VI. Summation

This section reviews points raised in the previous sections of this document and forms conclusions. It considers the outcomes of cumulative actions and effects. It summarizes the status and condition of sanctuary resources.

Context

The Stellwagen Bank sanctuary area has a long cultural tradition based around fishing and whaling. Humans have depended on the area's diverse and abundant marine resources for sustenance and economic prosperity for hundreds of years. Both Native American populations and Europeans chose to inhabit the shores of Massachusetts Bay because of the easily accessible and plentiful marine natural resources, such as cod and various species of whales that could be extracted. The historic exploitation of these resources forged a cultural tradition that is difficult to perpetuate today as a result of overfishing, coastal and ocean habitat destruction and rapid transformation of the region's economy.

The modern appreciation for the sanctuary's resources requires that they be protected for their intrinsic value, multiple ecosystem services, and recreational and ecotourism importance, while facilitating consumptive uses (including appropriate fish production) that are environmentally sustainable and compatible with the widely recognized need and Congressional mandate for resource protection. The sanctuary can have a role in working with harvesters and other stakeholder groups to help build local economies and work to maintain a sense of community while preserving cultural legacy, history and tradition. This management plan establishes the basis to take actions that can conserve sanctuary resources for current and future generations while simultaneously supporting community, culture and economy.

The sanctuary was designated for a multitude of reasons, not the least of which was its long history of human use, its high natural productivity and relative high species diversity. There are well over 575 known species in the sanctuary, including over 80 species of fish, and the list is largely incomplete. Living landscapes (anemone forests, sponge gardens, hydroid meadows, worm tube beds) carpet the seafloor and the associated marine communities support benthic and pelagic species that are dependent upon them. Water column and seafloor habitats provide feeding and nursery grounds for 22 marine mammal species, including the endangered humpback and fin whales and the critically endangered North Atlantic right whale.

The area supports foraging activity by 53 species of seabirds, dominated by gulls, storm petrels, gannets, auks (alcids), sea ducks and shearwaters. Fish and invertebrate populations include both demersal and pelagic species, such as cod, flounders, bluefin tuna, herring, lobster and scallops. Leatherback and Kemp's ridley sea turtles (endangered species) on occasion visit the area for feeding. Historic shipwrecks abound. Over the decade 1996-2005, sanctuary resources supported commercial activities that generated up to about $40-$60 million in direct sales value (principally from commercial fishing and whale watching) and sustained over a million visitors annually among the variety of environmental services provided.

Historic Importance

Sitting astride historic fishing grounds and shipping routes, the sanctuary has been a locus for a variety of human maritime activities for over four centuries. Beginning in the earliest days of the European exploration and settlement of North America, fishermen were drawn to the immensely productive fishing grounds off the New England coast. These initial forays paved the way for the European colonization of New England and the establishment of the English colony at Plymouth, Massachusetts. Fishery resources harvested from Stellwagen Bank played an important role as a trade commodity that ensured the success of the early English settlements established around Massachusetts Bay. Utilizing their local fisheries, New Englanders developed a trading network that spanned the Atlantic world and formed the basis for the region's early maritime-based economy.

New England developed its cultural identity through shipping and its interaction with other cultures. This cultural exchange was made possible by the international trading voyages that originated and returned to communities on the doorstep of the sanctuary. Vessels from Boston, Salem and other Massachusetts ports transited through the sanctuary on the way to the Far East, Europe and the Caribbean as part of a major marine transportation network. In addition to the commodities exchanged with Europe, tens of thousands of Europeans immigrated to the U.S. on vessels that passed through the sanctuary's waters on the way to Boston.

The major shipping corridors established in the past are still prominent today where they cross the sanctuary. Shipwrecks on the sanctuary's seafloor give evidence of the 400-year history of maritime transportation and commerce that passed through the area. To date, 40 shipwreck sites have been located in the sanctuary. Thirty-five shipwrecks are considered historic resources; four shipwreck sites are listed on the National Register of Historic Places. Historical research indicates that as many as 200 ships may have sunk in the sanctuary area. These shipwrecks are tangible connections to the past that allow the Sanctuary Program to study and better understand history as they encapsulate significant stages of shipbuilding.

The sanctuary's most notable shipwreck is the wooden hulled paddle wheel steamship *Portland*. Built in 1889 in Bath, Maine, for the run between Portland, Maine, and Boston, the steamship was one of the largest and most palatial vessels afloat until its loss with almost two hundred lives in 1898 during the "Portland Gale," the "perfect storm" of that century. The *Portland* was listed on the National Register of Historic Places in 2005 because of its historical and archaeological significance to New England and, more specifically, Maine and Massachusetts. The wreck is the most intact and best preserved New England "night boat" yet located. New England "night boats" were steamships that connected metropolitan areas separated by a distance of between 125 and 200 miles on mainly overnight voyages.

The shipwreck site of the coal schooners *Louise B. Crary* and *Frank A. Palmer* is another extraordinary sanctuary historical resource. The two Maine-built nearly 300 foot-long schooners collided in 1902 with full loads of coal from Virginia. Today, the vessels lie upright, intact to their main decks with their bows joined at the point of impact. In 2006 the shipwrecks were listed on the National Register of Historic Places because they exemplified the critical transportation network that supplied New England's energy needs. These shipwrecks are the best example of the great New England coal schooners located to date.

Venturing back to prehistory, Stellwagen Bank mostly owes its existence to the last great ice sheet (known as the Laurentide Ice Sheet) and to changes in sea level that accompanied and followed deglaciation. About 12,000 years ago, Stellwagen Bank stood well above sea level and may even have been connected to Lower Cape Cod or, at most, separated from the Cape by a shallow strait. Stellwagen Bank, then, closely resembled present-day Lower Cape Cod. Lakes, swamps and marshes probably dotted the landscape. Along the shore, there would have been beaches, sea cliffs, spits and lagoons. The climate was colder back then than it is now, and spruce and poplar forests and park lands of tundra shrubs and grasses may have covered the bank top.

