The Value of Sanctuaries, Parks, and Reserves (Protected Areas) As Tools for Conserving Marine Mammals

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Introduction

The number of marine sanctuaries, parks, and reserves throughout the world grew from only a few to more than 1,200 in less than 25 years (apparently starting in about 1970; Earle 1995:329). This number included primarily areas of the subtidal marine environment and therefore failed to reflect the many protected areas that incorporated intertidal, estuarine, or wetland areas but did not have a "marine" component (Kelleher et al. 1995). There clearly has been an enormous proliferation of marine protected areas around the world during the last quarter of the twentieth century. As one might expect, more than half of the marine protected areas included in the global inventory by Kelleher et al. (1995) were in the North Atlantic and North Pacific and their adjacent seas and about a fifth were in Oceania (New Zealand and Australia). One is also struck, however, by the fact that this proliferation has been a truly global phenomenon, encompassing all climatic zones and including countries large and small, rich and poor. The concept of protected areas is now understood to apply as much to the sea as to the land (Agardy 1994, 1997).

The designation of protected areas has long been used as a tool for wildlife conservation on land. A few terrestrial parks, sanctuaries, or reserves benefitting marine mammals have existed for a considerable time. The Congressional declaration in 1869 that the Pribilof Islands (St. Paul and St. George) were a "special reservation" under the authority of the U.S. Department of the Treasury brought regulation to the commercial hunt for northern fur seals (*Callorhinus ursinus*) (Scheffer et al. 1984). In 1892, Afognak Island in Alaska was designated, by Presidential proclamation, a "fish cultural and forest reserve" under the Forest Reserves Act. According to Lavigne et al. (1999), the purpose was, in part, to protect seals, walruses (*Odobenus rosmarus*), and sea otters (*Enhydra lutris*). Also in Alaska, the Walrus Islands State Game Sanctuary was declared in 1960 for the explicit purpose of protecting "the only regular summer hauling grounds for walrus still in existence on United States territory" (Kenyon 1960). "Seal Beach" on Kangaroo Island, South Australia, was established as a protected area for Australian sea lions (*Neophoca cinerea*) and New Zealand fur seals (*Arctocephalus forsteri*) in 1954 (Robinson and Dennis 1988). These modest early land-based efforts have been supplemented in recent years by an array of much more ambitious designations, some with the protection of marine mammals and their habitat as a major rationale, others simply including marine mammals as among the organisms that stand to benefit from management or protection.

Many marine mammal populations were depleted by commercial hunting. Although deliberate exploitation continues in some areas, major ongoing threats to marine mammal populations and species now include both incidental catch (Perrin et al. 1994) and reductions in prey abundance (Earle 1996) by commercial fisheries, chemical pollution (O'Shea 1999), human-generated underwater noise (Richardson et al. 1995; Gordon and Moscrop 1996), vessel strikes (Laist et al. in press), entanglement in derelict fishing gear and other marine debris (Laist 1996; Laist et al. 1999), deterioration of habitat due to human activities and development (Whitehead et al. 2000), and global climate change (MacGarvin and Simmonds 1996). This array of threats requires a variety of policy and management responses. Where spatial components of threats can be defined, establishment of marine protected areas can be a useful approach to management for conservation.

Statement of Objectives and Approach

This paper has three main objectives, as follows:

(1) To review the nature and scope of existing protected areas that are relevant to marine mammal conservation;

(2) Using examples from the literature, to assess the effectiveness and identify the strengths and weaknesses, in relation to marine mammal conservation, of different approaches toward designating and managing marine protected areas; and

(3) To develop recommendations concerning ways of improving the effectiveness of marine protected areas as tools for conserving marine mammals and their ecosystems.

The results are based mainly on a review of literature, including unpublished reports of management agencies and non-governmental organizations. In addition, individuals with experience in the development, management, or evaluation of marine protected areas have been consulted for advice and information (see Acknowledgments).

Definitions – What Is a Marine Protected Area?

The concept of a marine protected area embraces a number of different types of designation. A rigid and standardized terminology (see Glossary) may be useful in some contexts, but no attempt has been made to apply one here. Rather, sanctuaries, parks, reserves, preserves, and refuges are all considered to fall within the broad meaning of the term "marine protected area." In her taxonomy, Agardy (1997) refers to marine sanctuaries and parks (her Category 4) as ranging "from the seaward extensions of coastal terrestrial parks, to ecosystem-based multiple use marine parks, sanctuaries and biosphere reserves." This essentially describes the set of marine protected areas that are covered in the present paper. Many authors, particularly those concerned with the implications for fishing and fish stocks, use the term "marine reserve" to mean a "no-take" area or zone, i.e., an area where extractive activities such as fishing and plant removal are prohibited. However, even considering this single rubric, "marine reserve," the meaning varies from country to country. For example, in South Africa, marine sanctuaries are defined as areas providing total protection; marine reserves as areas where most species are protected but selected species can be taken; and fishery reserves as areas where only one or a few species of commercial value are protected (Hockey and Branch 1997). In New Zealand, the Marine Reserves Act of 1971 explicitly defines reserves as no-take areas established for scientific study (Walls 1998).

California's Interagency Marine Managed Areas Workgroup recently adopted the term "marine managed area." in part to avoid "the misimpression that the designated area is under complete protection, such that the extraction of marine resources is not allowed" (Resources Agency of California 2000:2). The workgroup also made the useful point that areas established administratively for recreational or commercial fishing restrictions, such as seasonal or geographic closures and size limits, should not be interpreted as falling within the definition of marine managed areas. Nor are these areas, which tend to be non-permanent and subject to change through time, generally recognized as marine protected areas [Agardy (1997:99) refers to them as "closed areas"]. Along the same lines, it is questionable whether designations such as the International Whaling Commission's whale sanctuaries in the Indian

Ocean and Southern Ocean, or Ireland's cetacean sanctuary, should be regarded as marine protected areas (see Appendix 1 for descriptions). An extreme suggestion is that the entire area south of 60ES is, by virtue of the Antarctic Treaty System, "the world's largest MPA" (Attwood et al. 1997).

Hooker et al. (1999) note with respect to the IUCN definition of a marine protected area (see Glossary) that legislation is a key element. In their example, it was important to emphasize that two earlier gestures intended to protect the northern bottlenose whales (*Hyperoodon ampullatus*) in The Gully, offshore of Nova Scotia, Canada, had not been legislated and therefore were not enforceable (see later). This insistence on legislation should apply even to marine protected areas declared by local communities because their efforts need to be guaranteed by governmental commitments (e.g., see the example of Mafia Island Marine Park, Tanzania; Fontaubert et al. 1996:51-52; also the many examples in the United Kingdom; Graham and Huff 1985). Thus, one required feature of a marine protected area is, or should be, that it be formally authorized by legislation or binding regulations of some kind. The recent Executive Order by President Clinton (26 May 2000; Executive Order 13158) defines Marine Protected Area as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein."

A marine protected area without a management plan is like a ship without a rudder. A plan expressing management objectives and mechanisms is a *sine qua non*, a first principle for effectiveness. Not only must a management plan exist, but it must be consistent with the goals and objectives of the site, feasible to implement, and subject to periodic review and revision. Even with a management plan, a protected area will be ineffective unless a director is empowered to implement it. Empowerment, in this instance, means that the director has the necessary legal authority, sufficient financial resources, and adequate staff to proceed with implementation.

General Review of Marine Protected Areas

Reasons for Establishing Marine Protected Areas

Salm and Clark (1984:15) cite six possible reasons for designating a marine protected area, as follows: (1) it is typical of an "important" ecosystem or habitat type, (2) it has high species diversity, (3) it is an area of "intense biological activity," (4) it provides "critical" habitat for a species or species group, (5) it has exceptional cultural value, or (6) it offers opportunities for "necessary" research or for determining baseline conditions. These criteria are similar to those used by Kelleher et al. (1995, Vol. I) to select "priority areas." However, the latter authors consider three additional factors: (7) naturalness, i.e., the extent to which an area approaches its pristine condition; (8) economic importance; and (9) practicality or feasibility of achieving protection. Among the "biological factors" to be considered in site selection, they also mention source-sink dynamics (see below), "key" breeding and migration areas, isolation and endemism, areas of high productivity, and "vulnerable" species. All of these criteria, taken together, embrace most of the possible reasons for establishing a marine protected area. Jones (1994) and Agardy (1997) reformulate the above criteria as goals or objectives for management of marine protected areas. The latter author emphasizes the utility of marine protected areas as "testing ground[s] for management" and their potential to "empower local users."

It has been argued that marine protected areas are ideally suited to "science-based conservation" (Agardy 1994; also see Agardy 1997; Dayton et al. 2000). Not only do they provide opportunities for studying baseline conditions (item 6 in the preceding paragraph) and monitoring environmental change, but they also make it possible to conduct scientific experiments under relatively natural conditions. Marine protected areas can help alleviate the consequences of scientific uncertainty. The effectiveness of different approaches to management can be tested within the context of one marine protected area, then used to inform decisions about how to design and manage marine protected areas more generally, as well as how to protect valued resources that lie outside protected area boundaries. In principle, a marine protected area should function as "a buffer against unforeseen yet potentially disastrous management mistakes" (Agardy 1994).

The Convention on Biodiversity (Article 8a,b, and e) calls for parties to establish a system of marine protected areas and buffer zones where special measures are needed to protect biodiversity (Fontaubert et al. 1996:15-18, 66). Under this convention, the Jakarta Mandate of 1995 urges that (a) selection of marine protected areas emphasize "ecosystem functioning" as well as the protection of specific stocks, (b) marine protected areas be incorporated within broader planning objectives that include multiple use, (c) local communities and resource users be encouraged to participate in the planning and management of marine protected areas, and (d) management plans consider "all three levels of biological diversity (ecosystem, species, and population or genetic)" (de Fontaubert et al. 1996:97). In general, the convention's wording (like that of the United Nations Convention on the Law of the Sea) emphasizes the importance of integrating resource *use* into the fabric of protected area management. Community-level organization and traditional modes of exploitation are particularly valued and encouraged. The content and tone of the Jakarta Mandate are unmistakable in urging that protected areas include provisions for human use and economic benefit.

Most other recent literature considers "multiple use" fundamental to the concept of marine protected areas (e.g., Dixon et al. 1993; Agardy 1994, 1997). Indeed, Kelleher (1998) observes that "the almost universal failure of protected areas to perform their designed functions in the face of opposition or apathy from local communities has led to widespread recognition that protected areas must meet the needs of these communities if they are to survive." This imperative is clearly a central issue in current thinking about marine protected areas. However, it is important not to abandon the concept of setting aside certain carefully selected areas where "use" of any kind is prohibited (with the possible exception of research). Although such designations will elicit local opposition for obvious reasons, the nature and severity of such opposition may depend on how the rationales for, and benefits of, designation are portrayed and explained from the outset. For example, the possibility that high production in a no-take area can replenish exploited populations of fish in surrounding areas could blunt at least some of the opposition to an off-limits approach, selectively applied. The objectives and reasons for establishing a protected area need to be explicitly stated as early in the designation process as possible. Ideally, these should be developed in consultation with resource users and others who have a realized or potential stake in the outcome.

Setting Boundaries for Marine Protected Areas

It has been recognized for some time that the boundaries of protected areas in the open sea might need to be fluid so that they follow the shifting spatial distribution of nutrients, organisms, and water masses (e.g., Salm and Clark 1984:153; Agardy 1994, 1997). While protected areas centered on coral reefs are generally amenable to fixed boundaries (Laist 1986), those intended to protect or manage temperate open-ocean systems may be less so, particularly when

the focal species of concern are as mobile and adaptable as some species of marine mammals. For example, there is clear evidence that the feeding distributions of cetacean populations can undergo major shifts, apparently related to variability in prey densities (Kenney et al. 1996) or oceanographic conditions (Forney 1999). The natural (and man-influenced) variability in distribution of mid-water resources on which so many marine mammals depend creates a formidable challenge to sanctuary design. There is also evidence, however, suggesting that cetacean distributions in some areas are "better defined by fixed features of the physical environment [i.e., depth in this instance] than by variable aspects of environment [e.g., sea surface temperature and month]" (Hooker et al. 1999:600; also see Selzer and Payne 1988; Baumgartner 1997).

Optimal design of a protected area intended to conserve a population would encompass that population's entire year-round distribution. While it may be possible to accomplish such a design for some resident or non-migratory species, the ranges of most marine mammal populations are too large for this to be practicable. When only a portion of a population's range can be included within a protected area, it is crucial to understand source-sink dynamics for that population. If the population's demographic rates are habitat-specific, it would be more important to protect some types of habitat than others (Pulliam 1988). There is obvious merit in selecting and designing protected areas on the basis of key breeding or feeding areas (see Kelleher et al. 1995, Vol. I:8). In practice, a number of protected beach areas exist to benefit land-breeding pinniped populations, and some of these extend to adjacent offshore waters. Such areas can be thought of as "source areas" for the pinniped populations. Similarly, polar bear (*Ursus maritimus*) denning habitat on land is relatively easy to delineate, and protection of such habitat is an efficient way of contributing to the conservation of this species (Prestrud and Stirling 1994). The gray whale (*Eschrichtius robustus*) refuges in Baja California, Mexico, and the humpback whale (*Megaptera novaeangliae*) sanctuary in Hawaii are examples of protected areas explicitly established to protect whale breeding grounds (see later).

There is danger that the relative ease of identifying and managing reproductively significant areas for marine mammals will detract from the equally crucial problem of protecting areas that are essential to the populations for other reasons. Animals need access to adequate food resources, and this can present enormous challenges to protected area design, especially for marine mammals that depend on pelagic food webs. A novel approach to the protection of pelagic systems is presented by Hyrenbach et al. (2000), who identify three types of open-ocean "hotspots," defined according to their dynamics and predictability in space and time. *Static systems* determined by topographic features, such as reefs, shelf breaks, submarine canyons, seamounts, and the lee shores of islands, are the easiest to define and manage. They are relatively stable, persistent hotspots that can be mapped. *Persistent hydrographic features*, such as currents and frontal systems, are more challenging because they are not stationary. Thus, they require either that a very large area be placed under protection, or that the boundaries be flexible. In the latter case, the boundaries would be determined by associations between species distributions and ocean properties, such as surface temperature or chlorophyll concentration, which can be monitored remotely. Zoning would be essential because aggregations of pelagic vertebrates often occur hundreds of kilometers "downstream" of the core areas of upwelling and high chlorophyll concentration, and these would need to be contained within buffer zones. Finally, and even more challenging, *ephemeral habitats* shaped by wind- or current-driven upwelling, eddies, and filaments constitute the third category of foraging hotspot. These more transient habitats probably require a protected area design based on real-time monitoring of ocean conditions using remote-sensing technology.

Although I am unaware of concrete examples in which either persistent hydrographic features or ephemeral habitats have been used to define the "fluid" boundaries of a marine protected area, consideration has been given recently to the idea of establishing temporary whale management zones around concentrations of feeding right whales (*Eubalaena glacialis*) off the east coast of North America. The timing and locality of high-density zooplankton patches that attract right whales are variable (e.g., Murison 1986; Murison and Gaskin 1989; Mayo and Marx 1990; Mayo and Goldman 1992; Wishner et al. 1995; Kenney et al. 1995). The idea would be to locate whale aggregations (through systematic surveys) and establish management zones within which, for example, fishing gear must be removed from the water and vessel traffic is either slowed down or re-routed.

