Conservation Efforts

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Efforts to conserve marine mammals began early in the twentieth century. The impetus for these efforts came from the recognition that populations of several highly valued species—fur seals and the sea otter (*Enhydra lutris*)—had been nearly extirpated by hunting. In most instances, self-regulation through market feedback had been the only thing that prevented extinctions. In other words, as the animal populations were reduced by overkill, it became increasingly difficult to hunt them profitably, so the hunting effort declined. This mechanism was clearly inadequate to protect the stocks of whales because modern whaling was a multispecies enterprise. As right whales (*Balaenidae, Eubalaena spp.*) and blue whales (*Balaenoptera musculus*) became scarce, the fleets simply redirected their attention to humpback, fin, and sei whales (*Megaptera novaeangliae, Balaenoptera physalus, and B. borealis*, respectively), but any right or blue whale encountered would still be killed. By the late 1920s and 1930s, the whaling industry had begun to place limits on oil production and had given some protection to the depleted right whales and gray whales (*Eschrichtius robustus*). Eventually, international agreements emerged to manage the industry on terms more favorable to conservation. It was not until the 1970s, however, that the multispecies problem in commercial whaling had been addressed properly. In fact, few serious efforts to conserve marine mammals for reasons other than as a response to stock depletion or exhaustion were made until the late 1960s and early 1970s.

A discussion of marine mammal conservation can be organized in a number of ways—according to different types of threat (e.g., directed hunting, bycatch in fisheries, chemical pollution), on a species or population basis, by geographical region, or chronologically (Tiwiss and Reeves, 1999; Whitehead et al., 2000; Evans and Raga, 2001; Reeves and Reijnders, 2002; Reynolds et al., 2005). The first part of this chapter is organized according to levels of governance. Conservation efforts have been and should be made at many different levels, from global international agreements all the way “down” to actions by local communities and individual citizens. Therefore, some efforts to conserve marine mammals at the international, regional, national, and local levels are reviewed, and this is followed by a discussion of some of the principal threats and how they are being addressed. Next is a brief overview of the geography of marine mammal conservation, which considers regional differences in the seriousness of threats and in how they are being addressed. Finally, an attempt is made to identify the most threatened marine mammal species and populations.

I. What Is “Conservation”?

“Conservation” is defined here as the preservation of wild populations so that they continue to replicate themselves in a natural context for an indefinite, but long, time into the future (i.e., at least hundreds of generations). This means that not only the animals themselves, but also the environments (habitats and “ecosystems”) that sustain them and the biotic communities to which they belong, need to be preserved. Neither the maintenance of a few individuals in zoo-like conditions, nor the preservation of frozen DNA, constitutes a conservation endpoint. Either of those approaches, however, can be part of a broader effort to achieve conservation goals.

The unit of conservation has traditionally been the species, classically defined as a group of interbreeding natural populations that is isolated reproductively from other such groups. In practice, conservation biologists generally agree that it is insufficient to be concerned only with preserving species. They argue that it is also important to preserve the natural variety within species, including genetic and behavioral variants. One way of achieving this more ambitious objective is by ensuring the survival of local or geographical populations (“stocks”). There is a substantial and growing body of literature on the “stock” concept as it applies to marine mammals (Taylor, 2005).

The term “conservation” has a long history and is often cast in three different perspectives: biocentric, economic, and ecologic.
Biocentric conservation emphasizes the intrinsic value of all life forms and is rooted in religious or philosophical beliefs that place humans on the same plane as other organisms. Although the concept of "animal rights" shares similar roots, it differs from biocentric conservation in that it focuses on the importance of individuals rather than on populations or genomes. Concerns about animal welfare and humane treatment also focus on individuals and are not always central to conservation, as defined here. Economic conservation regards wild animal populations as resources to be used for human benefit. A central tenet is sustainability; killing or other forms of extractive, or consumptive, use are allowed and perhaps even encouraged, but only on the condition that such use does not compromise the ability of a wild population to regenerate itself. Finally, ecologic conservation places a premium on the maintenance of natural systems and processes. Individuals, populations, and species derive importance from their functional relationships with the communities of which they are a part.

The term "conservation" is sometimes used as though it were synonymous with "protection," particularly in the anti-whaling/pro-whaling debate. As used here, conservation does not rule out killing or other forms of use as long as the central goal—population persistence—is assured. Other terms that have tended to replace "conservation" in many forums over the last quarter-decade are "sustainable development" and "sustainable use" (Lavigne, 2006), which assume (questionably) that (a) there is no inherent conflict or incompatibility between human wishes and wildlife needs, (b) wild organisms must be used if they are to be preserved, (c) scientific understanding is sufficient to define sustainability, and (d) mechanisms exist to ensure against "over-use."

II. International Conservation Efforts

Organized conservation efforts at the international level are carried out mainly by intergovernmental organizations established by treaties or conventions (Table I). A few non-governmental organizations (NGOs) also operate on a global basis. Some, such as the International Union for the Conservation of Nature (IUCN, actually a combination of inter- and non-governmental), International Fund for Animal Welfare (IFAW), and World Wide Fund for Nature (WWF), address a wide range of environmental issues.

The scale of any particular effort depends on the geographical distribution of the organisms (or phenomena) being conserved or the threat being addressed. Relatively few international conservation instruments focus solely on marine mammals. The best known is the International Whaling Commission (IWC), established under the International Convention for the Regulation of Whaling (ICRW) signed in Washington, DC, in 1946 (Gambell, 1999). A global conservation body was clearly necessary to manage the exploitation of the great whales, customarily defined as the baleen whales (Fig. 1) plus the sperm whale (Physeter macrocephalus). Most of these animals migrate over long distances and have been hunted on a truly worldwide scale for centuries (Reeves and Smith, 2006).

The IWCs authority as the body responsible for managing whaling worldwide has been challenged in recent years, and there is ongoing controversy about its scope and reach. Some member states (e.g., Japan, Denmark, and Russia) have traditionally insisted that "small cetaceans," meaning all toothed species except the sperm whale and the "bottlenose" whales (defined in the IWC schedule as the northern and southern bottlenose whales, Hyperoodon ampullatus and H. planifrons, respectively, Armonix's beaked whale, Berardius arnuxii, and Baird's beaked whale, B. bairdii), are not covered by the ICRW and that their exploitation and conservation are national, or at most regional, concerns. This interpretation of the Commission's competence ignores the fact that many populations of small cetaceans move seasonally across national borders or onto the high seas. It also fails to acknowledge the close biological relationships among the cetaceans, which mean that they face common threats (e.g., bycatch in fisheries, bioaccumulation of pollutants) and are similarly vulnerable to over-exploitation (Fig. 2). In the absence of IWC oversight, various bilateral and multilateral instruments have been developed to manage takes of small cetaceans (see Section III), and national programs of full protection or managed exploitation are typical (see Section IV).

Any international agreement is effective only if the parties ensure compliance and enforcement. Typically, sovereign states are unwilling to accede to a convention unless they are allowed to opt out of provisions with which they disagree. Under the ICRW, e.g., member countries have 90 days to consider their options before any amendment to the regulations comes into effect. Once an objection has been lodged, the measure is no longer binding on the objecting country. On this basis, Norway has continued commercial whaling for common minke whales (Balaenoptera acutorostrata) despite the IWC's global moratorium established in 1986. Japan and Iceland have used another "loophole" to continue (or resume) whaling. The ICRW allows contracting governments to grant special permits to take whales for scientific research. Although the IWC's scientific committee reviews and comments on permit proposals, its advice is non-binding. Japan has kept its commercial whaling industry viable by issuing permits to kill hundreds of common and southern minke whales (B. bonaerensis), plus a growing array of other species (Bryde's [B. edeni/brydei], sei, fin, and sperm whales) each year, allegedly for research purposes (but see, Cales et al., 2005).

