The Biological Viability of the Most Endangered Marine Mammals and the Cost-effectiveness of Protection Programs

A Report to Congress from
the Marine Mammal Commission
February 2008

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EXECUTIVE SUMMARY

As set forth in the Marine Mammal Protection Act and the Endangered Species Act, the citizens of the United States have placed great importance on preserving wild species and on maintaining marine mammal populations at levels well above what would place them at risk of extinction. Consistent with this concern, in 2004 Congress directed the Marine Mammal Commission to "…review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs."

The Commission reviewed 22 marine mammal taxa (i.e., species, subspecies, or population stocks) that occur regularly or entirely within U.S. waters and that are either listed as endangered or threatened under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act. The review considered methods for identifying taxa at elevated risk of extinction, evidence regarding their viability, threats to their conservation, and the current status and funding for recovery programs. The review also included an in-depth case study of the cost-effectiveness of recovery efforts for the North Atlantic right whale.

Of the 22 taxa, 2 are not considered to be viable: the Caribbean monk seal is considered extinct and the AT1 population of killer whales appears to be on the verge of extinction. The remaining 20 taxa are considered viable; that is, they can persist and recover if human-related threats are identified and addressed. Historical data indicate that many wild species, including a number of marine mammal taxa, have recovered from low numbers when human-related threats were managed effectively.

Recovery programs for endangered, threatened, and depleted taxa depend heavily on information regarding population structure and dynamics, population ecology and health, factors that act with special force on small populations, and the nature and severity of threats. Population viability analysis provides a mechanism for integrating the available data into an analysis of extinction risk. However, such analyses have been conducted for relatively few taxa due to a lack of critical data and insufficient emphasis on the use of such tools to enhance risk assessment.

Intentional killing was undoubtedly the greatest threat to marine mammals in the 1800s and early to mid-1900s. Since the early 1900s the passage, implementation, and enforcement of several key domestic laws and international treaties have contributed strongly to the conservation of many marine mammal taxa by limiting and in many cases prohibiting such killing. The Fur Seal Treaty, the International Convention for the Regulation of Whaling, the Marine Mammal Protection Act, and the Endangered Species Act may well have prevented the extirpation of some populations and possibly even the extinction of some species.

The primary human-related threats to marine mammals in U.S. waters have now shifted from intentional to indirect or incidental taking and degradation of habitat. Recovery efforts generally have been less successful at addressing indirect or incidental threats, which include competition with fisheries for prey, contaminants, disease, noise, coastal development and loss or degradation of habitat, and climate change.

The indirect threats posed by human activities often increase in proportion to human population size, economic growth, and consumption patterns. The consequences of "economic growth and development untempered by adequate concern and conservation" were incentives for passage of both the Marine Mammal Protection Act and the Endangered Species Act by Congress in the early 1970s. With regard to indirect threats, the findings, purposes, and challenges of the Marine Mammal Protection Act and the Endangered Species Act are more germane now than they were three decades ago.

Much remains to be learned about the threats facing marine mammals and about the actions needed to allow endangered taxa to recover. To be successful, marine mammal recovery programs must determine what critical information is lacking, obtain that information, and select or adjust recovery actions in response to the information. In the absence of critical information, a precautionary management approach is necessary to ensure conservation even though it may impose a risk of overprotection. Unfortunately, even under the best circumstances the recovery of marine mammals is limited by their inherently slow population growth rates, which means that recovery for some species will require decades or longer. Furthermore, as environmental and other conditions change, so too do some of the threats and options for recovery strategies. Strategies must be adapted as more is learned about the animals and the risks they face, and this adaptation must occur at a pace consistent with the adverse effects of socioeconomic development, climate change, and similar human-related phenomena.

Each year Congress allocates a substantial budget for marine mammal recovery programs, with two reasonable expectations. The first is that those funds will be used effectively and cost-effectively in accordance with the conservation framework established in the Marine Mammal Protection Act and Endangered Species Act. The second is that the funded programs will be adequate to achieve the goals of the Acts. In fact, recovery programs have achieved mixed results with regard to their effectiveness and cost-effectiveness. The inconsistency is due in part to insufficient information to assess extinction risks and guide recovery actions and in part to inadequate implementation of some programs. Nonetheless, no marine mammal taxon in U.S. waters has gone extinct during the period that the Acts have been in place, and many taxa have demonstrably benefited from the programs and protections implemented under the Acts. In contrast, during the same period, the Yangtze River dolphin appears to have become extinct and several marine mammals not under U.S. jurisdiction have declined to a very precarious state.

The agencies responsible for recovery programs have used congressional funding to balance competing interests and respond to a range of priorities, all under the constraint of a limited total budget. Congressional earmarks for specific species, threats, or conflicts may limit the agencies' discretion and their ability to prioritize recovery efforts.

In the end, certain at-risk taxa have received relatively high levels of attention in the form of specifically directed funding (e.g., western Steller sea lions), while certain other taxa have not received enough attention to prevent or even understand their ongoing decline (e.g., Cook Inlet beluga whales). Absent a more integrated, coherent national system for determining what the funding needs are, setting priorities, and determining how the limited funds should be allocated, the Marine Mammal Commission is concerned that recovery efforts for certain taxa will deteriorate into a patchwork of reactive crises, increasing the risk of extinction for those taxa, inflating the long-term costs required to bring about their recovery, and undermining our nation's goal of maintaining the health and stability of the marine ecosystem.

Therefore, the Marine Mammal Commission concludes that the national strategy for setting endangered marine mammal funding priorities—in an informed manner and cognizant of recovery needs—is not yet sufficiently coherent and consistent. The lack of coherence and consistency creates an obstacle to effective and cost-effective recovery efforts. To address this problem, the Marine Mammal Commission makes a single recommendation to Congress, as follows.

The primary agencies serving on the committee

The Marine Mammal Commission recommends that Congress require the development and implementation of a comprehensive national strategy for determining (a) the annual funding requirements for research, monitoring, and recovery actions for endangered, threatened, and depleted marine mammals, and (b) how those funds should be distributed to ensure that recovery efforts are optimally effective and cost-effective. The strategy should be developed and updated at least annually by a standing committee consisting of representatives from the responsible agencies.

would be those responsible for research and management of endangered, threatened, and depleted marine mammals—the National Marine Fisheries Service, U.S. Geological Survey, Fish and Wildlife Service, and the Marine Mammal Commission. *Ex officio* members of the committee would include the Council on Environmental Quality, the Smithsonian Institution, and the National Academy of Sciences. The Marine Mammal Commission would chair the committee. The strategy should include the following elements:

Funding for recovery: The comprehensive national strategy would include a separate fund for the specific purpose of addressing research and management needs for endangered, threatened, and depleted marine mammals. Funding levels would be determined annually and reported to Congress for its consideration during the budget process.

Prioritizing recovery efforts: The strategy would establish and be based on clear, objective criteria for assessing recovery needs including, among other things, risk of extinction, critical information gaps, expected conservation benefits, competing conservation needs, and related socioeconomic concerns. Prioritization would be based on structured and transparent risk/benefit analysis.

***Monitoring, reporting, and evaluation*:** On an ongoing basis, the types of information sought by the Commission to complete this current report should be readily available for consideration by all interested parties, including Congress, the responsible agencies, and non-governmental stakeholders. To that end, expenditures, activities, and results of the committee would be reported annually in the Marine Mammal Commission's Annual Report to Congress. The purpose of such information is to inform and adapt recovery processes by assessing past effectiveness, adjusting for existing shortcomings, and setting future directions. By measuring progress and identifying successes, problems, and inefficiencies, the strategy would provide a mechanism for holding the relevant agencies, including the Marine Mammal Commission, accountable for marine mammal and marine ecosystem conservation.

Adjusting total budget to needs: As the world's human population grows, the demands placed on ocean resources will increase. So, too, will the threats to many endangered, threatened, and depleted marine mammals and the ecosystems of which they are a part. Consequently, the total budget needs for conservation of endangered, threatened, and depleted taxa will change over time. Costs might decrease if recovery programs are successful and taxa recover. Alternatively, costs might increase if recovery programs are not successful or additional taxa are listed. A risk- and effectiveness-based assessment process will provide an orderly guide for appraisal and adjustment of overall budgetary needs.

The Marine Mammal Commission believes that the activities undertaken to satisfy this single recommendation will lead to more effective and cost-effective implementation of recovery programs within the conservation framework defined in the Marine Mammal Protection Act and the Endangered Species Act. More effective implementation is essential to address growing conservation challenges in a rapidly changing world.

INTRODUCTION

As part of the 2004 Omnibus Appropriations Bill, Congress directed the Marine Mammal Commission to "…review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." This report is the Commission's response to that charge.

The Endangered Species Act of 1973 (16 U.S.C. § 1531 et seq.) and the Marine Mammal Protection Act of 1972 (16 U.S.C. § 1361 et seq.) are the principal legislative instruments in the United States for protecting marine mammals. Together, those statutes affirm a deep national interest in conserving endangered marine mammals and establish a corresponding commitment to promote their survival and recovery.

The findings of the Endangered Species Act include the following (paraphrased from section 2 of the Act):

- Some wild species in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate conservation action;
- Other species have become so depleted in numbers that they are in danger of extinction;
- These species are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation;
- The United States has an international obligation to conserve the various species facing extinction; and
- The development and maintenance of conservation programs, with federal financial assistance and other incentives, is key to meeting the Nation's commitments and safeguarding its heritage of wild species for the benefit of all citizens.

The Endangered Species Act's stated purposes are—

- to provide a means of conserving the ecosystems on which endangered and threatened species depend;
- to provide programs for conserving endangered and threatened species; and
- to take steps for achieving the purposes of the various wildlife treaties and conventions to which the United States is a signatory.

The findings of the Marine Mammal Protection Act include the following (paraphrased from section 2 of the Act):

- Certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of human activities;
- Such species and population stocks should not be permitted to diminish beyond the point at which they cease to be significant functioning elements of the ecosystem, and measures should be taken to "replenish" those that have so diminished;
- Our knowledge of the ecology and population dynamics of marine mammals and of the factors affecting their ability to reproduce is inadequate;
- The protection and conservation of marine mammals and their habitats are necessary to assure the continued availability of economic and other benefits derived from these animals; and
- Marine mammals are of great aesthetic and recreational, as well as economic, significance, and it is the sense of Congress that they should be protected and encouraged to exist at optimum sustainable population levels, keeping in mind the carrying capacity of their habitat.

The primary objective of the Marine Mammal Protection Act is to maintain the health and stability of the marine ecosystem. This objective is to be accomplished, in part, by maintaining marine mammals within their optimum sustainable population range so that they constitute significant functioning elements of the ecosystems of which they are a part.

The citizens of the United States, through their representatives in Congress and the wording of the two statutes, have articulated the importance they place on preserving wild species and, in particular, on maintaining marine mammal populations at levels well above what would place them at risk of extinction. The Commission interpreted the 2004 directive from Congress as a desire

to evaluate how well we as a society and as a nation are satisfying those objectives, particularly with regard to marine mammals. It was in this context that the Marine Mammal Commission prepared this report to advise on whether extant species and populations of marine mammals are viable and whether efforts to protect them (and, by inference, ensure their viability) have been cost-effective.

Response To The Congressional Directive

After consultation with congressional staff, the Commission interpreted the directive to mean that Congress was most interested in endangered marine mammals occurring entirely or regularly in areas under U.S. jurisdiction. Therefore, the Commission focused its analyses on the 22 marine mammal species, subspecies, and populations (referred to generally in this report as "taxa") currently listed as endangered or threatened under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act (Table 1). The Commission also understood that the purpose of the directive was to obtain an assessment of the effectiveness with which funding was being used to implement recovery programs for the most endangered marine mammals, rather than an evaluation and comparison of the full range of possible societal costs associated with those programs.

To guide its response to the congressional directive, the Commission formed a steering committee (Appendix 1), reviewed systems for identifying imperiled species (Lowry et al. 2007; Appendix 2), reviewed the activities and status of protection programs (Weber and Laist 2007; Appendix 3), convened a workshop of experts to review population viability analysis (PVA) (Marine Mammal Commission 2007a, Appendix 4), and, with the National Marine Fisheries Service, convened a case-study review of the cost-effectiveness of the North Atlantic right whale recovery program (Reeves et al. 2007; Appendix 5). With the white papers and workshop reports in hand, the Commission proceeded with the analyses summarized in this report.

Figure 1. The Antillean manatee, one of three subspecies of the West Indian manatee, occurs in waters around Puerto Rico and elsewhere in the Caribbean. (Photograph © Avampini/ V & W /SeaPics.com)

Table 1. Endangered, threatened, and depleted marine mammals in U.S. waters (in approximate order of estimated abundance), and threats to their survival (in no particular order); see Appendices 2 and 3 for more detail.

Taxon	Listing status	Approx. number	Percent of K[a]	Trend last decade	Rec/Cons Plan[b]	Threats (known or considered likely)
Caribbean monk seal (*Monachus tropicalis*)	Endangered	0	0	Extinct	–	–
AT1 killer whale[c] (*Orcinus orca*)	Depleted	7	~40%	Declining	–	Prey availability, pollutants, disturbance from vessel traffic, small population effects
Southern resident killer whale (*Orcinus orca*)	Endangered	90	<60%	Variable	2005 (D)	Prey availability, pollutants, disturbance from vessel traffic including whale-watching, coastal development, small population effects
Eastern North Pacific right whale (*Eubalaena japonica*)	Endangered[d]	<100	<5%	Unknown	1991 (A)	Fishery interactions, vessel strikes, small population effects
Puerto Rico Antillean manatee[e] (*Trichechus inunguis*)	Endangered[d]	150-360	Unknown	Stable	1986 (A)	Fishery interactions, pollutants, vessel strikes, coastal development, small population effects
Cook Inlet beluga whale (*Delphinapterus leucas*)	Depleted	~300	~20%	Declining	2005 (D)	Fishery interactions, pollutants, disturbance, subsistence harvest, coastal development, small population effects
North Atlantic right whale (*Eubalaena glacialis*)	Endangered[d]	~300	<10%	Declining	2005 (A)	Fishery interactions, vessel strikes, small population effects
Hawaiian monk seal (*Monachus shauinslandi*)	Endangered	~1,100	<40%	Declining	2007 (A)	Fishery interactions, prey availability, disease, harmful algal blooms, disturbance, coastal development, climate change, entanglement, shark predation
Southern sea otter (*Enhydra lutris nereis*)	Threatened	~2,800	Unknown	Increasing	2003 (A)	Fishery interactions, disease, harmful algal blooms, pollutants, vessel strikes, coastal development
Blue whale (*Balaenoptera musculus*)	Endangered[d]	>3,000	<10%	Increasing[f]	2006 (D)	None known at the population level
Florida manatee (*Trichechus manatus latirostris*)	Endangered[d]	~3,300	Unknown	Increasing[f]	2001 (A)	Fishery interactions, disease, harmful algal blooms, vessel strikes, coastal development, loss of warm-water refuges, flood gates/navigation locks, habitat degradation
Humpback whale (*Megaptera novaeangliae*)	Endangered[d]	>7,000	Unknown	Increasing[f]	1991 (A)	Fishery interactions, vessel strikes

Guadalupe fur seal (*Arctocephalus townsendi*)	Threatened	~7,500	Unknown	Increasing	–	Fishery interactions
Western Arctic bowhead whale (*Balaena mysticetus*)	Endangered[d]	~10,500	~40%	Increasing	–	Fishery interactions, oil and gas development, noise, vessel strikes, climate change
Fin whale (*Balaenoptera physalus*)	Endangered[d]	>12,000	Unknown	Increasing[f]	2006 (D)	None known at the population level
Sperm whale (*Physeter macrocephalus*)	Endangered[d]	>15,000	Unknown	Unknown	2006 (D)	Noise
Mid-Atlantic coastal bottlenose dolphin (*Tursiops truncatus*)	Depleted	~33,000	Unknown	Unknown	Being developed	Fishery interactions, disease, harmful algal blooms, pollutants, coastal development
Western Steller sea lion (*Eumetopias jubatus*)	Endangered	~38,500	~20%	Stable?	2007 (D)	Fishery interactions, prey availability, killer whale predation
Southwest Alaska sea otter (*Enhydra lutris kenyoni*)	Threatened	~42,000	<20%	Declining	Being developed	Predation by killer whales, disease
Eastern Steller sea lion (*Eumetopias jubatus*)	Threatened	~45,000	Unknown	Increasing	2007 (D)	Fishery interactions, prey availability, killer whale predation
Eastern Pacific fur seal, Pribilof Islands population (*Callorhinus ursinus*)	Depleted	~688,000	~40%	Declining	1993 (A)	Fishery interactions, prey availability, disturbance from coastal (industrial) development
Sei whale (*Balaenoptera borealis*)	Endangered[d]	Unknown	Unknown	Unknown	1998 (D)	None known at the population level

[a] "K" is the environmental carrying capacity, which is defined as the largest population the environment may support over time; carrying capacity may itself vary with natural changes in environmental conditions. In the majority of cases, K is not known with confidence.

[b] "Rec/Cons Plan" indicates whether a recovery or conservation plan has been drafted (D) or adopted (A), and the latest year of such action.

[c] AT1 killer whales comprise a genetically distinct population of killer whales that inhabits coastal water of the Gulf of Alaska principally between Prince William Sound and Cook Inlet.

[d] Status is based on the species as a whole rather than individual populations or other groups below the species level.

[e] The Puerto Rico population is the only part of the Antillean manatee subspecies (part of the West Indian manatee species) occurring in U.S. waters.

[f] At least some populations (or areas) are thought to be changing as stated.

THE MOST ENDANGERED MARINE MAMMALS AND THEIR VIABILITY

The Endangered Species Act defines an "endangered species"[1] as one that is in danger of extinction throughout all or a significant portion of its range. Hence, "risk of extinction" is the ideal variable for evaluating and comparing degrees of endangerment among taxa. For the purpose of this review, we define "biological viability" (or simply "viability") to mean the potential for a taxon to persist far into the future with appropriate management of human-related threats. In general terms, species are often characterized as being either viable or not viable (implying a high or low potential for such persistence). However, a middle ground clearly exists between these two extremes. The transition from viable to not viable has been the subject of extensive research aimed at identifying the "minimum viable population." This term was based on the idea that a declining population would reach a predictable point at which factors driving it toward extinction would dominate and recovery would be impossible or highly unlikely. This approach has given way to a growing body of empirical data illustrating that for any given species the transition from viable to not viable is determined by a variety of factors, both natural and anthropogenic, and the location of the threshold for such transition cannot be readily and reliably predicted.

For many marine mammal taxa, the existing information is not sufficient to judge their viability with a high level of confidence. For practical purposes, however, all marine mammal taxa must fall into one of the following categories:

- *Taxa that are extinct.* These taxa cannot recover. The Caribbean monk seal and Steller sea cow are examples.
- *Taxa that are almost certain to become extinct in the near future*. The persistence of such taxa is improbable and there is little hope that they will continue to persist or can be saved, irrespective of human efforts. The AT1 stock of killer whales appears to fall in this category.
- *Taxa with the potential to persist far into the future but that may require the extra protection and active management provided for threatened or endangered species on an ongoing basis.* The Hawaiian monk seal may be one such species.
- *Taxa with the potential to recover but that require extra protection and active management until they have done so*. Most listed species fall within this category.
- *Taxa that have recovered.* The eastern North Pacific population of gray whales has recovered to the extent that it has been delisted under the Endangered Species Act.
- *Taxa that are not currently at risk of extinction and do not require the special protections or active management afforded by the Endangered Species Act so long as the protections of the Marine Mammal Protection Act are maintained.* Most marine mammals are in this category.

[1] The Act recognizes subspecies and distinct population segments as manageable units under the rubric "species."

The primary distinguishing elements of these categories are a taxon's (1) inherent potential for recovery and persistence, and (2) dependence on human intervention (e.g., policy decisions and management actions) to address threats. These two elements are becoming more entwined as the effects of human activities become more nearly ubiquitous and as the boundary between anthropogenic and natural risk factors becomes less clear (as in the case of climate change). In general, viability analyses incorporate both anthropogenic and natural factors that may influence a population's risk of extinction.

Systems for Identifying Species at Risk of Extinction

Assessments of extinction risk underlie most systems for identifying species and populations in need of additional protection or intervention. With increasing information about species at risk, these systems are becoming more quantitative and objective. In the United States the primary list used for identifying species at risk is the List of Endangered and Threatened Species of Wild Fauna and Flora maintained by the Fish and Wildlife Service under the Endangered Species Act. The most common international list is the Red List of Threatened Species developed by IUCN–The World Conservation Union. The U.S. Marine Mammal Protection Act identifies marine mammal species in need of additional protection based on their ability to function within their ecosystems rather than their risk of extinction. In practice, these species are designated as depleted if they fall below 60 percent of their estimated historic population level (42 *Fed. Reg.* 12010, 42 *Fed. Reg.* 64548). Any species listed as threatened or endangered under the Endangered Species Act is automatically designated as depleted under the Marine Mammal Protection Act.

The Endangered Species Act identifies five factors (16 U.S.C. § 1533(a)(1)) that must be considered during listing decisions:

(1) the present or threatened destruction, modification, or curtailment of a species' habitat or range;
(2) overutilization of the species for commercial, recreational, scientific, or educational purposes;
(3) disease or predation;
(4) inadequacy of existing regulatory mechanisms; and
(5) other natural or manmade factors affecting the species' continued existence.

The IUCN system has been developed over several decades and is applied over a range of geographical scales from global to regional or national. It also uses multiple criteria to indicate extinction risk for various conservation units (i.e., species, subspecies, and geographic populations). Each unit is assessed in a stepwise manner against a set of quantitative criteria or decision rules based on, among other things, reduction in population size, geographic range and area of occupancy, number of mature individuals, population structure, and analytical estimation of extinction probabilities. A species conservation unit that meets one or more of the criteria is assigned to the most protective of those possible categories (e.g., critically endangered, endangered, vulnerable, or near threatened).

Information Needs for Assessing Viability

Whether under the Endangered Species Act or the IUCN system, assessments of extinction risk or viability depend on the availability of key types of information. Initial marine mammal listings under the Endangered Species Act or its predecessors were based on qualitative assessments of limited quantitative data—although in some circumstances very limited data might still be very compelling. For example, listings of large whales (i.e., blue, fin, sei, humpback, right, bowhead and sperm whales) were based on their severe reductions as a result of commercial whaling and concern that existing international management was inadequate to ensure their conservation. Abundance was, and probably still is, the most common single consideration in listing decisions. However, depending on circumstances, other factors also are important determinants of extinction risk for a species. An abundant population may still be at risk if it is experiencing a significant, prolonged decline of undetermined or poorly managed cause(s) or if its habitat is being degraded or will be degraded in the near future, and so on. The Endangered Species Act addresses such circumstances with its all-inclusive listing factor of "other natural or manmade factors affecting the species' continued existence."

A comprehensive assessment of extinction risk (or, conversely, population viability) requires information on the following:

- population structure (e.g., species, subspecies, distinct population segments);
- population dynamics (e.g., numbers of individuals, age and sex structure, rates of reproduction and survival);
- population ecology and health (e.g., habitat, predators and prey, disease, parasites, contaminants)
- factors that apply with special force to small populations (e.g., social dysfunction, inbreeding, and environmental change); and
- current and projected threats (e.g., human-caused mortality, habitat destruction).

***Population Structure*:** Identification of the appropriate conservation unit should be the first step in assessment of extinction risk (Taylor 2005). Most species of marine mammals exist as multiple populations that are discrete from one another to varying degrees and that occupy different parts of the species' overall range (Reeves et al. 2004). Different populations can be subjected to different environmental conditions and to different types and levels of threat. In extreme cases, one or more populations of a single species may be endangered or even extirpated while other populations of that same species are thriving. The contrast between the substantial recovery of the gray whale population in the eastern North Pacific, the continued very low numbers of gray whales in the western North Pacific, and the extinction of the gray whale population in the North Atlantic illustrates the importance of recognizing different populations of the same species and managing them individually.

Important biological and ecological distinctions among populations may be subtle and difficult to discern without up-to-date scientific approaches. A variety of indicators have been studied (e.g., geography, demography, morphology; Dizon et al. 1991) using a variety of techniques (e.g., tagging, telemetry, photo-identification). More recently, genetic studies have dominated this field, revealing differences that often were not discernible using other methods (e.g., Reeves et al. 2004). Such insights are vital to understanding and maintaining the role of marine mammal populations as functioning elements of their ecosystems. Eastern and western Steller sea lions, southwest Alaska sea otters, and southern resident killer whales are three examples where population units below the species level have been explicitly recognized in listing actions under the Endangered Species Act, and where the recognition of such structure is proving essential to conservation (Taylor 2005). Better information on population structure is needed for many other listed marine mammals, as well as for non-listed species that may have population segments that merit listing.

Population Dynamics: For any particular population, determination of status requires information on a suite of parameters, including population size and distribution, vital rates such as reproduction and mortality, and age and sex structure, each of which may vary over time and space. Under the best circumstances, such data are often difficult to collect and may require years or decades of research and monitoring.

Directed research over the past 30 years or more has generated valuable long-term datasets for Florida manatees, Hawaiian monk seals, North Atlantic right whales, bowhead whales, southern sea otters, northern fur seals, Steller sea lions, and southern resident killer whales, all of which are depleted, threatened, or endangered taxa. For many other taxa, including some that are not listed, data on key demographic parameters are sparse, outdated, or entirely lacking (e.g., fin, sei, sperm, and blue whales; see Appendix 2; National Marine Fisheries Service 1998, 2006a, 2006b). Often assessments are based on crude population estimates generated from data collected opportunistically or on default values derived from related, better-studied taxa. Hence, such assessments can involve great uncertainty. Even rudimentary data are lacking for a number of non-listed species (e.g., many beaked whales, many North Pacific cetaceans, ice-associated seals; see Carretta et al. 2007, Angliss and Outlaw 2007). Thus, it is likely that some marine mammal taxa qualify for listing as depleted, threatened, or endangered but are not recognized as such.

Population Health and Ecology: The status of a taxon is influenced by the health and condition of individuals within the population, their biotic interactions with other taxa (e.g., predators, prey, parasites, symbionts, biotoxins), and by the physical and chemical characteristics of their environment (e.g., temperature, salinity, currents, bottom topography, contaminants). The interplay of these factors determines the overall health of a population and, more broadly, creates the ecological structure of the ecosystem in which the taxon exists. Understanding the nature of such structure lies at the heart of the ecosystem approach to conservation and management. Any change in that structure may affect the population or species through a variety of mechanisms and pathways. Population ecology has been characterized qualitatively for many marine mammal species, but quantitative evaluation is an extremely challenging task, generally requiring years of study and multidisciplinary research approaches. Such evaluation, however difficult, can be essential for distinguishing natural trends and variation from changes driven by human activities. This distinction is frequently at the center of controversies involving recovery actions.

Factors Affecting Small Populations: Small populations are susceptible to certain factors ("small-population factors") that elevate their risk of extinction. Such factors are often referred to as "Allee" effects (Allee 1931) and include inbreeding, disruption of social structure, unfavorable environmental conditions, demographic stochasticity (e.g., the chances of skewed sex ratios), and various types of catastrophes (e.g., severe weather, disease). The population size at which vulnerability to these factors becomes significant is difficult to determine and varies by species and circumstances. When these factors begin to feed back on themselves in a manner that hastens a population's decline toward extinction, the population is said to have entered an "extinction vortex" (Gilpin and Soulé 1986), which, although possibly reversible, significantly exacerbates the conservation challenge. The most recent research emphasizes the genetic consequences of small population size as a serious factor contributing to the risk of extinction (O'Grady et al. 2006). Small-population factors are not well characterized for marine mammals, but they should be considered when evaluating degree of endangerment.

Threats: Most, but not all, of the currently endangered, threatened, or depleted marine mammal taxa were reduced as a result of poorly managed or unmanaged commercial exploitation prior to the 1970s. Although considerable steps have been taken over the last few decades to reduce or eliminate such exploitation and some taxa have recovered, not all of them have responded as anticipated (even taking account of the inherently slow growth rates characteristic of marine mammal populations). A variety of risk factors (Table 1) have constrained recovery, including interactions with fisheries, collisions with vessels, entanglement in marine debris, and changes in habitat (e.g., reductions in prey availability, disturbances that disrupt normal feeding or reproductive behavior). It also is possible that the ecosystems in which these taxa occur have switched to alternative states, either naturally or as a result of human activities. A number of threats may affect each of these taxa, either independently or synergistically, and recovery efforts must address their cumulative impact (Reynolds et al. 2005).

Managers are increasingly turning to formal risk assessment to manage threats to marine mammals. Risk assessment requires information on the nature of the threats, cause-and-effect relationships, responsiveness to management efforts, and relative significance of the threats over time. Whereas direct threats (e.g., collisions, entanglement) often can be documented by examining carcasses or wounds, other threats may be more difficult to identify, assess, and mitigate. Investigators frequently must rely on correlations between observed population trends and potential risk factors to indicate which factors might be playing a significant role. For example, depletion of prey resources was regarded as a possible contributing factor in the decline of Hawaiian monk seals in a portion of the Northwestern Hawaiian Islands during the early 1990s and in the decline of the western Steller sea lion population in the 1970s to 1990s. Despite extensive research on both species, the relative importance of potential causes such as overfishing and natural shifts in oceanic regimes (conditions) continues to be debated by experts (National Marine Fisheries Service 2007a,b). Projecting the future effects of such risk factors is even more challenging. Analysis of threats is nevertheless central to any assessment of population viability and is an area where more research, more data, and greater predictive capability are needed.

Integrating Information Using Population Viability Analysis

To date, no simple method has been universally accepted for integrating all relevant information into an analysis of extinction risk. In the Commission's view, the preferred approach would involve quantitative analysis of all relevant species-specific factors pertaining to population structure, population dynamics, ecology, small-population factors, and threats (both current and projected). It would integrate all of the pertinent information, compensate for vital but missing data by using the best available default values, and recognize and explicitly account for uncertainty. It would be applied consistently across taxa, and would be sufficiently general to apply to data-poor species while flexible enough to incorporate new and detailed information as available.

With these requirements in mind, the Commission believes that population viability analysis (PVA) is the preferred framework. Properly conducted, PVA integrates information into a statistical model to estimate a population's risk of extinction over a set period based on known and projected threats. The results are probabilistic, which is appropriate for predictions incorporating uncertainty (like the paradigm of weather prediction). Results indicating a high probability of extinction may reflect an impact by anthropogenic factors rather than the population's intrinsic ability to reproduce and grow. If those factors can be identified and addressed by effective management action, the population's decline could be reversed to allow recovery. Thus, a predicted declining trend may simply underscore a need for management attention rather than an inevitable decline toward extinction. Presentations and discussions at the Commission's PVA workshop (Appendix 4) indicated that significant methodological progress is being made and that PVA is becoming a more widely accepted assessment tool.

Identifying the "Most Endangered" Marine Mammals

Formal quantitative PVAs have been conducted only for a small subset of the 22 marine mammal taxa currently listed as endangered or threatened or designated as depleted: southern resident killer whale, Cook Inlet beluga whale, North Atlantic right whale, Florida manatee, western Steller sea lion, and eastern Steller sea lion (Appendix 4). In the absence of similar analyses for the remaining taxa, the Commission was unable to compare PVA results for all listed species to make a conclusive, quantitatively-based ranking of degrees of endangerment.

Recognizing that limitation, but wishing to be as responsive as possible to the congressional directive, the Commission identified the most endangered marine mammals in U.S. waters based on the collective judgment of its Committee of Scientific Advisors on Marine Mammals. The committee based its judgments primarily on the information summarized in Table 1, including absolute population size, trends, and the degree to which the main threats were being managed effectively. In general, “most endangered” taxa include those that may be characterized according to some combination of (1) least numerous, (2) failing to recover at the expected rate, or (3) not receiving some needed protection or intervention. The Caribbean monk seal was excluded from this list because it is thought to be extinct. As described below, the committee judged the most endangered taxa in U.S. waters, in order of decreasing jeopardy, to be the following:

- AT1 killer whales
- eastern North Pacific right whales
- Cook Inlet beluga whales
- southern resident killer whales
- Puerto Rico population of Antillean manatees
- North Atlantic right whales
- Hawaiian monk seals

AT1 Killer Whales: The AT1 pod of killer whales (Figure 2) inhabits the northern rim of the Gulf of Alaska from Prince William Sound (considered its principal habitat) west to the Kenai Fiords near Cook Inlet. Movement and association patterns, prey selection (they prey on other marine mammals), vocal dialect, and genetics all indicate that AT1 killer whales form a distinct group, and they were recognized as such beginning in 1984 (Leatherwood et al. 1984a, Heise et al. 1992). At that time, the pod consisted of 22 individuals identified on the basis of photographs of distinctive markings, including three juveniles (indicating recent reproduction). All 22 animals were observed regularly between 1984 and 1988 (Matkin et al. 1999a).

In the spring of 1989, spilled oil from the tanker *Exxon Valdez* fouled much of Prince William Sound and spread westward through the AT1 pod’s range. At least 11 members disappeared by 1992 (Matkin et al. 1993, 1994). Another pod of killer whales (AB pod) that was seen swimming through a slick of *Exxon Valdez* oil also lost a large number of members during the first two years after the spill. Although the existing evidence does not prove that the disappearance of the AT1 killer whales was caused by the *Exxon Valdez* spill, it strongly suggests a link. In light of their decline, AT1 killer whales were designated as depleted under the Marine Mammal Protection Act in 2004 (69 *Fed. Reg.* 31322). The most recent count (2006) was seven whales, four of which were females, and the pod has not produced a single surviving calf since 1984 (C. Matkin, North Gulf Oceanic Society, pers. comm.).

In addition to oil spills, known or potential threats include disturbance by whale-watching boats, depletion of prey resources, and interactions with commercial fishing gear. The AT1 group’s recent failure to reproduce could be related to breeding behavior or to a physiological problem caused by oil contamination.

Given the very small population size, the lack of reproduction for the past two decades, and the fact that only four older females remain in the group, a formal model is not needed to demonstrate that the chance of the AT1 group persisting over the long term is very small. The pod likely will disappear as the remaining animals die. Accordingly, the Marine Mammal Commission concludes that AT1 killer whales probably are not biologically viable. This conclusion does not mean that further monitoring and protection are unjustified. Studies of this group of whales could provide rare insights into extinction processes. For example, continued monitoring could help answer such questions as whether remaining animals merge with another regional pod of killer whales, or whether other pods begin to exploit the prey resources formerly targeted by the AT1 whales.

Figure 2. AT1 killer whale photographed in Prince William Sound, Alaska. (Photograph courtesy of Craig Matkin, North Gulf Oceanic Society)

North Pacific Right Whale: The North Pacific right whale (Figure 3) was severely depleted by commercial whaling in the mid to late 1800s. The species appears to consist of a western population off Asia and an eastern population off North America. The western population, distributed primarily in coastal waters off Japan and Russia, is poorly studied but may number in the hundreds. The eastern population historically inhabited the Gulf of Alaska and southeastern Bering Sea; it may number fewer than 50 animals.

In the early to mid-1900s eastern North Pacific right whales were observed occasionally in the Gulf of Alaska and southeastern Bering Sea. In the early 1960s illegal whaling by the Soviet Union apparently removed more than 350 right whales in the eastern North Pacific (Yablokov 1995), curtailing any recovery that may have been occurring at the time. From the 1960s to 1996, right whales were sighted infrequently in the region between Mexico, Hawaii, and Alaska. In the summer of 1996, four right whales were seen in the southeastern Bering Sea (Goddard and Rugh 1998). Almost every summer since then, surveys by the National Marine Fisheries Service have documented at least a few animals in that area. In the summer of 2004 a satellite tag placed on one animal led researchers to an area north of the Alaska Peninsula where an estimated 23 right whales were seen, including three mother-calf pairs (Wade et al. 2006). The latter constitute the first definite evidence of calving in nearly a century. Photo-identification records and biopsy samples collected between 1996 and the end of 2004 provide evidence of at least 23 individuals, including 7 females (Richard LeDuc, Southwest Fisheries Science Center, pers. comm.).

Clearly, the status of North Pacific right whales, particularly the eastern population, is precarious. The locations of calving grounds and migration routes remain unknown, as do the risks to whales in different parts of their range. Given what is known about North Atlantic right whales, vessel collisions and entanglement in fishing gear likely pose risks wherever North Pacific right whales overlap in time and space with ship traffic or particular kinds of fishing gear (e.g., gillnets and traps or pots with connecting and/or vertical lines). Risk factors associated

Figure 3. North Pacific right whales sighted and tagged in the Bering Sea in August 2004. (Photograph by John Durban, National Marine Mammal Laboratory, and courtesy of National Marine Fisheries Service)

with small populations are highly relevant, particularly for the eastern population: the male-biased sex ratio of individuals in the eastern population over the last decade could reflect demographic stochasticity (i.e., more male offspring may have been born by chance) or differential survival (females may be more susceptible than males to a particular risk factor).

The viability of North Pacific right whales has not been analyzed formally. If, as seems plausible, the 23 individuals identified to date account for a large proportion of the remaining population in the eastern North Pacific, a formal PVA would not alter the obvious conclusion that this population is at a very high risk of extinction. The mother-calf pairs observed in 2004 indicate that the population is still reproductively active and therefore likely to be viable with a potential for recovery if given proper protection. Because of the naturally low reproductive rate of right whales, recovery necessarily will be a long, slow process.

Cook Inlet Beluga Whales: Beluga whales (Figure 4) occur in a number of populations throughout the Arctic and sub-Arctic. Evidence indicates that the population in Cook Inlet, Alaska, has been genetically and demographically isolated for thousands of years (O'Corry-Crowe et al. 1997). An aerial survey suggested an abundance of about 1,300 beluga whales in Cook Inlet in 1979 (Calkins 1989). Their abundance prior to that is not known, although they were a familiar sight to people in the Anchorage area until recently.

Systematic annual surveys began in 1993. Results indicate a population decline of at least 50 percent by the late 1990s, and the decline appears to have continued to the present. The 2006 estimate was 302, suggesting a decline of more than 75 percent in slightly over 25 years. The decline in numbers has been accompanied by a change in distribution and the whales are now confined mainly to coastal and estuarine areas of the inlet's shallow upper reaches (National Marine Fisheries Service 2005, Rugh et al. 2000, 2005; Speckman and Piatt 2000).

Although subsistence hunting for Cook Inlet beluga whales by Alaska Natives has occurred for centuries, the rate of removals increased sharply in the mid to late 1990s, causing or contributing to a rapid decline in the population. In 1999 Congress enacted a moratorium on hunting and in 2000 the National Marine Fisheries Service designated the population as depleted under the Marine Mammal Protection Act (65 *Fed. Reg.* 34590–34597). From 2000 to 2006, only five whales were taken legally. In spite of the reduction in removals, the population has not recovered as expected and other factors are now thought to be suppressing population growth. These may include fishery interactions, contaminants and noise associated with oil and gas exploration and production, vessel traffic, waste disposal, and urban runoff. Although scientists have assessed population abundance and trends since 1993, they have obtained few data pertaining to the life history of these animals, their ecology, or the above risk factors.

The Cook Inlet beluga whale population became a candidate for listing under the Endangered Species Act in 1991. After lengthy deliberation, including a status review in 1998 and two petitions to list the population as endangered in 1999, the National Marine Fisheries Service decided against listing. The Service's rationale was that subsistence hunting was being addressed through new regulations under co-management agreements, and no other factor had been identified as having a significant adverse effect on the population. IUCN–The World Conservation Union listed the Cook Inlet beluga population as "critically endangered" in 2006 (Lowry et al. 2006). In April 2007 the National Marine Fisheries Service responded to a petition from the Center for Biological Diversity by proposing to list the Cook Inlet beluga whale population as endangered (72 *Fed. Reg.* 19854–19862), but the actual decision is still pending.

If conditions prevailing in 2006 persist, the probability of further decline of this population is about 80 percent even with no removals by hunting (D. Goodman, Montana State University, pers. comm.). Analyses to date make clear that this population is in serious trouble and needs vigorous protection. In particular, research and management efforts are needed to investigate and address factors other than hunting that may be impeding recovery. If those factors are identified and addressed, the population should be able to recover.

Figure 4. Five stocks of beluga whales are recognized in U.S. waters, the most isolated being the Cook Inlet stock, which is separated from the other four stocks by the Alaska Peninsula. (Photograph © Elena Yatsenko www.dreamstime.com)

Southern Resident Killer Whales: Southern resident (fish-eating) killer whales (Figure 5) are a distinct group of whales that range from California to British Columbia but are found primarily in Puget Sound and coastal waters of southern British Columbia. The population consists of three relatively independent pods of related animals. Individuals in all three pods have been monitored annually since 1974, providing detailed records of population size and trends, survival, reproduction, and age and sex composition. Foraging, movements, and behavior patterns also have been studied.

Abundance prior to the late 1800s may have exceeded 200 animals, based on carrying capacity estimates and genetic evidence (Krahn et al. 2002). Since the 1960s the population has never numbered more than about 100 whales. Between 1962 and 1971, 55 whales were removed alive for public display, and at least a few others died during captures. By 1971 the population was estimated to number only 61 whales, and public concerns led to a prohibition on captures in U.S. waters beginning in 1976 and in British Columbia beginning in 1981. By 1995, the number of southern resident killer whales had increased to 98 whales, but it then declined again to a low of 81 in 2001. By 2006 the number had increased to 90 (National Marine Fisheries Service 2006c).

In 2001 the Center for Biological Diversity and 10 other conservation groups petitioned the National Marine Fisheries Service to list the southern resident killer whale population as endangered. The population was designated as depleted under the Marine Mammal Protection Act in 2003 and listed as endangered under the Endangered Species Act in 2005 after a lawsuit forced the issue. A PVA conducted as part of the listing process (Krahn et al. 2002, Krahn et al. 2004) considered a range of realistic scenarios involving small-population factors (e.g., catastrophes and both demographic and environmental variation), changes in carrying capacity, and density dependence. Depending on whether survival and reproductive rates were estimated from the preceding 29-year history or the most recent 10 years—which may better reflect ongoing threats—estimated extinction risks ranged from negligible to as high as 68 to 94 percent over the next 300 years.

Figure 5. A southern resident killer whale (K22) and her calf (K41) photographed in September 2006. As is the case for many marine mammal offspring, K41 did not survive its first winter. (Photograph courtesy of Ken Balcomb, Center for Whale Research)

The suggested risk factors for southern resident killer whales include high levels of contaminants, local or regional declines in available prey (particularly chinook salmon), and stress from vessel noise and the nearly constant attention of whale-watching boats (National Marine Fisheries Service 2006c). These human-related threats may be exacerbated by the fact that the population also is vulnerable to small-population effects. The end result is that southern resident killer whales face a serious risk of extinction that could easily become more severe because much of their summer habitat is surrounded by several large metropolitan areas with expanding coastal development. Addressing the major risk factors for these whales will require creative, aggressive, steadfast management; continued monitoring; and carefully directed research carried out cooperatively by the United States and Canada. If such management and research can be implemented effectively, the Commission believes this population is viable.

Puerto Rico population of Antillean Manatees: The Antillean manatee (Figure 6), a subspecies of the West Indian manatee, occurs in waters around the Greater Antilles and in coastal waters and rivers along the Caribbean coast of Central and South America from Mexico to Brazil. The only population of this subspecies living in U.S. territories occurs in waters around Puerto Rico. Most animals in this population rely principally on sea grass beds and coastal habitat on the eastern, western, and south-central coasts of the island and around Vieques Island about 17 miles east of Puerto Rico. The population was estimated at 150 to 360 animals in 2005 (Mignucci-Giannoni 2005). Given the limited number of past surveys and differences in the methods used, current population trends are uncertain (U.S. Fish and Wildlife Service 2007). Since the mid-1970s at least 156 manatee deaths have been reported for this population, with about one-third each attributed to anthropogenic, natural, and unknown causes (Mignucci-Giannoni et al. 2000, Mignucci-Giannoni 2006). Manatees have been killed for food throughout the Greater Antilles since before the time of Columbus (Powell et al. 1981). Although hunting in Puerto Rico has been prohibited for decades, poaching was the principal source of known human-related manatee deaths as recently as the 1980s. Since 1995, however, no hunting-related deaths have been reported, and boat strikes now appear to be the largest source of human-related manatee deaths. The first boat-related death was reported in 1981 and, between 1990 and 2005, at least 30 Puerto Rico manatees died from boat strikes (17 percent of all reported deaths in that period; Mignucci-Giannoni 2006). Entanglement in gillnets also has been a source of mortality, although the number of such deaths has declined. Other threats include coastal development, which can affect the sea grasses that manatees eat and the freshwater they drink, and periodic hurricanes that expose shallow nearshore waters to high waves and storm surges. Elsewhere in the wider Caribbean, manatees have high body burdens of some organic contaminants.

The observation of numerous calves in the 2005 survey (Mignucci-Giannoni 2005) indicates that these animals are reproducing well, but it remains to be seen if the birth rate is high enough to offset the mortality rate. If human-related threats can be managed effectively and the population does not suffer too much from the effects of catastrophic events (e.g., hurricanes) or other small-population factors, it should be viable with a potential for recovery.

Figure 6.
The Antillean manatee, a subspecies of the West Indian manatee, is nearly identical to the Florida subspecies and is mainly distinguishable by its range, less robust body, and slight but measurable cranial differences. (Photograph © Wayne Johnson www.dreamstime.com)

North Atlantic Right Whale: Historically, North Atlantic right whales (Figure 7) inhabited North Atlantic waters off both Europe and North America. Relentless commercial whaling from the 11th century through the 1920s all but eliminated the population off Europe. By the early 1900s, the

North American population had been reduced to a few hundred whales. Females accompanied by calves migrate annually from winter calving grounds off the southeastern United States to feeding grounds off New England and southeastern Canada. Adult males and females use the same summer feeding grounds, but the areas where most adult males and females without calves spend the winter are still unknown. Total abundance is uncertain, with a recent best estimate of about 300 (Kraus et al. 2001).

Collisions with ships and entanglement in fishing gear, principally lines from lobster traps and gillnets, are the major threats. Collisions accounted for 22 and entanglements for 6 of the 50 documented deaths between 1990 and 2006 (Waring et al. 2007, Marine Mammal Commission 2007b). These are minimum numbers because some carcasses are not detected and the cause of death cannot always be determined for those that are. Some animals observed entangled disappear and are not found again, dead or alive.

Figure 7: North Atlantic right whales photographed off North Carolina on 17 November 2007. (Photograph courtesy of the University of North Carolina/ Wilmington Marine Mammal Program)

Western North Atlantic right whales are relatively well studied. Annual research efforts began in the 1980s and have expanded steadily since then. Abundance, trends, and demographic parameters such as reproduction, survival, and age/sex distribution are estimated from individual sighting histories based on photographic or genetic matching. Reproduction also has been documented through annual calf counts in the winter calving grounds and the known summer nursery/feeding areas. Since 1993, the number of observed calves has varied from a low of 1 in 2000 to a high of 31 in 2001 (Waring et al. 2007).

This population may be experiencing the effects of small-population factors. Compared to several populations of the southern right whale, North Atlantic right whales have less genetic diversity and a longer average calving interval (Best et al. 2001, Kraus et al. 2001). These characteristics could be related to inbreeding, although longer calving intervals also may reflect environmental factors affecting food quality or availability and, hence, body condition and physiology. Periods of low reproduction, such as between 1998 and 2000 when only 11 births were reported (Waring et al. 2007), may indicate vulnerability to stochastic environmental factors such as oceanic or climatic variability.

A PVA using data from 1980 through 1998 indicated that North Atlantic right whales are not likely to go extinct within the next 100 years because of their long life span (possibly exceeding 100 years) (Fujiwara and Caswell 2001). The analysis indicated that their numbers may have been increasing at about 2.5 percent per year in the early 1980s, but the situation had changed by the late 1990s when the population was probably either stationary or declining slowly. If those trends continue in the future, extinction probabilities increase from about 20 percent in the next 200 years to 100 percent in the next 500 years. The most important factor influencing this trend is the survival of reproductively active females. Importantly, the analysis suggested that reducing the number of deaths of reproductive females by just two per year could be sufficient to arrest the decline. Since 1990, 17 of the 28 right whale deaths attributed to vessel collisions and entanglements were females, and 11 of those were known to be adults.

The Commission concludes that the North Atlantic right whale population is viable, but that reducing collision and entanglement-related deaths is necessary for recovery. Recovery will take a long time (probably more than 100 years of effective protection), but the potential for recovery has not been lost.

Hawaiian Monk Seal: Hawaiian monk seals (Figure 8) occur in six relatively discrete breeding subpopulations in the Northwestern Hawaiian Islands (NWHI) and a growing but small subpopulation scattered throughout the main Hawaiian Islands. Hunting by early Polynesian settlers likely extirpated the species from the main Hawaiian Islands 2,000 years ago, and sporadic hunting during the 1800s by commercial sealers, feather hunters, and ship-wrecked sailors seeking food severely reduced the number of remaining monk seals in the outlying, uninhabited NWHI (Gilmartin et al. 1983, Ragen 1999).

In the late 1800s and early 1900s visitors to some of the islands failed to sight a single seal (Rothschild 1893, Schauinslandi 1899, Wilder 1905, Dill and Bryan 1912).

The NWHI subpopulations recovered to a considerable extent by the 1950s, when the first range-wide counts were made (Kenyon 1972). From then through the 1980s, the number of monk seals in the NWHI declined, due in part to disturbance by Navy and Coast Guard personnel stationed on some breeding islands and atolls (Gilmartin et al. 1983). As the Navy and Coast Guard reduced the level of disturbance, seal numbers at some sites began to increase slowly. However, beginning in the early 1990s a sharp decline in the largest subpopulation, located at French Frigate Shoals, has more than offset the increases at other locations (Antonelis et al. 2006). Possible causes of this decline include competition from an unsustainable episode of commercial lobster fishing, natural oceanic cycles, climate change, competition for prey, shark predation, entanglement in derelict fishing gear, or some combination of those and other factors (Craig and Ragen 1999, Antonelis et al. 2006). Since the 1950s the total monk seal population has declined by more than 60 percent, with only about 1,100 animals now surviving in the wild.

Since the early 1980s researchers have tagged and observed almost every individual seal in the NWHI during seasonal field camps or visits to breeding sites. Key demographic parameters (e.g., age/sex composition, survival rates, trends in abundance, and reproduction rates) are known with a high degree of precision. Foraging behavior also has been well studied. No single subpopulation presently contains more than about 250 animals, and some subpopulations already may be experiencing small-population effects. At Laysan and Lisianski Islands, sex ratios skewed toward males likely reflect a chance occurrence of more male births or lower survival of females. Male aggression toward pups and females in those subpopulations may be aberrant behavior not typical of larger groups.

Because of persistently low juvenile survival, the age structure of the population is now distorted by a paucity of older juvenile and young adult animals. As a result, the number of Hawaiian monk seals will decline further before it can increase. The recent proclamation by President Bush of the NWHI as the Papahanaumokuakea Marine National Monument should provide a mechanism for minimizing or preventing many of the types of disturbance that have affected this species for the past two centuries. Nonetheless, it faces serious challenges that must be addressed to promote recovery. In the immediate future, management efforts are needed to reduce juvenile mortality caused by starvation, shark predation, and entanglement in marine debris, and to promote co-existence with humans in the main Hawaiian Islands (NMFS 2007a). Full recovery is a distant prospect at present, but the species is thought to have occupied the Hawaiian archipelago for 12 to15 million years (Repenning et al. 1979, Fyler et al. 2005) and likely has experienced a range of environmental conditions and periods of population reduction in the past. With dedicated and persistent management efforts, such recovery can reasonably be expected in the future.

Past Extinctions and Recoveries

A review of past extinctions and recoveries provides a useful perspective on the viability of highly endangered marine mammals. Many marine mammal populations have been severely reduced by human actions, and a few have become extinct.

Figure 8.
Hawaiian monk seal at a NWHI coral reef. (Photograph by James P. McVey, courtesy of NOAA Photo Library)

Northern (Steller's) sea cows inhabited kelp-forested coastlines of the Bering Sea until the second half of the 18th century. Encountered by Russian explorers in 1741, they were exterminated 27 years later by commercial seal and sea otter hunters who killed them for food (Stejneger 1887, Domning 1978). The last confirmed sighting of a Caribbean (West Indian) monk seal was in 1952 (Rice 1973). The species was probably extinct by the 1960s or 1970s, a victim of hunting, disturbance, and habitat destruction. The Japanese sea lion (some authorities consider it to have been a subspecies related to the California sea lion rather than a full species) apparently suffered a similar fate, although very little is known about its population history. Once present in many parts of the Sea of Japan, the last credible report of a Japanese sea lion was in 1951 (Rice 1998). As mentioned earlier, the North Atlantic population of gray whales apparently vanished sometime in the 18th or early 19th century (Mead and Mitchell 1984). Whaling was almost certainly a contributing, if not the decisive, factor in its demise. Most recently a two-month survey of the Yangtze River failed to sight a single baiji, or Yangtze River dolphin (Guo 2006). Surveys since the 1990s had individually sighted less than a score of these dolphins. The species, the sole representative of the family Lipotidae, may well be extinct.

Some other marine mammal species that were brought close to extinction have recovered partially, and a few have experienced nearly complete recovery. In almost all of these instances, protection from commercial exploitation was essential to allow recovery. Many populations of fur seals, elephant seals, manatees, sea otters, and baleen whales were exploited to a point where hunting them was no longer profitable and their survival was in doubt. In a few cases (e.g., Guadalupe fur seals, Juan Fernandez fur seals, northern elephant seals, southern sea otters), numbers were so low that the species or population was considered extinct, only to make a dramatic resurgence after rediscovery of remnant populations and the implementation of protective measures (e.g., Bartholomew 1950).

Terrestrial mammals and other taxonomic groups provide similar examples (Table 2). Such reversals demonstrate the resilience and adaptability of many wild species and underscore the importance of avoiding premature declarations of non-viability. At the same time, many of the examples involve terrestrial mammals and birds that were reduced to a few tens of animals and required intensive intervention in the form of captive breeding, translocations, or "headstart" programs. Such efforts do not appear to be feasible for many of the largest marine mammals, and it is therefore especially important to reduce potential sources of mortality and other factors that may impede recovery before marine mammal populations reach critically low levels.

The evolutionary history of marine mammal species indicates that they have had lengthy persistence times (hundreds of thousands to millions of years; Repenning 1976, Fordyce 2002) and therefore low natural extinction rates. Within recorded history, no marine mammal species or population is known to have gone extinct as a result of natural processes alone.

Table 2. Examples of wild populations that have rebounded or are recovering after being reduced to extremely low population sizes (Marine Mammal Commission 2007a)

Species, stock, or population	Estimate of minimum population size (approximate date)	Estimate of current wild population size	Source(s) of information
Marine mammals			
Northern elephant seal (*Mirounga angustirostris*)	20–100 (1890)	>175,000	Bartholomew and Hubbs 1960, Stewart et al. 1994
Southern sea otter (*Enhydra lutris nereis*)	50 (1938)	>2,500	Riedman and Estes 1990
Guadalupe fur seal [a] (*Arctocephalus townsendi*)	70–75 (1955)	>27,500	Hubbs 1956, Gallo 1994
Southern right whale (*Eubalaena australis*)	<300 (1920)	>7,500	Baker and Clapham 2004
Juan Fernandez fur seal (*Arctocephalus philippii*)	700–750 (1970)	>12,000	Hubbs and Norris 1971, United Nations Environment Programme [b]
Terrestrial mammals			
Black-footed ferret (*Mustela nigripes*)	18 (1987)	650	Black-footed ferret recovery team [c]
Tule elk (*Cervus elaphus nannodes*)	28 (1895)	3,200	McCullough et al. 1996, National Park Service 1998
Przewalski horse (*Equus ferus przewalskii*)	31 (1945)	175	Wakefield et al. 2003
European bison (*Bison bonasus*)	54 (1918)	1,700	Pucek 2004
Golden lion tamarin (*Leontopithecus rosalia*)	<200 (1970s)	1,500	Smithsonian National Zoological Park [d]
Birds			
Mauritius kestrel (*Falco punctatus*)	4 (1974)	800–1,000	Birdlife International [e]
Chatham island black robin (*Petroica traversi*)	5 – one breeding pair (1979)	250	New Zealand Department of Conservation 2001 [f]
Whooping crane (*Grus americana*)	21 (1944)	>300	Canadian Wildlife Service and U.S. Fish and Wildlife Service 2005
California condor (*Gymnogyps californianus)*	25–35 (1979)	127	California Department of Fish and Game [g]
Seychelles warbler (*Acrocephalus sechellensis*)	50 (1965)	>2,000	Birdlife International
Guam rail (*Gallirallus owstoni*)	100 (1983)	400	Smithsonian National Zoological Park [h]

[a] Considered extinct in the 1930s and early 1940s
[b] http://www.unep-wcmc.org/species/data/species_sheets/juanfern.htm
[c] http://www.blackfootedferret.org
[d] http://nationalzoo.si.edu/ConservationAndScience/EndangeredSpecies/GLTProgram/default.cfm
[e] http://www.birdlife.org/datazone/index.html
[f] http://www.doc.govt.nz/templates/podcover.aspx?id=32911
[g] http://www.dfg.ca.gov/wi`ldlife/species/t_e_spp/condor
[h] http://nationalzoo.si.edu/Support/AdoptSpecies/AnimalInfo/Guamrail/default.cfm

COST-EFFECTIVENESS OF PROTECTION PROGRAMS

The second part of Congress' directive was to make recommendations regarding the cost-effectiveness of current protection programs. Assessing cost-effectiveness requires determining both effectiveness and cost.

Effectiveness Of Protection Programs

Effectiveness is best determined on the basis of reduction in risk of extinction for taxa and degree of recovery to a more viable status. Conceptually, the simplest measures of effectiveness are (a) the number of species or populations prevented from going extinct in the wild, and (b) the number showing clear evidence of improved status. No marine mammal taxon in U.S. waters has gone extinct since passage of the Endangered Species Act and Marine Mammal Protection Act[2], and while that time frame (about 35 years) is too short for this to be a conclusive indicator of effectiveness[3], the fact certainly is encouraging.

Effectiveness also is difficult to judge by reference solely to population trends. Over the past decade, 8 of the 21 extant taxa considered in this review increased, 6 declined, 2 appeared to be stable, 1 could be considered to have been variable, and the trends of 4 are unknown. Although the proportion of listed species with stable or increasing populations may be greater now than in the 1970s when the two Acts were passed, lack of information on abundance and trends for many taxa precludes a comprehensive and reliable comparison. Furthermore, this kind of comparison is based on status "before and after," whereas the real question requires a "treatment/control" comparison; that is, how many of these population trends over the past few decades are better than they would have been in the absence of protection measures under the Endangered Species Act and the Marine Mammal Protection Act.

Coarse criteria for measuring effectiveness may be misleading as diagnostic tools because protection programs generally address multiple threats (Table 1) using a variety of measures, some of which may be more effective than others. Thus, the overall trend of a given taxon may mask certain threat-specific accomplishments or shortcomings.

For these reasons, comprehensive evaluation of "effectiveness" is difficult, particularly given current data limitations. At present, we can evaluate in a reasonably systematic way some of the components of effectiveness—the degree to which certain classes of threats have been identified and reduced or mitigated.

Recovery and Conservation Planning: Recovery plans created under the Endangered Species Act and conservation plans created under the Marine Mammal Protection Act are intended to identify threats, the research needed to evaluate them, and the management measures necessary to reduce or mitigate them (see Appendix 3 for a detailed review of existing plans and activities conducted under them). Such plans have been initiated, drafted, or adopted for 18 of the 22 taxa listed as endangered, threatened, or depleted (Table 1). The 16 that have been fully drafted or adopted provide generally thorough reviews of threats based on information available at the time they were prepared, which may have been many years ago. Although the threats identified in the various plans are often similar (e.g., entanglement, ship collision, contaminants, disturbance, and habitat loss or degradation), each taxon faces a different combination of the spectrum of anthropogenic and natural risk factors. Furthermore, the proximate causes of various threats and management of their effects can be very specific to each taxon because of its unique geographic distribution and ecology. Thus, with a few major exceptions (e.g., commercial whaling and disentanglement of large whales), research and management efforts cannot be treated as generic across taxa.

[2] The Caribbean monk seal likely was extinct before those Acts were passed, so they were almost certainly too late to contribute to its rescue. The species was listed under the Endangered Species Act largely as a precautionary gesture with the hope that some animals still survived and could be given protection.

[3] Some marine mammals live more than 100 years, as illustrated by the discovery of a harpoon head from the late 1800s in a bowhead whale killed for subsistence purposes in June 2007 (http://www.adn.com/news/alaska/wildlife /story/8972512p-8888238c.html).

Of the 16 drafted and adopted plans, 8 are at least 10 years old, are becoming substantively outdated, and are not consistent with the most recent procedural standards. The older plans identify broad, generic goals (e.g., downlisting and delisting) and objectives (e.g., minimizing causes of mortality and injury, protecting habitat, and monitoring population status and trends). Some older plans also identify administrative objectives, such as providing certain levels of staff support, coordinating activities of involved parties, and updating planning documents. The nine plans adopted or drafted since 2000 have similar broad goals and objectives but also include "objective and measurable criteria" for delisting, as required by 1994 amendments to the Endangered Species Act. In most cases, the criteria involve either population viability analyses to calculate extinction probabilities or target population growth rates to be achieved over specified lengths of time. Except in a few cases, progress toward meeting those criteria has not been formally analyzed. For the remaining taxa without a recovery or conservation plan (disregarding the Caribbean monk seal), broad goals may be apparent to managers, but more specific objectives and actions should be articulated to allow assessment of progress. Completion of initial plans would significantly improve the basis for evaluating the effectiveness of protection programs.

Although recovery and conservation plans are important to guide recovery efforts, they are useful only insofar as they are followed. All too often the necessary actions either are not taken or are not implemented effectively. Under such conditions, the plans may establish a standard against which program implementation can be judged, but they do not contribute effectively to recovery unless shortcomings in implementation are recognized and addressed.

Research: To address threats and promote recovery, protection programs for marine mammals involve two essential parts—research, which includes monitoring, and management, which includes enforcement. Researchers identify, collect, analyze, and interpret information needed to assess population status and threats and to formulate and evaluate protection and mitigation measures and population responses to those measures. Information needs for evaluating status and guiding recovery actions are largely the same as those required to determine viability or risk of extinction, as described previously (i.e., population structure, population dynamics, population ecology and health, small-population factors, and threats). The degree to which those information needs are met constitutes a first-level measure of recovery program effectiveness. The availability of information necessary for scientific assessment and management action varies greatly for listed marine mammals (Appendices 2 and 3). Recovery and conservation plans explicitly recognize such information needs, but in some cases almost none of the requisite research has been conducted, often due to funding constraints. In other cases, research has been attempted but results have been inconclusive because of small sample sizes, difficulty working in remote areas on hard-to-study animals, difficulty distinguishing the effects of different risk factors from one another, inappropriately directed or conducted research, or a variety of other complicating factors. Many protection programs have critical data gaps of some kind. A recent analysis by Taylor et al. (2007) indicates that, given the current level of effort devoted to stock assessments in the United States, precipitous declines (defined as declines in abundance of at least 50 percent over 15 years) could not be detected for 72 percent of large whale stocks, 90 percent of beaked whales, 78 percent of dolphins and porpoises, 5 percent of pinnipeds that haul out on land, and 100 percent of pinnipeds that haul out on sea ice.

Management: Managers translate research findings into policies and measures that, ideally, address threats in a manner that is consistent with existing law and sound conservation principles and that reflect current scientific understanding of the animals and their ecosystems. With some notable exceptions (e.g., captive breeding, relocation, habitat restoration), management actions for marine mammals generally focus on control or modification of human activities to achieve conservation objectives. Enforcement and compliance often are inadequate and efficacy uncertain. Thus, marine mammal protection programs often follow an informed trial-and-error approach where plans for recovery actions are adopted based on expert opinion and then modified over time based on perceptions of population response (e.g., trends in mortality or rate of increase). Studies to evaluate compliance with management requirements, or their effectiveness, are notably scarce.

Major Threats to Endangered, Threatened, or Depleted Marine Mammals: In 2003 the Marine Mammal Commission held an international meeting to identify future directions for marine mammal research (Reeves and Ragen 2004, Reynolds et al. 2005). The meeting, convened at the request of Congress, was organized around threats to marine mammals and sought to identify key directions for research to understand and address them. The following paragraphs summarize the efficacy of recovery programs in addressing those threats as they pertain to endangered, threatened, or depleted marine mammals in U.S. waters. Appendix 6 provides examples of varying degrees of effectiveness and cost-effectiveness in addressing threats to endangered, threatened, and depleted marine mammals.

Direct Interactions with Fisheries: Overall, the number of marine mammals killed annually incidental to fisheries in U.S. waters has been reduced significantly in recent years (Read et al. 2006). However, the record of efforts to reduce this mortality (often called "bycatch") of the endangered, threatened, and depleted taxa identified in this report has been mixed. Since the development and expansion of North Pacific and Bering Sea fisheries in the 1970s and 1980s, bycatch from the western stock of Steller sea lions has been reduced from hundreds or thousands of animals annually to only a few dozen (about 10 percent of its potential biological removal level[4]) in recent years (Angliss and Outlaw 2007). Bycatch of southern sea otters also has been reduced significantly through nearshore area closures of gillnet fisheries imposed by the state of California. Evidence that Hawaiian monk seals were being taken by an expanding pelagic longline fishery in the North Pacific led quickly to the establishment of a Protected Species Zone around the Northwestern Hawaiian Islands.

In contrast, large whales—particularly those that occur in nearshore waters—continue to become entangled in gillnets and in fishing line associated with pot fisheries. Entanglement is one of the two major problems affecting North Atlantic right whales that spend much of their lives off the East Coast of the United States (see later in this report). Entanglement in marine debris—primarily lost or discarded fishing gear—also is a persistent problem for Hawaiian monk seals (Henderson 2001) and northern fur seals (Fowler 1987). Despite some modest management efforts aimed at reducing entanglement injury to and deaths of individuals of these three taxa, the evidence suggests that entanglement remains a serious risk factor. To date, much of the effort to address entanglement has focused on gear modifications (right whales; see page 35), disentanglement (monk seals, northern fur seals, right whales), and removal of potentially entangling debris from nearshore habitats (monk seals and fur seals). Large amounts of actively fishing gear remain in the water, portions of that gear are lost or discarded, and the risk of entanglement from that lost or discarded gear does not appear to have abated.

Indirect Fisheries Interactions and Prey Availability: Competition with fisheries has reduced the prey available to a number of the marine mammals discussed in this report. The Magnuson-Stevens Fishery Conservation and Management Act defines optimum yield as the maximum sustainable yield less whatever is appropriate to account for economic, social, or ecological factors. However, insufficient effort has been made to operationalize that definition, and efforts to manage competition and other ecological effects of fishing have not been effective. Furthermore, research efforts to quantitatively document the extent of prey reduction and determine its impact have achieved little success in most of the cases where this issue has been investigated (see Plaganyi and Butterworth 2005 for a review). The designs of those studies merit reexamination. In some cases, fishery exclusion zones have been established to protect endangered marine mammals from reduction in prey, as well as to reduce bycatch and disturbance. Nonetheless, reduced availability of prey is likely to remain a risk factor for a number of endangered, threatened, or depleted species, including southern resident killer whales, Hawaiian monk seals, western Steller sea lions, southern sea otters, and Cook Inlet beluga whales.

Disease: Disease is a natural risk to all wild species (Gulland and Hall 2005). Exposure to a novel disease is a particular concern for small populations that occur only in relatively small geographic areas (e.g., Cook Inlet beluga whales) because such exposure may compromise a high proportion of the individuals in the affected population. The risks of exposure may increase initially if range expansion brings individuals into contact with new disease vectors (e.g., monk seals reoccupying the main Hawaiian Islands, where they are exposed to the diseases of domestic, feral, and wild species with which those individuals have not had previous contact) or if disease vectors (including other marine mammal species) extend their range (e.g., as a result of climate change). Human population growth and concentration in coastal areas are contributing to the spread of some diseases that may affect marine mammals. For example, sea otters off southern California have contracted toxoplasmosis from cat feces in sewage released into the marine environment (Miller et al. 2002). Similarly, some otters have been exposed to new parasites in areas where their prey (e.g.,

[4] The Marine Mammal Protection Act defines the potential biological removal level as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population" (16 U.S.C. § 1362 (3)(20)).

abalone, urchins) have been depleted by fisheries. To the extent that human-generated contaminants reduce immune system function in marine mammals, they can be considered to increase the likelihood of disease, albeit indirectly. Virtually all recovery efforts related to disease in marine mammals so far have been aimed at diagnosis or, in a few situations, quarantine rather than treatment or prevention. Possible immunization strategies have been considered but not yet pursued.

Harmful Algal Blooms: Over the past several decades harmful algal blooms have expanded from relatively uncommon and geographically isolated events to regular, seasonal occurrences that pose risks to a wide variety of marine organisms, including birds, fish, and marine mammals (Van Dolah 2000, 2005). Those risks can arise through a variety of ecological mechanisms, including direct ingestion by marine mammals that feed low on the food chain (e.g., large whales, Bargu et al. 2002), predation on contaminated fish (e.g., coastal bottlenose dolphins, Van Dolah 2005), and consumption of toxins accumulated on sea grasses (e.g., manatees, Flewelling et al. 2004) or in invertebrates (e.g., southern Alaska sea otters, Kvitek et al. 1991). A range of toxins may be involved, including saxitoxins off the northeast coast, brevetoxins off the Florida coast, and domoic acid off the West Coast. Harmful algal blooms have increased in frequency and become an added source of mortality that, again, poses a particular risk to small populations in restricted geographic areas. Most efforts to date have focused on diagnosis rather than treatment. Treatment may be an option in a few cases (e.g., Florida manatees). However, for most marine mammals, the only effective, and cost-effective, solution is to reduce the probability of such events by addressing the factors that cause them.

Contaminants: Thousands of manmade chemicals are finding their way into marine ecosystems (O’Hara and O’Shea 2005, Caroli et al. 1996). Such contaminants often are distributed widely by atmospheric and ocean currents, such as recently observed with polybrominated diphenyl ethers (PBDEs), compounds used in flame retardants and found in the tissues of wildlife around the globe (e.g., in the Antarctic, Corsolini et al. 2006). Even the herbivorous sirenians may accumulate contaminants at levels observed to cause adverse effects in other species (Ross et al. 1995). The primary concern is that contaminants impair reproductive or immune systems or cause cancers. Only a fraction of these chemicals are likely to pose actual risks, but exceedingly few are tested for their potential biological effects. AT1 killer whales (Ylitalo et al. 2001), southern resident killer whales (Krahn et al. 2002), Cook Inlet beluga whales (Becker et al. 2000), southern sea otters (Bacon et al. 1999, Nakata et al. 1998), bottlenose dolphins (Nakata et al. 2002), and northern fur seals (Krahn et al. 1997) are at elevated risk of adverse health or reproductive effects from contaminant exposure or bioaccumulation. Although many studies have investigated contaminant levels in marine mammals, few have examined their biological consequences (O’Shea 1999, O’Hara and O’Shea 2005). Wild marine mammals that have accumulated high levels of contaminants cannot be treated practically, and the only actions that can be taken to address this problem involve limiting exposure (e.g., preventing contaminant release into the environment, clean-up).

Sound: A variety of human activities introduce sound into the marine environment, including commercial shipping and other vessel traffic (e.g., fishing, military, recreational, whale-watching), seismic studies (particularly, but not exclusively, related to oil and gas development), sonar systems (e.g., military, fishing), and coastal development (e.g., blasting, dredging, pile driving) (Hildebrand 2005, Marine Mammal Commission 2007c). At least in some areas, sound background levels are doubling each decade (National Research Council 2003, McDonald et al. 2006). Introduced sound may have a variety of effects on marine mammals, including masking important natural sounds to which the animals need to respond, behavioral disturbance (e.g., leading to abandonment of habitat), injury (e.g., temporary and permanent loss of hearing), and death (potentially through direct trauma or secondarily through adverse behavioral response such as stranding; Anonymous 2001, Cox et al. 2006). Marine mammals in or near major ports, shipping lanes, oil and gas operations, or areas of coastal development are at elevated risk. Endangered, threatened, or depleted marine mammal taxa at risk in U.S. waters include southern resident killer whales in Puget Sound, bowhead whales and North Pacific right whales near oil and gas operations, North Atlantic right whales near major shipping ports and recreational areas, and Cook Inlet beluga whales near various construction and oil and gas operations. Efforts to monitor and assess the potential effects of sound sources have been largely ineffective, and in its 2006 report to Congress on anthropogenic sound, the Marine Mammal Commission emphasized the need for improvement in such efforts.

Vessel Strikes: Large whales that occur in or near major ports or shipping lanes and smaller marine mammals in nearshore waters are vulnerable to collisions with vessels of all sizes. A survey of vessel strikes involving large whales indicates that they are more likely to occur as vessel speeds increase above 10 knots (Laist et al. 2001, Vanderaan and Taggart 2006). Vessel strikes account for the largest proportion of observed human-caused deaths of North Atlantic right whales (Waring et al. 2007). To date, few measures have been implemented to protect large whales from vessel strikes (but see Johnson 2004 for an example of rerouting in Canadian waters). The National Marine Fisheries Service has proposed new measures to reduce or prevent such strikes, but the measures have not yet been approved for implementation. They include spatial and temporal routing measures and speed limits. The anticipated doubling of commercial shipping in the first three decades of this century (Department of Transportation 1999) gives special urgency to the need for effective implementation.

Boat strikes are the leading human cause of mortality of manatees in waters around Florida and Puerto Rico (U.S. Fish and Wildlife Service 2001). A number of measures have been proposed and implemented in the 13 Florida counties where manatees occur and are struck most often, but the overall effectiveness of those measures has yet to be determined (Laist and Shaw 2006). At least in Florida, the number of manatees killed annually has risen steadily over the past decades. The trend may reflect an increased number of manatees (and therefore more animals at risk), an increased amount of boating activity (about one million recreational boats are registered in Florida[5]), an increase in the risk of collision per boat or manatee, or some combination of those. Vessel strikes also are known to kill southern sea otters (Estes et al. 2003), and may begin to pose a risk to bowhead whales in the Arctic as vessel traffic increases with climate change and sea ice reduction.

Commercial Exploitation and Subsistence Hunting: Management measures under the Fur Seal Treaty, the International Convention for the Regulation of Whaling, and the Marine Mammal Protection Act have limited or prohibited intentional killing of marine mammals, thereby preventing severe depletion or even extinction of many populations and allowing at least partial recovery. Of the 21 extant marine mammals in U.S. waters listed as endangered, threatened, or depleted, none is currently exploited for commercial purposes. Five are subject to ongoing subsistence hunting: western Arctic bowhead whales, eastern and western stocks of Steller sea lions, southwest Alaska sea otters, and eastern Pacific fur seals. Cook Inlet beluga whales were hunted aggressively until the late 1990s and were so depleted that hunting has essentially been halted until clear signs of recovery are observed. Subsistence hunting of all five of those taxa is now co-managed by the National Marine Fisheries Service and Alaska Native organizations under agreements developed pursuant to section 119 of the Marine Mammal Protection Act. The hunt for bowhead whales is an example of highly effective co-management.

Coastal Development: More than half of the U.S. human population resides in coastal regions comprising less than one-fifth of the nation's land area (U.S. Census Bureau 2007). Projections indicate that the U.S. population will increase by about 115 to 120 million between now and 2050 (U.S. Census Bureau 2004), with at least half of that growth expected in coastal regions (Pew Oceans Commission 2003). Such development leads to loss of natural habitat, increased frequency and intensity of human interactions with marine mammals, and more exposure to pollution, noise, disease, and vessel traffic. Because they occur in nearshore waters, a number of endangered, threatened, and depleted taxa (including six of the seven identified as most endangered in this report) are vulnerable to the effects of further coastal urbanization, growth, and development. These include AT1 killer whales in Prince William Sound, southern resident killer whales in Puget Sound, manatees in Puerto Rico and Florida waters, beluga whales in Cook Inlet, North Atlantic right whales off the eastern U.S. coast, southern sea otters in California waters, Hawaiian monk seals in the main Hawaiian Islands, coastal bottlenose dolphins off the mid-Atlantic coast, and even eastern Pacific fur seals on the Pribilof Islands. The responsible agencies have managed the conflicts between human activities and marine mammal populations with mixed results (Appendix 3). Often the shortcoming is simply due to lack of resources to implement and enforce needed actions or the will to take those actions. It seems clear that human population growth with all its accompanying secondary effects cannot go on indefinitely without severe consequences for nearshore ecosystems.

Climate Variability and Change: Whether and how the endangered, threatened, and depleted taxa considered in this report will be affected by climate variability and climate change is uncertain (Tynan and DeMaster 1997, Laidre et al. in press, Moore and Huntington in press), although the potential long-term effects are cause for great concern. Arctic species are already being affected by the loss of sea ice and subsequent ecosystem changes (Stirling and Parkinson 2006, Ferguson et al. 2005), as well as by the increase in and diversification of human

[5] Florida Department of Highway Safety and Motor Vehicles (http://www.hsmv.state.fl.us/html/revrpts.html).

activities in the region. Bowhead whales undoubtedly will be affected by habitat changes (although the consequences of those effects may be positive or negative) as well as by increased shipping, fishing, etc. (Laidre et al. in press) that will follow the reduction in ice. The habitat of other taxa, such as Florida manatees and Hawaiian monk seals, will be affected by rising sea levels (Baker et al. 2006, Walton 2007, Titus and Richman 2001) and more frequent and intense storms. Perhaps the most severe effects of climate change will be experienced not by taxa that are now listed, but by others destined to become endangered, threatened, or depleted as a consequences of sea ice reduction, sea level rise, and the many other ecological and human-related changes that will occur (e.g., polar bears[6] and ice-associated seals). Short of prevention, we know of no effective means for addressing the physical consequences of climate change and the associated ecological transformations (Ragen et al. in press).

Cumulative Effects: Status of most marine mammals is determined by the combined influence of the threats discussed here, together with natural ecological factors. Effects may be additive for threats that are more or less independent of each other or synergistic for threats that interact. The impacts and significance of various risk factors vary, as does the degree to which they are amenable to management. Individually insignificant threats may be cumulatively significant, and addressing them either individually or collectively requires comprehensive research and management programs. Effective management of oil and gas operations off the North Slope of Alaska, for example, must take into account not only the effects of any single operation but also the effects of their combined activities and other risk factors in the region.

To be effective, conservation and management programs must ensure that populations are able to sustain long-term positive growth until they reach a healthy status and then maintain that status in the face of risk factors operating at that time. As a general rule, research and management programs that proactively address individual risk factors are preferable because they allow protective measures to be tailored to a specific set of circumstances, and such options are more likely to minimize unnecessary restraints on human activities (Reynolds et al. 2005). However, such an approach also requires funding for data collection and a predictive capability that exceeds current budgets for many of the taxa considered in this report.

[6] Polar bears are currently being considered for listing under the Endangered Species Act largely because of the effects of diminished sea ice due to global warming.

Analysis of cumulative effects is required by the National Environmental Policy Act and the Endangered Species Act. In practice, these analyses often have been poorly structured and limited by insufficient data. As a result, they provide little confidence that the total impacts of the various risk factors are being effectively considered and addressed. The ability of scientists and managers to understand and address cumulative impacts is vital to the conservation of marine mammals and ecosystems (National Research Council 2003). To that end, the Marine Mammal Commission will soon seek to engage related research and management agencies in an effort to develop practical and rigorous guidance for analyzing cumulative effects.

Efforts to promote the recovery of endangered, threatened, and depleted marine mammals by stopping or sharply curtailing intentional removals by hunting have been generally effective. In contrast, efforts to address problems of incidental (non-deliberate) removals, ecological disturbance, the introduction of contaminants or anthropogenic sound into the marine environment, or large-scale loss or degradation of habitat (e.g., climate change) have achieved less, sometimes because of simple failure to implement needed interventions and sometimes for lack of critical information. An information-driven approach to conservation is needed to minimize overprotection. To date, the information available to managers has varied widely by taxa and in some cases has been far from adequate to guide conservation efforts, particularly when addressing cumulative impacts.

Costs of Protection Programs

The following were used as the primary sources of information regarding funding for marine mammal protection programs (Appendix 3):

- annual administrative reports required by the Marine Mammal Protection Act and prepared by the National Marine Fisheries Service, Fish and Wildlife Service, and Marine Mammal Commission;
- National Marine Fisheries Service budget documents;
- congressional Appropriations Committee reports;
- annual surveys of federally funded marine mammal research conducted by the Marine Mammal Commission; and
- annual reports of federal and state expenditures on listed endangered and threatened species required by the Endangered Species Act and prepared by the Fish and Wildlife Service.

The first three sources rarely contain details on funding for individual protection programs and their accounting format and completeness vary yearly. For example, agency budget documents and Appropriations Committee reports might specify funding levels for certain protection programs or program components one year but lump them under broad categories the next. As a result, those sources were of limited use for determining how much was spent on particular protection programs or tasks in any one year or documenting trends over years. The Marine Mammal Commission's surveys were useful for assessing research expenditures but contained little information on management expenditures. Furthermore, much of the information in the Commission's reports is aggregated by agency or subject category, making it difficult or impossible to assign all reported expenditures to protection programs for individual taxa.

The most useful source of information on federal and state expenditures for listed endangered and threatened species is the series of reports compiled annually by the Fish and Wildlife Service pursuant to section 18 of the Endangered Species Act. Those reports contain funding data on recovery efforts by agency and listed taxon. Although they have become more detailed and complete over the years, those reports still lack some of the key information needed for this review. First, they do not provide information on expenditures for marine mammal taxa that are designated as depleted under the Marine Mammal Protection Act but are not listed under the Endangered Species Act. Second, they reflect annual and agency-based differences in accounting methods. Third, the specific activities undertaken with the reported funding are not described. Finally, because compiling and organizing the data takes time, reporting of program expenditures is delayed for several years. Therefore, the most recent data available for this review is from FY2004.

Despite such limitations, the available data reveal important patterns in funding for protection programs (Appendix 3):

- Between 1998 and 2004, total federal and state annual expenditures for the taxa considered in this report rose from $8.6 million in 1998 to $85.5 million in 2003 (Table 3 and Figure 9). Although data for fiscal years after 2004 were not available, congressional and agency budget documents indicate that funding for recovery work on endangered and threatened marine mammals has declined significantly since then.
- Annual expenditures are unevenly distributed, with marked differences in funding among taxa. In 2003, the year of peak funding for marine mammal protection programs, 89 percent of all funding was allocated to just four taxa: western Steller sea lions ($49.5 million); eastern Steller sea lions ($5.3 million); North Atlantic right whales ($11.7 million); and Florida manatees ($9.7 million).
- Most of the remaining funds were spent on three other taxa: Hawaiian monk seals ($2.1 million), humpback whales ($1.6 million), and southern sea otters ($1.4 million).
- In contrast, approximate funding for the first five of the seven taxa described in this report as most endangered—AT1 killer whales (less than $100,000), eastern population of North Pacific right whales ($100,00–$200,000), Cook Inlet beluga whales ($150,000), southern resident killer whales ($580,000), and Puerto Rico population of Antillean manatees ($50,000–$100,000)— totaled less than $1.2 million, or about 1.4 percent of the total expenditure, in 2003.
- The wide range and uneven distribution of funds for listed taxa suggests that available resources are distributed more on the basis of potential disruption of human activities rather than the actual recovery needs or the degree of endangerment of the species involved.
- Almost all of the reported funding for marine mammal protection programs was administered through four federal agencies: the National Marine Fisheries Service, the Fish and Wildlife Service, the U.S. Geological Survey, and the Coast Guard (Figure 10). Except for the Florida manatee program, which receives most of its funding from the state of Florida, state contributions to protection programs for listed taxa have been relatively small.

During the 1990s the annual number of persons assigned to research and administrative activities for all marine mammals (including non-listed taxa) by the National Marine Fisheries Service and the Fish and Wildlife Service (plus the U.S. Geological Survey after 1997) averaged about 167 and 49, respectively (Waring 2001). These are measured in terms of FTEs, or fulltime-equivalent positions, for permanent and contract staff. Staff time devoted to individual taxa was not reported. In FY2005 the National Marine Fisheries Service allocated at least 108.5 FTEs for work on the 18 listed marine mammal taxa under its jurisdiction (Table 3). The Fish and Wildlife Service and U.S. Geological Survey assigned about 17 FTEs each to recovery efforts for the four marine mammal taxa under their jurisdiction (Appendix 3).

Table 3. Approximate combined federal and state expenditures (in $ thousands) for endangered, threatened, and depleted taxa, FY1998–2004. State contributions, if any, to those totals are shown in parenthesis. Limited data are available for taxa designated as depleted only and for taxa only recently listed as threatened or endangered.

	Taxon	FY98	FY99	FY00	FY01	FY02	FY03	FY04
Most Endangered Taxa	Caribbean monk seal	10	0	0	8	0	0	0
	AT1 killer whale	<100	<100	<100	<100	<100	<100	<100
	Southern resident killer whale	–	–	–	–	–	580	1,098
	Eastern North Pacific right whale	100–200	100–200	100–200	100–200	100–200	100–200	100–200
	Puerto Rico Antillean manatee	25	35	50–100	50–100	50–100	50–100	50–100
	Cook Inlet beluga whale	150	150	150	150	150	150	150
	North Atlantic right whale	1,310 (1)	3,123 (290)	4,722 (127)	5,886 (145)	8,243 (280)	11,652 (123)	12,220 (504)
	Hawaiian monk seal	1,156	1,105 (0.4)	1,267 (14)	2,121 (14)	2,197 (14)	2,145 (15)	2,321
Southern sea otter		495	615 (156)	624 (35)	1,094 (35)	1,066 (35)	1,376 (40)	734 (20)
Blue whale		4 (1)	125	6	1	8	203	67 (2)
Florida manatee		1,540 (13)	4,316 (1,945)	9,668 (5,923)	9,298 (5,936)	8,496 (5,929)	9,724 (5,969)	9,787 (5,945)
Humpback whale		361 (41)	492 (8)	567 (11)	740 (11)	890 (11)	1,615 (18)	666 (7)
Guadalupe fur seal		0	2	2	0	0	0	0 (1)
Western Arctic bowhead whale		1 (1)	(3)	3 (3)	25 (25)	7	204	190
Fin whale		5 (1)	13 (0.3)	5 (1)	24 (2)	13 (1)	206 (1)	72 (3)
Sperm whale		5 (1)	7	3	27	1	203	2,270 (2)
Mid-Atlantic coastal bottlenose dolphin		–	–	–	748	2,000	1,987	3,950
Western Steller sea lion		3,079 (19)	7,234 (8)	13,1313 (6)	46,783 (2,338)[a]	55,998 (2,496)[a]	49,514 (1,200)	31,746 (1,200)
Southwest Alaska sea otter		–	–	–	20	68	745	939
Eastern Steller sea lion[b]		–	–	–	–	–	5,297 (1,203)	10,811 (1,203)
Eastern Pacific fur seal		180	603	1,957	–	–	–	–
Sei whale		5 (1)	4	4	12	1	203	66
APPROXIMATE TOTALS [c]		**$8,626 (79)**	**$18,124 (2,411)**	**$32,491 (6,120)**	**$67,337 (8,506)**	**$79,538 (8,766)**	**$86,204 (8,569)**	**$77,487 (8,887)**

[a] These funds were included in Fish and Wildlife Service reports as coming from the state but were, in fact, routed to the state through the National Marine Fisheries Service.

[b] Expenditures for FY1998–2002 are included under Western Steller sea lion (above).

[c] Where a range is given, total is based on an upper limit of that range.

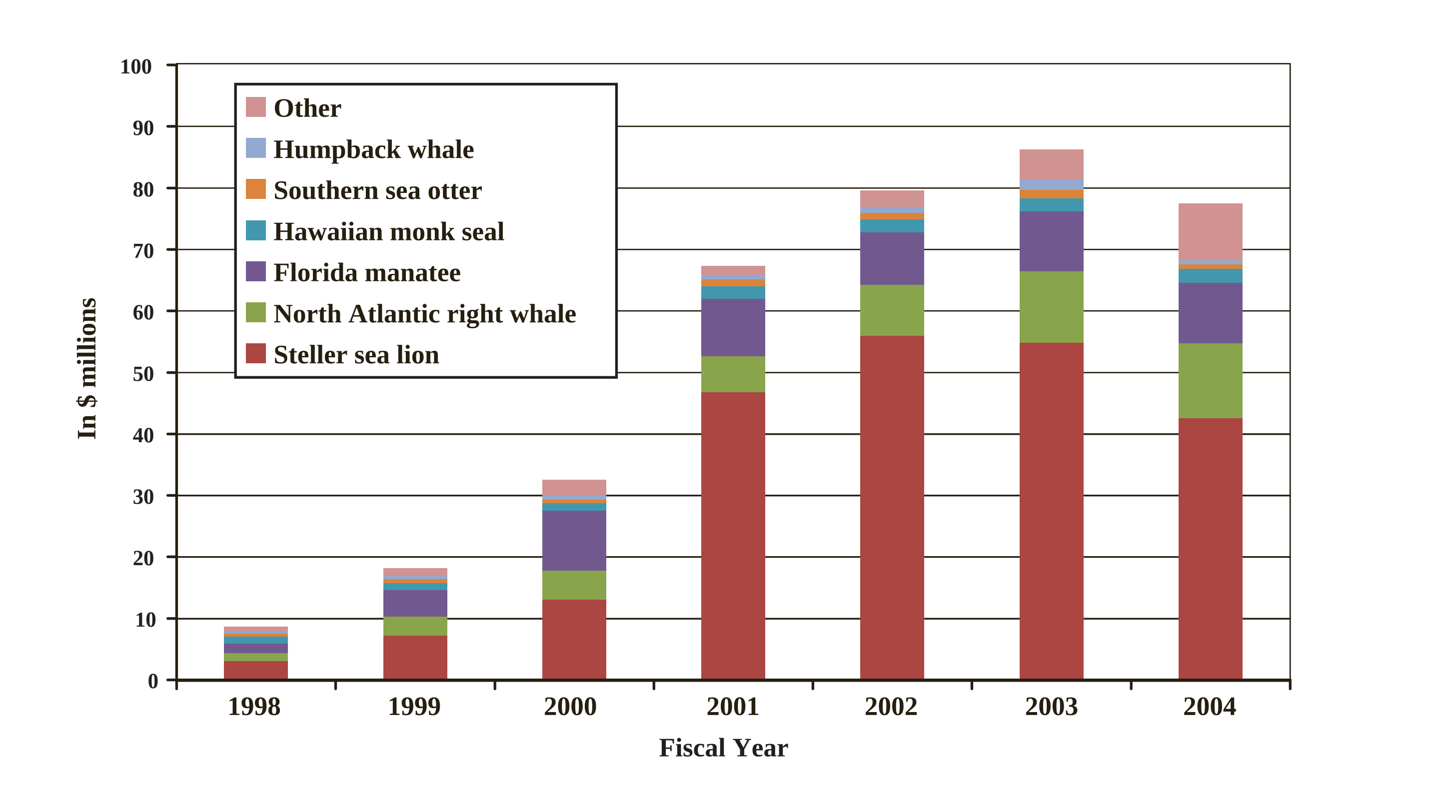

Figure 9. Combined annual federal and state expenditures (in $ millions) for taxa listed as endangered, threatened, or depleted, FY1998–2004.

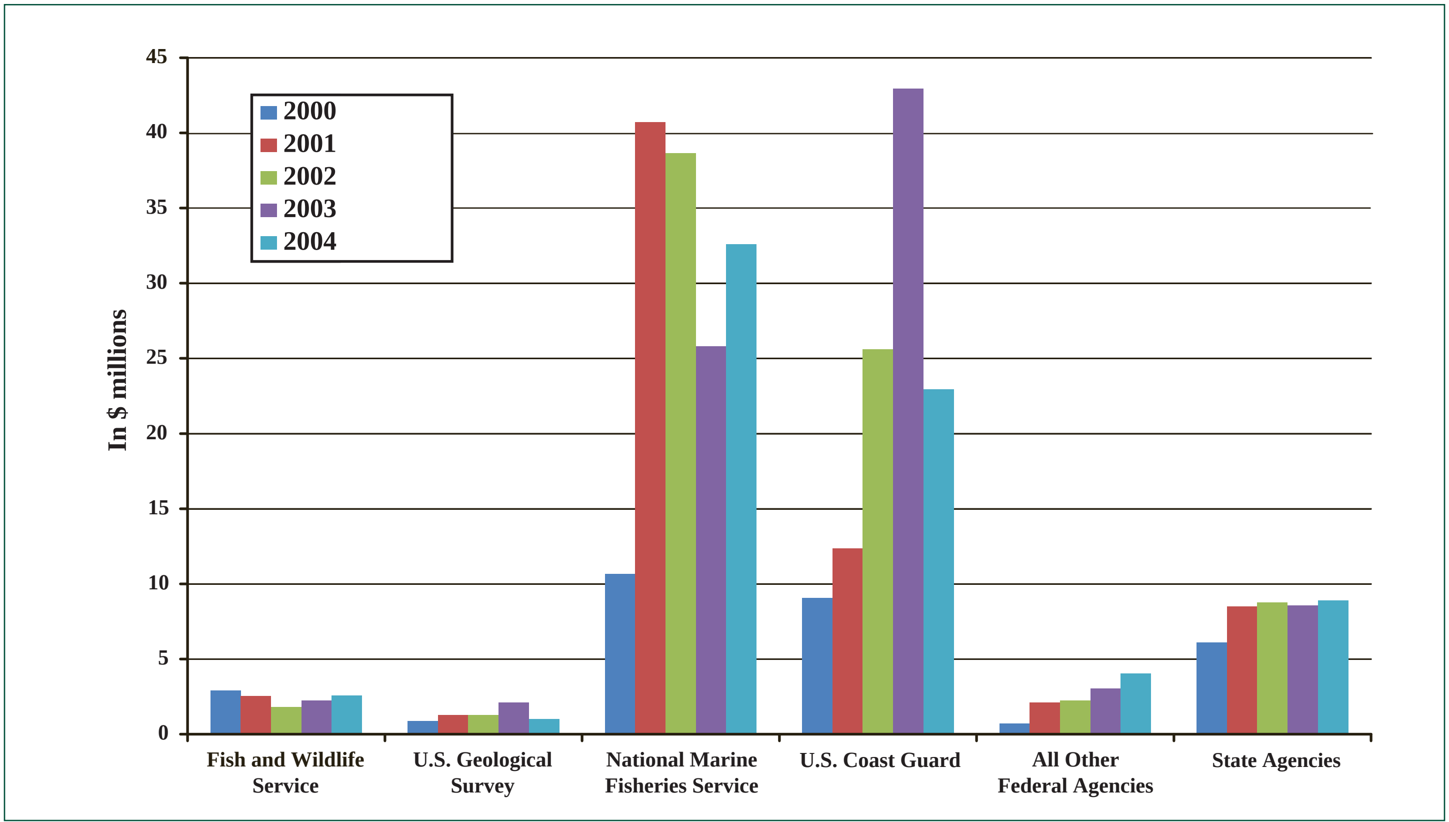

Figure 10. Expenditures (in $ millions) for taxa listed as endangered or threatened, by agency and by year, FY2000–2004.

Table 4. Estimated number of fulltime-equivalent staff positions (FTEs) devoted to protection programs for endangered, threatened, or depleted marine mammal taxa by the National Marine Fisheries Service, the Fish and Wildlife Service, and the U.S. Geological Survey in FY2005.

	Taxon	National Marine Fisheries Service		Fish and Wildlife Service	U.S. Geological Survey	Total
		Regional Offices and Headquarters	Science Centers			
Most Endangered Taxa	Caribbean monk seal	0	0	–	–	0
Most Endangered Taxa	AT1 killer whale	0.2	0	–	–	0.2
Most Endangered Taxa	Southern resident killer whale	2.1	4.4	–	–	6.5
Most Endangered Taxa	Eastern North Pacific right whale	0.6	2.8			3.4
Most Endangered Taxa	Puerto Rico Antillean manatee	–	–	1.0	0.8	1.8
Most Endangered Taxa	Cook Inlet beluga whale	2.3	0.5	–	–	2.8
Most Endangered Taxa	North Atlantic right whale	16.0	13.2	–	–	29.2
Most Endangered Taxa	Hawaiian monk seal	1.2	21.0	–	–	22.2
	Southern sea otter	–	–	2.0	1.5	3.5
	Blue whale	0.4	1.0	–	–	1.4
	Florida manatee	–	–	11.3	13.4	24.7
	Humpback whale	1.8	3.3	–	–	5.1
	Guadalupe fur seal	0	0.2	–	–	0.2
	Western Arctic bowhead whale	1.9	0	–	–	1.9
	Fin whale	0.6	0	–	–	0.6
	Sperm whale	0.5	1.2	–	–	1.7
	Mid-Atlantic coastal bottlenose dolphin	2.1	13.8	–	–	15.9
	Western Steller sea lion	1.1	13.3	–	–	14.4
	Southwest Alaska sea otter	–	–	2.5	1.5	4.0
	Eastern Steller sea lion	1.1	0	–	–	1.1
	Eastern Pacific fur seal	1.7	0	–	–	1.7
	Sei whale	0	0.2	–	–	0.2
	TOTAL FTEs	**33.6**	**74.9**	**16.8**	**17.2**	**142.5**

CASE STUDY: COST-EFFECTIVENESS OF THE NORTH ATLANTIC RIGHT WHALE PROTECTION PROGRAM

The Commission selected the North Atlantic right whale as a case study to examine cost-effectiveness of an entire protection program. We chose this species because it is highly endangered, Congress has allocated a relatively large amount of funding to its recovery, and the National Marine Fisheries Service recently adopted an updated recovery plan and is engaged in ongoing efforts to reduce vessel/whale collisions and entanglement of whales in commercial fishing gear.

To review this program the Commission appointed a five-person panel consisting of four current members and one former member of the Commission's Committee of Scientific Advisors on Marine Mammals, all familiar with the right whale recovery program. The panel conducted its review in cooperation with the National Marine Fisheries Service and other agencies and groups involved in implementing recovery activities. The review took place on 13–17 March 2006 in Woods Hole, Massachusetts, and focused on the status, costs, and results of all major research and management activities set forth in the North Atlantic right whale recovery plan and carried out during FY2003–2005. The panel summarized its findings regarding the cost-effectiveness of research and management components of the recovery program in a report to the Commission (Reeves et al. 2007, Appendix 5). The following summarizes the results of that review and presents the Commission's conclusions based on the panel's report.

Costs of the North Atlantic Right Whale Recovery Program

During FY2003 to 2005, the National Marine Fisheries Service and about a dozen other agencies and organizations spent combined annual totals of $13.1 million, $16.6 million, and $15.6 million for North Atlantic right whale recovery efforts (Table 5). Cost estimates for major components of the protection program (Table 6) generally corresponded well with priorities identified in the recovery plan. The cost estimates reported here may be inflated somewhat in instances where the same assets were used to meet multiple recovery objectives, making it difficult to apportion costs among tasks. For example, aerial surveys are used to alert mariners to whale locations, detect entangled whales, trigger fishery management zones in areas of whale concentrations, collect right whale sighting data, and obtain photographs for individual identification of animals.

Cost-effectiveness of Research

Overall funding for research in support of the North Atlantic Right Whale Recovery Program was about $4.2 million in FY2003, $5.7 million in FY2004, and $5.5 million in FY2005 (Table 6). The research program can be separated into six broad subject areas: distribution, abundance and trends, mortality, health and reproduction, habitat, and genetics. All six areas depend heavily on an identification catalogue maintained by the New England Aquarium. The catalogue archives information on individual life histories from photographic records and genetic samples. Catalogue data are used to investigate reproduction, survival, population abundance and trends, movement and habitat use patterns, and interactions with fishing gear and ships. All six areas of research require ongoing logistical and personnel support as well as periodic supplemental funds to purchase new equipment, upgrade operating systems, and carry out special analyses.

A variety of research activities are needed to support recovery efforts for the North Atlantic right whale, as illustrated in Table 6. These activities are generally aimed at the subject areas discussed earlier in this report: population dynamics, population health and ecology, factors affecting small populations, and threats. The utility of research cannot always be judged in advance, and the challenge for managers is to integrate research results in such a way as to identify the most effective and cost-effective recovery measures. The panel made the following recommendations to enhance the research program and, therefore, provide a stronger basis for effective and cost-effective management efforts:

- *The National Marine Fisheries Service should provide a one-time funding supplement to enhance the utility of the central identification catalogue and*

Table 5. Estimated agency and organization expenditures on western North Atlantic right whale recovery and protection work, FY2003–FY2005

Source	FY 03	FY 04	FY 05
Federal Agencies	$12,619,228	$16,107,899	$14,516,409
National Marine Fisheries Service	10,127,897	12,821,559	12,307,725
National Ocean Service (Marine Sanctuaries)	67,000	66,900	124,300
Navy	165,267	218,427	399,216
Coast Guard	789,466	1,964,658	1,063,533
Army Corps of Engineers	147,000	180,000	191,000
National Science Foundation	–	359,206	237,682
National Fish and Wildlife Foundation	1,322,598	497,149	192,953
State Agencies	$102,600	$72,800	$134,542
Florida	76,000	72,800	73,250
Massachusetts	21,600	0	61,292
Rhode Island	5,000	0	0
Nongovernmental Organizations	$379,678	$454,227	$907,926
International Fund for Animal Welfare	140,000	104,000	257,418
New England Aquarium	98,075	85,431	312,404
Provincetown Center for Coastal Studies	62,500	112,500	92,500
Woods Hole Oceanographic Institution/Ocean Life Institute	54,103	127,296	220,604
Whale Center of New England	25,000	25,000	25,000
Total All Sources	**$13,101,506**	**$16,634,926**	**$15,558,877**

sightings database by upgrading data storage and integrating a backlog of genetic and photographic records. These databases are central to research and monitoring efforts. They provide individual records of the animals in the population, their relationships, the times and locations where they were observed, and their behavior and condition. Such information is vital to assessing both the size and distribution of the population. To use that information most effectively, the catalogue and database should be updated and maintained.

- *The program should review distribution data to assess whether and how critical habitat designations should be changed to ensure that all appropriate areas have been identified and adequately protected.* Management strategies to mitigate entanglement and ship collisions focus on areas where right whales occur most frequently. Aerial surveys have revealed that some areas of predictably high use by right whales are not included in critical habitat and, on that basis, are omitted from area-specific management measures. To ensure effectiveness and cost-effectiveness of management measures, they must be implemented in the areas where right whales occur.

- *The program should assess population size and trend on an ongoing basis.* Managers, stakeholders, and the public should know whether the right whale population is increasing, decreasing, or stable. Such information is necessary to determine whether particular measures are effective and cost-effective.

- *The program should review funding support for stranding responses, including necropsy teams.* Existing cooperative agreements for stranding response should be maintained. Fishing gear that has been removed from stranded carcasses or from entangled living animals should be analyzed expeditiously. This information is essential for determining causes of death and the sex/age of the animals that have died, and is invaluable for assessing threats and their potential population-level effects.

- *The program should continue investigations of health and reproduction.* In particular, studies are needed to determine how injuries from ship strikes

Table 6. Expenditures on major research and management tasks identified in the North Atlantic right whale recovery plan, FY2003–2005

RESEARCH	FY 2003	FY 2004	FY 2005
Assess and monitor distribution	$2,726,367	$3,361,762	$3,362,294
Aerial surveys	2,017,000	2,906,544	2,984,470
Shipboard surveys	66,815	39,048	32,500
Acoustic monitoring	642,552	416,170	345,324
Assess abundance and trends	$556,262	$953,940	$804,984
Right whale identification catalogue	219,000	579,206	363,000
Right whale sightings database	98,962	117,815	124,949
Population modeling/abundance estimates	238,300	256,919	317,035
Assess and monitor right whale mortality	$102,596	$226,169	$307,259
Necropsy teams	0	65,000	65,000
Logistics	91,596	150,169	231,259
Diagnostics	11,000	11,000	11,000
Health and reproduction studies	$561,000	$513,044	$413,444
Habitat studies	$300,100	$664,224	$477,200
Habitat studies in the northeastern United States	0	161,200	100,100
Predictive modeling in the northeastern United States	119,100	198,100	196,100
Habitat modeling in the southeastern United States	56,000	56,000	56,000
Geographic Information System analyses	125,000	125,000	125,000
D-Tag studies	0	123,924	0
Genetics studies	$3,007	$25,002	$136,812
Total research	**$4,249,332**	**$5,744,141**	**$5,501,993**
MANAGEMENT			
Mitigate effects of vessel collisions	$3,722,393	$4,928,792	$4,582,970
Development of speed regulations	100,000	450,000	$450,000
Development of routing measures	269,400	264,400	291,000
Public outreach	9,000	80,000	97,000
Research on whale avoidance technologies	1,897,800	2,657,713	1,753,825
Enforcement	64,668	67,512	87,592
Whale sighting advisory systems for mariners (i.e., regional aerial surveys)	1,114,649	1,124,788	1,607,200
Mandatory ship reporting systems	266,876	284,379	296,353
Mitigate entanglements in fishing gear	$4,969,081	$7,684,466	$6,217,395
Administration (e.g., public hearings, take reduction team meetings, preparing EISs)	168,000	1,057,000	729,000
Development of gear modifications and gear buyback programs	1,129,400	1,713,605	1,839,405
Atlantic Large Whale Take Reduction Plan	2,101,714	2,648,400	2,216,586
Disentanglement	1,175,933	808,691	836,438
Enforcement	394,034	1,456,770	595,966
Total management	**$8,691,474**	**$12,613,258**	**$10,800,365**

and entanglement are affecting the health and reproductive capacities of individual right whales. Such information is necessary to assess the full consequences of these and other risk factors.

- *The program should continue to fund genetics studies based on the merits of proposed work.* Such studies are a core element of the research program and provide vital information about the population structure and relatedness. This information supplements other population data and provides a more complete understanding of population status. For example, genetic studies recently revealed that the total population must be larger than estimated on the basis of sightings alone.

