

The Pelagos Sanctuary for Mediterranean Marine Mammals

Case Study

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OVERVIEW

In the Mediterranean -- one of the best-known, heavily utilized bodies of water around the world -- a recent discovery provoked surprise and provided impetus for conservation. Large populations of eight marine mammal species, including several cetacean species, were discovered, supported by a permanent frontal system concentrating vast populations of zooplankton and other food sources. The presence of these spectacular mammals in such a heavily used area surprised the public and the scientific community alike. The confluence of this discovery, and heightened public awareness about a spate of marine mammal strandings resulting from disease and by-catch in the drift net fishery, has led to a drive to protect this newly discovered special feature. The governments of Italy, France, and Monaco made an unprecedented move to protect this high seas area by declaring it a marine mammal sanctuary called "Pelagos".

The drive to protect the area was led by a few environmental champions, who recognized both the threats and the opportunities to promote large-scale marine conservation. These champions include Prince Rainier III, who mobilized Monaco and led the neighboring states into multilateral agreements, top diplomats, legal scholars and the founder of Tethys, a highly regarded Italian Non-Governmental Organization (NGO). The opportunity to establish a tri-national marine protected area was, paradoxically, created by the lack of mechanisms for protecting the high seas, since Mediterranean countries have not yet declared 200-mile Exclusive Economic Zones (EEZs), and no legal framework existed for management of marine areas outside of the 12-mile territorial seas. The responsibility to successfully implement the Pelagos Sanctuary still rests on the three governments, but the conservation effort's success will likely rest on a committed drive by civil society to keep pressure on the public sector to live up to its commitments.

HISTORIC, CONFLICTING QUOTES ON WHALES IN THE MEDITERRANEAN

1985: *"The Mediterranean is not a very productive sea. [It]shows no appreciable upwelling... [and] visible blooms and red tides are of limited occurrence."*

-R. Margalef, 1985

but ...

1989: *"The oligotrophy of the western Mediterranean: a fading paradigm?"*

-G. Jacques, 1989

1899: "Concerning cetaceans, I had the opportunity of making interesting observations. For instance, it is generally believed that to find these animals one must travel to the Arctic seas ... In those regions, during two campaigns at sea, I haven't been able to sight a single cetacean, whereas from my home in Monaco, from my window, I can often see some. In order to find cetaceans, and to find them in large numbers, one must visit the Mediterranean."

-Albert 1 , Prince of Monaco,
(W.H. Kuehl, 1901)

but ...

1965: *"The Fin whale pays a heavy tribute to the whaling industry, and therefore, although its catches are theoretically regulated, the species' population size appears to be compromised. Such industry, however, is practically inexistent in the Mediterranean due to the rarity of these Cetacea."*

-A. Toschi, 1965

PROBLEM STATEMENT

The Pelagos Marine Sanctuary (Figure 1) was established for three primary reasons: (1) the discovery of significant populations of fin whales (*Balaenoptera physalus*) and numerous other cetacean species in the Ligurian Sea (Figure 2); (2) the emergence of signs that significant threats to these cetaceans existed, based primarily on evidence of a striped dolphin (*Stenella coeruleoalba*) epizootic, or mass disease event, in 1989, and increasing numbers of strandings of marine mammals accidentally caught in the drift net fishery; and (3) no adequate legal framework existed to provide an adequate mechanism for the protection of marine wildlife in the Mediterranean high seas, where most of these cetaceans are found.

The significance of the Mediterranean for cetaceans was not unknown during the history of its many great civilizations. In fact, the Romans called the coastline facing this portion of the Mediterranean the “coast of the whale.” Prince Albert 1^{er} of Monaco stated in 1899 that he was more likely to see whales from the window of his palace in Monaco than during whale research cruises in the Arctic. However, the notion of cetacean abundance in the Mediterranean was subsequently largely forgotten. In the 20th Century, mainstream ecology asserted that the Mediterranean was oligotrophic, or of relatively low productivity, and could not support significant populations of top marine predators. This was the commonly held perception until the late 1980s, when dedicated research cruises provided a different view of marine productivity in the area (Jacques, 1989), while others surveyed the entire Mediterranean for cetaceans (Notarbartolo di Sciara et al., 1993). The data from ship-based transects highlighted the presence of important cetacean habitats and populations within a wide marine area between Corsica and the continental coasts of France and Italy, known as the Corsican-Ligurian-Provençal basin (Forcada et al., 1995, 1996).

During the same period, public recognition of threats to marine biodiversity grew. In part this awareness was spurred by strandings caused by cetacean accidental catch, otherwise known as by-catch, in the Italian pelagic driftnet fishery for swordfish. (Pelagic drift net fisheries are those that take place offshore involving large hanging nets through which fish and other marine life try to swim but become entangled.) The national and international media highlighted these by-catch impacts, leading to United Nations Resolution 44/225 of Dec. 1989. This established a global moratorium on large-scale pelagic drift net fishing (Scovazzi, 1998). In addition to fishing, other major anthropogenic impacts on the marine environment began affecting cetaceans. Maritime traffic, including high-speed passenger vessels, pleasure craft, naval ships and expanding commercial whale watching activity were all increasing, with the risk of disturbance and collisions (Notarbartolo di Sciara et al., 2007). Growing ship traffic also carried with it the risk of hazardous substance release, such as occurred during the 1994 oil spill caused by the blaze of the tanker *Haven* off Genoa. These threats slowly entered the public consciousness.

Despite increased awareness of both the value and risk to the Ligurian Sea area and its wildlife, protection was limited by the legal regime of the Mediterranean states.

Mediterranean riparian states (those with watersheds emptying into the Mediterranean Sea) have never declared EEZs extending to 200 nautical Miles (n. mi.; 370 km). Thus ocean areas beyond the 12 n. mi. (22 km) territorial sea are high seas, without the management regimes made possible by national jurisdictions [see Box A]. In 1995, a revision of the Specially Protected Areas Protocol to the Barcelona Convention – the Mediterranean Regional Seas Agreement [see NCEP module: “*International Treaties for Marine Conservation*”] -- allowed consideration of high seas protected areas. This presented an opportunity to move forward with the strong public support for marine conservation felt in Italy, Monaco and France, and created a push for the establishment of a Ligurian Sea Marine Protected Area (MPA) (Notarbartolo di Sciara et al., 2007).