Mastodon and mammoth teeth have been dredged up from the seafloor near Stellwagen Bank, evidence of the animal life of the time. Early Paleoindians arrived in New England about 11,000 years ago, and they may have witnessed the beginning of the final chapter in the history of Stellwagen Bank as emergent land. By then, local sea level was rising as crustal rebound slowed and as the melting glaciers continued to return water to the ocean basins. About 10,000 years ago, Stellwagen Bank slipped beneath the sea.

Status Today

Today, whales swim where ancient elephants may have once trod. These marine mammals now make the waters of the Stellwagen Bank sanctuary one of the most intensively used whale habitats in the northeast continental region of the U.S. The humpback whales of the sanctuary represent the longest continuously studied group of baleen whales in the world. Matrilineal studies show evidence of four generations (1976-2006) of humpback use as well as intergenerational site fidelity to specific sanctuary feeding and nursery areas. Additionally, critical habitat designation was established for the North Atlantic right whale in 1994 inclusive of the southwestern part of the sanctuary.

The newly-established sister sanctuary relationship between the Stellwagen Bank sanctuary and the Dominican Republic humpback whale sanctuary is the first conservation management action worldwide to protect a migratory marine mammal species on both ends of its range (between sanctuary feeding/nursery grounds and the largest mating/calving grounds for humpback whales in the North Atlantic) by functionally linking two important national marine protected areas. The formal agreement was signed by both parties in December 2006. The sister sanctuary relationship is consistent with the Special Protected Area and Wildlife (SPAW) protocols of the United Nations Environment Program (UNEP) and may be extended to other Caribbean nations sharing the same population of humpback whales with the sanctuary.

The Stellwagen Bank sanctuary is a hotspot for prey abundance, which is what ultimately attracts the whales, sustains the fish and other wildlife, and supports the economic viability of most current uses in the sanctuary. Sand lance numbers in the sanctuary are the highest and most concentrated anywhere in the southern GoM. Atlantic herring also abound in the Massachusetts Bay/Cape Cod Bay system in relatively higher abundance than most elsewhere in the southern GoM. The margins of Stellwagen Bank are sites of high horizontal and vertical movement of both water and plankton due to the bank's exposure to GoM water circulation. The interaction between physical oceanography and bathymetry creates environmental conditions that result in

high primary productivity and the aggregation of biomass at multiple trophic levels.

A distinctive feature of the sanctuary's physical oceanography is the seasonal generation of internal waves over Stellwagen Bank. The sanctuary is considered to be the best place in the GoM to study this phenomenon because of ease of access and proximity to research infrastructure. Internal waves are particularly important for water column mixing and localized transport within the sanctuary area; they are generated by the tides in response to the sanctuary's complex seafloor topography. The entirety of the sanctuary seafloor has been mapped using multi-beam sonar at a vertical resolution of approximately 25 cm and a horizontal resolution of approximately 10 m. In conjunction with extensive ground-truthing (e.g., video, still photos, sediment samples), the sanctuary multi-beam map provides the most complete characterization of the seafloor in the GoM.

The Stellwagen Bank sanctuary lies within the Gulf of Maine Large Marine Ecosystem (GoMLME), one of the most productive marine areas in the world. Because of the highly varied topography, wide range of depths that cross water column boundaries, and high diversity of habitat types in a relatively small area, Stellwagen Bank sanctuary encompasses the wide range of landscapes, habitats, communities and the species representative of the GoM region. Via its position amidst the Maine Coastal Current and GoM counterclockwise gyre, the sanctuary is integrally connected with the rest of the GoM through water circulation and serves as both a source (for export) and a sink (for import) for larvae of various and numerous organisms.

For centuries, Stellwagen Bank has proved to be a rich and productive fishing ground, particularly for groundfish species like cod, haddock and flounder. Historically, fishermen have also been able to catch Atlantic halibut, swordfish and large schools of mackerel and herring. During the second half of the 20th century, the area gained fame as a whale watching destination. In 2007, *USA TODAY* (and previously in 2002, the World Wildlife Fund) named Stellwagen Bank one of the top ten premiere places in the world to watch whales. In 2006, the readers of *Offshore* magazine voted Stellwagen Bank the best place to watch wildlife and the number three favorite recreational fishing spot in the northeastern U.S. And, serving in the capacity as the U.S. partner of BirdLife International, Massachusetts Audobon (Mass Audubon) has designated Stellwagen Bank an Important Bird Area because of its exceptional habitat. But, challenges abound.

Current Challenges

On an annual basis, virtually every square kilometer of the sanctuary is physically disturbed by fishing, to greater or lesser degree, depending on the gear used (Figure 117). This assessment includes the portion of the sanctuary overlapped by the Western GoM fishery closure area, because regulations pertaining to that closure do not restrict all types of fishing. Graphic representations of fishing activity over time and space, based on charting anecdotal information and oral histories on Stellwagen Bank from local fishermen, also show that the whole of the sanctuary has been fished either commercially or recreationally at least since the 1980s (Hall-Arber and Ryznar, 2007). The disturbances caused by fishing are chronic as well as extensive; they are repetitive and recurring rather than single-impact events.

Fishing impacts and puts pressure on every resource state in the sanctuary, whether it is biogenic seafloor habitats, marine mammals or shipwrecks. Fishing has removed almost all of the big old-growth individuals among biologically important fish populations, reshaped biological communities and habitats in the process, and historically, reduced fish species diversity and richness in the sanctuary. Commercial fishing lands 17.0 million pounds to 18.4 million pounds of fish and crustaceans from the sanctuary each year on average (1996-2005), yet discards approximately 23% of the total catch as bycatch (based on 2002/2003 estimates). The part of the catch from the sanctuary that actually is landed amounts to between 1.85%–2.79% of the total New England landings value for all northeast fisheries. [This analysis omits Connecticut, which realized next to no landings from the sanctuary and which, if included, would reduce this percentage.]