- *The program should consider alternative research methods as a way of increasing cost-effectiveness.* In particular, the use of aerial surveys might be reduced through the use of alternative technologies. Aerial surveys are used to monitor whales in high-use areas, assess their distribution outside those areas, and collect photographs of individual whales for life history information (e.g., reproduction). However, such surveys account for more than half of all research expenditures, pose risks to human safety, and may be inefficient when used for multiple purposes. Passive acoustics, satellite telemetry, and shipboard sampling provide alternative approaches for collecting similar data, and may prove more cost-effective than aerial surveys for monitoring high-use areas and locating additional important whale habitats. Shipboard surveys may be more cost-effective because more types of data can be collected (e.g., photographs, biopsy samples, visual health assessments, fecal samples, observations of behavior, acoustic recordings, etc.) and more activities carried out (e.g., disentangling whales). A safer and more cost-effective approach might be to combine aerial surveys focused in areas where small survey vessels are unable to work easily, dedicated shipboard surveys in predictably used seasonal habitat, and passive acoustics and other approaches in place of more costly aerial surveys when and where feasible.

Cost-effectiveness of Management

Overall costs of management activities related to ship strike and entanglement risks totaled about $8.7 million in 2003, $12.6 million in 2004, and $10.8 million in 2005 (Table 6). These amounts include funding for research on mitigation measures, such as the development of whale-safe fishing gear and technology that might be used on ships to avoid hitting whales.

Measures to Mitigate the Risks of Ship Strikes: To prevent collisions between ships and whales, the National Marine Fisheries Service has urged mariners to follow precautions such as posting an extra lookout, changing travel routes, and reducing speed. Public outreach efforts have included distributing brochures, placards, and videos; publishing magazine articles and notices in Coast Pilots; preparing curricula for maritime academies; and broadcasting radio alerts to mariners. The Service also designated two mandatory ship-reporting areas—one in the right whale calving grounds off the southeastern United States and the other in feeding grounds off Massachusetts. Ships entering those areas are required to call a shore station for whale information. Intensive aerial surveys are flown to locate right whales and alert mariners via radio and telex.

The Service also has been developing routing measures and speed regulations and supporting related research. The latter includes studies of the feasibility of technological devices to reduce collision risks (e.g., alarms to alert whales to approaching ships and whale detection devices) and to help detect or predict when whales will be in certain areas (e.g., real-time passive acoustic monitoring and studies of prey density in Cape Cod Bay). Overall costs for research and management activities related to ship-strike mitigation ranged between $3.7 and $4.9 million per year from 2003 to 2005. More than two-thirds of those annual totals were spent on aerial surveys to sight whales and alert mariners, and on whale avoidance technologies (Table 6).

Regarding efforts to reduce ship strikes, the panel concluded that—

- *The evidence to date is not sufficient to evaluate the cost-effectiveness of the ship-strike mitigation efforts that have been implemented.* Only one study (Moller et al. 2005) has attempted to investigate compliance of mariners with recommended actions to avoid ship strikes. That study examined the tracks of 40 vessels through a mandatory ship reporting area to determine whether speed or course was altered in response to broadcast right whale alerts. Fewer than 10 percent of the ships changed course or slowed down in response to the alerts. The lack of response could indicate non-compliance or a determination by mariners that their vessels did not pose imminent risks to sighted whales, perhaps because of distance. Further analyses are needed to evaluate the effectiveness of outreach mechanisms (e.g., brochures, radio broadcasts, videos, etc.) to determine which are most likely to reach mariners and result in the use of recommended protection measures.

- *Vessel speed restrictions are urgently needed.* These include seasonal speed restrictions off major ports and temporary speed restrictions in areas where groups of right whales (including mother-calf pairs) are sighted. The panel recommended that a 10-knot speed limit be set in such areas.
- *Routing and reporting measures are urgently needed.* These include, but are not limited to, an automated information system that provides data on ship speeds and courses for enforcement purposes, right whale alerts to be sent to ships as they leave port as well as when they first enter mandatory reporting areas, and mandatory reporting of all known collisions with whales to the National Marine Fisheries Service or the Coast Guard.
- *Further research on ship-mounted sonar or alarm devices and whale-mounted tags is not likely to be cost-effective.* Relatively large investments have been made on research to investigate technologies for ship-strike risk reduction. Ship-mounted sonars have only limited ability to detect whales and, as large ships require long distances to slow and turn, available sonar devices offer little prospect of meaningful risk reduction. The use of alarm sounds for alerting whales to approaching ships adds more noise to the marine environment and may increase the risk. Tested sounds have caused whales to come to and remain at the surface where they are more likely to be struck (Nowacek et al. 2004). Finally, the idea of permanently attaching devices to right whales so that they can be detected and avoided by ships is impractical in view of (a) limited opportunities for tagging whales, (b) ongoing problems with tag attachment, retention, and battery life, and (c) potentially undesirable effects on the whales.
- *Continued research is needed on passive acoustic detection systems and whale behavior in relation to approaching ships.* The panel recognized the potential value of passive acoustic devices in certain areas (e.g., along shipping lanes and in areas heavily used by whales) where they could alert managers and ships when whales are present and thus trigger local speed or routing measures. Fully operational systems that deploy such devices would require the processing of large amounts of data and could be expensive.

  With regard to studies of whale behavior, the panel recommended further field work with tags to monitor underwater behavior of whales near ships.
- *The cost-effectiveness of recent rulemaking to prevent ship strikes would be determined by the specific measures adopted and their effectiveness.* During the period from 2003 to 2005 about $1.8 million was spent on efforts to develop regulations to reduce ship strikes. The panel regarded the cost to be commensurate with the importance, complexity, and controversial nature of the actions involved. Rule development has been slow, which the panel attributed to procedural delays. Analyses of the economic impacts of speed and routing options, preparation of an environmental impact statement, and public meetings were expensive and time-consuming, but unavoidable. The cost-effectiveness of the new rules cannot be determined until the rules have been implemented and evaluated. The key question will be whether the problem is solved to a sufficient degree to allow the right whale population to recover.

Measures to Mitigate the Risks of Entanglement in Fishing Gear: Entanglement in commercial fishing gear – principally lobster trap lines and gillnets – is the second most frequently documented cause of right whale mortality. At least 61 right whales have been entangled in fishing gear since 1986. The six confirmed deaths do not represent the true scale of entanglement impacts. Whales entangled in fishing gear frequently suffer from infections due to wounds, and their ability to feed efficiently can be compromised by the entangling line and/or netting material. Emaciation from such secondary effects increases the likelihood that entangled whales will be thin and sink after death and their carcasses will not be detected.

The National Marine Fisheries Service's strategy to address the entanglement problem rests principally on three approaches: (1) gear modifications to reduce entanglement risks (i.e., "whale-safe" fishing gear), (2) time and area restrictions, and (3) disentanglement. These approaches are implemented through the Atlantic Large Whale Take Reduction Plan, the provisions of which are based on advice from a take reduction team consisting of about 60 members representing involved fisheries, environmental groups, and government agencies. The measures imposed under the plan are exceedingly complex. They differ by time and area, with some measures applying throughout the U.S.

Atlantic Exclusive Economic Zone, others in designated seasonal management zones, and still others in dynamic management zones established temporarily in areas where large groups of right whales have been observed. The required gear modifications differ by fishery and are subject to numerous exceptions.

In FY2003 to FY2005, an average of about $1.6 million per year was spent on research to develop gear modifications and on buyback programs to encourage the use of sinking or neutrally buoyant line in the lobster fishery. The principal costs associated with time/area management were for enforcement and aerial surveys in support of dynamic area management. The Coast Guard and state agencies are responsible for enforcement and between 2003 and 2005 the cumulative cost was estimated at more than $2.4 million. The costs of aerial surveys in support of dynamic management areas were uncertain because they could not be separated from the costs of surveys for research and for support of ship advisory programs. The costs of maintaining the disentanglement network along the Atlantic coast totaled about $2.8 million for FY2003–2005, not including logistical support and other services contributed by the Coast Guard and others. The costs of meetings of the Atlantic Large Whale Take Reduction Team are uncertain, but given the need for travel, meeting facilitators, and preparation of background documents and reports, they probably total at least $150,000 per meeting.

Regarding efforts to reduce entanglement in fishing gear, the panel concluded that—

- *The Service has relied too much on gear modifications to prevent entanglement in fishing gear.* The development of fishing gear that does not entangle whales is an appropriate and worthy long-term goal. To date, however, only one potentially effective innovation has been developed for broad-scale application—the use of neutrally buoyant or sinking groundlines for trap fisheries. To avoid entanglements in buoy lines, the Service has relied principally on weak links. At least two unbroken weak links have been removed from entangled right whales, and more have been removed from other large whales, indicating that their mitigation value is limited. Despite the Service's acknowledgment that weak links are of limited effectiveness, it continues to rely heavily on them while proposing increasingly complex regulations requiring untested gear modifications. Furthermore, enforcement practices for gear modification requirements have been ineffective because enforcement patrols do not remove gear from the water for inspection.

- *All fisheries should be required to demonstrate that fishing gear is whale-safe before its use is approved in areas where right whales aggregate (e.g., designated critical habitats, seasonal area management zones, and dynamic area management zones).* This action would require a prohibition on the use of vertical lines, in addition to measures currently required or being contemplated under the Atlantic Large Whale Take Reduction Plan. In effect, this would entail strict time/area closures to all gear that has not been demonstrated to be safe. A shift in the burden of proof would stimulate fishermen to use their considerable creative ability to develop ways of catching lobsters and finfish without depending on methods that lead to whale entanglement.

- *Neither dynamic nor seasonal time/area regulations have provided adequate protection for right whales because implementation has been slow and incomplete*. The bureaucratic process required to designate dynamic management zones typically delays implementation for two weeks or longer after groups of whales are first sighted, thereby limiting the measure's usefulness. In addition, restrictions specified for such zones often have been voluntary. In both seasonal and dynamic management zones, fishing is allowed to continue if certain gear modifications are in use. Those modifications invariably rely on weak links that are of limited effectiveness for preventing entanglement.

- *Disentanglement efforts are not cost-effective compared to prevention of entanglement. But, in view of the great value in saving each individual whale, these efforts should continue because they have demonstrated some level of success in reducing entanglement impacts. However, they also should be subject to further assessment to minimize the human risks involved, and they should be funded by the programs authorizing the involved fisheries*. From January 2000 through the end of 2005, the responding network received 25 reports of entangled right whales. Disentanglement teams were able to remove some gear from 7, most of the gear from 4, and no gear from 14. Some of the whales that were partially disentangled subsequently died, but at least one disentangled female was later seen with a newborn calf. Network members have disentangled many more individuals of other large whale species, particularly humpback whales. Nonetheless, disentanglement is dangerous, costly work. In view of those dangers and the limited chances of success in dealing with complex entanglements, the panel recommended that a risk/benefit analysis be conducted to assess safety risks versus the likelihood of successful outcomes. It also recommended that the costs of disentanglement should be borne by the program or programs authorizing the involved fisheries (e.g., programs to implement fishery management plans), rather than by the right whale recovery program. In addition, the panel cited the need for better methods to chemically sedate entangled whales, improved means of attaching telemetry systems to track entangled animals, and more trained individuals to lead disentanglement teams.

- *The Atlantic Large Whale Take Reduction Team should be replaced by a less costly and more scientific advisory body, such as a small recovery team consisting of individuals with direct knowledge of right whale biology and whale entanglement issues*. Pursuant to the Marine Mammal Protection Act, the take reduction team is charged with providing advice on measures to reduce incidental mortality to the potential biological removal level (i.e., zero for this population) within six months of implementation.

  On most key issues, the team has consistently failed to reach consensus, and instead has offered majority and minority opinions. The panel concluded that the take reduction team, which has been in existence for nearly a decade, has been ineffective as a mechanism for developing mitigation strategies to deal with right whale entanglements. Believing that Congress did not envision such a protracted and open-ended process for reducing entanglement risks, the panel recommended that the Atlantic Large Whale Take Reduction Team be replaced.

The Marine Mammal Commission's Perspective

The Commission concurs with and supports the recommendations of the right whale program review panel. Although much useful work has been done, the combined research and management effort to date have not achieved and sustained a positive growth rate for the North Atlantic right whale. Whales are still dying in unsustainable numbers. Therefore, the Commission believes that, in failing to achieve their objective of right whale recovery, those efforts cannot be considered effective or cost-effective.

FINDINGS AND RECOMMENDATION

With regard to the viability of the most endangered marine mammals, the Commission finds that—

- Twenty-two marine mammal taxa occurring regularly or entirely in U.S. waters are listed as endangered or threatened under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act.
- Of those 22 taxa, the Caribbean monk seal is considered extinct and the AT1 population of killer whales is on the verge of extinction and is probably not biologically viable.
- The remaining 20 taxa are considered viable; that is, these 20 taxa can persist and recover if human-related threats are managed effectively. Historical data indicate that many wild species have shown considerable resilience and have recovered from low numbers when human-related threats were managed effectively.
- Protection programs for a number of listed marine mammal taxa are constrained by insufficient information, resulting in uncertainty with regard to both their risk of extinction and measures needed to promote recovery. Key types of information to project future status and guide recovery efforts include population structure, population dynamics, population ecology and health, small-population factors, and threats. Population viability analysis provides a mechanism for integrating the available data into an analysis of extinction risk. However, such an analysis has been conducted for only a limited number of taxa due to a lack of critical data and insufficient emphasis on the use of such tools to enhance risk assessment.

With regard to the effectiveness of recovery efforts, the Commission finds that—

- Since the early 1900s the passage of several key domestic laws and international treaties has had a profoundly positive effect on the status and recovery process of many marine mammal species. The Fur Seal Treaty, the International Convention for the Regulation of Whaling, the Marine Mammal Protection Act, and the Endangered Species Act have provided a strong framework for marine mammal conservation in U.S. waters and beyond. Those laws and treaties certainly have prevented the extirpation of some populations and possibly even the extinction of some species. The primary benefit was through cessation or strict regulation of intentional killing that had been largely unregulated.
- With the adoption of those laws and treaties, the primary human-related threats to marine mammals in U.S. waters shifted from intentional to incidental taking and degradation of habitat. Compared to the mostly effective curtailment of direct harvest, recovery efforts generally have been less successful at reducing to acceptable levels the indirect or incidental threats, which include competition with fisheries for prey; exposure to contaminants, disease, and noise; coastal development and loss or degradation of habitat; and climate change.
- Basic information is still lacking for a considerable number of marine mammal taxa, including many that are endangered, threatened, or depleted.
- Unfortunately, even under the best circumstances the recovery of marine mammals is limited by their inherently slow population growth rates, which means that recovery for some taxa will require decades, or longer.
- The indirect threats posed by human activities often increase in proportion to human population size, economic growth, and consumption patterns. The consequences of "economic growth and development untempered by adequate concern and conservation" were incentives for passage of both the Marine Mammal Protection Act and the Endangered Species Act by Congress in the early 1970s. With regard to indirect threats, the findings, purposes, and challenges of the Marine Mammal Protection Act and the Endangered Species Act are more germane now than they were three decades ago.

With regard to the cost-effectiveness of recovery efforts, the Commission finds that—

- Over the past decade, Congress has provided a commendable and much-needed increase in funding for recovery of endangered, threatened, and depleted marine mammal taxa.
- The distribution of funds for recovery efforts has been inconsistent with the extinction risks of the various endangered, threatened, and depleted taxa discussed in this report. Funds appear to have been directed primarily at the taxa whose recovery needs could impose significant constraints on human activities, while other taxa at higher risk of extinction have been neglected.
- Existing mechanisms to track expenditures for protection programs do not provide sufficiently detailed information to evaluate amounts spent per taxa or threat. Without this type of information, any attempt to determine the effectiveness and cost-effectiveness of recovery efforts—and thereby hold ourselves accountable—is bound to be confounded, incomplete, and unsatisfactory.

With regard to the effectiveness and cost-effectiveness of North Atlantic right whale conservation, the Commission concurs with the recommendations of its review panel and finds that—

- Efforts to date have not been sufficient to achieve and sustain a positive growth rate for the North Atlantic right whale. Whales are still dying in unsustainable numbers.
- The principal human causes of North Atlantic right whale mortality are ship strikes and entanglement in fishing gear.
- The key measures needed to reduce the risks of ship strikes are (a) reductions of ship speeds to 10 knots or less in areas where, and times when, right whales are known or likely to be present, and (b) ship routing to minimize spatial and temporal overlap with right whales.
- The key measures needed to reduce entanglement would shift the burden of proof so as to require fisheries to demonstrate that gear and methods are safe for right whales before they are approved for use in areas where right whales occur. Such a shift would reduce reliance on gear modifications of unproven and questionable utility. Other important measures to reduce entanglement include (a) re-examination of critical habitat areas, (b) implementation of time/area closures when and where whales are present, and (c) replacement of the Atlantic Large Whale Take Reduction Team with a smaller, more focused scientific advisory body to identify and recommend the measures needed to ensure North Atlantic right whale recovery.

Each year Congress allocates a substantial budget for marine mammal recovery programs with the expectation that those funds will be used effectively and cost-effectively in accordance with the conservation framework established in the Marine Mammal Protection Act and Endangered Species Act, and that the funded programs will be adequate to achieve the goals of the Acts. Recovery programs implemented under that framework have achieved mixed results with regard to their effectiveness and cost-effectiveness. Nonetheless, no marine mammal taxa in U.S. waters has gone extinct during the period that the Acts have been in place, and many taxa have demonstrably benefited from the programs and protections implemented under the Acts. In contrast, during the same period, the Yangtze River dolphin appears to have become extinct and several marine mammals not under U.S. jurisdiction have declined to a very precarious state.

Much remains to be learned about the threats facing marine mammals and about the recovery actions needed to allow endangered taxa to recover. The inconsistency in effectiveness and cost-effectiveness of U.S. recovery programs is due in part to insufficient information to guide recovery actions and in part to inadequate implementation of needed actions. Furthermore, as the world changes so too do some of the threats and options for successful recovery strategies. To be successful, marine mammal recovery programs must determine what critical information is lacking, obtain that information, and select or adjust recovery actions in response to the information. They must adapt as more is learned about the animals and the risks they face, and they must do so at a pace consistent with socioeconomic development and potentially adverse consequences thereof.

The agencies responsible for recovery programs undoubtedly have used congressional funding to balance competing interests and respond to a range of priorities, all under the constraint of a limited total budget. Agency discretion has been limited and their ability to prioritize recovery efforts compromised when Congress has earmarked certain funds for specific species, threats, or conflicts.

In the end, certain at-risk taxa have received relatively high levels of attention in the form of specifically directed funding (e.g., western Steller sea lions), while certain others have not received enough attention to stop or even understand their ongoing decline (e.g., Cook Inlet beluga whales). Absent a more integrated, coherent national system for determining what the funding needs really are, setting priorities, and determining how the limited funds should be allocated, we have reason to worry that recovery efforts for certain taxa will deteriorate into a patchwork of reactive crises, increasing the risk of extinction for those taxa, inflating the long-term costs required to bring about their recovery, and undermining our nation's goal of maintaining the health and stability of the marine ecosystem.

In light of the above considerations, the Marine Mammal Commission concludes that the national strategy for setting endangered marine mammal funding priorities, in an informed manner and cognizant of extinction risk, is not sufficiently coherent and consistent. The shortcomings undermine the effectiveness and cost-effectiveness of recovery efforts. To address this problem, the Marine Mammal Commission makes a single recommendation to Congress, as follows.

The Marine Mammal Commission recommends that Congress require the development and implementation of a comprehensive national strategy for determining (a) the annual funding requirements for research, monitoring, and recovery actions for endangered, threatened, and depleted marine mammals, and (b) how those funds should be distributed to ensure that recovery efforts are optimally effective and cost-effective. The strategy should be developed and updated at least annually by a standing committee consisting of representatives from the responsible agencies. The primary agencies serving on the committee would be those responsible for research and management of endangered, threatened, and depleted marine mammals—the National Marine Fisheries Service, U.S. Geological Survey, Fish and Wildlife Service, and the Marine Mammal Commission. *Ex officio* members of the committee would include the Council on Environmental Quality, the Smithsonian Institution, and the National Academy of Sciences. The Marine Mammal Commission would chair the committee. The strategy should include the following elements.

Funding for recovery: The comprehensive national strategy would include a separate fund for the specific purpose of addressing research and management needs for endangered, threatened, and depleted marine mammals. Funding levels would be determined annually and reported to Congress for its consideration during the budget process.

Prioritizing recovery efforts: The strategy would establish and be based on clear, objective criteria for assessing recovery needs including, among other things, risk of extinction, critical information gaps, expected conservation benefits, competing conservation needs, and related socioeconomic concerns. Prioritization would be based on structured and transparent risk/benefit analysis.

***Monitoring, reporting, and evaluation*:** On an ongoing basis, the types of information sought by the Commission to complete this current report should be readily available for consideration by all interested parties, including Congress, the responsible agencies, and non-governmental stakeholders. To that end, expenditures, activities, and results of the committee would be reported annually in the Marine Mammal Commission's Annual Report to Congress. The purpose of such information is to inform and adapt recovery processes by assessing past effectiveness, adjusting for existing shortcomings, and setting future directions. By measuring progress and identifying successes, problems, and inefficiencies, the strategy would provide a mechanism for holding the relevant agencies, including the Marine Mammal Commission, accountable for marine mammal and marine ecosystem conservation.

Adjusting total budget to needs: As the world's human population grows, the demands placed on ocean resources will increase. So too will the threats to many endangered, threatened, and depleted marine mammals and the ecosystems of which they are a part. Consequently, the total budget needs for conservation of endangered, threatened, and depleted taxa will change over time. Costs might decrease if recovery programs are successful and taxa recover. Alternatively, costs might increase if recovery programs are not successful or additional taxa are listed. A risk- and effectiveness-based assessment process will provide an orderly guide for appraisal and adjustment of overall budgetary needs.

The Marine Mammal Commission believes that the activities undertaken to satisfy this single recommendation will lead to more effective and cost-effective implementation of recovery programs within the conservation framework defined in the Marine Mammal Protection Act and the Endangered Species Act. More effective implementation is essential to address growing conservation challenges in a rapidly changing world.

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APPENDIX 1

Members of the Steering Committee for the Marine Mammal Commission's Project to Analyze the Biological Viability of the Most Endangered Marine Mammals and the Cost-effectiveness of Protection Programs.

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APPENDIX 2

Endangered, Threatened, and Depleted Marine Mammals In U.S. Waters

Endangered, Threatened, and Depleted Marine Mammals in U.S. Waters

A Review of Species Classification Systems and Listed Species

Prepared for the Marine Mammal Commission by

Lloyd Lowry
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2007

This is one of five reports prepared in response to a directive from Congress to the Marine Mammal Commission to assess the effectiveness of protection programs for the most endangered marine mammals in U.S. waters.

CONTENTS

EXECUTIVE SUMMARY

I. INTRODUCTION

In its 2004 appropriations bill, Congress directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." This report identifies "the most endangered marine mammal populations" in U.S. waters, evaluates the criteria and methods used to place marine mammal species and populations on the major protected species lists, and reviews current data on their biological status.

II. DESCRIPTION OF CLASSIFICATION SYSTEMS

Endangered Species Act

The Endangered Species Act (ESA), passed in 1973, employs a two-category system for listing species either as endangered ("in danger of extinction throughout all or a significant portion of its range") or threatened ("likely to become endangered in the foreseeable future"). Congress left the task of defining these terms to the federal agencies responsible for listing and delisting species, the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). The ESA defines the term "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." Although the ESA is international in scope, different kinds of protection apply in U.S. and foreign territory and in federal jurisdiction versus state or private property.

The listing process begins with a review of the species' taxonomy, life history, habitat and ecological relationships, and population status, and an analysis of threats known or thought to be causing the species to be endangered or threatened. The threats analysis considers the following five factors for both listing and reclassification decisions:

- present or threatened destruction, modification, or curtailment of its habitat or range;
- overutilization for commercial, recreational, scientific, or educational purposes;
- disease or predation;
- inadequacy of existing regulatory mechanisms; and
- other natural or manmade factors affecting its continued existence.

In practice, the agencies often use what has been called a "weight of the evidence" approach in which all extinction risk factors for which information is available are considered in the analysis but without a strict formula for combining the appraisals of the respective factors.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) uses population stocks (or simply stocks) as its unit of conservation and defines a stock as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature." The MMPA provides general protection to all marine mammal stocks and additional protection to those designated as "depleted." A species or population stock is considered depleted if it is below its optimum sustainable population (OSP) or if it is listed under the ESA. The MMPA defines OSP as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element." The responsible agencies have gone considerably farther in standardizing and quantifying criteria for evaluating status under the MMPA than they have for the ESA, and they have developed formulas relating to population size, carrying capacity, population growth rates, and incidental mortality rates. Similar to the ESA, the MMPA is international in scope but applies in different ways in U.S. and foreign territory.

IUCN–The World Conservation Union

IUCN–The World Conservation Union, through its Species Survival Commissions, evaluates the status of species, subspecies, and geographical populations worldwide and produces its "Red List" of threatened species. Its rule-based classification system uses both quantitative and qualitative criteria to place species within categories depending on the predicted degree of extinction risk. The criteria include measures of current population size, trend in population size, population structure, size of occupied range, and quantitative analysis of probability of extinction. The criteria can be applied to any taxonomic unit at or below the species level. Although the categories and criteria are intended primarily for global taxon assessments, they also may be applied at regional, national, or local levels. The IUCN assessments are not directly comparable with ESA listings, in part because they are not always done for the same taxonomic unit, and in part because the IUCN categories do not automatically carry a regulatory consequence so the terms like "endangered" are not fully portable between the classification systems. However, all 22 marine mammal taxa listed under the ESA and MMPA are considered in one way or another by the IUCN.

Summary of Current Listing Status

Out of the 22 marine mammal taxa reviewed, the ESA lists 14 as endangered and 4 as threatened; 4 are not listed. The MMPA lists all 22 taxa as depleted. The IUCN lists 1 of the taxa as extinct, 1 as critically endangered, 10 as endangered, 6 as vulnerable, 3 as lower risk, and 1 as data deficient (see Table 2). Both populations of sirenians are listed as endangered under the ESA and vulnerable on the IUCN Red List. Both populations of sea otters are listed as threatened under the ESA and endangered on the IUCN Red List. For the pinnipeds, three populations are listed under the ESA as endangered and two as threatened; one is not listed. The IUCN lists one pinniped population as extinct, three as endangered, and two as vulnerable. For the cetaceans, nine populations are listed as endangered and three are not listed under the ESA. The IUCN lists one cetacean population as critically endangered, five as endangered, two as vulnerable, three as lower risk, and one as data deficient.

Current IUCN, ESA, and MMPA approaches differ with respect to listing units. IUCN listings are often applied to entire species worldwide, while recent ESA and MMPA listings have been based on population segments or stocks. Under the ESA, all eight species of large whales are considered on a worldwide basis because they were first listed under the 1969 Endangered Species Conservation Act, a precursor to the ESA. Of the taxa considered here, the IUCN lists 10 species on a worldwide basis, including 5 species of large whales. Although many of the species considered include multiple isolated or relatively discrete population units, the nature of those units is often either not described or not yet recognized in the evaluation/listing process. More recent listings by stocks and population segments indicate that this is an evolving process.

In the United States, 11 marine mammal taxa were listed after passage of the Endangered Species Preservation Act or the Endangered Species Conservation Act, and none was subject to a baseline assessment of the five listing factors detailing the rationale for listing. Seven taxa were listed subsequent to passage of the ESA, one taxon was evaluated for listing and rejected, and three have not been evaluated. Under the MMPA, 16 taxa are listed as depleted due to their ESA listing, 5 taxa were listed following an OSP evaluation, and 1 taxon was listed without an OSP evaluation.

Available Data and Current Biological Status

A review of the data currently available on various biological attributes of listed species indicates that the quality of the data varies greatly. For only five taxa was data availability ranked as good in four or more of the six data categories considered. However, if both good and fair data quality are considered, 11 taxa have good or fair data in all six categories and 2 have good or fair in five categories. At the other extreme, 4 taxa have poor data availability in all of the categories and 8 in three or more categories. For taxa with good-to-fair abundance estimates, population sizes range from 8 for AT1 killer whales to 688,028 for eastern North Pacific fur seals. The taxa with the smallest estimated abundances are AT1 killer whales (8), North Pacific right whales (minimum 23), southern resident killer whales (84), Cook Inlet beluga whales (278), and Hawaiian monk seals (1,252). AT1 killer whales and Cook Inlet beluga whales are not listed under the ESA.

Major Findings and Conclusions

In many cases the ESA, MMPA, and IUCN listings have not kept pace with the growing body of knowledge on population (or stock) structure, although the more recent listing actions have considered biologically reasonable population units. In particular, the ESA lists all species of large whales as endangered on a worldwide basis despite the fact that many are known to exist in discrete regional populations. For large whales listed under the ESA, NMFS should (1) identify distinct population segments based on recent information on population structure and (2) evaluate the listing status of each newly identified population segment.

Some other taxa currently listed under the ESA should be reevaluated and possibly reclassified. For instance, Caribbean monk seals might be declared extinct, eastern Steller sea lions might be delisted, western Steller sea lions might be downlisted, and Cook Inlet beluga whales and AT1 killer whales might be listed as endangered or threatened.

There is concern among scientists that a lack of data has precluded the listing of some taxa that may in fact be endangered, threatened, or depleted (e.g., beaked whales). For those taxa, scientists often do not know what the population units are that should be of conservation concern, what their historical and current abundances were and are, whether numbers are currently increasing or decreasing, and what factors may be threatening the population. Without such data, it is essentially impossible to conduct thorough status reviews or to compare population status with the listing criteria used by any system. A more robust decision system is needed for coping with the likelihood that some species for which there is little available data are nevertheless endangered and in need of conservation attention.

I. INTRODUCTION

In fiscal year 2004 the Congress directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." The Commission interpreted, and confirmed with staff of the Senate Appropriations Committee, that this directive was focused on marine mammals occurring substantially in U.S. waters of the Atlantic, Pacific, and Arctic Oceans. The Commission undertook a series of reviews and prepared two reports (including this one) to provide a basis for its response to Congress. The purpose of this report is to summarize relevant information on the status of marine mammal species and populations that have been formally identified as requiring special protection. The second report (Weber and Laist 2007) reviews existing protection programs for the listed species. The other related reviews undertaken as part of the Commission's response to the directive have (1) examined modeling efforts to predict marine mammal population trends and assess their utility for evaluating degree of endangerment, and (2) assessed the cost-effectiveness of the recovery program for North Atlantic right whales.

The first line of protection for marine mammals in U.S. waters results from actions prescribed by the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Both Acts establish provisions for listing marine mammal species and populations with special conservation needs. The ESA creates a two-tiered system under which species and populations may be listed as "endangered" or "threatened." The MMPA establishes a single category system for listing species or populations as "depleted." Once listed, a species or population is eligible for additional protection measures specified in the Acts. At the time this report was drafted, 20 marine mammal species or populations occurring regularly in U.S. waters were listed under one or both Acts. Taxonomic revisions accepted since ESA listings were made have recognized northern right whales as two separate species (i.e., North Atlantic and North Pacific right whales) and West Indian manatees as consisting of two subspecies (i.e., Florida manatees and Antillean manatees). For this review, we considered each of these species and subspecies separately, thereby increasing the number of taxa considered from 20 to 22. Although marine mammals also are "listed" under many other classification systems of various organizations, the most widely recognized international system is the Red List of Threatened Species prepared by the International Union for the Conservation of Nature–The World Conservation Union (IUCN). Begun in the 1960s, the IUCN Red List has evolved into a multi-tiered classification system developed to identify species in greatest need of protection on a global basis.

To identify which marine mammals in U.S. waters are most endangered, this report reviews the ESA, MMPA, and IUCN species classification systems and summarizes information on the listing status and biological status of those species and populations now included under them. For each of the three classification systems, the report describes the criteria and process for listing species. For the listed species and populations, it summarizes available information on distribution and identified conservation units, evaluation and listing history, major biological datasets, and current biological status and trend. Based on this information, summary tables are provided to compare information across taxa. The findings and conclusions in this report are those of the authors and do not necessarily reflect those of the Marine Mammal Commission. They are intended to provide background information and suggestions for consideration by the Commission in developing its report to Congress.

II. MAJOR LISTING SYSTEMS FOR SPECIES AND POPULATIONS AT RISK

Endangered Species Act

Protection for endangered species under U.S. federal law began with the Endangered Species Preservation Act (ESPA) of 1966 (Public Law 89-669). This legislation directed the Secretary of the Interior to carry out conservation programs for endangered species and authorized measures to protect habitats. Species were to be determined as threatened with extinction upon a finding by the Secretary "after consultation with the affected States, that its existence is endangered because its habitat is threatened with destruction, drastic modification, or severe curtailment, or because of overexploitation, disease, predation, or because of other factors, and that its survival requires assistance." The Secretary was directed to seek the advice and recommendations of interested persons, including wildlife scientists, and to publish in the *Federal Register* the names of all species found to be threatened with extinction.

The ESPA was followed by the Endangered Species Conservation Act (ESCA) of 1969 (Public Law 91-135). This legislation authorized the Secretary to promulgate a list of wildlife threatened with extinction worldwide and to prohibit their importation into the United States. It also required that listing of endangered species be done pursuant to the rulemaking procedures of the Administrative Procedure Act.

The ESPA and the ESCA were superseded by the Endangered Species Act (ESA) of 1973 (Public Law 93-205), which was subsequently amended substantially in 1978, 1982, 1984, and 1988. With each succeeding Act, the list of already listed species was largely carried forward, notwithstanding changes in definitions and listing procedures. The purposes and policies of the current ESA as amended are stated in section 2 of the Act:

> (b) PURPOSES.—The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section.
> (c) POLICY.—(1) It is further declared to be the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act.
> (2) It is further declared to be the policy of Congress that Federal agencies shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species.

The ESA employs a two-category system for listing species either as endangered ("in danger of extinction throughout all or a significant portion of its range"; sec. 3[6]) or threatened ("likely to become endangered in the foreseeable future"; sec. 3[20]). An implicit third category is "not threatened or endangered," which includes species that have been evaluated but not listed as well as those that have never been evaluated. Congress left the task of defining these and other terms in the statute to the two federal agencies responsible for listing and delisting species, the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). In 1984 NMFS and FWS published joint regulations to govern the ESA listing process and the designation of critical habitat (50 C.F.R. §424). However, a multi-agency working group charged with making recommendations on the use of quantitative criteria concluded that the guidelines developed by those agencies have not yet achieved the desired level of consistency, standardization, and objectivity in the decision process for listing, reclassifying, or delisting species (DeMaster et al. 2004). The Act requires that recovery plans for endangered species include "objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list" (sec. 4(f)(1)(B)[ii]). This suggests that Congress intended that specific criteria be used in listing decisions. Recently NMFS has published reports recommending criteria to use for evaluating ESA listing status of marine species in general (DeMaster et al. 2004) and large whales in particular (Angliss et al. 2002).

The ESA defines the term "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (sec. 3[16]). FWS and NMFS agreed on a joint policy for identifying "distinct population segments" (DPSs) in 1996 (61 Fed. Reg. 4722). The policy states that DPSs are to be determined based on three sequential considerations: (1) the discreteness of the population relative to the rest of the species; (2) the significance of the population segment to the species; and (3) the population segment's conservation status in relation to the ESA's standards for listing (i.e., is the population segment endangered or threatened when treated as if it were a species?).

The policy goes on to state: "Listing, delisting, or reclassifying distinct vertebrate population segments may allow the Services to protect and conserve species and the ecosystems upon which they depend before large-scale decline occurs that would necessitate listing a species or subspecies throughout its entire range. This may allow protection and recovery of declining organisms in a more timely and less costly manner, and on a smaller scale than the more costly and extensive efforts that might be needed to recover an entire species or subspecies."

The listing process begins with a review of the species' taxonomy, life history, habitat and ecological relationships, and population status, and an analysis of threats that may be causing it to be endangered or threatened. The threats analysis must, at a minimum, consider the following five factors specified in section 4(a)(1) of the Act:

- present or threatened destruction, modification, or curtailment of its habitat or range;
- overutilization for commercial, recreational, scientific, or educational purposes;
- disease or predation;
- inadequacy of existing regulatory mechanisms; and
- other natural or manmade factors affecting its continued existence.

These factors serve as a checklist to be used in evaluating species status and indicate that any threat including “natural” sources can cause a species to be at risk and to merit ESA protection. In practice, the agencies often use what has been called a “weight of the evidence” approach in which all extinction risk factors for which information is available are considered in the analysis but without a strict formula for combining the appraisals of the respective factors (DeMaster et al. 2004). The ESA requires that listing decisions be based solely on the best scientific and commercial data available (sec. 4[b][1][A]), and it prohibits the consideration of economic impacts in making species listing decisions. The Act also requires FWS and NMFS to “conduct, at least once every five years, a review of all species included in a list” and “determine on the basis of such review whether any such species should—(i) be removed from such list; (ii) be changed in status from an endangered species to a threatened species; or (iii) be changed in status from a threatened species to an endangered species” (sec. 4[c][2]). Since 1994 FWS and NMFS have had a formal policy that listing recommendations and recovery plans are subject to independent peer review (59 Fed. Reg. 34270).

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA; Public Law 92-522) was passed in 1972 and has been amended several times, most recently in 2003. The first two findings in the Act pertain to protection for endangered species, and state (sec. 2):

> (1) certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man’s activities;
> (2) such species and population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population. Further measures should be immediately taken to replenish any species or population stock which has already diminished below that population. In particular, efforts should be made to protect essential habitats, including the rookeries, mating grounds, and areas of similar significance for each species of marine mammal from the adverse effect of man’s actions.

The MMPA provides general protection to all marine mammal species and population stocks and provides additional protections to those designated as “depleted.” Section 3(1) defines the term “depleted” as any case in which:

> (A) the Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under title II of this Act, determines that a species or population stock is below its optimum sustainable population;

(B) a State, to which authority for the conservation and management of a species or population stock is transferred under section 109, determines that such species or stock is below its optimum sustainable population; or

(C) a species or population stock is listed as an endangered species or a threatened species under the Endangered Species Act of 1973.

Section 3(11) defines the term "population stock" or "stock" as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature."

A species or stock that is not listed under the ESA will be classified as depleted only if it is determined to be below its optimum sustainable population (OSP) level. Section 3(9) of the MMPA defines OSP as "…with respect to any population stock, the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element."

NMFS regulations (50 C.F.R. § 216.3) clarify the definition of OSP as a population size that falls within a range from the largest supportable within the ecosystem (i.e., carrying capacity or K) to its maximum net productivity level (MNPL). Maximum net productivity is the greatest net annual increment in population numbers or biomass resulting from additions to the population from reproduction, less losses due to natural mortality. Historically, MNPL has been expressed as a range of values (generally 50 to 70 percent of K) determined theoretically by estimating what size stock in relation to the original stock size will produce the maximum net increase in population (42 Fed. Reg. 12010). The midpoint of this range (60 percent) was used to determine whether dolphin stocks in the eastern tropical Pacific Ocean were depleted (42 Fed. Reg. 64548) and in the final rule governing the taking of marine mammals incidental to commercial fishing operations (45 Fed. Reg. 72178).

Section 115 of the MMPA describes procedures for reviewing the status of species. It specifies that, when designation of a species as depleted may be appropriate, "the Secretary shall only make such a determination by issuance of a rule, after notice and opportunity for public comment and after a call for information" that should be made available in a status review. It also states that any determination made shall be based "solely on the basis of the best scientific information available." There is no required schedule for reexamining the status of depleted species once listed.

IUCN–The World Conservation Union

The Species Survival Commission (SSC) of the IUCN evaluates the status of species worldwide and produces its "Red List of Threatened Species" (see http://www.redlist.org). To encourage consistency in classifications within broad taxon groups, "Red List Authorities" are established for all taxonomic groups included on the List. In most cases, the Red List Authority is the SSC Specialist Group responsible for the species, group of species, or specific geographic area. The Red List Authorities are charged with ensuring that all species within their jurisdiction are evaluated against the Red List categories at least once every ten years and, if possible, every five years. The minimum documentation required for an assessment is specified, and assessments are reviewed both within the Red List Authority and by outside peer reviewers. Once approved, a classification is added, or a change is made, to the Red List.

IUCN uses a rule-based classification system with both quantitative and qualitative criteria to place species at risk in eight categories (IUCN 2001; Table 1). Those categories include "data deficient" as well as a distinction between "extinct" and "extinct in the wild." The criteria are based on current population size (expressed as mature individuals), trends in population size (past, present, and projected), population structure, size and degree of fragmentation of range (in two senses: extent of occurrence and area of occupancy), and quantitative analysis of probability of extinction (see Appendix 1).

The IUCN criteria are designed for application to any taxonomic unit at or below the species level and are the same for all taxa. Although the categories and criteria are intended primarily for global taxon assessments, they also may be applied at regional, national, or local levels. When applied at a more restricted level, a taxon may merit a different category than it does in a global assessment.

III. STATUS OF LISTED MARINE MAMMALS

West Indian manatee, Florida subspecies (*Trichechus manatus latirostris*) (ESA – endangered[1]; IUCN – vulnerable; MMPA – depleted)

Distribution and conservation units

The Florida manatee is one of two recognized subspecies of the West Indian (also called Caribbean) manatee (Rice 1998). Except for a few summer migrants that have traveled as far north as Rhode Island and as far west as Texas, Florida manatees occur only in waters of the southeastern United States. In winter they are limited almost exclusively to Florida. Four subpopulations are identified in the Florida Manatee Recovery Plan (FWS 2001): two on the eastern coast of Florida (one in the upper St. Johns River and the other along the Atlantic coast) and two on the western coast (one in southwest Florida from Tampa Bay south and the other in northwest Florida north of Tampa Bay). These four subpopulations were identified for management purposes and are not considered distinct population segments for purposes of listing under the ESA.

History of evaluation and listing

The Florida manatee is under the jurisdiction of FWS. Milestones relative to the subspecies' listing include the following:

- Subspecies listed as endangered under the ESPA in 1967.
- Entire species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- West Indian manatee recovery plan first adopted in 1980.
- First revision of recovery plan specific to the Florida population adopted in 1989.
- Second revision of Florida manatee recovery plan adopted in 1996.
- Subspecies listed as vulnerable by the IUCN in 1996.
- Third revision of Florida manatee recovery plan adopted in 2001.
- Species status currently being reviewed by IUCN.
- Species status under the ESA currently being reexamined by FWS.

No detailed explanation was given when the Florida subspecies of the West Indian manatee was listed as endangered under the ESPA in 1967 (32 Fed. Reg. 4001). Based on correspondence in FWS files, it apparently was listed at the recommendation of the State of Florida because of habitat concerns related to coastal development and boating activity. The entire species was later included on the list of endangered species in the 1970 ESCA (35 Fed. Reg. 18319) and the 1973 ESA.

[1] West Indian manatees are currently listed under the ESA as a single species; however, taxonomic studies (Domning and Hayek 1986) recognize two subspecies, one in Florida and the other from Central America to Brazil, including the Antilles.

Because the species was already listed when the ESA was passed, a formal analysis of threats and ESA listing factors was not done at that time.

The 2001 Florida Manatee Recovery Plan states its goal as "to assure the long-term viability of the Florida manatee in the wild, allowing initially for reclassification from endangered to threatened status (downlisting) and ultimately removal from the List of Endangered and Threatened Wildlife (delisting)" (FWS 2001). The plan provides criteria for downlisting and delisting the population based on "implementing, monitoring and addressing the effectiveness of conservation measures to reduce or remove threats which will lead to a healthy and self-sustaining population" (FWS 2001). The criteria are based largely on protecting important habitats (warm-water refuges, migratory corridors, feeding areas, calving and nursing areas) and controlling sources of human-caused mortality (boat strikes, entrapment in water control structures, fishing gear entanglement). Criteria also specify demographic benchmarks for survival, reproduction, and population growth rate. Downlisting and delisting decisions require that each of the four identified subpopulations meet the demographic benchmarks.

Major threats identified in the 2001 recovery plan were human-caused mortality (principally from boat strikes and to a lesser extent entrapment in flood gates and navigation locks), decreasing availability of warm-water refuges, and coastal development (FWS 2001). The recovery plan recommended that a full ESA status review be initiated in 2003. In April 2005 FWS announced its intention to conduct a status review and requested interested parties to submit relevant information (70 Fed. Reg. 19780).

In its 1996 Red List, the IUCN SSC listed the Florida manatee as vulnerable based on criterion A2d (IUCN 1996). The status of the taxon was evaluated most recently by the IUCN Sirenian Specialist Group at the International Mammalogical Congress in August 2005. The Group concluded that the Florida manatee should be listed as endangered based on criteria A3c, A3d, and C1 (Taylor et al. 2006), but such a change has not yet been made to the Red List. Potential threats that were identified at the time were watercraft mortality and serious injury, red tides, loss of warm-water habitat, habitat loss in general, disease, and possibly contaminants (J. Reynolds, pers. comm.).

Florida manatees are considered depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

Few directed studies were conducted on manatees in Florida prior to listing under the ESPA in 1967. Currently, however, they are among the most extensively studied marine mammals in the United States. Dedicated research since the late 1970s has produced several important long-term datasets. Most research is funded by federal and state agencies and carried out by scientists with the Department of the Interior (initially FWS and now the U.S. Geological Survey) and the State of Florida (the Fish and Wildlife Research Institute in the Florida Fish and Wildlife Conservation

Commission). Cooperating scientists with aquariums, universities, and other research institutes also contribute significant amounts of information.

The most extensive datasets are (1) manatee mortality records including (where possible) age estimates, causes of death, and archived tissue samples for more than 5,000 animals since the late 1970s; (2) a photo-identification catalogue with associated life history data including information on reproduction and survival rates for more than 2,000 animals; (3) aerial surveys and counts of animals at major winter refuges (several dating back to the late 1970s or early 1980s); and (4) satellite tracking data for a large number of individuals in many parts of the state. Many of these data have been compiled in a GIS system developed and maintained by the Fish and Wildlife Research Institute. Information also is available on manatee foraging behavior in numerous locations. Data also are collected on vessel traffic in manatee habitat to assess efforts to reduce collisions with boats and evaluate the efficacy of existing regulations.

Several population models have been developed for Florida manatees including a stage-based population viability analysis (PVA) model (Runge et al. 2004).

Current biological status

Surveys in the late 1970s indicated at least 800 to 1,000 manatees in Florida at that time (FWS 1980). The minimum population size for Florida manatees is now estimated at 3,300 animals based on aerial and ground counts in 2001 (Haubold et al. 2005). Most manatee biologists believe that abundance has increased since the early 1980s although improvements in survey methods probably account for at least some of the differences in estimates between then and now. The Manatee Recovery Team, with advice from its Population Status Working Group, evaluates status separately for each region using available data on reproduction, survival, and population growth. Based on that evaluation, the Northwest and Upper St. Johns River subpopulations appear to be increasing steadily, the Atlantic subpopulation appears to be demographically stable but evidence regarding its recent growth rate is inconclusive, and data for the Southwest subpopulation are not sufficient to evaluate status. The two subpopulations of uncertain status comprise more than 80 percent of the total population. Several of the human-related causes of mortality discussed above are likely responsible for limiting population growth.

FWS published the most recent stock assessment report (SAR) for the Florida stock of West Indian manatees in 2000 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR presents outdated information on population size and trend. It calculates a PBR of 3.0 and notes that the level of human-related mortality (primarily from watercraft collisions and water control structures) greatly exceeds the PBR.

West Indian manatee, Antillean subspecies (*Trichechus manatus manatus*), Puerto Rican population (ESA – endangered[2]; IUCN – vulnerable; MMPA – depleted)

Distribution and conservation units

The Antillean manatee is one of two recognized subspecies of the West Indian (also called Caribbean) manatee (Rice 1998). The largest known groups of Antillean manatees occupy waters of Belize and southeastern Mexico. They are also fairly numerous (but poorly surveyed) around certain rivers in Colombia and Brazil. However, distribution is very patchy due to past hunting and discontinuous habitat (Lefebvre et al. 1989). In many countries, manatees are now very rare or absent altogether. With regard to waters under U.S. jurisdiction, manatees occur in Puerto Rico where they are most abundant along the southern and eastern coasts. They generally do not occur in the Virgin Islands (FWS 1986).

History of evaluation and listing

The Antillean manatee is under the jurisdiction of FWS. Milestones relative to the population's listing include the following:

- Entire species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- West Indian manatee recovery plan (including Puerto Rico) first adopted in 1980.
- Puerto Rico manatee recovery plan adopted in 1986.
- Listed as vulnerable by the IUCN in 1996.
- Status being reviewed by IUCN in 2005.

The ESPA in 1967 listed the Florida subspecies of West Indian manatee as endangered but did not list the Antillean subspecies (32 Fed. Reg. 4001). When the ESCA was passed in 1970, the list of endangered species included the entire West Indian manatee species (35 Fed. Reg. 18319). No detailed explanation was given for the ESCA listing. The situation remained the same with passage of the ESA in 1973, and because the species was already listed when the Act was passed, a formal analysis of threats and ESA listing factors was not done at that time.

The Recovery Plan for the Puerto Rico Population of the West Indian Manatee states its goal as "to recover the population of manatees in Puerto Rico so that the Puerto Rican population of the Antillean manatee (*T. m. manatus*) can be delisted" (FWS 1986). The recovery plan does not specify criteria for downlisting and delisting because data on historical and current abundance are lacking. The plan identifies entanglement in gillnets and industrial development as factors that could be affecting the population and states that there is no evidence that natural factors are causing excessive mortality.

[2] See note 1 above.

In its 1996 Red List, IUCN listed the Antillean manatee as vulnerable based on criteria A1c, A1d, and C2a (IUCN 1996). The status of the taxon was most recently evaluated by the IUCN Sirenian Specialist Group at the International Mammalogical Congress in August 2005. The Group concluded that the Antillean manatee should be listed as endangered based on criteria A4c, A4d, and C1 (Taylor et al. 2006), but such a change has not yet been made to the Red List. Potential threats that were identified in the evaluation were habitat degradation and loss, hunting, accidental mortality, pollution, and human disturbance. Conservation actions are complicated by the fact that the subspecies occupies waters of a number of countries.

Antillean manatees are considered depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

Other than passing historical references to manatees in Puerto Rico, there is virtually no information on this population prior to its listing under the ESCA in 1967. Since then, information has improved significantly but remains very limited. Most research has been funded by the Department of the Interior and the U.S. Navy and is carried out by scientists with the U.S. Geological Survey and non-governmental institutions. Available data sources include counts from sporadic island-wide aerial surveys done since 1978, mortality records from carcass salvage efforts, several satellite tracking studies, and sighting records for few photo-identified individuals. Substantive long-term datasets are not available. Data on manatees in the Virgin Islands are limited to opportunistic sighting reports.

No models designed specifically for population viability analysis have been developed for the Antillean manatee population.

Current biological status

The abundance of Antillean manatees is largely unknown. FWS published a SAR for the Puerto Rico portion of the stock in 1995 (see http://www.nmfs.noaa.gov/pr/sars/species.htm), which cites a 1994 survey that produced a count of 86 manatees. The SAR uses that number as a minimum population estimate and calculates a PBR of 0. It states that Antillean manatees are a strategic stock because of high levels of human-caused mortality relative to population size and severe threats to important habitats. There are no good data to assess population trend in Puerto Rico, but overall the Antillean subspecies appears to be declining (J. Reynolds, pers. comm.).

Southern sea otter (*Enhydra lutris nereis*) (ESA – threatened; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Sea otters once occupied coastal waters all along the North Pacific rim from central Baja California to northern Japan, but their distribution is now discontinuous. Three subspecies are recognized in eastern Russia, Alaska-British Columbia-Washington, and California (Rice 1998). The southern (California) subspecies is geographically isolated from animals living farther north and differs from the other subspecies in cranial morphology (Wilson et al. 1991) and DNA characteristics (Cronin et al. 1996). The range currently occupied by the southern subspecies includes nearshore waters in central California from approximately Half Moon Bay to Point Conception. Also, a translocation program has established a small group of animals at San Nicolas Island.

History of evaluation and listing

The southern sea otter is under the jurisdiction of FWS. Milestones relative to the subspecies' listing include the following:

- Subspecies listed as threatened under the ESA in 1977.
- Qualified as depleted under the MMPA in 1977 by virtue of its listing under the ESA.
- First recovery plan adopted in 1982.
- Experimental population at San Nicolas Island established by translocation in 1987.
- Entire species listed as endangered by the IUCN in 2000.
- Revised recovery plan adopted in 2003.

In 1977 FWS determined that the southern sea otter was not endangered but should be listed as threatened under the ESA (42 Fed. Reg. 2965). The listing notice included an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—The current range is much reduced from what it was in historical time, and that habitat is potentially jeopardized by oil spills, pollution, and competition with humans.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—The original decline was caused largely by commercial exploitation. At the time of listing, illegal killing was known to occur but was not judged to be a current threat to the overall population.
C. *Disease or predation*—These factors were not known to pose a serious threat at the time.
D. *The inadequacy of existing regulatory mechanisms*—Existing laws were judged adequate to protect sea otters from direct taking, but methods for habitat protection were judged to be inadequate and would be improved with ESA listing.
E. *Other natural or manmade factors affecting its continued existence*—The most serious potential threat was judged to be a large oil spill that could affect a large portion of the remaining population.

The 2003 recovery plan reiterates those threats and notes that pollution and incidental take in fisheries are recognized problems (FWS 2003). Other threats that have been identified include disease, shark predation, and illegal shooting (MMC 2004).

The goal stated in the 2003 recovery plan is "to establish the long-term viability of the southern sea otter population sufficiently to allow delisting of the species" (FWS 2003). The plan establishes the following quantitative criteria for reclassification and delisting based on spring survey counts using standardized methods:

- Reclassification as endangered should be considered if the average population size over a three-year period is less than or equal to 1,850.
- Sea otters should remain classified as threatened as long as the average population size over a three-year period is more than 1,850 and less than 3,090.
- Delisting should be considered when the average population size over a three-year period is more that 3,090.

The recovery plan also states that if the proposed criterion for delisting is reached, it will be necessary to do a full evaluation of the ESA's five listing factors prior to changing the listing status. Rationales for the development of the delisting criteria are described in Ralls et al. (1996).

The status of sea otters was evaluated by the IUCN Otter Specialist Group in 2000, and the species was listed by the IUCN as endangered based on criteria A1a, A1c, and A1e (IUCN 1996). The southern subspecies was not evaluated as a separate taxon. Threats identified at the time were oil pollution, killer whale predation, poaching, and fishery interactions.

Southern sea otters are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated. However, FWS has estimated the lower bound of OSP at 8,400 animals for the entire California coast (FWS 2003). Because the lower bound of OSP is considerably greater than the population size at which southern sea otters would be considered for delisting under the ESA, it is possible that upon delisting the population would still be considered depleted under the MMPA.

Available data

Before listing under the ESA in 1977, information on southern sea otters was almost entirely limited to historical accounts of the fur trade and sporadic surveys done by the California Department of Fish and Game (CDFG) since the 1930s. Since 1977 a dedicated ongoing research program has developed involving the CDFG and the Department of the Interior, with significant contributions from the academic community and aquariums. The core of the research program has been standardized range-wide counts conducted annually in the spring and fall since 1982. The counts include information on the numbers of pups and independent animals. Data also have been collected on causes of and trends in mortality and on movement patterns. The former are from opportunistic and directed carcass salvage efforts; the latter are from radio tracking studies. Prey preferences, foraging patterns, and the effects of foraging otters on coastal marine communities also have been the subjects of focused research.

A population model has been developed for southern sea otters (T. Tinker and D. Doak, unpub.), but it has not been used for population viability analysis.

Current biological status

Estimates of the historical population of southern sea otters and estimates of carrying capacity for California are in general agreement at approximately 16,000 animals (Laidre et. al. 2001). By the early 1900s the southern sea otter was nearly extinct due to exploitation by fur hunters. A remnant group of perhaps 50 animals remained in central California when hunting was prohibited in 1911 under the North Pacific Fur Seal Convention. The number of sea otters generally increased along with the expansion of occupied range, and the population was estimated to number 1,789 in 1976, the year before ESA listing. The estimated population size was lower in 1983 (1,277) when annual spring counts using standardized methods began, but counts increased steadily to a peak in 1994 (2,359) and 1995 (2,377) before declining for several years. The population appears to have been increasing since about 2000, with the 2003 (2,505) and 2004 counts (2,825) the highest on record (see http://www.werc.usgs.gov/otters/ca-surveydata.html). In 2005 the count dropped slightly to 2,735.

FWS published the most recent SAR for southern sea otters in 1995 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR provides outdated information on population size and trend. It notes that the population is classified as threatened and depleted and calculates a PBR of seven animals. However, this evaluation has no legal implications because southern sea otters are specifically exempted from the incidental take management process specified in section 118 of the MMPA.

Some translocated populations of northern sea otters have shown population growth of 17 to 20 percent per year (Estes 1990). However, in California overall population growth has been much slower, apparently due to elevated mortality rates that have caused periods of population decline. Potential causes for elevated mortality have been identified as increased rate of disease, entanglement in coastal fishing gear, and decreased abundance of food (FWS 2003).

Northern sea otter, southwest Alaska population (*Enhydra lutris kenyoni*) (ESA – threatened; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Sea otters once occupied coastal waters all around the North Pacific rim from central Baja California to northern Japan, but their distribution is now discontinuous. Sea otters in eastern Russia, Alaska-British Columbia-Washington (called northern), and California are recognized as separate subspecies (Rice 1998). The southwest Alaska population is a part of the northern subspecies that occurs along the Alaska Peninsula and in the Aleutian Islands and eastern Bering Sea. The range of the southwest Alaska population extends from the western Aleutian Islands at the U.S.-Russia border to Cook Inlet. It is considered a taxon distinct from those to the west and east because of geographical barriers and morphological and genetic differences (Gorbics and Bodkin 2001).

History of evaluation and listing

The northern sea otter is under the jurisdiction of FWS. Milestones relative to the population's listing include the following:

- Population added to the list of candidate species for ESA listing in 2000.
- Petitioned to list sea otters in the Aleutian Islands as endangered or threatened under the ESA in 2000, but no action taken.
- Entire species listed as endangered by IUCN in 2000.
- Denied petition to list "Alaska stock" of sea otters as depleted under the MMPA in 2001.
- Southwest Alaska distinct population segment listed as threatened under the ESA in 2005.

The 2005 ESA listing notice for the southwest Alaska distinct population segment (70 Fed. Reg. 46366) included an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—This factor is not known to have been important in the decline.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—There is no commercial use of sea otters, and subsistence harvests are relatively low and do not pose an immediate threat.
C. *Disease or predation*—There is no evidence that disease has caused the population decline. Predation by killer whales has been identified as the most likely cause of the decline.
D. *The inadequacy of existing regulatory mechanisms*—Provisions of the MMPA allow for regulation of subsistence take by Alaska Natives and incidental take by commercial fisheries. Because those factors do not appear to be what is threatening the population, the MMPA was judged inadequate to prevent the continuing decline.
E. *Other natural or manmade factors affecting its continued existence*—Contaminants, particularly a large oil spill, could affect the remaining population.

The status of sea otters was evaluated by the IUCN Otter Specialist Group in 2000, and the species was listed by the IUCN as endangered based on criteria A1a, A1c, and A1e (IUCN 1996). Neither the northern subspecies nor the southwest Alaska population was evaluated as a separate taxon. Threats identified at the time were oil pollution, killer whale predation, poaching, and fishery interactions.

In 2001 FWS was petitioned by the Center for Biological Diversity to list the Alaska stock of sea otters as depleted under the MMPA (66 Fed. Reg. 46651), but the petition was denied. The agency found that "the petition does not present substantial information that the petitioned action is warranted. FWS has determined that the statewide population of sea otters in Alaska is larger than presented in the petition. Furthermore, the best available scientific information indicates that multiple stocks of sea otters exist in Alaska" (66 Fed. Reg. 55693). However, with listing of the southwest Alaska population as threatened under the ESA, the taxon qualified as depleted under the MMPA.

Available data

Almost no information is available documenting the recovery of southwest Alaska sea otters prior to the 1950s. From the late 1950s though the 1970s, however, some aerial survey counts were made in various parts of their range. In the 1980s the frequency of surveys increased significantly, including a few range-wide surveys completed during the past 20 years. Direct information on many population parameters (e.g., reproductive rates, mortality, survival rates, and age/sex) is very limited.

No models designed specifically for population viability analysis have been developed for southwest Alaska sea otters.

Current biological status

When sea otters became protected from commercial harvests in 1911, only 13 small remnant populations were known to exist, 6 of them within the bounds of the current southwest Alaska population (Kenyon 1969). With protection, southwest Alaska sea otters increased in abundance and may have been near carrying capacity in the 1980s when numbers were estimated at 55,100 to 73,700 in the Aleutian Islands alone. Surveys in 1992 indicated declines of more than 50 percent at some locations in the Aleutian Islands, and counts made in 2000 showed a further 70 percent decline during that eight-year interval. Additional surveys in 2000 and 2001 in Bristol Bay and along the Alaska Peninsula also showed major declines (Burn and Doroff 2005).

FWS published the most recent SAR for southwest Alaska sea otters in 2002 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR estimates the size of the population in 2002 as 41,474 and calculates a PBR of 830 animals. It states that the stock is considered strategic because it was a candidate species for ESA listing in 2002. The final rule on ESA listing gives a total population estimate of 41,865 for 2004, which compares to estimates of 94,050 to 128,650 in 1976 (70 Fed. Reg. 46366).

The cause or causes of the decline are not well understood. In good conditions, sea otter populations are capable of increasing at 17 to 20 percent per year (Estes 1990). For the southwest Alaska population there is no evidence for decreased reproduction or limitations due to food availability, which suggests that the current decline is caused by excessive mortality. Relatively small numbers of animals are killed in fishing gear and by Alaska Native subsistence hunters. One hypothesis suggests that increased predation by transient killer whales is the primary cause for the decline (Estes et al. 1998).

Caribbean monk seal (*Monachus tropicalis*) (ESA – endangered; IUCN – extinct; MMPA – depleted)

Distribution and conservation units

The Caribbean monk seal is known only from the Caribbean Sea, Gulf of Mexico, the subtropical coast of Florida, and adjacent subtropical areas, and is geographically isolated from other seals. It is now believed to be extinct (LeBoeuf et al. 1986).

History of evaluation and listing

The Caribbean monk seal is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESPA in 1967.
- Endangered status carried forward under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Listed as extinct by the IUCN in 1996.

No detailed explanation was given when the Caribbean monk seal was listed as endangered under the ESPA in 1967 (32 Fed. Reg. 4001). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The status of the Caribbean monk seal was most recently evaluated by the IUCN Seal Specialist Group in 1993, which noted that the species was believed to be extinct (Reijnders et al. 1993). In 1996 the IUCN listed the species as extinct (IUCN 1996).

Caribbean monk seals are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

Prior to listing under the ESPA in 1967, Caribbean monk seals were very poorly known. No directed studies have been undertaken since 1967. In the 1980s the Marine Mammal Commission supported a survey of fishermen in remote coastal villages on the Island of Hispaniola to determine if there had been any recent sightings, but no sighting reports were obtained (Woods 1987).

Current biological status

Caribbean monk seals were extensively hunted after the arrival of Europeans. The last confirmed sighting of this species in the United States was made in 1922, and the last sighting made anywhere was in 1952 at a remote bank off Honduras (Rice 1973). Although many (e.g., LeBoeuf et al. 1986 and IUCN 1996) consider the species to be extinct, Woods (1987) and Boyd and Standford (1998) present circumstantial evidence that a few individuals may still exist.

Hawaiian monk seal (*Monachus schauinslandi*) (ESA – endangered; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

The Hawaiian monk seal is geographically isolated from other seals and is considered a distinct species with no recognized subspecies (Rice 1998). The species exists as a metapopulation with six primary semi-isolated breeding colonies at Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and French Frigate Shoals. Although these colonies show considerable demographic independence (Ragen and Lavigne 1999) and are considered subpopulations, studies to date have found little genetic difference between them (Kretzmann et al. 1997, 2001). The Hawaiian monk seal occurs only in the Hawaiian archipelago with the majority of the population in the Northwestern Hawaiian Islands (Nihoa Island to Kure Atoll) and a relatively few animals in the main Hawaiian Islands (Hawaii Island to Niihau Island; Ragen and Lavigne 1999).

History of evaluation and listing

The Hawaiian monk seal is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species designated as depleted under the MMPA in 1976.
- Species listed as endangered under the ESA in 1976.
- Recovery plan adopted in 1983.
- Listed as endangered by the IUCN in 1996.
- Recovery plan revision currently underway.

The 1976 ESA listing notice (41 Fed. Reg. 33923) included an analysis of the five listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Human activity on beaches formerly used by monk seals has curtailed habitat use, displaced seals, and reduced recruitment. This was identified as the major factor threatening the species.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—This factor was not considered applicable.
C. *Disease or predation*—Shark predation, particularly on weaned pups, was identified as a problem for the reduced population. Disease was not known to be a factor.
D. *The inadequacy of existing regulatory mechanisms*—Although monk seals were afforded some protection by the Hawaiian Islands National Wildlife Refuge and the MMPA, additional protection, including protection for habitat, could be gained by ESA listing.

E. *Other natural or manmade factors affecting its continued existence*—Vessel traffic and recreational activities in waters where the species occurs may have deleterious effects.

The 1983 recovery plan (Gilmartin 1983) has not been updated although a new plan is currently being developed. The 1983 plan did not identify quantitative criteria for determining when the population had recovered but did describe the following four intermediate goals: (1) stopping the downward trend in numbers in the central and western portions of the species' range; (2) taking action to develop positive growth rates at most or all islands; (3) identifying and preventing human activities that could result in the degradation or destruction of habitats critical to the survival and recovery of the species; and (4) determining the population size that will result in maximum net productivity (Gilmartin 1983). The plan identified important threats as human disturbance (primarily from U.S. Coast Guard and Navy facilities), shark predation, mobbing by adult males, biotoxins (ciguatera), and entanglement in debris. A revision of the recovery plan is currently underway (NMFS in prep.[a]).

The status of the Hawaiian monk seal was most recently evaluated by the IUCN Seal Specialist Group in 1993 (Reijnders et al. 1993). Potential threats to its existence identified at the time were sensitivity to disturbance, male mobbing of adult females, and fishery interactions. In 1996 the IUCN listed the species as endangered based on criterion C2a (IUCN 1996).

NMFS published a proposed rule to designate the Hawaiian monk seal as a depleted species under the MMPA in 1976 (41 Fed. Reg. 24393) prior to its being proposed for ESA listing. The rationale given for a depleted listing was as follows: "Current population estimates indicate that the numbers of monk seals have been decreasing in recent years." No evaluation was done of the population's size relative to OSP. The species was subsequently designated as depleted (41 Fed. Reg. 30120).

<u>Available data</u>

Prior to listing under the ESA in 1976, information on Hawaiian monk seals was very limited. There are a few historical accounts, including some records of seal harvests from the 1800s, and a series of beach counts at various atolls in the Northwestern Hawaiian Islands beginning in 1956. Since 1976 an extensive monitoring program, funded and largely carried out by NMFS, has made Hawaiian monk seals one of the world's best-studied pinnipeds. Major components of the monk seal research program include (1) replicate beach counts at major pupping beaches conducted annually at most colonies since the early 1990s and periodically at many colonies since the 1970s; (2) life history records of a large proportion of individuals flipper-tagged at each major monk seal colony since the early 1980s (including information on age, sex, survivorship, and pupping intervals); (3) satellite tracking studies of seals at different colonies; (4) studies of prey preferences and foraging behavior; and (5) assessments of the health and condition of individuals.

Counts and life history data have been integrated into a population model that gives separate consideration to each major monk seal colony (Harting 2002). The model is suitable for PVA analysis but has not yet been used for that purpose.

Current biological status

The abundance of Hawaiian monk seals before the arrival of Polynesians is not known, but it is likely that the arrival of humans displaced seals from inhabited islands. The first comprehensive counts were made in 1958, and the population declined about 60 percent between then and 2001. Since regular counts began, the subpopulations have shown different dynamics. Counts at most locations declined after 1958, with the exception of French Frigate Shoals. That subpopulation grew rapidly from the early 1960s to the late 1980s, then declined by 70 percent during 1989–2001. Subpopulations at Laysan and Lisianski Islands have been relatively stable since 1990. In contrast, the subpopulation at Kure Atoll grew at an average rate of 5 percent per year after 1983, and the subpopulation at Pearl and Hermes Reef increased at approximately 7 percent per year during 1983–1999. Midway Islands was formerly largely unavailable to monk seals due to military presence, but its subpopulation began to increase after 1990. However, since 2000 all three of the western subpopulations have shown indications of decline. Based on increasing reports of pups being born in the main Hawaiian Islands, it appears that the number of monk seals has been increasing in that area since the 1990s (NMFS in prep.[a]).

NMFS published the most recent SAR for Hawaiian monk seals in 2005 (see http://www.nmfs .noaa.gov/pr/sars/species.htm). The SAR estimates the population size in 2003 as 1,252, and states that since 1993 the population has been declining at a rate of 1.9 percent per year. The SAR states that PBR is undetermined because recovery to MNPL would be unlikely in the foreseeable future if the calculated PBR level of takes was to occur. The Hawaiian monk seal is considered a strategic stock because it is listed as endangered under the ESA.

The declines in Northwestern Hawaiian Islands subpopulations have been attributed to low survival of juvenile seals, but it is not clear why survival has declined. Possible factors include shark predation, entanglement in marine debris, injuries and deaths caused by aggressive male seals, biotoxins, and/or nutritional limitations possibly related to climate cycles and/or commercial lobster fishing. Also, growth and reproductive rates vary among subpopulations, which suggests that some factor such as food availability is limiting reproductive output in some areas (NMFS in prep.[a]).

Guadalupe fur seal (*Arctocephalus townsendi*) (ESA – threatened; IUCN – vulnerable; MMPA – depleted)

Distribution and conservation units

The Guadalupe fur seal is considered to be a distinct species with a single breeding colony at Isla Guadalupe, Mexico (Reijnders et al. 1993, Rice 1998). Currently, a few animals occur in Southern California. Archeological remains indicate the species was taken prehistorically in California by Native Americans, but it is unclear whether breeding colonies ever occurred in California or if the species was ever abundant there (Hanni et al. 1997).

History of evaluation and listing

The Guadalupe fur seal is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESPA in 1967.
- Species listed as threatened under the ESA in 1985.
- Qualified as depleted under the MMPA in 1985 by virtue of listing under the ESA.
- Listed as vulnerable by the IUCN in 1996.

No detailed explanation was given when the Guadalupe fur seal was listed as endangered under the ESPA in 1967 (32 Fed. Reg. 4001). The species was not included on the 1970 list of species considered endangered under the ESCA (35 Fed. Reg. 18319), and there was no explanation given for its omission. This omission was carried forward when the ESA was passed in 1973, and the species therefore remained off the list until it was listed as threatened in 1985 (50 Fed. Reg. 51252). The listing notice included an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Habitat loss has not been the primary factor causing the reduced abundance of the species. Some human activities have the potential to affect their habitat, including offshore oil and gas development, high-intensity sonic booms from the U.S. Air Force's Space Shuttle Program, and disturbance by tourists and fishing vessels.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Prior commercial hunting was responsible for significantly reducing population size and range.
C. *Disease or predation*—There was no information available concerning disease or predation.
D. *The inadequacy of existing regulatory mechanisms*—Existing regulations were judged to be providing adequate protection within areas subject to Mexican and U.S. jurisdiction.
E. *Other natural or manmade factors affecting its continued existence*—The potential expansion of several fisheries into waters adjacent to Guadalupe Island could result in fur seal entanglement.

The ESA listing notice also provided the following criteria for determining when the species could be delisted: (1) the population has increased to 30,000 animals; (2) one or more additional rookeries have been established within the historic range; or (3) the population has reached the MNPL. If one or more criteria were met, NMFS would conduct a status review prior to proposing delisting.
The status of the Guadalupe fur seal was most recently evaluated by the IUCN Seal Specialist Group in 1993 (Reijnders et al. 1993). The only threat to its existence identified at the time was a possible lack of genetic diversity. In its 1996 Red Book, the IUCN listed the species as vulnerable based on criterion D2 (IUCN 1996).

Guadalupe fur seals are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

No breeding colonies of Guadalupe fur seals currently exist in U.S. waters, and a dedicated research program has not been established for this species in the United States. Following their near-extinction in the 1800s, almost no information was collected on the species until the 1950s. Since 1954 sporadic counts have been made at various times of the year at the rookery on Guadalupe Island. Reproduction, mortality, survival rates, and other population parameters are poorly known.

No models designed specifically for population viability analysis have been developed for Guadalupe fur seals.

Current biological status

Guadalupe fur seals were hunted nearly to extinction during the 19th century by commercial sealers and began to recover in the mid-20th century. NMFS published the most recent SAR for Guadalupe fur seals in 2000 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR gives a 1993 population estimate of 7,408, and states that the population had increased by 13.7 percent per year since the mid-1950s. It calculates a PBR of 104 animals and states that the Guadalupe fur seal is considered a strategic stock because it is listed as threatened under the ESA.

Northern fur seal, eastern Pacific (Pribilof Islands) population (*Callorhinus ursinus*) (ESA – not listed; IUCN – vulnerable; MMPA – depleted)

Distribution and conservation units

The northern fur seal is a distinct species with no recognized subspecies (Rice 1998). There are two populations recognized in U.S. waters: one that pups and breeds only at San Miguel Island in Southern California, and another that pups and breeds on rookeries in the Bering Sea (the eastern Pacific population). Fur seals from the eastern Pacific population mostly use several rookeries on St. George and St. Paul Islands in the Pribilof Islands. They also use a rookery on Bogoslof Island that was established naturally in the 1980s and has grown considerably since then. During the non-breeding season, fur seals range widely throughout the Bering Sea and North Pacific Ocean.

History of evaluation and listing

The northern fur seal is under the jurisdiction of NMFS. Milestones relative to the population's listing include the following:

- Population listed as depleted under the MMPA in 1988.
- Conservation plan adopted in 1993.
- Entire species listed as vulnerable by the IUCN in 1996.
- Conservation plan revision currently underway.

The status of the northern fur seal was most recently evaluated by the IUCN Seal Specialist Group in 1993 (Reijnders et al. 1993). Potential threats to its existence identified at the time were fishery interactions, entanglement in marine debris, and oil and gas exploration and development. In its 1996 Red Book, the IUCN listed the species as vulnerable based on criterion A1b (IUCN 1996). The eastern North Pacific population was not evaluated as a separate taxon.

The Pribilof Islands population of northern fur seals was designated as depleted under the MMPA in 1988 (51 Fed. Reg. 47156) because it had declined to a level less than 50 percent of what it was in the 1950s and there was no evidence that carrying capacity for the species had declined during that time. Therefore the population was determined to be below the lower bound of OSP, which was assumed to be 60 percent of K. The cause of the decline from 1956 to 1968 was thought to be commercial harvests of adult females. Declines after 1976 were thought to be a result of increased mortality of juveniles, perhaps due to entanglement in marine debris and/or changes in prey availability (NMFS 1993).

In 1993 NMFS published the Northern Fur Seal Conservation Plan. The goal of the plan is to "promote recovery of the fur seal population on the Pribilof Islands to a level appropriate to justify removal from MMPA listing" (NMFS 1993). It states that reconsideration of the depleted classification should occur when the sustained abundance (estimated population size or pup counts) reaches 60 percent of the peak historical estimate. The plan identified the following as human-related threats of possible importance at that time: incidental take in fisheries, competition for prey with commercial fisheries, entanglement in marine debris, disturbance and coastal development, toxic substances, and oil spills. A revised draft of the conservation plan is currently in agency review.

Available data

At one time Pribilof fur seals were the most intensely monitored pinniped in the world by virtue of their management under the Fur Seal Treaty of 1911. As part of efforts by Treaty parties—Russia, Japan, the United States, and Great Britain (for Canada)—to determine appropriate harvest levels, estimates of the number of pups, the number of breeding males, and the overall size of the Pribilof Islands fur seal herd were made annually throughout most of the 20th century. Until 1984 cooperative research among the Treaty parties also produced extensive data and analyses of other population parameters (e.g., survival rates by age and sex), at-sea distribution and movements, and feeding habits. The Treaty lapsed in 1984 and subsequently research efforts have decreased substantially. Because of funding limitations, research by NMFS has been limited largely to estimating key population parameters (e.g., the number of pups born and the number of breeding males) every other year in cooperation with the Pribilof Islands Aleut community.

A number of population models have been prepared for Pribilof Islands fur seals, but they have not been used for population viability analysis.

Current biological status

The size of the eastern Pacific population of northern fur seals has fluctuated considerably in the last 100 years, with recovery from overexploitation followed by periods of decrease and increase. As recently as the 1950s it was estimated to number about 2 to 2.5 million. NMFS published the most recent SAR for the population in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR estimates the population size as 688,028 (based on an extrapolation from pup counts made in 2004) and calculates a PBR of 14,546 animals. It states that the population is considered a strategic stock because it is listed as depleted under the MMPA. Counts of pups on the Pribilof Islands made during 1998–2004 have shown a steady decline (see http://nmml.afsc.noaa.gov/AlaskaEcosystems/nfshome/pribpup.htm). Potential causes for this most recent decline have not been identified. The colony on Bogoslof Island, however, has increased at a rate of about 12 percent per year since 1997 with pup production in 2005 estimated to exceed 12,000 pups.

Steller sea lion, eastern population (*Eumetopias jubatus*) (ESA – threatened; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Steller sea lions are a distinct species with no recognized subspecies (Rice 1998). However, two discrete populations are recognized, both of which are currently considered distinct population segments under the ESA and listed separately. The two populations are the eastern population, which includes animals from Cape Suckling, Alaska, east and south to California, and the western population, which includes animals from west of Cape Suckling to Russia. Eastern population Steller sea lions pup and breed on rookeries, and occupy haulouts, in southeast Alaska, British Columbia, Washington, Oregon, and California (NMFS 1995).

History of evaluation and listing

Steller sea lions are under the jurisdiction of NMFS. Milestones relative to the population's listing include the following:

- Advance notice of proposed rulemaking published to designate the entire species as depleted under the MMPA in 1988.
- Entire species listed as threatened under the ESA in 1990.
- Qualified as depleted under the MMPA in 1990 by virtue of listing under the ESA.
- Recovery plan adopted in 1992.
- Species listed as endangered by the IUCN in 1996.
- ESA listing revised in 1997; species split into two populations and the eastern population left as threatened.
- Revised recovery plan released for public review in 2006.

The status of Steller sea lions was first reviewed in 1988 (55 Fed. Reg. 16299). The review concluded that the number of adult and juvenile Steller sea lions counted in southwest Alaska had declined by at least 52 percent from 1956–1960 to 1985. Potential causes of the decline being investigated at the time of the review included fishery interactions, environmental changes, diseases, contaminants, predation, and commercial and subsistence harvests.

In 1990 the Steller sea lion was listed as threatened under the ESA throughout its range because NMFS determined that, given is declining trend, it was likely to become an endangered species within the foreseeable future (55 Fed. Reg. 49204). The 1990 listing notice included an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Activities that result in disturbance or changes in prey availability could be affecting suitability of habitat.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Commercial harvests of pups prior to the 1970s could explain early parts of the declines in some areas. Subsistence takes by Alaska Natives have been too small to have caused the overall decline.
C. *Disease or predation*—Disease was unlikely to have been a significant factor in the decline. Killer whale predation was probably unimportant when the sea lion population was high but could exacerbate a decline once numbers have been reduced.
D. *The inadequacy of existing regulatory mechanisms*—The MMPA prohibits most taking and has a mechanism to limit incidental take by fisheries. No inadequacies were noted.
E. *Other natural or manmade factors affecting its continued existence*—Incidental take in fisheries and intentional shooting may have had some impact but cannot explain the overall decline.

The 1992 Final Recovery Plan for Steller Sea Lions states its goal as "to promote the recovery of the Steller sea lion population to a level appropriate to justify removal from ESA listings" (NMFS 1992). The plan includes quantitative criteria that the recovery team recommended for reclassification and delisting based on counts and trends in counts of pup and non-pup Steller sea lions in the principal area of decline and elsewhere. However, the approved plan states that NMFS would not implement those recommendations, but instead would develop final criteria after further analyses, including a population viability analysis. Human-related threats identified in the plan were subsistence harvests, fishery-related taking, competition for food with commercial fisheries, toxic substances, entanglement in debris, and disturbance.

NMFS published a second status review of Steller sea lions in 1995. The review concluded that the species should be split into two populations. The eastern population was predicted to persist for the foreseeable future because its population trend was stable or increasing. No evaluation was done of ESA listing factors and no specific threats to the population were identified (NMFS 1995).

In 1997 NMFS revised the ESA listing to reflect new information on the species' population structure and status. It retained the classification of threatened for the eastern population based on the following rationale: "The eastern population segment has exhibited a stable population trend for the last 15 years; however, NMFS believes that the large decline within the overall U.S. population threatens the continued existence of the entire species. This is particularly true, since the underlying causes of the decline remain unknown and thus unpredictable. Therefore, despite the apparent stability of the eastern population segment, NMFS is maintaining a threatened listing for this portion of the geographic range" (62 Fed. Reg. 24345).

The 1997 listing notice included an analysis of the five ESA listing factors for the eastern population that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Human disturbance may have had an effect at certain rookeries in Oregon and California, and changes may have occurred in prey resources in California due to natural cycles, fisheries, and toxic substances.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Commercial harvest and illegal shooting may have been significant factors in the past but are not considered major factors at this time. Utilization for scientific or educational purposes has not been a significant factor.
C. *Disease or predation*—Neither disease nor predation is considered a significant factor currently affecting the population.
D. *The inadequacy of existing regulatory mechanisms*—The listing states, "A final determination with respect to whether existing regulatory mechanisms are adequate is difficult to make, given the lack of a clear cause of the decline."
E. *Other natural or manmade factors affecting its continued existence*—Removals from the eastern population due to incidental takes in fisheries and Alaska Native subsistence hunting are low. Concern has been expressed about the possible adverse effects of anthropogenic contaminants on the health and productivity of animals in California.

In May 2006 NMFS released a revised draft Steller Sea Lion Recovery Plan for public review (71 Fed. Reg. 29919).

The status of the Steller sea lion was most recently evaluated by the IUCN Seal Specialist Group in 1993 (Reijnders et al. 1993). Potential threats to its existence identified at the time were deliberate killing by fishermen, incidental take by fisheries, reduced food supply, and disease. In its 1996 Red Book, the IUCN listed the entire species as endangered based on criterion A1b (IUCN 1996). The status of the eastern population was not evaluated separately.

In 1988 NMFS published an advance notice of proposed rulemaking to list Steller sea lions as depleted under the MMPA, citing results of its status review and stating that "the current population may be below 50 percent of historic carrying capacity and below the lower bound of OSP for this population" (55 Fed. Reg. 16299). NMFS did not follow through on the depletion designation but instead proceeded to list Steller sea lions under the ESA. Therefore, the eastern population of Steller sea lions is considered as depleted under the MMPA because it is listed under the ESA. Its status relative to OSP has not been evaluated.

Available data

The basic population data available for Steller sea lions are counts of animals (usually both pups and non-pups) on rookeries during the pupping and breeding season. For California and British Columbia, some counts are available starting in the early 1900s. For Oregon and southeast Alaska, systematic counts began in the mid to late 1970s. Since sea lions were listed under the ESA in 1990, all major rookeries have been counted at regular intervals, usually every other year.

Prior to ESA listing, Steller sea lion research was funded and conducted primarily by NMFS and State agencies, especially the Alaska Department of Fish and Game (ADFG). After listing, Congress began to annually appropriate additional funds to investigate causes of the population's decline. Initially funding was earmarked primarily to support work by NMFS and ADFG, but later it was expanded to include a number of universities and other research and management agencies. Data have been gathered on a variety of subjects including distribution, abundance, movements, stock structure, vital parameters, life history, foraging ecology, behavior, physiology, contaminants, predation, and disease. The majority of effort has gone to studies of the western population, but significant data have been gathered also for the eastern population.

A model that can be used for population viability analysis has recently been developed for Steller sea lions (NMFS in prep.[b]).

Current biological status

NMFS published the most recent SAR for the eastern population of Steller sea lions in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR estimates total abundance as 44,996 (based on pup counts made in 2002) and calculates a PBR of 1,967 animals. It states that the eastern population of Steller sea lions is considered a strategic stock because it is listed as threatened under the ESA. Based on pup counts, Pitcher et al. (2007) estimate that the eastern population's abundance increased at a rate of 3.1 percent per year from the 1970s to 2005.

Steller sea lion, western population (*Eumetopias jubatus*) (ESA – endangered; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Steller sea lions are a distinct species with no recognized subspecies (Rice 1998). However, two discrete populations are recognized, both of which are currently considered distinct population segments under the ESA and listed separately. The two populations are the eastern population, which includes animals from Cape Suckling, Alaska, east and south to California, and the western population, which includes animals from west of Cape Suckling to Russia. Steller sea lions range around the rim of the North Pacific Ocean from California through Alaska and to Russia and Japan

(NMFS 1992). Western sea lions pup and breed on rookeries, and occupy haulouts, in central and western Alaska, eastern Russia, and northern Japan (NMFS 1995).

History of evaluation and listing

Steller sea lions are under the jurisdiction of NMFS. Milestones relative to the population's listing include the following:

- Advance notice of proposed rulemaking published to designate the entire species as depleted under the MMPA in 1988.
- Entire species listed as threatened under the ESA in 1990.
- Qualified as depleted under the MMPA in 1990 by virtue of listing under the ESA.
- Recovery plan adopted in 1992.
- Species listed as endangered by the IUCN in 1996.
- ESA listing revised in 1997; species split into two populations and the western population reclassified as endangered.
- Revised recovery plan released for public review in 2006.

The status of Steller sea lions was first reviewed in 1988 (55 Fed. Reg. 16299). The review concluded that the number of adult and juvenile Steller sea lions counted in southwest Alaska had declined by at least 52 percent from 1956–1960 to 1985. Potential causes of the decline being investigated at the time of the review included fishery interactions, environmental changes, diseases, contaminants, predation, and commercial and subsistence harvests.

In 1990 the Steller sea lion was listed as threatened under the ESA because NMFS determined that it was likely to become an endangered species within the foreseeable future, given its ongoing decline (55 Fed. Reg. 49204). The 1990 listing notice included an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Activities that result in disturbance or changes in prey availability could be affecting suitability of habitat.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Prior commercial harvests of pups could explain early parts of the declines in some areas. Alaska Native subsistence takes have been too small to have caused the overall decline.
C. *Disease or predation*—Disease was unlikely to have been a significant factor in the decline. Killer whale predation was probably unimportant when the sea lion population was high but could exacerbate a decline once numbers have been reduced.
D. *The inadequacy of existing regulatory mechanisms*—The MMPA prohibits most taking and has a mechanism to limit incidental take by fisheries. No inadequacies were noted.
E. *Other natural or manmade factors affecting its continued existence*—Incidental take in fisheries and intentional shooting may have had some impact but cannot explain the overall decline.

The 1992 Final Recovery Plan for Steller Sea Lions states its goal as "to promote the recovery of the Steller sea lion population to a level appropriate to justify removal from ESA listings" (NMFS 1992). The plan includes quantitative criteria that the recovery team recommended for reclassification and delisting based on counts and trends in counts of pup and non-pup Steller sea lions in the principal area of decline and elsewhere. However, the approved plan states that NMFS would not implement those recommendations but instead would develop final criteria after further analyses, including a population viability analysis. Human-related threats identified in the plan were subsistence harvests, fishery-related taking, competition for food with commercial fisheries, toxic substances, entanglement in debris, and disturbance.

NMFS published a second status review of Steller sea lions in 1995. The review concluded that the species should be split into two populations. Models using historical trends predicted that the western population could be reduced to very low levels within 100 years. The review concluded that the proximate cause of the population decline was primarily a reduction in juvenile survival, and that disease and changes in prey abundance were the most likely causes of that change. No evaluation was done of ESA listing factors (NMFS 1995).

In 1997 NMFS revised the ESA listing to reflect new information on the species' population structure and status. It changed the classification of the western population to endangered based on the following rationale: "Available data on population trends indicate that the western population segment of Steller sea lions is in danger of extinction throughout all or a significant part of its range. This population had exhibited a precipitous, large population decline at the time that the Steller sea lion was listed as a threatened species in 1990 and has continued to decline since the listing. Therefore, the western population segment of Steller sea lions is reclassified as an endangered species under the ESA" (62 Fed. Reg. 24345).

The 1997 listing notice included an analysis of the five ESA listing factors for the western population that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—There is no evidence that habitat factors are significant issues.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Commercial harvest and illegal shooting may have been significant factors in past declines but are not a major cause of recent population changes. Utilization for scientific or educational purposes has not been a significant factor.
C. *Disease or predation*—Disease and predation are not considered significant factors currently affecting the population.
D. *The inadequacy of existing regulatory mechanisms*—The listing states, "A final determination with respect to whether existing regulatory mechanisms are adequate is difficult to make, given the lack of a clear cause of the decline."
E. *Other natural or manmade factors affecting its continued existence*—Incidental catch in fisheries may have been a contributing factor to declines in some areas during certain periods. Alaska Native subsistence hunting may become significant if the population continues to decline

> and harvests continue at current levels. There is evidence that limitations in food availability, due either to commercial fishing or environmental changes, may be a factor in the ongoing decline. Concern has been expressed about possible effects of contaminants, but their possible significance is unknown.

In May 2006 NMFS released a revised draft Steller Sea Lion Recovery Plan for public review (71 Fed. Reg. 29919).

The status of the Steller sea lion was most recently evaluated by the IUCN Seal Specialist Group in 1993 (Reijnders et al. 1993). Potential threats to its existence identified at the time were deliberate killing by fishermen, incidental take by fisheries, reduced food supply, and disease. In its 1996 Red Book, the IUCN listed the entire species as endangered based on criterion A1b (IUCN 1996). The status of the western population was not evaluated separately.

In 1988 NMFS published an advance notice of proposed rulemaking to list Steller sea lions as depleted under the MMPA citing results of its status review and stating that "the current population may be below 50 percent of historic carrying capacity and below the lower bound of OSP for this population" (55 Fed. Reg. 16299). NMFS did not follow through on the depletion designation but instead proceeded with listing Steller sea lions under the ESA. Therefore, the western population of Steller sea lions is considered as depleted under the MMPA because it is listed under the ESA. Its status relative to OSP has not been evaluated.

Available data

The basic population data available for Steller sea lions are counts of animals (usually both pups and non-pups) on rookeries during the pupping and breeding season. The first systematic counts of the western population were made in the Gulf of Alaska and Aleutian Islands in the late 1950s. Subsequent counts were made during 1975–1979, 1984–1985, and 1989–1990. Since sea lions were listed under the ESA in 1990, all major rookeries have been counted at regular intervals, usually every other year.

Prior to ESA listing, research on the western stock of Steller sea lions was funded and conducted primarily by NMFS and ADFG. During 1975–1979 a major research project funded by the Outer Continental Shelf Environmental Assessment Program produced detailed information on the distribution, abundance, and life history of sea lions, principally in the Gulf of Alaska. After ESA listing, Congress began to appropriate additional funds annually to investigate the population's decline. Initially, funding was earmarked primarily to support work by NMFS and ADFG, but later it expanded to include a number of universities and other research and management agencies. Data have been gathered on a variety of subjects including distribution, abundance, movements, stock structure, vital parameters, life history, foraging ecology, behavior, physiology, contaminants, predation, and disease. The majority of effort has gone to studies of the western population, and a huge amount of information has been collected.

A model that can be used for population viability analysis has recently been developed for Steller sea lions (NMFS in prep.[b]).

Current biological status

NMFS published the most recent SAR for the western population of Steller sea lions in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR gives a minimum abundance of 38,513 (based on counts made in 2001–2004) and states that the population declined by 3.1 percent per year from 1991 to 2004. It calculates a PBR of 231 animals and states that the population is considered a strategic stock because it is listed as endangered under the ESA. Trend counts for the western Steller sea lion population declined by 81 percent from 109,880 in the late 1970s to 20,563 in 2004. The most recent count data suggest that the decline may have stopped and that sea lion numbers are increasing slowly in some regions (see http://nmml.afsc.noaa.gov/AlaskaEcosystems/sslhome/decline.htm).

Although reproductive and mortality rates are poorly known, the proximate cause of the decline is likely to be poor survival, especially of juveniles (NRC 2003). One theory has proposed that much of the mortality may be due to killer whale predation (Springer et al. 2003). The SAR notes that another possibility is that prey availability in sea lion foraging area has been reduced by commercial fishing and/or climate changes.

Blue whale (*Balaenoptera musculus*) (ESA – endangered; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

The blue whale is a cosmopolitan species with four recognized subspecies, one of which occurs in the Northern Hemisphere (Rice 1998). Current information suggests that multiple populations occur within different ocean basins. The Recovery Plan for the Blue Whale discusses North Atlantic and North Pacific populations separately (NMFS 1998a). For purposes of SARs required by the MMPA, NMFS has identified three stocks—western North Atlantic, eastern North Pacific (formerly called California/Mexico), and western North Pacific (formerly called Hawaii). Blue whales range widely in the North Atlantic and North Pacific from the subtropics to the subarctic, and are most common in offshore waters (Perry et al. 1999).

History of evaluation and listing

The blue whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.

- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- North Pacific population listed as lower risk and North Atlantic population as vulnerable by the IUCN in 1996.
- Recovery plan adopted in 1998.

No detailed explanation was given when the blue whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The Recovery Plan for the Blue Whale states its goal as "to promote the recovery of blue whale populations so that it becomes appropriate to remove them from the list of Endangered and Threatened Wildlife under the Endangered Species Act" (NMFS 1998a). Threats identified in the plan were collisions with vessels, entanglement in fishing gear, reduced food availability due to habitat degradation, and disturbance from low-frequency noise.

The most recent review of the status of blue whales under the ESA was published in 1999 (Perry et al. 1999). The review states, "Any reevaluation of blue whale status awaits the collection of more reliable information on stock structure, distribution and migration patterns, trends in abundance, causes of mortality, and factors affecting the recovery of blue whale stocks, as well as the development of objective delisting criteria." It recommends that the classification status of all blue whale stocks should remain as endangered. ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (offshore oil and gas development and noise from vessel traffic); overutilization (whale-watching, scientific research, photography, and associated vessel traffic); and other factors (vessel collisions and entanglement in fishing gear).

In 1996 the IUCN listed the blue whale species as endangered based on criteria A1a, A1b, and A1d (IUCN 1996). The North Atlantic population was listed as vulnerable based on criterion D1, and the North Pacific population was listed as lower-risk, conservation-dependent.[3] The status of blue whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). The report states that at the time there were no well-identified threats from human activities but notes that blue whales could be susceptible to changes in ocean productivity such as might result from climate change.

Blue whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

[3] The category of "lower-risk, conservation-dependent" is no longer in use, but the categorization for this taxon has not been changed because a formal reassessment of status has not been done.

Available data

Prior to listing under the ESCA in 1970, information on blue whales in U.S. waters was limited almost exclusively to historical whaling records and reports of scattered opportunistic sightings. Since then, there had been almost no directed studies to assess the status of blue whales in U.S. waters until the past few years. Recent studies include seasonal surveys to (1) count and photo-identify blue whales on feeding grounds in the eastern North Pacific (i.e., off the coast of California, Oregon, and Washington); (2) track the movements of whales using satellite tags after they leave waters off California; and (3) assess blue whale distribution and stock structure in the North Pacific and North Atlantic Oceans using acoustic recordings of their calls. Information on blue whales in U.S. waters, particularly in the North Atlantic Ocean, is generally very poor.

No models designed specifically for population viability analysis have been developed for blue whale populations in U.S. waters.

Current biological status

Blue whale populations in both the North Atlantic and North Pacific were greatly reduced by commercial whaling during the early and mid-1900s (NMFS 1998a). Gambell (1976) gives pre-exploitation population estimates of 4,900 blue whales for the entire North Pacific and 1,100 to 1,500 for the entire North Atlantic, but those estimates are considered speculative and statistically unreliable (Perry et al. 1999). NMFS published the most recent SARs for the western North Atlantic stock of blue whales in 2002 and the eastern and western North Pacific stocks in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). Stock status parameters given in the SARs are shown here.

Stock name	Abundance	PBR	Trend	Classification
Western North Atlantic	No reliable estimate	Unknown	Insufficient data	Strategic
Eastern North Pacific	1,744*	1.4	Possibly increasing	Strategic
Western North Pacific	No reliable estimate	Unknown	Insufficient data	Strategic

*A more recent analysis of ship survey data gave an estimate of 2,994 blue whales off Baja California, California, Oregon, and Washington during 1991–1996 (Calambokidis and Barlow 2004).

Bowhead whale, western Arctic population (*Balaena mysticetus*) (ESA – endangered; IUCN – lower risk; MMPA – depleted)

Distribution and conservation units

Bowhead whales are currently considered a single species with no identified subspecies (Rice 1998). Five populations are recognized for management purposes, only one of which, the western Arctic (also called Bering Sea or Bering–Chukchi–Beaufort Seas) population, occurs in U.S. waters (Shelden and Rugh 1995). Western Arctic bowhead whales range seasonally throughout the northern Bering, Chukchi, and Beaufort Seas, usually in association with sea ice.

History of evaluation and listing

The western Arctic bowhead whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Listed as lower-risk, conservation-dependent by the IUCN in 1996.

No detailed explanation was given when the bowhead whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time. A recovery plan has not been prepared for bowhead whales.

A review of the status of bowhead whales under the ESA was conducted in 1995. It concluded that the western Arctic stock was relatively large and had been increasing (Shelden and Rugh 1995). Although bowhead whales are killed by subsistence hunters, attacked by killer whales, and may die as a result of entanglement in fishing gear, the principal threat to the population identified in the review was impacts associated with offshore oil and gas development. No analysis was done of ESA listing factors, and the review made no recommendations on the population's status under ESA because objective criteria for downlisting or delisting had not been developed.

Shelden et al. (2001) proposed methods for developing objective criteria to classify species under the ESA, using bowhead whales as a case study. They reviewed the five ESA listing factors and concluded that they do not provide compelling reasons for listing western Arctic bowhead whales. They then applied a modeling approach developed by Gerber and DeMaster (1999) and concluded that, based on those results, the western Arctic population should be delisted under the ESA.

In 1996 the IUCN listed the western Arctic bowhead whale population as lower-risk, conservation-dependent[4] (IUCN 1996). The status of bowhead whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Its report notes that the western Arctic population has been growing for the past 20 years despite subsistence hunting. No potential threats to its existence were identified at the time.

The western Arctic bowhead whale population is designated as depleted under the MMPA because of its ESA listing. The population's status relative to OSP has not been evaluated. Shelden and Rugh

[4] See note 3 above.

(1995) provided an estimate of the lower end of the OSP range as 6,500 to 10,500, based on an estimated initial stock size of 10,945 to 17,431 (IWC 1995) and an assumption that the MNPL is 60 percent of K.

Available data

Prior to listing under the ESCA in 1970, information on bowhead whales in U.S. waters was limited almost exclusively to historical whaling records and reports of scattered opportunistic sightings. Since 1978 directed studies of western Arctic bowhead whales have been funded and conducted by NMFS, Minerals Management Service, Alaska Eskimo Whaling Commission, and North Slope Borough. The western Arctic bowhead whale population is now one of the best-studied large whale populations in the world. Principal research efforts have included periodic counts of migrating whales as they pass along the ice edge near Point Barrow to estimate the size of the population. Counts have been supplemented by acoustic surveys to account for whales passing by the counting stations beyond visual range. Population size also was estimated from aerial surveys in 1985 and 1986 using aerial photographs of whales and capture-recapture methods. The results have provided a good estimate of population size and trends over the past two decades. More recent studies include satellite-tracking work, genetic analyses to assess stock structure, and additional aerial photogrammetry studies to estimate stock size using mark-recapture methods. A number of studies have been done to evaluate the potential impacts of human activities, particularly noise from oil and gas exploration and development, on western Arctic bowhead whales.

A population viability analysis done for bowhead whales concluded that the western Arctic population should be delisted under the ESA (Shelden et al. 2001).

Current biological status

Bowhead whale numbers were severely reduced throughout the Arctic by commercial whaling in the 1800s and early 1900s. The pre-exploitation abundance of the western Arctic population was estimated to be 23,000 by Woodby and Botkin (1993) and 10,945 to 17,431 by the International Whaling Commission (1995). NMFS published the most recent SAR for the western Arctic population of bowhead whales in 2005 (see www.nmfs.noaa.gov/pr/sars/species.htm). The SAR estimates the population size as 10,545 and increasing at 3.4 percent per year. It calculates a PBR of 95 animals and states that western Arctic bowheads are considered a strategic stock because they are listed as endangered under the ESA.

The primary source of human-caused mortality for this population is subsistence hunting by Alaska Natives. Such hunting is closely regulated both by a cooperative agreement between NMFS and the Alaska Eskimo Whaling Commission and by the IWC.

Fin whale (*Balaenoptera physalus*) (ESA – endangered; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

The fin whale is a cosmopolitan species with two recognized subspecies: one in the Northern Hemisphere and the other in the Southern Hemisphere (Rice 1998). Animals in the North Atlantic and North Pacific are likely isolated, and the draft Recovery Plan for the Fin Whale and Sei Whale deals with them as separate populations (NMFS 1998b). For purposes of SARs required by the MMPA, NMFS has identified four stocks—western North Atlantic, California-Oregon-Washington, northeast Pacific, and Hawaii. Fin whales are an oceanic species that seasonally move north or south. In general, wintering areas and migration routes are poorly known (Perry et al. 1999).

History of evaluation and listing

The fin whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Listed as endangered by the IUCN in 1996.
- Draft recovery plan prepared in 1998 but not adopted.
- Draft recovery plan released for public review in 2006.

No detailed explanation was given when the fin whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

A draft Recovery Plan for the Fin Whale and Sei Whale was prepared by NMFS in 1998, but no action was taken to adopt it. The draft plan stated that its goal was "to promote recovery of all fin and sei whale populations to levels at which it becomes appropriate to downlist them from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA" (NMFS 1998b). Threats identified in the plan were vessel interactions (collisions and noise), entanglement in fishing gear, disturbance from low-frequency noise, and hunting. In July 2006 NMFS released a revised draft Recovery Plan for the Fin Whale for public review (71 Fed. Reg. 38385).

The most recent status review of fin whales under the ESA was published in 1999 (Perry et al. 1999). The review states, "Any reevaluation of fin whale status awaits the collection of more reliable information on stock structure, distribution and migration patterns, trends in abundance, causes of mortality, and factors influencing the recovery of fin whale stocks, as well as the development of objective delisting criteria." It makes no specific recommendation for reclassifying or delisting the species under the ESA. The ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (offshore oil and gas development); overutilization (whale-watching, scientific research, photography and associated vessel traffic, West Greenland and Icelandic harvests); disease (nematode infestations); and other factors (vessel collisions).

In 1996 the IUCN listed fin whales worldwide as endangered based on criteria A1a, A1b, and A1d (IUCN 1996). Individual populations were not evaluated separately. The status of fin whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Ship strikes were identified as a potential threat in that review.

Fin whales are considered as depleted under the MMPA because of their ESA listing. No formal evaluation has been conducted of their status relative to OSP.

Available data

Prior to listing under the ESCA in 1970, information on fin whales in U.S. waters was limited almost exclusively to data associated with efforts to manage commercial whaling (e.g., catch and sighting records and tag recovery). Since 1970 there have been very few studies directed specifically at fin whales in U.S. waters. Available information is limited largely to sighting data collected during aerial and shipboard surveys for marine mammals, stranding records, and a few photo-identification studies in localized areas. Recordings of fin whale calls have been analyzed to assess their distribution in the North Pacific, and fin whale sightings along the eastern United States were analyzed as part of a series of marine mammal and turtle surveys supported by the Bureau of Land Management between 1979 and 1981. For populations in U.S. waters, information on abundance, population dynamics, and trends is very limited.

No models designed specifically for population viability analysis have been developed for fin whale populations in U.S. waters.

Current biological status

Populations of fin whales in both the North Atlantic and North Pacific were greatly reduced by commercial whaling during the early and mid-1900s (NMFS 1998b). Pre-exploitation population estimates for fin whales are 42,000 to 45,000 for the entire North Pacific and 30,000 to 50,000 for the entire North Atlantic (Perry et al. 1999). NMFS published the most recent SARs for the California-Oregon-Washington stock of fin whales in 2003 and for the western North Atlantic, the northeastern Pacific, and the Hawaii stocks in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). Stock status parameters given in the SARs are shown on the opposite page.

Stock name	Abundance	PBR	Trend	Classification
Western North Atlantic	2,814	4.7	Insufficient data	Strategic
California-Oregon-Washington	3,279	15.0	Possibly increasing	Strategic
Northeastern Pacific	5,703	11.4	Insufficient data	Strategic
Hawaii	174	0.2	Insufficient data	Strategic

Humpback whale (*Megaptera novaeangliae*) (ESA – endangered; IUCN – vulnerable; MMPA – depleted)

<u>Distribution and conservation units</u>

Humpback whales occur in all the world's oceans except the Arctic Ocean and are currently considered a single species with no recognized subspecies (Rice 1998). They typically feed in summer at higher latitudes and winter at lower latitudes where they calve and breed. Based on whaling records, photographic resightings, and genetics data, about a dozen populations have been identified worldwide, with geographically distinct calving and breeding areas (Perry et al. 1999). The Recovery Plan for the Humpback Whale considers three populations in U.S. waters: one in the western North Atlantic, another in the central North Pacific, and a third in the eastern North Pacific (NMFS 1991a). In at least some instances, humpback whales show fidelity to specific summer feeding areas (Perry et al. 1999), and those feeding aggregations also may comprise important conservation units. For purposes of preparing SARs required by the MMPA, NMFS has identified four stocks—Gulf of Maine (formerly called the western North Atlantic stock), eastern North Pacific (formerly called the California-Oregon-Washington-Mexico stock), central North Pacific, and western North Pacific.

<u>History of evaluation and listing</u>

The humpback whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Recovery plan adopted in 1991.
- Listed as vulnerable by the IUCN in 1996.

No detailed explanation was given when the humpback whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The Final Recovery Plan for the Humpback Whale states its long-term goal as "to increase humpback whale populations to at least 60 percent of the number existing before commercial exploitation or of current environmental carrying capacity" and its interim goal as "a doubling of extant populations within the next 20 years" (NMFS 1991a). Threats identified in the plan were subsistence hunting, entanglement in fishing gear, collisions with vessels, acoustic disturbance, habitat degradation, and competition with humans for food resources.