Prestrud and Stirling (1994) point out that the 1973 International Agreement for the Conservation of Polar Bears and their Habitat specifically requires signatory nations to "take appropriate action to protect the ecosystem of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns." While a large proportion of the denning habitat used by polar bears is inside protected areas, their feeding sites and migration routes occur primarily in the dynamic offshore sea ice, which "does not fit into conventional thinking about protected areas" (Prestrud and Stirling 1994). Thus, designing protected areas to meet the ecological needs of polar bears has some of the same challenges as those outlined by Hyrenbach et al. (2000) for pelagic cetaceans and pinnipeds.

Options for Management

Kelleher and Kenchington (1993) describe two models for the structure of a marine protected area (also see Attwood et al. 1997; Salm and Clark 2000). One involves a general policy of regulating human activities "supplemented by the provision of special protection for comparatively small areas." The other involves creation of a single large protected area "with levels of protection varying within it according to a zoning plan." There are many examples of the former and few of the latter. The Great Barrier Reef Marine Park in Australia, established by the 1975 Great Barrier Reef Marine Park Act, is one of the largest (350,000km^2), and perhaps the most complexly managed protected area in the world (e.g., Tanzer 1998). Although the entire park is closed to petroleum exploration and development, and to spearfishing with scuba equipment, most other kinds of commercial or recreational activity are allowed in one or more zones within the park. About 4.5% of the park is closed to fishing and a quarter of it is closed to bottom trawling. Throughout the rest of the park, fishing is regulated through permits and zoning. Marine mammals, particularly the dugong (*Dugong dugon*), are among the species protected by the park's management regime (Baldwin 1985). A series of sanctuaries have been established along the Queensland coast where gillnets are either banned or restricted to reduce the bycatch of dugongs as well as turtles and small cetaceans (Tanzer 1998).

Zoning, even when it consists of no more than establishing core and buffer zones, is widely viewed as an optimal way of designing protected areas. It is essential for accommodating multiple uses of resources, resolving user conflicts, and achieving multiple objectives. Also, the core-buffer concept provides a way of dealing with the geo-graphic "uncoupling" of foraging habitats and prey aggregations from the physical forcing mechanisms responsible for water-column mixing and elevated production (Hyrenbach et al. 2000). Biosphere Reserves, which are supposed to serve the interests of both human (economic) development and conservation (see later), are required to have at least a core area of maximal protection and one or more buffer zones with less stringent restrictions on human activity. Many also have a transition zone with minimal management.

The concept of adaptive management has become central to modern thinking about marine protected areas. Agardy (1994, 1997) cites two conditions as necessary for resource management to be adaptive – first, that there be a "feedback loop" between science and management, and second, that there be a framework for "experimental manipulation" so that the effectiveness of tried management measures can be evaluated. Equally key to modern marine protected area management is the provision of mechanisms for community consultation and participation. Conflicts among interest groups are inevitable. Therefore, if a protected area is to be viewed by local people as legitimate and its long-term effectiveness assured, negotiation and compromise are necessary elements of decision-making, and provision needs to be made for participation by the people whose lives are directly connected to the area and its resources (Kelleher and Kenchington 1993; Beaumont 1997).

Need for Integration and Coordination

The terms "integration" and "coordination" are invoked repeatedly in the literature on marine protected areas, and with good reason. A fundamental feature of such areas, particularly those that abut a continental or island shoreline (which most of them do), is the coupling between wet and dry environments (Dixon et al. 1993; Agardy 1997). Land use in the coastal zone plays a critical role in determining the near-shore marine conditions "downstream." Therefore, without integrated coastal zone management to limit shore-based pollution and land degradation, investment in a coastal marine protected area may be ill-advised. "The high degree of linkage between marine environments and between the land and the sea imposes an urgent need for the integration of protected area management and overall conservation strategy in the coastal zone" (Kelleher et al. 1995, Vol I:4). Although coastal zone management cannot eliminate the effects of non-point-source pollution (e.g., by atmospheric transport) on a protected area, it can at least reduce the severity of aggregate human impacts.

In general, near-shore marine areas and marine resources are publicly owned and managed by state and federal governments, in contrast to land and land-based resources that often fall under proprietary ownership. Thus, designations in the marine environment often do not have the land-based conflicts and acquisition costs arising from private land ownership. However, they must instead contend with longstanding principles such as freedom of navigation and perceived public rights to exploit fish or other marine resources.

Split or mixed jurisdiction is a problem endemic to virtually every marine protected area. Duffus and Dearden (1993a), for example, point out that in Canada, the federal government has the power to deal with navigation, fisheries, and "general law-making" within the 3n.mi. territorial zone, but provincial governments have jurisdiction over living and non-living resources in the coastal zone. Within each of these levels of government, different agencies often have responsibility for different resources and different types of human activity in or near a given protected area. As a result, the Canadian Parks Service, for example, must negotiate and coordinate with numerous groups in order to establish, develop, and manage an area. Typically, in Canada and elsewhere, the park agency's mandate comes into conflict with that of the fishery management agency (in this case the federal Department of Fisheries and Oceans), and the latter is in a stronger position because of its traditional involvement with the marine environment and the fishing industry. The need for integration thus applies both to the ecological dimension of recognizing land-sea and ecosystem interactions and to the bureaucratic dimension of recognizing overlapping management authority.

In the United States, balancing the interests and authorities of the federal government with those of state governments is a major challenge. One of the greatest difficulties facing the National Marine Sanctuary program is that of reconciling the National Marine Fisheries Service's mandate to manage fisheries with the sanctuary program's

requirement to protect living resources within sanctuary waters (Weber 1997; Center for the Economy and the Environment 1999; see later). This will require that the sanctuary authorities carve out their own mandate from existing programs (one of which is fisheries) and coordinate among the relevant state and federal agencies. National parks with marine components and state marine managed areas face similar challenges, involving not only the federal fishery agency but also state fish and game departments with jurisdiction over fishing in near-shore waters (e.g., McArdle 1997; Resources Agency of California 2000). Kelleher (1998) regards the competition between government agencies responsible for fishery management and those responsible for environmental protection as "perhaps the greatest inhibition to progress in achieving successful MPA (or ICM) [marine protected area (or integrated coastal management)] establishment and management."

Protected Area Networks

Hockey and Branch (1997) point out that most marine protected areas in South Africa have been created "because of *ad hoc* local pressure," and thus the patchwork of sanctuaries, parks, and reserves has little coherence. The situation has been similar in many, perhaps most, other parts of the world despite the recognition that site selection should be systematic and rigorous. The idea of establishing a network of representative (or thematic) marine protected areas was adopted and promoted by IUCN in 1988 (Kelleher and Kenchington 1992), and similar reasoning has been applied at the national level in some countries (e.g., Canada: Duffus and Dearden 1993a; Australia: Agardy 1997) and at the state or provincial level in California (Resources Agency of California 2000) and British Columbia (Zacharias and Howes 1998). This is a form of gap analysis. Once biogeographic regions and zones are identified, it becomes possible to set priorities according to which of them are and are not included within the existing array of protected areas. Despite its beguiling simplicity, however, the representativeness approach will not necessarily ensure that areas critical to ecological processes and the species they support (including marine mammals) are conserved. Faced with an array of options for covering each "habitat type," decision-makers are likely to begin by selecting those that are the least controversial rather than those that are most at risk or that support the species of greatest concern. A similar danger exists in using fixed percentage targets for placing areas under protection (e.g., aiming to set aside 20% of the nation's total reef area in no-take reserves). Inevitably, and understandably, there will be a tendency to avoid those situations where resource-use conflicts are most difficult to resolve and where serious habitat degradation is already occurring.

There is an important distinction between a network of protected areas representing different ecosystems, geological or ecological phenomena, and species complexes on one hand, and a *connected* network of protected areas that can be thought of as a single large meta-park or meta-protected area on the other. The Great Barrier Reef Marine Park can be thought of as a network unto itself, but few other entities under a single management umbrella are comparably large-scale and complex.

Several examples exist of protected area networks that have become, or are on their way to becoming, unified systems providing population-level protection to marine mammals and other organisms. The coherence and continuity of these networks, however, derive from their near-shore, essentially linear conformation. The trilateral Wadden Sea Conservation Area in western Europe, for example, consists of "an almost unbroken stretch of nature reserves and national parks" in the southeastern part of the North Sea (Enemark et al. 1998). Denmark, Germany, and The Netherlands have held a series of intergovernmental conferences and established a Common Wadden Sea Secretariat to facilitate cooperation and coordination in managing the network. Harbor seals (*Phoca vitulina*) are among the species benefitting from the conservation area,

which encompasses more than two-thirds of the total Wadden Sea area.

Another example is a series of protected areas along the west coast of Florida, deliberately planned with the goal of providing comprehensive protection to the habitat of the regional manatee (*Trichechus manatus*) population. In 1984, the Marine Mammal Commission produced a plan to link several National Wildlife Refuges; manatee sanctuaries (small areas with seasonal prohibitions on all waterborne activities created under the authority of the Endangered Species Act and Marine Mammal Protection Act); designated "critical habitat" areas for manatees under section 7 of the Endangered Species Act; and Florida state parks, aquatic preserves, boat speed zones, outstanding water areas, wildlife management areas, and state land acquisition projects (purchases under the Conservation and Recreation Lands [CARL] Trust Fund) (Marine Mammal Commission 1984). Once completed, this network would limit coastal development in and near the core of the regional manatee population's range, while enhancing the effectiveness of boat speed regulations and the general ban on the "taking" of manatees. A more expansive "string of pearls" network of manatee refuges and sanctuaries is currently being considered by the Fish and Wildlife Service for other parts of Florida (D. Laist, pers. comm., 2000).

The potential benefits (and dangers) of using "conservation corridors" to allow faunal exchanges between protected areas have long been recognized by terrestrial ecologists, but until recently there has been little consideration of applying this approach to marine protected areas (see Harris et al. 1996). Among the obvious potential benefits of corridors are that they counteract the effects of habitat fragmentation and reduce the threats of inbreeding depression and demographic stochasticity to insular populations. Potential dangers are that they can facilitate the spread of pathogens, toxic substances, and invasive species; expose migrants to predation; and consume financial and other resources that might be better invested in more effective protection strategies (Simberloff and Cox 1987). The utility of a corridor will depend, among other things, on the species of concern, whether that species is likely to use it, and the size, composition, and condition of the populations being linked. Corridors in the marine environment, and particularly in the pelagic realm (Hyrenbach et al. 2000), may be intrinsically more difficult to design and manage than corridors linking land or freshwater protected areas. In a recent paper, Agardy and Engdahl (in press) acknowledge that marine corridors may not be strictly analogous to terrestrial ones. They nevertheless propose that conservation policies, based on integrated coastal planning, can serve as "virtual corridors" linking networks of protected sites (marine and terrestrial). As explained by one of the authors (T. Agardy, pers. comm., 2000), the idea is that the protected areas within a network should target critical habitat associated with the sea floor (e.g., reefs, sea mounts, seagrass beds, coves, intertidal areas) while the "corridor" linking them is policy that prevents the water column from being degraded.

Taxonomic Review

Protected areas have been used more often and more regularly with some groups of marine mammals than with others. For example, there are relatively many such areas that either were established specifically to protect New World manatees or that happen to protect these manatees and their habitat as an incidental benefit. In contrast, there are relatively few areas designated for the highly migratory cetaceans, and almost no offshore areas (feeding grounds or migratory routes) for pinnipeds. Special protection to pinniped haul-out beaches, however, is relatively common.

Also, there has been a tendency to create protected areas for threatened species, such as the vaquita (*Phocoena sinus*), monk seals (*Monachus* spp.), manatees, baleen whales, and river dolphins. This is not necessarily a bad thing. In fact, species protection can be seen "as a starting point for establishing a more comprehensive and ecologically realistic system of management" (Agardy 1994). Even though the protection initially provided to a "flagship species" (see Simberloff 1998) itself is often minimal, the public profile given to an area by some kind of special designation can be used to attract public and private funds, encourage research, and create needed infrastructure (for example, see discussion of El Vizcaino Biosphere Reserve, Mexico, below). At the same time, there is always a danger that the creation of a marine protected area will lead to complacency, that designation will be viewed as the end, rather than the beginning, of the conservation process. Also, site selection based on the appeal of particularly charismatic species may result in neglect toward less favored, but perhaps more threatened, species. Zacharias and Howes (1998) cite the example of British Columbia, where they suggest that certain habitat features are over-represented in protected areas owing to the popularity of killer whales (*Orcinus orca*) and sea otters, while depleted populations of invertebrates (clams, oysters, abalones, and sea cucumbers) have only "minimal" protection.

Nations with jurisdiction over beach and near-shore areas inhabited by the highly endangered Mediterranean monk seal (*Monachus monachus*) have been under considerable pressure to declare protected areas and introduce appropriate management measures for that species. The aggregate monk seal population, thought to number only a few hundred individuals, is fragmented, apparently with little or no movement and mixing between pockets of relative abundance. Protected areas for Mediterranean monk seals have a mixed record. At least three of them – National Marine Park of the Northern Sporades in Greece, the Desertas Islands Natural Reserve of Madeira, and Foça Specially Protected Area in Turkey – seem to have been successful in reducing seal mortality and allowing the local groups of seals to maintain their numbers and perhaps even increase somewhat (Neves and Pires 1998; various news items in *The Monachus Guardian*, available at http://www.monachus.org). The patchwork of protected areas for the Mediterranean monk seal contrasts with the situation for the endangered but somewhat more abundant Hawaiian monk seal (*Monachus schauinslandi*). Virtually the entire haul-out range of the Hawaiian species falls within the jurisdiction of the U.S. Fish and Wildlife Service's National Wildlife Refuge system (Lavigne 1999). For both species, however, fishing in waters adjacent to the protected haul-out sites constitutes a serious and ongoing threat in the form of entanglement in actively fished or discarded fishing gear, and possibly habitat disturbance and competition for prey (cf. Ragen and Lavigne 1999). Thus far, these conflicts have been addressed in Hawaii via a combination of "critical habitat" designation under the Endangered Species Act and fishery regulations enacted by the National Marine Fisheries Service (Lavigne 1999). In the Mediterranean and off northwestern Africa,

little progress of any kind has been made to protect the seals themselves while they are at sea or to reduce disturbance of their foraging habitat.

Species-focused protected areas for cetaceans in Mexico are discussed below under Biosphere Reserves. Particular concern about the endemic Hector's dolphin (*Cephalorhynchus hectori*) led to establishment of the Banks Peninsula Marine Mammal Sanctuary in 1988 under New Zealand's 1978 Marine Mammal Protection Act (Dawson and Slooten 1993). The 1170km^2 sanctuary consists of a 4n.mi.-wide band around the peninsula. Commercial gillnetting is prohibited year-round, and "amateur" (or recreational) gillnetting is prohibited during the four months of summer (November-February). Effectiveness of the sanctuary has been assessed from bycatch monitoring and from abundance surveys since 1988 (Department of Conservation 1992). The bycatch of dolphins is reported to have declined substantially, whereas the statistical power of the abundance surveys has been too low to allow a reliable evaluation of trend (Department of Conservation/Ministry of Agriculture and Fisheries 1994).

Geographical Review

It is far beyond the scope of this study to document, much less evaluate, the many protected areas around the world that ostensibly benefit marine mammals. A few examples are discussed in this section, and a few others are listed in Table 1 and described in Appendix 1. It is important to emphasize that the mere existence of a "protected" area does not ensure that any meaningful protection is provided. As Kelleher and Kenchington (1993:49) point out, "The world is littered with paper parks."