Atlantic herring accounts for the greatest volume by species landed from the sanctuary, averaging 3,200 metric tons annually (1996-2005) with the highest single-year landings of 7,726 metric tons in 2005. Although herring are currently not overfished, the availability of herring, particularly as a functional prey substitute for sand lance, may be a factor in determining the local abundance of whales, dolphins and other wildlife in the sanctuary. The local depletion of herring by fishing is a related concern. Herring and sand lance are key prey species that constitute a major segment of the forage base underlying all ecological functions and economic and recreational activities that define the sanctuary.

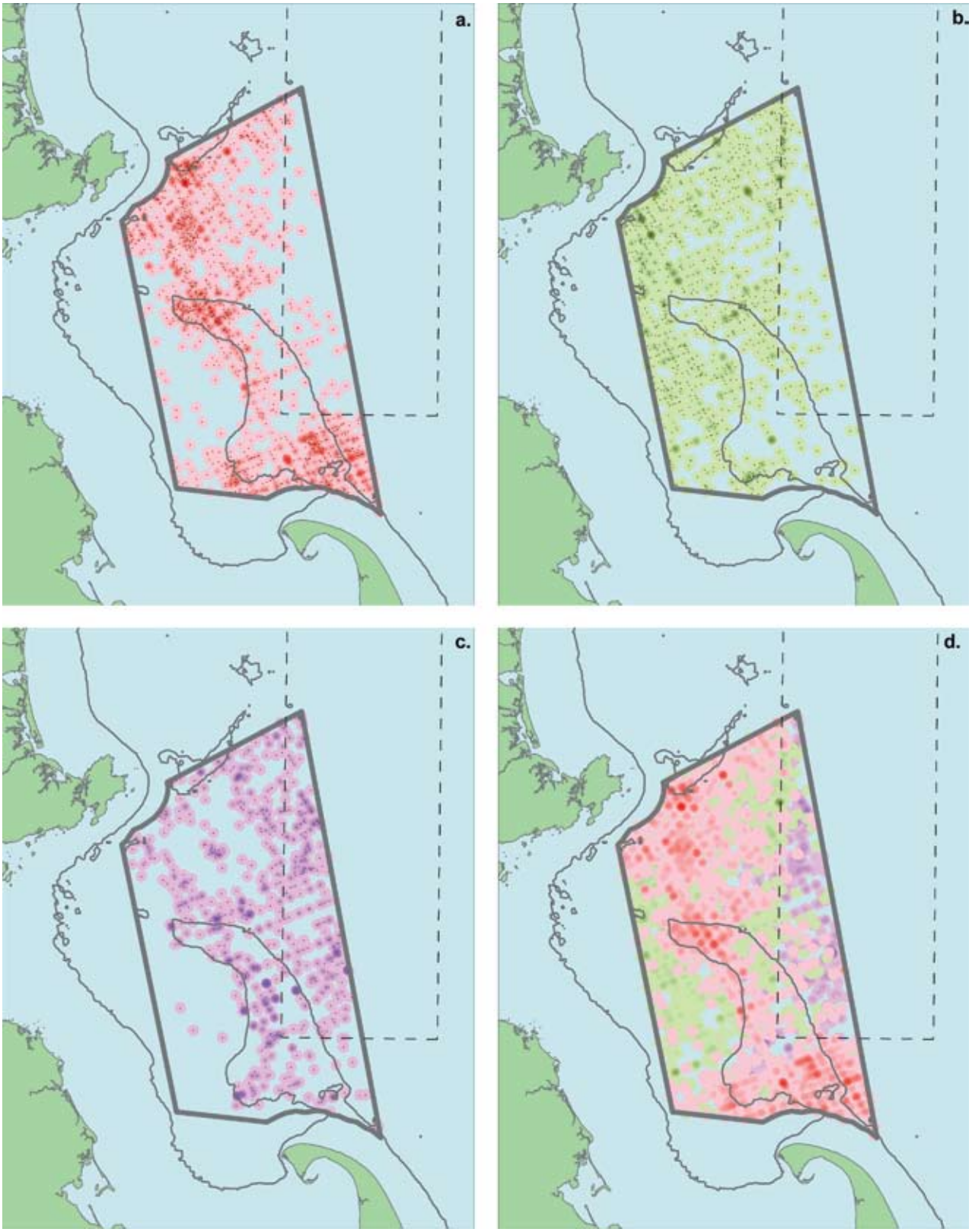
The sanctuary and adjoining area is a hot spot for observations of fishing gear entanglements with whales in the GoM. While this distinction makes the sanctuary an ideal location to focus disentanglement efforts for large whales, it is not a characteristic in keeping with the term "sanctuary." Analysis of scars on humpback and right whales in the GoM region indicate that between 50% and 70% of animals in some populations have been entangled at least once in their lives and between 10% and 30% of the population become entangled each year. Mortality subsequent to entanglement among humpback and right whales is on the order of 11%, although this rate is likely an underestimate because of the difficulty in quantification and follow-up in case studies.

Fishing gear has impacted nearly all historic shipwreck sites investigated in the sanctuary. While mobile fishing gears represent the biggest threat to the sanctuary's maritime heritage resources, virtually all common gear types are involved. Shipwrecks are a non-renewable sanctuary resource; they cannot recover from damage.

Because of its proximity to the Port of Boston, the sanctuary receives more commercial shipping traffic than any other location within US jurisdiction in the GoM. Concomitantly,

Figure 117. Spatial density patterns based on trips for all fishing recorded in the Stellwagen Bank sanctuary during July 2001–June 2002 based on Vessel Trip Report (VTR) data.

