Marine Protected Areas

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A marine protected area is defined by the International Union for the Conservation of Nature (IUCN) as any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment. Marine protected area, or "MPA," is the common generic term, although in various jurisdictions, MPAs are called marine reserves, marine parks, special areas of conservation (SACs), marine wildlife refuges, or national marine sanctuaries. The term "sanctuary," however, in reference to marine mammals, usually refers to the protection of a country's entire EEZ waters in a "national sanctuary" or to an "international sanctuary" on the high seas, e.g., the Indian Ocean Sanctuary. Such national and international sanctuaries typically ban cetacean or marine mammal hunting but rarely have in place detailed conservation measures, or a management plan.

MPAs have been set up to protect vulnerable species and ecosystems, to conserve biodiversity and minimize extinction risk, to re-establish ecosystem integrity, to segregate uses to avoid user conflicts and to enhance the productivity of fish and marine invertebrate populations around a reserve (Pauly *et al*., 2002; Hooker and Gerber, 2004). MPAs are also useful in terms of providing a public focus for marine conservation (Agardy, 1997). A given MPA may have any one or several of the above goals. A highly protected MPA set aside as a fishery no-take zone, e.g., could be useful for marine mammal conservation by helping predators and prey to recover (Bearzi *et al*., 2006). Also, setting up an MPA around marine mammals which function as umbrella species can often result in positive effects for many other species (Simberloff, 1998; Hoyt, 2005).

MPAs for marine mammals require targeted management measures to address marine mammal and ecosystem threats either as part of the MPA itself or through existing laws and regulations. Currently, in terms of conservation of most marine mammal populations, MPAs are too small, too few in number, and too weak in terms of protection, and most are "paper reserves"—MPAs in name only (Hoyt, 2005). Yet MPAs hold some promise for marine species and ecosystems when they include substantial highly protected (IUCN Category I) zones, use ecosystem-based management (CBM) principles, and function as part of larger MPA networks.

I. The Recent Growth and Development of Marine Protected Areas

Even though 71% of the surface of the Earth is ocean, the concept of MPAs is relatively recent, lagging far behind land-based protected areas. The Durban Accord and Action Plan from the V World Parks Congress in 2003 stated that approximately 11.5% of the world's land area has protected status compared to less than 1% of the world ocean and adjacent seas. The first notable MPA of appropriate scale was the Great Barrier Reef Marine Park (GBRMP), established in 1975, although it only achieved a strong level of protection in 2003. Its size, at 340,000 km^2, makes it one of the largest MPAs in the world managed on a zoned basis. In 2003, nearly a third of it, 111,700 km^2, became a highly protected, "no take" zone. Although created to protect the world's largest coral reef, GBRMP also contains cetacean populations including mating and calving humpback whales (*Megaptera novaeangliae*) and various dolphins.

The world's first MPA set up specifically for marine mammals was Laguna Ojo de Liebre, or Scammon's Lagoon, established by the Mexican Government in 1971 to protect a prime gray whale (*Eschrichtius robustus*) mating and calving lagoon in Baja California (see Fig. 1). In 1988 the surrounding area of desert and coast was brought together with the San Ignacio and Guerrero Negro lagoons

