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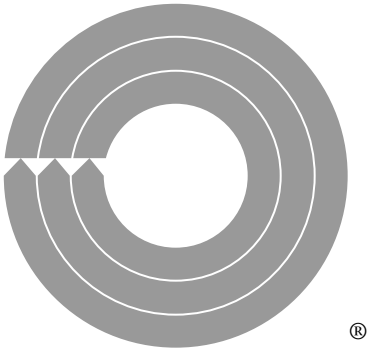

Building Capacity for Coastal Solutions

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RENEWABLE RESOURCES JOURNAL

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Special appreciation goes to our sponsors, the **National Oceanic and Atmospheric Administration** (NOAA), **U.S. Geological Survey** (USGS), **USDA Forest Service** (USFS), and **U.S. Environmental Protection Agency.** These agencies also provided technical support through the participation of capable representatives on the conference program committee.

Margaret A. Davidson, an exceptional NOAA administrator and a "public interest" director of RNRF's board, chaired the conference program committee. Other members of the committee who contributed to the meeting's success were: **Kelly Barnes** (American Society of Civil Engineers), **Thomas Bigford** (NOAA), **Deen Boe** (Society for Range Management), **James Colby** (Coastal America), **Peter Folger** (American Geophysical Union), **Thomas Franklin** (The Wildlife Society), **Albert Grant** (RNRF Chairman), **John Haines** (USGS), **Kenneth Lanfear** (American Water Resources Association), **Larry Pettinger** (American Society for Photogrammetry and Remote Sensing), **Gus Rassam** (American Fisheries Society), **Priscilla Reining** (RNRF Public Interest Director), **Doug Richardson** (Association of American Geographers), **Howard Rosen** (Society of Wood Science and Technology), **Barry Starke** (RNRF Vice-Chairman, and American Society of Landscape Architects), **Deanna Stouder** (USFS), and **David Trauger** (Virginia Tech).

Serving in the important capacity of working group chairs were: **Margaret Davidson, Tim Hennessey** (Univ. of Rhode Island), **Tony MacDonald** (Coastal States Organization), and **Michael Orbach** (Duke Univ. Marine Lab.). They presided over the working groups and prepared summary reports that have been incorporated into this report. Working group recorders were: **Sarah Ball** (Virginia Tech), **Joseph Gordon** (National Environmental Trust), **Mia Sealey** (Environmental Council of the States) and **Laura Walko** (NOAA). They assisted in capturing all of the excellent ideas and insights offered by delegates.

RNRF intern **Jason Myers** (Virginia Tech) provided critical research and logistical support.

RNRF Program Director **Ryan Colker** performed admirably in working with our committee volunteers, speakers, and delegates. He managed meeting logistics and contributed to this report as an editor.

Finally, sincere thanks go to the dedicated congress speakers and delegates who shared their expertise, experience, insight and passion for sustaining this country's coasts and oceans. A complete list of conference delegates appears in the appendix.

Robert D. Day
Executive Director

Executive Summary

Introduction

The coasts are a vital ecologic and economic resource. Coastal wetlands and estuaries are essential spawning, feeding, and nursery areas for fish and other marine life. Wetlands act as natural filters to reduce contaminants. One out of six U.S. jobs is marine-related, and one-third of the Gross Domestic Product is produced in coastal counties. The 180 million Americans and international visitors who enjoy coastal areas and coral reefs each year account for 85 percent of U.S. tourism revenues. International shipping brings more than $700 billion in goods to our ports.