HISTORY

Growing public awareness led civil society to take on an active role in promoting an MPA in the area. In 1990, an Italian NGO called the Tethys Research Institute [see Box B] proposed a project to promote the establishment of a marine protected area in the high seas encompassing the most important habitat for cetaceans in the region (Venturino, 1997). This project was submitted to the “European Association Rotary for the Environment,” which provided initial funding [see Box B]. Thus “Project Pelagos” was born. Tethys’ early work concentrated on examining the ecological representativeness of the area, its high species diversity, its intense biological activity, the presence of critical habitat for a number of pelagic species including cetaceans, and the opportunities that the area offered to baseline research.

“Project Pelagos” forged ahead into uncharted territory with its subsequent campaign for MPA establishment. At the time, the proponents of the project envisaged the creation of a Biosphere Reserve in the high seas of the Ligurian-Corsican-Provençal Basin – an area where it was thought that no legal regime could offer the high seas strict protection. It was anticipated that the international authority for this Biosphere Reserve would be headquartered in the Principality of Monaco, as the entirety of Monaco’s coastline faces this region (Notarbartolo di Sciara, 1997).

When in March of 1991, Tethys presented “Project Pelagos” to the public in Monaco, it had the support of local businessmen in the Rotary Club chapters in Italy (Milan), Monaco and France (Saint Tropez), and the European Association Rotary for the Environment. Prince Rainier III of Monaco received the proposal enthusiastically and granted support of the Principality. It was Prince Rainier III who then championed the idea that a sanctuary for cetaceans be eventually created in the Ligurian-Corsican-Provençal basin through a trilateral agreement among France, Italy and Monaco [see Box C].

The idea of a whale sanctuary was rapidly endorsed by a number of NGOs, most notably the World Wildlife Fund (WWF). At the 1994 World Conservation Union (IUCN) General Assembly in Buenos Aires, NGOs put forward Resolution 19.92 concerning the “Establishment of a Marine Sanctuary for Large and Small Cetaceans in the Ligurian Sea, Western Mediterranean,” which was successfully adopted.

Soon the environment ministers of Italy and France decided to join Monaco in the effort to establish a cetacean sanctuary in the high seas. Although a joint declaration of intention “concerning the institution of a Mediterranean sanctuary for marine mammals,” had been signed in Brussels in March 1993 by officials of the three countries, a five-year lull followed. However, thanks to vigorous lobbying by the NGO community, and in particular by WWF Italy, the issue reappeared in 1998 when it was taken up by the Italian Parliament. At this time, public opinion was very much in favor of a sanctuary, even among Italian fishermen, whose interests in using driftnets in that area had diminished as their attention went to other areas and gears.

A final document known as the “Agreement on the Creation of a Mediterranean Sanctuary for Marine Mammals” was produced in the second round of intergovernmental meetings. This was signed in Rome on 25 November 1999 and deposited with the Principality of Monaco (Table I). A declaration appended to the agreement stated that parties would voluntarily abide by the intent of the agreement even before it came into force. In November 2001, the Parties to the Barcelona Convention adopted the decision of inscribing the Sanctuary in the List of the Specially Protected Areas of Mediterranean Importance (SPAMIs). The Sanctuary entered into force on the 21st of February 2002, after having been ratified by Monaco (2000), France (2001), and Italy (2002).

THE PELAGOS SANCTUARY

The Pelagos Sanctuary for Mediterranean Marine Mammals is a large protected area covering more than 87,000 km² of sea surface in the north-western Mediterranean Sea, between south-eastern France, the Principality of Monaco, north-western Italy and northern Sardinia (Figure 1). The waters of the Sanctuary contain the internal maritime and territorial waters of France, Monaco and Italy, as well as the adjacent high seas. In contrast to most of the offshore Mediterranean waters, this marine area is characterized by very high levels of primary productivity in what is known as a frontal system, caused by an interaction among oceanographic, climatic and geomorphologic factors. These interactions cause high levels of local primary production, with *chlorophyll a* concentrations exceeding 10 mg m⁻³ (Jacques, 1989), which supports an important zooplanktonic biomass, in large part euphausiids (Figure 3; Sardou et al., 1996). Zooplankton, in turn, attracts to the area a variety of marine predators, cetaceans included. These species, however, must coexist in the Sanctuary with very high levels of human pressure (Anonymous, 1999).

The oceanographic dynamics of this permanent frontal system and the physical – biological links that sustain this productive ecosystem are subject to several short-term and long-term perturbations, including climatic changes in weather (e.g., precipitation, wind patterns, storminess), river run-off (e.g., fresh-water and nutrient inputs), and thermohaline (temperature and salinity-driven dynamics of seawater) circulation in the Mediterranean Sea. These oceanographic shifts can influence the magnitude and the

timing of primary productivity, the phytoplankton and zooplankton community structure, and the population dynamics and concentration of euphausiids [see Box D].

The large densities of euphausiids (Figure 3) attract resident and transient populations of marine mammals to the area. Fin whales number in the several thousands, and appear to be permanent residents [see Box E]. In addition to the fin whale concentrations, the Pelagos Sanctuary provides suitable feeding and breeding habitats for the entire community of cetaceans inhabiting the Mediterranean Sea. Seven odontocete species toothed whales (sperm whales *Physeter macrocephalus*, Cuvier's beaked whales *Ziphius cavirostris*, long-finned pilot whales *Globicephala melas*, Risso's dolphins *Grampus griseus*, common bottlenose dolphins *Tursiops truncatus*, striped dolphins *Stenella coeruleoalba*, and short-beaked common dolphins *Delphinus delphis*) regularly occur within Sanctuary waters (Figure 2; Notarbartolo di Sciara, 1994; Beaubrun, 1995). Because these species are also susceptible to entanglement in fishing gear and ship strikes (Figure 4), they will also benefit from the protection afforded by the Pelagos Sanctuary. Additionally, the highly endangered Mediterranean monk seal *Monachus monachus*, which was extirpated from this area in the mid 20th century, could theoretically re-colonize the Sanctuary waters if its population increased (Notarbartolo di Sciara, 1990; Notarbartolo di Sciara and Demma, 1997).