The Republic of South Africa is known for its extensive array of marine protected areas, many of which include marine mammal habitat. In South Africa, as in the United States, cetaceans and pinnipeds are fully protected from deliberate taking (under the Sea Fishery Act and the Seabirds and Seals Protection Act), so to some extent the protection from hunting provided in reserves, parks, and other protected areas is redundant. A recent review indicated that more than 20 South African marine protected areas are visited at least seasonally by southern right whales (*Eubalaena australis*), 13 by humpback whales, 12 by Indo-Pacific hump-backed dolphins (*Sousa chinensis*), 2 by Heaviside's dolphins (*Cephalorhynchus heavisidii*), 15 by common dolphins (*Delphinus* sp.), 2 by dusky dolphins (*Lagenorhynchus obscurus*), 19 by bottlenose dolphins (*Tursiops* sp.), and 12 by Cape fur seals (*Arctocephalus pusillus pusillus*) (Attwood et al. 1997). These numbers include West Coast and Tsitsikamma National Parks but not Wilderness National Park, which encompasses 28km of Indian Ocean shoreline inhabited by bottlenose and hump-backed dolphins (Cockcroft and Joyce 1998). They also do not include the 600km-long Skeleton Coast Park in Namibia, which contains Cape Cross Seal Reserve (Cockcroft and Joyce 1998). Whale-watching, centered on the right whales that come inshore during the winter calving season, has been avidly promoted in South Africa since the mid-1990s (Findlay 1998; Cockcroft and Joyce 1998). Most of the watching is from shore vantage points, often along managed trail networks within coastal nature reserves or parks. The Walker Bay (Hermanus) and De Hoop Marine Reserves, in particular, are advertised for their exceptional whale-watching opportunities. These reserves extend only 5km offshore, and thus provide no more than local protection to the marine habitat of mammals. Karczmarski (2000) advocates the creation of multi-use management areas with controlled nature tourism, in combination with strict reserves in a few critical areas, as a strategy for protecting hump-backed dolphins in South Africa. Seals in the region probably derive some benefit from the fact that beach areas where they rest, breed, and nurse their young are protected, for example at Robberg and Mossel Bay's Seal Island.

On the west coast of Africa, there are few marine protected areas that might benefit marine mammals. Senegal has been a regional leader in providing genuine protection to its national parks,

and two of them are relevant to marine mammal conservation. Parc National des Oiseaux du Djoudj and Parc National du Delta du Saloum both contain habitat for African manatees (*Trichechus senegalensis*), and the latter also includes waters inhabited by Atlantic hump-backed dolphins (*Sousa teuszi*) (K. Van Waerebeek, pers. comm., 17 December 1999). Two national parks in The Gambia include manatee and dolphin habitat: Niumi has hump-backed dolphins and Kiang West has bottlenose dolphins (*Ibid.*). Although enforcement of protective regulations within these parks is far from complete, at least the habitat has been less degraded than it otherwise would have been without the efforts of park management (*Ibid.*).

In the Mediterranean Sea region, the most important existing marine protected areas (from the narrow perspective of concern about marine mammals) are those centered on monk seals (see above) as well as the new cetacean sanctuary (Appendix 1). In addition, there are a number of sites in Denmark, France, The Netherlands, and the United Kingdom that include protection of haul-out areas for harbor seals and gray seals (*Halichoerus grypus*) (Gubbay 1995). Special sanctuaries exist for cetaceans in Ireland and the German Wadden Sea (Appendix 1). In the Mediterranean and elsewhere in Europe, a European Union initiative (Directive 92/43) has prompted governments to establish *Natura 2000* reserves – protected areas intended to preserve endangered species and habitats. Thus, "Special Areas of Conservation" are, or soon will be, designated for bottlenose dolphins in the Shannon Estuary (Ireland) and in Cardigan Bay and Moray Firth (UK) (E. Rogan, pers. comm., 16 April 2000).

There is no shortage of marine and coastal protected areas in the central and western Indian Ocean, many of which claim the dugong to be among their resident fauna (see Wells et al. 1995; Gaudian et al. 1995). An Indian national park and several Bangladeshi protected areas in the Sundarbans potentially benefit river dolphins (both *Platanista* and *Orcaella*). Most marine protected areas in southeast Asia are intended to protect sea turtle nesting sites, mangrove forests, and coral reefs (Bleakley and Wells 1995), but some may provide incidental benefits to marine mammals.

Arctic protected areas in Canada, Greenland, and Svalbard are mentioned elsewhere in this report (see following text and Appendix 1).

In South America, marine mammals (including the freshwater Amazon manatee, *Trichechus inunguis*, and the two freshwater dolphins, *Inia geoffrensis* and *Sotalia fluviatilis*) occur in numerous national parks and reserves (e.g., Capozzo and Junín 1991; Flórez et al. 1992; Reyes 1992).

Australia has several marine protected areas, besides the Great Barrier Reef Marine Park, intended explicitly to conserve marine mammals. One of the most prominent is the Great Australian Bight Marine National Park, which includes a Whale Sanctuary in the Head of the Bight intended to provide strict protection to an area used by southern right whales during their calving and early nursing season and by Australian sea lions for feeding. Another example is Macquarie Island, a Tasmanian National Park and Wildlife Sanctuary for many years, designated a UNESCO Biosphere Reserve in 1977, and inscribed on the World Heritage list in 1997. The Australian federal government recently announced its intention to establish a large marine park (16 million hectares) along the east coast of Macquarie, principally for the conservation of seals, penguins, and albatrosses. More than a third of the park is to consist of a no-take zone where both fishing and mining are completely prohibited. Three otariids (New Zealand, Antarctic, and subantarctic fur seals; *Arctocephalus forsteri*, *A. gazella*, and *A. tropicalis*, respectively) and the southern elephant seal (*Mirounga leonina*) breed on the island. Although the otariid breeding population on Macquarie is small relative to the total populations of the three species, it is estimated that one seventh of the world population of southern elephant seals haul out there in spring and summer (information from the World Wide Web).

Although not addressed in detail here, the Antarctic has a large and complex array of protected areas established under the Antarctic Treaty system (Berkman 1992; Kimball 1999). As mentioned earlier, the entire marine region fits the IUCN definition of a marine protected area, with zoning on a mega-scale. A number of relatively small areas within the Antarctic, classified as Specially Protected Areas or Sites of Special Scientific Interest, are relevant to pinniped conservation (ADADEST and Dingwall 1995). The 1972 Convention for the Conservation of Antarctic Seals designates three ocean areas as seal reserves, with a combined area of 190,000km^2 (ADADEST and Dingwall 1995). Furthermore, the International Whaling Commission's Southern Ocean Sanctuary provides another layer of protection for the commercially valuable baleen whales and the sperm whale (*Physeter macrocephalus*) (Appendix 1).

Economic Benefits

In numerous studies, the principal economic benefits of marine protected areas have been defined in terms of fishery enhancement (Bohnsack 1996, Hastings and Botsford 1999) or increased tourism, particularly in relation to diving on coral reefs (Dixon et al. 1993, Dixon 1993). Except for no-take reserves, it is common for marine protected areas to allow consumptive uses of at least some resources, but rarely marine mammals. The most common form of use of marine mammals within protected areas is tourism, with obvious direct economic benefits in the form of revenues derived from activities such as whale-, dolphin-, sea otter-, seal-, and manatee-watching. Tens of thousands of people visit the Crystal River National Wildlife Refuge in Florida each year to view and dive with wild manatees in Kings Bay. According to information on the web site, Great Outdoor Recreation Pages, this attraction is estimated to represent an annual local economic benefit of $7 million (www.gorp.com). Development of whale- and dolphin-watching has generally proceeded independently of protected area designations although there has certainly been some degree of connection in some cases (e.g., Stellwagen Bank National Marine Sanctuary, Hawaiian Islands Humpback Whale National Marine Sanctuary, Pacific Rim National Park and Reserve, Glacier Bay National Park and Preserve). As part of the ongoing negotiations over protection vs. use within a designated area, it is sometimes possible to argue that enhanced revenues from non- or low-consumptive tourism help to compensate for lost income from foregone extractive activities (e.g., commercial fishing).

The relatively sedentary behavior of sea otters and some pinnipeds (seasonally) and their close association with land have sometimes made it possible to link the development of shoreline-centered protected areas with the economic benefits of marine mammal-focused "ecotourism." For example, Seal Bay Conservation Park and Point Labatt Conservation Park, both in South Australia, are visited by some 70,000 and 30,000 people, respectively, each year (Robinson and Dennis 1988). Año Nuevo State Park in California is visited annually by 250,000 people, primarily to view northern elephant seals (*Mirounga angustirostris*) (S. Allen, pers. comm., 9 May 2000). These areas are managed intensively to protect their natural landscapes and the colonies of sea lions and seals that serve as the main attractions for tourists. The trade-off between economic and ecological goals (Dixon 1993) seems to have been taken into account in these examples. Visitation is managed to minimize disturbance to the animals, ensure visitor safety, and preserve the ecological integrity of the beach areas.

It is of interest that in at least one instance – Robson Bight Ecological Reserve in British Columbia, Canada, declared in 1982 (Hoyt 1990) – the *exclusion* of whale-watching has been touted as one of the protected area's regulatory benefits to the whales (Phillips 1996). More broadly, it has been suggested that marine sanctuaries might use the promotion *and regulation* of marine mammal-oriented tourism as a major rationale for their existence (e.g., Center for the Economy and the Environment 1999).

Breiðafjörður Conservation Area in West Iceland, established in 1995, provides an exceptional example of a marine protected area in which both nature tourism and "sustainable use" through hunting of marine mammals co-exist. Seal hunting and whale-watching are encouraged, the former as a traditional activity and the latter as a new development (Petersen et al. 1998).

Conservation Benefits for Marine Mammals

It is often difficult to demonstrate and quantify the conservation benefits of a particular management measure, especially for animals as cryptic and dispersed as marine mammals. Reynolds and Gluckman (1988) cited evidence indicating that manatees, like some game birds and ungulates, recognize and make preferential use of areas that are relatively "safe" from harmful human activities. These authors considered the large and rapid increases in manatee numbers in protected waters around Crystal River, Blue Springs Run, the Port Everglades power plant, and the Kennedy Space Center as showing that "sanctuaries and refuges" can be effective tools for manatee conservation. For many marine mammal species, however, detecting trends is difficult and costly (Taylor and Gerrodette 1993). Moreover, even when a population increase is documented, the cause may be uncertain. In other words, it can be difficult to prove that a protected area, rather than some other natural or human-influenced variable, was responsible. Although it should be relatively easy to evaluate the effectiveness of measures intended to reduce bycatch mortality, such as the gillnet restrictions in the Banks Peninsula sanctuary (see above), this, too, requires a substantial and long-term commitment of resources.

The potential benefits to marine mammals of effective fishery management policies are huge, including (a) reduced bycatch of the mammals themselves as a result of gear restrictions and effort limits; (b) increased amount and diversity of prey as a result of reduced fishing pressure, reduced fish bycatch, and habitat protection; and (c) reduced disturbance to pinniped pupping areas caused by commercial fishing operations. For this reason, sound management of fisheries is almost always in the overall long-term best interests of marine mammals. Thus, marine protected areas that are intended to protect fish brood stocks, enhance fish production, and prevent the degradation of fish habitat can usually be regarded as contributing, at least indirectly, to marine mammal conservation. The obverse applies all too often, however. That is, either because of strong resistance to increased fishery regulation or because of jurisdictional conflicts between agencies, many marine protected areas have no authority to manage fisheries. As a result, the conservation benefits for fish and marine mammals fall well short of the expectations of those who supported the area's protected designation.

It is instructive to consider the example of British Columbia, where more than 4% of the "non-abyssal" marine environment (i.e., that portion inshore of the 1000m contour) is included within nominally protected areas, giving the Canadian province "one of the most protected marine environments in the world" (Zacharias and Howes 1998). Only two small areas are entirely closed to fishing – one a provincial park and the other a municipal park. Moreover, if one uses a fairly strict definition of "protection," such as one requiring that bottom trawling, dumping, dredging, and non-renewable resource development are all prohibited, the total marine area under protection in British Columbia dwindles from 5253km^2 to only 214km^2 (*Ibid.*).

Two other types of benefit deserve mention here. First, protected area designations can encourage and provide new funding for research. In some instances, designations come with new, albeit limited, funding opportunities. In others, existing funding sources are more willing to support research to assist in defining and helping manage resources in a designated protected area simply because of the official acknowledgment of the resources' importance. The new information gained from the research can then be used to argue for or justify the need for stronger management.

Second, designations often come with new staff to speak on behalf of resource-protection needs in decision-making processes. Even when a designation does not come with new staff, the individuals assigned responsibility for the area are in a stronger position to push for protection of resources recognized as especially important by virtue of the designation.

Conservation Benefits for Other Species

It is equally useful to consider the extent to which a marine protected area established to benefit a marine mammal species, or a group of marine mammal species, can provide ancillary benefits for other organisms and indeed for entire ecosystems. Advocates of protected areas centered on favored (i.e., especially charismatic) organisms typically invoke the belief that such species can function as "flagships" or "umbrellas" and thus serve as guarantors of broad-scale conservation. A flagship species is one that has become "a symbol and leading element of an entire ecosystem conservation campaign"; an umbrella species, one "with such demanding habitat requirements and large area requirements that saving it will automatically save many other species" (Simberloff 1998). A third concept, that of the "keystone species," has sometimes been used to justify single-species conservation efforts in the belief, or in some cases certain knowledge, that particular species influence their communities or ecosystems in ways that are disproportionately large relative to their abundance (Power et al. 1996). Whales, dolphins, sea otters, and manatees are unquestionably good flagship species, as they readily attract funding and other forms of support to almost any conservation initiative. It is therefore not surprising that materials publicizing the Gray's Reef and Stellwagen Bank National Marine Sanctuaries highlight the fact that right whales occur there, even though the original sanctuary designations had little to do with conserving right whales (see below). The network of protected areas for manatees along the west coast of Florida, mentioned earlier, was justified, in part, by the expectation that it would contribute not only to the long-term protection of manatee habitat, but also to "the conservation of many other species of wildlife indigenous to that coastal region" (Twiss 1985; also Anonymous 1985). Implicit in this expectation was the belief that the Florida manatee would function as an umbrella species. Similarly, Perrin and Brownell (1989) claimed that preserving river dolphins in their natural habitat would help preserve "a good portion of the species diversity of the ecosystem." Finally, the sea otter has long been put forth as a classic example of a keystone species (Estes and Palmisano 1974). However, any consequent interest in establishing protected areas for sea otters has been offset by the antipathy of fishermen, who view the otters mainly as competitors for shellfish rather than as keystone contributors to community or ecosystem integrity (see VanBlaricom and Estes 1988).

Claims of flagship, umbrella, or keystone status for marine mammals need to be judged critically. Consider, for example, the question of whether protecting river dolphins can automatically be expected to benefit other species. Prohibitions against the deliberate taking of favored species do not, by themselves, offer anything of consequence to other species or the ecosystem. Thus, "umbrella" effects cannot be expected from simply designating a "sanctuary" for dolphins (or manatees) and trying to prevent poaching there. Broader measures are necessary. For example, river dolphins in the South Asian subcontinent are under severe pressure from incidental capture in fishing gear, especially the widely used plastic monofilament gillnets that also threaten many other forms of aquatic life. Because unselective fishing methods are wasteful almost by definition, their elimination will often be beneficial to humans as well as to wildlife. Using dolphin bycatch as leverage to achieve meaningful regulation of fishing activities should benefit other non-target wildlife species that are subject to entanglement (e.g., turtles, snakes, crocodilians, otters, and some fishes; see Smith et al. 1996). Smith et al. (1998) argue that "aquatic biodiversity sanctuaries" created by banning fishing in deep pool areas with eddy countercurrents can protect both dolphins and the broodstocks of

commercially valuable fish. Whether one regards the fish or the dolphins as the "umbrellas" becomes a semantic issue; what is important is that both groups benefit.