(a): Mobile fishing gear, e.g., bottom and mid-water trawls, scallop dredges, etc. (b): Fixed fishing gear, e.g., lobster traps, sink gillnets, etc. (c): Recreational fishing, e.g., party and charter boats. (d): All gear types and recreational fishing combined. The patterns are Kriged density plots of the VTR data using a 1,000 m search radius and analyzed by ESRI ARCGIS. VTR gear codes: (a) DRC, DRS, OTF, OTM, OTS, PTM; (b) GNS, LLB, PTC, PTH, PTL; (c) Party/Charter (Trip ID: 2, 3). The 1,000 m search radius is consistent with the length of fixed gear sets, falls within the length of mobile gear tows in the sanctuary, and the area of influence of recreational fishing.



the sanctuary is a hot spot for vessel/whale strikes along the eastern seaboard of the U.S. Approximately 10% of the vessel/whale collisions recorded world-wide were reported from the sanctuary area including Cape Cod Bay and Boston Harbor. Species struck included fin, humpback, sei, minke and North Atlantic right whale, four of which are listed as endangered under the Endangered Species Act and all of which are protected under the Marine Mammal Protection Act. During a two-year study in the sanctuary, commercial whale watch boats, ostensibly operating under provisions of the NOAA whale watching guidelines, exhibited a non-compliance level of 78% while engaged in that activity.

Further, the sanctuary may be prone to biological invasion by exotic species, based on factors associated with community maturity and the niche opportunities for introduction of exotics created by a history of lowered species diversity and extensive chronic habitat disturbance by fishing. These conditions co-occur with the sanctuary's location amid extensive commercial shipping traffic that can serve as primary vectors for the introduction of exotics from hull bottoms and ballast water. Harmful algal blooms and degraded water quality continue to be concerns with continuing coastal development and increasing urbanization in the region, coupled with unrelenting population growth and commensurate waste-management needs. Creeping offshore industrialization along the western boundary of the sanctuary in the form of deepwater LNG ports may lead to chronic underwater noise affecting sanctuary resources in virtual perpetuity.

Compatible Uses

While it is important to appreciate the sanctuary's history and today's challenges, it is also important to recognize that the sanctuary is mandated by Congress to facilitate only those uses compatible with the sanctuary's primary objective of resource protection. Therein lies both the opportunity and the challenge; the opportunity to correct practices harmful to sanctuary resources, and the challenge to accomplish that goal in ways that create positive outcomes for users and that can be supported by the general public. It is this public at large for which sanctuary resources are held in common trust.

The term "compatible" is articulated as the standard for acceptable use pursuant to the purposes and policies section of the National Marine Sanctuaries Act. But the Act does not define, nor does it provide the criteria to apply, that standard. It may be useful to define this term and make it operational, the means to which is proposed in the Compatibility Determination Action Plan that follows in the next section. The underlying concept is to identify and allow uses that restore and maintain ecological integrity, protect maritime heritage resources and foster an ethic of environmental sustainability in the sanctuary. Current practices, some steeped in history, others of more recent origin, may have to be modified or even dissuaded. Innovation, experimentation and incentives can affect successful transition over time.

While the term "compatible" may be difficult to define bureaucratically, the concept may be easier to understand metaphorically. Essentially, human activities should not "bankrupt" the Stellwagen Bank sanctuary. The NMSA prohibits the destruction, loss or injury to any sanctuary resource managed under law or regulations for the sanctuary. The sanctuary's living and cultural resources can be considered forms of capital, managed as though they were holdings in a diversified investment portfolio, all capable of bearing interest. The goal is to realize successful investment (i.e., management) outcomes over the long term by minimizing or at least spreading risk.

For example, seafloor biogenic and water column habitats can be considered the saving accounts, the most conservative investments because they must endure perpetually to offer reliability. Fish species of commercial and recreational interest can be considered the high-yield stocks that potentially pay big dividends but incur the greatest risk because they are associated with conditions of high variability and uncertainty. If successfully applied, the compatible use standard should offer a reasonable return on investment for the users of the sanctuary without harming the principal held by the public at large.

Cumulative Impacts

Effects of Fishing

The principal effects of fishing on sanctuary resources act through multiple pathways to cumulatively impact biological community interactions (Figure 118). Resulting changes in the composition of biological communities ultimately affect the ecological integrity and biological diversity of the Stellwagen Bank sanctuary. All of these effects are documented as occurring in the sanctuary and are variously discussed in the section Resource States as well as summarized in Figure 118.

