Marine Sanctuaries and Marine Planning

Protecting endangered marine life.

by Dr. David Wiley
Research Coordinator
National Oceanic and Atmospheric Administration

Dr. Leila Hatch
Marine Ecologist
National Oceanic and Atmospheric Administration

Mr. Michael Thompson
Environmental Geographer
National Oceanic and Atmospheric Administration

Dr. Kurt Schwehr
Head of Ocean Engineering
Google

Dr. Craig MacDonald
Superintendent
Stellwagen Bank National Marine Sanctuary

U.S. national marine sanctuaries are federally designated marine protected areas that are often located in highly productive waters, which makes these sanctuaries important to a diverse, economically vital human user community and for biodiversity conservation. As a result, appropriate sanctuary management must balance conflicting goals. Fortunately, sanctuaries have been early adapters in marine planning.

Marine planning is a transparent, ecosystem-based, science-driven decision making process developed with a high level of stakeholder and public involvement. As established marine planning practitioners, national marine sanctuaries can provide valuable case studies and insights.

The co-occurrence of endangered whales and commercial ships made the Stellwagen Bank National Marine Sanctuary a historic "hot spot" for lethal collisions. Photo courtesy of NOAA/Stellewagen Bank National Marine Sanctuary.

Marine Planning in Action

For example, the National Oceanic and Atmospheric Administration's (NOAA) Stellwagen Bank National Marine Sanctuary, an 852-square-mile marine protected area located off the coast of Massachusetts and New Hampshire, hosts some of the largest aggregations of endangered large whales (such as the humpback, fin, and North Atlantic right whales). However, the Boston Traffic Separation Scheme (BTSS), a major shipping route, transits it.

Because of its close proximity to transiting ships, the area has become a "hot spot" for collisions between vessels and whales. To reduce incidents near the sanctuary and in its surrounding waters, we used a marine planning process to:

- identify a new BTSS route to spatially separate whales and ships,
- gain stakeholder and government acceptance for the route,
- verify mariner compliance,

- assess approaches to improve whale detection,
- improve communications.

Separating Whales and Ships

To understand the spatial distribution of whales, we:

- plotted the distribution and relative abundance of right and other baleen whales within the sanctuary and adjacent waters,
- identified whale high-use areas,
- modeled various traffic separation scheme reconfigurations through the sanctuary to spatially separate whales and ships,
- calculated the risk reduction and industry impact of alternative paths.

We used a geographic information system (GIS) mapping tool to compile geographic data to help us plot the distribution and relative abundance of whales and identify their habitat. Afterward, we worked with the maritime community to investigate variously reconfigured traffic separation schemes to minimize the number of whales in the shipping path as well as reduce impacts to industry (including transit time, turning angles, and number of turns).

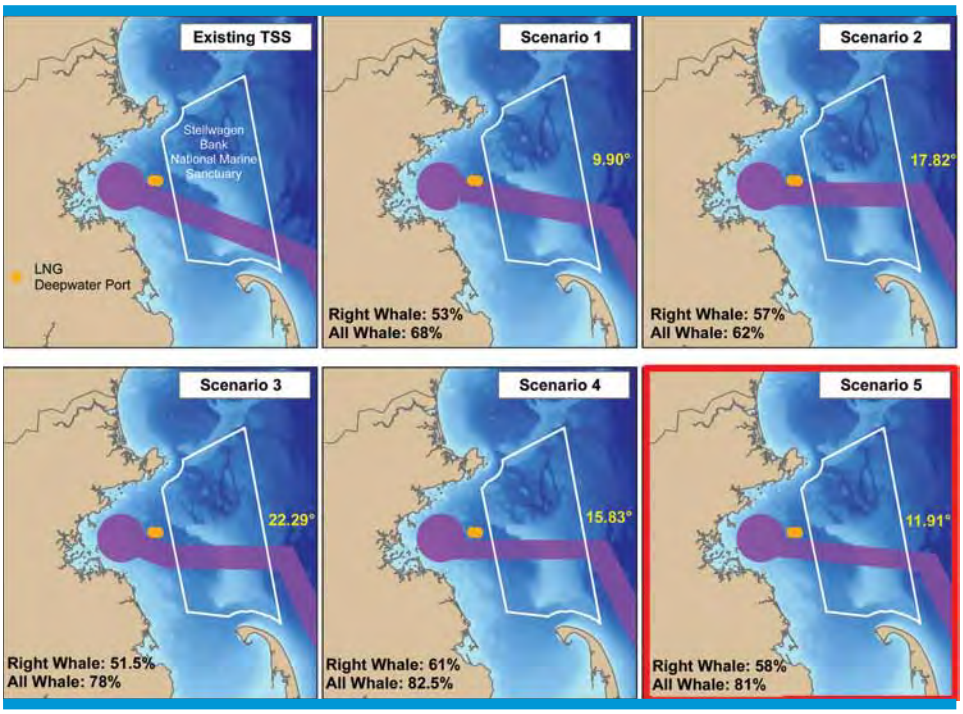
The consensus choice: rotating the western end of the Boston Traffic Separation Scheme 12 degrees and narrowing the traffic separation scheme by one nautical mile. Analysis indicated that there were 81 percent fewer baleen whale sightings and 58 percent fewer right whale sightings in the modified BTSS relative to the one that was superseded. Industry transit times increased nine to 22 minutes for vessels traveling between 10 and 25 knots, and the number of required turns remained the same.

