

# Marine Conservation Biology

THE SCIENCE OF MAINTAINING  
THE SEA'S BIODIVERSITY



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# 21 The Role of Legal Regimes in Marine Conservation

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Conservation biologists study species and their supporting ecosystems in order to fashion tools to restore populations and natural systems imperiled by human activities. Therefore, conservation biology is a crisis discipline founded on the explicit normative principle to preserve biological diversity (Noss 1994; Soulé 1991). To meet this challenge, conservation biology draws on a range of scientific disciplines, from genetics to systematics, from ecology to wildlife biology. Because conservation biologists ultimately depend upon policies and laws to achieve their objectives, they must understand how these processes operate and be prepared to participate. Working directly with policy makers ensures that they make and implement the best, most effective, science-based decisions (Meffe 1998). In this chapter, after a brief overview of the legal regimes for marine conservation, we use the laws of the United States to illustrate the basic types of national legal regimes, the opportunities and impediments within these regimes to the application of marine conservation biology, and the lessons for conservation biologists.

## Overview of Legal Regimes for Marine Conservation

Most modern industrialized nations have enacted laws governing the extraction of natural resources

and the protection of the environment within their sovereign boundaries. Laws for the protection of land-based environments have proliferated since 1970, but the pace of change in marine law has been even more dramatic. After centuries in which the major principle was the freedom of the sea, international law of the sea now recognizes that sovereign rights can extend to a distance of 200 nautical miles from a nation's shoreline. Many nations now include significant areas of the sea within their national jurisdiction and have enacted specific laws and policies to fulfill their international rights and duties to utilize, conserve, and manage their sea areas (Jacobson and Rieser 1998). National legislation seeking to protect marine life and environments from the impacts of human activities mirror goals embodied in a number of international legal regimes.

International law of the sea recognizes the limits of the marine realm's resources. Fisheries can be depleted and marine ecosystems can be altered by human activities before we fully understand them. New norms emanating from international environmental law such as "sustainable development" and the "precautionary principle" are finding expression in treaties for marine protection and management (Thorne-Miller 1999).

Today there are many legal regimes and institutions, from international to local, aimed at the conservation of marine wildlife and natural systems (lu-

dicello and Lytle 1994). Marine international legal regimes build upon the framework of rights and responsibilities enumerated in the 1982 UN Convention on the Law of the Sea. Imperiled marine species, for example, are protected through restrictions on global trade under the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the ban on commercial whaling adopted under the International Convention for the Regulation of Whaling. Defining national responsibilities toward biodiversity is the goal of the Convention on Biological Diversity. Parties to the Convention adopted a program of action on marine and coastal biodiversity at its second plenary meeting, in Jakarta, Indonesia, in 1995 (de Fontaubert et al. 1998).

Nations that fish on the high seas have new obligations to cooperate with coastal and other fishing nations to conserve and manage those species. The 1995 UN Agreement on Straddling and Highly Migratory Fish Stocks breaks new ground in setting standards for responsible fishing and fisheries management in specifying a duty to apply a precautionary approach and to protect bycatch species from falling below biologically safe levels. The Agreement is also the first international fisheries agreement to identify marine biodiversity as a value worth protecting in its own right (Rieser 1997). Nations participating in regional fisheries management institutions like the International Commission for the Conservation of Atlantic Tunas (ICCAT), created by treaty in 1969, are now required to adopt enforceable and precautionary conservation measures to prevent overfishing and to allow fish stocks to rebuild to levels that are biologically appropriate.

While marine legal regimes vary in their approach and effectiveness, they follow a few basic models. At the national level, nations commonly have a series of laws that:

1. Identify and protect species at risk of extinction
2. Manage fish stocks found within the territorial sea and exclusive economic zone (EEZ)
3. Require an environmental assessment of pro-

posed activities likely to have a significant impact on the environment

4. Identify and protect geographic areas that are of especially high biological, cultural, or aesthetic value (Thorne-Miller 1999)

Pollution control legislation is also common among developed nations. Such measures reduce the threat of discharges of pollutants from vessels ranging from oil to nonindigenous organisms, as well as land-based sources that alter estuarine and near-coastal waters. Integrated coastal zone management that can link activities on land to their impacts on marine waters is recognized increasingly as an essential tool (Cicin-Sain and Knecht 1998).