The most recent review of the status of humpback whales under the ESA was published in 1999 (Perry et al. 1999). It states as follows: "Assuming that abundance levels are accurate and continue to increase, anthropogenic threats are reduced, adequate monitoring plans are developed and implemented, and information on population trends continue to be collected, the western North Atlantic and central North Pacific stocks should be considered for downlisting to threatened status." This recommendation was apparently based in part on an unpublished paper by Gerber and DeMaster (1997) that developed possible classification criteria for humpback whales based on abundance, trends in abundance, changes in distribution, and regulatory status. ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (vessel traffic, oil and gas exploration); channel dredging and coastal development (western North Atlantic stock only); overutilization (whale-watching, scientific research, photography, and associated vessel traffic); hunting by whalers near West Greenland and St. Vincent and the Grenadines (western North Atlantic stock only); disease (saxitoxin—western North Atlantic stock only); and other factors (entanglement in fishing gear, vessel collisions, and human depletion of fish stocks—western North Atlantic stock only). Subsequently, Gerber and DeMaster (1999) proposed quantitative criteria for classifying humpback whales under the ESA and concluded as follows: "It was determined that the best estimates of current abundance for the central population of North Pacific humpback whales were larger than the estimated threshold for endangered status but less than the estimated threshold for threatened status. If accepted by the responsible management agency, this analysis would be consistent with a recommendation to downlist the central stock of humpback whales to a status of threatened, whereas the status of eastern and western stocks would remain endangered."

In 1996 the IUCN listed humpback whales worldwide as vulnerable based on criteria A1a and A1d (IUCN 1996). Individual populations were not evaluated separately. The status of humpback whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Potential threats identified in the review include ship collisions, entanglement in fishing gear, and noise disturbance, but the report notes that humpbacks seem able to tolerate living in close proximity to many human activities.

Humpback whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

Prior to listing under the ESCA in 1970, information on humpback whales in U.S. waters was limited almost exclusively to data associated with efforts to manage commercial whaling (e.g., catch and sighting records and tag recovery). Since then, a considerable amount of information has been gathered on humpback biology, especially in their nearshore calving and feeding areas. Some of this work has been funded and conducted by NMFS, but large contributions have been made by many other organizations and individuals. The development of methods to identify individuals from markings on their flukes has produced data on stock structure, movements, and vital rates. Photo-identification data have also been used to estimate population sizes using mark-recapture methods. Information on mortality has been collected through regional stranding programs. Genetic analyses of biopsy samples have been used to examine population structure. A number of animals have been tagged with satellite-linked transmitters that have produced data on movements and behavior. Additional data on distribution and abundance has been collected during aerial and shipboard surveys for other marine mammals.

During the 1980s and early 1990s a number of researchers studied humpback whales, often independently collecting data in small parts of a population's range. However, in 1992–1993 investigators from several institutions and several countries came together to conduct a cooperative international study called YoNAH (Years of the North Atlantic Humpback), which produced a comprehensive picture of the biology of North Atlantic humpback whales. More recently a similar international program called SPLASH (Structure of Populations, Levels of Abundance, and Status of Humpbacks) has been initiated to assess and sample humpback whales throughout the North Pacific Ocean.

No models designed specifically for population viability analysis have been developed for humpback whale populations in U.S. waters.

Current biological status

All humpback whale populations in the Northern Hemisphere were reduced by commercial whaling between the mid-1800s and mid-1900s (NMFS 1998b). The pre-exploitation abundance of humpback whales for the entire North Pacific Ocean has been estimated as 15,000, but there is no comparable estimate for the North Atlantic (Perry et al. 1999). NMFS published the most recent SARs for humpbacks in the Gulf of Maine, the eastern North Pacific, the central North Pacific, and the western North Pacific in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). Stock status parameters given in the SARs are shown on the following page.

Stock name	Abundance	PBR	Trend	Classification
Gulf of Maine*	902	1.3	Increasing	Strategic
Eastern North Pacific	1,391**	2.3	Increasing	Strategic
Central North Pacific	4,005	12.9	Increasing	Strategic
Western North Pacific	394	1.3	Insufficient data	Strategic

*Most humpback whales in the North Atlantic are part of a single large population that breeds in the West Indies in winter and disperses to various feeding grounds, including the Gulf of Maine, in summer. Based on data from 1979 to 1993, Stevick et al. (2003) estimated the size of the "West Indies population" at 10,752 whales with an annual rate of increase at 3.1 percent.
**Calambokidis and Barlow (2004) estimate an abundance of 687 whales for the eastern North Pacific population.

North Atlantic right whale (*Eubalaena glacialis*) (ESA – endangered[5]; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Right whales occur in temperate to subtropical latitudes in both the Northern and Southern Hemispheres. The initial Recovery Plan for the Northern Right Whale treated all Northern Hemisphere right whales as a single species with two populations (NMFS 1991b). However, the current convention is to recognize the North Atlantic right whale (*E. glacialis*) and North Pacific right whale (*E. japonica*) as separate species (Rosenbaum et al. 2000). The revised recovery plan dealt only with *E. glacialis* (NMFS 2005), and NMFS is currently taking steps to recognize current right whale taxonomy in ESA listings (68 Fed. Reg. 17560). Western North Atlantic right whales feed between spring and fall in waters off New England and southeastern Canada. In fall, reproductive females and some juveniles migrate to winter calving grounds primarily off Georgia and Florida (Perry et al. 1999). Five major concentration areas have been identified in coastal waters off the United States and Canada including the nearshore waters of Florida and Georgia, the Great South Channel, Cape Cod Bay, the Bay of Fundy, and the Scotian Shelf.

History of evaluation and listing

The right whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Recovery plan adopted in 1991.

[5] Right whales are currently listed under the ESA as a single species, but here we consider whales in the North Atlantic and North Pacific as separate taxa. This is consistent with currently accepted taxonomy and also reflects the fact that NMFS is in the process of making regulatory changes to list them separately (68 Fed. Reg. 17560).

- Listed as endangered by the IUCN in 1996.
- Revised recovery plan adopted in 2005.

No detailed explanation was given when the right whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The most recent ESA status review of right whales was published in 1999 (Perry et al. 1999). The review states, "Any reevaluation of northern and southern right whale status awaits collection of more reliable information on abundance, distribution, and threats from human activities…as well as the development of objective delisting criteria." It makes no specific recommendation for reclassifying or delisting the species under the ESA. ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (offshore oil and gas development, pollution, and channel dredging); overutilization (whale-watching and scientific research), regulatory inadequacy (a lack of vessel traffic and fishing regulations); and other factors (vessel collisions and entanglement in fishing gear).

The 2005 revised Recovery Plan for the North Atlantic Right Whale states, "There has been no apparent sign of recovery in the previous 15 years and the species may be rarer and more endangered than previously thought." It goes on to state, "The possibility of biological extinction in the next century is very real." The plan states that its ultimate goal is "to promote the recovery of North Atlantic right whales to a level sufficient to warrant their removal from the List of Endangered and Threatened Wildlife and Plants under the ESA," and its intermediate goal is "to reclassify the species from endangered to threatened" (NMFS 2005). Criteria for reclassification from endangered to threatened were specified in the plan as follows:

- All available data indicate that the population is increasing.
- The population has increased for a period of 35 years at an average rate of at least 2 percent per year.
- None of the ESA listing factors are known to be limiting population growth.
- A peer-reviewed population viability analysis shows that the population has no more than a 1 percent chance of reaching the quasi-extinction level in 100 years.

Criteria for delisting North Atlantic right whales were not included in the recovery plan because NMFS concluded that decades of population growth would need to occur before delisting could be considered.

The 2005 recovery plan includes an analysis of the five ESA listing factors that concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—Habitat degradation may occur from a number of sources (e.g., oil spills, vessel traffic, noise, dredging, and contaminants) and actions should be taken to ensure that habitats are protected.

B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Recreational, scientific, and educational activities are regulated, and currently no whales may be taken for commercial purposes. Prior to delisting, it should be affirmed that such activities will be adequately regulated in the future.
C. *Disease or predation*—No evidence indicates that these factors are limiting recovery, but few data are available. Prior to delisting, it should be affirmed that disease is not affecting the population and is not likely to do so in the foreseeable future.
D. *The inadequacy of existing regulatory mechanisms*—Regulations may be insufficient to adequately protect the population. In particular, it may be necessary to strengthen regulations to eliminate or reduce ship strikes and entanglement in fishing gear.
E. *Other natural or manmade factors affecting its continued existence*—No natural factors are known to be limiting recovery. Human factors known to be of high significance are ship strikes and entanglement in fishing gear. Other human factors of concern include contaminants, coastal development, and noise.

In 1996 the IUCN listed the North Atlantic right whale as endangered based on criterion D1 (IUCN 1996). The status of North Atlantic right whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Ship strikes and entanglement in fishing gear were identified as the most significant threats in that review.

North Atlantic right whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

<u>Available data</u>

Prior to the listing of northern right whales under the ESCA in 1970, information on North Atlantic right whales was limited to historical whaling records and reports of scattered opportunistic sightings. In the late 1970s and early 1980s, a dedicated research program was developed through the efforts of independent scientists. Research since then has made this species one of the most extensively studied large whale species in the world. Most research has been carried out by non-governmental scientists with funding from federal agencies. NMFS provides the principal source of funding, although the U.S. Navy, Coast Guard, Army Corps of Engineers, various state agencies, and non-governmental foundations and groups also provide significant contributions.

The central pillar of available data is a photo-identification catalogue believed to include most of the population. The catalogue includes information on the age (year born or first sighted) and sex for a large proportion of the current population. Extensive aerial and shipboard sighting surveys provide resighting information from which life history information (e.g., calving rates, movement patterns, survival and mortality rates, injury and entanglement rates, etc.) can be derived. Genetic samples have been collected from many known individuals to assess filial relationships and confirm individual identifications. A dedicated carcass salvage program expanded in the early 1990s provides information on causes of many deaths.

A population model has been developed for the North Atlantic right whale population (Caswell et al. 1999) that has been used for population viability analysis.

Current biological status

Commercial hunting of right whales began as early as the 11th century in the eastern North Atlantic, in the 1500s off eastern Canada, and in the 1600s along the East Coast of the United States (Reeves 2001); there are no estimates of pre-exploitation population size (NMFS 1991b, Perry et al. 1999) although catch records indicate the population numbered at least a few thousand (Reeves 2001). The North Atlantic population may have numbered fewer than 100 animals when international protection was put in place in 1935. NMFS published the most recent SAR for North Atlantic right whales in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm), and estimated the population size in 1998 as 299. There is some indication that the population grew slowly during 1986–1992, but the survival rate declined in the 1990s. The SAR states that because of the likelihood that the population is declining the PBR is set at 0 animals. It also states that North Atlantic right whales are a strategic stock because they are listed as endangered under the ESA and because average annual fishery mortality and serious injury exceed PBR.

Caswell et al. (1999) have estimated that the North Atlantic right whales began declining at 2.4 percent per year in the 1990s. They predict that, if current conditions continue, the upper bound on expected time to extinction is 191 years.

North Pacific right whale (*Eubalaena japonica*) (ESA – endangered[6]; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

Right whales occur in temperate to subtropical latitudes in both hemispheres. The initial Recovery Plan for the Northern Right Whale treated all Northern Hemisphere right whales as a single species with two populations (NMFS 1991b). However, North Pacific right whales (*E. japonica*) are currently considered a species distinct from the North Atlantic (*E. glacialis*; Rosenbaum et al. 2000). The revised recovery plan dealt only with *E. glacialis* (NMFS 2005), and NMFS is currently taking steps to recognize current right whale taxonomy in ESA listings (68 Fed. Reg. 17560). In the North Pacific right whales were once found throughout the ocean basin north of 35 degrees (Clapham et al. 2004, Shelden et al. 2005). They now occur in separate groups in the east and west that presumably constitute separate populations (Perry et al. 1999, Clapham et al. 2004).

History of evaluation and listing

The right whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

[6] See note 5 above.

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Recovery plan published in 1991.
- Listed as endangered by the IUCN in 1996.

No detailed explanation was given when the right whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The 1991 Recovery Plan for the Northern Right Whale devotes most of its attention to the western Atlantic population. With regard to the eastern Pacific population, the plan notes that at the time it was written there were no predictable areas where right whales occurred and therefore it was impossible to propose specific recovery measures (NMFS 1991b). The plan did not identify any major threats for the eastern Pacific stock, but they were assumed to be similar to those for the western Atlantic population (i.e., vessel interactions, entanglement in fishing gear, and habitat degradation).

The most recent ESA status review of right whales was published in 1999 (Perry et al. 1999). It states, "The eastern North Pacific right whale stock remains severely depleted. Virtually nothing is known about its current size, trends in abundance, distribution, or migration patterns. The size of this stock is thought to be very small, but there are no reliable estimates of abundance. The classification of this stock should not change at this time, and is not likely to change in the foreseeable future." ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (offshore oil and gas development) and other factors (entanglement in fishing gear).

In 1996 the IUCN listed the North Pacific right whale as endangered based on criterion D1 (IUCN 1996). The status of North Pacific right whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Ship strikes and entanglement in fishing gear were identified as the most significant threats.

North Pacific right whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

<u>Available data</u>

Prior to listing under the ESCA in 1970, information on right whales in the eastern North Pacific was limited almost entirely to historical whaling records and reports of scattered opportunistic sightings. From 1970 to the mid-1990s information was limited to rare opportunistic sighting records scattered in the region from Southern California to Alaska to Hawaii. No dedicated studies were possible because there was no location in the eastern North Pacific where right whales were known to occur regularly in any numbers. Since 1997 when a small group of right whales was found in the southeastern Bering Sea, efforts have been undertaken each summer in that area to locate, photograph, and collect biopsy samples from individuals. With almost no recent information on their occurrence in other areas or during other seasons, eastern North Pacific right whales are the least well known of all listed marine mammals in U.S. waters.

No models designed specifically for population viability analysis have been developed for North Pacific right whales.

Current biological status

Commercial hunting of right whales in the western North Pacific began in the 1500s along the Asian coast; there are no estimates of their pre-exploitation abundance (Perry et al. 1999). In the mid- to late 1800s intensive whaling occurred in the eastern North Pacific and by the end of the 19th century, right whales were rare throughout the region. The most recent SAR for North Pacific right whales was published in 2003 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). The SAR does not provide a population estimate but notes that a few right whales have been seen in a portion of the southeastern Bering Sea each summer since 1996 and a very few sightings have been made in other areas. As of 2005, 23 individuals had been identified by photo-identification or genetic samples collected between 1998 and 2004 (P. Wade, pers. comm.). The population size may be only a few tens of animals, and its trend is unknown. The SAR does not calculate a PBR because there are insufficient data to estimate population size. It states that North Pacific right whales are considered a strategic stock because they are listed as endangered under the ESA.

Sei whale (*Balaenoptera borealis*) (ESA – endangered; IUCN – endangered; MMPA – depleted)

Distribution and conservation units

The sei whale is a cosmopolitan species with separate subspecies in the Northern and Southern Hemispheres (Rice 1998). Animals found in the North Atlantic, North Pacific, and Southern Oceans are almost certainly separate populations and are dealt with separately in the draft Recovery Plan for the Fin Whale and Sei Whale (NMFS 1998b). For purposes of preparing SARs required by the MMPA, NMFS has identified three stocks—Nova Scotia (formerly called the western North Atlantic stock), eastern North Pacific, and Hawaii. Sei whales range widely in oceanic waters of the North Atlantic and North Pacific, migrating from high-latitude summer feeding areas to lower-latitude winter breeding areas.

History of evaluation and listing

The sei whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.
- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Listed as endangered by the IUCN in 1996.
- Draft recovery plan prepared in 1998 but not adopted.

No detailed explanation was given when the sei whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

A draft Recovery Plan for the Fin Whale and Sei Whale was prepared by NMFS, but no action has been taken to adopt it. The draft plan states that its goal is "to promote recovery of all fin and sei whale populations to levels at which it becomes appropriate to downlist them from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA" (NMFS 1998b). The draft plan suggests that, because they rarely occur in nearshore waters, sei whales may be less susceptible to human-caused threats than fin whales.

The most recent review of the status of sei whales under the ESA was published in 1999 (Perry et al. 1999). It states, "Any reevaluation of sei whale status awaits the collection of more reliable information on stock structure, distribution and migration patterns, trends in abundance, causes of mortality, and factors influencing the recovery of sei whales stocks, as well as the development of objective delisting criteria." It makes no specific recommendation for reclassifying or delisting the species under the ESA. ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (offshore oil and gas development); overutilization (whale-watching, scientific research, photography, and associated vessel traffic; Icelandic harvests), disease (parasite infestations), and other factors (vessel collisions).

In 1996 the IUCN listed sei whales as endangered worldwide based on criteria A1a, A1b, and A1d (IUCN 1996). Individual populations were not evaluated separately. The status of sei whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). No specific threats were identified in that review.

Sei whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

<u>Available data</u>

Prior to listing under the ESCA in 1970, information on sei whales in U.S. waters was limited almost exclusively to data associated with efforts to manage commercial whaling (e.g., catch and sighting records and tag recovery). Since 1970 there has been no directed research program on sei whales in the United States, and available information is limited to a few isolated studies, sighting reports during aerial and shipboard surveys for other marine mammals, and stranding records. For populations in U.S. waters, information on abundance, population dynamics, and trends ranges from very limited to almost none.

No models designed specifically for population viability analysis have been developed for sei whale populations in U.S. waters.

Current biological status

Sei whale populations in both the North Atlantic and North Pacific Oceans were greatly reduced by commercial whaling during the early and mid-1900s (NMFS 1998b). The pre-exploitation population size for the entire North Pacific Ocean has been estimated at 42,000, but there is no comparable estimate for the North Atlantic Ocean (Perry et al. 1999). NMFS SARs for sei whales were published in 2003 for the eastern North Pacific stock and in 2005 for the Nova Scotia and Hawaii stocks (see http://www.nmfs.noaa.gov/pr/sars/species.htm). Stock status parameters given in the SARs are shown here.

Stock name	Abundance	PBR	Trend	Classification
Nova Scotia	No reliable estimate	Unknown	Insufficient data	Strategic
Eastern North Pacific	56	0.1	Insufficient data	Strategic
Hawaii	77	0.1	Insufficient data	Strategic

Sperm whale (*Physeter macrocephalus*) (ESA – endangered; IUCN – vulnerable; MMPA – depleted)

Distribution and conservation units

The sperm whale is a cosmopolitan species occurring in all the world's oceans except the Arctic Ocean; there are no recognized subspecies (Rice 1998). It is generally recognized, however, that there are a number of discrete populations. For purposes of preparing SARs required by the MMPA, NMFS has identified five stocks—North Atlantic, California-Oregon-Washington, North Pacific, Hawaii, and northern Gulf of Mexico. Sperm whales occur throughout deeper parts of the North Atlantic and North Pacific Oceans from the equator to polar regions. Mature females, calves, and immature animals stay in temperate and tropical waters while adult males range farther north.

History of evaluation and listing

The sperm whale is under the jurisdiction of NMFS. Milestones relative to the species' listing include the following:

- Species listed as endangered under the ESCA in 1970.
- Endangered status carried forward under the ESA in 1973.

- Qualified as depleted under the MMPA in 1973 by virtue of its listing under the ESA.
- Listed as vulnerable by the IUCN in 1996.
- Draft recovery plan released for public review in 2006.

No detailed explanation was given when the sperm whale was listed as endangered under the ESCA in 1970 (35 Fed. Reg. 18319). Because the species was already listed when the ESA was passed in 1973, a formal analysis of threats and ESA listing factors was not done at that time.

The most recent ESA status review of sperm whales was published in 1999 (Perry et al. 1999). It states, "Any reevaluation of sperm whale classification status awaits the collection of more reliable information on distribution, migration patterns, abundance, and trends in abundance on a stock-specific basis, as well as the development of objective delisting criteria." It also suggests that the North Atlantic and North Pacific populations might be candidates for downlisting if better information becomes available on their abundance and stock identity and if human-related sources of mortality are controlled. ESA listing factors identified in the status review as possibly influencing recovery were destruction or modification of habitat (pollution, and offshore oil and gas development); overutilization (whale-watching, scientific research, and associated vessel traffic), disease or predation (papillomavirus and calicivirus and killer whale predation), and other factors (entanglement in fishing gear).

In July 2006 NMFS released a draft Recovery Plan for the Sperm Whale for public review (71 Fed. Reg. 38385).

In 1996 the IUCN listed sperm whales worldwide as vulnerable based on criteria A1b and A1d (IUCN 1996). Individual populations were not evaluated separately. The status of sperm whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Ship strikes and entanglement in fishing gear were identified as potential threats at the time.

Sperm whales are considered as depleted under the MMPA because of their ESA listing. Their status relative to OSP has not been evaluated.

Available data

Prior to listing under the ESCA in 1970, information on sperm whales in U.S. waters was limited almost exclusively to data associated with efforts to manage commercial whaling (e.g., catch and sighting records and tag recovery). Since 1970 there has been no directed sperm whale research program in the United States, and available information is limited to a few isolated studies, sighting reports during aerial and shipboard surveys for other marine mammals, and stranding records. Probably the best known population in U.S. waters is in the Gulf of Mexico where the Minerals Management Service has recently supported studies to tag and track sperm whales to help assess impacts of noise from offshore oil and gas exploration and development. Very few directed studies have been undertaken on sperm whales in U.S. waters of the Atlantic or Pacific. For the populations in U.S. waters, information on abundance, population dynamics, and trends varies from very limited to almost none.

No models designed specifically for population viability analysis have been developed for sperm whale populations in U.S. waters.

Current biological status

Sperm whale populations in the North Atlantic and especially the North Pacific were heavily harvested by commercial whalers from the 1800s to the mid-1900s (Perry et al. 1999). Pre-exploitation abundance estimates for the North Pacific and North Atlantic are in the hundreds of thousands, but those estimates are considered unreliable (Perry et al. 1999). The most recent SARs for sperm whales were published in 2003 for the California-Oregon-Washington and northern Gulf of Mexico stocks and in 2005 for the North Atlantic, North Pacific, and Hawaii stocks (see http://www.nmfs.noaa.gov/pr/sars/species.htm). Stock status parameters given in the SARs are shown here.

Stock name	Abundance	PBR	Trend	Classification
North Atlantic	4,804	7.0	Insufficient data	Strategic
California-Oregon-Washington	1,233	1.8	Insufficient data	Strategic
North Pacific	No reliable estimate*	Unknown	Insufficient data	Strategic
Hawaii	7,082	11.0	Insufficient data	Strategic
Gulf of Mexico	1,349	2.2	Insufficient data	Strategic

*Barlow and Taylor (2005) estimated the number of sperm whales in a region of the eastern North Pacific extending from the West Coast of the United States to Hawaii as 26,300 based on visual surveys and 32,100 based on acoustic surveys. The surveys included all or part of the range of the California-Oregon-Washington, North Pacific, and Hawaii stocks.

Beluga whale, Cook Inlet population (*Delphinapterus leucas*) (ESA – not listed; IUCN – critically endangered; MMPA – depleted)

Distribution and conservation units

Beluga whales occur only in arctic and subarctic waters of the Northern Hemisphere and are considered a single species with no identified subspecies (Rice 1998). Genetics studies confirm five demographically isolated populations in Alaska that each have their own summer concentration areas (O'Corry-Crowe et al. 1997). For purposes of preparing SARs required by the MMPA, NMFS has identified five stocks, only one of which, the Cook Inlet population, has been listed. Cook Inlet beluga whales are isolated both genetically and geographically. They are separated from the nearest other beluga whale population in the Bering Sea by the 900-km-long Alaska Peninsula. Cook Inlet beluga whales currently occur mostly in Cook Inlet where they seem to remain throughout the year (Hobbs et al. 2005). In summer they are most common near the mouths of large rivers in the upper inlet. A small group occurs in Yakutat Bay where they may be resident. Few sightings have been made in adjacent waters of the Gulf of Alaska (NMFS in prep.[c]).

History of evaluation and listing

The Cook Inlet beluga whale is under the jurisdiction of NMFS. Milestones relative to the population's listing include the following:

- Population listed as a candidate species for listing under the ESA in 1988.
- Species listed as vulnerable by the IUCN in 1996.
- NMFS petitioned in 1999 to list Cook Inlet beluga whales as depleted under the MMPA and endangered under the ESA.
- Population listed as depleted under the MMPA in 2000.
- Determination made that ESA listing was not warranted in 2000.
- Draft conservation plan released for public review in 2005.
- Listed as critically endangered by the IUCN in 2006.

In 1998 NMFS initiated a status review for the Cook Inlet beluga whale population (63 Fed. Reg. 64228). Reasons given for initiating the review were that (1) beluga whale counts made in 1998 were the lowest on record and had been declining since at least 1994, and (2) Alaska Native subsistence harvests, which had risen from about 15 whales per year in the early 1990s to about 100 whales per year (including whales struck and lost) in the mid-1990s, appeared to be exceeding sustainable levels.

In 1999 NMFS received petitions from the State of Alaska to list Cook Inlet beluga whales as depleted under the MMPA and from several organizations and individuals to list them as endangered under the ESA (64 Fed. Reg. 17347). NMFS determined that each of the petitions presented substantial information indicating that the listing action might be warranted, and later in 1999 it published a proposed rule to designate the population as depleted (64 Fed. Reg. 65298). In 2000 NMFS listed the population as depleted (65 Fed. Reg. 34590), noting that the abundance estimate for 1998 (347 whales) was likely less than 35 percent of K (estimated to be at least 1,000), which would be far below the population's MNPL level. The notice did not directly address causes of the decline or threats to the population.

Later in 2000 NMFS determined that the Cook Inlet population did not merit listing as endangered or threatened under the ESA based on its conclusion that the population was not in danger of extinction or likely to become so in the foreseeable future (65 Fed. Reg. 38778). The notice acknowledged that the population was small and had declined markedly in recent years. With regard to ESA listing factors NMFS concluded the following:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—"A significant part of the habitat for this species has been modified by municipal, industrial and recreational activities in Upper Cook Inlet. However, the data do not support a conclusion that the range of CI belugas has been diminished by these activities."

B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Mortality caused by overharvesting by Alaska Natives is of serious concern, and some of the products resulting from those harvests have been sold.
C. *Disease or predation*—There is no indication that disease has been a significant factor in the decline. Killer whale predation does occur but is not likely to be having a significant impact.
D. *The inadequacy of existing regulatory mechanisms*—Although there is a need to regulate subsistence hunting and development in beluga whale habitats, "NMFS believes that an inadequate regulatory mechanism has not caused the stock to become in danger of extinction, nor is it likely to do so in the foreseeable future."
E. *Other natural or manmade factors affecting its continued existence*—A number of other factors were identified that could affect Cook Inlet beluga whales including stochastic events, strandings, subsistence harvests, fishery interactions, oil spills, other pollutants, noise, and prey availability. The only one of these factors that was thought to be of significance was subsistence harvesting.

Overall NMFS concluded that because "legislative and management actions have been taken to reduce the subsistence harvest to levels that will allow the beluga whale stock to recover," a listing under the ESA was not warranted. The decision was appealed by some of the petitioners but was upheld in federal appeals court.

In 2005 NMFS released a draft Conservation Plan for the Cook Inlet Beluga Whale for public review (70 Fed. Reg. 12853). Its stated goal is recovery of the Cook Inlet stock of beluga whales to a population size of no fewer than 780 whales (NMFS in prep.[c]). The plan reviews the population's biology and status, as well as natural and human factors that could be affecting its recovery. It also contains a section on ESA listing that analyzes the five ESA listing factors and concludes that "there is evidence that one or more of these factors would apply to this stock." It also notes that the decision in 2000 not to list the population was based on the assumption that subsistence hunting was the only factor affecting the population, and that, because the population has not grown as expected since hunting has been controlled, the assumption may have been wrong. It goes on to state, "In consideration of the factors described above, and because it has been five years since the last Status Review for these whales occurred, we believe it is appropriate to again assess this stock for possible listing under the ESA. Therefore, NMFS will initiate a formal Status Review for the CI beluga whale commensurate with the development of this Conservation Plan." In 2006 NMFS announced in the *Federal Register* that it was again initiating a review of the status of Cook Inlet beluga whales to determine whether they should be listed under the ESA (71 Fed. Reg. 14836).

In 1996 the IUCN listed the entire beluga whale species as vulnerable based on criteria A1a, A1b, and A1d (IUCN 1996). The Cook Inlet population was not evaluated separately. The status of beluga whales was evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). General threats to the species identified in the review were hunting and vessel traffic. An assessment specific to the Cook Inlet population was conducted by the IUCN Cetacean Specialist Group in

2006 (Lowry et al. 2006), and the population was listed as critically endangered in the 2006 IUCN Red List.

Available data

Relatively little research has been done on Cook Inlet beluga whales. From the 1960s to the 1980s, a few counts were made by the ADFG and other biologists. In 1993 NMFS began flying beluga whale surveys in Cook Inlet. Based on those surveys, population estimates using standardized methods have been produced each year since 1994. Satellite telemetry studies also have been undertaken to track beluga whale movements, distribution, and behavior. Some data on genetics, contaminants, and life history have been collected from animals stranded and taken by Alaska Natives for subsistence purposes. It has generally been assumed that biological characteristics of Cook Inlet beluga whales are similar to those of western Alaska beluga whale populations that have been better studied.

A population model specific to Cook Inlet beluga whales that can be used for population viability analysis has been developed (D. Goodman, unpub.).

Current biological status

The most recent SAR for Cook Inlet beluga whales was published in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm). It gives a population estimate of 357 whales and calculates a PBR of 2.0 animals per year. The population size estimates declined rapidly from 1994 (653 animals) to 1998 (349 animals), after which the decline appeared to stop. Annual abundance estimates for 1999–2004 have ranged from 313 to 435 and show no trend (NMFS in prep.[c]). The estimate for 2005 was 278 (R. Hobbs, pers. comm.). An analysis of population growth that includes the 2005 count suggests that the population is most likely declining at about 1 percent per year (Lowry et al. 2006). The SAR states that Cook Inlet beluga whales are a strategic stock because they are listed as depleted under the MMPA. Identified sources of human-caused mortality are subsistence hunting and incidental take in fisheries, both of which appear to be very small at the current time.

Bottlenose dolphin, mid-Atlantic coastal population (*Tursiops truncatus*) (ESA – not listed; IUCN – data deficient; MMPA – depleted)

Distribution and conservation units

Bottlenose dolphins occur in tropical and temperate regions of the North Pacific and North Atlantic Oceans in both coastal and offshore waters. Although they are currently considered a single species with no identified subspecies, their taxonomy and population structure are not fully resolved (Rice 1998). It was previously thought that a single coastal migratory stock ranged along the U.S. Atlantic coast from as far north as Long Island, New York, to as far south as central Florida (Scott et al. 1988). It was this "mid-Atlantic" coastal population that was listed as depleted under the MMPA after a large dolphin die-off along the U.S. mid-Atlantic coast in the late 1980s. However, new information suggests that their stock structure is more complicated. For purposes of preparing SARs required by the MMPA, NMFS currently uses eight bottlenose dolphin management units along the U.S. Atlantic coast.

History of evaluation and listing

The mid-Atlantic coastal bottlenose dolphin is under the jurisdiction of NMFS. Milestones relative to the population's listing include the following:

- Petitioned to list the mid-Atlantic coastal population as depleted in 1988.
- Population listed as depleted under the MMPA in 1993.
- Listed as data deficient by the IUCN in 1996.

In 1987–1988 a major die-off of bottlenose dolphins occurred along the U.S. Atlantic coast. Shortly thereafter, NMFS estimated that the regional population could have been reduced by as much as 60 percent. As a result, the Center for Marine Conservation petitioned NMFS to list the population as depleted under the MMPA. Final action to do so was completed in 1993 (58 Fed. Reg. 17789). In its analysis of population status, NMFS was unable to compare pre- and post-die-off population sizes because of insufficient abundance data. Instead, it described a model that looked at estimates of stranding rates, natural mortality rates, and birth rates, and estimated that there had been a 53 percent reduction in abundance during the die-off period (54 Fed. Reg. 41654). Because this would have resulted in a population size less than 50 percent of its carrying capacity (assuming that carrying capacity had not changed) and thus below its OSP level, NMFS concluded that the population was depleted under the MMPA definition. Although the final rule advised that NMFS would prepare a conservation plan for the population, this was assigned a low priority relative to work on other listed species and work to develop a bottlenose dolphin take reduction plan. As a result, the conservation plan has not been completed.

In 1996 the IUCN listed the bottlenose dolphin as data deficient (IUCN 1996). The U.S. mid-Atlantic coastal population was not evaluated separately. The status of bottlenose dolphins was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Acute threats were identified in some regions but not for the western North Atlantic, although the report notes the occasional occurrence of major unexplained mortality events.

Available data

Prior to its listing as depleted in 1993, information on the Atlantic coastal migratory population of bottlenose dolphins was limited primarily to data from some stranded animals and to an estimate of abundance and distribution obtained during a series of marine mammal and sea turtle surveys funded by the Bureau of Land Management between 1979 and 1981. Since 1993 periodic aerial and vessel surveys have been carried out to assess abundance. Recent research has focused largely on genetic studies using biopsy samples to better resolve the population structure and range of the various bottlenose dolphin groups along the Atlantic coast. Determining the distribution and overlap in ranges between what appear to be separate coastal and offshore migratory populations is particularly important. Other recent research has included studies to track the movements of a few individual dolphins with satellite-linked tags and efforts to monitor causes of mortality of stranded animals. Overall, abundance, trends, population parameters, and other details of the Atlantic coastal migratory population remain poorly known, although significant studies have been done in some local areas (e.g., Read et al. 2003).

No models designed specifically for population viability analysis have been developed for bottlenose dolphins in U.S waters.

Current biological status

NMFS most recently revised the SAR for the mid-Atlantic coastal population of bottlenose dolphins (now called the western North Atlantic coastal population) in 2005 (see http://www.nmfs.noaa .gov/pr/sars/species.htm). Abundance estimates are given for a number of migratory and non-migratory components of the population and suggest a total abundance of about 33,000. Population trend is unknown. Rather than calculating a single PBR for the total population, the SAR calculates multiple PBRs for a complex of small management units. It states that the western North Atlantic coastal population is considered a strategic stock because it is listed as depleted under the MMPA and because incidental takes in fisheries exceed PBR in some areas. The SAR further notes that although the coastal migratory population is designated as depleted under the MMPA, the depletion designation should be reevaluated based on the current system of management units.

Killer whale, southern resident population (*Orcinus orca*) (ESA – endangered; IUCN – lower risk; MMPA – depleted)

Distribution and conservation units

The killer whale is currently considered a single species with no identified subspecies (Rice 1998). However, the current taxonomy is outdated and needs revision (Reeves et al. 2004, Krahn et al. 2004). Four populations of resident killer whales are recognized in the eastern North Pacific: southern, northern, southern Alaska, and western Alaska residents (Krahn et al. 2004). The southern resident population is the only listed taxon. Killer whales are locally common along the coast of the eastern North Pacific, especially from California northward. Southern residents are known to occur in the coastal waters off central California, Washington, Vancouver Island, and the Queen Charlotte Islands (Krahn et al. 2004).

History of evaluation and listing

The southern resident killer whale is under the jurisdiction of NMFS. Milestones relative to the population's listing include:

- Entire species listed as lower risk by the IUCN in 1996.
- NMFS petitioned to list the population as endangered or threatened under the ESA in 2001.
- NMFS determined that ESA listing was not warranted, but that MMPA listing may be warranted in 2002.
- Population listed as depleted under the MMPA in 2003.
- Finding relative to the ESA listing petition challenged in court, and NMFS directed to proceed with a listing proposal in 2003.
- Population listed as endangered under the ESA in 2005.

NMFS received a petition from the Center for Biological Diversity and several other organizations in 2001 to list the eastern North Pacific southern resident population of killer whales as an endangered or threatened species under the ESA. NMFS determined that the petition presented substantial information indicating that a listing may be warranted and thus conducted an ESA status review. A Biological Review Team (BRT) was established for this purpose and, in accordance with its report (Krahn et al. 2002), NMFS determined that southern resident killer whales are not a "species" as defined by the ESA and that listing was therefore not warranted (67 Fed. Reg. 44133). The BRT report identified potential risk factors that could influence the southern resident killer whale population, including changes in prey availability caused by fluctuations in environmental conditions, contaminants, noise from whale-watching vessels, diseases and parasites, declines in salmon stocks that are important prey, and catastrophes such as oil spills and harmful algal blooms.

Later in 2002 NMFS' decision was challenged in U.S. District Court. In 2003 the court set aside the not warranted finding, ruling that NMFS had erred in using incorrect taxonomy when determining whether southern resident killer whales constituted a distinct population segment under the ESA. The court therefore remanded the matter back to NMFS and required the agency to issue a new finding consistent with the court's order by December 2004. As a result a new BRT was convened to produce a new status report.

The 2004 status report (Krahn et al. 2004) concluded that North Pacific resident killer whales should be considered as an unnamed subspecies of the global killer whale species, and that the southern resident group likely comprises a distinct population segment of that subspecies. The report does not specifically address the five ESA listing factors but makes the following statements regarding threats to the population: "Concern remains about whether reduced quantity or quality of prey are affecting the Southern Resident population. In addition, levels of organochlorine contaminants are not declining appreciably and those of many newly emerging contaminants (e.g., brominated flame retardants) are increasing, so Southern Residents are likely at risk for serious chronic effects similar to those demonstrated for other marine mammal species (e.g., immune and reproductive system dysfunction). Other important risk factors that may continue to impact Southern Residents are oil spills and noise and disturbance from vessel traffic."

The report included a PVA model that predicted a 1 to 15 percent probability that the population would decline to a quasi-extinction threshold within 100 years and a 4 to 68 percent probability that it would do so within 300 years. The report also considered IUCN listing criteria and concluded that the taxon would qualify for listing under criterion D because it includes only 41 mature individuals. In conclusion, the report stated, "Taken together, the population dynamics of the Southern Residents describe a population that is at risk for extinction, due either to incremental small-scale impacts over time (e.g., reduced fecundity or subadult survivorship) or to a major catastrophe (e.g., disease outbreak or oil spill)." Based on findings of the status review, NMFS proposed listing southern resident killer whales as a threatened species under the ESA in 2004 (69 Fed. Reg. 76673).

In 2005 NMFS took final action to list the southern resident killer whale population as endangered under the ESA (70 Fed. Reg. 69903). The analysis of the five ESA listing factors accompanying the action concluded as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*—The habitat of southern resident killer whales has been modified by contaminants, vessel traffic, and changes in prey availability.
B. *Overutilization for commercial, recreational, scientific, or educational purposes*—Capture for public display in the 1970s likely affected the southern resident killer whale population. Whale-watching may currently be having some impact.
C. *Disease or predation*—There is no evidence that disease has caused the population decline, but there is concern that high levels of contaminants may cause immunosuppression.
D. *The inadequacy of existing regulatory mechanisms*—Existing regulatory mechanisms have not been adequate to prevent contaminants from accumulating in southern resident killer whales.
E. *Other natural or manmade factors affecting its continued existence*—There is concern that an oil spill could impact the remaining population.

At the time NMFS initially declined to list southern resident killer whales under the ESA, scientific information evaluated during the status review (Krahn et al. 2002) indicated that the population might qualify as depleted under the MMPA. Therefore, in 2002 NMFS began the process for determining if the stock was depleted. In 2003 it determined that the taxon constituted a population stock as defined under the MMPA and that its abundance (80 animals in 2002) was below the lower bound of MNPL (84 based on an estimated minimum historical abundance of 140). Southern resident killer whales were therefore designated as depleted (68 Fed. Reg. 31980).

In its 1996 Red Book, the IUCN listed killer whales as lower-risk, conservation-dependent[7] (IUCN 1996). The southern resident population was not evaluated separately. The status of killer whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003). Threats to killer whales in the Washington–British Columbia region identified during that review were contaminants, depletion of prey populations, and disturbance from vessel traffic.

[7] See note 3 above.

Available data

The southern resident killer whale population has been well studied. Because killer whales can be identified from photographs and the southern resident population lives in an area easily accessed by scientists and whale-watchers, extensive population data have been collected annually. Most of its members are known individually and have been monitored over the past several decades or since birth. Most research on southern resident killer whales has been carried out by non-governmental scientists with funding from various foundations and other non-governmental sources in addition to NMFS. Distribution, abundance, movements, behavior, and life history parameters have been described in detail. Biopsy samples and stranded animals have provided data on genetics and contaminant levels.

In its 2004 status report (Krahn et al. 2004) the BRT for southern resident killer whales developed a population model and did a population viability analysis.

Current biological status

The most recent SAR for the southern resident population of killer whale, published in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm), reports a population size of 84 animals and states that the population has declined from 99 animals in 1995. It calculates a PBR of 0.8 and states that southern resident killer whales are a strategic stock because they are listed as depleted under the MMPA.

Killer whale, AT1 group (*Orcinus orca*) (ESA – not listed; IUCN – lower risk; MMPA – depleted)

Distribution and conservation units

Killer whales are currently considered a single species with no identified subspecies (Rice 1998). However, the current taxonomy is outdated and in need of revision (Reeves et al. 2004, Krahn et al. 2004). For purposes of preparing SARs required by the MMPA, NMFS recognizes seven killer whale stocks in U.S. waters. The AT1 group is considered to be part of the eastern North Pacific transient stock. Killer whales are common along the coast of the eastern North Pacific, especially from California northward. AT1 killer whales seem to have a very restricted distribution in the central Gulf of Alaska, occurring mostly in Prince William Sound and nearby fiords of the Kenai Peninsula.[8]

[8] http://www.fakr.noaa.gov/protectedresources/whales/killerwhales/at1statreview0703.pdf

History of evaluation and listing

The AT1 group of eastern North Pacific transient killer whales is under the jurisdiction of NMFS. Milestones relative to the taxon's listing include the following:

- Entire species listed as lower risk by the IUCN in 1996.
- NMFS petitioned to list the taxon as depleted under the MMPA in 2002.
- Taxon listed as depleted under the MMPA in 2004.

In 2002 NMFS was petitioned by the National Wildlife Federation and several other conservation groups to list AT1 killer whales as depleted under the MMPA. A status review in 2003 reported that the abundance of the AT1 group had declined from 22 animals in 1988 to 9 in 2002.[9] It also concluded that the AT1 group is "a genetically distinct, socially isolated group of killer whales" and that, while it is currently considered part of the eastern North Pacific transient stock, it probably qualifies as an independent population stock under the MMPA. The review goes on to state, "If the AT1 group is considered a population stock under the MMPA, there is little doubt that it would be considered to be below its MNPL level, as it has declined by more than 50 percent from historic levels (since 1984). Therefore, under that scenario, the AT1 group would be considered to be below OSP." Based on the status review, NMFS determined that the AT1 group is a population stock as defined by the MMPA and, therefore, designated the group as depleted in 2004 (69 Fed. Reg. 21321). Threats to the population identified in the status review were oil spills and other contaminants, declines in prey availability, fisheries interactions, and whale-watching and vessel traffic.

In its 1996 Red Book, the IUCN listed killer whales worldwide as lower-risk, conservation-dependent (IUCN 1996) .[10] The AT1 group was not evaluated separately. The status of killer whales was most recently evaluated by the IUCN Cetacean Specialist Group in 2003 (Reeves et al. 2003), but the AT1 group was not specifically addressed.

Available data

The AT1 group of killer whales has been relatively well studied. Studies began in the late 1970s and intensified after the 1989 *Exxon Valdez* oil spill in Prince William Sound. Because killer whales can be identified from photographs, a considerable amount of data is available on the distribution, movements, and biological characteristics of individual members in the AT1 group. Biopsy samples and stranded animals have provided data on genetic relationships and contaminant levels.

No models designed specifically for population viability analysis have been developed for AT1 killer whales.

[9] Ibid.
[10] See note 3 above.

Current biological status

The most recent SAR for the AT1 group of transient killer whales, published in 2005 (see http://www.nmfs.noaa.gov/pr/sars/species.htm), reports a population size of eight animals and calculates a PBR level of zero. The trend in abundance is declining, and there have been no documented births since 1984. The SAR states that the AT1 killer whale group is a strategic stock because they are listed as depleted under the MMPA.

IV. SUMMARY AND CONCLUSIONS

Characteristics of ESA, MMPA, and IUCN classification systems

The ESA is the principal U.S. law that requires actions to prevent extinction of species. It provides for the listing of species, subspecies, or distinct population segments as endangered or threatened based on their likelihood of going extinct within the foreseeable future. Species so listed are then eligible for protective provisions set forth in the Act. There is no set formula for making ESA listing determinations; rather they are based on an analysis of factors that may cause extinction.

Evaluation of marine mammals for listing under the ESA is done by either FWS (for sirenians, otters, walruses, and polar bears) or NMFS (all other species). For listing actions, FWS stresses an evaluation of threats using case-by-case professional judgment (DeMaster et al. 2004). Taxa are listed if one or more of the threat factors indicate a likelihood of extinction. Taxa may be reclassified or delisted based on a combination of population size, population trend, distribution, and abatement of threats (D. Crouse, pers. comm.). NMFS also considers the five factors when evaluating taxa for listing but recently has been giving more emphasis to use of "structured expert opinion" that looks at a variety of qualitative and quantitative measures of extinction risk, as well as an analysis of threats under the five listing factors (Angliss et al. 2002, DeMaster et al. 2004, M. Nammack, pers. comm.).

All marine mammals listed under the ESA are considered to be depleted under MMPA provisions. The MMPA also allows species or population stocks not listed under the ESA to be listed as depleted if they are determined to be below their OSP level. OSP is defined based on population size and population dynamics and is generally considered to be a range from the largest supportable in an ecosystem (K) down to the level at which the population shows maximum net productivity (generally considered to be 60 percent of K). Therefore, in addition to those taxa threatened with extinction, taxa listed as depleted may include some that are still quite abundant but are known to be substantially depleted compared to historical levels.

The IUCN listing system uses eight categories ranging from data deficient up to critically endangered. A combination of quantitative and qualitative criteria are used to assign taxa to the various categories. Although this approach has the advantage that criteria and thresholds for listing are specified, concern has been expressed that the IUCN system may not be optimal for marine mammals because it is intended primarily to evaluate species risk at the global level and is designed for all species, most of which have life history characteristics that are much different from those of cetaceans and pinnipeds (Angliss et al. 2002).

The ESA and IUCN systems have a similar purpose, that is to identify taxa at risk of becoming extinct within the foreseeable future. The comparability of the categories used by the two classification systems has not been formally analyzed, but the IUCN categories of critically endangered and endangered are roughly equivalent to ESA endangered, while the IUCN category vulnerable is similar to ESA threatened (Angliss et al. 2002). The MMPA category of depleted has no real biological equivalent in either the ESA or IUCN systems and, in some respects, is more similar to the category "overfished" under the Magnuson-Stevens Fisheries Conservation and Management Act. Nevertheless, the protections provided by the MMPA for depleted stocks are similar to the prohibitions on take of listed species under ESA.

A critical issue in listing is the taxonomic or population unit selected for evaluation. This is a subject where science and management are progressing rapidly, and it has become evident that in many cases proper conservation must address population units smaller than entire species (Taylor 2005). The current version of the ESA specifically recognizes the possible need to list distinct population segments, and federal agencies have specified policies for determining when such segments occur based on reproductive isolation and evolutionary considerations. However, many species were first listed in 1970 after the ESCA was passed and they have not been subjected to rigorous status reviews using more appropriate population units. The MMPA allows depleted designation for species or population stocks, the latter of which has a definition similar to that of a distinct population segment. The IUCN states that its primary purpose is evaluating species at the global level, but its listing system also allows for evaluations of lower taxonomic units and smaller geographic regions (IUCN 2004). Although all three systems allow for listings based on relevant conservation units, many listings are still for entire species worldwide.

The 1994 amendments to the MMPA require that NMFS and FWS prepare SARs for all stocks of marine mammals under their jurisdictions. The amendments further require that the agencies review the SARs annually for any stock designated as "strategic," which includes any taxon listed as endangered or threatened under the ESA or depleted under the MMPA. Therefore, the stocks referred to in the SARs should reflect the most current understanding of proper population units to use in conserving marine mammals based on the most recent scientific information. Table 3 shows, for selected large whale species, the population units used to make status evaluations in the ESA, IUCN, and MMPA SAR systems. For blue, fin, humpback, sei, and sperm whales, the ESA lists the entire species while the SARs provide separate evaluations of three to five stocks within each species. Clearly, for these species, currently available data and analyses show that status should be evaluated based on much smaller units than are currently used as the basis for ESA and IUCN classifications. The failure to use appropriate units very likely will result in both over-protection (e.g., a stock being considered as endangered as part of a global taxon when in fact the stock itself has recovered) and under-protection (e.g., a stock at risk not remaining listed as endangered or threatened because the global taxon has recovered). A reevaluation of the ESA listing status of large whales using currently accepted population units should be a high priority for action by NMFS.

Summary of species listing status

The 22 listed marine mammals include two sirenian populations, two sea otter populations, two phocid seal species, four otariid populations, eight species of large whales, and four populations of small whales or dolphins (Table 2). Under the ESA, 14 of these taxa are listed as endangered, 4 as threatened, and 4 are not listed. Eleven of the ESA listed taxa were first listed under the ESPA or ESCA, and six were listed subsequent to passage of the ESA. Of the four taxa not listed under the ESA, one was evaluated for listing and rejected, and three have not been evaluated. All 22 taxa are listed as depleted under the MMPA, 16 by virtue of their ESA listing and 6 as a result of a formal determination that their population was below OSP. The IUCN lists 1 of the taxa as extinct, 1 as critically endangered, 10 as endangered, 6 as vulnerable, and 4 as lower risk or data deficient.

Despite different criteria and methods used for status evaluations, the ESA and IUCN systems have resulted in quite comparable listings of most marine mammals. Fifteen of the 18 taxa listed as endangered or threatened under the ESA also are listed as critically endangered, endangered, or vulnerable by IUCN. Of the four taxa not listed under the ESA, one is listed as critically endangered by IUCN, and one is listed as vulnerable worldwide.

Some of the apparent discrepancies in how individual taxa are listed under the various systems are due to differing definitions of the listing categories. For example, a species can qualify as depleted under the MMPA because it is below OSP while it is still relatively numerous and not in immediate danger of extinction. The ESA and IUCN allow for use of different listing criteria, and therefore it is not surprising that taxa are sometimes assigned to slightly different categories under the two systems. Furthermore there are major differences in the nature of population units being evaluated for listing. The IUCN listings considered here generally applied to entire species worldwide, while recent ESA and MMPA listing actions have dealt more with population segments or stocks. Unless the population units being evaluated are identical, there is no reason to expect that different listing systems will produce comparable results.

Biological status of listed taxa

Most of the listed marine mammal taxa are not abundant, are known to be declining or of unknown trend, and are substantially reduced in numbers compared to historical levels (Table 4). However, there are some major variations. Estimates of abundance for taxa listed as endangered under the ESA range from 0 to 38,513, with only four taxa estimated to number more than 10,000. (Note, however, that abundance data are incomplete for several large whale taxa, and the numbers given are therefore underestimates.) Estimates for threatened taxa range from 2,825 to 44,996, with two numbering fewer than 10,000 and two more than 40,000. Abundance estimates for taxa listed as depleted under the MMPA but not listed under the ESA range from 8 to 688,028. Populations of two of those taxa are estimated to number fewer than 300 individuals. Of taxa listed as endangered under the ESA, five are known or thought to be increasing and three to be declining. (Note that large whales were considered increasing if any stock was increasing, but such a judgment is uncertain, given available data.) For threatened taxa, three are known or thought to be increasing and one declining. For taxa listed only as depleted, three are known or thought to be declining.

Species for which new information may warrant a reexamination of listing classifications

The quality of data currently available on the biology of listed species was subjectively evaluated based on expert judgment of the authors of this report in consultation with other species experts. Six general categories of population and ecological data were evaluated (Table 5). For only five taxa was data availability ranked as good in four or more of the six data categories considered. If both good and fair data quality are considered, the situation is much better—11 taxa have good or fair in all 6 categories and 2 have good or fair in 5 categories. At the other extreme, four taxa have poor data availability in all of the categories and eight in three or more categories.

Table 6 summarizes the biological and listing status for the 13 taxa that have good or fair data quality in at least five data categories. Although an evaluation of the appropriateness of current listing classifications was not the primary objective of this report, the table shows some obvious instances where reconsideration of listing status would appear to be appropriate. For example, western Arctic bowhead whales are relatively numerous and have been increasing steadily in abundance for at least the last 20 years. Consideration might be given to downlisting or delisting this population under ESA provisions. At least some stocks of humpback whales are both relatively numerous and increasing; these also might be candidates for downlisting or delisting if they are evaluated as appropriate distinct population segments using the most recent abundance data (e.g., from the SPLASH program). The eastern population of Steller sea lions is currently numerous and increasing and should be considered for ESA delisting. The western population of Steller sea lions is comparatively numerous and, if the apparent recent increasing trend is confirmed and continues long enough to convincingly be interpreted as more than just the effect of temporary environmental variation, the population might be considered for ESA downlisting. Two taxa listed as depleted under the MMPA but not currently listed under the ESA—AT1 killer whales and Cook Inlet beluga whales—are at very low population sizes and are not known to be recovering, and their ESA status should be reevaluated. Finally, the Caribbean monk seal, which has not been observed since the early 1950s, probably warrants delisting on grounds that it is now extinct.

Finally, it is important to remember that this review included only those taxa that are already listed under the MMPA and/or ESA and that our suggestions above deal only with a subset of those for which there are relatively good population data. There is legitimate concern among some marine mammal scientists that some other taxa may qualify for protective listing, and might in fact be among the "most endangered marine mammal populations" if adequate data were available to make an evaluation. However for those taxa we often do not know what the population units are that should be of conservation concern, what their historical and current abundances were and are, whether numbers are currently increasing or decreasing, and what factors may be threatening the population. Without such data, it is essentially impossible to conduct thorough status reviews or to compare population status with the listing criteria used by any system. In the absence of status reviews and listing evaluations, such taxa are *de facto* considered to be not endangered or threatened and not depleted and thus will not be afforded the extra protection that might be warranted. A good example of this are the various species of beaked whales. A more robust decision system is needed for coping with the likelihood that some species for which there is little available data are nevertheless endangered and in need of conservation attention. Evaluation of whether, and if so how, such taxa should be listed under the ESA and MMPA will be a huge challenge, but it is one that must be faced if the conservation and recovery goals of these laws are to be realized.

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Table 1. International Union for the Conservation of Nature classification categories (IUCN 2001)

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between Data Deficient and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Table 2. Marine mammal taxa currently listed as endangered or threatened under the ESA or depleted under the MMPA, with the current IUCN classification also shown

Taxon name	ESA listing	IUCN classification	MMPA listing
West Indian manatee, Florida population	Endangered	Vulnerable	Depleted
West Indian manatee, Antillean population	Endangered	Vulnerable	Depleted
Southern sea otter	Threatened	Endangered[11]	Depleted
Northern sea otter, southwest AK population	Threatened	Endangered[11]	Depleted
Caribbean monk seal	Endangered	Extinct	Depleted
Hawaiian monk seal	Endangered	Endangered	Depleted
Guadalupe fur seal	Threatened	Vulnerable	Depleted
Northern fur seal, eastern Pacific population	Not listed	Vulnerable[11]	Depleted
Steller sea lion, eastern population	Threatened	Endangered[11]	Depleted
Steller sea lion, western population	Endangered	Endangered[11]	Depleted
Blue whale	Endangered	Endangered[12]	Depleted
Bowhead whale, western Arctic population	Endangered	Lower risk, cd[13]	Depleted
Fin whale	Endangered	Endangered[11]	Depleted
Humpback whale	Endangered	Vulnerable[11]	Depleted
North Atlantic right whale	Endangered	Endangered	Depleted
North Pacific right whale	Endangered	Endangered	Depleted
Sei whale	Endangered	Endangered[11]	Depleted
Sperm whale	Endangered	Vulnerable	Depleted
Beluga whale, Cook Inlet population	Not listed	Critically endangered	Depleted
Bottlenose dolphin, mid-Atlantic coastal population	Not listed	Data deficient[11]	Depleted
Killer whale, southern resident population	Endangered	Lower risk, cd[11,13]	Depleted
Killer whale, AT1 group	Not listed	Lower risk, cd[11,13]	Depleted

[11] Listing applies to the entire species worldwide; individual populations have not been evaluated.
[12] Listing applies to the entire species worldwide; North Pacific population listed as lower risk; North Atlantic population as vulnerable.
[13] See note 3 above.

Table 3. Conservation units used to evaluate status of selected large whale species in the ESA, IUCN, and MMPA evaluation systems

Species name	Currently accepted taxonomy	ESA listing	IUCN evaluation	MMPA Stock assessment reports
Blue whale	Single species with one Northern Hemisphere subspecies	Entire species	Worldwide	Western North Atlantic Eastern North Pacific Western North Pacific
Fin whale	Single species with one Northern Hemisphere subspecies	Entire species	Worldwide	Western North Atlantic California-Oregon-Washington Northeastern Pacific Hawaii
Humpback whale	Single species with no recognized subspecies	Entire species[14]	Worldwide	Gulf of Maine Eastern North Pacific Central North Pacific Western North Pacific
Sei whale	Single species with one Northern Hemisphere subspecies	Entire species	Worldwide	Nova Scotia Eastern North Pacific Hawaii
Sperm whale	Single species with no recognized subspecies	Entire species	Worldwide	North Atlantic California-Oregon-Washington North Pacific Hawaii Gulf of Mexico

[14] The recovery plan for humpback whales recognizes three populations in the western North Atlantic, central North Pacific, and eastern North Pacific.

Table 4. Summary of the biological status of marine mammal taxa currently listed as endangered or threatened under the ESA or depleted under the MMPA

Taxon	Current population size	Current population trend	Population size relative to historical level
Endangered Species			
West Indian manatee, Florida	>3,300	Increasing?	Unknown
West Indian manatee, Antillean	Unknown	Declining?	Reduced?
Caribbean monk seal	0	N/A	Extinct
Hawaiian monk seal	1,252	Declining 1.9 percent per year	Reduced 60 percent from 1958
Steller sea lion, western population	38,513	Increasing?	Reduced 81 percent from 1970s
Blue whale[15]	>2,994	Increasing?	Reduced
Bowhead whale, western Arctic population	10,545	Increasing 3.4 percent per year	Reduced 54 percent from the 1800s
Fin whale	>11,970	Unknown	Reduced
Humpback whale	>6,692	Increasing	Reduced
North Atlantic right whale	299	Declining?	Reduced
North Pacific right whale, eastern population	>23	Unknown	Reduced
Sei whale[16]	>133	Unknown	Reduced
Sperm whale[17]	>14,468	Unknown	Reduced
Killer whale, southern resident population	84	Unknown	Reduced 40 percent from historical levels
Threatened Species			
Southern sea otter	2,825	Increasing?	Reduced
Northern sea otter, southwest Alaska population	41,865	Declining	Reduced 55 to 67 percent from 1976
Guadalupe fur seal	7,408	Increasing	Reduced
Steller sea lion, eastern population	44,996	Increasing	Unknown

15 Data not available for the North Atlantic and western North Pacific stocks.
16 Data not available for the Nova Scotia stock.
17 Data not available for the North Pacific stock.

Table 4. Summary of the biological status of marine mammal taxa currently listed as endangered or threatened under the ESA or depleted under the MMPA (continued)

Taxon	Current population size	Current population trend	Population size relative to historical level
Species Listed Only as Depleted			
Northern fur seal, eastern population	688,028	Declining	Reduced 65 percent from the 1950s
Beluga whale, Cook Inlet population	278	Declining?	Reduced 57 percent from 1994
Bottlenose dolphin, mid-Atlantic coastal population	33,000	Unknown	Reduced
Killer whale, AT1 group	8	Declining	Reduced 64 percent from 1988

Table 5. Summary of the quality of available data for marine mammal taxa currently listed as endangered or threatened under the ESA or depleted under the MMPA (G=good, F=fair, P=poor)

Taxon name	Total population size	Trend in pop. size	Population structure	Vital rates	Habitat needs	Limiting factors
West Indian manatee, Florida	G	G	G	G	G	G
West Indian manatee, Antillean	P	P	P	P	F	F
Southern sea otter	G	G	G	G	G	F
Northern sea otter, southwest Alaska	G	G	F	F	G	F
Caribbean monk seal	—	—	—	—	—	—
Hawaiian monk seal	G	G	G	G	G	G
Guadalupe fur seal	P	P	P	P	P	P
Northern fur seal, eastern Pacific	G	G	G	F	F	F
Steller sea lion, eastern population	G	G	G	F	F	F
Steller sea lion, western population	G	G	G	F	F	F
Blue whale	P	P	P	P	P	P
Bowhead whale, western Arctic	G	G	F	F	F	F
Fin whale	F	P	P	F	P	P
Humpback whale[18]	F	F	F	F	F	F
North Atlantic right whale	F	F	G	G	F	G
North Pacific right whale	P	P	P	P	P	P
Sei whale	P	P	P	P	P	P
Sperm whale	F	P	F	F	P	P
Beluga whale, Cook Inlet	G	G	G	P	F	F
Bottlenose dolphin, mid-Atlantic coastal	P	P	P	P	F	F
Killer whale, southern resident	G	G	G	G	F	F
Killer whale, AT1 group	G	G	G	G	F	P

[18] Results from the SPLASH project should greatly improve data available for North Pacific populations.

Table 6. ESA and MMPA listings of taxa with good or fair data in at least five data categories (grouped by listing status and arranged within groups in order of increasing abundance)

Taxon name	Current pop. size	Current pop. trend	Relative pop. size	ESA/MMPA listing
Killer whale, southern resident	84	Unknown	Reduced 41 percent	Endangered
North Atlantic right whale	299	Declining?	Reduced	Endangered
Hawaiian monk seal	1,252	Declining	Reduced 60 percent	Endangered
West Indian manatee, Florida	>3,300	Increasing?	Unknown	Endangered
Humpback whale	>6,692	Increasing	Reduced	Endangered
Bowhead whale, western Arctic	10,545	Increasing	Reduced 57 percent	Endangered
Steller sea lion, western population	38,513	Increasing?	Reduced 82 percent	Endangered
Southern sea otter	2,825	Increasing?	Reduced	Threatened
Steller sea lion, eastern population	44,996	Increasing	Unknown	Threatened
Northern sea otter, southwest Alaska	41,865	Declining	Reduced 62 percent	Threatened
Killer whale, AT1 group	8	Declining	Reduced 59 percent	Depleted
Beluga whale, Cook Inlet	278	Declining?	Reduced 72 percent	Depleted
Northern fur seal, eastern Pacific	688,028	Declining	Reduced 60 percent	Depleted

VII. APPENDIX

Summary of Quantitative Features of the IUCN Rule-based Approach

See IUCN (2001) for a more complete description of the criteria. Bolding indicates the differences between the classifications of "critically endangered," "endangered," and "vulnerable." (wl) = "whichever is longer, up to a maximum of 100 years." (From DeMaster et al. 2004)

<u>Critically endangered</u>

A. Reduction in population size
- ≥ **90 percent** decline in past **10** years or **3** generations (wl), if understood and reversible and stopped
- ≥ **80 percent** decline in past **10** years or **3** generations (wl), if not understood or reversible or stopped
- ≥ **80 percent** decline projected for next **10** years or **3** generations (wl)
- ≥ **80 percent** decline including past and future **10** years or **3** generations (wl), if not understood or reversible or stopped

B. Geographic range
- extent of occurrence < **100** km^2
- area of occupancy < **10** km^2

C. Population size < **250** mature individuals and:
- continuing decline ≥ **25 percent** in future **3** years or **1** generation (wl)
- no subpopulation with > **50** mature individuals, or ≥ **90 percent** mature individuals in one subpopulation

D. Population size < **50** mature individuals

E. Quantitative analysis showing Pr(extinction) ≥ **50 percent** within **10** years or **3** generations (wl)

<u>Endangered</u>

A. Reduction in population size
- ≥ **70 percent** decline in past **10** years or **3** generations (wl), if understood and reversible and stopped
- ≥ **50 percent** decline in past **10** years or **3** generations (wl), if not understood or reversible or stopped
- ≥ **50 percent** decline projected for next **10** years or **3** generations (wl)
- ≥ **50 percent** decline including past and future **10** years or 3 generations (wl), if not understood or reversible or stopped

B. Geographic range
- extent of occurrence < **5000** km^2
- area of occupancy < **500** km^2

C. Population size < **2,500** mature individuals and:
- continuing decline ≥ **20 percent** in future **5** years or **2** generations (wl)

• no subpopulation with > **250** mature individuals, or ≥ **95 percent** mature individuals in one subpopulation

D. Population size < **250** mature individuals

E. Quantitative analysis showing Pr(extinction) ≥ **20 percent** within **20** years or **5** generations (wl)

Vulnerable

A. Reduction in population size

• ≥ **50 percent** decline in past **10** years or **3** generations (wl), if understood and reversible and stopped

• ≥ **30 percent** decline in past **10** years or **3** generations (wl), if not understood or reversible or stopped

• ≥ **30 percent** decline projected for next **10** years or **3** generations (wl)

• ≥ **30 percent** decline including past and future **10** years or **3** generations (wl), if not understood or reversible or stopped

B. Geographic range

• extent of occurrence < **20,000** km^2

• area of occupancy < **2000** km^2

C. Population size < **10,000** mature individuals and:

• continuing decline ≥ **25 percent** in future **10** years or **3** generations (wl)

• no subpopulation with > **1,000** mature individuals, or **100 percent** mature individuals in one
subpopulation

D. Population size < **1,000** mature individuals

E. Quantitative analysis showing Pr(extinction) ≥ **10 percent** within **100** years (wl)

APPENDIX 3

The Status of Protection Programs for Endangered, Threatened, and Depleted Marine Mammals in U.S. Waters

The Status of Protection Programs for Endangered, Threatened, and Depleted Marine Mammals in U.S. Waters

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One of a series of reports prepared in response to a directive from Congress to the Marine Mammal Commission to examine the biological viability and cost–effectiveness of protection programs for the most endangered marine mammals in U.S. waters

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I. INTRODUCTION AND PURPOSE OF STUDY

As part of its fiscal year 2004 Omnibus Appropriations Act, Congress directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." Pursuant to this directive, the Marine Mammal Commission sought to address four basic questions:

1. What are the most endangered marine mammal populations in U.S. waters?
2. What is their biological viability?
3. What is the biological effectiveness of current protection programs?[1]
4. What is the cost-effectiveness of expenditures to implement those programs?

This report reviews protection programs for the 22 taxa listed under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA) and is intended to complement other parts of the Commission's response to Congress, including—

- The report of a workshop to examine population viability analyses (PVAs) conducted to date on marine mammals in U.S. waters and ways to improve their usefulness for management (Marine Mammal Commission 2007).
- A report to examine systems for classifying marine mammals under the ESA, the MMPA, and IUCN–The World Conservation Union's Red List of Threatened Species, including a review of information on the current biological condition of each listed species (Lowry et al. 2007).
- A more in-depth review of the cost-effectiveness of recovery efforts for the North Atlantic right whale (Reeves et al. 2007).

These reports provide background information for use by the Commission as it prepares its findings and recommendations for submission to Congress.

This report is divided into three major sections. The first discusses provisions of the MMPA and the ESA that form the foundation for most marine mammal protection programs. The second profiles protection programs for all 22 listed taxa. Each profile summarizes information on the taxon's status, major threats, management framework, critical habitat, recovery planning, major management actions, and staffing and funding levels. The third summarizes overall trends in protection programs for the listed species and populations, based on those profiles. Appendices include tables and charts with estimates of expenditures for related conservation programs, additional details regarding key provisions of the MMPA and the ESA, and information on the status of the various taxa.

With regard to the allocation of funding levels related to recovery, the species profiles present cost data from four principal sources. First, they include actual funding spent by various federal

[1] For purposes of the study, the terms "protection" and "protection program" encompass all activities undertaken under the auspices of federal programs to reverse a population's decline and restore the population to its former abundance. This definition includes, but is not limited to, research and regulatory and other management actions, including enforcement, public outreach, and recovery planning.

and state agencies as reported to the U.S. Fish and Wildlife Service for its annual reports to Congress on federal and state expenditures for listed species, a report required by the ESA. Second, the profiles include information on species-specific research and management actions reported to the Marine Mammal Commission as part of its annual surveys of federally funded marine mammal research. Third, funding levels listed in agency budget documents are identified to the extent that line items clearly focus on an individual species. And fourth, the profiles present projected annual funding needs set forth in recovery plans at the time of their adoption. In almost all cases, funding projections in recovery plans are substantially higher than actual allocations.

Although these were the best available sources of funding data and provide a general picture of funding levels provided or believed necessary to foster a species' recovery, readers also should be aware that accounting practices used by the reporting agencies often differ greatly among agencies and even within agencies between years. Thus, funding levels reported here from different sources are not always consistent, and aggregate funding levels should be considered as general approximations at best.

II. MAJOR FEDERAL STATUTORY PROTECTION MEASURES

Provisions of the MMPA and the ESA form the foundation and framework for most marine mammal protection activities. Those provisions are summarized briefly below and in greater detail in Appendix A.

THE MARINE MAMMAL PROTECTION ACT

When it was passed in 1972, the MMPA fundamentally changed the management of human activities affecting marine mammals and their ecosystems. The Act sets as its primary objective "…to maintain the health and stability of the marine ecosystem." Consistent with this objective, it calls for maintaining marine mammals at their "optimum sustainable population keeping in mind the carrying capacity of the habitat."

The Secretary of Commerce, acting through the National Marine Fisheries Service (NMFS), has primary authority for all cetaceans (i.e., whales and dolphins) and pinnipeds (i.e., seals and sea lions) except walruses. The Commerce Secretary also implements the MMPA's provisions for managing incidental take of all marine mammals in commercial fisheries. The Secretary of the Interior, acting through the U.S. Fish and Wildlife Service (FWS), has authority for managing all manatees, dugongs, polar bears, sea and marine otters, and walruses. The Act also established the Marine Mammal Commission, whose primary responsibility is to provide an independent source of advice and oversight to the Services and other federal agencies on implementation of the Act's provisions. The MMPA preempts state laws or regulations relating to the taking of marine mammals unless authorized through a formal process by which management authority can be transferred to individual states. However, states are not prevented from cooperating with NMFS and FWS in conservation efforts consistent with the Act's objectives, and in many cases they are vital partners in this regard.

Other important features of the MMPA include the following:

- Moratorium on taking: The Act imposed a moratorium on taking that includes both intentional and unintentional capture, killing, and harassment (including potential injury) of marine mammals. Subject to certain limitations or requirements, exemptions and exceptions to the moratorium are authorized for the following purposes:

  – Non-wasteful taking by Alaska Indians, Aleuts, or Eskimos when the taking is for subsistence purposes or for the purpose of creating authentic handicrafts and clothing;
  – Taking for scientific research, public display, enhancement, or commercial or educational photography;
  – Taking of small numbers of marine mammals incidental to activities other than commercial fishing;
  – Taking of non-depleted marine mammals under the Act's waiver provisions;
  – Deterring marine mammals from damaging fishing gear and catch or private property;
  – Taking by government officials for the protection and welfare of a marine mammal, the protection of public health and welfare, or relocation of nuisance animals; and
  – Taking in defense of one's self or another person in immediate danger.

- Depleted species: The Act directs the responsible agencies to designate a species as "depleted" if its abundance declines below its optimum sustainable population (OSP) level. This level is defined as a range between the population size that produces the maximum rate of net productivity and the maximum number that can be supported by the ecosystem. For species or populations designated as depleted, the Act authorizes the preparation of conservation plans to restore them to OSP levels. Species designated as depleted also are considered strategic stocks for which take reduction plans are to be prepared if they are taken incidentally in a category I or II fishery (see Appendix A for explanation of fishing categories).

- Taking incidental to commercial fishing: The Act calls for reducing mortality and serious injury of marine mammals incidental to commercial fisheries, first to below a stock's potential biological removal (PBR) level and ultimately to "insignificant levels approaching a zero mortality and serious injury rate." PBR is defined as the number of animals that can be removed from a population, not counting natural mortality, while retaining a high degree of assurance that the population will remain within the OSP range or, if it is depleted, will increase toward its OSP level. As the implementing agency, NMFS must place all U.S. commercial fisheries into one of three categories based on their level of incidental taking. Depending upon the classification, fishermen must undertake actions to meet the standards of the Act. For fisheries that are not meeting those standards, NMFS is required to convene a take reduction team to prepare a plan for that purpose.

THE ENDANGERED SPECIES ACT

In 1973 Congress passed a major revision of two earlier versions of the ESA—the Endangered Species Preservation Act (ESPA) of 1966 and the Endangered Species Conservation Act (ESCA) of 1969. Like the MMPA, the ESA is intended to conserve individual species and the ecosystems upon which they depend. The aim of the Act is "to bring any endangered species or threatened species to the point at which the measures provided pursuant to this [Act] are no longer relevant." As with the MMPA, the Department of Commerce has lead responsibility for cetaceans and pinnipeds (other than walruses) listed as endangered or threatened, and the Department of the Interior has lead responsibility for the recovery of listed manatees, dugongs, and sea and marine otters.

The Act defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered in the foreseeable future. The Act identifies five factors that must be considered in evaluating whether to list a species under either category:

- The present or threatened destruction, modification, or curtailment of the species' habitat or range;
- Overutilization for commercial, recreational, scientific, or education purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms; and
- Other natural or manmade factors affecting the species' survival.

The economic impact of a listing may not be considered in listing determinations.

Specific protection provisions in the ESA include the following:

- Prohibition on taking endangered and threatened species: The ESA makes it unlawful to take an endangered or threatened species. Taking includes intentional and unintentional harm or harassment, including modification of habitat that significantly impairs essential behavioral patterns to the extent that it kills or injures listed species. This prohibition also is generally applied to activities affecting threatened species through regulations issued by the two Services. Exemptions to this prohibition include the following:

  – Taking by certain Alaska Natives and non-native permanent residents of Alaska Native villages primarily for subsistence purposes. Such taking may be regulated if it is found that the taking materially and negatively affects the species;
  – Taking for scientific research or enhancement of a population;
  – Taking incidental to an otherwise lawful activity provided there is an acceptable plan and funding to mitigate takings and that the takings will not "appreciably reduce the likelihood of the survival and recovery of the species in the wild"; and
  – Taking incidental to federal actions that are subject to section 7 consultation for which a "no-jeopardy" biological opinion is issued.

- Designation of critical habitat: The ESA requires designation of critical habitat for listed species, with some exceptions. Critical habitat includes geographical areas "on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection." Unlike listing decisions, a decision to designate critical habitat may consider economic impacts. The Act requires that federal agencies avoid destruction or adverse modification of critical habitat.

- Preparation of recovery plans: The ESA requires the development and implementation of a recovery plan for a listed species unless the Secretary of the Interior or the Secretary of Commerce finds that a recovery plan will not promote the conservation of a listed species. These plans must include objective and measurable criteria for removing the species from the list of endangered and threatened species, measures needed to recover the species, and estimates of the time and costs required to carry out those measures.

- Section 7 consultations: Section 7 of the ESA requires that all federal agencies use their authorities to further the conservation objectives of the Act and that they consult with the Services to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat. Consultation may be informal or formal, depending on the likely effect of the activity. A formal consultation results in the preparation of a written biological opinion by the relevant Service on whether the activity is likely to jeopardize the existence of the listed species or modify its habitat. If so, reasonable and prudent alternatives to the proposed action must be identified to avoid jeopardy or adverse modification.

OTHER AUTHORITIES

Listed marine mammals also are protected by other federal statutes and international agreements to which the United States is a party (Appendix A). Among the more important domestic statutes are provisions under the National Environmental Policy Act requiring the preparation of environmental assessments and impact statements; the Magnuson–Stevens Fishery Conservation and Management Act requiring the preparation of fishery management plans; the National Marine Sanctuaries Act, which authorizes the establishment of marine sanctuaries; and the Outer Continental Shelf Lands Act, which authorizes and regulates the leasing of U.S. outer continental shelf areas for purposes of oil, gas, and hard mineral exploration and development. Important international agreements include the International Convention for the Regulation of Whaling and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

III. SPECIES-SPECIFIC PROTECTION PROGRAMS

SIRENIANS

Florida Manatee

Status: The Florida manatee (*Trichechus manatus latirostris*) is a subspecies of the West Indian manatee that occurs only in the southeastern United States. The species as a whole occurs from the southeastern United States through the Greater Antilles and Central America to northern Brazil. It was first listed as endangered under the ESPA in 1967 (FWS 2001), and that listing was carried forward under the ESCA and ESA. Florida manatees are not listed separately but are considered endangered by virtue of the species' listing as endangered throughout its range. In April 2005 the Service announced plans to begin a five-year review of the Florida manatee to determine whether information is sufficient to warrant downlisting or delisting the species (FWS 2005c). Florida manatees also are protected under the state of Florida's Manatee Sanctuary Act.

Although the Florida subspecies ranges as far west as Texas and as far north as Rhode Island, its distribution is concentrated in coastal waters and rivers of Florida (Lefebvre et al. 2001). Four subpopulations have been identified for management purposes, including two along Florida's Atlantic coast and two on the Gulf of Mexico coast. Forty-seven percent of the total population is estimated to be in the Atlantic subpopulation, 4 percent in the St. Johns River subpopulation, 12 percent in the northwest subpopulation, and 37 percent in the southwest subpopulation (FWS 2001).

A reliable method for estimating total abundance has not been developed because of shortcomings in survey techniques; however, a minimum population has been estimated based on counts of animals at winter refuges (FWS 2001). In the 1980s the total population was estimated to number at least 1,200 manatees. More comprehensive surveys involving aerial and ground counts were initiated in 1991, and in January 2001 a total of 3,300 manatees were counted. The current population is therefore thought to number at least 3,300 (Haubold et al. 2005). Roughly equal numbers of manatees occur on Florida's east and west coasts. In the absence of a series of reliable total population estimates, trends in abundance have been assessed using survival rates from photo-identification, mortality records, and reproduction rates. The 2001 revision of the Florida manatee recovery plan includes the assessments shown in Table 1 for each of the four subpopulations. (See also Table 3 for recovery criteria.)

The most recent stock assessment report for Florida manatees estimates the potential biological removal (PBR) level to be between 0 and 3 and notes that human-related manatee mortality far exceeds those levels (FWS 2000). The report also concludes that establishing any level for PBR would be inappropriate and inconsistent with the Florida manatee recovery plan.

Table 1. Status of four major subpopulations of Florida manatees relative to recovery criteria in the 2001 recovery plan (FWS 2001)

Northwest	Southwest	Upper St. Johns	Atlantic
Exceeds survival, reproduction, and population growth criteria	Estimates of survival and population growth not yet available; reproduction criterion has been exceeded for group that summers in Sarasota Bay	Meets or exceeds survival, reproduction, and population growth criteria	Meets reproduction criterion; may meet survival and population criteria
Although overall deaths are relatively low, watercraft-related deaths are increasing rapidly	Overall deaths are high; watercraft-related deaths are increasing rapidly	Overall deaths are moderate; watercraft-related deaths increasing slowly	Overall deaths are high; watercraft-related deaths increasing moderately

Major Threats: About one-third of all known Florida manatee deaths are directly related to human activities, principally collisions with vessels, which constitute the most immediate threat to their survival (Rathbun and Wallace 2000, MMC 2005). Overall, the total number of manatee deaths has grown steadily since 1976 when mortality records were first compiled. Between the 1980s and 1990s average annual reported mortality doubled (MMC 2001). Without good estimates of population size, it is unclear whether this change reflects an increased mortality rate, a relatively stable mortality rate accompanying an increased population size, or some combination of the two. In the long term, the major threat to Florida manatees is thought to be the potential loss of warm-water habitat necessary to survive cold winter periods. Other threats include entrapment in floodgates and navigation locks, incidental take in fishing gear, habitat destruction, cold stress, and naturally produced biotoxins associated with red tides (FWS 2001).

<u>Boat Collisions</u>: Boat collisions are the largest source of human-caused manatee deaths and injuries in Florida, accounting for about one-quarter to one-third of all known deaths. Between 1976 and 2005 watercraft-related deaths of manatees ranged from a low of 15 in 1983 to a high of 95 in 2002 with an average of 81 deaths per year between 2001 and 2005 (Laist and Shaw 2006). Although the total number of deaths has been increasing steadily, the proportion of annual mortality caused by boats has remained relatively stable.

<u>Loss of Warm-Water Refuges</u>: Perhaps the major long-term threat to Florida manatees is the loss of warm-water refuges. This is due both to the likely closure of industrial facilities, principally power plants, that produce warm-water discharges now used by most Florida manatees in winter, and potential declines of warm-water flows at natural springs due to groundwater withdrawal for human uses (FWS 2001, Laist and Reynolds 2005a,b). In the past, manatees likely relied on warm-water springs in central Florida and passive thermal basins (i.e., persistent pockets of warm water) in southernmost Florida to survive the lethal effects of cold winter temperatures. Hunting prior to the 1900s apparently drastically reduced manatee use of natural springs and, as Florida developed and warm-water outfalls from power plants became available, manatees expanded their restricted winter range in southernmost Florida using those discharges as refuges. About 60 percent of all Florida manatees currently winter at 10 major power plant outfalls. Along the Atlantic coast, 85 percent depend on five power plant outfalls (Laist and Reynolds 2005b). Of nine warm-water refuges with at least one winter count of more than 200 manatees, six are power plants, one is a natural spring, and two are passive thermal basins in southernmost

Florida. Even at power plants, manatees wintering there can be at risk due to plant malfunction or maintenance shutdowns or because the plants do not heat water to temperatures warm enough for manatees.

Although some power plants have recently been upgraded to operate for another 20 to 30 years, others will likely be shut down, perhaps as soon as the next few years (MMC 2005). Plants built before the early 1970s, including those that have been or may be upgraded after 1972, are allowed to continue discharging warm water from plant cooling systems under a regulatory variance. Power plants built since the early 1970s are not allowed to do so. According to the 2001 Florida manatee recovery plan, “in the absence of stable, long-term sources of warm water and winter habitat, large numbers of manatees may succumb to the cold” (FWS 2001).

Discrete groups of manatees also depend on discharges from warm-water springs (Laist and Reynolds 2005b). Nearly the entire subpopulation of 170 manatees in the upper St. Johns River depends on Blue Spring to survive winter cold periods. In recent years, drought and groundwater withdrawals for domestic and agricultural uses may have contributed to reduced flow rates. In a few other cases, manatee access to warm-water springs is restricted by human modifications. At Homosassa Springs on the gulf coast of Florida, a fence has been placed across the spring run to confine a few captive manatees near the spring discharge where they serve as an attraction for visitors to a state wildlife park. Ironically, this restricts wild manatees to lower portions of the spring run where water temperatures in winter are somewhat cooler than the discharges at the head of the spring run (MMC 2005). In other cases, dams and locks have blocked access to springs once used by manatees. Spring runs made shallow by siltation also limit manatee access to some warm-water spring discharges.

<u>Floodgates and Navigation Locks</u>: The second largest source of human-related manatee mortality is crushing and drowning in floodgates and navigation locks. Between 1976 and 2000 these structures caused between 3 and 16 deaths per year, representing about 4 percent of total manatee mortality (MMC 2005).

<u>Other Anthropogenic Causes</u>: Other anthropogenic causes of manatee death include entanglement and ingestion of marine debris such as monofilament fishing line, incidental take in shrimp nets, vandalism, and entrapment in sewer pipes. Between 1976 and 2000 these sources combined to account for approximately 3 percent of all recorded manatee deaths (FWS 2001).

<u>Other Habitat Degradation</u>: Large portions of habitat upon which manatees rely for food, resting, calving, nurturing young, or as travel corridors have been and are being altered by expanding development (FWS 2001). Some areas once inaccessible for boating are now heavily used navigation routes and open to other human activities. Polluted runoff, boat propellers, and dredging have damaged or destroyed grass beds on which manatees feed (MMC 2001). Hydrilla, an exotic plant that has supplanted native aquatic species, has become a new food source for manatees (FWS 2001). Although eaten by manatees, Hydrilla is managed as a nuisance plant (FWS 2001). Table 2 lists some of the habitat-related concerns for each of the four subpopulations of Florida manatees (FWS 2001).

Table 2. Major habitat protection concerns for the four subpopulations of Florida manatees (FWS 2001)

Northwest	Southwest	Upper St. Johns	Atlantic
• Spring flow rates • Water quality effects on submerged aquatic vegetation (SAV) • Storm-related salinity fluctuation effects on SAV • Storm-related effects on adult survival • Human disturbance at springs • Conflicts between weed control and SAV • Papilloma virus	• Manatee dependence on power plants as thermal refuges • Increasing boat traffic • Red-tide-related deaths • Water control structure deaths • Water quality effects on SAV • Storm-related salinity fluctuation effects on SAV • Storm-related effects on adult survival • Human disturbance	• Spring flow rates • Increasing boat traffic • Water quality effects on SAV • Water control structure deaths • Conflicts between weed control and SAV	• Manatee dependence on power plants as thermal refuges • Increasing boat traffic • Use of Intra-coastal Waterway as a manatee travel corridor • Water control structure deaths • Water quality effects on SAV • Storm-related salinity fluctuation effects on SAV • Human disturbance

Natural and Undetermined Causes: About two-thirds of all known manatee deaths between 1976 and 2000 (FWS 2001, MMC 2005) were caused by natural and undetermined causes. Natural causes include disease, parasitism, and reproductive complications. In some years, exposure to cold has been a major cause of death. The greatest number of cold-related deaths occurred following a winter cold spell in 1989 when at least 46 manatees died. Red tides also cause episodes of high manatee mortality. In the spring of 1996 at least 145 manatees died during a red-tide event in southwestern Florida. In many cases, causes of death cannot be determined because of badly decomposed carcasses or other reasons. Undetermined deaths may be caused by either natural or human-related factors.

Management Framework: At the federal level, FWS has lead responsibility for conservation and recovery of Florida manatees (FWS 2001, MMC 2004). Among other things, FWS oversees development and implementation of the Florida Manatee Recovery Plan (FWS 2001), conducts section 7 consultations on federally authorized projects that may affect manatees, enforces federal and state manatee protection regulations, and oversees efforts to rescue and rehabilitate injured manatees (MMC 2001). The Sirenia Project and the Patuxent Wildlife Research Center in the U.S. Geological Survey's (USGS) Biological Resources Division have the lead in manatee research at the federal level. Among other things, they develop population models, assess life history information from photo-identification records, and conduct research on feeding ecology and habitat needs.

The Florida manatee recovery program is unique among marine mammal recovery programs in that staff and funding levels provided for recovery work by the state agencies exceed those provided by the federal government. At the state level, the Florida Fish and Wildlife Conservation Commission exercises lead responsibility through its Imperiled Species Management Section and the Fish and Wildlife Research Institute. The management section oversees state regulatory, planning, and public education activities related to manatee protection, including the development of boat speed regulations and oversight of manatee protection plans developed by Florida counties with important manatee habitat. The Fish and Wildlife Research Institute oversees the carcass salvage and necropsy program, conducts aerial surveys, assists in the rescue of injured manatees, and maintains a geographic information system of data on manatees and manatee habitats.

Other agencies and organizations play important roles as well. The Army Corps of Engineers and the South Florida Water Management District have been designing and installing devices to prevent manatees from being crushed and drowned in floodgates and navigation locks. The U.S. Coast Guard and the Florida Fish and Wildlife Conservation Commission's Division of Law Enforcement enforce boat speed zones. The non-profit Save the Manatee Club has purchased equipment, funded research, and lobbied state and federal legislatures for funding and actions to support manatee recovery. The Florida Power & Light Company has funded aerial surveys of manatee abundance at power plants and produced public education materials. A number of marine aquaria and zoological parks have provided facilities and medical treatment to rehabilitate injured and distressed manatees for release back into the wild. The Marine Mammal Commission provides support for projects and helps in identifying recovery priorities through periodic reviews of manatee recovery efforts.

FWS first established a recovery team for West Indian manatees in 1976. The recovery team, which has been restructured and expanded several times, was last restructured in 2002. It now includes more than 140 people representing 60 agencies and groups and carries out its work through 12 working groups.

Critical Habitat: Critical habitat for manatees was designated in several areas of Florida in 1976 (40 Fed. Reg. 58308). It was the first of any listed marine mammal species to have such areas designated. The designated areas include most of the species' Florida range as it was known in 1976. Since that time, critical habitat has not been revised to reflect new understanding of manatee distribution and habitat needs.

Recovery Plan: FWS first adopted a recovery plan for West Indian manatees in 1980 (FWS 2001). The initial plan focused principally on the Florida subspecies and, to a lesser extent, on Antillean manatees in Puerto Rico and the U.S. Virgin Islands. When it first revised the plan, the Service developed separate recovery plans for Florida manatees (adopted in 1989) and Puerto Rico manatees (adopted in 1986, see below.) Two subsequent plan revisions were adopted for the Florida manatee in 1996 and 2001. Steps to prepare a fourth revision are currently underway. The goal of the current recovery plan is "to assure the long-term viability of the Florida manatee in the wild," allowing for downlisting to threatened and later to delisting, based in part of criteria shown in Table 3 (FWS 2001).

The recovery plan includes four objectives and dozens of associated tasks. The objectives and some of the major tasks include the following (FWS 2001):

<u>Minimize causes of manatee disturbance, harassment, injury, and mortality</u>

- Continue state and federal review of permitted activities to minimize impacts to manatees and their habitats
- Minimize collisions between manatees and watercraft

Table 3. Criteria for downlisting and delisting Florida manatees under the Endangered Species Act of 1973 (FWS 2001)

Downlist to Threatened	Delist
1. Reduce threats to manatee habitat or range as well as threats from natural and manmade factors by— • Identifying minimum spring flows • Protecting selected warm-water refuge sites • Identifying foraging habitats associated with warm-water refuges for protection • Identifying other important habitat (e.g., migratory corridors, feeding areas, and calving/nursing areas) for protection • Reducing unauthorized human-caused "take"	1. Reduce or remove threats to manatee habitat or range, as well as threats from natural and manmade factors, by enacting and implementing federal, state, or local regulations that— • Adopt and maintain minimum spring flows • Protect a network of warm-water refuge sites • Protect foraging habitats associated with the network of warm-water refuge sites • Protect a network of other important manatee habitats • Reduce or remove unauthorized human-caused "take"
2. Achieve the following population benchmarks in each of the four regions for the most recent 10-year period, with 95 percent level of statistical confidence: • Average annual rate of adult manatee survival is 90 percent or greater • Average annual percentage of adult female manatees with first or second year calves in winter is 40 percent or greater • Average annual rate of population growth is equal to or greater than zero	2. Achieve the following population benchmarks in each of the four regions for an additional 10-year period after downlisting to threatened, with 95 percent level of statistical confidence: • Average annual rate of adult manatee survival is 90 percent or greater • Average annual percentage of adult female manatees with first or second year calves in winter is 40 percent or greater • Average annual rate of population growth is equal to or greater than zero

- Enforce manatee protection regulations
- Assess and minimize mortality caused by large vessels
- Eliminate manatee deaths in water-control structures, navigational locks, and drainage structures
- Rescue and rehabilitate distressed manatees and release back into the wild
- Eliminate or minimize harassment due to other human activities

Determine and monitor the status of manatee populations

- Conduct a five-year status review
- Determine life history parameters, population structure, distribution patterns, and population trends
- Evaluate and monitor causes of mortality and injury
- Define factors that affect health, well-being, physiology, and ecology

Protect, identify, evaluate, and monitor manatee habitats

- Protect, identify, evaluate, and monitor existing natural and industrial warm-water refuges and investigate alternatives
- Establish, acquire, manage, and monitor regional protected area networks and manatee habitat

- Ensure that minimum flows and levels are established for surface waters to protect resources of importance to manatees
- Assess the need for revising critical habitat

<u>Facilitate manatee recovery through public awareness and education</u>

- Develop, evaluate, and update public education and outreach programs and materials
- Coordinate development of manatee awareness programs and materials in order to support recovery
- Develop consistent manatee viewing and approach guidelines

Major Management Actions: Major actions to protect and conserve the Florida manatee include the following:

<u>Boat Collisions</u>: In 1989 the state of Florida initiated major efforts to reduce boat collisions with manatees. In conjunction with steps being taken by FWS, the state's initiative called for a three-pronged approach: regulations to limit boat speed and access in 13 key counties and specific areas where collision risks are greatest; enforcement of those rules; and restrictions on developing boating access facilities in key manatee habitat (MMC 2005).

Reducing speeds of watercraft may reduce manatee injuries and deaths largely by providing manatees more time to detect and avoid oncoming watercraft (Laist and Shaw 2006). It also provides vessel operators more time to detect and avoid manatees and reduces the force of collisions to levels that manatees might survive. By 2000 the state had established speed zones in all 13 key counties, with additional speed zones in parts of 11 other counties. Several types of speed zones are used depending on site-specific assessments of manatee habitat, vessel traffic patterns, and other factors. The two principal types of speeds zones include one that exempts marked channels and another that includes them. Speed limits within zones typically vary from idle or slow in non-channel areas and up to 30 mph in marked channels (MMC 2005). A third type of zone (i.e., shoreline slow speed zones) limits speeds within certain distances of shore and a fourth type (i.e., no entry areas) excludes all watercraft. The Florida Fish and Wildlife Conservation Commission has continued efforts to expand and refine speed zones and to introduce them in other counties. In addition, FWS has restricted boat speeds in several national wildlife refuges and has established 13 manatee refuges in various parts of Florida for purposes of strengthening or complementing state boat speed rules to protect manatees.

Development of boat speed rules is a demanding, iterative effort conducted county-by-county and area-by-area. The process involves the collection and analysis of manatee distribution and vessel traffic data, interagency meetings, public hearings, sign posting, public education, and enforcement operations. Controversy has often surrounded establishment of these zones. In Lee County in southwestern Florida—which often has led all Florida counties in annual watercraft-related manatee deaths—an appellate court invalidated state speed zones in five areas in 2004 after a particularly contentious rule challenge (MMC 2005). In the absence of those county rules, FWS issued emergency rules under the MMPA and the ESA to reinstate measures comparable to the annulled state speed zones (70 Fed. Reg. 17863).

Efforts to enforce boat speed restrictions were limited as new rules were adopted in the 1990s (MMC 2001). In 1997 the Service began dedicated enforcement operations in selected areas. In 2000 the Service received a special congressional appropriation that enabled it to establish a part-time enforcement strike team that increased its enforcement efforts fivefold. In 1998 the Coast Guard also began increasing its enforcement efforts. In 2000 the Florida Division of Law Enforcement, the primary source of enforcement for manatee rules, significantly increased its efforts. Boater compliance studies have been conducted periodically in various areas, principally by the state, to assess boater compliance and help identify enforcement priorities.

There has been little evidence of a decline in watercraft-related manatee deaths since the establishment of speed zones. Indeed, the total annual number of watercraft-related deaths has increased at roughly the same pace as the increase in total mortality. The failure to reduce watercraft-related deaths may be due to low compliance, inadequately designed speed zones, and/or increasing numbers of boats and manatees. A review of manatee deaths in two connected waterways in eastern Florida since 2002 suggested an abrupt decrease in the number of collision-related manatee deaths when channels with speed-limit exemptions were removed and all boaters were required to go slow both inside and outside the marked channels (Laist and Shaw 2006). The removal of speed-exempt channels also may have simplified enforcement and enhanced compliance.

A second approach to reducing watercraft-related deaths has been to limit the development of marinas and other watercraft access facilities. Both the Florida Department of Environmental Protection and the U.S. Army Corps of Engineers require permits for new marinas, boat ramps, private piers, and docks, and the Florida Fish and Wildlife Conservation Commission and FWS have a formal role in reviewing such permit applications. Restrictions and limitations imposed through this process to protect manatees have been controversial.

To facilitate review and approval of boating facilities, the governor of Florida launched an effort in 1989 to encourage the 13 key counties to adopt comprehensive manatee protection plans as part of required growth management plans. The manatee protection plans, which are reviewed by the Commission and FWS, are to include guidance on locating new watercraft access facilities in a manner consistent with the protection of manatees. By the end of 2004, 10 Florida counties had adopted state-approved manatee protection plans.[2]

<u>Floodgates and Navigation Locks</u>: Efforts in the 1980s to reduce manatee deaths in floodgates and navigation locks involved simple modifications in the timing of gate closures. Those measures appeared to reduce such deaths until the early 1990s when they increased sharply to a high of 16 deaths in 1994 (FWS 2001). In response, an interagency task force was established early in the 1990s, including representatives of the South Florida Water Management District, the U.S. Army Corps of Engineers, the Florida Wildlife Commission, FWS, and other agencies. The task force has overseen efforts to design and install pressure-sensing devices on gates and locks implicated in manatee deaths. The sensors trigger mechanisms that reverse closing gates, operating much like elevator doors. By 2006 most of the structures responsible for manatee deaths prior to the early 1990s (approximately 25 structures) had been modified. Manatee deaths

[2] James A. Valade, personal communication. 2005. U.S. Fish and Wildlife Service, 6620 Southpoint Drive, Room 310, Jacksonville, FL 32216.

at retrofitted structures subsequently declined substantially; however, some deaths have continued at structures not previously implicated and at retrofitted gates not operating properly. Adjustments have been developed for those not operating properly, and plans for retrofitting the remaining structures are being developed. The cost for modifying lift gates at flood control structures and some navigation lock gates has been about $150,000 per gate, while the cost for modifying navigation locks with swinging barn door-style gates has been about $1 million per lock.

<u>Warm-Water Refuges</u>: In 1999 FWS and Florida Power & Light Company convened a workshop to evaluate the potential impact of the loss of industrial warm-water refuges in the event that power plants are retired. As a result of this workshop, a Warm-Water Task Force was formed within the Florida Manatee Recovery Team. The task force is composed of representatives of state and federal agencies, power companies, environmental organizations, and the scientific community. Its purpose is to develop and implement measures to assure the availability of natural warm-water springs as winter refuges for manatees while minimizing mortality associated with future power plant closures.

Research supported by the Florida Power & Light Company, the Marine Mammal Commission, and Reliant Energy examined ways of mitigating the potential effect of power plant closures by developing solar-heated refuges that could sustain manatees during the winter pending an increase in manatee subpopulations dependent on natural springs (Laist and Reynolds 2005a, MMC 2005). These findings were incorporated into a draft warm-water refuge action plan by the Warm-Water Task Force. Among other things, the plan calls for maintaining a network of warm-water habitats for each of the four Florida manatee subpopulations to maintain their current range.

In 2000 Florida Governor Jeb Bush and the Florida Department of Environmental Protection convened a Springs Task Force (not part of the manatee recovery team) to restore, protect, and enhance Florida springs. Its charge includes establishing and maintaining minimum spring discharge levels for a variety of environmental reasons, including manatee protection. At the behest of representatives from the Florida Manatee Recovery Team, the St. Johns Water Management District, which has management responsibility for Blue Spring, supported a study to identify the minimum spring flow necessary to maintain an optimal population of manatees at the spring during the winter. Based on this study, the district proposed minimum spring flows for the next 25 years.

<u>Other Habitat Degradation</u>: Several approaches have been taken to prevent or mitigate degradation of important manatee habitat. As noted above, FWS and the state of Florida review hundreds of permit applications to the U.S. Army Corps of Engineers and Florida Department of Environmental Regulation for construction projects in areas that include important manatee habitat (FWS 2001). County manatee protection plans also are expected to include provisions incorporated into local growth management plans, including policies on locating boat facilities (FWS 2001).

Both the state of Florida and FWS also have acquired tens of thousands of acres of land, particularly in the Crystal and Homosassa Rivers area intended, in part, to protect manatee habitat (FWS 2001). FWS also has adopted regulations for designating manatee refuges (areas in which human activities may be regulated) and manatee sanctuaries (areas in which all waterborne activity is prohibited) (44 Fed. Reg. 60962). Manatee sanctuaries have been designated primarily to prevent divers from driving animals away from warm-water discharges at the Crystal and Homosassa Rivers. Eight small sanctuaries covering a total of about 60 acres have been established at those locations. With access by swimmers as well as boats prohibited in marked sanctuary boundaries, manatees quickly learned to use those areas to escape unwanted human attention. About a dozen manatee refuges covering many thousands of acres also have been established by FWS to regulate boat speeds in several areas of Florida where state measures were deemed inadequate or have been annulled following legal challenges.

<u>Manatee Rescue and Rehabilitation Efforts</u>: A recovery team working group led by FWS staff coordinates a network of state and local agencies and private organizations that rescues, rehabilitates, and releases dozens of injured and distressed manatees annually (FWS 2001). Such animals typically include animals hit by boats, entangled in fishing line or marine debris, caught in pipes or other structures, or debilitated due to exposure to red tides or cold. Between 1973 and 2005 more than 375 manatees were captured, treated, and returned to the wild, and many others were assisted and released on site (FWS 2001). Although a significant number of animals brought into captivity for special treatment died of their injuries or health problems during transport or treatment, animals released after successfully completing treatment appear to have a high rate of success in readapting to the wild. In 2005, FWS estimated that rehabilitation costs exceeded $5 million, with about two-thirds of that provided by oceanariums.

Staff and Funding Levels: Information on FWS and USGS funding allocations for research and management activities on Florida manatees is provided in annual administrative reports required by the MMPA (FWS 1981–1996, FWS, FWS and National Biological Service 1996, FWS and USGS 1997–2004). Although those reports do not itemize funding for all management activities in detail, they indicate that departmental funding levels between 1980 and 2000 ranged from at least $373,000 in 1986 to $1.4 million in 2000 (Table 4). In most of those years, funding for research accounted for between one-half and two-thirds of all itemized funding for manatees. In 2000 nearly $500,000 was appropriated specifically for enforcing manatee protection rules, principally boat speed rules.

FWS annual reports on endangered species expenditures by all federal and state agencies (FWS 2003b-d, 2005d-f, 2006) provide information on the total level of manatee funding by all federal and state agencies. Those reports indicate that total federal funding for Florida manatee recovery averaged about $3.1 million per year (Table 5, Appendices C.1-7). Unlike all other marine mammal recovery programs, state expenditures for recovery have exceeded those of federal agencies since 2000. State of Florida funding for Florida manatee activities remained relatively steady at nearly $6 million annually between 2000 and 2004. An uncertain amount of additional funding is provided by private organizations, such as oceanaria, which help maintain and treat injured and distressed manatees, and the Save the Manatee Club, which helps provide funding for research and certain equipment needs. Regarding staff, FWS currently estimates that it devotes about 11.3 full-time equivalents (FTEs) per year to manatee recovery activities[3]; the

[3] James A. Valade, personal communication. 25 June 2006. U.S. Fish and Wildlife Service, 6620 Southpoint Drive, Room 310, Jacksonville, FL 32216.

Table 4. Department of the Interior funding allocations (in $ thousands) for West Indian manatee research and management activities under the MMPA and ESA as cited in administrative reports required by the MMPA: 1980–2000 (FWS 1981–1996, FWS and National Biological Service 1996, FWS and USGS 1997–2004)

Year	Research and Development	Management †	Grants to States ‡	Total
1980	330	N/A	184	514
1981	379	320	396	1,095
1982	333	234	0	567
1983	320	191	0	511
1984	262	117	15	399
1985	379	114	117	610
1986	248	87	38	373
1987	310	31	115	456
1988	310	75	75	460
1989	325	75	105	505
1990	344	350	100	799
1991	625	389	87	1,101
1992	673	145	70	888
1993	670	621	90	1,381
1994	597	N/A	77	674
1995	468	N/A	76	544
1996	483	N/A	26	509
1997	556	N/A	26	582
1998	648	N/A	26	674
1999	810	N/A	26	836
2000	823	551	26	1,400

† Includes only management costs specifically identified for manatees; does not include support for all enforcement, permit, or administrative tasks
‡ Includes grants under section 6 of ESA to Florida and Georgia

USGS also supports about 13.3 FTEs who work on manatee research and monitoring studies as part of its Sirenia Project. It is not known whether or to what extent staff salaries are included in the funding estimates presented here

According to the Marine Mammal Commission survey of federally funded marine mammal research (Waring 2002), expenditures for biological and population assessment studies on manatees and dugongs in FY1991–FY2000 ranged from $544,000 in FY2000 to $1.3 million in FY1995 (see Appendix F). The principal sources of funding were FWS and USGS.

Projected cost estimates for work during the first five years under the Florida manatee recovery plan adopted in 2001 (Table 6) identified annual expenditures of approximately $8.3 million by all involved governmental and non-governmental groups (FWS 2001). Those costs include

Table 5. Federal and state expenditures (in $ thousands) for recovery of the West Indian manatee, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	927	526	–	–	99	1,551	13	1,565
1999	1,145	526	–	619	117	2,407	1,945	4,351
2000	2,727	466	–	461	166	3,820	5,923	9,743
2001	2,363	510	–	480	85	3,438	5,936	9,373
2002	1,710	523	–	228	182	2,643	5,929	8,571
2003	2,070	971	–	713	75	3,830	5,969	9,799
2004	2,432	428	–	831	226	3,917	5,945	9,862

activities ranked under three priority categories. However, several significant costs—such as enforcement by the U.S. Coast Guard and state agencies and the installation of gate-reversing mechanisms on floodgates and navigation locks by the Army Corps of Engineers and South Florida Water Management District—were excluded from those cost estimates.

Table 6. Projected funding needs (in $ thousands) to implement recovery activities for Florida manatees during the first five years after adoption of the 2001 Revised Florida Manatee Recovery Plan (FWS 2001)

Objective	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Objective 1: Minimize causes of manatee disturbance, harassment, injury, and mortality	4,238	4,238	4,238	4,193	4,193	21,100
Objective 2: Determine and monitor the status of manatee populations	2,488	2,449	2,506	2,496	2,511	12,450
Objective 3: Protect, identify, evaluate, and monitor manatee habitats	1,370	1,333	1,331	1,331	1,343	6,708
Objective 4: Facilitate manatee recovery through public awareness and education	288	258	258	258	258	1,320
TOTAL	8,384	8,278	8,333	8,278	8,305	41,578

Antillean Manatee, Puerto Rico Population

Population Status: The Antillean manatee (*Trichechus manatus manatus*) is a subspecies of the West Indian manatee that inhabits the coastal waters of Central America and northern South America and the larger Caribbean Islands (USGS 2005a). The species as a whole was first listed as endangered under the ESPA in 1967. That listing was carried forward under the ESCA and ESA. The Antillean subspecies is not listed separately but is considered endangered by virtue of the species' overall listing. Other than the Florida manatee, the Puerto Rico population of the Antillean subspecies is the only other group of manatees under U.S. jurisdiction. This subspecies is believed to be a relatively discrete population occurring in rivers and coastal waters of Puerto Rico. The extent to which manatees move between Puerto Rico and other parts of the Greater Antilles is uncertain.