The United Nations Convention on the Law of the Sea (UNCLOS) was ratified in 1982. Rather than strengthening efforts to conserve marine mammals, however, this framework convention has tended to provide states with a rationale for opting out of agreements such as the ICRW. Under the convention, the idea that countries have exclusive sovereign rights to manage resources within 200 nautical miles of their coastlines became firmly entrenched. This has been interpreted to mean that the hunting of coastal stocks of marine mammals should not be subject to international oversight and regulation. Also, although Article 65 calls for member states to "work through the appropriate international organizations" for the conservation, management, and study of cetaceans, it leaves governments with considerable latitude to interpret what that means. Canada, e.g., withdrew from the IWC in 1982, arguing that a bilateral commission with Greenland sufficed as an "appropriate international organization" to manage the hunting of belugas (Delphinapterus leucas) and narwhals (Monodon monoceros) (see Section III) and that the obligation of "working through" an appropriate international body to manage the hunting of bowhead whales (Balaena mysticetus) could be discharged by occasionally sending experts and observers to IWC meetings.

The Antarctic, an important seasonal feeding ground for migratory whale populations and home to several endemic seal species, is a global commons. As such, it requires its own international regime of protection and conservation (Kimball, 1999). The Antarctic Treaty system consists of four separate instruments: the initial framework treaty signed in 1959 (entered into force in 1961), the seals convention of 1972, the marine ecosystem-oriented Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) of 1980, and a 1988 convention on mineral resources. As a whole, this system is nearly comprehensive, particularly taking into account the overlapping responsibilities of the IWC and other instruments.

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### TABLE 1
Current International Conservation Conventions and Institutions

<table>
<thead>
<tr>
<th>Name of Entity</th>
<th>Year of Initiation</th>
<th>Location of Secretariat or HQ</th>
<th>Primary Mandate or Responsibility in Relation to Marine Mammals</th>
<th>Comments on Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)</td>
<td>Signed 1973, entered into force 1975</td>
<td>Geneva, Switzerland</td>
<td>Regulation and monitoring of international trade in products from species and populations classified as threatened</td>
<td>Highly politicized and rancorous, but continued through 1990s to be largely effective.</td>
</tr>
<tr>
<td>International Union for the Conservation of Nature (IUCN)</td>
<td>Established 1948</td>
<td>Gland, Switzerland (with country offices)</td>
<td>Maintains Red List of Threatened Species, sponsors specialist groups (e.g., Cetacean, Seal, Sirenia, Polar Bear, Otter), provides advice to CITES and IWC</td>
<td>Specialist groups provide scientific expertise, promote and coordinate conservation research.</td>
</tr>
<tr>
<td>World Wide Fund for Nature (WWF)</td>
<td>Established as World Wildlife Fund in 1961</td>
<td>Gland, Switzerland (with many national affiliates)</td>
<td>Lobbies for conservation, supports conservation research, and participates in international conservation fora</td>
<td>Influences policies of IWC and CITES, many national affiliates conduct local or regional marine mammal research and conservation programs (e.g., Philippines, USA, Canada, Hong Kong, Malaysia).</td>
</tr>
<tr>
<td>TRAFFIC Network (trade monitoring program of IUCN and WWF)</td>
<td>1976</td>
<td>Cambridge, UK (with regional or national offices)</td>
<td>Monitoring international trade in wildlife, works in close cooperation with CITES Secretariat</td>
<td>Important role in documentation of trade, with emphasis on threatened species.</td>
</tr>
<tr>
<td>Convention on the Conservation of Migratory Species of Wild Animals (CMS; or Bonn Convention)</td>
<td>Signed 1979, entered into force 1983</td>
<td>Bonn, Germany</td>
<td>Conservation of “entire populations or any geographically separate part of the population of any species or lower taxon…, a significant proportion of whose members cyclically and predictably cross one or more national boundaries.”</td>
<td>HAS RECOGNIZED CETACEANS, BUT NOT PINNIPEDS OR SIRENIANS, AS HIGHLY MIGRATORY SPECIES; see Table 2 for relevant regional agreements.</td>
</tr>
<tr>
<td>Convention for the Conservation of Antarctic Seals</td>
<td>1972, entered into force 1978</td>
<td>None, but scientific advice is provided by Scientific Committee on Antarctic Research’s Group of Specialists on Seals, based in Cambridge, UK</td>
<td>Conservation of Antarctic seals, regulation of sealing, facilitation of scientific research on seals</td>
<td>First international conservation agreement to be established prior to the initiation of exploitation.</td>
</tr>
<tr>
<td>United Nations General Assembly Drift-net Resolution 46/215</td>
<td>1991, took effect end of 1992</td>
<td>None</td>
<td>Elimination of large-scale (longer than 2.5km), high-seas drift net fishing (and thus elimination of the large associated bycatch of marine mammals)</td>
<td>More than 1000 vessels were withdrawn from this type of fishing, but drift netting continues inside national 200nmi Exclusive Economic Zones (and probably to some extent illegally in international waters).</td>
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</table>
such as the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Dumping Convention) and the 1973–1978 Convention for the Prevention of Pollution from Ships (the MARPOL Convention). It should provide an adequate legal basis for protecting Antarctic marine mammal populations. What it cannot do is reverse the devastation of the southern stocks of baleen whales caused by the whaling industry. Nor can it protect the seal and whale populations from the ongoing (and worsening) effects of climate change (see Section VIII).

Figure 1  (A) A fin whale (Balaenoptera physalus) is butchered at a whaling station in Iceland on July 11, 1988. (B) A young Icelandic poses with baleen. Iceland used a scientific rationale to justify continued whaling operations for a few years after the International Whaling Commission’s moratorium took effect in 1986. Later, in 1992, Iceland withdrew from the commission, only to rejoin in 2002. Along with Norway and Japan, Iceland has been a strong advocate of resumed commercial whaling and the reopening of international trade in whale products. Photographs by Steve Leatherwood.

Figure 2  (A) Sri Lankans begin butchering a Risso’s dolphin (Grampus griseus; in August 1985). A diverse array of dolphins and whales are killed in Sri Lanka, partly as a bycatch of net fisheries and partly by direct harpooning. Estimates of the total annual kill of small cetaceans in Sri Lanka during the 1980s were in the tens of thousands. (B) Harbor porpoise (Phocoena phocoena) skin and meat are sold, along with other local wildlife, for domestic consumption in West Greenland. The annual reported catch of harbor porpoises in Greenland averaged about 2300 between 2000 and 2005. Photographs by Steve Leatherwood.
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has been in force since 1975. Although CITES has little relevance when the products of exploitation are only for domestic consumption or when animals are captured alive and placed in institutions within the country of origin, it becomes highly relevant when the animals or their products or derivatives cross international borders. The economic stakes can be high, and this is certainly true of the trade in whale meat and blubber, which are in demand by Japan. Under CITES, species and geographical populations can be listed in one of three appendices. Appendix I species or populations are threatened with extinction, and trade in their products for primarily commercial purposes is prohibited. Those in Appendix II are not considered to be in immediate danger of extinction but may become so unless trade is strictly regulated. The third appendix includes species or populations that are subject to national regulation and for which multilateral cooperation is necessary to avoid over-exploitation. The goals of monitoring and regulation are achieved through a system of permits and certificates for export or import issued by national governmental authorities. As of 2007, when the 14th Meeting of the Conference of the Parties took place in The Hague, all of the commercially valuable baleen whales were listed in CITES Appendix I, as were some of the odontocetes, including the sperm whale. Also, a series of resolutions, consolidated in 1979 and calling for CITES member states to honor IWC restrictions on whaling by prohibiting the trade of whale products, remained in force even though it had been challenged forcefully by Japan and Norway. In addition to its role in the whaling arena, CITES has been used to limit the trade in live cetaceans for public display and research (Fisher and Reeves, 2005).

The United Nations ban on pelagic drift nets was a major conservation achievement. In the early 1990s, at least 40 million non-target fish, sharks, seabirds, marine mammals, and sea turtles were being killed annually by the Japanese drift net fishery for squid. Altogether, the high-seas squid drift net fisheries in the North Pacific were killing approximately 15,000–30,000 northern right whale dolphins (Lissodelphis borealis), 11,000 Pacific white-sided dolphins (Lagenorhynchus obliquidens), and 6000 Dall’s porpoises (Phocoenoides dalli) each year. Drift nets set for salmon, tuna, and billfish were taking thousands more dolphins, porpoises, whales, and pinnipeds each year. The threats to populations of pelagic cetaceans, pinnipeds, seabirds, and many other organisms from large-scale, high-seas drift nets were judged sufficiently severe and widespread to necessitate action by the United Nations. A resolution passed by the General Assembly in 1991 called on member nations to enact a moratorium on such drift netting by the end of 1992. This global ban was a valuable step and undoubtedly helped avert catastrophic declines in some marine animal populations. However, the UN decree could not affect the use of these nets inside the 200 nautical mile limit of coastal states. Consequently, pinnipeds and cetaceans continue to be killed in large numbers by drift nets deployed in coastal waters. Also, the global proliferation of pelagic long lining (at times as a replacement for drift netting) has brought new problems, including both depredation (when mammals damage or remove caught fish) and bycatch (when mammals are hooked or entangled in the gear) (Read, 2005).