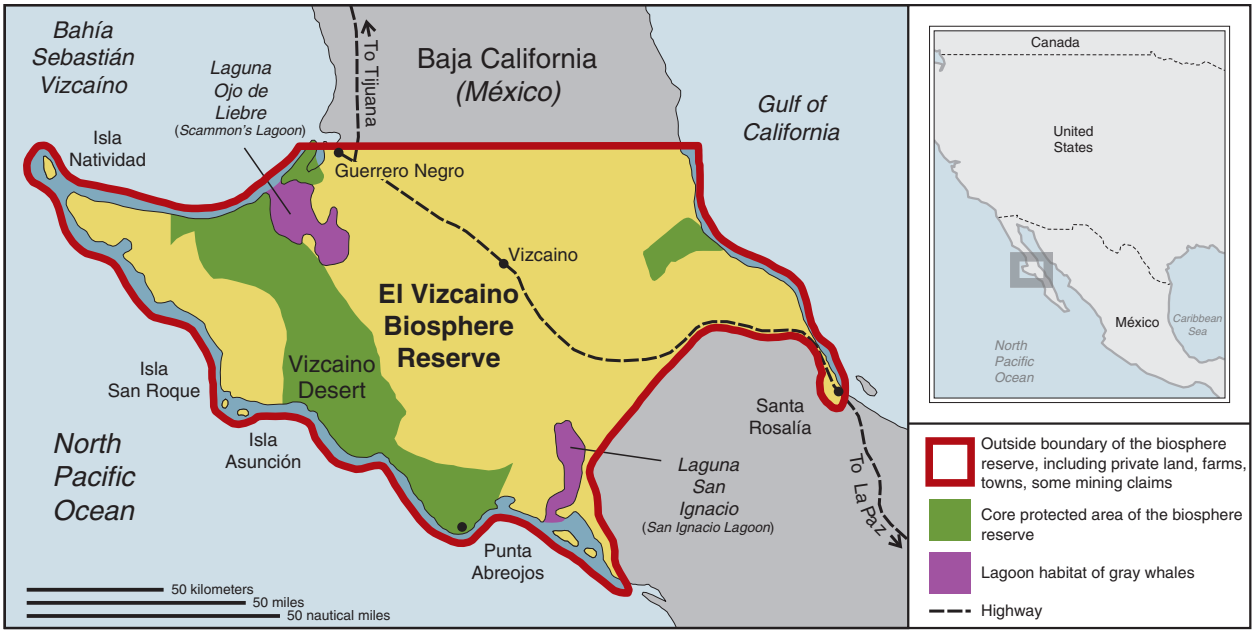

Figure 1 El Vizcaino Biosphere Reserve. *In 1971 Laguna Ojo de Liebre was made a whale refuge by Presidential decree; protection of Laguna San Ignacio and Laguna Guerrero Negro followed in 1979 and 1980; in 1988, the entire lagoon complex was officially designated a MAB biosphere reserve and UNESCO World Heritage site status followed in 1993. Map by Lesley Frampton.*

to form El Vizcaino Biosphere Reserve. Among cetaceans, gray whales have easy-to-define habitat requirements because they bring their calves every winter to semi-enclosed salt-water lagoons.

Worldwide, as of 2008, there were more than 4500 MPAs, most of them declared in the past two decades. At least 375 MPAs feature or include marine mammals, while a further 200 have been proposed (Hoyt, 2005). Some notable MPAs are shown in Table I. Only an estimated 0.0001 (one ten-thousandth, or 0.01%) of the world ocean is set aside in highly protected IUCN Category I areas.

New Zealand MPA pioneer Bill Ballantine says that we should aim for at least 10% of the world ocean to be in highly protected MPAs (Ballantine, 1995). In a 1998 statement entitled "Troubled Waters: A Call to Action," more than 1600 scientists and conservationists declared that we should aim for 20% of the sea as highly protected MPAs by the year 2020 (Roberts and Hawkins, 2000). Other calls, mainly to address the worldwide collapse of commercial fisheries, have suggested between 20% and 50% of the sea to be protected to enable over-exploited fish stocks to recover. The consensus from MPA practitioners around the world at the V World Parks Congress was that at least 20–30% of each marine and coastal habitat should be in highly protected areas.

II. Criteria for Selecting MPAs for Marine Mammals

Protecting mobile, wide-ranging marine mammals such as cetaceans and pinnipeds presents unique challenges using the tool of a fixed-boundary protected area. A number of marine mammal species migrate thousands of kilometers twice a year to feeding or breeding areas. Even the feeding or breeding grounds of a population may be spread over a wide area. Although some populations have site fidelity, there may be considerable movement within individual feeding or breeding grounds. Such dispersion is partly due to the peculiarity of ocean habitat. Besides static topographic features defined largely by slope and depth (the marine equivalent of mountains and valleys), there are persistent yet ever-moving hydrographic features such as currents and frontal systems and ephemeral habitats created by wind- or current-driven upwellings and eddies (Hyrenbach *et al.*, 2000). The option is to conserve large areas and build in flexible boundaries for intra-seasonal protection to accommodate uncertainty, as well as to build networks of MPAs as described in Section VII.

The starting point for establishing marine protected areas should be long-term research of populations of marine species and ecosystems (Simmonds and Hutchinson, 1996; Twiss and Reeves, 1999). "Snapshot" boat or aerial surveys or single season studies are not enough; a several year research period, with dedicated surveys and quantified effort, is ideal. Spatial habitat preference modeling, combining marine mammal sightings, and behavioral observations with oceanographic/environmental and physiographic data, can then be used to characterize cetacean habitats, e.g., as has been done in the western Mediterranean Sea in studies of various dolphins and fin whales (*Balaenoptera physalus*) (Cañadas *et al.*, 2002; Cañadas *et al.*, 2005; Cañadas and Hammond, 2006). The resulting work has lent a strong scientific basis to the choice of marine habitat suitable for protection: the so-called cetacean critical habitat.

However, the dilemma is that time is short for protection and studies can be costly and time-consuming. Partial knowledge must often dictate action to protect populations or ecosystems, with additional research employed as it comes in to refine boundaries and extent of coverage. In Australian waters, governments have taken the approach of seeking to identify critical habitat for marine species, including whales and dolphins, before awarding formal habitat protection (Prideaux, 2003b). This approach, as long as it does not become an excuse for delay, could significantly increase the potential value of future MPAs with cetaceans.

