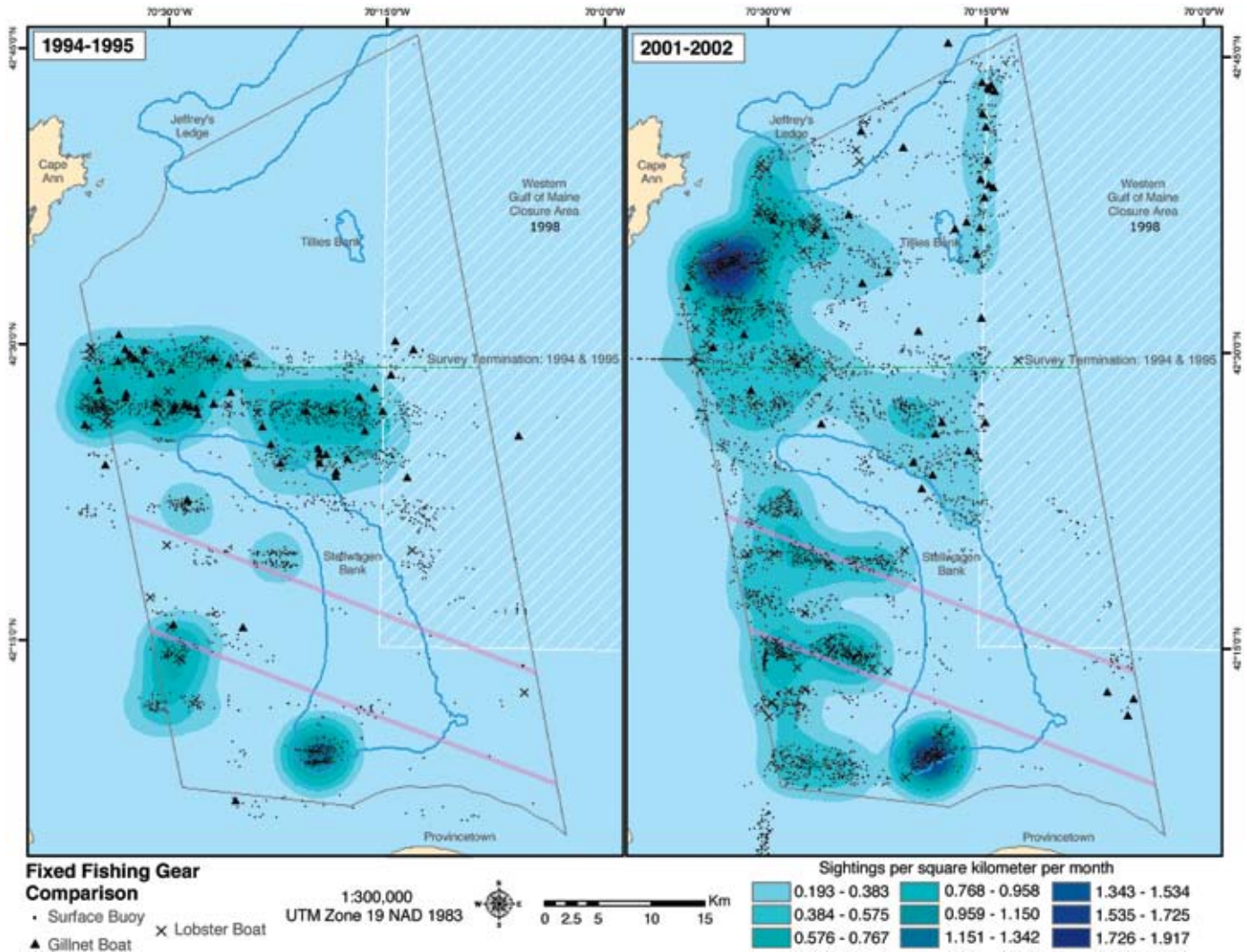
Mobile Gear

Otter Trawl Fishery. Bottom otter trawlers or “draggers” target primarily groundfish by towing a large conical net along the seabed (Von Brandt, 1984). The net opening is maintained by the action of a buoyant “headrope” (on the top), a weighted “footrope” (on the bottom), and the spreading effect of heavy trawl “doors” (up to 450 kg or approximately 1,000 lbs) on either side of the net’s mouth. The resistance of the doors moving through the water maintains a net opening width of 15 to 25 m (50–80 ft) (Carrothers, 1981). Fish are captured by the forward motion of the net along the bottom, which causes fish to enter the net’s mouth and collect in the anterior “cod end”. Fish capture is facilitated by the movement of the footrope along the bottom that disturbs bottom dwelling fish and forces them up into the path of net. The footrope can be modified with rollers or other devices that provide fishermen with access to rocky or uneven bottom (Carr and Milliken, 1998). Midwater otter trawls and pair trawls are similarly configured but fish above the bottom in the water column for species such as Atlantic herring.

Scallop Dredge Fishery. A scallop dredge consists of an approximately 5 m (15 ft) wide rigid metal box trailing a bag of metal rings. The weight of the dredge (up to 700 kg or 1500 lbs) and the angle of the forward cutting bar force the dredge to dig a few centimeters (1–2 in) into the seabed. The forward motion of the cutting bar dislodges scallops from the bottom causing them to pass over the bar and collect in the trailing chain bag. Scallop vessels usually tow two dredges simultaneously at speeds under approximately 5 knots (Rago and McSherry, 2001). Scallop dredges are considered “dry” dredges in that they do not use water jets or suction in the capture process.

FIGURE 101. COMPARISON OF THE DENSITY AND DISTRIBUTION OF SURFACE BUOYS WITHIN THE STELLWAGEN BANK SANCTUARY OVER TWO SURVEY PERIODS: FROM MAY 1994 THROUGH AUGUST 1995 AND FROM JULY 2001 THROUGH JUNE 2002.

Each point represents the sighting of one or more surface buoys. Surface buoys are indicators of fixed fishing gear (trap or gillnet) “sets” that can extend thousands of meters along the seafloor. Two surface buoys equal one set. Trap and gillnet sets cannot be unambiguously differentiated by surface buoys. Sightings of actively fishing lobster (trap) and gill net vessels are provided as an aid to determining the type of gear in an area. The 1994–1995 survey covered only the southern two thirds of the sanctuary prior to establishment of the Western GoM Closure in 1998. The spatial patterns are Kriged density plots using a 5,000 m search radius and analyzed by ESRI ARCGIS. (Source: 1994–1995 sanctuary data; 2001–2002 from Wiley *et al.*, 2003).



LANDINGS VALUE AND VOLUME

As acknowledged above, the VTR data under-represent the total landings of lobster and bluefin tuna from catches in the sanctuary. Fishery landings differ from catch (see Sidebar). Additional data on lobster landings from Massachusetts Offshore Area 19 and data on bluefin tuna landings from NOAA Fishing Area 4, both areas being greater in size and subsuming the sanctuary (Figure 103), were adjusted by subtracting values already reported in the VTR data. The difference was added to the VTR base amount to identify a likely maximum for total commercial fishery landings from the sanctuary (Tables 13 and 14). Landings value is reported in 2005 dollars.

Landings from party boats and charter boats are reported in the VTR system as quantity of fish, not landed value or pounds as required for all other gear types, and are not represented in this summary of total commercial fish landings. Sales generated by those boats derive from charter and head fees, not from ex-vessel landings. Party boat fishing and charter boat fishing are treated separately under the subsequent section on recreational fishing.

State and County

Based on the VTR data, total commercial fishery landings value from the sanctuary during 1996–2005 ranged from a low of \$12.5 million in 2003 to a high of \$19.6 million in 2000 (Table 13). The average annual total landings value from the sanctuary was \$15.6 million over this period. The

FIGURE 102. COMPARISON OF THE DENSITY AND DISTRIBUTION OF MOBILE FISHING VESSELS (STERN DRAGGER, EASTERN DRAGGER AND SCALLOP DREDGE) WITHIN THE STELLWAGEN BANK SANCTUARY OVER TWO SURVEY PERIODS: FROM MAY 1994 THROUGH AUGUST 1995 AND FROM JULY 2001 THROUGH JUNE 2002.

Each point represents the sighting of an active fishing vessel. The 1994–1995 survey covered only the southern two thirds of the sanctuary prior to establishment of the Western Gulf of Maine Closure Area in 1998. The spatial patterns are Kriged density plots using a 5,000 m search radius and analyzed by ESRI ARCGIS. (Source: 1994–1995 sanctuary data; 2001–2002 from Wiley *et al.*, 2003).

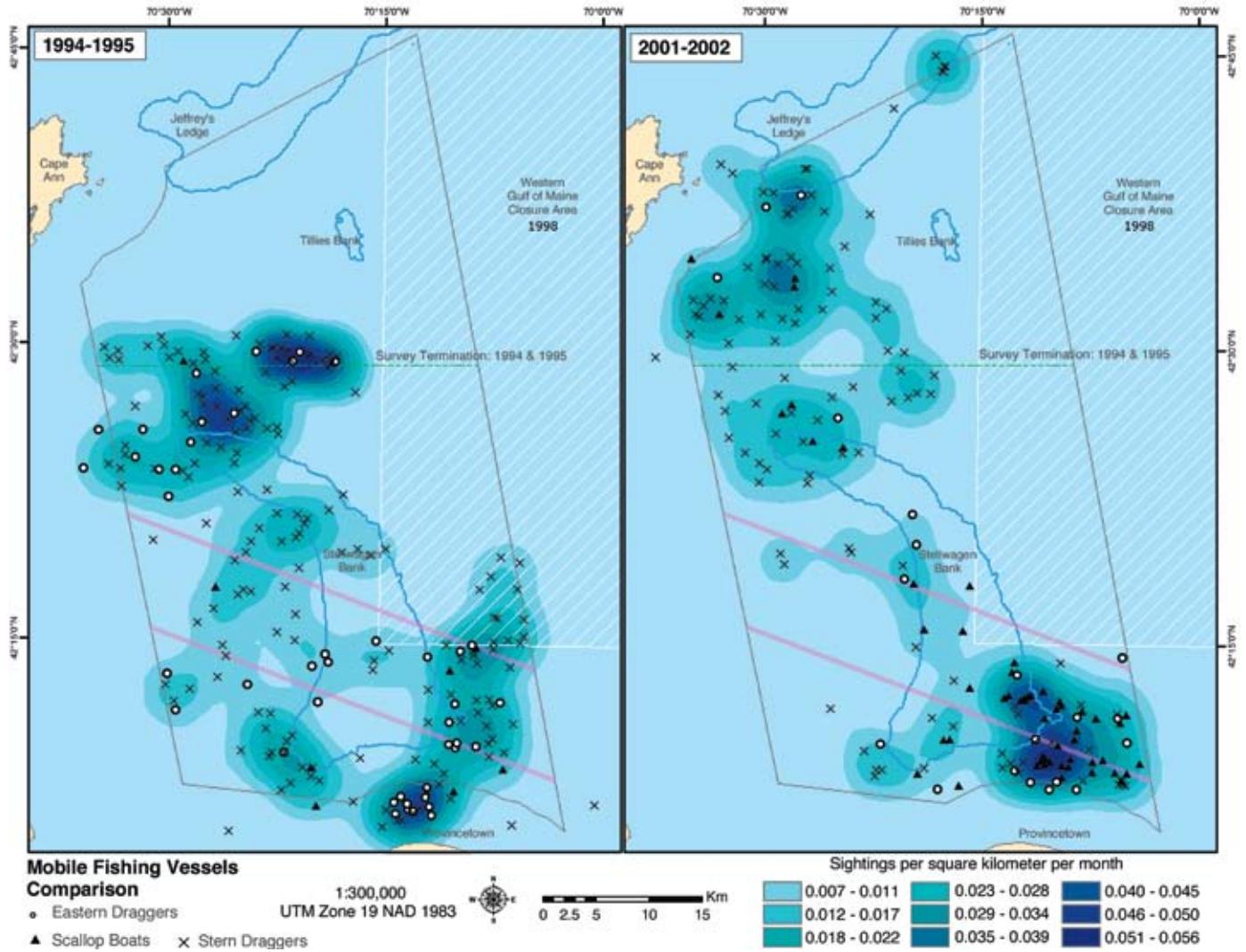
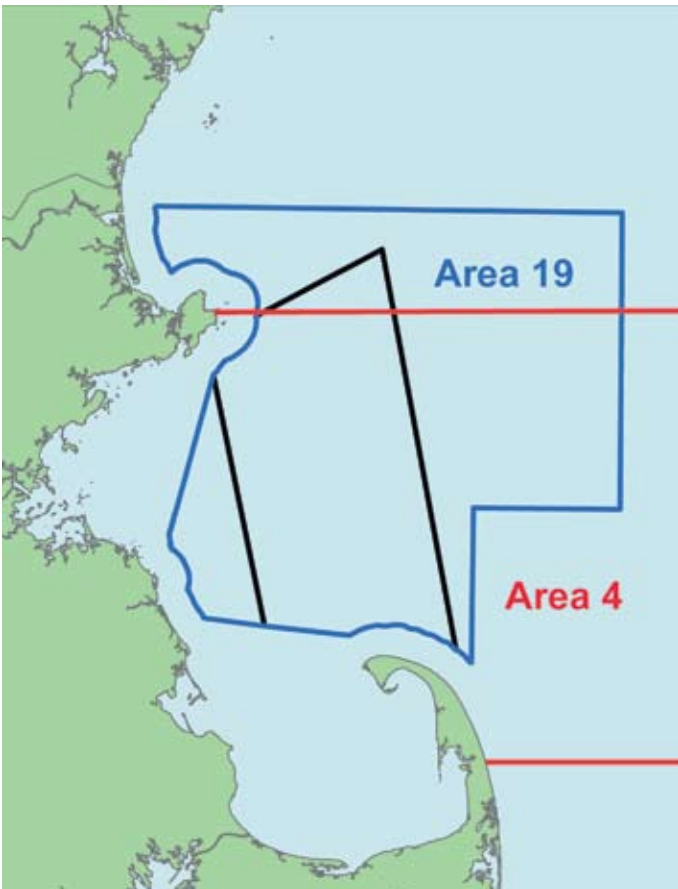


TABLE 12. COMMERCIAL VESSELS FISHING WITHIN THE STELLWAGEN BANK SANCTUARY BY STATE OF HOMEPORT.

State of Homeport	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total
Massachusetts	318	315	276	276	328	293	267	228	249	231	2,781	85.0
New Hampshire	16	13	16	20	29	32	13	13	26	26	204	6.2
Maine	24	19	19	13	21	17	17	15	14	27	186	5.7
Rhode Island	4	7	9	10	6	7		6	3	5	57	1.7
New York	2	4	5	4	1	4	3		2		25	0.8
New Jersey	3	2	5	5	1		1		1		18	0.6
Total	367	360	330	328	386	353	301	262	295	289	3,271	100.0

FIGURE 103. SIZE AND LOCATION OF THE STELLWAGEN BANK SANCTUARY RELATIVE TO STATE OF MASSACHUSETTS OFFSHORE AREA 19 FOR REPORTING LOBSTER LANDINGS AND NOAA FISHING AREA 4 FOR REPORTING BLUEFIN TUNA LANDINGS.

NOAA Fishing Area 4 extends directly eastward to the furthest extent of the 200-mile U.S. Exclusive Economic Zone (EEZ).



upper possible average annual value for this period after adjustment for lobster and bluefin tuna was \$23.3 million; annual adjusted upper values ranged between \$17.2 million in 2004 to \$33.3 million in 1997. Comparable landings information in pounds is presented in Table 14 but, except where noted, the remainder of this discussion is based on dollar value (2005\$).

Massachusetts ports received the bulk of the landings (97.8%) and determined the overall temporal pattern in value, which trended down over the decade (Table 12 and Figure 104). [Landings in pounds show a steeper decline with an uptick in 2005 due to record catches of Atlantic herring, a low value product, in the sanctuary that year (Table 13 and Figure 105).] Landings in Maine ranged from \$0.03 million in 2003 to \$ 0.36 million in 2001. Landings in New Hampshire ranged from \$0.03 million in 1997 to \$0.37 million in 2005. Landings in both Maine and New Hampshire, while low overall, varied by an order of magnitude over this period. Landings in Rhode Island were the lowest and most variable. New Hampshire was the only state to see higher landings in 2005 than in 1996, trending opposite to these other states.

The percent of total landings from the sanctuary by county landed for the period 1996–2005 is presented in Figure 106. Essex County in Massachusetts received 64.2% of the landings, followed by Plymouth County (13.8%), Barnstable County (9.8%) and Bristol County (7.9%), all also in Massachusetts. Landings in all other counties amounted to 2% of the total or less. Landings information is presented in aggregate by county, rather than by port, to ensure that data confidentiality is maintained.