Deciding whether a taxon or taxonomic group deserves the keystone label depends on a solid understanding of its ecological significance, which itself may depend as much on the context or the circumstances as on species traits (Power et al. 1996). In considering the ecological roles of marine mammals, Bowen (1997) found less than a handful of good examples of possible keystone species in addition to the sea otter. Gray whales exert strong influence on benthic communities that they exploit for food, and dugongs help shape the seagrass communities on which they graze. Power et al. (1996) cite the role of baleen whales as krill consumers in the Antarctic (May et al. 1979), making them an example of what can be thought of as a "keystone guild." In principle, protected areas centered on keystone species offer an efficient way of achieving community- or ecosystem-level conservation. However, the required standard of knowledge about ecological relationships and processes is high, and any initiative built on the keystone-species argument must be carefully considered.

Although no attempt is made here to address the related and controversial issue of "indicator species" (Landres et al. 1988), it is of interest that the U.S. National Park Service uses pinniped species for monitoring the "health" of coastal ecosystems. The presence of pinnipeds is defined as a "vital sign" indicating ecosystem function and condition (S. Allen, pers. comm., 9 May 2000). Simberloff's (1998) concept of *faute de mieux* may apply in this instance. He argues that "charismatic" vertebrate species are often chosen as indicators simply because the manager "feels obliged to monitor them anyway and nourishes the vague hope that [they] will fortuitously reflect the health of the entire system." A judgment as to whether pinnipeds are good indicator species must await the results of field research designed to address this question explicitly.

Marine Mammals and Protected Areas in North America: Selected Case Studies

The Broader United States Context

Systems and programs of natural area protection within the United States have been established by states, counties, municipalities, and private concerns (e.g., The Nature Conservancy) (see Laist and Bigford 1979), and some of these benefit marine mammals (e.g., the manatee sanctuary at Blue Springs State Park, designated in 1975, and the motorboat speed zones established under Florida's Manatee Sanctuary Act of 1978). At the federal level, again with reference only to the United States as an example, resource management policies of agencies such as the Department of Commerce, Department of Defense, U.S. Forest Service (Department of Agriculture), Department of Energy, and Bureau of Land Management (BLM, Department of the Interior) sometimes contribute to marine mammal conservation by preserving habitat, protecting or enhancing prey resources, and reducing coastal pollution. For example, the BLM's role in Outer Continental Shelf (OCS, meaning the subsoil and seabed seaward of the line of state jurisdiction) mineral leasing gives this agency the potential to provide biologically important areas with protection from industrial development, in effect creating marine protected areas. The bureau, with assistance from the U.S. Geological Survey and other agencies, can use its authority to deny requests by oil and gas companies to explore or exploit particular OCS tracts. In one instance, a tract off the coast of Georgia was withdrawn from development explicitly to preserve a patch of "live bottom habitat" (Laist and Bigford 1979:23) that

would later become Gray's Reef National Marine Sanctuary (see below).

Although the emphasis here is on the National Marine Sanctuaries Program of the Department of Commerce and the National Parks system of the Department of the Interior, other legislative instruments and programs play, or could play, an important role in protecting marine mammals and their habitat within areas under U.S. jurisdiction. No mention is made of marine protected areas, *per se*, in the Marine Mammal Protection Act. However, section 2 states that one of the Act's goals is to protect essential habitat, including rookeries, mating grounds, and areas of similar significance (Baur et al. 1999:64). Moreover, the act includes habitat acquisition and improvement within the definitions of "conservation" and "management," and it gives the lead agencies authority (under section 112) to protect "essential habitat" via rules and regulations. To date, this authority has been used only sparingly, and usually in conjunction with other agencies and legislation. Examples include the designations of "Manatee Protection Areas" in Florida (50 CFR, Part 17) and the ship traffic control zones within Glacier Bay National Park and Preserve, Alaska, to protect humpback whales from disturbance on their feeding grounds (Baur et al. 1999:64-65; and see below). Also, in section 108 of the Marine Mammal Protection Act, the federal government is directed to encourage international or bilateral agreements to protect ocean and land areas "of special significance to the health and stability of marine mammals" (Baur et al. 1999:65). This direction provides the basis for U.S. participation in a range of protected area initiatives. Under the Endangered Species Act (sections 3 and 4), the federal government has authority to designate and give special protection to "critical habitat" of endangered and threatened species and populations; it also has authority to acquire habitat for conservation purposes (section 5) (Baur et al. 1999:69).

The National Wildlife Refuge System, administered by the U.S. Fish and Wildlife Service, provides a mechanism for the Department of the Interior to pursue its mandate to protect marine mammals and endangered species and their habitat (see Chadwick 1996). In 1997, the National Wildlife Refuge System Improvement Act explicitly affirmed that wildlife conservation is the system's mission. Several of the more than 500 National Wildlife Refuges are specifically intended to conserve important habitat for marine mammals, among them the following (from Baur et al. 1999): Arctic National Wildlife Refuge (polar bears, seals, and whales), Alaska Maritime National Wildlife Refuge (walruses, seals, sea lions, sea otters, and cetaceans), Hawaiian Islands and Midway Atoll National Wildlife Refuges (monk seals and cetaceans; also see Lavigne 1999), Seal Beach in California (seals), and Crystal River in Florida (manatees). Many others provide protection to marine mammals and their habitat as a side-benefit of their founding mandate.

National Parks and Related Sites in the United States

National parks in the United States (and Canada) are expected to accommodate and promote recreational use (enjoyment) by people, while keeping the park environments in a natural state and preserving biotic diversity within park boundaries (e.g., Sellars 1997). The Organic Act of 1916 defines the mission of National Parks as to "conserve the scenery and the natural and historic objects and the wildlife therein and provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." The Redwood National Park Act of 1988 (16 USC 79A-79Q) reaffirms that the National Park Service's mission is to protect, manage, and administer the areas under its jurisdiction "in light of the high public value and integrity" of the park system, and that it must preserve "the values and purposes for which these various areas have been designated."

Many areas managed by the National Park Service contain marine mammal habitat or at least are adjacent to waters where marine mammals occur. At a minimum, these include Acadia National Park (Maine), Biscayne National Park (Florida),

Cabrillo National Monument (California), Cape Cod National Seashore (Massachusetts), Cape Hatteras National Seashore (North Carolina), Cape Lookout National Seashore (North Carolina), Channel Islands National Park (California), Dry Tortuga National Park (Florida), Everglades National Park (Florida), Glacier Bay National Park and Preserve (Alaska), Golden Gate National Recreation Area (California), Gulf Islands National Seashore (Washington), Kalapapa National Historic Monument (Hawaii), Katmai National Park (Alaska), Kenai Fjords National Park (Alaska), Padre Islands National Seashore (Texas), Point Reyes National Seashore (California), Redwood National Park (California), San Juan Islands National Historic Park (Washington), and Virgin Islands National Park. Each of those sites has one or more special protective measures in place for marine mammals as well as a monitoring or research program directed at marine mammals, whether using in-house staff or outside contractors (S. Allen, pers. comm., 26 April 2000).

The area category within the national park system of greatest relevance to marine mammals is the network of National Seashores. These sites encompass shoreline segments and nearshore islands that remain undeveloped and relatively undisturbed. Growing human populations and expanding recreational activities increasingly threaten such areas. In 1999, President Clinton designated all western coastal islets to be monuments under the jurisdiction of the Bureau of Land Management (S. Allen, pers. comm., 9 May 2000).

Among the National Park Service's sites, none has been more directly and persistently embroiled in issues of marine mammal conservation than the Glacier Bay site in southeastern Alaska. Glacier Bay was originally designated a National Monument in 1925, with the principal goal of preserving and providing access to the scenic glacial landscape. The boundaries of the Monument were expanded in 1939, more than doubling the size of the protected area. Its status was changed to a National Park in 1980 as a result of the Alaska National Interest Lands Conservation Act. The Glacier Bay-Admiralty Island Biosphere Reserve was established in 1986 (see later), and in 1992 Glacier Bay became part of a UNESCO World Heritage Site in combination with Wrangell-Mount St. Elias National Park and Canada's Kluane National Park (again, see later). The park area is presently more than 3.2 million acres, of which somewhat less than 20% consists of marine waters. Some 2,770,000 acres are designated as wilderness, and of this, about 2% is marine waters.

There was little awareness that humpback whales used the waters of Glacier Bay until the 1970s when Jurasz and Jurasz (1979) published a description of the whales' spectacular surface "lunge feeding" and "bubblenet feeding" on clupeids and euphausiids in the bay. Already at the time of the Juraszes' study, the spectacle of feeding humpbacks had become one of the park's major tourist attractions. The vast majority of park visitors come by sea. According to 1998 visitation records, somewhat more than 405,000 people visited the park that year, and nearly 85% of them arrived on cruise ships (www.nps.gov/glba/).

When use of Glacier Bay by humpbacks declined substantially in 1978 and 1979, for reasons thought to be related to vessel disturbance, the Park Service responded by establishing temporary regulations to limit the number of cruise ships entering the bay and to manage all kinds of vessel activity. Also, a research program sponsored by the National Park Service, National Marine Fisheries Service, and Alaska cruise ship industry sought to determine with greater certainty the cause(s) of the whales' change in distribution and habitat use (e.g., Johnson 1983; Baker et al. 1982, 1983). Although it has proven difficult to demonstrate a simple, direct cause-effect link between vessel activity and fluctuations in the number of humpbacks using Glacier Bay, the Park Service, in consultation with the National Marine Fisheries Service, has continued to restrict entry and manage vessel traffic in a precautionary manner in order to reduce the potential for disturbance (see Marine Mammal Commission 1994:78-80). A vessel management plan came into

effect in 1996 after broad public consultation. It allows two cruise ships, three tour boats, six chartered vessels, and 25 private boats to enter the bay per day (www.nps.gov/glba/). In addition, motorized vessels and floatplane landings are seasonally excluded from designated wilderness waters; special protection is given to areas considered sensitive for whales, sea lions, seals, and seabirds (e.g., designated "whale waters" where vessel traffic is either prohibited or restricted – CFR 36 section 13.65); and cruise ships must adhere to pollution and noise minimization protocols while inside the bay. An ongoing research and monitoring program is in place to evaluate the effectiveness of the management plan.

Parallel with the controversy about the possible adverse effects of tour vessels on humpback whales, the Park Service was under pressure to regulate commercial fishing in the waters of Glacier Bay National Park (e.g., Marine Mammal Commission 1992:56-58). Legislation has been drafted that would restrict commercial fishing in park waters, but this legislation has yet to be passed by Congress.

Both Channel Islands National Park (established in 1980) and Point Reyes National Seashore (established in 1962) were created in part to protect and preserve marine mammals and their habitat. The two sites serve as important source areas for pinniped populations. Enabling legislation for Channel Islands National Park, the borders of which extend to 1nmi offshore (see McArdle 1997), refers specifically to protecting "the pinnipeds which breed and pup almost exclusively on the Channel Islands, including the only breeding colony for northern fur seals south of Alaska" (Sec. 201; *fide* S. Allen, pers. comm., 26 April 2000). Similarly, the enabling legislation for Point Reyes National Seashore, which encompasses marine waters within a quarter mile of shore (see McArdle 1997), makes explicit reference to protecting marine mammals. Although a major drawback at both sites is the lack of authority to manage fishing, they provide good protection to pinniped haul-out habitat. Also, recreational boating (including kayaking) is restricted in areas where pinnipeds are likely to be disturbed, and at Point Reyes jet skis are prohibited entirely. National Park Service staff are actively exploring ways to implement no-take zones within the marine waters of the two parks (S. Allen, pers. comm., 9 May 2000).

National Parks and Related Sites in Canada

As in the United States, there are several terrestrial national parks or national park reserves (parks where native land claims are unresolved) in Canada that border waters inhabited by marine mammals. These include Terra Nova in Newfoundland, Cape Breton Highlands in Nova Scotia, Forillon in Quebec, Kouchibouguac in New Brunswick, Auyuittuq in southeastern Baffin Island, and Pacific Rim at the southern end of Vancouver Island (Mondor 1985). In four of them, the park borders extend a small distance offshore (Forillon, Pacific Rim), subsume waters inside a string of barrier islands (Kouchibouguac), or incorporate fiord waters (Auyuittuq). Little active management occurs, however, in the marine components of these parks (Mondor 1985; D. Duffus, pers. comm., 25 March 2000). Commercial fishing continues in the three temperate-region parks, and "subsistence" hunting of marine mammals continues in the fiords of Auyuittuq. Nevertheless, it can probably be assumed that pinnipeds hauling out along the shores of the three temperate-region parks derive some benefit from the prohibition on shoreline development, and this benefit may offset the disturbance caused by park visitors who use the beaches for recreation. Also, some effort is made to manage human activities in Auyuittuq so as to minimize impacts on female bears in maternity dens and prevent human-bear conflicts that could lead to the killing of bears (Calvert et al. 1998).

In Canada, the national parks system is administered by the Department of Canadian Heritage, Parks Canada, which began development of a marine parks policy in 1971 (Duffus and Dearden 1993a). The long-term goal is to have a system with representation from each of 29 "marine

natural regions." Criteria for selection are to include (1) feasibility of long-term conservation of the marine environment, together with associated islands and coast; (2) potential for public understanding and enjoyment; and (3) regional economic benefit. Permanent human communities are supposed to be excluded inside park boundaries, but commercial fishing is to be allowed as long as it is well managed (Duffus and Dearden 1993a). The designation of marine national parks in Canada has been an excruciatingly slow process. Several important areas for marine mammals (e.g., the West Isles region of the lower Bay of Fundy, the Lancaster Sound region off northern Baffin Island, and Georgia Strait in southern British Columbia) have been proposed and studied extensively, only to be rejected as a result of local opposition or jurisdictional conflict (Mondor 1985; Duffus and Dearden 1993a).

Wapusk National Park, established in 1996 on the Manitoba coast of Hudson Bay, represents a potentially significant step toward conserving polar bears and their denning habitat (see Lunn et al. 1998, Calvert et al. 1998). Already in 1968 the province of Manitoba had established the Cape Tatnam and Cape Churchill Wildlife Management Areas, which provided authority to regulate human activities in key denning and summering areas (Stirling 1986). These areas provide buffer zones immediately around the national park. In addition, Ontario's large (24,000km^2) Polar Bear Provincial Park lies along the Hudson Bay coast to the south. Lunn et al. (1998) point out that the management of polar bears, particularly in regard to visitor protection, is relevant to four National Parks (Aulavik and Tuktut Nogait in the Northwest Territories, Ivvavik in the Yukon, and Wapusk), two National Park Reserves (Auyuittuq and Ellesmere Island in the Northwest Territories), and four National Historic Parks and Sites (Prince of Wales' Fort, Sloop Cove, Cape Merry Battery, and York Factory in Manitoba).

The initiative to establish the Saguenay-St. Lawrence Marine Park was driven by concern about the small population of white whales (*Delphinapterus leucas*) centered at the confluence of the Saguenay and St. Lawrence Rivers (see Lesage and Kingsley 1998). Included within the park is an area at the head of the deep, cool Laurentian Channel where densities of krill rival those found in the Antarctic (Simard and Lavoie 1999). As a result, park waters attract baleen whales (primarily blue [*Balaenoptera musculus*], fin [*B. physalus*], minke [*B. acutorostrata*], and humpback) in summer and autumn which, together with the white whales, support a profitable tourism industry.