Yet, coastal resources are under increasing pressure. While coastal counties comprise only 17 percent of the U.S. contiguous land area, more than half the population lives in these areas. Coastal population increases by 3,600 people per day—a rate of growth that may result in an additional 27 million residents by 2015. Along with increasing populations come increased land consumption and automobile use. Nonpoint source water pollution and erosion from agriculture, forestry, and urban and suburban areas have further contributed to stress of coastal ecosystems. Critical habitat, including estuaries and coastal marshes, is being modified or destroyed as coastal development increases. Invasive species are out-competing native species. Pollution from neighboring and distant countries can greatly impact near-shore marine resources. Other pressures include:

- Point and nonpoint source pollution: regularly more than 5,000 square miles of hypoxic waters appear in the Gulf of Mexico in the summer.
- Overfishing: despite the recovery of some fish stocks, for stocks with known status in 2001, 30 percent were experiencing overfishing, were overfished, or both.
- Invasive species: the rate of marine introductions has risen exponentially over the past 200 years and shows no sign of leveling off.
- Harmful algal blooms: outbreaks in the Chesapeake Bay in 1997 cost the Maryland seafood and recreational fishing industry more than $50 million in lost harvest, jobs, and sales.
- Coastal-dependant commerce: 90 percent of international trade is carried out by sea.
- Recreational use: 75 million Americans were directly involved in on-the-water activities in 1998.
- Costs of hazards: 2004 was the costliest U.S. hurricane season on record with an estimated damage of $42 billion and 59 U.S. deaths from nine hurricanes and seven tropical storms.

While the effects of these and other coastal resource problems are most dramatic along the coasts, the causes can develop far inland. Building capacity to address these issues—from local communities (both coastal and inland) to federal agencies—is critical to finding and implementing solutions.

Two national commissions, the Pew Oceans Commission and the U.S. Commission on Ocean Policy, identified many concerns regarding our oceans, but also left unresolved questions about implementation and action (see text box on page 10 for more information on the two commissions). Directors of the Renewable Natural Resources Foundation decided that this consortium of professional, scientific, and educational organizations needed to enthusiastically support the extraordinary work of both commissions.

RNRF's "Congress on Building Capacity for Coastal Solutions" brought together a select group of professionals from its member organizations and leaders from government, industry, academia, and nongovernmental organizations (Appendix A). Delegates met December 5–6, 2004, at the headquarters of the American Geophysical Union in Washington, D.C. (See Appendix B for a copy of the Congress program).

The specific goals of the congress were to consider findings and recommendations of the commissions, and to identify other high priority activities for early action.

Following discussions of the objectives and background information in plenary sessions, delegates were divided into small working groups. These working groups examined the issues and possible solutions in greater depth. The findings and recommendations of congress delegates do not necessarily reflect policies and views of RNRF, its

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member organizations, or the sponsoring agencies.

Complexities in Ocean and Coastal Governance

The current approach to ocean and coastal governance is crisis-driven resulting in a failure to develop a long-term holistic policy approach. The myriad of ad hoc laws (about 145 federal statutes) and federal agencies (more than half of the 15 existing federal cabinet level departments plus several independent agencies) pertaining to ocean and coastal policy add to the confusion.

- Greater collaboration and consultation across natural resource agencies, including state agencies, will allow for a more comprehensive management approach.
- An ecosystem-based approach to management—rather than existing piecemeal species-by-species management—allows for the integration of complexities inherent in natural systems.
  - Adaptive management should be used in these efforts, but steps should be taken to overcome current agency rules and regulations that prevent its widespread use.
- Establishing regional commissions or councils based on watersheds or ecosystems will provide the most promising path to comprehensive and integrated management of coastal resources.
  - Such councils must have effective leadership and direction from federal and state agencies along with continuity in service by council members and program funding. The Atlantic States Marine Fisheries Commission can serve as a model for a starting point.
- An international effort to protect the oceans as a common resource is necessary. The U.S. can be a leader in this effort, but first must join the international community and ratify the United Nations Convention on the Law of the Sea.

Information Technology and Science Capacity

Effective governance strategies depend on understanding coastal resources, the impacts they face, and the success of existing efforts. Information technology and science provide part of the basis for this understanding. However, significant barriers to data sharing, integration, and communication exist. These include the sheer volume of data, real or perceived security issues, complexities associated with regional integration, and technology gaps between users and providers.