Despite the creation of these legal institutions, however, human activities continue to alter marine ecosystems extensively. Studies indicate that in the global waters, large predatory fishes, such as tunas, swordfish, and billfish, have declined 90 percent since the dawn of industrialized fishing (Myers and Worm 2003). Similarly, in the northwest Atlantic Ocean, scientists estimate that all recorded shark species, with the exception of makos, have declined more than 50 percent in the last 8 to 15 years (Baum et al. 2003). In US waters, many marine wildlife and fish populations have fallen to record low levels despite 25 years of management and protection under these regimes. In the upcoming pages we will explore why these regimes fail, despite a growing set of scientific tools to increase our understanding of natural processes, and provide examples of ways in which we can make them work better.

### Case Study of US Legal Institutions for Marine Conservation

To understand the challenges facing marine biodiversity, we now turn to a brief examination of a national legal regime for marine conservation, using US laws to illustrate common approaches and problems. Where relevant, we refer to parallel international institutions created under treaties.

## Endangered Species Legislation

One of the earliest and most potent conservation laws in the United States, the Endangered Species Act of 1973 (ESA), mandates the conservation of individual endangered and threatened species and the ecosystems upon which those species depend. The US Supreme Court describes the ESA as "the most comprehensive legislation for the preservation of endangered species ever enacted by any nation," and maintains that the ESA requires that species' extinctions should be halted, no matter what the cost.<sup>1</sup>

When a species has been proposed for listing under the ESA, the responsible federal agency must determine whether the species faces a risk of extinction. The ESA allows subspecies to be listed, and it requires that determinations of what constitutes a species and its risk of extinction be made on the basis of "the best scientific and commercial data available." The agency is required to designate critical habitat for the species at the same time as the listing "to the maximum extent prudent and determinable."

Any person can petition the government to determine whether the status of a species warrants listing, removal from listing, or revisions to a critical habitat designation. Within the marine realm, examples of endangered or threatened species include all the large cetaceans, every species of sea turtle in US waters, Steller sea lions (*Eumetopias jubatus*), Hawaiian monk seals (*Monachus schauinslandi*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), and smalltooth sawfish (*Pristis pectinata*). The white abalone (*Haliotis sorenseni*) was listed as endangered in 2001, probably due to reproductive failure stemming from overexploitation. It remains the only marine invertebrate listed under the ESA.

Clearly, fewer marine species have been listed under the ESA than terrestrial species. Fishes and invertebrates in particular are underrepresented, perhaps due to the lack of detailed knowledge about their status. Recently, a group of scientists undertook a study to gather all available information on marine fishes and evaluate their risk of extinction (Musick et al. 2000). Their

study represents one of the first attempts to develop a list of marine, estuarine, and diadromous fishes that might be at risk of extinction. In 2002, however, the US government decided not to list two fish populations: the Atlantic white marlin (*Tetrapturus albidus*), estimated to be at 5 to 15 percent of its unfished biomass (NOAA 2002a), and a population of bocaccio rockfish (*Sebastes paucispinis*) off the coast of California, estimated to be at only 3.6 percent of its unfished abundance (NOAA 2002b). In both instances, the decision not to list was based upon the promise that the population declines would be reversed by new management measures implemented through regional and international fishery management bodies.

Under US law, once a species has been listed, the Secretary of Commerce or Interior (depending on the species) must develop and implement a "recovery plan" that will provide for the conservation and survival of the species. Because the ESA prohibits "takings," federal and state actions may not "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" an endangered or threatened species, or attempt to engage in these activities. The term *harm* from this list includes the modification of a species' habitat that disrupts essential behavioral patterns such as feeding or breeding.<sup>2</sup> Under these legal definitions, the government is required to evaluate both direct and indirect actions that impair species' survival, thus increasing the scope of legal protection. Actions that harm listed species, whether they occur on private or public land or in the sea, are prohibited. The US federal government has developed recovery plans for some listed marine species, including leatherback sea turtles (*Demochelys coriacea*), Hawaiian monk seals, and short-nosed sturgeon (*Acipenser brevirostrum*). However, even after decades of management, all of these species remain endangered, and many of the activities identified in the recovery plans, including research essential to understanding the causes of species' declines, have either not been funded or simply not carried out. Environmental citizen suits have played an essential role in achieving whatever effectiveness the ESA has had, but the courts usually have not al-

lowed citizen suits to compel agencies to carry out the research and actions needed to recover a listed species (Bean and Rowland 1997).