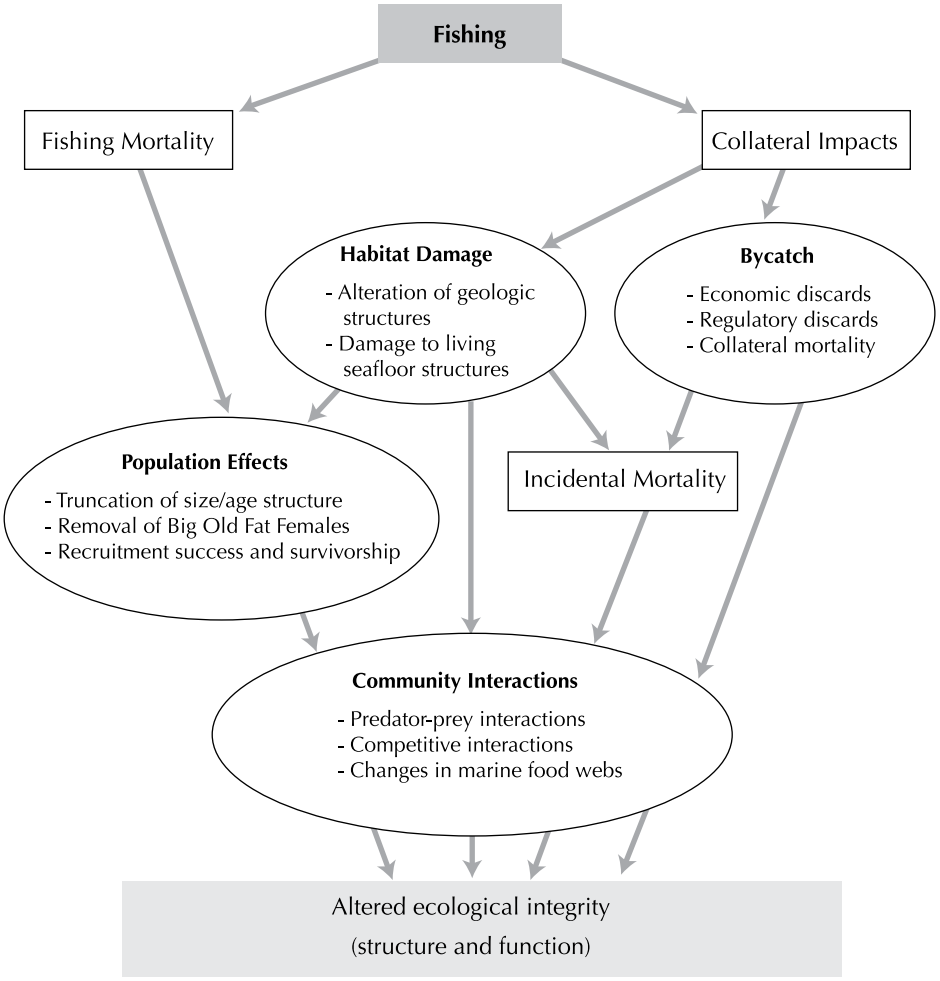
Fishing effects fall within two categories: effects due to (1) the direct mortality of the fish caught and landed for sale, and (2) the collateral impacts caused by the fishing activities themselves. Fishing mortality impacts community interactions indirectly through population-level effects on targeted species of economic or recreational importance. These population effects include the truncation of old-growth age structure and removal of the most reproductively significant fraction of the population. These altered populations then directly affect the structure and function of their associated biological communities through multiple ecological processes, including predation and competition that, in turn, affect food webs and trophic dynamics.

The collateral impacts of fishing are more numerous and exert their effects in more complex ways. Fishing activities can damage seafloor habitats by altering and simplifying their physical structure and by impairing and rendering biogenic (living) habitats dysfunctional. Habitat damage reduces shelter availability and can exert population effects through recruitment success and survivorship. The removal of biomass as fishery bycatch has unintended community-level consequences mediated through collateral and inci-

dental mortality of discards. Discards can be economic in kind (i.e., non-saleable species) or regulatory (e.g., fish below minimum size, numbers caught exceeding allowable level of take). Bycatch mortality can be direct, as the result of capture, or incidental, due to injury or habitat displacement. Both habitat damage and bycatch mortality directly impact the structure and function of biological communities in the sanctuary.

Figure 118 indicates that the sanctuary cannot effectively conserve its biodiversity by managing just for population-level effects of fishing on commercially important species, and that the ultimate goal of sanctuary management must be the protection and restoration of its biological communities. The figure also indicates that the key to protecting and restoring biological communities within the sanctuary must be modification of fishing activities to make them environmentally sustainable such that habitats are not damaged and excessive biomass as bycatch is not removed. If the sanctuary is to be effectively managed for biodiversity conservation, fishing in the sanctuary cannot continue to be prosecuted solely in terms of the more conventional sense of sustainable production. Rather, the calculation of optimum yield within the sanctuary should explicitly include the protection of biological diversity pursuant to the objectives of the National Marine Sanctuaries Act.

Figure 118. Cumulative impacts caused by fishing in the Stellwagen Bank sanctuary, mediated through directed mortality and collateral impacts affecting community interactions, leading to altered ecological integrity.



Adapted from Morgan and Chuenpagdee, 2003

Effects on Marine Mammals

Three principal sources pressure marine mammals in the sanctuary: (1) fishing, (2) shipping and boating, and (3) human population, industry and harmful algal blooms (HAB) (Figure 119). All three sources contribute varying levels of pollutants and chemical contaminants, which can have negative effects on marine mammals.

The principal effects due to fishing include the reduced forage base available for marine mammals due to local depletion of herring, entanglement in fixed fishing gear, and behavioral disturbance associated with tuna fishing activities in the vicinity of whales feeding and underwater noise. The principal effects due to shipping and boating include vessel strikes of whales and behavioral disturbance associated with whale watching and underwater noise.

These effects can cause the mortality, injury and/or harassment of marine mammals possibly leading to their reduced local abundance in the sanctuary. Reduced local abundance of marine mammals in the sanctuary can in turn diminish the public's recreational enjoyment of the place, depress its ecotourism value, and alter the role of marine mammals as a functional element of the sanctuary ecosystem.

Effects on Maritime Heritage Resources

Fishing, diving and remote sensing all have the potential to diminish the archaeological integrity of maritime heritage resources in the sanctuary by altering shipwreck characteristics and site context (Figure 120). Fishing impacts have been documented on nearly all historic shipwreck sites investigated in the sanctuary. While diving and remote sensing currently are occurring infrequently in the sanctuary, their potential impacts on historic shipwrecks (indicated by dashed lines in the figure) are considered in the summary of cumulative impacts presented here.

The principal effects due to fishing include structural damage associated with gear impacts

and removal of artifacts through gear entanglement and "capture" in bottom trawls and gillnets. Hook and line fishing also causes these impacts through boat anchoring and the use of heavy sinkers and jigs. Access to the sites by remote sensing technology and divers may be negatively affected by lost nets and lines that entangle the wrecks and impede close approach.

While diving on a shipwreck does not necessarily have negative impacts, divers can cause structural damage through boat anchoring/grappling/tying onto a shipwreck. Divers have also been known to remove artifacts. Likewise, although remote sensing does not necessarily damage a maritime heritage resource, accidental damage is possible through entanglement, and certain remote technologies, such as ROVs, can remove artifacts from an archaeological site.