- Developing information technology standards is necessary for effective communication. They allow data users and providers to overcome technology gaps. They also would allow development of a national data framework.
- Overcoming agency cultures and structures that inhibit sharing is crucial—government managers should be rewarded for collaborating.
  - A forum of representatives from federal agencies, state and local government, universities, industry, and community organizations should be convened to discuss the development of standards and opportunities for data sharing.
- A culture of linked portals, openness, and interoperability must be fostered.
- An urgent research and development effort is necessary to advance technologies in collecting biological and habitat data. Ocean science also needs better landscape-level science and planning to include synergistic effects, multi-stressor issues, and matters of scale.
- Delegates expressed concern about the decreasing availability of discretionary spending—particularly for monitoring and research programs. Consistent funding is crucial as data becomes more valuable the longer that it is collected.
- Educating the public on the availability and use of data, and how it is used by agencies, could lead to greater support.
  - Building scientific literacy and capacity in all communities including the general public and policymakers is crucial—an expanded coastal education program is necessary.

Mobilizing and Empowering Communities

Local communities have the greatest opportunity to address coastal issues, but they need the necessary knowledge and desire to actively engage. To effect change, the coastal community must include not only those who live on the coast, but also all those who live in the greater watersheds. Everyone lives in a coastal watershed and should recognize how they impact the coasts and how the coasts impact them. Coastal solutions require a mix of national and local efforts.

- The scientific community must look beyond the biophysical environment, and interact with constituents and organizations interested in public policy and management in order to implement effective ocean governance. Social and cultural analyses are necessary.

- Good communication and education are essential to empowering a community.
  - Policy makers and scientists must listen, build trust, and communicate openly. Knowledge of alternatives to, and potential impacts of, a given proposal is crucial. Equally important are clear objectives and consideration of the proposal's costs and benefits. Connecting individual actions to environmental impacts is vital.
- The professional and scientific community has an obligation to provide citizens with the tools, education, and technical assistance necessary to become active and effective participants.
  - Scientists must be more engaged with the community. Fostering scientific and environmental literacy will increase interest and grassroots efforts in governance at all levels. Educational programs should be created for citizens upstream from the coast.

Next Steps

Over the past two years, people who care for the coasts (shouldn't that be everyone?) have witnessed the first comprehensive reviews of coastal and ocean policy in more than 30 years. It happened because the need is great and the risk of loss is certain. The coasts and oceans have never been under greater pressure—and it's more than they can sustainably bear.

And what a challenging time it is for our greatest common resources to suffer such threats. The United States, historically a world leader in many endeavors, faces unprecedented deficits and, thus, little discretionary funding to meet coastal and ocean program needs. The tragedy of deficits has been compounded by the loss of U.S. Senator Fritz Hollings' leadership. He was for many years the champion of coasts and oceans. His successor in mission is not yet apparent.

So what will become of the commissions' work—the many excellent findings and recommendations? Many delegates to the RNRF congress have observed that President Bush's response, an initiative to be directed by the Council on Environmental Quality, is not a substantive step toward resolving the threats faced by coasts and oceans.

Clearly, more must be done and advocates are needed. Will commissioners of the Pew Oceans Commission and the U.S. Commission on Ocean Policy continue their efforts on behalf of the coasts and oceans? Will they be encouraged and joined by leaders in state and federal government? Will the professional, scientific, and educational communities more actively join the debate? Finally, will champions on Capitol Hill emerge?

An obvious need and first step is to organize and coordinate efforts on behalf of the coasts. A forum should be convened and include federal and state agency leaders; ocean commission members; and representatives of professional, scientific, educational, community, academic, and industry organizations. Forum outcomes could be a strategic plan to implement recommendations of the commissions, and to support funding for ocean and coastal science and management.

The case for action is compelling.

