

The Work of the Pew Oceans Commission: Implications for Land Managers

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Until fairly recently, the oceans were considered an essentially boundless frontier. Their vastness, and our lack of understanding of marine capacities and processes, combined to create a perception of the oceans as infinitely exploitable, both for their biological and mineral resources and for their utility as waste dumps. The last few decades have seen tremendous growth in our knowledge about the marine environment and its plant and animal denizens, although that there is a great deal yet to learn is a profound understatement. Through research on global warming, we have come to recognize the oceans' role in maintaining global climatic and atmospheric balances. The oceans are the atmosphere's primary source of oxygen, and serve the increasingly vital function of absorbing carbon dioxide and other greenhouse gases. We now know that the oceans form a highly complex global system, containing a myriad of interacting marine and coastal ecosystems and a stunningly diverse array of marine life, from invertebrates, fish, seabirds, turtles, corals and plants to microscopic plankton and the world's largest mammals, the great whales.

These past several decades have also seen ecological and economic experiences— notable among them global warming, the growing volumes of marine pollution, and the collapse of once abundant fish stocks— that have undeniably refuted the idea that the oceans are too vast to be affected by human activities. Instead, it has become clear that, in the marine environment, unplanned development and overexploitation of resources and ecosystem functions fol-

low the same familiar patterns of resource exhaustion and environmental degradation as they do on land. As we have become aware of the adverse impacts that human activities are having on the oceans, we have also been awakened to our essential dependence on the health of the marine environment.

In the United States, policies and practices that affect the marine environment are long overdue for a comprehensive review. The last, and to date only, such review occurred in the late 1960s. In 1969, after two and a half years of work, the federal Commission on Marine Science, Engineering and Resources—known as the Stratton Commission after its chair, Julius A. Stratton—presented its final report to Congress. *Our Nation and the Sea: A Plan for National Action* contained some 120 recommendations, including those that led to the Coastal Zone Management Act of 1972, and the development, under the auspices of the Commerce Department, of the National Oceanic and Atmospheric Administration (NOAA). The Stratton Commission's report, however, also reflected the utilitarian and Cold War tenor of its times in its emphasis on the ocean as a frontier for development. Given what we have since learned about the role of the oceans in the global ecosystem, and about the threats currently facing marine and coastal environments, it is clearly time for a new review.

The Pew Oceans Commission

In 1999, the non-profit corporation Strategies for the Global Environment received a \$3.5 million grant from the Pew Charitable Trusts to establish an independent, bipartisan body to undertake such a review. The Pew Oceans Commission was launched in May 2000, under the leadership of Christine Todd Whitman, then governor of New Jersey. Upon Whitman's appointment as head of the US Environmental Protection Agency earlier this year,

vice-chair Leon E. Panetta, former Chief of Staff for the Clinton administration, took on the role of commission chair. The Commission's membership roster reflects the great care that was taken to ensure a balanced, experienced group representing a broad range of interests and perspectives. Among the Commission's nineteen members are current and former state governors, business representatives, conservationists, economists, fishermen, scientists, and academics.

The mission of the Pew Oceans Commission is to conduct "a national dialogue on the policies needed to restore and protect living marine resources in US waters" (Boesch et al, 2001). The Commission's work is thus centered explicitly on the conservation of marine life, and emphasizes the need for improved stewardship of the marine environment. The Commission has identified six "principal threats"—coastal development, pollution, climate change, aquaculture, invasive species and unintended impacts of fishing—around which to structure its inquiry. The geographic area under consideration includes all US coastal regions and all waters within the US Exclusive Economic Zone. This zone, established by the Magnuson-Stevens Fisheries Act of 1976, begins three miles offshore at the edge of state waters. It extends 200 miles seaward from the over 95,000 miles of coastline of the US and its territories, and encompasses more than 3.4 million square miles of coastal and open ocean waters.

As a means of gathering public input and sharing information about marine issues, the Commission is hosting a series of regional meetings in coastal cities across the US. The group is also reviewing scientific material and consulting with scientists and policy makers. Early in 2002, the Commission will present to Congress a final report containing its findings and formal recommendations. Along the way, the Commis-

sion and its staff are preparing a series of papers and scientific reports addressing important marine issues.