III. Regional and Bilateral Conservation Efforts

In cases involving species or populations with well-defined distributions that cross several national boundaries, multilateral regional bodies have sometimes been established to monitor and manage exploitation (Table II). Included among these are some “international” instruments that are in fact regional because their scope is defined by the limited geographical ranges of the animals involved. For example, membership in the Inter-American Tropical Tuna Commission (IATTC), which is involved in managing the incidental mortality of dolphins in purse seines, has been geographically diverse since it was created in 1949 under a treaty between the USA and Costa Rica. Only states with an interest in fishing for tuna in the eastern tropical Pacific Ocean have joined the commission, and over the years this has included France, Japan, Vanuatu, the USA, and Mexico in addition to a number of Central and South American countries. Thus, while the commission is international in the sense of having a geographically varied membership, its purview is distinctly regional. Similarly, the International Agreement on the Conservation of Polar Bears and their Habitat involves only the northern circumpolar countries where polar bears occur, and it is therefore treated here as a regional agreement.

The 1911 Treaty for the Preservation and Protection of Fur Seals (often referred to as the North Pacific Fur Seal Convention) involved four countries: Great Britain (signing on behalf of Canada), the USA, Russia, and Japan. This was essentially an agreement among the states involved in the exploitation of northern fur seals (Callorhinus ursinus), which are endemic to the North Pacific Ocean. Pelagic sealing was banned, and as part of the agreement, Japan and Canada were allocated a portion of the profits from the controlled killing (mainly of “surplus” male seals) on the Pribilof (USA) and Commander (Russia) islands. This treaty lapsed in 1941, when Japan withdrew, and was replaced in 1957 by the Interim Convention on the Conservation of North Pacific Fur Seals. The northern fur seal is frequently cited as a conservation success story. Elimination of pelagic sealing, in combination with regulations limiting the kill at breeding rookeries, allowed the seal population to make a strong recovery from its depleted state in the early 1900s. The population reached about 2 million in the 1950s but had dipped below a million by the early 1980s. Numbers in US waters stood at about three-quarters of a million in 2006. The 1957 interim convention, having lapsed in 1984, has not been replaced.

The polar bear (Ursus maritimus) treaty mentioned earlier is often cited as an example of an effective international agreement. Discussions among the range states—Canada, the USA, Denmark (on behalf of Greenland), Norway, and the Soviet Union (now Russia)—began in the mid-1960s, when the future of the polar bear was of great concern because of overhunting and habitat deterioration (Lyster, 1985). The three main objectives of the agreement, which was signed in 1973 and took effect in 1978, were to ensure that appropriate restrictions were placed on hunting, that polar bear habitat was preserved, and that needed research was conducted in a coordinated fashion. The Polar Bear Specialist Group of the IUCN Species Survival Commission has served as a de facto scientific committee, meeting every few years to share information, discuss research needs, and assess the state of polar bear conservation. At its 14th working meeting in 2005, the group concluded that the total population of wild polar bears was between about 20,000 and 25,000, more than half of them in Canada. It stressed the serious implications of climate change and pollution, the need for better regulation of hunting and ship traffic, and the importance of identifying and protecting critical habitat.

The multinational hunt for harp and hooded seals (Pagophilus groenlandicus and Cystophora cristata, respectively) in the northern North Atlantic proceeded without meaningful regulation until the late 1950s, when Norway and the Soviet Union established a bilateral commission to set quotas for commercial catches of harp and hooded seals as well as walruses (Odobenus rosmarus) in the northeastern Atlantic. The reach of this agreement has been interpreted to include large areas of the Greenland and Barents seas, Denmark Strait, and waters...
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TABLE II
Regional or Bilateral Conservation Agreements Currently in Effect

<table>
<thead>
<tr>
<th>Name of Entity</th>
<th>Year of Initiation</th>
<th>Location of Secretariat or HQ</th>
<th>Mandate or Objectives</th>
<th>Comments on Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-American Tropical Tuna Commission (IATTC)</td>
<td>1949</td>
<td>La Jolla, California</td>
<td>Initially to document and manage tropical tuna fisheries; since then, expanded to include documentation, mitigation, and regulation of dolphin mortality incidental to fishing operations in eastern tropical Pacific</td>
<td>Operates program to: place observers aboard tuna vessels, reduce dolphin mortality through diagnosis and solution of gear problems, and training for captains and crews; provides mechanism for linking tuna industry with government agencies and environmental NGOs.</td>
</tr>
<tr>
<td>North Atlantic Marine Mammal Commission on Narwhal and Beluga</td>
<td>1992</td>
<td>Tromsø, Norway</td>
<td>Sustainable use and management of marine mammals in the North Atlantic Ocean</td>
<td>Emphasis on ecological interactions (e.g., rationales for culling marine mammals to protect fish stocks), hunting rights of coastal communities, forum for scientific information exchange.</td>
</tr>
<tr>
<td>Canada/Greenland Joint Commission on Narwhal and Beluga</td>
<td>1989</td>
<td>None (Ottawa, Canada; Nuuk, Greenland)</td>
<td>Cooperative research and management related to “shared” stocks of narwhals and white whales</td>
<td>Forum for bilateral studies and sharing of information, with management measures left to national authorities and local “co-management” bodies.</td>
</tr>
<tr>
<td>Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas ( ASCOBANS)</td>
<td>Signed 1991 (concluded under CMS, the Bonn Convention — see Table 1), entered into force 1994</td>
<td>Bonn, Germany</td>
<td>Cooperation to achieve and maintain a “favourable conservation status” for small cetaceans in the region</td>
<td>Most effort has been directed at estimating abundance and incidental takes of harbor porpoises and dolphins and at seeking ways to reduce bycatch.</td>
</tr>
<tr>
<td>Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area ( ACCOBAMS)</td>
<td>1996 (concluded under CMS, the Bonn Convention — see Table 1), entered into force 2001</td>
<td>Monaco</td>
<td>Cooperation to achieve and maintain a “favourable conservation status” for cetaceans in the region, including the complete prohibition of deliberate taking and establishment of a network of “specially protected areas to conserve cetaceans”</td>
<td>Differs from ASCOBANS in that scope includes all cetaceans, not only “small” species; focuses on bycatch, disturbance and injury by recreational and industrial vessel traffic, prey depletion; planning basin-wide population surveys.</td>
</tr>
<tr>
<td>International Agreement on the Conservation of Polar Bears and their Habitat</td>
<td>Signed 1973, entered into force 1976</td>
<td>None; follows rotating chairmanship of IUCN Polar Bear Specialist Group</td>
<td>To prevent polar bear populations from becoming endangered because of hunting or other human activities</td>
<td>Provides a framework for communication and cooperation among circumpolar countries, emphasis on research and monitoring; signatory states are supposed to “enact and enforce such legislation and other measures as may be necessary to give effect to the Agreement.”</td>
</tr>
<tr>
<td>U.S.-Russia Agreement on Cooperation in the Field of Environmental Protection</td>
<td>1972</td>
<td>None (Washington and Moscow)</td>
<td>Marine Mammal Project, under Area V of the Agreement, provides for information exchange, coordination of research activities, and joint or cooperative research</td>
<td>Annual scientific meetings, formerly focused on Bering and Chukchi seas regions, now also considers, e.g., Caspian seals, bycatch in Japanese salmon drift nets operating within Russian EEZ.</td>
</tr>
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</table>

near the island of Jan Mayen. A similar bilateral agreement pertaining to the northwestern Atlantic was signed by Canada and Norway in 1971. A series of regional bodies have become involved in monitoring the North Atlantic seal hunt and assessing the harp and hooded seal populations to provide management advice. Starting in the 1960s, a Sealing Panel of the International Commission for Northwest Atlantic Fisheries (later the Northwest Atlantic Fisheries Organization, or NAFO) recommended overall quotas and other conservation measures (e.g., opening and closing dates for sealing from ships) related to hunting of the western populations. In recent years, scientific advice
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on harp and hooded seal stocks has come from a working group convened jointly by the International Council for the Exploration of the Sea (ICES) and NAFO. This group's advice is presented to the North Atlantic Marine Mammal Commission (NAMMCO), which in turn offers management advice to its members. Canada decides unilaterally on sealing quotas in the western North Atlantic, whereas Norway and Russia continue to allocate quotas in the West Ice (Jan Mayen) and East Ice (White Sea) on a bilateral basis.