Although a great deal of attention has been given to Robson Bight Ecological Reserve in Johnstone Strait, British Columbia, an area made famous by the "rubbing rocks" where the local "northern resident community" of killer whales congregate in the summer (Hoyt 1990; Kruse 1991; Duffus and Dearden 1993b), this attention seems far out of proportion to the size and proven significance of the designated area (Duffus and Dearden 1995). The 190 or so whales that visit the reserve do so for only a brief period of each year. As a provincial reserve (not federal as indicated by Kruse 1991), the special protection provided extends only to recreational use (i.e., whale-watching) and land use on the adjacent shoreline and in the nearby Tsitika River valley (i.e., mainly logging). It does not affect marine shipping, fishing, or the whales themselves, as these fall under federal authority. The evaluation of Robson Bight reserve by Duffus and Dearden (1995) is instructive as it could well apply to many other small marine protected areas: "... the fallacy of tokenism – that is, giving the public the appearance of protecting an important whale habitat, when neither the importance of the site to the whales, nor the veracity of the protection is established – creates a political 'success' that may mask an ecological failure."

National Marine Sanctuaries in the United States

The Marine Sanctuary Program of the National Oceanic and Atmospheric Administration (NOAA) is perceived as the centerpiece of U.S.

federal efforts to develop a marine protected area system (Chadwick 1998). The program is authorized under Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (33 USC § 1401 *et seq.*; MPRSA), and its mandate is to preserve or restore marine areas for their conservation, recreational, ecological, or esthetic values (MPRSA, section 302a). The Office of Ocean and Coastal Resource Management of the National Ocean Service administers the program. At present, 13 marine sanctuaries are designated (Table 2). Of this number, three (Monitor, Fagatele Bay, and Thunder Bay) are essentially irrelevant in the present context because they are small, focused on the protection of historically significant wrecks or wreckage, and do not encompass significant amounts of marine mammal habitat. Three other sanctuaries (Gray's Reef, Florida Keys, and Flower Garden Banks) are intended primarily to facilitate protection, restoration, and use of coral reefs. They may benefit marine mammals, but if they do it is probably only to a small degree or indirectly. The Gray's Reef sanctuary website claims that the site contains "part of the only known winter calving ground for the highly endangered North Atlantic right whale" (http://www.omsgraysnatset.html; also see Chadwick 1998:22). However, the proportion of the calving and nursing ground actually inside the sanctuary is small, and well offshore from where most right whale mothers and calves are sighted. Perhaps the greatest contribution by the sanctuary is in the form of support for whale research in nearby waters and public awareness efforts. Atlantic spotted dolphins (*Stenella frontalis*) and bottlenose dolphins (*Tursiops truncatus*) are probably the most common marine mammals in the Florida Keys sanctuary, judging by their general distribution and habitat preferences. The Flower Garden Banks site is not thought to be of any particular significance to marine mammals (R. Davis, pers. comm., 20-21 March 2000). The other seven sanctuaries were selected and designed at least partly to benefit marine mammals. Interest in both Stellwagen Bank in the Atlantic and the Hawaiian Islands in the Pacific was driven by concern about humpback whales (Weber 1988a; Chadwick 1998). The other five sanctuaries encompass large tracts of ocean off the mainland Pacific coast and include within their borders habitat for a large variety, and large numbers, of marine mammals, some of which are listed as endangered, threatened, or depleted. Their known importance to marine mammals unquestionably played a role in the selection of these sanctuary sites.

The marine sanctuary program has fallen well short of the high expectations surrounding it (Weber 1988b, 1997; Chadwick 1998; Center for the Economy and the Environment 1999). Among the program's difficulties have been the inadequacy of funding during the first decade of its existence; under-staffing (only partly because of budgetary constraints); reluctance to regulate fishing and other extractive industries; and NOAA's emphasis on multiple use rather than preservation. Most significantly to date, sanctuaries have made little or no progress toward implementing regulations to reduce fishing pressure, prohibit or restrict the use of certain types of fishing gear in order to protect habitat, or close areas completely to fishing. For example, Chadwick (1998) describes the situation in the Channel Islands sanctuary, where the intensive squid fishery has implications for marine mammals, both in terms of reduced availability of prey and the potential for incidental mortality from entanglement in the fishing gear. Lights and noise from the squid boats, which operate at night, also disturb hauled-out pinnipeds and roosting seabirds (S. Allen, pers. comm., 9 May 2000). This general failure of sanctuaries to become involved directly in fishery management is not due to their lack of authority. In fact, they have the authority to regulate as long as they provide the relevant fishery management council(s) with an opportunity to prepare draft fishing regulations. Any such draft regulations must adhere to the Magnuson-Stevens Fisheries Conservation and Management Act, but only to the extent that they remain consistent with the purposes of the sanctuary. The sanctuary (through the Secretary of Commerce) may over-rule the council's recommendations (J. Sobel and C. Recchia, pers. comm., June 2000).

Although in some sanctuaries significant progress has been made toward resource protection, e.g., by the establishment of no-take zones in the Florida Keys sanctuary (Weber 1997; Chadwick 1998), there is little evidence of such progress in the two whale-centered sanctuaries – Hawaiian Islands and Stellwagen. The Hawaiian sanctuary is non-regulatory and therefore its conservation efforts have been limited to education, outreach, and support for research (Center for the Economy and the Environment 1999). Problems that could be of considerable ecological consequence in sanctuary waters, such as agricultural runoff and naval exercises, remain unaddressed (J. Darling, pers. comm., 19 March 2000). At Stellwagen, existing prohibitions on sand and gravel mining, waste dumping, and petroleum development are arguably important, although there is no strong commercial incentive for any of these types of development at present (Center for the Economy and the Environment 1999). Commercial fishing, including trawling and dragging (Chadwick 1998), continues inside the sanctuary with no special regulation (some 200-250 commercial vessels fishing in and around the sanctuary generate an estimated $15.3million/yr in revenues; www.sanctuaries.nos.noaa.gov/omsstellwagenmanag.html); heavy ship traffic into and out of Boston harbor continues to cross the bank (2700 vessels carrying 20 million tons of cargo per year; Center for the Economy and the Environment 1999); and previously acknowledged concerns about nearby urban waste disposal (see Phillips 1996) have not diminished since 1992 when the sanctuary was declared (C. Mayo, pers. comm., 24 March 2000). Boston's new wastewater outfall and a dump site for dredge spoil are both within a few miles of the sanctuary's borders (Center for the Economy and the Environment 1999). The sanctuary, however, may soon begin addressing at least some of these issues, as its management is considering regulatory measures regarding vessel traffic and fishing.

The Stellwagen sanctuary provides an example of how difficult it is to design a sanctuary around the seasonal presence of a highly mobile and opportunistic species, in this case the humpback whale. Already by the time it was decided to establish the Stellwagen sanctuary in the early 1990s, use of the bank by humpbacks, especially adults and mother-calf pairs, was rapidly declining (Weinrich et al. 1997). One plausible hypothesis was as follows (from Weinrich et al. 1997): Humpbacks were exceptionally abundant on Stellwagen Bank during the late 1970s and early to mid 1980s because the stocks of herring (*Clupea harengus*), their preferred prey, had crashed as a result of overfishing on Georges Bank and in the northern Gulf of Maine. Meanwhile, sand lance (*Ammodytes* spp.), which may compete with and are preyed upon by herring, were irrupting in the southwestern Gulf of Maine (including Stellwagen Bank) and thus became an alternate prey choice for the whales. By the late 1980s and early 1990s, with the recovery of herring stocks, the humpbacks returned to their previous distribution centered on Georges Bank and elsewhere in the Gulf of Maine. Whatever the cause of the shift in humpback whale distribution, the situation demonstrates the complexities and challenges of habitat protection in a fluid, dynamic ocean environment.

As is true of Gray's Reef sanctuary (see above), the staff of Stellwagen sanctuary have recently emphasized its potential relevance to right whale conservation even though the bank seems not to be a particularly critical area for the species. There is little evidence to support the statement by Chadwick (1998:22) that Stellwagen is "part of an important winter feeding area" for right whales.

In both the Hawaii and Stellwagen examples, major concessions were said to have been made to the fishing industry in order to gain support for sanctuary designation. Regardless of whether these concessions were official or legally binding (at least in the case of Stellwagen they were not, according to J. Sobel and C. Recchia, pers. comm., June 2000), they have been viewed as impediments to achieving significant changes in fishing methods or intensity. Thus, the obvious conflicts between commercial fishing and the sanctuary program's avowed primary objective of "resource protection" have remained unaddressed,

or at least inadequately addressed (e.g., see Brailovskaya 1998). Mayo's view of the Stellwagen sanctuary, that it is still engaged in a search for identity or mission, applies equally to the Hawaii sanctuary. In both, the possibilities for meaningful resource protection has been constrained by the compromises that were made to achieve designation. Hopefully, the effect of these constraints will diminish over time and prove to reflect little more than the slow process inherent in building effective management.

The most active programs at the Stellwagen and Hawaii sanctuaries are those involving public education and community "outreach." Volunteer participation is encouraged in the monitoring and education programs. The sanctuary staffs also strive to affiliate with research activities as often as possible, trumpeting the value of "partnerships" with academic institutions, non-governmental organizations, and government agencies involved in research. They work closely with private tour operators and readily point out the economic and public relations value of mammal and bird watching. Chadwick (1998) concluded, after spending a year investigating the sanctuary program for *National Geographic* magazine, that the sanctuaries had made themselves "clearinghouses for information about the ocean environment" and that they "mainly coordinate research by other agencies and institutions while reaching out through them to educate the public."

Marine Protected Areas under Canada's Oceans Act

Canada's Oceans Act of 1997 designated the Department of Fisheries and Oceans as the lead agency in developing a national "oceans strategy," which was explicitly expected to include a national system of marine protected areas. The act specifies that protected areas can be designated for the conservation and protection of (1) fishery resources, including marine mammals and their habitat; (2) endangered or threatened species and their habitat; (3) "unique" habitat; (4) areas of high biological diversity or productivity; or (5) any other resource or habitat necessary to fulfill the mandate of the minister (Fisheries and Oceans Canada 1998). Emphasis is on integrated management, with equal consideration for environmental and socio-economic effects. The approach is to somehow balance the protection of "ecological integrity" with "compatible use," while improving scientific understanding and contributing to the "social and economic sustainability" of coastal human communities.

To date, several "pilot" marine protected areas have been announced, and one of these is centered on The Gully, a deep canyon about 260km offshore of Nova Scotia. The Gully's importance as habitat for marine mammals has been established by the work of Hal Whitehead and his students at Dalhousie University in Halifax. They have shown that a small population of northern bottlenose whales inhabits The Gully year-round (Whitehead et al. 1997a, 1997b) and that the area is also used at least seasonally by sperm whales, various dolphin species, and baleen whales including fin, humpback, blue, minke, and occasionally sei whales (*Balaenoptera borealis*) (Gowans and Whitehead 1995; Hooker et al. 1999). On the strength of the consistent presence of cetaceans, the Dalhousie group has urged that The Gully be designated as a marine protected area under the Oceans Act (see Hooker et al. 1999). The presence of deep-sea corals and a diverse fish fauna has helped buttress the argument that the area meets at least one, if not several, of the criteria for designation. Although the Department of Fisheries and Oceans declared The Gully to be a "whale sanctuary" in 1994, this designation amounted to nothing more than a commitment to provide advisories to mariners through printed circulars and recommend that they either avoid transiting the area or take precautions to prevent collisions with bottlenose whales (Faucher and Whitehead 1995; Hooker et al. 1999). Fishing and marine debris have been cited as problems for marine mammals in the region, but the principal threats are considered to be those related to petroleum development in and around The Gully, specifically the Sable Offshore Energy Project (Faucher and Weilgart 1992; Geddes 1998; Hooker et al. 1999). Therefore, those involved in

the planning and lobbying for the new designation as an official Oceans Act marine protected area have had to address not only fishery and pollution issues, but also those surrounding the regulation and management of seismic testing, drilling, transport of hazardous material, ship and small vessel traffic, and other aspects of petroleum development in the region.

Right whales are a major conservation concern in marine waters of southeastern Canada. The Department of Fisheries and Oceans designated two "seasonal conservation areas" for right whales in 1993, one in the lower Bay of Fundy and one in Roseway Basin on the Scotian Shelf (Brown et al. 1995). These, however, have no legislative or regulatory authority and are simply administrative measures that depend on voluntary actions by vessel operators to avoid collisions with whales. The boundaries of the conservation areas are marked on nautical charts, a pamphlet with guidelines is distributed to ship captains, and radio advisories are provided when right whales are observed to be present in the shipping lanes. Designation of one or more protected areas for right whales under the Oceans Act was discussed by the Canadian right whale recovery team in 1998, but to date no tangible progress has been made.

UNESCO Biosphere Reserves and World Heritage Sites

The Biosphere Reserve Program is administered by the United Nations Educational, Scientific and Cultural Organization, or UNESCO, as part of its Man and the Biosphere Program. It is premised on the conviction that economic growth and human "development" can be reconciled with the maintenance of ecological complexity and diversity. The mechanism for attempting to achieve this elusive state of reconciliation is the creation of zoned, multiple-use reserves (Batisse 1990, 1993). Agardy (1997:209) views the biosphere reserve model as having particular potential "in coastal areas, where conventional 'garrison reserve' measures to preserve nature or protect the environment are not compatible with the open, multi-jurisdictional, and common property nature of marine systems." Biosphere reserves generally have core, buffer, and transition zones, with the idea that by providing full protection to the core areas "where critical processes that drive the system are concentrated," it will be possible in the buffer zones and outside the reserve "to continue to reap its resources and derive benefits from its use, leading to greater economic and sociological sustainability" (*Ibid*.).

The principal criteria for designation of Biosphere Reserves include representativeness, diversity, naturalness, and effectiveness as a conservation unit. Secondary criteria include knowledge of the area's history, the presence of rare or endangered species, and the site's value for education and research (Agardy 1993; Kelleher et al. 1995, Vol. I:10). A Biosphere Reserve is supposed to perform at least three functions, as follows: (1) conservation of ecosystems and biological resources, (2) development that is "ecologically sustainable," and (3) logistical support for monitoring, research, and education. Sites are nominated by national governments and must meet a minimal set of criteria and standards before being officially added to the World Network. While the designation process may be fairly rigorous, it is important to emphasize that the Biosphere Reserve Programme does not have the force of a treaty behind it. Thus, the impetus for pursuing particular policies for conservation or sustainable development comes largely from the informal status that accompanies designation. Most Biosphere Reserves include, or consist of, areas that are managed under some other instrument, such as a national park or nature reserve. However, the emphasis in the biosphere reserve concept on "sustainable use" and human economic development (Batisse 1990; Kenchington and Agardy 1990) means that no-take reserves or wilderness parks cannot, by themselves, become Biosphere Reserves. Regardless of how a Biosphere Reserve is constituted, whether by combining two or more existing protected areas or by starting from ground level, a management plan and an appropriate mechanism for coordination and oversight are essential.

As of January 2000, there were 368 Biosphere Reserves located in 91 countries (www.unesco.org/mab/wnbr). Kelleher et al. (1995, Vol. I:10, 38-39) found that about a quarter of the total Biosphere Reserves (314 in 1992) had a marine (including subtidal features) or coastal (coastal intertidal or terrestrial features) component. It is likely that this percentage has increased since then.