Condition Summary

A "snap-shot" of the inferred state or health of key sanctuary resources is provided in the Stellwagen Bank sanctuary *Condition Report* (NOAA, 2007). The report is linked to resource conditions more fully described in the Resource States section of this document. The *Condition Report* summary table, excerpted and updated here (see following note), was originally intended to provide a preliminary overview of the status and trends of sanctuary resources as well as the basis for making judgments concerning status (Table 24). The summary table results are generally consistent with and representative of findings presented in this document, although not fully comprehensive of all issues. For more details, refer to the full *Condition Report* (http://stellwagen.noaa.gov).

[Note: Long-term changes in fish species diversity (1975-2005) measured as species richness (Figure 38) do not appear to be changing in any consistent way (question 9); indices are at levels comparable to the 1970s and the rating is upgraded to fair-poor. Sand lance has been deleted as a key species in jeopardy (question 12), adjusting for increases in sand lance availability in consecutive years from 2006 through 2009. Maximum length of cod increased over 1990-2005 (Figure 44), reversing a long-term downward trend (1963-2000) (Figure 43), indicating that conditions may be improving (question 12).]

The assessment of late 19th- and early 20th-century fisheries of Stellwagen Bank (Claesson and Rosenberg, 2009) provides baselines for comparison to the current ecosystem conditions reported in the *Condition Report*. Comparison of the habitat and living resources condition categories in the sanctuary ca. 2006 versus ca. 1900 are presented in Table 24, as adapted from Claesson and Rosenberg (2009). The comparison indicates that conditions are significantly different today, in most cases signifying considerable dete-

Figure 119. Effects on marine mammals caused by the cumulative impacts of human activities in the Stellwagen Bank sanctuary that could alter their role as a functional element of the sanctuary ecosystem.

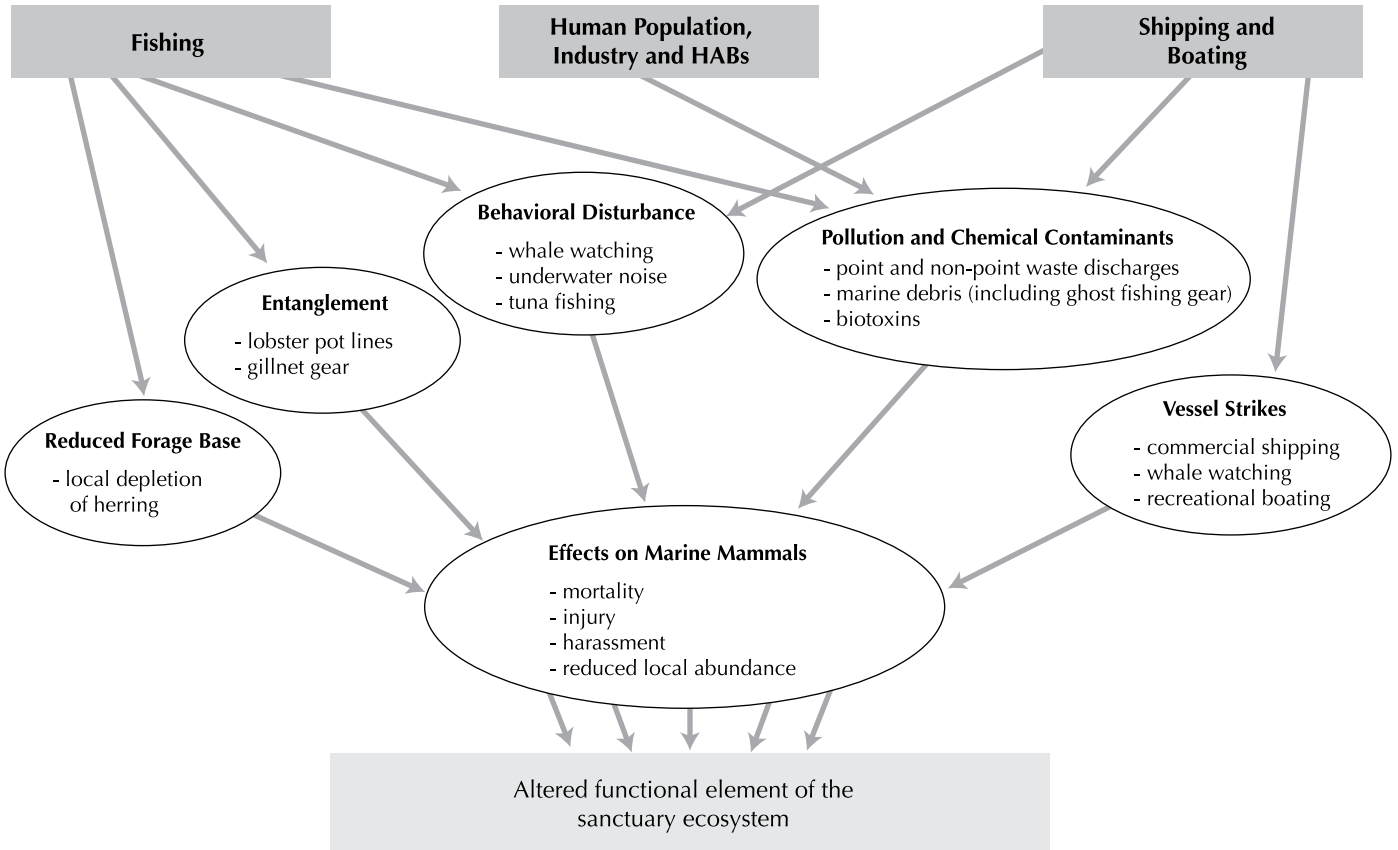
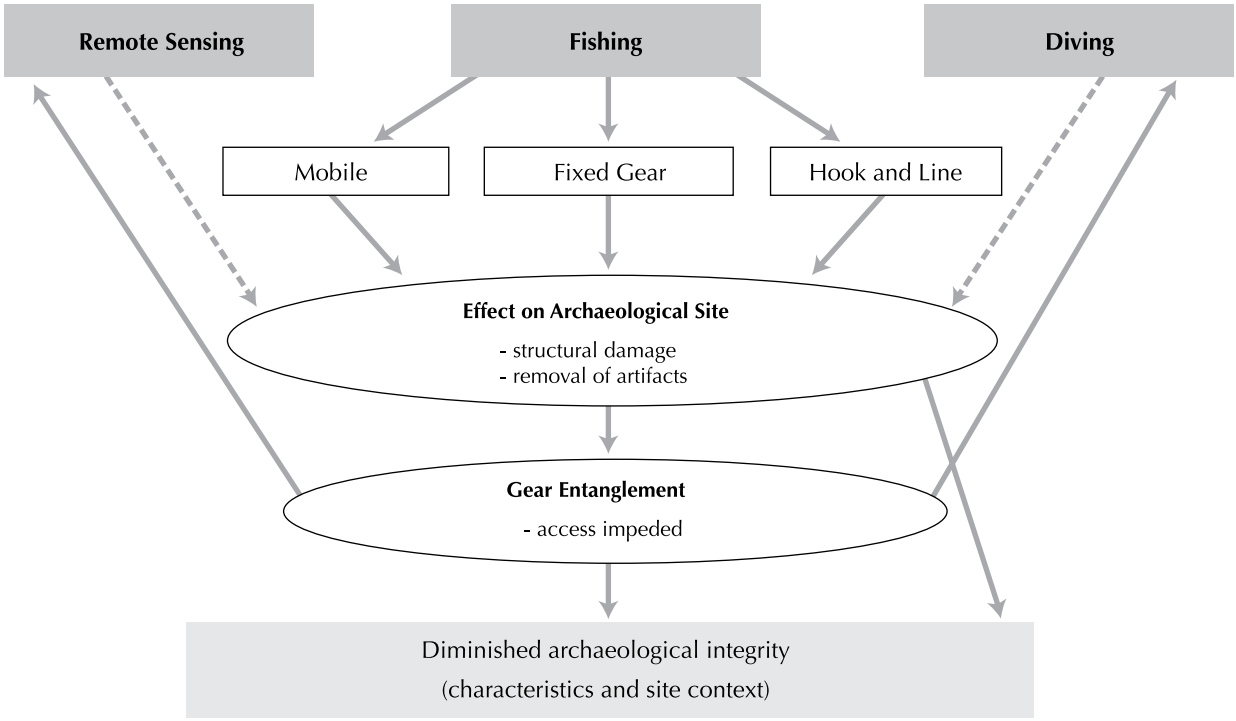