CURRENT STATUS

In spite of the difficulties posed by the formidable task of granting protection to cetacean populations in such a large area, and within such a heavily exploited environment, the Pelagos Sanctuary has already resulted in a number of positive outcomes. These include: raising public awareness; taking what for the region is the rare but necessary step of creating and implementing a management plan; catalyzing voluntary measures by the three governments to minimize environmental impacts on the area; and providing a demonstration model for large scale, ecosystem-based management, high seas MPAs, the utility of regional seas agreements, the use of species as "umbrellas" to protect whole ecological communities, and the role of individuals in carrying forward a conservation vision. These positive developments are discussed in more detail below.

Raising public awareness is a crucial aspect of conservation, especially in regard to the marine environment where the negative anthropogenic impacts on the environment mostly go unseen. Before the creation of the Sanctuary, very few people among the general public in France, Italy, Monaco, and even within the scientific community, were aware of the presence of resident whale populations in these waters. At least eight ecologically distinct cetacean species are regular residents of these waters (Notarbartolo di Sciara, 1994), and new genetic evidence indicates that many of these are likely distinct from their North Atlantic counterparts (Reeves and Notarbartolo di Sciara, 2006). The Sanctuary helped to educate the public about the diverse cetacean fauna in this region.

The Sanctuary was unusual in adopting a detailed management plan soon after the Agreement entered into force. This is relevant since few of the dozens of MPAs

throughout the Mediterranean Basin have any management plan at all. In addition to thinking through the management process, the Sanctuary effort has considered financial feasibility for conservation. The allocation of sizeable funds to promote the Agreement's goals through the ratification laws of some of the participating countries (notably, Italy allocated about half a million euros / year) is making financial resources available for marine conservation. The Sanctuary also provides an arena for effective regulation of the emerging whale watching industry, to avoid the risk of unwanted detrimental impacts of the increasing numbers of human / cetacean interactions.

As soon as the treaty for the establishment of the Sanctuary was signed, several institutions started offering acts of goodwill attuned to the spirit of the Agreement, even though the law may not have required these acts. Examples include the decision by the Italian Navy to refrain from conducting naval exercises (involving the use of ordnance or sonar) in the Sanctuary area, and the decision of the Italian Ministry of the Environment to discontinue the discharge in Sanctuary waters of the toxic mud dredged from the area's harbors. Some provisions of the Agreement (e.g., the prohibition of offshore high-speed motor races; the adoption of rules and codes of conduct to regulate whale watching) have introduced immediate further improvements in the animals' environment.

The Pelagos Sanctuary provides an unprecedented demonstration of many important tenets of large scale marine conservation. Having been designed to include the Ligurian permanent frontal system and its surrounding biological effects, the Sanctuary has a scale that was defined by natural, as opposed to political, considerations, and provides a sound basis for ecosystem-based management (Hyrenbach et al., 2000; Gerber et al., 2005). Originally envisioned for the protection of whales and dolphins, through the provisions of the Agreement the Sanctuary in fact provides protection to a wealth of other species that are associated to whales and dolphins by sharing the same ecosystem (e.g., the Mediterranean devil ray *Mobula mobular*, the basking shark *Cetorhinus maximus*, and many species of large pelagic fishes). Thus the Sanctuary is a prime example demonstrating the validity of the "umbrella species" argument, and shows how a creative implementation approach can reconcile MPA designs with the dynamic nature of ocean systems.

Similarly, the inscription of the Pelagos Sanctuary in the list of SPAMIs (Specially Protected Areas of Mediterranean Importance) of the SPA Protocol to the Barcelona Convention, thereby binding all Countries that are party to the Protocol to the provision of the Agreement, has demonstrated an important practical application of a Regional Sea Convention.

Finally, the unconventional series of events that led to the creation of the Sanctuary is a testimony to the empowerment and role of champions, both individuals and NGOs [see Box C].

SPECIAL CHALLENGES

MANAGEMENT

There are still considerable shortcomings to the current approach to management of the Pelagos Sanctuary. There was a lot of innovation and creativity in the process of establishment of the Pelagos Sanctuary, and now such innovative spirit and approach is needed in management as well. This might be a difficult feat since the actors are confronted with the more mundane demands of political and administrative matters.

The development and implementation of MPAs is a long and laborious process, often spanning several decades (see NCEP module: *Marine Protected Areas and MPA Networks*). Historically, MPAs have followed a diverse array of implementation venues, ranging from top-down (e.g., implementation via a decree of the central government), to bottom-up (e.g., implementation spurred by efforts of grass-root marine conservation organizations or individuals) approaches. While the broad array of political and working structures devised to implement and design MPAs is well beyond the scope of this case study, students should be aware that these diverse roads to implementation exist. The Pelagos Sanctuary illustrates the important roles that pioneering champions and non-governmental organizations can play in initiating and steering the MPA design and implementation process.

The implementation of the Pelagos Sanctuary has been a very dynamic process, with the identity and the roles of the different actors involved changing over time. Some of the most critical achievements of this implementation process may appear rather fortuitous, and merely the result of being at the right time and in the right place. However, they have been the result of tenacious and unrelenting work of committed and visionary marine conservationists. In other words, the ability and opportunity to take advantage of propitious conditions (e.g., political climate, public opinion and awareness, developing international collaborations and agreements) whenever they presented themselves, often precipitated rapid advances in the implementation process. These critical developments punctuated long periods of inaction, caused by changes in the political climate and transient declines in the public awareness of the plight of Ligurian Sea cetaceans.