Species and Gear

The top ten species landed from the sanctuary during 1996–2005 based on ex-vessel dollar value and volume (pounds) are indicated in Table 15. Lobster and cod contributed the greatest value; four species (lobster, cod, yellowtail flounder and sea scallops) accounted for more than half (60.0%) of the total ex-vessel value. Atlantic herring contributed the greatest volume (41.0%) and together with cod accounted for half (51.4%) of the total pounds landed. Overall, the top ten species accounted for 85.2% of total landings value and 86.3% of total volume landed from the sanctuary.

The top ten gear types fished in the sanctuary based on ex-vessel value and volume for the same period are also provided in Table 15. The bottom otter trawl-fish accounted for the highest dollar value of landings from the sanctuary (35.4%) and the midwater pair trawl accounted for the greatest landed volume (26.5%). Four gear types (bottom otter trawl-fish, lobster pot, sink gill net and sea scallop dredge) accounted for the greatest ex-vessel value (88.7% of total) and four gear types (midwater pair trawl, bottom otter trawl-fish, sink gill net and midwater otter trawl) accounted for the greatest volume of pounds landed (83.9%). Overall, the top ten gear types accounted for 99.0% of total landings value and 99.1% of total volume landed from the sanctuary.

Distinguishing between Catch and Landings

“Landings” is defined as the part of the fish catch that is unloaded and put ashore for sale. The distinction between catch and landings is important because considerable quantities of fish and fishable invertebrates caught are discarded at sea as bycatch. The overall discard to landings ratio (0.49) in northeast fisheries in 2002–2003 was among the highest nationwide (Harrington *et al.*, 2005); essentially a third of everything caught was discarded (32.7 % of total nominal catch). The discard to landings ratio in the fishery for northeast groundfish in 2002–2003 was 1.79 indicating that nearly two-thirds of the catch (64.2%) was discarded (i.e., only one fish was landed for every three fish caught). While the by-catch of protected species such as marine mammals, turtles and sea birds is a major conservation issue, those species were not included in these calculations. More recent discard rates for this northeast fishery show that discarding from bottom trawls and gill nets is substantially reduced (NOAA Fisheries Service, personal communication, 2008).

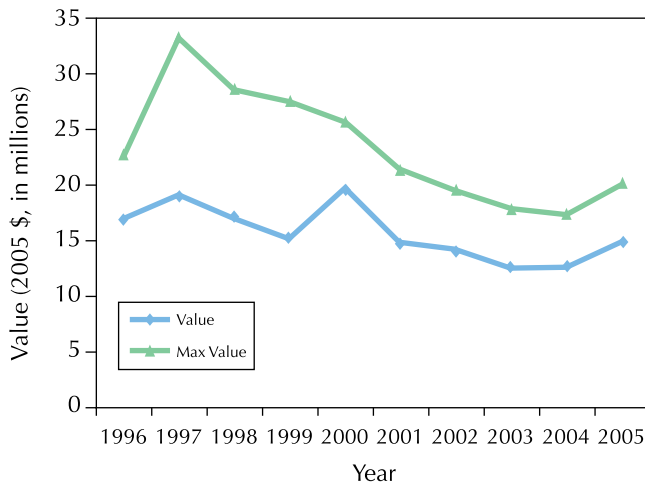
TABLE 13. LANDINGS VALUE (2005\$) BY COMMERCIAL FISHING IN THE STELLWAGEN BANK SANCTUARY BY STATE AND COUNTY LANDED (1996-2005). TABLE IS BASED ON VTR DATA WITH ADJUSTMENTS MADE FOR AREA 19 AND AREA 4 LANDINGS.

Vessel Trip Report Data												
State and County Landed	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total
Maine	63,354	251,482	125,521	130,811	157,974	361,936	196,933	26,266	92,036	145,166	1,551,481	0.99
Washington	0	265	0	0	0	0	0	2,024	0	0	2,289	0.00
Hancock	850	0	0	0	3,092	316,199	96,532	0	0	0	416,672	0.27
Knox	0	105,926	80,087	53,621	22,092	0	0	0	0	0	261,727	0.17
Lincoln	0	0	3,883	426	10,585	0	1,246	0	0	0	16,141	0.01
Sagadahoc	4,255	0	0	0	0	0	0	0	0	0	4,255	0.00
Cumberland	50,086	122,728	25,154	73,242	113,393	27,125	97,091	21,681	86,178	86,864	703,542	0.45
York	8,163	22,563	16,397	3,522	8,811	18,612	2,065	2,561	5,857	58,302	146,854	0.09
New Hampshire	72,967	28,490	39,964	121,861	332,430	261,227	133,748	148,721	260,850	370,201	1,770,459	1.13
Rockingham	72,967	28,490	39,964	121,861	332,430	261,227	133,748	148,721	260,850	370,201	1,770,459	1.13
Massachusetts	16,720,219	18,737,542	16,620,546	14,783,746	19,062,685	14,094,167	13,723,907	12,292,621	12,222,166	14,273,689	152,531,287	97.61
Essex	8,732,583	10,526,240	11,225,017	10,225,216	11,927,139	9,289,915	9,312,114	2,900,418	9,212,145	10,849,245	100,303,763	64.19
Suffolk	594,643	513,646	221,546	143,678	570,989	145,608	102,481	45,342	166,966	150,424	2,655,323	1.70
Norfolk	1,744	27,135	6,666	0	42,366	29,532	15,925	3,335	29,342	7,049	163,096	0.10
Plymouth	2,975,603	2,600,429	2,934,051	2,575,654	4,172,305	1,358,764	961,650	1,264,538	1,468,468	1,247,526	21,578,988	13.81
Barnstable	1,326,212	1,270,883	1,457,121	1,366,509	1,565,946	2,295,199	1,921,863	1,438,251	1,081,316	1,601,205	15,324,505	9.81
Nantucket	0	0	0	0	21,702	0	0	0	0	0	21,702	0.01
Dukes	0	0	0	0	24,231	8,314	12,880	24,852	0	4,002	74,279	0.05
Bristol	3,089,434	3,793,567	752,481	472,689	736,452	966,835	1,396,993	512,154	263,929	413,426	12,397,959	7.93
Other MA	0	5,641	3,664	0	1,555	0	0	0	0	813	11,672	0.01
Rhode Island	20,538	34,679	63,547	22,740	3,967	43,991	16,927	36,989	0	3,681	247,060	0.16
All RI Counties	20,538	34,679	63,547	22,740	3,967	43,991	16,927	36,989	0	3,681	247,060	0.16
All Other Counties	3,032	0	134,818	23,010	0	0	7,101	0	0	1,998	169,958	0.11
VTR Total	16,877,079	19,052,193	16,984,397	15,082,168	19,557,056	14,761,321	14,078,617	12,504,597	12,575,052	14,794,735	156,267,213	100.00
Additional Data Sources (modified by subtracting values already reported in Vessel Trip Report Data)												
Offshore Area 19 Lobster	4,709,061	10,269,317	8,348,659	8,012,993	4,410,118	4,022,054	3,766,661	4,253,402	3,525,367	3,707,774	55,025,407	
Federal Area 4 Bluefin Tuna	983,926	3,940,467	3,200,957	4,338,574	1,626,347	2,419,523	1,536,272	1,010,777	1,071,393	1,554,766	21,683,002	
Adjusted Total	5,692,988	14,209,783	11,549,615	12,351,567	6,036,465	6,441,577	5,302,933	5,264,179	4,596,761	5,262,541	76,708,409	
Overall Total	22,570,066	33,261,976	28,534,012	27,433,735	25,593,520	21,202,898	19,381,550	17,768,776	17,171,812	20,057,276	232,975,622	

TABLE 14. LANDINGS IN POUNDS BY COMMERCIAL FISHING IN THE STELLWAGEN BANK SANCTUARY BY STATE AND COUNTY LANDED (1996-2005). TABLE IS BASED ON VTR DATA WITH ADJUSTMENTS MADE FOR AREA 19 AND AREA 4 LANDINGS.

		Vessel Trip Report Data												
State and County Landed	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total		
Maine	207,333	548,017	313,771	1,444,946	170,826	84,955	421,258	11,938	64,086	359,683	3,626,813	2.13		
Washington	0	64	0	0	0	0	0	1,035	0	0	1,099	0.00		
Hancock	1,050	0	0	0	2,260	51,030	15,000	0	0	0	69,340	0.04		
Knox	0	91,544	287,559	571,866	64,634	0	0	0	0	0	1,015,603	0.60		
Lincoln	0	0	2,176	99	7,210	0	330	0	0	0	9,815	0.01		
Sagadahoc	366	0	0	0	0	0	0	0	0	0	366	0.00		
Cumberland	204,868	447,527	13,596	872,565	88,066	20,900	405,401	10,361	62,852	337,121	2,463,257	1.45		
York	1,049	8,882	10,440	416	8,656	13,025	527	542	1,234	22,562	67,333	0.04		
New Hampshire	45,906	23,268	22,079	70,171	243,684	194,457	372,061	451,498	179,217	1,210,240	2,812,581	1.65		
Rockingham	45,906	23,268	22,079	70,171	243,684	194,457	372,061	451,498	179,217	1,210,240	2,812,581	1.65		
Massachusetts	14,997,849	21,985,280	25,640,158	18,791,535	11,957,970	11,736,627	14,742,787	9,218,717	10,597,011	22,609,500	162,277,434	95.28		
Essex	11,049,365	15,218,614	21,760,724	13,462,473	7,753,228	8,600,173	12,363,538	7,140,379	8,720,955	18,280,362	124,349,811	73.01		
Suffolk	316,935	343,001	216,517	49,261	349,513	82,994	58,173	34,484	121,833	98,018	1,670,729	0.98		
Norfolk	608	6,056	1,488	0	7,476	5,890	3,756	640	6,100	1,837	33,851	0.02		
Plymouth	2,284,997	4,399,816	2,191,020	3,503,532	1,613,768	516,236	354,410	752,931	814,452	638,676	17,069,838	10.02		
Barnstable	409,072	869,152	1,155,689	1,464,239	1,569,644	1,684,638	1,231,896	738,968	539,347	506,481	10,169,126	5.97		
Nantucket	0	0	0	0	17,544	0	0	0	0	0	17,544	0.01		
Dukes	0	0	0	0	21,015	7,950	10,345	18,950	0	2,525	60,785	0.04		
Bristol	936,872	1,147,382	312,955	312,030	624,747	838,746	720,669	532,365	394,324	3,081,132	8,901,222	5.23		
Other MA	0	1,259	1,765	0	1,035	0	0	0	0	469	4,528	0.00		
Rhode Island	225,000	190,000	190,102	13,096	2,968	141,285	35,977	25,050	0	3,141	826,619	0.49		
All RI Counties	225,000	190,000	190,102	13,096	2,968	141,285	35,977	25,050	0	3,141	826,619	0.49		
All Other Counties	662	0	742,488	18,871	0	0	4,736	0	0	1,402	768,159	0.45		
VTR Total	15,476,088	22,746,565	26,908,598	20,338,619	12,375,448	12,157,324	15,576,819	9,707,203	10,840,314	24,183,966	170,310,944	100.00		
Additional Data Sources (modified by subtracting values already reported in Vessel Trip Report Data)														
Offshore Area 19 Lobster	1,177,862	837,101	1,628,137	1,549,096	742,601	769,263	789,107	825,361	699,694	674,620	9,692,842			
Federal Area 4 Bluefin Tuna	479,789	490,241	680,616	684,169	227,611	388,720	253,976	195,582	54,998	440,063	3,895,765			
Adjusted Total	1,657,651	1,327,342	2,308,753	2,233,265	970,212	1,157,983	1,043,083	1,020,943	754,692	1,114,683	13,588,607			
Overall Total	17,133,739	24,073,907	29,217,351	22,571,884	13,345,660	13,315,307	16,619,902	10,728,146	11,595,006	25,298,649	183,899,551			

FIGURE 104. TRENDS IN VALUE (2005\$) OF ANNUAL COMMERCIAL FISHERY LANDINGS FROM THE STELLWAGEN BANK SANCTUARY FOR THE PERIOD 1996–2005.



Two species caught in the sanctuary, American lobster and Atlantic herring, are notable because of the inverse relationship exhibited between their landed value and volume and their relationship to one another in the conduct of fishing. Lobster accounted for 23.9% of the landed value, but landings were only 4.6% of volume. By contrast, herring accounted for 3.4% of the landed value, but landings were 41.0% of volume. Lobster is high value/low volume (poundage), while herring is low value/high volume. Lobster is caught entirely for human consumption, while a large share of the herring catch is for use as bait in the pot fishery for lobster.

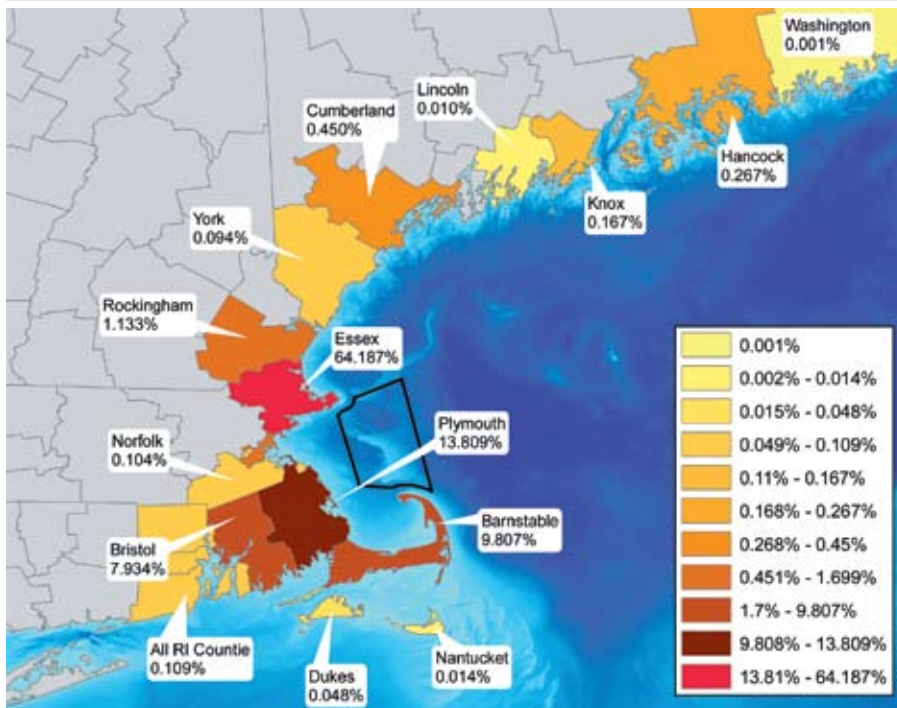
FIGURE 105. TRENDS IN ANNUAL COMMERCIAL FISHERY LANDINGS IN POUNDS FROM THE STELLWAGEN BANK SANCTUARY FOR THE PERIOD 1996–2005.



Northeast Landings Value

The ex-vessel value of commercial fishery landings from the sanctuary based on the VTR data is compared to the total value of commercial landings by state for Rhode Island, Massachusetts, New Hampshire and Maine (all of coastal New England except Connecticut) for the period 1996–2004 (Table 16). At the time of this analysis, the New England landings data were not available for 2005. These data are for all species caught in the northeast area fisheries and were provided by the NOAA Fisheries Service Northeast Fisheries Science Center. Landings value was adjusted and continues to be reported in 2005 dollars. Essentially all (99.9%) of the commercial fishery landings from the sanctuary over that period were landed in the ports of these four states.

FIGURE 106. DISTRIBUTION OF COMMERCIAL FISHERY LANDINGS FROM THE STELLWAGEN BANK SANCTUARY BY COUNTY LANDED BASED ON TOTAL LANDINGS VALUE FOR THE PERIOD 1996–2005.



The total value of commercial fishery landings from the sanctuary was 4.2% of the total landings value for Massachusetts, 0.8% for New Hampshire and 0.04% or less for Maine and Rhode Island based on the VTR data alone. The total value of landings from the sanctuary was 1.9% of the total landings value for all fisheries in New England. When the upper possible values based on adjusted lobster and bluefin tuna landings are added to the VTR data and factored into this analysis, the total value of landings from the sanctuary was still no more than 2.8% of the New England total over the decade. This analysis omits Connecticut, which realized next to no landings from the sanctuary and which, if included, would reduce this percentage.

