CHAPTER 3: SETTING THE NATION'S SIGHTS

The first step in any call for change should be to paint a picture of the desirable end result and specify the principles that will guide the changes. For U.S. ocean policy to improve, it must be based on a positive vision for the future, broad guiding principles, and translation of those principles into an effective governance system with working policies and programs.

In keeping with the latest scientific understanding about the world, management based on ecosystems rather than political boundaries should be at the heart of any new ocean policy framework. Success also depends on greatly improved public awareness of the relationship between the oceans and human existence, the connections among the land, air, and sea, the balance of benefits and costs inherent in using ocean and coastal resources, and the role of governments and citizens as ocean stewards.

IMAGINING A BRIGHTER FUTURE

The potential benefits associated with oceans and coasts are vast; however, the problems we face in protecting them and realizing their full potential are numerous and complex. There is a growing awareness of the connectivity within and between ecosystems and the impacts of human activities on the marine environment. The need for change emerged as a compelling theme at each of the U.S. Commission on Ocean Policy's public meetings—change not only in management and policies, but also in public awareness and education, and in the use of science and technology. However, before attempting to reform any system, it is important to identify the desired result. What would an improved ocean management system achieve? What would be its most important attributes? How would the oceans and coasts benefit from this improved system? What would the world look like after such reforms were realized?

In the desirable future, the oceans and coasts would be clean, safe, and sustainably managed. The oceans would contain a high level of biodiversity and contribute significantly to the economy, supporting multiple beneficial uses, including food production, development of energy and mineral resources, recreation, transportation of goods and people, and the discovery of novel life-saving drugs and other useful products. The coasts would be attractive places to live, work, and play, with clean water and beaches, easy public access, vibrant economies, safe bustling harbors and ports, adequate roads and services, and special protection for sensitive habitats. Beach closings, toxic algal blooms, proliferation of invasive species, and vanishing native species would be rare. Better land use planning and improved predictions of severe weather and other natural hazards would save lives and money.

In the desirable future, management of the oceans and coasts would follow ecosystem boundaries, looking at interactions among all elements of the system, rather than addressing isolated areas or problems. In the face of scientific uncertainty, managers would balance competing considerations and proceed with caution. Ocean

governance would be effective, participatory, and well coordinated among government agencies, the private sector, and the public.

An improved ocean governance framework would recognize the critical importance of good information and provide strong support for physical, biological, social, and economic research. Investments would be made in the tools and technologies needed to conduct this research: ample, well-equipped surface and underwater research vessels; reliable, sustained satellites; state-of-the-art computing facilities; and innovative sensors that withstand harsh ocean conditions. A widespread network of observing and monitoring stations would provide data for research, planning, marine operations, timely forecasts, and periodic assessments. Scientific findings and observations would be translated into practical information, maps, and products used by decision makers and the public.

Better education would be a key element of the desirable future, with the United States once again joining the top ranks in math, science, and technology achievement. An ample, well-trained, and motivated workforce would be available to study the oceans, set wise policies, apply technological advances, engineer new solutions, and teach the public about the value and beauty of the oceans and coasts throughout their lives. As a result of this lifelong education, people would understand the links among the sea, land, air, and human activities, and would be better stewards of the nation's resources.

Finally, the United States would be a leader and full partner globally, sharing its science, engineering, technology, and policy expertise, particularly with developing countries, to facilitate the achievement of sustainable ocean management on a global level.

The Commission believes this vision is practical and achievable.