To increase confidence in our conservation decision, we used GIS mapping to identify ecological correlates that could explain the decreased sightings in the newly reconfigured traffic separation scheme. The result: fewer prey in the realigned BTTS. The key prey source for many whale species—the American sand lance—occurs predominantly over sandy seafloor substrate. Analysis revealed that the substrate underlying the original Boston Traffic Separation Scheme consisted of 48 percent sand, while the substrate underlying the realigned BTSS was 16 percent sand, indicating a reduced occurrence of prey in the new area. In addition, modeling indicated that currents would also tend to aggregate the prime prey of North Atlantic right whales away from the realigned traffic separation scheme.

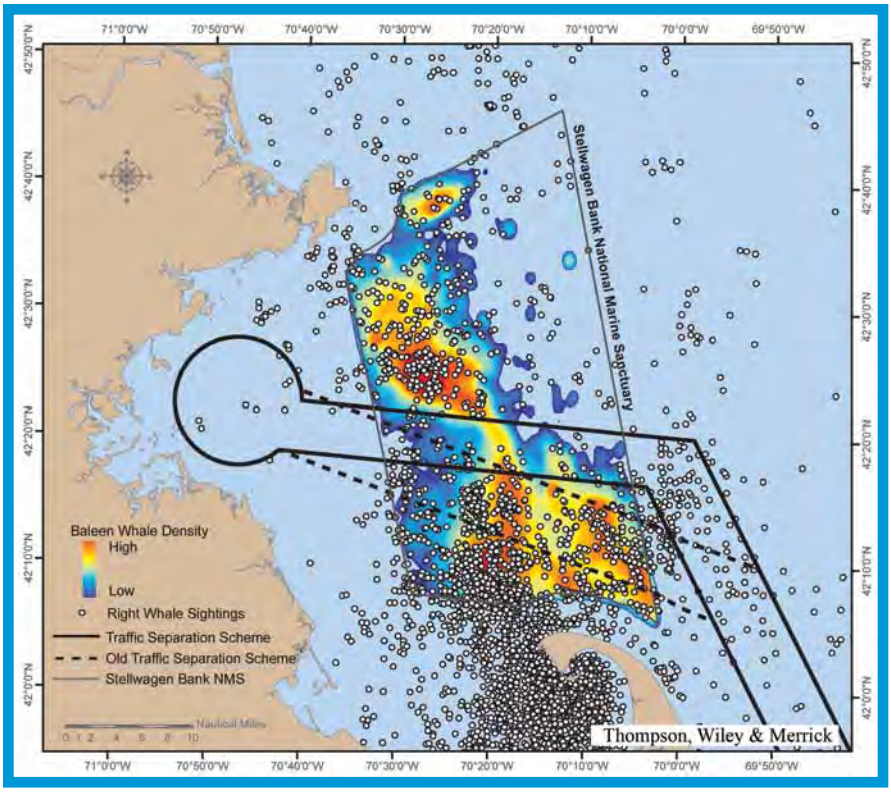
Working with Stakeholder and Governmental Organizations

During the analysis, we engaged in an iterative stream of meetings with the Boston Port Operators Group, which represents the local, national, and international shipping communities. This engagement began early in the process, allowing the operators group to view the data and verify its validity. The sanctuary scientific team analyzed any questions, concerns, and ideas and presented the results at the following month's meeting.