Historical accounts of manatees in Puerto Rico include references to their use as food by aborigines and Spanish explorers, but information is insufficient to estimate former abundance or the extent to which hunting reduced their numbers (Rathbun and Possardt 1986). Aerial surveys since the late 1970s and mid-1980s reveal that most manatees in Puerto Rico occur on the eastern end of the island and along the southern coast in shallow, protected bays, and in sea grass beds along the northwestern shore of Vieques Island, about 10 miles east of Puerto Rico (Rathbun et al. 1985). Based on actual counts of animals during surveys conducted in 2005, the Puerto Rico population of Antillean manatees numbers at least 121 animals. Considering animals possibly not seen during that survey, some researchers suspect there are between 150 and 360 manatees and that the population is not declining. The PBR level has been set at zero (FWS 1994a).

Major Threats: In the 1980s the principal causes of manatee deaths in Puerto Rico were identified as poaching for food and unintentional entanglement in gillnets (Rathbun and Possardt 1986). Over time, poaching has become less frequent although boat collisions have increased. During the late 1980s and early 1990s, 43 percent of all known manatee mortalities in Puerto Rico were due to boat collisions (FWS 1994a). More recently, however, an assessment by USGS suggests that loss of habitat and small population size also are primary threats to this population (FWS 2005b).

Management Framework: The principal agencies involved with research and recovery efforts are the Commonwealth of Puerto Rico's Department of Natural and Environmental Resources, the Fish and Wildlife Service, the Caribbean Fishery Management Council, the U.S. Navy, and the U.S. Coast Guard (Rathbun and Possardt 1986, USGS 2005a). The non-profit Caribbean Stranding Network has conducted manatee carcass salvage and manatee rescue, rehabilitation, and release activities in Puerto Rico over the last 20 years.

Critical Habitat: None designated.

Recovery Plan: FWS adopted a recovery plan for Puerto Rico manatees in 1986 (Rathbun and Possardt 1986). The lack of information on historical and current abundance prevented the development of a quantitative recovery target for this population, and the plan's goal was therefore to establish a population "large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes and stochastic and catastrophic events." The plan's objectives were defined as follows:

- Identify, assess, and reduce human-related mortality, especially that related to gillnet entanglement;
- Identify and minimize alteration, degradation, and destruction of habitats important to the survival and recovery of the Puerto Rico manatee population; and
- Develop the criteria and biological information necessary to determine whether to reclassify the Puerto Rico population of manatees and, if so, when.

Among other actions, the plan recommended continuation of aerial surveys, improvements in the carcass salvage program, and public education aimed at reducing entanglement in gillnets.

Major Management Actions: Over the years, aerial surveys have been conducted intermittently, and carcass salvage and necropsy efforts have been maintained and improved to help monitor population status and trends. Past management efforts have stressed public education aimed at preventing poaching and reducing entanglement in gillnets. Boat speed zones have been established in some areas, including an identified manatee feeding area located within a naval base at Roosevelt Roads on the eastern end of the island. As noted earlier, some injured and distressed animals have been rescued, rehabilitated, and released back to the wild. In recent years, USGS has carried out a number of research projects to better identify habitat-use patterns through radio tracking individual animals and mapping their nearshore benthic habitats (USGS 2005a). Some management actions also have been taken to prevent disturbance and to restrict development in specific areas where manatees feed, rest, and obtain fresh water.

Staff and Funding Levels: Because West Indian manatees are listed as a species, FWS administrative reports under the MMPA and expenditure reports under the ESA do not separate funding data for Puerto Rico manatees from Florida manatees. As a result, information on funding is uncertain but is believed to be a very small fraction of total funding reported for all West Indian manatees (see Florida manatee above and Appendices C.1–7). FWS supported at least one FTE to work on manatees in Puerto Rico in 2005 and USGS supported 0.8 FTE.[4]

SEA OTTERS

Southern Sea Otter

Status: The southern sea otter (*Enhydra lutris nereis*) is one of three subspecies of sea otters. Its historical range is thought to have stretched from southern Canada to central Baja California. All three sea otter subspecies were hunted to near-extinction in the 18th and 19th centuries until hunting was prohibited in 1911 under the North Pacific Fur Seal Convention (Wilson et al. 1991). The species as a whole once ranged in coastal waters from Hokkaido, Japan, through the Kuril Islands around the North Pacific rim and south to Baja California. The population is

[4] James A. Valade, personal communication. 25 June 2006. U.S. Fish and Wildlife Service, 6620 Southpoint Drive, Room 310, Jacksonville, FL 32216; Cathy Beck, personal communication. 1 November 2006. Sirenia Project, U.S. Geological Survey. 2201 NW 40th Terrace, Gainesville, FL 32605

thought to have numbered between 150,000 and 300,000 animals before commercial exploitation (Rotterman and Simon-Jackson 1988). In 1938 a remnant colony of approximately 50 southern sea otters was discovered in central California. In 1977 the southern sea otter was listed as threatened under the ESA because of its low abundance, limited distribution, and vulnerability to impacts from oil spilled by tankers and offshore oil development. To promote recovery and minimize the risk of a single large oil spill affecting the entire population, an attempt was made in the 1980s to establish a second southern sea otter population by translocating animals from the central California mainland coast to San Nicolas Island off southern California. The San Nicolas Island colony has not increased as expected and now numbers about 25 to 30 animals (FWS 2003b).

Based on annual surveys conducted since the 1970s, the number of southern sea otters has increased slowly, despite two apparent periods of decline. In 1976 the population numbered an estimated 1,789 individuals; it then declined to 1,372 animals in 1984 (FWS 2003b). After 1985 population growth resumed and counts peaked at 2,377 animals in 1995 before beginning a four-year decline to 2,090 animals in 1999. Recent surveys suggest that population growth has resumed. In 2003 and 2004 counts of sea otters during spring surveys rose to 2,505 and 2,825, respectively, for a three-year average of 2,490 animals (USGS 2004). However, the overall rate of growth (less than 5 percent per year) has remained far below recovery rates of 15 percent or more observed in sea otter populations in some areas of Alaska prior to the 1970s and the 20 percent recovery rate reported for expansion into some unoccupied areas (FWS 2003b). Because the legislation authorizing a translocation of southern sea otters included provisions to address interactions with fisheries, California sea otters have been exempted from the fishery management provisions of the MMPA, and no PBR has been calculated for this population (FWS 1995).

Major Threats: At the time of listing in 1977 the primary threat to southern sea otters was thought to be a major oil spill from a tanker (42 Fed. Reg. 2968). Since then, other threats have emerged, including mortality incidental to commercial fishing, disease, chemical contaminants, naturally occurring biotoxins, and increased exploration and development of oil and gas resources off the California coast (FWS 2003b). The slow recovery of sea otters in California appears to be due to relatively high mortality among all age classes rather than low reproduction rates (MMC 2004). Among the likely explanations for the slow rate of recovery is incidental mortality in coastal fishing gear, increases in the rate of infectious disease, and decreases in food abundance (FWS 2003b).

<u>Oil Spills</u>: Sea otters with oiled fur face a high probability of dying due to hypothermia and toxic effects. Although the death of oiled otters depends, in part, on the extent to which they are covered, the recovery plan estimates that the probability of an oiled otter dying from related impacts is likely to be at least 50 percent (FWS 2003b).[5] The plan states, “we do not believe it is possible to avoid a catastrophic loss to the sea otter population in the event of a major spill in the vicinity of the sea otter’s current range.” The *Exxon Valdez* oil spill in 1989, which spread over an area covering hundreds of miles, underscored the scale of this threat. Spreading more than

[5] It is believed that sea otters may survive with oil on less than 10 percent of their body surface but that levels of coverage greater than 25 percent will lead to death (FWS 2002e).

400 miles in 30 days, that spill covered an area equal to the entire central California range of southern sea otters.

Incidental Catch in Commercial Fisheries: Between the late 1960s and early 1980s entanglement and drowning in gillnets and trammel nets are estimated to have caused an average of 80 sea otter deaths a year (Wendell et al. 1985). This mortality was apparently sufficient to cause a decline in the population that was reversed after a series of incremental actions taken by the state of California between 1982 and 1990 to restrict the use of gillnets in and around key sea otter habitats (Estes 1990). Fishing gear used in coastal pot and set net fisheries also may pose an entanglement hazard for southern sea otters; however, the revised recovery plan concludes that there is insufficient information to evaluate its possible impact on sea otters (FWS 2003b).

Disease: Infectious disease is believed to have been an important factor limiting population growth (Lafferty and Gerber 2002). Between 1991 and 1995 disease and infections from parasites, fungi, and bacteria were responsible for roughly 40 percent of all deaths for which causes were determined by the southern sea otter carcass salvage and necropsy program (Thomas and Cole 1996). Other causes of death included emaciation (10 percent), miscellaneous conditions such as gastrointestinal obstructions (13 percent), shark predation (7 percent), gunshot (4 percent), and unknown (18 percent). The most frequent infection was peritonitis induced by parasitic acanthocephalan worms in the digestive tract, followed by bacterial infections, protozoal encephalitis, and coccidioidomycosis (a systemic infection caused by a fungus) (FWS 2003b).

The variety and prevalence of infectious diseases found in necropsied sea otters suggest that southern sea otters are far more vulnerable to death by diseases than are other marine mammals (Thomas and Cole 1996). This, in turn, suggests that the immune function of southern sea otters may be compromised due to congenital, genetic, or environmental factors. The degree to which high exposure to pathogens may contribute to the frequency of infection in sea otters is unknown. There is evidence from live animals that these infectious agents are particularly common near human population centers (O’Shea et al. 1999).

Other Threats: Food availability and emaciation also may threaten southern sea otters. Emaciation, in turn, may compromise immune systems and expose sea otters to infectious diseases (Thomas and Creekmore 2005). The movement of male otters south of Point Conception may indicate limitations in food availability in the core of their current range. Examination of carcasses also suggests that the rate of pre-weaning mortality is higher in central California than it is in the large Alaska sea otter populations (FWS 2003b).

Management Framework: FWS is the lead federal agency for recovery of the southern sea otter. The California Department of Fish and Game is the principal state agency involved in recovery efforts. Annual fall and spring surveys of sea otters in California began in 1982 and are conducted cooperatively by scientists from USGS, the California Department of Fish and Game, FWS, and the Monterey Bay Aquarium, and with experienced volunteers. These organizations, together with the California Academy of Sciences, the Santa Barbara Museum of Natural History, beach clean-up crews for coastal cities, and others, are the principal members of the California Sea Otter Stranding Network. The network is responsible for recovering and examining carcasses. Since southern sea otters were first listed, FWS has established a sea otter recovery team and reconstituted it twice. The team's principal task has been to develop and revise recovery plans. For much of the 1980s recovery efforts focused on developing a translocation plan to move otters from the mainland colony to San Nicolas Island, and the recovery team did not meet. Instead FWS convened an Interagency (Translocation) Project Review Team to help guide and oversee recovery work during that period.

Critical Habitat: None designated.

Recovery Plan: A recovery plan for the southern sea otter was first adopted in February 1982 (FWS 1982). Its goals included the following:

- Establishing new sea otter colonies outside the existing sea otter range;
- Reducing vandalism, harassment, and incidental take;
- Incorporating recovery measures into local coastal development plans;
- Setting the recovery target as the OSP size; and
- Establishing a research program to assess and monitor the status of sea otters and their habitat.

In 1989 FWS reconstituted the recovery team to update the 1982 plan. FWS subsequently prepared revised draft plans in 1991 and 1996, but neither was adopted. In January 2000 a third draft revised recovery plan was circulated for public and agency review and, based on comments from the public and the recovery team, FWS adopted a final revised recovery plan in February 2003 (FWS 2003b). Its goal is "to establish the long-term viability of the southern sea otter population sufficiently to allow delisting the species." The revised plan concludes that a genetically viable population would be one with a minimum three-year average count of 1,850 animals. It therefore identifies that population size as the threshold for reclassifying the southern sea otter population as endangered under the ESA. The plan also establishes a three-year average count of 3,090 animals as the threshold for evaluating whether to remove southern sea otters from the list of threatened and endangered species. If delisted, the population could still be considered depleted under the MMPA because the lower limit of the OSP level for southern sea otters currently is estimated to be approximately 8,400 animals.

To develop a recovery strategy for the new plan, FWS reviewed the results of past management actions and concluded, in part, that the San Nicolas Island translocation had not been successful either in significantly reducing the chances of a large loss of otters due to a single major oil spill or other catastrophic event or in creating a separate population that could be used to restock the mainland population. The revised recovery plan therefore set forth the following elements for its recovery strategy (FWS 2003b):

- <u>Restriction of range due to management provisions related to the translocation program</u>: Evaluate the translocation program in light of changed circumstances and determine whether one or more criteria for declaring the translocation a failure have been met.
- <u>Disease</u>: Collect and analyze tissues for evidence of stress or disease; determine sources of disease agents and stress; minimize factors causing stress and disease.

- Incidental take in fishing gear: Evaluate the causes of mortality; monitor incidental take in commercial fisheries; evaluate the effectiveness of fishing regulations for preventing bycatch; evaluate incidental take in trap/pot fisheries; determine and take possible steps to reduce or eliminate mortality incidental to fisheries.
- Oil spills: Implement and monitor Coast Guard vessel management plans; assess the current risk of tanker accidents and other sources of oil spills, including offshore platforms, pipelines, and marine terminals; implement an oil spill contingency plan that includes a sea otter response plan.
- Contaminants: Evaluate causes of mortality; analyze tissues for environmental contaminants and archive tissues for future analysis; determine sources of environmental contaminants; determine contaminant levels in sea otter prey and habitat.
- Intentional take: Evaluate causes of mortality; minimize intentional take.

Major Management Actions: Efforts to protect and recover southern sea otters have focused on (1) establishing a new sea otter colony by translocating some otters to San Nicolas Island, (2) establishing a vessel traffic management system to reduce the chance of an oil tanker spill that could affect the sea otter range, and (3) reducing the incidental take of sea otters in commercial fisheries.

Translocation: To mitigate the possible impact of a major oil spill, the 1982 recovery plan recommended a translocation of sea otters to establish a new colony far enough removed from the mainland colony that it would be unlikely that a single spill would affect both areas (FWS 2003b). San Nicolas Island off southern California was selected as the appropriate translocation site, and in 1986 Congress passed legislation authorizing the creation of an experimental sea otter colony at that location by translocating otters from the mainland population (PL 99-625). To address concerns about subsequent range expansion into areas where sea otter foraging could affect commercial and recreational shellfish fisheries, the legislation also created a management zone south of the sea otter's mainland range. Any sea otters that moved into that management area were to be removed by non-lethal means and transported back to their range farther north (52 Fed. Reg. 29754). It was expected that the translocated population would stabilize at roughly 70 sea otters within one or more years and would reach carrying capacity in 10 or more years.

Between August 1987 and July 1993 more than 180 sea otters were moved from their mainland range to San Nicolas Island (FWS 2003b). Most translocated otters quickly disappeared or returned to their mainland range, leaving a small number of animals at the island. Since then, counts at San Nicolas Island have increased very slowly, and the population numbered about 27 animals in 2002. At the same time, increasing numbers of animals from the mainland population moved into the management zone where the Service had limited success in capturing and removing them. In light of these developments, FWS is considering steps to formally declare the translocation a failure, discontinue the otter-free management zone in southern California, and allow the otters at San Nicolas Island to remain there (FWS 2005a).

Vessel Traffic Management: Under auspices of the Monterey Bay National Marine Sanctuary, the National Oceanic and Atmospheric Administration (NOAA) and the Coast Guard worked with stakeholders to develop a plan for managing large vessel traffic in and near the sanctuary area to reduce the risk of oil spills, groundings, and collisions (FWS 2003b). The plan called for transiting vessels to remain minimum distances from shore, instituting an offshore vessel traffic separation scheme, monitoring vessel traffic, establishing a response network to assist vessels in distress, and implementing a mariner education program. To date, several of these recommendations have been implemented. In May 2000 the International Maritime Organization approved a U.S. proposal to establish offshore vessel traffic lanes for ships entering and leaving ports north and south of the sea otter range. In addition, the California Department of Fish and Game's Office of Spill Prevention and Response has developed contingency plans to protect wildlife, including sea otters, from the impacts of oil spills (FWS 2003b). This program also sponsors a network of professionally trained volunteers, paid staff, and veterinarians who can retrieve and attempt to rehabilitate oiled animals.

Fisheries Interactions: To reduce the bycatch of sea otters, as well as other marine mammals and seabirds in trammel nets and gillnets, the California legislature adopted a series of area closures between 1982 and 1990. The first closure adopted in 1982 closed a portion of Monterey Bay out to 10 fathoms from shore, but the measure simply displaced fishermen to other parts of the sea otter's range. In 1985 the measure was expanded to include the entire sea otter range out to the 15-fathom contour. Although this level reduced the incidental take of sea otters, animals continued to be taken in deeper waters, and in 1986 and 1990 the state legislature extended the closed area to 20 and 30 fathoms, respectively. The 1986 action reduced observed takes to low levels and in the late 1980s sea otter counts began to increase. The 1990 action essentially eliminated all sea otter bycatch. Since 1990 the closed area has been extended out to the 60-fathom contour to reduce bycatch of marine mammals other than sea otters and seabirds (FWS 2003b). In addition, the state has required that traps used to catch nearshore finfish be outfitted with a 5-inch ring in the entry funnel to prevent sea otters from getting caught in trap openings.

Staff and Funding Levels: Funding allocations by FWS and USGS for southern sea otter research and management work are identified in annual administrative reports prepared by those agencies pursuant to requirements of the MMPA (FWS 1981–1996, FWS and National Biological Service 1996, FWS and USGS 1997–2004). Although those reports do not itemize funding for all management activities (e.g., funding for enforcement and permit management is combined for all marine mammals under the jurisdiction of the Department of the Interior), they indicate that departmental funding for southern sea otter recovery work increased during the 1980s to a high of $1.3 million in 1990 when steps were being taken to implement the sea otter translocation (Table 7, Appendices C.1–7). During the 1990s funding levels declined substantially.

According to FWS reports on expenditures for endangered species by all federal and state agencies since 1998 (FWS 2003 b–e, 2005 d–f, 2006), annual federal funding of sea otter recovery again increased from $495,000 in 1998 to $1.37 million in 2003 (Table 8, Appendices C.1–7). FWS funding during that period ranged between $95,200 in 1999 and $184,100 in 2001. Most funding for southern sea otter activities was provided by USGS for research. In 2003, for example, USGS reported expenditures of $1,152,986 for southern sea otter activities. State of California funding for southern sea otter activities between 1998 and 2004 ranged between $35,100 and $156,000 (FWS 2005d)

Table 7. Department of the Interior funding allocations (in $ thousands) for southern sea otter research and management activities under the MMPA and ESA as cited in administrative reports required by the MMPA: 1980–2000 (FWS 1981–1996, FWS and National Biological Service 1996, FWS and USGS 1997–2004)

Year	Research/ Development	Management *	Grants to States ^	Total
1980	405	Not provided	162	567
1981	353	120	160	553
1982	318	144	0	462
1983	320	64	141	525
1984	244	171	93	508
1985	289	421	92	802
1986	362	377	88	827
1987	362	449	102	913
1988	310	448	106	864
1989	756	350	100	1,206
1990	821	386	100	1,307
1991	756	399	0	1,155
1992	605	366	0	971
1993	498	244	0	742
1994	403	Not provided	0	403
1995	429	Not provided	10	439
1996	398	Not provided	0	398
1997	389	Not provided	0	389
1998	389	Not provided	60	389
1999	233	Not provided	0	456
2000	290	Not provided	0	290

∗ Includes only management costs specifically identified for southern sea otters; does not include support for all enforcement, permit, or administrative tasks

^ Includes grants under section 6 of ESA to California

According to the Marine Mammal Commission's survey of federally funded marine mammal research (Waring 2002), federal expenditures for biological and population assessment research on sea otters between FY1991 and FY2000 ranged from $463,000 in FY1997 to $1.4 million in FY2000 (see Appendix F). The principal sources of funding were FWS and USGS. The Commission's survey also reported funding to investigate fisheries/sea otter interactions. That work ranged between $132,000 in FY1996 and FY1997 to $1.3 million in FY2000 with most of the funds provided by FWS.

Table 8. Federal and state expenditures (in $ thousands) for the recovery of southern sea otters, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	97	389	–	–	9	495	–	495
1999	95	317	–	–	47	459	156	615
2000	174	403	–	–	13	589	35	624
2001	184	868	–	–	7	1,059	35	1,094
2002	170	856	–	–	5	1,031	35	1,066
2003	156	1,154	–	–	26	1,336	40	1,376
2004	134	578	–	–	3	714	20	734

Northern Sea Otter, Southwest Alaska Population

Status: Sea otters once ranged from the Hokkaido, Japan, through the Kuril Islands around the North Pacific rim south to Baja California and numbered between 150,000 and 300,000 animals (Rotterman and Simon-Jackson 1988, FWS 2002e). The range of the northern sea otter (*Enhydra lutris kenyoni*), one of three subspecies of sea otters, extends along the coast from the Aleutian Islands to the state of Washington (Jameson et al. 1982). FWS considers sea otters west of the entrance to Cook Inlet and Kodiak Island and along the Aleutian Islands to be a distinct population segment of northern sea otters, referred to as the southwest Alaska population (FWS 2002e).

Commercial hunting between the late 1700s and early 1900s reduced all northern sea otter populations to a combined total of perhaps 1,000 to 2,000 animals scattered among 13 remnant populations. Six of those remnant populations were within the range of the southwest Alaska sea otter population. In 1911 commercial hunting of sea otters was banned under the Convention on Conservation of North Pacific Fur Seals (Rotterman and Simon-Jackson 1988). After cessation of hunting, sea otter numbers grew rapidly. By 1976 the southwest Alaska population had increased to an estimated 94,050 to 128,650 animals and was thought to be at or above its pre-exploitation population size (Calkins and Schneider 1985). Since the mid-1980s, however, the population has declined precipitously (Doroff et al. 2003). Periodic surveys suggest their number has decreased by at least 55 to 67 percent with declines of more than 90 percent in some areas. Surveys since 2000 indicate annual rates of decline of 12 percent on the south side of the Alaska Peninsula and 29 percent in the western and central Aleutians (70 Fed. Reg. 46366). With the exception of the Kodiak area, there is no evidence that the decline has abated. Based on aerial surveys in 2000–2004, FWS estimates that the southwest Alaska sea otter population numbers 41,865 animals (70 Fed. Reg. 46366). Although the Service was petitioned in 2001 to list all sea otters in Alaska as depleted, the petition was rejected on grounds that substantial declines were limited largely to southwest Alaska and that sea otters in that area constituted a separate population. In 2005 FWS designated the southwest Alaska sea otter population of the northern sea otter as threatened under the ESA (70 Fed. Reg. 46366).

Major Threats: Despite the sharpness and geographic extent of the southwest Alaska sea otter population decline, its cause remains uncertain. In listing the population as threatened, FWS evaluated the following possible factors (70 Fed. Reg. 46366):

Oil Spills: Like the southern sea otter, the northern sea otter is extremely vulnerable to oil spills. At this time, oil and gas development occurs only in Cook Inlet, and tanker transport is relatively infrequent in the range of the southwest Alaska sea otter population. Although there is no evidence to suggest that oil spills caused the decline, the threat of a major oil spill remains a matter of concern, given experience with the *Exxon Valdez* spill, which demonstrated that a large oil spill could affect coastlines hundreds of miles from a spill site.

Hunting: Subsistence hunting of sea otters does not appear to have been a factor in the decline of the southwest Alaska sea otter population. In Kodiak, where most sea otter hunting occurs, the harvest has ranged between 0.4 and 1.3 percent of the estimated population size. Little or no subsistence hunting occurs in areas with the steepest declines in sea otter numbers.

Habitat Loss: FWS has found no evidence that the loss of habitat has contributed to the sea otter decline although it may be an important factor in recovery.

Competition for Prey: FWS has found no evidence that commercial catch of prey species has been a factor in the decline, that sea otters are nutritionally stressed, or that their foraging success has declined.

Predation: Perhaps the most plausible explanation for the decline in southwest Alaska sea otters is increased mortality caused by killer whale (*Orcinus orca*) predation (Estes et al. 1998). FWS cites the following evidence in support this hypothesis:

- An increase in the number of observed attacks by killer whales on sea otters during the 1990s;
- A correspondence between the decrease in sea otter numbers and expectations from computer models of killer whale energetics;
- The scarcity of beachcast otter carcasses, which would be expected if disease or starvation were the cause of the decline; and
- Markedly lower mortality rates between sea otters in sheltered lagoons compared to those in exposed bays more accessible to killer whales.

Management Framework: FWS has lead federal responsibility for the management and recovery of southwest Alaska sea otters. Some aspects of management are implemented though a cooperative agreement with an Alaska Native organization called the Alaska Sea Otter and Steller Sea Lion Commission. Collaboration between the United States and Russia also is carried out under the auspices of the U.S.-Russia Agreement on Cooperation in the Field of Protection of the Environment and Natural Resources. Other agencies that support or participate in recovery work include USGS and the Alaska SeaLife Center, both of which conduct research. Since designating the population as threatened, FWS has convened a recovery team to help develop a southwest Alaska sea otter recovery plan (70 Fed. Reg. 46377).

Critical Habitat: When designating southwest Alaska sea otters as threatened, FWS concluded that designation of critical habitat for the population segment would be prudent (70 Fed. Reg. 46377). However, the Service stated that it was unable to identify the physical and biological features essential to the conservation of the population. Given that finding and the lack of understanding about the cause for the population's decline, it therefore deferred critical habitat designation.

Recovery Plan: In 1994 the Service released a conservation plan for all Alaska sea otters in response to amendments to the MMPA authorizing such plans (FWS 1994b). The plan proposed three goals: (1) maintain the Alaska sea otter population level within its OSP range; (2) maintain healthy habitats for sea otters; and (3) allow for a variety of human uses.

The plan then identified the following objectives to achieve those goals:

- Identify the OSP range for sea otters, including factors that may influence how such a range is defined;
- Monitor the size, status, and trends of sea otter populations and collect life history data for developing population models and establishing removal guidelines;
- Establish cooperative working relationships with Alaska Natives to help support their conservation and management efforts related to Native sea otter harvest and use;
- Characterize and monitor sea otter habitat, status, and trends;
- Identify, avoid, and minimize human threats to sea otters and their habitat and, if possible, resolve resource conflicts; and
- Establish cooperative programs to further the conservation and management of sea otters in Alaska.

Accompanying each of the objectives was a list of specific activities with projected funding needs for the first five years of implementation. As of the date of this report, initial efforts were being taken by the recovery team to develop a draft southwest Alaska sea otter recovery plan.

Major Management Actions: Since the mid-1990s FWS has entered into an annual cooperative agreement with the Alaska Sea Otter and Steller Sea Lion Commission. The commission represents a consortium of 60 Alaska tribes and tribal organizations. With FWS, the Commission co-manages subsistence uses of sea otters throughout Alaska and facilitates sea otter research by tribes and local residents. Through the cooperative agreement, support is provided for skiff surveys to determine local sea otter population trends, for collecting samples from harvested animals, and for documenting traditional Alaska Native knowledge of sea otters. Other actions taken in support of recovery have focused on population monitoring and research planning.

Staff and Funding Levels: Because southwest Alaska sea otters were not added to the list of endangered and threatened species until 2005, funding data does not appear in past FWS expenditure surveys and past estimates of funding for research and management are not available. FWS estimates that it devoted 2.5 FTEs to southwest Alaska sea otter research and management in 2005.[6] In 2005 the FWS Alaska Regional Office allocated approximately

[6] Rosa Meehan, personal communication. 23 August 2005. Chief, Marine Mammal Management, U.S. Fish and Wildlife Service, 1011 Tudor Road, Anchorage, AK 99503.

$120,000 to charter a research vessel and administered a $663,000 congressional add-on for studies of southwest Alaska sea otters by the Alaska SeaLife Center. Information was not available on expenditures by other agencies, such as USGS.

Funding needs projected for the first five years of conservation work under the Alaska sea otter conservation plan (FWS 1994b) suggested that annual expenditures should have ranged from $700,000 to $1.04 million per year for a five-year total of $4.36 million. Actual expenditures during that period are uncertain.

PINNIPEDS

Caribbean Monk Seal

Caribbean monk seals (*Monachus tropicalis*) once inhabited the Caribbean Sea and parts of the Gulf of Mexico from the the Bahamas west to the Yucatan Peninsula and south along the east coast of Central America (44 Fed. Reg. 1979). They were listed as endangered throughout their range under the ESPA in 1967. That listing was carried forward under the ESCA, but for uncertain reasons was omitted from the initial list of endangered and threatened species under ESA. By the time the ESA was passed in 1976, some scientists already considered the species to be extinct; however, in 1979, it was again listed as endangered at the recommendation of the Marine Mammal Commission to afford protection in the event of its rediscovery. Presently, no Caribbean monk seals exist in captivity and no populations are known to occur in the wild. The last reliable record of the species was at a small colony at Seranilla Bank west of Jamaica in 1952. The species is now widely considered to be extinct (Kenyon 1977) and in 1994 the IUCN listed the species as such on its Red List of Threatened Species (Groombridge 1994).

Major Threats: Like the Hawaiian monk seal, the Caribbean monk seal appears to have been quite approachable and vulnerable to hunting and human disturbance. Organized and opportunistic hunts reduced the number of monk seals in the 17th and 18th centuries.

Management Framework: NMFS has lead responsibility for the species. As no Caribbean monk seals have been sighted since passage of the ESA and MMPA, no species-specific management teams have been established. In November 2006 the Service announced plans to carry out a five-year status review of the Caribbean monk seal under the provisions of the ESA to determine whether the species should be removed from the list of endangered and threatened species or reclassified (71 FR 69100).

Critical Habitat: None designated.

Recovery Plan: None drafted or adopted.

Staff and Funding Levels: NMFS has devoted no staff or funding to Caribbean monk seal recovery work. In 1985 the Marine Mammal Commission provided about $1,000 to help determine the validity of rumored Caribbean monk seal sightings and to survey remote Caribbean fishing villages for evidence of surviving animals. The survey produced no firm evidence of the species' continued existence. Based on FWS surveys of funding for listed endangered and threatened species between 1998 and 2004 (FWS 2003b–d, 2005d–f, 2006), a combined total of $18,000 was spent on this species over that seven-year period (Appendix C).

Hawaiian Monk Seal

Status: The Hawaiian monk seal *(Monachus schauinslandi)* occurs only in the Hawaiian archipelago. It is the most endangered seal in U.S. waters and one of the most endangered seals in the world. It was listed as endangered under the ESA in 1976. The population consists of six main breeding colonies in the Northwestern Hawaiian Islands (NWHI) and a dispersed, but growing population in the main Hawaiian Islands (NMFS 2006a). Monk seals apparently did not occur in the main Hawaiian Islands when Captain James Cook discovered the islands in the late 1700s, and it seems likely that earlier Polynesian settlers had eliminated them from that portion of their range (Baker and Johanos 2004, MMC 2001).

The breeding colonies in the NWHI are relatively isolated. Movement of seals between colonies is limited, and the individual colonies therefore constitute relatively discrete subpopulations with independent trends and recovery issues. For example, between the 1950s and the 1980s the colony at French Frigate Shoals grew rapidly to become the species' largest group, producing nearly half of all monk seal pups. During the same period, other colonies declined or remained relatively stable. These trends were reversed in the late 1980s when juvenile survival, and perhaps reproduction, at the French Frigate Shoals colony began declining sharply, and the western colonies began increasing slowly. In 2001 a total of 1,224 seals were observed in the NWHI, and 52 were counted in the main Hawaiian Islands, with the total abundance estimate about 60 percent less than estimates based on counts in 1958 (NMFS 2006a). It appears that their overall numbers declined by 4.2 percent per year until 1993. Since then, the rate of decline has been 1.1 percent per year. The current best estimate of abundance is 1,252 animals (NMFS 2006a). Because of the species' low abundance and declining trend, a PBR level for the Hawaiian monk seal is undetermined.

Major Threats: Intensive hunting in the 19th century is thought to have significantly reduced Hawaiian monk seal abundance in the NWHI (Ragen and Lavigne 1999). After recovering somewhat in the early 20th century, most subpopulations declined again in the last half of the 20th century. The suspected cause of declines between the 1950s and early 1980s was human disturbance on pupping and resting beaches as a result of military and Coast Guard activity (Kenyon 1972, Ragen and Lavigne 1999, MMC 2002). Perhaps the greatest current threat to monk seals in the NWHI is reduction in prey availability due to commercial fishing and/or natural environmental change. The small, isolated nature of NWHI atolls makes their populations especially vulnerable to human and natural perturbations. Most of the species' decline since the 1980s has occurred at French Frigate Shoals where reduced juvenile survival rates characterized the decrease. Based on observations of weaned pups in emaciated or underweight condition, limited prey availability is believed to have precipitated the decline at that atoll. Similar signs of poor juvenile survival have been observed more recently at other atolls.

Fishery Interactions: Monk seals are known to feed on lobsters as well as other species caught incidentally in lobster traps. Intensive fishing for spiny lobsters began in the NWHI in the late 1970s shortly before the monk seal decline began at French Frigate Shoals. At the peak of the NWHI lobster fishery between 1985 and 1990, fishing effort exceeded one million trap nights per year, most of which focused on the banks and atolls nearest to French Frigate Shoals. In 1999 the fishery was closed after spiny lobster abundance declined dramatically. Spiny lobsters have shown little sign of recovery since 1999, and parts of their range are now dominated by slipper lobsters, suggesting a major shift in the ecology of lobster populations in the NWHI. Decadal climate cycles also are a possible factor affecting lobster populations and other monk seal prey (Polovina 2005), but information is not sufficient to distinguish between the effects of climate and fishing operations (MMC 2001).

Direct interactions between monk seals and the lobster, pelagic longline, and bottomfish fisheries also have been documented. At least one monk seal was entangled and drowned in lobster gear, and several others are known to have been injured by hooks from longline, bottomfish gear, and recreational fishing. Information on monk seal deaths and injuries in fisheries is limited, partly because efforts to monitor fishing operations have been inadequate (Ragen and Lavigne 1999, NMFS 2006a).

Entanglement in Marine Debris: Entanglement of monk seals in marine debris, particularly derelict fishing nets, also is a significant threat in the NWHI. Seven entanglement deaths and 238 cases of live entangled seals have been recorded through 2003 (NMFS 2006a). Almost all of these entanglements were seen on beaches. In most instances, either the animals were disentangled or the entanglements were considered minor ones from which the seals would be able to free themselves. Of greater concern is the unknown number of seals that become entangled and die unobserved at sea because they are unable to swim to shore. With rare exceptions, derelict fishing gear found attached to seals or fouling atoll reefs and beaches are from remote fisheries operating outside Hawaiian waters.

Other Sources of Mortality: Other sources of mortality for NWHI seals include aggressive behavior by adult male seals towards pups, juveniles, and females; shark predation; and naturally occurring biotoxins. Adult male aggression has caused the death and serious injury of numerous pups and females at Laysan and Lisianski Islands. It has been identified as a major impediment to the recovery of colonies at both atolls and also has been observed at French Frigate Shoals where at least eight pups were killed by aggressive males in 1997 (NMFS 2006a). Shark predation has recently become a significant source of mortality at French Frigate Shoals. Approximately 25 percent of all pups born at that colony in 1999 were killed by sharks.

In 1978 ciguatera, a naturally occurring biotoxin, is thought to have killed a few tens of seals although no similar die-offs have been recorded since. Disease and contaminants do not appear to have been a major source of past mortality for monk seals in the NWHI (Ragen and Lavigne 1999). However, disease risks are a growing concern due to the possibility of seals becoming exposed to new diseases in the main Hawaiian Islands (Hawaiian Monk Seal Recovery Team 2005, Braun and Yochem 2006). Contaminant risks exist in the NWHI from occasional vessel groundings and fuel spills and from discarded equipment and pollution left from earlier Navy and Coast Guard activities (Hawaiian Monk Seal Recovery Team 2005).

Threats in the main Hawaiian Islands. Monk seal pups and adults in the main Hawaiian Islands tend to be larger than those in the NWHI, suggesting that prey availability is not a limiting factor in the main Hawaiian Islands at this time. Rather, the major threats in this area are disturbance at haul-out and pupping sites by beachgoers and dogs, hooking on fishing gear (particularly with recreational fishing), collisions with boats, exposure to oil spills, and diseases transmitted from other animals. To date, two seals are known to have been killed by fishing gear in the main

Hawaiian Islands, and a number of seals have been found with embedded hooks or entangled in gillnets. One seal is thought to have been killed by a boat collision. There is limited evidence that disease has been a cause of deaths for monk seals in the past, but currently it is a significant concern (Hawaiian Monk Seal Recovery Team 2005). Recent information suggests that since 2003 one seal may have died as a result of leptospirosis and another from toxoplasmosis, representing the first reported cases of each (NMFS 2006a).

Management Framework: Although NMFS has lead responsibility for recovery of Hawaiian monk seals, other agencies play important roles. FWS manages wildlife habitat and human activities on lands and waters of the Hawaiian Islands National Wildlife Refuge and the Midway Atoll National Wildlife Refuge (MMC 2002). The Coast Guard assists with enforcement and control of pollution. NOAA and FWS, in coordination with the state of Hawaii manage the Papahānaumokuākea Marine National Monument, which extends out 50 nautical miles (nmi) from atolls and submerged banks in the NWHI. The Western Pacific Fishery Management Council is responsible for developing fishery management plans for federal waters in the region. The Marine Mammal Commission holds periodic reviews of the monk seal recovery program, makes recommendations for recovery needs, and provides funding for research and management projects on an opportunistic basis.

The state of Hawaii, which owns Kure Atoll, also has jurisdiction over waters from the refuge boundaries out to 3 nmi around all emergent lands in the NWHI with the exception of Midway Atoll (MMC 2002). In 2005 the state of Hawaii adopted rules designating all NWHI state waters as a marine refuge within which all commercial activity, including almost all fishing, is banned. The state government also is an important partner in management efforts in the main Hawaiian Islands.

Critical Habitat: In 1986 NMFS designated all beaches and nearshore waters shallower than 10 fathoms around all of the NWHI (except Sand Island on the Midway Atoll, which was then used as a naval air station) as critical habitat for Hawaiian monk seals. In 1988 the seaward boundary was extended to the 20-fathom isobath around the NWHI (again excluding Sand Island), partly at the recommendation of the Marine Mammal Commission (OPR 2005).

Recovery Plan: In 1980 NMFS established a Hawaiian Monk Seal Recovery Team composed of scientists and agency resource managers (MMC 2002). The team developed a draft plan adopted by NMFS in March 1983 (Gilmartin 1983). In 1989 NMFS appointed a new recovery team that met annually to review monk seal recovery efforts and provide advice on research and management. In 2001 NMFS again reconstituted the recovery team and charged it with updating the 1983 recovery plan. A draft revised plan was submitted to NMFS in 2005 and circulated for public comment in late 2006 (NMFS 2006e). The goal of the draft plan is "…to assure the long term viability of the Hawaiian monk seal in the wild, allowing initially for reclassification to threatened status and, ultimately, removal from the List of Endangered and Threatened Wildlife" (NMFS 2006e). To accomplish this goal, four major actions are identified:

- Improving the survival of females, particularly juvenile females, in subpopulations of the NWHI by maintaining and enhancing the species' habitat and prey base, targeting research to better understand factors affecting juvenile survival, intervening when possible to improve

rates of juvenile and adult female survival, protecting females from aggressive groups of male seals and shark predation, and continuing to remove marine debris and disentangle seals;
- Maintaining field teams in the NWHI to carry out research and management actions;
- Ensuring continued natural growth of the monk seal population in the main Hawaiian Islands; and
- Reducing the possibility of inadvertent introduction of infectious diseases.

The draft plan also describes specific actions to conserve monk seal habitat, reduce interactions with commercial fisheries, investigate factors affecting prey limitation, conduct population monitoring and research, prevent the spread of infectious diseases, minimize the impact of natural biotoxins, reduce aggression by groups of male seals toward females, prevent entanglement in marine debris, reduce sources of human disturbance, reduce the impact of vessel groundings, minimize risks of shark predation, reduce the impact of contaminants, prepare a main Hawaiian Island monk seal management plan, and carry out a public education and outreach program.

The draft plan recommends that reclassification as threatened be considered when the following criteria are met: (1) the total number of monk seals in the NWHI exceeds 2,900 seals, (2) at least five of the six major breeding colonies have 100 individuals or more and the subpopulation in the main Hawaiian Islands exceeds 500 animals, and (3) female survivorship and birth rates in the major NWHI and main Hawaiian Islands colonies are high enough to assure that population growth rates are not declining

Major Management Actions: Since publication of the initial monk seal recovery plan in 1983, much has been done to address the most direct and obvious causes of the monk seal decline. Some of those actions are summarized below.

<u>Improve survival rates of juvenile females</u>: To address problems related to poor juvenile survival and limited prey availability, NMFS has undertaken two types of interventions: (1) a “head start” program at Kure Atoll and (2) a capture, rehabilitation, and release program for undersized pups from French Frigate Shoals. Both efforts sought to enhance survival of female pups to save their reproductive potential. Under the head start program, newly weaned female pups at Kure Atoll were captured, placed in pens at the atoll, and fed for several months to improve their chances of survival during the first year of life. Under the pup rehabilitation program, female pups at French Frigate Shoals judged unlikely to survive because of their small size (girth) at weaning were captured, transported to facilities in the main Hawaiian Islands for rehabilitation, and later released at Kure Atoll where prey availability did not appear to be limiting survival. These programs were successfully carried out between 1981 and 1992 but were suspended in 1993 when a group of 12 female pups taken into captivity for rehabilitation developed an undiagnosed eye disease that blinded most of them. An attempt was made to reinitiate the program with releases at Midway Atoll in the mid-1990s, but it was discontinued because of poor survival of the released animals. More recently, NMFS developed plans for a “second chance” program at French Frigate Shoals. Under that program, juvenile seals (rather than newly weaned pups) showing signs of poor nutrition a few months after weaning are to be caught, placed in pens at the atoll for feeding, and released on site after fattening. Although steps were taken to implement

the new program in the summer of 2004, no seals deemed eligible for the program were observed at that time. The program may be resumed in the future, depending on funding.

Interactions with Commercial Fisheries: The potential effects of NWHI fisheries on monk seal prey resources, as well as direct interactions between monk seals and fishing gear, are considered within the context of four fishery management plans developed by the Western Pacific Fishery Management Council and implemented by NMFS. These include fishery plans for crustaceans (i.e., lobster), bottomfish (e.g., snapper and grouper), pelagic species (e.g., tuna and swordfish), and precious corals.

Crustacean Fishery In the late 1970s and early 1980s a fishery targeting spiny lobsters in the NWHI grew rapidly. As the fishery expanded, the Western Pacific Fishery Management Council recommended a fishery management plan adopted by NMFS in 1983. To protect monk seal foraging habitat, the plan established no-fishing zones within 20 nmi of Laysan Island and within the 10-fathom contour around all other atolls. To prevent monk seals from wedging their heads in trap openings, the plan also specified a maximum trap opening size. Initially, the plan allowed the take of all the lobsters that could be caught above a minimum size limit. As lobster abundance quickly declined, the plan was modified to allow catch levels that were expected to maintain lobster population abundances at or above 20 percent of the size thought to occur in the absence of fishing. As this and other major amendments to the plan were proposed, NMFS conducted formal section 7 consultations pursuant to the ESA. Despite concern expressed by the Marine Mammal Commission and others throughout the 1990s that the fishery was reducing available monk seal prey, NMFS concluded that lobster fishing had no effect on monk seal prey availability (MMC 2004). In early 2000, shortly after a lawsuit challenged the basis for this conclusion, NMFS suspended the fishery on grounds that it was uncertain about the status of NWHI lobster populations (MMC 2004). Since then, NMFS has kept the NWHI lobster fishing quota at zero.

Bottomfish fishery—The bottomfish fishery is a hook-and-line fishery that targets sizes and species of fish not normally eaten by monk seals. Occasionally, monk seals become hooked while taking bait or caught fish off of hooks. Monk seals also sometimes remain near fishing vessels and feed on discarded bycatch. After passage of the Magnuson-Stevens Fishery Conservation and Management Act in 1976, the number of fishing vessels and landings of bottomfish grew until 1987 when they began to decline to a much lower level, around which they now fluctuate. Requirements relative to monk seals have been limited primarily to observer and reporting requirements. In the NWHI bottomfish fishery, vessels must carry observers when requested to do so and must report interactions with monk seals. Most interactions reported by fishermen and observers involve seal sightings near fishing vessels and, very rarely, hookings. In 2002 NMFS prepared a section 7 biological opinion on the bottomfish fishery management plan and concluded that the fishery would not jeopardize monk seals or their critical habitat. The state of Hawaii also requires logbooks for state waters around the main Hawaiian Islands; however, information on interactions with protected species is not required, and the logbooks therefore provide no information on interactions with monk seals (NMFS 2006a).

Pelagic longline fishery—In the early 1990s as a pelagic longline fishery developed for swordfish and tunas near the NWHI, several seals were found with embedded longline hooks and other injuries thought to be associated with this fishery. In response the fishery management council recommended, and NMFS adopted, a 50-nmi no-fishing zone for this fishery around the NWHI and in corridors between the islands. The measure appears to have nearly eliminated hookings in this fishery (NMFS 2006a).

Precious corals—Although no commercial harvests of precious corals used in the jewelry industry have occurred in the NWHI, the Western Pacific Fishery Management Council drafted a fishery management plan to allow some coral harvesting in the area. The council, however, has recommended against harvesting of gold corals because some seals forage in beds of this species at depths of 500 meters or greater (NMFS 2006a). NMFS has not adopted the draft plan.

New fishery restrictions in federal waters around the NWHI—In late 2000 and early 2001 fishery management in the NWHI became subject to new management restrictions when President Clinton signed two Executive Orders designating the NWHI Coral Reef Ecosystem Reserve (MMC 2002). The reliance of Hawaiian monks seals on this regional coral reef ecosystem was cited as an important consideration leading to the designation. The Presidential orders directed that all landings and fishing permits for commercial fishing within reserve waters be capped at levels that existed in the year prior to the 4 December 2000 designation date. As bottomfish were the only landings taken from reserve waters during that period, the designation precluded fishing for other species. The directive also required the use of precautionary management principles and the establishment of 15 "reserve preservation areas" within which no fishing of any kind is allowed. The orders also directed that the National Marine Sanctuary Program consider designation of the area as a national marine sanctuary. The sanctuary designation process, however, was superceded on 15 June 2006 when President Bush signed an Executive Order designating the reserve as the Papahānaumokuākea Marine National Monument. In doing so, he instituted a ban on all commercial fishing except bottomfish fishing, which is to be phased out within five years.

Fishery restrictions in state waters of the NWHI—In 2001 the state of Hawaii proposed designating all state waters in the NWHI as a state fishery management area to establish access permit requirements that would allow the state to control commercial fishing. Following receipt of comments urging the adoption of more restrictive measures, the state modified its proposal and, late in 2005, adopted rules designating the area as a state marine refuge within which all commercial and recreational fishing is prohibited.

<u>Entanglement in Marine Debris</u>: For more than 15 years, field teams responsible for monk seal research have routinely disentangled seals found entangled in marine debris and removed hazardous debris from beaches. Since the late 1990s divers also have removed derelict nets and lines from submerged reefs in the NWHI. Between 1996 and 2003 NMFS and cooperating organizations removed 470 metric tons of nets and other debris from NWHI coral reefs (NMFS 2006a).

<u>Aggression by Groups of Male Seals</u>: To minimize seal deaths and injuries caused by aggressive male seals, NMFS has captured adult male seals known or suspected to have displayed aggressive behavior and relocated them in other areas. In 1994, 22 adult males were captured at Laysan Island for relocation to the main Hawaiian Islands (Ragen and Lavigne 1999, NMFS

2006a). Since then, the number of seals killed by aggressive males at Laysan Island has declined dramatically (NMFS 2006a). Similarly, in 1998 two aggressive males responsible for killing pups at French Frigate Shoals were relocated to Johnston Atoll, after which injuries to pups at French Frigate Shoals declined.

Shark Predation: NMFS also has taken steps to reduce shark predation on monk seals at French Frigate Shoals. Research field teams have attempted to catch and kill those sharks that patrol pupping beaches and prey on pups when they enter the water. In 2001 NMFS field teams killed five sharks exhibiting predatory behavior at Trig Island. Also in 2001 field teams moved 18 weaned pups to other islands at the atoll where no sharks exhibited patrolling behavior (MMC 2002).

Human Disturbance: To help minimize seal disturbance by people and pets at pupping and haul-out sites in the main Hawaiian Islands, NMFS and the State of Hawaii Division of Aquatic Resources have launched cooperative efforts with volunteers and local officials to educate the public about seal protection needs and to mark off temporary seal safety zones around hauled-out animals (MMC 2002). On Kauai, where seals haul out most frequently, a fulltime coordinator was hired by the state to work with local authorities and the volunteer Monk Seal Watch Program. NMFS also has hired a similar coordinator for the other main islands. To mitigate the injury to seals hooked on fishing gear or entangled, procedures have been put in place to expedite a response by trained experts and to provide veterinary assistance as needed. In some cases where interactions with people pose particular risks for seals or people, seals have been captured and relocated.

Disease and Contaminants: To address disease and contaminant risks, monk seals are occasionally captured and moved away from hazardous areas, and efforts are made to monitor for the presence of pathogens. Efforts also have been taken to improve monitoring of seals for the presence of disease and contaminants. Steps also are currently being taken to investigate the feasibility and safety of vaccinating Hawaiian monks seals against phocine morbillivirus, a distemper virus that has caused significant mortality in other seal species and may be spread to monk seals from other pinnipeds that occasionally visit the Hawaiian Islands (Braun and Yochem 2006).

Staff and Funding Levels: According to the Marine Mammal Commission survey of federally funded marine mammal research (Waring 2002), expenditures for biological and population assessment research on Hawaiian monk seals between FY1991 and FY2000 ranged from less than $500,000 in FY1991 to nearly $1.9 million in FY2000 (see Appendix F). NMFS was the principal source of funding.

Efforts to recover Hawaiian monk seals have received regular appropriations from Congress for many years. According to FWS annual reports on endangered species expenditures (FWS 2003b–d, 2005d–f, 2006), NMFS allocated an average of about $2.1 million per year to monk seal recovery work between 1998 and 2004 (Table 9, Appendices C.1–7). Although not reported in endangered species expenditure reports, FWS also has allocated funding annually for monk seal-related activities in its Hawaiian Islands National Wildlife Refuge since the 1970s. Recent funding levels have been approximately $75,000 per year (FWS and USGS 1997–2004). The

Table 9. Federal and state expenditures (in $ thousands) for the recovery of Hawaiian monk seals, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	1,504	–	12	1,516	–	1,516
1999	–	–	1,052	48	4	1,104	0.4	1,105
2000	–	–	1,210	–	43	1,253	14	1,267
2001	–	–	2,100	2	5	2,108	14	2,121
2002	–	–	2,100	46	38	2,184	14	2,197
2003	–	–	2,100	–	30	2,130	15	2,145
2004	–	1	2,164	105	51	2,321	–	2,321

state of Hawaii, the Marine Mammal Commission, and NOAA's Hawaii Humpback Whale National Marine Sanctuary also have contributed modest amounts of funding not reflected in the FWS annual expenditure surveys. NMFS budget documents specify budget allocations for Hawaiian monk seal activities below those levels reported to FWS for the annual expenditures reports. Line items specifically related to monk seals in those documents rose from $798,000 in 2001 to $816,000 in 2004 (see Appendix E).

Table 10. Projected funding needs (in $ thousands) to implement recovery activities for Hawaiian monk seals during the first five years after adoption of the 2005 draft revised recovery plan (NMFS 2006e)

Action Objective	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Conserve monk seal habitat	11,362	312	312	112	112	12,210
Reduce interactions with fisheries	1,625	1,625	1,625	1,625	1,625	8,125
Investigate food limitation	940	970	1,020	970	870	4,770
Population research, monitoring	1,550	1,500	1,450	1,450	1,450	7,400
Prevent infectious disease	610	567	567	567	567	2,898
Minimize impacts of biotoxins	425	200	125	75	75	900
Reduce aggression by male seals	*	*	*	*	*	*
Prevent entanglements	1,335	1,325	1,310	1,285	1,270	6,525
Reduce human disturbance	1,249	1,249	1,249	1,249	1,249	6,245
Reduce effects of vessel groundings	487	75	62	62	132	818
Reduce shark predation	350	250	250	250	250	1,350
Reduce impacts of contaminants	65	-	-	-	-	65
Main Hawaiian Islands mgmt. plan	40	10	-	-	-	50
Public education and outreach	310	150	150	150	150	910
TOTAL	20,368	8,233	8,120	7,795	7,750	52,226

* The cost for this task is included in costs for other tasks.

NMFS estimates that its headquarters and regional offices devoted 1.2 FTEs to monk seal management activities in 2005, while its fishery science centers devoted at least 21 FTEs to Hawaiian monk seal research activities.[7] Most of those positions are devoted to research and conservation efforts (e.g., disentangling seals, capturing and moving aggressive male seals, removing sharks, etc.) by field teams visiting the NWHI annually to monitor major breeding colonies. As shown in Table 10, the revised draft monk seal recovery plan (NMFS 2006e) projects total implementation costs for the first five fiscal years after adoption at $52.3 million (including activities ranked from priority 1 through 3).

Guadalupe Fur Seal

Population Status: The range of the Guadalupe fur seal (*Arctocephalus townsendi*) once extended south from Monterey, California, to the Revillagigedo Islands off southern Baja California, Mexico. The species' initial population size has been estimated to have been at least 20,000 animals and perhaps as many as 100,000 (Fleischer 1987, NMFS 2006a). Commercial hunting in the 19th century nearly drove the species to extinction. In 1911, commercial harvesting was prohibited under terms of the North Pacific Fur Seal Treaty.

Following the capture of two adult males at Guadalupe Island off Mexico in 1928, this species was not reported again until 1949 (Bartholomew 1950). Since then, its abundance has increased at an estimated annual growth rate of 13.7 percent. The current best estimate of abundance, which is based on extrapolations from counts of animals on rookeries in 1993, is 7,408 seals. Based on that estimate, a PBR of 91 animals was calculated (NMFS 2006a). The species also has been expanding into its former range. Guadalupe fur seals are regularly sighted in low numbers on San Miguel and San Nicolas Islands off southern California, and in 1997 a pup was born at San Miguel Island.

The species was listed as threatened under the ESCA in 1970, but for unknown reasons it was omitted from the list of threatened species carried forward under the ESA. In November 1983 the Center for Environmental Education (now The Ocean Conservancy) petitioned NMFS to list the species as endangered. In December 1985 NMFS listed the species as threatened. It also is listed as threatened under California state law.

Major Threats: The cessation of commercial hunting in the early 1900s removed the major cause of the species' decline. Other possible threats include incidental mortality and injury in commercial fisheries and entanglement in debris. Incidental mortality of Guadalupe fur seals has not been documented in any U.S. or Mexican fisheries (NMFS 2006a). However, in the 1990s incidental mortalities of unidentified marine mammals that may have included Guadalupe fur seals were documented in drift and set gillnet fisheries off southern California and off the Pacific coast of Baja California, Mexico. Some fur seals also may be killed as a result of entanglement in derelict fishing gear and marine debris. As indicated above, however, such mortality has not prevented the species' abundance from increasing steadily.

[7] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115

Management Framework: NMFS is the lead agency for implementation of the ESA and the MMPA regarding Guadalupe fur seals. No recovery teams have been established specifically to promote the recovery of this species.

Critical Habitat: In listing Guadalupe fur seals as threatened under the ESA, NMFS rejected a request by the petitioner to designate waters in the Channel Islands off southern California as critical habitat (50 Fed. Reg. 51254). NMFS concluded that other management measures would provide sufficient protection and noted that the species' primary breeding grounds are under the jurisdiction of Mexico.

Recovery Plan: No recovery plan has been prepared. When the species was listed as threatened in 1985, NMFS identified criteria for initiating a status review to determine whether Guadalupe fur seals should be delisted (50 Fed. Reg. 51256):

- Growth of the population to 30,000 animals (the lower end of estimates of the initial population size);
- Establishment of one or more additional rookeries within the species' historical range; and
- Growth in abundance to the level at which maximum net productivity level occurs.

Major Management Actions: NMFS does not actively manage the conservation of Guadalupe fur seals although it has provided some funding for research.

Staff and Funding Levels: According to FWS annual reports on endangered species expenditures for 1998–2004 (FWS 2003b–d, 2005d–f, 2006), federal agencies reported expenditures for Guadalupe fur seal activities that ranged between zero in most years to $2,200 in 2000 (Appendices C.1–7). NMFS budget documents for the period FY2001–FY2005 did not identify any funding specifically for Guadalupe fur seals. NMFS estimates that its fishery science centers devoted at least 0.2 FTE on Guadalupe fur seal research activities in 2005, but that its headquarters and regional offices spent no time on this species that year.[8]

Northern Fur Seal, Eastern Pacific (Pribilof Islands) Population

Population Status: Northern fur seals (*Callorhinus ursinus*) range from southern California north to the Bering Sea and west as far as Honshu Island in Japan (Angliss and Lodge 2003d). There are five populations on at least six island groups: the Commander Islands (Russia), the Kuril Islands (Russia), Robbin Island (Russia), the Pribilof Islands and Bogoslof Island in the eastern Bering Sea (United States), and San Miguel Island off southern California (United States) (NMFS 1993). In the past, about 75 percent of all northern fur seals worldwide occurred on the Pribilof Islands during the breeding season (Angliss and Lodge 2003d). From 1918 until 1984 fur seals from this population were harvested commercially for their pelts under terms of the Convention on Conservation of North Pacific Fur Seals. The Convention was established to stop pelagic sealing practices that had nearly eliminated all populations by the late 1800s. Under its

[8] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.

terms, harvests were limited to juvenile male seals that haul out at rookeries in the spring. Pelts from the land-based harvest were allocated among the four signatory nations (i.e., the United States, the Soviet Union, Japan, and Canada). This harvest practice resulted in a steady increase in abundance through the first half of the 1900s. By the 1950s the Pribilof Islands' fur seal herd may have exceeded two million animals—a level thought to be near their pre-exploitation population size (NMFS 1993).

In the late 1950s harvest practices were changed to include a take of adult females. At the time, it was thought this would result in a brief decline in population size, followed by an increase in pup production, which would increase the number of juveniles available for harvest. The population size soon began to decline as expected, but after a take of about 300,000 females over several years, pup production failed to increase. As a result, harvests were again limited to juvenile males in the late 1960s. It was expected that the decline would reverse within a few years; however, the decline continued through the early 1980s, by which time the Pribilof Islands fur seal population was less than half its size in the early 1950s. As a result of the decline, harvests were steadily reduced, and in 1984 the United States declined to ratify an extension of the Convention. Management authority therefore reverted to domestic legislation under the MMPA and the Fur Seal Act. Under this authority, commercial harvests are prohibited, and taking is limited to subsistence harvests by Alaska Natives at a much-reduced level.

The reason for the continued decline long after the harvest of females was suspended has not been determined. Entanglement of juvenile seals in marine debris was postulated a possible cause. Based on a status review done by NMFS in response to a petition to list North Pacific fur seals as threatened under the ESA, NMFS designated the Pribilof Island fur seal population as depleted under the MMPA in 1988. The action was taken because the population was less than 50 percent of its size in the 1950s and below 60 percent of its carrying capacity (53 Fed. Reg. 17888). In the late 1980s and early 1990s the population stabilized at its reduced level, but in the mid-1990s it again began to decline for uncertain reasons. Based on a count made in 2004, the current best estimate of abundance for the Pribilof Islands fur seal population is 688,028. The calculated PBR level is 14,546 animals (NMFS 2005a).

Major Threats: The following have been identified as known or potential threats to the Pribilof Islands fur seal population:

<u>Prey Availability</u>: In its analysis of population trends at the time fur seals were designated as depleted in 1988, NMFS concluded that expansion of groundfish fisheries in the North Pacific (i.e., trawl fisheries for pollock, flatfishes, and other demersal finfish) had not reduced the carrying capacity for northern fur seals (53 Fed. Reg. 17891). However, in a conservation plan for the fur seal population adopted in 1993 (NMFS 1993), NMFS noted that the biomass of Pacific herring and walleye pollock in the Bering Sea and Aleutian Islands area had changed significantly since the 1960s. Given the importance of pollock as prey for northern fur seals, NMFS suggested that expansion of fisheries for those species may have altered the northern fur seal's food supply, but that the causes for the shifts in prey abundance and their impact on northern fur seals were largely unknown. In the conservation plan NMFS also drew parallels with the decline of the Steller sea lion.

Incidental Catch in Fisheries: In designating Pribilof Islands fur seals as depleted in 1988, NMFS evaluated information on the number of fur seals caught incidentally in commercial fisheries. It concluded that although some animals were taken in foreign and domestic fisheries, the number was insignificant (53 Fed. Reg. 17893). More recently, NMFS estimated that minimum annual mortality in commercial fisheries is 15 fur seals per year based on observer data and self-reporting by fishermen (NMFS 2005a). This level of mortality is well below the PBR level for this population and is considered insignificant and approaching a zero mortality and serious injury rate.

Entanglement in Marine Debris: Mortality of juvenile seals due to entanglement in marine debris, particularly packing bands and derelict trawl nets, has been suggested as a significant factor in the decline of the population in the 1970s and early 1980s (Fowler 1982, 1985). Those analyses suggested that as many as 50,000 fur seals per year may have been entangled and drowned at sea in derelict fishing nets and other marine debris adrift in the North Pacific Ocean. Juvenile fur seals, which spend their first two years of life entirely at sea after leaving the rookeries, are thought to be particularly susceptible to entanglement because of their smaller head size relative to trawl net mesh sizes and their tendency to interact with floating objects. Documentation of this hypothesis, however, has proved elusive because of the vast pelagic habitat used by fur seals. Entanglement rates observed on rookeries have been on the order of three to four per thousand animals observed but may not accurately reflect pelagic entanglement rates because they are limited to animals that survive long enough to swim ashore. The rate of entanglement among subadult males observed on rookeries, however, appears to have declined somewhat since the early 1980s (NMFS 1993, 2005a).

Habitat Concerns: Recent industrial and other development on the Pribilof Islands may affect fur seal rookeries through the discharge of seafood processing waste, oil and contaminant spills, increased direct human disturbance, and increased levels of noise and olfactory pollution (NMFS 2005a). Pup production at two of three rookeries nearest to human settlements and sewer outfalls has declined.

Management Framework: As noted previously, fur seals were managed under the Fur Seal Convention until 1984. While the Convention was in force, it was implemented in the United States under the Fur Seal Act, which superseded the authority of the MMPA. When the Convention expired in October 1984, management authority reverted to the MMPA. NMFS is responsible for management actions, some of which are implemented in cooperation with the Aleut communities of St. Paul and St. George Islands (Pribilof Islands), which continue to take some fur seals for subsistence purposes. There currently is no conservation or recovery team specifically for northern fur seals.

Critical Habitat: Not applicable

Recovery Plan: Because northern fur seals are not listed as endangered or threatened, no recovery plan has been prepared. However, in June 1993 NMFS approved a final conservation plan for northern fur seals under authority added to the MMPA in 1988 (NMFS 1993). The plan is presently under revision. Its goal is to restore the population of northern fur seals to the point where it is no longer considered depleted. The 1993 plan used a population estimate for the

1940s and 1950s of 2.1 million animals as the basis for estimating the population's OSP level. The plan also used the peak production of pups in the same period as a benchmark. The point at which the population could be considered not depleted is described as follows:

> The population level at which maximum productivity would occur, and the level at which NMFS would reconsider the depleted classification, would occur at a sustained population level (total abundance estimate) and/or a sustained level of annual pup production which are 60 percent of the peak historical estimates.

The plan identifies the following two objectives to achieve its goal:

- Continue and, as necessary, expand research or management programs to monitor population trends and detect natural or human-related causes of change in the population and habitats essential to its survival and recovery; and
- Assess and avoid or mitigate possible adverse effects of human-related activities on or near the Pribilof Islands and other essential habitat throughout the population's range.

Specific recovery actions described in the plan include monitoring the status and trend of the population; monitoring health, condition, and vital parameters; assessing causes of mortality; minimizing effects of disturbance; investigating feeding ecology and factors affecting energetic requirements; investigating relationships between fur seals and fishery resources; assessing effects of natural ecosystem changes; and coordinating conservation efforts with other agencies and countries.

Major Management Actions: Upon expiration of the Fur Seal Convention in 1984, management authority reverted to the MMPA and the Fur Seal Act. With that shift, the commercial harvest was prohibited, and the Service issued regulations to manage subsistence taking by residents of the Pribilof Islands. Prior to that time, the Aleut community relied on fur seals killed in the commercial harvest for meat. In June 1986 NMFS issued a final rule regulating the subsistence take of fur seals (51 Fed. Reg. 24828). Like the past commercial harvest, the subsistence harvest is limited to juvenile male seals. Under the harvest regulations, annual projections of harvest needs are developed by NMFS based on household surveys of Pribilof Island Native hunters. Those projections are used to develop annual harvest level guidelines. Since the late 1980s harvest levels have declined gradually. Between 1999 and 2003 they declined from 1,193 to 654 (NMFS 2005a). NMFS officials have observed the hunt annually. NMFS, in cooperation with Native hunters, also has supported various research projects, including efforts to monitor entanglement rates among seals on the rookeries. As noted above, NMFS also adopted a conservation plan in 1993. Designation of the northern fur seal as depleted in 1988 imposed additional restrictions on taking of the species, as presented in the description of the MMPA discussed previously.

Staff and Funding Levels: NMFS budget documents for the period FY2001–FY2005 do not identify specific funding for research or management activities involving Pribilof Island fur seals. NMFS estimates that its headquarters and regional offices devoted at least 1.7 FTEs on northern fur seal management activities and that its fishery science centers currently devote at least 8.4 FTEs on research activities for this population during 2005.[9] The Marine Mammal Commission's survey of federally funded marine mammal research (Waring 2002) reports that expenditures for biological research and population assessment for northern fur seals in FY1991–FY2000 ranged from $6,000 in FY1991 to $1.9 million in 2000 (see Appendix F). NMFS was the principal source of funding.

Cost estimates for the first five years of recovery work, developed when the northern fur seal conservation plan was adopted in 1991, projected annual funding needs ranging from $1.27 to $1.67 million per year for a five-year total of $7.2 million (NMFS 1991). Actual expenditures during that period are uncertain but are believed to have been much lower. NMFS administrative reports required by the MMPA do not provide information on expenditures for this population, and FWS annual reports on expenditures for threatened and endangered species do not include data on this species because it is not listed as endangered or threatened.

Steller Sea Lion, Eastern Population

Status: The eastern population of Steller sea lions (*Eumetopias jubatus*), one of two recognized Steller sea lion populations, is distributed east and south of Cape Suckling, Alaska (i.e., a point at 144° W longitude west of Prince William Sound in the northern Gulf of Alaska) along the west coast of North America to southern California (NMFS 2005a). The population was initially listed as threatened under the ESA in 1990 when the entire species was listed as such. In 1997 the listing was modified to recognize the western population as endangered while retaining the threatened status for the eastern population.

Based on aerial surveys from southeast Alaska, British Columbia, Washington, Oregon, and California in 2002, the eastern population numbers an estimated 44,996 animals and is increasing (NMFS 2005a). However, between 1980 and 2001 Steller sea lion abundance in central and southern California at the southern extreme of the population's range declined by half to 1,500 to 2,000 animals older than pups. Elsewhere in California and Oregon, counts of non-pups at trend sites have remained relatively stable since the 1980s. Counts of non-pups in southeast Alaska increased at about 2 percent annually between 1979 and 2002 to 9,951 while non-pup counts in British Columbia increased at an average annual rate of 2.8 percent between 1971 and 1998 (NMFS 2005a). The status of the population relative to its OSP size is unknown. The PBR level was calculated as 1,967 (NMFS 2005a).

Major Threats: From 1999 to 2003 observers monitored several commercial fisheries believed to take Steller sea lions incidentally (NMFS 2005a). The observed fisheries included longline, trawl, gillnet, and troll fisheries in Alaska, Oregon, Washington, and California. Combining data from observers and reports by fishermen, the average incidental take in U.S. fisheries between 1999 and 2004 has been estimated to average 3.8 eastern Steller sea lions per year. Incidental take in both U.S. and Canadian fisheries is estimated to number at least 4.2 sea lions per year.

[9] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115

Because this total is less than 10 percent of the PBR level, it is considered insignificant and approaching a zero mortality and serious injury rate. Between 1999 and 2002 an average of about 45 animals were shot annually because they were preying on salmon in aquaculture pens in British Columbia. Such shooting is no longer allowed (NMFS 2005a).

Mortality from other known human-related sources is also relatively low. Between 2000 and 2003 subsistence takes by Alaska Natives averaged just four animals per year (NMFS 2005a). Before Steller sea lions were listed as threatened in 1990, indiscriminate shootings were thought to be a potentially significant source of mortality (NMFS 2005a) despite the fact that it was illegal under the MMPA after 1972. Since 1999 two illegal shootings of Steller sea lions were documented from stranded animals and were successfully prosecuted.

Management Framework: The management framework for the eastern population of Steller sea lions is described in the recovery plan adopted in 1992. The framework is the same as for the western Steller sea lion population and is discussed later.

Critical Habitat: In 1993 the Service designated waters and lands within 3,000 ft of rookeries and major haul-out sites east of 144° W longitude as critical habitat.

Recovery Plan: A recovery plan for Steller sea lions throughout their U.S. range was approved in 1992 (see the western Steller sea lion section). A plan specific to the eastern population has not been developed. However, a new plan addressing both the western and eastern populations was developed and made available for public review in 2006 (71 Fed. Reg. 29919).

Major Management Actions: Other than steps taken to designate critical habitat, population-specific management actions to promote recovery of eastern Steller sea lions have been limited largely to section 7 consultations concerning activities that could potentially affect the population.

Staff and Funding Levels: Until recently, the cost of recovery activities for eastern Steller sea lions has not been reported separately from that of the western population. Before 2003 FWS annual expenditure reports for endangered species (FWS 2003b–d, 2005d–e) combined funding for both eastern and western Steller sea lion populations. In 2003 and 2004 those surveys indicate that NMFS spent $4.1 and $9.6 million, respectively, on the eastern population's recovery, while the state of Alaska spent $1.2 million each year (FWS 2005f, 2006) (Table 11, Appendix C.6–7, Appendix D). For the most part, those efforts included measuring parameters in the relatively healthy eastern population for purposes of comparison with the endangered western population to help elucidate causes of the latter's decline. NMFS estimates that it devoted at least 6.4 FTEs in staff effort on eastern Steller sea lion recovery work (1.3 FTEs by its regional offices and headquarters and 5.1 FTEs by its science centers) during 2005.[10]

[10] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115

Table 11. Federal and state expenditures (in $ thousands) for the recovery of the eastern population of Steller sea lions, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006) (Dash means no data were provided.)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998 [a]	–	–	3,040	–	20	3,060	19	3,079
1999 [a]	–	–	4,879	2,291	56	7,226	8	7,234
2000 [a]	–	–	5,243	7,810	54	13,107	6	13,113
2001 [a]	–	–	33,312	11,067	66	44,445	2,338	46,783
2002 [a]	–	–	29,295	24,172	35	53,502	2,496	55,998
2003 [b]	–	–	4,090	N/A	4	4,094	1,203	5,297 [c]
2004 [b]	–	–	9,605	N/A	3	9,608	1,203	10,811 [c]

[a] Includes funding for both eastern and western populations
[b] Includes funding only for eastern population
[c] Excludes Coast Guard support for enforcement

Steller Sea Lion, Western Population

Status: The western population of Steller sea lions, one of two currently recognized populations, occurs along the North Pacific Ocean rim from the Kuril Islands and Okhotsk Sea to Cape Suckling, Alaska. Between the 1970s and late 1990s western Steller sea lions declined by 80 percent in the Gulf of Alaska and the Bering Sea/Aleutian Islands (NOAA Fisheries 2000). In 1990 the entire species was listed as threatened throughout its range (NMFS 1992). Subsequent research revealed that the species was comprised of two separate populations, and in 1997 NMFS designated the western population as endangered while continuing to recognize the eastern population as threatened.

The number of Steller sea lions in the western population was estimated to be at least 140,000 animals in the 1950s and 1960s (NMFS 2005a). Counts in the late 1970s indicated a decline to roughly 110,000 animals, and between 1975 and 1985 the population continued to decline at an average annual rate of 5.9 percent (National Research Council 2003). The rate of annual decline increased dramatically to 15.9 percent between 1985 and 1990 before returning to about 5 percent through the 1990s. Since 2000 counts of the population have increased slightly. Between 2002 and 2004 counts at trend sites increased about 5.2 percent per year. The best estimate of total population size based on surveys in 2004 is 38,513 sea lions, which is is 32 percent less than the count in 1990 and more than 70 percent below counts estimates from the 1950s and 1960s. The current PBR level is 231 animals (NMFS 2005a).

Major Threats: The cause of the decline of Steller sea lions has been the subject of great controversy and scientific debate because of the potential effect of conservation measures on major groundfish fisheries in Alaska (NRC 2003, MMC 2002, NOAA Fisheries 2000). Possible causes of the decline include disease, pollution, entanglement in marine debris, commercial and subsistence harvest of sea lions, illegal killing, predation by killer whales and sharks, natural environmental changes in carrying capacity, and interactions with commercial fisheries, including both incidental catch and depletion of available prey resources. Most of these factors are not thought to have been likely causes of the population decline.

- Disease, pollution, and entanglement in marine debris are not considered significant sources of mortality (MMC 2002).
- Steller sea lions have not been harvested commercially since the passage of the MMPA in 1972 (National Research Council 2003). Between 1963 and 1972, 45,178 pups were harvested in the eastern Aleutian Islands and the Gulf of Alaska (NMFS 1992). Although half of the pups on some islands were killed in some years, the effect of this take does not explain the long-term decline since the early 1970s.
- The mean annual subsistence take by hunters in Alaska coastal communities—principally in the Pribilof Islands—was 187 sea lions between 2000 and 2003 (NMFS 2005a), a level not considered a likely cause of the decline.
- After the initial listing of Steller sea lions as threatened in 1990, shootings of sea lions by fishermen are thought to have become less frequent. In 1998 two such violators were successfully prosecuted, but no successful cases were brought between 2000 and 2003 (NMFS 2005a).
- The role of predation by killer whales is controversial. Evidence suggests that such predation had limited effects during the major part of the decline in the 1970s and 1980s but may now be more significant given the species' much-reduced population size (NMFS 2005a).
- Analyses of fishery observer data between 1990 and 2003 suggest an average annual take of 25 sea lions incidental to groundfish trawl, longline, and trap, and salmon gillnet fisheries in the Bering Sea/Aleutian Islands and in the Gulf of Alaska (NMFS 2005a). When self-reporting by fishermen and stranding data are added, the minimum mean annual mortality rate increases to 31 sea lions per year. Because this level exceeds 10 percent of the PBR level for western Steller sea lions, current levels of incidental take in fisheries are not considered insignificant and approaching a zero mortality and serious injury rate (NMFS 2005a).[11] Although incidental taking in fisheries exceeds this target level for fishery-related mortality, the current minimum estimate of all sources of human-caused mortality (218 animals) is below the calculated PBR level.

Much of the debate about causes of the decline of Steller sea lions has centered upon the degree to which climate change and fishing have reduced prey and, by extension, the nutritional fitness of Steller sea lions (National Research Council 2003, MMC 2002, NMFS 1992). The oceanographic regime of the North Pacific undergoes periodic shifts that can have profound effects on fisheries and wildlife populations, including sea lion prey species. A significant regime shift occurred in the late 1970s, and one hypothesis is that the shift led to a decrease in available prey of high nutritional quality, thereby compromising growth and survival of juvenile sea lions and reproduction of adult females. Alternatively, intensive fishing by foreign fleets off Alaska between the late 1950s and early 1970s may have been a major factor in changing the abundance levels of prey populations.

[11] In calculating the PBR level for the western population of Steller sea lions, NMFS applied the recovery factor for an endangered species of 0.1 (NMFS 2005a). At the same time, NMFS noted that this recovery factor and the entire regime of PBR were based on the assumption that direct human-related mortalities would be the primary reason for declines in marine mammal abundance—an assumption that may not be warranted for Steller sea lions.

Currently operating fisheries also may affect Steller sea lion populations by reducing prey. Both fisheries (including those for pollock, Atka mackerel, and Pacific cod) and sea lions exploit the same species in the same geographic regions during the same seasons (MMC 2002). During the course of the sea lion decline, harvests were managed to reduce the biomass of some prey species by as much as 65 percent or more. Recent management strategies are attempting to limit reductions to 60 percent of their estimated unfished biomass. The extent to which prey species can be removed without significant ecological effects on marine predators such as the Steller sea lion is not clear and is a subject being addressed in section 7 consultations. The effects of removing such a large percentage of available biomass are further confounded by the manner in which they are removed. Much of the controversy regarding fishery effects on Steller sea lions has focused on where and when the prey are removed because the concentration of fishing effort in time and space can exacerbate effects by causing excessive localized depletions. In addition, fishing concentrated in areas close to rookeries and haul-out sites can exacerbate general reductions in biomass because sea lions must then extend their foraging range and use more energy to find the prey needed. All of these effects are considered to be most significant for young animals making the transition to independent foraging and for females that must support their own nutritional needs plus those of dependent pups and developing fetuses. Evidence collected in the 1970s and 1980s indicated that growth, survival, and reproduction all may have been compromised during that period, suggesting the animals were subject to nutritional limitations. Unfortunately, the effects of oceanic regime shifts and fishing may become expressed more or less identically, making discrimination between these potential causes difficult.

A National Academy of Sciences panel reviewed the principal hypotheses for the decline of the western population of Steller sea lions and divided them into two trophically based categories: bottom-up and top-down categories (National Research Council 2003). The former includes effects that alter the carrying capacity of the ecosystem and that could affect the physical condition of sea lions (e.g., large-scale fisheries, climate change, pollutants, and disease). The latter includes effects that are independent of the system's carrying capacity but could still cause sea lion mortality (e.g., increased predation by killer whales or sharks, incidental taking in fishing gear). The panel concluded that there is no definitive evidence to support any particular hypothesis for the decline of the western population of Steller sea lions.

Management Framework: NMFS is the lead federal agency responsible for managing Steller sea lions. Implications that fisheries off Alaska have been a major factor in the decline of Steller sea lions have received great attention. Fishery management plans for walleye pollock, Pacific cod, and Atka mackerel in the Bering Sea/Aleutian Islands region and the Gulf of Alaska have been the subject of numerous formal consultations under section 7 of the ESA and numerous directives by the courts and Congress. Between 1998 and 2003 NMFS conducted six different section 7 consultations related to Steller sea lions, all but one of which examined groundfish fisheries.

The initial forum within which these fishery management plans are discussed and developed is the North Pacific Fishery Management Council. Like other regional fishery management councils, the North Pacific council has the lead in drafting and recommending measures under which the fisheries operate. Those measures must be reviewed by NMFS and meet standards of the Magnuson–Stevens Fishery Conservation and Management Act, the ESA, the MMPA, and the National Environmental Policy Act.

Congress also has played an active role in managing interactions between Alaska groundfish trawl fisheries and Steller sea lions. For instance, in its appropriations bill for FY2001, Congress modified the reasonable and prudent alternatives in a biological opinion. Congress also required that measures aimed at compliance with the ESA be developed consistent with the procedures and requirements of the Magnuson–Stevens Fishery Conservation and Management Act.

NMFS administers a coordinated Steller sea lion research program that includes participants from the Alaska Department of Fish and Game, the North Pacific Universities Marine Mammal Research Consortium, the Alaska SeaLife Center, and other agencies and organizations. The program includes extensive studies to monitor population trends and elucidate possible causes of the Steller sea lion decline (NOAA Fisheries 2000). Since Steller sea lions were listed in 1990, NMFS has conducted annual subadult/adult and biennial pup counts. Other studies have examined sea lion feeding ecology and prey biomass. The University of Alaska Fairbanks and a consortium of fishing companies have undertaken research under the aegis of the Pollock Conservation Cooperative Research Center.

NMFS also has taken steps to manage subsistence harvests of Steller sea lions in cooperation with Alaska Native hunters. From 1995 to 1997 NMFS sponsored efforts to increase Native awareness of the status of Steller sea lions and to encourage local management of the subsistence harvest. In 1997 representatives from Alaska Native communities in the Aleutian and Pribilof Islands formed a regional marine mammal commission to help manage certain marine mammals, including Steller sea lions, taken for subsistence purposes (NOAA Fisheries 2000). In 1999 an Alaska Native organization known then as the Alaska Sea Otter Commission added Steller sea lions to its responsibilities. Since then NMFS has worked with both the Native commission and the tribal government of St. Paul to develop a range-wide conservation program for Steller sea lions.

Critical Habitat: In 1993 NMFS designated critical habitat in three types of areas (58 Fed. Reg. 45269):

- Waters within 20 nmi of all rookeries and major haul-out sites west of 144° W longitude;
- Foraging areas in Shelikof Strait, the southeastern Bering Sea, and Seguam Pass in the central Aleutian Island chain; and
- Waters and lands within 3,000 ft of all rookeries and major haul-out sites east of 144° W longitude (i.e., for the eastern Steller sea lion population).

Recovery Plan: Soon after the 1990 listing of Steller sea lions as threatened throughout their range, NMFS convened a Steller Sea Lion Recovery Team, which prepared the first recovery plan for the species (NMFS 1992). The plan’s goal was to promote the recovery of Steller sea lions “…to a level appropriate to justify removal from the ESA listings.” It also identified criteria for reclassifying and delisting the species based on an initial benchmark of 90,000 animals older than pups counted at selected trend sites located between the Kenai Peninsula to Kiska Island in the Aleutians. The recovery team recommended the following:

- If the counts at designated trend sites in the area fall below 17 percent of the benchmark value, the species should be listed as endangered;
- If the counts are greater than 17 percent but less than 40 percent of the benchmark, the species should remain threatened, with the following exception; if the count is greater than 17 percent but less than 25 percent of the benchmark, the population should be listed as endangered if any of the following conditions apply:
  - The count at designated trend sites declines by at least 10 percent over three or more consecutive survey years;
  - The overall pup production index at trend sites declines by 10 percent over the count in the previous two-year period; or
  - The number of animals declines by at least 10 percent over a three-year period in three or more of the six other regions from Russia to California.

The recovery plan included the following criteria for delisting the Steller sea lion (NMFS 1992): (1) the trend count in the area is greater than 40 percent of the benchmark value of 90,000 animals older than pups, and (2) the number of animals is stable or increasing in at least three of the six other regions. NMFS decided not to adopt these criteria, pending further analysis.

The recovery plan also identifies recovery actions to accomplish the following:

- Identify habitat requirements and protect areas of special biological significance;
- Identify management stocks;
- Monitor status and trends of sea lions;
- Monitor health, condition, and vital parameters;
- Assess and minimize causes of mortality;
- Investigate feeding ecology and factors affecting energetic status; and
- Implement a recovery plan and coordinate recovery activities.

In 2001 NMFS convened a new 20-member recovery team to draft a revised recovery plan for both the western and eastern Steller sea lions. A revised recovery plan has been developed by the team and was made available for public review in 2006 (71 Fed. Reg. 29919).

Major Management Actions: Management actions put into place with the initial listing of Steller sea lions in 1990 include the following (MMC 2001):

- Prohibiting the discharge of firearms within 100 yards of a sea lion;
- Prohibiting most vessels from transiting within 3 nmi of major rookeries in the Aleutian Islands and Gulf of Alaska; and
- Monitoring incidental mortality and reducing the allowable annual take quota from 1,350 to 675 sea lions.

Between 1991 and 1998 NMFS established no-trawl zones within 10 nmi of 37 sea lion rookeries in Alaska, with seasonal extensions to 20 nmi around six major rookeries in the eastern Aleutian Islands and the Bering Sea, and prepared several biological opinions on the effects of trawl fisheries on sea lions. Among other things, the opinions led the North Pacific Fishery Management Council and NMFS to adjust time and area catch allocations to prevent concentrated fishing effort in foraging areas beyond the no-trawl zones around major haul-out sites (MMC 2001).

1998 Fishery Actions: NMFS issued several biological opinions finding that the pollock fisheries in the Bering Sea /Aleutian Islands areas and Gulf of Alaska could jeopardize Steller sea lions and their critical habitat. The opinions included reasonable and prudent measures that further dispersed fishing effort and limited catches in sea lion foraging areas. The agency also recommended studies on the efficacy of no-trawl zones, the foraging range of young-of-the-year Steller sea lions, and site-by-site relationships between fishing effort and trends in juvenile survival. Partially in response to litigation, NMFS issued additional biological opinions late in December 1998 on management plans for all three fisheries. Although one opinion for the proposed Atka mackerel fishery concluded that the fishery was not likely to jeopardize Steller sea lions or their designated critical habitat, a separate opinion concluded that the proposed plan for the Gulf of Alaska and the Bering Sea/Aleutian Islands groundfish fishery would do so. Upon reaching this conclusion, the opinion proposed a management framework to avoid jeopardy by dispersing fisheries adjacent to rookeries and haul-out sites, both temporally and spatially. NMFS later incorporated measures developed by the North Pacific Fishery Management Council into the biological opinion as reasonable and prudent alternatives, allowing the fishery to proceed.

1999 Fishery Actions: Measures developed in the December 1998 biological opinions were implemented by regulation in January 1999. In December 1999 NMFS issued a biological opinion on the total allowable catch of groundfish recommended by the North Pacific Fishery Management Council for 2000 (NOAA Fisheries 2000). The opinion concluded no jeopardy or adverse modification of critical habitat.

2000 Fishery Actions: In November 2000 NMFS issued a biological opinion on new measures for Gulf of Alaska and the Bering Sea/Aleutian Islands groundfish fisheries (NOAA Fisheries 2000). The opinion found that the fisheries, as implemented under the fishery management plans, would jeopardize the continued existence of Steller sea lions and adversely modify their critical habitat. The biological opinion set out the following reasonable and prudent alternatives to be phased in, beginning in 2001:

- Adopting a more precautionary rule for setting overall catch limits;
- Extending 3-nmi no-fishing zones around rookeries and haul-out areas to sites not already protected;
- Closing areas around some rookeries and haul-out sites out to 20 nmi;
- Establishing catch limits on a seasonal basis inside critical habitat and two seasonal releases of quotas outside of critical habitat; and
- Establishing a procedure for setting limits on catch levels in critical habitat based on the biomass of target species in critical habitat.

To help address uncertainties about interactions between fisheries and Steller sea lions, Congress authorized a significant increase in funding for Steller sea lion research late in 2000. The legislation also directed that certain modifications be made in the reasonable and prudent alternatives and that the North Pacific Fishery Management Council and the National Academy of Sciences undertake an independent review to assess underlying hypotheses regarding interactions between Steller sea lions and fisheries and recommend reasonable and prudent management measures.

2001 Fishery Actions: NMFS began phasing in reasonable and prudent alternatives reflective of its 2000 biological opinion and congressional directives. A new biological opinion was released recommending additional measures to avoid interactions between sea lions and fisheries. A National Research Council report concluded that fishing might have negative effects on Steller sea lions, but that data are limited and circumstantial (National Research Council 2003). The report recommended studies to monitor population trends and investigate temporal and spatial scales of sea lion foraging and hypotheses concerning local prey depletion. The report also concluded that, on a single-species basis, the fish stocks in the Alaska region were generally well managed although long-lived species with low recruitment may require more protective management. The review also concluded that there is not a sufficient basis to conclude that the existing management strategy is safe on an ecological basis and therefore protective of the ecosystem as a whole.

2002 Fishery Actions: NMFS issued rules making previous measures adopted in 2001 permanent (60 Fed. Reg. 956). Ongoing litigation resulted in a court decision recommending that NMFS further modify its reasonable and prudent alternatives.

2004 Fishery Actions: In December 2004 NMFS issued a final rule revising Steller sea lion protection measures in the pollock and Pacific cod fisheries in the Gulf of Alaska (69 Fed. Reg. 75865). The regulations changed fishing closures near four Steller sea lion haul-out sites and revised the seasonal quotas for pollock. In doing so, NMFS concluded that the measures would be unlikely to affect Steller sea lion populations beyond levels identified in the 2000 biological opinion.

Staff and Funding Levels: Cost projections developed for the first five years of recovery work when the Steller sea lion recovery plan was adopted (NMFS 1992) suggested funding needs ranging from between $1.18 to $2.83 million per year for a five-year total of $11.4 million. Actual expenditures during that period are uncertain; however, according to the Marine Mammal Commission’s survey of federally funded marine mammal research (Waring 2002), annual expenditures for biological and population assessment research on Steller sea lions (including both eastern and western populations) during the 1990s ranged from $4,000 in FY1991 to $1.9 million in FY1997 (Appendix F). The principal sources of funding were NMFS and the National Ocean Service, which funded studies on foraging patterns and competition for prey.

Prior to 2003 FWS annual reports on endangered species expenditures also combined funding data for eastern and western Steller sea lions consistent with their listing as a single species under the ESA. According to those reports, federal expenditures for recovery of both populations in 1998 were about $3.1 million, and state expenditures were $19,000 (FWS 2003d). Federal expenditures grew quickly in succeeding years to $7.2 million in 1999, $13.1 million in 2000, and $44.4 million in 2001 (Table 12, Appendices C.1–7) (FWS 2003b–d, 2005d–f, 2006). In 2003 overall federal funding for western Steller sea lions alone reached $48.3 million. Of that total, $8.2 million was spent on research by NMFS (largely on contracts with other institutions) and $39.9 million was spent on enforcement by the U.S. Coast Guard (FWS 2005d).[12] NMFS estimates that it devoted at least 14.4 FTEs in staff effort on eastern Steller sea lion recovery work (1.1 by its regional offices and headquarters staff and 13.3 by its science centers) during 2005.[13]

NMFS budget documents indicate that budget allocations for Steller sea lions (including both eastern and western populations) declined from $35 million in 2001 to $17.7 million in 2004 (see Appendix E).

Table 12. Federal and state expenditures (in $ thousands) for the recovery of western population of Steller sea lions, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006) (Dash means no data were provided.)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998 [a]	–	–	3,040	–	20	3,060	19	3,079
1999 [a]	–	–	4,879	2,291	56	7,226	8	7,234
2000 [a]	–	–	5,243	7,810	54	13,107	6	13,113
2001 [a]	–	–	33,312	11,067	66	44,445	2,338	46,783
2002 [a]	–	–	29,295	24,172	35	53,502	2,496	55,998
2003 [b]	–	–	8,180	39,940	194	48,314	1,200	49,514
2004 [b]	–	–	9,605	20,856	85	30,546	1,200	31,746

[a] Includes funding for both eastern and western populations
[b] Includes funding for western population only

CETACEANS

Blue Whale

Population Status: Blue whales (*Balaenoptera musculus*), the largest animals ever to live on earth, are found in all the world oceans. They have been divided into three subspecies: *B. m. intermedia* in Antarctic waters, *B. m. musculus* in the Northern Hemisphere, and *B. m. brevicauda* in the southern Indian Ocean and southwestern Pacific Ocean. For purposes of preparing stock assessment reports required under the MMPA, blue whales in U.S. waters have been divided into three populations: western North Atlantic, eastern North Pacific, and western North Pacific (NMFS 2006a). Blue whales were listed as endangered as a species throughout their range under the ESCA in 1970. That designation was carried forward under the ESA. The International Whaling Commission (IWC), the international organization responsible for

[12] Coast Guard cost estimates include the cost of vessel operations, including all crew and prorated maintenance costs, during periods when the vessel's primary mission is identified as enforcement of fishery regulations to protect Steller sea lions.
[13] P. Michael Payne, personal communication, 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

regulating commercial and subsistence whaling, classifies all populations of blue whales worldwide as “protection stocks” (i.e., stocks at less than 10 percent of their maximum sustainable yield level and for which no commercial whaling is allowed).

Western North Atlantic Population: In the western North Atlantic, blue whales are most common off the east coast of Canada and only occasionally enter U.S. waters (NMFS 2002c). The only basis for an estimate of abundance for this population is a count of 308 blue whales made in the Gulf of St. Lawrence in 1987.

Eastern North Pacific Population: Although the IWC considers blue whales throughout the North Pacific as a single population, it is now thought that as many as five separate populations occur in the North Pacific (NMFS 2005a, Reeves et al. 1998). One of these feeds principally along the coasts of California, Oregon, and Washington in summer and winters in calving grounds off Mexico and Central America. Based on surveys off California between 1996 and 2002, NMFS (2005a) concluded that the best estimate of abundance for this population is 1,744 whales. Based on a different analysis of those data by Calambokidis and Barlow (2004), however, the size of the population was estimated to be 2,994 whales. In general, their abundance appears to be increasing although it is possible that increases in blue whale counts since the mid-1990s simply reflect an increasing use of the California feeding grounds. The PBR level calculated for this population is 1.4 whales, which is greater than the documented mortality from ship strikes or fisheries (NMFS 2006a).

Western North Pacific Population: The western North Pacific population of blue whales is thought to winter in the central North Pacific and summer along the Aleutian Islands. However, based on rare sightings and acoustic recordings, blue whales enter the U.S. Exclusive Economic Zone off Hawaii at least occasionally (NMFS 2006a). No data are available to estimate population size or PBR level.

Major Threats: All populations of blue whales worldwide, including those in U.S. waters, were nearly eliminated by commercial whaling. A prohibition on hunting for blue whales was adopted by the IWC in 1966 (NMFS 2006a), but by that time whalers had taken at least 9,500 blue whales in the North Pacific and 11,000 in the North Atlantic, leaving populations in each ocean estimated to be fewer than 1,000 animals at that time. Current threats include the following:
Fishery Interactions: Although blue whales may have been incidentally taken in offshore drift gillnet fisheries and longline fisheries, there are no confirmed records of such takings off Hawaii, California, or the U.S. Atlantic coast (NMFS 2006a,b).

Vessel Collisions: Blue whales are occasionally injured or killed by collisions with ships (Laist 2001, NMFS 2006a). In March 1998 a 66-ft male blue whale, likely killed when struck, was carried into Rhode Island waters on the bow of a tanker. In the eastern North Pacific, ship strikes were implicated in the deaths of at least four blue whales between 1980 and 1993 (Jensen and Silber 2003).

Noise: Rising levels of anthropogenic noise in all the world’s oceans may disrupt long-distance communication of blue whales as well as other species of great whales. Whether such effects could alter their population abundance and trend is unknown.

Management Framework: NMFS is the lead federal agency responsible for managing blue whales. In cooperation with the Department of State, NMFS develops and coordinates scientific advice and U.S. positions on related management issues considered at meetings of the IWC. No interagency management teams currently exist to assist or oversee management activities specifically related to blue whales.

Critical Habitat: None designated.

Recovery Plan: In July 1998 the Service adopted a recovery plan for blue whales (Reeves et al. 1998). Its primary purpose is "…to identify a set of actions that will minimize or eliminate effects of human activities that are detrimental to the recovery of blue whale populations." Its immediate objectives "are to identify factors that may be limiting the populations and actions necessary to allow the populations to increase." Key actions highlighted in the plan focus on research to improve understanding of blue whale populations. The identified actions involve (1) determining population structure, (2) estimating population sizes and trends, (3) identifying and protecting essential habitats, (4) minimizing sources of human-caused injury and mortality, (5) coordinating federal, state, and international recovery efforts, (6) assessing detrimental effects of interactions with vessels, and (7) improving the collection of information from stranded and entangled animals.

Major Management Actions: To address the impact of commercial whaling, the IWC imposed a ban on hunting blue whales in the North Atlantic in 1955 and in the North Pacific in 1966 (Reeves et al. 1998). In 1986–1987 the ban was extended globally when the IWC, with the support of the U.S. delegation, adopted a moratorium on all commercial whaling. Other than preparing a blue whale recovery plan and blue whale stock assessment reports, NMFS has undertaken no management measures designed specifically to protect blue whales in U.S. waters. Most management actions related to blue whales involve actions focused on endangered whales in general. Although a few directed studies have been undertaken to assess the occurrence and movements of blue whales in the population off California, Oregon, and Washington, most information on blue whales in U.S. waters has been collected opportunistically (e.g., through stranding programs or incidental to studies on other species) or through studies to assess the regional composition of fauna.

Staff and Funding Levels: According to available budget data, NMFS allocated $994,000 in FY2003 for the recovery of endangered large whales (e.g., bowhead, blue, fin, sei, and sperm whales). The amount devoted specifically to blue whales is uncertain (see Appendix E). NMFS estimates that its headquarters, regional offices, and fishery science centers devoted at least 1.6 FTEs to blue whale recovery activities (0.4 by its headquarters and regional office staff and 1.2 by its regional science centers) in 2005.[14] According to FWS annual expenditure reports on endangered species (FWS 2003b–d, 2005d–f, 2006), very little or no funding has been devoted explicitly to blue whales by NMFS in recent years (Table 13, Appendices C1–7). Most recent funding has involved Coast Guard enforcement activities.

[14] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115

Table 13. Federal and state expenditures (in $ thousands) for the recovery of blue whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	–	–	3	3	1	4
1999	120	–	–	–	5	125	–	125
2000	–	–	–	–	6	6	–	6
2001	–	–	–	–	1	1	–	1
2002	–	–	–	7	1	8	–	8
2003	–	–	–	199	4	203	–	203
2004	–	–	–	60	4	65	2	67

Cost projections developed for the first five years of recovery work when the blue whale recovery plan was adopted in 1998 (Reeves et al. 1998) suggested funding needs ranging from between $138,000 and $673,000 per year between 1999 and 2003 with a five-year total of $1.95 million. Actual expenditures during that period are uncertain but were clearly below those levels.

Bowhead Whale, Western Arctic Population

Population Status: The only population of bowhead whales (*Balaena mysticetus*) occurring in U.S. waters is the western Arctic population. This is the largest of five bowhead whale populations found worldwide (NMFS 2005a). The western Arctic population migrates annually from winter areas in the northern Bering Sea through the Chukchi Sea to summer grounds in the Beaufort Sea. Arctic Native communities have hunted bowhead whales for more than 1,000 years at levels that are not thought to have had a significant effect on overall abundance. From the late 1800s to the early 1900s, however, commercial whaling reduced the western Arctic population to fewer than 3,000 bowhead whales, and in 1970 the species was listed as endangered throughout its range under the ESCA. That designation was carried forward under the ESA. The IWC has classified all populations of bowhead whales as protection stocks for which no commercial whaling is allowed.

Based on a count in 2001, the best abundance estimate for the western Arctic population is 10,545 whales (NMFS 2005a). Past counts suggest that the population has been increasing steadily at an average annual rate of 3.1 percent since 1978. The PBR level is 95 whales. Based on an estimated pre-exploitation population size of 12,599 whales, the lower limit of its OSP size has been estimated at between 6,500 and 10,500 whales (Shelden et al. 2003a).

Major Threats: With the cessation of commercial whaling, the principal management issues concerning western Arctic bowhead whales have been the subsistence harvest by Alaska Natives, the effects of noise and possible oil spills associated with offshore oil and gas development, and, more recently, the effects of climate change. Vessel collisions and entanglement in fishing gear also pose potential threats.

Subsistence whaling: Under subsistence whaling quotas established by the IWC, the number of bowhead whales taken annually by Alaska Natives has been below calculated PBR levels for the western Arctic bowhead whale population since such calculations were first made in the mid-1990s. The number of whales landed annually between 1999 and 2003 ranged from 35 whales in 2000 and 2003 to 49 whales in 2001 (NMFS 2006a). As indicated previously, the western Arctic bowhead whale population has continued to increase in size steadily over the past 20 years under the existing harvest management measures.

Oil and Gas Development: Because much of the habitat of the western Arctic bowhead whale population is within active or potential lease sale areas, oil and gas exploration and development off Alaska have increased the species' risk of exposure to pollutants and noise (Shelden and Rugh 1995, NMFS 2005a). Although bowhead whales are sensitive to noise and appear to avoid seismic operations, there is little evidence that increased levels of noise associated with activities to date have impeded their recovery (NMFS 2005a). Oil spills also pose a potential threat; however, to date no major spills are known to have affected bowhead whales within their range.

Entanglement: Incidents of entanglement by bowhead whales in commercial fishing gear appear to be infrequent. Available information on such interactions comes principally from whales found entangled in fishing gear by Alaska Natives during the subsistence harvest. It suggests that such interactions occur principally in crab pot gear. From 1999 to 2003 the estimated average annual rate of entanglement was 0.2 whale per year (NMFS 2005a).

Climate Change: Although there are insufficient data to make reliable predictions, changes in Arctic weather, sea-surface temperatures, ice extent, and prey availability may affect ice-associated animals such as bowhead whales (NMFS 2005a). Both positive and negative effects are possible (Shelden et al. 2003a).

Vessel Collisions: Injury and mortality caused by collision with vessels appear to be infrequent although this is probably due largely to the low levels of commercial vessel traffic within the species' Arctic habitat (Laist et al 2001). Three of 236 bowhead whales taken during the aboriginal subsistence hunt in the Beaufort Sea showed evidence of vessel injuries, and no known mortalities have been recorded (67 Fed. Reg. 55768). Collision risks could increase substantially in the future if seasonal pack ice coverage continues to retreat and northern sea routes are developed for shipping.

Management Framework: NMFS and the Alaska Eskimo Whaling Commission have primary responsibility for conservation and management of bowhead whales. However, as a member of the IWC, the United States follows management recommendations for subsistence whaling developed by the IWC (Shelden and Rugh 1995). Subsistence harvests are managed and monitored by the Alaska Eskimo Whaling Commission under a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA), NMFS's parent agency. The Commission is composed of whaling captains and crewmembers and is directed by a board of 10 commissioners, one from each whaling village. Besides allocating quotas among its member villages and providing funds to the North Slope Borough for periodic censuses of the bowhead whale population, the Commission has funded research to improve harpoons used in the hunt and to reduce the number of whales struck but lost.

Together with the Department of State and the Alaska Eskimo Whaling Commission, NMFS and other NOAA offices develop policies and quota requests and coordinate scientific advice for IWC meetings.

Critical Habitat: No critical habitat has been designated for western Arctic bowhead whales. In February 2000 the Center for Biological Diversity and the Marine Biodiversity Protection Center petitioned NMFS for such action, but the petition was rejected (67 Fed. Reg. 55767) for the following reasons:

- The decline in bowhead whale abundance and reason for listing the species was overexploitation by commercial whaling; habitat issues were not a factor in the decline;
- There is no indication that habitat degradation is impeding population growth;
- The population is abundant and increasing; and
- Existing laws and practices adequately protect the species and its habitat.

Recovery Plan: In June 1998 NMFS determined that a recovery plan for bowhead whales was not needed due to the population's abundance and trend and the effectiveness of the agreement between NOAA and the Alaska Eskimo Whaling Commission in managing the subsistence hunt (67 Fed. Reg. 55769).

Major Management Actions: Since 1977 the IWC has recommended quotas for the subsistence hunt of bowhead whales by Alaska Natives. Those quotas, which have ranged between 14 and 67 whales per year (not including unused strikes that can be carried forward), have represented 0.1 to 0.5 percent of the estimated total population size. In recent years, Russian Natives also have taken a few whales under these quotas. The most recent IWC quota is a block quota of 280 whales for the period 2003–2007 with a limit of 67 strikes in any single year. The average annual take by Natives in Alaska and Russia has been 52 whales. Since 1996, when NMFS began calculating PBR levels, the IWC has set annual strike quotas of 65 to 67 whales, which have been below the PBR level.

NMFS manages potential impacts of noise from oil and gas operations through incidental harassment authorizations issued under the MMPA exemption for the small take of marine mammals incidental to activities other than fishing. Such authorizations can be issued only if the actions they permit are believed to have no more than a negligible impact on the population and no immitigable adverse effect on the availability of bowhead whales to subsistence users. NMFS also consults with the Minerals Management Service, the Army Corps of Engineers, and the Environmental Protection Agency on the effects of oil and gas exploration and development on the outer continental shelf under section 7 of the ESA and the Fish and Wildlife Coordination Act. Recent opinions have concluded that effects of proposed offshore oil and gas exploration on bowhead whales do not jeopardize the population.

Staff and Funding Levels: According to NMFS budget documents (Appendix E), the agency allocated $994,000 in FY2003 for the recovery of endangered large whales (e.g., bowhead, blue, fin, sei, and sperm whales). The amount devoted specifically to bowhead whales is uncertain. NMFS also has transferred funds appropriated by Congress to the Alaska Eskimo Whaling Commission ranging from $399,000 in FY2001 to $492,000 in FY2003. According to FWS annual expenditure reports for endangered species (FWS 2003b–d, 2005d–f, 2006), total federal funding for work on bowhead whales ranged from zero to $203,000 between 1998 and 2004 (14, Appendices C1–7); however, all federal funding for this species (e.g., funding passed to the Alaska Eskimo Whaling Commission) is not reflected in those numbers. NMFS estimates that it devoted at least 4.1 FTEs in staff effort on bowhead whale recovery work (0.6 by its regional offices and headquarters and 3.5 by its science centers) during 2005.[15] Funding for those salaries clearly has not been included in funding levels reported in the FWS annual expenditure reports.

Table 14. Federal and state expenditures (in $ thousands) for the recovery of western Arctic bowhead whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	–	–	–	–	1	1
1999	–	–	–	–	–	–	3	3
2000	–	–	–	–	–	–	3	3
2001	–	–	–	–	–	–	25	25
2002	–	–	–	7	–	7	–	7
2003	–	–	–	199	5	204	–	204
2004	–	–	–	60	130	190	–	190

The Marine Mammal Commission survey of federally funded marine mammal research (Waring 2002) reports that funding for biological and population assessment research on bowhead whales between FY1991 and FY2000 ranged from $280,000 in FY2000 to $1.5 million in 1999 (see Appendix F). The principal sources of funding were NMFS and the Minerals Management Service. Recent funding levels have been increased to more than $1 million to address research questions raised by the IWC Scientific Committee and to help prepare a request to the IWC for a new subsistence quota.