TABLE I
Notable Marine Protected Areas, National & International Sanctuaries for Marine Mammals[a]

Name	*Location*	*Size*	*Date*	*Species*	*Notes*
Abrolhos National Marine Park	58 km off southern Bahia State, Brazil	913 km^2	1984	Humpback whale, large coral reef	First national marine park protects coral reef & humpback breeding areas; pioneer seismic protection zones around the park have recently been withdrawn
Auckland Islands Marine Mammal Sanctuary & Marine Reserve	Auckland Islands, New Zealand subantarctic, 460 km south of New Zealand	4,840 km^2	1993; addt'l protection: 2003	Southern right whale; New Zealand sea lion; various endemic fauna & flora	Important sea lion colony & right whale breeding area; high level of protection
Bunaken Marine National Park	off Manado in Minahasa Province, on north Sulawesi, Indonesia	790.6 km^2	1991	Sperm, short-finned pilot & other tropical whales & dolphins; large coral reef	At first a paper park but improving with tourism interest; allows fishing & other development
Banks Peninsula Marine Mammal Sanctuary	Banks Peninsula, east coast of South Island, New Zealand	1140 km^2	1988	Hector's dolphin	Commercial gill nets banned but protected area may need to be larger so as not to fragment populations
El Vizcaino Biosphere Reserve	Baja California, México	25,468 km^2	1971	Gray whale	Mating & calving grounds
Galápagos Marine Resources Reserve & Galápagos Whale Sanctuary	Galápagos Islands, 975 km west of Ecuador, in the equatorial Pacific, Ecuador	158,000 km^2	1979; Whale Sanctuary: 1990	Galápagos sea lion, Galápagos fur seal; sperm, short-finned pilot, humpback whale & tropical dolphins; various endemic fauna & flora	High protection for wildlife but concern about tourism impacts
Gerry E. Studds Stellwagen Bank National Marine Sanctuary	Southern Gulf of Maine off Massachusetts, USA	2,181 km^2	1993	Humpback, North Atlantic right, fin, minke, pilot whales	Pop-ups to monitor noise levels (ensonification); no discharge or mining but fishing unrestricted
Great Barrier Reef Marine Park & World Heritage Area	Queensland, Australia	340,000 km^2	1975	Humpback whale, dwarf minke whale, dugong; large coral reef	1/3 highly protected area; intensive management
Hawaiian Islands Humpback Whale National Marine Sanctuary	Hawaiian Islands, USA	3,368 km^2	1997	Humpback whale; tropical dolphins	MPA based around humpback whale; no restrictions on fishing or military activities
Ilhas Desertas Natural Reserve	Desertas Islands, Madeira	96.7 km^2	1990	Mediterranean monk seal (also: bottlenose dolphin)	High level of protection & small seal population has increased
Commander Islands Biosphere Reserve (Zapovednik)	Commander Islands, 50 km east of Kamchatka Peninsula, Russia	36,490 km^2	1993	Sperm & killer whales; fur seal; Steller sea lion; spotted harbor & ringed seals; sea otter	Protected zone extends 50 km around Commander Islands; largest Russian MPA; local fishing, hunting & tourism allowed
Marine Mammal Sanctuary of the Dominican Republic	Northeast of the Dominican Republic including Silver Bank, Navidad Bank & part of Samaná Bay, Dominican Republic	2,500 km^2	1986, 1996	Humpback whale; Bryde's, pilot & sperm whales; bottlenose & pantropical spotted dolphins; manatee	Law of the Environment & Natural Resources (2000) strengthens environmental standards & protects coral reefs with breeding areas for humpbacks. From Feb–Apr, Silver Bank has densest concentration of humpbacks in North Atlantic (up to 3,000 present); humpbacks from 5 feeding stocks in the w. North Atlantic aggregate on the bank.

(*continues*)

TABLE I (continued)