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TOTAL CATCH BY COMMERCIAL FISHING

As noted above, commercial fishing landed 17.0 million pounds (7,725 mt)

TABLE 15. TOP TEN SPECIES LANDED AND TOP TEN COMMERCIAL FISHING GEAR TYPES USED IN THE STELLWAGEN BANK SANCTUARY (1996–2005) BASED ON LANDED VALUE (2005\$) AND VOLUME (LBS.).

a. Species				b. Species			
		Total lbs 1996–2005	% Total 1996– 2005			Total value 1996–2005 (2005 \$)	% Total 1996– 2005
1	Herring, Atlantic	70,084,751	40.99	1	Lobster, American	37,643,120.87	23.93
2	Cod	17,781,281	10.40	2	Cod	27,428,431.67	17.44
3	Dogfish, Spiny	17,429,616	10.19	3	Flounder, Yellowtail	16,021,158.90	10.19
4	Flounder, Yellowtail	12,187,130	7.13	4	Scallop, Sea	13,239,975.18	8.42
5	Lobster, American	7,781,831	4.55	5	Monkfish (Round/tails/livers)	11,189,345.56	7.11
6	Monkfish (Round/tails/livers)	5,799,527	3.39	6	Flounder, Witch / Gray Sole	8,269,795.59	5.26
7	Hake, Silver/Whiting	4,385,477	2.57	7	Flounder, Winter / Blackback	5,552,683.01	3.53
8	Flounder, Witch/Gray Sole	4,374,122	2.56	8	Herring, Atlantic	5,374,683.03	3.42
9	Flounder/ Winter/Blackback	3,952,821	2.31	9	Flounder, American Plaice /Dab	4,808,256.36	3.06
10	Pollock	3,806,895	2.23	10	Tuna, Bluefin	4,448,954.58	2.83

c. Gear Types				d. Gear Types			
		Total lbs 1996–2005	% Total 1996– 2005			Total value 1996–2005 (2005 \$)	% Total 1996– 2005
1	Pair Trawl, Midwater	45,305,120	26.52	1	Otter Trawl, Bottom, Fish	55,674,129.20	35.40
2	Otter Trawl, Bottom, Fish	43,002,828	25.17	2	Pot, Lobster	35,358,454.48	22.48
3	Gill Net, Sink	36,598,845	21.42	3	Gill Net, Sink	35,176,080.73	22.37
4	Otter Trawl, Midwater	18,352,059	10.74	4	Dredge, Scallop, Sea	13,251,335.64	8.43
5	Purse Seine	8,521,839	4.99	5	Pair Trawl, Midwater	4,242,985.73	2.70
6	Pot, Lobster	7,523,142	4.40	6	Longline, Bottom	4,160,609.74	2.65
7	Longline, Bottom	5,352,766	3.13	7	Hand Line/Rod & Reel	3,093,587.95	1.97
8	Dredge, Scallop, Sea	2,448,887	1.43	8	Harpoon	2,041,146.18	1.30
9	Pot, Hag	1,426,663	0.84	9	Otter Trawl, Midwater	1,539,612.43	0.98
10	Hand Line/Rod & Reel	913,209	0.53	10	Purse Seine	1,077,952.71	0.69

to 18.4 million pounds (8,342 mt) of fish and crustaceans from the sanctuary on average per year during 1996–2005 (Table 14). The lower estimate is the VTR landings; the upper estimate is the VTR landings plus adjustments for lobster and bluefin tuna.

These landings are minimal estimates of total catch from the sanctuary because they do not include the landings by

charter and party boats and by private recreational fishing, nor do they include the bycatch and regulatory discards associated with all the fisheries involved. This total also does not include biomass estimates for seafloor biogenic habitat and associated biological community losses due to fishing. These losses could be considerable given the broad spatial extent over which the sanctuary is routinely fished.

A first order approximation of the level of commercial fishery discards in the sanctuary in 2002/2003 is 4.0 million pounds (1.8 mt) on average per year. The total VTR landings for the sanctuary in 2002/2003 were 13.3 million pounds (6.0 mt) on average per year. This approximation suggests that commercial fishery discards amounted to about 23% of total average annual catch (17.3 million pounds or 7.8 mt) in the sanctuary in 2002/2003.

[Note: The level of commercial fishery discards in the sanctuary in 2002/2003 was approximated as follows. The regional total discard to landings ratio for northeast commercial fisheries in 2002/2003 was

TABLE 16. COMPARISON OF EX-VESSEL VALUE (2005\$) OF COMMERCIAL FISHERY LANDINGS FROM THE STELLWAGEN BANK SANCTUARY (1996–2005) BY NEW ENGLAND STATE LANDED RELATIVE TO TOTAL VALUE OF FISHERY LANDINGS IN THOSE STATES FROM ALL SOURCES.

Adjusted total is likely maximum value for commercial fishing in the sanctuary.

State Landed	Total *	Sanctuary	% Sanctuary
Massachusetts	3,274,371,313	138,257,598	4.22
Maine	3,226,531,641	1,406,314	0.04
New Hampshire	178,314,569	1,400,258	0.79
Rhode Island	949,036,882	243,379	0.03
VTR total	7,628,254,405	141,307,549	1.85
Adjusted Total		212,753,418	2.79

* Source: Northeast Fisheries Science Center, NOAA Fisheries Service

0.49 (Harrington *et al.*, 2005). Fishery ratios ranged between a high of 1.790 for northeast groundfish to a low of 0.040 for Atlantic herring. The VTR landings data (fisheries for lobster and bluefin tuna were not included in the calculation of the ratios) for the sanctuary were partially stratified by fishery type. Since herring accounted for an average of 41% of the landings from the sanctuary during 1996–2005 (Table 14), the 0.040 ratio for the herring fishery was applied to the average of the 2002/2003 herring landings; the regional total ratio of 0.49 was applied to the remainder of the fishery landings averaged over 2002/2003.]



RECREATIONAL FISHING

Although a few party boats initiated a recreational ground fishery in the Stellwagen Bank area in the late 1940s, commercial vessels supporting recreational fishing have only regularly worked the area since the mid 1970s (NOAA, 1993). Previous to that time, the recreational fishery was largely based in nearshore waters within 4.8 km or 6.4 km (3 mi. or 4 mi.) off the coast. The seaward movement of recreational fishing in the mid 1970s is attributed to the decline in nearshore groundfish stocks, which necessitated vessels moving farther offshore to catch these species. Three decades later in 2006, readers of *Offshore* magazine voted Stellwagen Bank the number three favorite recreational fishing spot in the northeast (*Offshore*, July 2006).

Recreational fishing in the sanctuary is divided into two categories: party/charter boat and private. In the party/charter boat category, commercial operators take customers fishing for a fee. In the private category, individuals own or rent boats that they use to go fishing. Party boats are usually 15.2 m (50 ft.) or longer and carry 20 to 80 passengers. Charter boats generally measure 7.6 m to 9.1 m (25 to 30 ft.) and carry an average of six paying passengers (hence the expression “six-pack” charters). Private boats often measure 6.1 m (20 ft.) or longer and carry one to several anglers.

DATA TYPES AND SOURCES

Fishing Vessel Trip Report (VTR) data for the period 1996–2005 (described above) were used to characterize party and charter boat fishing in the sanctuary, and consisted of the reported quantity (i.e., number) of fish landed by species. A comparable data base for private recreational fishing

specific to the sanctuary does not exist. The sample size for private recreational fishing boats in the standardized survey database (described above) for the sanctuary is too limited for reliable analysis at the scale of the sanctuary. Shipboard survey tracklines were run primarily during weekdays and likely under-sampled boating activities occurring during weekends and holidays, when this sector would be expected to be most active. Alternatively, results from the NOAA Marine Recreational Fisheries Statistics Survey Query were used to draw general inferences about private recreational fishing in the sanctuary (Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division [<http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html>]).

NOAA Survey Query data are the estimated pounds caught by species, based on a standardized random telephone survey of the general public. Data from the survey query used in this analysis are for offshore Massachusetts (i.e., Federal Exclusive Economic Zone three to 200 miles off the coast), which is an area inclusive of, but many times the size of, the Stellwagen Bank sanctuary. The data are also problematic because they include catches from two distinct biogeographic provinces, i.e., the database is inclusive of species from the GoM to the north of Cape Cod and from the mid-Atlantic shelf to the south. While there is sharing of seasonal transitional species between these segments of offshore Massachusetts, the two provinces are associated with differing species assemblages and ranges, a fact apparent in the species mix listed in the query results.

PARTY AND CHARTER

SPATIAL DISTRIBUTION AND DENSITY

Party and charter boats show distinctly different spatial patterns of use within the sanctuary (Figure 107). This figure is based on the VTR data for the period July 2001–June 2002, which is the base period for analyses of spatial distribution and density established in this document for treatment of fishing. The Western Gulf of Maine Closure Area (WGoM-CA) also is indicated in this Figure; 22 percent of this closed area overlaps the eastern side of the sanctuary and is known as the “sliver.”

As previously explained, the WGoMCA (and sliver) was established by NOAA Fisheries Service in 1998 at the recommendation of the NEFMC for the purpose of recovering groundfish stocks, specifically cod and haddock. Bottom-tending trawl gear and gill nets were specifically excluded from this closed area, but recreational hook and line remained among the allowable gear for catching groundfish there. Party and charter boats have come to view the sliver as a refuge from competing forms of commercial groundfishing.

Trip density for party boats was highest across all but the southern-most part of the sliver and over most of the northern half of the sanctuary; trip density was lowest over Stellwagen Bank and in the southwest quadrant of the sanctuary. Trip density for charter boats was highest over almost all of Stellwagen Bank and portions of the sliver; trip density was

lowest in the western and north-central portions of the sanctuary. High trip densities for both party and charter boats occurred in the sliver, but the concentrated coverage indicated there for party boats is compelling.

FLEET CHARACTERISTICS

Fishing by party boat and charter boat in the sanctuary is conducted by vessels with home ports of registry from across the entire eastern seaboard from Florida to Maine (Table 17). Three states (Massachusetts, New Hampshire and Maine) accounted for essentially 94% of the total number in each category; Massachusetts accounted for the great majority of the party (76.6%) and charter boats (78.7%) fishing in the sanctuary. Other states represented in the total include Vermont, Rhode Island, Connecticut, New York, Virginia, West Virginia, Missouri, North Carolina and Florida.

Between 1996 and 2005, an average of 25 party (range 17–43) and 44 charter (range 27–75) boats fished in the sanctuary each year. The number of party boats each year remained relatively steady over 1996–2003, increasing sharply over 2004–2005 (Table 17a). The number of charter boats each year trended upwards over 1996–2003, also increasing sharply over 2004–2005 (Table 17b). These trends are illustrated in Figure 108.

The annual number of trips for party boats over this period ranged from 133 to 517 with an annual mean of 292; the

range for charter boat trips was 352 to 937 and the mean was 598. The annual number of party boat anglers ranged from 3,416 to 21,150 (mean 10,610); the range for charter boat anglers was 3,377 to 6,142 (mean 4,808). On average over this period, party boats made half the number of trips as charter boats but took twice the number of anglers. These data are summarized in Table 18. Counts based on these measures all increased over this period.

PRICING AND SALES VALUE

General approximation of the direct sales value of party boat and charter boat fishing in the sanctuary suggests a combined total of about \$2.5 million in 2005. This calculation is based on a representative “head” fee of \$50 per party boat passenger and a representative charter cost of \$1,200 per trip, using the VTR data for number of passengers and trips in 2005 (Table 18). This approximate value is rounded upwards to account for tips to crew members, which is customary and which can be 10%-20% of the purchase price. Representative pricing was provided by several companies offering party boat fishing in the sanctuary and by the Stellwagen Bank Charter Boat Captains Association.

LANDINGS CHARACTERISTICS

As remarked earlier, “landings” is defined as the part of the fish catch that is unloaded and put ashore. The distinction

FIGURE 107. SPATIAL DENSITY PATTERNS BASED ON FISHING TRIPS FOR PARTY BOAT (a) AND CHARTER BOAT (b) FISHING IN THE STELLWAGEN BANK SANCTUARY DURING JULY 2001–JUNE 2002.

The patterns are Kriged density plots using a 5,000 m search radius and analyzed by ESRI ARCGIS. VTR gear code: Party/Charter (Trip ID: 2, 3).

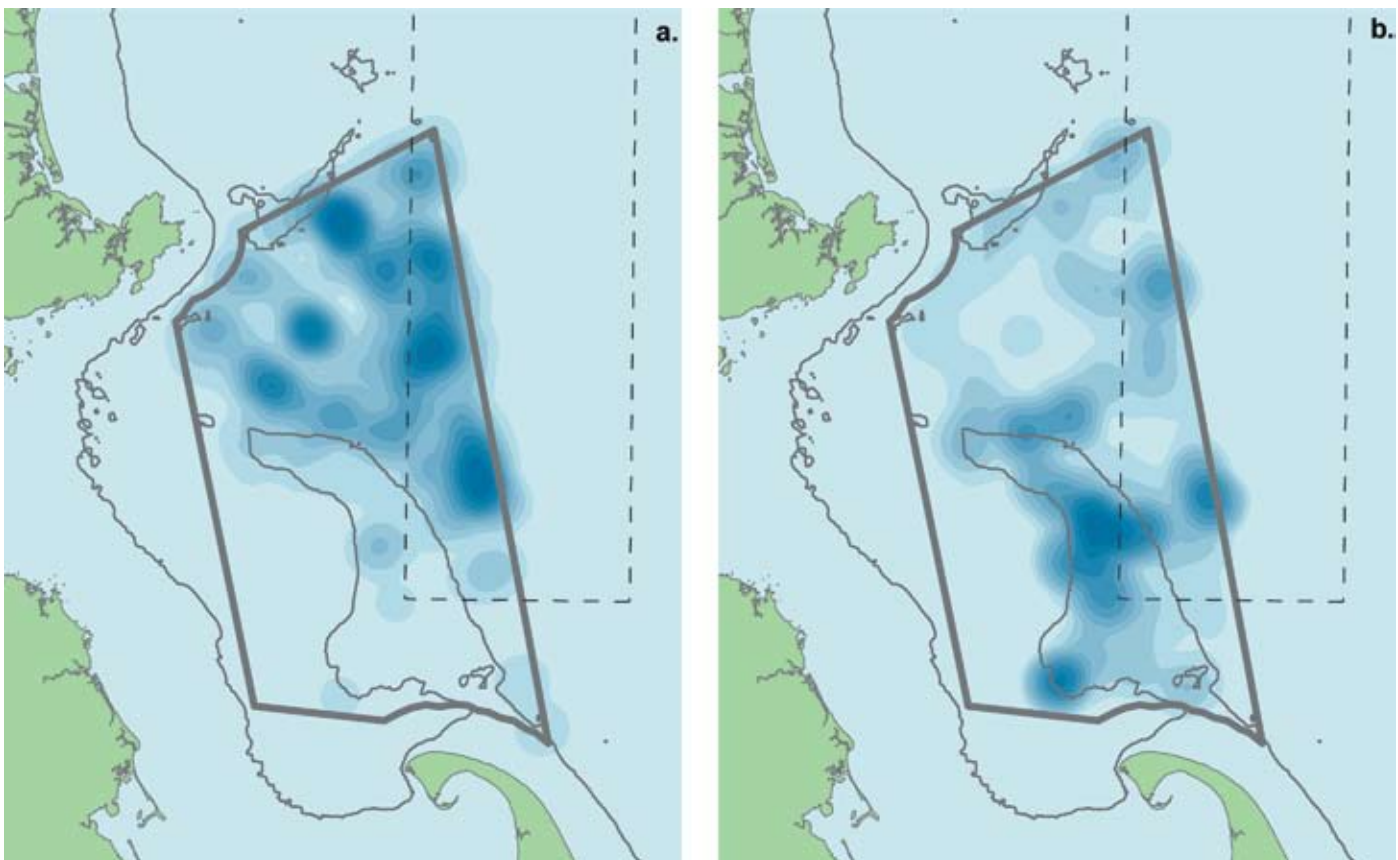


TABLE 17. NUMBER OF (a) PARTY BOATS AND (b) CHARTER BOATS BY STATE OF HOME PORT THAT LANDED FISH FROM THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

a. Party Boats												
State of Home-port	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total
Massachusetts	32	31	25	31	27	28	22	25	32	39	292	76.6
New Hampshire	5	4	1	3	5	5	6	5	8	7	49	12.9
Maine		4	2	2	2	4			2	3	19	5.0
Rhode Island	1	2		1				1		2	7	1.8
New York			1	1			1		1		4	1.0
Connecticut		1				1				1	3	0.8
Florida		1	1		1						3	0.8
North Carolina						1			1		2	0.5
Virginia			1	1							2	0.5
Total	38	43	31	39	35	39	29	31	44	52	381	100
a. Charter Boats												
Massachusetts	41	49	36	44	54	46	52	43	81	94	540	78.7
New Hampshire	6	4	4	6	8	12	11	14	13	14	92	13.4
Maine	1	1	1	2	2	2	1		3	2	15	2.2
Florida	1	1	2	2	2	1	1	1	1	1	13	1.9
New York	2	2	1		1		1			2	9	1.3
Connecticut					1	2	1	1	1		6	0.9
Vermont		1	1	1	1						4	0.6
West Virginia				1	1				1	1	4	0.6
Rhode Island				1						1	2	0.3
Missouri	1										1	0.1
Total	52	58	45	57	70	63	67	59	100	115	686	100

TABLE 18. NUMBER OF VESSELS, TRIPS AND ANGLERS FISHING IN THE STELLWAGEN BANK SANCTUARY BY (a) PARTY BOATS AND (b) CHARTER BOATS DURING 1996–2005.