Fin Whale

Population Status: Fin whales (*Balaenoptera physalus*) were listed as endangered throughout their range under the ESCA in 1970, and that designation was carried forward under the ESA. For purposes of preparing stock assessment reports required by the MMPA, NMFS recognizes four fin whale populations in U.S. waters: a western North Atlantic population, a California/Oregon/Washington population, a northeast Pacific population, and a Hawaii population. The stock structure of fin whale populations, however, is not well known (NMFS 2006b). It is thought that populations in different oceans may be divided into subpopulations that use different feeding grounds. Under the IWC management system, the Nova Scotia stock of fin whales (i.e., the western North Atlantic population) and all populations in the North Pacific are classified as protection stocks for which no commercial whaling is allowed.

[15] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

Western North Atlantic Population: Fin whales are one of the most common large whales observed along the northeastern U.S. coast. The IWC currently recognizes fin whales off the eastern U.S. coast, Nova Scotia, and Newfoundland to be a separate stock. Roughly half of all individually identified whales observed feeding in Massachusetts Bay have been observed there in multiple years, suggesting a degree of site fidelity. The best available abundance estimate for fin whales between Georges Bank and the Gulf of St. Lawrence is 2,814 (NMFS 2006b). Available information is not sufficient to determine trends in abundance, and the PBR level is 4.7 whales per year. Because documented human-caused deaths have averaged more than one whale per year in recent years, which is greater than 10 percent of the PBR level, the rate of human-caused mortality and injury is not considered insignificant and approaching zero.

California/Oregon/Washington Population: The IWC recognizes two populations of fin whales in the North Pacific Ocean: one in the East China Sea and one elsewhere in the North Pacific (NMFS 2006a). Although there is little information to determine population structure, some genetic studies suggest that fin whales in the Gulf of California are isolated from those elsewhere in the North Pacific and represent an "evolutionary unique population" (NMFS 2006a). By 1973 commercial whaling had reduced North Pacific fin whale abundance from an estimated 42,000 to 45,000 animals to between 13,620 and 18,680 animals (Ohsumi and Wada 1974). Surveys in 1996 and 2001 produced an estimate of 3,279 fin whales off California, Oregon, and Washington. NMFS calculates the PBR level to be 15 fin whales in this area. Recently documented fishery-caused deaths have averaged about 1.0 whale per year, while confirmed vessel related-deaths have averaged 0.4 fin whale per year (NMFS 2006a).

Northeast Pacific Population: This population occurs across the northern North Pacific Ocean from British Columbia to Japan and north to the Bering Strait (NMFS 2005a). A combination of estimates from surveys between 1999 and 2003 in the central and eastern Bering Sea and along the Alaska Peninsula and Aleutian Islands suggests the number of fin whales west of the Kenai Peninsula is at least 5,703 whales (NMFS 2005a). Information to assess the population's trend is insufficient and PBR for the population is calculated to be 11.4 whales per year. About 0.6 fin whale a year is known to have been killed recently in this area, which is less than 10 percent of PBR. Thus, the estimated mortality and serious injury rate for the area west of the Kenai is considered insignificant and approaching zero.

Hawaii Population: Fin whales sightings off Hawaii are rare; however, recordings of fin whale vocalizations indicate their presence (NMFS 2006a). Based on a ship survey in 2002, an abundance of 174 fin whales was estimated for waters within 200 nmi of Hawaii. The calculated PBR level for this stock is 0.2. Fishing-related mortality of fin whales in Hawaiian waters has not been reported, and incidental take levels, if any take occurs, are considered to be insignificant and approaching zero.

Major Threats: A draft recovery plan for fin and sei whales (Reeves et al. 1998) identified the following threats for both species:

Vessel Interactions: Fin whales are the species of whale most commonly injured or killed by ship strikes off both the Atlantic and Pacific coasts of the United States. Based on recent but limited data, NMFS estimates known mortality due to vessel collisions to be at least 1.4 fin whales per year in the North Atlantic. Limited evidence also suggests that fin whales may alter their behavior in response to whale-watching vessels off Atlantic Canada and the northeastern United States. Off the U.S. Pacific coast, the most likely sources of vessel disturbance may be industrial, military, and fishing vessel traffic.

Entrapment and Entanglement in Fishing Gear: Fin whales are killed or injured annually by inshore fishing gear off Atlantic Canada and the eastern United States, as well as off the Pacific coast of the United States and Mexico. During the 1980s the southern California offshore drift gillnet fishery killed an estimated 73 rorqual whales per year. Some of those whales may have been fin whales, but it is unclear how many. Shark and swordfish driftnet fisheries off Baja California, Mexico, also have likely killed fin whales. The frequency of entanglements is difficult to estimate because of limited observer coverage for relevant fisheries and because the offshore distribution of fin whales makes it unlikely that whale carcasses will strand on land.

Habitat Degradation: The principal concern regarding habitat degradation is the possible depletion of fin whale prey (small schooling fish) by commercial fishing. In addition, high-energy, low-frequency underwater sound transmissions for research and military purposes may disturb fin whales or interfere with their vocal communications.

Hunting: Until the mid-1970s fin whales were hunted intensively in the North Atlantic and North Pacific Oceans. Currently, populations occurring in U.S. waters are legally hunted only in Greenland for aboriginal subsistence use. Although commercial hunting is currently banned under the IWC moratorium on commercial whaling, that measure was adopted as a temporary measure that could be removed, thereby opening the possibility for a resumption of commercial harvesting by other nations at some point in the future. The government of Iceland, which withdrew from the IWC several years ago, has recently announced plans to take a small number of fin whales commercially despite IWC provisions against such takes.

Management Framework: NMFS is the lead federal agency responsible for managing activities affecting fin whales. Together with the Department of State, NMFS and other parts of NOAA develop scientific advice and U.S. positions for meetings of the IWC. No recovery team or other interagency management team has been established to oversee or undertake management activities specifically for fin whales. However, take reduction teams have been established to address the take of multiple large whale species, including fin whales, in the offshore drift gillnet fishery off California and in trap and gillnet fisheries along the Atlantic coast (NMFS 2006a,b).

Critical Habitat: None designated.

Recovery Plan: In 1998 NMFS contracted for the preparation of a draft recovery plan addressing both fin and sei whales. Although completed in 1998, the draft plan (Reeves et al. 1998) was never adopted formally by NMFS. In 2006 NMFS released a new draft fin whale recovery plan for public review and comment (NMFS 2006c). The immediate and ultimate goals of the new draft plan are to recover fin whale populations to the point where they can be downlisted to threatened and delisted from the list of endangered species. A two-tier system of criteria is proposed in the draft plan for making reclassification and delisting decisions. The first tier considers population status and trends and identifies the following standards:

- For reclassifying as threatened, the overall population in each ocean basin (1) must have remained stable or increased for at least 1.5 generations (26 years) or (2) must have satisfied a risk analysis standard of no more than a 1 percent chance of quasi-extinction in 100 years.
- For removing the species from the list, the overall population in each ocean basin (1) must have remained stable or increased for at least three generations (51 years) or (2) have less than a 10 percent probability of becoming endangered in 20 years.

The second tier describes standards relative to the five listing factors established by the ESA.

- *Destruction, modification, or curtailment of the species habitat or range*: For downlisting, fishing interactions, vessel interactions, prey reduction, and effects of anthropogenic noise must have been assessed and needed management actions must have been initiated. For removal from the list, management actions must have been proven effective.
- *Overutilization for commercial, recreational, or educational purposes*: For downlisting, direct human kills must be managed on a sustainable basis by the IWC, and for removal from the list, those management actions must have been proven effective and consistent with MMPA standards for maintaining populations at OSP levels.
- *Disease or predation*: For both downlisting and removal from the list, assessments must have been undertaken showing that these factors are not appreciably affecting recovery.
- *Inadequacy of existing regulatory mechanisms*: For both downlisting and removal from the list, the IWC must be regulating directed take on a sustainable basis, and applicable authorities must be adequately regulating takes due to vessel collisions and fishery interactions.
- *Other natural or manmade factors*: For both downlisting and removal from the list, anthropogenic factors must have been investigated and determined not to be limiting recovery.

To meet these goals and criteria, the draft plan identifies eight actions. These involve tasks to (1) maintain an effective program of international whaling regulation, (2) determine population discreteness and structure, (3) develop and apply methods to estimate population size and monitor trends in abundance, (4) conduct risk analyses for whales in each ocean basin, (5) identify and protect habitat essential to recovery, (6) minimize human sources of injury and mortality, (7) determine and minimize detrimental effects of anthropogenic noise, and (8) develop a plan for monitoring the population after the species is removed from the list. Because the whales move across international borders, the draft plan stresses the importance of a multinational research and management approach.

Major Management Actions: With regard to fin whales, management by NMFS over the last several decades has focused principally on participation in the IWC. The IWC began managing commercial whaling for fin whales in 1969 in the North Pacific and in 1976 in the North Atlantic (Reeves et al. 1998). In 1976 it adopted a ban on hunting fin whales in the North Pacific, and in 1987 it did so for the North Atlantic. Since then, the only authorized take of fin whales likely to belong to a population that occurs in U.S. waters has been an annual quota of 10 whales for aboriginal subsistence hunters in Greenland. In recent years, however, the IWC has received proposals from some members to lift the commercial whaling moratorium. Although these have been rejected to date, regulated harvests of fin whales could resume at some point in the future.

Since the late 1990s the incidental take of fin whales in commercial fisheries (principally trap and gillnet fisheries) has been addressed through take reduction plans developed for multiple species of endangered large whales and through periodic section 7 consultations on fishery management plans. Take reduction plans covering fin whales and other large whales have been developed for trap and gillnet fisheries along the Atlantic coast and for drift gillnet fisheries along the U.S. Pacific coast. Because estimated take levels for fin whales have been below the calculated PBR levels, entanglement risks for fin whales generally have not been a central focus of protection measures. However, because fin whale habitats overlap those of other large whales and because fin whales can be entangled in the same gear types, fin whales are thought to benefit from mitigation measures designed largely with other whale species in mind.

Staff and Funding Levels: NMFS reported no funding specifically for fin whales between 2000 and 2004 in FWS surveys of expenditures for ESA listed species (FWS 2005d-f). According to NMFS budget documents, NMFS allocated $994,000 in FY2004 funding to the recovery of endangered large whales (Appendix E), an uncertain portion of which may have included research relative to fin whales. NMFS estimates that it devoted at least 0.9 FTE in staff effort on fin recovery work (0.6 by its regional offices and headquarters and 0.3 by its science centers) during 2005.[16]

Funding for fin whales reported by other federal agencies and states in FWS annual expenditure surveys (FWS 2003b–d, 2005d–f, 2006) ranged between $4,870 in 2000 to $205,900 in 2004 (Table 15, Appendices C.1–7). Most of this funding was reported by the U.S. Coast Guard for enforcement. For example, in 2003, the Coast Guard reported expenditures totaling $198,897.

Table 15. Federal and state expenditures (in $ thousands) for the recovery of fin whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	–	–	4	4	1	5
1999	–	–	–	9	4	13	0.3	13
2000	–	–	–	–	4	4	1	5
2001	–	–	–	–	22	22	2	24
2002	–	–	–	7	5	13	1	13
2003	–	–	–	199	6	205	1	206
2004	0.2	–	–	63	6	69	3	72

[16] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

The draft fin whale recovery plan (NMFS 2006d) projects future funding needs for implementing each of the eight major recovery actions identified above, but the plan does not break down those costs annually. As shown in Table 16, those funding needs were developed for each of the three ocean basins in which fin whales occur and totaled approximately $30.2 million over the next 20 years for all areas.

Table 16. Projected funding needs ($ thousands) to implement the draft 2006 fin whale recovery plan (NMFS 2006d)

Ocean Basin*	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Action 7	Action 8	Total
N. Atlantic (2012)	301	267	2,150	100	225	1,625	787	75	5,530
N. Pacific (2012)	101	366	1,500	100	225	1,625	788	75	4,780
S. Ocean (2026)	523	667	18,000	200	500	–	–	–	23,140

* Years in parentheses are the earliest expected date for meeting recovery criteria.

Humpback Whale

Population Status: Humpback whales (*Megaptera novaeangliae*) occur in all the world oceans except the Arctic Ocean. All populations were severely depleted by commercial whaling in the 20th century (NMFS 1991b). Humpback whales were listed as endangered throughout their worldwide range under the ESCA in 1970, and that designation was carried forward under the ESA. In the North Pacific, an estimated 28,000 humpbacks were killed during the period of modern commercial whaling, including 2,000 off Oregon and Washington, 3,400 off California, and 2,800 off Baja California. By 1966 their numbers throughout the North Pacific were thought to have been reduced to as few as 1,000 to 1,200 whales. In the North Atlantic, between 14,000 and 18,000 humpback whales were killed. The IWC has classified all populations of humpback whales worldwide as protection stocks for which no commercial hunting is permitted.

Since the 1960s populations in both oceans have been recovering. The total number of humpback whales in the North Atlantic Ocean is currently estimated at 11,570 whales (NMFS 2006b) and more than 6,000 whales are estimated to occur in the North Pacific Ocean (NMFS 2006a). For purposes of preparing stock assessment reports under the MMPA (NMFS 2005a, 2006a,b), NMFS currently recognizes four populations that occur at least seasonally in U.S. waters: one in the North Atlantic (the Gulf of Maine population) and three in the North Pacific (the eastern North Pacific population, the central North Pacific population, and the western North Pacific population).

Gulf of Maine Population: Although almost all humpback whales in the North Atlantic share winter breeding grounds in the Caribbean, they appear to use at least six summer feeding grounds around the rim of the North Atlantic Ocean (NMFS 2006b). A high degree of site fidelity to individual feeding grounds apparently is ingrained in newborn calves as they follow their mothers to the feeding grounds. As a result, discrete groups or subpopulations of whales tend to use different feeding grounds. Humpback whales also occur seasonally in the spring in coastal waters between the Chesapeake Bay and Cape Hatteras. It is not clear if those individuals are part of the subpopulation that uses summer feeding grounds in the Gulf of Maine. The best abundance estimate for the Gulf of Maine subpopulation is 902 animals (NMFS 2006b). Gulf of Maine humpback whales are thought to be increasing at a rate consistent with the overall 3.2 percent annual rate of increase observed for humpback whales throughout the North Atlantic basin (Stevick et al. 2003).

The PBR level for the Gulf of Maine subpopulation is 1.3 (NMFS 2006b). Between 1999 and 2003 recorded fishery-related deaths and serious injures for humpback whales in the Gulf of Maine averaged at least 2.8 per year, exceeding the PBR level. About one-half of all humpback whales in the Gulf of Maine bear scars caused by entanglement in fishing gear, suggesting that the incidence of entanglement is far greater than mortality records indicate. In addition, six other human-related deaths and injuries were recorded between 1999 and 2003 off mid- and south Atlantic states although it is unclear whether those whales were part of the Gulf of Maine subpopulation. Among the documented humpback whale carcasses available for examination, human factors, principally collisions with ships, contributed to or caused death in nearly 60 percent of the cases (Wiley et al. 1995).

<u>Eastern North Pacific Population</u>: The eastern North Pacific population of humpback whales winters in calving grounds off Central America and Mexico and migrates to summer feeding grounds along the coast between California and southern British Columbia. The best estimate of abundance for the eastern North Pacific population is 1,391 animals (NMFS 2006a). The population appears to have been growing steadily, with the exception of a brief period in the late 1990s when it may have declined. The PBR level for this population is 4.6, but because the whales spend half their time outside U.S. waters, the PBR for U.S. waters is estimated at 2.3 whales per year. The total known mortality in recent years, including 1.2 whales per year from entanglement and 0.2 from ship strikes, is less than the PBR level (NMFS 2006a). Because the fishery-related takes off California exceed 10 percent of the PBR level, the fishery mortality and serious injury rate is not considered to be insignificant and approaching zero.

<u>Central North Pacific Population</u>: The central North Pacific population spends winter and spring off the Hawaiian Islands and migrates to feeding areas off northern British Columbia, southeast Alaska, and Prince William Sound west to the Bering Sea (NMFS 2005a). The best estimate of abundance is 4,005 whales based on surveys in Hawaii. As in the North Atlantic, humpback whales in the central North Pacific population appear to maintain a high degree of site fidelity to feeding areas. Minimum estimates of abundance for feeding stocks identified to date include 651 around Kodiak Island, 410 around the Shumagin Islands, 315 in Prince William Sound, 961 in southeast Alaska, and 850 to 1,000 in British Columbia (which may include some animals from southeast Alaska) (NMFS 2005a). The PBR level for the entire central North Pacific population is 12.9, including 3.0 for southeast Alaska and 9.9 for areas north of southeast Alaska (NMFS 2006a). Commercial fisheries are thought to cause at least 3.4 humpback whale deaths per year. Because this rate is more than 10 percent of the calculated PBR level, the incidental mortality and serious injury rate due to fishing is not considered insignificant or approaching zero. Although the population as a whole appears to be increasing, its rate of increase is uncertain.

Western North Pacific Population: Humpback whales in the western North Pacific population spend winter and spring off Japan and probably migrate to the Bering Sea and the Aleutian Islands to feed in summer (NMFS 2005a). Photo-identification studies from winter breeding areas have resulted in an abundance estimate of 394 whales. Because of limited study and overlap with feeding grounds of humpback whales from the central North Pacific population, there are no reliable estimates of abundance on feeding grounds. The PBR level is calculated to be 1.3, and the minimum annual mortality due to U.S. commercial fisheries is estimated as 0.5 whale (NMFS 2005a). Available information suggests that incidental mortality caused by fisheries off Japan and Korea averages at least 1.1 to 2.4 whales per year, which would make the total human-caused mortality exceed the PBR level.

Major Threats: Humpback whales are exposed to human activities more than most other great whales because they spend much of their time in coastal waters near human population centers (NMFS 1991b). Threats to humpback whales include entanglement and entrapment in fishing gear, collisions with vessels, competition for prey with commercial fishing, disturbance by whale-watching vessels, pollution from coastal development, and displacement and disturbance caused by noise and vessel traffic. Although the level of human-caused mortality and serious injury is unknown, current information indicates that these threats may be impeding, but not preventing, recovery of most populations in U.S. waters.

Entanglement and Entrapment: As described above, deaths and serious injuries as a result of fisheries currently exceed the calculated PBR level for humpback whales in the Gulf of Maine subpopulation, and possibly for the western North Pacific population. Data show that whales from the central North Pacific population frequently interact with fishing gear, but the level of serious injury and mortality appears to be below PBR. Entanglement of eastern North Pacific humpback whales in a drift gillnet fishery appears to have been significantly reduced by measures adopted under a take reduction plan requiring the use of pingers and buoy line extenders to increase the depth at which nets are set (NMFS 2006a). However, some entanglements also occur in unidentified fisheries.

Prey Reduction: Although humpback whales feed on small schooling fish such as herring and sardines that are targets for commercial fisheries in some areas, prey removal by fisheries does not appear to be limiting the recovery of humpback whale populations in U.S. waters.

Vessel Collisions: Injuries and deaths due to vessel strikes may be as or more common than those from entanglement. Between 1999 and 2003, 15 vessel-related deaths or injuries were documented for humpback whales along the Atlantic coast; six involved whales that were killed, eight involved cases with insufficient information to determine severity, and one was known to have caused a minor, non-lethal injury (NMFS 2006b). For the eastern North Pacific population, vessel-related deaths and injuries appear to be less frequent, averaging at least 0.2 per year between 1999 and 2003 (NMFS 2006a). At least seven vessel-related deaths and injuries were reported for the central North Pacific population between 1999 and 2001, resulting in a minimum estimate of 0.8 deaths and serious injuries per year in Alaska (NMFS 2006a). There has been a substantial increase in reports of vessel collisions in Hawaii since 2001, and such injuries and deaths will likely increase for this population in coming years. No information is available on collision records for the western North Pacific population.

Whale-Watching: In New England, southeast Alaska, California, and Hawaii, whale-watching activity has increased, raising concerns that disturbance from whale-watching vessels may cause humpback whales to abandon or reduce their use of preferred habitats, particularly preferred calving grounds in Hawaii (NMFS 2005e, NMFS 1991b). In southeast Alaska, noise and disturbance by increased numbers of large tour ships may have caused whales to reduce their use of feeding grounds in Glacier Bay during the 1980s (Baker and Herman 1989).

Management Framework: NMFS is the lead federal agency responsible for managing activities affecting humpback whales. Together with the Department of State, NMFS and other NOAA offices develop policies and coordinate scientific advice for meetings of the IWC. Humpback whales also receive focused attention from managers of several national marine sanctuaries, including designated sanctuaries off Massachusetts, California, and Hawaii, and from the National Park Service at Glacier Bay National Park and Monument in southeastern Alaska. Although a recovery plan was adopted for humpback whales in 1991, no recovery or implementation teams have been established for this species. Interactions with fishing gear are addressed by take reduction teams established by NMFS to recommend take reduction plans for large whale species, including humpback whales.

Critical Habitat: None designated.

Recovery Plan: NMFS adopted a recovery plan for humpback whales in 1991. The plan identifies three goals:

- A biological goal for building and maintaining populations to levels large enough to be resilient to chance events such as episodic changes in oceanographic conditions, epizootics, anthropogenic environmental catastrophes, or inbreeding;
- A numerical goal for achieving a population size consonant both with the biological goal and with continuing human use of the oceans. The long-term goal is to achieve population sizes equal to the historical environmental carrying capacity in U.S. waters; and
- A management goal for changing the classification of particular populations from endangered to threatened and removing them from the list of protected species.

As an interim goal, the plan sought to double the size of humpback whale populations in 20 years. Major identified objectives included (1) maintaining and enhancing habitat, (2) identifying and reducing direct human-related injury and mortality, (3) monitoring population parameters, and (4) improving coordination of recovery activities.

Major Management Actions: The IWC has prohibited commercial exploitation of humpback whales worldwide since 1966. However, an aboriginal subsistence quota of two humpback whales per year has been authorized by the IWC to the government of St. Vincent and The Grenadines in the Caribbean.

Since adopting a recovery plan for humpback whales, NMFS has supported the maintenance of whale photo-identification catalogues to assist in monitoring reproductive rates and other life history parameters. NMFS also has undertaken studies to estimate abundance and determine genetic relationships. Coordinated international research on humpback whales in the North Atlantic was conducted during 1992 and 1993 in an effort known as the Years of the North

Atlantic Humpback (Project YoNAH). A similar effort called Structure of Populations, Levels of Abundance and Status of Humpbacks (SPLASH) was initiated for the North Pacific in 2004; data collection is expected to be completed in 2006. The SPLASH program involves cooperative efforts by NMFS, the National Marine Sanctuaries Program, and various national and foreign research organizations to determine the population status, structure, and trends of humpback whales throughout the North Pacific Ocean basin.

Since 1986 NMFS has monitored fishery interactions through fishery reporting requirements, observer programs in several large pelagic fisheries off the Atlantic coast, and opportunistic sighting reports of entangled animals by aerial survey teams, Coast Guard patrols, and the public (NMFS 2006b). Based on information from these sources as well as stranding records, 11 serious injuries or deaths related to fisheries were identified in trap fisheries in the 1990s, and in 1997 the Service elevated the Gulf of Maine and mid-Atlantic lobster pot fishery from a category III fishery to a category I. Since 1998 entanglement of humpback whales in this fishery and East Coast gillnet fisheries has been addressed by the Atlantic Large Whale Take Reduction Team and the take reduction plan developed to reduce interactions in both types of fishing gear. Major features of that plan have included efforts to disentangle whales, require modification of fishing gear to reduce entanglement risks, and restrict fishing in key whale habitats. Although these efforts have focused primarily on reducing entanglement risks for North Atlantic right whales, the actions, particularly disentanglement efforts, also benefit humpback whales. Experience in disentangling humpback whales in the northeastern United States has led to similar efforts in Alaska, Hawaii, and California.

To address disturbance by whale-watching vessels, NMFS has developed recommended guidelines for whale-watching activities for several regions and promulgated regulations limiting the distances at which vessels can approach whales in waters off both Hawaii in 1995 (50 Fed. Reg. 3775) and Alaska in 2001 (66 Fed. Reg. 29502), and the National Park Service also has restricted vessel speeds and access to Glacier Bay in southeast Alaska to protect feeding humpback whales. The National Ocean Service also has implemented education and outreach efforts to protect humpback whales using national marine sanctuaries at Stellwagen Bank off eastern Massachusetts, the Channel Islands and Farallon Islands off California, and coastal waters around the main Hawaiian Islands. In response to increasing reports of collisions between humpback whales and vessels off Hawaii, managers of the Hawaiian Islands Humpback Whale National Marine Sanctuary have focused particular attention on advising vessel operators as to actions they can take to avoid hitting whales.

Staff and Funding Levels: Cost projections for recovery work during the first five years after the Humpback Whale Recovery Plan was adopted in 1991 were estimated to range from $2.69 to $8.14 million per year with a five-year total of $20.62 million (NMFS 1991b). Actual expenditures during that period are uncertain but are believed to have been much lower. Funding for work on humpback whales reported in annual FWS expenditure surveys (FWS 2003b–d, 2005d–f, 2006) indicate that NMFS funding levels between 2001 and 2004 ranged from $53,000 in Fiscal Year 2001 to $1.15 million in Fiscal Year 2003 (Table 17, Appendices C.1–7). Most funding in 2003 supported the SPLASH program. Recent NMFS budget documents indicate that NMFS received $994,000 in FY 2003 funding for the recovery of endangered large whales. The amount devoted specifically to humpback whales from this source is uncertain (Appendix E).

Table 17. Federal and state expenditures (in $ thousands) for the recovery of humpback whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	240	–	80	320	41	361
1999	–	–	131	277	76	484	8	492
2000	–	–	53	349	154	556	11	567
2001	–	–	53	324	352	729	11	740
2002	–	–	150	280	449	879	11	890
2003	–	–	1,150	199	248	1,597	18	1,615
2004	–	–	–	416	243	659	7	666

NMFS estimates that it devoted at least 7.1 FTEs in staff effort on humpback whale recovery work (1.8 by its regional offices and headquarters and 5.3 by its science centers) during 2005.[17]

The Marine Mammal Commission's survey of federally funded marine mammal research (Waring 2002) reports that between FY1991 and FY2000 funding for research on humpback whales ranged from $107,000 in FY1991 to $673,000 in FY1994 (see Appendix F). In 2000, the most recent year reported, federal research funding was $342,000. The principal sources of funding were NMFS and the Department of Defense's Strategic Environmental Research and Development Program. Recently funding has increased above those levels as a result of support from various agencies for the SPLASH program.

North Atlantic Right Whale

Population Status: All species and populations of right whales worldwide were severely depleted by centuries of commercial whaling that continued into the early 1900s. The IWC has classified all right whale populations as protection stocks. In 1970, when right whales were initially listed as endangered under the ESCA, right whales in the North Atlantic and North Pacific Oceans were considered to be separate populations of a single species called the northern right whale. That designation was carried forward under the ESA. Recent genetic analyses, however, indicate that North Atlantic and North Pacific right whales are separate species (*Eubalaena glacialis* and *E. japonica*, respectively). Based on that information, NMFS is taking steps to reclassify them separately under the ESA. In the North Atlantic, the only remaining population considered viable inhabits the western North Atlantic Ocean off the coasts of the United States and Canada. A population that occurred off Europe has been all but eliminated by commercial whaling. The North Atlantic species currently is estimated to number at least 299 animals; its PBR level is set at zero (NMFS 2006b).

The western North Atlantic population has shown little evidence of increasing since research efforts began in the early 1980s. Modeling studies suggest that the population began to decline at

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[17] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

about 2 percent per year in the early to mid-1990s (Caswell et al. 1999). The current recovery plan, adopted in 2005, concludes that the possibility of biological extinction within the next century “is very real” (NMFS 2005b). A series of five consecutive years (2001–2005) in which documented calf counts have averaged more than 20 per year, however, has been an encouraging prospect for future recovery.

Major Threats: Deaths due to collisions with ships and entanglement in fishing gear are the principal reasons for the species’ failure to recover since the cessation of commercial hunting (MMC 1990, Kraus et al. 2005, NMFS 2005b). Most deaths due to ship collisions are caused by large vessels (Laist et al. 2001). Most entanglements appear to involve lines from actively fished lobster traps and gillnets (NMFS 2005b). Between 1990 and 2005 more than 50 percent of all documented right whale deaths were caused by ship collisions (18 deaths) or entanglements (5 deaths) (MMC 2006). Additional deaths undoubtedly occurred but were not recorded. A recent study concluded that only 17 percent of all deaths are observed (Kraus et al. 2005). Between 2000 and the end of 2005, 25 live right whales were observed entangled in fishing gear, 2 of which were later found dead and 7 of which were in poor condition when last sighted (MMC 2006). For the period 1999–2003 NMFS estimates that human-caused mortality averaged 2.6 deaths per year in U.S. and Canadian waters (NMFS 2006b), including one vessel-related death per year and 1.6 entanglement-related deaths per year.

Other threats to North Atlantic right whales identified in the revised recovery plan include habitat degradation, noise, contaminants, underwater explosives, climate and ecosystem change, and commercial exploitation (NMFS 2005b).

Management Framework: Before the 1980s management of right whales worldwide was principally through the IWC, the international organization responsible for the regulation of whaling. Under the International Convention for the Regulation of Whaling, the management authority that eventually led to the formation of the IWC in 1946, commercial hunting for right whales has been banned worldwide since the 1930s. A dedicated research program on western North Atlantic right whales was not begun until the early 1980s when a small remnant population was discovered off the U.S. East Coast. Dedicated management efforts were not initiated until 1987 when, at the recommendation of the Marine Mammal Commission, NMFS convened a recovery team to develop a draft recovery plan. A final plan was adopted in 1991. The team was then disbanded, and NMFS established two regional recovery plan implementation teams: one for summer feeding areas off the northeastern United States and the other off the southeastern United States where whales calve in winter. The teams, composed of federal, state, and non-governmental representatives, are charged with helping the Service implement recovery actions. The southeastern team continues to meet, but the northeastern team does not.

In 1997 NMFS established the Atlantic Large Whale Take Reduction Team to provide advice on measures to reduce entanglement risks in fishing gear. NMFS also is assisted by the Right Whale Consortium, an organization of non-governmental marine mammal scientists working at various universities and research institutes. The consortium and its members conduct much of the right whale research and monitoring work, manage a right whale photo-identification catalogue and associated data, convene annual reviews of research findings, participate on various management teams, and carry out most disentanglement work with funding from NMFS. Several state agencies also assist in recovery work with supplemental funding provided by appropriations under the ESA. The U.S. Coast Guard carries out fisheries enforcement, vessel management, and other recovery activities in cooperation with NMFS. NMFS also cooperates with Canada's Department of Fisheries and Oceans on related recovery activities.

Critical Habitat: Early studies of right whales identified five seasonal high-use right whale habitats, three of which are in U.S. waters (Kraus and Kenny 1991). These are—

- coastal Florida and Georgia used as a calving ground in winter;
- Cape Cod Bay used as a feeding ground in late winter and early spring;
- the Great South Channel east of Cape Cod, Massachusetts, used as a feeding ground in spring and early summer;
- the Bay of Fundy between New Brunswick and Nova Scotia, Canada, used as a feeding ground in summer and early fall; and
- the Scotian Shelf, including Browns and Baccaro Banks, Roseway Basin, southeast of Nova Scotia, used as a feeding ground principally in the fall.

In 1994 NMFS designated the three areas in U.S. waters as critical habitat for northern right whales. In July 2002 the Ocean Conservancy petitioned NMFS to expand the designated critical habitats based on regular sightings of right whales in adjacent waters. NMFS found that the petition included information warranting consideration, but in August 2003 it concluded that the petition did not provide all the information necessary to justify such an action. It therefore deferred action to revise the boundaries, pending analyses of sighting data. No further action has been taken. Canada's Department of Fisheries and Oceans has designated the two areas in Canada as whale conservation areas.

Recovery Plan: The Service adopted an initial recovery plan for right whales in both the North Atlantic and North Pacific in 1991. In 2005 a revised recovery plan for North Atlantic right whales was adopted (NMFS 2005b). The ultimate goal of the revised plan is to promote recovery of North Atlantic right whales to a level sufficient to warrant their removal from the list of endangered and threatened species. Its interim goal is to achieve a population level that would allow the species to be reclassified as threatened. The plan identifies the following criteria for reclassifying the western Atlantic population as threatened:

- The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population;
- The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2 percent per year;
- None of the known threats to northern right whales (summarized in the five listing factors) is known to limit the population's growth rate; and
- Given current and projected threats and environmental conditions, the right whale population has no more than a 1 percent chance of quasi-extinction in 100 years.

The recovery plan does not include criteria for delisting because of the very low abundance and the need for decades of population growth to reach abundance levels at which the species could be considered for delisting.

To achieve its goals, the revised recovery plan identifies five objectives: (1) significantly reduce human-caused mortality, injury, and disturbance; (2) develop demographically based recovery criteria; (3) identify, characterize, protect, and monitor important habitats; (4) monitor the status and trends of the population; and (5) coordinate federal, state, international, and non-governmental recovery actions.

Highest priority under the plan is placed on actions to reduce entanglement in fishing gear and ship collisions.

Major Management Actions: To reduce entanglement, NMFS has relied principally on efforts to (1) develop and require the use of fishing gear thought to be less likely to ensnare whales and (2) disentangle whales that are observed entangled. To develop fishery management strategies, NMFS relies on advice from the Atlantic Large Whale Take Reduction Team. The team, composed of representatives from involved fisheries, state and regional fishery management agencies, conservation groups, federal agencies, and academic organizations, considers entanglement risks for several endangered whale species but focuses almost entirely on North Atlantic right whales. In 1997 NMFS adopted an Atlantic Large Whale Take Reduction Plan. Its goal was to reduce the mortality and serious injury of right whales to below its PBR level, which, because of the species' depleted status, has been set at zero. Measures adopted to meet this goal include (1) actions to disentangle whales found entangled, (2) requirements for modifying gear thought by the Service to reduce whale entanglement risks throughout certain fisheries, (3) seasonal management areas where additional gear modifications are required, and (4) seasonal time/area closures in areas where right whales aggregate seasonally.

Reducing right whale entanglements has proven to be one of the most difficult and controversial challenges of any endangered marine mammal recovery program. Since 1997 the take reduction plan has undergone a series of major and minor modifications, none of which has resulted in meeting required goals. Measures implemented in 1997 resulted in no observable reductions in right whale entanglements, and in 2001 NMFS initiated formal consultations pursuant to section 7 of the ESA on its own fishery management plans for four lobster and gillnet fisheries along the U.S. East Coast. The consultations concluded that the plans were jeopardizing the continued existence of North Atlantic right whales and identified reasonable and prudent alternatives. Those alternatives included new gear modification requirements, development of a dynamic area management process to temporarily close or manage fishing in areas where right whales aggregate to feed, and development of new seasonal management areas. In consultation with the Atlantic Large Whale Take Reduction Team, such measures were implemented late in 2001. They, too, yielded no observable reduction in right whale entanglement. After the take of a whale in gear previously considered safe, NMFS reconvened the take reduction team in 2003 to develop another major revision of the take reduction plan. Reinitiation of consultations on relevant fishery management plans has not been undertaken as of this writing, and implementation of new measures is not expected until 2007.

Efforts to reduce ship collisions have relied on voluntary actions by vessel operators to avoid hitting whales. Major actions identified in the recovery plan include developing educational materials to advise mariners as to how to identify and avoid hitting right whales, implementing mandatory ship reporting systems in key habitats to advise mariners of collision risks and encourage voluntary efforts, conducting aerial surveys in key habitats to locate whales and advise mariners of their location, and developing a ship strike reduction strategy with speed and routing requirements (NMFS 2005). Efforts to develop the latter have been ongoing since the late 1990s but have not yet been completed. NMFS requested comments on its strategy in 2004 (70 Fed. Reg. 36121), and in 2006 it completed a draft environmental impact statement evaluating alternative speed and routing restrictions. Accompanying that statement, NMFS proposed regulations (71 Fed Reg. 36299) to seasonally limit vessel speeds to 10 knots within 30 nmi of major East Coast ports and to impose temporary speed restrictions around large aggregations of right whales wherever they are detected. Final rules are expected in 2007. NMFS also has conducted formal consultations with the Navy and the Coast Guard under section 7 of the ESA on the operation of their vessels in areas where right whales are likely to occur. The consultations recommended that crews of Coast Guard and Navy vessels watch out for right whales and reduce speeds to levels they determine appropriate in key right whale habitats.

Staff and Funding Levels: The Marine Mammal Commission survey of federally funded marine mammal research (Waring 2002) reports that funding for northern right whale biological and population assessment by all federal agencies increased from $641,000 in FY1991 to $3.1 million in FY2000 (Appendix F). Research funding by NMFS grew from $194,000 to $1.8 million during that period. The next largest source of funding was the Navy whose funding declined from $970,000 in FY1997 to $611,000 in FY2000.

Between 1998 and 2004 funding for North Atlantic right whale conservation increased steadily. Since then it has declined substantially. According to annual FWS expenditure reports for work on endangered species (FWS 2003b–d, 2005d–f, 2006), appropriated funding for NMFS right whale conservation activities increased from $1.5 million in 1998 to $5.2 million in 2001 and $11.2 million in 2004 (Table 18, Appendices C.1–7). Although most federal funding appropriated specifically for right whales has been allocated to NMFS, Coast Guard expenditures for enforcement and assistance in disentanglement efforts grew to $4.4 million in 2004. NMFS budget documents indicate that allocations for right whale research and recovery activities declined in 2005 (Appendix E). NMFS estimates that it devoted 29.2 FTEs to North Atlantic right whale conservation working during 2005, including 20.5 in New England, 5.5 in the southeastern United States, and 2.25 at headquarters.[18]

In 2002 the National Fish and Wildlife Foundation established a National Whale Conservation Fund recommended by the Marine Mammal Commission and subsequently mandated by Congress. The foundation is a not-for-profit organization established by Congress in 1984 to help secure non-governmental donations for wildlife conservation work. Since 2002 NMFS has partnered with the foundation to coordinate various grant programs through the fund. The foundation has funded more than 20 gear research projects related to right whale conservation at levels ranging from about $4,000 to $20,000. It also supported related state agency conservation initiatives in Massachusetts, New York, New Jersey, Maryland, North Carolina, South Carolina, Georgia, and Florida at levels ranging from about $50,000 to $500,000 per year.

[18] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.

Table 18. Federal and state expenditures (in $ thousands) for the recovery of northern right whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	2	–	1,100	–	357	1,458	1	1,460
1999	–	–	1,542	892	549	2,983	290	3,273
2000	–	–	4,168	433	143	4,744	127	4,872
2001	–	–	5,270	474	147	5,891	145	6,036
2002	–	–	7,120	857	136	8,113	280	8,393
2003	–	–	10,270	1,098	312	11,679	123	11,802
2004	0.2	–	11,225	444	197	11,866	504	12,370

As shown in Table 19, the 2005 revision of the North Atlantic right whale recovery plan projects estimated annual recovery program costs for the first five years of recovery work under the plan (including activities ranked from priority 1 through 3) to be between $7.69 and $9.96 million (NMFS 2005b).

Table 19. Projected funding needs (in $ thousands) to implement recovery activities for North Atlantic right whales during the first five years after adoption of the 2005 North Atlantic Right Whale Recovery Plan (* = staff time only)

Action	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Significantly reduce sources of human-caused death, injury, and disturbance	6,060	6,250	5,505	4,675	4,565	27,045
2. Develop demographically based recovery criteria	*	*	0	0	0	0
3. Identify, characterize, protect, and monitor important right whale habitats	735	865	880	770	585	3,845
4. Monitor the status and trends of abundance and distribution of the western North Atlantic right whale	2,365	2,645	2,630	2,360	2,235	12,235
5. Coordinate federal, state, international, and private efforts to implement the recovery plan	180	200	250	250	300	1,180
TOTAL	9,330	9,960	9,265	8,055	7,695	44,305

North Pacific Right Whale

The northern right whale was listed as endangered throughout its range under the ESCA in 1970. That designation was carried forward under the ESA. At the time of those listing actions, right whales in both the North Pacific and North Atlantic Oceans were considered to be part of same species. Recent genetic analyses, however, indicate that North Pacific right whales are a separate species (*Eubalaena japonica*), and NMFS is taking steps to reclassify them as such under the ESA. Historical whaling records suggest there are two North Pacific populations—one in the eastern North Pacific Ocean in U.S. waters and one in the western North Pacific Ocean off Russia. Commercial whaling in the late 1800s and early 1900s drastically reduced both populations, and the IWC has classified North Pacific right whales as a protection stock. In its 1991 recovery plan for northern right whales, NMFS suggested that the pre-exploitation abundance of right whales throughout the North Pacific might have exceeded 11,000 animals, and that its abundance in 1991 probably ranged from 100 to 500 (NMFS 1991).

Between the 1960s and mid-1990s the eastern North Pacific population was known only from a few sightings of individuals and pairs scattered between Mexico, Hawaii, and Alaska. In the summer of 1996 four right whales were sighted in the southeastern Bering Sea. Since then, sightings of a few individuals have been reported annually in the same area. Photo-identification and biopsy studies between 1996 and 2004 indicate that there are at least 23 individual right whales in the population, including three cow-calf pairs. The surviving population may number only a few tens of animals, making it one of the world's most endangered mammal populations (MMC 2005). In its 2003 stock assessment report, NMFS reported that it was unable to provide a reliable estimate of abundance. As a result, a PBR level for the population has not been calculated (NMFS 2005a).

Major Threats: The 1991 recovery plan identified vessel interactions, entrapment and entanglement in fishing gear, habitat degradation, and hunting as potential threats, but almost no information was available on the level of those threats (NMFS 1991a). The low abundance and scattered distribution of eastern North Pacific right whales confound assessments of the scale of current threats (NMFS 2005a).

Management Framework: The Northern Right Whale Recovery Team convened by NMFS in 1987 considered management needs for North Pacific right whales in developing the draft Northern Right Whale Recovery Plan (NMFS 1991a). However, the team was not reconvened after the plan was adopted, and no regional team has been established specifically for North Pacific right whales.

Critical Habitat: In February 2002 NMFS rejected a petition by the Center for Biological Diversity to designate most of the eastern Bering Sea as right whale critical habitat (MMC 2004). NMFS based its decision on a conclusion that essential features of critical habitat could not be identified, given available information. It therefore advised that it would continue to analyze the situation (68 Fed. Reg. 51758). In June 2005 in response to a lawsuit filed by the Center for Biological Diversity in 2004, a federal court in San Francisco found the NMFS decision not to designate critical habitat to be arbitrary and capricious, and it directed the Service to proceed with a critical habitat proposal. In late July 2006, NMFS published final rules to designating critical habitat in an area of about 36,000 sq mi in the southeastern Bering Sea and a small area south of Kodiak Island in the Gulf of Alaska (71 Fed Reg. 38277).

Recovery Plan: The 1991 recovery plan for northern right whales included a separate, although brief section on North Pacific right whales (NMFS 1991a). The plan noted that the lack of information on where North Pacific right whales occur precluded the identification of site-specific research and management actions. Upon identification of such areas, the recovery plan recommended that the following objectives be pursued:

- Initiate studies to determine the population size and monitor trends in abundance of the North Pacific right whale;
- Identify and protect habitats essential to the survival and recovery of North Pacific right whales;
- Collect and analyze information on the areas and seasons where potential conflicts exist between vessel traffic and North Pacific right whales and the types of vessels involved;
- Vigorously enforce whale protection laws;
- Continue the international ban on hunting and other directed lethal take;
- Reduce and eliminate injury and mortality caused by fisheries and fishing gear; and
- Maximize efforts to acquire scientific information from dead or stranded North Pacific right whales.

Although NMFS has published a revised recovery plan for North Atlantic right whales (NMFS 2005), it has not done so for North Pacific right whales.

Major Management Actions: Other than efforts to designate critical habitat, no management actions have been taken for North Pacific right whales. As indicated above, since 1996 NMFS has supported studies annually to better identify the number and distribution of right whales feeding in the southeastern Bering Sea in summer.

Staff and Funding Levels: Prior to the mid-1990s, no staff or funding was devoted specifically to North Pacific right whales by NMFS. Funding specifically for North Pacific right whales is not reported in the Fish and Wildlife Service's summary of federal expenditures on endangered species between 1998 and 2004 (FWS 2003b–d, 2005d–f). Based on information provided to the Marine Mammal Commission during its recent annual meetings, however, NMFS has provided between $100,000 and $200,000 per year since 1996 for various studies, including aerial and shipboard surveys, acoustic detection studies, satellite telemetry, and genetic sampling of right whales in Alaska. The Coast Guard has contributed ship time for studies, but its costs for doing so are unknown. NMFS estimates that it devoted at least 3.4 FTEs in staff effort on North Pacific right whale recovery work (0.6 by its regional offices and headquarters and 2.8 by its science centers) during 2005.[19]

Sei Whale

Population Status: Sei whales (*Balaenoptera borealis*) were hunted commercially in the early to mid-1900s. The species as a whole was listed as endangered throughout its worldwide range under the ESCA in 1970, and that designation was carried forward under the ESA. The IWC classifies the Nova Scotia population of sei whales and all populations in the North Atlantic as protection stocks for which all commercial catch limits are set at zero. Sei whales in the eastern

[19] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

North Pacific are also classified as protection stocks. Although the population structure of sei whales is not well understood, NMFS recognizes three populations in U.S. waters, based largely on historical whaling records: a Nova Scotia population in the western North Atlantic, an eastern North Pacific population, and a Hawaii population.

Nova Scotia Population: The distribution of the Nova Scotia population is centered in Canadian waters, but in spring and summer a portion of the population moves south to feed in U.S. waters of the Gulf of Maine and Georges Bank (NMFS 2006b). Generally, those whales remain offshore along the edge of the continental shelf, but occasionally they enter shallower waters, presumably in search of prey when food in offshore waters is insufficient. In 1977 the sei whale population in Canadian waters was estimated at 1,393 to 2,248 animals. Based on aerial surveys in the late 1970s and early 1980s, sei whale abundance between Cape Hatteras and Nova Scotia was estimated to be 280 whales. There are no more recent estimates, and information is insufficient to determine current population size, population trends, or the PBR level (NMFS 2006b).

Eastern North Pacific Population: The IWC recognizes one population of sei whales in the North Pacific (NMFS 2006a). In its stock assessment reports, however, NMFS considers whales off the Pacific coast of North America to be a distinct population separate from the population that occurs throughout the rest of the North Pacific. Commercial whaling in the North Pacific reduced sei whale abundance from an estimated pre-exploitation level of 42,000 whales to between 7,260 and 12,620 whales in 1974. Between 1947 and 1987 commercial whalers took 61,500 sei whales in the North Pacific, of which 410 were taken off central California. Shipboard surveys in 1996 and 2001 yielded an estimated abundance of 56 whales off California, Oregon, and Washington. Based on that estimate, NMFS calculates a PBR of 0.1.

Hawaiian Population: Although information on the population structure of sei whales in the North Pacific is insufficient to identify individual stocks with confidence, NMFS recently decided to prepare a separate stock assessment for sei whales in Hawaiian waters to avoid the risk of assuming them to be part of a single panmictic stock. Based on vessel surveys in 2002, the abundance of sei whales in U.S. waters around Hawaii was estimated to be 77 whales, with a PBR of 0.1.

Major Threats: Vessel collisions and entanglement in fishing gear are potential threats to sei whales. Off the northeastern U.S. coast, a few recent collision-related sei whale deaths have been recorded (Laist et al. 2001, NMFS 2006b). There were no documented deaths due to entanglement in fishing gear. No recent sei whale deaths or serious injuries have been recorded in the eastern North Pacific or Hawaiian waters from collisions or entanglement (NMFS 2006a).

Management Framework: NMFS has not established a recovery team or other management team for sei whales. The agency has limited its management actions to efforts to control commercial whaling through the IWC and the development of take reduction plans for large whale species along the U.S. Atlantic and Pacific coasts.

Critical Habitat: None designated.

Recovery Plan: Although a draft recovery plan for fin and sei whales was completed in 1998 (Reeves et al. 1998), it was not adopted (see fin whales above).

Major Management Actions: The IWC did not begin regulating commercial hunting for sei whales until 1970 (Reeves et al. 1998). Commercial hunting for the species was prohibited in the North Pacific in 1976 but continued in the North Atlantic until 1986 when the IWC's moratorium on all commercial whaling went into effect. Other than addressing the impact of commercial whaling through the IWC, NMFS management actions regarding sei whales have been limited largely to conducting section 7 consultations and the development and implementation of take reduction plans that apply to large whales in general.

Staff and Funding Levels: According to FWS annual expenditure reports (FWS 2003b–d, 2005d–f, 2006), funding for work on sei whales between 1998 and 2004 ranged from $3,600 in 2000 to $202,900 in 2003 (Table 20, Appendices C.1–7). Most reported expenditures have been by the U.S. Coast Guard for enforcement and reflect an apportionment of expenditures for ship time to enforce rules generally applicable to large whales. According to budget documents, NMFS allocated $994,000 in FY2003 for the recovery of endangered large whales (e.g., blue, bowhead, fin, sei, sperm, and North Pacific right whales, Appendix E). It is not clear how much, if any, of that funding was dedicated to sei whales. NMFS estimates that it devoted at least 0.2 FTE in staff effort on sei whale recovery work (all by its regional offices) during 2005.[20]

Table 20. Federal and state expenditures (in $ thousands) for the recovery of sei whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	–	–	4	4	1	5
1999	–	–	–	–	4	4	–	4
2000	–	–	–	–	4	4	–	4
2001	–	–	–	–	12	12	–	12
2002	–	–	–	–	1	1	–	1
2003	–	–	–	199	4	203	–	203
2004	–	–	–	60	6	66	–	66

Sperm Whale

Population Status: Sperm whales (*Physeter macrocephalus*) were drastically reduced in numbers worldwide by commercial whaling in the 1800s and early 1900s. The species as a whole was listed as endangered throughout its range under the ESCA in 1970, and that designation was carried forward under the ESA. The IWC has classified sperm whales worldwide as protection stocks for which commercial catch limits have been set at zero. Information on the population structure of the species is limited. The IWC currently considers sperm whales in the North Atlantic to be single population and those in the North Pacific to be

[20] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.

divided into eastern and western populations. Abundance of sperm whales in the North Atlantic is unknown. For the eastern North Pacific Ocean, estimates include 22,700 whales for tropical latitudes and 24,000 (based on visual sightings) and 39,200 (based on visual sightings and acoustic data) for eastern temperate latitudes, although it is unclear whether whales from this area enter U.S. waters (Barlow and Taylor 1998). In contrast to the IWC, NMFS currently recognizes five sperm whale population stocks in U.S. waters for purposes of preparing stock assessment reports: a North Atlantic population, a northern Gulf of Mexico population, a California/Oregon/Washington population, a Hawaii population, and a North Pacific population.

North Atlantic Population: Sperm whales that occur off the U.S. Atlantic coast are likely part of a larger population (NMFS 2006b). Based on surveys carried out in 2004, the best available estimate of abundance for sperm whales in U.S. waters off the East Coast is 4,804 whales. The PBR level is 7. Data are insufficient to determine population structure or trends.

Northern Gulf of Mexico Population: Based on strandings, sightings, and historic whaling catches, sperm whales in the northern Gulf of Mexico are currently considered a distinct population for management purposes (NMFS 2006b). Pooled data from surveys conducted in 1996–2001 yield a best estimate of abundance of 1,349 whales in the northern Gulf of Mexico, and a PBR level of 2.2. Data are insufficient to determine population trends.

California/Oregon/Washington Population: Recent genetic analyses of sperm whales in the eastern North Pacific suggest that the whales along the California coast differ markedly from those sampled farther offshore (NMFS 2006a). Although there appear to be large numbers of sperm whales west and south of the U.S. Exclusive Economic Zone off the West Coast, it is not clear whether those whales enter U.S waters. The best available abundance estimate, which is derived from surveys in 1996 and 2001, is 1,233 sperm whales off California, Oregon, and Washington. The PBR level is 1.8. Data are insufficient to determine population trends.

Hawaii Population: Hawaii was the center of a sperm whale fishery in the 19th century (NMFS 2006a). Strandings and sound recordings document the continued presence of sperm whales in these waters. Preliminary results of genetic studies suggest a significant difference between whales sampled off the U.S. mainland coast and those off Hawaii (NMFS 2006a). Based on a shipboard survey in 2002, the abundance of sperm whales in the U.S. Exclusive Economic Zone around the Hawaiian archipelago is 7,082 whales resulting a PBR of 11. Information is insufficient to determine population trends.

North Pacific Population: The range of the North Pacific sperm whale population considered in NMFS stock assessment reports extends from British Columbia, Canada, through Alaska, west to Russia. Current information is not sufficient to estimate its abundance, trend, or PBR level (NMFS 2005a).

Major Threats: Sperm whales were hunted with varying degrees of intensity until the moratorium on commercial whaling went into effect in 1986–1987. Between 1800 and 1987 commercial whalers took at least 436,000 sperm whales worldwide (NMFS 2006a). The actual take may have been as high as one million. Although commercial harvests are currently banned worldwide under the IWC's moratorium on commercial whaling, the moratorium was adopted as a temporary measure and may be removed in the future, thereby raising the possibility of resumption in commercial hunting of sperm whales. Because of their offshore distribution, sperm whales have less exposure to many types of human impact than do some coastal species, but they are still vulnerable to entanglement in fishing gear, collisions with ships, chemical contaminants, and noise pollution (NMFS 2002b).

<u>Entanglement and Entrapment in Fishing Gear</u>: Although sperm whales are known to become entangled in gillnets and longlines, the frequency of such events appears to be very low. In recent years, there has been no evidence of entanglements for the northern Gulf of Mexico and Hawaii populations. In the North Atlantic, three sperm whale entanglements were documented between 1993 and 1998, but since then only one entanglement has been documented, suggesting a minimum annual rate of mortality and serious injury of 0.2 (NMFS 2006b). Along the Pacific coast, an average of one sperm whale per year was killed or seriously injured in offshore drift gillnets between 1997 and 2001 (NMFS 2006a). For waters off Alaska, the incidental mortality and serious injury rate based on known reports is 0.4 whale per year. These rates are less than 10 percent of calculated PBR levels and are considered insignificant and approaching zero.

<u>Ship Strikes</u>: Although there have been several reports of ship strikes involving sperm whales in areas such as the Canary Islands and parts of the Mediterranean Sea (Laist et al. 2001, NMFS 2002b), fewer than five collisions have been recorded between sperm whales and ships in U.S. waters (Jenson and Silber 2003). Highest risks appear to occur when sperm whales use habitats close to land where ship traffic is greater.

<u>Contaminants</u>: In some areas, high contaminant loads have been found in sperm whales (Ferber 2005). In the North Atlantic, levels of mercury and PCBs were low in sperm whales sampled, but cadmium levels were high (NMFS 2006b). Whether or how such contaminant levels affect sperm whales is not known.

<u>Noise</u>: Noise associated with oil and gas activities (particularly seismic surveys and drilling), military activities (particularly sonars used to detect submarines), and routine ship traffic may affect sperm whales (Mate et al. 1994). Such effects have been of particular concern in the Gulf of Mexico because of the extent of seismic surveys to locate and delineate oil and gas reserves.

Management Framework: NMFS is the lead federal agency responsible for managing sperm whales. Together with the Department of State, NMFS and other offices in NOAA develop and coordinate scientific advice and U.S. positions for meetings of the IWC. NMFS and the Minerals Management Service share responsibility for ensuring that noise and other possible impacts associated with offshore oil and gas exploration and development do not adversely affect sperm whales. No recovery team or other interagency management team has been established to oversee or assist management activities specifically related to sperm whales. However, sperm whales have been considered in some take reduction plans developed for large whales taken incidentally in commercial fisheries.

Critical Habitat: None designated.

Recovery Plan: A draft recovery plan for sperm whales was circulated for public comment early in the summer of 2006 (NMFS 2006d). The immediate and ultimate goals of the draft plan are to recover sperm whale populations to the point where they can be downlisted to threatened and delisted from the list of endangered species. A two-tier system of criteria is included in the draft plan for reclassification and delisting purposes. The first tier addresses population benchmarks and identifies the following standards:

- For reclassifying as threatened, the overall population in each ocean basin (1) must have remained stable or increased for at least 1.5 generations (26 years) or (2) must have satisfied a risk analysis standard of no more than a 1 percent chance of quasi-extinction in 100 years.
- For removing the species from the list, the overall population in each ocean basin (1) must have remained stable or increased for at least 3 generations (51 years) or (2) have less than a 10 percent probability of becoming endangered in 20 years.

The second tier describes standards relative to the five listing factors established by the ESA.

- *Destruction, modification, or curtailment of the species habitat or range*: For downlisting, fishing interactions, vessel interactions, prey reduction, and effects of anthropogenic noise must have been assessed and needed management actions must have been initiated. For removal from the list, management actions must have been proven effective.
- *Overutilization for commercial, recreational, or educational purposes*: For downlisting, direct human kills must be managed on a sustainable basis by the IWC, and for removal from the list, those management actions must have been proven effective and consistent with MMPA standards for maintaining populations at OSP levels.
- *Disease or predation*: For both downlisting and removal from the list, assessments must have been undertaken showing that these factors are not appreciably affecting recovery.
- *Inadequacy of existing regulatory mechanisms*: For both downlisting and removal from the list, the IWC must be regulating directed take on a sustainable basis, and applicable authorities must be adequately regulating takes due to vessel collisions and fishery interactions.
- *Other natural or manmade factors*: For both downlisting and removal from the list, anthropogenic factors must have been investigated and determined not to be limiting recovery.

To meet these goals and criteria, the draft plan identifies nine objectives: (1) coordinate state, federal, and international recovery actions, (2) determine population discreteness and structure, (3) develop and apply methods to estimate population size and monitor trends in abundance, (4) conduct risk analyses for whales in each ocean basin, (5) identify and protect habitat essential to recovery, (6) identify and minimize human sources of injury and mortality, (7) determine and minimize detrimental effects of anthropogenic noise, (8) maximize efforts to acquire scientific information from dead, stranded, and entangled whales, and (9) develop a plan for monitoring the population after the species is removed from the list. Because sperm whales move across international borders, the draft plan stresses the importance of a multinational research and management approach.

Major Management Actions: A ban on pelagic whaling for sperm whales in the North Pacific was first adopted by the IWC in 1980. It was extended globally in 1986–1987 when the IWC adopted a moratorium on all commercial whaling and set catch quotas for all stocks at zero. Section 7 consultations between NMFS and the Minerals Management Service have examined the effects of oil and gas exploration and development on sperm whales in the Gulf of Mexico and have concluded that such activities are not likely to jeopardize their continued existence. Research is being undertaken in the Gulf of Mexico to improve information on possible noise-related effects. Implementation of a take reduction plan for drift gillnets along the Oregon/Washington/California coast in 1997 included measures, such as education of skippers and the use of pingers, designed to reduce the take of marine mammals, including sperm whales.

Staff and Funding Levels: According to NMFS budget documents, NMFS allocated $994,000 in FY2003 funding to the recovery of endangered large whales (Appendix E). It is not clear how much of this was devoted to sperm whales. NMFS estimates that it devoted at least 2.2 FTEs in staff effort on sperm whale recovery work (0.5 by its regional offices and headquarters and 1.7 by its science centers) during 2005.[21] Annual FWS reports on expenditures for endangered species (FWS 2003b–d, 2005d–f, 2006) indicate that total funding related to sperm whale research and conservation between 1998 and 2004 ranged from $1,200 in 2002 to $2.27 million in 2004 (Table 21, Appendices C.1–7). Almost all the reported funding for 2003 was for U.S. Coast Guard enforcement activities.

Table 21. Federal and state expenditures (in $ thousands) for the recovery of sperm whales, 1998–2004 (Source: FWS 2003b–d; 2005d–f; 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
1998	–	–	–	–	4	4	1	5
1999	–	–	–	6	1	7	–	7
2000	–	–	–	–	3	3	–	3
2001	–	–	–	–	27	27	–	27
2002	–	–	–	–	1	1	–	1
2003	–	–	–	199	4	203	–	203
2004	6	–	–	60	2,203	2,268	2	2,270

In recent years, the Minerals Management Service and partner agencies and organizations have been assessing the effects of noise from seismic air guns used to explore for oil and gas reserves on sperm whale distribution and abundance in the Gulf of Mexico. Between 2002 and 2007 more than $10 million has been allocated or committed in support of this study.[22]

The draft sperm whale recovery plan projects future funding needs to implement each of the nine major management actions identified previously (NMFS 2006d). As shown in Table 22, funding

[21] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.
[22] Ann Jochens, personal communication. 12 June 2006. Texas A&M University, College Station TX 77843; William Lang, personal communication. 12 June 2006. Program Director, Division of Ocean Sciences, National Science Foundation, 4301 Wilson Blvd., Suite 725, Arlington, VA 22230.

needs were developed for each of the three ocean basins in which sperm whales occur and total $37.14 million over the next 20 years.

Table 22. Projected funding needs (in $ thousands) to implement recovery activities for sperm whales in the 2006 draft sperm whale recovery plan (NMFS 2006d)

Ocean Basin*	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Action 7	Action 8	Action 9	Total
North Atlantic (2012)	250	500	9,000	100	525	385	520	2,623	75	13,950
North Pacific (2012)	220	500	13,500	100	525	385	520	2,650	75	4,780
Southern Ocean (2026)	220	250	3,000	200	475	180	410	–		4735

* Dates in parentheses are estimates of the earliest possible dates for meeting recovery criteria.

Beluga Whale, Cook Inlet Population

Population Status: Distinct populations of beluga whales (*Delphinapterus lecuas*) are found in five areas off Alaska: the Beaufort Sea, the eastern Chukchi Sea, the eastern Bering Sea, Bristol Bay, and Cook Inlet (NMFS 2005d). Studies indicate that Cook Inlet beluga whales comprise the most discrete and isolated population in U.S. waters and that most whales remain in the inlet year-round (NMFS 2005d). Before 1994 there were no regular, systematic surveys of beluga whales in Cook Inlet; however, based on an aerial survey count of 479 whales in August 1979 and on a correction factor for unobserved whales, NMFS estimates a population abundance of 1,300 whales at that time. In 1994 NMFS began comprehensive, systematic aerial surveys of beluga whales in Cook Inlet (NMFS 2005d). Between 1994 and 1998 the surveys documented a decline of 47 percent, from 653 to 347 animals (NMFS 2005d). Based on the 2003 survey results, their abundance was estimated at 357 whales. The most recent NMFS stock assessment report uses those results to calculate a PBR of 2 (NMFS 2005a). Beluga whales are an important subsistence resource for Alaska Natives, and subsistence hunting levels were severely limited beginning in 1999 because of the population's decline. Although the limited harvest was expected to allow the population to recover, the anticipated increase in population size has not occurred (Lowry et al. 2006).

In 1988 NMFS included the Cook Inlet beluga whale population on its list of candidate species for listing under the ESA (53 Fed. Reg. 33516). Although inclusion on that list did not, in itself, impose restrictions, it signaled that federal agencies should take beluga whales into account in their planning. In 1998 NMFS began the process of deciding whether to designate Cook Inlet beluga whales as depleted under the MMPA or as threatened or endangered under the ESA (64 Fed. Reg. 56258). In 1999 NMFS received two petitions to list the Cook Inlet beluga whales as endangered under the ESA; both petitions identified unregulated hunting as a major cause for the decline of the population. On 31 May 2000 NMFS announced a decision to deny the petitions and designated the Cook Inlet population as depleted under the MMPA (65 Fed. Reg. 34590).

Although NMFS denied the two petitions to list the population under the ESA, in 2006 NMFS began a reexamination of the merits of such a listing in view of the population's failure to increase since harvest limits were imposed (71 Fed. Reg. 14836).

Major Threats: In 1999 NMFS concluded that the cause of the decline was high levels of mortality from subsistence hunting by Alaska Natives—including whales that were both struck and landed and those that were struck but lost and presumed dead (65 Fed. Reg. 38778). Although the precise level of mortality due to hunting is uncertain, the estimated average number of animals killed annually in subsistence harvests between 1995 and 1997 was 87 whales (NMFS 2005a).

Beluga whales in Cook Inlet frequent shallow waters near developed coastal areas around Anchorage and ascend freshwater rivers. Because of this, they face a wide range of human-related threats in addition to subsistence hunting. These include vessel traffic and habitat alteration due to coastal development, as well as natural threats (NMFS 2004d; NMFS 2005a,d).

<u>Natural Threats</u>

- *Stranding Events*: Strandings of beluga whales are common on tidal mud flats in Cook Inlet, but whales often are able to free themselves on incoming tides. Between 1988 and 2004 NMFS recorded strandings of 804 beluga whales, including 129 reported mortalities (Vos and Shelden 2005). Of those strandings, 91 occurred between 1998 and 2004. Some strandings coincided with occurrences of killer whales in the inlet and may be the result of attempts to avoid predation.
- *Predation*: Cook Inlet beluga whales are preyed upon by killer whales (Shelden et al. 2003b). Although little is known about the level of predation, it could be significant, especially in light of the severely reduced size of the population.
- *Parasitism and Disease*: Little is known about the effects of disease on Cook Inlet beluga whales.
- *Habitat Capacity and Environmental Change*: Climate change may affect the availability of prey for beluga whales, chiefly salmon and eulachon, but to date there is no evidence that prey availability is a limiting factor.

<u>Human-induced Threats</u>

- *Subsistence Harvest*: Alaska Natives hunt Cook Inlet beluga whales for food and traditional handicrafts. Take levels for Cook Inlet beluga whales are now limited to those authorized through a co-management agreement with NMFS. Although the decline in Cook Inlet beluga whale abundance in the 1990s can be explained largely by the level of Native take, the population's failure to recover in recent years is apparently due to other factors.
- *Commercial Fishing*: Beluga whales in Cook Inlet may be taken incidentally in fisheries for shellfish, groundfish, herring, and salmon. The only records of beluga whale mortality in commercial fisheries are from the early 1980s. Observer coverage of these fisheries is limited, but no incidental mortality was reported by observers or in fishery logbooks between 1990 and 2000 (NMFS 2005a).

- *Pollution*: Cook Inlet beluga whales are exposed to many kinds of pollutants commonly found in urban and industrial areas. Sources include partially treated sewage and runoff, discharges from industrial activities, such as petroleum exploration, fish-processing facilities, mining and agricultural operations, accidental oil spills, and routine discharges from oil exploration and development operations. With the exception of copper, beluga whales in Cook Inlet show lower levels of contaminants in their tissues than beluga whale populations elsewhere in Alaska (NMFS 2005d).
- *Vessel Traffic*: Beluga whales are vulnerable to being struck by vessels, particularly near river mouths and other favored habitats that were once relatively isolated but are now accessible by boats.
- *Tourism and Whale-Watching*: Currently there are no vessel-based commercial whale-watching operations in upper Cook Inlet where beluga whales are most easily observed. NMFS has concluded that whale watching is not a substantial threat to Cook Inlet beluga whales (NMFS 2005d).
- *Coastal Development*: Beluga whales are found primarily in nearshore waters where they may come into conflict with development of adjacent lands and shallow waters. The effects of coastal development are poorly known, and NMFS is proposing that standards for coastal development be prepared, particularly in Knik Arm, an important summer feeding area for beluga whales near Anchorage (NMFS 2005d).
- *Noise*: Like other toothed whales, beluga whales use sound to communicate, locate prey, and navigate. In Cook Inlet, a wide variety of human activities generate noise that may affect beluga whales.
- *Oil and Gas*: Although oil and gas production in Cook Inlet is past its peak, about 238 wells are presently in production and approximately six new wells are drilled each year (NMFS 2005d). Both state and federal governments continue to offer leases for exploration and development. Oil spills could affect beluga whales directly or significantly alter their habitat.

Management Framework: Lead federal responsibility for managing beluga whales rests with NMFS. The management framework established by the MMPA provides an exemption for the taking of marine mammals by Alaska Natives for subsistence uses and the production of handicrafts. The Act allows limits on subsistence hunting only if a species has been designated as depleted. NMFS therefore had no authority to regulate hunting by Alaska Natives when the level of hunting increased in the mid-1990s (65 Fed. Reg. 38778). Because of concern about high levels of subsistence take, in 1999 the U.S. Congress enacted legislation (PL 106-31, section 3022, 113 Stat. 57, 100) establishing a moratorium on hunting Cook Inlet beluga whales unless authorized through a co-management agreement between Alaska Native organizations and NMFS. The moratorium was made permanent by legislation passed in 2000 (PL 106-553), and conforming regulations were adopted by NMFS (65 Fed. Reg. 17973). NMFS is currently developing a conservation plan under the MMPA to identify and help guide research and management work to recover the Cook Inlet beluga whale population (NMFS 2005d).

Critical Habitat: Critical habitat is not applicable because the Cook Inlet beluga whale population currently is not listed as endangered or threatened under the ESA. However, the draft conservation plan characterizes habitats in Cook Inlet according to their importance to the population (NMFS 2005d).

Recovery Plan: Because Cook Inlet beluga whales are not listed under the ESA, a recovery plan has not been developed for this population. However, in 2005 NMFS released a draft conservation plan for Cook Inlet beluga whales prepared under authority of the MMPA (NMFS 2005d). Its stated purpose is to recover the Cook Inlet beluga whale population to its OSP level. Based on current estimates of carrying capacity, it recommends that NMFS consider removing the Cook Inlet population from the list of depleted species when the population reaches 780 animals. The draft plan sets out three objectives for achieving this goal:

- Identify and eliminate or mitigate factors that are responsible for the decline of the Cook Inlet beluga whales or that may be preventing their recovery;
- Continue and, as necessary, expand research and management programs to monitor trends and detect natural or human-related factors affecting the Cook Inlet population of beluga whales and its habitat; and
- Assess the success of implementing conservation actions and high-priority studies identified in the plan.

Major Management Actions: In May 1999 President Clinton signed legislation establishing a moratorium on the taking of Cook Inlet beluga whales by Native subsistence hunters unless authorized by a cooperative agreement between NMFS and affected Alaska Native organizations (§3022 PL 106-31). That moratorium was to have expired in October 2000, but it was extended indefinitely by Public Law 106-553. In 2000 NMFS issued a proposed rule to establish harvest limitations under a formal rulemaking process set forth in the MMPA. Based on the recommendations of an administrative law judge and the findings of an environmental impact statement, NMFS published interim final regulations that set a harvest level of 1.5 whales per year for 2001–2004 (MMC 2005). Since 2000 NMFS has entered into cooperative agreements with the Cook Inlet Marine Mammal Council under which limited hunts have been authorized. The 2003 agreement calls for maintaining the beluga whale population at “levels that will allow for long-term sustainable harvests” (NMFS 2005d). In 2004, as required under a stipulation agreed to by the parties to the rulemaking, NMFS and the Council suspended the hunt because of the unusually high number of beluga whale deaths (20) recorded the previous year. The parties to the rulemaking also agreed that NMFS would develop a long-term harvest regime to govern subsistence taking after 2004 (MMC 2005). The long-term harvest plan has not been finalized.

Staff and Funding Levels: Because Cook Inlet beluga whales are not listed under the ESA, funding levels for this population are not reported in annual FWS expenditure reports for endangered and threatened species. The Marine Mammal Commission’s survey of federally funded marine mammal research (Waring 2002) reports that federal expenditures for research on all beluga whale populations between FY1991 and FY2000 ranged from $160,000 in FY1991 to $781,000 in FY1995 (see Appendix F). The proportion devoted to Cook Inlet beluga whales is unknown. In 2000, the most recent year reported, the funding level was $351,000. The principal sources of funding were NMFS, the Navy, and the National Science Foundation. Between FY2002 and FY2004 NMFS allocated roughly $150,000 annually for research and management activities related to Cook Inlet beluga whales. NMFS estimates that it devoted at least 6.1 FTEs in staff effort on Cook Inlet beluga whale recovery work (2.3 by its regional offices and headquarters and 3.8 by its science centers) during 2005.[23]

[23] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.

The draft conservation plan (NMFS 2005d) projects cost estimates amounting to a total of $4.7 million for identified activities (including all activities ranked from priority 1 through 3) during the first five years of recovery work after plan adoption (Table 23). The estimates, however, are provided only for activities associated with objective 1 (i.e., identify and eliminate or mitigate factors responsible for the decline of the Cook Inlet beluga whales or which may be preventing their recovery). Costs associated with objectives 2 and 3 are not provided.

Table 23. Projected funding needs (in $ thousands) to implement objective 1 during the first five years after adoption of the 2005 draft Cook Inlet beluga whale conservation plan (NMFS 2005d)

Actions	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Stranding events	103	164	103	91	108	569
Predation	6	8	10	12	14	50
Subsistence harvest	56	56	45	18	45	220
Commercial fishing	12	22	32	27	32	125
Vessel traffic	0	215	210	28	128	581
Tourism/whale-watching	38	63	41	31	35	208
Noise	20	40	40	20	20	140
Oil and gas activities	90	90	85	70	75	410
Research	72	137	78	118	80	485
Oil spills	60	110	100	75	75	420
Enforcement	70	65	70	63	67	335
Outreach and education	0	0	50	15	15	80
Marine discharges and pollution	10	10	15	15	20	70
Habitat alteration and coastal development	15	15	20	20	25	95
Knik Arm development	10	35	40	28	28	141
Legal/administrative support	150	170	140	150	150	760
TOTAL	**722**	**1,200**	**1,079**	**781**	**917**	**4,699**

Bottlenose Dolphin, Mid-Atlantic Coastal Population

Population Status: Mid-Atlantic coastal bottlenose dolphins (*Tursiops truncatus*) are a morphologically distinct group of dolphins that generally remains in waters less than 25 meters deep along the U.S. Atlantic coast from Long Island, New York, to Florida (NMFS 2002). Based on genetic analyses, photo-identification, satellite telemetry, and analyses of stable isotopes, at least seven management units have been identified within the population’s range (i.e., northern migratory, northern North Carolina, southern North Carolina, South Carolina, Georgia, northern Florida, and central Florida) (NMFS 2006b).

In 1987–1988 a large die-off of at least 742 dolphins reduced the number of Atlantic coastal bottlenose dolphins by what was then thought to be more than half their abundance. As a result, NMFS designated the population as depleted under the MMPA in 1993. The proximate cause for the die-off was determined to be a neurotoxin produced by a red tide dinoflagellate, *Ptychodiscus brevis*. However, the affected dolphins also carried high levels of organochlorines and other contaminants that may have predisposed them to effects of the neurotoxin (54 Fed. Reg. 41654). Aerial surveys are the primary source of information on distribution and abundance of coastal bottlenose dolphins. Surveys since the 1987–1988 die-off suggest that their abundance is substantially greater than previously thought (NMFS 2002). Results of surveys, conducted in 2002, are shown in Table 24 (69 Fed. Reg. 65129).

Table 24. Estimates of abundance, bycatch, and potential biological removal for mid-Atlantic coastal bottlenose dolphin management units in 2002 (NMFS 2006a)

Management Unit	Abundance	Estimated Bycatch 2001–2002	Potential Biological Removal
SUMMER (May-October)			
Northern migratory	17,466	112	146.2
Northern North Carolina	7,079	8	40.8
Oceanic	6,160		32.6
Estuary	919		82.0
Southern North Carolina	4,787	0	19.9
Oceanic	3,646		18.6
Estuary	141		1.2
WINTER (November-April)			
Winter Mixed (Northern migratory, northern and southern North Carolina)	16,913	58	135.6
ALL YEAR			
South Carolina	2,325		19.6
Georgia	2,195		17.2
Northern Florida	448	0	N/a
Central Florida	10,652	6	N/a

Major Threats: Because they inhabit nearshore waters, mid-Atlantic coastal bottlenose dolphins are exposed to a number of anthropogenic and natural threats caused by interactions with commercial fisheries, red tides, contaminants, and focused recreational attention.

Incidental Catch in Fisheries: Perhaps the principal threat to coastal bottlenose dolphins is bycatch in coastal fisheries, primarily large-mesh gillnet fisheries (NMFS 2006a). Analyses indicate that bycatch rates are highest within state waters, particularly in North Carolina and Virginia, during winter. Among the fisheries of greatest concern are the mid-Atlantic coastal gillnet fishery, the Virginia pound net fishery, the mid-Atlantic beach seine fishery, the Atlantic blue crab trap fishery, the North Carolina inshore gillnet fishery, the North Carolina roe mullet stop net fishery, the North Carolina long-haul seine fishery, the southeast Atlantic gillnet fishery, and the southeastern U.S. Atlantic shark gillnet fishery (69 Fed. Reg. 65128) (see Appendix B and later discussion). Although no bycatch has been documented by observers for the summer southern North Carolina management unit, stranding data indicate that dolphins also are taken as bycatch in that area and time of year (69 Fed. Reg. 65129).

Red Tides: Neurotoxin poisoning associated with red tides appears to be an infrequent cause of major mortality for bottlenose dolphins; however, over the last 15 years at least six die-offs much smaller than the 1987–1988 event have been recorded (MMC 2004). Limited understanding about the population structure of coastal bottlenose dolphins and their abundance makes it impossible to accurately assess the impact of such die-offs.

Contaminants: Coastal bottlenose dolphins are exposed to a wide range of pollutants from land-based run-off. Like many other marine mammals that inhabit nearshore areas, bottlenose dolphins carry high levels of some contaminants. The direct and indirect effects of contaminants have not been established but may include impairment of immune function (a possible contributing factor in the large 1987–1988 die-off) and reproduction.

Tourism: Over the past decade, both legal and illegal commercial dolphin-watching ventures have encouraged close human interactions (e.g., feeding) with bottlenose dolphins. These activities have increased dramatically, particularly in the southeastern United States. A study by Samuels et al. (2003) concluded that dolphins are vulnerable to injury and death as a result of human contact and that important natural behaviors can be disrupted through such contact. For the last several years, NMFS has been considering regulations to govern such operations.

Management Framework: NMFS has lead federal responsibility for conserving mid-Atlantic coastal bottlenose dolphins under the authority of the MMPA. Section 118(f)(1) of the MMPA requires the preparation and implementation of take reduction plans for strategic marine mammal stocks that interact with category I or category II fisheries. Coastal bottlenose dolphin populations in the Atlantic qualify as strategic stocks because fishery-related incidental mortality exceeds current estimates of PBR levels for some management units and because the population is designated as depleted (NMFS 2006b). In February 1997 NMFS convened a take reduction team, but the team determined that information was insufficient to develop management measures. After further research and analyses, NMFS convened a new take reduction team in October 2001. That team met five times and submitted recommendations to NMFS in May 2002. The Service determined that those recommended measures would not meet the statutory requirement for reducing incidental mortality and serious injury to below the PBR level. No other teams exist specifically for the purpose of managing mid-Atlantic coastal bottlenose dolphins. The population is now managed according to a complex structure of “management units.”

Critical Habitat: Critical habitat is not applicable because the mid-Atlantic coastal bottlenose dolphin population is not listed under the ESA.

Recovery Plan: Provisions for preparing a recovery plan are not applicable because the mid-Atlantic coastal bottlenose dolphin population is not listed under the ESA. However, when NMFS proposed designating the population as depleted under the MMPA in 1991, it advised that it would prepare a conservation plan (56 Fed. Reg. 40595). In May 2001 a draft conservation plan was provided to the Marine Mammal Commission, which subsequently submitted comments to NMFS (MMC 2004). However, a draft plan has not been circulated for public review.

Major Management Actions: In November 1988 the Center for Marine Conservation petitioned NMFS to designate the coastal bottlenose dolphin population as depleted under the MMPA (54 Fed. Reg. 41654). Proposed rules to do so were published in August 1991 (56 Fed. Reg. 40594) and adopted in 1993 (58 Fed. Reg. 17789). At the time, it was thought that there was only one coastal population distributed along the Atlantic coast. Although this is no longer believed to be the case, the stock structure remains uncertain, and the depleted designation remains in effect. The principal management focus has been on reducing incidental mortality and serious injury in coastal fisheries. In November 2004 NMFS proposed regulations based on recommendations prepared by the Bottlenose Dolphin Take Reduction Team (69 Fed. Reg. 65127). They called for restrictions on fishing areas, gillnet soak times, and amounts of gear, with specific measures differing by management unit. Other recommendations were made for education and outreach efforts and for research, particularly to improve understanding of population stock structure. Final rules implementing those measures were published in 2006 (71 Fed. Reg. 24775).

Staff and Funding Levels: Because mid-Atlantic coastal bottlenose dolphins are not listed under the ESA, estimated expenditures spent on this population are not reported in annual FWS expenditure reports required under the ESA. According to the Marine Mammal Commission's survey of federally funded marine mammal research (Waring 2002), expenditures for biological and population assessment research on bottlenose dolphins between FY1991 and FY2000 ranged from $822,000 in FY1997 to $2.5 million in FY1995 (Appendix F). This funding, however, is not restricted explicitly to the mid-Atlantic coastal population. The principal sources of funding were NMFS and the Navy.

NMFS estimates that it devoted at least 15.9 FTEs in staff effort on coastal mid-Atlantic bottlenose dolphin conservation (2.1 by its regional offices and headquarters and 13.8 by its science centers) during 2005.[24] NMFS budget documents indicate that it allocated $748,000 to coastal bottlenose dolphins in FY2001, $2 million in FY2002, $1.99 million in FY2003, and $3.96 million in FY2004 (Appendix E).

Killer Whale, Southern Resident Population

Status: The taxonomy of killer whales (*Orcinus orca*) is poorly known, but new information is being developed. Until recently, killer whales were considered to be a single species worldwide (69 Fed. Reg. 76674). Based on recent information, this is no longer believed to be the case. NMFS currently recognizes several distinct groups of killer whales in the North Pacific Ocean, including resident, transient, and offshore populations, each of which differs from the others in significant ways. A distinct group of southern resident killer whales occurs in waters straddling the U.S.-Canada border between Washington and British Columbia. This group is further divided into three pods designated J, K, and L.

In the late 1960s and early 1970s, 47 killer whales were removed for purposes of research and public display, reducing the southern resident population to about 70 animals (MMC 2002). The

[24] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910.

population subsequently increased to a high of 99 whales in 1995 but then declined to 79 whales by 2001. The decline seems to have resulted from a decrease in fecundity and an increase in mortality of immature and mature females. In 2001 the Center for Biological Diversity and other environmental groups petitioned NMFS to list southern resident killer whales as threatened or endangered under the ESA (69 Fed. Reg. 76673). Based on findings by a biological review team, NMFS denied the petition, concluding that southern resident killer whales did not constitute a separate species or a distinct population segment under the Act. In May 2003, however, NMFS designated the population as depleted under the MMPA.

In response to litigation successfully challenging the decision on the initial ESA petition, NMFS reexamined the possibility of listing southern resident killer whales under the ESA. A new biological review team convened by NMFS concluded that southern resident killer whales meet the definition of a distinct population segment (Krahn et al. 2002). NMFS subsequently proposed listing the population as threatened (69 Fed. Reg. 76678). In taking this action, NMFS cited new results from population modeling studies that suggested, under the most optimistic recovery scenario, the population has a 0.1 to 3 percent probability of extinction in 100 years. Under the most pessimistic scenario, it was predicted to have a 39 to 67 percent probability of extinction in 100 years. In support of its proposal to list southern resident killer whales as threatened rather than endangered, NMFS cited evidence of a small increase in abundance since 2000 and noted that the recruitment of several juvenile male and female whales to breeding age was expected in the next few years (69 Fed. Reg. 76679). In 2005 NMFS took final action and decided to list the southern resident killer whale population as endangered, rather than threatened, under the ESA (70 Fed. Reg. 69903). According to the notice, the listing as endangered instead of threatened resulted from information received during the comment period and a reanalysis of threats facing the population. The count of southern resident killer whales in 2005 was 84 whales; its PBR level is calculated to be 0.8 (NMFS 2006a).

Major Threats: Although specific causes for the slow growth and periodic declines in abundance of southern resident killer whales remain unknown, a number of possible factors were identified by the most recent biological review (Krahn et al. 2002). Since the mid-1980s the abundance of salmon, a principal prey species for southern resident killer whales, has declined in Puget Sound. In addition, the whales have been found to have high levels of organochlorines, including PCBs and a chemical flame retardant, that has been associated with compromised immune systems and reproductive function in other species. Oil spills and noise and disturbance from vessel traffic, including whale-watching ventures, also are considered possible factors in the decline. Noise-related impacts associated with the operation of sonar by Navy vessels passing through the species' habitat also have been a source of concern. In support of its listing proposal, NMFS also cited concerns about the limited number of reproductive males and the lack of reproduction by some sexually mature females.

Management Framework: At present, no recovery team or other interagency management team has been convened specifically to oversee or assist NMFS in implementing recovery efforts for southern resident killer whales. In its proposal to list the population as threatened, NMFS announced that it would convene a recovery team if designation were to occur. In March 2005 NMFS released a preliminary draft conservation plan under the MMPA (NMFS 2005c).

Critical Habitat: In listing southern resident killer whales as endangered, NMFS declined to propose critical habitat, citing difficulty in identifying critical habitat for a group of animals whose foraging areas vary in time and space and which do not use specific breeding, nursing, or resting areas. In June 2006, however, NMFS proposed designating more than 2,500 square miles of inland waters in Puget Sound, the Strait of Juan de Fuca, and around the San Juan Islands as critical habitat. Final designation of the area was made in November 2006 (71 Fed. Reg. 69054).

Recovery Plan: In March 2005 NMFS released a preliminary draft conservation plan under the MMPA (NMFS 2005c). This preliminary draft plan, structured much like a recovery plan, identifies proposed actions to accomplish the following objectives:

- Monitor the status and trends of the southern resident killer whale population;
- Protect the population from factors that may contribute to its decline or reduce its ability to recover;
- Protect the population from additional threats that may disturb, injure, or kill the whales or affect habitat;
- Conduct research to facilitate and enhance conservation efforts;
- Develop public information and education programs;
- Respond to killer whales found stranded, sick, injured, or isolated, that pose a threat to the public, or that exhibit nuisance behaviors; and
- Promote transboundary and interagency coordination and cooperation.

Although NMFS has not announced plans to prepare a recovery plan for southern resident killer whales, the draft conservation plan presumably would provide a basis for doing so.

Canada's Department of Fisheries and Oceans has convened a recovery team for southern resident killer whales that includes representatives of the Washington Department of Fish and Wildlife and NMFS. The team has begun developing a recovery plan under Canadian authority (69 Fed. Reg. 76679).

Major Management Actions: In announcing its proposal to list the southern resident killer whales as threatened, NMFS described initial management needs including public education, outreach, and stewardship activities in cooperation with the Seattle Aquarium and the Whale Museum. A major focus of outreach efforts would be promoting responsible whale-watching behavior and enforcement in cooperation with the Washington Department of Fish and Wildlife (69 Fed. Reg. 76679). NMFS also noted that it would evaluate protective regulations available under the ESA. As noted above, NMFS designated southern resident killer whales as endangered in 2005 and designated critical habitat in November 2006.

Staff and Funding Levels: Because southern resident whales were not listed under the ESA until 2005, funding levels for this population have not been reported in past annual FWS expenditure reports for listed endangered and threatened species. However, budget documents indicate that NMFS allocated $746,000 in FY2003 and $1.5 million in FY2004 for actions related to recovery of southern resident killer whales. NMFS estimates that its headquarters, regional offices, and fisheries science centers devoted 7.1 FTEs to research and management activities (2.1 by its regional office and headquarters staff and 5 by its science centers) related to the southern resident killer whale population in 2005.[25] Projected funding needs to carry out tasks identified in the 2005 southern resident killer whale conservation plan during the first five years after adoption of the plan totaled $13.6 million (Table 25).

Table 25. Projected funding needs (in $ thousands) to implement conservation activities for southern resident killer whales during the first five years after adopting the draft 2005 southern resident killer whale conservation plan (NMFS 2005c)

Actions	Year 1	Year 2	Year 3	Year 4	Year 5	Total
MANAGEMENT						
Identify contaminant clean-up sites	30	30	–	–	–	60
Minimize risks from oil spills	20	–	–	–	–	20
Minimize disturbance from vessels	220	270	290	310	290	1,380
Develop public outreach programs	172	132	142	132	142	720
Respond to distressed/stranded whales	N/A	N/A	N/A	N/A	N/A	N/A
Pursue cooperation with Canada	10	230	200	240	160	840
RESEARCH AND MONITORING						
Monitor status and trends	20	100	100	100	100	420
Assess distribution and movements	419	975	1,025	1,025	1,025	4,469
Assess diet	112	190	190	190	190	872
Assess population dynamics	32	130	130	130	130	552
Determine metabolic rates	40	75	75	75	75	340
Assess changes in prey availability	–	200	200	200	200	800
Assess effects of noise	150	325	325	325	325	1,450
Assess effects of contaminants/disease	55	210	210	210	210	895
Assess genetic relationships	70	150	150	100	100	570
Improve research technology	50	50	50	50	50	250
TOTAL	1,400	3,067	3,087	3,087	2,997	13,638

Killer Whale, AT1 Group

Status: The AT1 group of killer whales is a genetically and socially distinct group of transient killer whales in the northern Gulf of Alaska. This group has been resighted annually in Prince William Sound and the Kenai Fjords area (NMFS 2005a). Like other transient killer whales, the AT1 whales are specialized feeders on marine mammals, particularly harbor seals (*Phoca vitulina*) and Dall's porpoises (*Phocoenoides dalli*). Although their range overlaps with other killer whale populations, they have never been observed to associate with whales from other groups.

[25] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

Under the MMPA, AT1 killer whales are considered part of a larger eastern North Pacific transient killer whale population (NMFS 2003a). The minimum population estimate for the eastern North Pacific population is 346 animals. Although some AT1 killer whales were first observed in 1978 in Prince William Sound, the group was not identified as a separate unit until 1984 (NMFS 2003). At that time, three individuals were identified as juveniles, indicating that reproduction had occurred in the previous eight years. In 1987, 9 of the 22 whales counted in the group were males. This is considered a very high percentage of males. All 22 whales were observed regularly until the *Exxon Valdez* oil spill in March 1989. Since that time, the population has steadily declined. The most recent abundance estimate is eight whales, including four aging females (NMFS 2005a). No new calves have been documented since 1984.

In November 2002 several conservation organizations submitted a petition to NMFS to designate the AT1 group of transient killer whales as depleted under the MMPA (68 Fed. Reg. 3483). In response, NMFS convened a status review group that subsequently concluded that AT1 killer whales had a distinct vocal dialect and pattern of movement and were genetically distinct from other transient killer whales (NMFS 2003). Based on those findings, NMFS concluded that AT1 killer whales constituted a population stock as defined by the MMPA and that the population of nine animals remaining at the time had declined to 41 percent of their presumed carrying capacity (i.e., the 22 whales documented in the late 1980s). In June 2004 NMFS issued a final rule designating the group as depleted under the MMPA (69 Fed. Reg. 31321).

Major Threats: Threats identified for AT1 killer whales by NMFS include the following:

Oil Spills: AT1 killer whales appear to have been harmed by the 1989 *Exxon Valdez* oil spill (NMFS 2003). Eleven members of the group have disappeared since the spill, and at least some of those animals are thought to have died because of it. The AB pod of resident killer whales in Prince William Sound also was observed swimming through the spill and, within two years, it lost 13 of its 36 members. Although steps have been taken to reduce the likelihood of large spills occurring in the future, such a threat will continue to exist as long as oil is transported through habitats used by these whales.

Environmental contaminants: Seven members of the AT1 group were found to have significantly higher levels of organochlorine concentrations than resident killer whales in the same area (NMFS 2003). The high levels are similar to those found in other North Pacific transient killer whales and are consistent with a diet that includes other top-level predators. Exposure to organochlorines may be contributing to the absence of observed reproduction in this group over the past 20 years.

Prey Availability: The abundance of harbor seals in Prince William Sound—a primary prey item for AT1 killer whales—declined 63 percent between 1984 and 1997 after the *Exxon Valdez* oil spill (NMFS 2003). This may have limited the whales' ability to find adequate food and compromised their health and reproduction.

Fisheries Interactions: Although a number of fisheries operate in the range of AT1 killer whales, incidental take and mortality of killer whales has been documented only for the Bering Sea groundfish trawl and longline fisheries (NMFS 2003).

Whale-Watching and Vessel Traffic: It appears that AT1 killer whales are not likely to be affected by the increase in whale-watching in Alaska (NMFS 2003). Most whale-watching activities in Prince William Sound and Kenai Fjords interact with resident killer whales. Although other types of vessel traffic also have increased, it is unknown whether or to what extent vessel noise might impair the ability of killer whales to navigate, forage, and communicate.

Management Framework: NMFS is the lead agency responsible for conserving killer whales. No interagency management teams have been established explicitly to oversee or assist with recovery of this group of killer whales.

Critical Habitat: Critical habitat is not applicable because the AT1 killer whale population is not listed as endangered or threatened under the ESA.

Recovery Plan: In designating AT1 killer whales as depleted in June 2004, NMFS announced its intent to develop a conservation plan under provisions of the MMPA (69 Fed. Reg. 31322). A draft plan had not been circulated for public review as of the compiling of this report.

Major Management Actions: No specific management actions for AT1 killer whales have been taken to date. Recovery work on this group of whales has been limited to research and monitoring by NMFS' National Marine Mammal Laboratory and contracted researchers to determine demographic parameters and monitor their abundance (69 Fed. Reg. 31322).

Staff and Funding Levels: Because AT1 killer whales are not listed under the ESA, funding levels for this population are not reported in annual FWS expenditure reports for endangered and threatened species. NMFS estimates that it devoted 0.5 FTE in staff effort (0.2 by its regional offices and headquarters and 0.3 by its science centers) to the AT1 group of killer whales.[26] No estimates of funding levels for research activities specific to this group of whales could be identified.

[26] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

IV. OVERVIEW AND TRENDS

STATUTORY PROTECTION PROVISIONS

The ESA and the MMPA provide the foundation for most marine mammal protection activities. For species listed as threatened or endangered, the ESA is generally more important. Among the most important provisions of the ESA are (1) a prohibition on the taking of listed species, including adverse modification of their critical habitat; (2) requirements for preparing and implementing recovery plans that identify necessary recovery actions and associated costs; and (3) requirements for all federal agencies to use their respective authorities to protect listed species and to consult with either NMFS or FWS if any actions they authorize, fund, or carry out are likely to jeopardize the continued existence of a listed species or adversely modify its critical habitat. In this regard, the Act authorizes the designation of areas as critical habitat if they contain biological or physical features essential for a species' survival.

The MMPA prohibits intentional as well as unintentional injury, death, or harassment of all marine mammals, including those listed as endangered or threatened. This prohibition is subject to some exceptions, such as non-wasteful taking by Alaska Natives for subsistence and handicraft purposes and for authorized scientific research and enhancement activities. The MMPA also provides exemptions for (1) taking small numbers of marine mammals incidental to activities other than commercial fishing if the taking is authorized by regulations, and (2) taking incidental to commercial fishing, provided that the take does not exceed a PBR level calculated specifically for the stock. For fisheries not achieving this standard, NMFS is required to convene a take reduction team and prepare a take reduction plan to reduce takes to below the PBR level. If a marine mammal stock falls below its OSP level, it also must be listed as "depleted." Besides further limiting the taking from stocks so listed, the Act authorizes the preparation of a conservation plan similar to a recovery plan under the ESA.

Other relevant legislation includes the Magnuson-Stevens Fishery Conservation and Management Act, which establishes national standards for harvesting fish and authorizes the development of fishery management plans. In part, national standards under this Act require that fishery management plans prevent overfishing while achieving an optimum yield that takes into account interactions with other species, such as marine mammals, and ecosystem elements. The Act also requires minimizing bycatch of marine mammals and other non-target species. Most fishery management plans, however, have not directly addressed the impact of fisheries on marine mammals.

Other important statutes include the National Environmental Policy Act, which requires the preparation of environmental impact statements for major federal actions that may affect the environment; the Outer Continental Shelf Lands Act, which guides the exploration and development of oil and gas reserves in federal waters and requires consideration of environmental effects on marine mammals and other species; and Title III of the Marine Protection, Research and Sanctuaries Act, which authorizes the designation and management of national marine sanctuaries that include marine areas of national significance, some of which are particularly important as marine mammal habitats.

The conservation of marine mammals, including listed species, also is subject to provisions of several international treaties. For example, the International Convention for the Regulation of Whaling established the International Whaling Commission, which recommends limits on commercial and subsistence harvests of whales by member countries. The Convention on International Trade in Endangered Species of Fauna and Flora establishes controls on international trade in wildlife species by its member countries.

POPULATION STATUS

The abundance of listed marine mammal populations varies widely. Some are among the world's rarest mammals, such as the AT1 group of killer whales (with eight individuals), eastern North Pacific right whales (numbering perhaps a few tens of animals), and North Atlantic right whales (numbering about 300 animals). Other populations are far larger but have experienced alarming declines in recent decades. For instance, the eastern North Pacific population of northern fur seals has declined from more than two million to an estimated 688,028 animals, while western Steller sea lions, which numbered more than 150,000, now number about 38,000 animals. Excluding Caribbean monk seals—which are widely considered to be extinct—the 21 listed marine mammal taxa include 7 with known or probable declining trends, 8 that have shown signs of increasing over the past 25 years, and 6 whose population trends are unknown.

SPECIES PROTECTION PROGRAMS

As of December 2006, 14 marine mammal species and populations occurring regularly in U.S. waters were recognized as endangered under the Endangered Species Act and four others were listed as threatened (Lowry et al. 2007). By virtue of these listings, all 18 taxa are automatically classified as depleted under the MMPA. Four other marine mammal taxa were independently listed as depleted.

Differences in the behavior, distribution, and preferred habitats of these marine mammals present a wide variety of recovery challenges. Some large whales annually migrate thousands of miles across the jurisdictions of several countries and are exposed to diverse threats including entanglement in fishing gear, contamination by pollutants, and collisions with vessels. The movements of other marine mammals, such as Florida manatees, Hawaiian monk seals, and southern sea otters, are comparatively limited, with animals remaining largely or entirely under U.S. jurisdiction. Those taxa tend to be limited to coastal waters where, again, human activities can have profound effects on population growth and survival.

A significant development for marine mammal conservation programs in recent years has been an improvement in the understanding of population structure through new genetic studies and better data on species distribution and ecology. The implications of this new information have yet to be fully reconciled with current assessments of the conservation status and recovery goals for the listed marine mammals. For example, although humpback whales are listed as a single species and classified as endangered worldwide, at least four separate populations have now been identified in U.S. waters alone. Furthermore, there appear to be at least six subpopulations of humpback whales whose use of discrete feeding grounds suggests that they would not be readily repopulated by whales from different subpopulations if they were to be reduced. Similar behavioral patterns appear to isolate groups of killer whales and Florida manatees. To integrate rapidly advancing understanding of stock structure into recovery programs, management agencies are struggling to reassess and revise recovery priorities, goals, and conservation strategies to conform to this new understanding. Failure to understand and account for population structure can lead to poorly directed management actions, ineffective recovery effort, and the loss of ecologically significant species groups.

THREATS TO MARINE MAMMAL SPECIES AND POPULATIONS

In the 19th and 20th centuries, commercial hunting greatly reduced most of the listed marine mammal taxa, and it was thought that cessation of hunting would allow the species to recover fully. Because marine mammals tend to be long-lived and to reproduce slowly, their recovery from severe depletion is a long process at best and, in some cases, will take more than 100 years even after factors limiting population growth have been controlled. Some species and populations have shown signs of recovery since directed harvests ended. After decades of protection, the eastern Pacific population of gray whales recovered to near-pre-exploitation levels, allowing it to be removed from the endangered species list in 1994. Since passage of the ESA and MMPA, several other listed species also have shown varying degrees of recovery, including some populations of humpback whales, blue whales, sperm whales, and fin whales, Guadalupe fur seals, and Florida manatees. In a few cases—particularly for populations that were reduced to very low levels—a variety of factors is preventing or slowing recovery, and it often is not clear which factors are most influential.

The most prevalent impediments to the growth of listed marine mammal taxa in U.S. waters include incidental entanglement in fishing gear, ship strikes, reduction in prey availability, entanglement in marine debris, and the effects of natural biotoxins. Other factors that have been important for at least some species are subsistence harvests, coastal development, contaminants, oil spills, disturbance and harassment by people, climate change, predation, disease, entrapment in physical structures, and loss or degradation of key habitats (see Appendix G). The significance of different types of stresses varies by species and population. For example, entanglement in marine debris is a serious threat to Hawaiian monk seals but a relatively minor threat to Florida manatees and great whales. Entrapment in floodgates and navigation locks poses a threat unique to Florida manatees. Ship strikes and collisions with smaller vessels affect a number of species but have had their greatest effect on Florida manatees and North Atlantic right whales. Mid-Atlantic bottlenose dolphins are most affected by fishery interactions, contaminants, and disease. Although significant progress has been made in reducing incidental injury and mortality of many marine mammals in fisheries, direct (e.g., entanglement in active fishing gear) and indirect (e.g., removal of marine mammal prey items) interactions continue to impede the recovery of a number of listed marine mammals.

Examples of significant natural threats to species are male mobbing and shark predation on Hawaiian monk seals, cold winter weather and periodic red tides on Florida manatees and bottlenose dolphins, and outbreaks of disease on bottlenose dolphins. In some cases, causes of decline remain unknown or subject to controversy (e.g., southwest Alaska sea otters, northern fur seals, and Steller sea lions) despite directed study. In many cases involving natural threats, human-related factors may have subtle underlying influences. For example, red tide-related die-offs may be indirectly related to effects of contaminants that impair animal immune systems, and the frequency or intensity of red tides themselves may be related to pollution from land run-off or, potentially, changes in ocean temperature and currents secondary to climate change. Similarly, cold stress in some manatees may be related to the location and reliability of warm-water outfalls created by power plants and used by manatees during winter.

MANAGEMENT FRAMEWORK

Although NMFS and FWS exercise lead responsibility for marine mammals under their respective jurisdictions, the conservation of many endangered, threatened, and depleted marine mammal taxa rely on a much broader group of federal, state, and non-governmental partners. The activities of these agencies and groups often are organized through recovery teams, take reduction teams, implementation teams, Alaska Native organizations, and other formal and informal advisory groups.

The most elaborate example of this approach is the Florida manatee recovery program. Although FWS and the Florida Fish and Wildlife Conservation Commission carry out most formal regulatory aspects of the program and USGS and the Florida Fish and Wildlife Research Institute undertake most manatee research, the current manatee recovery team includes more than 140 members from 60 agencies and groups. The team's activities are coordinated through 12 working groups and task forces. The cooperative efforts of these organizations help address many of the tasks identified in the recovery plan that the lead agencies could not undertake alone, given limited resources. However, the breadth of involvement also presents an enormous organizational challenge.

Cooperative programs with large numbers of partners also exist for North Atlantic right whales and Steller sea lions. Somewhat less complex, but no less crucial, partnerships exist for bowhead whales, Hawaiian monk seals, and southern sea otters. In some cases, other agencies or organizations play key decision-making roles in recovery efforts. For instance, the North Pacific Fishery Management Council has developed and incorporated measures to reduce fishery impacts on western Steller sea lions into its groundfish fishery management plans, and the Alaska Eskimo Whaling Commission allocates and enforces Native subsistence catch quotas for bowhead whales. Congress also has played an important role in many recovery programs by directing appropriations to species or projects and, in a few cases, by enacting legislation designed to address species-specific management issues. Examples of the latter include statutory provisions authorizing the translocation of southern sea otters and legislation prohibiting the subsistence hunting of Cook Inlet beluga whales except as provided in co-management agreements.

Conservation programs for many listed species, however, are far less developed. For example, blue whales, sperm whales, fin whales, sei whales, and Guadalupe fur seals receive very little species-specific management attention from NMFS or other agencies. Because the United States is a member of the IWC, NMFS and the Department of State have actively represented U.S. interests at IWC meetings to promote protection of whales from commercial exploitation. Also, the National Marine Sanctuary Program has supported research and public education regarding marine mammals that occur in national marine sanctuaries.

CRITICAL HABITAT

Although the ESA now requires designating critical habitat for species or populations that are listed, such areas have not been designated for most listed marine mammals. This is partly because this requirement was not in effect when most marine mammals were first listed. In addition, data to identify such areas are not available for some species, and both NMFS and FWS have been reluctant to dedicate resources to this purpose for species already listed. Where such efforts have been made, it has often been in response to litigation to compel such designations. Only 7 of the 18 marine mammal taxa currently listed have had critical habitat designated (i.e., North Atlantic and North Pacific right whales, southern resident killer whales, Hawaiian monk seals, eastern and western Steller sea lions, and Florida manatees).

RECOVERY PLANS AND TEAMS

Recovery plans or conservation plans have been completed and adopted for 9 of the 18 marine mammal taxa listed as endangered or threatened under the ESA and one of the four taxa listed only as depleted under the MMPA (Table 26). In a few cases, these plans have been updated periodically to reflect new information and issues. For example, the Florida manatee recovery plan has been updated three times at roughly five-year intervals, and the recovery plans for northern right whales and southern sea otters have both been revised once since initial adoption. Recovery plans for Hawaiian monk seals and Steller sea lions and the conservation plan for northern fur seals are currently being updated for the first time. Recovery plans for humpback whales and Antillean manatees are more than a decade old and have not been updated. Draft recovery plans also have been developed or initiated for four other taxa (fin whales, sperm whales, sei whales, and southwest Alaska sea otters), but no plans have been developed or planned for three taxa (bowhead whales, Guadalupe fur seals, and Caribbean monk seals). With regard to the four taxa listed only as depleted under the MMPA, a conservation plan was adopted for one (the Pribilof Islands population of northern fur seals) and draft plans are in varying stages for the other three. A draft conservation plan for mid-Atlantic bottlenose dolphins was prepared several years ago but has not been circulated for pubic review, a draft conservation plan for Cook Inlet beluga whales was released in 2005, and an intent to prepare a draft conservation plan for AT1 killer whales was announced in 2004.