Name	*Location*	*Size*	*Date*	*Species*	*Notes*
Monterey Bay National Marine Sanctuary	North central California coast, USA, adjoining Gulf of the Farallones NMS	13,802 km^2	1992	Gray, fin, blue, minke, humpback whales; various dolphins; sea otter; Steller & California sea lions	Largest US NMS (part of growing California state & national MPA network) prohibits oil & gas exploration & waste dumping but no fisheries restrictions
Northeast Greenland National Park	Northeast Greenland	Land: 846,100 km^2; water: 110,600 km^2	1974, expanded 1988	Beluga, narwhal, minke whale, white-beaked dolphin, walrus, polar bear	Commercial hunting & mineral development banned but concern remains about high levels of subsistence hunting
Papahanaumokuakea Marine National Monument	Northwest Hawaiian Islands, USA	340,000 km^2	2006	Humpback whales; tropical dolphins	World's largest highly protected MPA; to allow no commercial fishing & limited tourism
PELAGOS Sanctuary for Mediterranean Marine Mammals	Ligurian Corsican & northern Tyrrhenian seas, western Mediterranean Sea, Italy, Monaco, France & High Seas	87,492 km^2	1999; SPAMI, 2001	Fin, sperm, minke, Cuvier's beaked whale; bottlenose, striped, common & Risso's dolphin	More than 50% on the high seas of the Mediterranean; first high seas as well as tri-national MPA
Saguenay-St. Lawrence Marine Park	St. Lawrence River, Québec, Canada	1,138 km^2	1998	Beluga, fin, humpback & minke whales; Atlantic white-sided dolphin & harbor porpoise	Multiple-use zoning with heavy traffic; protects most southerly population of belugas from tour boats
Seal Bay Conservation Park	Kangaroo Island, South Australia, Australia	49.5 km^2	1971	Australian sea lion (also: New Zealand fur seal)	Intensively managed to protect population & for tourism
Shark Bay Marine Park & World Heritage Area	Shark Bay, Western Australia	23,000 km^2	1990	Indo-Pacific bottlenose dolpin, humpback whale, dugong, green & loggerhead turtles	High visitor level especially to Monkey Mia; tourism controlled
National EEZ Sanctuaries for Marine Mammals	21 countries & territories (10 in the South Pacific)	120,000 km^2 to 16 million km^2	Various	Mainly all cetaceans; some include all marine mammals plus turtles	No hunting. These are not MPAs, but with management plans & enhanced protected zones could help conservation.
International Whale Sanctuaries	Indian Ocean Sanctuary, Southern Ocean Sanctuary, Eastern Tropical Seascape	IOS: 103.6 million km^2; SOS: 50 million km^2; ETS: 2.1 million km^2	Various	Mainly baleen whales & sperm whale	No commercial hunting

[a]For a complete directory of more than 600 proposed & existing MPAs & sanctuaries for cetaceans, see www.cetaceanhabitat.org

Defining critical habitat is the crux of the matter. Governments and other agencies have adopted various definitions for critical habitat, but, it is essentially the places, or conditions, where marine mammals feed, socialize, rest, breed, and raise their young as well as where their prey lives. Some times part of migration routes are included, too. The challenge is determining the level of protection needed as well as when areas are essential for day-to-day survival, as well as for maintaining a healthy population growth rate.

The actual selection process for MPAs starts with defining the goals of any proposed MPA in view of marine mammals found and threats to their existence paired with the need to devise the rationale for the proposal (Hoyt, 2005; Notarbartolo di Sciara, 2007). Threats include fishing conflicts (overfishing, bycatch, entanglements), ship collisions, pollution, habitat degradation, and the chronic, high noise levels (ensonification) from shipping traffic as well as acute loud sounds from seismic activities, and low- and mid-frequency Navy sonar. To date, few managent plans for MPAs have addressed fishing conflicts, pollution, or habitat degradation, and noise in a comprehensive way.

Then the question must be asked: Is an MPA the most effective tool—the answer or part of the answer—in terms of addressing threats to marine mammals and ensuring that a favorable conservation status is maintained? At the same time, stakeholders must be brought on board from the start so that the MPA selection process ideally grows out of a community, taking into account socio-economic and other concerns. The most effective MPAs proceed from the bottom up;

top-down approaches usually only work if they institute bottom-up procedures early in the process. Even then, it is sometimes impossible to orchestrate public participation and such MPA proposals may ultimately fail.

The next steps are to compile bibliographic information, collect updated scientific data on the animals, human activities, and the threats; and to recommend highly protected zones or core areas as within the MPA. A comprehensive proposal with maps and information on every aspect should then be presented to stakeholders as well as authorities involved in the legal process. This is rarely a one-time process but usually involves a lengthy consultation phase during which stakeholders examine the proposal and help to shape it until conflicts are resolved and acceptable proposals can be formulated.

III. Designing MPAs for Marine Mammals

MPAs either tend to be managed for multiple- or zoned use. Management for multiple-use is found to a great extent in the flagship US national marine sanctuaries, as well as in the special areas of conservation created under the European Union (EU) Habitats and Species Directive. Multiple-use allows or in some cases tries to regulate a wide variety of uses, from shipping and tour boat traffic to sports and commercial fishing, at "acceptable" levels of use throughout the marine protected area. Of course, some uses may be entirely excluded if deemed too harmful—e.g., oil and gas exploration, waste dumping, and certain kinds of fishing.

In contrast, zoned use, or zoning, attempts to create zones in locations and at sizes appropriate for one or more compatible uses, excluding other uses, but attempting to accommodate all or most uses within a number of zones located within a single MPA. Of course, not every MPA can accommodate every use; many are too small and are most suited to a high level of protection throughout the MPA.