The 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage (commonly known as the World Heritage Convention) provides a mechanism, also administered by UNESCO, for recognizing natural sites that are of "outstanding universal value." The criteria for selection are that a site (1) be an outstanding example of a major stage in the earth's evolutionary history; (2) be an outstanding example of significant geological processes, biological evolution, and human interaction with the natural environment; (3) contain unique, rare, or superlative natural phenomena, formations, or features, or areas of exceptional natural beauty; or (4) provide habitat for rare or endangered plants or animals. Most of the natural (as opposed to cultural) World Heritage Sites are national parks, Biosphere Reserves, or both, and between a quarter and a third of them have marine or coastal components (Kelleher et al. 1995, Vol. I:9, 37). Inscriptions are purely symbolic but imply an expectation that responsible governments will maintain or enhance the values initially attributed to the sites. UNESCO's World Heritage Committee maintains and publicizes a "List of World Heritage in Danger," which contains those World Heritage Sites judged to be threatened by "serious and specific dangers," ranging from large-scale industrial or touristic development projects to natural catastrophes and armed conflicts. The danger list provides a means of allocating technical and financial aid to assist state parties in protecting sites under their care, and a mechanism for focusing world attention on immediate threats to highly valued landscapes.

U.S. participation in the Biosphere Reserve network is administered within the State Department. As of June 1999, there were 47 Biosphere Reserves in the United States. A few of these have potential relevance to marine mammal conservation. They include (year of Biosphere Reserve designation in parentheses, followed, when appropriate, by year of World Heritage Site designation): Aleutian Islands (1976), Channel Islands (1976), Everglades and Dry Tortugas (1976; WHS for Everglades 1979), Olympic (1976; WHS for Olympic National Park 1981), Virgin Islands (1976), Virginia Coast (1979), Hawaiian Islands (1980), Glacier Bay (1986; WHS for Glacier Bay National Park 1992), and Golden Gate (1988).

Mexico's national system of protected areas is divided into four categories: National Parks, Natural Monuments, Ecological Reserves, and Biosphere Reserves (Dedina and Young 1995). Of these, Biosphere Reserves play the most prominent role in marine mammal conservation. Source habitats of two cetacean species, one of them (the gray whale) the sole living representative of an entire family (Eschrichtiidae) and the other considered one of the world's most critically endangered marine cetaceans (the vaquita), are centered in two Mexican Biosphere Reserves. In both cases, the Biosphere Reserve designation is the primary mechanism for protecting these animals and their habitat. Sian Ka'an Biosphere Reserve, on the central coast of Quintana Roo, also encompasses marine mammal habitat, most significantly freshwater and coastal areas inhabited by Antillean manatees (*T. manatus manatus*) (e.g., Colmenero-R. and Zárate 1990).

El Vizcaino Biosphere Reserve was approved as a national Biosphere Reserve by the Government of Mexico in 1988 and by UNESCO in 1993. It consists of a vast terrestrial component in Baja California Sur together with the semi-enclosed waters of Laguna Ojo de Liebre (Scammon's Lagoon) and Laguna San Ignacio. Laguna Ojo de Liebre had been declared a "whale refuge" in 1971 – "the first of its kind in the world" (Dedina and Young 1995:14) – and Laguna San Ignacio became a "Whale Refuge and Maritime Tourist Attraction Zone" in 1979 (*Ibid.*). The reserve is

administered by the Ministry for Environment, Natural Resources and Fisheries (SEMARNAP). Although a draft management plan for the Biosphere Reserve had been submitted and was under review by 1994 (Dedina and Young 1995), it still had not been approved and implemented as of September 1999 (Rössler et al. 1999).

The two lagoons were inscribed on the World Heritage List in 1993 as the Whales Sanctuary of El Vizcaino. Importantly, although the Mexican government had nominated the site on the basis of three criteria (numbers 2, 3, and 4 listed above), the inscription was ultimately based on only one of them (number 4) – that the site should contain "the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation" (Rössler et al. 1999). The World Heritage Committee's decision was intended primarily to recognize the global importance of the lagoons as calving and nursing grounds for gray whales.

A proposal for an evaporative saltworks on the shores of Laguna San Ignacio to supplement the existing saltworks at Guerrero Negro (Laguna Ojo de Liebre) was considered by the Mexican government during the 1990s (Dedina and Young 1995; Mate 1995). Although initially unsuccessful, the proponents continued their efforts to develop a comprehensive environmental impact assessment in the hope of obtaining approval for their project. For its part, the Mexican government established an independent scientific advisory committee to review the assessment, once completed (see Marine Mammal Commission 1998).

Early in 1999, several non-governmental organizations petitioned UNESCO to consider adding the Whales Sanctuary of El Vizcaino to the List of World Heritage in Danger, citing both the record of environmental malpractice by the salt company at Guerrero Negro and the looming threat of a new saltworks at San Ignacio. Accordingly, a mission was sent by UNESCO to evaluate the situation in August 1999. This mission concluded that although the values for which the site was inscribed were not in immediate danger under present conditions (i.e., the gray whale population is not endangered and has continued to increase in recent years), any "significant change to the present situation" (which a new saltworks certainly would represent) would necessitate prompt re-evaluation (Rössler et al. 1999). The mission report also pointed out that state parties have a responsibility to maintain a World Heritage Site's "conditions of integrity," and that in the present instance these go beyond merely ensuring that the gray whale population is stable or growing. In the mission team's view, the "relatively pristine condition" of Laguna San Ignacio was a key element of the original inscription, and therefore the new salt project could threaten the integrity of the site. Soon after the mission report had been accepted by the World Heritage Committee (December 1999), the government of Mexico announced its decision to halt further consideration of the saltworks proposal (March 2000).

This example is less straightforward than it might appear. Concern about the conservation of gray whales is what initially prompted the Mexican authorities to designate the Biosphere Reserve and to propose a portion of it as a World Heritage Site. The gray whale was undeniably a "flagship species" for both designations, and the importance of the lagoons as gray whale calving and nursing areas was repeatedly emphasized in the campaign by non-governmental organizations to convince Mexican authorities that they should deny permission for construction of a new saltworks. These organizations exploited the fact that addition of the Whales Sanctuary to the World Heritage in Danger List would be a major embarrassment to the Mexican administration. Even though there was no clear evidence that evaporative salt production and transport threatened gray whales, and even though the World Heritage Committee ultimately decided against listing the site as in danger, the Mexican government ruled against the proposed development, citing the need to preserve the ecosystems, endemic species, and "unique scenic landscapes"

of the Biosphere Reserve and World Heritage Site (statement by President Ernest Zedillo, 2 March 2000, available from www.unesco.org/whc/nwhc).

In effect, Mexico accepted the UNESCO argument that the value of the World Heritage Site goes beyond its function as a gray whale nursery and includes the natural landscape and the integrity of the lagoon ecosystems. Thus, one interpretation of the outcome is that the gray whale served as both a flagship and an umbrella species, effectively fueling and sustaining public interest in the saltworks controversy, which has finally been resolved with the recognition that the entire Laguna San Ignacio ecosystem deserves protection from industrial development.

A management plan for the Biosphere Reserve of the Upper Gulf of California, published in 1995, provides "a general framework for the protection, conservation and restoration of the biota and environment" (Anonymous 1997). However, little progress has been made in reducing threats to the vaquita.

Conclusions

Only a small subset of the world's marine protected areas have been created for the explicit purpose of conserving marine mammals. In most instances, stated goals are more general, ranging from protection of biological diversity and ecological "health," to improved fish production and direct economic benefit for humans. In North America, several reserves, sanctuaries, or parks were established primarily to protect marine mammals. These include the Upper Gulf of California and El Vizcaino Biosphere Reserves in Mexico (vaquita and gray whale, respectively); the Hawaiian Islands and Stellwagen Bank National Marine Sanctuaries in the United States (humpback whales); Channel Islands National Park and Point Reyes National Seashore in the United States (seals and sea lions); and the Saguenay-St. Lawrence Marine National Park and Wapusk National Park in Canada (white whale and polar bear, respectively).

In assessing the value to marine mammal conservation of these and other protected areas, it is necessary to consider whether they provide incremental benefits that are not already being provided by other forms of protection. In the United States, for example, marine mammals benefit from the protection provided under the Marine Mammal Protection Act and, for some species, the Endangered Species Act; the designation and protection of "critical habitat" under the Endangered Species Act (in the United States); and various other legislative and regulatory processes (e.g., time and area closures to certain types of fishing activity). In both Mexico and Canada as well, laws and regulations exist to prevent, or at least regulate, the hunting of marine mammals. Although assessments of conservation value certainly need to be conducted on a species, population, or site-specific basis, it is probably fair to conclude that, overall, the direct benefit derived by marine mammals from the existing array of protected areas in North America is considerably less than it could be. What management there is of fishing and vessel traffic, both potentially harmful to marine mammals, comes primarily as a result of legislative or regulatory processes that are independent of protected area authorities.

In some situations, a protected area could prove detrimental to marine mammal conservation by encouraging increased use that is incompatible with the animals' needs. As the history of Yellowstone, Yosemite, Banff, and other popular North American national parks demonstrates, too much recreational use can destroy the values that led to park designation in the first place. To a certain extent, this may be happening, on a relatively small scale, to manatees in Crystal River

National Wildlife Refuge. A serious potential drawback of multiple-use management is that by advertising an area's resources and facilitating their use, the overall productivity and diversity of the area will become degraded with time, eventually reducing the regional carrying capacity, particularly for high-order predators.

Most authors who have considered the realized and potential benefits of marine protected areas have concluded that, if nothing else, such areas can perform a valuable education and research function. Marine mammals are ideal "flagship species" because of the great popular interest in and affection for them (e.g., see Lavigne et al. 1999). As a result, protected areas inhabited by marine mammals have the potential to draw people's attention and engage them in broader conservation dialogue, and also to attract support for conservation-related research. Duffus and Dearden (1993a) conclude concerning the Canadian context: "Marine parks themselves play only a minor role in protection; their significance is in public education." This significance may be crucial to conservation, but it is extremely difficult to demonstrate or quantify. It is also uncertain whether public support can be maintained for a marine protected area that performs no regulatory (i.e., protection) function.

Is it desirable to designate more marine protected areas, or would it be better to invest resources in improving those that already exist? This question cannot be answered categorically. Kelleher and Recchia (1998; also see Kelleher and Kenchington 1993; Kelleher et al. 1995, Vol. I:6-7) conclude that, "It is better to have an MPA which is not ideal in an ecological sense but which meets the primary objective than to strive vainly to create the 'perfect MPA'." Similarly, the statement by Agardy (1994), quoted earlier, implies that it may be both practical and desirable to use concern for a valued species (e.g., an endangered monk seal or baleen whale) as the basis for establishing a protected area, then strive to broaden the goals of management to incorporate other species, ecological processes, and ultimately entire ecosystems. It could be argued, however, that the designation process itself should be, and is, an exercise in "public education." Thus, the basis for selecting and designing sites should rest on sound ecological principles and not simply be a response to the clamor for a favored species (e.g., the humpback whale sanctuary in Hawaii).

In many instances, marine protected areas were established after careful planning on ecological grounds, but their potential has been subverted by a failure to account adequately for social and political factors. Of these factors, two stand out as particularly widespread and important (Kelleher and Kenchington, 1993). First is the challenge of achieving legitimacy in the eyes of the people who live in and near a protected area and use its resources. Although virtually all protected area designations are accompanied by documentation paying lip service to the principles of community consultation, participation, even "ownership," few examples of genuine community engagement seem to exist. This should not be surprising in view of the costs involved – in terms of time, funding, and compromise.

Second is interagency conflict, particularly between the authority responsible for fishery management and the entity charged with developing and managing the protected area. Often, both groups are themselves conflicted over their contradictory mandates. Fishery departments are charged with improving the economic state of the fishing industry while at the same time protecting the integrity of fish resources. Protected area officials are expected to pursue, simultaneously, the objectives of biodiversity preservation and "sustainable use" (recreation, controlled resource extraction, etc.). Although there is probably no single, simple way to resolve these conflicts, Kelleher (1998) suggests an approach that may at least get things started in the right direction. He argues that working groups dealing with marine protected areas be interdisciplinary and interdepartmental, with staff from both (or all) competing agencies as well as representation from scientific and advocacy groups. He adds that it would be helpful if the reward system could be changed so that scientists gained credit for

contributing to conservation efforts, such as the development of marine protected areas, and not only (or mainly) for their publication record.

A major obstacle to the creation of protected areas in offshore waters has been insufficient understanding of pelagic food webs, species behavior and life histories, and ecological processes. Technology has also been a strong limiting factor. Hyrenbach et al. (2000) argue that these limitations have been largely overcome in recent years and that "even though our understanding is by no means perfect, ... imperfect knowledge is no excuse for a lack of action." In their view, the only remaining obstacle is the lack of political will.

Recommendations

1. The limited progress of many protected areas in meeting expectations is related to the implicit assumption that designation is the end rather than the beginning of a conservation process. It is essential that authorities responsible for site designation be committed to ensuring adequate long-term funding and staffing, timely preparation and implementation of management plans, and realistic evaluation of accomplishments in relation to stated objectives.

2. The U.S. National Marine Sanctuary Program should be encouraged to strengthen existing sanctuaries. Such strengthening may require drastic measures, possibly including substantial redesign in some instances. The latter should take advantage of opportunities for integration between or among sites (e.g., in California, many state and federal protected areas are spatially contiguous or proximate; see McArdle 1997, Resources Agency of California 2000). One of many examples is the Farallon Islands National Wildlife Refuge bordering the Gulf of the Farallones National Marine Sanctuary. A proposed 10-mi.-wide no-take zone bordering the refuge would encompass about a third of the sanctuary's entire area and afford protection to a large, diverse assemblage of pinnipeds and seabirds (Evans 1998).

3. Management plans for marine sanctuaries are subject to mandatory review every five years. This requirement, if met, would provide a mechanism for ensuring that sanctuaries adapt to or take advantage of advances in knowledge, changes in environmental conditions, and opportunities for consolidation and integration (cf. Weber 1996). This requirement should be taken seriously and the necessary resources be made available to facilitate these periodic reviews.

4. The potential of National Park Service lands and National Wildlife Refuges in the United States to contribute to marine mammal conservation has only begun to be realized. Both the National Park Service and the U.S. Fish and Wildlife Service (which administers the refuge program) should be encouraged and supported in efforts to expand their reach into the marine environment. It would be useful for each of these agencies to undertake a systematic review of marine mammal habitat on and adjacent to lands under their respective juridictions. The purpose of such reviews would be to identify opportunities for greater involvement in the conservation of marine mammal habitat, including prey resources. It is important that national parks and wildlife refuges be seen as complementary, rather than as competing alternatives, to national marine sanctuaries.

5. A marine protected area or a marine component of a land-based protected area is most likely to contribute to marine mammal conservation if the protected area's management body has both the authority and the will to regulate fisheries. At a minimum, fishing effort within a protected area should be frozen at the time of designation and until an appropriately precautionary management plan is in place. "Limiting entry and technology will allow fishermen to continue their traditional way of life, while helping to insure that sanctuary [or the protected area's] resources are protected from increased numbers of fishermen or more fish-killing capability" (Weber 1997:34). Even though wholesale devolution or transfer of authority from fishery agencies to protected area management bodies is probably unrealistic (and possibly undesirable), incremental acquisition of authority to regulate fishing will often be a highly desirable medium- and long-term goal.

6. No-take zones not only benefit fish and invertebrate populations, which in turn improve the prey base for marine mammals, but they can also provide areas where marine mammals are relatively safe from accidental capture in fishing gear (bycatch) and from disturbance by fishing operations. In general, the Marine Mammal Commission and other conservation-oriented agencies should promote the expanded use of no-take zones within present and future marine protected areas.