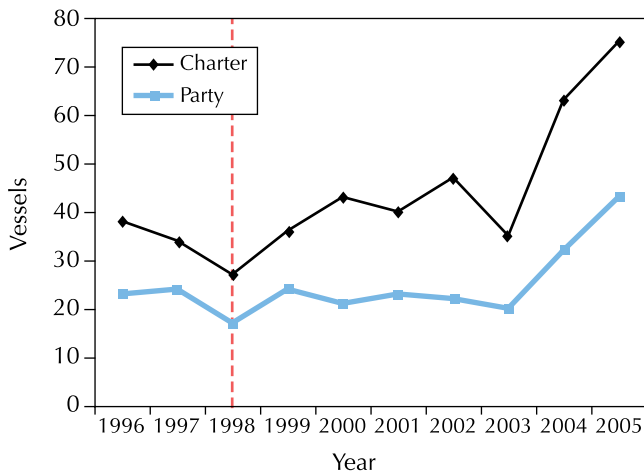
a. Party Boats				b. Charter Boats			
Year	Vessel	Trip	Angler	Year	Vessel	Trip	Angler
1996	38	772	26,501	1996	51	622	7,521
1997	43	799	27,060	1997	57	679	6,683
1998	31	676	23,654	1998	44	619	5,339
1999	39	814	27,891	1999	57	692	6,261
2000	35	740	26,335	2000	69	1,082	8,489
2001	39	912	34,885	2001	63	1,109	9,471
2002	29	912	32,703	2002	67	1,255	9,273
2003	31	798	29,373	2003	59	987	8,285
2004	45	1,510	55,815	2004	100	1,586	12,410
2005	53	1,268	46,849	2005	115	1,841	13,012
Total	383	9,201	331,066	Total	682	10,472	86,744

between catch and landings is important because quantities of fish are discarded at sea as bycatch. The discard to landings ratio in northeast recreational fisheries is not known, but discarding does occur. Recreational discards can be sublegal size fish or undesired species caught, for example.

Discard mortality also is not well known for the north-east recreational fisheries. However, species like cusk are particularly susceptible to discard mortality because of the barotrauma experienced in being brought to the surface from depth. Landings are invariably minimum indications of

FIGURE 108. TREND IN NUMBER OF PARTY AND CHARTER BOATS FISHING IN THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

Establishment of the Western Gulf of Maine Closure Area (WGoMCA) in 1998 is indicated by the vertical line.



the total numbers of fish caught and the total mortality experienced in recreational as well as commercial fisheries.

State and County

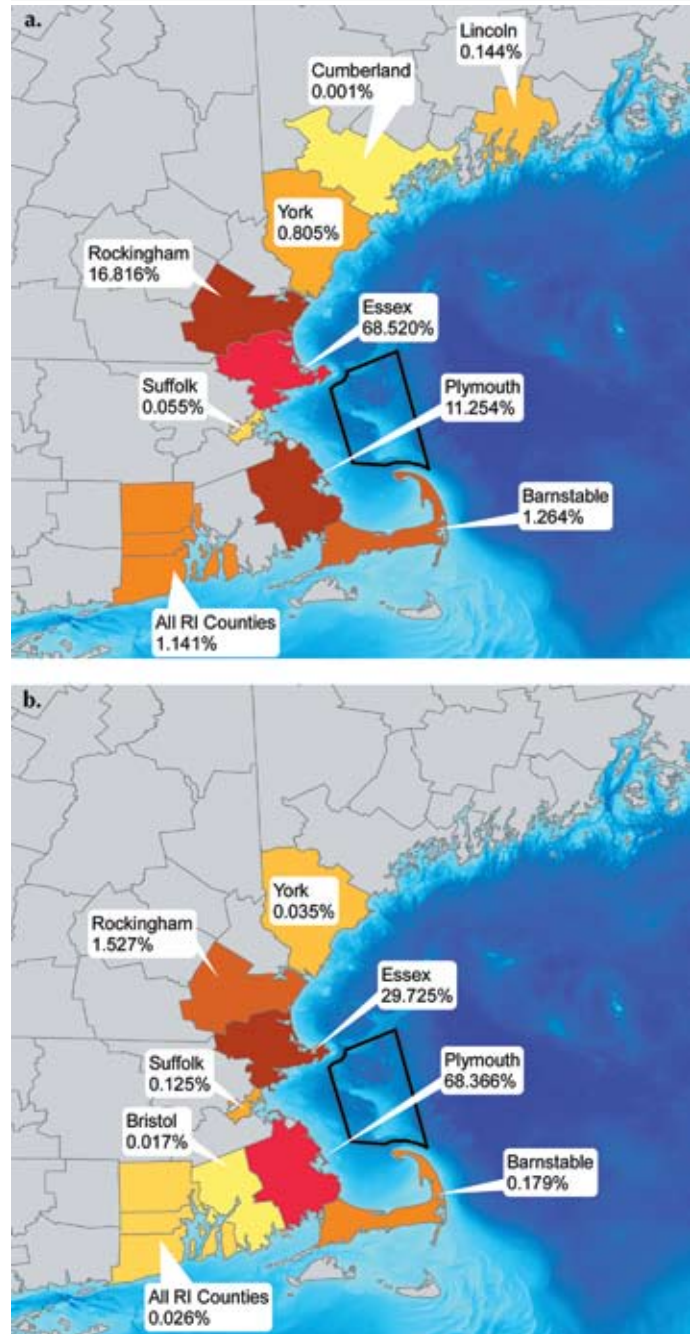
The total number of 353,459 fish landed by party boats from the sanctuary during 1996–2005 (Table 19a) was less than the total 503,735 fish landed by charter boats over that period (Table 19b). Massachusetts ports received 81.1% and New Hampshire ports received 16.8%, together totaling 97.9% of the party boat landings from the sanctuary. Massachusetts ports received 98.4% of the landings from charter boats. Massachusetts and New Hampshire ports are predominant in the party boat fishery in the sanctuary, while Massachusetts ports dominate charter boat fishing there.

The percent of party and charter boat landings from the sanctuary by county is presented in Figure 109. Essex County in Massachusetts received 68.5% of the party boat landings followed by Rockingham County in New Hampshire (16.8%) and Plymouth County in Massachusetts (11.3%), together totaling 96.6% of the party boat landings during 1996–2005. By contrast, Plymouth County received 68.4% of the charter boat landings followed by Essex County (29.7%), together totaling 98.1% of the charter boat landings over the same period. These results are consistent with the spatial patterns of use presented earlier in this section in which party boats demonstrated intensive use of the northern portions of the sanctuary, while charter boats predominantly used the southern portions, especially Stellwagen Bank proper (Figure 107).

WGoMCA

Establishment of the WGoMCA in 1998 did not have an immediate effect on the number of party boats fishing in the sanctuary (Figure 108), but counts of party boat trips and anglers increased steeply two years after the closure was instituted (Figure 110). By contrast, the effect on char-

FIGURE 109. DISTRIBUTION OF (a) PARTY BOAT AND (b) CHARTER BOAT LANDINGS (NUMBER OF FISH) FROM THE STELLWAGEN BANK SANCTUARY BY COUNTY LANDED FOR THE PERIOD 1996–2005.



ter boats was more immediate (Figures 108 and 111). The number of charter boats and, especially, the number of trips increased greatly between 1999 and 2005. Party boats are much larger vessels than charter boats and represent more substantial capital investment. In a fluctuating business environment fraught with regulatory risk such as involves fishing, the greater lag in rate of increase in the number of party boats relative to charter boats is to be expected for this reason.

The greater reliance of party boats on fishing in the sliver portion of the sanctuary relative to charter boats was noted

TABLE 19. QUANTITY OF FISH LANDED BY (a) PARTY BOATS AND (b) CHARTER BOATS FISHING IN THE STELLIWAGEN BANK SANCTUARY BY STATE AND COUNTY LANDED (1996–2005).

State and County Landed	a. Party Boats											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total
Maine	0	664	618	264	1,298	0	0	0	315	197	3,356	0.95
Lincoln	0	0	509	0	0	0	0	0	0	0	509	0.14
Cumberland	0	0	0	0	0	0	0	0	0	2	2	0.00
York	0	664	109	264	1,298	0	0	0	315	195	2,845	0.80
New Hampshire	1,031	796	102	2,103	3,774	5,271	10,367	7,394	16,338	12,263	59,439	16.82
Rockingham	1,031	796	102	2,103	3,774	5,271	10,367	7,394	16,338	12,263	59,439	16.82
Massachusetts	26,417	16,738	14,119	22,589	20,266	34,207	26,251	28,241	48,736	49,067	286,631	81.09
Essex	20,207	15,067	12,799	20,234	16,426	31,703	23,841	26,123	39,959	35,831	242,190	68.52
Suffolk	0	0	0	0	0	0	0	93	0	102	195	0.06
Plymouth	6,187	1,659	1,320	2,355	3,840	2,504	2,210	2,025	8,002	9,675	39,777	11.25
Barnstable	23	12	0	0	0	0	200	0	775	3,459	4,469	1.26
Rhode Island	0	0	0	0	0	0	0	0	2,065	1,968	4,033	1.14
All RI Counties	0	0	0	0	0	0	0	0	2,065	1,968	4,033	1.14
All Other Counties	0	0	0	506	0	97	865	0	410	0	1,878	0.53
Total	27,448	18,198	14,839	24,956	25,338	39,478	36,618	35,635	67,454	63,495	353,459	100.00
b. Charter Boats												
Maine	0	0	0	6	0	0	0	0	99	72	177	0.04
York	0	0	0	6	0	0	0	0	99	72	177	0.04
New Hampshire	2,189	318	384	1,939	86	189	552	1,408	386	242	7,693	1.53
Rockingham	2,189	318	384	1,939	86	189	552	1,408	386	242	7,693	1.53
Massachusetts	24,755	22,648	26,052	50,732	73,119	104,736	65,807	29,463	42,205	56,219	495,736	98.41
Essex	7,452	11,462	14,880	15,551	15,776	22,733	13,264	14,719	16,436	17,460	149,733	29.72
Suffolk	0	0	0	0	0	0	0	0	111	520	631	0.13
Norfolk	0	0	0	0	0	0	0	0	0	1	1	0.00
Plymouth	17,303	11,113	11,162	35,181	57,343	82,003	52,098	14,728	25,583	37,870	344,384	68.37
Barnstable	0	73	0	0	0	0	445	16	50	318	902	0.18
Bristol	0	0	10	0	0	0	0	0	25	50	85	0.02
Rhode Island	0	0	0	0	0	0	0	0	0	129	129	0.03
All RI Counties	0	0	0	0	0	0	0	0	0	129	129	0.03
All Other Counties	0	0	0	0	0	0	0	0	0	92	92	0.02
Total	26,944	22,966	26,436	52,677	73,205	104,925	66,359	30,871	42,690	56,662	503,735	100.00

FIGURE 110. TRENDS IN NUMBER OF ANGLERS AND TRIPS BY PARTY BOATS FISHING IN THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

Establishment of the WGoMCA in 1998 is indicated.

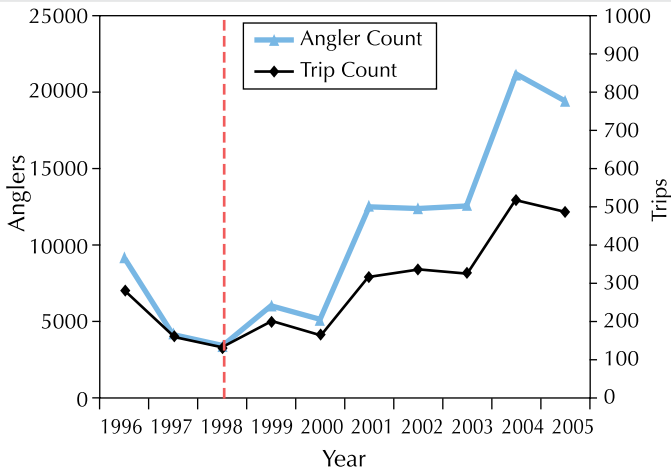


FIGURE 112. TRENDS IN PARTY BOAT AND CHARTER BOAT LANDINGS (QUANTITY) FROM THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

Establishment of the WGoMCA in 1998 is indicated.

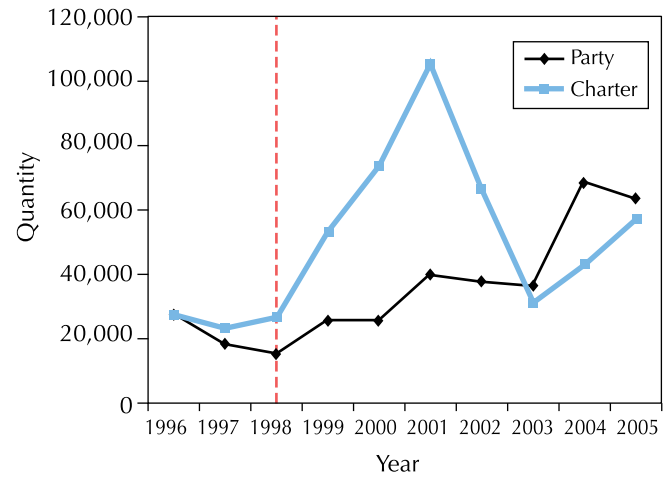
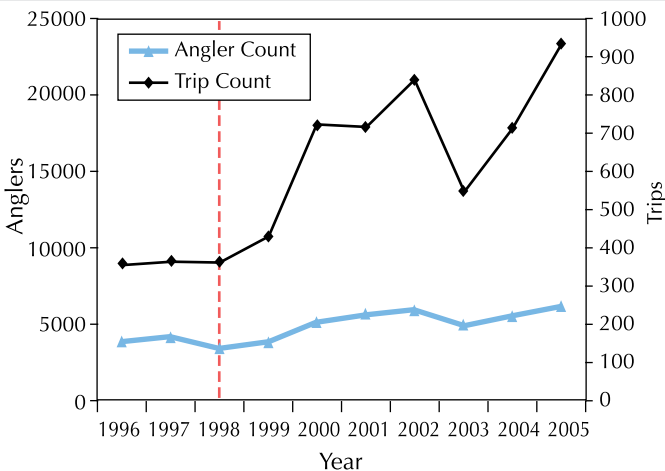


FIGURE 111. TRENDS IN NUMBER OF ANGLERS AND TRIPS BY CHARTER BOATS FISHING IN THE STELLWAGEN BANK SANCTUARY DURING 1996–2005.

Establishment of the WGoMCA in 1998 is indicated.



in the previous section on spatial distribution and density (Figure 107). In the 2001–2002 base period used to analyze the spatial densities of party and charter boat fishing in the sanctuary, 43% of party boat trips and 42% of party boat anglers fished within the sliver compared to 29% of charter boat trips and 34% of charter boat anglers. Figure 112 compares the annual quantity of fish landed from the sanctuary by party and charter boats over 1996–2005. The steep rise in quantity of fish landed following establishment of the sliver in 1998 is evident for charter boats but not party boats.

The steep drop in charter boat landings in 2002 and 2003 (Figure 112) appears to be the result of an interim final rule, issued pursuant to northeast multi-species recreational and party/charter vessel restrictions, that imposed possession limits on cod and haddock taken in the WGoMCA during August 1, 2002 to August 22, 2003, with Amendment 13

taking effect at the later date (NOAA Small Entity Compliance Guide, 2002). Landings by party boats, which use the sliver more often than charter boats, remained essentially level over these two years. The overall effect of these possession limits by 2005 was to bring near parity to the quantity of fish landed by party boats and charter boats fishing in the sanctuary.

The apparent contradiction inherent in the fact that party boats use the sliver more intensely than charter boats, yet their landings were less affected by the interim final rule may be explained by differences in the species composition of party and charter boat landings. As indicated in the following section, cod, in particular, and haddock constituted a greater share of charter boat landings as compared to party boat landings.