Multiple-use management has had a long history on land, with mixed, often poor results, but land-based protected areas have now employed zoned use successfully for several decades and this is the widely accepted model for many national parks and protected areas. The biosphere reserve concept uses zoning for land-based protected areas and this has also been adapted for MPAs (Batisse, 1990). Biosphere reserves feature a zoned architecture with substantial key core areas reserved for strict protection, surrounding zones for research, tourism, education, and other "light use," and still other zones open for sustainable use of marine resources and as transition areas to the wider community (see Fig. 2).

Highly protected core areas are easy to define for marine mammals spending time on rookeries and haul-outs, and with confined home ranges such as for bottlenose dolphins (*Tursiops* spp.) or humpback and gray whales on winter breeding grounds. But what about marine mammals with less well-defined breeding habitat or on feeding grounds subject more to changing oceanographic conditions? One solution could be to employ adaptable time and area closures such as are used for salmon or other fisheries in various parts of the world. It would be possible to use the biosphere reserve concept to create large overall MPAs with a number of moveable, highly protected "core areas" corresponding to marine mammal critical habitat with boundaries that can be adjusted as needed. Such adjustments would be constantly reviewed and sensitive to seasonal and annual signals from the wider environment. To achieve this fine-grained kind of critical habitat management, however, it is necessary to try to understand ecosystem processes and the impacts that humans have on such processes. An appropriate tool for this is EBM.

IV. Ecosystem-Based Management

EBM, or ecosystem management, is the management of the uses of ecosystems. An ecosystem *per se* needs no management. It is the escalating human interactions with ecosystems and the damaging human impacts on ecosystems and species that need to be managed. Still, it has become clear that human uses must be accommodated within ecosystem capacities. EBM is a regime that recognizes that ecosystems are dynamic and inherently uncertain yet seeks to manage the human interactions within ecosystems to protect and maintain ecological integrity and to minimize adverse impacts. EBM is widely talked about and is being attempted by some managers but it remains at an embryonic stage, though Australia, e.g., is building its regional marine planning on EBM (Smyth *et al.*, 2003).

To embark on EBM, fundamental shifts in management thinking and research must take place (Hoyt, 2005):

- Management must move from a *reactive* to a *proactive* style. This requires ongoing scientific analysis and the ability to adapt management practice quickly when new information signals the need for a change.
- Research has to re-orient itself to view the ecosystem as a whole, using multiple components such as stability of reef or sea floor, predator presence and water quality as indicators of management success.
- Risk assessments of management choices must be reviewed regularly and adapted to new information.
- Multiple sectoral uses (e.g., commercial and sports fishing) as well as the resulting impacts (e.g., cetacean bycatch), must be viewed as cumulative rather than isolated.
- Managers, policy makers and the public must be alert to the misuse of the term "EBM," particularly by those seeking to justify the culling of predators.
- The ultimate aim is to maintain the ecosystem as it naturally occurs—not to adapt it to human needs but to enable it to accommodate an acceptable level of human use.

Thus, it is important to understand more about the whole ecosystem, rather than focusing on one or other isolated area or species. Without doubt, these are major tasks to undertake in any large marine area, but they are necessary steps to manage human involvement with marine ecosystems.

EBM as a management regime grew out of the widely acknowledged failure of single species management, primarily of fisheries. EBM requires an ongoing research commitment to unravel and model the complex linkages in marine ecosystems. But where knowledge is lacking, it is accepted that a precautionary approach should be invoked to protect ecosystems (Hoyt, 2005). Part of this precautionary approach is creating MPAs as safeguards built into the system from an early stage to secure ecosystem integrity in the absence of scientific certainty.

V. The Legal Process for Setting up MPAs

To achieve legal status, MPA proposals situated within a country's waters must seek state/provincial/local and/or national approval in law. Such legal status along with appropriate enforcement provisions can be difficult and time-consuming to establish; some governments have only recently approved MPA legislation and others have weak or even no legislation available (Scovazzi, 1999; Hoyt, 2005).

In most parts of the world, regional treaties and international organizations are available to assist with the MPA designation process. These bodies include the IUCN World Commission for