The different recovery and conservation plans vary greatly in content. The goals of recovery plans developed prior to the mid-1990s were generally qualitative and often called for increasing populations to undefined levels that would allow downlisting or delisting with adequate levels of protection for the species and its habitats. Recent plans (e.g., for North Atlantic right whales and Florida manatees) reflect the 1994 amendments to the ESA that require objective, measurable criteria for determining when species have recovered. Those plans generally have far more specific goals, such as downlisting or delisting the species after specific quantitative criteria have been met. In such cases, however, meeting the quantitative benchmarks merely triggers a qualitative analysis of the five listing factors set forth in the ESA and to date, with the exception of Florida manatees, no analyses have been undertaken to measure progress against identified criteria.

Table 26. Status of recovery plans and conservation plans prepared under the Endangered Species Act and Marine Mammal Protection Act for endangered, threatened, and depleted marine mammals.

Common Name	Adopted Plans	Draft Plans	Plans Currently under Development or Revision
Florida Manatee	1980, 1989, 1991, 1996, 2001		Revision
Puerto Rican Manatee	1986		
Caribbean Monk Seal			
Hawaiian Monk Seal	1983	2006	
Western Steller Sea Lion	1992	2006	
Blue Whale	1998	2006	
Western Arctic Bowhead Whale			
Fin Whale		1998, 2006	
Humpback Whale	1991		
North Atlantic Right Whale	1991, 2005		
North Pacific Right Whale	1991		
Sei Whale		1998	
Sperm Whale		2006	
Southern Resident Killer Whale		2005	
Southern Sea Otter	1982, 2003		
Southwest Alaska Sea Otter			Development
Guadalupe Fur Seal			
Eastern Steller Sea Lion	1992		Revision
Eastern North Pacific Northern Fur Seal		1993	Revision
Cook Inlet Beluga Whale		2005	
Mid-Atlantic Coastal Bottlenose Dolphin			Development
AT1 Killer Whale			

Although causes of population declines and obstacles to recovery are not always apparent, all of the recovery and conservation plans provide thorough analyses of known and suspected or potential conservation threats as they are understood at the time the plans are written. As most plans are developed by teams of stakeholders and scientists and are made available for public comment, the plan development process provides an important opportunity for reaching agreement on conservation issues and needs and for encouraging and directing involvement by concerned agencies and groups. Developed plans also vary in the degree to which they focus on reducing the factors contributing to the unfavorable status of listed species. In most cases, initial recovery plans have focused more on identifying research priorities to clarify and provide a more informed basis for management actions.

Approved recovery plans typically outline sets of prioritized tasks that provide a basis for projecting funding needs over a five-year period. The funding needs invariably exceed levels the lead agencies expect to provide but have served to encourage, justify, and guide cooperative involvement and funding by partner agencies and organizations. Periodic plan revisions have provided renewed opportunities for encouraging and guiding partner agencies and groups in light of new information and progress. However, because many taxa either do not yet have approved recovery or conservation plans or have plans that are more than 10 years old, the benefits of provisions for preparing plans under the ESA and MMPA have not been used to their fullest extent for all listed taxa.

The role and composition of recovery teams has varied by species and over time. As noted above, the recovery team for Florida manatees has evolved from a small team composed principally of scientists to one that now includes more than 150 members representing management agencies, industry and environmental groups, academia, and the public. This shift reflects a change in focus from research to provide information for decision-making to one of coordinating a wide range of research, monitoring, and recovery activities performed by many different institutions. Similarly, the recovery teams initially convened by NMFS for Hawaiian monk seals were composed principally of scientists, but recent membership changes have reduced the number of scientists and increased representation from involved agencies and stakeholders. However, because the lead agencies have convened teams for only a few listed taxa, the provisions authorizing them to establish teams have been underused.

MANAGEMENT ACTIONS

In most cases, recovery program management measures—particularly regulations—have been developed through an adaptive management approach. That is, management measures have been adopted incrementally and remain in effect until they are determined to be insufficient, at which time they are supplemented or replaced with new measures. This approach reflects agency desires to minimize the risk of imposing unnecessary measures. However, it also can result in management programs that develop too slowly and are ineffective or minimally effective. Adaptive management presumes an ability to measure the effectiveness of implemented measures. Effectiveness is usually evaluated by one of two methods: (1) monitoring trends in overall population abundance or particular population parameters (e.g., rates of mortality) in response to a particular measure, and (2) studies to assess the extent to which relevant stakeholders use or comply with recommended or required measures.

The North Atlantic right whale recovery program typifies the adaptive management approach although, in this case, one that has been unsuccessful. To reduce entanglement in fishing gear, NMFS adopted a take reduction plan in 1997 that relied largely on requirements for modifying fishing gear. As observed right whale entanglements continued with little evidence of a decline, NMFS has had to make frequent minor and major changes to its plan. However, instead of implementing fundamentally different approaches with a higher probability of addressing entanglement risks, adopted changes have relied on expanded requirements for the same gear modifications, so far resulting in little or no progress. To reduce right whale deaths due to ship collisions, NMFS initially relied on public outreach and voluntary actions by vessel operators. Initial outreach efforts were supplemented by mandatory ship reporting measures in the late 1990s to ensure that vessel operators transiting key habitats were aware of available information on right whales, collision risks, and avoidance measures. As those measures failed to reduce the frequency of collision-related right whale deaths, steps were initiated to develop a fundamentally different approach involving new speed and routing requirements. Adaptive management also has been used incrementally to better effect for expanding the scope of restrictions on fisheries interacting with southern sea otters and Steller sea lions and for boat speed limits to protect Florida manatees. In the Steller sea lion case, however, the changes in management were driven more by litigation than by recognition of and response to inadequate protection measures.

The scope and scale of recovery programs for listed marine mammals varies greatly depending on many factors including the types of threats, the adequacy of information with which to design management measures, public interest, and available funding. As indicated in the following section on staffing and funding, roughly 95 percent of the funding allocated to the 18 taxa listed as endangered or threatened has been devoted to 7 taxa (Florida manatees, California sea otters, Hawaiian monk seals, eastern and western Steller sea lions, North Atlantic right whales, and humpback whales). For the other 11 listed taxa (Puerto Rico manatees, southwest Alaska sea otters, Caribbean monk seals, Guadalupe fur seals, North Pacific right whales, bowhead whales, blue whales, fin whales, sei whales, sperm whales, and southern resident killer whales), recovery programs involve limited studies to assess population trends and limited management actions. Management efforts for large whales generally involve programs that cover multiple taxa simultaneously (e.g., take reduction plans addressing several species and participation in the IWC management program). Funding levels for the four taxa listed only as depleted under the MMPA are moderate to small. In general, no single factor or set of factors explains the disparate scope of recovery efforts.

For many of the taxa receiving the most funding, interactions with commercial fisheries have been and may continue to be the major issue (i.e., North Atlantic right whales, mid-Atlantic coastal bottlenose dolphins, Steller sea lions, Hawaiian monk seals, and southern sea otters). Management measures to address fishery interactions with listed marine mammals have frequently involved biological opinions prepared pursuant to section 7 of the ESA and lawsuits filed by environmental groups to compel greater protection for listed marine mammals. Adopted management actions have focused on the design of fishing gear, voluntary or mandatory use of fishing gear modifications, time/area fishing closures, fishery observer programs, disentanglement programs, and, in the case of southern sea otters, attempts to exclude animals from certain areas. In several cases, NMFS has convened take reduction teams composed of fishermen, government agency officials, conservationists, and other interests to recommend take reduction plans under the MMPA for reducing incidental injury and mortality. Although work to develop plans for non-listed marine mammals appears to have resulted in added protection in some cases (e.g., Gulf of Maine harbor porpoises), efforts to develop plans for listed taxa, such as North Atlantic right whales and bottlenose dolphins, have been less successful. In the case of North Atlantic right whales, entanglement rates have not declined since the take reduction plan was first implemented in 1997 despite periodic efforts to reconvene and expand the take reduction team and to implement significant plan modifications. In the case of bottlenose dolphins, limits on available information have delayed plan adoption. In these cases, it appears that MMPA provisions requiring the formation of take reduction teams and the preparation of take reduction plans have not been effective and that alternative approaches for identifying needed measures may be needed.

The depletion of prey resources by commercial fisheries also is a significant issue for some listed taxa (e.g., Steller sea lions and Hawaiian monk seals). Such indirect fishery interactions are nominally addressed in fishery management plans under the Magnuson-Stevens Fishery Conservation and Management Act, but our understanding of such potential impacts and efforts to investigate them have been inadequate to date. Following litigation concerning the effects of management plans for fisheries that might affect Steller sea lions, the North Pacific Fishery Management Council and NMFS limited fishing in or near certain sea lion habitats (e.g., rookeries and foraging areas), but they have not addressed the large-scale question of whether fishing under a maximum sustainable yield-based paradigm is safe for marine ecosystems. With regard to possible effects of lobster fishing on Hawaiian monk seals, the Western Pacific Fishery Management Council and NMFS rejected management recommendations by the Marine Mammal Commission for nearly 10 years until litigation and uncertainty as to the status of the lobster stock compelled NMFS to close the fishery entirely. Although efforts to address such indirect interactions are consistent with directives that fishery management plans establish optimal yield levels that take into account ecological factors, such efforts have been inconsistent at best and suggest that clearer guidance and direction are needed.

As a general matter related to both incidental taking in fishing gear and effects on prey availability, federal managers appear particularly reluctant to consider creating or modifying time/area closure provisions to address interactions with marine mammals. Although such actions are invariably controversial, time/area closures are routinely adopted and used to manage targeted fish stocks. However, most fishery management councils and NMFS have given little consideration to integrating time/area closure systems to benefit both marine mammal conservation and fish conservation objectives at the same time. A broader approach in preparing fishery management plans to adopt closure systems that attempt to meet conservation benefits for both fish stocks and marine mammals would be a positive step toward addressing conservation needs for marine mammals.

In several cases, state agencies have appeared more willing than federal agencies to establish fishery closures to protect marine mammals. For example, over the last decade, the state of California has excluded trap and net fishing from important sea otter habitats. In 2005 the state of Hawaii restricted all types of fishing in state waters of the Northwestern Hawaiian Islands to protect marine life, including Hawaiian monk seals.

Several listed taxa, particularly large whales and Florida manatees, are affected by vessel collisions. To reduce collision risks for whales, federal managers have relied largely on outreach and voluntary actions by mariners. The most ambitious efforts in this regard have focused on North Atlantic right whales that use calving grounds off Florida and Georgia and feeding grounds off New England. Those efforts advise vessel operators on ways to reduce collision risks and provide them with real or near-real time reports of whale sighting locations. Because these efforts have not reduced observed levels of collision-related right whale deaths, NMFS is developing regulatory measures to restrict vessel speeds and routing in key right whale habitats. Such rules have already been developed by the state of Florida and FWS to protect Florida manatees. Some of those rules have been contentious and subject to legal challenges. FWS and the state also have sought to reduce boat collisions with manatees by limiting or conditioning permits for marinas and other watercraft facilities in manatee habitat and by encouraging comprehensive manatee protection plans as part of county growth management plans.

Other management issues common to many listed marine mammal taxa are entanglement in marine debris and harassment by human activities. The taxa most affected by marine debris appear to be Hawaiian monk seals and the Pribilof Islands population of northern fur seals. Management actions to reduce marine debris impacts have included efforts to disentangle individual animals, public education to foster proper disposal practices, and volunteer beach clean-ups. Dedicated at-sea clean-up efforts also have been undertaken to remove hazardous debris from reefs adjacent to monk seal pupping beaches in the Northwestern Hawaiian Islands. To date, pleas for voluntary action to properly dispose of trash does not appear to have reduced debris levels. Efforts to reduce human disturbance have generally focused on keeping people some minimal distance away from animals. For example, NMFS has established a 100-yard minimum approach distance for humpback whales in Hawaii and Alaska and a 500-yard minimum approach distance for North Atlantic right whales. The agency also has developed non-binding whale-watching guidelines specific to each of its regions of the county. For Florida manatees, FWS has established no-entry manatee sanctuaries at warm-water refuges where manatees can avoid attention by swimmers and divers. To minimize disturbance of Hawaiian monk seals on beaches in the main Hawaiian Islands, volunteers working with NMFS and the state of Hawaii post temporary safety zones around hauled-out animals to keep beachgoers at a proper distance. These measure have had varying degrees of success.

For several listed marine mammal taxa, management programs include or encourage steps to purchase land or set aside areas whose development or use could adversely affect marine mammals or their habitat. Both the state of Florida and FWS have acquired tens of thousands of acres of land adjacent to waterways heavily used by Florida manatees. The importance of the Midway Islands as monk seal pupping habitat was a factor prompting the U.S. Navy to transfer the area to FWS for use as a national wildlife refuge. In several cases, marine areas have been designated as national marine sanctuaries largely or in part because of their importance as habitat for listed marine mammals (e.g., the Hawaiian Islands Humpback Whale National Marine Sanctuary, the Stellwagen Bank National Marine Sanctuary, and the Papahānaumokuākea Marine National Monument).

Another element common to management programs for several listed taxa (e.g., southern sea otters, Hawaiian monk seals, and Florida manatees) is direct intervention to improve survival rates or reduce risks (e.g., head start programs, translocations, and rescue/rehabilitation programs). Because of logistical limitations, direct intervention programs are generally not feasible for large whales (with the exception of disentanglement efforts noted previously). In the late 1980s FWS implemented a program to relocate southern sea otters outside their existing range in California to establish a new colony at an offshore island that would reduce the risk of a catastrophic event, such as an oil spill, affecting the entire remaining population. Between 1981 and 1993 NMFS attempted to increase the survivorship of Hawaiian monk seal pups at French Frigate Shoals and Kure Atoll by taking them into captivity for brief periods and then releasing them back into the wild. Injured and distressed Florida manatees are routinely brought into captivity for rehabilitation and release back into the wild.

STAFFING AND FUNDING

Staffing and funding are significant factors affecting the scope of recovery programs. Both have increased substantially since directed management programs were first required by the MMPA and ESA in the 1970s. NMFS estimates that it spent 131.4 FTEs in staff time on research and management activities for the 18 listed species and populations under its jurisdiction during 2005. Of this, 32.7 FTEs were by headquarters and regional office staffs for management purposes and 98.7 by the staff of fisheries science centers principally for research (Table 27) (Payne and Bengtson pers. comm.[27]). Seventy percent of that staff time was devoted to four taxa: North Atlantic right whales, western Steller sea lions, Hawaiian monk seals, and mid-Atlantic bottlenose dolphins. Nearly three-quarters of the remaining staff effort was devoted to four other taxa: southern resident killer whales, humpback whales, eastern Steller sea lions, and beluga whales. FWS and USGS allocated at least 30.9 FTEs in staff effort to the four listed marine mammals under jurisdiction of the Department of the Interior, most of which was devoted to the recovery efforts for Florida manatees.

Information on funding allocated to listed marine mammals is fraught with limitations. The most systematic and useful sources of information were (1) annual administrative reports prepared by FWS and USGS pursuant to a requirement of the MMPA (FWS 1981–1996, FWS and National Biological Service 1996, FWS and USGS 1997–2004), and (2) annual reports on recovery program expenditures for all endangered and threatened species prepared by FWS pursuant to a requirement in the ESA (FWS 2003b–d, 2005d–f, 2006). NMFS also prepared annual administrative reports pursuant to MMPA requirements through the early 2000s; however, its reports did not provide information on species-specific funding allocations. Annual MMPA administrative reports by FWS and USGS were more useful, but those also do not summarize total costs by species and address only the listed marine mammals under Department of the Interior jurisdiction (i.e., manatees and sea otters) and combine budget data for some categories for all marine mammals. Requirements for those reports have since been eliminated. Recent National Oceanic and Atmospheric Administration budget books also provide line-item summaries of appropriations that include information for some species, but many relevant line-items list only receiving organizations, and it is not clear what taxa or what work is being addressed. The Marine Mammal Commission's annual surveys of federally funded marine mammal research provide species-specific information on research projects but do not address funding for management activities and are organized by agency rather than species.

Perhaps the single most useful source of funding data are the FWS annual reports of expenditures for all endangered and threatened species. Those reports include a species-by-species summary of all "reasonably identifiable federal expenditures primarily for the conservation of endangered and threatened species," including expenditures by states receiving grants under section 6 of the ESA. In part, the reports identify taxa-specific funding levels by federal and state agencies for the listed marine mammals that receive the most funding. They do not, however, itemize costs for listed marine mammals that receive low levels of funding (generally those less than $1 million) or are not listed as endangered or threatened (i.e., species listed only as depleted under the MMPA). They also do not necessarily reflect costs that are not clearly related to a specific species. In this regard, agencies providing funding data have broad latitude in determining how they tabulate their expenditures. As a result, accounting methods differ across agencies. For example, budget data for the Coast Guard, whose enforcement and

[27] P. Michael Payne, personal communication. 17 August 2005. Chief, Marine Mammals Division, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD 20910; John Bengtson, personal communication. 8 December 2006. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA 98115.

support activities accounted for half of all reported expenditures on listed marine mammals in 2003, include all costs for ship operations (e.g., fuel costs, depreciation, and crew salaries) while on missions whose primary objective relates to listed species. Other agencies, however, apparently may not include such administrative and overhead costs. It also is unclear whether and how cost accounting methods by reporting agencies have changed over time, the extent to which participating agencies may have changed, or to what degree agency staff salaries are reflected. Notwithstanding such limitations, FWS reports provide the most comprehensive source of funding data available for listed marine mammals.

Table 27. Estimated number of full time equivalent staff positions (FTEs) devoted to marine mammal protection programs by the National Marine Fisheries Service and the Fish and Wildlife Service in fiscal year 2005 (P. M. Payne and J. Bengtson pers. comm.).

Species	NMFS Regional Offices & Headquarters	NMFS Fisheries Science Centers	Fish and Wildlife Service	U.S. Geological Survey	Total
Florida Manatee	–	–	11.25	13.36	24.61
Puerto Rican Manatee	–	–	1.00	0.75	1.75
Caribbean Monk Seal	0	0	–	–	0
Hawaiian Monk Seal	1.20	21.00	–	–	22.20
Western Steller Sea Lion	1.10	13.30	–	–	14.40
Blue Whale	0.35	1.18	–	–	1.53
Western Arctic Bowhead Whale	0.60	3.50	–	–	4.10
Fin Whale	0.60	0.28	–	–	0.88
Humpback Whale	1.80	5.30	–	–	7.10
North Atlantic Right Whale	16.00	13.20	–	–	29.20
North Pacific Right Whale	0.60	2.80	–	–	3.40
Sei Whale	0.20	0	–	–	0.20
Sperm Whale	0.53	1.70	–	–	2.23
Southern Resident Killer Whale	2.10	4.95	–	–	7.05
AT1 Killer Whale	0.20	0.25	–	–	0.45
Southern Sea Otter	–	–	2.00	?	2.00+
Guadalupe Fur Seal	0	0.20	–	–	0.20
Eastern Steller Sea Lion	1.30	5.13	–	–	6.43
Eastern North Pacific Fur Seal	1.70	8.40	–	–	10.10
Cook Inlet Beluga Whale	2.30	3.78	–	–	6.08
Mid-Atlantic Coastal Bottlenose Dolphin	2.10	13.75	–	–	15.85
Southwest Alaska Sea Otter	–	–	2.50	?	2.50+
TOTAL FTEs	32.68	98.72	16.75+	14.11+	162.16+

Based on those reports, federal expenditures for ESA-listed marine mammal taxa increased steadily from $8.5 million in 1998 to a high of $82.6 million in 2003, and then declined to $71.2 million in 2004 (Table 28). During that same period, expenditures by states receiving ESA section 6 grants increased from $40,100 to $8.9 million. Much of this increase can be attributed to funding for Steller sea lions. Excluding funds for that species, reported expenditures for the other ESA-listed marine mammals increased from $2.9 million to $17.1 million between 1998 and 2000 and then increased at a slower rate, reaching $28.6 million in 2004. For most listed marine mammals, more than half of all funding has been devoted to research and monitoring. The high expenditures on research reflect the fundamental need for demographic and biological data. Such data are essential for making and justifying management decisions in environmental impact statements, recovery and conservation plans, budget documents, and other decision-making records. For several listed marine mammals (e.g., AT1 killer whales, several great whales, and Guadalupe fur seals), research and monitoring studies are virtually the only activities funded.

Funding for marine mammal taxa listed under the ESA is heavily weighted toward a few taxa (Figure 1). Of the $82.6 million in federal and state expenditures reported during the peak funding year of 2003, 91 percent was allocated to four taxa: western and eastern Steller sea lions ($49.5 million and $5.3 million, respectively), North Atlantic right whales ($11.8 million), and Florida manatees ($9.8 million). More than half of the remaining funds were allocated to three other taxa: Hawaiian monk seals ($2.1 million), humpback whales ($1.6 million), and southern sea otters ($1.4 million). The remaining $1 million was distributed among the other nine ESA-listed taxa and was reported principally by the Coast Guard for enforcement. Overall, more than half of all reported expenditures for ESA-listed marine mammals in 2003 ($42.9 million) was reported by the Coast Guard for enforcement, principally related to Steller sea lions and North Atlantic right whales. Excluding Coast Guard funds from the 2003 total, federal and state expenditures totaled $39.6 million, with 88 percent allocated to eastern and western Steller sea lions ($14.9 million), North Atlantic right whales ($10.7 million), and Florida manatees ($9.85 million). An additional 12 percent was allocated to Hawaiian monk seals, southern sea otters and humpback whales. Only 0.4 percent of the funding by agencies other than the Coast Guard in 2003 was spent on the other nine listed taxa. Overall, federal agencies accounted for nearly all spending on all listed marine mammal taxa except Florida manatees, where the state of Florida has provided more than 60 percent of reported expenditures since the 1990s.

Funding levels for species listed only as depleted are less clear. Funding for bottlenose dolphins has exceeded $2 million in some years, but funding for Cook Inlet beluga whales, AT1 killer whales, and the eastern North Pacific fur seal population has rarely, if ever, exceeded about $200,000 to $400,000 annually.

During the period 2001–2004 expenditures reported by NMFS for listed marine mammals declined from $40.7 million to $32.6 million; those reported by FWS remained relatively steady at between about $2 million to $2.5 million (Figure 2). At the same time, Congress earmarked increasing amounts of funding to both agencies for various activities on specific taxa. Most notable in this regard were earmarks for Steller sea lions and North Atlantic right whales. A significant amount of the congressional earmarks was targeted to non-federal research organizations for research and monitoring activities. Although data have not been compiled for

2004 and 2005, congressional appropriations to NMFS and FWS for work on marine mammal recovery programs have been further reduced. As a result of recent budget cuts and increasing numbers of earmarks, the ability of NMFS and FWS to allocate funds among taxa on a discretionary basis is very limited.

Table 28. Total estimated federal and state expenditures on endangered and threatened species in fiscal years 1998–2005. Numbers in parentheses are state funding levels; all amounts are in $ thousands.

Species	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04
West Indian Manatee (Florida + Puerto Rico taxa)	1,565 (13)	4,351 (1,945)	9,743 (5,923)	9,373 (5,936)	8,571 (5,929)	9,799 (5,969)	9,862 (5,945)
Southern Sea Otter	495 (0)	615 (156)	624 (35)	1,094 (35)	1,066 (35)	1376 (40)	734 (20)
Caribbean Monk Seal	10 (0)	0 (0)	0 (0)	8 (0)	0 (0)	0 (0)	0 (0)
Hawaiian Monk Seal	1,156 (0)	1,105 (0.4)	1,267 (14)	2,121 (14)	2,197 (14)	2,145 (15)	2,321 (0)
Steller Sea Lion (East + West taxa)	3,079 (19)	7,234 (8)	13,113 (6)	46,783 (2,338)	55,998 (2,496)	–	–
Eastern Steller Sea Lion	–	–	–	–	–	5,297 (1,203)	10,811 (1,203)
Western Steller Sea Lion	–	–	–	–	–	49,514 (1,200)	31,746 (1,200)
Guadalupe Fur Seal	0 (0)	2 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (1)
Blue Whale	4 (1)	125 (0)	6 (0)	1 (0)	8 (0)	203 (0)	67 (2)
Bowhead Whale	1 (1)	(0) (3)	3 (3)	25 (25)	7 (0)	204 (0)	190 (0)
Fin Whale	5 (1)	13 (0.3)	5 (1)	24 (2)	13 (1)	206 (1)	72 (3)
Humpback Whale	361 (41)	492 (8)	567 (11)	740 (11)	890 (11)	1,615 (18)	666 (7)
Northern Right Whale (N. Pacific + N. Atlantic taxa)	1,460 (1)	3,273 (290)	4,872 (127)	6,036 (145)	8,393 (280)	11,802 (123)	12,370 (504)
Sei Whale	5 (1)	4 (0)	4 (0)	12 (0)	1 (0)	203 (0)	66 (0)
Sperm whale	5 (1)	7 (0)	3 (0)	27 (0)	1 (0)	203 (0)	2,270 (2)
TOTAL (All Marine Mammals)	$8,505 (81)	$17,222 (2,410)	$30,207 (2,410)	$66,244 (8,505)	$77,147 (8,765)	$82,567 (8,570)	$71,175 (8,887)
Percent of funding relative to all listed taxa	2.2% (0.5%)	2.6% (4.3%)	5.8% (6.1%)	10.2% (11.1%)	10.7 (11.7%)	12.1% (12.6%)	9% (14.5%)

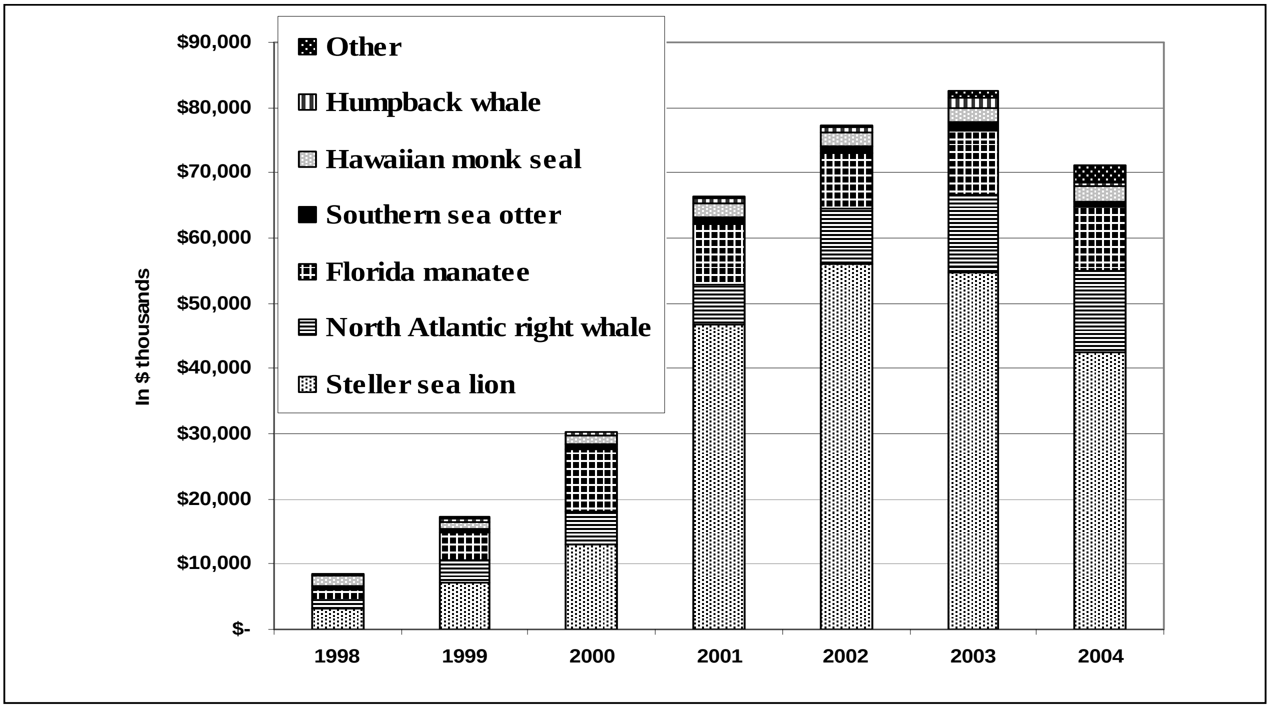

Figure 1. ***Expenditures for recovery activities on all taxa listed as endangered or threatened by species and by year, 1998 2004***

Recent trends in congressional funding for endangered marine mammal programs pose at least two major challenges for lead agencies. First, appropriated funding has not been sufficient to address all high-priority needs identified in recovery and conservation plans. Second, the increasing proportion of funding appropriated as earmarks limits the agencies' ability to respond to new information and issues. Although most earmarks have usefully addressed important research and management needs, they have reduced the ability of the lead agencies, particularly NMFS, to allocate funds based on its best assessment of greatest need or opportunity. In addition, although earmarks often allow the start-up of new programs, they do not provide a basis for carrying out long-term research or management work. As a result, modifications to existing recovery programs are difficult, and the implementation of new recovery initiatives for species and populations that may be equally or even more endangered than those receiving the most funding is limited. In addition, for those species that do receive significant funding, it is very difficult for the agencies to plan and support multi-year commitments that often are essential to achieve program goals.

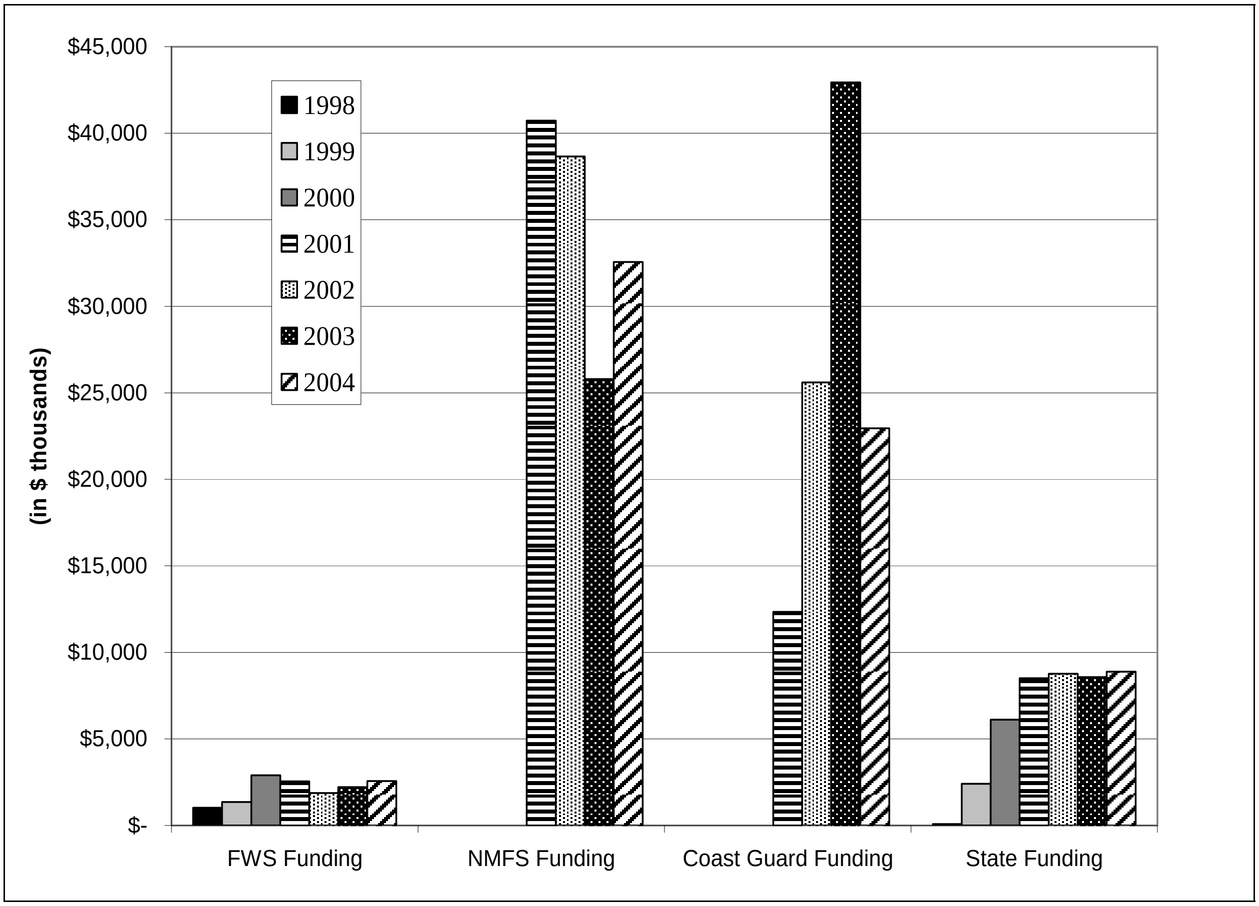

Figure 2. Expenditures for recovery activities on all taxa listed as endangered or threatened by agency and by year, 1998–2004. (Data for NMFS and USCG were not reported separately prior to 2001)

Where resources have been available, recovery efforts for threatened, endangered, and depleted marine mammal populations have become increasingly sophisticated. In some cases, improved research techniques have better defined factors responsible for population declines or failure to recover. In other cases, resolution of such causes has remained elusive. For most taxa, improved information, particularly with regard to stock structure, has made it clear that the task of recovery is far more complex than previously thought. Managers must consider not just a single, broadly distributed species but multiple populations and subpopulations, each of which may be affected by different threats and human activities in a variety of ways that are not always apparent. This has made scientific and political decisions concerning how to mitigate the impact of human activities more difficult.

Pressures on marine mammal populations, not to mention other marine wildlife, are clearly increasing as human demands for food, waste disposal, and economic development continue to grow. Although recovery programs for listed marine mammals have made great strides in addressing these issues, and some listed species are making good progress toward recovery, constraints on funding levels and agency flexibility loom as significant impediments in addressing pressing needs for other species.

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VII. APPENDICES

APPENDIX A. MAJOR FEDERAL STATUTORY PROTECTION MEASURES

MARINE MAMMAL PROTECTION ACT

Passage of the Marine Mammal Protection Act (MMPA) in 1972 marked a dramatic departure from previous regimes for managing living marine resources (Bean and Rowland 1997). Rather than aiming to manage marine mammals for their maximum sustainable yield, the Act established as its primary objective "…to maintain the health and stability of the marine ecosystem." As consistent with this objective, the Act also established a goal "…to obtain an OSP keeping in mind the carrying capacity of the habitat." The Act defines OSP as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element." This definition was further refined by NMFS in regulations as "a population size, which falls within a range from [the carrying capacity of the] ecosystem to the population level that results in maximum net productivity." Thus, rather than establishing a management regime focused on maximizing economic returns, it sought to assure that marine mammals are maintained as vital, functioning parts of a healthy marine environment.

The Act vested the Secretaries of Commerce and the Interior with responsibility for implementing its provisions. The Secretary of Commerce, acting through the National Marine Fisheries Service, has primary authority for all species in the order Cetacea (whales and porpoises), as well as all species in the order Pinnipedia (seals and sea lions) except walruses. The Commerce Secretary also implements the Act's provisions on incidental take of all marine mammals in commercial fisheries. The Secretary of the Interior, acting through the U.S. Fish and Wildlife Service, exercises authority for the Act's application to manatees, dugongs, polar bears, sea and marine otters, and walruses. The Act also established the Marine Mammal Commission, whose primary responsibility is to provide an independent source of advice and oversight to the Services and other federal and state agencies with regard to the Act's implementation. In assigning these responsibilities, the Act pre-empts state laws or regulations relating to the taking of marine mammals unless authorized through a process by which management authority can be transferred to individual states.

Moratorium on Taking and Relevant Exceptions

A central feature of the MMPA is its moratorium on "taking" and importing of marine mammals. This moratorium is subject to exceptions, exemptions, and waivers, whose number and breadth has grown as Congress has amended the Act (Bean and Rowland 1997). In defining "take," Congress included both intentional and unintentional capture, killing, and harassment of marine mammals. Harassment, in turn, has been defined to include actions that have the potential to injure or disturb a marine mammal or marine mammal stock in the wild.

Native Exemption: Section 101(b) of the Act exempts Alaska Indians, Aleuts, and Eskimos from the Act's prohibitions on taking when the taking is for subsistence purposes or for purposes of creating and selling authentic Native articles of handicrafts and clothing and the taking is not accomplished in a wasteful manner. Native takes of depleted species may be limited by regulation. Section 119 of the Act, adopted in 1994, authorizes the Secretaries of Commerce and the Interior to "…enter into cooperative agreements with Alaska Native organizations to conserve marine mammals and provide co-management of subsistence use by Alaska Natives."

Permits for Scientific Research, Public Display, Enhancement, and Photography: The MMPA authorizes the Services to issue permits for the taking or importation of marine mammals for the purposes of scientific research, public display, or enhancing the survival or recovery of a species or population. Amendments in 1994 provided additional authorization to grant permits for the taking of marine mammals in the course of educational or commercial photography.

The 1994 amendments to the MMPA also authorized the Services to issue letters of general authorization for research that may disturb but not injure a marine mammal or marine mammal population (MMC 2005). Such general authorizations are not allowed for activities that involve the taking of endangered or threatened species, which remain subject to separate ESA permitting requirements.

Small-Take Authorizations: Section 101(a)(5) of the MMPA directs NMFS and FWS to authorize the taking of small numbers of marine mammals incidental to activities other than commercial fishing (MMC 2005), provided that certain findings are made. In 1986 Congress amended the Act to allow the taking of marine mammals from depleted species and populations, as well as from non-depleted species and populations (MMC 2005). There are three basic types of such small-take authorizations:

- Authorization for most types of small takes require the promulgation of regulations that identify permissible methods of taking and specify reporting and monitoring requirements. The Services must determine that the taking will have a negligible impact on the affected populations and will not have an unmitigable adverse impact on the availability of such populations for subsistence purposes. Authorizations, under section 101(a)(5)(A), may be effective for as long as five years.
- In 1994 Congress added section 101(a)(5)(D) to streamline such authorizations if the taking will involve harassment only. Such authorizations do not require the promulgation of regulations but are subject to public notice and comment. Such authorizations may be issued for no longer than one year at a time.
- In 2003 Congress revised the small-take provisions as they apply to "military readiness activities." Among other things, it removed the small numbers and geographic specificity limitations and required the consideration of several factors such as personal safety and practicality in designing mitigation measures.

The Marine Mammal Commission generally comments on all such applications and associated regulations.

Taking Incidental to Commercial Fishing: In passing the MMPA, Congress set a goal of reducing the mortality and serious injury of marine mammals incidental to commercial fisheries "to insignificant levels approaching a zero mortality and serious injury rate" (NMFS 2004c). In amending the Act in 1994, Congress set a deadline of April 30, 2001, for achieving the goal of insignificant levels of incidental mortality and serious injury incidental to fisheries. Section 118(b) includes four elements (NMFS 2004b):

- Fisheries must reduce incidental mortality and serious injury to insignificant levels approaching zero;
- Fisheries that do reduce their levels of incidental mortality and serious injury to insignificant levels shall not be required to make further reductions;
- NMFS must review the progress of all commercial fisheries in meeting this goal and identify fisheries where additional information is required in order to assess the level of incidental mortality in a fishery; and
- If a fishery is not meeting the goal of zero mortality and injury rate, NMFS must use the mechanisms in section 118(f), including the convening of take reduction teams and the preparation, approval, and implementation of take reduction plans.

The 1994 amendments also included a mechanism (section 101(a)(5)(E)) for authorizing limited incidental take of marine mammals listed under the Endangered Species Act if NMFS or FWS determine that:

- The incidental mortality and serious injury will have a negligible impact on the species or stock;
- A recovery plan has been or is being developed under the ESA; and
- If required, a monitoring program has been established under section 118.

The MMPA allows intentional lethal taking of marine mammals in commercial fishery operations only if it is "imminently necessary in self-defense or to save the life of another person in immediate danger." Fishermen may intentionally take marine mammals by nonlethal means to deter them from damaging gear, catch, or other property under certain circumstances (MMC 2002). Section 101(a)(4) requires that the two Services publish guidelines on how to deter marine mammals safely (MMC 2002), but neither agency has yet published and finalized such guidelines.

Sections 117 and 118 of the MMPA require NMFS to carry out a comprehensive program to reduce interactions between marine mammals and commercial fishing operations (NOAA Fisheries 2000). That program includes—

- the preparation of stock assessment reports,
- convening of scientific review groups,
- publishing a list of fisheries,
- convening take reduction teams to develop take reduction plans, and
- meeting short- and long-term goals for reducing incidental takes of marine mammals.

<u>Stock Assessment Reports:</u> Section 117 requires marine mammal stock assessment reports to be prepared for all marine mammal stocks in U.S. waters. These reports are to be updated periodically based on use of the "best scientific information available."

The MMPA defines a population stock as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature." NMFS has interpreted this to mean "a management unit that identifies a demographically isolated biological population" (NMFS 2003b). A stock may be delineated based on its distribution and movements or population trends, as well as differences in morphology, genetics, contaminant and natural isotope loads, parasites, and oceanographic habitats. Reproductive isolation is proof of demographic isolation, according to the Service. (As a policy matter, the Service considers this definition to be different from the ESA definition of a distinct population segment, which it interprets as requiring that a population not only be distinct but that it represent an important component of the evolutionary legacy of the species [i.e., that it constitute an evolutionarily significant unit] in order to qualify for listing as endangered or threatened.)

Stock assessment reports must include a determination of the stock's potential biological removal (PBR) level. PBR is defined as the maximum number of animals—not including natural mortalities—that may be removed from a marine mammal population while still allowing that population to reach or maintain its OSP level. The stock assessment reports also must identify those stocks that are to be considered "strategic stocks." These include stocks with levels of human-caused mortality that exceed PBR, as well as any stock listed as endangered or threatened under the ESA, declining and likely to be listed as such in the foreseeable future, or listed as depleted under the MMPA (NMFS 2004b). Of the 145 marine mammal stocks assessed in 1995, 47 were determined to be strategic stocks (MMC 2002). The MMPA requires that assessments of strategic stocks be reviewed at least annually and those of other stocks be reviewed at least once every three years.

Under the MMPA, a species is designated as depleted when it falls below its OSP or if it is listed as endangered or threatened under the ESA. Once a species is determined to be depleted, a conservation plan may be developed to guide research and management actions to restore the species. As of June 2005, five marine mammal stocks had been designated as depleted independently of listing under the ESA.[28] They are the North Atlantic coastal bottlenose dolphin, the eastern spinner dolphin, the North Pacific or northern fur seal, the northeastern offshore spotted dolphin, and the Cook Inlet beluga whale.

Of these five depleted populations, NMFS has prepared draft conservation plans for North Atlantic coastal bottlenose dolphins and Cook Inlet beluga whales.

Scientific Review Groups: Under section 117 of the Act, the Secretary of Commerce established three regional scientific review groups—one each for Alaska, the Pacific Coast and Hawaii, and the Atlantic coast including the Gulf of Mexico (NOAA Fisheries 2000). Besides reviewing draft stock assessments, the review groups advise NMFS on a wide range of issues, including population status, trends, stock identity and dynamics, necessary research on marine mammals stocks, and methods to reduce incidental mortality and injury.

[28] The Hawaiian monk seal and the bowhead whale also were designated depleted under a separate action although both species also now qualify by virtue of their endangered status.

List of Fisheries: Section 118 requires NMFS to publish annually a list of fisheries that places all U.S. commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals (69 Fed. Reg. 48407). The list of affected species generally is based on observer data, logbook data, stranding reports, and reports of fishermen. Since 1996 some fisheries have been classified as category II fisheries by analogy to other gear types that are known to injure or kill marine mammals rather than on documented interactions (NOAA Fisheries 2000).

Fisheries are classified according to the impact of all fisheries on each marine mammal population, then the impact of individual fisheries on each population, measured as a ratio of the number of animals killed or injured to the PBR level (69 Fed. Reg. 48408).

- *Category I Fisheries*: Annual mortality and serious injury in a given fishery is greater than or equal to 50 percent of the PBR level.
- *Category II Fisheries*: Annual mortality and serious injury in a given fishery is between 1 and 50 percent of the PBR level, and the total number of deaths and serious injuries from all fisheries is greater than 10 percent of the stock's PBR level.
- *Category III Fisheries*: Annual mortality and serious injury in a given fishery is less than or equal to 1 percent of the PBR level or the total annual mortality and serious injury across all fisheries is less than or equal to 10 percent of the stock's PBR level.

In 2004 NMFS identified 7 category I fisheries, 34 category II fisheries, and 174 category III fisheries (69 Fed. Reg. 48407). Of the seven category I fisheries, six were listed as taking endangered, threatened, or depleted species (see Appendix B). Another 19 category II fisheries and 26 category III fisheries were listed as taking endangered, threatened, or depleted species of marine mammals.

Owners of vessels or gear engaging in a category I or II fishery are required by section 118(c)(3) to register with NMFS to engage lawfully in those fisheries or to be authorized to take a marine mammal incidental to their fishing operations (69 Fed. Reg. 48409). Participants in category III fisheries are not required to register with NMFS. Regardless of the category of a fishery, participants are required by law to report to NMFS all incidental injuries and mortalities occurring during commercial fishing operations (69 Fed. Reg. 48409). The Service defines injury as a wound or other physical harm, as well as the ingestion of or entanglement in fishing gear. Participants in category I and II fisheries are required to take on board an observer upon request by NMFS.

Zero Mortality Rate Goal: As mentioned above, the MMPA has always included a goal of reducing incidental mortality and serious injury to insignificant levels approaching a zero rate. However, Congress did not provide clear guidance in the interpretation of the so-called zero mortality rate goal, which includes zero serious injury. In July 2004 NMFS finalized a rule defining the threshold below which the rate of mortality or serious injury should be considered insignificant (69 Fed. Reg. 43338). Under the final rule, the agency set the threshold at 10 percent of a marine mammal stock's PBR level. In cases where the Service has inadequate information to determine population abundance or the rate of mortality and serious injury, it treats such stocks as experiencing incidental mortality and serious injury above insignificant levels (NMFS 2004c). Stocks treated in this manner include the northeastern Pacific fin whale, the North Pacific sperm whale, and the Hawaiian monk seal.

Take Reduction Plans: Section 118 of the MMPA requires that NMFS develop and implement a take reduction plan where a strategic stock of marine mammals interacts with a category I or II fishery and allows for development of take reduction plans for other category I fisheries where any stock of marine mammals interacts with a category I fishery that results in a high level of mortality and serious injury across a number of marine mammal stocks (NMFS 2004b).

The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the incidental mortality and serious injury rate in a fishery to levels less than the PBR level for all affected marine mammal stocks. The overall goal is to reduce this rate to insignificant levels approaching a zero mortality and serious injury rate within five years of implementation. In seeking to achieve the latter goal, NMFS must take into account the economics of the fishery, the availability of existing technology, and existing fishery management plans.

Where human-caused mortality and serious injury is believed to be equal to or greater than the stock's PBR level, a take reduction team must prepare a take reduction plan within six months of the finding (MMC 2004). If NMFS has insufficient funds to prepare and implement all required take reduction plans, it gives priority to marine mammal stocks with mortality and serious injury rates greater than the stock's PBR level, stocks with a small population size, and stocks with the highest rate of decline (NMFS 2004c).

Four of the six take reduction teams convened by NMFS concerned fisheries that involved marine mammal populations listed as endangered or threatened under the ESA include the Pacific Offshore Cetacean, Atlantic Offshore Cetacean, Atlantic Large Whale, and Atlantic Bottlenose Dolphin teams.

ENDANGERED SPECIES ACT

In 1973 Congress passed a major revision of earlier versions of the endangered species legislation passed in 1966 and 1969, which had required the listing of species but provided no meaningful protection (FWS 2004). The principal purposes of the Endangered Species Act (ESA) of 1973 are to conserve "the ecosystems upon which endangered and threatened species depend" and to conserve and recover listed species. The Act placed responsibility for implementation in the hands of the Secretary of the Interior and the Secretary of Commerce, who delegated this authority to FWS and NMFS. Unlike the MMPA, the ESA allows states to adopt state laws and regulations relating to the taking of listed species, provided that those laws and regulations are more restrictive than those applicable under the Act. States may enter into cooperative agreements with the Services for carrying out certain recovery and other functions.

Like the MMPA, the ESA contemplates not only the conservation of individual species but also of the ecosystems upon which they depend. The aim of the Act is to employ all methods necessary "to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." To this end, the Act places a positive duty upon federal agencies to conserve endangered and threatened species and to promote their recovery (Bean and Rowland 1997).

In 1978 Congress added a requirement for the preparation of recovery plans[29] to aid in achieving the Act's goal of restoring endangered and threatened species so that the protections of the Act would no longer be needed (Bean and Rowland 1997). Later amendments provided greater detail on the contents and timing of such plans, as discussed later.

Prohibitions on Taking Endangered and Threatened Species and Exceptions

The ESA makes it unlawful to "take" an endangered species (FWS 2004). The Act defines take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The Services have defined "harm" by regulation as "an act which actually kills or injures wildlife" (64 Fed. Reg. 60727). Such an act "may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." The Secretary of the Interior also defined harass as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." NMFS has not defined these terms (FWS and NMFS 1998).

None of the prohibitions described here apply to activities affecting threatened species unless the appropriate Service issues regulations to that effect (Bean and Rowland 1997). The Services may issue prohibitions applicable to all threatened species or applicable only to individual threatened species.

Like the MMPA, the ESA includes exemptions to the prohibition on taking endangered species, which have expanded over time (Bean and Rowland 1997):

Native Exemption: From the beginning, the ESA provided an exemption to certain Alaska Natives and non-native permanent residents of Alaska Native villages to take listed species primarily for subsistence purposes and to sell non-edible byproducts when made into authentic Native handicrafts (Bean and Rowland 1997). The appropriate Service may regulate the harvest of listed species if it finds that the taking "materially and negatively affects" the species.

Permits for Scientific Research: The ESA authorizes the Services to issue permits allowing otherwise prohibited acts for the purposes of scientific research or enhancement of a population. Before issuing such permits, the Services must find that the activity will not "operate to the disadvantage" of the species.

Incidental Taking of Listed Species: In 1982 Congress provided authority to permit the taking of an endangered species incidental to an otherwise lawful activity (Bean and Rowland 1997).

[29] The Fish and Wildlife Service defines recovery as the process by which the decline of an endangered or threatened species is arrested or reversed and threats removed or reduced so that the species' survival in the wild can be assured (FWS 2004).

Such permission may be granted only if there is an acceptable plan and funding to mitigate the takings and only if the takings will not "appreciably reduce the likelihood of the survival and recovery of the species in the wild."

Incidental taking may also be authorized through a so-called "section 7(b)(4) statement" for federal actions that are subject to consultation under section 7(a)(2) of the ESA. If the Service determines that the "no-jeopardy" standard has been met and the authorized level of incidental taking will not jeopardize the continued existence of the species, it is to specify the level of taking that is allowed and set forth reasonable and prudent measures and related conditions designed to minimize the impact. For listed marine mammals, an incidental take statement may not be issued unless that taking has also been authorized under section 101(a)(5) of the MMPA.

Listing Categories and Processes

Fundamental to the structure of the ESA are two classifications of species: endangered and threatened (Bean and Rowland 1997). An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered in the foreseeable future. In order to be listed, a species must be determined to be endangered or threatened because of any of five factors:

- The present or threatened destruction, modification, or curtailment of the species' habitat or range;
- Overutilization for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms;
- Other natural or manmade factors affecting the species' survival.

The listing of a species is the result of a rulemaking, which results in placing a species on the "List of Endangered and Threatened Wildlife," published at 50 C.F.R. § 17.11.

Once a species is placed on the list as endangered, all protective measures of the Act apply to the species and its habitat. Section 9 of the Act prohibits any person subject to the jurisdiction of the United States from, among other things, taking, importing, exporting, shipping in commerce in the course of a commercial activity, selling, or offering for sale any endangered species. In 1994 the Services adopted a policy of establishing a procedure at the time of listing that would identify activities that would or would not constitute a violation of the prohibitions on taking found in section 9 of the Act.

Prohibitions applicable to threatened species are established through regulations published pursuant to section 4(d) of the Act. These "protective regulations" need not, but often do include all of the prohibitions applicable to endangered species under section 9.

All species of plants and animals, except pest insects, are eligible for listing. The Act defines "species" broadly to include subspecies as well as distinct population segments of vertebrate species. The Services adopted a policy in 1996 that interpreted the term "distinct population segment" (61 Fed. Reg. 4722). This interpretation includes three elements:

- Discreteness of the population segment in relation to the remainder of the species to which it belongs;
- The evolutionary significance of the population segment to the species to which it belongs; and
- The population segment's conservation status in relation to the Act's standards for listing.

A population segment may be considered discrete if it is markedly separated from other populations of the same taxon by physical, physiological, ecological, or behavioral factors or is delimited by international government boundaries within which differences in management and other factors may be significant. Determining whether a population segment is significant may be based upon such findings as persistence of the population in an ecological setting unusual or unique for the taxon.

Recovering threatened or endangered species may sometimes benefit from reintroduction of the species into areas of its former range. Under section 10(j), the ESA defines such experimental populations as a geographically described group of reintroduced plants or animals that is isolated from other existing populations of the species (FWS 2002). Regardless of the species' designation elsewhere, an experimental population is considered threatened.

As of August 2006, 1,879 species were listed, including 1,310 in the United States. Of the 566 animal species with U.S. distribution, 410 species are listed as endangered and 156 as threatened. This includes 16 marine mammal species (see Table A-1).

Table A-1. Marine mammals in U.S. waters listed as endangered or threatened under the ESA

Common Name	Scientific Name	Where Listed
Endangered		
West Indian manatee	*Trichechus manatus*	Entire range
Northern sea otter	*Enhydra lutris kenyoni*	Southwest Alaska DPS
Steller sea lion	*Eumetopias jubatus*	Western population
Caribbean monk seal	*Monachus tropicalis*	Entire range
Hawaiian monk seal	*Monachus schauinslandi*	Entire range
Blue whale	*Balaenoptera musculus*	Entire range
Fin whale	*Balaenoptera physalus*	Entire range
Sei whale	*Balaenoptera boreali*	Entire range
Humpback whale	*Megaptera novaeangliae*	Entire range
Bowhead whale	*Balaena mysticetus*	Entire range
Right whale	*Eubalaena glacialis*	Entire range
Gray whale	*Eschrichtius robustus*	Western Pacific Ocean
Sperm whale	*Physeter catodon*	Entire range
Threatened		
Southern sea otter	*Enhydra lutris nereis*	California (except experimental population at San Nicolas Island)
Steller sea lion	*Eumetopias jubatus*	Eastern population
Guadalupe fur seal	*Arctocephalus townsendi*	Entire range

Candidate Lists: Periodically, the Services publish a list of U.S. species that appear to meet the definitions for threatened or endangered (FWS 2004). As of June 2005, 44 marine species were on the species of concern list, two of which were marine mammals. The Cook Inlet population of beluga whales was originally placed on the candidate list in 1988; the southern resident population of killer whales was placed on the candidate list in 2001. Because of the large number of candidates and limited resources to conduct reviews, in the late 1970s the Services began developing systems for setting priorities among candidate species. In 1983 FWS adopted a priority system based on three criteria: the degree or magnitude of threat, the immediacy of the threat, and the taxonomic distinctiveness of the species (monotypic genus, then species, subspecies, variety, or vertebrate population).

Although the Services may initiate the listing process, individual citizens may also petition to have a species considered for listing under section 4(b) of the ESA. Within 90 days of receiving a petition, FWS or NMFS must publish a finding as to whether there is "substantial information" indicating a listing may be warranted. If the Service finds that a listing may be warranted, it must, within one year, make a finding as to whether the listing is or is not warranted. If, after the year, the Service finds that a listing is warranted, it may issue a proposed rule to list the species or, if other listing activities have a higher priority, it may defer issuing a proposed rule. In these latter cases, the Service must annually find whether the listing is warranted and either propose a rule to list the species, find that a listing is not warranted, or that it remains precluded by other, higher-priority listing actions.

Downlisting or Delisting Species: Every five years the Services review the status of listed species, as required by section 4(c)(2) of the Act. The Services base this review on goals for downlisting and delisting identified in recovery plans prepared for listed species. Based on this review, the Services may determine that a species may warrant downlisting or delisting (48 Fed. Reg. 43103). In considering whether to downlist or delist a species, the Service must follow the same process as when considering whether to list a species, including assessment of the status of the species and of existing threats and issuance of a proposed rule. To delist a species, the Services must determine that the species is not threatened by any of the five factors noted earlier. If a species is delisted, the Service must monitor the species for at least five years.

Designation of Critical Habitat

The ESA requires designation of critical habitat for listed species, with some exceptions (FWS 2004). Critical habitat includes geographic areas "on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection." Those features include the following:

- Space for individual and population growth and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, and rearing of offspring, and
- Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of the species.

Designation of critical habitat must take into account possible economic impacts. An area may be excluded if the benefits of exclusion outweigh the benefits of designation and if the exclusion will not result in the extinction of the species (NMFS 2004). If it is found that designation would increase the degree of threat to a species (e.g., by informing would-be collectors of its location) or that the designation would not benefit the species, critical habitat does not have to be designated. Section 7(a)(2) of the Act requires that federal agencies avoid the destruction or adverse modification of critical habitat, whether or not the species currently uses that habitat.

Preparation of Recovery Plans

Unless the Secretary of the Interior or the Secretary of Commerce finds that a recovery plan will not promote the conservation of a listed species, the ESA requires the development and implementation of such a plan. Section 4(f)(1)(B) specifies the contents of a recovery plan as follows:

- a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
- objective, measurable criteria which, when met, would result in a determination…that the species may be removed from the list; and,
- estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

Although recovery plans do not have the force of regulation, they do serve as the principal tool for guiding each species' recovery process (NMFS 2004).

The agencies may appoint recovery teams to assist in the development and implementation of recovery plans, and those teams may include non-agency participants. As of June 2005 recovery plans had been adopted for 8 of the 16 marine mammal populations listed previously in this report, with separate plans prepared for Florida and Puerto Rico populations of the West Indian manatee and a single plan addressing both the eastern and western Steller sea lion populations.

In October 2004 NMFS issued interim guidance on recovery planning for listed species (NMFS 2004). In it, the Service emphasizes an ecosystem approach to recovery planning that encompasses the health of a species' habitat and ecosystem rather than simply the species' abundance and range (NMFS 2004). Similarly, the guidance calls for a shift in focus from simply increasing a species' numbers to alleviating threats that are contributing to the endangered or threatened status of a species or are likely to do so in the future. According to the guidance, a recovery plan should include an assessment of threats that determines the relative importance of each. The first step in the process is preparing a recovery outline based on currently available information. The recovery outline includes a preliminary strategy for guiding initial recovery actions and for making determinations regarding critical habitat, consultation, and take (NFMS 2004). The plan also is to identify recovery priorities using guidelines adopted by the Services in 1990 (55 Fed. Reg. 24296). Using this protocol, species are ranked on a scale from a high of 1 to a low of 12 regarding the magnitude of threat, recovery potential, and conflict with development projects or other economic activity. The recovery outline must also include a vision statement and a brief action plan.

A plan's recovery strategy should identify key facts and assumptions and specific objectives, together with their priority and timing, and recovery criteria—measurable and objective targets or values by which progress toward achievement of recovery objectives, especially the reduction or elimination of threats, can be measured. In determining priorities for recovery actions, a plan must use the following criteria (55 Fed. Reg. 24296):

- Priority Action 1: Actions that must be taken to prevent extinction or to prevent the species from declining irreversibly;
- Priority Action 2: Actions that must be taken to prevent a significant decline in a species' population or habitat quality or in some other significant impact short of extinction; and
- Priority Action 3: All other actions necessary to provide for full recovery of the species.

NMFS guidance requires that recovery plans describe actions and identify the length of time to complete the action, the responsible parties, and estimates of the costs. Regarding the last element, the guidance calls for estimating costs for the first five to ten years and until full recovery is achieved. Although citing the Act's requirement to identify costs, the guidance acknowledges the difficulty of estimating costs far into the future. Finally, NMFS guidance requires review of recovery plans after the five-year review of a listed species.

For a species listed as endangered or threatened and as depleted, a recovery plan required by the ESA generally serves also as the conservation plan required by the MMPA. Besides the components of a recovery plan identified here, a recovery plan should include information identified in Senate Report 100-92, according to the Service's guidance (NMFS 2004):

- an assessment of the status of the species or population and its essential habitat;
- a description of the nature, magnitude, and causes of any population declines or loss of essential habitat;
- an assessment of existing and possible threats to the species and its habitat;
- a discussion of critical information gaps;
- a description and discussion of research and management that could be undertaken to meet the objectives of the plan; and
- a schedule for implementing the research and management actions.

The guidance also calls for including goals and criteria for delisting under the ESA as well as goals and criteria for attaining OSP levels as required by the MMPA. Recovery plans must also include any take reduction plans developed under the MMPA, as well as any plans regarding rescue, rehabilitation, and captive breeding.

Section 7 Consultations and Obligations of Federal Agencies

Section 7 of the ESA contains several provisions that are designed to protect threatened and endangered species and designated critical habitat in the United States, its territorial seas, and the high seas. Section 7(a)(1) of the Act directs NMFS, FWS, and all other federal agencies to use their authorities to promote the conservation of threatened and endangered species. Section 7(a)(2) requires federal agencies to engage in consultations with NMFS, FWS, or both to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat that has been designated for these species.

There are several forms of consultation, but the most common forms are “informal” and “formal.” Informal consultations are designed to determine if formal consultation on a federal action is required. Federal agencies can, however, work with the Services during an informal consultation to modify a particular action to eliminate the likelihood of adversely affecting listed resources. As a result, they may avoid having to consult formally on the action. If, however, a federal action is likely to adversely affect listed resources, agencies are generally required to engage in a formal consultation with the Services. Formal consultations are designed to determine if federal actions are likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat (FWS and NMFS 1998).

Formal consultations generally conclude when the Services provide a federal agency with their “biological opinion” on an agency action. Biological opinions, which document the Services’ conclusions on an action and the reasons and evidence that led them to their conclusions, can conclude that an action is or is not likely to jeopardize the continued existence of threatened or endangered species or is or is not likely to result in the destruction or adverse modification of critical habitat that has been designated for these species. If the Services conclude that a federal action is likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat, they are required to work with federal agencies and any applicants to develop and recommend “reasonable and prudent alternatives” to the original proposal that are not likely to jeopardize the species or result in the adverse modification of critical habitat.

When the Services conclude that a federal action is not likely to jeopardize threatened or endangered species or result in the destruction or adverse modification of critical habitat, or when they can recommend reasonable and prudent alternatives that avoid these outcomes, but the action is still likely to “incidentally take” a threatened or endangered species, the Services are required to include an “incidental take statement” in their biological opinions. These statements exempt “take” associated with an action from the normal prohibitions of the Act. To receive these exemptions, federal agencies must (1) comply with reasonable and prudent measures and terms and conditions that the Services include in their incidental take statements and (2) for listed marine mammals, obtain an incidental take authorization under section 101(a)(5) of the MMPA.

Most federal agencies that operate in coastal and marine waters of the United States, its territorial seas, or the high seas—the U.S. Navy, U.S. Coast Guard, the Army Corps of Engineers, and NOAA, among others—engage in consultations with the Services to insure that their operations are not likely to jeopardize threatened or endangered species or result in the destruction or adverse modification of critical habitat designated for these species. NMFS engages in consultations on its fishery management plans and other actions related to its oversight of fisheries. The Minerals Management Service engages in consultations with the Services on oil and gas or mineral leasing, exploration, development, and production on the outer continental shelf. The U.S. Navy, National Science Foundation, Minerals Management Service, NOAA, and other federal agencies that fund research in the territorial seas of the United States or the high seas engage in consultations with the Services.

Before NMFS or FWS issues any permits for scientific research on ESA-listed marine mammals —or activities that are taken to enhance the propagation or survival of these species—in the United States, its territorial seas, or the high seas, those permits undergo formal section 7 consultation.

OTHER AUTHORITIES

National Environmental Policy Act

Under the National Environmental Policy Act, major federal actions that may have significant effects on the environment trigger a requirement for the preparation of an environmental impact statement that must describe any unavoidable adverse environmental effects, alternatives to the action, and the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In recent years, these requirements have played a significant role in the evaluation of the impact of major fisheries off Alaska on endangered Steller sea lions.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 established a regional system for the development and conservation of marine fisheries in the Exclusive Economic Zone. Unlike the MMPA, the Magnuson-Stevens Act did not preempt state management authority for fisheries that occur primarily in state waters. The Act vested the Secretary of Commerce, acting through NMFS, with authority to review, approve, disapprove, and implement fishery management plans developed by regional fishery management councils. The regional councils include representatives of various sectors of the commercial and recreational fishing industry, other interests, state fisheries managers, and several federal agencies.

The Act establishes 10 national standards that fishery management plans must meet. National Standard 1 calls for preventing overfishing "while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry."[30] The optimum yield is a catch level that takes into account factors including ecological interactions with other species and ecosystem components. National Standard 9 calls for minimizing bycatch, to the extent practicable, and where bycatch cannot be avoided, minimizing mortality. Although amendments in 1996 changed some provisions to make management more risk-averse and cognizant of ecosystems, managers have remained largely focused on production and yield.

[30] The term "optimum," with respect to the yield from a fishery, means the amount of fish that—

(A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

(B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and

(C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Since 1977 regional fishery management councils have developed many fishery management plans, which have been reviewed and implemented by the Service. To varying degrees, the councils have increasingly taken into account the impact of fisheries on marine mammals. However, these considerations remain incompletely addressed in most cases.

National Marine Sanctuary Program

The National Marine Sanctuary Program in the National Ocean Service, established under the Marine Protection, Research, and Sanctuaries Act of 1972, authorizes the Secretary of Commerce to designate and manage areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities. The Act also directs the Secretary to facilitate all public and private uses of those resources that are compatible with the primary objective of resource protection. The sanctuary program may regulate activities identified at the time a sanctuary is designated or during regular revisions of sanctuary management plans. The appropriate fishery management council must be given the opportunity to draft any fishery-related regulations if the sanctuary managers determine that fishery management measures are needed to meet the sanctuary's goals.

Of 13 existing sanctuaries, the following are relevant to the conservation of listed species of marine mammals: Channel Islands, Monterey Bay, Gulf of the Farallones, and Cordell Bank off California, Olympic Coast off Washington, Hawaiian Islands Humpback Whale, Flower Garden Banks off Texas/Louisiana, Florida Keys, Gray's Reef off Georgia, and Stellwagen Bank off Massachusetts. The National Marine Sanctuary Program also is responsible for managing the Papahānaumokuākea Marine National Monument, which includes lands and waters in the Northwestern Hawaiian Islands.

Outer Continental Shelf Lands Act

The Outer Continental Shelf Lands Act (OCSLA) establishes federal jurisdiction over submerged lands seaward of state boundaries. The Act authorizes the Secretary of the Interior to grant leases for purposes of oil and gas exploration and development under conditions that ensure safe and environmentally sound activities. The Act calls for the development of five-year leasing programs, individual lease sales, geological and geophysical exploration, and plans for the exploration, development, and production of lease resources. The Act stipulates that economic, social, and environmental values of renewable and non-renewable resources are to be considered in the management of the outer continental shelf. Lease conditions may stipulate measures designed to avoid and monitor possible effects on marine mammals.

The Minerals Management Service in the Department of the Interior has primary responsibility for the OCSLA program. All stages of the exploration and development process are subject to environmental review, including section 7 consultations under the ESA and small take provisions of the MMPA. In support of these reviews, the department has in the past provided substantial funding for research regarding marine mammal populations, behavior, habitats, and other relevant matters.

International Convention for the Regulation of Whaling

Soon after the end of World War II, the United States led efforts to build on earlier international treaties for the management of commercial whaling. These efforts culminated in 1946 when the International Convention for the Regulation of Whaling was concluded (Bean and Rowland 1997). The convention established the International Whaling Commission (IWC) composed of one representative from each signatory nation. The IWC Schedule recommends species and stocks of whales to be protected, seasons or closed areas, size and catch limits, and methods of whaling. Amendments to the IWC Schedule require support by three-fourths of the members. In July 1982 the IWC agreed to a moratorium on commercial whaling, which went into effect in 1986. Most countries currently abide by the moratorium although some have continued to catch whales under a formal exception to the rule or provisions that allow them to catch whales for scientific research purposes.

The National Oceanic and Atmospheric Administration and the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs are responsible for preparing and representing U.S. positions at IWC meetings.

Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Convention on International Trade in Endangered Species of Wild Fauna and Flora was concluded in 1973. The Convention has 169 parties, including the United States. It establishes a system for listing species on one of three appendices. Appendix I includes species threatened with extinction for which commercial trade is prohibited or strictly limited. Appendix II includes species for which trade must be controlled in order to avoid utilization incompatible with their survival. Appendix III includes those species that receive special regulatory protection by at least one member country.

In general, Appendix I species may be imported only for other than commercial purposes and if the trade will not be detrimental to the survival of the species. Appendix II species may be exported for commercial purposes only if the export will not be detrimental to the survival of the species.

FUNDING FOR RESEARCH AND MANAGEMENT ACTIVITIES

Federal funding for the conservation of listed marine mammal species can be examined from at least four independent sources: (1) an annual report on expenditures for species listed under the ESA compiled by the Fish and Wildlife Service, (2) congressional appropriation documents, (3) individual agency budget documents, and (4) a federal survey of marine mammal funding compiled by the Marine Mammal Commission. Determining expenditures by federal and state agencies for recovery of listed species of marine mammals is severely confounded by inconsistencies in the way cost estimates are reported by different agencies, changes in how costs are reported over time, and lumping of funding among various categories that may or may not be limited to marine mammals. The most systematically gathered source of information is an annual report on endangered species expenditures prepared by the Fish and Wildlife Service, but even this suffers from several flaws described later. Public budget documents vary in their organization and detail by agency and by year. Congressional appropriation documents frequently include line-item appropriations for specific species or purposes; however, these are often pass-through funds for external organizations, have little relevance for determining internal agency expenditures, and may or may not be reported consistently from year to year. Agency program staffs generally have limited knowledge of all expenditures for individual species.

ESA Annual Report

Section 18 of the ESA, adopted in 1988, requires that the Fish and Wildlife Service report annually on expenditures for the conservation of threatened and endangered species. The Service assembles the report from annual submissions by all involved federal agencies (FWS 2003a). The Service has provided little guidance on how agencies are to develop their cost estimates and what guidance has been provided has changed somewhat over time. The Service has limited capacity to evaluate and verify these reports, and the estimates it receives may factor in varying costs and are accepted with little or no checking.

The most recent report covers FY2003, when agencies reported $1.2 billion in total expenditures, $785 million of which was ascribed to individual species and $101 million devoted to related land acquisition (FWS 2003a). The balance of expenditures was for activities that benefited a number of listed species or supported general implementation of the Act. The median expenditure that year for individual species with at least $100 in expenditures was $20,100, with 95 species receiving more than $1 million. The maximum expenditure for any individual species was $49.5 million for the western population of Steller sea lions, $39.9 million of which was reported by the Coast Guard for enforcement. Annual expenditures reported for Steller sea lions and other individual listed species of marine mammals between 1998 and 2003 are shown in Appendices C.1–6. Total expenditures for marine mammals in 2003 reached $83.7 million. The second highest total for a marine mammal, and ninth overall for all listed species, was for northern right whales at $11.8 million. After western Steller sea lions and right whales, the marine mammal species receiving the largest expenditures were West Indian manatees ($9.8 million), eastern Steller sea lions ($5.3 million), Hawaiian monk seals ($2.1 million), humpback whales ($1.6 million), and southern sea otters ($1.3 million).

Expenditures for other endangered marine mammals (blue whales, bowhead whales, fin whales, sei whales, and sperm whales) amounted to a little more than 1 percent of all expenditures allocated for the recovery of listed marine mammals. Although federal expenditures account for nearly all governmental spending on most listed marine mammals, state funding in 2003 accounted for more than half of all funding for the recovery of southern sea otters and the West Indian manatee in Florida. Expenditures for listed species of marine mammals grew from 2 to 12 percent of all expenditures for terrestrial and aquatic species of plants and animals.

Since 2001 it has been much easier to track the reported expenditures of individual agencies by species (See Appendices C.4–6). In 2003 the Coast Guard expenditures for enforcement of regulations concerning nine listed species (West Indian manatees, Steller sea lions, blue whales, bowhead whales, fin whales, humpback whales, right whales, sei whales, and sperm whales) amounted to nearly 60 percent ($42.9 of $74 million) of all federal expenditures for listed marine mammals.[31] By comparison, total Coast Guard expenditures in 2001 for marine mammal enforcement amounted to $12.3 million, of which $11.1 million was dedicated to Steller sea lions. The Coast Guard estimate includes the total cost for operating vessels (e.g., all crew and amortized maintenance costs) during periods when marine mammal enforcement is logged as the vessel's primary mission. During the same period (i.e. 2001–2003), expenditures for listed marine mammal species reported by NMFS declined from $40.7 million to $25.8 million and FWS reported a decline from $2.5 million to $2.2 million.

The funding for Steller sea lion and North Atlantic right whale conservation illustrates a broader feature of federal and state expenditures for listed species—namely disproportionate funding. For example, in 2003, about 1.6 percent of all listed species received roughly half of the funding that could be reasonably attributed to individual species (FWS 2003a). Those species that received separate appropriations from Congress or state legislatures are generally the species that attract the greatest public interest and enjoy the support of members of Congress on key committees.

Congressional Budget Allocations

In fiscal years 2004 and 2005 Congress made dozens of separate appropriations for individual marine mammal species (Table A-2) and, within these appropriations, allocations to specific programs or institutions (House of Representatives Report 108-792 [2004]). These included allocations for Cook Inlet beluga whale research, the Beluga Whale Committee, bowhead whale spatial studies, research on the southern resident population of killer whales, right whale activities, state cooperative plans on right whales, Hawaiian monk seals, and Steller sea lions.

Table A-2. Species-Specific Congressional Appropriations (in $ thousands) for Marine Mammals, 2001–2005

Species/Population	FY2001 Enacted	FY2002 Enacted	FY2003 Enacted	FY2004 Enacted	FY2005 Request
Steller sea lions	35,054	32,145	18,233	17,683	13,846
North Atlantic right whales	4,989	6,850	9,936	12,193	5,850
Beluga whales	225	375	373	370	375
Hawaiian monk seals	798	825	820	816	825
Manatees	0	0	248	248	0
Bottlenose dolphins	748	2,000	1,987	3,958	0
North Pacific southern resident killer whales	0	0	746	1,458	0
Endangered large whales	0	0	994	(10)	1,000

FWS has entered into cooperative agreements with individual states regarding implementation of the ESA. In FY2002 the Service awarded roughly $106 million to states under five types of endangered species grants (FWS 2002). In 2004 this amount declined to $86.5 million, most of which was spend on land acquisition (USFWS 2004c).

[31] According to Coast Guard budget documents, operating expenses for living marine resources enforcement amounted to $347 million in 2003 and was set to rise to $497.9 million in 2005 (USCG 2004).

Agency Budget Documents: Another source of information is agency budget documents. Only NMFS budget information was easily available for this study (see Appendix E). Budget allocations (in thousands of dollars) for individual listed species for the period 2001–2005 are shown on the preceding page.

Marine Mammal Commission Survey of Federally-Funded Research

The Marine Mammal Commission carries out a survey of federally funded marine mammal research and studies. The most recent report in this series covers the period FY1974–FY2000 (Waring 2002). Like FWS annual report on endangered species expenditures, this report was derived from agency reports, which vary in completeness and accuracy by agency and by year. In particular, agencies sometimes encounter difficulties in separating administrative, management, enforcement, and research costs.

Like other sources of information presented in this report, this source documents substantial increases in funding for several species. Funding for stock assessment and biological research for northern right whales grew from $641,000 in FY1991 to $3.1 million in FY2000. Similar research on Hawaiian monk seals grew from $493,000 to $1.9 million during the same period, while Steller sea lion research funding grew from $4,000 to $4.2 million. Northern fur seal research funding grew similarly from $6,000 in FY1991 to $2.0 million in FY2000.

APPENDIX B

YEAR 2004 CATEGORY I, II, AND III FISHERIES AFFECTING SPECIES LISTED AS ENDANGERED, THREATENED, OR DEPLETED

Table B – 1. 2004 Category I Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted

(Source: 69 FR 48407–48423)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Coastal gillnet	Mid-Atlantic	>655	Humpback whale		Bottlenose dolphin, coastal
Sink gillnet	Northeast U.S.	341	North Atlantic right whale, humpback whale, fin whale		
Large pelagic longline	Atlantic Ocean, Caribbean, Gulf of Mexico	<200	Humpback whale		
Lobster trap/pot	Gulf of Maine, Mid-Atlantic	13,000	North Atlantic right whale, humpback whale, fin whale		
Angel shark/halibut and other species large-mesh set gillnet	California	58		Southern sea otter	
Longline/set line for swordfish, tuna, billfish, mahi mahi, wahoo, oceanic sharks	Hawaii	140	Humpback whale, sperm whale		

Table B – 2. 2004 Category II Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted

(Source: 69 FR 48407–48423)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Inshore gillnet	North Carolina	94			Bottlenose dolphin, coastal
Anchored float gillnet	Northeast U.S.	133	Humpback whale		
Gillnet	Southeast Atlantic	779			Bottlenose dolphin, coastal
Shark gillnet	Southeast U.S. Atlantic	6	North Atlantic right whale		Bottlenose dolphin, coastal
Atlantic blue crab pot	Florida	>16,000	West Indian manatee		
Atlantic mixed species pot	Atlantic coast	Unknown	Fin whale, humpback whale		
Haul seine	Mid-Atlantic	25			Bottlenose dolphin, coastal
Long-haul seine	North Carolina	33			Bottlenose dolphin, coastal
Roe mullet stop net	North Carolina	13			Bottlenose dolphin, coastal
Pound net	Virginia	187			Bottlenose dolphin, coastal
Salmon drift gillnet	Alaska, Bristol Bay	1,903		Steller sea lion	Northern fur seal
Salmon set gillnet	Alaska, Bristol Bay	1,014			Northern fur seal

Table B – 2. 2004 Category II Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted (continued)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Salmon drift gillnet	Alaska, Cook Inlet	576			Beluga whale
Salmon drift gillnet	Alaska Peninsula and Aleutian Islands	164			Northern fur seal
Salmon set gillnet	Alaska Peninsula and Aleutian Islands	116	Steller sea lion, humpback whale		
Salmon drift gillnet	Alaska, Prince William Sound	541	Steller sea lion		Northern fur seal
Salmon drift gillnet	Southeast Alaska	481	Humpback whale	Steller sea lion	
Purse seine	Southeast Alaska	416	Humpback whale		
Thresher shark/swordfish drift gillnet	California and Oregon	113	Sperm whale, fin whale, humpback whale	Steller sea lion	Northern fur seal

Table B – 3. 2004 Category III Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted (continued)

(Source: 69 FR 48407–48423)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Gillnet	Caribbean	>991	West Indian manatee, West Antillean		
Inshore gillnet	Delaware	60	Humpback whale		
Inshore gillnet	New York, Long Island Sound	20	Humpback whale		
Inshore gillnet	Rhode Island, southern Massachusetts, New York Bight	32	Humpback whale		
Shrimp trawl	Southeastern Atlantic, Gulf of Mexico	>18,000			Bottlenose dolphin, coastal
Monkfish trawl	Atlantic	Unknown			Bottlenose dolphin, coastal
Menhaden purse seine	Mid-Atlantic	22	Humpback whale		
Tub trawl groundfish bottom longline/hook-and-line	Gulf of Maine	46	Humpback whale		
Tuna, shark, swordfish hook-and-line, and harpoon	Gulf of Maine	26,223	Humpback whale		

Table B – 3. 2004 Category III Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted (continued)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Herring stop seine/weir	Gulf of Maine	50	North Atlantic right whale, humpback whale		
Haul/beach seine	Caribbean	15	West Indian manatee, West Antillean		
Blue crab trap and pot	Gulf of Mexico	4,113	West Indian manatee, Florida		
Salmon gill net	Alaska, Cook Inlet	745	Steller sea lion		
Miscellaneous finfish set gillnet	Alaska	3	Steller sea lion		
Salmon set gillnet	Alaska, Prince William Sound	30	Steller sea lion		
Salmon troll	Alaska	2,335	Steller sea lion	Steller sea lion	
Halibut longline/set line	Alaska	3,079	Steller sea lion		
Atka mackerel trawl	Alaska, Aleutian Islands	8	Steller sea lion		
Flatfish trawl	Alaska, Aleutian Islands	26	Steller sea lion		

Table B – 3. 2004 Category III Fisheries Affecting Species Listed as Endangered, Threatened, or Depleted (continued)

Gear	Area	Estimated Number of Vessels/Persons 2004/2000	Endangered Species	Threatened Species	Depleted Species
Pollock trawl	Alaska, Bering Sea	120	Steller sea lion, humpback whale		
Groundfish trawl	California, Oregon, Washington	585	Steller sea lion		Northern fur seal
Sablefish pot	Alaska	6	Humpback whale		
Lobster, prawn, shrimp, rock crab, fish pot	California	608		Southern sea otter	
Lobster trap	Hawaii	15	Hawaiian monk seal		
Bottomfish hand line and jig	Hawaii	434	Hawaiian monk seal		
Tuna hand line and jig	Hawaii	144	Hawaiian monk seal		

NOTE: Many other species are taken in these fisheries that are not endangered, threatened, or depleted.

APPENDIX C

FEDERAL AND STATE EXPENDITURES FOR LISTED SPECIES OF MARINE MAMMALS

Appendix C.1. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 1998 (Source: USFWS 1998)

Species	FWS	USGS	NMFS	Other Federal	Total Fedeal	State	Total State and Federal	% Total By Species
West Indian manatee	927	526	–	99	1,551	13	1,565	18.40
Southern sea otter	97	389	–	9	495	–	495	5.82
Caribbean monk seal	–	–	–	10	10	–	10	0.11
Hawaiian monk seal	–	–	1,504	12	1,516	–	1,516	17.82
Guadalupe fur seal	–	–	–	–	–	–	–	–
Steller sea lion (eastern and western populations)	–	–	3,040	20	3,060	19	3,079	36.20
Blue whale	–	–	–	3	3	1	4	0.05
Bowhead whale	–	–	–	–	–	1	1	0.02
Fin whale	–	–	–	4	4	1	5	0.06
Humpback whale	–	–	240	80	320	41	361	4.24
Northern right whale	2	–	1,100	357	1,458	1	1,460	17.16
Sei whale	–	–	–	4	4	1	5	0.06
Sperm whale	–	–	–	4	4	1	5	0.06
Total expenditures for listed marine mammal species	**1,025**	**915**	**5,884**	**602**	**8,424**	**81**	**8,505**	**100.00**
Total expenditures for all listed species (marine mammals and others)	54,123	5,855	28,151	278,188	366,316	16,338	382,654	
Marine mammal expenditures as percentage of expenditures for all listed species	1.9%	15.6%	20.9%	0.2%	2.3%	0.5%	2.2%	

Appendix C.2. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 1999 (Source: USFWS 2003c)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	1,145	526	–	619	117	2,407	1,945	4,351	25.27	3,732	28.53
Southern sea otter	95	317	–	–	47	459	156	615	3.57	615	4.70
Caribbean monk seal	–	–	–	–	–	–	–	–	–	–	–
Hawaiian monk seal	–	–	1,052	48	4	1,104	0.4	1,105	6.42	1,057	8.08
Guadalupe fur seal	–	–	–	–	2	2	–	2	0.01	2	0.02
Steller sea lion (eastern and western populations)	–	–	4,879	2,291	56	7,226	8	7,234	42.00	4,943	37.78
Blue whale	120	–	–	–	5	125	–	125	0.73	125	1.00
Bowhead whale	–	–	–	–	–	–	3	3	0.01	3	0.02
Fin whale	–	–	–	9	4	13	0.3	13	0.07	4	0.03
Humpback whale	–	–	131	277	76	484	8	492	2.85	215	1.64
Northern right whale	–	–	1,542	892	549	2,983	90	3,273	19.00	2,381	18.20
Sei whale	–	–	–	–	4	4	–	4	0.02	4	0.03
Sperm whale	–	–	–	6	1	7	–	7	0.04	1	0.01
Total expenditures for listed marine mammal species	**1,360**	**843**	**7,604**	**4,142**	**865**	**14,813**	**2,410**	**17,222**	**100.00**	**13,082**	**100.00**
Total expenditures for all listed species	52,749	5,428	36,195	23,740	227,063	345,175	91,907	437,082			
Marine mammal expenditures as % of expenditures for all listed species	2.6%	15.5%	21.0%	17.4%	0.4%	4.3%	2.6%	3.9%			

Appendix C.3. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 2000 (Source: USFWS 2003b)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	2,727	466	–	461	166	3,820	5,923	9,743	32.25	9,282	43.87
Southern sea otter	174	403	–	–	13	589	35	624	2.07	624	2.95
Caribbean monk seal	–	–	–	–	–	–	–	–	–	–	–
Hawaiian monk seal	–	–	1,210	–	43	1,253	14	1,267	4.19	1,267	5.99
Guadalupe fur seal	–	–	–	–	2	2	–	2	0.01	2	0.01
Steller sea lion (eastern and western populations)	–	–	5,243	7,810	54	13,107	6	13,113	43.41	5,303	25.07
Blue whale	–	–	–	–	6	6	–	6	0.02	6	0.03
Bowhead whale	–	–	–	–	–	–	3	3	0.01	3	0.01
Fin whale	–	–	–	–	4	4	1	5	0.02	5	0.02
Humpback whale	–	–	53	349	154	556	11	567	1.88	218	0.01
Northern right whale	–	–	4,168	433	143	4,744	127	4,872	16.13	4,439	20.98
Sei whale	–	–	–	–	4	4	–	4	0.01	4	0.02
Sperm whale	–	–	–	–	3	3	–	3	0.01	3	0.01
Total expenditures for listed marine mammal species	**2,901**	**869**	**10,674**	**9,053**	**592**	**24,088**	**6,119**	**30,207**	**100.00**	**21,156**	**100.00**
Total expenditures for all listed species	66,536	6,021	53,029	24,589	273,691	423,866	100,311	524,177			
Marine mammal expenditures as % of expenditures for all listed species	4.4%	14.4%	20.1%	36.8%	0.2%	5.7%	6.1%	5.8%			

Appendix C.4. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 2001 (Source: USFWS 2005f)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	2,363	510	–	480	85	3,438	5,936	9,373	14.15	8,893	16.50
Southern sea otter (except experimental population)	184	868	–	–	7	1,059	35	1,094	1.65	1,094	2.03
Caribbean monk seal	–	–	–	–	8	8	–	8	0.01	8	0.01
Hawaiian monk seal	–	–	2,100	2	5	2,108	14	2,121	3.20	2,119	3.93
Guadalupe fur seal	–	–	–	–	–	–	–	–	–	–	–
Steller sea lion (eastern and western populations)	–	–	33,312	11,067	66	44,445	2,338	46,783	70.62	35,716	66.27
Blue whale	–	–	–	–	1	1	–	1	0.00	1	0.00
Bowhead whale	–	–	–	–	–	–	25	25	0.04	25	0.05
Fin whale	–	–	–	–	22	22	2	24	0.04	24	0.04
Humpback whale	–	–	53	324	352	729	11	740	1.12	416	0.77
Northern right whale	–	–	5,270	474	147	5,891	145	6,036	9.11	5,562	10.32
Sei whale	–	–	–	–	12	12	–	12	0.02	12	0.02
Sperm whale	–	–	–	–	27	27	–	27	0.04	27	0.05
Total expenditures for listed marine mammal species	**2,547**	**1,378**	**40,735**	**12,348**	**732**	**57,739**	**8,505**	**66,244**	**100.00**	**53,897**	**100.00**
Total expenditures for all listed species	50,294	11,241	95,879	28,219	388,314	573,976	76,633	647,580			
Marine mammal expenditures as % of expenditures for all listed species	5.1%	12.3%	42.5%	43.8%	0.2%	10.1%	11.1%	10.2%			

Appendix C.5. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 2002 (Source: USFWS 2005e)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	1,710	523	–	228	182	2,643	5,929	8,571	11.11	8,343	16.19
Southern sea otter	170	856	–	–	5	1,031	35	1,066	1.38	1,066	2.07
Caribbean monk seal	–	–	–	–	–	–	–	–	–	–	–
Hawaiian monk seal	–	–	2,100	46	38	2,184	14	2,197	2.85	2,151	4.17
Guadalupe fur seal	–	–	–	–	–	–	–	–	–	–	–
Steller sea lion (eastern and western populations)	–	–	29,295	24,172	35	53,502	2,496	55,998	72.59	31,826	61.75
Blue whale	–	–	–	7	1	8	–	8	0.01	1	0.00
Bowhead whale	–	–	–	7	–	7	–	7	0.01	–	0.00
Fin whale	–	–	–	7	5	13	1	13	0.02	6	0.01
Humpback whale	–	–	150	280	449	879	11	890	1.15	609	1.18
Northern right whale	–	–	7,120	857	136	8,113	280	8,393	10.88	7,536	14.62
Sei whale	–	–	–	–	1	1	–	1	0.00	1	0.00
Sperm whale	–	–	–	–	1	1	–	1	0.00	1	0.00
Total expenditures for listed marine mammal species	**1,880**	**1,379**	**8,665**	**25,606**	**853**	**68,382**	**8,765**	**77,147**	**100.00**	**51,540**	**100.00**
Total expenditures for all listed species	76,341	11,878	180,735	27,319	348,339	644,611	74,606	719,218			
Marine mammal expenditures as % of expenditures for all listed species	2.5%	11.6%	4.8%	93.7%	0.2%	10.6%	11.7%	10.7%			

Appendix C.6. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 2003 (Source: USFWS 2005d)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	2,070	971	–	713	75	3,830	5,969	9,799	11.87	9,085	22.93
Southern sea otter (includes experimental population)	156	1,154	–	–	26	1,336	40	1,376	1.67	1,376	3.47
Caribbean monk seal	–	–	–	–	–	–	–	–	–	–	–
Hawaiian monk seal	–	–	2,100	–	30	2,130	15	2,145	2.60	2,145	5.41
Guadalupe fur seal	–	–	–	–	–	–	–	–	–	–	–
Steller sea lion (eastern population)	–	–	4,090	–	4	4,094	1,203	5,297	6.41	5,297	13.37
Steller sea lion (western population)	–	–	8,180	39,940	194	48,314	1,200	49,514	59.97	9,574	24.16
Blue whale	–	–	–	199	4	203	–	203	0.25	4	0.01
Bowhead whale	–	–	–	199	5	204	–	204	0.25	5	0.01
Fin whale	–	–	–	199	6	205	1	206	0.25	7	0.02
Humpback whale	–	–	1,150	199	248	1,597	18	1,615	1.96	1,416	3.57
Northern right whale	–	–	10,270	1,098	312	11,679	123	11,802	14.29	10,705	27.02
Sei whale	–	–	–	199	4	203	–	203	0.25	4	0.01
Sperm whale	–	–	–	199	4	203	–	203	0.25	4	0.01
Total expenditures for listed marine mammal species	**2,226**	**2,125**	**25,790**	**42,944**	**912**	**73,997**	**8,570**	**82,567**	**100.00**	**39,623**	**100.00**
Total expenditures for all listed species	92,011	12,167	150,898	47,732	313,875	616,683	68,146	684,829			
Marine mammal expenditures as % of expenditures for all listed species	2.4%	17.5%	17.1%	90.0%	0.3%	12.0%	12.6%	12.1%			

Appendix C.7. Federal and state expenditures (in $ thousands) for listed species of marine mammals in 2004 (Source: USFWS 2006)

Species	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal	% Total By Species	Total State and Federal $ Excl. USCG	% Total By Species Excl. USCG
West Indian manatee	2,432	428	–	831	226	3,917	5,945	9,862	13.86	9,030	18.73
Southern sea otter	134	578	–	–	3	714	20	734	1.03	734	1.52
Caribbean monk seal	–	–	–	–	–	–	–	–	–	–	–
Hawaiian monk seal	–	1	2,164	105	51	2,321	–	2,321	3.26	2,216	4.60
Guadalupe fur seal	–	–	–	–	–	–	1	1	0.00	1	0.00
Steller sea lion (eastern population)	–	–	9,605	–	3	9,608	1,203	10,811	15.19	10,811	22.42
Steller sea lion (western population)	–	–	9,605	20,856	85	30,546	1,200	31,746	44.60	10,890	22.58
Blue whale	–	–	–	60	4	65	2	67	0.09	6	0.01
Bowhead whale	–	–	–	60	13	190	–	190	0.27	130	0.27
Fin whale	0.2	–	–	63	6	69	3	72	0.10	9	0.02
Humpback whale	–	–	–	416	243	659	7	666	0.94	250	0.52
Northern right whale	0.2	–	11,225	444	197	11,866	504	12,370	17.38	11,925	24.73
Sei whale	–	–	–	60	6	66	–	66	0.09	6	0.01
Sperm whale	6	–	–	60	2,203	2,268	2	2,270	3.19	2,210	4.58
Total expenditures for listed marine mammal species	**2,571**	**1,007**	**32,559**	**22,956**	**3,040**	**62,290**	**8,887**	**71,177**	**100.00**	**48,221**	**100.00**
Total expenditures for all listed species	128,534	10,940	151,230	33,091	408,359	732,154	60,965	793,120			
Expenditures for listed marine mammal species as % of expenditures for all listed species	2.0%	9.2%	21.5%	69.4%	0.7%	8.5%	14.6%	9.0%			

APPENDIX D

FEDERAL AND STATE EXPENDITURES (IN $ THOUSANDS) FOR LISTED SPECIES OF MARINE MAMMALS BY YEAR: 1998 – 2004

(Source: USFWS 1998, 2003b, 2003c, 2005b, 2005d, 2005f, 2006)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
West Indian Manatee								
1998	927	526	–	–	99	1,551	13	1,565
1999	1,145	526	–	619	117	2,407	1,945	4,351
2000	2,727	466	–	461	166	3,820	5,923	9,743
2001	2,363	510	–	480	85	3,438	5,936	9,373
2002	1,710	523	–	228	182	2,643	5,929	8,571
2003	2,070	971	–	713	75	3,830	5,969	9,799
2004	2,432	428	–	831	226	3,917	5,945	9,862
Southern Sea Otter								
1998	97	389	–	–	9	495	–	495
1999	95	317	–	–	47	459	156	615
2000	174	403	–	–	13	589	35	624
2001	184	868	–	–	7	1,059	35	1,094
2002	170	856	–	–	5	1,031	35	1,066
2003	156	1,154	–	–	26	1,336	40	1,376
2004	134	578	–	–	3	714	20	734
Caribbean Monk Seal								
1998	–	–	–	–	10	10	–	10
1999	–	–	–	–	–	–	–	–
2000	–	–	–	–	–	–	–	–
2001	–	–	–	–	8	8	–	8
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–

Federal and State Expenditures (in $ thousands) for Listed Species of Marine Mammals by Year: 1998 – 2004 (continued)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
Hawaiian Monk Seal								
1998	–	–	1,504	–	12	1,516	–	1,516
1999	–	–	1,052	48	4	1,104	0.4	1,105
2000	–	–	1,210	–	43	1,253	14	1,267
2001	–	–	2,100	2	5	2,108	14	2,121
2002	–	–	2,100	46	38	2,184	14	2,197
2003	–	–	2,100	–	30	2,130	15	2,145
2004	–	1	2,164	105	51	2,321	–	2,321
Guadalupe Fur Seal								
1998	–	–	–	–	–	–	–	–
1999	–	–	–	–	2	2	–	2
2000	–	–	–	–	2	2	–	2
2001	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	1	1
Steller Sea Lion (eastern and western populations)								
1998	–	–	3,040	–	20	3,060	19	3,079
1999	–	–	4,879	2,291	56	7,226	8	7,234
2000	–	–	5,243	7,810	54	13,107	6	13,113
2001	–	–	33,312	11,067	66	44,445	2,338	46,783
2002	–	–	29,295	24,172	35	53,502	2,496	55,998
2003 (eastern)	–	–	4,090	–	4	4,094	1,203	5,297
2003 (western)	–	–	8,180	39,940	194	48,314	1,200	49,514
2004 (eastern)	–	–	9,605	–	3	9,608	1,203	10,811
2004 (western)	–	–	9,605	20,856	85	30,546	1,200	31,746

Federal and State Expenditures (in $ thousands) for Listed Species of Marine Mammals by Year: 1998 – 2004 (continued)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
Blue Whale								
1998	–	–	–	–	3	3	1	4
1999	120	–	–	–	5	125	–	125
2000	–	–	–	–	6	6	–	6
2001	–	–	–	–	1	1	–	1
2002	–	–	–	7	1	8	–	8
2003	–	–	–	199	4	203	–	203
2004	–	–	–	60	4	65	2	67
Bowhead Whale								
1998	–	–	–	–	–	–	1	1
1999	–	–	–	–	–	–	3	3
2000	–	–	–	–	–	–	3	3
2001	–	–	–	–	–	–	25	25
2002	–	–	–	7	–	7	–	7
2003	–	–	–	199	5	204	–	204
2004	–	–	–	60	130	190	–	190
Fin Whale								
1998	–	–	–	–	4	4	1	5
1999	–	–	–	9	4	13	0.3	13
2000	–	–	–	–	4	4	1	5
2001	–	–	–	–	22	22	2	24
2002	–	–	–	7	5	13	1	13
2003	–	–	–	199	6	205	1	206
2004	0.2	–	–	63	6	69	3	72
Humpback Whale								
1998	–	–	240	–	80	320	41	361
1999	–	–	131	277	76	484	8	492
2000	–	–	53	349	154	556	11	567
2001	–	–	53	324	352	729	11	740
2002	–	–	150	280	449	879	11	890
2003	–	–	1,150	199	248	1,597	18	1,615
2004	–	–	–	416	243	659	7	666

Federal and State Expenditures (in $ thousands) for Listed Species of Marine Mammals by Year: 1998 – 2004 (continued)

Fiscal Year	FWS	USGS	NMFS	USCG	Other Federal	Total Federal	State	Total State and Federal
Northern Right whale								
1998	2	–	1,100	–	357	1,458	1	1,460
1999	–	–	1,542	892	549	2,983	290	3,273
2000	–	–	4,168	433	143	4,744	127	4,872
2001	–	–	5,270	474	147	5,891	145	6,036
2002	–	–	7,120	857	136	8,113	280	8,393
2003	–	–	10,270	1,098	312	11,679	123	11,802
2004	0.2	–	11,225	444	197	11,866	504	12,370
Sei Whale								
1998	–	–	–	–	4	4	1	5
1999	–	–	–	–	4	4	–	4
2000	–	–	–	–	4	4	–	4
2001	–	–	–	–	12	12	–	12
2002	–	–	–	–	1	1	–	1
2003	–	–	–	199	4	203	–	203
2004	–	–	–	60	6	66	–	66
	Sperm Whale							
1998	–	–	–	–	4	4	1	5
1999	–	–	–	6	1	7	–	7
2000	–	–	–	–	3	3	–	3
2001	–	–	–	–	27	27	–	27
2002	–	–	–	–	1	1	–	1
2003	–	–	–	199	4	203	–	203
2004	6	–	–	60	2,203	2,268	2	2,270

Appendix E

National Marine Fisheries Service Line Items Related to Endangered Marine Mammal Species: 2001–2005 (in $ thousands)

(Source: NOAA Budget Bluebooks for FY2003 and FY2005)

Budget Line Item	FY2001 Enacted	FY2002 Enacted	FY2003 Enacted	FY2004 Enacted	FY2005 Request
SCIENCE AND TECHNOLOGY					
STELLER SEA LIONS					
Alaska Fisheries Foundation	–	500	994	961	–
Alaska SeaLife Center	5,967	5,000	4,968	5,912	1,400
Recovery Plan: Base	21,952	16,800	4,968	3,562	9,796
North Pacific Universities MM Consortium	798	3,500	2,484	2,465	800
University of Alaska Gulf Apex Predator	998	1,000	994	989	1,000
Endangered Species Act	848	850	844	841	850
Steller sea lion/pollock research	1,996	2,000			
PROTECTED SPECIES MISCELLANEOUS					
Marine mammals, sea turtles, others	9,517	3,500	3,477	3,433	3,500
Right whale activities	1,592	2,250	4,968	10,322	2,250
Right whale NE Consortium	2,894	1,000	–	–	–
Hawaiian monk seals	798	825	820	816	825
Alaska harbor seal research	898	900	894	3,958	900
Manatee: New College	–	–	248	248	–
Marine mammal strandings	3,991	4,000	3,974	3,694	4,000
Bottlenose dolphin research	748	2,000	1,987	3,958	–
North Pacific southern resident killer whales	–	–	746	1,458	–
Recovery of endangered large whales	–	–	994	(10)	1,000

National Marine Fisheries Service Line Items Related to Endangered Marine Mammal Species: 2001– 2005 (continued)
(in $ thousands)

Budget Line Item	FY2001 Enacted	FY2002 Enacted	FY2003 Enacted	FY2004 Enacted	FY2005 Request
CONSERVATION MANAGEMENT					
MARINE MAMMALS					
Cook Inlet beluga	–	150	149	147	150
Right whale activities	503	2,100	4,968	(108)	2,100
Right whale cooperative state plans	–	1,500	–	1,979	1,500
Charleston health and risk assessment	–	800	795	396	–
Alaska Sealife Center	–	–	994	989	–
Steller sea lion recovery plan: state of Alaska	2,495	2,495	1,987	1,964	–
NATIVE ALAS A MARINE MAMMALS					
Alaska Eskimo Whaling Commission	399	400	497	492	400
Alaska Eskimo Whaling Comm: Prt of AEV	–	–	–	99	–
Alaska harbor seals	150	150	149	147	150
Aleut Pacific Marine Resources Observatory	125	125	124	61	125
Beluga Whale Committee	225	225	224	223	225
Bristol Bay Native Association	50	50	50	50	50

APPENDIX F

FEDERAL FUNDING OF RESEARCH ON LISTED MARINE MAMMAL SPECIES BY RESEARCH ISSUE: FY1991–FY2000 (in $ thousands)

(Based on Table 6 in Waring 2002)

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
International Whaling Commission											
Assessment of stocks	NMFS				75	184			70	108	393
	MMC			8							
	NSF	49									
	DOS	8	45	72	112	63	12	14	22	8	18
Subtotal		**57**	**45**	**80**	**187**	**247**	**12**	**14**	**92**	**116**	**411**
Fisheries/Sea Otter Interactions											
	FWS	323	205	207	157	157	132				1,181
	USGS							132			132
	MMC					3					3
Subtotal		**323**	**205**	**207**	**157**	**160**	**132**	**132**			**1,316**
Bowhead whale											
Assessment of stocks	NMFS	912	655	499	314	298	315	413	465	400	
	MMS	264	513	549	549	495	482	485	450	450	266
	NSF										14
Biology	MMS	55						625	376	$ 650	
Subtotal		**1,231**	**1,168**	**1,048**	**863**	**793**	**797**	**1,523**	**1,291**	**1,500**	**280**

Federal Funding of Research on Listed Marine Mammal Species by Research Issue: FY1991–FY2000 (continued)
(in $ thousands)

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Humpback whale											
Population assessment	NMFS	45	250	240	388	208		175	136	121	
	MMC	8	2	8		10					
	NPS	21	16	16	20			70	70	60	229
	SERDP				265	45	241				
	NOS					1	2	12	61	2	26
Biology	NPS	13									27
	NMFS	20									
	NOS										60
	NSGCP			43							
	MMC					2					
Subtotal		**107**	**268**	**307**	**673**	**266**	**243**	**257**	**267**	**183**	**342**
Northern Right Whale											
Population assessment	NMFS	194	235	324	510	371	827	379	552	869	1,797
	MMC	2	28	20			6			1	
	MMS	196									
	USCG				80					285	
	Navy							970	350	693	611
	NSGCP										57
	DOT										217
Biology	Navy					90	80				197
	NSF	200									
	NMFS	45				228	97	51			212
	MMS	4	13								
	NOS							25			
	USCG							80	140		
Subtotal		**641**	**276**	**344**	**590**	**689**	**1,010**	**1,505**	**1,042**	**1,848**	**3,091**

Federal Funding of Research on Listed Marine Mammal Species by Research Issue: FY1991–FY2000 (continued)
(in $ thousands)

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Beluga whale											
Population assessment	MMS	80						28			75
	MMC									2	
	NMFS	25	184	276	173	185	205	405	205	199	186
Biology	Navy				172	387	115	5			
	NSF	55	57		107	209	146	106		90	90
Subtotal		**160**	**241**	**276**	**452**	**781**	**466**	**544**	**205**	**291**	**351**
Bottlenose dolphin											
Population assessment	MMC		4	5					1		
	NMFS	32	105	65	750	845			722	601	443
	EPA		23	10	56	5					
	NSGCP			86	83	83					
	NASA								9	5	
	NPS								10		
Biology	Navy	864	525	677	786	1,504	975	671	634	805	1,398
	DHHS	109					35				
	NSF	100	168				18	151	17	160	162
	NMFS	35	250			20			31		
	NOS									10	252
	NSGCP									13	13
Subtotal		**1,140**	**1,075**	**843**	**1,675**	**2,457**	**1,028**	**822**	**1,424**	**1,594**	**2,268**
Northern Fur Seal											
Population assessment	NMFS	6	7	9	95	24	24	24	106	603	
Biology	NMFS		4	4					74		1,957
	NSF					$ 138					
Subtotal		**6**	**11**	**13**	**95**	**162**	**24**	**24**	**180**	**603**	**1,957**

Federal Funding of Research on Listed Marine Mammal Species by Research Issue: FY1991–FY2000 (continued)
(in $ thousands)

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Hawaiian Monk Seal											
Population assessment	NMFS	448	731	717	519	1,109	1,450		769		1,152
	Navy					30	9				
Biology	NPS								5	5	
	NSGCP	25	14	34							
	Army	20									
	NMFS										745
Subtotal		**493**	**745**	**751**	**519**	**1,139**	**1,459**		**774**	**5**	**1,897**

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Steller Sea Lion											
Population studies	NMFS		191	101			779	1,580	1,407	1,203	2,560
	NOS										1,100
	MMC	3									
	NPS	1	2		16			20	20		3
	NSGCP		25	20							
Biology	NMFS		690	713	750	591	895	304			
	Navy									15	
	NOS										512
Subtotal		**4**	**908**	**834**	**766**	**591**	**1,674**	**1,904**	**1,427**	**1,218**	**4,175**

Federal Funding of Research on Listed Marine Mammal Species by Research Issue: FY1991–FY2000 (continued)
(in $ thousands)

Issue	Funding Agency	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Manatees and Dugongs											
Population studies	FWS		23					47	186	1	76
	NASA	10	10	24	24	24	26	24	20	25	25
	MMC		3	13					3		
	USGS								231	232	167
	NPS								11		
	Navy										64
Biology	FWS	437	716	681	594	620	484	152	3	172	32
	USGS							409	234	215	180
	Army	145				282	282				
	MMC	4		6							
	NASA	8	7	7	7	7					
	NSF		50	52							
	Navy					375	330				
Subtotal		**604**	**809**	**783**	**625**	**1,308**	**1,122**	**632**	**688**	**645**	**544**

Sea Otter											
Population studies	FWS	210	24	15	43	124	45	7	116	73	193
	USGS							329	599	552	353
	NPS		360	360							
	MMC					3					
	NOS							9	7		5
Biology	MMC	3									
	NSGCP										150
	FWS	703	690	544	403	409	429	8	71		25
	USGS							105	195	170	483
	NSF	174	122	122						5	
	NPS									68	180
	MMS	7									
	USAF				149						
	NOS						2	5	5	7	
Subtotal		**1,097**	**1,196**	**1,041**	**595**	**536**	**476**	**463**	**993**	**875**	**1,389**

APPENDIX G

SUMMARY OF THE STATUS AND PROTECTION PROGRAMS FOR LISTED MARINE MAMMALS

Species	Legal Status	Best Abund. Estimate	Minimum Population Estimate	Potential Biological Removal	Minimum Annual Mortality Fisheries	Meeting Zero Mortality Goal?	Minimum Annual Mortality Other	Potential Threats	Recovery/ Conservation Plan	Critical Habitat
West Indian manatee	Endangered									Yes
Florida population		3,300	3,300	3	Undeter.	Undeter.	~298	Boat collisions; loss of warm–water refuges; flood gates/navigation locks; habitat degradation	2001 (Update In Process)	1976
Antillean population		121	121	0	Undeter.	Undeter.	Undeter.	Fishery interactions; boat collisions	1986	
Southern sea otter	Threatened	2,735	2735	7	Undeter.	Not available	Undeter.	Oil spills; fishery interactions; disease	2003	None
Northern sea otter, *SW Alaska*	Threatened	41,865	33,203	830	Undeter.	Not available	Undeter.	Oil spills; predation by killer whales; infectious disease	Draft In Process	
Caribbean monk seal	Endangered	0	0						None	None
Hawaiian monk seal	Endangered	1,252	1,224	Undeter.	Undeter.	No	Undeter.	Prey availability; fishery interactions; debris entanglement; shark predation	1983 (Update In Process)	1986, 1988
Guadalupe fur seal	Threatened	7,408	3,028	104	Undeter.	Yes	Undeter.	Fishery interactions	None	
Northern fur seal										
Eastern Pacific	Depleted	688,028	676,540	14,546	15	Yes	870	Prey availability; fishery interactions; debris entanglement; industrial development	1993	

Summary of the Status and Protection Programs for Listed Marine Mammals (continued)

Species	Legal Status	Best Abund. Estimate	Minimum Population Estimate	Potential Biological Removal	Minimum Annual Mortality Fisheries	Meeting Zero Mortality Goal?	Minimum Annual Mortality Other	Potential Threats	Recovery/ Conservation Plan	Critical Habitat
Steller sea lion									1992 (Update In Process)	Yes
Western population	Endangered	44,916	38,513	231	30.9	No	187.3	Prey availability; fishery interactions; predation by killer whales		1993
Eastern population	Threatened	43,728	43,728	1,967	5.3	Yes	2	Fishery interactions; subsistence hunting		1993
Blue whale	Endangered								1998	None
Western North Atlantic		Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Ship strikes		
Pacific Coast		1,774	1,384	1.4	0	Yes	0.2	Ship strikes		
Hawaii		Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Not available		
Bowhead whale	Endangered								None	None
Western Arctic population	Endangered	10,545	9,472	95	0.2	Yes	40	Fishery interaction; oil and gas development; climate change; ship strikes		
Fin whale	Endangered								Draft (2006)	None
Western Atlantic		2,814	2,362	4.7	0.4	No	1	Ship strikes; fishery interactions		
Pacific Coast		3,279	2,541	15	1	Yes	0.4	Fishery interactions; ship strikes		
Northeast Pacific		5,703	5,703	11.4	0.6	Yes	0.2	Fishery interactions; ship strikes		
Hawaii		174	191	0.1	0	Undeter.	Undeter.	Not available		

Summary of the Status and Protection Programs for Listed Marine Mammals (continued)

Species	Legal Status	Best Abund. Estimate	Minimum Population Estimate	Potential Biological Removal	Minimum Annual Mortality Fisheries	Meeting Zero Mortality Goal?	Minimum Annual Mortality Other	Potential Threats	Recovery/ Conservation Plan	Critical Habitat
Humpback whale	Endangered								1991	None
Gulf of Maine		902	647	1.3	2.8	No	0.4	Fish. interactions; ship strikes		
Eastern North Pacific		1,391	1,158	2.3	1.2	No	0.2	Fish. interactions; ship strikes		
Central North Pacific		4,005	3,698	12.9	3.4	No	0.8	Fish. interactions; ship strikes		
Western North Pacific		394	367	1.3	0.69	No	Undeter.	Fish. interactions		
Northern right whale	Endangered								1991	Yes
North Atlantic		299	299	0	1.6	No	1	Fish. interactions; ship strikes	2005	1994
North Pacific		Undeter.	23	Undeter.	Undeter.	Undeter.	Undeter.	Fish. interactions; ship strikes	(1991)	2006
Sei whale	Endangered								Draft (1998)	None
Nova Scotia		Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Ship strikes; fish. interactions		
Eastern North Pacific		56	35	0.01	0	Yes	0	Ship strikes; fish. interactions		
Hawaii		77	37	0.1	0	Undeter.	Undeter.	Ship strikes; fish. interactions		
Sperm whale	Endangered								Draft (2006)	None
North Atlantic		4,804	3,539	7	0	Yes	0.4	Fish. interactions; ship strikes		
Northern Gulf of Mexico		1,349	1,114	2.2	0	Yes	0	Fish. interactions; ship strikes		
Pacific Coast		1,233	885	1.8	1	No	Not available	Fish. interactions; ship strikes		
Hawaii		7,082	5,531	11	0	Undeter.	0	Fish. interactions; ship strikes		

Summary of the Status and Protection Programs for Listed Marine Mammals (continued)

Species	Legal Status	Best Abund. Estimate	Mininum Pop. Estimate	Potential Biological Removal	Minimum Annual Mortality Fisheries	Meeting Zero Mortality Goal?	Minimum Annual Mortality Other	Potential Threats	Recov/ Cons. Plan	Critical Habitat
Sperm whale	Endangered								Draft (2006)	None
North Pacific		Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Undeter.	Fishery interaction; ship strikes		
Cook Inlet beluga whale	Depleted	357	366	2	0	Yes	1	Subsistence harvest; fishing interactions; vessel traffic; coastal development	Draft (2005)	None
Mid–Atlantic coastal bottlenose dolphin	Depleted								Draft (2001)	None
Northern Migratory		17,466	14,621	146.2	11	No	Undeter.	Fishery interactions; contaminants		
Northern North Carolina		7,079	4,083	40.8	8	No	Undeter.	Fishery interactions; contaminants		
Southern North Carolina		4,787	1,987	19.9	Undeter.	Yes	Undeter.	Fishery interactions; contaminants		
Winter Mixed		16,913	13,558	135.6	58	No	Undeter.	Fishery interactions; contaminants		
South Carolina		2,325	1,963	19.6	Undeter.	Undeter.	Undeter.	Contaminants		
Georgia		2,195	1,716	17.2	Undeter.	Undeter.	Undeter.			
Northern Florida		448	328	Undeter.	0	Yes	Undeter.			
Central Florida		10,652	7,377	Undeter.	6	Yes	Undeter.	Contaminants		
Southern resident killer whale population	Depleted	84	84	0.8	0	Yes	0	Prey availability; contaminants; oil spills	In Process	Proposed
AT1 Group, killer whale	Depleted	9	9	0	0	Yes	0	Oil spills; contaminants; prey availability; fishery interactions; vessel traffic		None

APPENDIX 4

Report of the Workshop on Assessing the Population Viability of Endangered Marine Mammals in U.S. Waters

Report of the Workshop on Assessing the Population Viability of Endangered Marine Mammals in U.S. Waters

13 15 September 2005
Savannah, Georgia

Prepared by the Marine Mammal Commission

2007

This is one of five reports prepared in response to a directive from Congress to the Marine Mammal Commission to assess the cost-effectiveness of protection programs for the most endangered marine mammals in U.S. waters.