The Pew Oceans Commission is an expression of the current wave of national interest in marine conditions, policy, and research. This trend may have been inspired in part by the designation of 1998 as the International Year of the Ocean. NOAA in that year published a report about the Stratton Commission entitled *Looking Back, Looking Forward: Lessons from the 1969 Commission on Marine Science, Engineering, and Resources*. Two recently-established federal bodies are also undertaking large-scale inquiries into marine conditions and policy, although their emphases are somewhat different from that of the Pew Oceans Commission.

In June of 2000, President Clinton put forth an Ocean Exploration Directive. That September saw the passage of the Exploration of the Seas Act, and in December the NOAA-based Oceans Exploration Panel published *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration*. While citing stewardship, the Oceans Exploration Panel's interest in marine exploration contains a strong current of economic incentive, especially in the realms of biotechnology, minerals and energy development.

President Clinton's August 2000 signing of the Oceans Act of 2000 established a federal Commission on Ocean Policy to review and make recommendations on federal marine policies. The nomination process for this bipartisan, sixteen-member commission began in January of this year, and final appointments were to have been made by the President before April 20. With the change in administration, the current status of the Commission on Ocean Policy is unclear. As of May 30, nominations had been made, but President Bush had not yet appointed Commission members.

The Pew Oceans Commission's Report on Marine Pollution

Marine Pollution in the United States, released on February 27, 2001, is the first of the Pew Oceans Commission's scientific re-

ports (Boesch et al., 2001). This report, which considers one of the six principal threats identified by the Commission, was prepared by a team of six scientists: five from the University of Maryland Center for Environmental Science, and one from the University of Rhode Island. The report begins with a review of the reductions in pollution that have occurred in the past 30 years under the Clean Water Act and other policies, then goes on to identify and discuss two major marine pollution threats— toxic contaminants and nutrient pollution—and their sources. Throughout, the authors have taken care to describe clearly and accessibly, but without losing important scientific detail, the mechanisms behind the pollution problems they consider. These problems are chronic and widespread, and while the Commission is ultimately operating with an eye toward national-level policy, the report includes a broad range of individual examples of pollution effects and past efforts to manage them in specific marine locations, among them the Southern California Bight, Chesapeake Bay, and the Gulf of Mexico. The report concludes with a discussion of the policy implications presented by toxic contaminants and nutrient pollution, and recommendations for strategies to address these threats to the marine environment.

The report starts off with a concise definition of pollution: "Pollution occurs when a substance, an organism, or energy (e.g., sound or heat) is released into the environment by human activities and produces an adverse effect on organisms or the environmental processes on which they depend." A table early in the report identifies ten forms of marine pollution: toxic contaminants, nutrients, oil, radioactivity, sediments, debris, thermal inputs, noise, human pathogens, and alien species. Of these, the authors believe toxic contaminants and nutrient pollution to be the most serious marine pollution threats.

It is significant that the report's definition moves beyond the conventional understanding of pollution as exclusively non-living, physical substances and their accompanying environmental impacts, and encompasses as well non-physical intru-

sions and invasive species. The detrimental effects of introducing heat—cooling tower water, for example—into freshwater and marine ecosystems supporting heat-sensitive species has been well documented. Marine mammals, with their highly-developed sonar senses, are often extremely sensitive to noise from engines, sonar, seismic techniques employed in mineral and petroleum exploration, and low-frequency sound technologies used in research and by the military. The debate about whether Atlantic Salmon, introduced to Pacific Northwest waters through aquaculture practices, can be classified as pollution has resulted in high-level hearings in Washington State.

Nutrient Pollution and Toxic Contaminants

The largest section of *Marine Pollution in the United States* is dedicated to a discussion of the sources and effects of nutrient pollution, which it identifies as "the most pervasive pollution risk" for the marine environment. Briefly, an excess of nutrients—organic matter, phosphorus and nitrogen in particular—in an aquatic system stimulates the rapid growth of phytoplankton. In coastal waters, this phytoplankton growth both creates and combines with increased levels of suspended solids in the water column, preventing light from reaching bottom-dwelling marine plants. The burgeoning phytoplankton populations, often in the form of algal blooms (some of which are toxic and can be harmful to both humans and marine organisms) eventually die and sink. The subsequent jump in populations of decomposer organisms rapidly depletes the dissolved oxygen in the water column, especially near the bottom. This process, called eutrophication, can reduce dissolved oxygen levels to the extent that the waters become hypoxic (two milligrams or less of dissolved oxygen per liter).