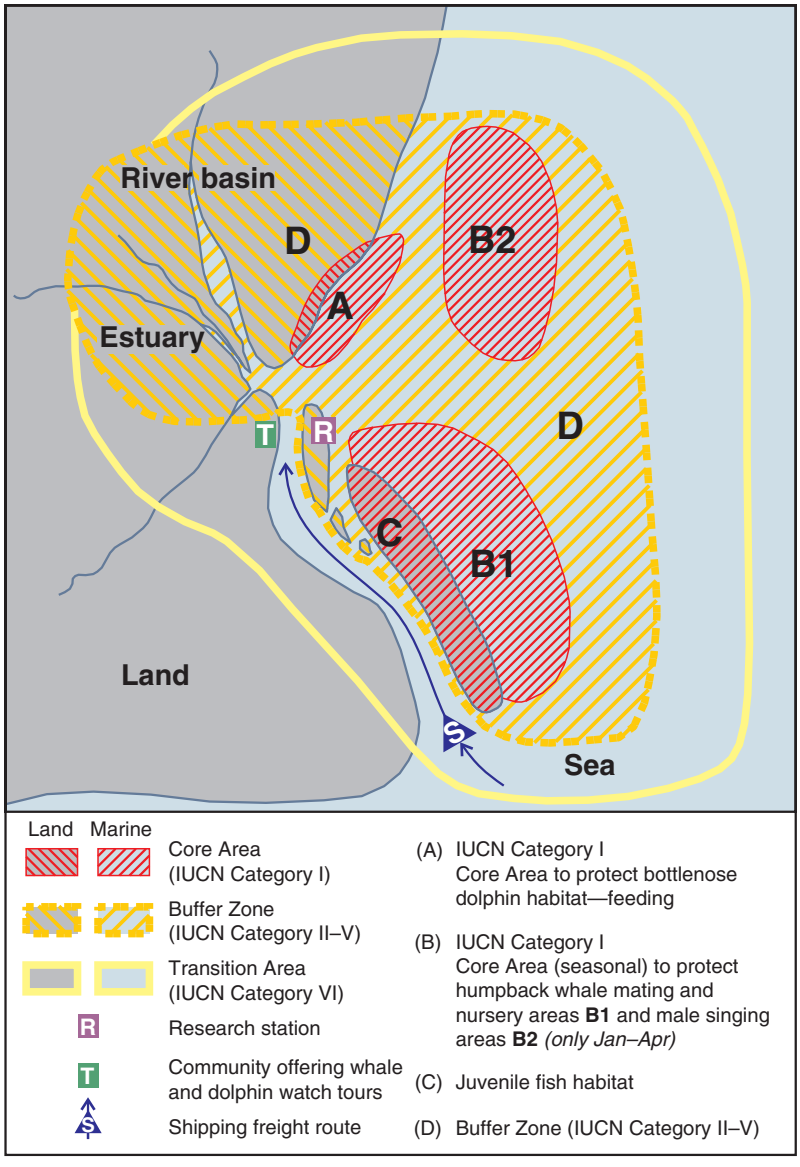

Figure 2 The Architecture of a Biosphere Reserve. *This map shows the various zones of a hypothetical marine- and land-based biosphere reserve area. Core areas (IUCN Category I) are devoted to strict nature reserve protection; these are surrounded by buffer zones (Category II–V) where activities compatible with the conservation objectives occur, and the buffer zones are in turn surrounded by a more or less defined transition zone (Category VI) which integrates the local people and sustainable resource management into the fabric of the overall reserve. To be effective, the biosphere reserve model must include zoned highly protected areas that are declared and enforced through legislation with management plans formulated by the community, including all stakeholders. Map by Lesley Frampton.*

Protected Areas (WCPA, Marine) with its many regional offices, as well as regional agreements such as ACCOBAMS (the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area), the SPAW Protocol in the Caribbean, and the SPREP Convention in the South Pacific.

In addition, international recognition and further protection of an MPA can be valuable. The International Maritime Organization (IMO), e.g., has granted the status of "particularly sensitive sea area" (PSSA) to parts of the GBRMP; such a PSSA requires a compulsory pilotage system through the most sensitive parts of the park. MPAs can also be awarded further protection through World Heritage Site or MAB Biosphere Reserve status (UNESCO), or at the regional level, e.g., designation as a Special Protected Area of Mediterranean Interest (SPAMI). These and other designations are helpful in terms