NAMMCO is a regional body established in 1992 by several countries that had become frustrated by the IWC's unwillingness to allow the resumption of commercial whaling. Its membership consists only of Iceland, Norway, Greenland, and the Faroe Islands, the latter two belonging to the Kingdom of Denmark but with "home rule" governments. NAMMCO has devoted much of its attention to species for which there is little or no direct conflict with the IWC, notably harp and hooded seals, ringed seals (*Pusa hispida*), gray seals (*Halichoerus grypus*), walruses, long-finned pilot whales (* Globicephala melas*), and northern bottlenose whales.

An international treaty, the Convention on the Conservation of Migratory Species of Wild Animals (or Bonn Convention), provides a mechanism for developing regional conservation agreements. Three that deal explicitly with cetaceans have been concluded thus far. The Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS) entered into force in 1994, with a membership that initially included Belgium, Denmark, Germany, the Netherlands, Poland, Sweden, and the UK (Finland, France, and Lithuania have since joined then). A major achievement has been the instigation, planning, and completion of two large-scale abundance surveys of cetaceans throughout the Baltic and North Seas, one of them (in 2005) extending westward to include a large area of the contiguous northeastern Atlantic. A second CMS-generated instrument, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS), was concluded in 1996 and entered into force in 2001. Both of those agreements have tried to address a wide range of issues, including incidental mortality in fisheries, chemical pollution, and underwater noise. The development, and especially the implementation, of conservation plans for populations of special concern (e.g., harbor porpoises, *Phocoena phocoena*, in the Baltic; short-beaked common dolphins, *Delphinus delphis*, in the Mediterranean; Fig. 3) has been a major challenge. The third agreement is a memorandum of understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region. It was opened for signatures in 2006 and the first meeting was held in early 2007. As is true of most multilateral instruments, these ultimately depend on the willingness of sovereign state parties to enact and enforce any proposed measures.

Canada and Greenland have a bilateral agreement to manage the hunting of transboundary stocks of white whales and narwhals. In 1989, the two governments signed a memorandum of understanding that recognized the importance of hunting to the Inuit and called for "the rational management, conservation and optimum utilization of living resources of the sea" as reflected in the UNCLOS (see section II). The Joint Commission on Conservation and Management of Narwhal and Beluga meets annually, as does its Scientific Working Group. In addition to management advice directed at government agencies and, in Canada, the Nunavut Wildlife Management Board (a "co-management" body established under an aboriginal land-claims agreement), the commission's Scientific Working Group plans and undertakes collaborative research on narwhals and belugas.

**Figure 3** Short-beaked common dolphins (*Delphinus delphis*) in Kalamos, western Greece, where they were plentiful as recently as the mid-1990s but are now rarely seen. The Mediterranean population of common dolphins is officially listed by IUCN as endangered. A conservation plan commissioned by UNEP's Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area has been available since 2004, but no significant implementation of measures outlined in the plan has occurred. Photograph by Giovanni Bearzi/Tethys Research Institute.

**IV. National Conservation Efforts**

In the USA, the Marine Mammal Protection Act was passed by Congress in 1972, and it has been the cornerstone of a massive domestic commitment to conservation (Baur et al., 1999). Although the MMPA is not the only such law in the world (many countries confer full legal protection to marine mammals), it is undoubtedly the most sweeping of its kind. At the time of the act's passage, a predominant concern was the annual slaughter of more than 100,000 young harp and hooded seals on the spring pack ice off Newfoundland and in the Gulf of St. Lawrence. Public outrage at film footage of seal pups being clubbed to death was probably the most influential single factor in forcing Congress to pass legislation. In addition, however, there was growing concern about the deplorable condition of the world's stocks of large whales, especially the blue whale. Moreover, controversy swirled around the killing of pelagic dolphins by the American tuna fleet in the eastern tropical Pacific (Gosliner, 1999). The estimated kill from 1960 through 1971 had been more than 370,000 dolphins annually (totaling nearly 4.5 million by that time), and environmentalists were understandably outraged.

The resulting legislation was both comprehensive and innovative. An immediate embargo was placed on the importation of marine mammal products, with only a few specified exceptions. Deliberate taking was banned, although Alaskan Eskimos and other aboriginal people were allowed to continue hunting marine mammals for food, skins, and other products as long as the main purpose was to meet basic community needs. A strong emphasis in the act was placed on research, and science was accorded a prominent role in influencing how decisions were to be made. Existing federal departments were given the responsibility of implementing the new law, with the Department of Commerce to manage cetaceans and most pinnipeds and the Department of the Interior to manage polar bears, sea otters, sirensians, and walruses. In addition, however, an entirely new and independent federal agency, the Marine Mammal Commission, was established to oversee implementation.
The goals of management, as set forth in the Marine Mammal Protection Act, were to achieve and maintain “optimum sustainable populations” of marine mammals and to reduce incidental mortality from fishing operations (including tuna seining) to “insignificant levels approaching zero.” An optimum sustainable population has been defined operationally as having a lower bound at the maximum net productivity level and an upper bound at the unexploited population (carrying capacity) level. By defining population status in terms of productivity, the act emphasized the health and stability of ecosystems rather than economic yield. The ambitious and lofty goals of the act have been pursued over the past 35 years with what appears to be an undiminished national commitment to the conservation of marine mammals.

The European Union has used a more selective approach to achieve certain objectives related to marine mammal conservation. In 1983, the European Community (as it was then called) established a controversial ban on the importation of products from seal pups. The explicit goal was to stop the clubbing of young white-coated harp seals and blue-backed hooded seals, a concern related primarily to animal welfare. In combination with closure of the US import market from 1972, the European ban effectively destroyed the profitability of sealskin production in North America and Greenland, with serious unintended economic and social consequences in Eskimo communities where the hunting of ringed seals was a major source of income. Canada was forced to stop the commercial hunt for unwounded harp and hooded seals, essentially bringing the large-scale, ship-based sealing industry to a halt. For more than a decade, the populations of harp and hooded seals were allowed to increase. Since the mid-1990s, however, Canada’s commercial sealing industry has been reinvigorated with government subsidies and aggressive product marketing, particularly focused on the export of seal penises to China and other Asian countries, so the kill of harp and hooded seals has returned to levels not seen since the early 1970s.

The European Community also effectively banned the importation of whale products in 1982–1983 by declaring that all cetaceans would be treated as though they were in Appendix I of CITES (no commercial trade allowed). Greenland, with its special relationship to Denmark, was exempted from the ban, meaning that narwhal tusks could be imported to EU countries under the normal provisions of CITES Appendix II. Thus, although the EU measure caused a steep decline in the value of narwhal ivory from Canada (Fig. 4), it had comparatively little effect on the market for tusks from Greenland, which was traditionally centered in Europe. Having lost access to the American market and much of the European market for narwhal ivory, entrepreneurs in Canada found new buyers in Asia, a pattern similar to that seen with seal products.