Understanding Ocean and Coastal Problems

Introduction

Developing solutions requires a thorough understanding of the issues impacting coastal resources. Christophe Tulou, former president, Center for SeaChange, and former executive director of the Pew Oceans Commission, introduced the issues along with an examination of the efforts undertaken by the two national commissions. Current ocean and coastal problems can be attributed to a number of interrelated causes—a major decline in fish stocks, the pollution of ocean waters, the explosion in coastal development, the decline of marine ecosystems, and the fragmentation of ocean governance.

As recently reported by a team of scientists, the number of large fish has declined to about ten percent of what it was in 1950.[1] Further complicating our ability to understand and manage fisheries is the overwhelming lack of knowledge. Currently, the condition of approximately one third of fish stocks is known. Current commercial fishing practices are unsustainable and wasteful. More than 2.3 billion pounds of fish are discarded each year, accounting for a quarter of the total catch.

Human impacts on the land are just as troubling. Between 1982 and 1997, developed land in the U.S. increased by 34 percent (or 25 million acres) while population during the same period increased by only 15 percent. Thus, land consumption occurred at nearly twice the pace of population growth. Many coastal areas—including New Orleans, New York, San Francisco, and Charleston, South Carolina—experienced even greater development, putting greater strain on the nation's coasts.

Besides the obvious destruction of green space, with this increase in development comes an increase in the amount of impervious cover—hard surfaces where water cannot penetrate including parking lots, roads, and rooftops. If impervious cover approaches ten percent of a watershed, the rivers and streams of that watershed[2] become seriously degraded. This degradation is amplified on the coasts where the consequences of all upstream land-use decisions coalesce.

Nonpoint source water pollution, or runoff, from these impervious surfaces, along with agricultural runoff and atmospheric deposition from industrial processes, leads to nutrient overload in rivers and streams, and ultimately in their outlets along the coast.[3] This increase in nutrient loads has contributed to a proliferation in "dead zones" (hypoxic areas[4]) along the coast.

Another issue of increasing concern is the impact of climate change on coastal wetlands and estuaries and coral ecosystems. Sea level rise can significantly change an ecosystem's ability to filter contaminants or to provide necessary nursery grounds for juvenile organisms or habitat for native species. Coral bleaching also leads to a decline in species that depend on that particular ecosystem.

While understanding current factors affecting the coasts is important, it is equally important to understand why coastal ecosystems are collapsing. We are removing more resources than the natural system is able to reproduce, and introducing more contaminants than the system is able to assimilate. Further, government and management processes are failing. The current approach is crisis-driven, resulting in a rush to address problems of the moment without developing a long-term, holistic policy approach. Adding to the confusion, ocean and coastal policy is governed by a myriad of ad hoc laws—about 145 federal statutes.

These crises led to a realization in both the private and public sector that action was necessary. The Pew Charitable Trusts formed the nonpartisan and independent Pew Oceans Commission to examine some of these issues. The U.S. Congress passed the Oceans Act of 2000 establishing a presidentially appointed U.S. Commission on Ocean Policy to make recommendations for a coordinated and comprehensive national ocean policy. A discussion of the two commissions, along with their goals, findings, and recommendations can be found in the text box "A Tale of Two Commissions" on the following page.

A Tale of Two Commissions

Much has changed since the release of the Stratton Commission's report *Our Nation and the Sea* in January 1969. No longer is concern for the oceans focused solely on the development and exploitation of ocean resources. Increased pressures and new threats emerged such as sea-level rise and an increased frequency of storms due to global warming, harmful algal blooms, and increasing populations. The ad hoc approach to ocean governance that developed since the Stratton report no longer meets current management needs. In recognition of these changed needs, two commissions were formed to examine elements of existing ocean policy and recommend changes. Following each section of this report, relevant recommendations made by each of the commissions are included for reference.