Species

The top ten species caught by party and charter boat fishing in the sanctuary during 1996–2005 based on number of fish landed are indicated in Table 20. The top four species in each vessel category in descending order were Atlantic cod, haddock, pollock and cusk, together totaling 90.5% of the party boat landings and 96.9% of the charter boat landings. Cod and haddock made up 80.9% of the party boat landings and 89.4% of the charter boat landings. Importantly, cod alone made up 54.1% of the party boat landings but 77.0% of the charter boat landings.

As explained above, the WGoMCA was established to help rebuild groundfish stocks, specifically cod and haddock. The highest spatial densities of party and especially charter boats were in the closed area where it overlapped the sanctuary (sliver). Party and charter boats appear to target areas in the sanctuary that produce high landings of these two species. The spatial differences in their fishing patterns may reflect alternate strategies: party boats generalize to catch a mix of cod and haddock and charter boats specialize to catch primarily cod.

As explained previously, cusk and Atlantic wolffish are on the Species of Concern List for the Endangered Species Act. These two species, albeit at relatively low numbers, were among the top ten species landed by party and charter boats fishing in the sanctuary (Table 20). These species have no directed management plan under the MFCMA despite continued exploitation of their populations. Atlantic halibut also are on the Species of Concern List and were reported within the VTR system as being caught on party and charter boats in the sanctuary during 1996-2005.

PRIVATE

There are no comparable data available to assess private recreational fishing at the scale of the sanctuary. NOAA Survey Query data, as explained above, are used to draw general inferences. Landings data in pounds caught by species in the federal offshore waters of Massachusetts (three to 200 miles off the coast) are presented in Table 21.

The survey query data in these tables were adjusted by removing transitional species more associated with the offshore waters to the south of Cape Cod. These species were rarely listed among the party and charter boat landings in the sanctuary based on the VTR reports. Further adjustment was made for striped bass which is illegal to catch or possess in federal waters of the Exclusive Economic Zone (which includes the sanctuary). These data sets allow comparison (1) between survey query private/rental (Table 21a) and combined party/charter (Table 21b) landings and general comparison (2) between survey query party/charter and the VTR party boat and charter boat landings.

GENERAL CHARACTERISTICS

After adjustment to remove the species less likely to be caught in the sanctuary, the survey query private/rental landings (Table 21a) and party/charter landings (Table 21b) indicate that Atlantic cod are caught in the greatest number. When cod, other cods/hakes and pollock are combined, the subtotal amounts to 72.7% of the total landings for private/rental and 89.8% for party/charter.

The survey query party/charter subtotal (89.8%) compares favorably to 90.5% for the VTR party boat subtotal that groups cod, haddock, pollock and cusk together (above). The survey query party/charter landings (Table 21b) demonstrate further similarity to the VTR party boat landings by including Atlantic mackerel, bluefish and spiny dogfish among the species more commonly caught.

The adjusted survey query private/rental landings are considered to be a reasonable representation of that category of recreational fishing in the sanctuary. The general pattern that emerges to characterize all categories of recreational fishing in the sanctuary is one of scaled difference: from a high degree of specialization for cod by charter boat fishing, through mixed species concentration preferably for cod and haddock by party boat fishing, to more generalized fishing and species switching by private recreational boats.

The survey query data provide some indication of effort trends in recreational fishing in the federal waters off Massachusetts, although the wide coverage area limits the applicability to the sanctuary. In general, the number of angler trips and the number of anglers engaged in recreational fishing in offshore waters of Massachusetts increased over the 1996–2005 timeframe. The number of people fishing in the offshore waters of Massachusetts more than doubled, reflecting similar rate increases in party boat and charter boat fishing in the sanctuary as indicated under the “Fleet Characteristics” subsection of this document.

STRIPED BASS

Striped bass cannot be fished for, caught, possessed or retained within the federal waters of the U.S. Exclusive Economic Zone [50 CFR 697.7(b)] except in certain waters off Rhode Island and New York. However, the original NOAA Survey Query data indicate sizeable landings of striped bass by private/rental fishing boats (20.5% of the total) and by commercial party/charter boats (9.4% of the total) in the federal Exclusive Economic Zone off Massachusetts. Table 21, which summarizes these data, indicates that private/rental landings of striped bass totaled 6.25 million pounds

TABLE 20. TOP TEN SPECIES CAUGHT BY (a) PARTY BOAT AND (b) CHARTER BOAT FISHING IN THE STELLWAGEN BANK SANCTUARY DURING 1996–2005 BASED ON NUMBER OF FISH LANDED.

a. Party Boat Species				b. Charter Boat Species			
		Total qty 1996–2005	% Total 1996–2005			Total qty 1996–2005	% Total 1996–2005
1	Cod	192,659	54.14	1	Cod	387,215	77.03
2	Haddock	95,150	26.74	2	Haddock	62,022	12.34
3	Pollock	21,652	6.08	3	Pollock	29,234	5.82
4	Cusk	12,634	3.55	4	Cusk	8,507	1.69
5	Dogfish, Spiny	8,263	2.32	5	Tuna, Bluefin	4,665	0.93
6	Mackerel, Atlantic	8,252	2.32	6	Wolffish / Ocean Catfish	3,977	0.79
7	Wolffish / Ocean Catfish	5,307	1.49	7	Mackerel, Atlantic	3,284	0.65
8	Redfish / Ocean Perch	2,653	0.75	8	Redfish / Ocean Perch	847	0.17
9	Bluefish	1,809	0.51	9	Dogfish, Spiny	588	0.12
10	Ocean Pout	1,260	0.35	10	Striped Bass	451	0.09

TABLE 21. LANDINGS (POUNDS) BY SPECIES IN THE FEDERAL OFFSHORE WATERS OF MASSACHUSETTS BY (a) PRIVATE/RENTAL BOATS AND (b) PARTY/CHARTER BOATS DURING 1996–2005 BASED ON THE NOAA SURVEY QUERY DATA. ADJUSTMENTS WERE MADE AS DETAILED IN THE TEXT.

a. Private Rental												
Species Landed	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% Total
Atlantic Cod	653,602	122,940	738,601	346,096	884,419	2,682,180	1,983,851	3,426,837	2,619,733	1,881,481	15,339,740	63.79
Atlantic Mackerel	499,155	425,671	103,685	473,200	220,409	334,711	453,310	266,404	304,484	98,166	3,179,195	13.22
Bluefish	377,469	209,331	218,813	74,732	0	243,710	274,808	224,294	255,998	601,144	2,480,299	10.31
Other Cods/hakes	1,812	0	54,663	17,035	45,267	178,848	207,369	32,727	255,476	697,776	1,490,973	6.20
Pollock	74,862	0	4,881	26,493	467	318,044	139,767	9,991	0	196,758	771,263	3.21
Summer Flounder	8,728	8,036	63,195	18,799	63,224	46,749	88,166	68,396	37,405	43,206	445,904	1.85
Other Tunas/mackerels	0	0	0	0	0	0	0	0	0	171,595	171,595	0.71
Winter Flounder	5,613	6,149	11,795	381	15,296	8,364	4,795	893	1,263	0	54,549	0.23
Other Fishes	14,700	4,092	3,858	0	0	11,285	14,806	0	5,463	0	54,204	0.23
Dogfish Sharks	0	0	7,086	0	5,029	0	0	0	29,473	0	41,588	0.17
Little Tunny/ Atlantic Bonito	0	3,768	0	0	0	0	0	6,228	0	0	9,996	0.04
Sculpins	3,516	1,151	0	0	0	0	0	0	0	0	4,667	0.02
Red Hake	0	0	0	0	0	2,046	0	0	0	0	2,046	0.01
Herrings	1,958	0	0	0	0	0	0	0	0	0	1,958	0.01
Cunner	0	818	0	0	0	0	68	0	0	0	886	0.00
Totals	1,641,415	781,956	1,206,577	956,736	1,234,111	3,825,937	3,166,940	4,035,770	3,509,295	3,690,126	24,048,863	100.00
Other Species Fished But Less Likely Caught In Sanctuary												
Black Sea Bass	9,795	4,334	789	3,364	227,250	4,493	23,896	2,511	19,114	36,131	331,677	
Tautog	89,934	25,789	8,300	0	0	0	0	31,083	0	0	155,106	
Scup	25,617	14,852	35,931	2,452	1,096	10,620	22,075	0	25,236	0	137,879	
White Perch	0	0	11,402	0	0	0	0	0	0	0	11,402	
Totals	125,346	44,975	56,422	5,816	228,346	15,113	45,971	33,594	44,350	36,131	636,064	
Illegal												
Striped Bass	297974	562,684	466,626	309,815	444,445	704,478	554,411	1,090,730	1,089,930	729,050	6,250,143	

TABLE 21. LANDINGS (POUNDS) BY SPECIES IN THE FEDERAL OFFSHORE WATERS OF MASSACHUSETTS BY (a) PRIVATE/RENTAL BOATS AND (b) PARTY/CHARTER BOATS DURING 1996-2005 BASED ON THE NOAA SURVEY QUERY DATA. ADJUSTMENTS WERE MADE AS DETAILED IN THE TEXT.

Species Landed	b. Party/Charter											Total	% Total
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005			
Atlantic Cod	954,991	1,450,252	1,532,702	1,384,341	2,336,530	1,035,699	750,840	986,922	411,491	1,087,790	11,931,558	75.38	
Other Cods/hakes	1,812	0	54,663	17,035	45,267	178,848	207,369	32,727	255,476	697,776	1,490,973	6.20	
Bluefish	34,372	306,627	105,298	17,524	125,794	44,493	117,302	29,352	241,860	160,151	1,182,773	7.47	
Pollock	12,059	40,102	26,766	42,516	18,530	275,326	25,245	29,952	131,011	209,759	811,266	5.12	
Atlantic Mackerel	10,183	34,815	12,762	19,786	2,767	46,678	0	31,455	10,020	0	168,466	1.06	
Other Fishes	15,132	20,620	15,406	6,310	16,903	10,159	8,430	16,460	10,234	21,333	140,987	0.89	
Cunner	0	747	0	1,052	0	0	0	30,102	159	542	32,602	0.21	
Summer Flounder	12,482	82	0	0	11,918	1,473	459	201	0	0	26,615	0.17	
Dogfish Sharks	0	0	679	0	0	0	0	324	2,275	18,808	22,086	0.14	
Other Tunas/mackerels	0	4,176	0	0	0	0	0	0	2,119	9,969	16,264	0.10	
Winter Flounder	0	0	439	0	0	1,486	1,660	229	573	1,709	6,096	0.04	
Eels	0	875	0	0	0	553	0	0	0	0	1,428	0.01	
Skates/rays	0	0	0	0	0	0	0	0	0	719	719	0.00	
Little Tunny/atlan-tic Bonito	0	0	406	0	0	0	0	0	0	0	406	0.00	
Sculpins	0	0	0	0	0	0	0	0	0	298	298	0.00	
Herrings	0	0	0	0	79	0	0	0	0	115	194	0.00	
Other Flounders	0	0	0	0	0	0	0	0	0	165	165	0.00	
Red Hake	53	0	0	0	0	0	0	0	0	0	53	0.00	
Totals	1,046,792	1,870,470	1,721,733	1,507,259	2,785,772	1,549,796	987,642	1,201,170	946,185	2,212,771	15,829,590	100.00	
Other Species Fished But Less Likely Caught In Sanctuary													
Scup	32,350	51,429	125,360	11,799	260,895	25,714	184,545	72,240	11,433	1,407	777,172		
Black Sea Bass	558	1,217	201	201	12,912	1,616	11,777	64,401	728	0	93,611		
Spanish Mackerel	55,653	0	0	0	0	0	0	0	0	0	55,653		
Tautog	0	893	573	739	0	0	0	7,116	443	844	10,608		
White Perch	0	439	0	0	0	0	0	0	0	0	439		
Dolphins	0	0	408	0	0	0	0	0	0	0	408		
Totals	88,561	53,978	126,542	12,739	273,807	27,330	196,322	143,757	12,604	2,251	937,891		
Illegal													
Striped Bass	597	212,523	187,534	42,456	190,250	66,050	145,559	116,215	173,224	515,325	1,649,733		

and that party/charter landings of striped bass totaled 1.65 million pounds over the 1996–2005 period.

This situation requires immediate remedy. There either is a low level of understanding about the federal regulation, in which case there is need of considerable directed education to inform the public of this prohibition, or there is a high rate of violation, in which case there is need for increased enforcement. Or the question in the survey query needs to be rewritten and better specified, so that people responding do not place themselves in jeopardy by ostensibly admitting guilt to violation of federal law and to assure survey data quality.



WHALE WATCHING

COMMERCIAL WHALE WATCHING

The Stellwagen Bank sanctuary is one of the top-ten premiere whale-watching locations in the world, one of only three such areas in U.S. waters, as listed by the World Wildlife Fund in 2002 (ENS, 2006 and *USA TODAY*, 2007); it was voted best in the Northeast for wildlife watching by the readers of *Offshore* magazine in 2006 (*Offshore*, 2006). Threatened and endangered species of whales are the attraction for more than a million visitors who go whale watching in the sanctuary each year (Hoyt, 2001). While the educational opportunity provided on whale watching trips can have a positive effect on efforts to protect whales, growth of the industry, use of larger and faster boats amid variable operational standards, interactive with a pervasive small boat recreational fleet of viewers (intermixed with small boats trolling for bluefin tuna close to whales), raise concerns for the welfare of the whales. Recent research concludes that whale-watch operators do not need to get close to whales to satisfy their customers, as many other variables are important (Orams, 2000).

Commercial whale watching on Stellwagen Bank began in 1975 from Provincetown, Massachusetts, inaugurating commercial whale watching on the U.S. East Coast (see Sidebar). Today, whale watching in the sanctuary is among New England's most notable recreational industries. It is estimated that more than 1.2 million passengers participated in

whale watching tours in New England in 2000, generating annual total direct sales of more than \$30 million to the region and \$24 million to Massachusetts alone. Massachusetts accounted for nearly 80% of the New England totals for both passengers and revenues (Hoyt, 2001) and virtually all of Massachusetts whale watching occurs in the Stellwagen Bank sanctuary. Whale watching activity in the sanctuary area has been the subject of a series of studies covering the years from its inception (Lewis, 1988; Ramage, 1990; Hoagland and Meeks, 2000; Hoyt, 2001; O'Connor *et al.*, 2009).

For sanctuary bound New England whale watchers, the activity represented more than a third of the value of their entire vacation (Hoyt, 2001). In an earlier study, more than two-thirds of the surveyed whale watchers had planned to go whale watching as part of their vacation (Hoagland and Meeks, 2000). In a 1988 survey of Massachusetts whale watchers, 45% stated that their primary purpose was whale watching, with 65% traveling more than 250 miles (400 km). Only 18% of respondents in that survey were from Massachusetts; 64% were from elsewhere along the U.S. east coast (Lewis, 1988; Hoyt, 2001). A whale watcher survey conducted in 2008 out of Barnstable, MA, found that 76% of the passengers surveyed were not aware of the Stellwagen Bank sanctuary prior to taking their trip (WDCS, 2008), indicating the importance of the whale watch cruise as a means to educate the public about the sanctuary. The majority of whale watching in New England originates from Massachusetts ports with those boats regularly visiting the Stellwagen Bank sanctuary (Hoyt, 2001).

Commercial advertising that whale watching will be done in the “Stellwagen Bank National Marine Sanctuary,” rather than at “Stellwagen Bank,” can be an important distinction affecting market appeal and purchasing behavior. A survey of attitudes toward whale watching in the sanctuary conducted by Boston University's Communication Research Center (1996–1997) found that 38.5% of potential customers would prefer to go whale watching if they knew the activity would occur within the sanctuary; an additional 47.8% would be equally interested. The survey also found that when going whale watching at Stellwagen Bank, 77% of customers would prefer a naturalist specifically trained about the sanctuary. When respondents were given a hypothetical situation of having two boat choices, with the only difference between the boats being that the naturalist on one boat had additional training about the sanctuary, 84% chose that boat. The survey had a margin of error of +/- 4.5%. Sanctuary branding and naturalist certification demonstrate strong marketing cache.

The concept of “eco-tourism” has a significant impact on the whale watching industry. As the industry matures and diversifies, whale watching is increasingly incorporated into broader tourism packages that are offered to the public. Typically, hotels, educational organizations, whale watch operations and travel agencies make joint arrangements (Carter, 1994) to offer whale watching packages that include transportation, an overnight hotel stay, shoreside recreation

and classroom lectures (Evans, 1994). In addition to carrying tourists and students, almost all whale watching trips to the sanctuary feature a naturalist on board to interpret marine life for the public, and some also collect and record sightings data. In 2009, NOAA Fisheries Service Protected Resources Division, the Whale and Dolphin Conservation Society and Stellwagen Bank sanctuary launched “Whale Sense” to promote responsible whale watching. “Whale Sense” is a collaborative, voluntary program recognizing commercial whale watching operations committed to a higher standard of whale watching (www.whalesense.org).