After about 15 years, the Pelagos Sanctuary implementation process is transitioning from an initial “visionary” phase, stimulated by conservation-minded individuals and organizations, to an “administrative – institutional” phase, whereby the management mechanisms and governance institutions will be established (see Table I). However, the Sanctuary is still struggling to get up to speed with a recently established, undermanned management body, in the new headquarters at the Ducal Palace in Genoa, Italy. Most of the management functions are still undertaken by the Meeting of the Parties and by national and tri-national steering committees. These temporary solutions are clearly inadequate to face the demanding tasks posed by such a large and complex protected area.

As the identity and the roles of the actors change during this phase transition, the implementation process is at the risk of falling into a period of inaction caused by a mismatch in the incentives and expectations driving these two implementation phases. Namely, disparities in the vision, commitment, and socio-economic drivers influencing the actions of government administrators, NGOs, scientists, and the public at large, will continue to shape the implementation process. Yet, this paralysis could derail the implementation process, by rendering the Sanctuary management plan ineffective. A failure to account for dynamic socio-economic and ecological conditions (e.g., changing fishery threats and cetacean distributions over time, global change), and the inability to implement the management plan (e.g., lacking enforcement) could easily condemn this visionary pelagic Sanctuary to remain a “paper park” devoid of real protective measures for cetaceans. Several political and scientific steps are required to ensure that the implementation process progresses unhindered and leads to an effective Sanctuary capable of achieving its conservation goals over the long-term. The continued engagement of NGOs will be critical at this stage, both in an oversight role and as a catalyst for public awareness and participation in the implementation process [see Box B].

SCIENTIFIC MONITORING

A critical aspect of MPA management entails the continued monitoring of the changing ecological and anthropogenic conditions, including the status of the protected resources, the patterns of human use in time and space, and the status and trends in existing and anticipated threats. This need for adaptive management is perhaps most critical in the Pelagos Sanctuary, given the dynamic nature of this productive frontal habitat and the highly migratory habits of cetaceans.

An estimated at least one thousand fin whales aggregate within the Pelagos Sanctuary in summer (Forcada et al., 1995), each being capable of consuming up to several hundred kilograms of euphausiids daily. These predators have large energetic requirements, which are supported by the productive food web of the Ligurian Sea. While dense prey concentrations are likely critical for fin whales, very little is known about the mechanisms responsible for the observed patterns of *chlorophyll a* distribution and euphausiids concentration. Thus, it is critical to gain an understanding of the physical processes that sustain high localized ocean productivity, and the trophic links supporting the food webs exploited by cetacean aggregations in this area.

Therefore, an understanding of the dynamics and the scales of the processes responsible for the formation of these important physical (e.g., hydrographic front) and biological (e.g., euphausiid concentrations) aspects will be critical to assess the degree to which the Pelagos Sanctuary will encompass the fin whale foraging grounds in the future. Furthermore, an improved understanding of the ecological significance of the Pelagos Sanctuary for marine mammals over the long-term requires an assessment of their local trophic requirements and of the abundance and dynamics of their fish and squid prey (Hooker and Gerber, 2004). In particular, the extent that the location and

extent of these features vary in time and space will influence the criteria and the success of any zonation process. The Parties to the Pelagos Sanctuary Agreement are still insisting that no zoning measures be introduced in the management plan. Zoning is the spatial definition of activities permitted within delimited areas of a PA, and can range from heavier restrictions on human use within “core” areas, to regulated activities such as limited fishing or recreation allowed in “buffer” areas. Conflicting activities, such as extraction and recreation, may be spatially separated using zoning (see NCEP module “*Protected Areas and Biodiversity Conservation I: Reserve Planning and Design*”). Yet, the reasons for such insistence against zoning at Pelagos are not easy to understand. The zoning component is essential to proper management and conflict resolution, and could at least be tried out to deal with the least conflicting activities, such as whale watching.

Protecting cetaceans represents an extraordinary challenge, because these highly-mobile vertebrates range over 100s – 1000s of kilometers and may engage in seasonal migrations. Therefore, any cetacean population and species will remain susceptible to unmitigated threats and impacts outside of any sanctuary which is smaller than the annual range. In principle, MPAs may be used to protect the feeding and foraging grounds and the migration corridors where these species concentrate. Nevertheless, due to the large ranges of these species, no sanctuary will ever provide a “silver bullet” capable of mitigating all anthropogenic impacts. Thus, MPAs often prove most effective when used in conjunction with other more diffuse conservation measures (e.g., bycatch mitigation measures) enacted within the broader range of the species (Gerber et al., 2005). Ultimately, the degree of aggregation and the habitat associations of the Ligurian Sea cetaceans will influence their susceptibility to different anthropogenic threats, and the ability of the Pelagos Sanctuary to mitigate those impacts.

Because the cetaceans of the Ligurian Sea are susceptible to different threats and impacts inside and outside MPA waters, the Pelagos Sanctuary management plan should consider the threats and protections that exist both within and outside its jurisdiction. Moreover, it is critical to anticipate how MPA implementation will change the magnitude and the spatial distribution of these threats, given the known impacts of displaced fishing effort (Sanchirico, 2000; Sanchirico et al., 2002). The pervasive problems of displaced effort and enforcement that complicate MPAs throughout the world may also be a factor in the Pelagos Sanctuary. For example, shifting gillnet fisheries into less productive areas may actually increase the overall fishing effort. Thus, any spatial restriction may merely intensify bycatch impacts outside of the MPA, by shifting the fishing pressure into adjacent areas. MPA managers should anticipate the likely ecosystem-level consequences of Sanctuary implementation. In particular, narrowly-focused single-species conservation actions may merely reduce the bycatch of one threatened or popular species at the expense of other taxa. Thus, it is imperative to coordinate management and monitoring actions within and outside the sanctuary boundaries.