7. The United States should pursue bilateral and multilateral initiatives, particularly with Canada and Mexico, to connect and coordinate the management of protected areas affecting migratory species of marine mammals. The gray whale (and possibly also the Guadalupe fur seal, *Arctocephalus townsendi*) on the west coast and the right whale on the east coast are the species most in need of, and most obviously amenable to, such integration. Although non-governmental organizations have begun to explore and develop the idea of protected area networks in both the Gulf of Maine, where the right whale is potentially a flagship species, and the coastal waters from Baja California to the Bering Sea, which encompass the gray whale's long-distance migration (Anonymous 1999, 1999/2000a), these ideas need to be considered more seriously by government agencies in the three countries.

8. Serious consideration should be given to the proposal by Brailovskaya (1998) for a National Marine Wilderness Preservation Act that would establish the intrinsic importance of protecting marine biological diversity. The political acceptability of such an act would be enhanced by citing the beneficial effects of no-take (i.e., "wilderness") reserves on fishery yields (e.g., Roberts 1995; Bohnsack 1996), but the legislation itself should entrench the idea that marine organisms and systems have value in their own right.

9. A federal interagency task force involving the Departments of Commerce, the Interior, State, Transportation, and Defense, the Environmental Protection Agency, and other interested agencies should be convened to evaluate the merits of establishing a series of large regional marine management areas, similar to the Great Barrier Reef Marine Park, to protect and manage significant marine resources and habitats associated with major regional marine ecosystems and biogeographic features in ocean areas of the United States. Areas to be considered should be on the scale of the Florida Keys Coral Reef Marine Sanctuary, the combined size of the Farallons, Cordell Bank, and Monterey Bay National Marine Sanctuaries, or larger. In particular, the task force should consider the merits of systematically identifying, integrating, and strengthening measures to

protect essential habitat components for regionally significant populations and communities of fish, marine mammals, sea turtles, seabirds, and other marine life. In this regard, it should consider site-specific zoning and measures to regulate human activities, such as commercial and recreational fishing, aquaculture, vessel traffic, whale-watching, mineral exploitation, and dredging.

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Glossary

Biosphere Reserve: Criteria for selection are representativeness, naturalness, biological diversity, and effectiveness as a conservation unit (Agardy 1993). "Biosphere Reserves are not analogous to national parks, sanctuaries, or other traditionally managed forms of protected area. Their design and operation is rooted in sustainable use rather than protectionism and promotes stewardship by human beings rather than their exclusion" (Agardy 1993).

Cetacean Sanctuary: A place where no cetacean is allowed to be killed, taken alive, or harassed; the environmental qualities necessary for cetaceans to perform their biological functions (e.g., breeding, calving, migrating, feeding) are not impaired by human activities; only benign scientific research and observations by the public are allowed, and then only under appropriate controls; and public awareness of the significance of cetaceans in the natural environment can be enhanced (Anonymous 1979).

Ecological Reserve: An area where all extractive activities are prohibited (Anonymous 1999/2000b).

Marine Life Reserve: Used in California to denote an area where all extractive activities are prohibited (Anonymous 1999/2000b).

Marine Managed Area: A named, discrete marine or estuarine area (in California) designated using legislative, administrative or voter-initiative processes, and intended to protect, conserve, or otherwise manage a variety of resources and their uses (Resources Agency of California 2000).

Marine Protected Area: Any area of inter-tidal or sub-tidal terrain, together with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation to manage or protect part or all of the enclosed environment (Kelleher and Kenchington 1992).

Marine Reserve: Some authors consider this term synonymous with "no-take zone," i.e., an area where the removal of specified resources such as marine mammals, fish, shellfish, and sea-grasses is prohibited (e.g., Bohnsack 1996).

National Marine Sanctuary (US): An area with resource or human use values of "special national significance" (to include conservation, ecological, research, recreational, commercial, educational, aesthetic, cultural, historical, archaeological, or paleontological values) that is managed primarily to protect those values (paraphrased from Weber 1997).

National Park (US): Generally a large natural area with a wide variety of attributes, sometimes including significant historical assets, where hunting, mining, and "consumptive activities" are not authorized (Weber 1997).

National Preserve (US): An area with characteristics associated with national parks but in which public hunting, trapping, and hydrocarbon development are allowed (Weber 1997).

National Seashore (US): A segment of coastline that is managed in the same manner as a National Park following passage of the Redwood National Park Act of 1988 (16 USC 79A-79Q).

The following definitions are slightly paraphrased from IUCN (1994; objectives from Kelleher 1998). Taken together, they constitute the IUCN Protected Area Management Categories:

Strict Nature Reserve: An area with outstanding or representative ecosystems, geological or physiological features, or species, available

primarily for scientific research or environmental monitoring. Objective: strict protection.

Wilderness Area: A large, unmodified or only slightly modified area that retains its natural character and influence, without permanent or significant human habitation, protected and managed so as to preserve its naturalness.

National Park: An area designated to protect the "ecological integrity" of one or more ecosystems, exclude exploitation or occupation that would compromise the purposes of designation, and provide spiritual, scientific, educational, and recreational opportunities, all of which must be "environmentally and culturally compatible." Objective: ecosystem conservation and recreation.

Natural Monument: An area with one or more specific natural or natural/cultural features, of outstanding or unique value due to their inherent rarity, representative or aesthetic qualities, or cultural significance. Objective: Conservation of natural features.

Habitat/Species Management Area: An area subject to active intervention for management purposes intended to maintain habitat or to meet the requirements of particular species. (Agardy [1997:102] regards the IWC whale sanctuaries in the Indian Ocean and Southern Ocean as examples of this type of protected area.) Objective: conservation through active management.

Protected Seascape: An area of distinct character and significant esthetic, ecological, or cultural value, managed to preserve "traditional interaction" between humans and the coastal environment. Objective: seascape conservation and recreation.

Managed Resource Protected Area: An area containing predominantly unmodified natural systems, managed to maintain biological diversity but also provide for "sustainable use." Objective: sustainable use of natural ecosystems.

Appendix 1: Selected Examples of Protected Areas Outside North America That Contribute to Marine Mammal Conservation

International Whaling Commission (IWC) Whale Sanctuaries

Although the creation of whale sanctuaries by the International Whaling Commission is often regarded as a recent development, the sanctuary concept was present long before the IWC came into existence. In 1913-14, the authorities in Western Australia declared a sanctuary offshore of Norwegian Bay, aimed at preventing Norwegian whalers from hunting whales on their calving grounds (Tønnessen and Johnsen 1982:224). Under an international whaling agreement in 1938, the area of the Antarctic (south of 40ES) between the South Shetland Islands (70EW) and the eastern Ross Sea (160EW) was declared a sanctuary, initially for two years. According to Tønnessen and Johnsen (1982:461), this decision was uncontroversial because "very few whales were known to be found in this area, and no expedition would consider catching there." The sanctuary was not opened to whaling until 1955, when it was opened provisionally for three years. It quickly became evident that the density of whales in sanctuary waters had been underestimated, and the area remained open to whaling thereafter. Again, as Tønnessen and Johnsen (1982:563) succinctly explain, "The opening of the Sanctuary was a sacrifice made by science to whaling in the (feeble) hope that this would correspondingly ease pressure on stocks in other sectors."

The Indian Ocean Sanctuary, extending from the Asian land mass in the north, southward to 55ES, was established in 1979 for ten years, and it has been extended twice since then. It is scheduled for review in 2002. The Southern Ocean Sanctuary, established in 1994, has its northern border along 40ES latitude except in the Indian Ocean, where it is along 55ES, and the Pacific Ocean, where it is along 60ES. This sanctuary is also scheduled for reconsideration at 10yr intervals. In both instances, management consists of a ban on commercial whaling by IWC member states. Because the IWC does not officially consider most toothed cetaceans other than the sperm whale as being within its competence, the sanctuary provides no benefit to them. Also, every year since the worldwide moratorium on commercial whaling began in 1986, Japan has taken hundreds of minke whales inside the Southern Ocean Sanctuary as part of a scientific research program.

Wadden Sea National Park of Schleswig-Holstein (Germany)

In 1999, the parliament of the North German state of Schleswig-Holstein established a sanctuary for small cetaceans off the islands of Sylt and Amrum in the North Sea. The main purpose of the sanctuary is to restrict human activities, such as gillnet fishing, jet skiing, and high-speed motor boating, to the benefit of harbor porpoises (Reeves and Notarbartolo di Sciara 1998). Aerial surveys and stranding programs indicate that these waters are used by porpoises to give birth and nurse their young (Sonntag et al. 1999), and therefore that the sanctuary may protect a "source habitat" (*sensu* Pulliam 1988) for the North Sea's harbor porpoise population.

International Sanctuary for Mediterranean Cetaceans

A sanctuary for cetaceans was initially declared in the northwestern Mediterranean Sea by ministers from Italy, France, and Monaco in 1993 (Gordon et al. 2000). In 1995, the Barcelona Convention Protocol for Specially Protected Areas and Biodiversity was revised to facilitate the establishment of protected areas on the high seas within the Mediterranean Basin, where all national jurisdictions extend only 22.2 km offshore rather than the

global standard Exclusive Economic Zone width of 200 n.mi (G. Notarbartolo di Sciara, pers. comm. 3 Dec. 1999). Accordingly, the 96,000 km^2 sanctuary, centered in the Ligurian Sea, was formally established in 1999. Most of the area of the sanctuary is on the high seas. Although the sanctuary was initially intended to protect both monk seals and cetaceans, seals no longer occur in the area, so it is essentially a cetacean sanctuary. Striped dolphins and sperm whales occur regularly and are relatively abundant within the sanctuary, and both species are threatened throughout the Mediterranean by entanglement in driftnets, pollution, and possibly reduced prey due to overfishing (Aguilar 2000; Gordon et al. 2000).

Irish Whale and Dolphin Sanctuary (Ireland)

Ireland itself was declared a whale and dolphin sanctuary in 1991 (Rogan and Berrow 1995). The boundaries of the sanctuary encompass the Irish state's entire 200n.mi. exclusive economic zone. Its legal status hinges solely on three legislative instruments – the Whale Fisheries Act of 1937, the Wildlife Act of 1976, and an amendment to the Whale Fisheries Act in 1982 which extended full protection to all cetaceans, not just the baleen whales. The main significance of the Wildlife Act is that it protects cetaceans, and their habitat to 12n.mi. offshore, from "willful interference." Although calling the Irish EEZ a sanctuary may be a misnomer in some respects, the declaration is said to have had a number of ramifications, including enhancement of research, public education and awareness, and development of dolphin watching (E. Rogan, pers. comm., 15 April 2000).

Svalbard (Spitsbergen)

The marine mammals in and around the Svalbard archipelago in the northeastern Atlantic Ocean were plundered from the early 1600s (bowhead whales and walruses) to the mid-1900s (white whales). As a result, the bowhead and walrus populations there were essentially extirpated, and the white whale population greatly reduced. Norway acquired Svalbard after the First World War. In 1973, approximately half of the archipelago was declared (by royal decree) to be within nature reserves or national parks. The borders of these protected areas extend to 4nmi offshore, and hunting and trapping are entirely prohibited within them. At present, some 72% of Svalbard's territorial waters are inside protected areas.

Protection of polar bear denning habitat was one of the main reasons for establishing the vast (19,030 km^2) Northeast Svalbard Nature Reserve, which contains one of the most important polar bear denning sites (for birth and early nursing) in the world (I.L.B. Gjertz, pers. comm., 10 Dec. 1999). All access to this site is prohibited year-round.

Moffen Nature Reserve is a small (16 km^2) island north of Spitsbergen. It is inside the Northwest Spitsbergen National Park (3560 km^2) and is specially protected from 15 May to 15 September when all access to within 300m of the shoreline is prohibited. The reserve was established as a bird and walrus sanctuary in 1983, by which time it had become clear that Svalbard's walrus population was coming back from virtual extinction (Born 1984). Moffen remains the best-known walrus haul-out site in Svalbard because of its accessibility and frequent visitation by tourists and others (Gjertz and Wiig 1984; Gjertz, pers.comm. 10 Dec. 1999).

Close to 99% of the haul-out habitat presently used by walruses in Svalbard is within protected areas. All extractive (=consumptive) economic activity, apart from shrimp trawling in waters deeper than 100m, is forbidden within the boundaries of these protected areas, so a large part of the hauling and feeding habitat for walruses in Svalbard is legally protected. Importantly, however, intensive trawling for Icelandic scallops (*Chlamys islandica*) has taken place since the mid-1980s in Svalbard waters, at depths of 20-70m, and there is reason to believe that this has damaged benthic communities on which walruses depend (Born et al. 1995). Moffen Nature Reserve is located in the center of the richest scallop banks

in Svalbard. According to Norwegian biologist Ian Gjertz (in Born et al. 1995:80): "In the mid-1980s this led to a siege of Moffen by a fleet of trawlers that, whenever given a chance, violated the protected area. This activity occurred in spite of the increased surveillance by the coastguard and police."

Another important consideration in regard to walruses and protected areas in Svalbard is that most of the animals hauling out there are males. The assumption is that they are part of a population whose distribution includes Franz Josef Land in Russia. Presumably, females and calves occur mainly in the latter archipelago and to some extent in the extreme northeastern parts of Svalbard (Gjertz and Wiig 1994). Thus, it could be argued that the protected areas in Svalbard benefit primarily the male component of the population, and that therefore a vital component of the population is left out of the protected area network. Franz Josef Land was declared a federal zakasnik (nature reserve; 42,000km^2) in 1994 and is contained within the proposed Russian Arctic National Park, which was approved by Arkhangelsk District in 1999 (Nikiforov and Mescherskaya 1999).

The world's northernmost population of harbor seals lives along the west coast of Prins Karls Forland, off the central west coast of Spitsbergen (Prestrud and Gjertz 1990). Some of this population's feeding areas and most its known haul-out and pupping sites are within Forlandet National Park (540km^2) (I.L.B. Gjertz, pers. comm., 10 Dec. 1999).

An initiative is underway to expand the protected area network in Svalbard (Prokosch 1999). The polar bear is the marine mammal species most likely to benefit from such expansion (the proposed Hopen Island Nature Reserve contains denning habitat).

Greenland National Park and Melville Bugt Nature Reserve (Greenland)

Greenland National Park, established in 1974, covers the northeastern third of the country (972,000km^2, mostly land). Initially, polar bears and walruses were to be completely protected within the park's borders, but since 1976 hunting by Greenlanders has been allowed. The only special restrictions are that the hunters do not settle permanently in the area and that they do not rely on assistance from park maintenance facilities (Born 1995). Melville Bugt Nature Reserve, established in 1980, exists explicitly for the benefit of Greenlandic hunters. Special permits from the Home Rule Government are required for entry into the reserve. In addition to being open to hunting, both the park and the reserve are open to mineral exploration and exploitation, under permit (Born 1995).

Bouvetøya (Bouvet Island), Antarctica (Norway)

The Antarctic island of Bouvet was officially designated as a Norwegian dependency in 1930. A principal reason for making the claim was Norway's interest in Antarctic whaling (B. Njastad, Norwegian Polar Institute, pers. comm., 15 Dec. 1999). The island had been one of the many sites of industrial sealing in the early 1800s, and it can be assumed that the population of Antarctic fur seals (*Arctocephalus gazella*) using the island as a pupping and breeding site was rapidly depleted (if not exterminated) by mid-century (Bonner 1982). Sealing was prohibited in 1929, and in 1935 the Norwegian government declared all seals on the island to be protected species. In 1971, the entire island and its territorial waters (to 4n.mi. from shore) were declared a nature preserve. Access to the island and human activities within the reserve are strictly regulated under both the royal decree of 1971 and the "Management Plan for CEMP – Bouvetøya." Only authorized scientific activities and a certain amount of tourism are allowed at Bouvet Island.