Although the ESA provides strong protections after a listing occurs, species tend to be on the brink of extinction before they are listed. Often, by the time species are listed as endangered, populations have dropped so far below healthy levels that they are at risk of losing genetic diversity or might become extinct due to stochastic events (Wilder et al. 1999). The 2001 listing of the white abalone falls into this category. Additionally, the listing process has become highly politicized, resulting in long delays in the listing or the designation of critical habitat (Tobin 1990), or in the rejection of the petition to list a subpopulation or to revise an existing critical habitat designation.

Even when a species is listed as threatened or endangered under the ESA, implementation of the Act can be less than effective. The ESA's single-species focus fails to develop regional plans to evaluate and protect imperiled ecosystems upon which listed species often depend. In this sense, the ESA falls short of applying the principles of conservation biology, which require a holistic, adaptive management approach. Only litigation under the ESA and national environmental impact assessment legislation has forced responsible federal agencies to consider comprehensive strategies to reduce the threats to listed marine wildlife.

At the international level, nations have had even more difficulty agreeing whether to list marine species as endangered. Under CITES, a growing number of marine species have been proposed for listing on either Appendix I (banning all international trade among member nations) or II (requiring monitoring of trade) due to seriously declining populations and the perceived failure of international and national management institutions to protect them. Proposals for listing the Atlantic bluefin tuna (*Thunnus thynnus*) in Appendix II have been unsuccessful in the face of intensive lobbying by countries such as Japan and Canada (Safina 1998; US Congressional Research Service 1995). The continued protection of large whales

has met similar resistance through attempts to remove or downgrade their listing under CITES. Their removal would allow trade to recommence in whale meat and other products, thus undermining the international moratorium on commercial whaling adopted by the International Whaling Commission.

### Marine Mammal Legislation

Lethal encounters with vessels and fishing gear consistently threaten marine wildlife. In 1972, the United States adopted the Marine Mammal Protection Act (MMPA) to address the most notorious of these interactions: fishermen encircling and drowning groups of dolphins with purse seines while capturing yellowfin tuna (*Thunnus albacares*) in the eastern tropical Pacific Ocean (Gosliner 1999). The MMPA is designed to protect and conserve populations of marine mammals that have become depleted, and marine scientists played critical roles in the law's passage and in drafting key provisions (Bauer et al. 1999). Under the Act, when a marine mammal population is below its "optimal sustainable population" level, the Secretary of Commerce is required to list it as "depleted" and prepare a conservation plan for the species.

The MMPA prohibits the "taking" of marine mammals, but includes certain exceptions. Regulated takings are allowed, for example, in commercial fisheries, for Native Alaskan subsistence purposes, and for scientific research. Despite the Act's goal of maintaining mammal populations to ensure the health and stability of marine ecosystems, the regulations implementing this standard focus primarily on species' population levels and do not address habitat degradation or destruction. Unlike the ESA, the MMPA has no parallel requirement to define critical or essential habitat for marine mammals. In the sea, impacts on habitat include humanmade noise generated by commercial shipping, military weapons testing, and military surveillance systems. Cumulative degradation of the acoustic habitat remains a significant threat for which the MMPA has inadequate decision criteria (National Research Council 2000; Natural Resources Defense Council 1999).

The inadequacy of these criteria became apparent after the National Marine Fisheries Service (NMFS), which administers the MMPA, granted the US Navy authorization for worldwide deployment of a low-frequency, active sonar system to detect submarines. Environmental groups challenged the validity of such a broad authorization under the MMPA's exemption for takes of small numbers of marine mammals in specific geographic regions. After a federal court found flaws in NMFS' decision to grant the authorization, including an inadequate consideration of available scientific information,<sup>3</sup> the Navy agreed to limit deployment to specific marine regions near North Korea. The US Congress, however, then used the Defense Department's authorization act for fiscal year 2004 to enact a broad exemption for national defense activities from the MMPA,<sup>4</sup> touching off a debate that potentially will pit marine mammal conservation against national security while US soldiers are facing hostilities in Iraq and Afghanistan (Kaufman 2003).