Figure 120. Effects on maritime heritage resources in the Stellwagen Bank sanctuary caused by cumulative impacts and leading to diminished archaeological integrity.



rioration of sanctuary resources over the past century. One notable exception is cod, the catch of which has increased significantly from the early 1900s levels. Inversely, the widely held belief that the sanctuary and GoM haddock populations are healthy and sustainable is called into question when compared to 1900s catch levels. The inverted proportional catch of cod-haddock may signal that the Stellwagen Bank system has shifted from its historical 'steady state,' is unstable and undergoing trophic-level reorganization (Claesson and Rosenberg, 2009).

The summary table indicates the need for management actions that address the degraded conditions of key habitats and living resources in the Stellwagen Bank sanctuary. Based on the 2006 assessment, over half of all categories (10 of 17) had fair through poor ratings, with eight of ten relating to habitat or living marine resources. The general trend for habitat and living resources appears to be static and in need of improvement, an indication that pressures on living resources are high, requiring targeted management efforts. The status of seafloor communities and habitats in the sanctuary remains problematic. Monitoring programs for water quality and a number of other concerns (e.g., environmental contaminants, invasive species) need to be more sufficiently addressed as well. The physical integrity of historic shipwrecks requires protection from human use, particularly from fishing gear impacts. Based on comparison with ca. 1900 condition assessments, there is a general downward trend in the condition of key habitats and living resources in the sanctuary. This downward trend heightens and emphasizes the need for directed management actions to improve these conditions.

The summary table rates resource status on a scale from good to poor; the timelines used for comparison vary from topic to topic and across a century. Recent trends were generally based on observed changes in status over the past five years (2001-2006), unless otherwise specified. Evaluations of status, trends and final ratings over this time period were made by sanctuary staff, based on interpretation of quantitative and, when necessary, non-quantitative assessments and observations of scientists, managers and sanctuary users with pertinent knowledge. Results of historical trend analysis and resource condition ratings for the sanctuary are reported in Claesson and Rosenberg (2009). Both the *Condition Report* and the Claesson and Rosenberg report were peer-reviewed and comply with the White House Office of Management and Budget's peer review standards as outlined in the *Final Information Quality Bulletin for Peer Review.*

Moving Forward

The broad range and technical specificity of the information compiled in this document was derived from the very hard work of nearly 200 people participating on ten working groups representing all stakeholder interests in the sanctuary. These individuals were committed to developing a better understanding of the condition of sanctuary resources through the management plan revision process. Many of these individuals were staff specialists of fishery management agencies, especially NOAA Fisheries Service NERO

and NEFSC, who freely made their expertise and extensive databases available to the sanctuary for use in many of the analyses and research projects referenced. Many of the members of these working groups were fishermen, who committed themselves to this planning process and engaged positively in the dialogue by bringing their practical experience to bear on the issues; so too, members of the whale watching and maritime industries, environmental organizations, academic institutions and the public at large gave valuable input.

This document provides background information necessary for managing the sanctuary for biodiversity conservation and clarifies the scale and scope of fishing and other activities in the sanctuary. The information provides a detailed picture of the present condition of sanctuary resources and the activities exerting pressures on them. There is now the basis to consider how things should be done differently to improve sanctuary management, since that is what the findings indicate is needed.