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EXECUTIVE SUMMARY

Congress, in its 2004 Omnibus Appropriations Act, directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." As part of its response to the directive, the Commission convened a workshop to examine the state of science regarding population viability analysis (PVA) for marine mammal populations. The workshop was held 13–15 September 2005 in Savannah, Georgia. Its goals were to (1) review estimates of the viability of the most endangered marine mammals, (2) review the status of ongoing modeling efforts, particularly PVA, for endangered marine mammals, and (3) develop recommendations to improve listing and management decisions based on explicit consideration and improved estimation of population extinction risk.

The workshop focused on the 22 marine mammal taxa occurring in U.S. waters and either listed as threatened or endangered under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act. Participants agreed that, with two or possibly three exceptions, all those taxa—with appropriate management—appear to have the potential for persisting into the future. The first exception is the Caribbean monk seal, which has not been observed and documented since 1952 and is presumed to be extinct. The second is the AT1 stock of killer whales, which numbers fewer than 10 individuals, has not produced a single surviving calf for more than 20 years, and is highly unlikely to persist beyond the lifetimes of existing individuals. The possible third exception is the eastern population of North Pacific right whales, which has been a matter of concern based largely on the rarity of sightings, lack of information on the population, and its history of commercial exploitation. That concern has been tempered somewhat by recent evidence of successful reproduction (observations of cow-calf pairs). In addition to these obvious exceptions, the stock structure of many marine mammal species is poorly known, and participants noted that some additional stocks, yet to be identified, may be unlikely to persist into the future. For the taxa that were considered to be potentially viable, the available published analyses at the time of the workshop were not sufficient for a systematic and consistent quantification of their respective viabilities. The workshop identified methodological issues that need to be addressed to allow meaningful quantitative comparisons among viability estimates.

Participants reviewed the current state of PVA for marine mammals and other wildlife. For candidate species or species that are already listed, the growing trend is to use PVA to support listing and management decisions. PVA provides a mechanism for integrating all relevant data into a quantitative assessment to produce an estimate of extinction risk over a defined period of time. Such analyses are more objective than the qualitative listing approaches used to date, more amenable to explicit inclusion of all relevant data, more transparent with respect to assumptions and uncertainties, more easily standardized, and more conducive to the kind of structured decision-making that is needed to improve listing and management of endangered, threatened, and depleted taxa.

Participants also highlighted several common impediments to quantitative analyses for many marine mammal taxa. These include poor understanding of stock structure, insufficient biological data for recognized taxa, insufficient data for characterizing potential relationships between specific threats or management actions and population responses, and difficulty in predicting future threats and management actions that may affect their risk of extinction. Further, participants expressed a need for caution when using commercially available analytical software without proper documentation and without an understanding of the structure, function, and assumptions incorporated into the software.

Participants generally agreed with the findings of the Quantitative Working Group convened by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (DeMaster et al. 2004) to develop quantitative criteria for listing decisions. Among other things, those findings included the need for (1) performance testing of models used in the listing process to determine the likelihood of correct vs. incorrect decisions, given the life histories of species involved and uncertainties in the data or analytical results, and (2) clear links between policy decisions and quantitative models, particularly with regard to interpreting the uncertainty reflected in model results.

Finally, participants in the Savannah workshop considered and expressed support for a proposed decision tree incorporating simple PVAs to assess the status of poorly known taxa and guide listing decisions. The decision tree would use available data on the species of interest; default values where data are lacking; a structured, standardized, and simple analytical framework; and explicit guidelines for interpreting results. With appropriate development, the decision tree might be used to structure listing decisions in much the same manner as the potential biological removal concept is used to identify strategic stocks in the management of marine mammal/fishery interactions under the Marine Mammal Protection Act.

I. INTRODUCTION

In its 2004 Omnibus Appropriations Act, Congress directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." In response to the directive, the Commission reviewed systems for classifying species (Lowry et al. 2007), reviewed current protection programs (Weber and Laist 2007), conducted a case study of the North Atlantic right whale recovery program to examine the issue of cost-effectiveness in depth (Reeves et al. 2007), and held a workshop on the state and utility of population viability analysis (PVA) in the management of marine mammal populations.

The population viability workshop was held 13–15 September 2005 in Savannah, Georgia. Its goals were to (1) review estimates of the viability of the most endangered marine mammals, (2) review the status of ongoing modeling efforts, particularly PVAs, for endangered marine mammals, and (3) develop recommendations to improve listing and management decisions based on explicit consideration and improved estimation of extinction risk. This report summarizes the discussions and findings of the workshop.

II. BIOLOGICAL VIABILITY

For the purposes of this report, we define *biological viability* (or simply *viability*) to mean the potential to persist far into the future with appropriate management of human-related threats. Although species are often characterized as either viable or not viable (implying a high or low potential for such persistence), there is a meaningful intermediate area between these two extremes. The transition from viable to not viable has been the subject of extensive research aimed at identifying the "minimum viable population." This term was based on the idea that a declining population would reach a predictable point at which factors driving it toward extinction would dominate and recovery would be impossible or highly unlikely. This concept has been largely abandoned in the face of a growing body of contrary, empirical data illustrating that viability is generally a function of multiple natural and anthropogenic influences, the transition from viable to nonviable is dependant on species and circumstances, and a threshold for such transition that can be applied generally across taxa is not readily and reliably predicted.

Practically speaking, the viability of marine mammal taxa can be categorized as follows:

- Taxa that are extinct. These are taxa that have zero potential of persisting, as exemplified by the Steller's sea cow.
- Taxa that are almost certain to become extinct in the near future. The persistence of such taxa is highly improbable and there is little or no hope that they will continue to persist or can be saved, irrespective of human efforts. The AT1 stock of killer whales appears to fall into this category.

- Taxa with the potential to persist far into the future, but that may require the extra protections provided for threatened or endangered species on an ongoing basis. The Hawaiian monk seal may be one such species.
- Taxa with the potential to recover fully but that require extra protections until they have done so. Most listed species fit this category.
- Taxa that have recovered. The eastern North Pacific population of gray whales is the best example of this category.

The primary distinguishing elements of these categories are (1) a taxon's inherent potential for recovery and persistence, and (2) its dependence on human intervention (e.g., management actions and policy decisions) to address threats. These two elements are becoming more entwined as the effects of human activities become more nearly ubiquitous (e.g., climate change) and the boundary between anthropogenic and natural risk factors becomes less distinguishable (e.g., climate change). As a rule, scientists conducting PVAs have not made this distinction but rather have estimated population viability as a function of the list of known risk factors, both natural and anthropogenic, that may influence a population's persistence. The primary outcome of a PVA is a measure of the population's probability of extinction over a set period[1] based on the projected effects of such risk factors. Thus, a PVA is an approach to risk analysis that attempts to predict the probability of extinction based on available data. Except in rare situations that are usually apparent even without modeling, its results generally do not provide definitive answers as to when a species is no longer viable. For example, results of a PVA indicating that a population is declining toward extinction may be due to anthropogenic factors unrelated to its intrinsic ability to reproduce and grow. If those factors can be identified and addressed by effective management action, the population's decline could be reversed to allow recovery. Thus, a predicted declining trend may simply underscore the urgent need for management attention. A review of the taxa considered in this report indicates that they have all been influenced in a significant manner by human activities.

Factors affecting population viability generally fall into three categories. The first includes features of the population itself (e.g., abundance, age/sex structure, distribution, life history characteristics such as reproductive and survival rates). The viability of a marine mammal population may be a particular concern if, for example, it contains only a limited number of reproductive females (for example, the AT1 stock of killer whales includes only two or three females of reproductive age). The second category includes factors that are a function of the population's environment or ecology (e.g., availability of prey, abundance of predators, exposure to disease, variation in the physical parameters of the environment). Small populations

[1] PVAs often indicate the risk that a population will reach some specific, small number other than zero, called a "quasi-extinction" threshold. Such thresholds are generally based on the assumption that extinction is virtually certain at or below the chosen level. They are required for demographic models that describe animal abundance using real numbers (rather than integers) that may approach zero exponentially but never actually reach that level. Quasi-extinction thresholds are often used when modeling marine mammal populations because actual extinction may be delayed beyond the time period modeled, even for rapidly declining populations, if individual animals are relatively long-lived. Some authors have interpreted the quasi-extinction threshold to represent the lip of an extinction vortex (an interaction of risk factors creating adverse feedback loops that hasten a population toward extinction), but this interpretation is often difficult to demonstrate and justify.

occupying limited areas may be especially vulnerable to catastrophes. For example, Florida manatees, which tend to have clustered distributions in shallow waters, are vulnerable to toxic effects of periodic red tides. The third category includes factors that are a function of human activities (e.g., habitat destruction, competition for prey, disturbance, contaminants). Human activities, particularly exploitation, likely played a decisive role in the extinction of the Steller sea cow, Caribbean monk seal, Japanese sea lion, and North Atlantic gray whale, and have placed many other marine mammal taxa at risk of extinction (e.g., right whales).
Small populations also are especially vulnerable to the following sources of variability (also called stochasicity).

Genetic Variability—Two major concerns for small populations are (1) whether they contain sufficient genetic diversity to persist in the face of changing environmental conditions, and (2) whether mating between a limited number of breeding individuals will lead to the expression of deleterious genes affecting reproduction or survival (hence, population growth rate) because of inbreeding or genetic drift (i.e., random fluctuations in gene frequency). Although the former concern is often related to a species' ability to adapt to change over long periods of time (i.e., evolutionary time frame), the rapid pace of climate change illustrates that this concern also is relevant to short-term changes (i.e., ecological time frame). As a general rule, genetic diversity decreases with decreasing population size. Smaller populations are therefore less likely to contain sufficient genetic variation to persist in the face of selection imposed by significant environmental change. With regard to inbreeding, matings in small populations are more likely to be between related individuals, which increases the probability that deleterious recessive genes will be expressed in their offspring. The probability of such events also is influenced by the species' mating pattern. For example, inbreeding effects are more likely in polygamous than in monogamous species. Even in the absence of inbreeding, genetic drift in small populations can result in the expression of genetic defects. The effects of genetic drift and inbreeding depression may not be expressed for several to many generations, with the time frame depending on population size, the initial genetic diversity, the frequency of deleterious genes, and the reproductive strategy. Thus, their adverse consequences are more likely to manifest themselves in populations that are held at low abundance for long periods of time or that are repeatedly reduced to small size.

Demographic Variability—Demographic variability is the result of random variations in biological processes or parameters, such as survival, reproduction, or sex ratio at birth. If the fate of each individual in a population is subject to the same probability, the resulting variation will be a function of population size. That is, as the size of a population shrinks, the likelihood that it will deviate from the expected norm for that process or parameter will increase. For example, if the expected sex ratio at birth is 50 percent females and 50 percent males, a substantial deviation from that sex ratio is more likely to occur in a small population than in a larger one[2]. For depleted marine mammal populations, having more females generally is beneficial because of their role in reproduction, whereas a relative increase in males generally is detrimental. The

[2] Similarly, significant deviation from the expected 50:50 heads to tails ratio is more likely to occur if you flip a coin a few times versus many times.

actual consequences of such deviations depend on the population's composition and social structure, including its reproductive strategy, but they become more likely to affect the long-term persistence of a population as its abundance declines.

Environmental Variability—Environmental variability can alter population demographics by changing prey abundance, weather or oceanographic conditions, or abundances of predators. All individuals in a population may be affected, whether the population is large or small. Populations that occupy large areas may be exposed to a range of environmental conditions and thus may experience a degree of buffering from poor conditions in portions of the range. Small populations are more likely to occupy smaller areas where environmental conditions tend to be more homogeneous and, therefore, such populations may be more vulnerable to unfavorable circumstances. Metapopulations (collections of related subpopulations) may be buffered against such circumstances if animals are dispersed among subpopulations experiencing different environmental conditions.

Catastrophic Variability—Catastrophic variability has been considered by some to be an extreme form of environmental variability and by others to be a separate type of risk factor because its nature and spatial-temporal patterns (e.g., hurricanes, tsunamis) are inconsistent with those of environmental variability. Here too, the problem for small populations is that all or some large percentage of the individuals in the population may be exposed to the effects of the same catastrophic event if their distribution is limited relative to the distribution of the event. Metapopulation structure and broad distribution enhance resilience to catastrophic variation.

Allee Effects—Population parameters also vary as a function of animal density. As the number of individuals in a population declines, the potential for population growth may increase because of reduced competition for prey, habitat, or other resources. However, at very low levels, populations also may experience accelerating declines in reproductive or survival rates due to so-called Allee effects. For example, if animals are sparsely distributed, adult females may be unable to find mating partners. Similarly, strategies for foraging, predator avoidance, and rearing young may be impaired in very small populations if those behaviors depend on the cooperation or participation of multiple individuals. Allee effects and other risk factors may combine either additively or synergistically to create cumulative effects that, ultimately, determine the population's risk of extinction. Such interactions may create negative feedback loops that hasten decline toward extinction, a phenomenon referred to as an extinction vortex.

Population Structure—Finally, assessment of the risk factors discussed here is confounded by insufficient information on population (or stock) structure. The conservation and management frameworks established by the Endangered Species Act, the Marine Mammal Protection Act, and related statutes are predicated on scientists being able to identify appropriate units to conserve. As indicated earlier, stock structure is poorly understood for many marine mammal species despite recent progress using molecular genetics techniques. The failure to recognize distinct population segments[3] or population stocks increases risk if, for any number of reasons, some are more vulnerable than others to the above-described risk factors and they are managed in a manner that does not recognize and adjust for that vulnerability. The identification and characterization of population structure are essential for accurate assessment of population viability. Therefore, this subject warrants continued scientific investigation.

III. POPULATION VIABILITY ANALYSIS

To support and improve listing and management decisions for taxa that are either candidate species or are already listed as endangered or threatened, the growing trend is toward more structured, objective decision-making using the best available quantitative tools to determine risk of extinction. All of the early marine mammal listings involved species that were reduced to low levels by human exploitation (usually commercial hunting) and ineffective or non-existent management. Those listing decisions required expert judgment and a degree of qualitative assessment. Even the best information available at that time was subject to important limitations. Abundance, for example, is clearly an important consideration with regard to the risk of extinction. However, it has subsequently become clear that abundance is only one indicator of extinction risk, and an imperfect one at that. Some small populations may have a low probability of extinction because of favorable environmental conditions and an absence of significant threats, whereas some large populations may have a high probability of extinction because of poor environmental conditions and significant threats. As noted above, the risk of extinction also is a function of a potentially wide range of factors, including those related to the taxon itself, its environment, and the threats posed by human activities.

PVAs provide a means for integrating many kinds of information to produce robust indicators of extinction risk. Such analyses vary in form as a function of the population under consideration, its life history traits, the nature and amount of data available on its biology and population dynamics, the nature and amount of data available on factors that may affect its risk of extinction (e.g., threats), and the modeler's technical (i.e., mathematical) preferences. When feasible, such analyses incorporate the types of variation described earlier, usually by representing variables as distributions of possible values and running multiple analyses drawing randomly from those values to estimate the range of possible outcomes and their probability. The results can be used for a number of purposes, including informing listing processes under the Endangered Species Act and Marine Mammal Protection Act, evaluating the effects of past management actions, and predicting the effects of proposed actions.

At the workshop, participants discussed existing PVA models or similar quantitative analyses for California sea otters, Cook Inlet beluga whales, Florida manatees, Hawaiian monk seals, North

[3] In 1996 the National Marine Fisheries Service and the Fish and Wildlife Service finalized a policy statement interpreting the Endangered Species Act term "distinct population segment" to mean a population that is (1) discrete from the remainder of the species (e.g., markedly separate), (2) significant to the species (e.g., its loss could cause a major gap in the range or includes unique genetic characteristics), and (3) threatened or endangered based on the Act's five listing factors. Use of the term in this report is intended to be consistent with that interpretation.

Atlantic right whales, southern resident killer whales, and the eastern and western stocks of Steller sea lions (Appendix 1). Several of the models had been used to inform listing decisions, but the others were not used for that purpose because they were created after listing had already occurred. These latter models were created for other purposes and varied in their objectives, model parameters, and complexity. In all cases the models were constrained to varying degrees by limited information pertaining to biology (e.g., reproductive and survival rates), cause-and-effect relationships between specific threats or management actions and population responses, and factors likely to determine the nature and extent of future threats. Given limitations in available data, scientists developing each of the models were required to make certain simplifying assumptions (e.g., homogeneity in vital rates over space or time, relevant risk factors). As is generally the case in science, the assumptions warrant further consideration and testing. However, an important characteristic of these models (and of PVA models in general) is that all such assumptions are made explicit, and therefore the potential implications of erroneous assumptions can be directly evaluated using sensitivity analyses. Moreover, as new information becomes available, the data used in the models can be updated, the model processes refined, and the validity of simplifying assumptions re-evaluated, all of which will result in more robust and reliable model results. Thus, PVA is an evolving process, open to review and subject to improvement as new information and insights become available.

IV. VIABILITY OF THE MOST ENDANGERED MARINE MAMMALS

To assess the biological viability of the most endangered marine mammals, the workshop focused on the 22 species and stocks occurring in U.S. waters and listed as endangered or threatened under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act (Table 1). Some other marine mammal species (e.g., the Yangtze River dolphin or baiji[4]) may be equally or more endangered but were not discussed in detail at the workshop or included in this report because they do not occur in U.S. waters or have not been listed. A wide variety of taxa, including marine mammals and other species, either have been rendered extinct or have been brought near to extinction before rebounding. Those cases also provide useful insights regarding the question of species viability.

Extinctions and recoveries

Human activities have caused the extinction of at least four marine mammal taxa. The northern (Steller's) sea cow inhabited kelp-forested coastlines of the Bering Sea until the second half of the 18th century, when it was driven extinct by commercial seal and sea otter hunters who hunted sea cows for food (Stejneger 1887, Forsten and Youngman 1982). The last reliable sighting of a Caribbean (West Indian) monk seal was in 1952 (Kenyon 1977); this species also was a victim of uncontrolled hunting, disturbance, and habitat destruction. The Japanese sea lion was last sighted and documented in 1951 and is listed as extinct by IUCN–The World

[4] During the preparation of this report, an international team of marine mammal scientists conducted an extensive survey of the Yangtze River and failed to detect a single baiji.

Conservation Union (IUCN). It was exploited for various purposes and persecuted because it was perceived as a competitor of fisheries. The North Atlantic population of gray whales vanished by the 18th century, and whaling almost certainly was a contributing, if not decisive, factor in its demise.

A number of other marine mammal taxa have been brought near to extinction and then recovered, at least partially, following protection from the main threat, which almost always has been deliberate exploitation (Table 2). Many populations of fur seals (*Arctocephalus* spp.), elephant seals (*Mirounga* spp.), sea otters, and baleen whales were harvested to the point where hunting for them was no longer profitable. In a few cases (e.g., Guadalupe fur seal), numbers were so low that a species or population was considered extinct, only to be discovered again and to recover under protection. These examples (and examples from other taxonomic groups, Table 2) demonstrate the potential resilience and viability of wild species and populations, even when reduced to low population size.

Assessment of biological viability

PVAs have not been completed for most of the 22 taxa considered at the workshop because of insufficient information or lack of a standard for conducting such analyses on data-poor species. The general opinion of workshop participants was that all but 2 or possibly 3 of the 22 listed marine mammal taxa are potentially viable if human-related threats are effectively managed. The Caribbean monk seal probably is extinct, and the AT1 stock of killer whales does not appear to be biologically viable, regardless of recovery efforts. The viability of the eastern population of North Pacific right whales has been a matter of concern based on its history of exploitation, rarity of sightings, and lack of biological information on the population.

The discussion of viability for the remaining taxa was based primarily on PVAs or a combination of expert opinion and varying amounts of quantitative information. Of the eight taxa for which quantitative biological analyses had been conducted, three (Florida manatee, eastern population of Steller sea lions, and southern sea otter) have experienced positive growth in recent years, although growth rates have been difficult to characterize (Florida manatee) or slower than expected (southern sea otter, eastern population of Steller sea lions). Thus, each of these three taxa is reasonably considered biologically viable although the persistence of at least two of them likely will continue to depend on rigorous, effective management of known threats (i.e., disease, contaminants, and fisheries for the southern sea otter and boat strikes and loss of warm-water refuges for the Florida manatee).

The Hawaiian monk seal is now declining at about 4 to 5 percent per year, and its total population size in 2005 was estimated at 1,250 to 1,300. The species consists of seven reproductively isolated subpopulations including one in the main Hawaiian Islands and six in the remote Northwestern Hawaiian Islands. The subpopulations are subject to a range of threats (e.g., reduced prey availability, entanglement, shark predation, male aggression, disease). Although monk seals benefit from a robust research program that helps direct a growing management effort and although some sweeping protection and conservation measures have been implemented recently, the species clearly is at risk of extinction. Rigorous, effective management of human-related threats is essential to its conservation. The species has persisted for 12 to 15 million years in approximately the same geographic range, and there is no reason to believe that it cannot continue to persist far into the future as long as human-related threats are managed effectively.

The western population of Steller sea lions has declined by about 80 percent in the past three decades, and much of the decline has yet to be explained. Contributing causes may include natural changes in environmental conditions leading to a reduction in prey, predation by killer whales that lost a preferred prey source because of commercial whaling, deliberate or incidental killing in connection with fisheries, and competition for prey with large-scale commercial fishing that rapidly expanded in the region in the 1960s and early 1970s. The most recent abundance estimate is about 38,000 animals, and recent counts suggest that the population may have stabilized. Although there is still cause for concern regarding the future of this population and much remains to be learned about the importance of various risk factors, there is no basis for concluding that the population is incapable of persisting if human-related threats are managed effectively.

The number of North Atlantic right whales was reduced by commercial whaling prior to the 1940s and currently numbers about 300 to 350 whales. This population's estimated rate of increase was positive in the 1980s but apparently declined in the 1990s due to mortality from ship strikes and entanglement in fishing gear. The population appears capable of maintaining a positive population growth rate if human-related threats are controlled, and therefore it appears to be viable.

The southern resident stock of killer whales occurring each summer in the Puget Sound area has been subject to a range of human-related threats. A relatively large portion of the population was captured in the 1960s and early 1970s to supply animal-display facilities. Prior to that, the animals were subject to unregulated shooting and harassment (Hoyt 1981). In recent years, the stock has been subject to three primary threats: loss of prey (primarily chinook salmon) secondary to loss of salmon habitat and fishing, exposure to contaminants, and noise and disturbance due to watercraft traffic, including whale-watching vessels. Abundance of the stock under pristine conditions is unknown although it is likely to have been in the low hundreds. Although the elevated risk of extinction for this stock is a matter of significant concern, there is no basis for concluding that its low numbers and recent decline are due to an inherent lack of biological viability, particularly in view of the multiple human-related threats to which the stock is exposed.

Abundance of the Cook Inlet beluga whale was reduced sharply in the 1990s by Alaska Native subsistence harvests. The harvest was restricted in the late 1990s, but trend analysis of abundance estimates from 1994 through 2006 indicates a statistically significant decline. Research is urgently needed to identify the causes for continued decline after the harvest was brought under control. A number of natural and anthropogenic factors could be contributing to the continued decline. There is no basis for concluding that the population has lost the potential to recover, but it is clear that its recovery potential is eroding rapidly and the population is in great need of rigorous, effective management to identify and address the factors perpetuating the decline.

PVAs have not been conducted or were not discussed at the workshop for the remaining 12 taxa considered. The bowhead whale, fin whale, humpback whale, sperm whale, mid-Atlantic stock of bottlenose dolphins, Guadalupe fur seal, northern fur seal, and southwest Alaska stock of northern sea otters all are either known to be increasing or number at least 10,000 animals, and there is no basis for concluding that any of them has lost the potential to recover and persist. Blue and sei whale population structure and abundance are not well known. The National Marine Fisheries Service recognizes eastern and western North Pacific blue whale stocks and a North Atlantic stock. The eastern North Pacific stock, the only one for which an abundance estimate is available, consists of about 3,000 animals and may be increasing. It is therefore reasonably considered to be viable. The status of the other two blue whale stocks that occur in U.S. waters is not known, although the general sense of workshop participants was that they are capable of persisting if human threats are effectively managed. There are no current, reliable estimates of sei whale abundance in the North Pacific and North Atlantic Oceans. The sei whale estimate of >133 in Table 1 represents a combined minimum estimate for the eastern North Pacific and Hawaii stocks, but likely it is strongly and negatively biased. Better estimates of sei whale abundance are clearly needed and will provide a better basis for judging the viability of sei whale stocks. The Antillean subspecies of West Indian manatee occurred historically over a relatively large range in coastal areas of Central and South America and around islands in the Caribbean Sea. Manatees are now rare in the U.S. Virgin Islands, and the most recent (1994) count in Puerto Rico suggested a minimum of 86 animals. As the Antillean manatee is threatened in U.S. waters mainly by boat strikes and entanglement in fishing nets, the primary recovery challenge appears to be controlling those human-related threats. Any further decline in numbers would erode the potential for recovery of the manatee populations in Puerto Rico and the Virgin Islands. Outside U.S. waters, deliberate killing also poses a significant risk and undermines the potential for recovery. Finally, the viability of the eastern population of North Pacific right whales is a significant concern. Since the mid-1990s only 23 individuals have been identified, including three cow-calf pairs. It is unlikely that the identified animals represent the entire population, but it also seems unlikely that there are a great many more than that number. Whether 23—or even 25 to 50—individuals would be sufficient for recovery is unclear. However, populations of other mammal species have recovered from such low numbers (e.g., northern elephant seals, southern sea otters) so there is a basis for hoping that this population is still capable of recovery.

V. IMPROVING LISTING DECISIONS

Two efforts to improve listing decisions were discussed at the workshop, one undertaken by the National Marine Fisheries Service and the Fish and Wildlife Service, and one proposed by Dr. Daniel Goodman. Those efforts are summarized briefly below.

uantifying the listing process

In 2004 the National Marine Fisheries Service and Fish and Wildlife Service convened a Quantitative Working Group to evaluate listing decisions under the Endangered Species Act and develop procedures that would be "more transparent, consistent, and scientifically and legally defensible." The working group identified several conceptual models for listing purposes, all of which are directly or indirectly related to risk of extinction (DeMaster et al. 2004).

The working group noted that implementation of these approaches would require explicit policy input. Specifically, policy guidance must be provided regarding the degree to which errors in the listing process are acceptable if they result in over-protection (i.e., listing species that, in fact, are not endangered or likely to become so in the foreseeable future) versus under-protection (i.e., failing to list species that, in fact, are endangered or likely to become so). The extent to which the process should be precautionary (i.e., favor over-protection) also would require specification.

In many cases, the Fish and Wildlife Service and National Marine Fisheries Service must make listing decisions for species with very limited information on either population status or threats. The working group recommended that in those cases quantitative proxies, or "alternative decision metrics," be developed (e.g., a 95 percent decline in abundance could serve as a proxy for an unacceptable probability of extinction). Both listing standards and proxies should be tested to determine the likelihood of correct versus incorrect listing decisions, given the life history of a species and uncertainty in the data or analytical results. The working group has initiated such performance testing for a suite of potential listing standards and proxies. An additional option recommended for consideration by the working group is a threshold approach similar to that used by a number of other organizations including IUCN in its Red List of Threatened Species, parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora for listing species on its appendices, and the Committee on the Status of Endangered Wildlife in Canada for listing species under the Canadian Species at Risk Act.

A theoretical decision tree for listing under the Endangered Species Act

Participants at the Commission's PVA workshop also considered a theoretical decision-making framework for listing decisions proposed by Dr. Goodman. The framework was developed to simplify and standardize listing decisions using quantitative tools and criteria, better document the decision-making process, provide default assessment methods for data-poor taxa, and guide the use of limited resources to develop more reliable assessments. The suggested framework is designed to classify "at-risk" populations into four categories based on their population dynamics and then use category-specific quantitative modeling approaches to assess a population's viability and determine whether the population should be listed based on defined decision rules. The four suggested categories are (1) populations that are too small, (2) populations that are nearly too small, (3) populations that are large but declining, and (4) populations that are large but have volatile population dynamics (Table 3). For each category, standards would be established for classifying species as threatened or endangered.

Several technical and scientific issues would have to be addressed before such a framework could be used. The framework would have to include options for taxa with known threats but little or no population data. Also, the term "too small" would have to be defined, and quantitative assessment methods for each category would need to be developed and tested. Those methods would require some flexibility to take into account different life history types (e.g., long-lived versus short-lived species or species with low versus high reproductive rates). Although some at-risk marine mammals may fit less cleanly than others into these four categories, an explicit decision tree framework with specific categories and corresponding quantitative assessments would enhance the objectivity and consistency of the listing process for data-poor taxa. For that reason, workshop participants favored the development of such a framework. With appropriate development, the decision tree might help structure listing decisions in much the same manner as the potential biological removal concept has structured the management of incidental take of marine mammals in commercial fisheries under the Marine Mammal Protection Act.

VI. IMPROVING OTHER MANAGEMENT DECISIONS

In addition to listing decisions under the Endangered Species Act, decisions regarding a range of marine mammal management actions are based on qualitative assessments of limited quantitative data on population status, trends, and threats. The underlying analyses often are not explicit with regard to assumptions and uncertainties, and therefore they can seem subjective and arbitrary. This problem can be addressed, at least in part, by making the decision-making process more explicit, objective, and quantitative. For example, when deciding among management actions, quantitative models can be used to analyze or predict their alternative effects, thereby informing the decision-making process. Such models also can provide a mechanism to evaluate the significance of assumptions and uncertainty inevitably associated with management decisions. In addition, they may help identify factors likely to affect population recovery and help characterize the nature and significance of the likely effects. All of these benefits—if communicated effectively between scientists and managers—would result in a more structured and comprehensive process for making management decisions.

Recently both the Fish and Wildlife Service and the National Marine Fisheries Service have increased their use of explicit, quantitative models to inform management decisions. In part, this increase is related to requirements for "objective, measurable" recovery criteria in recovery plans prepared under the Endangered Species Act. Quantitative models can be and have been used to assess relative risks from various threats and relative benefits of alternative management strategies in the recovery planning process. They also have been used in section 7 consultations under the Endangered Species Act to assess the effects of incidental takes of individuals from species or populations listed as endangered or threatened.

Many PVA analyses have been conducted using VORTE (Bob Lacy, Department of Conservation Biology, Chicago Zoological Society) or other standardized software. Although such software can be very useful for heuristic purposes (e.g., exploring the dynamics of different populations and the effects of different management actions), workshop participants expressed concern that it may be used without adequate understanding of the actual structure, function, and assumptions incorporated into the software model. Such uninformed use may result in misunderstanding of population status and risk of extinction. Although participants did not necessarily suggest that complex models should be created from first principles for each analysis, they did suggest that analyses using standardized software should be conducted with a thorough understanding of their limitations and assumptions. All the case studies presented at the workshop and reviewed here were customized models specifically tailored to the circumstances of the population and the nature of the available data.

VII. ACKNOWLEDGMENTS

The Marine Mammal Commission thanks all those who participated in, or provided support for, the workshop. The Commission is especially grateful to the presenters and panel members who led many of the discussions. A steering committee of experts directed the Commission’s response to the Congressional directive, including this workshop. Its members were David Cottingham, Deborah Crouse, Daniel Goodman, Lloyd Lowry, Linda Manning, Randall Reeves, Michael Simpkins, and Phil Williams. David Laist managed various components of the Commission’s response, and Michael Simpkins and Timothy Ragen collaborated on preparation of the workshop report. SRA International, particularly Linda Manning and Regan Maund, provided expert assistance in planning and facilitating the workshop and also helped with drafting of this report. Elizabeth Taylor, a 2005 Knauss Sea Grant Fellow at the Commission, also contributed substantially in organizing the workshop and drafting early versions of this report. Jeff Benoit from SRA International and Suzanne Montgomery provided editorial assistance for later revisions. Katherine Ralls helped with the development of Table 2.

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Table 1. Summary of the biological status of 22 marine mammal species and stocks currently listed as endangered or threatened under the Endangered Species Act or designated as depleted under the Marine Mammal Protection Act (from Lowry et al. 2007). uestion marks indicate apparent population trends that have not been confirmed.

Taxon	Current population size	Current population trend	Population size relative to historical level
Endangered species			
West Indian manatee, Florida	>3,300	Increasing?	Unknown
West Indian manatee, Antillean	Unknown	Declining?	Reduced?
Caribbean monk seal	0	N/A	Extinct
Hawaiian monk seal	1,252	Declining 4.9 percent a year	Reduced 60 percent from 1958
Steller sea lion, western population	38,513	Stable	Reduced 81 percent from the 1970s
Blue whale[1]	>2,994	Increasing?	Reduced
Bowhead whale, western Arctic population	10,545	Increasing 3.4 percent a year	Reduced 54 percent from the 1800s
Fin whale	>11,970	Unknown	Reduced
Humpback whale	>6,692	Increasing	Reduced
North Atlantic right whale	299	Declining?	Reduced
North Pacific right whale, eastern population	>23	Unknown	Reduced
Sei whale[2]	>133	Unknown	Reduced
Sperm whale[3]	>14,468	Unknown	Reduced
Killer whale, southern resident population	84	Unknown	Reduced
Threatened species			
Southern sea otter	2,825	Increasing	Reduced
Northern sea otter, southwest Alaska population	41,865	Declining	Reduced 55 to 67 percent from 1976
Guadalupe fur seal	7,408	Increasing	Reduced
Steller sea lion, eastern population	44,996	Increasing	Unknown
Depleted (only) species			
Northern fur seal, eastern population	688,028	Declining	Reduced 65 percent from the 1950s
Beluga whale, Cook Inlet population	278	Declining?	Reduced 57 percent from 1994
Bottlenose dolphin, mid-Atlantic coastal population	33,000	Unknown	Reduced
Killer whale, AT1 group	8	Declining	Reduced 64 percent from 1988

[1]Data are not available for the North Atlantic and western North Pacific stocks.
[2]Data are not available for the Nova Scotia stock.
[3]Data are not available for the North Pacific stock.

Table 2. Examples of wild populations that have recovered from extremely low population sizes, with ( ) or without the assistance of captive/assisted breeding programs ( ) indicates that additional animals survive in captivity.

Species, stock, or population	Estimate of minimum population size (approximate date)	Estimate of current wild population size	Source(s) of information
Marine mammals			
Northern elephant seal (*Mirounga angustirostris*)	20–100 (1890)	>175,000	Bartholomew and Hubbs 1960, Stewart et al. 1994
Southern sea otter (*Enhydra lutris nereis*)	50 (1938)	>2,500	Riedman and Estes 1990
Guadalupe fur seal[5] (*Arctocephalus townsendi*)	70–75 (1955)	>7,000	Hubbs 1956, Gallo 1994
Southern right whale (*Eubalaena australis*)	<300 (1920)	>7500	Baker and Clapham 2004
Juan Fernandez fur seal (*Arctocephalus philippii*)	700–750 (1970)	>12,000	Hubbs and Norris 1971, UNEP[6]
Terrestrial mammals			
Black-footed ferret (*Mustela nigripes*)	18 (1987)	650^{+}	Black-footed ferret recovery team[7]
Tule elk (*Cervus elaphus nannodes*)	28 (1895)	3,200	McCullough et al. 1996, NPS 1998
Przewalski horse (*Equus ferus przewalskii*)	31 (1945)	175^{+}	Wakefield et al. 2003
European bison (*Bison bonasus*)	54 (1918)	1700^{+}	Pucek 2004
Golden lion tamarin (*Leontopithecus rosalia*)	<200 (1970s)	$1{,}500^{+}$	Smithsonian Natl. Zoological Park[8]
Birds			
Mauritius kestrel (*Falco punctatus*)	4 (1974)	800–1,000	Birdlife International[9]
Chatham island black robin (*Petroica traversi*)	5 – one breeding pair (1979)	250	NZ DOC 2001[10]

[5] Considered extinct in the 1930s and early 1940s
[6] United Nations Environment Programme; http://www.unep-wcmc.org/species/data/species_sheets/juanfern.htm
[7] http://www.blackfootedferret.org/
[8] http://nationalzoo.si.edu/ConservationAndScience/EndangeredSpecies/GLTProgram/default.cfm
[9] http://www.birdlife.org/datazone/index.html
[10] also see: http://www.doc.govt.nz/Conservation/001~Plants-and-Animals/001~Native-Animals/Black-Robin.asp

Table 2, continued.

Species, stock, or population	Estimate of minimum population size (approximate date)	Estimate of current wild population size	Source(s) of information
Whooping crane (*Grus americana*)	21 (1944)	>300+	CWS and FWS 2005
California condor (*Gymnogyps californianus)*	25–35 (1979)	127+	California Dept. of Fish and Game[11]
Seychelles warbler (*Acrocephalus sechellensis*)	50 (1965)	>2,000	Birdlife International[5]
Guam rail (*Gallirallus owstoni*)	100 (1983)	400+	Smithsonian Natl. Zoological Park[12]

[11] http://www.dfg.ca.gov/hcpb/species/t_e_spp/tebird/condor.shtml
[12] http://nationalzoo.si.edu/Support/AdoptSpecies/AnimalInfo/Guamrail/default.cfm

Table 3. A theoretical decision tree and analytical recommendations for listings under the Endangered Species Act

Decision Tree Categories	PVA Model Recommendation
Populations that are too small	When a species or population is already known to be too small (through obvious proxy measures), then no PVA is necessary; the population should be listed.
Populations that are nearly too small	When a population is nearly too small, the important question is whether the population is likely to become too small. In that case, a simple PVA model could be designed to test whether the current or foreseeable population trend is, or is likely to be, negative.
Populations that are large, but declining	When a population is large but declining, the important question is whether the population could decline too much. In that case, a population viability model could be designed to test whether the current or foreseeable trend is likely to cause the population to become too small. The model would need to be slightly more complex because it must evaluate the possibility that the population decline could halt before the population became too small.
Populations that are large, but have volatile population dynamics	When a population is large but volatile (highly variable), the important question is whether the volatility in population dynamics is large enough to cause the population to become too small. For populations with a high degree of variability, a model could be designed to test whether the population could reach a critical threshold size as a result of random fluctuations. Such models must accurately represent the variability in various population parameters.

APPENDIX I

Examples of Existing Marine Mammal Population Models

North Atlantic Right Whales (Presented by Hal Caswell, Woods Hole Oceanographic Institution)

__Background and purpose__: The North Atlantic right whale is the least abundant species of large whale in the world. It occurs primarily along the East Coast of the United States and Canada. It was reduced to levels approaching extinction by centuries of commercial whaling and is listed as endangered under the Endangered Species Act. Current abundance is about 300 to 350 whales. Entanglement in fishing gear and collisions with ships are the major factors impeding recovery. A model was developed to estimate the population's reproductive, survival, and population growth rates; predict extinction risks; and evaluate hypotheses about factors influencing population trends, including potential effects of variable oceanographic conditions.

__Approach__: The matrix population model is based on biologically defined life history stages. It incorporates environmental and demographic variability by using observed variations in vital rates over the past 20 years. Parameters (e.g., stage-specific reproductive and survival rates) are estimated using mark-recapture methods (Caswell 2001, Fujiwara and Caswell 2002, Caswell and Fujiwara 2004). The estimation procedure automatically incorporates effects of uncertainty in the data and provides confidence intervals around parameter estimates.

__Data__: The model uses data from 1980 through 1998 on age, sex, and reproduction for individual whales documented in a photo-identification catalog of the population. The catalog is believed to include at least some records for most of the individuals in the population, although the number of resighting records varies greatly among individual whales. The data are subjected to a multi-stage mark-recapture analysis to estimate parameters under a variety of statistical hypotheses that consider variation over time and the effects of environmental variables. Information-theoretic criteria are used to select the statistical hypotheses that are most highly supported by the available data.

__Results__: The analysis suggests that the population was increasing at about 4 percent per year in the early 1980s, but that the growth rate declined until it became negative in the mid-1990s. The decline appears to be due to a declining trend in birth rates and survival of mothers and calves between 1980 and 1998. The rate of decline has varied with the North Atlantic Oscillation, suggesting that the population's dynamics are affected by changing atmospheric and oceanographic conditions. By the late 1990s the estimated population growth rate was below replacement level, indicating that the population would not persist without mitigation of human impacts. As for all marine mammals, population growth is most sensitive to the survival of mature females. All other things equal, a reduction of human-related mortality by two adult females per year could return the population growth rate to replacement level. Further reduction would allow recovery, albeit at a slow rate.

Recent publications using the model:

Caswell, H., M. Fujiwara, and S. Brault. 1999. Declining survival probability threatens the North Atlantic right whale. Proceedings of the National Academy of Science 96:3308–3313.

Fugiwara, M., and H. Caswell. 2001. Demography of the North Atlantic right whale. Nature 414:537–541.

Caswell, H., and M. Fujiwara. 2004. Beyond survival estimation: mark-recapture, matrix population models, and population dynamics. Animal Biodiversity and Conservation 27:471–488.

Kraus, S. D., M. W. Brown, H. Caswell, C. W. Clark, M. Fujiwara, P. K. Hamilton, R. D. Kenney, A. R. Knowlton, S. Landry, C. A. Mayo, W. A. McLellan, M. J. Moore, D. P. Nowacek, D. A. Pabst, A. J. Read, and R. M. Rolland. 2005. North Atlantic right whales in crisis. Science 309:561–562.

Caswell, H. 2006. Applications of Markov chains in demography. Pages 319–334 *in* (A. N. Langville and W. J. Stewart, eds.) MAM2006: Markov Anniversary Meeting. Boson Books, Raleigh, NC, USA.

Caswell, H. 2007. Sensitivity analysis of transient population dynamics. Ecology Letters 10:1–15.

Southern Resident Killer Whales (Presented by Paul Wade, National Marine Mammal Laboratory, National Marine Fisheries Service)

Background and purpose: Southern resident killer whales comprise three distinct pods, identified as J, K, and L pods, that occur principally in Washington's Puget Sound and southern British Columbia, Canada. Historically, the population may have included more than 200 individuals. In the mid-1960s the stock was thought to number at least 100 animals, but it then declined sharply in the late 1960s and early 1970s as a result of live captures for aquaria. By 1995 abundance had recovered to 98 animals. Since then, the stock first declined to 81 animals in 2001 and then increased to 88 animals in 2004. The declining trend seems to have been driven primarily by changes in the largest pod, L pod. The recent increase, however, has been driven primarily by an increase in J and K pods. Pod-specific trends are important because males rarely mate with females from their own pod (and resident killer whales in the North Pacific mate only within their ecotype). As a result, the reproductive success of a resident pod is determined not only by the fecundity of the females within that pod but also by the availability of fertile males from other resident pods. Three potential factors may be impeding recovery of southern resident killer whales: high contaminant loads; declines in available prey, particularly salmon; and disturbance by whale-watching ventures and other vessel activity. The purpose of this model was to estimate extinction risks for southern resident killer whales as part of a status review to inform decision-makers regarding listing of the stock as threatened or endangered under the Endangered Species Act.

Approach: The analysis used a sex-, age- and pod-structured model that allowed for (1) demographic variability, (2) environmental variability, (3) potential catastrophes, (4) Allee effects, and (5) variation in carrying capacity. Variation in survival rates was based on observed rates over the past 30 years, with an apparent 6-year cycle. Allee effects were imposed using social constraints on reproduction: females in a pod could not become pregnant unless another pod included an adult male. Carrying capacity was allowed to vary with values ranging from 100 to 400 animals.

Data: Demographic parameters for the model were estimated using censuses of southern resident killer whales conducted annually since 1974. Parameters included age and sex composition, survival, fecundity, and reproduction of each of the population's three pods. Initial parameters and ranges for environmental variability, catastrophes, and carrying capacity were based on a literature review and expert judgment. The model was initialized with the known 2003 age, sex, and pod composition and was projected into the future for 100, 200, and 300 years. Because survival rates varied throughout the 29-year census record, the model was run using survival estimates from three subsets of the data: the most recent 10 years (with the lowest survival rates), the most recent 14 years, and all 29 years.

Results: Scenarios using survival estimates from the preceding 29 years of data resulted in 0.1 to 3 percent likelihood of extinction in 100 years and 2 to 42 percent in 300 years. Scenarios using survival estimates from the most recent 10 years resulted in 1 to 19 percent likelihood of extinction in 100 years and 68 to 94 percent in 300 years. Survival rates in all three pods followed a similar pattern; the largest pod, which occurs farthest from shore, was the most severely affected by changes in survival. In addition, changes were evident in all age and sex classes, but old males appeared to be most affected. The results suggest that the patterns in survival may be caused by environmental factors (e.g., changes in prey availability through time). Results of the analysis supported a 2006 decision to list southern resident killer whales as endangered.

Recent publications using the model:

Krahn, M. M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, and R. S. Waples. 2004. Status review of Southern Resident killer whales *(Orcinus orca)* under the Endangered Species Act. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-62. 73 pp.

Cook Inlet Beluga Whales (Presented by Daniel Goodman, Montana State University)

Background and purpose: Data from National Marine Fisheries Service aerial surveys indicate that the Cook Inlet beluga whale stock declined from an estimated 653 individuals in 1994 to 347 in 1998, and then declined at a lower rate to 278 in 2005. The decline from 1994 to 1998 was due primarily to subsistence harvesting by Alaska Natives. After the harvest was brought under management control in 1998 (only three whales were harvested between 1999 and 2004), the stock was expected to recover at a rate of 2 to 6 percent annually. Its failure to recover suggests that other factors also are affecting this stock. Its summer range contracted concurrently with the decline, and beluga whales now are rarely seen in offshore waters or the lower reaches of the inlet. Because their remaining habitat is near Anchorage, the largest urban area in Alaska, the whales are exposed to a range of human activities. An analysis was conducted to characterize the trend to date and project whether the population is likely to decline further.

Approach: The analysis fits an exponential population growth model to past survey estimates and produces a distribution of possible growth rates, including negative values consistent with a decline. The distribution of growth rates is then used to predict the trend in the near future. The model does not include the effects of subsistence harvest (which may be negligible at present) or environmental variability.

Data: The analysis used annual abundance estimates (and variances of those estimates) from aerial surveys conducted between 1994 and 2004.

Results: The results suggest that even without environmental variation and harvests, the likelihood of continuing decline is 45 percent.[1] The National Marine Fisheries Service currently is reviewing a petition to list the Cook Inlet beluga whale stock as endangered under the Endangered Species Act.

Recent publications using the model:

Lowry, L., G. O'Corry-Crowe, and D. Goodman. 2006. *Delphinapterus leucas* (Cook Inlet population). *In* 2006 IUCN Red List of Threatened Species. IUCN–The World Conservation Union.

Florida Manatees (Presented by Michael Runge, Patuxent Wildlife Research Center, U.S. Geological Survey)

Background and purpose: The West Indian manatee, listed as endangered under the Endangered Species Act, is comprised of Antillean and Florida subspecies. The Florida subspecies occurs in rivers and coastal waters of the southeastern United States. Because of their limited tolerance for cold temperatures, most Florida manatees winter near warm-water discharges from natural springs or power plant outfalls located in the southern two-thirds of the Florida peninsula. The anticipated loss of discharge sites as a result of power plant closures represents a long-term threat that would reduce available habitat and lower the effective environmental carrying capacity for manatees. At present, the largest source of direct human-related manatee mortality—and

[1] A more recent analysis using the same model and data from 1994 to 2006 suggests an 81 percent probability that the population is declining (i.e., the growth rate is negative).

probably the most significant factor impeding population recovery—is collisions with boats. Watercraft-related deaths typically account for a quarter to a third of all manatee deaths annually.

Since 1985 population models have been used to assess trends in manatee abundance. More recently, modeling objectives have focused on evaluation of negative and positive effects of specific threats and management actions. At the Savannah workshop, the model's utility for predicting population trends and estimating the effects of changes in carrying capacity were described. The model will be used to inform reclassification decisions under the Endangered Species Act and Florida state statutes.

Approach: The model projects population trends based on reproduction and survival probabilities for each of several life history stages, such as calves, juveniles, adult males, and adult females. The model accounts for variability in demographic parameters and the largely independent dynamics of four relatively discrete manatee subpopulations in Florida. The model incorporates catastrophes (e.g., red tide bloom, disease epidemic), density dependence, and changes in habitat availability (e.g., availability of winter warm-water refuges). Additional factors can and will be added to address specific questions that arise, such as the effects of specific management actions, hurricanes, and climate change.

Data: Extensive data were used to develop model parameters (e.g., survival rates, reproductive rates, carrying capacity), including 10 to 25 years (depending on subpopulation) of photo-identification mark-recapture data on more than 1,000 animals. Estimates for model parameters such as carrying capacity and density dependence were based on the advice of an expert panel.

Results: The model has been used to estimate population trends for each of four regional subpopulations in Florida. When based on data from the last 10 years, the model indicates that manatees are increasing in three regions: the northwest (growth rate [λ] = 1.037), upper St. Johns River ($\lambda = 1.062$), and Atlantic ($\lambda = 1.010$). Manatees in the southwest region appear to be declining ($\lambda = 0.989$), based on the most recent 10 years of data. Further analysis suggests that management actions should focus on increasing adult survival rates and that improved monitoring of those rates would reduce the overall uncertainty in model results.

Recent publications using the model:

Runge, M. C. 2003. A model for assessing incidental take of manatees due to watercraft-related activities. In U.S. Fish and Wildlife Service Environmental Impact Statement: Rulemaking for the incidental take of small number of Florida manatees (*Trichechus manatus latirostris*) resulting from government programs related to watercraft access and watercraft operation in the state of Florida, Appendix I (March 2003) U.S. Fish and Wildlife Service. Jacksonville, FL.

Runge, M. C., C. A. Langtimm, and W. L. Kendall. 2004. A stage-based model of manatee population dynamics. Marine Mammal Science 20:361–385.

Haubold, E. M., C. Deutch, and C. Fonnesbeck. 2006. Final biological status review of the Florida manatee, *Trichechus manatus latirostris*. Florida Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission. St. Petersburg, FL.

Hawaiian Monk Seals (Presented by Albert Harting, Harting Biological Consulting)

Background and purpose: The Hawaiian monk seal is the most endangered seal in U.S. waters. Hawaiian monk seals occur almost entirely in the Hawaiian archipelago, where about 90 percent of all animals live on and around the remote Northwestern Hawaiian Islands. The majority of pups are born at six relatively discrete breeding subpopulations located at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, and Kure Atoll. Since the late 1950s when Hawaiian monk seals were first studied, beach counts at these six major pupping colonies have declined by more than 60 percent. The total population is currently estimated to number fewer than 1,300 animals and is declining at a rate of about 4 to 5 percent per year.

Threats to monk seal recovery include both human-related and natural factors that have varied over time and by colony. The human-related factors include disturbance and displacement of hauled-out seals by people and animals, entanglement in derelict fishing gear, depletion of prey resources by commercial fishing, interactions with recreational and commercial fishing gear, and oil spills. Natural factors include shark predation; naturally occurring biotoxins; disease; aggressive behavior by some adult male seals toward pups, juveniles, and adult females; the effects of oceanographic changes on prey resources; and the loss of pupping beaches to erosion. In general, the small, isolated nature of the Northwestern Hawaiian Islands makes their local ecosystems exceedingly vulnerable to both natural and human impacts.

A metapopulation model was developed to predict population abundance over relatively short time horizons (5 to 20 years), assess the sensitivity of the population to natural or management-induced perturbations, and perform long-range projections for risk assessments and population viability analyses.

Approach: The metapopulation model represents the species as a group of spatially distinct and largely independent breeding subpopulations. The primary events during each simulation year are births and deaths, both of which could be affected by simulated catastrophes. The simulation also can include specific natural perturbations (e.g., adult male aggression and shark predation), migration between subpopulations, and management actions (e.g., captive rearing or translocation of pups and removal of aggressive adult males). Density-dependent regulation of reproductive and survival rates also can be incorporated in simulations.

Data: The model uses the life history and demographic data collected through an intensive program of cohort tagging and replicate seasonal counts of each subpopulation. These efforts, conducted since the early 1980s, provide detailed data for estimating age-specific survival and reproductive rates, current age/sex structure, inter-site movement rates, and the effects of specific natural perturbations (e.g., shark predation rates).

__Results__: This model has been used for analyzing the impact of shark predation on monk seal recovery at French Frigate Shoals, conducting National Environmental Policy Act assessments, analyzing potential impacts of an epizootic outbreak in the Northwestern Hawaiian Islands, and assessing the likely benefits from proposed management interventions. Further development of this model will include linking the model to oceanographic data, analyzing historical data for evidence of density-dependent regulation to refine the density-dependence formulation now used in the model, and adding the main Hawaiian Islands monk seal subpopulation to the model.

Due primarily to poor juvenile survival rates, long-term projections using survival rates derived from observations in recent years (2001–2005) indicate a decline at all subpopulations except Laysan Island, with French Frigate Shoals declining most precipitously. Projections utilizing survival rates (and variances) from all data years (1985–2005) again predict a marked decline at French Frigate Shoals, with a gradual decline at Kure Atoll (remaining subpopulations stable or increasing).

__Recent publications using the model__:

Harting, A. L. 2002. Stochastic simulation model for the Hawaiian monk seal. Ph.D. thesis, Montana State University, Bozeman. 328 pp.

National Marine Fisheries Service. 2006. Draft recovery plan for the Hawaiian monk seal, *Monachus schauinslandi*. National Marine Fisheries Service. Silver Spring, MD. 148 pp.

Steller Sea Lions — Western Stock (Presented by Daniel Goodman, Montana State University)

__Background and purpose__: Over the past three or four decades, Steller sea lions have declined precipitously throughout portions of their range, and the species was listed as threatened under the Endangered Species Act in 1990. In 1997 the species was determined to consist of at least two distinct population segments. The western population segment, occurring from the central Gulf of Alaska and westward, was listed as endangered, while the eastern segment, occurring from California through Southeast Alaska, remained listed as threatened. The decline of the western stock slowed during the 1990s, and since 2000 its abundance may have stabilized. The cause or causes of decline have been a matter of extensive debate and controversy. Leading hypotheses include nutritional stress as a result of competition with commercial fisheries and/or shifting environmental conditions, and predation by killer whales. The marked changes observed in western Steller sea lion abundance in recent decades suggest that the population may face significant extinction risks even at relatively high abundance. A population viability analysis was undertaken to estimate the population’s extinction risk.

Approach: The PVA for western Steller sea lions simulated a random population growth regime based on observed, unexplained variation over recent decades, with the assumption that such variation would continue into the future. The results were summarized in terms of probability of extinction over time and were used to inform efforts by the Steller Sea Lion Recovery Team to develop recovery criteria (National Marine Fisheries Service 2006).

Data: Available data consist of 45 years of episodic census figures. Additional information on environmental variation also was used in the model.

Results: The analysis concluded that in the next 100 years the population has a 37 percent chance of declining to an effective population size of 1,000 animals, which equates to a total population size of 4,743 animals.

Recent publications using the model:

National Marine Fisheries Service. 2006. Draft Revised Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). National Marine Fisheries Service, Silver Spring, MD.

Steller Sea Lions — Eastern Stock (Presented by Daniel Goodman, Montana State University)

Background and purpose: The eastern stock of Steller sea lions, a distinct population segment from California through Southeast Alaska, has increased steadily in size since the 1980s. It is recovering from human-caused mortality from the late 1800s to the 1970s. A population growth model was developed to determine whether the population is still growing.

Approach: The analysis fits an exponential growth model to past survey estimates to produce a distribution of possible growth rates. The distribution indicates the likelihood of continued increase. The residuals of the growth model are random and relatively small, suggesting that neither external factors (e.g., environmental variation) nor density dependence is altering the population dynamics appreciably, and those factors need not be incorporated into the model.

Data: The available data were drawn from annual censuses conducted from 1976 to 2002.

Results: The exponential growth model fits the population data well and indicates that the population is still growing.

Recent publications using the model:

National Marine Fisheries Service. 2006. Draft Revised Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). National Marine Fisheries Service, Silver Spring, MD.

California Sea Otters (Presented by Martin Tinker, Dept. of Ecology and Evolutionary Biology, University of California, Santa Cruz)

__Background and purpose__: Over-exploitation for the fur trade in the 18th and 19th centuries brought sea otters in the North Pacific to near-extinction by the early 1900s. When commercial harvesting was banned by an international treaty in 1911, only a small remnant population of what is now recognized as the southern sea otter subspecies survived in California along the coast between Monterey and Big Sur. Recovery of the subspecies after 1911 was extraordinarily slow, and in 1977 the U.S. Fish and Wildlife Service listed the subspecies as threatened under the Endangered Species Act. In the late 1980s a translocation program was implemented to establish southern sea otters at San Nicolas Island off southern California and thereby provide another colony that could serve as a source for recovery efforts if the still-small mainland population were to be affected by a large catastrophe, such as an oil spill. At the same time, the Service established a management zone south of Point Conception where sea otters were to be excluded to prevent a southward expansion of the sea otter range and thereby protect commercial shellfish fisheries in southern California.

Recent surveys indicate that the population is increasing but still at a slower rate than expected. The population also has been expanding its range northward as well as southward into the management zone. In the late 1990s the number of otters in the management zone increased, and efforts to remove them were limited and largely unsuccessful. In addition, the translocated population failed to increase as expected and currently numbers just a few tens of animals. As a result, the Fish and Wildlife Service is considering steps to declare the translocation program a failure and to allow the mainland population to continue its expansion southward.
A population model was developed at the request of the Fish and Wildlife Service to project the rate of population recovery and range expansion over time. It provides a general framework for evaluating management options and conservation strategies for the southern sea otter.

__Approach__: The model is stage-based and incorporates spatial structure, movement rates, and demographic information. The model begins by estimating survival rates by location and time for each age/sex class (stage). The survival rates are then combined with stage-specific dispersal kernels to parameterize a multi-state matrix model for the entire population (structured by spatial region and allowing for inter-regional movements), which utilizes stage-structured difference equations to predict annual rates of range expansion into unoccupied habitat. Uncertainty is explicitly incorporated by using Monte Carlo simulations that allow all parameters to vary within the full range of previously observed values, and simulations include variance due to measurement and process error.

__Data__: The model uses survey data from the past 20 years (including total counts and counts of mature animals and dependent pups), age-at-death data from beach-cast carcasses, and radio telemetry data from free-ranging sea otters. From these data sources, estimates are derived (using maximum likelihood methods) for stage-specific reproduction, survival, and annual individual movement distances for identified age and sex components of regional subpopulations, as well as associated variance estimates for each parameter.

Results: Survival rates vary regionally, with lowest survival in the north and highest in the south. Female survival decreased in the mid-1990s. Sea otters are expanding their range southward at a rate of about 6 km/year.

Recent publications using the model:

Tinker, M. T., D. F. Doak, J. A. Estes, B. B. Hatfield, M. M. Staedler, and L. Bodkin James. 2006. Incorporating diverse data and realistic complexity into demographic estimation procedures for sea otters. Ecological Applications 16:2293–2312.

Tinker, M. T., J. A. Estes, K. Ralls, T. M. Williams, D. Jessup, and D. P. Costa. 2006. Population Dynamics and Biology of the California Sea Otter (*Enhydra lutris nereis*) at the Southern End of its Range. MMS OCS Study 2006–2007. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-31063.

U.S. Fish and Wildlife Service. 2005. Draft Supplemental Environmental Impact Statement on the Translocation of Southern Sea Otters. Ventura, California. 242 pp + appendices.

APPENDIX II

Workshop Attendees

Presenters	
Hal Caswell	Wood Hole Oceanographic Institution
Jean Cochrane	U.S. Fish and Wildlife Service
Deborah Crouse	Endangered Species Office, U.S. Fish and Wildlife Service
Daniel Goodman	Montana State University, Bozeman
Albert Harting	Harting Biological Consulting
Lloyd Lowry	Marine Mammal Commission, Committee of Scientific Advisors
Marta Nammack	National Marine Fisheries Service
Michael Runge	Patuxent Wildlife Research Center, U.S. Geological Survey,
Barbara Taylor	Southwest Fisheries Science Center, National Marine Fisheries Service
Martin (Tim) Tinker	Dept. of Ecology and Evolutionary Biology, University of California, Santa Cruz
Paul Wade	National Marine Mammal Laboratory, National Marine Fisheries Service
Michael Weber	Consultant
Attendees	
Steven Beissinger	University of California, Berkeley
Daryl Boness	Marine Mammal Commission, Committee of Scientific Advisors
Douglas Burn	U.S. Fish and Wildlife Service
Therese Conant	National Marine Fisheries Service, Office of Protected Resources
Paul Dayton	Scripps Institution of Oceanography, University of California, San Diego
Daniel Doak	Dept. of Ecology and Evolutionary Biology, University of California, Santa Cruz
Thomas Eagle	National Marine Fisheries Service
David Gouveia	National Marine Fisheries Service
Dawn Jennings	U.S. Fish and Wildlife Service
Craig Johnson	National Marine Fisheries Service
Rosa Meehan	U.S. Fish and Wildlife Service
Katherine Ralls	Smithsonian National Zoological Park, Conservation & Research Center
Randall Reeves	Okapi Wildlife Associates
Gregory Silber	National Marine Fisheries Service
Robert Small	Alaska Department of Fish and Game
James Valade	U.S. Fish and Wildlife Service
Marine Mammal Commission and SRA Staff	
David Cottingham	Marine Mammal Commission
David Laist	Marine Mammal Commission
Linda Manning	SRA International
Regan Maund	SRA International
Timothy Ragen	Marine Mammal Commission
Michael Simpkins	Marine Mammal Commission
Elizabeth Taylor	Marine Mammal Commission

APPENDIX III

Workshop Agenda

Workshop bjectives

- Review efforts to use PVA and other types of population models for endangered, threatened and depleted marine mammals occurring substantially in U.S. waters;
- Evaluate the extent to which PVA or other types of models can be relied upon for determining population status and predicting population trends for ESA classification listing decisions; and
- Evaluate the ability of PVA or other types of models to improve the decision-making process with regard to developing and selecting potential management actions other than ESA classification listing decisions.

Day ne ***Review e isting efforts to use P A and other types of population models for endangered, threatened and depleted marine mammals***

8:30 9:00 Opening Remarks, Introductions, and Agenda Review *(David Cottingham)*

9:00 10:30 Current Approaches to the Assessment and Management of Listed Species under U.S. Law

- Overview of U.S. Fish and Wildlife Decision-making Processes from Listing through Delisting — Current Approaches (*Deborah Crouse)*
- Overview of National Marine Fisheries Service Decision-making Processes from Listing through Delisting — Current Approaches (*Marta Nammack)*
- Cases of U.S. Fish and Wildlife Service Use of Decision-Making Tools Including PVA *(ean Cochrane)*
- Current Tools and New Approaches at the National Marine Fisheries Service (*Barbara Taylor and Paul Wade*

10:30 10:45 Break

10:45 5:00 Reviewing Existing Marine Mammal Population Models

- Florida Manatees (*Mike Runge)*
- Hawaiian Monk Seals (*Albert Harting)*
- North Atlantic Right Whales (*Hal Caswell)*
- Southern Resident Killer Whales (*Paul Wade)*
- California Sea Otters (*Tim Tinker)*
- Steller Sea Lions and Cook Inlet Beluga Whales (*Daniel Goodman)*

Day Two	***Evaluate the e tent to which P A or other types of models can be relied upon for determining population status and predicting population trends for ESA classification listing decisions***
8:30 9:00	**Opening Remarks/Agenda Review**
9:00 9:45	**Overview of Available Information on the Status of Listed Marine Mammals (***Lloyd Lowry)*
9:45 10:00	**Break**
10:00 12:30	**Panel Session IA:** What steps could or should be taken to better use or develop PVA models or other types of models to improve ESA classification decisions for "data rich" species?
12:30 2:00	**Lunch break**
2:00 5:00	**Panel Session IB:** What steps could or should be taken to better use or develop PVA models or other types of models to improve ESA classification decisions for "data poor" species?
5:00 - 5:30	**Closing Remarks**
Day Three	***Evaluate the ability of P A methods to improve decision making processes for developing and selecting potential management actions other than ESA classification decisions***
8:30 9:30	**Overview of the Status of Protection Programs for Listed Marine Mammals** *(Michael Weber)*
9:30 11:00	**Panel Session II** What steps could or should be taken to develop or improve population models for use in making routine/operational management decisions for the endangered, threatened, and depleted species?
11:00 11:15	**Break**
11:15 1:00	**Panel Session II, continued**
1:00 2:00	**Closing Remarks and Next Steps**

APPENDIX 5

Report of the North Atlantic Right Whale Program Review

REPORT OF THE NORTH ATLANTIC RIGHT WHALE PROGRAM REVIEW

13–17 March 2006, Woods Hole, Massachusetts

Report prepared for the
Marine Mammal Commission by

Randall R. Reeves
Andrew J. Read
Lloyd Lowry
Steven K. Katona
Daryl J. Boness

2007

This is one of five reports prepared in response to a directive from Congress to the Marine Mammal Commission to assess the effectiveness of protection programs for the most endangered marine mammals in U.S. waters.

Table of Contents

I. Overview Statement by the Review Panel

The approximately 350 North Atlantic right whales alive today constitute a biologically viable population with potential for recovery. Although calf production has been variable and appears to be lower than in some populations of southern right whales, we believe that reproduction and recruitment in the North Atlantic population are adequate to support a recovery but only if the number of whales killed by ship strikes and entanglement in fishing gear is significantly reduced. In fact, much of the potential recruitment to the population is being lost to such removals, seriously inhibiting population growth. With such a small population, any progress toward recovery could be offset by random processes and events (e.g., inbreeding, a natural catastrophe, or a disease outbreak). The longer the population remains mired in its present state of low numbers because of regularly occurring ship strikes and entanglement, the greater is the danger that such processes and events will drive the population to a level from which it cannot recover.

The last 100 years have seen an unbroken chain of human impact on right whales, marked by a shift in the mid-1930s (when international legal protection, albeit incomplete, was conferred on the whales) from deliberate to non-deliberate "whaling." From a demographic and biological standpoint, "whaling" on this population has continued uninterrupted and may have intensified in recent decades as its habitat has become increasingly hazardous.

In terms of public investment to remedy this situation, the most cost-effective approach to protection and recovery of North Atlantic right whales would be to eliminate high-speed (>10 knots) vessel traffic and risk-conferring fishing gear (e.g., traps with vertical lines and set or drift gillnets) from the whales' environment, or at least from areas where the whales occur most frequently. In fact, one way to assess the cost-effectiveness of these measures would be to calculate the public expenditures that would have been saved (i.e., available for reallocation to other priorities) if the mortality from ship strikes and entanglement had been significantly reduced in the 1970s or 1980s when the whale population apparently was increasing. To the best of our knowledge, no such calculation has previously been contemplated, much less undertaken.

From a cost-effectiveness standpoint, comprehensive, science-based management actions that can be scaled back as conditions improve would be greatly preferable to the piecemeal and prolonged process of incremental regulatory expansion that has been pursued over the past 15 years. In effect, many of the accumulated program costs (to say nothing of the costs of legal actions brought against the National Oceanic and Atmospheric Administration [NOAA] and other agencies) can be properly viewed as the costs of past inaction. Protection of right whales has been subjugated to the social and economic expectations of an ever-expanding, increasingly urban human society with which the whale population must co-exist. The compatibility of the two—a healthy, recovered right whale population on one hand and expansive coastal development on the other—cannot be taken for granted.

II. INTRODUCTION AND PRO ECT BACKGROUND

As part of the 2004 Omnibus Appropriations Bill, the Senate Appropriations Committee directed the Marine Mammal Commission to "review the biological viability of the most endangered marine mammal populations and make recommendations regarding the cost-effectiveness of current protection programs." One of the Commission's activities in response to that directive was to organize and conduct, in close consultation with the National Marine Fisheries Service (NMFS), a review of the federal recovery program for the endangered North Atlantic right whale and the federal and non-federal research in support of it. This species was chosen for a case study because of its degree of endangerment, the large scale of research and recovery efforts related to it, and Congress's particular awareness of and interest in the species. It was understood from the outset that the review would need to include a workshop where a panel would have opportunities to engage in discussions with relevant experts.

The present report, together with other background papers and the report of a workshop on population viability analysis, was prepared for use by the Commission in developing a report that it will submit to Congress as a response to the congressional directive. The workshop on population viability analysis was held in September 2005 and, among other things, considered natural factors affecting the population dynamics and recovery of very small populations of marine mammals. Workshop participants noted that small populations are particularly vulnerable to demographic and environmental stochasticity and to the loss of genetic variability. As population size is reduced, populations become increasingly vulnerable to such chance factors and, as a result, can be driven to smaller and smaller size in what conservation biologists refer to as an "extinction vortex." It was also noted, however, that population viability is a vague term that is best stated in terms of the probability of extinction within a specified time frame. The September 2005 workshop concluded that, with possibly one or two exceptions, all marine mammal populations in U.S. waters, including North Atlantic right whales, are viable. In other words, with effective management, even populations that are greatly reduced should be capable of recovery.

The right whale review involved the following steps:

- A steering group, including members of the review panel (Attachment 1), the Commission staff, and SRA International (a consulting firm contracted by the Commission to help organize meetings and draft reports in response to the congressional directive), prepared a draft workshop agenda and a series of questions to be directed at agency representatives, contractors, and others involved in right whale research and management.
- After considering the draft agenda and list of questions, NMFS representatives offered to help organize the workshop and requested that the scope of the review be modified somewhat to meet the agency's own need for external (independent) review of its right whale science program.

- In January and February 2006 the steering group met several times with NMFS representatives to develop the workshop format and logistics.
- In advance of the workshop, and with assistance from NMFS and Commission staff, SRA International prepared extensive background reading materials for the panel. These included explicit written responses to the steering group's list of questions.
- The workshop was held at the Marine Biological Laboratory, Woods Hole, Massachusetts, on 14–17 March. The agenda and list of participants are provided in Attachments 2 and 3.

The panel prepared this report after the workshop. It consists of two main parts: a review and evaluation of the federal government's North Atlantic right whale research and monitoring program (including university and nongovernmental organization-sponsored research) and a review and evaluation of the federal government's North Atlantic right whale protection and recovery program.

A. EVALUATING EFFECTIVENESS

Any evaluation of cost-effectiveness implicitly assumes that information is available to assess effectiveness, preferably quantitatively but at least qualitatively. To judge effectiveness throughout its report, the panel sought to use the downlisting criteria (i.e., from endangered to threatened status) specified in the 2005 version of the Recovery Plan for the North Atlantic Right Whale (National Marine Fisheries Service 2005). The criteria, paraphrased from the plan, are—

(1) "Population ecology" (range, distribution, age structure, sex ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) indicate an increasing population.
(2) The population has increased at an annual rate of 2 percent or greater for 35 years.
(3) None of the five listing factors—habitat degradation, deliberate use, disease or predation, inadequate regulations, and mortality/serious injury from ship strikes and fishery interactions—is known to be limiting the population's growth rate.
(4) The estimated probability of quasi-extinction in 100 years is no more than 1 percent.

The panel attempted to evaluate the relevance and importance of research and monitoring efforts according to the extent to which they either had addressed these criteria or could be expected to address them in the future. Similarly, it tried to evaluate protection and recovery programs according to whether they had brought the population closer to meeting the downlisting criteria or could reasonably be expected to do so in the future.

Judging effectiveness with reference to the criteria in the recovery plan was complicated by the following:

- Unless it is known whether the population is increasing, decreasing, or at an equilibrium, it is difficult to know whether any particular intervention, or for that matter the entire package of interventions as a whole, is having any positive effect. Because the population's rate of increase is not estimated on a regular basis, and indeed because we cannot even assess whether the population is currently increasing or decreasing, there is little or no basis for confirming effectiveness.

- For effectiveness to be assessed in relation to specific management measures, causal connections need to be established between such measures and the desired outcome or outcomes. In other words, it has to be shown, for example, that a reduction in the rate of serious injuries or deaths of right whales (and its concomitant effect on status) was due to a particular fishery management measure or change in shipping traffic. Without a means of associating cause and effect in this way, any judgment about the effectiveness of individual protective measures is highly speculative.
- Compliance with management measures needs to be verified. It has to be shown that prescribed changes in human activities or behavior (e.g., in the types of fishing gear deployed or the speeds and routes of vessel traffic in specified areas or seasons) are actually being made. Otherwise, there is danger that apparent correlations between regulatory actions and trends in the whale population will be misleading.
- Data on the whale population's "performance" in response to management measures, as well as data on compliance by regulated parties, need to be gathered at very large spatial and temporal scales (tens of thousands of square miles and decades). Given the expense and logistics involved, this means that datasets are often incomplete or have low statistical power.

In the view of some NMFS representatives, the effectiveness of the right whale program cannot be judged solely on the basis of the delisting criteria because the agency is bound to adhere to several other relevant mandates. Specifically, Endangered Species Act (ESA) section 7 consultations require that any alternatives to a proposed activity be "reasonable and prudent," and section 118(f) of the Marine Mammal Protection Act (MMPA) specifies that NMFS must take into account the economics of the fishery and the availability of existing technology when seeking to reduce incidental mortality or serious injury of marine mammals. The inadequacy of specific information concerning the dynamics of entanglement, right whale foraging ecology, and right whale behavior, in general, makes it difficult for NMFS to develop measures that are not only effective in protecting right whales but that also meet the "reasonable and prudent alternative" requirement of the ESA and give due consideration to fishery economics and technology as required under the MMPA. The panel acknowledges that these competing components of the ESA and MMPA further complicate the agency's position and hinder progress toward achieving some of the downlisting criteria. Nonetheless, when evaluating the effectiveness of past actions and identifying future actions that might be more effective, the panel did not feel constrained to consider those other mandates. Its conclusions and recommendations are based solely on judgments about what actions are most likely to be effective in achieving the recovery of North Atlantic right whales.

B. EVALUATING COST-EFFECTIVENESS

To aid it in evaluating cost-effectiveness, the panel benefited from a detailed compilation of expenditures on right whale recovery and research by federal and state government agencies and nongovernmental organizations over the past three fiscal years (FY2003/04 to FY2005/06). That information was compiled by Jeff Benoit of SRA International, who contacted agencies and organizations directly. It was supplemented by workshop presentations in which representatives of federal agencies and certain major contractors attempted to place the expenditures in context.

Determining how to measure and assess cost-effectiveness proved a major challenge for several reasons, including the following:

- Assessing cost-effectiveness depends on the ability to assess effectiveness. As discussed above, that can be very difficult.
- Reliable information on the actual costs of implementing management measures is needed, but such information is seldom available for individual program components. Moreover, because some program components (e.g., aerial surveys) simultaneously serve multiple research and management functions, it can be difficult to partition costs for specific activities or purposes within the overall recovery program.
- A metric of cost-effectiveness is needed that is conceptually coherent and feasible to apply. For example, cost-effectiveness might be measured in terms of right whale deaths prevented per unit of federal funds invested in a given type of intervention. Thus, if a 50 percent reduction in adult female mortality could be achieved with a $1 million investment in a certain management action, while a $10 million investment would be required to achieve a similar reduction in mortality with a different management action, the relative cost-effectiveness of the two measures could easily be assessed and compared. However, uncertainty regarding the magnitude and causes of right whale deaths, together with frequent changes in regulations, makes it virtually impossible to devise a practical and appropriate metric for cost-effectiveness in the present context.

Systemic constraints also exist and deserve mention. Among these are the following:

- Inadequacy and uncertainty of funding for critical activities make it difficult for agencies to develop cost-effective programs, which require the ability to plan, introduce measures in a stepwise fashion, monitor and evaluate outcomes, and adapt if necessary.
- The conflicting mandates within and between government agencies inevitably reduce effectiveness of many kinds—biological, economic, and political. For example, the Coast Guard must respond, first and foremost, to demands related to human safety and homeland security, even if in the process it means putting right whales at greater risk of ship strikes. Similarly, the Department of Commerce is responsible for protecting and enhancing the economic interests of U.S. business, industry, and individuals, yet it also is expected to protect right whales from shipping and fishing gear.

Such constraints are to be expected in a modern nation with a large bureaucracy and frequently changing government administrations. What is important here, however, is to acknowledge that cost-effectiveness alone may not be an appropriate guide to the public interest.

The panel was at once mindful of the intrinsic difficulties and limitations summarized above and the desire expressed by Congress for information concerning the effectiveness and cost-effectiveness of the right whale protection program. In the complete absence of rigorous, conclusive studies evaluating the effectiveness of specific measures, the best that the panel can offer is a series of judgments based on the information provided to it. Given their subjective nature, some of these judgments are bound to be controversial. Where doubt has been expressed concerning the effectiveness or cost-effectiveness of a given aspect of the program, the panel would like nothing better than to be proven wrong by an appropriate study.

III. FINDINGS OF THE PANEL:

RESEARCH ON NORTH ATLANTIC RIGHT WHALES AND MONITORING THE WHALE POPULATION

As noted above, the downlisting criteria are framed around the demography of the North Atlantic right whale population. Any assessment of status must provide basic information on the rate of population increase or decrease, parameters controlling that rate (births and deaths), and the ecological factors affecting those parameters. This section of the report reviews the NMFS right whale science program. Research and monitoring efforts related to recovery management are discussed in sections IV and V.

A. RANGE AND DISTRIBUTION

A great deal has been learned over the past 25 years about the distribution of right whales in the western North Atlantic, yet surprisingly large gaps in knowledge remain. The winter distribution of a significant portion of the population is unknown. The routes taken by whales moving between the southeastern U.S. calving grounds and northern feeding areas have been only partially documented. In particular, the extent to which migrating whales remain in coastal waters or travel offshore as they pass the mid-Atlantic states (between the Carolinas and New England) is uncertain. A significant fraction of adult females take their dependent calves somewhere other than to the main summer nursery area in the Bay of Fundy. Paternity analyses of DNA from biopsy samples suggest that the number of males in the population is 16 to 21 percent greater than the number documented through photo-identification and genotyping. Opportunistic sightings of right whales in the Gulf of St. Lawrence, south of Greenland, around Iceland, and in northern Norway show that some individuals occur far beyond the well-known high-use areas in the Gulf of Maine, Bay of Fundy, and Scotian Shelf regions during summer. The boundaries of designated critical habitat do not appear to define all of the areas used intensively by right whales. Improved understanding of right whale distribution and movement patterns should, therefore, remain a research priority, both for better assessing the status of the population and for designing a comprehensive protection regime.

Seasonal (winter and spring) aerial surveys in the Southeast, Cape Cod Bay, and Great South Channel and year-round surveys in the Gulf of Maine have provided some useful information on distribution patterns, although these surveys are not designed solely for that purpose. Instead, the surveys are conducted, in part, to provide information necessary for management (e.g., providing warnings to mariners) and are therefore flown more frequently than would be necessary for population monitoring purposes alone (e.g., annual calf counts). Since 2001 federally funded studies of right whale distribution also have been expanded to include broadscale aerial surveys beyond the well-described habitats in New England, Bay of Fundy, and the calving grounds. For example, these expanded surveys were expected to cover the entire coasts of North and South Carolina in winter/spring of 2005/2006 and 2006/2007.

There is a clear desire on the part of NMFS to reduce the frequency of aerial survey flights in critical habitats and to phase out broadscale aerial surveys for detecting locations where whales occur and to replace them with another method, such as passive acoustic monitoring. The impetus for such a shift is rooted in at least three factors: (1) the emergence of the requisite technology to conduct real-time acoustic monitoring, (2) concerns about human safety in offshore aerial surveys, and (3) the high and rising costs of aircraft use (due, in part, to measures to address safety). The review panel regards all three factors as worthy of consideration and agrees that the Service should continue to support efforts to develop and refine alternative monitoring capabilities. However, any shift away from aerial surveys needs to proceed with due recognition of the potential benefits and drawbacks of new approaches. The panel's thoughts in regard to passive acoustic monitoring are presented here.

Benefits: Once an acoustic monitoring system has been deployed and a system for processing data from it has been set up, this approach offers the potential for continuous, long-term monitoring of an area to detect vocalizing right whales—regardless of visibility, sea conditions, or time of day—at relatively low cost and with little risk to human safety. Preliminary results of studies in Cape Cod Bay, as reported to the workshop by Chris Clark of Cornell University, indicate that when whale densities are low, acoustic detection is more efficient than visual detection. It should be possible to establish acoustic monitoring stations at remote locations where right whales are known or suspected to have occurred in the past but have yet to be adequately surveyed (e.g., the Gulf of St. Lawrence and the eastern margins of the Grand Bank). The availability of real-time acoustic data also offers the possibility of improving the cost-effectiveness of certain aerial (and shipboard) survey efforts by allowing flights (or cruises) to go directly to areas where at least some right whales are known to be present. Finally, the recent inclusion of passive acoustics as part of NOAA's Integrated Ocean Observing System is a welcome development that can be expected to contribute new information on right whale range and distribution.

Drawbacks**:** Although listening can establish the presence of calling right whales (within a radius of about 5 to 10 nautical miles [nmi] of a buoy in optimal listening conditions using current technology), a lack of detections cannot establish their absence from an area. A failure to detect calls may occur because the whales are not vocalizing or because of acoustic masking by noise from ship traffic or other sources. Further work is required before we understand the factors responsible for variation in calling rates, such as behavioral and reproductive state, time of day, and location, and the effect of this variation on detection probabilities using passive acoustic methods. Call characteristics and rates cannot be used to determine numbers of right whales present or to detect and assess entangled or injured whales, and it is not yet possible to identify individual right whales acoustically. Further development is needed to improve techniques for transmitting detections in real time and for analyzing and interpreting the acoustic data. Another drawback is that reduction or cessation of large-scale aerial surveys will lead to a loss of information critical to population assessment and monitoring. For example, calf counts are obtained from aerial surveys, and many of the detections of whales entangled in fishing gear are made during aerial surveys. Also, a reduction in aerial survey effort will mean fewer photographic records and therefore a loss of data for use in population analyses that involve photo-identification (e.g., abundance estimation and assessments of individual health). For this reason, aerial surveys cannot be eliminated, but rather the current broadscale surveys should be replaced by a system of focused surveys designed to provide information necessary for demographic assessment. Such focused surveys could be conducted at much less cost (and risk to human life) than the current broadscale system of surveys. The utility of such surveys could be improved by incorporating knowledge gained from predictive modeling based on environmental correlates of right whale presence and absence. There will also be a continuing need for follow-up visual documentation of at least some of the acoustic detections (e.g., for periodic ground-truthing), which can be accomplished from aircraft or boats.

A balance is needed to ensure that, during the transition from aerial surveys to passive acoustic monitoring (or some other monitoring method), data critical to population monitoring continue to be collected and well-justified aerial survey programs are not terminated prematurely. Moreover, there continues to be a need for other tools that will improve knowledge of distribution patterns, perhaps including analyses of isotopic signatures from tissue samples and the deployment of satellite tags on a carefully selected sample of right whales. The panel was not able to reach consensus on the important question of whether satellite-tagging technology has been adequately developed and field-tested to ensure that it can be safely and effectively used on North Atlantic right whales. It does agree, however, that if any such program is initiated, it should include a follow-up monitoring component to assess the health and condition of tagged animals. Development of less invasive, long-term tags also should be encouraged and supported, and close consideration given to the potential of shipboard surveys to provide additional information on range and distribution.

The value of shipboard surveys deserves special consideration. Although not generally as cost-effective as aerial surveys for obtaining large-scale, synoptic views, shipboard surveys have fewer safety issues and provide a much wider array of opportunities for data collection (e.g., photography, biopsy sampling, fecal sampling, visual health assessments, observations of behavior, group size determination, acoustic recording, and measurements of environmental conditions). The photographs from shipboard surveys are the only ones that provide sufficient detail and are of high enough quality to support visual health assessment and, importantly, analyses of wounds and scars from interactions with fisheries. These latter analyses are, at present, the only means available for assessing the effectiveness of management actions to reduce entanglement risk. In part because of those advantages, shipboard surveys can be highly cost-effective in comparison to aerial surveys in some circumstances. For example, the designated right whale critical habitat in Cape Cod Bay was undetected as such during the broadscale aerial surveys conducted by the University of Rhode Island in 1979–1981. The significance of the area as habitat for right whales was, however, recognized from shipboard observations during the late 1970s and 1980s. In Cape Cod Bay, as in some other parts of their range, right whales in scattered groups or individuals making prolonged dives (18 to 25 minutes) are much more likely to be detected by shipboard surveys than by broadscale aerial surveys.

Some of the data on right whale distribution have come from aerial surveys in support of management programs. There has not always been a clear and consistent distinction between research/monitoring and management functions of the surveys. Although integration can enhance cost-effectiveness, it also can create the potential for data collection and analyses that serve management but are not optimal for addressing key research questions. Therefore, the types of data needed for research and for management (mitigation) should be distinguished when designing and implementing aerial survey programs.

Table 1: Costs of actions to study range and distribution, FY2003/FY2005

Activity/Source	FY 03	FY 04	FY 05
Aerial Surveys	$2,017,000	$2,906,544	$2,984,470
NMFS	1,484,000	1,854,000	2,345,000
Navy	155,000	155,000	155,000
U.S. Coast Guard	237,000	370,544	299,470
U.S. Army Corps of Engineers	141,000	174,000	185,000
National Fish and Wildlife Foundation	0	353,000	0
Massachusetts Environmental Trust	0	0	36,475
Shipboard Surveys	66,815	39,048	32,500
NMFS	N/A	N/A	N/A
New England Aquarium	64,315	36,548	31,000
Provincetown Center for Coastal Studies	2,500	2,500	2,500
Acoustic Monitoring	642,552	416,170	345,324
NMFS	627,552	416,170	285,324
International Fund for Animal Welfare	0	0	60,000
Stellwagen Bank National Marine Sanctuary	15,000	0	0
TOTAL	$2,726,367	$3,361,762	$3,362,294

Note: The costs for aerial surveys and acoustic monitoring summarized in the table represent investments in both management and research, i.e., in both ship strike mitigation (early warning and avoidance systems; see section IV.A) and investigations of right whale range and distribution.

Costs of ship time provided in-kind by NMFS (i.e., by making NMFS vessels available for dedicated right whale work) were not provided to the panel but were significant in all three years.

Contribution to recovery program

Reliable information on range and distribution is needed to identify critical habitat, facilitate the monitoring of right whales within high-use areas, plan research activities, and trigger or tune management actions. Knowing the entire range and distribution is important to ensure that animals have adequate protection throughout the year and that no large groups of individuals are unaccounted for.

Cost-effectiveness of actions

During FY03/05, a total of $9.45 million was spent on activities that contributed relevant data. Of that total, $7.91 million was spent on aerial surveys. The challenge of obtaining detailed information on the range, distribution, and movements of this whale population is formidable. There is no quick, simple, or inexpensive way to do it. The current state of knowledge represents an accumulation of data over many decades and from many different sources, some of it from activities carried out for other purposes. These factors make it impossible to quantify the true cost of studying the species' range and distribution. Clearly, aerial surveys have absorbed a large proportion of the total funding for studying this topic, and the fraction has increased steadily from 74 percent in FY03 to 89 percent in FY05. Although the majority of the funds (72 percent) expended on surveys came from NMFS, other agencies and organizations provided $2.23 million over the three years.

The review panel accepts the judgment of NMFS scientists that alternative methods (passive acoustic monitoring, satellite tracking, shipboard surveys in unstudied areas, etc.) will ultimately prove more cost-effective and safer than aerial surveys. At the same time, the panel recognizes that some recent aerial surveys have fulfilled multiple, and important, research and management purposes. For example, photo-identification data have been obtained, and many of the detections of entangled right whales have been made during aerial surveys.

Shipboard surveys, in addition to providing data on range and distribution, offer opportunities to collect samples and data of many kinds. Actual expenditures for shipboard surveys during FY03/05 are greatly underrepresented in the foregoing table of costs, which includes only the amounts raised from non-NMFS sources to supplement the support provided in-kind by NMFS. More realistic estimates of the total amounts invested in shipboard surveys are approximately $300,000 in FY03, $286,000 in FY04, and $281,000 in FY05 (S. Kraus, pers. comm., October 2006).

Passive acoustic monitoring is a promising but still not fully developed tool and therefore is at present only potentially cost-effective for improving knowledge of range and distribution. Moreover, its eventual effectiveness might be restricted to areas that are readily accessible and known to be used by right whales. A significant investment has been made in development of passive acoustics methods, with $1.4 million spent on this topic during FY03/05, the vast majority by NMFS. Although controversial and not without some risk to the health of right whales, satellite tracking is a potentially cost-effective means of completing the inventory of habitat used by North Atlantic right whales. No expenditures to support satellite-tracking studies during FY03/05 were identified.

Recommendations

The apparent intent of NMFS to move away from aerial surveys and toward passive acoustic methods for assessing right whale range and distribution is both prudent and desirable. It is important, however, that the transition occurs gradually and with due regard to the need for continuity in collecting photo-identification data, especially in the southeast region and in Great South Channel. In the short term, the panel recommends that aerial surveys be continued as needed to supply critical management information, while development, testing, and deployment of passive acoustic technology proceeds. A combined program of focused aerial surveys in areas where small survey vessels are unable to work easily (e.g., offshore in the Great South Channel or on the Northeast Peak of Georges Bank) and dedicated shipboard surveys in predictably used seasonal habitat of right whales would likely be the most cost-effective approach. It would address multiple management and science needs while allowing flexibility to respond to changes in whale distribution as well as the emergence of enhanced acoustic monitoring capabilities. Other approaches, including satellite tagging and isotope analyses, should be explored to determine what role they might play in refining our understanding of right whale range and distribution. In the medium to long term, aerial surveys explicitly for determining range and distribution should be used only in a carefully focused manner as needed to complement alternative methods. A major purpose of range and distribution studies should be to provide data needed to reassess the current designation of critical habitat under the Endangered Species Act.

B. ABUNDANCE AND TRENDS

Databases

Two separate but related databases are supported by NMFS: the North Atlantic Right Whale Identification Catalog (hereafter, the Catalog), maintained at the New England Aquarium and the Right Whale Sightings Database (hereafter, the Sightings Database), maintained at the University of Rhode Island (URI). Both databases play critical roles in right whale conservation.

The Catalog is the cornerstone of right whale research and monitoring. It provides records of individual whale sightings that are used to estimate reproductive parameters, mortality rates, and other input to demographic models. In addition, the Catalog serves to link many other types of samples (e.g., biopsies) and information (e.g., health assessments) to individual whales. Among other services provided by the Catalog team are the provision of real-time data on individual whale identities for researchers engaged in biopsy darting or tagging; information on identity and health assessment of stranded, injured, or entangled right whales; and responses to requests for data to be used in many types of scientific and management analyses.

Ongoing maintenance of the Catalog has two essential aspects: (1) field collection of photographic images and associated data, and (2) photographic analysis, matching, confirmation, integration, and cataloguing previously unidentified individuals. Each year, approximately 3,000 sighting records are added to the Catalog. Somewhat paradoxically, the advent of digital photography has increased the workload of the New England Aquarium team as field researchers now contribute many more images every year, creating a backlog in processing and archiving the information. In addition, the rich database of genetic information obtained from biopsy sampling has not yet been fully integrated into the Catalog. Ongoing curation and maintenance of the Catalog requires 4.7 person-years annually. The panel notes that the cost of the Catalog would rise substantially if there were a need to train new personnel for its curation and maintenance.

Maintenance of the Sightings Database involves processing, validating, and integrating survey and sightings datasets. This database, which includes records of species other than right whales (e.g., sea turtles and other marine mammals), serves NMFS and individual researchers by providing tailored subsets of data—e.g., for analyses used in stock assessment reports, environmental impact assessments, plans and designs of protected areas, and analyses of habitat. Like the Catalog, it has experienced rapid growth, doubling in the past three years to more than two million records. Much of the increase is due to expanded aerial survey effort.

The manager of the Sightings Database at URI (R. D. Kenney) has prepared a detailed manual explaining the procedures involved in its upkeep, but the panel is concerned about the extent to which the continuity and function of this database depend on Kenney's continued availability.

Trends in Abundance

Despite the fact that the four primary criteria for downlisting this population pertain directly to its demography, there is no current or recent statistically derived estimate of the number of North Atlantic right whales. The most recent (2005) NMFS Stock Assessment Report notes "…no estimate of abundance with an associated coefficient of variation has been calculated for this population." The primary factor responsible for this situation is not lack of data, as the Catalog provides a rich source of information on individual histories. Instead, the limiting factor is variation in the probability of sighting individual whales. That is, not all whales occur in specific study areas (and are thus available to be photographed) each year.

Mark-recapture and matrix population models applied to the Catalog data by Caswell et al. (1999) and Fujiwara and Caswell (2001) suggest that the population began to decline around 1992 after a period of modest growth. The models incorporated variation in sighting probabilities because estimates of survival and population growth that do not take into account such variation may give spurious and misleading results. The published model results incorporate sightings data only up to 1996.

NMFS scientists suggested at the workshop that the "minimum number of individuals known to be alive" is a potentially useful metric for tracking the population's status, but the panel disagrees. Instead, the panel believes that, as called for in the Recovery Plan, a true estimate of population growth rate, or a reasonable proxy, should be generated on a regular basis, perhaps as part of the NMFS Stock Assessment Report process. Such estimates will become particularly important as specific management measures are implemented to reduce anthropogenic sources of mortality. Without a statistically appropriate demographic metric, it will be difficult or impossible to gauge the success or failure of management measures, let alone their cost-effectiveness.

Demographic metrics other than population growth rate may prove effective for monitoring population status. For example, this population's growth rate is particularly sensitive to changes in the survival rate of adult females. Furthermore, adult females have consistently higher sighting probabilities than other age and sex classes. It might be possible, therefore, to monitor the status of the North Atlantic right whale population by tracking changes in the survival rate of adult females. Further effort should be put toward the development of such a metric that would allow authoritative assessment on a regular and timely basis (e.g., annually). This would require identifying the data requirements and ensuring that they are met in a timely fashion. To achieve this, maintenance and more frequent updating of the Catalog will be necessary to ensure availability of the data for modeling purposes in a reasonable time frame.

Table 2: Costs of actions to study abundance and trends, FY2003/FY2005

Activity/Source	FY 03	FY 04	FY 05
Right Whale Identification Catalog	$219,000	$579,206	$363,000
NMFS	207,000	215,000	223,848
New England Aquarium	7,000	0	139,152
National Science Foundation	0	359,206	0
International Fund for Animal Welfare	5,000	5,000	0
Right Whale Sightings Database	98,962	117,815	124,949
NMFS	98,962	117,815	124,949
Population Modeling/ Abundance Estimates	238,300	256,919	317,035
NMFS	228,300	229,483	296,128
Woods Hole Oceanographic Institution	0	17,436	10,907
International Fund for Animal Welfare	10,000	10,000	10,000
TOTAL	$556,262	$953,940	$804,984

Note: Also see cost table on page 11; survey and monitoring work carried out for multiple purposes has contributed much of the data used in analyses of abundance and trends.

Contribution to recovery program

(a) *Databases*. Both principal databases—the Catalog and the Sightings Database—are essential to right whale recovery efforts. Many aspects of both research and management depend directly on access to up-to-date information that they contain. This information can be and often is provided very quickly (e.g., in the case of identifying an entangled whale).

(b) *Trends in Abundance*. Demographic analyses of the right whale population should be a high priority for NMFS. Any future assessment of the effectiveness of right whale recovery efforts will depend on an ability to determine whether the population is growing and, if it is, which specific actions are responsible. Also, given continued uncertainty regarding the effectiveness of various management actions, further investigations are warranted into the contribution of demographic processes (e.g., survival of the different age and sex classes, and birth rates) to population growth rates. Some may argue that the current situation is so dire that detailed demographic analyses are superfluous. The panel rejects such an argument and believes that, given the significant investment of public funds in efforts to promote the recovery of this population, it is essential for managers, stakeholders, and the public to know whether the North Atlantic right whale population is increasing, decreasing, or stable.

Cost-effectiveness of actions

(a) *Databases*. During FY03/05, a total of $1.5 million was spent on maintenance of the two primary right whale databases ($1.16 million on the Catalog and $0.34 million on the Sightings Database). Both databases are essential for right whale recovery and have been diligently maintained in a cost-effective manner. Furthermore, the Sightings Database includes important information on other protected species that is being curated and made available to NMFS and others at no cost to those programs.

(b) *Trends in Abundance*. During FY03/05 a total of $0.81 million was spent on population monitoring and abundance estimates. The current lack of statistically derived estimates of either abundance or trend means that further investment in this task will be necessary to provide fundamental information needed for effective management.

Recommendations

(a) *Databases*. The Catalog and the Sightings Database are both essential elements of the right whale recovery program and, as such, they should be fully funded on a stable basis. Each database has particular needs that must be met during the next few years to place data processing and analyses in support of the recovery program on a sound footing over the medium to long term. Therefore, in addition to continuation of base support for the Catalog at a level of approximately $360,000 (actual operating costs in FY 2005), the panel recommends that NMFS provide a one-time funding supplement to the New England Aquarium to cover the costs of clearing the data backlog and integrating genotype information with the photo-identifications.

The panel further recommends that NMFS continue to support the Sightings Database at a level adequate to cope with the growing rate of data input. Because much of the effort being expended on the database is due to sightings of sea turtles and other marine mammals, it would be appropriate for some support to come from programs focused on those species.

The panel also recommends that NMFS consider the need to broaden administrative support, and thus increase funding, for both databases to ensure the long-term continuity of these invaluable resources.

(b) *Trends in Abundance*. The panel recommends that NMFS develop a system for regular assessment of right whale numbers so that trends in abundance can be determined. As noted above, such a system could either estimate a rate of increase directly, or use a surrogate parameter, such as adult female survival, to determine the likely trend of the population. The panel further recommends that NMFS take advantage of the considerable expertise in demographic modeling in academic institutions to develop the methods for this assessment.