At its most extreme, eutrophication can exhaust dissolved oxygen levels completely—a condition known as anoxia. Few marine organisms can survive in hypoxic or anoxic situations. Air-breathing and highly mobile animals—birds, marine mammals, turtles, and some fish and crustaceans—may be able to move away from eutrophic regions.

Bottom-dwellers and slow-moving animals—shellfish, corals, starfish and water column drifters—are unable to escape, and can suffocate. Plants, while they may initially experience a spurt of foliage growth, also tend to die under eutrophic conditions, resulting in potentially long-term loss of important marine habitat. The decomposing biomass further exacerbates the low-oxygen situation. Eutrophication is generally a local condition, and can vary seasonally. Perhaps the most striking example of chronic eutrophication in US waters is the “dead zone” in the Gulf of Mexico. Beginning near the mouth of the Mississippi-Atchafalaya River Basin, this eutrophic “dead zone” can cover an area of up to 12,000 square miles (20,000 square kilometers).

Toxic pollutants are also a matter of great concern in the marine environment, and to the Pew Oceans Commission. Toxic contamination occurs in all of the nation’s coastal waters, and tends to be most concentrated near urban and industrial centers. “Legacy contaminants”—persistent toxic substances like lead, DDT, and PCBs that are either restricted or no longer produced or used in the US—continue to be a threat to marine life. Despite the absence of new net inputs of these contaminants, their presence in marine sediments remains a source of long-term exposure. These contaminants and other, newer toxic threats present the potential for long-term, bioaccumulative effects, especially in predators and, not insignificantly, for humans as well. Recent research has demonstrated that some toxics act as endocrine disruptors, mimicking or altering hormonal activity, and in some cases posing species-level reproductive implications. That these effects can occur from exposures to extremely minute concentrations indicates the need for extreme caution in the production and management of these substances. Synergistic effects of potential combinations of toxic pollutants in the environment are largely unknown, and are extremely difficult to study and assess. On the subject of toxic contaminants in the marine environment, the only real certainty is the uncertainty of their effects, both in the short and the long term. The lessons learned from experiences with DDT in the 1960s

and 1970s are no less salient in the 21st century.

By Land or by Air: Diffuse Sources of Marine Pollution

The Clean Water Act of 1972 plus national and international laws preventing ocean dumping have gone a long way toward reducing the marine pollution originating from specific, identifiable point sources. Restrictions and bans on the manufacture and use of certain toxic substances (PCBs, DDT, lead gasoline additives) have largely halted the accumulation of those persistent toxic contaminants in the environment. Diffuse or non-point sources, however, are difficult to identify and regulate, and have been little affected by these actions. Pollutant contributions from such sources appear to have actually increased. It is toward these diffuse, land-based sources that the Pew Oceans Commission turns most of its attention in *Marine Pollution in the United States*.

Urban and agricultural runoff, river and stream alteration, coastal development, and various land use practices all contribute to marine nutrient pollution and eutrophication. Leading the way are the inorganic nitrogen fertilizers used in agriculture, and animal wastes from livestock farming. Publicly-owned sewage treatment works handling combined storm drain and municipal sewer systems often discharge untreated sewage during storm events, providing a direct pathway into the marine environment for nutrients and pathogens. Urban street runoff can contain significant quantities of organic material, as well as oil and particulates from vehicle exhaust. Development, land-clearing, and forestry practices contribute silt and organic matter, and the resulting bare and impervious surfaces increase and hasten the quantities of runoff reaching the oceans.

Runoff effects are by no means confined to coastal areas. Rivers and groundwater are capable of transporting to the oceans pollutants that originate well inland. Degradation or destruction of riparian areas and wetlands reduces their flood-control and nutrient processing functions. The channelization and alteration of rivers and streambeds speeds water flow and increases

the streams’ capacity for transporting sediments and other materials. These same diffuse source mechanisms that convey nutrients downstream also carry toxic contaminants such as pesticides, and industrial and mining wastes.

Pollutants carried to the ocean by rivers, groundwater, and surface runoff tend to accumulate in coastal waters. Water, however, is not the only medium through which pollutants can reach the oceans. Atmospheric deposition, the mechanism of transport for the substances that produce acid rain, is also a pathway through which pollutants reach marine ecosystems. In dry deposition, airborne particles settle out of the atmosphere to land on the ground or the water’s surface. In wet deposition, particles and gases combine with or adhere to falling rain or snow. Airborne nutrients include nitrous oxides (NO_x) from fossil fuel combustion and ammonia from agricultural sources. More disconcerting is the presence of toxic contaminants in the waters and marine life of remote Arctic and Antarctic regions, a phenomenon that demonstrates the global extent of the spread of anthropogenic chemicals by atmospheric deposition. Some human populations in Arctic regions have been affected by persistent toxics present in the wild foods central to their diets (Bocking, 2001).