BUILDING OCEAN POLICY ON SOUND GUIDING PRINCIPLES

To achieve the vision, national ocean policy should be guided by a set of overarching principles. Although existing ocean policies address specific issues or resources with varying degrees of success, there are no broad principles in place to guide the development and implementation of new policies, provide consistency among the universe of different policies, and assess the effectiveness of any particular policy. The fundamental principles that should guide ocean policy include the following:

- **Sustainability:** Ocean policy should be designed to meet the needs of the present generation without compromising the ability of future generations to meet their needs.
- **Stewardship:** The principle of stewardship applies both to the government and to every citizen. The U.S. government holds ocean and coastal resources in the public trust—a special responsibility that necessitates balancing different uses of those resources for the continued benefit of all Americans. Just as important, every member of the public should recognize the value of the oceans and coasts, supporting appropriate policies and acting responsibly while minimizing negative environmental impacts.
- **Ocean–Land–Atmosphere Connections:** Ocean policies should be based on the recognition that the oceans, land, and atmosphere are inextricably intertwined and that actions that affect one Earth system component are likely to affect another.
- **Ecosystem-based Management:** U.S. ocean and coastal resources should be managed to reflect the relationships among all ecosystem components, including humans and nonhuman species and the environments in which they live. Applying this principle will require defining relevant geographic management areas based on ecosystem, rather than political, boundaries.

- **Multiple Use Management:** The many potentially beneficial uses of ocean and coastal resources should be acknowledged and managed in a way that balances competing uses while preserving and protecting the overall integrity of the ocean and coastal environments.
- **Preservation of Marine Biodiversity:** Downward trends in marine biodiversity should be reversed where they exist, with a desired end of maintaining or recovering natural levels of biological diversity and ecosystem services.
- **Best Available Science and Information:** Ocean policy decisions should be based on the best available understanding of the natural, social, and economic processes that affect ocean and coastal environments. Decision makers should be able to obtain and understand quality science and information in a way that facilitates successful management of ocean and coastal resources.
- **Adaptive Management:** Ocean management programs should be designed to meet clear goals and provide new information to continually improve the scientific basis for future management. Periodic reevaluation of the goals and effectiveness of management measures, and incorporation of new information in implementing future management, are essential.
- **Understandable Laws and Clear Decisions:** Laws governing uses of ocean and coastal resources should be clear, coordinated, and accessible to the nation's citizens to facilitate compliance. Policy decisions and the reasoning behind them should also be clear and available to all interested parties.
- **Participatory Governance:** Governance of ocean uses should ensure widespread participation by all citizens on issues that affect them.
- **Timeliness:** Ocean governance systems should operate with as much efficiency and predictability as possible.
- **Accountability:** Decision makers and members of the public should be accountable for the actions they take that affect ocean and coastal resources.
- **International Responsibility:** The United States should act cooperatively with other nations in developing and implementing international ocean policy, reflecting the deep connections between U.S. interests and the global ocean.

TRANSLATING PRINCIPLES INTO POLICY

While articulating a vision for the future and identifying fundamental principles are necessary first steps, these must then be translated into working policies and programs. Four concepts serve as guideposts for developing and implementing new ocean policies: ecosystem-based management; incorporation of scientific information in decision-making; improved governance; and broad public education.

Ecosystem-based Management

Sound ocean policy requires managers to simultaneously consider the economic requirements of society, the need to protect the nation's oceans and coasts, and the interplay among social, cultural, economic, and ecological factors. These factors are closely intertwined, just like the land, air, sea, and marine organisms. Activities that affect the oceans and coasts may take place far inland. For example, land-based sources of pollution, such as runoff from farms and city streets, are a significant source of the problems that plague marine ecosystems. Ocean policies cannot manage one activity, or one part of the system, without considering its connections with all the other parts. Thus, policies governing the use of U.S. ocean and coastal resources must become ecosystem-based, science-based, and adaptive.

Ecosystem-based management looks at all the links among living and nonliving resources, rather than considering single issues in isolation. This system of management considers human activities, their benefits, and their potential impacts within the context of the broader biological and physical environment. Instead of developing a management plan for one issue (such as a commercial fishery or an individual source of pollution), ecosystem-based management focuses on the multiple activities occurring within specific areas that are defined by ecosystem, rather than political, boundaries.

Defining New Management Boundaries

Splitting the natural world into clearly defined management units is a somewhat arbitrary process. Existing management boundaries primarily follow political lines. However, new scientific understanding of ecosystems makes it possible to design management areas that conform more closely to ecological units.