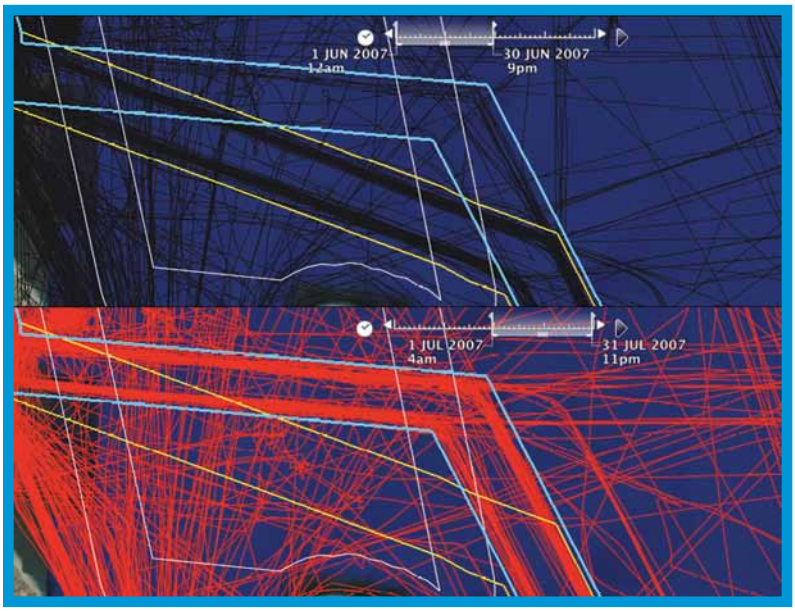
Following the consensus choice of a new BTSS route, our activity transitioned to the governmental policy arena, where team members made presentations to and garnered the support of the relevant agencies (such as the Office of National Marine Sanctuaries, NOAA Fisheries, National Ocean Service, and the U.S. Coast Guard). The combined agendas of industry priorities, conservation needs, and federal planning activities came into alignment, and the International Maritime Organization accepted the proposal



Working together, scientists and stakeholders investigated the conservation value and industry impact of various alternatives based on the number of whales avoided, the number/angle of turns, and ship transit time. Scenario 5 (red border) was the consensus choice. Graphics courtesy of NOAA/Stellewagen Bank National Marine Sanctuary.



The realigned Boston Traffic Separation Scheme moved ship transits from high- to low-use whale areas. Graphic courtesy of NOAA/Stellewagen Bank National Marine Sanctuary.



The top pane shows the vessel traffic pattern prior to the BTSS shift (June 1 to 10, 2007) and the bottom pane the vessel traffic pattern post-shift (July 1 to 31, 2007). The original BTSS is depicted in yellow and the new BTSS in blue. Monitoring demonstrated high compliance. Graphic courtesy of Dr. Kurt Schwehr.

in December 2006. The new Boston Traffic Separation Scheme became active the following July.

This was the first time in the U.S. that a TSS was shifted to mitigate whale/ship collisions, and the transparent process helped create a rapprochement among the various stakeholders, so subsequent actions to reduce the likelihood of collisions were viewed in a favorable light.

AIS Evaluates Compliance

An important but often neglected aspect of marine planning and a core principle of adaptive management is monitoring to ensure that the desired impact is achieved and adequate data exists to support decisions to perpetuate, discontinue, or alter the new scheme. Since commercial ships use the Boston Traffic Separation Scheme on a voluntary basis, we evaluated mariner adherence to the new alignment as an indicator of the efficacy of the conservation action.

Large vessels are required to carry an Automatic Identification System (AIS) transceiver, which transmits the ship's name, position, speed, and heading (among other things) with updates occurring as often as every two seconds. While originally conceived as a real-time collision avoidance system, this information can also be gathered, archived, and analyzed to give insights into ship traffic over time. With respect to the BTSS, AIS analysis indicated that nearly 100 percent of the shipping traffic shifted from the old pattern to the new alignment.

While this vessel compliance with the new traffic separation scheme resulted in substantial reduction in the risk of collisions between ships and whales, the large numbers of whales using the sanctuary and their highly variable behavior means that there will always be some risk of whales within the reconfigured BTSS. Ship traffic transiting the Boston Traffic Separation Scheme is also variable. For example, shortly after realignment, developers proposed building two deep water ports for offloading liquefied natural gas (LNG) adjacent to the national marine sanctuary, bringing increased traffic through the BTSS.