C. MORTALITY

Estimating mortality rates and determining causes of death are both critical components of the right whale research program. Estimates of mortality (or survival) rates are required to understand the demography of the population, as noted earlier. It is essential to know the causes of death in order to understand which, and to what extent, anthropogenic factors are affecting the population.

Estimating mortality rates is not straightforward because perhaps only half, or less than half, of all deaths are discovered and reported (Knowlton and Kraus 2001, Kraus et al. 2005). To account for deaths that are not observed, the Catalog assumes that any whale not resighted within six years has died. Sighting records suggest that this assumption is reasonable in most but not all cases. For example, right whale 1035 was seen 10 times between 1978 and 1986 in waters off New England but was not resighted again until 2002, an interval of 16 years. Conversely, right whale 1102 was the subject of an intensive disentanglement operation in 2001 before disappearing in very poor condition. Although this whale almost certainly died, it is still considered a living animal in the Catalog because no carcass has been found. With a longer time series of observations, it may be possible to reevaluate the probability of mortality having occurred after a given period of absence from the Catalog.

The necropsy program ranks alongside the Catalog and the Sightings Database as an indispensable aspect of right whale recovery efforts. Evaluation of the effectiveness of mitigation and protection measures will depend ultimately on an ability to demonstrate a reduction in mortality from ship strikes and entanglements. Therefore, the capability to determine cause of death, which begins with carcass detection and ends only with a definitive necropsy diagnosis, needs to be maintained and enhanced.

During the period from 2000 to 2005, causes of death were determined for about half of the right whales known to have died (12 of 23). Concerted efforts by NMFS, the Coast Guard, and the Navy have been responsible for substantial improvements in the detection, reporting, and recovery of carcasses. Likewise, NMFS, the U.S. Geological Survey, and a few exceptionally committed researchers have greatly improved the quality and standardization of necropsy protocols so that more information is obtained from each carcass. In particular, there have been improvements in the diagnosis of blunt trauma associated with ship strikes. All of these efforts, however, require sustained funding. Appropriate levels of support (salaries and adequate funds for logistical expenses) are needed to keep necropsy team leaders engaged (only three teams are currently in place). Arrangements for sites to perform necropsies are essential, so agreements with the relevant state agencies for access to necropsy sites should be updated and expanded. In addition, further standardization of necropsy protocols and the training of a broader pool of necropsy team leaders are necessary.

The difficulty and complexity of obtaining conclusive results from necropsies and associated pathology and forensic investigations should not be underestimated. Difficult, uncomfortable, and stressful work by a small but dedicated cadre of individuals has provided the critical data presently available on causes of death for right whales. Although the panel recognizes and appreciates that work, it also believes that more effort is needed to investigate causes of death and, importantly, to trace those causes to precise times, localities, and circumstances. As explained by representatives of NMFS, determination of the exact type of fishing gear that was responsible for a given entanglement, and where the entanglement occurred, requires painstaking, careful documentation and can involve substantial logistical and legal complications. Nevertheless, the current long delays between carcass discovery and reporting with regard to the type of entangling gear (many months and, sometimes, years) are unacceptable. Mandatory gear marking (not only buoys, but also line and net material) as a condition for permission to fish with high-risk gear and methods (e.g., lobster traps and gillnets) is certainly desirable, and its feasibility should be evaluated. (For more discussion, see section IV.B. Also, note that much of the gear removed from right whales is obtained during attempts at disentanglement of live animals rather than during necropsies.)

The panel is well aware of how difficult it often is to determine, even approximately, where an entanglement took place or a ship strike occurred without observing the event. Nevertheless, knowing something about the proportions of lethal events that occur inside or outside areas designated as critical habitat, in shipping lanes, or on known migratory routes is essential for assessing effectiveness and improving management measures. This will require continued support for efforts to detect and examine carcasses, investigate the etiology of wounding and scarring on live animals, and determine where whales were killed, injured, or entangled.

Table 3: Costs of actions to study mortality, FY2003/FY2005

Activity/Source	FY 03	FY 04	FY 05
Necropsy Teams	$0	$65,000	$65,000
NMFS	0	65,000	65,000
Logistics	91,596	150,169	231,259
NMFS	70,000	70,000	70,000
U.S. Coast Guard	21,596	80,169	161,259
Diagnostics	11,000	11,000	11,000
NMFS	11,000	11,000	11,000
TOTAL	$102,596	$226,169	$307,259

Contribution to recovery program

Increased efficiency in detecting dead right whales at sea, better coordination among cooperating agencies in responding to carcasses, more consistent necropsy protocols, and new postmortem techniques have allowed the stranding program to play an increasingly important role over the past decade. The response to stranding events is now an integral part of the right whale recovery program, contributing information on the rates and causes of death that is vital to understanding the population's status and the anthropogenic threats affecting it.

Cost-effectiveness of actions

About $636,000 was spent during FY03/05 to secure right whale carcasses and examine them. Although NMFS expenditures over that three-year period remained relatively stable, Coast Guard assistance with logistics (principally retrieving floating carcasses) increased substantially. Coast Guard expenditures for logistics accounted for 38 percent of the total amount spent on mortality studies.

The investments by NMFS and the Coast Guard, together with the many hours of volunteer labor contributed by necropsy teams, have yielded significant information on the causes of right whale deaths. Such information is essential to the development of management and conservation actions that will assist in right whale recovery. Considering travel expenses, equipment needs (including rental of heavy construction equipment for moving carcasses), costs for laboratory analyses, volunteer help, and the difficulty of retrieving floating carcasses, this component of the recovery program is judged to have been very cost-effective.

Recommendations

Stranding response is a core responsibility of the recovery program and requires an adequate, ongoing funding base. This funding should be used principally to cover the recurrent but unpredictable costs of travel for necropsy teams. Funds should be made available each year to ensure that these teams are adequately equipped, stranded animals are moved to suitable sites for necropsy, heavy equipment is available for moving carcasses at necropsy sites, and essential laboratory analyses are conducted in a timely manner. The process of establishing cooperative agreements with the Navy, Coast Guard, and others for assistance in towing carcasses and securing shore areas to conduct necropsies appears well under way. Existing agreements should be maintained and others pursued to completion as needed. Finally, although recognizing the need for thoroughness and quality control, the panel believes that the analyses of gear removed from right whale carcasses (and entangled live animals) can and should be completed in a more timely and efficient manner.

D. ASSESSMENT OF HEALTH AND REPRODUCTION

Fecundity rates in the North Atlantic right whale population have shown significantly more inter-annual variation than expected by chance alone, and there have been two multi-year periods of very low calf production in the past two decades. In addition, there have been increases in the inter-birth intervals of individual females during the past two decades, suggesting that reproductive output has declined. Multiple hypotheses have been proposed to explain this variation and the possible decline in births, including long-term fluctuations in ocean conditions that affect copepod production, exposure to toxins and pathogens, and genetic factors. Whether the observed variation is intrinsic to the species, caused by fluctuations in the environment, a result of human activities, or an artifact of sampling heterogeneity (e.g., caused by annual differences in behavior and habitat choices by individual whales) remains uncertain. It is possible that multiple factors are responsible, acting either additively or synergistically.

The above hypotheses have been examined to some extent, but, regardless of what is causing the variability, it is difficult to conceive of ways to substantially improve the health status of right whales and, in turn, increase their fecundity, by modifying human activities. It is possible that exposure to pathogens would be reduced through elimination (or at least improved management) of sources of contamination (e.g., sewage). Also, to the extent that human activities are responsible for the increased frequency and geographic expansion of harmful algal blooms, and if these are a health threat to right whales, it may be possible to take some kind of preventive action. Removal of entangling debris from adult females could improve their health and increase the likelihood that they will produce a calf. Otherwise, the health of right whales, and therefore their reproductive output, appears largely beyond human influence.

Investigations of right whale health nevertheless may be useful for understanding why this population is not recovering. Poor health of individual right whales could help explain why fecundity in this population is lower than the rates observed in some Southern Hemisphere right whale populations. Refinement of techniques that improve knowledge of animal health can play an important role in risk identification and assessment.

An impressive array of methods for assessing right whale health has been developed, including a visual health assessment protocol (Pettis et al. 2004) and an analysis of skin lesions (Hamilton and Marx 2005) using photographic images; fecal sampling and analyses of reproductive and stress hormones, lipid metabolism, parasites, etc. (e.g., Rolland et al. 2005); measuring blubber thickness with ultrasound (Moore et al. 2001); and efforts to carry out standard necropsies and associated histopathology on dead right whales (Moore et al. 2004). Application of such tools, and the development of new tools for health assessment, will continue through integration with (and at least limited support from) programs other than the NMFS right whale recovery program. It is important to recognize that health assessment, like many other parts of the overall right whale research and monitoring program, is subsidized by these other programs and that, conversely, core elements of the NMFS right whale program (photographic and genetic sampling, database management and maintenance, stranding response, surveys, etc.) provide the foundation that facilitates, and provides a necessary context for, such assessment. Further, the interest, initiative, and inventiveness of individual researchers are what drive much of this work.

Table 4: Costs of actions to assess health and reproduction, FY2003/FY2005

Source	FY 03	FY 04	FY 05
NMFS	$561,000	$425,000	$321,000
Woods Hole Oceanographic Institution/Ocean Life Institute	0	88,044	92,444
TOTAL	$561,000	$513,044	$413,444

Contribution to recovery program

Although various hypotheses have been formulated to explain the observed inter-annual variation in calf production of this population, there is no evidence that the variation is due to any human action. Nor is there evidence that the population's failure to recover is due to poor health or reproductive impairment. More knowledge about individual animal health and reproductive condition will contribute to interpretations of observed trends and inform management planning, but it may not be possible to apply this knowledge directly to improve the population's fecundity or status. Understanding how right whale reproduction might be coupled with broad ocean trends or cycles in productivity would provide an important context for evaluating the effectiveness of actions under human control.

Compromises to health and reproduction can, in some instances, be the result of injuries sustained from ship strikes or encounters with fishing gear. Therefore, in that sense, assessment of health and reproduction is, like the necropsy program, an integral part of the recovery program's effort to improve understanding of threat factors.

Cost-effectiveness of actions

During FY03/05, a total of $1.49 million was spent on reproduction and health studies, with a steady decline in the level of support over that period. With the exception of support from the Woods Hole Oceanographic Institution's Ocean Life Institute in FY04 and 05, all of the identified funding has been provided by NMFS. However, research on right whale health and reproduction has been funded in diverse and creative ways, making it difficult to assess its true costs. Moreover, some of the most important insights have come from efforts by individual scientists who have, by their own initiative and resources, pursued studies with relatively modest levels of federal funding. Much of what is known about right whale health and reproduction is a direct or indirect product of the Catalog, costs of which were included in Section III.B above. Overall, excellent scientific value has been realized from the federal funds invested in studies of right whale health and reproduction in recent years.

Recommendations

It is important that investigations of health and reproduction continue at some scale and that particular attention (and funding) be directed toward determining how serious injuries from ship strikes and entanglement are affecting the health and reproductive capabilities of individual right whales. Therefore, the panel encourages individual scientists to maintain their investigations in these areas ancillary to other programs and also encourages NMFS to provide them both direct and in-kind support. The panel recommends specifically that NMFS continue to support visual health assessment, which is relatively inexpensive and provides information potentially useful for predicting and explaining inter-annual variation in calf production and for monitoring injuries caused by ship collisions and entanglements.

E. Habitat

Major advances have been made over the past decade toward understanding habitat features that are important to right whales, especially in the calving and feeding areas off eastern North America. Management can benefit directly from improved understanding of (a) why right whales go where they go, (b) the cues that prompt them to move into or leave a given area, and (c) how they use the different types of habitat that they occupy.

In the southeastern United States, time series of right whale sightings from aerial surveys have been used to develop predictive models and characterize calving habitat for right whales. Among the more significant findings are that warm Gulf Stream waters represent a thermal limit and help define right whale offshore distribution within the calving grounds and that most sightings are in water depths of 10 to 20 m. This work, as well as analyses of sightings per unit of effort and predictive modeling, has led NMFS scientists to conclude that right whale habitat may extend outside the area designated as critical habitat for right whales in the Southeast. The aerial surveys discussed earlier (section III.A), designed to sample all nearshore waters off North and South Carolina, are expected to provide relevant data for further habitat analyses, including reevaluation of critical habitat designations.

In the Northeast, studies of right whale habitat in Cape Cod Bay have been ongoing for the past two decades, led by the Provincetown Center for Coastal Studies and supported by NMFS through contracts with the Massachusetts Department of Marine Fisheries. The studies have shown a tight coupling between high zooplankton abundance at the surface and relatively high-density occurrences of right whales. Right whales apparently come into the bay following an ecological signal of some kind that leads them to encounter large zooplankton concentrations. Why they leave the bay when they do is less clear and may have to do with memory of large copepod concentrations in other feeding areas to the north and east of Cape Cod Bay.

In the lower Bay of Fundy, a major summer feeding area, right whales appear to be closely associated spatially and temporally with dense patches of the copepod *Calanus finmarchicus* that often form just above the bottom-mixed layer in response to tidal movements. Evidence from digital archival tags (D-tags) indicates that the whales typically change their orientation while diving to feed near the bottom so that the dorsal surface of the head sometimes comes into contact with the seafloor. This research seems well justified because of its scientific value and clear relevance in addressing conservation concerns, particularly with regard to why and how right whales become entangled in fishing gear set over sandy bottom habitat. Similar D-tag studies in other types of habitat (e.g., rocky bottom) would likely provide information useful to management.

Major existing gaps in knowledge include (1) factors that determine the timing and routing of right whale movements between the Southeast and the Northeast (essentially as they go from North Carolina to Cape Cod); (2) factors that influence the presence of individuals other than reproductive females on the calving ground (e.g., is there a social component driving habitat selection in winter?); and (3) the large-scale physical processes that determine where and when concentrations of right whale prey (especially *C. finmarchicus*) will become available. The work mentioned in III.A should provide data to address these knowledge gaps through modeling and other types of analysis.

Table 5: Costs of actions to study habitat, FY2003/FY2005

Activity/Source	FY 03	FY 04	FY 05
Habitat Studies in the Northeast			
NMFS	$0	$161,200	$100,100
Predictive Modeling in the Northeast			
NMFS	119,100	198,100	196,100
Modeling in the Southeast			
NMFS	56,000	56,000	56,000
Florida Wildlife Research Institute GIS Analysis			
NMFS	125,000	125,000	125,000
D-TAG Studies			
National Fish and Wildlife Foundation	0	123,924	0
TOTAL	$300,100	$664,224	$477,200

Contribution to recovery program

Understanding the habitat requirements of right whales and the ecological factors driving those requirements is vital for effective management. Such information is necessary for informed decision-making concerning critical habitat designations and to allow prediction of where and when concentrations of whales will occur (e.g., by linking them to prey concentrations) and therefore where and when protective measures should be applied.

Cost-effectiveness of actions

During FY03/05, a total of $1.44 million was spent on habitat studies. A large portion of the funding for aircraft surveys came directly from NMFS, was directed toward states for the purpose of flying surveys, or, in some instances, was provided through the National Fish and Wildlife Foundation on the advice of NMFS. In addition, many of the analyses of this population's habitat have relied on data from the multi-purpose field and data management activities, costs of which are discussed in sections III.A and III.B. There was no straightforward way for the panel to determine what portion of the costs of multi-purpose data collection and data management should be apportioned to habitat studies. Therefore, the panel was unable to determine the true costs, or the cost-effectiveness, of recent habitat assessment work.

The finescale studies of right whale diving and habitat use (e.g., using D-tags) have delivered high value in relation to the scale of funding (a one-time grant of $123,924). Importantly, such fine-scale studies often have numerous applications, only one of which is to improve understanding of habitat requirements and habitat use. Understanding the population's habitat requirements can help focus survey and other research efforts and thereby minimize cost and maximize effectiveness.

Recommendations

Most activities proposed in areas designated as critical habitat are automatically subject to increased scrutiny by ESA section 7 requirements. Also, the boundaries of critical habitat may be used as a basis for various regulatory actions (e.g., some of those currently in place under the Atlantic Large Whale Take Reduction Plan). Longstanding designations of right whale critical habitat have proven well justified, but the panel believes that a reanalysis is needed. It should include reconsideration of the boundaries of currently designated critical habitat areas and evaluation of new areas for possible designation.

The panel also recommends the continuation of localized studies of factors determining habitat use (e.g., triggers for arrival and departure of whales in a given area, threshold plankton concentrations to support right whale feeding, and multivariate predictive modeling of habitat).

F. GENETICS

Genetic analyses of North Atlantic right whales provide important information on the identity, sex, and relatedness of individual whales, the current and historic genetic diversity of this population, the relationship of these right whales to other populations and species, and insight into the potential effects of small population size on vital parameters and health. NMFS has not funded any genetics research on North Atlantic right whales during the last three years. However, genetic analyses have been conducted during this period using biopsy material obtained through NMFS-supported field programs and with the support of sighting histories documented in the Catalog. One of the important findings of this research is that the photo-identification procedures are extremely robust with a very low (less than 1 percent) error rate.

Another important finding from genetic studies is that a significant portion (16 to –21 percent) of the reproductively active males in this population has not been sampled; their existence is known only indirectly by excluding all other males in a paternity analysis. This finding suggests that the population is larger than currently believed, particularly if an equivalent number of females also have not been sampled (although there is no *a priori* reason to believe that this would hold for females).

About 40 percent of the calves born each year are not taken by their mothers to the Bay of Fundy feeding ground. Since callosity patterns on neonates are not sufficiently developed for reliable photo-identification, genetic sampling of calves produced by "non-Fundy" females on the southeastern U.S. calving ground is an important component of population monitoring. This work requires real-time coordination with the New England Aquarium staff to direct biopsy sampling toward new calves that have not yet been sampled. The resulting information helps to refine understanding of the total number of calves produced each year.

The research by scientists at Trent University on mating incompatibility and fetal loss due to genetic characteristics ("inbreeding") may prove relevant in helping to explain this population's apparently low fecundity compared to that of some southern right whale populations.

Table 6: Costs of actions to study genetics, FY2003/FY2005

Source	FY 03	FY 04	FY 05
NMFS	$0	$0	$0
National Fish and Wildlife Foundation	0	0	45,135
Woods Hole Oceanographic Institution	0	21,233	78,766
New England Aquarium	3,007	3,869	12,911
TOTAL	$3,007	$25,002	$136,812

Note: The costs involved in collecting tissue samples for genetic analyses (e.g., costs of shipboard surveys, necropsies, and disentanglement attempts) are not reflected in this table. (For such costs, see sections III.A, III.C, and IV.B, respectively.)

Contribution to recovery program

Genetic research adds to understanding of the demography of this population and is interesting scientifically. Like the research on reproduction and health assessment, however, it should not detract from support for surveys of right whales, maintenance of the key databases, studies to document causes of mortality, and habitat assessment.

Cost-effectiveness of actions

During FY03/05 a total of $164,821, all of it from sources other than federal agencies, was invested in studies of genetics. The panel did not consider it appropriate to make a judgment about cost-effectiveness. Nevertheless, the finding that up to one-fifth of the males in this population has never been sampled is certainly a high-value result.

Recommendations

Further genetics studies should be supported according to the merits of individual proposals (in terms of both conservation relevance and scientific quality) and the availability of funds. This research component is a core element of the recovery program that, from a budgetary and practical standpoint, should be incorporated largely into the activities described in Section III.B.

H. PERMITS

The panel's review of the right whale research program did not address research permits as a separate issue or in detail. However, this issue was raised by some of the involved scientists during the course of the workshop. It was clear that, as a strategy for litigation avoidance, NMFS has been seeking to comply fully with the requirements of the National Environmental Policy

Act (NEPA) with respect to issuance of research permits. Because North Atlantic right whales are endangered, concerns about the potentially negative effects of research on them (e.g., disturbance from repeated close approaches and physical harm or health impairment associated with tagging) go beyond animal welfare and humane treatment alone; they extend to the potential for effects at the population level that would run counter to the goals of conservation. Without discussing individual cases, the panel is convinced that extremely long delays in permit issuance have sometimes seriously impeded progress on both population monitoring (e.g., biopsy sampling of calves in the Southeast) and the development of effective mitigation (e.g., field experiments with new types of rope to reduce entanglement risks and D-tagging to improve understanding of whale behavior). The process has created serious inefficiencies, increased costs, and delayed research that could guide recovery actions. NMFS has prepared an environmental impact statement to address NEPA-related issues specifically with regard to scientific research. The environmental assessment was intended, in part, to speed up the permit issuance process while at the same time ensuring that NMFS would be in full compliance with its NEPA obligations. The panel nevertheless concludes that the problem of having critical monitoring and mitigation work delayed by the permitting process needs to be addressed as a matter of urgency and not folded into a prolonged, comprehensive process of systemic reform.

IV. FINDINGS OF THE PANEL:

PROTECTION AND RECOVERY

The vast majority of the federal government's effort with regard to protection and recovery has revolved around the twin goals of reducing deaths or serious injury from ship strikes and entanglement in fishing gear (bycatch). That emphasis is entirely appropriate.

A. SHIP STRIKE REDUCTION

On average, one or two ship strike deaths of right whales are documented annually along the East Coast of North America. Given that not all events are reported and not all right whale carcasses are recovered and subjected to a definitive necropsy, these numbers almost certainly underestimate the true mortality caused by ship strikes. The potential biological removal (PBR) level (the number of deaths and serious injuries that the population can withstand in addition to natural mortality as defined in the Marine Mammal Protection Act) has been set at zero for this population, meaning that any ship strike-related mortality or serious injury is unsustainable and should not be permitted.

To date, measures to reduce collision risks have consisted primarily of providing advice to vessel operators and urging them to exercise caution and seek to avoid hitting right whales. The main elements of NOAA's ship strike reduction strategy can be summarized as follows:

- The use of aerial surveys, known as Early Warning System (EWS) flights in the Southeast and Sighting Advisory System (SAS) flights in the Northeast. The surveys have been conducted annually in the Southeast during winter (1 December to 31 March) since 1993 and year-round in New England since 1997. Once right whales have been detected, mariners are alerted via NAVTE , Notices to Mariners, the Mandatory Ship Reporting (MSR) outgoing message, NOAA weather radio, and other routes, and advised (at least through the "NOAA-mediated" outlets) to reduce speeds (to no more than 10 knots) and increase vigilance in the area(s) of the sighting(s).
- Since 1997 enforcement of a "500-yard no-approach" regulation for all vessels (including whale-watching boats) and aircraft in the vicinity of any right whale.
- MSR systems, jointly funded by NOAA and the Coast Guard, in place since 1999, to provide information, including that obtained from the early warning and advisory system surveys, to mariners entering areas where right whales occur in New England and Florida/Georgia. These systems apply to vessels larger than 300 gross tons.
- Since mid-2005 NOAA advisories specifying that speeds of 10 to 12 knots or less should be maintained in areas of known or expected right whale presence, communicated to mariners via NOAA weather radio and other NOAA outreach mechanisms.
- Consultations under Section 7 of the Endangered Species Act that have led the Army Corps of Engineers, the Coast Guard, and the Navy to modify their operating procedures

in areas where, or at times when, the risks of ship strikes on right whales are considered especially high.

- Interagency collaboration, especially with the Coast Guard, Navy, and Canada's Department of Fisheries and Oceans, on right whale conservation measures.
- Extensive outreach and mariner education efforts.

These measures have not brought an end to ship strikes, nor is there any evidence that they have reduced the incidence of such events. Between September 2001 and February 2006 at least seven right whales, including four adult females, a juvenile female, and a female calf, have died from ship strikes. Those losses to the reproductive potential of the population are alarming by any standard, and even more so considering the likely negative bias in the number of deaths observed. It must be concluded, therefore, that although the ship strike reduction strategy may have prevented some collisions, it has not been successful in addressing this threat to North Atlantic right whales.

Recognizing the need for stronger measures, NMFS has been developing and evaluating a number of initiatives since the late 1990s. The options being considered consist primarily of (a) regulating vessel speeds, (b) changing vessel routing, (c) expanding mariner awareness and education efforts, and (d) developing and testing collision avoidance technology. The primary approach is to separate whales and vessels to the maximum extent feasible. Where such separation cannot be assured, a secondary approach is to reduce vessel speeds. This order of priority is well justified given what is known and not known about ship/whale interactions.

<u>Regulation of vessel speeds</u>

A proposed rule that would establish speed limits of 10 or 12 knots for large vessels (>65 ft) in specified areas is currently working its way through the rulemaking process, with the expectation that final regulations could take effect by mid-2007. Two types of areas would be designated: seasonal management areas (SMAs), where right whales are regularly expected to occur in relatively high densities, and dynamic management areas (DMAs), where right whales occur unpredictably. The first would impose speed restrictions during specified periods each year; the latter would involve temporary (15-day) imposition of speed restrictions.

Although this was not made explicit during the review, DMAs presumably would involve triggering criteria similar, if not identical, to those used for dynamic area management of fisheries (see IV.B). In other words, some threshold density (e.g., 0.4 whales per nmi^2) documented by direct observation (aerial or shipboard, but possibly in the future by passive listening devices) would trigger the DMA designation process.

Information presented by NMFS representatives at the workshop indicated that the cost implications of reducing vessel speeds as suggested in the proposed rule are small relative to the total value of East Coast shipping ($325.1 billion). The direct costs of a 10-knot limit are estimated at $66.4 million and the overall costs at $116.1 million (including direct and secondary costs). Corresponding costs of a 12-knot limit are estimated to be $44.1 million and $62.4

million. Difficulties of monitoring and enforcing speeds of vessels at sea need to be addressed, bearing in mind evidence that suggests relatively small differences (a few knots) in vessel speed can make a crucial difference in whether a lethal strike on a whale does or does not occur.

NMFS can expect to be challenged to demonstrate quantitatively the conservation benefits of vessel speed regulation. For example, how many fewer ship strike deaths of right whales can be expected if the limit is set at 10 knots rather than 12? There should be no illusions about the feasibility of producing robust calculations of that kind, given the many uncertainties and biases in the data on numbers, locations, and causes of ship strikes, as well as the small sample sizes in the available database (ship strikes on right whales are rare events in absolute terms). Nevertheless, the panel shares the opinion of many other scientists, based on the best data available, that a significant reduction in lethal ship strikes would be achieved if vessel traffic were limited to 10 knots or slower within areas of high right whale density.

The Automated Identification System (AIS) currently used on vessels larger than 300 gross tons provides mariners with information on the location of other similarly equipped vessels within a range of about 60 nmi. Although not intended for such a purpose, AIS transmissions have the potential to monitor point-to-point ship speeds and could be used for enforcement of ship speed limits. To do so, however, would require a shore-based receiving system, which the system is apparently designed to accommodate. The review panel believes that such a system offers considerable promise for future monitoring and enforcement systems.

Regulation of vessel routing

Frequently when a right whale carcass is initially sighted near a shipping lane off a major port, the death proves to have been the result of a collision. (It must be borne in mind, however, that the precise locations of most ship strikes are unknown, and strikes may happen anywhere within the species' range.) Therefore, steps have been taken to adjust some shipping lanes in both Canada and the United States to reduce the risks to right whales.

According to a Canadian official at the workshop, an analysis of data on whale distribution and shipping traffic indicated that shifting the western boundary of the traffic lanes in the Bay of Fundy westward by 3.9 nmi would reduce the probability of ship strikes by 80 to 90 percent. As a result, the traffic separation scheme (or shipping lanes) in the Bay of Fundy was altered in 2003 specifically to achieve such a reduction in risk. This required a formal procedure in which Canadian officials prepared a proposal for submission to, and acceptance by, the International Maritime Organization (IMO).

In the United States, NMFS submitted a proposed change to the port of Boston's shipping lanes to the IMO in April 2006. If approved, this change could be implemented by mid-2007. The proposal includes a 12-degree shift in orientation of the northern leg and a narrowing of the two traffic lanes by approximately one-half mile each. These changes are expected to result in a 58 percent reduction in the risk of ship strikes on right whales and an 81 percent reduction in the risk of strikes on other large whales. Although it is not mandatory that vessels entering and leaving Boston follow identified traffic lanes, most vessels do adhere to them. The panel commends the Service and the staff of the Stellwagen Bank National Marine Sanctuary for the painstaking work involved in bringing this measure to its present stage.

NMFS also is considering non-regulatory measures to establish recommended routes for ships in Cape Cod Bay and the Southeast, developed collaboratively with the Coast Guard (e.g., using Port Access Route Studies). Such recommended routes would be communicated via navigation charts and other means. The intention of the measures would be to reduce the overlap between whales and ships by minimizing ship transit distances through the highest-use whale habitat and encouraging ships to avoid specific whale aggregation areas. NMFS has indicated that it will monitor adherence to the designated shipping lanes and assess the need for making them mandatory.

The panel was advised by a representative of the Coast Guard that, although shipping lanes are generally non-mandatory, IMO rules do allow them to be made mandatory. Moreover, it was noted that the main purpose of a traffic separation scheme normally is to reduce the risks of collisions between ships or with fixed objects, and of groundings. The panel welcomes and commends the evident willingness of both NOAA and the Coast Guard to proceed with measures involving traffic separation schemes for the unorthodox purpose of reducing risks to right whales.

Finally, NMFS is considering establishment of an Area To Be Avoided in the Great South Channel where right whales congregate to feed in the spring. Such a designation would require IMO approval, and it is anticipated that a formal proposal will be ready for submission by April 2007. There is adequate evidence of this area's importance to right whales to justify at least seasonal regulation of vessel traffic there. In the panel's view, serious consideration should be given to the possibility of complete closure to large vessel traffic during part or all of May and June each year. Regardless of how the area is configured or managed, it will be important to anticipate and allow for unintended consequences, such as the displacement of high-speed traffic and exposure of whales to greater risks in another part of their range (e.g., while they are moving into or out of the restricted area). Although approximately 90 percent of existing Areas To Be Avoided are voluntary, the panel strongly encourages a mandatory approach in this instance for two reasons: (1) the fact that such a high proportion of the population uses the area on a regular basis, and (2) the whales' intensive use of the area is strongly seasonal, so closure could be confined to a relatively small part of the year.

Awareness, outreach, and education

The Service has invested significantly in a campaign to make mariners aware of the ship strike problem and to encourage steps on their part to prevent collisions with right whales. Brochures, pamphlets, placards, magazine articles, and videos have been distributed widely; navigational and regulatory charts pertaining to U.S. East Coast shipping are annotated with cautionary notices; and information on right whale collision risks and advice on how to avoid them is posted on relevant Web sites. The campaign has wisely extended beyond the shipping industry to include enforcement agencies (marine police, Coast Guard, etc.), the military, the cruise ship industry, and the recreational boating community.

Research and development

Representatives of NMFS expressed their intention to continue the search for technologies that would either allow vessel operators to detect whales in advance so that they could steer to avoid collisions or that would alert whales to oncoming vessels and allow them to take evasive action. They regard passive acoustics as a particularly attractive avenue of investigation, hoping that improvements in detecting right whales (in real time) will allow regulations to be fine-tuned with minimal economic impacts. Also, as indicated earlier, it is hoped that passive acoustics will, in time, reduce the need for costly aerial surveys.

There is also a strong impetus within NMFS to improve understanding of the physical dynamics of vessel/whale interactions. Some of this work involves tests in flow tanks using right whale models. Although such tests are potentially informative, the panel was skeptical whether static models and laboratory conditions would provide useful insights justifying the relatively high costs of such studies. That said, it is important to acknowledge the insights gained in the past from laboratory studies of hydrodynamic effects of large vessels (Knowlton et al. 1995) and field studies of right whale behavior and responsiveness (e.g., Nowacek et al. 2001, 2004), both supported by NMFS funding. Both types of studies have revealed specific problems that need to be taken into consideration for a ship strike reduction strategy to be successful.

A pilot project currently underway in the Stellwagen Bank National Marine Sanctuary (with active involvement by NMFS in its design and implementation and with partial funding from NMFS) holds promise for combining data from passive acoustic monitoring with vessel traffic data from AIS transmissions to manage ship/whale interactions on a real-time basis. Ideally, such an approach could facilitate the designation of dynamic management areas (see earlier discussion and section IV.B) and provide a means of monitoring vessel responses to advisories concerning the locations of right whale sightings. Although the panel recognizes the potential value of this approach, it is concerned about possible limitations, both practical and fiscal. For example, a large amount of computing capacity will be required to manage, process, and integrate the massive flow of data coming from both passive acoustic monitoring and the AIS. There also will always be a risk that right whales are present but not heard in a given area, whether because they are not vocalizing or because their sounds are being masked by ship or ambient noise. Although it was pointed out that buoys are already in place for the pilot acoustic monitoring project and therefore the costs of deployment on Stellwagen Bank should be modest, extending the buoy network to cover known or suspected high-use areas throughout the entire range of right whales along the U.S. East Coast will require a huge amount of infrastructure with significant associated cost implications.

Compliance with advisories

Studies of the extent to which vessel operators use EWS/SAS advisories and recommendations are notably lacking, as are studies of how information provided through other awareness and education programs has been used to reduce the risk of ship strikes. Results of a pilot project using AIS to assess voluntary compliance with speed and routing advice in the Great South Channel were not encouraging. Only 2 of 40 monitored ships changed course to avoid right whale aggregations and only 1 reduced its speed measurably (Moller et al. 2005).

Representatives of the Navy and Coast Guard offered the panel assurances that they have protocols onboard their vessels for observing and avoiding right whales. However, no data were provided on, for example, when and where observations had led to avoidance maneuvers or near misses had been noted by the onboard observers. Without such data, it is difficult to judge effectiveness and impossible to generate ideas on how to improve effectiveness. Although data on near misses have been collected opportunistically in a standardized manner since 2001 as part of the EWS aerial survey program in the Southeast, it was unclear if those data had been analyzed and used to refine mitigation measures. Moreover, the panel questioned how meaningful such reports would be, given that they come from surveys that provide no coverage at night or during inclement weather. For enforcement as well as scientific purposes, a priority should be placed on obtaining high-quality photographs or video of vessel interactions with right whales.

NMFS and the Coast Guard appear to be assessing compliance with the MSR systems with rigor and transparency, noting increased compliance rates over time following the initiation of steps to issue citations for non-compliance. Ongoing problems are recognized and efforts are being made to address them. With regard to the EWS program’s effectiveness, however, the panel was puzzled to learn that mariners are advised of right whale sightings only as they approach ports and not as they leave. The reason for this asymmetry was said to be that, under the existing IMO-approved arrangement, the Coast Guard is empowered to board vessels and enforce measures as a condition of port entry but not necessarily once a vessel leaves port.

NMFS representatives stated their belief that outgoing mariners almost certainly would receive information about right whales in the normal course of checking NOAA radio and other sources before or as they leave port, although that apparently has not been verified. In the Southeast, harbor pilots are issued pagers that receive real-time information on sightings for their use as they pilot vessels both into and out of port. A NOAA e-mail address is also available for vessel operators to send messages and to receive automated responses giving information on whale locations. In the panel’s view, it is important to verify that mariners are aware of right whale locations both when entering and leaving port. If that is not occurring, steps should be taken to correct this deficiency. It is equally important to ensure that individuals who receive right whale advisories respond appropriately. In other words, more studies of the kind mentioned earlier for Great South Channel are needed to assess the extent to which such advisories are heeded by mariners.

The panel also notes that MSR messages sent to vessels by the Coast Guard do not include speed advisories because the Coast Guard considers specification of a speed that is "safe" for whales to be premature. This is despite the fact that NOAA-mediated outlets have begun advising vessels to reduce speeds to 10 to 12 knots or slower in high-risk areas or circumstances. The panel believes that it is very important for specific ship speed advisory information to be included in the MSR and other Coast Guard-generated messages.

Table 7: Costs of actions to reduce ship strikes, FY2003/FY2005

Activity/Source	FY 03	FY 04	FY 05
Development of speed regulations	$100,000	$450,000	$450,000
NMFS	$100,000	$450,000	$450,000
Development of routing measures	269,400	264,400	291,000
NMFS	149,700	204,700	219,000
U.S. Coast Guard	35,000	35,000	35,000
International Fund for Animal Welfare	60,000	0	0
Stellwagen Bank National Marine Sanctuary	24,700	24,700	37,000
Public outreach	9,000	80,000	97,000
NMFS	0	71,000	71,000
International Fund for Animal Welfare	9,000	9,000	26,000
Research on whale avoidance technologies	1,897,800	2,657,713	1,753,825
NMFS	1,874,047	2,611,699	1,685,332
New England Aquarium	23,753	46,014	68,493
Compliance studies	0	0	0
Enforcement	64,668	67,512	87,592
NMFS	0	0	0
U.S. Coast Guard	64,668	67,512	87,592
Whale sighting/advisory systems (i.e., EWS/SAS aerial surveys)	1,114,649	1,124,788	1,607,200
NMFS	617,000	558,000	988,000
U.S. Coast Guard	201,649	237,788	279,200
U.S. Navy	155,000	155,000	155,000
U.S. Army Corps of Engineers	141,000	174,000	185,000
Mandatory ship reporting systems	266,876	284,379	296,353
NMFS	110,000	110,000	110,000
U.S. Coast Guard	156,876	174,379	186,353
TOTAL	$3,722,393	$4,928,792	$4,582,970

Note: The values shown for "whale sighting/advisory systems" are redundant with (for Navy and Army Corps of Engineers) or subsumed within (for NOAA and Coast Guard) those given for aerial surveys in section III.A.

Contribution to recovery program

Rulemaking

Management of vessel traffic to reduce the frequency and severity of ship strikes is vital to the recovery of North Atlantic right whales. The panel questions the effectiveness of the mitigation program currently in place, which consists primarily of encouraging voluntary action on the part of vessel operators to avoid collisions with whales. Ship strikes have continued to occur with no evidence of a reduction in their frequency or severity. The recent strategy proposed by NMFS, which includes mandatory speed restrictions and new routing measures, however, offers considerable promise.

Awareness, Outreach, and Education

The belief that these efforts will contribute to recovery qualifies as common sense, but there is no evidence that complete reliance on them to encourage voluntary action has made a significant difference with regard to reducing ship collisions thus far. Little information was provided to the panel that could be used to evaluate whether the work carried out to date has contributed to recovery or has been well directed. Further, there is little basis for determining the relative value of the different types of awareness, outreach, and education products.

Research and Development

Valuable insights have been gained from studies of ship hydrodynamics and the behavior and responsiveness of right whales when approached by ships. Overall, the results point to two major conclusions: (1) it is unrealistic to expect a technological solution to this problem in the near term, and probably even the medium term; and (2) the only available solution is to separate ships from right whales in space and time. Although data are limited, the best evidence available confirms that ship speed affects the risk of collisions with whales and therefore that the imposition of speed limits is an appropriate measure.

Cost-effectiveness of actions

During FY03/05 a total of $13.23 million was spent on actions to reduce ship strikes on right whales. Of that total, NMFS provided $10.38 million.

Rulemaking

The total cost during FY03/05 to develop speed regulations and routing measures as part of ship strike reduction strategies was $1.82 million. The large investment in this aspect of the recovery program is consistent with its importance. Although the new ship strike reduction strategy currently being proposed appears carefully developed and sensible, the biological costs of the slow pace of development, in terms of dead right whales, have been substantial. Such high financial costs and the long development time must be evaluated in the context of procedural rulemaking requirements—environmental impact statement preparation, economic impact analyses, scoping processes, port access route studies, etc. Assuming that the various elements of the strategy are implemented during the coming months as anticipated, the program may well be judged cost-effective. However, this will depend on the specific provisions of the various elements, particularly those related to speed limits and routing measures, and the extent to which vessel operators comply with them.

The slowness of rulemaking is largely systemic and therefore not necessarily a reflection of inattention on the part of NMFS. Although not rapid, the work of NMFS scientists and managers in this regard appears to have been thorough and conscientious.

The present early warning system consists of detection of right whales via dedicated aerial surveys and platforms of opportunity (e.g., Coast Guard aircraft and vessels, research vessels, and whale-watching vessels), followed by notification of vessel operators, with the expectation that they will respond appropriately to avoid collisions with right whales. During FY03/05 a total of $4.7 million was spent to gather data and operate the system. The effectiveness (and thus cost-effectiveness) of the system, in terms of preventing ship strikes, is difficult to evaluate with the information available. The panel acknowledges that useful data on whale distribution, entanglements, and individual identification have been gathered by the aerial surveys.

Studies of ship traffic volume and routing have been accomplished in a rigorous, thorough manner and have been effective in providing support for rulemaking. A great deal of valuable information on traffic volumes and patterns has been obtained and is being analyzed through the MSR system. The continued collection and analysis of such data are warranted, particularly for assessing compliance with, and cost-effectiveness of, new vessel routing measures.

Awareness, Outreach, and Education

During FY03/05, $187,000 was spent specifically on public awareness, outreach, and education, with $142,000 allocated by NMFS and the remainder by the International Fund for Animal Welfare. Without an empirical analysis of some kind to evaluate the effectiveness of different mechanisms or media (e.g., brochures, posters, radio broadcasts, training films, etc.) for bringing about changes in vessel operations in right whale high-use habitat (e.g., posting watches, adjusting speeds, or changing routes), it is impossible to determine whether this program has been cost-effective.

Research and Development

During FY03/05, $6.31 million was spent on research related to whale avoidance technology (e.g., whale detection devices, acoustic alarms, ship hydrodynamics, and the behavior and responsiveness of right whales when approached by ships). This accounted for 48 percent of the total amount spent during that period for ship strike reduction. As indicated earlier, those expenditures have failed to produce a technological solution that would allow ship traffic to operate without restraint (e.g., a vessel-mounted acoustic device that would detect whales or cause them to move away as the vessel approached). Further investment of federal funds in efforts to develop or test such devices is not likely to be cost-effective.

Recommendations

Rulemaking

The situation with ship strikes of right whales is well past the point at which precautionary action became justified; such action is long overdue. Therefore, regulatory action should be taken with all possible haste. If further delays arise in the rulemaking schedule presented at the workshop (i.e., final action by early 2007), the panel recommends that emergency rulemaking authority be used. Ongoing research will improve our understanding of whale behavior, ship hydrodynamics, the role of speed, and other factors potentially relevant to incidence and severity of ship strikes, and it may be possible to revise or scale back regulations accordingly. The panel recommends that NMFS proceed as rapidly as possible to implement a speed limit of 10 knots for seasonal and dynamic management areas, with the understanding that this precautionary approach (i.e., 10 knots rather than some faster speed) is appropriate for addressing one of the two most serious threats to North Atlantic right whales. In addition, the panel recommends that the proposed changes in the Boston shipping lanes and in the recommended routes for Cape Cod Bay and ports in the Southeast, as outlined during the review, be implemented without delay, accompanied in each case by rigorous monitoring to assess the extent to which the new routes are being used. Finally, in view of the Great South Channel's clear, consistent importance as a seasonal feeding ground for right whales, the panel urges establishing this area as a mandatory Area To Be Avoided for periods when right whales are present.

The panel urges NMFS to consider using the presence of a single mother/calf pair as a sufficient basis for triggering the dynamic management process because of (a) their exceptional vulnerability as they spend more time at the surface than other whales, (b) the mother's relatively high reproductive value to the population, and (c) the fact that six of the seven right whales known to have been killed by ship strikes between 2001 and 2006 were females. Depending on expert judgment with regard to the animals' likely mobility in a given context (e.g., whether they are likely to be passing through or instead remain for a long period), dynamic management areas triggered by this criterion may be designated for a shorter or longer period than is usual.

The panel also recommends that MSR messages be sent to vessels on their reported departure dates so that right whale advisories are available to ships when leaving port, as well as when entering.

Awareness, Outreach, and Education

It may be true that more public awareness, outreach, and education will always be useful. However, the panel has two specific recommendations in this regard. First, there needs to be a sharper focus on mechanisms to ensure that accurate, relevant messages reach specific target audiences (e.g., the people responsible for bridge operations of ships). The effectiveness of measures taken, whether they are mandatory or voluntary, ultimately depends on their comprehension and acceptance by vessel operators. Therefore, it is important that NMFS solicit the views of vessel operators, harbor pilots, and ship captains concerning the types of information they would find useful and how that information would be most effectively communicated. Second, evaluation is needed of the effectiveness of the awareness, outreach, and education efforts to justify continuation, much less expansion, of this program. To date, there appears to have been no effort to evaluate effectiveness, despite the availability of simple techniques for doing so (e.g., interviews with harbor pilots and ship captains).

There will always be a need to educate new generations of vessel operators and reinforce messages with seasoned mariners, which means that ship strike avoidance procedures and awareness of right whales and their plight must be institutionalized as part of ongoing training and certification processes. Although doing so may be straightforward in the North American context, there is an increasing need to extend such awareness and training to foreign operators. Therefore, more attention should be given to the non-U.S. component of the shipping industry, i.e., mariners from foreign countries who operate in the international maritime trade and regularly call at U.S. East Coast ports. The panel believes that NMFS should increase its work with other agencies and organizations (e.g., the Department of State and the IMO) to make foreign mariners aware of the ship strike problem and of the applicable U.S. guidelines and regulations. This will become even more important as new rules are adopted and implemented.

The panel recognizes and accepts that the contents of brochures and other materials might need to include certain types of information that are somewhat peripheral to mitigation, *per se*. For example, providing basic information on how to identify right whales and on their natural history and conservation status is justified simply because of the inherent value of raising awareness of the animals' existence and basic traits. However, the panel is concerned that certain other key messages that are directly relevant to mitigation may not be being communicated effectively at present. For example, advice on specific speeds that are "safe" for whales generally have not been included in outreach materials in the past, although some steps have been taken recently to correct this deficiency. In particular, given the responses received from representatives of the various agencies at the workshop, it is unclear what, if any, penalties would apply for deviations from designated ship channels. If there are consequences, it is essential that these be clearly stated and that the relevant mariners be made aware of them. Similarly, if there are incentives for voluntary compliance with guidelines or advisories, these should be explained clearly and disseminated widely.

Research and Development

The panel reiterates its recommendation to continue development of passive acoustic monitoring as an alternative or supplement to other types of monitoring, especially aerial surveys.

Further studies of compliance should be conducted to evaluate the effectiveness of voluntary approaches to mitigation. Such studies must remain a high priority even as new measures are taken, whether they are voluntary or mandatory (recognizing that, in the latter case, evaluation may be tantamount to enforcement). AIS seems to offer an excellent tool for these kinds of studies as well as for monitoring and research. Therefore, infrastructure needed to make AIS useful for these purposes should be developed.

The panel recommends that carefully planned field studies to investigate right whale behavior in relation to vessel approaches should be accorded higher priority for funding than work in flow tanks with right whale models. Both types of studies should be considered for funding on their merits and as discretionary funds become available.

All available information on ship strikes of right whales along the East Coast of North America needs to be compiled and analyzed in the context of proposed ship routing changes. For example, it would be useful to know what proportion of the strikes occurred, or might have occurred, within the 30 nmi radii of the nine U.S. ports planned for speed restrictions under the current ship strike reduction strategy. Also, further analyses to compare ship traffic to right whale distribution, including predictive modeling, should continue as needed to support refinement and reevaluation of the ship strike avoidance strategy.

A major data gap is knowing where, when, and under what circumstances (e.g., vessel speed, visibility conditions) ship strikes occur. The most obvious source of such data is the vessel operators themselves. The panel therefore recommends that a regulatory mechanism be devised that would require operators of vessels that strike whales to report the incident and describe the circumstances. Only by increasing the size and quality of the ship strike database will it become feasible to design cost-effective measures that both reduce whale mortality and minimize disruption to shipping.

B. FISHERY BYCATCH REDUCTION

Entanglement in fishing gear (bycatch) is the second primary anthropogenic source of mortality for North Atlantic right whales. There have been 61 confirmed cases of right whales carrying fishing gear since 1986 (Kraus et al. 2005). It is often difficult to determine which fishery is responsible for an entanglement, but when the entangling gear on right and humpback whales in the western North Atlantic has been identified, it has usually (89 percent of the time) been either sink gillnet gear or trap (pot) gear set for lobsters (Johnson et al. 2005). Both types of gear are set on the sea bottom, with vertical lines that extend to floats at the surface to mark the location of the gear. Right whales can become entangled in any part of the gear, but most entanglements in which the part of the gear could be identified involved the buoy lines or the ground lines used to connect adjacent traps or nets (Johnson et al. 2005). At least five recent right whale entanglements have been linked to Canadian lobster or gillnet gear.

Entanglement is seldom immediately lethal to right whales. Instead, entangled whales usually swim off with part or all of the gear, which they may carry for periods of months or years. It can take some time before a whale is sighted and reported as carrying gear, a factor that frustrates most efforts to determine exactly where the entanglement occurred. Depending on the severity of the entanglement, the animal may become emaciated and weakened as a result of an inability to feed, or it may succumb to infections or other trauma. Death may occur months or even years after the initial entanglement. Entanglements also may reduce the reproductive success of affected animals, which may, in turn, have an effect on the population's recruitment rate.

The NMFS strategy to reduce and eliminate entanglement is two-tiered: a long-term program to develop gear modifications that will reduce the risk of entanglement in these fisheries, and, in the meantime, restricting the use of potentially dangerous fishing gear in times and areas where right whales occur. The ultimate goal is to design "whale-safe" fishing gear that will not entangle right whales and to require that this gear be used throughout areas where right whales occur. This goal is to be achieved by working cooperatively with the fishing industry and other stakeholders to design and test gear modifications that will reduce the risk of entanglement at reasonable cost to the fishing industry. In the meantime, while whale-safe gear is being developed (implicitly recognizing that this may take considerable time), NMFS is identifying times and areas where whales co-occur with high-risk fisheries and restricting the use of potentially risky gears through the dynamic area management (DAM) and seasonal area management (SAM) programs as well as in designated critical habitat. In most cases, conservation actions within DAM and SAM areas require, or encourage, the use of fishing gear that has been modified to reduce the likelihood of life-threatening entanglement.

While working toward the eventual reduction or elimination of entanglements, NMFS also is supporting efforts to disentangle whales observed carrying fishing gear. As explained below, those efforts do not contribute to a solution of the entanglement problem, and they carry a unique set of inherent risks, but they do at least prevent the deaths of a few entangled whales. The disentanglement program is reviewed in this section of the report.

As noted earlier, the PBR level for this whale population has been set at zero, meaning that any fishing-related mortality or serious injury is unsustainable and should not be permitted. Nevertheless, it will be extremely difficult to eliminate entanglement as a source of mortality for right whales without significant changes (and economic costs) to affected fisheries. These fisheries are important to the economies of coastal states. For example, the panel was informed that, under the Atlantic Large Whale Take Reduction Plan (ALWTRP), NMFS currently manages about 6,000 lobster fishermen who set more than 2 million traps.

Complicating efforts to resolve the entanglement issue is the fact that NMFS has a dual charge—on one hand to promote and manage fisheries and on the other to protect right whales and encourage their recovery. These often-conflicting mandates are administered by separate programs within the agency. The role of the federal regional fishery management councils and the various state fishery management agencies in developing management plans complicates matters further. To overcome these complications, the entanglement problem needs to be recognized as a fishery management crisis that requires decisive action at the highest levels of government. The extinction of North Atlantic right whales would represent a fundamental failure in both fishery management and the conservation of protected resources in the United States.

Modifications to fishing gear and practices

Since its establishment in 1996 the ALWTRT has been working with NMFS to reduce mortality and serious injury of right whales in commercial fishing gear through the large whale plan. The major focus has been to develop modifications to existing fishing gear and practices to make it less likely that right whales will become entangled. The plan has been amended several times to reflect new modifications or to extend modifications to new times, areas, or fisheries. It also includes seasonal and temporal restrictions under the SAM and DAM programs.

The following provisions currently apply to lobster trap and anchored gillnet fisheries managed under the ALWTRP throughout the U.S. Exclusive Economic Zone (out to 200 nmi from shore):

- No buoy lines floating at the surface;
- All gear must be hauled from the water at least once every 30 days; and
- Fishermen are encouraged, but not required, to maintain knot-free buoy lines.

Specific requirements for lobster trap and gillnet fisheries (e.g. sinking groundlines, net panel and buoy line weak links, gear marking) vary by management area. In addition, a number of specific modifications are required for lobster trap and anchored gillnet fisheries in areas managed under the SAM and DAM programs, including the following:

- Prohibition on the use of floating ground lines and/or buoy lines;
- Weak links required at buoys and net panels; and
- Limits on the number of buoy lines per trap (pot) trawl or net string.

Despite a decade-long period of development, the suite of regulations implemented to date has not been successful in reducing the observed entanglement rate of right whales in commercial fishing gear. There is good evidence that in some circumstances (e.g., when the line is wrapped around the tail stock) weak links do not work. For example, two lines with intact weak links have been recovered from entangled right whales since 2002. Knowlton et al. (2005) noted that "Entanglements are frequent and the annual rate has remained high and is increasing." Thus, it is clear that the management program to date has failed to eliminate entanglements. The situation is dire, and more effective actions are urgently required.

In June 2003 NMFS published a Notice of Intent to prepare an environmental impact statement (EIS) to analyze alternatives for further amending the ALWTRP to increase its effectiveness in reducing the entanglement rates of right and other large whales. The draft EIS was issued in February 2005, followed by a proposed rule and request for comment in June of that year. The two preferred alternatives (and all other alternatives) in the amended plan focus on further modification and extension of current techniques, including, but not limited to, the following:

- Expansion of the use of weak links;
- Requirement to use neutrally buoyant or sinking ground line; and
- Inclusion of several other fisheries under the plan.

It is difficult to imagine any scenario in which the limited suite of modifications described in the draft EIS will significantly reduce the frequency with which right whales become entangled in fixed fishing gear. For example, a large proportion of well-documented entanglements have involved buoy and surface lines (although in many cases, just pieces of line are found on whales, and these cannot be attributed to a particular part of the gear), which would not be changed by the proposed regulations. The panel learned that some individuals within the fishing industry oppose efforts to address the problem of buoy lines, citing technical, economic, and safety issues associated with any modification of end lines. Further, according to NMFS, it has proven extremely difficult to modify vertical lines in a way that makes them less risky for whales but still feasible for use by the fishermen. This is plainly evident from the detailed information provided in the NMFS Working Draft of a Strategy to Reduce Large Whale Entanglement Risk Associated with Vertical Line. Nevertheless, without addressing the risk of entanglement in vertical lines, it will not be possible to solve the entanglement problem. It is critical to remember that the goal of this program is not simply to reduce current rates of entanglement but to eliminate serious injury and mortality due to entanglement altogether.

The panel acknowledges that some modifications to fishing practices are currently in place under the ALWTRP, and others are being considered. Nevertheless, the panel concludes that the measures implemented to date, as well as those in the proposed modifications to the ALWTRP, are inadequate. They also may prove more costly than necessary in the long run. The provisions may result in greater long-term economic costs to the fisheries involved than would be the case if effective regulations were implemented immediately to eliminate the risk of entanglement. In particular, regulations should be put into place as quickly as possible to prohibit the use of vertical lines in all areas where right whale aggregations may be expected (i.e., critical habitat and DAM and SAM areas). This prohibition should remain in place until gear modifications are developed that can provide reasonable assurance that entanglement will not occur. Such a prohibition would do two things: (1) place the burden of proof on the fishing industry to demonstrate that it has developed whale-safe gear, and (2) harness the vast creative energy of fishermen to develop ways to catch lobsters and finfish without using gear that has the potential to entangle whales.

Finally, there is a pressing need for improvement in the processes for developing, evaluating, and testing potential gear modifications. NMFS has implemented a competitive grants program, administered through a cooperative agreement with the National Fish and Wildlife Foundation (NFWF) and designed to provide funding opportunities to fishermen, academic researchers, and other interested parties. Once a gear research project has been completed, the researcher may request that NMFS consider the gear modification as a potential management tool for incorporation into the ALWTRP. The panel is concerned that this arrangement has not delivered innovative, effective gear modifications in a timely manner. As noted by participants at the 2004 Workshop on Modification of Fishing Gear to Reduce Large Whale Entanglements, there is an urgent need for a dedicated, coordinated research program that combines gear research with research on whale behavior. For such a program to be effective, there also needs to be a change in the process of issuing scientific research permits to make it easier to evaluate and field-test promising approaches.

Area management

Since 2002 NMFS has employed spatially explicit SAM and DAM approaches to reduce right whale interactions with commercial fishing gear. The SAM program was intended to protect right whales in two areas where predictable seasonal aggregations occur in and adjacent to the currently designated critical habitat areas of Cape Cod Bay and the Great South Channel. The DAM program allows NMFS to impose temporary gear specifications or restrictions on the deployment of lobster trap and anchored gillnet fishing gear in areas north of 40 N where aggregations of right whales are reported. A DAM action is triggered by a reliable report of right whales that meets a certain density threshold (0.04 whales per nmi^2). Once a DAM action has been triggered, NMFS may temporarily restrict or request the use of certain types of gear within an area buffered around the original sighting location.

As is the case with the other components of the NMFS fishery interactions strategy, no evidence is available to evaluate effectiveness of the area management approach in reducing right whale entanglements. The panel recognizes the rationale behind the SAM and DAM measures (i.e., to encourage wider use of gear thought to be safer for whales) but concludes that area management, as conceived and implemented to date, is unlikely to enhance right whale conservation unless more stringent restrictions are placed on fisheries operating within prescribed areas.

NMFS has been unwilling to implement conservation actions in either DAM or SAM areas that would eliminate the risk of entanglement. Currently, a series of regulatory measures (e.g., required use of weak links, limits on the number of buoy lines) apply to each SAM area, but these have not eliminated entanglements. NMFS can take several actions in DAM zones, including the following:

- require removal of gear for a 15-day period;
- request voluntary removal of gear in the area for a 15-day period; and/or
- require gear modifications for a 15-day period.

Before implementing a DAM zone, NMFS is required to follow certain steps, including intra-agency documentation and public notification through the *Federal Register*. DAM zones can be extended beyond 15 days if warranted.

With very few exceptions, NMFS has not required the removal of fishing gear in DAM areas. Instead, DAM designations have consistently recommended or required that fishermen incorporate certain modifications in their gear. In addition, internal processing, approval, and publication procedures result in a two-week (or longer) delay in implementing DAM measures after the initial sighting triggers for management action have been met. Obviously, some whales may become entangled and many or all of them may leave the area during this delay interval.

Until truly whale-safe fishing gear is developed, the DAM approach likely will be effective only if fishermen are required to remove lobster and gillnet gear quickly from areas with aggregations of right whales. This poses a potential safety problem for fishermen, who could be required to remove large quantities of fixed gear on short notice in poor weather. This, together with the frequency and unpredictability of DAM events, hampers the approach's effectiveness.

The DAM approach also requires ongoing aerial surveys to ensure that aggregations of whales are detected outside SAM and critical habitat areas. As noted elsewhere in this report, those surveys are useful for analysis of habitat use, provide important sighting information to the Catalog and Sightings Database and give valuable support to the disentanglement program. However, there are questions about their cost-effectiveness as a management measure, particularly given the delays in implementation, and concerns about their safety.

In addition to the problems outlined earlier, effective implementation of DAM and SAM programs requires enforcement. (Note that if the measures were voluntary, as they sometimes have been, the issue of enforcement would be moot.) Enforcement of fishery management regulations in these areas is primarily the responsibility of the Coast Guard working with the NMFS Office for Law Enforcement. The cost of this enforcement is difficult to estimate due to the multiple tasks addressed in most Coast Guard missions. Relatively few patrols are dedicated to enforcing provisions of the ALWTRP or other right whale conservation measures although such work may be performed while addressing other primary tasks. The panel was advised that enforcement patrols do not remove gear from the water for inspection, which means that an assessment of compliance with gear modification rules or recommendations is possible only if fishermen are encountered while actively hauling their gear.

NOAA holds joint enforcement agreements with the states of Maine, Massachusetts, Rhode Island, and Virginia. The panel was informed that 22 cases of alleged violations of ALWTRP gear requirements had been investigated, resulting in five cases being forwarded for further action to the NOAA Office of General Counsel. Overall, however, no information was readily available on the level of enforcement effort or the proportion of the total deployed gear that had been inspected.

Finally, the panel is concerned about the evident inability of NMFS to prevent the continuation and even proliferation of fisheries that pose risks to right whales within existing management areas. For example, a right whale calf was entangled and killed in a gillnet set in the Southeast Restricted Area in January 2006. The use of gillnets in this Restricted Area is managed under provisions of the ALWTRP. A new gillnet fishery for whiting (southern kingfish) recently emerged inside the Restricted Area, evidently without having been preceded by a determination that it was "safe" for right whales. The panel notes that failures to anticipate and mitigate the potential impact of allowing new fisheries to develop in right whale habitat can worsen the problem of entanglement, as happened in this case.

<u>Disentanglement</u>

The disentanglement program involves dangerous, costly work that is only marginally effective. People involved in the program risk their lives to help compensate for the fact that the entanglement problem has not been solved. Demographic models suggest that preventing the deaths of even a few females could shift the population trend from a slow decline to a slow increase, which makes abandonment of the disentanglement program unthinkable. From another perspective, a response of some kind to alleviate the suffering imposed on entangled animals is also an important consideration. Almost three-quarters of living right whales in the western North Atlantic show evidence of past entanglements (e.g., scars, wounds, or bits of gear still attached), and perhaps 10 to 30 percent of the population interacts with fishing gear each year. During the period from January 2000 through the end of 2005 the disentanglement network received 25 reports of entangled North Atlantic right whales (Marine Mammal Commission 2006). Network responders were able to remove some of the gear from seven of those animals and all or most of the gear from four others. A few of those 11 animals likely died or were seriously injured. For the other 14 animals, either there was no opportunity to remove the gear or attempts to do so were unsuccessful. The panel commends the people involved in the disentanglement effort for their dedication and commitment.

The following elements of the disentanglement effort are germane to this review:

- At present, only three individuals on the U.S. East Coast are authorized by NMFS (based on training and experience levels) to lead disentanglement attempts on right whales; two others are authorized to lead attempts involving other whale species.
- Aerial surveys have been responsible for many of the detections of entangled right whales, and aircraft have also been used to direct the disentanglement teams to whale locations and provide images helpful for planning disentanglement strategies.
- The success rate for disentangling right whales is much lower than for other species because right whales are comparatively difficult to deal with. For example, it typically takes one attempt to disentangle a humpback whale whereas it can take as many as six or eight attempts to remove the gear from a right whale.
- Outcomes of disentanglement attempts are difficult to predict. Some whales that experts believed would survive after disentanglement have not while others with a poor prognosis have survived and reproduced.
- A major frustration for the disentanglement teams is that entanglements posing the greatest danger to the animal, such as those involving line wrapped around the head, mouth, or flipper, are the most difficult to resolve successfully.
- To date, no attempt to disentangle a right whale has been stopped on the basis of poor survival prospects, nor has any attempt been made to euthanize a right whale because of its condition. It is not clear how humane euthanasia could be accomplished with this species.
- The disentanglement program responds to events involving humpback and minke whales as well as right whales, although the entire federal contribution to funding comes directly out of the right whale program’s budget.

Further investment in the disentanglement program is clearly needed to make it safer and more effective. Among the immediate priorities are the following:

- development of a method to chemically sedate or restrain entangled whales;
- development of a more effective telemetry system that can be securely attached to trailing gear and provide real-time monitoring data; and
- establishment of reliable, long-term cooperative agreements with state agencies and the Coast Guard, especially in the Southeast, to ensure that vessels and aircraft are available when and as needed to support disentanglement efforts.

Consideration also should be given to novel approaches that would facilitate disentanglement and reduce the risks to human health and safety. These might include some unusual ideas, for example, the employment of remotely operated robotic devices or trained marine mammals (e.g., sea lions).

Finally, the panel stresses that the costs of disentanglement, including the personal risks faced by members of the disentanglement network, should be incorporated explicitly into fishery management decisions and cost-benefit assessments. In other words, rather than these costs being accounted against the right whale recovery program and borne quietly by a few dedicated individuals, they should be considered a responsibility and a funding obligation of fishery management. Requirements to modify fishing methods or equipment are matters of concern not only for the purpose of right whale conservation but also for the purpose of human safety. The highest priority should be given to methods, such as those described earlier, that will eliminate entanglement and thus eliminate the need for the disentanglement program.

Take reduction process

The ALWTRT has been ineffective as a mechanism for developing mitigation strategies to deal with right whale entanglement. A number of presenters at the workshop described the ALWTRT as unique in several respects. It is the longest serving take reduction team, having existed for more than a decade. The team is very large, with 58 members (including three from NMFS) divided into two regional sub-teams. It is by far the largest take reduction team to date. Not surprisingly, the ALWTRT has been unable to reach consensus on most important issues and, instead, has usually delivered majority and minority opinions to NMFS. Management options leading to the proposed rule currently under consideration were discussed by the ALWTRT in 2003. In the panel's view, the take reduction team process was never intended to operate in such a prolonged, open-ended fashion. In fact, it appears that those who crafted the 1994 amendments to the Marine Mammal Protection Act intended exactly the opposite.

The panel believes that other mechanisms would be more effective for developing mitigation strategies and for combining those strategies with other conservation approaches. For example, a small recovery team, consisting of individuals with direct experience in addressing right whale biology and whale bycatch issues, itself advised on technical aspects of gear modification by a group of gear specialists and fishing industry experts, might be much more effective than the current take reduction team approach (see section V later in this report). Such a team also might be able to interact in a more efficient manner with regional fishery management councils and other bodies.

Table 8: Costs of actions to reduce fishery bycatch, FY2003/FY2005

Activity	FY 03	FY 04	FY 05
Administration (e.g., public hearings, convening TRTs, preparing EIS, labor, etc)	$168,000	$1,057,000	$729,000
NMFS	168,000	1,057,000	729,000
Development of gear modifications and buyback	1,129,400	1,713,605	1,839,405
NMFS	1,129,400	1,713,605	1,614,405
New England Aquarium	0	0	200,000
Provincetown Center for Coastal Studies	0	0	25,000
Atlantic Large Whale Take Reduction Plan	2,101,714	2,648,400	2,216,586
NMFS	2,101,714	2,648,400	2,216,586
Disentanglement	1,175,933	808,691	836,438
NMFS	1,088,000	613,400	608,000
U.S. Coast Guard	37,933	95,291	153,438
Provincetown Center for Coastal Studies	50,000	100,000	75,000
Enforcement	394,034	1,456,770	595,966
NMFS (Joint Enforcement Agreements with Maine, Massachusetts, Rhode Island, and Virginia)	60,000	162,000	200,000
U.S. Coast Guard	334,034	1,294,770	395,966
TOTAL	$4,969,078	$7,684,466	$ 6,217,395

Note: Coast Guard costs do not include staff time dedicated to policy development, drafting regulations, training, and providing enforcement guidance to personnel in the field.

Contribution to Recovery

Modifications to fishing gear and practices

The current suite of gear modifications has not succeeded in eliminating entanglements, nor is there any evidence that it has reduced the frequency with which right whales become entangled in fixed gear. Further, the panel was given no reason to believe that the gear modifications in recently proposed amendments to the ALWTRP will meet take reduction goals, given the insufficiency of attention to resolving entanglement risks from vertical (i.e., buoy) lines. In some areas of Massachusetts, NMFS has funded a buyback program to encourage fishermen to switch from sinking to neutrally buoyant ground lines. However, participation has been voluntary and limited in geographic scope. The panel commends the agency's efforts to reduce the profile of ground lines and to include some measures addressing vertical line, as described and discussed in the Working Draft of a Strategy to Reduce Large Whale Entanglement Risk Associated with Vertical Line, and included in the currently proposed rulemaking. Nonetheless, it concludes that past and planned efforts at gear modification are unlikely to be adequate for solving the right whale entanglement problem.

Area Management

No evidence was presented during the review to indicate that the DAM and SAM programs have been effective in reducing serious injury and mortality of right whales in fixed fishing gear. A fundamental problem with both approaches is that critical aspects of the fishing gear (especially vertical lines) have not been addressed adequately in either past or currently proposed regulations. In addition, the DAM approach takes too long to implement due to the bureaucratic requirements of the current regulatory process. The panel concludes, therefore, that neither program, in its present form, is likely to contribute significantly to population recovery.

Disentanglement

With numbers so low, even a few successful disentanglements of right whales are potentially significant. The panel emphasizes, however, that the same could be said of other measures (e.g., gear modifications, fishery closures) where it is likely that one or more whales have been "saved" even though there is no direct evidence to prove it. The important point is that disentanglement and the other measures, taken together, have not solved the bycatch problem.

Also, it is necessary to acknowledge the possibility that the very existence of the disentanglement program makes the prevention of entanglement seem less urgent. Such a perception could deflect resources away from necessary restrictions on fisheries and allow public officials to delay difficult but necessary measures to eliminate the use of fishing gear that entangles whales. In other words, there is a danger that the program could function as an indirect subsidy to fisheries by compensating (or attempting to compensate) for a major flaw in how they operate. At the same time, the panel recognizes that removal of gear from entangled right whales has been a primary source of information for the identification of gear types and fisheries that pose a risk to right whales; this information is critical to the development of appropriate mitigation measures.

Take reduction process

The take reduction process has been ineffective at providing solutions to the entanglement problem. The process is slow, cumbersome, and often divisive. Even when incremental steps have been agreed to by the ALWTRT, very long delays have ensued in the rulemaking process required for implementation. This slow pace of change has resulted in frequent and costly litigation and rulemaking actions. As noted earlier with regard to ship strike reduction (section IV.A), much of the slow pace of rulemaking is systemic and unavoidable. Despite the agency's continuing failure to resolve this critical issue, many individual NMFS scientists and managers have been working diligently and conscientiously to do so.
Many members of the ALWTRT have expressed skepticism that the take reduction process will be able to deliver meaningful conservation recommendations. Decisive actions are required to conserve right whales, and the take reduction process is not the vehicle to deliver them.

Cost-effectiveness of actions

Expenditures to develop and implement actions that address the entanglement problem totaled \$18.87 million during FY03/05. Of that amount, NMFS provided \$16.10 million.

Modifications to fishing gear and practices

During FY03/05 a total of \$4.67 million was spent on gear modifications and buybacks. Much of the funding for gear development has focused on gear modifications with questionable prospects for reducing entanglement risks (e.g., weak links, line cutters, and new buoy designs) although some investment has been made in more promising approaches involving the elimination of line from the water column (e.g., pop-up buoys). Funding to reimburse fishermen willing to switch from floating to sinking or neutrally buoyant ground lines (buyback programs) may have been helpful. According to NMFS, state and industry representatives report that the buyback programs funded by NMFS and administered through various state agencies, together with the DAM program, have raised awareness and encouraged fishermen to switch over their lines prior to any implementation of requirements mandating such change. The panel is concerned, however, that the use of presumably safer types of line has not yet become sufficiently widespread. The current suite of modifications in the ALWTRP apparently has not succeeded in significantly reducing or eliminating entanglement of right whales in fishing gear. Those proposed in the latest amendments to the plan appear to have the potential to reduce entanglement, but on present evidence it is difficult to assess how significant such a reduction might be. The panel contends that more stringent measures, such as the elimination of all fixed gear with vertical lines in areas of right whale aggregations, would be more cost-effective in the long term. Such measures would have immediate economic consequences for affected fisheries, but the panel believes that those costs would be overcome by the ingenuity of fishermen if they had the needed incentive to develop whale-safe gear rapidly. Furthermore, the longer the delay in implementing such effective measures, the greater will the need become for even more draconian action.

Area Management

It is difficult to estimate the total cost of the area management approach. Cost accounting is confounded by the fact that aerial surveys have multiple purposes, only one of which is to detect concentrations of right whales for establishing DAMs (see section III.A). Much has been learned about the distribution of right whales, and the surveys have been important to the disentanglement program. However, the primary goal of reducing or eliminating the entanglement of right whales in fishing gear has not been achieved. As noted, protection measures in the DAM and SAM areas, as implemented to date, have not been adequate.

Disentanglement

During FY03/05 the investment in disentanglement efforts totaled \$2.82 million, not including some expenditure by the Coast Guard. As a protection measure, *per se*, disentanglement is not cost-effective. Moreover, it entails considerable risks to human safety for the small returns in terms of numbers of right whales saved from serious injury or death. In assessing cost-effectiveness, it is necessary to recognize that a substantial part of the disentanglement effort, and therefore its cost, has been devoted to species other than right whales. This confounds any analysis of the cost-effectiveness of right whale disentanglement efforts. Although disentangling other whales may provide training opportunities and lead to improved techniques, such efforts do not contribute directly to right whale conservation. The panel did not attempt to evaluate cost-effectiveness from the perspective of all disentanglement efforts for all whale species.

Take reduction process

During FY03/05 expenditures by NMFS related to the ALWTRP totaled $6.96 million, which represents 37 percent of all funds spent on the bycatch issue. (The ALWTRP and ALWTRT address humpback and fin whales, as well as right whales.) The take reduction process has been neither efficient nor cost-effective in reducing or eliminating the entanglement of right whales in fishing gear. Costs specifically for support of ALWTRT meetings were not provided for this review, but considering travel by members, the number of members, meeting facilitation, printing of background documents, etc., the total cost of each meeting of the full team likely exceeds $200,000. The funds used to convene the current TRT and its regional subteams to discuss and develop management advice that has proven to be ineffective could have been, and should have been, invested in better means of dealing with this pressing problem.

Recommendations

Modifications to fishing gear and practices

The panel recommends that all fisheries using fixed gear in areas where right whale aggregations occur be required to demonstrate that the gear is whale-safe before its use is approved. At present, this would require a prohibition on the use of vertical lines, in addition to the measures currently required or being contemplated as part of the ALWTRP. Such restrictive measures could be relaxed once gear modifications are developed, tested, and shown to be whale-safe. The panel is confident that the East Coast fishing community could meet the challenge posed by such a restriction. Without such measures, right whales will continue to die in lobster and gillnet gear, leading to more lawsuits, additional costs to fishermen, and expensive rulemaking and administrative expenses. The panel also recommends modification to the scientific research permit system to allow more expeditious testing of whale-safe fishing gear and associated concepts.

Area management

The current approach to area management has not reduced the frequency of right whale entanglements. In its stead, the panel recommends a reevaluation of right whale critical habitat, guided by a recovery team (see section V). Critical habitat should include all areas in which right whales occur frequently in both the feeding and breeding grounds. In those areas, management measures should include elimination of the use of fishing gear that could entangle right whales. To be clear, the panel recommends that all designated critical habitat should be closed to the use of fishing gear that poses a risk to right whales. Trap fisheries should be limited to gear with no fixed vertical lines and no floating ground lines. It should be possible to implement such measures within critical habitat through a combination of ESA section 7 provisions and the take reduction and recovery mandates that apply to right whales under both the ESA and MMPA.

At present, the panel cannot envision a whale-safe gillnet. No new fisheries should be authorized in right whale critical habitat until the gear to be used has been demonstrated to be whale-safe.

<u>Disentanglement</u>

The occasional success of disentanglement in saving a right whale justifies continuation of this program until actions are taken to reduce entanglements to close to zero or eliminate them entirely. The panel recommends that the right whale recovery program's budget not be used to support efforts to disentangle other species or to expand such efforts outside eastern North America, even though it agrees that such expansion may be desirable for conservation generally. The panel also recommends that an independent review be conducted to assess the risks and benefits of the disentanglement program. The review should explicitly consider (1) the probability of serious injury or death to humans involved; (2) the record of success and failure in attempts to disentangle right whales; (3) the merits of, and alternatives to, disentangling some right whales, particularly those individuals in such poor condition that they are likely to die and whales that are entangled in such a way that the probability of safe or successful disentanglement is very low; and (4) the indirect benefits of disentanglement, including knowledge gained concerning which fisheries are involved, increased public awareness, and research opportunities to sample, track, and study the behavior and movements of entangled (and disentangled) individuals.

<u>Take reduction process</u>

The panel recommends that the current ALWTRT, including the two regional sub-teams, be disbanded. The take reduction team should be replaced by a recovery team (see section V) that would guide NMFS in the development and implementation of management strategies to eliminate the entanglement of right whales in fishing gear. Such a team would be able to act in a more efficient, cost-effective manner, without the constraints and dysfunctional history of the ALWTRT. A group of gear specialists and fishing industry experts could advise the team in technical aspects of gear modification. The current approach simply will not result in effective conservation and represents a waste of limited resources that should be invested in more productive ways. In reaching this conclusion, the panel was mindful of the fact that disbanding the ALWTRT would have implications for humpback whales and fin whales as well as right whales. However, reducing the mortality of right whales is of transcendent importance as a conservation priority, and therefore the panel considers the implications for the other two species to be far less critical. Furthermore, it is not clear that the efforts of the ALWTRT are reducing the frequency or severity of entanglements for these other two species.

IV. FINDINGS OF THE PANEL: CROSS-CUTTING AND GENERAL

Coordination

The panel recommends that NMFS create a North Atlantic right whale recovery team as provided for in the Endangered Species Act. The team should be constituted for the purpose of helping NMFS promote recovery of this whale population to the point where it satisfies the downlisting criteria in the current recovery plan. Two immediate functions of the team would be to assist with a reevaluation of critical habitat designations and an evaluation of management options for eliminating right whale entanglement.

In addition, there is a need to bring regional fisheries management councils into the take-reduction process to a much greater extent than has been the case to date. This may require amendment of the Marine Mammal Protection Act and/or the Magnuson-Stevens Fisheries Conservation and Management Act to mandate a direct link between right whale bycatch reduction measures and the fishery management process. It may also require an additional oversight mechanism to ensure that councils do not veto, alter, or override essential protection measures.

Implications of mitigation measures

Two important aspects of mitigation need to be considered at all stages. First, some of the measures may offer ancillary benefits in addition to preventing harm to right whales. For example, slowing ship traffic may reduce the risks of collisions with other whales or between vessels. Restrictions on the use of gillnets and traps could be part of management plans designed to reduce fishing pressure on target and other non-target species, leading to better overall fishery management. Also, the process of developing whale-safe measures to harvest lobsters and finfish could lead to the development of safer or more efficient methods for capturing the target species. Second, proposed measures should be evaluated for unintended negative consequences, whether direct or indirect. For example, a fishery closure in a right whale feeding area could lead to a shift of fishing effort into a migration path. Similarly, a change in traffic routing could lead to a higher incidence of collisions with another valued species (e.g., humpback whales). Even though such a change might be tolerable from a conservation standpoint, it would be important to anticipate it and be prepared to respond.

Feasibility of enforcement

A great deal of momentum has developed in the direction of using passive acoustic monitoring to track the presence of right whales in different areas. The scientific approach is appealing, and the idea of dependence on remote sensing is attractive because it promises to be more cost-effective and safer. A premise of investing in and pursuing such an approach is that it will facilitate real-time measures to reduce risks to right whales (principally via dynamic management). Although the panel is not opposed to the concept, it is concerned about the ability of enforcement agencies to deliver such protective measures in a timely and effective way. The poor record to date in this regard must be considered the best guide to what can be expected in the future. Total closures of sensitive areas to high-speed ship traffic, risk-prone fishing gear, or both, on a seasonal or permanent basis, may be the only truly enforceable (and thus effective) approach to protecting right whales from the two most important risk factors impeding their recovery.

Fundamental importance of certain core program elements

A commitment to predictable, long-term funding for core recovery-related work, including development and implementation of take reduction and threat mitigation measures, maintaining and updating key databases, and investigating causes of right whale deaths and serious injuries, is of paramount importance. In particular, the Catalog is indispensable. Any major change in how the photo-identification data are collected and managed could have serious implications for population monitoring and, in turn, the ability to assess the effectiveness of recovery efforts. For example, if funding cuts were to limit field efforts and allow sampling at only two- or three-year intervals instead of annually, this would affect the ability to monitor critical demographic parameters, such as survival and fecundity. Given the present state of North Atlantic right whales, it is essential to continue collecting the field data needed to monitor the population with maximum possible resolution.

Where and with whom does responsibility for right whale recovery lie

The Secretary of Commerce has ultimate responsibility to ensure that the goals of the Recovery Plan for the North Atlantic Right Whale are met. Pursuit of those goals can be driven by one of three approaches: (1) develop and implement ineffective measures that will likely result in lawsuits and judicial decisions to direct actions by federal agencies; (2) rely on public awareness and education efforts to motivate and guide voluntary actions by fishermen, vessel operators, etc.; or (3) take the initiative to restrict activities known to be harmful to right whales and cope with the negative response from some stakeholders. All three options promise to be costly. However, from the standpoint of meeting recovery plan goals, the third is most likely to be effective on an acceptable time scale.

The language in the recovery plan does not adequately reflect that human-caused mortality for this whale population should be reduced to zero. Rather, the plan refers to significant reductions as the most that can be expected. The panel believes that NMFS should be pursuing the goal of zero human-caused mortality and serious injury of right whales, as clearly expressed by the setting of a PBR level of zero and as stated in the required goals of take reduction plans. The same goal appears not to have been carried forward with regard to ship strikes and general recovery planning. Obviously, working toward such a goal will require a number of different steps that are not likely to be taken simultaneously. Nevertheless, recovery planning needs to be geared toward elimination, not just reduction, of anthropogenic mortality and serious injury. With regard to reducing the number of right whales killed by fishing gear, the panel believes that responsibility for addressing this issue has been misplaced and a major change is needed. The little progress that has been made to date has been due to efforts of conservationists, scientists, and Office of Protected Species staff in NMFS who have tried to use legislation, such as the Endangered Species Act and the Marine Mammal Protection Act, to force fishery managers to take action to reduce whale entanglements. Unlike some other interactions between marine mammals and fisheries, right whales are not attempting to depredate catches or competing with fishermen for resources. Rather, they are simply using their habitat as they have for hundreds of thousands of years. From the whales' perspective, fisheries have developed in some of the same areas very recently, and some of those fisheries are now taking whales as a bycatch. The Department of Commerce, acting through NMFS, is required by law to regulate bycatch as part of fishery management plans developed under the Magnuson-Stevens Fishery Conservation and Management Act. They do this routinely for non-target species of shellfish, finfish, sea birds, sea turtles, and other taxa. NMFS has clearly recognized that there should be no fishery bycatch of North Atlantic right whales as it has set the PBR level for this population at zero. Therefore, fishery managers have the responsibility to modify management plans as necessary to eliminate right whale bycatch, and the panel strongly recommends that they be instructed to recognize and meet this responsibility.

Relations with Canada

A significant proportion of the known present-day feeding habitat of North Atlantic right whales lies in Canadian waters. Also, some of the deaths from ship strikes and entanglements occur in Canada. Therefore, bilateral efforts are essential to achieve coordination and consistency in measures to protect right whales and their critical habitat. Also, conducting research and monitoring to assess the population's status, investigating factors limiting population recovery, and developing and testing mitigation methods cannot be carried out efficiently without the cooperation of Canadian authorities.

The panel was pleased to learn that cabinet-level discussions are underway to negotiate a bilateral right whale conservation agreement between Canada and the United States. Although Canada's reconfiguration of the Bay of Fundy shipping lanes is deservedly regarded as a signal achievement, the Canadian government's approach to right whale conservation has been otherwise passive in comparison to that of the U.S. government. The whale-watching industry in Canada is unregulated, there is no Canadian equivalent to the critical habitat designations for right whales under the U.S. Endangered Species Act, and no substantive measures have been taken in Canada to address the right whale entanglement problem. Entanglement is one area where bilateral dialogue is essential, but it is important to avoid letting U.S. fishing interests transfer responsibility for the entanglement problem to Canadian fisheries. Fisheries in both countries need to be managed to address this problem.

Another issue that should be high on the bilateral agenda concerns U.S. plans to construct a liquid natural gas (LNG) tanker terminal in Maine. Such a development will create a major new threat to the right whale population. A proposal for an oil tanker terminal at Eastport in the late 1970s provided the impetus for surveys of right whales in the lower Bay of Fundy and Quoddy region. Those surveys led directly to the right whale research and monitoring program in this area by the New England Aquarium. Impact assessment and site selection for the LNG tanker terminal need to be addressed immediately by authorities in both countries. Also, the high-speed ferry that operates between Yarmouth, N.S., and Bar Harbor, ME, making two trips per day (including one at night), represents a potentially serious hazard for right whales. Its operations are currently not regulated to avoid whale collisions and it is exempt from the traffic separation scheme in the Bay of Fundy. Moreover, plans are underway for the ferry to serve additional sites in Maine, which would almost certainly imply additional risks to right whales.

Funding

Although the data available for this review are not comprehensive, they indicate that a total of $45.6 million was spent by all U.S. agencies and groups involved in implementing the right whale recovery program during the three fiscal years 2003/04 through 2005/06. Of that amount, 95.5 percent came from federal agencies, 3.8 percent from nongovernmental organizations, and less than 1 percent from state agencies. The National Marine Fisheries Service was the greatest single source of funding ($35.3 million).

Table 9: Costs of all actions to promote recovery of western North Atlantic right whales, FY2003/FY2005

Source	FY 03	FY 04	FY 05
Federal Agencies	$12,639,287	$16,200,810	$14,707,144
NMFS	10,127,897	12,798,559	12,353,725
NOS (National Marine Sanctuaries)	67,000	89,900	124,300
Navy	165,267	218,427	399,216
Coast Guard	809,525	2,075,569	1,208,268
Army Corps of Engineers	147,000	180,000	191,000
National Fish and Wildlife Foundation	1,322,598	497,149	192,953
State Agencies	102,600	72,800	134,442
Florida	76,000	72,800	73,250
Massachusetts	21,600	0	61,292
Rhode Island	5,000	0	0
Nongovernmental Organizations	379,678	456,227	907,926
International Fund for Animal Welfare	140,000	104,000	257,418
New England Aquarium	98,075	86,431	312,404
Provincetown Center for Coastal Studies	62,500	112,500	92,500
Woods Hole Oceanographic Institution/Ocean Life Institute	54,103	127,296	220,604
Whale Center of New England	25,000	25,000	25,000
TOTAL ALL SOURCES	$13,121,565	$16,729,837	$15,749,512

The objective of this review was not simply to document how much money had been invested in right whale recovery efforts or to project how much should be spent in the future. Rather, the objective was to evaluate whether the funds invested had been used in a cost-effective manner. The panel's conclusions in that regard are explained in sections III and IV of this report. After a surge in federal funding for right whale research and conservation beginning in 2000, the trend of financial support has reversed direction and is now on a downward trajectory. Overall funding peaked in FY04 at more than $16.7 million but declined by almost $1 million in FY05, due largely to a reduction of support from NMFS. During the review, the panel was advised that NMFS funding for FY06 was expected to decline to $7.8 million, a reduction of 53 percent from the FY2004 level.

The panel has concluded that some parts of the recovery program do not appear to have been cost-effective and that significant improvements in cost-effectiveness may be possible in some areas (e.g., aerial surveys, bycatch reduction). However, the panel also has identified a number of essential tasks that are currently underfunded or that should be expanded (e.g., catalog and database management, passive acoustic monitoring, studies of effectiveness of management actions, compliance assessment). Overall, the needs for additional funding appear much greater than any savings that might be realized by paring down program elements that currently are not considered cost-effective. Therefore, any reduction in the overall federal commitment to right whale protection will mean that some high-priority work is not carried out. This, in turn, is likely to increase the risk that recovery of this population will never be achieved.

Overall strategy and implementation

Although the objectives of the North Atlantic right whale recovery program are appropriate, overall strategy and implementation are not adequately accountable. Federal actions have not reflected a sense of urgency about reducing right whale mortality that is consistent with the gravity of the species' peril. The current approach is not precautionary but rather is one of waiting for conclusive evidence and/or industry acceptance before moving ahead with protective actions. This is particularly true of attempts to reduce interactions between right whales and fishing gear. Therefore, the panel recommends that NMFS and other agencies act more aggressively to prevent right whale mortality. In general, they should set higher standards of protection and place greater reliance on the ability of industry to adapt to those standards, rather than continuing to depend on a complex, shifting, inefficient, and ineffective network of regulatory measures to protect the whales. The guiding principle should be to separate high-risk human activities from right whales, in both space and time, to the maximum extent feasible.

V. Acknowledgments

The panel acknowledges the support and cooperation of everyone who contributed to the planning and execution of the review. This includes staff at SRA International, the Marine Mammal Commission, and the National Marine Fisheries Service (headquarters and regional offices). Two individuals deserve special mention. Wilhelmina Innes at the Commission provided a remarkably clear, detailed set of meeting minutes that facilitated report preparation. David Laist, also at the Commission, contributed in many ways. Most importantly, the panel benefited from his longstanding involvement with right whale conservation and his attention to details that otherwise would have escaped notice. Finally, the panel acknowledges the constructive, detailed reviews of a draft of this report provided by NMFS staff at its headquarters office, the Northeast and Southeast Fisheries Science Centers, and the Northeast and Southeast Regional Offices. The collegial spirit they maintained while watching their programs undergo detailed scrutiny was exemplary. Also, the panel appreciates the helpful review received from Scott Kraus of the New England Aquarium.

VI. References

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APPENDIX I

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North Atlantic Right Whale Program Review

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APPENDIX II

AGENDA

NORTH ATLANTIC RIGHT WHALE PROGRAM REVIEW

Marine Biological Laboratory
Woods Hole, MA
14–17 March 2006

TUESDAY, 14 MARCH

8:00 – 8:30 COFFEE AND DANISH

8:30 – 8:45 OPENING REMARKS
David Laist, Marine Mammal Commission
Linda Manning, SRA International
Lloyd Lowry, Marine Mammal Commission

8:45 – 9:45 OVERVIEW OF RECOVERY PROGRAM
Michael Payne, NOAA
Richard Merrick, NOAA
Jerry Conway, Department of Fisheries and Oceans, Canada

9:45 – 10:45 MONITOR STATUS AND TRENDS OF ABUNDANCE
Richard Pace, NOAA

10:45 – 11:00 BREAK

11:00 – 12:00 RIGHT WHALE DISTRIBUTIONAL STUDIES
Lance Garrison, NOAA

12:00 – 1:15 LUNCH

1:15 – 2:15 MAJOR RIGHT WHALE DATABASES
Philip Hamilton, New England Aquarium
Robert Kenney, University of Rhode Island

2:15 – 3:15 STOCK STRUCTURE AND INDIVIDUAL IDENTIFICATION – GENETICS
Richard Pace, NOAA

3:15 – 3:30 BREAK

3:30 – 4:30 REPRODUCTION AND HEALTH ASSESSMENTS
Teri Rowles, NOAA

4:30 – 5:30 RESPONSE TO STRANDINGS
Teri Rowles, NOAA

WEDNESDAY, 15 MARCH

8:30 – 9:15	HABITAT STUDIES AND ASSESSMENTS Lance Garrison, NOAA
9:15 – 10:30	OVERVIEW OF FISHERY INTERACTIONS David Gouveia, NOAA
10:30 – 10:45	BREAK
10:45 – 11:45	OVERVIEW OF TAKE REDUCTION EFFORT David Gouveia, NOAA
11:45 – 1:00	LUNCH
1:00 – 3:00	IMPLEMENTATION OF SPECIAL MANAGEMENT AREAS David Gouveia, NOAA
3:00 – 3:15	BREAK
3:15 – 5:15	IMPLEMENTATION OF GEAR MODIFICATIONS AND GEAR RESEARCH Diane Borggaard, NOAA Glen Salvador, NOAA

THURSDAY, 16 MARCH

8:30 – 9:00	FISHERIES OUTREACH AND EDUCATION Diane Borggaard, NOAA
9:00 – 9:45	DISENTANGLEMENT EFFORTS Teri Rowles
9:45 – 10:00	BREAK
10:00 – 10:30	OVERVIEW ON VESSEL INTERACTIONS Gregory Silber, NOAA Jerry Conway, Department of Fisheries and Oceans, Canada
10:30 – 12:00	INTRODUCITON TO SHIP STRIKE MITIGATION PROGRAM Gregory Silber Barbara Zoodsma, NOAA
12:00 – 1:15	LUNCH
1:15 – 2:15	VESSEL TRAFFIC MANAGEMENT Gregory Silber, NOAA Jerry Conway, Department of Fisheries and Oceans, Canada

2:15 – 3:15	MANDATORY SHIP REPORTING SYSTEM Gregory Silber, NOAA
3:15 – 3:30	BREAK
3:30 – 4:15	NORTHEAST AND SOUTHEAST RIGHT WHALE SIGHTING AND REPORTING SYSTEMS Tim Cole, NOAA Barbara Zoodsma, NOAA
4:15 – 5:15	MARINER OUTREACH, EDUCATION AND TRAINING Barbara Zoodsma, NOAA Kristen Koyama, NOAA

FRIDAY, 17 MARCH

8:30 – 9:30	RESEARCH TO IMPROVE UNDERSTANDING OF HOW WHALES AND VESSELS INTERACT Gregory Silber, NOAA
9:30 – 10:30	RESEARCH TO IMPROVE MITIGATION TOOLS FOR REDUCING VESSEL INTERACTIONS Gregory Silber, NOAA Richard Merrick, NOAA
10:30 – 10:45	BREAK
10:45 – 11:45	REVIEW AND DISCUSSION OF INFORMATION PRESENTED
12:00	ADJOURN

APPENDIX III

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APPENDIX 6

Expenditures on Protection Programs and Levels of Effectiveness

No overarching review mechanism or central source of data exists for tracking actual expenditures on specific research and management activities for endangered, threatened, and depleted marine mammals and assessing the effectiveness and impact of those activities. Furthermore, responsibility for recovery activities often is shared among different agencies or parts of agencies, and in some cases non-governmental organizations. Absent an effective accounting mechanism at the appropriate level of detail, the Commission gathered data on expenditures for various protection programs to illustrate varying degrees of effectiveness and cost-effectiveness in addressing recovery-related issues.

Issue of concern (approximate cost and level of effectiveness)	Recovery action(s)
Commercial whaling $300,000 to $360,000 annually from 2002 to 2006 Highly effective	Management of commercial whaling through the International Whaling Commission (IWC) has been highly effective. Commercial whaling prior to the 1970s left many large whale populations severely depleted if not close to extinction. The Marine Mammal Protection Act and the Endangered Species Act effectively banned commercial whaling in U.S. waters, but migratory large whale populations continued to be exposed to commercial whaling outside U.S. waters. Various actions taken by the IWC, leading up to and including a global moratorium on commercial whaling after 1986, provided nearly complete protection for large whales. However, some IWC member countries continue hunting, either by objecting to restrictive measures, or by establishing national research programs that involve lethal sampling—with meat from carcasses sold commercially. Aboriginal subsistence whaling is allowed for bowhead whales by the United States and Russia, minke and fin whales by Greenland, and humpback whales by St. Vincent and the Grenadines. At least some populations of large whales that occur in U.S. waters, including those of gray, bowhead, humpback, blue, and fin whales, have progressed toward recovery as a result of protections conferred by the U.S. government as well as the IWC and governments of other nations. Recovery may require 100 years or more because some populations were severely depleted, have inherently low reproductive rates, and/or are still subject to other threats (e.g., ship collisions and entanglements in fishing gear). In addition, changes in ecosystem conditions, either through natural mechanisms or human influence, may affect the recovery rate of these populations. The Department of State has delegated the lead for representing the United States at IWC meetings to the National Oceanic and Atmospheric Administration. Major costs include membership dues, travel, and staff time. Management through the IWC has prevented the deaths of tens of thousands of whales over the past twenty years and, again, has been highly effective.

Subsistence whaling for bowhead whales $310,000 to 610,000 annually from 2000 to 2005 Highly effective	Co-management of subsistence hunting for bowhead whales off the north slope of Alaska has been highly effective. For centuries, Alaska Natives have hunted bowhead whales for subsistence. The Marine Mammal Protection Act allowed them to continue whaling. In 1978 the IWC recommended quotas for aboriginal subsistence whaling. That same year the National Marine Fisheries Service established a cooperative agreement with the Alaska Eskimo Whaling Commission (an organization of whalers representing the various Native villages that take bowhead whales) allowing the Commission to manage the hunt by assigning portions of the quotas to the villages and establishing a system for reporting and enforcing violations, among other things. For its part, the Service would seek quotas from the IWC consistent with the subsistence needs of Alaska Natives and would help monitor the status and trend of the whale population. Major costs include funding for the Commission to carry out its responsibilities, Service oversight of the bowhead whale management program, and research. The bowhead population is estimated to exceed 10,500 animals, has been growing at 3.5 percent per year, and appears capable of recovery with the harvest (current quota is 67 strikes per year). The Marine Mammal Commission considers the management program for the western Arctic bowhead whale to be highly effective and cost-effective in terms of both assuring population recovery and meeting Alaska Native traditional subsistence hunting needs[3].
Subsistence hunting of Cook Inlet beluga whales About $400,000 annually Ineffective	In contrast to the bowhead whale situation, management of subsistence hunting of Cook Inlet beluga whales was not effective before 2000, and management of the stock generally has not been effective. Subsistence harvesting of these whales increased during the 1980s and early 1990s and by 1998 the population had declined from about 1,300 in 1979 to about 350. The National Marine Fisheries Service did not have the authority to regulate the hunt because the population was not officially designated as depleted. In 1999 Congress temporarily banned the deliberate taking of Cook Inlet beluga whales for subsistence, and in 2000 the Service designated the population as depleted, entered into a cooperative agreement with an organization of Cook Inlet Native marine mammal hunters, and began to develop hunt regulations. From 2000-2005, an average of one whale was taken per year. Despite those measures, the 2006 estimate of abundance was 302, indicating further decline and suggesting that factors other than hunting are now inhibiting recovery. Funding for Cook Inlet recovery efforts include annual surveys (about $150,000 annually), management actions including preparation of recovery related documentation (conservation plan, environmental impact statements), and costs for about 2.5 full-time management staff. The Service has not initiated an effective research program to investigate the additional factors that may be precluding recovery. This situation exemplifies ineffective management that will likely delay time to recovery, expose the affected population to added risk of extinction, and result in excessive and unnecessary recovery costs. The limited funding that has been provided has been crucial for assessing abundance and trends, and those funds have been spent effectively. Annual survey results indicate that the population is not recovering and more research and management are needed to identify, characterize, and manage the factors impeding recovery.

Southern sea otter vulnerability to oil spills Preparation for translocation $670,000; annual costs from 1988 to 1990 for research and management $660,000 to $986,000; combined costs in 2003 to 2005 were estimated at about $311,000 Ineffective	Management of southern sea otters included a translocation program to protect the population from a large-scale oil spill. This well-intentioned effort has been of limited effectiveness, at best. In the mid-1980s, at the recommendation of the Marine Mammal Commission and others, the Fish and Wildlife Service initiated a translocation program to establish a second sea otter population at San Nicolas Island (in the Channel Islands). The aim was to reduce the possibility that a single oil spill could eliminate all sea otters in California waters. The new population also could provide a source of otters for restocking the mainland population if such an event occurred. The Service established a "management zone" south of the existing sea otter range to address fishermen's concerns; otters entering this zone were to be captured and returned to north of Point Conception. Between 1987 and 1990, the Service moved 139 sea otters to San Nicolas Island. Most either disappeared or returned to their mainland range and growth of the San Nicolas Island population was unexpectedly slow. In the late 1990s, large numbers of sea otters from the mainland population began moving south into the management zone, and moving them back north proved more difficult than expected. The Fish and Wildlife Service currently is considering whether to declare the translocation program a failure and terminate efforts to restrict the sea otters' southern range expansion. Toward that end, Service staff drafted a review of the translocation program, published a policy statement announcing plans to suspend efforts to remove otters from the management zone, prepared a draft supplemental environmental impact statement on the translocation program, and held numerous public hearings and meetings with stakeholder groups. The Service estimates the cost of developing the draft supplemental environmental impact statement at about $311,000 spread over fiscal years 2003 through 2005, with staff requirements of 1.6 FTEs in 2003 and 2004 and 0.75 in 2005[2]. A population of about 30 animals still inhabits the waters off San Nicolas Island, but the translocation did not achieve its goals. The reasons for the failure of this population to grow are not yet known. The attempt to establish a new population was reasonable and intended to address a real population need, although in the end the effort was not effective.
Incidental take of southern sea otters off California Expenditures unknown Highly effective	Management of the incidental taking of sea otters off the coast of California is an example of highly effective management by a state. Commercial hunting in the 1700s and 1800s reduced sea otters to near-extinction throughout the North Pacific. An international treaty in 1911 banned such hunting, but the southern sea otter (between southeast Alaska and Mexico), was thought to have been extirpated. In the 1930s, a colony of about 50 otters was discovered near Big Sur, California. By 1977, when the subspecies was listed as threatened, its range included 160 miles of central California coastline and its numbers were about 1,800. Population growth then stopped or slowed due to mortality in a trammel net (a type of gillnet) fishery for halibut, which was killing up to 150 sea otters per year. The state of California took a series of steps between 1982 and 1990 to prohibit trammel nets and other gillnets in areas inhabited by sea otters. The closed area increased in size with each step and by 1990, incidental takes of sea otters by gillnets in California had been nearly eliminated without appreciable effect on commercial halibut landings. Concurrently, sea otters increased in number and expanded their range. The associated costs are not known but included funds for public hearings, development of management measures, observer programs, and enforcement. The fishery closures imposed by the state of California have been highly effective.

Incidental take of Hawaiian monk seals in pelagic longline fishery Expenditure unknown Highly effective	Management of incidental taking of Hawaiian monk seals in a pelagic longline fishery provides an example of quick and effective action by the National Marine Fisheries Service with the Western Pacific Fishery Management Council. In 1990 and early 1991, nine Hawaiian monk seals were found on NWHI beaches with longline hooks embedded in their skin, fishing line trailing from their mouths due to ingested hooks, and blunt-trauma injuries on their heads suggesting they had been struck. The observations coincided with a rapid increase in Hawaii-based longline vessels (from about 50 in 1988 to over 140 in 1991) fishing for swordfish in the central North Pacific. The National Marine Fisheries Service adopted a recommendation by the Western Pacific Fishery Management Council to establish a protected species zone within 50-nautical-miles of the NWHI and to prohibit longline fishing inside the zone. Subsequent to the fishing closure, observations of monk seals with embedded longline hooks ceased. The cost to implement those measures is unknown, but appears to have been limited almost entirely to staff time for Council and Service personnel, placement of observers on a sample of longline fishing vessels, and enforcement. The evidence strongly suggests that the regional expansion of longline fishing operations was responsible for the monk seal hookings and that the protection measures taken in response were well chosen and effective.
Hawaiian monk seal entanglement in marine debris $2.6 million annually for initial cleanup, $0.5 million projected for annual maintenance Partially effective	The effort to remove fishing and other debris from the Northwestern Hawaiian Islands provides an example of partially effective management action. Since 1982, more than 250 monk seals have been observed entangled in derelict trawl netting and line (mostly from elsewhere in the North Pacific), and other types of debris. Entangling debris can impede movement and animals may be unable to forage or evade predators, may drown, or may sustain lethal wounds from the abrasive cutting action of the entangling material. Between 1982 and 2005, researchers disentangled and released 179 seals, 69 seals managed to extricate themselves, and 8 seals are known to have died. The interventions undoubtedly prevented more serious injuries or deaths. However, researchers are present in the NWHI for only a few weeks to months at a time and observe only a portion of entangled seals. In addition, seals that are entangled in the water may not be able to return to land where they can be observed and disentangled. Thus, the full extent of this problem is unknown. In 1996 teams of divers from the National Marine Fisheries Service began surveying NWHI reefs to estimate the amount of debris and its accumulation rate. They found up to 94 nets or net fragments per square kilometer in the most heavily fouled reef areas. Between 2001 and 2005 the Coral Reef Conservation Program of the National Ocean Service funded an intensive clean-up effort; 400 metric tons of derelict netting were removed from offshore reefs and an additional 45 metric tons were picked up from beaches. International education and outreach efforts have not been successful at curtailing net debris at its source and an estimated 52 tons of additional debris drifts into the NWHI each year. Although some monk seal deaths and injuries have been prevented, entanglements continue and the underlying cause of the problem persists. Until international measures are taken to reduce the careless disposal and loss of nets, lines and other debris, disentanglement and clean-up efforts will need to continue, and probably intensify, at considerable cost.

Mortality of Florida manatees About $5 million annually Highly effective	Research and management efforts to respond to and investigate manatee deaths have been highly effective in providing information essential to identify and characterize threats to manatees and guide recovery actions. Every year, scores of injured or distressed manatees are reported to Federal, state, and local authorities. The animals have been hit by boats, entangled in fishing line, caught in various structures, or stressed by exposure to red tides or cold temperatures. Since the early 1980s, more than 800 rescues have been attempted and, at the end of 2005, 385 manatees had been brought into captivity for treatment and released back into the wild. Many others had been assisted and released directly at rescue sites. Preliminary indications are that rehabilitated animals successfully readapt to the wild; several rehabilitated and released females are known to have produced calves. The major costs of this program include sending trained responders and equipment to rescue sites, transporting animals, providing medical care and food to recovering animals, and assessing status of released animals. The Fish and Wildlife Service estimates that overall costs in 2005 totaled at least $5 million: $3.4 million of that was provided by cooperating oceanaria, $1.5 million by the Florida Fish and Wildlife Commission, and $51,000 by the Fish and Wildlife Service. Considering the results, in-kind services and contributions, and ancillary benefits for public education, the Commission considers these efforts to have been highly cost-effective, but the larger problem of substantial numbers of manatees being killed annually by vessel strikes continues, and merits additional action.
Mortality of Florida manatees in water control structures $7.2 million to date, about $14.6 million when completed Effective	Measures to address manatee mortality in water control structures illustrate recovery efforts that require considerable initial investment but that will become increasing effective and cost-effective over time. Between 1991 and 2000 an average of 10 manatees were killed every year in water control structures. Manatees trapped between closing doors or pinned against narrow openings by strong currents were crushed or drowned. Most deaths occurred at a few specific gates and locks operated by the South Florida Water Management District and the Army Corps of Engineers. After attempts to modify opening and closing procedures failed to solve the problem, the two agencies, in cooperation with the Florida Department of Environmental Protection and the U.S. Fish and Wildlife Service, began installing reversing mechanisms that operate like elevator doors to prevent manatee entrapment. From 2001 to 2005 the average number of deaths was reduced to four a year, with those deaths occurring either at structures that had not yet been equipped with protection devices or where the devices had malfunctioned. When installation is completed, these devices could prevent an average of 10 deaths a year. Although initially costly, maintenance fees for these modifications should be considerably less, and the Commission believes these modifications will prove to be increasingly cost-effective over time.

[1] The Marine Mammal Commission is planning a 2008 review of co-management efforts to assess progress since the 1994 amendments to the Marine Mammal Protection Act and identify directions for the coming decade.

[2] S. Henry, personal communication. Ventura Fish and Wildlife Office. U.S. Fish and Wildlife Service. Ventura, CA. November 2006.

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