Since the 1960s, scientists have developed and refined the concept of "large marine ecosystems," (LMEs). These regions divide the ocean into large functional units based on shared bathymetry, hydrography, productivity, and populations. LMEs encompass areas from river basins and estuaries to the outer edges of continental shelves and seaward margins of coastal current systems (Figure 3.1).[1] Large marine ecosystems are not currently employed as management areas, although they were used in part to define the fishery management regions in the Magnuson–Stevens Fishery Conservation and Management Act. On land, watersheds have often been identified as appropriate ecosystem-based management units, particularly for issues related to hydrology and water pollution. Because of the connection between land-based activities and ocean conditions, an appropriate geographic boundary for ecosystem-based management of ocean areas might combine all or part of a large marine ecosystem with the watersheds that drain into it.

While determining appropriate new boundaries is necessary to move toward ecosystem-based management, it is also important to maintain sufficient flexibility to manage on both larger and smaller scales when necessary. For example, air pollution problems must be dealt with on national and even international levels, while certain water pollution issues may need to be addressed on a small-scale watershed level. Managers should be able to adapt to the scale of different activities and the ecosystems they affect.

Figure 3.1 Large Marine Ecosystems Correspond to Natural Features

Ten large marine ecosystems (LMEs) have been identified for the United States. These LMEs are regions of the ocean starting in coastal areas and extending out to the seaward boundaries of continental shelves and major current systems. They take into account the biological and physical components of the marine environment as well as terrestrial features such as river basins and estuaries that drain into these ocean areas.

Source: University of Rhode Island Environmental Data Center, Department of Natural Resources. <http://mapper.edc.uri.edu/website/lmeims/viewer.htm> (Accessed January 2004).

Aligning Decision Making within Ecosystem Boundaries

The current political and issue-specific delineation of jurisdictional boundaries makes it difficult to address complex issues that affect many parts of the ecosystem. Economic development in a coastal area may fall under the jurisdiction of several local governments, and natural resource management under the jurisdiction of one or more states, while pollution control and environmental monitoring of the same area may be overseen by several federal agencies. Yet water, people, fish, marine mammals, and ships flow continually across these invisible institutional borders.

Ecosystem-based management can provide many benefits over the current structure. The coordination of efforts within a specific geographic area allows agencies to reduce duplication and maximize limited resources. It also provides an opportunity for addressing conflicts among management entities with different mandates. Less obvious, but equally important, ecosystem-based management may engender a greater sense

of stewardship among government agencies, private interests, and the public by promoting identification and connection with a specific area.

Finally, ecosystem-based management makes it easier to assess and manage the cumulative impacts of many different activities. For example, the U.S. Army Corps of Engineers' wetlands permitting program has been criticized for not evaluating cumulative impacts in its review of individual dredge-and-fill permits. A true ecosystem-based management approach would ameliorate this fragmented approach.

While ecosystem-based management is being attempted in some places on a limited basis, applying it broadly and successfully will take time and effort. In particular, the transition to such management will require explicit recognition of the uncertainty of current information and understanding. This uncertainty creates risks. One widely accepted guideline for managing in the face of uncertainty and risk is to adopt a precautionary and adaptive approach.

Precautionary and Adaptive Management

Scientific uncertainty has always been, and will probably always be, a reality of the management process. Because scientists cannot predict the behavior of humans or the environment with 100 percent accuracy, managers cannot be expected to manage with complete certainty. Nevertheless, scientists *can* provide managers with an estimate of the level of uncertainty associated with the information they are providing. Managers must incorporate this level of uncertainty into the decision-making process, support the research and data collection needed to reduce the uncertainties, and be prepared to adapt their decisions as the information improves.

The *precautionary principle* has been proposed by some parties as a touchstone for managers faced with uncertain scientific information. In its strictest formulation, the precautionary principle states that when the potentially adverse effects of a proposed activity are not fully understood, the activity should not be allowed to proceed. While this may appear sensible at first glance, its application could lead to extreme and often undesirable results. Because scientific information can never fully explain and predict all impacts, strict adoption of the precautionary principle would prevent most, if not all, activities from proceeding.