The information base developed by broad-based research and monitoring programs will be critical to integrate the Sanctuary management plan with other cetacean and

ecosystem protections outside of its waters. In particular, the long-term protection of the Ligurian Sea cetaceans will benefit from the following actions: (i) coordination with the objectives of other conservation and management initiatives (most notably, ACCOBAMS, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area), (ii) integration of other existing fisheries and coastal zone management concepts within sanctuary management objectives, and (iii) adherence to the principles of adaptive management and the precautionary principle (Mangel et al., 1996; Dayton, 1998). The precautionary principle or approach to management of resources recommends taking action against a specific practice that may cause damage to the environment even if there is no proof of a causal link. Essentially, in the presence of scientific uncertainty or absence of data, precautionary action should be taken to conserve the species or address the environmental problem (see NCEP module: “*International Treaties for Marine Conservation and Management*”).

LOOKING TO THE FUTURE

The Pelagos Sanctuary for Mediterranean Marine Mammals, admittedly a work in progress, has already achieved significant results, despite the challenges posed by protection of highly mobile animals in the large scale, dynamic marine environment. To realize its full potential, the Sanctuary should articulate clear objectives, initiate a monitoring regime that feeds information into adaptive management, and devise tangible ways to assess effectiveness.

The Pelagos Sanctuary management plan clearly formulates the purpose of this MPA: (i) manage human activities within Sanctuary waters to minimize impacts, (ii) increase scientific knowledge of cetaceans and their habitats within the Sanctuary, and (iii) promote awareness among professionals, practitioners, and the wider public.

These broad overarching goals provide a tangible target for the management of this MPA, which will help steer the implementation plan and the design of a monitoring plan to assess Sanctuary effectiveness. In addition to the systematic ecological and socio-economic research program envisioned by the management plan, effective stewardship will require developing measurable and tangible objectives that are much more specific than the general Sanctuary goals listed above. These may include measures of biotic integrity (e.g. standing stocks, productivity), and environmental variability (e.g. oceanography, disturbance regimes), along with appropriate indicators of physical and biological variability at short (inter-annual) and long (climate change) temporal scales (Zacharias et al., 2006).

By linking the broader management goals with the field monitoring program, these quantitative and measurable objectives will help identify those habitats, processes, and threats ‘critical’ to achieve the management objectives. In doing so, these metrics of success will catalyze research, outreach, and education within the Sanctuary and in the broader Mediterranean Sea.

RECOMMENDATIONS

On the basis of the Sanctuary management plan, we can advocate two general recommendations for a monitoring program and associated quantitative metrics of success:

1) Develop a broad biogeographic and ecosystem-level analysis of cetacean ecology, including their distributions, abundance, habitats, and community structure. This approach should quantify changing conditions within and outside Sanctuary waters, and consider genetic, stock, species, community, and ecosystem levels. Potential metrics could include changes in ocean productivity over time, studies of the density and distribution of cetaceans, research on the population structure (e.g., age classes) and reproductive rates on cetaceans, and investigations of the abundance and composition of their zooplankton / fish / squid prey.

2) Establish a program to map the spatial and temporal distributions of the threats to cetaceans and the oceanographic processes supporting ocean productivity and prey availability within and outside of the Sanctuary. Potential metrics could include changes in bycatch rates and ship strikes, surveys of floating marine debris and derelict fishing gear, studies of pollutants in the food web and in cetacean tissues, studies of anthropogenic noise levels in the area, as well as monitoring of human activities (whale watching, oil tanker and cargo vessel traffic, fishery distributions) within and outside the Sanctuary.

CONCLUSIONS

In summary, the development of a coordinated Sanctuary management plan and a quantitative monitoring program will be critical to ensure the effective implementation of the Pelagos Sanctuary and the long-term conservation of Ligurian Sea cetaceans. This dual approach will provide the information foundation required for long-term management of the Sanctuary, as well as clear guidelines to assess the Sanctuary's effectiveness. The lack of clear metrics of success is a dangerous pitfall of MPA implementation, because the inability to gauge the success of these management actions can result in disillusionment, loss of credibility, and community / industry backlash against established and future parks and marine zoning initiatives (Agardy et al., 2003).

DISCUSSION QUESTIONS

1. What were the major contributing factors in the development of the Pelagos Sanctuary? Which would you consider the most important?
2. Describe the two-edged sword that the existing international legal framework presented (hint: discuss whether the lack of EEZ helped or hurt the process)
3. What seems to be more important in this case: institutions or individuals?

4. What accounts for how surprised the scientific community and the public was when the discovery of this important area occurred?
5. What is the role of civil society in MPA establishment?
6. If you were a stakeholder in this process (fisher, coastal resident, tourist, whale watching operator, cetacean researcher, naval officer, ferry captain) what would you do?

ADDITIONAL READING

If you would like to learn more about the Pelagos Marine Sanctuary, please see:

Notarbartolo di Sciara G, T. Agardy, D. Hyrenbach, T. Scovazzi, and P. Van Klaveren. 2007. The Pelagos Sanctuary for Mediterranean marine mammals. *Aquatic Conservation: Marine and Freshwater Ecosystems*. In press.

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BOXES

Box A. High Seas

“One of the difficulties with dealing with the high seas is that even the concept of high seas is poorly understood and that their definition is more legal than biological in nature - though obviously their ecology is of considerable importance. Under the legal regime set up by the United Nations Convention on the Law of the Sea, which was adopted in 1982 and is commonly referred to as a constitution for the oceans, coastal States are responsible for the management of marine resources within their coastal waters, broadly defined as an area that extends from the coastline to 200 nautical miles (n.m.) offshore. These areas under coastal states jurisdiction include internal waters within the coastal baselines (e.g. bays, estuaries, etc.), territorial seas generally extending to 12 nautical miles offshore, and exclusive economic zones (EEZs) extending from the limits of the territorial sea to 200 n.m. from the coast. This is particularly important because coastal States could, theoretically at least, control and impose limits on exploitation of resources within their zone of jurisdiction. No single entity, however, has such power on the high seas and the regime that prevails is one of freedom of exploitation. This freedom is not absolute but is mainly constrained by the rights of other states to share in the exploitation of resources, and what is sorely missing is an emphasis on conservation, or at the very least sustainability.”