TABLE II
Developing Networks of MPAs for Marine Mammals

Name	*Location*	*Action*	*Species*
1. Wadden Sea Conservation Area	SE North Sea off Germany, Denmark, Netherlands	Series of national parks & nature reserves	harbor seal; also harbor porpoise present
2. Sister sanctuaries of Gerry E. Studds Stellwagen Bank National Marine Sanctuary & Marine Mammal Sanctuary of the Dominican Republic	Southern Gulf of Maine off Massachusetts & Caribbean Sea off NE Dominican Republic	Bilateral "sister sanctuary" relationship formally established 2007 with education, research & other planned links	humpback whale on feeding & breeding grounds
3. Natura 2000 network	European Union (EU) waters	Special areas of conservation (SACs) declared for *Tursiops* & *Phocoena* but no protection yet for all other cetaceans	bottlenose dolphin, harbor porpoise
4. MPAs proposed for the ACCOBAMS MPA Work Program (the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea & contiguous Atlantic Area)	Mediterranean & Black seas	18 MPAs proposed 2007 by the Scientific Committee to the Parties to protect cetaceans throughout the ACCOBAMS region; countries have agreed in principle to begin work to establish the MPAs	bottlenose, common, Risso's & striped dolphins; harbor porpoises; fin, sperm, Cuvier's beaked, killer whales
5. 21 manatee sanctuaries	Gulf of Mexico, west coast of Florida	Several protected areas for the critical habitat of manatees	West Indian manatee
6. Various protected areas & recovery plans	Western North Atlantic including Bay of Fundy & Gulf of Maine & approaches	Several marine sanctuaries, conservation zones, species recovery plans & IMO & pilot controls on shipping off NE US & Canada but remains to be seen if this will reduce mortalities from ship strikes.	North Atlantic right whale
7. 9 national (EEZ) marine mammal sanctuaries established among SPREP (South Pacific Region Environment Program) Convention members	South Pacific Ocean: American Samoa, Cook Islands, Fiji, French Polynesia, New Caledonia, Niue, Papua New Guinea, Samoa, Vanuatu	National sanctuaries set up to protect marine mammals & ban whaling in national waters; countries through SPREP plan to devise management &/or zoned conservation plans	Humpback whale, tropical dolphin species including blackfish species; dugongs; turtles in some countries

of expanding the remit of an MPA into an important component of an international network.

Whatever designations are obtained, it is useful to consider achieving protection status not as a final goal but as a *first* stage or step toward conservation (Hoyt, 2005).

In some countries, MPAs are situated and must also be considered in the broader context of a general management plan for coastal and marine resources, that is, an umbrella program for conservation of renewable resources as well as implementation of EBM principles (Salm and Clark, 2000; Augustowski and Palazzo, 2003).

VI. Management Plans, Monitoring, and Evaluation

The management plan is at the heart of the success or failure of an MPA. It is the working plan for what the MPA hopes to do and accomplish along with the time frame for its activities and the schedule for its review.

Many MPAs exist only or mainly on paper. It is fair to say, however, that all MPAs begin as a piece of paper, and it is up to government and stakeholders to devise, put in practice, and enforce their management plan (Hoyt, 2005). Creating effective protected areas, whether marine- or land-based, is an iterative, participatory process, and is bound to fail if the management plan is seen as set in stone or as a fixed law imposed from the outside. As with MPA design, management must be both top-down and bottom-up. The following are the key steps leading to effective management (Hoyt, 2005; Notarbartolo di Sciara, 2007):

(1) engaging stakeholder involvement from the beginning and throughout the process;
(2) formulating clear management objectives for the proposed MPA;
(3) creating a management body;
(4) developing a management plan, subject to periodic re-examination and revision;
(5) offering management training;
(6) conducting research for baseline numbers, inventory, status and monitoring purposes;
(7) promoting and offering educational programs for the local community and visitors;
(8) developing effective enforcement regimes; and
(9) conducting periodic management review and other evaluations to assess whether objectives are being met.

The last provision is essential to the long-term success of the MPA. Without such evaluations, even MPAs that start out with considerable success may decline in value and fail. An MPA must have clearly defined objectives against which its performance is regularly checked, and a monitoring program to assess management effectiveness and recommend changes (Kelleher, 1999). A number of methods are available for conducting a review (Pomeroy *et al.*, 2004).

Management of an MPA for cetaceans and pinnipeds is similar to managing any other type of MPA (Notarbartolo di Sciara, 2007) but there are several differences that must be kept in mind. MPAs for marine mammals require large sizes to accommodate these highly mobile animals, with all the attendant complications and added problems from size alone. The movement of populations across many national borders and even to opposite ends of an ocean dictate the necessity of creating MPA networks to ensure comprehensive protection. Finally, the use of high seas habitat by many populations of cetaceans and pinnipeds, means that effective legal measures—as well as practical mechanisms for implementation and enforcement—will need to be devised for the high seas (see Section VIII).

VII. Networks of MPAs

An MPA network can be defined as "an organized collection of individual MPAs operating co-operatively and synergistically, at various spatial scales and with a range of protection levels, to fulfill ecological aims more effectively and comprehensively than individual sites could alone." (WCPA/IUCN, 2006). The idea of creating networks of MPAs is particularly suited to marine mammals. In addition to their long migrations, marine mammals may depend on food webs whose critical habitats are widely separated. Thus, networks are essential to create an effective conservation plan for these wide-ranging species, as well as for the marine ecosystems that help to support them.

A number of MPA networks are beginning to be assembled to confer population-level protection to marine mammals (Reeves, 2000; Hoyt, 2005) (see Table II.) Establishing a network is mainly a "top-down" exercise with governments or regional associations acting as the main initiators and mechanisms. In Table II, individual governments with large territories or undertaking bilateral agreements (United States, Canada, Dominican Republic) have been responsible for nos. 2, 5, and 6. Regional associations, including political and economic unions such as the EU, and conservation agreements and treaties such as ACCOBAMS which draw on the Barcelona Convention are responsible for 1, 3, and 6.