Before the recent MMPA amendment that grants exemptions for the military, the largest exception to the MMPA prohibition against taking marine mammals applied to commercial fishing operations. While commercial fishing operations are allowed to take marine mammals, the Act required that such takes be reduced to levels approaching a zero rate by May 1, 2001. Unfortunately, this goal has not yet been met. Each year, the Commerce Secretary is required to publish a list of fisheries that interact with marine mammals, as well as stock assessments for the species incidentally killed by fishing operations. Using this information, the Secretary calculates a precautionary estimate of the level of mortality that the population can withstand, called the "potential biological removal" (PBR) level. Managers use this estimate to keep incidental take rates below one-fifth of the population's potential rate of increase (Caswell et al. 1998).

In 1994, Congress amended the MMPA to require take reduction plans for strategic stocks of marine mammals. Strategic stocks are populations that are either threatened or endangered, or are being reduced

significantly by human activities, and that also are affected seriously by commercial fisheries. Take reduction plans have the immediate goal of reducing marine mammal takes from commercial fishing to levels less than the PBR. Over the longer term, these plans endeavor to reduce the takes to levels approaching zero within five years. In recent years, conservation biologists and marine mammal scientists from outside the government have participated in these take reduction planning efforts by serving on consensus-based take reduction teams (Young 2001). This process, like the ESA recovery planning process, provides another opportunity for scientists to promote application of conservation biology approaches directly on a species by species basis.

### **Fisheries Management Legislation**

The Magnuson-Stevens Fishery Conservation and Management Act (FCMA) is the central federal statute governing the management of US marine fisheries. Enacted in 1976 to implement the United States' newly declared 200-nautical-mile exclusive fishery zone, early versions of the Act focused on replacing foreign fishing fleets with American fishing vessels and providing a system to define the maximum sustainable level of fish extraction. By the early 1990s, only the first of these goals had been achieved. Accordingly, in 1996, Congress substantially amended the FCMA with the Sustainable Fisheries Act to achieve three central goals: (1) prevent overfishing and rebuild overfished stocks, (2) avoid and minimize bycatch, and (3) identify and protect essential fish habitats (EFH). Given that overexploitation and habitat destruction are principal factors contributing to loss of biodiversity, the FCMA contains the basis for achieving some of the aims of marine conservation biology. The actual implementation record, unfortunately, betrays that promise, partly as a result of the decision-making process created under the Act. Despite 25 years of federal management, numerous fish populations managed under the FCMA remain overfished. In 2002, 41 percent of all federally managed fish stocks were either at unsustainably low levels

(overfished) or being fished at too high a rate (overfishing) (NMFS 2002).

The FCMA established eight regional fishery management councils and charged each council with responsibility for developing fishery management plans (FMPs) to govern the fisheries under its jurisdiction. Council members are appointed by a political process that requires approval of state governors and authorization from the Secretary of Commerce. Typically, council members represent the fishing industry and the fisheries managers from the states within the region (Eagle et al. 2003; Okey 2003).

The FCMA requires the councils to determine whether overfishing is occurring and to put measures in place to prevent or reverse it. The statute defines "overfishing" as "a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis." In general, fishery managers seek to maintain the fishery's biomass at the level of maximum sustainable yield (MSY); that is, the population that produces "the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions."<sup>5</sup> The Act also requires that conservation and management measures be based upon "the best scientific information available." However, determining what constitutes the best scientific information is not always a straightforward task. Is the most recent information always the best information? How do you determine if sound scientific methodologies were followed? Managers have not developed sufficient guidance on what is the "best available science" and what it means to "base" conservation measures upon the best available science (Bisbal 2002). Instead, challenges to the quality of the scientific information have been used at times to justify delay in adopting needed reductions in fishing effort or modification of fishing practices (Pikitch 2003).