(taken from: De Fontaubert, C. 2006. High seas: the last frontier for ocean management, The W2O Observer. Available at http://www.thew2o.net/archive_new.html?id=25)

Box B. NGOs

by Tundi Agardy

The Pelagos Sanctuary was initially promoted by two NGOs, the Tethys Research Institute and the European Association Rotary for the Environment, and subsequently supported by a number of environmental NGO, most notably the World Wide Fund for nature (WWF).

The Tethys Research Institute (www.tethys.org) is a non-governmental research organization having as its main goal the promotion of the conservation of the marine environment through the collection of scientific knowledge. Tethys aims at protecting the Mediterranean biodiversity by promoting the adoption of a precautionary approach for the management of natural resources. Public awareness and conservation activities, coupled with education and capacity building, find their strength in Tethys' scientific background. The activities conducted by Tethys seek to prevent the decline of marine species – cetaceans in particular - and to encourage a sustainable use of the marine environment, particularly where habitat degradation makes it necessary. Founded in 1986 in Milan, Italy, by Giuseppe Notarbartolo di Sciara and Egidio Gavazzi, the institute is headquartered at the Milan's City Aquarium, and has offices in Venice hosted by the Civic Natural History Museum of that city. Tethys has conducted longitudinal studies of bottlenose dolphins in the northern Adriatic Sea since 1987, and on both common and bottlenose dolphins in the eastern Ionian Sea. Research methods used by Tethys included remote sensing and telemetry, relative abundance and line-transect population studies, the combined use of laser range-finding binoculars and GPS to passively track and record the horizontal movements of whales, bioacoustic research, photo-identification and behavioral sampling, remote biopsy sampling for genetic and toxicological analyses, and historical research. With a core of about 35 collaborators (largely marine biology professionals and students) and a membership averaging 300/year, the Tethys Research Institute has involved in its campaigns thousands of people from all over the world, and has developed a network that is constantly growing.

The European Association Rotary for the Environment (www.aera.it) is a non-profit organization which was founded in the early '90s in Milano by the Rotary Clubs of Districts 2030-2040-2050-2080-2110. The organization pursues its aim of social solidarity through educational activities, scholarships, and the development of environment-friendly technologies.

Strong support in promoting the Pelagos Sanctuary was provided in Italy and France by the Worldwide Fund for Nature (WWF). In particular, the Italian branch of WWF (www.wwf.it) worked in tandem with the Mediterranean Programme of WWF (www.panda.org/mediterranean) to catalyze the effort. The WWF Mediterranean Programme's goal is to conserve the natural wealth of the Mediterranean and to promote the sustainable use of natural resources for the benefit of all. It focuses primarily on the conservation of forest, freshwater and marine ecosystems, promoting the establishment of protected areas and resource use practices that maintain

biodiversity and ecological functions. The Mediterranean Programme of WWF also works to promote a sustainable fisheries regime in the entire basin, to prevent nature loss from mass tourism development, to ensure that the European Union's Mediterranean policy is ecologically sustainable and socially equitable, and to improve and implement measures against marine pollution. WWF generally works to build the conservation capacity of individuals and organizations. Importance is given to communications and advocacy to inform people, to raise awareness and to persuade decision makers and stakeholders to act.

BOX C. Champions of the Ocean Environment: The Role of Individuals in Establishing MPAs

by Tundi Agardy

The birth of the Pelagos Sanctuary would not have been possible, or even imaginable, without a few dedicated individuals who championed the idea and carried it forward.

The early conceptualization of a vast marine mammal sanctuary was partly the brainchild of Giuseppe Notarbartolo di Sciara, who continues his involvement with Pelagos to this day. Giuseppe is an Italian marine biologist, who is well known throughout Europe as a conservation leader and television personality. He was a guest of “*Noah’s Ark*”, a documentary series on wildlife of the world, and is the marine science advisor for “*Geo + Geo*,” a live show televised daily throughout Italy; he is the recipient of the Golden Trident Award by the International Academy of Underwater Sciences and Techniques. Giuseppe’s interest in marine mammals grew out of a lifelong love of the sea. His ancestors were mariners and his father was a founder of the Centro Velico di Caprera, which honed his interest in Italy’s marine environs and pointed his childhood fascination with animals towards marine life.

Opportunities for research on marine mammals in Italy were non-existent in the 1970s, however, so when he finished his studies at University of Parma, working on gobies, he traveled to the U.S. At Hubbs-Sea World in San Diego, he worked on beluga whales and whale sharks, and ended up doing his Ph.D. at Scripps Institution of Oceanography on manta rays in the Gulf of California (where he discovered a new species that he named after his good friend and mentor Walter Munk). Returning to Italy brought Giuseppe to a fateful encounter with many of the other champions who would become so instrumental in fostering Pelagos. Key was his membership in and subsequent coordination role in the marine mammal working group of CIESM (the International Council on the Exploration of the Mediterranean Sea). Also critically important was his founding of *Tethys Research Institute*, the NGO specializing in the study of Mediterranean cetaceans that spearheaded the establishment of the Pelagos Sanctuary. In 1996, the Environment Minister of Italy nominated Giuseppe for the presidency of ICRAM (the Central Institute for Applied Marine Research), and his term there brought him into the realm of diplomacy and politics – providing him invaluable insight and tools for continuing his push for establishment of the Sanctuary.