Acoustic Detection Buoys

To lower the increased risk of LNG traffic and whale collisions, the Stellwagen Sanctuary science team and various federal agencies worked with stakeholders and conservation groups to develop a strategy that would provide near real-time right whale detection. The result: an acoustic detection system, which consists of 10 automatic detection buoys that "listen" for right whale calls.

Cornell University's Bioacoustics Research Program staffers are available 24/7 to examine the calls and

eliminate any false alerts or to confirm whale sounds. The staff reports whale alerts to LNG vessel masters. LNG ships are mandated to slow to 10 knots in areas of whale detection and heighten observation to avoid striking them. These alerts remain active for 24 hours, and other mariners are also requested to slow.

This first-of-its-kind approach to vessel routing represents a second successful outcome from applying a marine spatial planning approach to resolve potential conflicts among existing and intensifying uses and biodiversity conservation.

Lessons Learned

As a concept, marine planning is gaining traction around the world. As practitioners move forward, learning from past endeavors can inform future efforts. In our ongoing project, we have found the following conditions lead to success:

- **High quality, locally produced scientific information.** Good decisions require good data. This is particularly true in potentially contentious situations. While information derived from literature and/or from other locations can be important and should not be ignored, it is unlikely to yield a perfect fit for local challenges or lead to widely supported decisions. Information for decisions should be powered by data specific to the problem and location.
- **Scientific information collected/analyzed in conjunction with stakeholders.** The traditional perception that science provides credible and unbiased information, because research is conducted in isolation from those most impacted by its results (stakeholders), is not valid. Such research contributes to stakeholder entrenchment by allowing stakeholders to construct myriad reasons to reject it, rather

Whale Alert

The *Whale Alert* app, available on iTunes, is a free iPad/iPhone-based mobile application that notifies users regarding right whale protection and management information along the U.S. eastern seaboard, including:

- **Current ship location.** An icon depicts a ship's real-time GPS-derived location.
- **Seasonal management areas.** As a ship enters one of these areas, a pop-up window appears, notifying the mariner that he/she should be traveling at less than 10 knots.
- **Mandatory ship reporting areas.** When a ship enters one of these areas, a pop-up display appears, reminding the mariner to contact the Coast Guard to receive right whale information.
- **Areas to be avoided.** IMO-sanctioned areas to protect right whales appear on *Whale Alert* when and where they are active.

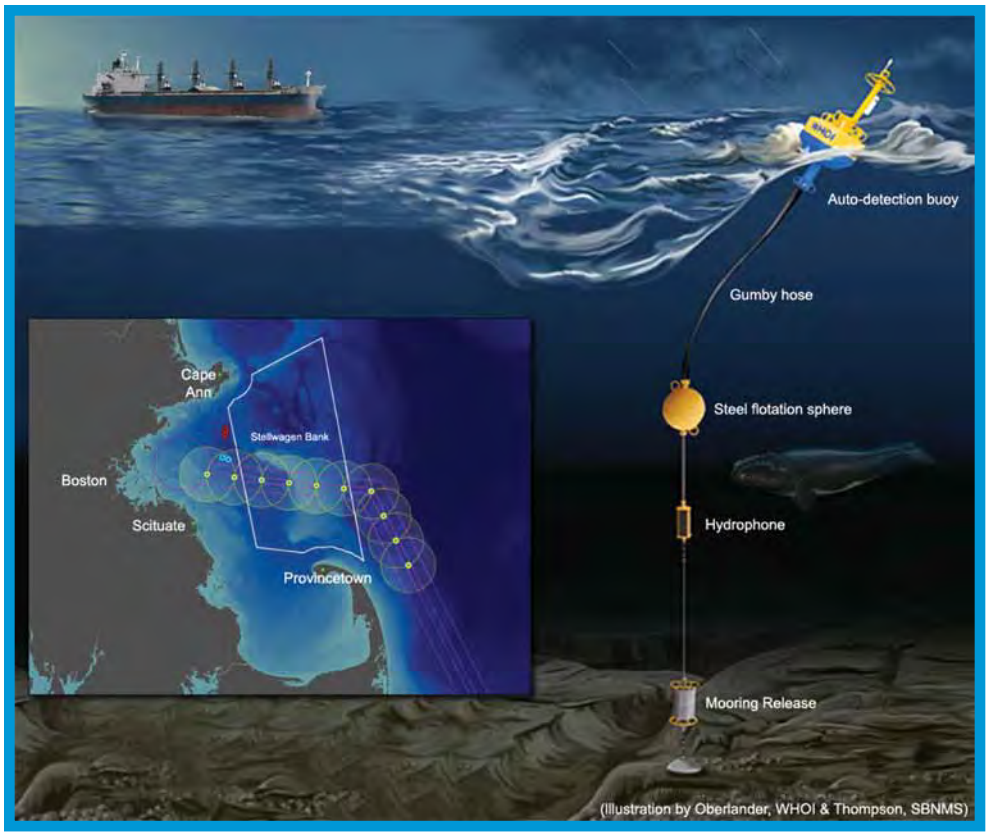
Graphic courtesy of NOAA.