The FCMA also requires that the councils address the issue of bycatch, species unintentionally caught in fishing operations that are kept or discarded by the fisherman (Crowder and Murawski 1998). The stan-

dard provides that conservation and management measures "shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." The Act also finds that essential fish habitat is vital to the nation's fisheries and requires FMPs to "describe and identify essential fish habitat for the fishery . . . minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat."

The decision-making process under the Act clearly favors short-term commercial interests over long-term sustainability. The regional councils are heavily dominated by advocates for fishing interests, and the National Marine Fisheries Service (NMFS), the government agency responsible for fisheries management, has been reluctant to insist that the councils adopt a precautionary approach in setting quotas (Eagle and Thompson 2003), controlling bycatch, and protecting habitat (Dayton et al. 2003). When NMFS has adopted fish stock rebuilding programs, commercial fishing interests' lawsuits have tied up management plans in court (National Academy of Public Administration 2002). Conservation groups have turned to litigation as well to enforce conservation duties, and have won significant court victories, as the following two cases demonstrate.

In 1998, the Mid-Atlantic Fishery Management Council submitted a recommendation to NMFS for the 1999 quota for summer flounder (*Paralichthys dentatus*), an overfished species subject to a rebuilding plan. NMFS rejected the recommendation because it had an "unacceptably low probability" (3 percent) of achieving the rebuilding plan's target, substituting instead a commercial fishing quota that had only an 18 percent chance of controlling fishing mortality rates and rebuilding the stock. Conservation groups then sued the government for failing to "ensure" that the population be rebuilt. The federal court agreed with the conservation groups and struck down the NMFS quota. The court concluded that "at the very least," the Act required a quota that had at least a 50

percent chance of meeting the duty to prevent overfishing and begin rebuilding. The court further observed that "only in Superman Comics' Bizarro world, where reality is turned upside down, could the Service reasonably conclude that a measure that is at least four times as likely to fail as to succeed" offers confidence that the population will rebuild.<sup>6</sup>

The second case concerned the FCMA's requirement that NMFS identify essential fish habitat and "minimize to the extent practicable the adverse effects on such habitat caused by fishing." NMFS identified EFH in all fishery management regions and commissioned a literature review that summarized studies from the United States and elsewhere on the effects of fishing on habitat. This review found that in virtually all cases, fishing gear had disturbed ocean floor habitat and that, in the absence of site-specific data on impacts, models based on disturbance theory would support protective measures (Auster and Langton 1999). In spite of these findings, neither the regional fishery management councils nor NMFS took steps to assess the specific effects of fishing gear, nor did they take any steps to minimize the effects of fishing on EFH. As a result, bottom trawling, scallop dredging, and other fishing practices that can disrupt benthic habitats continued largely unabated throughout the US EEZ.

In June 1999, several environmental groups filed suit challenging NMFS's failure to take steps to minimize the adverse effects of fishing on EFH as a violation of the FCMA. In response, NMFS took the position that fishing could continue in the absence of definitive proof that a particular fishing practice was producing a documented, negative impact on a specific area of the ocean floor, and that this negative impact was affecting fish species adversely. Furthermore, NMFS argued that the environmental groups had the specific burden to demonstrate conclusively the negative effects of a particular fishing practice.<sup>7</sup> The court found that the councils all had identified EFHs within their regions, yet none had adopted any further management measures that would restrict fishing gear in order to minimize adverse effects on habitat. The court concluded, however, that the management

plans met the EFH requirements of the federal fisheries law, deferring to NMFS's interpretation that it required site-specific information on adverse effects before such measures would be warranted.<sup>8</sup> The court also found that the environmental assessments accompanying the plans were inadequate, and required the councils to prepare a more rigorous analysis of alternatives for reducing fishing gear impacts.

The government's position in the EFH litigation illustrates the limited degree to which managers are likely, on their own initiative, to apply the precautionary approach that underlies marine conservation biology. Rather than acting in a precautionary fashion and agreeing to take steps to limit the adverse effects of bottom-tending fishing gear, the government insisted that conservation plaintiffs must proffer site-specific, detailed proof that gear is causing adverse effects at specific locations on the ocean floor. Due to a lack of funding for research, however, such information is often hard to obtain. Moreover, the government position ignored the clear intention of the Congress in enacting the EFH provisions in 1996. Under these circumstances, the ruling by the court in the EFH case that FCMA does not require the government to conduct or fund research to better understand the impact of fishing on habitat was both erroneous and unfortunate.