In contrast to the precautionary principle, the Commission recommends adoption of a more balanced *precautionary approach* that weighs the level of scientific uncertainty and the potential risk of damage as part of every management decision. Such an approach can be explained as follows:

> **Precautionary Approach:** To ensure the sustainability of ecosystems for the benefit of future as well as current generations, decision makers should follow a balanced precautionary approach, applying judicious and responsible management practices based on the best available science and on proactive, rather than reactive, policies. Where threats of serious or irreversible damage exist, lack of full scientific certainty shall not be used as a justification for postponing action to prevent environmental degradation. Management plans and actions based on this precautionary approach should include scientific assessments, monitoring, mitigation measures to reduce environmental risk where needed, and periodic reviews of any restrictions and their scientific bases.

According to this approach, scientific uncertainty—by itself—should neither prevent protective measures from being implemented nor prevent uses of the ocean. Managers should review the best available science and weigh decisions in light of both the level of scientific uncertainty and the potential for damage. When the level of uncertainty is low and the likelihood of damage is also low, the decision to proceed is clearly supported. At the other extreme, when the level of uncertainty is high and the potential for irreversible damage is also high, managers should clearly not allow a proposed action to proceed. In the real world, managers will most likely face decisions between these two extremes, where the correct outcome will require

balancing competing interests, using the best available information despite considerable uncertainty, and imposing some limits or mitigation measures to prevent environmental damage. After a decision is made, managers must continue to gather the information needed to reduce uncertainty, periodically assess the situation, and modify activities as appropriate.

Goals and Objectives for Ecosystem-based Management Plans

As with any major, complex undertaking, ecosystem-based management should be guided by clear, measurable goals and objectives. These goals should cover multiple uses and should be based on a combination of policy judgments, community values, and science. Although good science is essential for solving problems and scientists should advise managers about the consequences of various courses of action, science cannot determine the "best" outcome in the absence of clearly identified management goals. The setting of goals and objectives will depend on a blending of values and information.

Where multiple desirable but competing objectives exist, it is not possible to maximize each. For example, both recreational boating and marine aquaculture are potential uses of nearshore marine waters. Both provide benefits and costs to society, and both have impacts on the environment that can be lessened with proper planning. However, these activities can also conflict with each other: a large-scale aquaculture operation would prevent access by recreational boaters to certain waters. Science can inform managers of the potential positive or negative impacts of each activity but cannot ultimately determine whether to favor aquaculture or boating. Instead, a community judgment must be made, weighing the value of each activity against its potential impacts.

Ecosystem-based management will lead to better decisions that protect the environment while balancing multiple uses of ocean areas. Managers will need to work with the scientific community to develop the necessary information and understanding to support such complex decisions. But the critical process of setting goals to guide management will require active participation by many different stakeholders with divergent views. This will be difficult to achieve without changes to the existing governance system.

Biodiversity

One of the central goals for ecosystem-based management should be the explicit consideration of biodiversity on species, genetic, and ecosystem levels. While humans have always depended on particularly valued marine species for food, medicine, and other useful products, there has been a tendency to ignore species that do not have a clear, recognizable impact on society. However, it is now understood that every species makes some contribution to the structure and function of its ecosystem. Thus, an ecosystem's survival may well be linked to the survival of all species that inhabit it.

Species diversity, or the number of species within an ecosystem, is one measure of biodiversity. However, biodiversity is also significant at larger and smaller scales. Within a single-species population, it is important to preserve *genetic diversity*—the bedrock of evolution. Maintaining genetic diversity is important for species to adapt to changing environmental conditions. It is also important to understand and protect *ecosystem diversity,* the number of different ecosystems and different kinds of ecosystems, on Earth.