Naturalists and researchers, who educate passengers about the whales’ natural history and interpret the behavior of whales encountered on the trips, staff most of the whale watch boats. Scientists have used whale watch boats as accessible and economical research platforms to collect data on whales in the area. In the sanctuary, whale watch boats are particularly valuable in monitoring life histories of individuals. These whale watch data have played a significant role in the definition of the structure of the North Atlantic humpback whale population including distribution, stock identity, reproductive parameters, abundance, population composition, migratory destinations, behavior and human-related impacts (Robbins, 2000).

Humpback whales are the primary attraction for whale watch trips because of their long seasonal residence in the sanctuary, their highly visible behavior at the sea surface, and because of their known genealogy based on individual identification markings on their tail flukes. In addition to humpbacks, fin whales, minke whales and white-sided dolphins are commonly seen. North Atlantic right whales are less frequently encountered, owing both to their critically endangered population status (i.e., fewer right whales overall to frequent the sanctuary), to the shorter period of residence within the sanctuary (generally late winter or early spring to approximately July) and regulations restricting vessel approach.

Until the 2006 season when numbers rebounded to a historic high, the total number of whale sightings in the sanctuary had been declining over the past decade. Scientists suggest that reduced local availability of sand lance, the main food source of humpback and fin whales which attracts the whales to the sanctuary, may have been the primary cause of this earlier decline in sightings (Payne *et al.*, 1990; Weinrich *et al.*, 1997; Kenney *et al.*, 2001). Prey field mapping by sanctuary scientists tagging humpback whales during the 2006 - 2009 seasons revealed large quantities of sand lance in the sanctuary and in the immediate vicinity of feeding humpbacks.

RECREATIONAL WHALE WATCHING

Recreational boaters are most numerous and often aggregate in the sanctuary during the major portion of the whale watch season from May to September. While participation in whale watching by this sector is presumed high, there are no quantitative assessments to indicate levels of participation. These smaller private craft, dubbed the “mosquito fleet”

The Whale Watching Cruise

Commercial whale watch cruises are conducted in the sanctuary from April through October, when the greatest concentrations of whales are present. In 2006, at least 13 dedicated whale watching businesses with between 18–23 boats operated from six Massachusetts ports—four out of Gloucester; three out of Boston; two out of Provincetown and Plymouth respectively; and, one each out of Barnstable and Newburyport. Some operators use their boats for other purposes such as fishing, sightseeing or commuter transportation (Wright, 1994). Additionally, other chartered vessels may engage in whale watching.

Commercial whale watch boats range in size from approximately 15 m (50 ft. with 35-40 passenger capacity) to over 42 m (140 ft. with 400 passenger capacity). Some boats are propelled by screw propellers and other by jet drives. The whale watch operations can be categorized into two groups: those deploying boats which regularly operate at speeds from 16-20 knots, and those deploying high speed boats which regularly operate at speeds from 25-38 knots (Wiley *et al.*, 2008).

Vessels may make one to three trips per day to the sanctuary. A 4-6 hour trip averages \$30-40. The tour schedule of most commercial whale watch boats begins in April, with one trip scheduled daily through June with two trips scheduled on weekends. School groups are the main market during this time. The season peaks during July and August; operators generally offer two to three trips per boat daily, catering to a generalized tourist market. Schedules are reduced after Labor Day. Seasonal demand and variable weather conditions determine trip frequency. Some companies have more than one vessel and also operate charter fishing trips or other types of sightseeing tours.

by commercial whale watch operators, follow commercial whale watch boats and/or seek out whales independently.

NOAA whale watch guidelines have been in place since 1985 for the Northeast region. These guidelines represent the best practices for the industry as endorsed by the federal government. There are occasional, albeit largely undocumented, reports of whale harassment and collisions between non-commercial vessels and whales. Evidence of smaller boat vessel collisions (i.e., less than 15.2 m or 50 ft.) are supported by photographs of cuts and scars on the backs, flukes and fins of cetaceans (CCS, 1991). A more detailed description of the guidelines is found in Appendix M.

In an attempt to educate private boaters that are whale watching in the sanctuary, the Whale and Dolphin Conservation Society, in collaboration with the Stellwagen Bank sanctuary and NOAA Fisheries Service Protected Resources Division, developed a public education program entitled “See a Spout, Watch Out! Responsible Whale Watching.” Additionally,

the International Fund for Animal Welfare worked with the Commonwealth of Massachusetts, the Provincetown Center for Coastal Studies and NOAA Fisheries Service to distribute educational material on this subject to registered boaters throughout Massachusetts. Development of such cooperative outreach programs can inform boaters when whales are in the vicinity and to act responsibly around these animals. However, these programs have been largely land-based and an on-the-water program is needed to increase outreach to vessels in the vicinity of whales.



OTHER RECREATION AND TOURISM

In addition to fishing and whale watching mentioned above, other popular recreational and tourism activities include diving, bird watching and boating, some of which take place in and around the waters of the sanctuary. There are 65 small boat harbors and over 80 boating and yacht club sites along the Massachusetts coast giving access to the sanctuary.

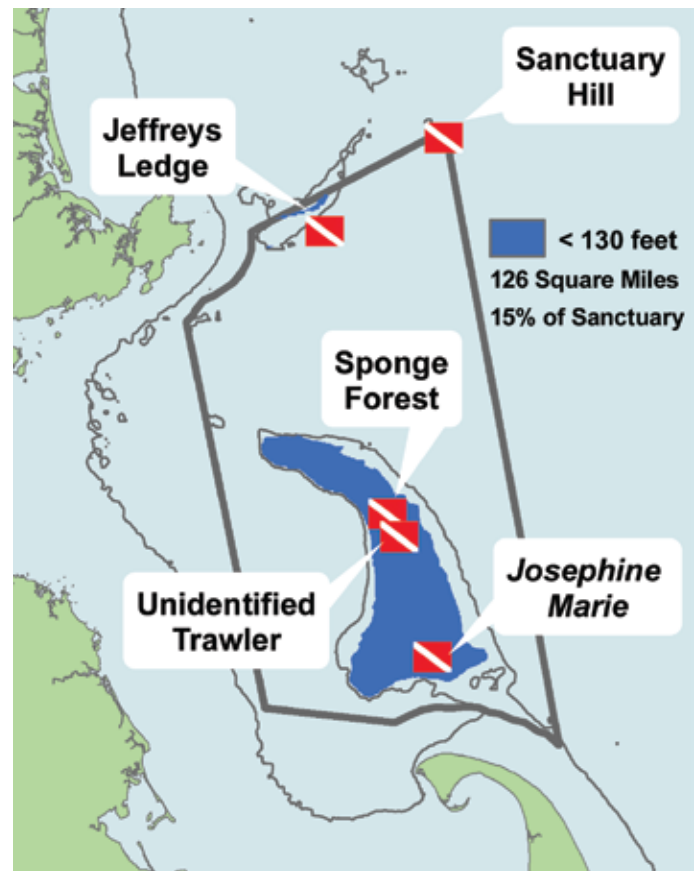
DIVING

While the most frequently visited New England dive spots are relatively close to shore, the sanctuary offers SCUBA divers a chance to explore different offshore environments at the mouth of Massachusetts Bay; however, strong currents and exposed waters create challenging dive conditions. Almost 15% of the sanctuary's total seafloor area (126 square miles) is less than 130 feet deep and within depth limits for recreational diving. The shallowest areas are found on top of Stellwagen Bank as well as on parts of southern Jeffreys Ledge and Sanctuary Hill (Figure 113). Recent research has identified specific locations on Stellwagen Bank, Jeffreys Ledge and Sanctuary Hill as interesting dive sites due to complex habitat. Several modern shipwrecks at shallower sites also serve as interesting dive attractions.

Stellwagen Bank's shallowest depths are located at its southern end, which rises to within 65 feet of the surface. In this area, the sandy bottom can be pockmarked with lobster holes. Moving north along the Bank's top, the seafloor slopes to a relatively constant depth of 100-110 feet. While diving Stellwagen Bank's sandy areas offers opportunities to view schooling fish, other areas of the sanctuary with hard

FIGURE 113. SANCTUARY MAP SHOWING THAT ALMOST 15% OR 126 SQUARE MILES OF THE STELLWAGEN BANK SANCTUARY IS WITHIN THE RECREATIONAL DIVE LIMIT OF 130 FEET.

Most of this area, depicted here in blue, lies on top of Stellwagen Bank but additional areas include parts of southern Jeffreys Ledge and Sanctuary Hill.



bottom habitat generally prove more visually rewarding to visit.

One such dive site named Sponge Forest encompasses areas with cobble and scattered boulders that provide a hard substratum for encrusting marine invertebrates. The area is named after the large finger sponges found growing at scattered locations across the seafloor. During summer months, this area is frequented by numerous small assemblages of cod using the sponge habitat in much the same manner as fishes occupying coral reefs. Sponge Forest lies within the Traffic Separation Zone of the Port of Boston's Traffic Separation Scheme (TSS). Dive vessels must be on the lookout for large cargo vessels transiting the area and must not impede the passage of these vessels. Vessel operators must follow all regulations pertaining to the safe operation of vessels in a TSS.

On the sanctuary's northern boundary, rocky ridges on the southern edge of Jeffreys Ledge rise to within 115 feet of the surface. The shallowest portion of Jeffreys Ledge is comprised of piled cobble and boulders. Anemones, stalked tunicates and coralline algae reside on the rocks making for a colorful landscape when illuminated with a dive light. The piled

boulders on Jeffreys Ledge create a complex structure with many crevices for marine fishes such as cusk and wolffish.

In the sanctuary's northeast corner, Sanctuary Hill rises from 325 feet to 115 feet and is topped with solid granite and piled boulders. Like on Jeffreys Ledge, the hard substratum typical of Sanctuary Hill is home to a variety of invertebrates and fishes that live on and among the piled boulders. Since Sanctuary Hill is 18 nautical miles offshore, the bedrock outcropping experiences strong currents. Blue and porbeagle sharks reportedly visit areas with steeply sloping topography such as Sanctuary Hill.

In addition to sites showcasing natural habitats, the sanctuary offers several modern shipwrecks for divers to explore. The fishing vessel *Josephine Marie* lies on the southern end of Stellwagen Bank in 105 feet of water. The 80-foot long steel-hulled stern trawler was built in 1969 in Mobile, Alabama. Based out of Gloucester, the *Josephine Marie* actively fished in Massachusetts Bay until 1 February 1992 when disaster struck. While returning from a routine fishing trip, the *Josephine Marie's* crew radioed the Coast Guard that they were taking on water and needed immediate help. The trawler's crew abandoned ship and were rescued by the F/V *Italian Gold*. The red and black-hulled *Josephine Marie* lies upside down with its bow facing roughly southeast. Divers should be aware of hazards such as strong currents and entangled fishing gear at this site.

Another trawler shipwreck rests on Stellwagen Bank in 105-110 feet of water north of the *Josephine Marie*. The trawler is broken into four pieces: pilothouse, hull, stern, and net reel. Smaller hull fragments surround the site. As the shipwreck sits on a mostly featureless sand bottom, it attracts schools of cod and pollock that swim in proximity to the structure. The identity of this trawler has not been determined and the sanctuary is seeking help from anyone who might know its name. The trawler lies within the Outbound Lane of the Port of Boston's Traffic Separation Scheme (TSS). Dive vessel operators must follow all regulations pertaining to the safe operation of vessels in a TSS.

BIRDWATCHING

The sanctuary provides a rewarding birding opportunity for both novices and experienced birders. At least 53 seabird species occur within the sanctuary's boundaries; however, their abundance and distribution change constantly from season to season and from year to year. A detailed list of seabird species found within the sanctuary and the GoM area is presented in Appendix J.

Each year since 1998, the Massachusetts Audubon Society (MASS Audubon) and the sanctuary have collaborated to conduct the Stellwagen Bank Sanctuary Christmas Bird Count. In earlier years, the count covered a 15-mile diameter circle that included the southern end of Stellwagen Bank (and sanctuary) and the northern tip of Cape Cod. Starting in 2009, the count adopted a new sampling format.

Unlike the traditional circle, the new Stellwagen Bank count covers a set of E-W track lines some 2.5 nm apart, based

upon previous marine resource surveys in the sanctuary (see Figure 47). The old "circle" count only covered the southern portion of Stellwagen Bank and included part of Cape Cod. While allowing for shore-based counts when open ocean cruises were not feasible because of inclement weather, that format incidentally included many coastal shorebirds as well as seabirds. The new count area and sampling format focuses only on sanctuary resources (seabirds); the annual count may be extended to include other seasons as well as winter.

BOATING

Personal boating in the sanctuary often occurs as an ancillary activity to recreational fishing, whale watching, bird watching and diving which have been previously discussed. The considerable distance offshore and open ocean conditions constrain sanctuary access to day trips by larger more expensive boats. Sailboats frequent the sanctuary in coastwise transit from port to port, but rarely as the primary destination. Recreational boaters typically transit the sanctuary going to and from Boston, coming from the Cape Cod Canal or Cape Cod Bay, and from Provincetown or Cape Ann.



MARITIME TRANSPORTATION

Massachusetts Bay is a body of water in which commercial maritime activities abound and which is home to many harbors that ring the coast from Cape Cod to Cape Ann. The historic Ports of Boston, Gloucester, Salem Sound and Plymouth are active industrial ports, but the former two account for the majority of the commercial shipping traffic. As an indication of volume, there were 4,561 vessel trips made to and from these ports and an additional 2,149 vessels traveled through the Cape Cod Canal in 2003 (USCG, 2006). The majority of these vessels cross the sanctuary en route to and from these ports or in transit to ports to the north and south along the eastern seaboard. Approximately 800 commercial fishing vessels use Massachusetts Bay as a fishing area or as a transit zone to open ocean fishing areas (USCG, 2006).

TRAFFIC AND ROUTING

Vessels crossing the sanctuary come from multiple sources, but two in particular. The first is vessels arriving at and departing from the Port of Boston. There is a vessel Traffic Separation Scheme (TSS) established by the International Maritime Organization (IMO), that is recommended for this approach to Boston Harbor (Figure 79). The TSS originates in the Great South Channel, heads in a northerly direction until just off the easterly side of Provincetown (Buoy "BD"), where it proceeds in a northwesterly direction, crossing the sanctuary and ending in a precautionary area off the entrance to Boston Harbor. Most of the vessels entering and exiting Boston Harbor are large container ships, tankers, liquefied natural gas (LNG) carriers, cruise ships, salt and scrap ships, military vessels and some research vessels; they tend to cross the sanctuary along a west-east axis. High speed ferries reaching speed as great as 40 knots transit portions of the sanctuary in service along the Provincetown/Boston route.

The second source of vessel traffic across the sanctuary is coming from or going to the Cape Cod Canal. The majority of vessels utilizing the Canal include tug and tow boats, fishing vessels, recreational boats, military vessels, passenger and cargo ships and some tankers. Most of these vessels tend to cross the sanctuary along a north-south axis.

Large commercial ships arriving at and departing from the Port of Boston generally use the voluntary TSS. This scheme was established to prevent collisions by maintaining separation between inbound and outbound vessels. With the exception of the TSS, vessels operating in the vicinity of the Port of Boston are unencumbered with regard to track. Vessel masters may use whatever course and speed they wish,

consistent with the International Convention for the Prevention of Collisions at Sea (COLREG), weather conditions, sea state, visibility and other marine operations taking place along their intended track. Ships arriving from the southeast and east will typically make directly for the precautionary area and the TSS.

Non-TSS traffic, approaching from the east and northeast, typically follows historic tracks from Europe and Canada that are not marked on published navigational charts or maintained by the USCG. Figure 114 provides a three-dimensional representation of large commercial vessel traffic crossing the sanctuary based on USCG Automatic Identification System (AIS) data for April–May 2006. The tracks for vessels crossing the sanctuary going to or from the Port of Boston by way of the TSS predominate.

PORT ACTIVITY

PORT OF BOSTON

Because the sanctuary's location straddles the mouth of Massachusetts Bay, it is the "gateway" to maritime commerce in Massachusetts, principally the Port of Boston. The Port of Boston is the largest seaport in New England and is among the oldest and busiest ports in the country. The seaport currently handles more than \$8 billion worth of goods annually and is the largest handler of container cargo in New England (25 container shipping lines), shipping and receiving 1.2 millions tons each year. The terminals in the Port of Boston are equipped to handle 1.3 million tons of general cargo, 1.5 million tons of non-fuels bulk cargo and 12.8 millions tons of bulk fuel cargos each year (MassPort, 2006a). The Port of Boston is also a major maritime energy trans-shipment and storage location for the New England region, including many shipments of refined petroleum products via tanker and barge as well as LNG to the terminal in Everett, MA, that meet 90% of Massachusetts' petroleum consumption needs.