National conservation efforts are often influenced by international law or governance, and such influence can be for either good or ill. The US government, in implementing the Marine Mammal Protection Act, has had to take account of what are sometimes conflicting commitments under international agreements. For example, the USA has always belonged to the IATTC, whose primary goal is to maximize tuna catches. A sometimes uneasy alliance has been forged over the years between the IATTC and the US National Marine Fisheries Service, the agency responsible for pursuing the “zero mortality rate” goal for dolphins mandated by the Marine Mammal Protection Act. Although substantial progress has been made toward that goal by the late 1980s, animal protection groups continued to mount legal challenges, insisting that the procedure of setting purse seines around dolphins to catch tuna should cease altogether. Their efforts led to the “dolphin-safe” labeling of canned tuna and to embargoes on US imports of tuna from countries continuing to “fish on dolphins.” The IATTC took the position that by redirecting all fishing effort away from “dolphin sets” and toward “school sets” and “log sets” (neither of which involve dolphin encirclement), the bycatch of other species (e.g., billfish and turtles) and the proportion of undersized tuna in the catch would both increase. In general, the Fisheries Service has tended to assign a higher priority to dolphin protection than has the IATTC, and the relationship between the two agencies has been strained because of this and other differences. To make matters worse, Mexico mounted a challenge to the tuna embargoes under the General Agreements on Tariffs and Trade (GATT), insisting that they were unwarranted and unacceptable impediments to free trade. The dispute-resolution panel ruled that the embargoes were indeed inconsistent with GATT provisions, and the USA consequently had to seek a balance between its commitment to marine mammal protection and its support for the principle of free trade (Gosliner, 1999).

In a more positive vein, the IWC has managed to influence the conservation of small cetaceans in Japan, despite Japan’s refusal to recognize the commission’s authority to impose measures related to dolphins, porpoises, and smaller species of toothed whales. A variety of small cetaceans have been hunted in Japanese coastal waters for many decades (Fig. 5). The IWC Scientific Committee’s standing Subcommittee on Small Cetaceans meets annually to review the status of species, particular threats, and technical approaches to eliminating or managing threats. In its reviews of stocks, the subcommittee has repeatedly found evidence of over-exploitation by the Japanese coastal cetacean fisheries. As a result, the government of Japan has been forced, through international pressure from governments and NGOs, to implement research programs and management measures.

The most glaring (but not only) example is the striped dolphin (Stenella coeruleoalba). A drive hunt for striped dolphins, in which entire schools are herded toward shore and killed en masse, has
taken place annually on Japan’s Izu Peninsula for more than a century. Catches of as many as 22,000 animals occurred in some years during the 1940s and 1950s. By the 1980s, when the hunters introduced a voluntary catch limit of 5000 dolphins, the annual average catch had declined to less than 3000/year, presumably because the dolphin population was seriously depleted. Finally, in 1989, quotas were imposed. Although the hunt should have stopped entirely to allow the population to recover, the striped dolphin example at least helped demonstrate that stronger measures by the national government in Japan would be needed to prevent further over-exploitation.

V. Local and Individual Conservation Efforts

Top-down approaches to resource management have often failed. The cost of policing human actions is likely to be unacceptably burdensome when local people assign little or no legitimacy to the management regime. It is generally agreed that the greater the local or community involvement, the more likely it is that conservation efforts will succeed in the long run (Mangel et al., 1996). Marine mammal hunting communities in the Arctic and in Australia [where dugongs (Dugong dugon) are the principal prey species] have forged cooperative management (“co-management”) agreements with government agencies. Ideally, such agreements recognize the interests and rights of local people, and the broader national and international concerns are represented by the central government.

A prominent example is the Alaska Eskimo Whaling Commission (AEWC), which was established in 1977 by whalers in northern Alaska in reaction to the IWC’s controversial decision to ban bowhead whaling. After several years of difficult negotiations, marked by threats, lawsuits, and even a grand jury investigation into violations of the agreed bowhead quota in 1980, a cooperative agreement was reached between the AEWC and the National Oceanic and Atmospheric Administration (NOAA), the federal body directly responsible by law for implementing IWC decisions within the USA. Under this agreement, the AEWC assumes responsibility for managing the hunt, monitoring compliance with the quota and other regulations, and reporting each year’s results. Quotas on the number of strikes and landings of bowheads are still negotiated through the IWC.

Singling out the contributions of individuals to the cause of conservation is an arbitrary undertaking. The conscientious daily efforts of bureaucrats, scientists, writers, educators, fishermen, engineers, veterinarians, lobbyists, lawyers, and political activists all merit recognition. Several individuals are mentioned here, but with the caution that their work, while it may be exemplary, is not necessarily exceptional.

As discussed further later (under Section VII), the rescue and rehabilitation of injured or otherwise incapacitated individual marine mammals may have little or no conservation value. Nevertheless, in some circumstances, especially when an endangered species is involved, intervention can be important. Jon Lien, a professor at Memorial University in Newfoundland, began working with fishermen in the late 1970s to devise ways of extricating whales from fishing gear. The problem of entrapment and entanglement was a concern of conservationists because, at the time, humpback whales in the North Atlantic were considered endangered (their status has improved since then). It was of concern to fishermen because of the economic losses associated with damaged gear and lost fishing time, as well as the personal danger involved when dealing with these large animals at sea. Lien gained the confidence of fishermen and developed a successful program for assisting in the safe release of entrapped or entangled whales. Subsequently, Charles Mayo, David Mattila, and their associates at the Center for Coastal Studies on Cape Cod began rescuing whales from fishing gear on the US coast, with an emphasis on endangered right whales (Eubalaena glacialis). Disentanglement teams are now integral to right whale recovery efforts in the eastern USA and southeastern Canada, thanks to the pioneering efforts of Lien, Mayo, and Mattila. A similarly successful program centered on rescuing harbor porpoises, minke whales, and occasionally right whales trapped in herring weirs has been in operation in Canada’s Bay of Fundy for more than two decades (Fig. 6).

One of the greatest obstacles to conservation can be the difficulty of defining and demonstrating the significance of a threat.

Figure 5 Japanese fishermen have hunted small cetaceans for many decades, often driving hundreds of animals toward shore where they are killed en masse. Rough-toothed dolphins (Steno bredanensis), shown here, are rarely taken in drive hunts, and even more rarely is a photographer on hand to record the carnage. Photograph by Rusty White, courtesy of Hubbs Marine Research Institute.

Figure 6 A harbor porpoise (Phocoena phocoena) that had been trapped in a herring weir in Passamaquoddy Bay, New Brunswick, Canada (summer 1980), being lifted from a seine net before tagging and release. Efforts to extricate marine mammals from fishing gear and return them to the wild typically require that fishermen and scientists work together cooperatively. Photograph by Randi Olsen.
Marine debris pollution provides a clear example (Laist et al., 1999). Although it is widely accepted today that marine debris, such as derelict fishing gear and plastic packaging material, is a menace to wildlife, the problem's seriousness was not recognized until the early 1980s. Charles Fowler, a scientist with the National Marine Fisheries Service in Seattle, was engaged in research to determine the cause of the continuing decline of North Pacific fur seals (see Section III). Despite bureaucratic resistance and the skepticism of scientific colleagues, Fowler pressed ahead with the task of marshaling data to test the hypothesis that entanglement in debris was a major cause of juvenile mortality in fur seals. His painstaking compilation of evidence, together with mathematical models, finally convinced others that at least this one marine mammal species was being affected at the population level. Fowler's work provided the impetus for a chain of events, from beach clean-up campaigns to the signing of international treaties, intended to reduce the ocean's burden of debris and therefore lessen the risks to seals and cetaceans, to say nothing of seabirds, turtles, and other marine wildlife.

One final example of an individual's ability to change the course of conservation policy again relates to dolphin mortality in the eastern tropical Pacific tuna fishery. By the late 1980s, many conservationists had forgotten about this issue, assured that dolphin mortality had been reduced substantially as a result of changes in fishing techniques and the imposition of annual quotas on the number of dolphins from each species that could be killed before fishing would have to cease. In 1987–1988, however, Sam LaBudde, who described himself as an "itinerant biologist," spent 5 months aboard a Panama-registered tuna boat. Although he had signed on as an ordinary seaman and cook, he carried a video camera and clandestinely recorded grisly footage of dolphins being killed. When the scenes were aired on national television, it galvanized public support within the USA for strong measures to be taken against the non-American tuna fleet. While LaBudde's actions can be viewed as either heroic or deceitful, depending on one's point of view, there is no doubting his courage or his influence on the course of conservation.