Right whale management information as displayed on an iPad via *Whale Alert*. Color coding is as follows:

- seasonal management area, orange;
- dynamic management area, grey;
- area to Be avoided, red;
- recommended routes, purple;
- mandatory ship reporting perimeter, blue;
- acoustic buoy without a right whale detection, green;
- acoustic buoy with a right whale detection, yellow.

than contributing to problem solving by providing agreed-upon information for decisions. Research that is inclusive and balanced by a diversity of interests provides results that stakeholders view as more credible and acceptable.

- **Data that is presented so that all participants can understand it.** Too often scientists expect stakeholders to accept undesired information based on obtuse models and statistical probabilities. It is incumbent upon scientists to develop techniques that show results clearly and concisely, rather than expecting stakeholders to "trust" science or become scientifically literate for the occasion.
- **A driver for timely action.** While stakeholder involvement and cooperation were essential to the process, it is unlikely to have occurred without a regulatory impetus for action. At the time of our activities, the estimated North Atlantic right whale population was approximately 300 animals, and the



Buoys detect the presence of a right whale through the whale's "up call," and use a satellite connection to relay the call spectrogram to scientists for species confirmation. LNG companies paid for the acoustic detection system as part of their USCG and MARAD licensing agreements. Illustration by E. Paul Oberlander, Woods Hole Oceanographic Institution, and graphic adapted courtesy of NOAA/Stellewagen Bank National Marine Sanctuary.

Whale Alert is a free mobile software application that provides up-to-date information pertaining to North Atlantic right whale management initiatives and regulations and displays it on digital nautical charts. Graphic courtesy of NOAA/Stellewagen Bank National Marine Sanctuary.

Endangered Species Act and the Marine Mammal Protection Act required further reductions in human-caused serious injury or death. In addition, a number of lawsuits had been directed at NOAA's National Marine Fisheries Service alleging inaction in protecting right whales from ship strike and fishing gear entanglement.

We share these tips to help other marine stakeholders manage the delicate processes that come with successful marine planning, and to capture the lessons we learned during this marine planning process.

About the authors:

Dr. David Wiley is the research coordinator for NOAA's Stellwagen Bank National Marine Sanctuary. His research has ranged from studying endangered whales to mapping marine hazardous dumpsites. He is the recipient of numerous honors, including a Switzer Environmental Leadership award, the International Society for Marine Mammalogy's award for Excellence in Scientific Communication, an Ian Axford (Fulbright) Fellowship in Public Policy, and the U.S. Department of Commerce's Gold Medal for scientific leadership.

Dr. Leila Hatch is a marine ecologist at the Stellwagen Bank National Marine Sanctuary, where she focuses on characterizing underwater soundscapes, assessing the impacts of ocean noise on marine animals, and mitigation and monitoring programs to address those impacts. She received a doctoral degree from Cornell University in evolutionary biology, where her research focused on baleen whale molecular genetics and acoustic behavior.

Dr. Kurt Schwehr is head of ocean engineering for Google. He received a PhD in marine geophysics from Scripps Institution of Oceanography and is an affiliate professor at UNH CCOM. He has worked on ocean mapping, disaster response, and software for Mars rovers. He is co-author on IMO circulars 289 and 290 for AIS.

Mr. Michael Thompson is an environmental geographer at NOAA's Stellwagen Bank National Marine Sanctuary where he conducts geographic information systems analyses in support of the sanctuary mission, while facilitating compatible use.

Dr. Craig MacDonald is superintendent of Stellwagen Bank National Marine Sanctuary where he oversees sanctuary policies, facilities, and vessel operations. He is responsible for management planning, education and outreach, and diverse technical projects. He is a Fellow of the Marine Technology Society, holds graduate degrees in oceanography and marine biology, completed postdoctoral studies in fisheries science, and is a certified public administrator.