VIII. High Seas MPAs

Many marine mammal species, including sperm (*Physeter macrocephalus*), beaked, and other toothed whales, large baleen whales and a number of pinnipeds spend part or even most of their life cycles in pelagic waters off the continental shelves and far from the coasts. Large portions of their critical habitats may be in the 50% of the world ocean classed as international waters, or high seas, i.e., outside the 200 nm limits declared by most countries under the United Nations Convention on the Law of the Sea (UNCLOS) (Hoyt, 2005). In such areas—where no single state or authority has the power to designate MPAs, adopt management schemes, or enforce compliance—new strategies must be devised to protect and manage high seas habitats (Thiel and Koslow, 2001).

Various international agreements have the potential to be used to create high seas MPAs. For example, UNCLOS says that States are in a position to take strong conservation measures on the high seas, as long as they cooperate with other States, show that the measures they want to take would enhance the conservation of resources, and that they are based on the best scientific evidence available (de Fontaubert, 2001). Article 194 of UNCLOS establishes a mandate for high seas MPAs by stipulating measures to protect rare and fragile ecosystems as well as the habitat of depleted, threatened, or endangered species and other forms of marine life while Article 197 asks for cooperation on a global basis (Prideaux, 2003a).

Another key treaty, the Convention on Biological Diversity (CBD), has with the work of its scientific advisors, the Subsidiary Body on Scientific, Technical, and Technological Advice (SBSTTA), planned a program of work that includes the creation of high seas MPAs. UNCED: Agenda 21, although it is a "soft-law" instrument, also recognizes the possibility of enacting MPAs on the high seas.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) may also become an important instrument for high seas critical habitat protection. The harmonization of work plans between CBD and CMS integrates CMS and migratory species into the work program and implementation of CBD with regard to protected areas, as well as the ecosystem approach, and the drive to develop indicators, assessments, and monitoring. In addition, CMS focuses on the establishment of regional agreements (such as ACCOBAMS), which increases its adaptability to regional circumstances. If high seas and multi-jurisdictional cetacean critical habitats are to be protected, CMS and CMS regional agreements may be the most appropriate framework to develop this regime (Prideaux, 2003b).

Besides all of the above approaches (UNCLOS, CBD, CMS, and UNCED: Agenda 21), the IWC whale sanctuaries provide a useful precedent of nations working together to agree on conservation on the high seas. Future IWC agreements could embrace, or even create themselves, highly protected high seas MPAs, though current divisions in the IWC make this unlikely in the near future. In any case, it is important to recognize that those states that are not party to the various conventions and treaties are not bound by them. Yet most states now recognize or are party to at least two of the important conventions for future high seas MPA development: UNCLOS and CBD. Still, it is a huge challenge for the world's nations to come together with the necessary foresight and imagination to create a comprehensive network of MPAs on the new frontier of the high seas.

In 1999, an agreement to create the world's first high seas MPA was signed by France, Monaco, and Italy. The PELAGOS Sanctuary for Mediterranean Marine Mammals, located partly in the national waters of these three countries and partly on the high seas, contains resident populations of sperm, fin, and Cuvier's beaked whales (*Ziphius cavirostris*), as well as striped (*Lagenorhynchus coeruleoalba*), common bottlenose (*Tursiops truncatus*), Risso's (*Grampus griseus*) and short-beaked common dolphins (*Delphinus delphis*.) (see Fig. 3). In 2001, a high seas agreement was forged under the Barcelona Convention, making PELAGOS a SPAMI which confers the official protection of all signatory Mediterranean countries in both national waters and on the high seas (Notarbartolo di Sciara *et al.*, 2008). It could take several years for PELAGOS to come up to speed and to function as a valuable conservation tool. The marine mammals of the Mediterranean are important of course, but no less important is the precedence of both transborder and high seas cooperation by this designation and the implications for other potential areas and cooperation by States. For these reasons, it is hoped that the management plan put in place will employ EBM principles and be effective in terms of identifying and protecting marine mammal critical

Figure 3 Map of the PELAGOS Sanctuary for Mediterranean Marine Mammals. *The PELAGOS Sanctuary for Mediterranean Marine Mammals is the world's first high seas MPA. It was designated in 1999 as a transborder MPA in the national waters of France, Italy, and Monaco. In 2001, it was declared a Special Protected Area of Mediterranean Interest (SPAMI) under the Barcelona Convention which gives it protection on the high seas of the Mediterranean. Map by Lesley Frampton.*

habitat core areas as well as responsive to new data and management strategies as they arise in future.

See Also the Following Articles

Conservation Efforts ■ Endangered Species and Populations ■ Habit at Pressure ■ Management

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