Prince Rainier III of Monaco was another key champion in the 15 years of developments that ultimately led to the Pelagos Sanctuary. The Monegasque royal family had had a longstanding relationship with the sea and marine science, beginning with the reign of Prince Albert I (1848-1922), who set out to follow the “career of a navigator” (the title he put on his memoirs). Prince Albert I directed 3,698 operations at sea, founded the Oceanographic Institute with its centers in Paris and Monaco in 1906, and founded CIESM in 1919. Prince Rainier III followed his ancestor’s footprints, becoming appointed President of CIESM in 1956, at a time when the institution had grown to 17 member states and much influence. Fifteen years later, he created the *Albert I of*

Monaco Prize for Oceanography to recognize other champions of marine science and conservation. Prince Rainier's concern for the marine environment and marine pollution continued to grow. In 1970 he took the initiative for launching a Franco-Italo-Monagasque project for cooperation between the administrative, technical, and scientific authorities of the three countries. This set the stage for the RAMOGE Convention (named after its geographic spread from St Raphael in France through Monaco, and to Genoa), which created a legal framework for cooperation between the three countries in the region of the greater Ligurian Sea – the very same region that would become the territorial sea portion of the Pelagos Sanctuary. So it was that in 1991 when *Tethys* and its NGO partners presented the proposal for Pelagos in Monaco, the idea found a ready, willing, and eminently capable champion in Prince Rainier III. It is reassuring to learn that his son, Prince Albert II, is intending to carry on his legacy.

The Pelagos Sanctuary might never have happened without the personal support of Carlo Ripa di Meana and Segolène Royal, who in 1991 were Ministers of the environment, respectively, of Italy and France. Ripa di Meana and Royal had an informal breakfast conversation in Scotland during an European environment summit, in the presence of Ambassador Giuseppe Cassini, then diplomatic counselor to Ripa di Meana. They agreed that Italy would support the creation of a transboundary French-Italian marine park in the Strait of Bonifacio, between the islands of Sardinia (Italy) and Corsica (France). This was a matter close to the French heart, and France was grateful. In turn, the Italian diplomats lobbied their French colleague to support the promotion of the Pelagos concept. Soon after the meeting in Scotland, Ambassador Cassini organized and chaired in Genoa and Nice a series of French-Italian-Monagasque intergovernmental meetings to move forward with the Sanctuary, which led to the signing of the 1993 Brussels declaration. It was since the Genoa meeting that substantial support for the construction of the legal framework of the Sanctuary Agreement was secured from Tullio Scovazzi, professor of international law at the University of Milan. In 1995, Prof. Scovazzi contributed substantially to the drafting of the revised SPA Protocol to the Barcelona Convention. His recent involvement with the Pelagos Sanctuary strongly contributed to the inclusion in that Protocol of a provision for the creation in the Mediterranean of high-seas MPAs.

BOX D. From Phytoplankton to Fin Whales

by David Hyrenbach

The dominant circulation pattern in the Ligurian Sea, a cyclonic (anti-clockwise) current, flowing north along Corsica and Tuscany and hugging the coast of Liguria and mainland France in a westerly direction (Margalef, 1985), creates a permanent hydrographic *frontal system* which separates coastal and offshore waters (Millot and Taupier-Letage, 2004). The dynamics of the *water masses* associated with the front generate intense biological activity along this boundary, leading to enhanced levels of primary production, concentrations of *zooplankton* (including the *euphausiids* *Meganyctiphanes norvegica*, Figure 3) and dense concentrations of top marine predators (including krill-eating Fin Whales *Balaenoptera physalus*, fish-eating Striped Dolphins *Stenella coeruleoalba*, and squid-eating Sperm Whales *Physeter macrocephalus*; Forcada et al., 1995, 1996; Goffart et al., 1995; Sardou et al., 1996; Gordon et al., 2000).

The marine productivity of this region is influenced by several intermittent oceanographic processes, including vertical mixing due to storms and wind events, coastal upwelling of nutrient-rich water at canyons and shelf-breaks, and the input of terrigenous nutrients from rivers – most notably the nutrients and organic substances contributed by the Rhone (Arnau et al., 2004). These processes are influenced by the dynamics of the mistral, the prevailing north-westerly wind in this region, which mixes the water column bringing nutrients up into the *euphotic zone*, fuelling high localized ocean productivity (Gonella et al., 1977). The resulting high levels of primary production support high standing stocks of *chlorophyll a* concentration. This is a metric of the abundance of the phytoplankton primary producers and the amount of the productivity at the base of the *pelagic* food web - over 10 g m^{-3} (Jacques, 1989). These enriched localized values are equivalent of those found in well-known productive eastern boundary currents, like the California Current system (*chlorophyll a* concentration $> 1 \text{ mg m}^{-3}$; Kahru and Mitchell, 2000). This enhanced productivity supports high zooplankton biomass, including swarming euphausiid crustaceans (krill), and attracts aggregations of upper-trophic marine predators, including fin whales (Sardou et al., 1996).

It has been estimated that baleen whales consume between 3 – 4 % of their body weight every day during the feeding season (Klumov, 1963; Sergeant, 1969). Fin whales consume large amounts of euphausiids every day, with the estimates ranging from 1000 – 2800 kg (Tynan, 2004). Even though the diet and stomach contents of fin whales vary geographically and with the type of prey ingested, several published reports have documented that fin whales can consume large quantities of euphausiids (560 kg consumed in 8 hours off Nova Scotia, Brodie et al., 1978; 700 kg consumed four times a day in the Antarctic, Zenkovich, 1970). Overall, it has been estimated that an adult fin whale requires 2,000 – 2,500 kg of euphausiids to meet the daily metabolic requirements (Lockyer, 1981). Thus, over a three month summer residency period, a fin whale would consume 180 – 225 metric tons of euphausiids. These calculations underscore the critical ecosystem processes, linking primary producers, zooplankton

and fin whales, which make the Ligurian Sea such a unique and especial habitat in the Mediterranean Sea.

BOX E. Fin Whale Natural History in the Mediterranean

by David Hyrenbach

Fin whales, the second largest animal that ever existed on Earth, are very large cetaceans – reaching up to 25 meters in length and 60 tons in weight (Figure 2). Humans have been aware of the existence and the aggregation of these large marine predators in the Ligurian Sea for centuries, with the Romans already recognizing this area as the “coast of the whales”. However, in spite of their large size and charismatic nature, such memories have been lost in subsequent centuries. Currently, these cetaceans are impacted by human activities, at a time when we are only starting to understand their ecology and life history in the Mediterranean.