Because scientists have tended to study specific habitats, such as coral reefs, mangroves, or wetlands, quantitative measures of marine biodiversity at larger scales are rare. Nevertheless, there is broad consensus that the biodiversity of life in the oceans is being affected by human activities. Studies indicate that in many marine and coastal locations, community composition has changed to conditions that are less valuable from ecological, economic, and even cultural perspectives.[2] There have been reductions in food and medicinal species and alterations of aesthetic and recreational values important to humans, including much greater abundance of less desirable species like toxic algae and bacteria.

Despite the importance of biodiversity to ecosystem functions and values, very little is known about how biodiversity arises, is maintained, and is affected by outside forces including climate variability and direct human impacts.

Science for Decision Making

Ecosystem-based management provides many potential benefits, but also imposes new responsibilities on managers. The need to collect good information and to improve understanding is perhaps foremost among these new responsibilities. Despite considerable progress over the last century, the oceans remain one of the least explored and most poorly understood environments on the planet.

Greater knowledge can enable policy makers and managers to make science-based decisions at the national, regional, state, and local levels. Existing research and monitoring programs, which tend to be agency- and issue-centric, should be reoriented to become ecosystem-based. This will help resolve the current mismatch between the size and complexity of marine ecosystems and the many fragmented research and monitoring programs for coastal and ocean ecosystems.

In addition to the need for better understanding, the nation lacks effective mechanisms for incorporating scientific information into decision-making processes in a timely manner. As knowledge improves, it must be actively incorporated into policy through an adaptive process. To make this policy translation effective, local, state, regional, and national managers need an avenue to communicate their information needs and priorities.

Better coordination can facilitate more efficient use of existing funds. However, to significantly improve U.S. management of oceans and coasts and make ecosystem-based management a reality, the nation will need to commit to greater investments in ocean science, engineering, exploration, observations, infrastructure, and data management. Increased investments will help restore the pre-eminence of U.S. ocean capabilities, which has eroded since the end of the Cold War.

Although multiple use conflicts are common in coastal and ocean environments, efforts to understand the social, cultural, and economic dimensions of ocean issues have received surprisingly little support. Because of this, studies of humans and their behavior—so critical to virtually every ecosystem—deserve special emphasis.

Climate Change

The causes and impacts of climate variability and climate change are among the most pressing scientific questions facing our nation and the planet. Changing atmospheric composition and global temperatures, due to natural variation and human activities, have the potential to significantly affect societies and environments on local, regional, and worldwide scales. Decision makers require reliable information on which to base both short- and long-term strategies for addressing these impacts. In addition, a growing awareness of the possibility of abrupt climate change (characterized by extreme climatic shifts over relatively short time periods) reinforces the need for enhanced prediction and response capabilities.

Although a solid body of knowledge exists on which to base immediate actions, continued improvements in understanding will help refine these strategies over time. Two areas in particular need of elucidation are 1) the role of oceans in the global cycling of water, heat, and carbon and 2) the effects of changes in atmospheric chemistry and temperatures on marine ecosystems and biological processes themselves. For example, research shows that over the last 200 years the oceans have absorbed 48 percent of the carbon dioxide emitted by human activities.[3] This has resulted in elevated concentrations of carbon dioxide in ocean waters,

impairing the ability of certain marine organisms to produce protective shells, with potentially profound impacts on marine productivity and biodiversity.[4] Armed with expanded research findings in these areas and others, and with more comprehensive ocean observations, the nation's leaders will be able to modify management strategies to more effectively predict and mitigate the potential impacts of climate change.

Effective Ocean Governance

National ocean policy can only be implemented if an effective governance system is in place. Many of the guiding principles defined in this chapter speak directly to this need. An effective governance system will be predictable, efficient, and accountable. Laws, policies, and programs must be well coordinated and easily understood by regulated parties and the public. A comprehensive framework should be in place that defines the appropriate roles for different levels of government, the private sector, and citizens, promoting effective partnerships for managing ocean and coastal resources. Equally important, decision makers and the public should be accountable for decisions and actions that affect the ocean and its resources.