VI. Protected Areas

The designation of specially protected areas (e.g., reserves, sanctuaries, parks) is a tool increasingly used to achieve conservation goals. Of the many such areas around the world, relatively few exist for the explicit purpose of benefiting marine mammals (Hoyt, 2005). Mexico declared Scammon's Lagoon (Laguna Ojo de Liebre) a refuge for gray whales in 1971, and San Ignacio Lagoon was given similar status in 1979. Also, Mexico established a Biosphere Reserve in the upper Gulf of California in 1993 mainly to protect the highly endangered vaquita (Phocoena sinus) and the totoaba, an endangered sea bass (Totoaba macdonaldi). New Zealand created the Banks Peninsula Marine Mammal Sanctuary in 1988 to protect Hector's dolphins (Cephalorhynchus hectori), like the vaquita an endemic coastal species, from entanglement in gill nets. 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, intended to protect harbor porpoises from the dangers associated with gillnet fishing, jet skiing, and high-speed motor boating. In the USA, the Hawaiian Islands Humpback Whale Sanctuary was declared in 1993, and several other marine sanctuaries were established in large part because of public interest in the marine mammals that use them for feeding, breeding, or both (e.g., the California Channel Islands, Gulf of the Farallones, Monterey Bay, and Stellwagen Bank sanctuaries).

In addition to those areas explicitly created to benefit marine mammals, there are many small sites in the Antarctic and on the sub-Antarctic islands that are designated as specially protected areas or sites of special scientific interest under the Agreed Measures for the Conservation of Antarctic Fauna and Flora (1964), or as nature reserves under national legislative instruments, many of which protect vital haul-out habitat for pinnipeds. Norway's Svalbard (Spitsbergen) archipelago in the northeastern North Atlantic was the site of some of the worst excesses of early whaling and walrus killing, yet since 1973 about half of the land area has been declared to be inside nature reserves and national parks, and the Svalbard population of walruses is expanding rapidly.

All too often, protected areas are created in response to a public outcry, but without an accompanying ongoing commitment to enforce meaningful restrictions on human activities within them. The marine sanctuary program in the USA, e.g., has failed to meet the public's high expectations, largely because no serious attempt has been made to regulate fishing within the sanctuaries. To the program's credit, though, the dumping of wastes and the exploration for oil and gas have been strictly regulated, and this may be seen as having conservation value for marine mammals and other organisms. So-called "paper parks" and "paper reserves" can be counterproductive for conservation because they provide false assurance that space and resources have been set aside for wildlife.

VII. Strategies to Enhance the Survival and Reproduction of Individuals

At times, human intervention can improve the chances for individual marine mammals to survive and reproduce. Organized programs for rescuing marine mammals that strand (come ashore) alive or that are injured and debilitated do manage to release some animals after rehabilitation. However, the success rate is low, and the conservation value of such programs has often been called into question. Many strandings represent "natural" mortality. Thus, while intervention may be justified as a humane gesture intended to improve the welfare of the stranded animals, it can also be argued that natural processes should be allowed to proceed without human interference. Only in a few special cases can rescue, rehabilitation, and release efforts be considered to have made a clear, positive difference for a marine mammal population.

Most of the rivers in southern Asia inhabited by river dolphins are partitioned by irrigation dams (called barrages). When dolphins on the upstream side of such dams get too close to the intake structures of adjacent canals, they run the risk of becoming marooned in the canals, unable to return to the safety of the main river channel. Wildlife officers and conservationists sometimes attempt to locate and rescue these ill-fated dolphins. Between January 2000 and July 2007, at least 46 Indus dolphins (Platanista gangetica minor) were trapped in canals near Sukkur Barrage in Pakistan (Gill Braulik and WWF-Pakistan/Uzma Khan, personal communication, 21 July 2007). The majority of them were successfully captured and returned to the river. Sindh Wildlife Department and WWF-Pakistan are developing a systematic procedure for notification and response, and are refining a protocol for rescuing river dolphins that enter irrigation canals. Also, on several occasions Ganges dolphins (Platanista gangetica gangetica) have become trapped in isolated pools, shallow streams, or rice paddies, and have been successfully captured and released into safer areas (Fig. 7).

In Florida, several facilities that display captive marine mammals have been collaborating for many years with the US. Fish
Conservation Efforts

Rescue and rehabilitation programs can contribute to conservation in less direct ways, too. For example, as John Reynolds (1999) has pointed out, “Educating people about manatee conservation as they watch recuperating animals in a zoo setting can make a strong impression that may do more to encourage actual conservation than reading an article or watching a documentary about manatees.” The whale and river dolphin rescue efforts mentioned earlier also serve to heighten awareness, educate people about conservation issues, and inspire actions to prevent further entanglement and entrapment. Reynolds also points out that manatees in captivity have allowed scientists to study their species’ reproduction, osmoregulatory capabilities, and sensory abilities. Knowing more about manatee biology and physiology is important for conservation.

Finally, rescue and rehabilitation programs offer opportunities to instrument and monitor animals after release. This can lead to new discoveries about the animals and allow researchers to test new study methods. There are many examples, but one in particular stands out. In 1997 an adult male bottlenose dolphin (Tursiops truncatus), nicknamed “Gulliver,” stranded in Florida. He was treated for a variety of ailments and, after about 4 months in captivity, released far offshore bearing a satellite-linked transmitter. Gulliver’s travels were impressive. After a week moving northward along the continental shelf, he headed southeast, swimming against the North Equatorial Current. He traversed waters more than 5000 m deep and reached an area northeast of the Virgin Islands before his transmitter stopped working, having covered 4200 km in 47 days. This study showed that bottlenose dolphins can be extremely mobile and that previous assumptions about the distributional limits of pelagic stocks needed to be reconsidered.

Another example of human intervention to enhance survival comes from the northwestern Hawaiian Islands, where biologists from the US National Marine Fisheries Service have captured and translocated endangered monk seals (Monachus schauinslandi). In one program on Laysan Island, they caught some adult males that had been seen participating in “mobbing,” or collective attacks on adult females and juvenile seals. The males were moved by ship to Johnston Island, some 600 miles south of Laysan, and released in the hope that they would survive but not return to carry on their destructive behavior toward other monk seals. In another program, called “Headstart,” female pups at Kure Atoll have been collected after weaning and kept in a fenced beach enclosure for several months. The watered portion of the enclosure is kept well stocked with fish taken from nearby reefs, and the young seals have a chance to learn to forage in safety from large sharks, adult male monk seals, and hazardous fishing gear—all potential causes of mortality. The idea is that by the time they are released, they will have survived a critical stage in the life cycle and be ready for independence.

Captive breeding, with the intention of using captive-born young to reestablish a species in its former range or to supplement a depleted wild population, is sometimes employed as a conservation strategy when necessary and feasible. However, only one serious attempt has been made to restock a wild population of marine mammals with animals that were conceived, born, and reared in captivity. A number of captive-born harbor seals (Phoca vitulina) were released into the Dutch Wadden Sea, where their species had been depleted (although harbor seals are not threatened globally). The released seals were monitored with telemetry devices, and early results suggested that they had survived and adapted reasonably well.

Although captive breeding programs have been discussed in relation to Yangtze River dolphins, or baiji (Lipotes vexillifer), and Mediterranean monk seals (Monachus monachus), both gravely endangered, none of these programs have come to fruition.

Figure 7  Interest in marine mammals, and concern about their conservation, is not limited to wealthy, countries. In Bangladesh, e.g., young conservationists are eager to contribute, and they collaborate with local and international scientists to study and conserve freshwater and coastal cetaceans (A). Here, a Ganges river dolphin (Platanista gangetica) is returned to the Sundarbans Delta after having been found stranded, its long beak fouled with monofilament gill netting (B). Photographs by Mowgliz, courtesy of Brian Smith.
A much-publicized “seminatural reserve” was established for river dolphins in a Yangtze River oxbow, but this facility was stocked primarily with finless porpoises (*Neophocaena phocaenoides*) rather than dolphins. The single female baiji introduced to the reserve became entangled in fishing gear and died. No attempt was made to place this female with the lone male baiji in captivity (which itself later died), so there was no prospect of captive breeding. Efforts to capture additional baiji for captivity or for stocking the seminatural reserve failed, and a recent survey led investigators to conclude that the baiji is likely extinct and that further capture and translocation efforts would be pointless (Turvey et al., 2007).