External pressure from the scientific community eventually forced the agency to abandon the position it took in the EFH litigation. The National Academy of Sciences published a report in 2002 on trawling effects and concluded that sea floor habitat can and should be protected from fishing gear impacts in the absence of site-specific information (National Research Council 2002). After the report was released, NMFS directed the councils to use the latest scientific information, including the NRC report, in their new environmental assessments.

### **Environmental Impact Assessment Legislation**

Although not specifically aimed at marine conservation, the National Environmental Policy Act of 1969 (NEPA) plays an important role in improving the de-



cision-making processes under the laws described above, due largely to the efforts of environmental citizen suits. NEPA's purpose is to ensure that federal agencies carefully consider and inform the public about the environmental consequences of their actions. NEPA requires federal agencies to evaluate the environmental impacts of all "major federal actions significantly affecting the quality of the human environment" through the preparation of an environmental impact statement (EIS). The EIS must be circulated among the public and other agencies for review and comment and must contain a description of the proposed federal action and a range of alternatives. The EIS must be prepared in advance of the decision to act or not to act on the proposal, bringing to light the full ecological implications of the possible range of decisions, including consideration of the cumulative impacts of various actions.

The ultimate role of the EIS is to ensure that the federal agency decision maker has the necessary information regarding environmental consequences to make a determination to proceed. Failure to prepare an adequate environmental analysis can be challenged in court, and if the court finds a serious violation, the court can order a new analysis. As mentioned in the previous section, the court in the fish habitat case required the regional fishery management councils to redo their environmental assessments of fishing gear impacts on essential fish habitat. The new EISs had to consider the latest scientific information on gear impacts, the sensitivities of special seafloor habitats, and the availability of practical measures to reduce or eliminate damage to these areas.

NEPA has been used as a legal lever for moving fishery managers to adopt an ecosystem approach. Again, because of the availability of citizen suits to enforce its decision-making requirements, courts have returned fishery management plans to NMFS and the councils for a broader analysis of the ecological impacts of fishery extractions. The leading example of this tactic is the lawsuit challenging the management of the largest single-species fishery in the world, the walleye pollock (*Theragra chalcogramma*) fishery off

Alaska. Groundfish fisheries off Alaska were managed for many years without a full environmental impact analysis to determine the pollock fishery's effect on the marine ecosystems of the Bering Sea and the Gulf of Alaska. These ecosystems had also undergone tremendous change over the past 20 years and at least one resident species, the western population of Steller sea lions, had been listed as endangered (National Research Council 2003). The federal court ordered the agency to prepare a comprehensive analysis of the fishery and the ecosystems, and to consider and compare the likely impacts of a wide range of alternative management strategies on the sea lion and other protected species in the region.<sup>9</sup> The court held that NEPA effectively enlarges the scope of fisheries management to require consideration of how the fishery is managed in light of the entire marine ecosystem (Kalo et al. 2002). The resulting programmatic EIS requires the most comprehensive consideration of the impact of fisheries on a marine system ever prepared under the federal fisheries law since its enactment in 1976.

The value of NEPA to marine biodiversity and informed decision making is clear. In federal fishery management efforts, for example, instead of focusing solely on the effects that fishing has on the managed fish stock, an EIS should present the impacts of the fishing activity on the larger marine ecosystem. Despite the single-species focus of the MSY-based management program established under the FCMA, NEPA provides a basis for managers to take a larger look at how entire marine ecosystems are changing in response to growing fishing efforts. Whether they will take advantage of this mechanism for ecosystem management in fisheries other than the Alaska pollock—and whether their efforts in Alaska result in meaningful analysis—remain to be seen.