Participation by a broad sector of the public is essential to a successful ocean governance system. Facing an array of complex problems and competing desires, interested parties must reach agreements on what actions are needed, which are of greatest priority, and how to implement decisions once they are made. Public input is critical to this decision-making process so that all interests are fairly represented and support is built from the ground up. Without a truly participatory form of ocean governance, dispute and litigation are inevitable. At the same time, clear roles, jurisdictions, and authorities must be delineated to avoid gridlock and allow progress.

Today, no federal entity has the mission to evaluate the vast array of federal actions affecting ocean and coastal resources and to advocate for more effective approaches, prioritized investment, improved agency coordination, and program consolidation where needed. Nor is there a coherent national policy for ocean management that guides the missions of various federal agencies. A more unified federal voice is also needed in discussing policy options with the many nonfederal stakeholders.

Not since the Stratton Commission in the 1960s has an opportunity such as this existed. One of the top priorities of this Commission is to instigate changes in ocean governance that will result in tangible improvements, today and for future generations.

Public Education

Education has provided the skilled and knowledgeable workforce that made America a world leader in technology, productivity, prosperity, and security. However, rampant illiteracy about science, mathematics, and the environment now threaten the future of America, its people, and the oceans on which we rely.

Testing results suggest that, after getting off to a good start in elementary school, by the time U.S. students graduate from high school their achievement in math and science falls well below the international average.[5] Ocean-related topics offer an effective tool to keep students interested in science, increase their awareness of the natural world, and boost their academic achievement in many areas. In addition, the links between the marine environment and human experience make the oceans a powerful vehicle for teaching history, culture, economics, and other social sciences. Yet teachers receive little guidance on how they might use exciting ocean subjects to engage students, while adhering to the national and state science and other education standards that prescribe their curricula.

A 1999 study indicated that just 32 percent of the nation's adults grasp simple environmental concepts, and even fewer understand more complex issues, such as ecosystem decline, loss of biodiversity, or watershed

degradation.[6] It is not generally understood that nonpoint source pollution threatens the health of our coastal waters or that mercury in fish comes from human activities via the atmosphere. Few people understand the tangible value of the ocean to the nation or that their own actions can have an impact on that resource. From excess applications of fertilizers, pesticides, and herbicides on lawns, to the trash washed off city streets into rivers and coastal waters, ordinary activities can and do contribute significantly to the degradation of the marine environment. Instilling a stewardship ethic in the American public is an important element of a national ocean policy. Without an acknowledgement of the impacts associated with ordinary behavior and a willingness to take the necessary action—which may incur additional costs—achieving a collective commitment to more responsible lifestyles and new policies will be difficult.

Excellent lifelong education in marine affairs and sciences is essential to raising public awareness of the close connection between the oceans and humans, including our history and culture. This awareness will result in better public understanding of the connections among the ocean, land, and atmosphere, the potential benefits and costs inherent in resource use, and the roles of government and citizens as ocean stewards.

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[1] Sherman, K., and L. Alexander, eds. *Variability and Management of Large Marine Ecosystems*. AAAS Selected Symposium 99. Boulder, CO: Westview Press, 1986.

[2] Norse, E., ed. *Global Marine Biological Diversity: A Strategy for Building Conservation into Decision Making*. Washington, DC: Island Press, 1993.

[3] Sabine, C.L., et al. "The Oceanic Sink for Anthropogenic CO_2." *Science* 305 (2004): 367-371.

4 Feely, R.A., et al. "Impact of Anthropogenic CO_2 on the $CaCO_3$ Systems of the Oceans." *Science* 305 (2004): 362-366.

[5] Calsyn, C., P. Gonzales, and M. Frase. *Highlights from TIMSS* [Third International Mathematics and Science Study]. Washington, DC: National Center for Education Statistics, 1999.

[6] National Environmental Education & Training Foundation [NEETF]. *1999 National Report Card: Environmental Readiness for the 21st Century*. Washington, DC: NEETF/Roper Starch Worldwide, 1999.