The Pew Oceans Commission

In June 2000, a bipartisan, independent group was formed to chart a new course for the nation's ocean policy. Their mission was to identify policies and practices necessary to restore and protect living marine resources in U.S. waters and the ocean and coastal habitats on which they depend. The Pew Commission also was charged with raising public awareness of the principal threats to marine biodiversity and the importance of ocean and coastal resources to the U.S. economy. Commissioners came from science, fishing, conservation, government, education, business, and philanthropy. Leading scientists were consulted to determine priority issues and write reports summarizing the scientific information available on those subjects.

Four committees within the commission were formed to review the core issues of governance, fishing, pollution, and coastal development. It also investigated marine aquaculture, invasive species, ocean zoning, climate change, science, and education. Over two years, the commission held a series of 15 regional meetings, public hearings, and workshops to listen to those who live and work along the coasts. For more information and to view the Pew Commission's report, *America's Living Oceans: Charting a Course for Sea Change*, visit http://www.pewoceans.org.

The U.S. Commission on Ocean Policy

Recognizing the growing economic importance and ecological sensitivity of the oceans and coasts, and the inadequacies of the current management regime, congress enacted the *Oceans Act of 2000,* in August 2000. The act established the U.S. Commission on Ocean Policy as a fully independent yet publicly financed commission to carry out the first comprehensive review of marine-related issues and laws in more than 30 years. The commission was directed to address numerous issues ranging from the stewardship of fisheries and marine life to the status of knowledge about the marine environment. It also examined relationships among federal, state, and local governments and the private sector in carrying out ocean and coastal activities. The commission also was to prepare recommendations on developing a coordinated and comprehensive national ocean policy. The commission sought suggestions to reduce duplication, improve efficiency, enhance cooperation, and modify federal agency structure.

In July 2001, President George W. Bush appointed 16 commissioners. Twelve were selected from lists submitted by minority and majority leadership from the House and Senate and four were chosen directly by the president. Commission members come from diverse positions and professional backgrounds in: federal, state, and local governments; private industry; and academic and research institutions.

Four working groups were established in the areas of governance; stewardship; research, education, and marine operations; and investment and implementation. A multidisciplinary science advisory panel consisting of experts in living and nonliving marine resource issues also was formed with the assistance of the National Academy of Sciences.

Since release of the commission's report, President Bush has released an ocean action plan (http://ocean.ceq.gov). In response to the commission's recommendations, a secretarial-level Committee on Ocean Policy already has been established within the Executive Office of the President. However, the commission's call for increased investment in ocean science, conservation, and management may go unheeded. The president's fiscal year 2006 federal budget proposal reflects a nine percent cut to NOAA's total funding over 2005 fiscal year appropriations.

The commission's formal duties concluded on December 19, 2004, but commissioners pledged to continue to work to educate the nation about their report and to monitor implementation of their recommendations.

For more information on the U.S. Commission on Ocean Policy or for a copy of the final report, *An Ocean Blueprint for the 21st Century*, visit http://www.oceancommission.gov.

Complexities in Coastal and Ocean Governance

More than half of the 15 existing federal cabinet-level departments plus several independent agencies play important roles in the development and implementation of ocean and coastal policy. State and local government also have responsibilities. Timothy Hennessey, professor of political science and marine affairs, University of Rhode Island, discussed the difficulty in managing coastal resources with such dispersed jurisdiction.

Globally, there are 64 large marine ecosystems (LMEs)—ten have been identified in the United States. These LMEs are regions of the ocean encompassing coastal areas out to the seaward boundaries of continental shelves and major current systems. They take into account biological and physical components of the marine environment, as well as terrestrial features such as river basins and estuaries, which drain into these ocean areas. Five components are present within the orientation of these systems. Three are scientific: productivity, fisheries, and ecosystem health; and two are socioeconomic: governance, and the value of the resources overall.