Acknowledgements:

Many people have contributed to these projects. The authors especially want to thank: Chris Clark of the Bioacoustic Research Program, Cornell Laboratory of Ornithology; Patrick Ramage, Jake Levenson, and April Wobst of the International Fund for Animal Welfare; Deborah Hadden and Brad Wellock of the Massachusetts Port Authority; Andy Hammond of the Boston Harbor Pilots Association; Richard Merrick, Tim Cole, Christin Khan, and Beth Josephson of NOAA's Northeast Fisheries Science Center; David Gouveia of NOAA's Northeast Regional Office; Peter DeCola, Patience Whitten, George Detweiler, and Irene Gonin of the U.S. Coast Guard; Larry Meyer, Colin Ware, and Roland Arsenault of the Center for Coastal and Ocean Mapping, University of New Hampshire; Brad Winney and Virgil Zetterlind of EarthNC. Special thanks to Ms. Lindy Johnson, former general council for International Law, National Oceanic and Atmospheric Administration. She worked tirelessly on issues related to land- and sea-based sources of marine pollution, environment and navigation, marine protected areas, coral issues, noise, and marine mammals and vessel strikes of right whales. Her legacy is the large number of international environmental treaties that she negotiated, and, in particular, her work on protecting North Atlantic right whales from vessel strikes.

Additionally, *Whale Alert* was designed with considerable input from stakeholders. The Massachusetts Port Authority and Boston Harbor Pilots Association were lead groups, while NYK Line and the Norwegian and Holland America cruise lines were part of a test fleet to gain additional industry input and make the app operational. The U.S. Coast Guard was instrumental in working with the team to transmit information via AIS. On the conservation side, the International Fund for Animal Welfare provided important program input and funding. In addition to the Stellwagen Bank NMS, scientists and engineers from the Bioacoustic Research Program at Cornell University, the Center for Coastal and Ocean Mapping at the University of New Hampshire, NOAA's Northeast Fisheries Science Center, and the Woods Hole Oceanographic Institution provided expertise supporting different aspects of the app. EarthNC, with extensive experience in spatial mapping and real-time mobile data acquisition, aided app development.

Bibliography:

Final recommendations of the Interagency Ocean Policy Taskforce. The White House Council on Environmental Quality, 2010. p.p. 77.

Automatic Identification System; vessel carriage requirement. Washington, D.C.: U.S. Department of Homeland Security, U.S. Coast Guard. Federal Register. 60559-60570. Oct. 22.

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). IALA Guideline No. 1028 on the Automatic Identification System (AIS), 2003. Part I. Operational issues,1. Saint Germain en Laye, France.

International Telecommunications Union (ITU) 1998-2010, M.1371. *Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band.*

Jensen, A.S. and G.K. Silber (2003.) *Large whale ship strike database.* U.S. Department of Commerce and National Oceanic and Atmospheric Administration. Technical Memorandum, NMFS-OPR, p.p. 37.

Kraus, S. D., P. K. Hamilton, R. D. Kenney, A. Knowlton and C. K. Slay (2001). *Reproductive parameters of the North Atlantic right whale.* J. Cetacean Res. Manage. (Special Issue) 2: p.p. 231-236.

Lubchenco, J. (1995). *The role of science in formulating a biodiversity strategy. Bioscience* 45: s-7-s-9.

Meyer, T.L., R.A. Cooper and R.W. Lagnton. 1973. *Relative abundance, behavior and food habits of the American sand lance, Ammodytes americanus, from the Gulf of Maine.* Fish Bull., US 77:243-253.

National Oceanic and Atmospheric Administration (NOAA). *Final Rule To Implement Speed Restrictions to Reduce the Threat of Ship Collisions.* Federal Register, 2008. Vol. 73, No. 198, October 10, 2008. Rules and Regulations DEPARTMENT OF COMMERCE 50 CFR Part 224 [Docket No. 040506143–7024–03]. National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

Wiley, D.N. (2011). *Increasing the Social Power of Scientific Information used for Decisions on Marine Protected Areas in New Zealand.* Fulbright New Zealand. Wellington, New Zealand, p. 82.

Wiley, D.N., J.C. Moller and K. Zilinskas (2003). *The distribution and density of commercial fisheries and baleen whales within the Stellwagen Bank National Marine Sanctuary.* July 2001-June 2002. Marine Technology Society Journal. Vol. 37(1), p.p. 35-53.