Recommendations and Implications for Environmental Professionals

Marine Pollution in the United States concludes with several recommendations for reducing marine nutrient and toxic pollution. On the subject of toxics, the report holds that “the most effective way to reduce the harmful impacts of toxic contaminants on marine ecosystems is to eliminate or restrict their use or production.” Secondary to this direct policy approach are the ongoing actions of effluent and emissions treatment. The third prong of a comprehensive approach to reducing toxic contaminant pollution is remediation. “Legacy contaminants” already present in the environment require long-term management as they continue to be released to the oceans from soils, marine and terrestrial waste sites, and contaminated sediments.

Effective land-based management of the diffuse sources of marine pollution requires a large-scale perspective. *Marine Pollution in the United States* recommends an integrated geographical approach, taking landscapes, watersheds, and their relevant airsheds as management units, and considering marine impacts up front. The report emphasizes the need for ever more, ever better science and monitoring to serve as the foundation for these new policies and practices. Citing uncertainty and the precautionary principle, the report calls for caution and adaptability in policies and management regimes. On local, state and regional levels, there has already been some progress in the US toward this type of integrated, adaptive management framework. The challenge will be to bring these new ideas and practices into the development of federal policy.

Management of fisheries resources also comprises part of this new integrated management model. For example, eutrophication and overharvest can combine to create a pernicious positive feedback loop that speeds both the degradation of marine habitat and the depletion of fish stocks. Destruction of the upstream spawning habitats of anadromous fish species such as salmon can significantly impact their ocean-going populations. Such dynamics highlight the need for coordination of land- and marine-based policies and practices. The Pew Oceans Commission is devoting a great deal of attention to the environmental and economic consequences of modern fishery policies and activities.

Land-based environmental professionals in the fields of wetland restoration, land-use planning, environmental policy, waste prevention and management, sewage treat-

ment, and contaminated site remediation, among many others, will benefit by keeping track of or participating in the Pew Oceans Commission's activities. Innovations in sewage treatment planning, including the new trend toward smaller, localized systems that return treated wastewater to the environment by way of constructed wetlands and local irrigation rather than marine outfalls, will help to prevent nutrient pollution and eutrophication. Well-planned development that minimizes land-clearing and impervious surfaces, advances in efficient transportation and infrastructure design, clean and renewable energy technology, alternatives to toxics, rethinking forestry and agriculture—research and practice in all of these realms will be needed to reduce the multiple threats to the marine environment being investigated by the Pew Oceans Commission.

Conclusion

Rain and snow fall from the sky, and water flows downhill. Gravity ensures that all things eventually run to the sea. Historically, it appears that the oceans have been the last geographic realm to be considered by the environmental and planning policies of industrial society. Perhaps this is the result of a common property market failure in a private property economy. Perhaps it is because, unlike the elements of air and fresh water, our human biology does not require us to consume directly the salty water that is the essential substance of the oceans. Perhaps it is easy for a flightless, air-breathing, land-dwelling species to feel indifferent to a watery reality so vast, uninhabitable, and apparently alien. For whatever reason, the oceans have become the ultimate place for industrial society to wash its hands. The existence of the Pew Oceans

Commission is evidence that this attitude is shifting. The Commission's focus on ocean stewardship and the long-term protection of marine life, and the emphasis in *Marine Pollution in the United States* on integrated, precautionary, adaptive management on a geographic scale, bode well as harbingers of a new, more cooperative and thoughtful approach to human-marine relations.

For more information about the Pew Oceans Commission, and the full text of *Marine Pollution in the United States*, visit the Commission's website at www.pewoceans.org. Several of the other publications mentioned in this article are also available online. The Oceans Exploration Panel's December 2000 publication *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration* is available at oceanpanel.nos.noaa.gov. NOAA's 1998 *Looking Back, Looking Forward: Lessons from the 1969 Commission on Marine Science, Engineering, and Resources* can be found in the Publications section of www.nos.noaa.gov. The Stratton Commission's 1969 report *Our Nation and the Sea: A Plan for National Action* may be found at www.lib.noaa.gov/edocs/stratton/title.html.

References

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