The action plans that follow in the next section are preceded by a statement and discussion of the vision for the sanctuary that was developed by the Sanctuary Advisory Council as part of the management plan revision process. This vision draws contrast to the current conditions in the sanctuary:

"The Stellwagen Bank National Marine Sanctuary is teeming with a great diversity and abundance of marine life, supported by diverse, healthy habitats in clean ocean waters. The ecological integrity of the sanctuary is protected and fully restored for current and future generations. Human uses are diverse and compatible with maintaining natural and cultural/resources."

The first step to realizing this vision is compiling a current accounting of the status of the sanctuary's resource states, which this first part of the document has done. The next step is to convert this knowledge into actions that can reasonably be taken on the basis of what is now known. These actions and their respective strategies and activities are proposed in the action plans that follow. The action plans are based extensively on the advice of the Sanctuary Advisory Council working groups and these recommendations should be put into practice.

Table 24. Revised summary of findings from the Stellwagen Bank sanctuary *Condition Report* (2006) compared to the assessment of sanctuary resource conditions *ca.* 1900 (Claesson and Rosenberg, 2009)

Refer to Appendix A in the *Condition Report* (2006) for an explanation of the questions posed in this table.

While providing a useful overview pertinent to most key sanctuary resources, the table is not inclusive of all resource conditions and associated pressures such as local depletion of prey species for endangered whales, increased underwater noise from industrial sources, etc. that are covered in this document. Blank cells under Rating category appear where resource conditions were not determined.

#	Questions/Resources	Rating		Basis for Judgment	Description of Findings
		2006	1900		
Water					
1	Are specific or multiple stressors, including changing oceanographic and atmospheric conditions, affecting water quality?	—		Numerous contaminants at low levels.	Selected conditions may preclude full development of living resource assemblages and habitats, but are not likely to cause substantial or persistent declines.
2	What is the eutrophic condition of sanctuary waters and how is it changing?	—		Specific aspects of on-going monitoring, as explained in text, with references.	Conditions do not appear to have the potential to negatively affect living resources or habitat quality.
3	Do sanctuary waters pose risks to human health?	—		Specific aspects of on-going monitoring, as explained in text, with references.	Conditions do not appear to have the potential to negatively affect human health.
4	What are the levels of human activities that may influence water quality and how are they changing?	—		Vessel discharges. MWRA outfall.	Some potentially harmful activities exist, but they do not appear to have had a negative effect on water quality.
Habitat					
5	What is the abundance and distribution of major habitat types and how are they changing?	—	▼	Alteration of microhabitat due to bottom dragging & dredging.	Selected habitat loss or alteration may inhibit the development of assemblages, and may cause measurable, but not severe declines in living resources or water quality.
6	What is the condition of biologically-structured habitats and how is it changing?	—	▼	Fishing gear impacts.	Selected habitat loss or alteration has caused or is likely to cause severe declines in some, but not all, living resources or water quality.
7	What are the contaminant concentrations in sanctuary habitats and how are they changing?	—		Limited monitoring results.	Selected contaminants may preclude full development of living resource assemblages, but are not likely to cause substantial or persistent degradation.
8	What are the levels of human activities that may influence habitat quality and how are they changing?	▼	▼	Fishing gear impacts, shipping.	Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.
Living Resources					
9	What is the status of biodiversity and how is it changing?	—	▼	Long-term changes in fish diversity.	Selected biodiversity loss has caused or is likely to cause severe declines in some, but not all ecosystem components, and reduce ecosystem integrity.
10	What is the status of environmentally sustainable fishing and how is it changing?	—	▼	Published and unpublished literature on regional and local groundfish populations.	Extraction has caused or is likely to cause severe declines in some, but not all, ecosystem components, and reduce ecosystem integrity.
11	What is the status of non-indigenous species and how is it changing?	▼		Recent invasives discovered.	Non-indigenous species exist, precluding full community development and function, but are unlikely to cause substantial or persistent degradation of ecosystem integrity.
12a	What is the status of key species and how is it changing?	▲	▲	Cod	Cod catch has increased significantly from early 1900s levels.

Table 24. Continued.

12b	What is the status of key species and how is it changing?		▲	Haddock	The reduced abundance of haddock has caused or is likely to cause severe declines in some, but not all, ecosystem components, and reduce ecosystem integrity; and prospects for recovery are uncertain.
13	What is the condition or health of key species and how is it changing?	—		Whale strikes & entanglements.	The diminished condition of selected key resources may cause a measurable, but not severe, reduction in ecological function, but recovery is possible.
14	What are the levels of human activities that may influence living resource quality and how are they changing?	—		Stable levels of activity.	Selected activities have caused or are likely to cause severe impacts, and cases to date suggest a pervasive problem.
Maritime Archaeological Resources					
15	What is the integrity of known maritime archaeological resources and how is it changing?	▼		Fishing gear impacts.	The diminished condition of selected archaeological resources has reduced, to some extent, their historical, scientific, or educational value, and may affect the eligibility of some sites for listing in the National Register of Historic Places.
16	Do known maritime archaeological resources pose an environmental hazard and is this threat changing?	—		Lack of hazardous cargo.	Known maritime archaeological resources pose few or no environmental threats.
17	What are the levels of human activities that may influence maritime archaeological resource quality and how are they changing?	▼		Fishing gear impacts.	Selected activities warrant widespread concern and action, as large-scale, persistent, and/or repeated severe impacts have occurred or are likely to occur.

Status: Good | Good/Fair | Fair | Fair/Poor | Poor | Undetermined

Trends:

▲ Conditions appear to be improving toward one of the higher categories.

— Conditions do not appear to be changing.

▼ Conditions appear to be declining toward one of the lower categories.

□ Conditions not determined