The majority of vessel activity occurring in and around the sanctuary throughout the year is dominated by the transport of petroleum products, cargo and LNG. Large, deep draft commercial ships in this service include: tanker ships, container ships, dry bulk carriers, roll on-roll off (RO-RO) ships and gas carriers (including LNG carriers). These deep draft ships made an average of 2,257 transits per year to and from the Port of Boston over the period 2000–2005 (Table 22). There was no pronounced seasonality characteristic of this traffic for the three years sampled (2001–2003) (Figure 115). Commercial deep draft and other maritime traffic entering and leaving the Port of Boston and transiting Massachusetts Bay is characterized in Table 23.

To accommodate the worldwide trend toward larger vessels, the Massachusetts Port Authority (MassPort) began the Boston Harbor Navigation Improvement Project (BHNIP) to deepen key

FIGURE 114. THREE-DIMENSIONAL REPRESENTATION OF LARGE COMMERCIAL VESSEL TRAFFIC (156 SHIPS) CROSSING THE STELLWAGEN BANK SANCTUARY BASED ON USCG AIS DATA FOR APRIL–MAY 2006.

The former vessel Traffic Separation Scheme (TSS) is indicated where it crosses the sanctuary and Massachusetts Bay.

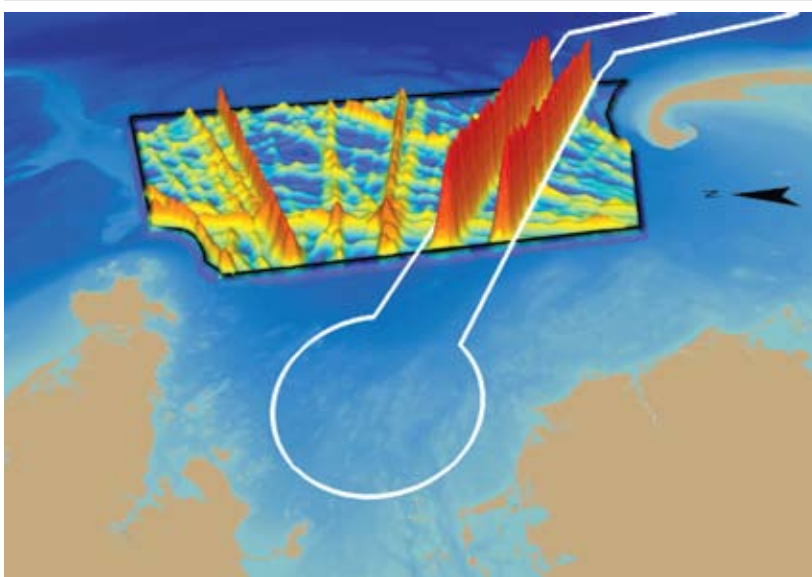


TABLE 22. ANNUAL SHIPPING TRANSITS OF COMMERCIAL DEEP DRAFT VESSELS TO/FROM THE PORT OF BOSTON (2000–2005).

Source: Boston Harbor Pilots Association

Year	Transits
2000	2,188
2001	2,028
2002	2,230
2003	2,260
2004	2,299
2005	2,541
Average	2,257

portions of the harbor in 1998. The project was completed in 2000 and, as a result, Boston's channels are now deeper than those of many east coast ports. To date, despite the deepening of portions of Boston Harbor, vessel traffic has remained relatively stable, and there has been no significant increase in the size of vessels utilizing the harbor. While it is expected that vessel activity will continue to be dominated by the movement of petroleum products, MassPort anticipates an increase in the number of large LNG tankers utilizing the Port of Boston.

Ten major cruise lines currently service Boston as either a port of call or a cruise departure and return location. In recent years, cruise ship activity to Cruiseport Boston, particularly between the months of April through October, increased steadily as a result of the growing popularity of northern-bound cruise vacations, particularly to maritime Canada. There currently are approximately 100 cruise ship departures from or ports of call at Boston annually and this

number is expected to increase. With the presence of a state-of-the-art cruise ship terminal, the Black Falcon Cruise Terminal on the Reserved Channel, the port could support considerable expansion in this type of maritime activity.

Cruise ship activity is being heavily promoted and the annual number of passengers has increased dramatically, tripling between 1996 (69,075 passengers) and 2005 (233,000 passengers) (MassPort, 2005, 2006a). The Request for Expressions of Interest (RFEI) to construct a new cruise ship terminal (MassPort, 2006b), projects that the Port could increase the total number of cruise passengers to over 400,000 each year. This would approximately double the 2005 number. Boston is now considered one of the fastest growing high-end cruise markets in the country.

PORT OF GLOUCESTER

Since the first American fishing settlement was established in Gloucester in 1623, fishermen and traders made it one of the country's most famous deepwater harbors. During the first half of the 19th century, Gloucester supported an active fishing industry and a prosperous trade network. Later in the century, Gloucester turned its attention almost entirely to fishing and became known as the center for fisheries under sail. Today, the port sustains its fisheries role while seeking diversification.

The Port of Gloucester is 15 miles north of Boston. It is an import and export point for Canadian and European ports of call. Its direct connection to the Massachusetts interstate road system makes the Port of Gloucester the most accessible over-the-road port in Massachusetts and an effective inter-modal transport center between Canada and the U.S. It is poised to support regular cruise ship service to Canadian maritime destinations. Gloucester is also the largest

TABLE 23. CHARACTERISTICS OF COMMERCIAL DEEP DRAFT VESSELS AND OTHER MARITIME TRAFFIC ENTERING/LEAVING THE PORT OF BOSTON. NUMBER OF TRANSITS INDICATED IS FOR 2005.

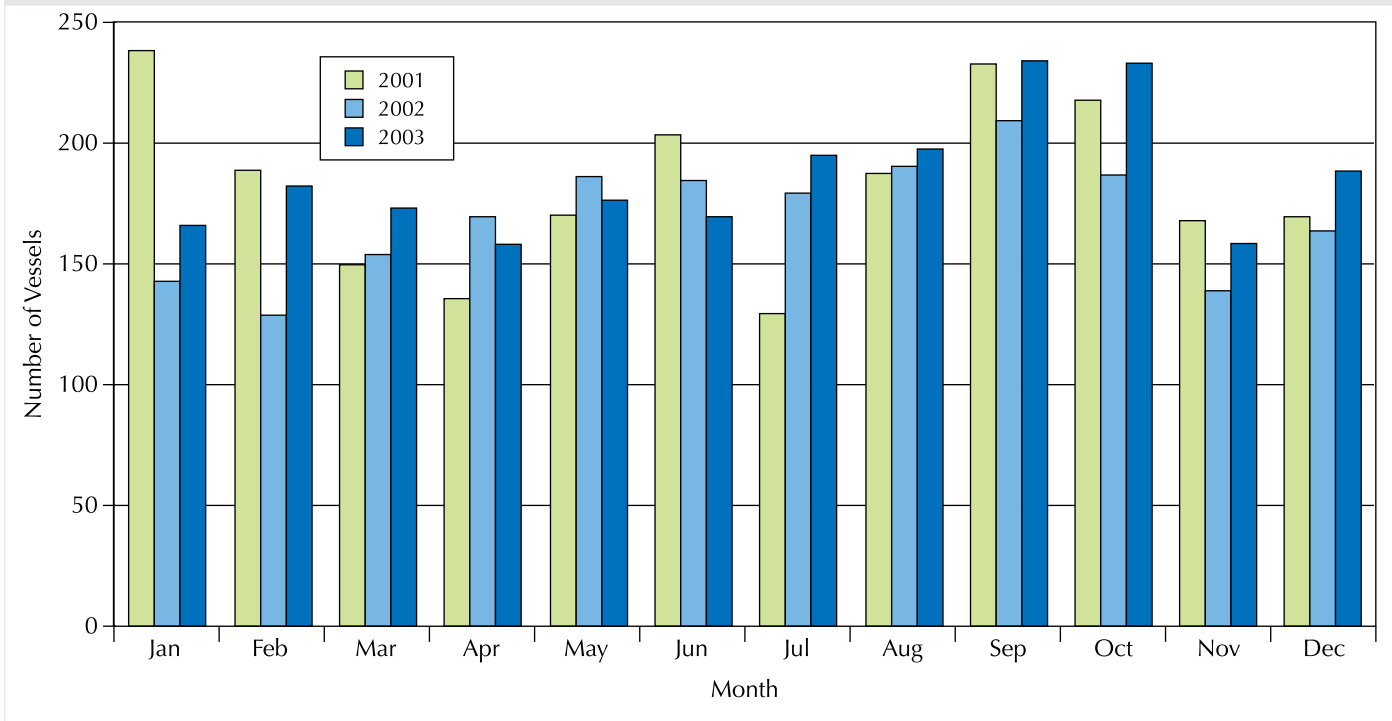
Source: USCG, 2006.

Type of Ship	Hull	Displacement (tonnes)	Speed (knots)	Complement	Transits/Year
Passenger Cruise Ship	Steel	56,000	Cruising: 20–25 Top: 32.5	Passengers: 920–2,758 Crew: 545–1,253	295
Whale Watching Boats	Steel/Aluminum	<1,000	Cruising: 11 Top: 40	Passengers: 150 Crew: 2–3	3,328
Container Ship	Steel	64,000	20/25	25	455
Bulk Cargo	Steel	32,000	15	25	244
Tankers	Steel	64,000	15	25	1,160
RO-RO Ship ¹	Steel	37,500	15-25	25–30	41
LNG Carrier ²	Steel	108,000	20	25–30	126
Dredging Vessels (Tugs)	Steel	3,700	5	3	365
Petroleum Barge (Tugs)	Steel	3,700	5	3	1,420
LNG DWP OSV ³	Steel	<1,000	13	8	240
Fishing Trawlers (ocean-going)	Steel	2,600	12	4	11,885
Lobster Boats	Fiberglass/Wood	<1,000	15	2	39,000

¹Roll on-Roll off ²Liquified Natural Gas ³Deep water port operations support vessel

FIGURE 115. NUMBER OF COMMERCIAL DEEP DRAFT VESSEL TRANSITS TO/FROM THE PORT OF BOSTON BY MONTH FOR THE YEARS 2001–2003.

Source: Boston Harbor Pilots Association.



commercial fishing port on Massachusetts Bay and was ranked 13th among the top 100 U.S. commercial fisheries ports in 2003 based on landings.

The outer and inner harbors support approximately 225 deep-water commercial fishing vessels up to 300 ft. (91 m) in length. Depending on the season, harbor use is approximately 40% commercial and 60% recreational. The number of lobster boats in the harbor varies widely, from 250-300 for Gloucester and 400-800 regionally for Cape Ann (which includes the neighboring towns of Beverly and Essex).

OTHER HARBORS

In addition to the Ports of Boston and Gloucester, mentioned above, there are several other harbors in Massachusetts whose activities use sanctuary resources. These harbors principally include Provincetown, Plymouth, Scituate, Green, Cohasset, Lynn, Marblehead and Salem.

During the 19th century, Provincetown Harbor was considered a major port, being home to approximately 175 whaling vessels and an equal number of Grand Banks fishing schooners. Today, only a small commercial fishing fleet exists; Provincetown and its harbor have become largely dependent upon tourism. Whale watch boats, fishing party boats and recreational boats prevail.

Plymouth Harbor experienced a similar history and transformation. For centuries, Plymouth Harbor served host to numerous cargo and fishing vessels and was home to a prolific shipbuilding enterprise, which made the harbor famous world-wide. Following the Civil War, shipbuilding ceased and shipping in and out of the harbor declined

as more modern vessels became too large to enter. Today, Plymouth Harbor is a departure point predominantly for pleasure boaters, whale-watching vessels and recreational fishing parties, although still receiving some commercial traffic. Plymouth Harbor is part of a complex that includes the small boat harbors in the neighboring towns of Kingston and Duxbury, once also historic centers for shipbuilding during the age of sailing schooners, but now primarily recreational in character.

Scituate Harbor is considered to be one of the better deep-water harbors on the Massachusetts south shore and supports a fleet of approximately 55 commercial fishing vessels, recreational charter fishing boats and numerous pleasure boats. While supporting an active commercial fleet, Scituate is primarily a recreational and seasonal-use harbor with approximately 700 moorings (harbor and rivers) and 650 slips (combined in nine private and two public marinas) in the summer season.

Green Harbor in the neighboring town of Marshfield is often associated with Scituate as a commercial fishing harbor. It is a principal harbor for the landing of bluefin tuna in Massachusetts Bay (along with Gloucester and Provincetown). It supports a small commercial fleet of groundfish and lobster vessels as well as charter boats and shelters a primarily recreational mix of small boats.

Cohasset Harbor is a small harbor used primarily by residential and summer season boaters. In addition to its large private recreational fleet, the harbor supports a small commercial lobster fleet of approximately 25 boats.

Lynn Harbor accommodates approximately 300 recreational vessels, 60 small commercial vessels, 10 commercial passenger ferries and approximately 50 commercial fishing vessels. About 40% of vessel traffic is commercial; the remaining 60% being recreational.

Marblehead Harbor is primarily a recreational summer-use harbor with 2,200 mooring permits issued each year. The harbor shelters approximately 30 commercial fishing boats.

Salem Harbor is primarily used for recreational purposes with limited commercial traffic delivering coal and petroleum products. There are 1,400 registered moorings in the harbor; there are 10,000 recreational boats berthed within Salem Sound. The harbor supports a fleet of approximately 100 commercial fishing vessels.

Due to the volume, frequency and types of vessels transiting the sanctuary area from numerous ports and harbors, the potential for vessel-vessel collisions, accidental oils spills and vessel discharges as well as vessel collisions with marine mammals are issues of concern. For more information regarding discharges and marine mammal vessel strikes refer to the sections of this document on Discharge and Disposal Activities and Marine Mammal Vessel Strikes.

PROHIBITED USES

MINERALS MINING

The Secretary of the Interior has the statutory authority and responsibility to plan for and to conduct the offering of leases of outer continental shelf (OCS) acreage, as directed in the Outer Continental Shelf Lands Act, as amended (OCSLA) (43 U.S.C. § 1331 et seq.). Within the U.S. Department of the Interior (US DOI), the Minerals Management Service (MMS) has primary responsibility for management of OCS minerals operations. Minerals operations under the MMS regime include offshore oil and gas development and sand and gravel mining. However, exploring for, developing or producing industrial materials within the Stellwagen Bank sanctuary is prohibited (15 C.F.R Part 922 Subpart N, Sec. 922.142). "Industrial material" means "mineral," as defined in Sec. 922.3, which in turn is defined as clay, stone, sand, gravel, metalliferous ore, non-metalliferous ore, or any other solid material or other matter of commercial value. There is also a statutory prohibition (see Sand and Gravel subsection below).

OFFSHORE OIL AND GAS

On June 26, 1990, a Presidential Order was signed preventing any further OCS leasing and development activity within the Georges Bank area of the North Atlantic Planning Area, which includes the sanctuary until after the year 2000. This period of time was again extended on June 12, 1998, when President Clinton issued an Executive Memorandum that prevented such activities until June 30, 2012 (Presidential Executive Memorandum 1111, 1998). No exploratory wells have been drilled anywhere on the Atlantic OCS region since 1984. Further, Stellwagen Bank sanctuary regula-

tions prohibit alteration of the seabed and discharge of most matter.

The Energy Policy Act of 2005 directs the Secretary of the Interior to inventory and analyze oil and natural gas resources beneath all of the waters of the OCS using "any available technology, except drilling, but including 3-D seismic technology to obtain accurate resource estimates" (Energy Policy Act of 2005). Not only does the Energy Policy Act's inventory include areas currently under drilling moratoria, it requires the MMS to identify resources and explain how legislative, regulatory, and administrative programs or processes restrict or impede the development of identified resources and the extent that they affect domestic supply.

SAND AND GRAVEL

Within the past decade, the Boston metropolitan area has experienced significant and rapid economic growth, which has in turn encouraged substantial industrial, commercial and residential development. Pressures on both the housing industry and transportation systems to meet the demands of this growth have resulted in increased consumption of and demand for sand and gravel resources, for use as aggregate in construction activities. However, extraction of sand and gravel has considerable potential to adversely impact the biological integrity of the sanctuary (e.g., fish, invertebrates and marine mammals) as well as physically alter the surface profile of Stellwagen Bank and its attendant oceanography. As a result, in 1992, at the time of the sanctuary's designation, sand and gravel mining were made prohibited activities within the borders of the sanctuary. In addition, under Stellwagen Bank sanctuary regulations 15 C.F.R Part 922 Subpart N, drilling into, dredging or otherwise altering the seabed of the sanctuary is strictly prohibited.