### Legislation to Protect Special Geographic Areas or Habitats

Although marine protected areas (MPAs) have gained attention as a valuable conservation tool, the United States has few laws explicitly designed for protecting

marine areas from human use (Brax 2002; National Research Council 2001). The National Marine Sanctuaries Act of 1972 provides for the designation and management of marine areas of special significance. Despite often-intense opposition and controversy, roughly a dozen marine sanctuaries have been designated in the United States, largely through direct action by the Congress rather than the administrative process envisioned in the original legislation. Designation does not require restrictions on activities within the sanctuaries, making them far from the model of a marine protected area. Recently, however, managers and advisory bodies for the Florida Keys National Marine Sanctuary have identified and set aside areas within the existing sanctuary boundaries as marine reserves, and a similar process has identified a network of marine reserves within the boundaries of the Channel Islands National Marine Sanctuary off southern California (Airamé et al. 2003).

In 2000, President Clinton signed an executive order calling upon all departments within the Executive Branch to create a national system of marine protected areas.<sup>10</sup> In two subsequent orders, President Clinton created the largest MPA under US jurisdiction to date, the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.<sup>11</sup> Controversy surrounding this action, however, illustrates two of the chronic problems in marine management: the apparent overlap in authorities among various pieces of legislation (i.e., the FCMA and the National Marine Sanctuaries Act) and the absence of a clear mandate that protection of biological diversity is to take priority over other US marine policies (Chapman 2002). The struggle in the United States to establish marine protected areas faces opposition from fishing interests partly because of the lack of legislation providing a mechanism for comprehensive planning for marine areas. In contrast, Australia's new regional marine planning process is based on the large marine ecosystems concept and reflects a governmental commitment to strategic, ecosystem-based management of the Australian EEZ. Australia announced this commitment at the end of the International Year of the Ocean, in December

1998, as part of its national marine policy (Bergin and Haward 1999).

### **Impediments to Marine Biodiversity Conservation under Current Legal Regimes**

The conservation of biological diversity is hampered by at least three major impediments: the lack of public awareness and saliency, the limited knowledge base about the effects of human activities on ecosystem function, and the lack of mandates and tools (Houck 1996). As the foregoing review of the US marine legislation makes clear, all three of these are present in the marine realm. The institutional impediments to applying conservation biology have been succinctly described in a number of publications, including the *Global Marine Biodiversity Strategy* (Norse 1993). Of these impediments, marine conservation has suffered most from fragmented, risk-prone decision making and the misallocation of the burden of proof.

Fragmented decision making can have several meanings. First, within the government, two departments might share the management of one species. For example, the protection of endangered sea turtles is divided between the US Department of the Interior, which is responsible for sea turtle nests and adults while on land, and the Department of Commerce, which is responsible for sea turtles while in the water. Second, two offices within the same agency might compete with conflicting mandates, such as within the National Marine Fisheries Service under the US Department of Commerce. Within NMFS, the Office of Sustainable Fisheries is responsible for regulating fishing vessels, which can entangle turtles in their fishing gear, while the Office of Protected Resources is responsible for reducing the number of turtles that are caught. Third, and probably most important, fragmentation occurs when the budget process and priorities are disconnected from and out of touch with the legislative demands for management and conservation. As a consequence, agencies are called upon to do more with less. Legislative demands on agencies grow

while budgets for research and management programs contract. This situation forces agencies to engage in triage.

Another impediment to marine protection is the challenge of evaluating risk in management decisions when science is uncertain. When resource managers consider restraining extractive activities, the burden of justifying the restraint often falls on the parties who seek protection from the potentially harmful action, instead of the parties causing the harm. Under this approach, decision makers accept the potentially severe but uncertain risk of potentially long-term or irreversible ecological change to avoid accepting the more certain but shorter-duration economic costs of conservation strategies. Rather than acting upon the best scientific information available (as these laws require) and proceeding cautiously in the face of uncertainty, managers often believe they must have proof beyond a reasonable doubt before they can adopt protective measures that restrict marine users (Wilder et al. 1999).

In essence, marine protection efforts face a powerful catch-22: a limited societal investment in increasing our understanding of the sea through applied scientific research, coupled with a misconceived and baseless requirement to prove with conclusive scientific evidence that our growing demands on the sea are harming it. ESA recovery plans, for example, often detail the research needed to determine if resource extraction is causing a population's decline, but these studies are rarely funded unless there is a crisis, such as a court-ordered shutdown of the extractive activity.