Translocation efforts played a role in the sea otter’s reoccupation of parts of its original range. More than 700 otters were taken from high-density areas in Alaska during the 1960s and early 1970s and released at unoccupied sites in British Columbia, Washington, and Oregon. Populations are now well established in British Columbia and Washington. A controversial attempt was made during the 1980s to establish a new population of sea otters in the California Channel Islands in view of the risk that an oil spill could destroy the mainland population. More than 135 otters were captured and translocated to San Nicolas Island, but their numbers did not increase as expected and by the mid-2000s only about 30–35 remained.

VIII. Reduction of Environmental Pollution (Chemical and Acoustic)

The role of pollution in impairing the productivity and survival of marine mammals was first realized in the 1970s, when a correlation was found between the rate of reproductive failure (premature births, still births, and abortions) in California sea lions (*Zalophus californianus*) and elevated tissue levels of DDT (Vos et al., 2003). Also during the 1970s, studies of seals in the Baltic and North seas provided suggestive evidence that organochlorine pollutants pose serious risks to the health and reproductive potential of marine mammals. The production and use of DDT, PCBs, and some other dangerous persistent organochlorine chemicals began to be restricted in North America and western Europe in the 1970s, and there has been a general trend toward further restrictions since then. Unfortunately, however, the problem is far from solved. For example, India continued to produce 4000 metric tons of DDT at least as recently as the mid-1990s, and at least some of the former Soviet states have continued to manufacture and use PCBs. Moreover, the persistent nature of these chemicals means that they continue to be present in the environment, either temporarily sequestered in sediments or recycling in food webs, and therefore marine mammals continue to be vulnerable to their effects. While it must be acknowledged that the principal motivation for banning the release of harmful substances into the environment has had less to do with protecting marine mammals than with protecting human health (and birds, in the case of DDT), there is no doubt that reports of high levels of contaminants in marine mammals have contributed to public concern (O’Hara and O’Shea, 2005).

Acoustic pollution is thought to be especially damaging to cetaceans, as they depend heavily on sound for information about their environment, for foraging, and for communication. Military sonar has been implicated in numerous mass strandings of cetaceans, particularly beaked whales (Hildebrand, 2005). Noise associated with the offshore exploration, development, and transport of oil and gas has been a particular source of concern, and many millions of dollars have been invested in studies of effects (Richardson et al., 1995). In some instances, notably those involving seismic and drilling noise in the Arctic, steps have been taken to minimize the exposure of whales and seals to high-energy sounds. In some countries, government agencies and companies have conducted monitoring programs to determine when marine mammals are present in an area so that operations can be suspended or moved to protect them. In a similar vein, the sites and timing of military exercises have, in a few instances, been planned with the safety of marine mammals and other marine wildlife as a primary consideration.

It has become increasingly clear that human-induced changes in global climate will have (and probably already have had) significant effects on marine mammal populations. The effects will be most obvious for ice-associated species: the phocid seals in the Arctic and Antarctic and the walrus and polar bear in the Arctic. These animals use sea ice as a platform for resting, giving birth, or, in the case of polar bears, hunting. As the extent and thickness of pack ice decrease from global warming, these species will lose critical habitat. Once again, as in the case of toxic chemical pollution, the primary motivation for taking steps to reduce emissions of greenhouse gases and ozone-depleting substances has been concern about human welfare rather than a desire to conserve marine mammals.

IX. Reduction of Conflicts with Fisheries

Fishery policies are the key to many of the most pressing marine mammal conservation problems. While there are examples of effective action to reduce marine mammal mortality in fishing gear, such as the UN ban on high-seas drift netting, the seasonal or permanent closure of certain areas to gill netting, and the development and implementation of deterrence programs using pingers and similar devices, the sad truth is that many critical situations simply continue to deteriorate (Fig. 8). For example, although some legal limits
have been placed on gill netting and commercial fishing in a portion of the northern Gulf of California, there has been little effective enforcement, and vaquitas remain in jeopardy (Rojas-Bracho et al., 2006; Jaramillo-Legorreta et al., 2007). In China’s Yangtze River, it is illegal to fish with electricity and explosives, yet there is almost no enforcement, and river dolphins (if any survive, which seems unlikely) and finless porpoises continue to be killed and injured as unintended victims (Turvey et al., 2007).

X. Reduction of Disturbance and Direct Harm from Vessel Traffic

Manatees living in Florida’s motorboat- and barge-infested waterways are frequently struck and injured, if not killed outright, by watercraft (also see section VII). On average, about 50 Florida manatees are killed by boat collisions each year, and many more are injured and harassed by vessel traffic. Although this problem had been recognized, it was not until the late 1970s and early 1980s that serious efforts were made to reduce the risk of collisions and disturbance. More than 20 areas have been designated as protection zones for manatees, where vessel speed is regulated and signs warn visitors of the need to exercise caution. In some key manatee congregation areas, all waterborne human activity, including diving, boating, and swimming, is prohibited.

Another marine mammal species that is clearly threatened by ship strikes is the North Atlantic right whale. Where thousands of right whales were present in the past, all that remains is a small population of about 350 to 400 centered along the east coast of Canada and the USA. Several right whales are killed by ship collisions each year. This mortality, combined with that caused by entanglement in fishing gear, is considered sufficient to have stalled population recovery (Kraus et al., 2005). Efforts have been made in both Canada and the USA to map the seasonal distribution and movements of right whales and to caution vessel captains to watch for and avoid them. Both countries have also modified the official shipping lanes into key ports in the hope that this will reduce the risk of ship strikes.

It remains to be seen whether manatees and right whales will be able to withstand the effects of human activities in the coastal and inshore waters we share with them. Thus far, our own species’ recreational and commercial use of the marine environment has been regarded as sacrosanct, and the few gestures made to accommodate the needs of these other species have had to overcome strenuous resistance from boaters, the shipping industry, military authorities, and others.

XI. Giving Economic Value to Living Wild Marine Mammals

In the 1950s, a few nature enthusiasts in southern California began venturing into near-shore waters to watch gray whales. At the time, scientists were just beginning to document the remarkable recovery of this whale population—a result of the protection from whaling afforded by the IWC and, in recent years, Mexico’s protection of the breeding lagoons in Baja California. Interest in watching whales grew steadily, and by the mid-1970s, conservationists were suggesting that the “non-consumptive” use of whales as objects of tourism might eventually rival whaling in economic value. The 1980s and 1990s saw the rapid proliferation of tour enterprises for observing whales and dolphins. Even in the whaling countries of Norway, Iceland, and Japan, whale watching has become a popular and remunerative form of recreation. In eastern Canada, helicopter tours to the pack-ice pupping grounds of harp seals have been encouraged by animal-welfare groups as a way of demonstrating that seals also can generate income (tourism revenues) without having to be killed. In the Antarctic and Arctic, opportunities to observe marine mammals are an important aspect of nature-oriented tourism.

XII. Zoogeography of Marine Mammal Conservation

Threats to marine mammal species and populations are relatively well understood and are being addressed to some degree in North America, Europe, South Africa, Australia, and New Zealand. However, even in those parts of the world, serious problems remain. In fact, North Atlantic and North Pacific (Eubalaena japonica) right whales, Hawaiian monk seals, northern (or Steller) sea lions (Eumetopias jubatus), and sea otters in US waters, Mediterranean monk seals and some local populations of bottlenose dolphins, harbor porpoises, and short-beaked common dolphins in Europe, dugongs in parts of Australia, and Hector’s dolphins in New Zealand are still in trouble. Elsewhere in the world, marine mammal populations are slipping away even before there has been a chance to document their distribution and abundance, or to elucidate their ecological roles.

Table III lists 20 of the world’s most threatened marine mammal taxa. The list is by no means authoritative, or exhaustive. Some species, such as the franciscana dolphin (Pontoporia blainvillei) and Caspian seal (Pusa caspica), might merit inclusion except for the fact that their total numbers are still believed to be in the tens of thousands. For other species, such as the West African manatee (Trichechus senegalensis) and Amazonian manatee (T. inunguis), we have very little understanding of how many there are or the extent to which their distribution has been reduced by over-exploitation, incidental mortality in fishing gear, and habitat deterioration. For these and many other situations, there has been little or no active conservation. Another concern is that by limiting the list to recognized species and subspecies, geographical populations are left out. In particular, numerous geographically isolated populations that are known to be in serious trouble are missing simply because they have not been accorded a subspecies designation. Among the more obvious examples are several freshwater populations of Irrawaddy dolphins (Orcaella brevirostris), the western Pacific population of gray whales, and the Cook Inlet (Alaska) population of belugas, all of which number in the tens or low hundreds and are listed by IUCN as Critically Endangered.