SUBMERGED CABLES AND PIPELINES

The laying of submerged cables and pipelines is a prohibited activity under Stellwagen Bank sanctuary regulations 15 C.F.R., Subpart N, Sec. 922.142. Drilling into, dredging or otherwise altering the seabed of the sanctuary, or constructing, placing or abandoning any structure, material or other matter on the seabed of the sanctuary is prohibited. However, prohibited activities can be permitted on a case-by-case basis if they meet regulatory/statutory criteria.

CABLES

In August of 2000, the Hibernia high-capacity fiber optic cable was laid across 12.1 miles (19.5 km) of seafloor in the northern part of the sanctuary under terms and provisions of a ONMS authorization/special use permit issued to the company, 360 Networks Inc. Cable ownership and permit monitoring responsibility was transferred to the company, CVC Inc. in 2002. The underwater cable provides a direct link between North America and the Republic of Ireland. The cable is designed for a life expectancy of 25 years and is buried at an average depth of approximately 1.5 m (4.9 ft.) into the seafloor. The cable was laid using a sea plow controlled from a cable ship on the surface. While an advisory to mariners has been posted to alert vessels to

the cable's position, recent monitoring suggests, that while most of the cable remains buried, it may be at risk of exposure and damage where it is routed through muddy basins subjected to fish trawling or dredging.

The presence of a cable in an active fishing area could cause problems with damage to both the cable and fishing gear. Some have speculated that cables on the sea bottom could create obstacles to the movement of bottom-dwelling organisms (Darnell, 1976). The trench and fill required for burying cables and pipelines could disturb sensitive fish spawning areas; the activity of the installation equipment could disturb marine mammals and seabirds; and excavation activity could disturb or destroy marine archaeological sites.

The impact of laying fiber optic cables to seafloor habitats and associated taxa along the cable route is not yet fully known, although the issue is being assessed in the sanctuary. In 2001, following the laying of the cable, additional sampling stations were added to the on-going Seafloor Habitat Recovery Monitoring Project (SHRMP). This 10-year program was initiated in 1998 following creation of the Western Gulf of Maine Closure Area (WGoMCA) to study the recovery rates of seafloor habitat (physical and biogenic) and associated taxa (such as fishes) in the sanctuary following the cessation of fishing. The project now compares the effects of fishing to the effects of the laying of fiber optic cable, as well as to the effects of background environmental variation. Biannual sampling is conducted using remotely operated vehicles (ROVs), video drift cameras, side scan sonar and S4 current meters. The project is expected to continue through 2010.

PIPELINES

No pipelines currently exist within the sanctuary's boundaries. However, located to the west of the sanctuary and running through state waters from Beverly, Massachusetts, to Weymouth, Massachusetts, is a pipeline called the "HubLine." This 48.3-km (30-mi), 76.2-cm (30-in diameter), natural gas pipeline will connect the 901.2-km (560-mi) Maritimes & Northeast pipeline with the 1,609.3-km (1,000-mi) Algonquin pipeline (Duke Energy, 2005a). Applications to the Federal Energy Regulatory Commission (FERC) on October 10, 2000, were filed by Algonquin Gas Transmission, L.L.C. to begin construction of the pipeline (Duke Energy, 2005b).

Currently, the offshore portions of this pipeline have been completed. Most portions of this pipeline were buried at a minimum depth of 1 m (3.3 ft); however, several sections required horizontal directional drilling, conventional dredging, jetting, plowing and blasting. This operation is certain to have had an impact on the local benthic environment (Estrella, 2004). Impact assessment, mitigation and restoration are being carried out by the NOAA Fisheries Service, EPA, the Massachusetts Department of Environmental Protection (DEP) and the Massachusetts Division of Marine Fisheries (DMF). The most significant problem with pipelines, and with electrical transmission cables which use circulating oil

for cooling, is the possibility of leaks causing contamination of the surrounding waters.

DEEPWATER LIQUEFIED NATURAL GAS (LNG) PORTS

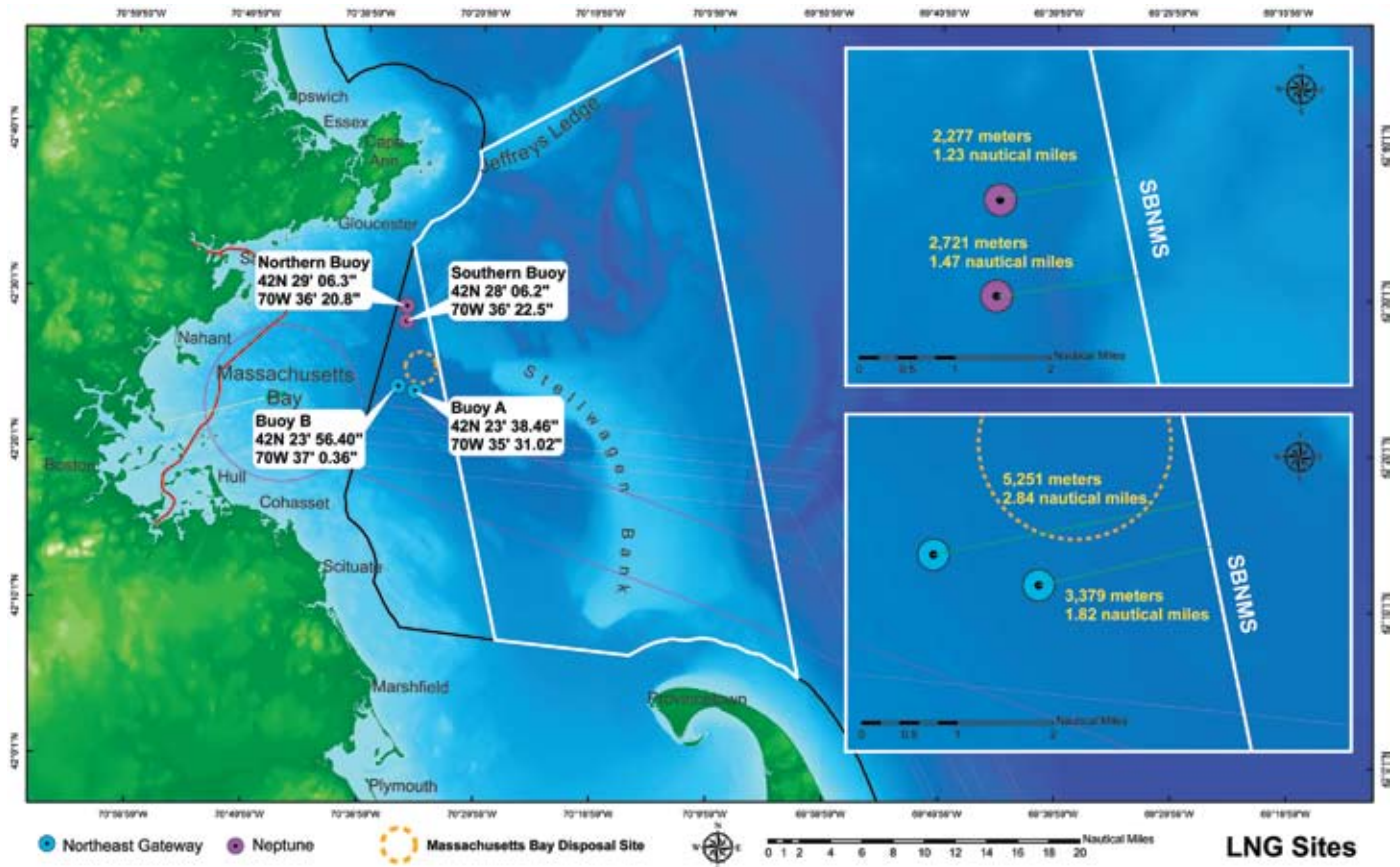
Construction of a deepwater LNG port is a prohibited activity within the sanctuary by virtue of the prohibition against alteration of the seafloor and discharge of matter. A deepwater LNG port is a system of pipelines, mooring buoys, anchors, risers and related equipment and is regulated under the Deepwater Port Act (DWPA) and administered by the USCG and the Maritime Administration (MARAD).

In late 2004, the Stellwagen Bank sanctuary was notified that two companies, Northeast Gateway Energy Bridge, LLC (Gateway) and Neptune, LLC (Neptune), would be applying for deepwater port licenses to install LNG import terminals and associated pipelines very near the sanctuary. While located outside of the sanctuary the proposed projects were found likely to affect sanctuary resources. Both applicants proposed operating for 30–40 years within habitat utilized by four endangered whale species (North Atlantic right, humpback, fin and sei) for feeding, nursing and migration. The proposed port sites are near multiple state ocean sanctuaries with the closest port site being 1.2 nm from the Stellwagen Bank sanctuary's western border and the farthest being 2.8 nm (Figure 116). Although the ports are located just outside of the boundary of the sanctuary NOAA determined that they constitute a significant threat to sanctuary resources, and mitigation measures were developed to reduce the risk of impact.

With the release by the USCG and MARAD of the Draft Environmental Impact Statements (DEISs) for the Gateway and Neptune projects on May 19 and June 2, 2006, respectively, formal consultation with the USCG and MARAD was initiated by the ONMS under Section 304(d) of the National Marine Sanctuaries Act (NMSA). These were the most significant consultations under Section 304(d) to date and supplemented separate consultation under ESA and MMPA by the NOAA Fisheries Service. Under the NMSA, the ONMS had 45 days from initiation to develop and recommend reasonable and prudent alternatives for implementation by the licensing agencies (USCG and MARAD) to prevent injury to sanctuary resources. The NMSA defines sanctuary resource as "any living or non-living resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary."

Based on information provided by the USCG and MARAD, the ONMS found that the projects, considered individually and together, were likely to have significant, constant, and long-term adverse effects upon resources of the sanctuary due to the following: 1) increased risk of ship strikes to the sanctuary's endangered whale populations including the North Atlantic right whale; 2) increased acoustic exposure to marine mammal and fish species; 3) increased risk of whale entanglement and loss of benthic habitat in the sanctuary due to displaced fishing effort; 4) possible re-suspension of toxic materials during construction; 5) diminished visual

FIGURE 116. LOCATION OF TWO SEPARATE LIQUEFIED NATURAL GAS (LNG) DEEPWATER PORTS, NORTHEAST GATEWAY AND NEPTUNE, PROPOSED ADJACENT TO THE WESTERN BOUNDARY (INSERTS) OF THE STELLWAGEN BANK SANCTUARY. EACH PORT WOULD HAVE AT LEAST TWO OFFSHORE INSTALLATIONS INDICATED BY THE BUOY LOCATIONS.



aesthetics; and 6) entrainment of planktonic and fishery resources by LNG carriers at port and during transit.

The ONMS made twelve 304(d) recommendations for Neptune and thirteen recommendations for Gateway suggesting conditions to be included if the project licenses were approved in order to minimize the impacts of port construction and operation on sanctuary resources. Three recommendations in particular were critical to mitigating the impacts on marine mammals. They called for implementation of passive acoustic technologies to detect and/or monitor the presence of whales relative to LNG vessel transits and LNG port construction and operation. Recommendations on fishery resource impacts and water use echoed those made by NOAA Fisheries through the Essential Fish Habitat consultation process and by the Environmental Protection Agency through National Pollutant Discharge Elimination System (NPDES) permitting.

Both federal and state agencies evaluated the mitigation options to address issues raised under the National and Massachusetts Environmental Policy Acts, and the USCG and MARAD evaluated mitigation options through the finalization of the NEPA process and resulting licenses and associated conditions. A formal response from the USCG to the ONMS regarding the 304(d) recommendations was released in mid October 2006 and Final Environmental Impact State-

ments (FEISs) for Gateway and Neptune were released in late October/early November 2006. Public hearings for the FEISs were held in Massachusetts the first week of November 2006. NOAA Fisheries Service issued biological opinions for the two projects following consultations under the Endangered Species Act in early 2007, and USCG/MARAD issued records of decision conditionally approving both ports soon after. The Neptune port was licensed in January 2007 and the Northeast Gateway was licensed in May 2007.

Northeast Gateway finalized construction in December 2007, with operations commencing in January 2008. Neptune finalized construction in October 2009, with operations scheduled to commence in spring 2010. Real-time passive acoustic detection buoys to reduce risk of whale-ship collisions were deployed in January 2008 in the Boston Traffic Separation Scheme and are to be maintained for the life of the port (25-40 years). Additional real-time buoys were deployed to listen for right whales during construction activities to trigger mitigation action reducing ensonification and collision risk. Finally, an array of bottom-mounted archival passive acoustic recording units are in place and are monitoring the noise produced by port construction and operation relative to pre-construction conditions. This final monitoring array is in place for five years.

WIND POWER GENERATION

Securing a windmill to the seafloor or anchoring a floating windmill is a prohibited activity in the sanctuary under the current regulations (15 C.F.R Paer 922 Subpart N). Consideration for generating power using windmills secured to the land or seafloor is becoming more prevalent in New England. The combination of steady, year-round winds and a nearby power-hungry populace makes the Massachusetts coast a seemingly attractive site for this type of activity. Currently, a major proposal to build an offshore wind farm consisting of 130 windmills, each 247 ft. high, in Nantucket Sound is under consideration by government agencies. There is another proposal to place a similar wind farm in Buzzards Bay, Massachusetts. The sanctuary is not aware of any commercial interest in placing windmills on top of Stellwagen Bank at this time.

The Massachusetts Oceans Act of 2008 required the Commonwealth's Secretary of Energy and Environmental Affairs to develop a comprehensive ocean management plan, following a scientific and stakeholder process that led to a draft plan in June 30, 2009 and the final promulgation of the plan in December 31, 2009. The Draft Massachusetts Ocean Plan prioritized areas for renewable energy development (including wind power) within state waters, in Buzzards Bay and off Marthas Vineyard Island, and proposed adjacent federal waters for feasibility analysis. Additional provisional Wind Energy Areas within Massachusetts Bay were identified during the screening process but were not prioritized due to environmental and technical limitations.

MARICULTURE

Mariculture (or the aquaculture of marine products) is a prohibited activity within the sanctuary by virtue of the prohibition against alteration of the seafloor and discharge of matter. While the practice of mariculture is gaining recognition and popularity throughout the northeast region, few proposals have yet been made to conduct aquaculture activities in federal waters off the Massachusetts coast. Such activities would require a Section 10 permit (Rivers and Harbors Act) from the U.S. Army Corps of Engineers (USACE) and, depending on the nature and location of the project, a federal consistency review by the Massachusetts Coastal Zone Management (MCZM) Office to determine consistency with the policies of the MCZM Program.

ARTIFICIAL REEFS

The placement of artificial reefs (ARs) in the Stellwagen Bank sanctuary is a prohibited activity by virtue of the prohibition against alteration of the seafloor and discharge or deposit of matter into the sanctuary. There has never been a proposal to place an artificial reef in the sanctuary, which is located offshore within the U.S. Exclusive Economic Zone (EEZ).

There is currently little interest in establishing facilities within the EEZ by the commercial sector, largely because of the lack of formal regulatory structure (Stickney et al., 2006). However, ARs have been established in other sanctuaries and this situation has precipitated development of a national policy on ARs for the sanctuary program.

This national policy addresses how the ONMS considers proposals to establish artificial reefs in sanctuaries. The policy is meant to build upon, not replace, the National Artificial Reef Plan developed in accordance with the National Fishing Enhancement Act.

Artificial reef development is generally prohibited in NMSs and may only be undertaken in these marine protected areas for educational, research and resource management purposes. Because the impacts of ARs are not entirely understood, the ONMS will proceed cautiously in considering permits for AR development in NMSs. The ONMS will use information obtained from monitoring ARs currently in NMSs and elsewhere to determine the extent and type of future AR development allowable in NMSs.

This policy recognizes that there may be situations where ARs help a sanctuary achieve its mission. The relative merit of ARs in NMSs is the subject of continued debate within the national program.

Concerns over ARs include:

- Destruction of benthic species and habitats upon emplacement;
- Collateral damage if the ARs were to break apart;
- Attraction of biomass from surrounding natural habitats;
- Toxic contamination from PCBs, asbestos, hydrocarbons or other toxic materials left in the ARs; and
- Attraction of fishing activities, which target large, vulnerable breeding adults and spawning aggregations.

Potential benefits of ARs are:

- Provision of habitat for selected fish and invertebrate species;
- Concentration of uses (recreational fishing and diving) and their diversion from other more sensitive areas;
- Enhancement of user opportunities that increase awareness of a sanctuary.