An estimated 3,500 fin whales occur in the western Mediterranean, most of which concentrate in the Corsican-Ligurian-Provençal Basin (Figure 1) to feed on krill during summer, although this species can be observed there year-round (Forcada et al., 1996; Notarbartolo di Sciara et al., 2003). These cetacean densities are in fact similar to those encountered within other high density areas, illustrating the truly remarkable nature of these whale concentrations. The ecological significance of the Ligurian Sea for Fin Whales, both in the Mediterranean and on a global context, is underscored by the predictable and dense concentration of this protected species within a fairly restricted geographic area. Researchers have documented both the return of individual whales to the Pelagos Sanctuary year after year, and their residence during the summer. Part of the population is now known to reside in the area also during winter, as demonstrated by acoustic monitoring (for instance, see Clark et al., 2002). Fin whales show significant site fidelity, as evidenced by the numerous re-sightings of recognizable individuals made during a 9-year study (1990–98). For instance, single individuals have been encountered up to four instances in different years, and up to three times within the same season. These re-sightings of the same individuals have been recorded at intervals spanning 1 to 90 days (Notarbartolo di Sciara et al., 2003).

Novel satellite tracking technology has also allowed researchers to study the movements of individual fin whales in the Ligurian Sea, and throughout the Western Mediterranean. These recent data have revealed that a large sample of tagged whales remained within the Sanctuary throughout the year. One whale ventured outside of the Mediterranean, and eventually returned to the Sanctuary (C. Guinet, pers. comm.).

The Ligurian Sea is a critical habitat for Mediterranean fin whales, as illustrated by their dense aggregations, the predictability of their presence in the area, and their special natural history. Fin whales forage and breed in the Ligurian Sea, where they occur in all seasons. On a population level, the realization that fin whales in the Mediterranean and Atlantic are genetically distinct further underscores the conservation significance of the Ligurian Sea (Berubé et al., 1998).

TABLES

TABLE I. TIME LINE

Year	Event
1980s	Widespread concern in Italy and France for the impact of pelagic driftnets and other human activities on cetacean populations in the area.
1990	The Tethys Research Institute formulates "Project Pelagos" for a Reserve of the Biosphere in the Ligurian-Corsican-Provençal Basin to protect cetaceans. The study is sponsored by the European Association Rotary for the Environment (AERA).
1991	Tethys and AERA present "Project Pelagos" in Monaco, at the presence of Prince Rainier III, who embraces the idea.
1992	The governments of Italy and France join Monaco in an international effort to establish a marine mammal sanctuary in the area.
1993	France, Italy and Monaco sign in Bruxelles a Declaration of intent for the establishment of a marine mammal sanctuary in the area.
1999	France, Italy and Monaco sign in Rome the Agreement on the creation of an international sanctuary for marine mammals in the Mediterranean.
2001	The Parties to the Barcelona Convention inscribe the Sanctuary in the List of Specially Protected Areas of Mediterranean Importance (SPAMIs).
2002	The Agreement on the Sanctuary comes into force.
2004	The Sanctuary management plan is developed and adopted.

FIGURES

FIGURE 1. THE PELAGOS MARINE SANCTUARY

Source: Tethys Institute



FIGURE 2. SELECTED CETACEAN SPECIES OF THE LIGURIAN SEA

Source: Massimo Demma



FIGURE 3. EUPHAUSIID ZOOPLANKTON

Source: Jamie Hall/NOAA

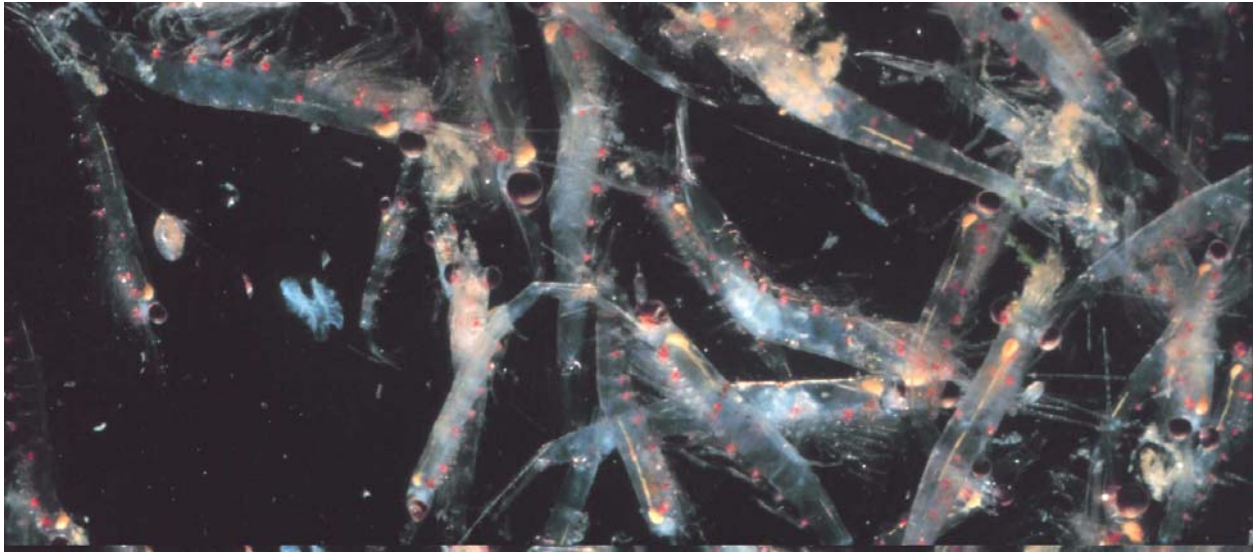


FIGURE 4. CETACEAN ENTANGLED IN FISHERIES EQUIPMENT

Source: Alberto Romeo