Endemism is a feature that is often associated with vulnerability. Many of the species and subspecies in Table III are on the list because they occur in only one place. For example, the baiji was confined for the last several decades of its existence (it is likely now extinct) to the main stem of the Yangtze River, and the Indus river dolphin to the main stem of the Indus. The vaquita is limited to the upper portion of the Gulf of California, and the Saimaa, Ungava, and Ladoga ringed seals occur only within single networks of freshwater rivers and lakes. The effects of endemism are, of course, scale dependent—the smaller the range, the more vulnerable the population tends to be. A species or population that ranges throughout, or on both sides of, an ocean basin is usually less vulnerable than one limited to a single stretch of coastline or a single river or lake. However, an extensive range and great mobility also mean that management for conservation (e.g., protection from hunting, entanglement in fishing gear, exposure to ship strikes, and other threat factors) must be pursued on a large spatial scale and, often, across multiple jurisdictions.

The conservation challenges that lie ahead are truly endless. As the global economy becomes more integrated and as the human appetite (and capacity) for consuming our planet’s resources expands,
<table>
<thead>
<tr>
<th>Taxon</th>
<th>Range States</th>
<th>Approx. Abundance</th>
<th>Main Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Caribbean monk seal, <em>Monachus tropicalis</em></td>
<td>Mexico, USA, Bahamas, Jamaica, Cuba, Haiti, Dominican Republic, Guadeloupe, and other Caribbean states</td>
<td>Probably extinct</td>
<td>Deliberate killing, loss of habitat due to development</td>
</tr>
<tr>
<td>2. Baiji or Yangtze river dolphin, <em>Lipotes vexillifer</em></td>
<td>China</td>
<td>Probably extinct</td>
<td>Fishery bycatch, loss and degradation of habitat due to development, contamination and depletion of prey resources, vessel strikes and disturbance</td>
</tr>
<tr>
<td>3. Vaquita, <em>Phocoena sinus</em></td>
<td>Mexico</td>
<td>100s</td>
<td>Fishery bycatch</td>
</tr>
<tr>
<td>4. Mediterranean monk seal, <em>Monachus monachus</em></td>
<td>Turkey, Greece, Italy, Mauritania, Morocco, Western Sahara, Libya, Madeira (Portugal)</td>
<td>500</td>
<td>Fishery bycatch, shooting by fishermen, loss of pupping and pup-rearing habitat</td>
</tr>
<tr>
<td>5. North Atlantic right whale, <em>Eubalaena glacialis</em></td>
<td>Canada, USA, Iceland, Norway, UK, Spain, Portugal, France</td>
<td>350–400</td>
<td>Ship strikes, fishery bycatch, possibly effects of small population size (depletion from past over-exploitation)</td>
</tr>
<tr>
<td>6. North Pacific right whale, <em>Eubalaena japonica</em></td>
<td>Russia, Japan, Korea, China, Canada, USA, Mexico, Canada</td>
<td>Mid to high 100s</td>
<td>Ship strikes, fishery bycatch, possibly effects of small population size (depletion from past over-exploitation)</td>
</tr>
<tr>
<td>7. Hawaiian monk seal, <em>Monachus schauinslandi</em></td>
<td>USA (Hawaiian archipelago)</td>
<td>1,000</td>
<td>Fishery bycatch, disturbance on pupping beaches, debris entanglement, possibly prey depletion by commercial fisheries</td>
</tr>
<tr>
<td>8. Hector’s dolphin, <em>Cephalorhynchus hectori</em></td>
<td>New Zealand</td>
<td>7,000</td>
<td>Fishery bycatch, vessel strikes</td>
</tr>
<tr>
<td>10. Maui’s (North Island Hector’s) dolphin, <em>Cephalorhynchus hectori mahi</em> (new subspecies recognized in 2002)</td>
<td>New Zealand</td>
<td>100</td>
<td>Fishery bycatch</td>
</tr>
<tr>
<td>11. Saimaa ringed seal, <em>Pusa hispida saimensis</em></td>
<td>Finland</td>
<td>280</td>
<td>Fishery bycatch, changes in habitat due to water management policies, chemical contamination</td>
</tr>
<tr>
<td>12. Ungava harbor seal, <em>Phoca vitulina mellonae</em></td>
<td>Canada</td>
<td>Low to mid 100s</td>
<td>Loss and fragmentation of habitat due to water management policies, hunting</td>
</tr>
<tr>
<td>13. Red Sea dugong, <em>Dugong dugon henurochilis</em></td>
<td>Egypt, Saudi Arabia, Yemen, Eritrea, Sudan</td>
<td>Probably low 1,000s at most, possibly only 100s</td>
<td>Fishery bycatch, hunting</td>
</tr>
<tr>
<td>14. Bludan or Indus river dolphin, <em>Platanista gangetica minor</em></td>
<td>Pakistan</td>
<td>1,200</td>
<td>Loss and fragmentation of habitat due to water management policies, accidental movement into canals and other unsafe areas, fishery bycatch, chemical contamination</td>
</tr>
<tr>
<td>15. Yangtze River finless porpoise, <em>Neophocaena phocaenoides asiaeorientalis</em></td>
<td>China</td>
<td>1,500–2,000</td>
<td>Fishery bycatch, loss, degradation, and fragmentation of habitat due to water management policies and sand mining; possibly contamination and depletion of prey resources</td>
</tr>
<tr>
<td>16. Southern sea otter, <em>Enhydra lutris nereis</em></td>
<td>USA</td>
<td>2,800–3,000</td>
<td>Fishery bycatch, human-mediated disease</td>
</tr>
<tr>
<td>17. Susu or Ganges river dolphin, <em>Platanista gangetica gangetica</em></td>
<td>India, Bangladesh, Nepal</td>
<td>At least low 1,000s</td>
<td>Fishery bycatch, deliberate hunting, loss and fragmentation of habitat due to water management policies, accidental movement into canals and other unsafe areas, chemical contamination</td>
</tr>
<tr>
<td>18. Florida manatee, <em>Trichechus manatus latirostris</em></td>
<td>USA, Bahamas (occasionally)</td>
<td>3,500</td>
<td>Vessel strikes, fishery bycatch, exposure to toxic organisms (probably related to human activities), habitat modifications due to water management and energy policies</td>
</tr>
<tr>
<td>19. Antillean manatee, <em>Trichechus manatus manatus</em></td>
<td>Caribbean and Atlantic mainland coastal states from Mexico to Brazil, Cuba, Puerto Rico, Trinidad, Dominican Republic, and other Caribbean island states</td>
<td>Unknown but probably 1,000s</td>
<td>Fishery bycatch, deliberate hunting and trapping</td>
</tr>
<tr>
<td>20. Ladoga ringed seal, <em>Pusa hispida ladogensis</em></td>
<td>Russia</td>
<td>About 5,000</td>
<td>Fishery bycatch, disturbance at haul-out sites</td>
</tr>
</tbody>
</table>
marin marine mammal will inevitably experience new threats, even while long-lasting ones persist. We are in danger of losing numerous populations, some species, and a few genera (e.g., *Monachus*). One entire family of cetaceans, the *Delphinidae*, appears to have been lost very recently (Turvey et al., 2007). Another river dolphin family, the Phocidae, is far from secure, particularly given the ever-mounting pressure on the freshwater systems inhabited by the two extant sub-species in southern Asia. However, the impression of the array of conservation efforts may seem on paper; it is far from adequate (Bearzi, 2007). Only with a genuine, broad-scale change in how we value the remnants of the world’s natural variety and abundance, and thus in how we use and care for the Earth’s precious resources, can we hope to head off a cascade of marine mammal extinctions in the coming decades.

See Also the Following Articles

Captive Breeding | Competition with Fisheries | Conservation Ecology | Distribution | Fishing Industry | Effects of Illegal and Pirate Whaling | Pollution and Marine Mammals

References