This confusion over the burden of proof in marine conservation has been attributed to the erroneous societal presumption that economic uses of the sea take precedence over nonconsumptive uses and the integrity of marine ecosystems (Dayton 1998). The benefits of extractive uses are much easier to measure in dollars than the costs (Norse 1993). When faced with uncertainty about a particular impact, managers appear more concerned with avoiding the imposition of short-term economic costs than with avoiding long-term ecological damage that is not easy to quantify.

Another concept that has thwarted the implementation of environmental laws concerns the perceived need for perfect science. As a concept, perfect science is an oxymoron, but opponents of marine conservation have increasingly invoked the "lack of data" argument to justify a lack of action to protect the marine environment. "At present there is too often the feeling that in a properly run fishery the scientific advice should have the reliability of the predictions of the time of sun rise or of eclipses" (Peterson 1995). The conservation biology response to the perfect science argument is the precautionary approach (Botsford and Parma, Chapter 22). The precautionary approach asserts that in the face of uncertainty, management decisions should err on the side of conservation so as to avoid irreparable damage. Marine conservation biologists have asserted that management should take place on the ecosystem level; the precautionary approach is a step in that direction, given the uncertainty in our understanding of ecosystem structure and dynamics.

The science-based standards of the laws reviewed here afford a basis for biodiversity protection and ecosystem-based management (National Marine Fisheries Service 1998). Yet, as our brief examples show, significant institutional impediments to marine conservation remain; these impediments will stymie the application of conservation biology approaches unless scientists familiar with these approaches bring their expertise to bear as participants in the decision-making process (see, e.g., Salzman 1989).

## Conclusions

As managers come to recognize the limitations of traditional management approaches in the protection of marine ecosystems, they increasingly will seek the advice and assistance of marine conservation biologists. Scientists will have an opportunity to refashion these regimes to provide greater protection to marine biological diversity. Their success in this endeavor, however, will depend largely on how much they can increase both society's understanding and apprecia-

tion of healthy marine ecosystems and its related investment in research.

Success will also require effective strategies for countering the "absence-of-evidence" argument. Obviously, decision makers need more and better science, as well as effective communication of this information. Perhaps the greatest challenge for marine scientists and marine science educators, however, comes from an institutional barrier within the scientific community itself. This has been called the myth of scientific objectivity, the argument that in order to preserve science's legitimacy and credibility, scientists must not become involved in public policy debates (Lavigne 1999). It is from within the scientific enterprise itself that marine conservation biologists must find the support and encouragement of their peers to engage in the policy process, to describe what we know already about living systems, and to argue that we have enough knowledge to justify acting as better stewards immediately.

## Notes

1. *Tennessee Valley Authority v. Hill*, 437 US 153, 180 (1978).
2. *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687 (1995).
3. *Natural Resources Defense Council v. Evans*, 279 F. Supp.2d 1129(N.D. Cal. 2003).
4. H.R. 1588, National Defense Authorizations Act for Fiscal Year 2004, §319, amending 16 USC §1371, presented to the President, Nov. 21, 2003.
5. 50 Code of Federal Regulations §600.310(c) (NOAA, NMFS, National Standard Guidelines).
6. *Natural Resources Defense Council, et al. v. Daley*, 209 F.3d 747, 754 (D.C. Cir. 2000).
7. Defendants' memorandum of points and authorities in support of their motion for summary judgment and in opposition to plaintiffs' motion for summary judgment, *American Oceans Campaign v. Daley*, Civ. No. 99-982, Jan. 14, 2000.
8. *American Oceans Campaign v. Daley*, 183 F.Supp. 2d 1 (D.D.C. 2000).
9. *Greenpeace v. NMFS*, 55 F.Supp.2d 1248 (W.D. Wash. 1999).
10. Marine Protected Areas, Executive Order No. 13158, 65 *Fed. Reg.* 34909 (May 26, 2000).
11. Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, Executive Order No. 13178, 65 FR 76903 (Dec. 4, 2000); Executive Order No. 13196, 66 *Fed. Reg.* 7395 (Jan. 23, 2001).

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