The fur seal population increased from about 4000 in 1978-79 (Haftorn et al. 1981) to 7900 in 1990 and 64,000 in 1997 (B. Njastad, Norwegian Polar Institute, pers. comm., 15 Dec. 1999). Southern elephant seals haul out regularly in the Nyrøysa area but are not known to use Bouvet as a pupping or breeding site (*Ibid*.).

Table 1. Protected areas outside North America intended (at least in part) to benefit marine mammals (also see Appendix 1). [1]

Name of Area	Location or Country	Marine Mammals Affected	Year Established	Comments
INTERNATIONAL				
IWC Indian Ocean Sanctuary	Indian Ocean, 20-130EE and north of 55ES	Mainly baleen whales and sperm whale	1979	Commercial whaling banned
IWC Southern Ocean Sanctuary	Antarctic to 40°S except in Indian Ocean (55°S) and Pacific Ocean (60°S)	Mainly baleen whales and sperm whale	1994	Commercial whaling banned
OCEANIA				
Flinders Chase National Park	Cape du Couedic, Kangaroo Island, South Australia	New Zealand fur seal	?	Visitation managed to protect seals from disturbance
Point Labatt Conservation Park	South Australia mainland	Australian sea lion	1973	Protects haul-out beach as well as waters to 1nmi offshore
Seal Bay Conservation Park	Kangaroo Island, South Australia	Australian sea lion (New Zealand fur seal also present)	1971 (having existed in other forms since 1954), expanded 1974	Intensively managed to promote tourism and maintain the sea lion population
Banks Peninsula Marine Mammal Sanctuary	East coast of South Island, New Zealand	Hector's dolphin	1988	Prohibits commercial gillnetting, limits recreational gillnetting
Great Barrier Reef Marine Park	Australia	Dugong, humpback whale, Indo-Pacific hump-backed dolphin, pygmy minke whale	1975	Intensively and complexly managed area, with dugong as a major focus of conservation efforts
Great Australian Bight Marine National Park	Approx. 300km of coastline in South Australia, incl. waters to 3nmi offshore	Southern right whale, Australian sea lion	1996	Includes year-round exclusion zone in Head of the Bight where right whales congregate in winter (with their calves), and six prohibited areas, each 1nmi in radius, around sea lion breeding colonies
Maza Wildlife Management Area	Western Province, Papua New Guinea (184,230 ha)	Dugong	1978	Intended to protect dugong habitat and manage continued hunting; effectiveness uncertain (Asigau 1991)
EUROPE				
Northeast Greenland National Park	972,000 sq. km of land in NE Greenland	Walrus, polar bear	1974, expanded 1988	Prevents commercial hunting but allows "subsistence" hunting; restricts (but does not prohibit) mineral development

[1] **This list is illustrative rather than comprehensive; many more protected areas with relevance to marine mammals exist throughout the world.**

Name of Area	Location or Country	Marine Mammals Affected	Year Established	Comments
Wadden Sea National Park of Schleswig-Holstein	German Wadden Sea, east side of North Sea	Harbor porpoise	1999, national park jurisdiction extended to include coastal waters around isles of Sylt and Amrum	Bans high-speed watercraft, industrial fishing, etc. in porpoise "nursery" area
International Sanctuary for Mediterranean Cetaceans	Ligurian Sea, Northwestern Mediterranean Basin (96,000 sq. km)	Fin, sperm, Cuvier's beaked, and long-finned pilot whales; Risso's, striped, bottlenose, and short-beaked common dolphins	1999, by agreement of Italy, France, and Monaco	Only in initial stages; whale watching regulated, high-speed offshore competitions to be regulated or prohibited, monitoring of cetacean populations
National Marine Park of Alonnissos Northern Sporades	Greece	Mediterranean monk seal	1986	Awareness and enforcement have been effective in reducing monk seal mortality
Nature Reserve of Las Desertas Islands	Madeira Natural Park, Madeira	Mediterranean monk seal	1990	Protection has been effective, and the small local population of seals has increased
Foça Specially Protected Area	Turkish Black Sea coast	Mediterranean monk seal	199?	Uncertain
Valaam Archipelago Nature Reserve	Lake Ladoga, Karelian Republic of Russia	Ladoga ringed seal	1992	Further restrictions needed to reduce disturbance of hauled-out seals by campers (Sipilä and Hyvärinen 1998)
Franz Josef Land State Nature Reserve	NE Russia (42,000 sq. km, of which 62% is marine)	Arctic seals, whales, polar bears	1994	Nominal protection from disturbance
White Sea Nature Reserve	NE Russia	Arctic seals and belugas	?	Nominal protection from disturbance
Kara Sea Nature Reserve	Central Russian Arctic	Arctic seals and whales	?	Nominal protection from disturbance
ASIA				
Sha Chau and Lung Kwu Chau Marine Park	Hong Kong	Indo-Pacific hump-backed dolphin (locally called Chinese white dolphin)	1996	Prohibits high-speed watercraft and some kinds of fishing
National Chambal Sanctuary	Chambal River, India (157km)	Ganges river dolphin	1978	Primary purpose: protection of gharial (*Gavialus gangeticus*)
Vikramshila Gangetic Dolphin Sanctuary	50km segment of Ganges River in Bihar state, India	Ganges river dolphin	1991	Nominal protection to dolphins; monitoring abundance
Sind Dolphin Reserve	Segment of Indus River between Sukkur and Guddu barrages, Pakistan (170km?)	Indus river dolphin	1974	Nominal protection to dolphins

Name of Area	Location or Country	Marine Mammals Affected	Year Established	Comments
AFRICA				
Djoudj National Park	NW Senegal, includes Senegal River delta	West African manatee	?	Unclear if still effective for this species
Saloum Delta National Park	Central Senegal	West African manatee, Atlantic hump-backed dolphin	1976?	Poaching and bycatch in fisheries occurs, but these and other harmful activities would be worse without the protection provided by park staff (K. Van Waerebeek, pers.comm.)
Niumi National Park	Gambia	Atlantic hump-backed dolphin, probably West African manatee	?	Poaching and bycatch in fisheries occurs, but these and other harmful activities would be worse without the protection provided by park staff (K. Van Waerebeek, pers.comm.)
Kiang West National Park	Gambia	Bottlenose dolphin, probably West African manatee	?	Poaching and bycatch in fisheries occurs, but these and other harmful activities would be worse without the protection provided by park staff; some commercial dolphin watching (K. Van Waerebeek, pers.comm.)
National Park of Banc d'Arguin	Mauritania; ca. 12,000 sq. km, including coastal waters mainly <5m deep	Mediterranean monk seal, Atlantic hump-backed dolphin, bottlenose dolphin	1976	Artisanal fishing is allowed within the park and probably involves substantial bycatch of marine mammals, but exclusion of industrial fishing and other general protection given to wildlife and fish probably benefits marine mammals to some extent.
SOUTH AMERICA				
Galápagos Islands Marine Resources Reserve and Whale Sanctuary	Ecuador	Galápagos fur seal, Galápagos sea lion, coastal cetaceans	National Park established 1979, whale sanctuary 1990	Full protection for all wildlife
National Marine Park of Fernando de Noronha	345 km off coast of Rio Grande do Norte state, Brazil	Spinner dolphin	1988	Dolphin-watching is a major feature, and the local spinner dolphin population is closely monitored; a primary purpose of the park designation was to facilitate and regulate dolphin-watching.
Abrolhos Marine National Park	Bahia State, Brazil	Humpback whale	?	?
National Park Natural Isla Gorgona	Near Guapi, NW Colombia (ca. 49,200ha)	Humpback whale (calving area)	1985	See Flórez-González (1991)
Lobos Island Ecological Reserve	Near border between states of Santa Catarina and Rio Grande do Sul, Brazil	South American sea lion and fur seal	1983	Protected haul-out site

Name of Area	Location or Country	Marine Mammals Affected	Year Established	Comments
Environmental Protection Area of Anhatomirim / Bay of Dolphins	Florianópolis, Santa Catarina, Brazil (3000 ha of marine and contiguous terrestrial area)	Tucuxi (marine type)	1992	Nominal protection from harassment
Golfo San José Whale Sanctuary (Marine Provincial Park)	Peninsula Valdés, Argentina	Southern right whale	1974	Popular sight for whale watching and research, whale population closely monitored, continuing need for restrictions on industrial activity
Provincial Wildlife Reserve of North Point (Punta Norte)	Peninsula Valdés, Argentina	Southern elephant seal	?	Protects breeding haul-out beach
Provincial Wildlife Reserve of Punta Pirámides	Peninsula Valdés, Argentina	Southern sea lion	?	Protects breeding haul-out beach
Pacaya-Samiria National Reserve	Peruvian Amazon (2,080,000 ha)	Boto, tucuxi, Amazon manatee	1972	Nominal protection to animals, some limitation of industrial activity
Estaçao Ecológica do Lago Mamirauá	Western Brazilian Amazon (1,124,000 ha)	Boto, tucuxi, Amazon manatee	1990	May provide some benefits by excluding commercial fishing and hunting but allows "subsistence" hunting of manatees to continue
CENTRAL AMERICA				
Silver Bank National Humpback Whale Sanctuary	Dominican Republic (bank is about 35km^2)	Humpback whale	1986 (presidential decree)	Prohibits whaling, waste disposal, and alteration of the sea bottom on the bank; this is a major breeding ground for humpbacks
Biotopo para la Conservación del Manatí Chocon-Machacas	NE shore and surrounding habitat of El Golfete, Guatemala	West Indian manatee	1979	First manatee reserve in Central or South America (Lefebvre et al. 1989; Marsh and Lefebvre 1994)
Corozal Bay Wildlife Sanctuary	Belize	Antillean manatee	1998	Created specifically to protect manatees (Morales-Vela et al. 2000)
Miskito Coast Protected Area	Atlantic coast, Nicaragua	West Indian manatee, tucuxi	1991	Established primarily to protect sea turtle nesting grounds
Tortuguero National Park	Atlantic coast, Costa Rica	West Indian manatee	1970	Benefits to manatees incidental
Coppename River Nature Reserve	Surinam (10,000 ha)	West Indian manatee	?	Benefits to manatees incidental

Table 2. The 13 National Marine Sanctuaries in the United States and their relevance to the conservation of marine mammals [data from Center for the Economy and the Environment 1999 or http://www.sanctuaries.nos.noaa.gov]

Sanctuary (Year of Designation)	Location (Size)	Marine Mammals	Regulations and other Relevant Features	Evaluation *
Monitor (1975)	Cape Hatteras, North Carolina (shipwreck site only)	Not relevant	None	Of no importance to marine mammals
Channel Islands (1980)	22n.mi. off Santa Barbara, CA; includes all waters within 6n.mi. of mean high tide on Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara islands (1658n.mi^2)	Numerous mysticete and odontocete cetaceans; phocid and otariid pinnipeds	Prohibitions on dumping and discharging, alteration of the seabed, and cargo ships within, respectively, 6, 2, or 1n.mi. of any island; extensive visitor support, public education, and resource inventory programs; active in facilitating research	Of major importance to numerous marine mammal populations; supplements regulations applying to Channel Islands National Park; recreational and commercial fishing and kelp harvesting are allowed
Gulf of the Farallones (1981)	Immediately north and west of San Francisco (948n.mi.^{2})	Numerous mysticete and odontocete cetaceans; phocid and otariid pinnipeds	Prohibitions on mineral exploration and exploitation, dumping and discharging, alteration of the seabed, and cargo ships within 2mi around Farallon Islands, Bolinas Lagoon, and other specified areas	Of major importance to numerous marine mammal populations; supplements regulations applying to Point Reyes National Seashore and Golden Gate National Recreation Area
Gray's Reef (1981)	17.5n.mi. off Sapelo Island, GA (23mi^2)	Right whale	Managed mainly to accommodate sport fishing and diving; education program raises awareness about right whales	Despite claimed importance as right whale "calving" habitat, original designation was unrelated to this feature, and the claim itself is questionable; main purpose is to protect a sandstone reef ecosystem ("live bottom habitat")

Sanctuary (Year of Designation)	Location (Size)	Marine Mammals	Regulations and other Relevant Features	Evaluation *
Fagatele Bay (1986)	American Samoa, South Pacific Ocean (0.25mi^2)	Humpback whale, several dolphin species	Emphasis on "community outreach" and education; some biophysical monitoring; restrictions on fishing methods	No direct importance for marine mammal conservation; main purpose is to protect a tropical coral reef ecosystem
Cordell Bank (1989)	45n.mi. northwest of Golden Gate Bridge, San Francisco (397n.mi.^{2})	Dall's porpoise, humpback whale	Prohibitions on oil, gas, or mineral exploration and exploitation, dumping and discharging, and taking benthic invertebrates or algae from the bank or within 50-fathom isobath surrounding it	Main purpose is to protect a major upwelling area; sanctuary status has little or no effect on fishing, which is probably the most significant threat to marine mammals on the bank
Florida Keys (1990)	Southern Florida (221mi-long archipelago; 3674mi.^{2})	Primarily common, bottlenose, and Atlantic spotted dolphins, Florida manatee	Management is complex and involves accommodation for multiple use (especially recreational diving, snorkeling, and fishing, and commercial fishing); zoning; some no-take zones	Probably contributes at least indirectly to conservation of some odontocete cetaceans, and possibly manatees, by supporting their food base; main purpose is to protect a subtropical coral reef ecosystem
Stellwagen Bank (1992)	Off Cape Cod, Massachusetts (842mi^2 or 2181km^2)	Mysticete whales, particularly humpback, fin, right, and minke; several odontocetes; harbor seal	Prohibition on any alteration of the seabed (e.g., sand and gravel mining); agreement with the U.S. Coast Guard provides enhanced enforcement capability	Has had difficulty establishing its relevance to conservation, but there is potential for regulating harmful activities and raising awareness
Monterey Bay (1992)	348n.mi. along the central California coast, average width 30n.mi. (5328mi.^{2})	Sea otter; numerous mysticete and odontocete cetaceans; phocid and otariid pinnipeds	Prohibitions on oil, gas, and mineral exploration and exploitation, dumping and discharging, and alteration of the seabed; some restrictions on vessel and aircraft traffic	Of major importance to numerous marine mammal populations; recreational and commercial fishing are allowed

Sanctuary (Year of Designation)	Location (Size)	Marine Mammals	Regulations and other Relevant Features	Evaluation *
Hawaiian Islands Humpback Whale (1992)	Areas bordering all the main Hawaiian Islands (1300mi^2)	Humpback whale, many odontocete species, Hawaiian monk seal (occasional)	No regulations specific to the sanctuary; primarily engaged in education and monitoring of human activity	Main purpose is to enhance protection and public enjoyment of humpback whales, but of no evident regulatory benefit to marine mammals
Flower Garden Banks (1992; Stetson Bank added 1996)	110mi off Louisiana and Texas coast (56mi.^{2}); Stetson Bank 70n.mi. S of Galveston, TX	None known	None of relevance	Main purpose is to protect northernmost coral reef in US; of little direct relevance to marine mammal conservation
Olympic Coast (1994)	Washington coast from U.S.-Canada border southward for 117n.mi., average width, 30n.mi. (2500n.mi.^{2})	Numerous mysticete and odontocete cetaceans; phocid and otariid pinnipeds	Prohibitions on oil, gas, and mineral exploration and exploitation, dumping and discharging, and alteration of the seabed; some restrictions on aircraft traffic	Of major importance to numerous marine mammal populations; recreational and commercial fishing are allowed; Indian treaty rights to hunting and fishing are honored
Thunder Bay (2000)	Lake Huron (Great Lakes), Michigan (shipwreck site)	None	None	Of no importance to marine mammals

* In all sanctuaries where marine mammals are present, there may be indirect benefits in the form of education programs and support for research administered through the sanctuary.