One of the major problems of managing natural resources within jurisdictions is that pollution and fish are not stationary—they do not observe political boundaries. For example, within the Northeast Shelf LME (from Maine to North Carolina), many viable programs exist but they are not integrated into a regional/ecosystem-based approach. The U.S. Commission on Ocean Policy recommended amending the Coastal Zone Management Act to include inland watersheds in planning. This ambitious recommendation would incorporate all relevant impacts into coastal management.

Within the Chesapeake Bay watershed, effort has been made to establish a regional framework recognizing existing jurisdictional limitations. The watershed is very large, encompassing 64,000 square miles, including six states and the District of Columbia. One of the greatest threats to the Chesapeake system is nonpoint source pollution. Goals to address pollution problems were developed cooperatively by the watershed states in 2003.

Tributary strategies have been developed for each major tributary that drains land from multiple states. Annual allocations are set for the watershed and then divided into the nine river basins. The allocations are further subdivided by political boundaries giving each entity individual targets. The individual goals are added together to assure that the cumulative goals are met. The states coordinate the activities and the federal government provides funding through the Chesapeake Bay Program, state implementation grants, the Farm Bill, and the Clean Water Act Revolving Fund.

Many critics argue that political boundaries make the managing of watersheds all but impossible. However, in the Chesapeake Bay watershed, pollution limits are set all the way down to the local level, and when taken in the aggregate, the watershed is managed to a particular goal, adopted by the participating states.

Findings and Recommendations

Within the working groups, delegates discussed some of the challenges in coastal resource management under the current structure and recommendations for improving governance—including the formation of regional councils.

Overcoming Current Challenges

Delegates discussed existing coastal management approaches to assess what has worked best. Currently, the large number of legislative authorities and agencies makes management very cumbersome. Furthermore, coastal management has been driven more by economic rather than conservation goals. Conservation should be a primary goal, not a by-product.

Greater collaboration and consultation across natural resources agencies (NOAA, USDA Forest Service, EPA, Fish and Wildlife Service, Bureau of Land Management, and U.S. Geological Survey) will allow for formation of a more comprehensive and all-inclusive management approach. Expanding

collaborative efforts to include state natural resources agencies would further enhance development of a comprehensive approach to coastal management. Delegates recommended examining the Canadian natural resource agencies as an example of a more integrated approach.

Existing boundaries separating federal from state jurisdiction weaken management—ecosystems should be managed as a whole. An ecosystem wide management scheme is necessary—piecemeal management, species-by-species, does not allow for integration of complexities inherent in natural systems. Policy makers, scientists, and managers should consider all inputs and elements of an ecosystem—including pollution, existing resources, and habitats—when developing management plans. Efforts to deal with nonpoint source pollution, for example, need a coastal focus—NOAA does not have the authority to manage nonpoint source pollution, and EPA's §319 programs are not related to enforceable policy.

Adaptive management should be used in an effort to integrate ecosystem complexities. However, current rules and regulatory frameworks within agencies prevent its widespread use. Currently, agencies must predict and discuss all possible scenarios to implement adaptive management. Each agency needs to examine why it cannot implement adaptive management and take necessary steps to allow implementation.

Within NOAA, the formation of regional offices would allow for more integrated management approaches through the formation of teams of scientists and managers with expertise and knowledge on the particular region. This is an opportunity to set an example of ecosystem-based regions rather than the arbitrary mix of regions currently existing across other agencies.

A meaningful and widely accepted international effort to protect the oceans as a common resource also is needed—much like the Montreal Protocol did for the atmosphere. The U.S. can be a leader in this effort, but must first join the international community and ratify the United Nations Convention on the Law of the Sea.

Formation and Management of Regional Councils

Delegates concluded that the most promising path to comprehensive and integrated management of coastal resources would be through the widespread establishment of regional commissions or councils. Geographic jurisdiction of such councils should be based upon watersheds, ecosystems, or other meaningful divisions. Currently, councils and commissions of various sizes and authority exist throughout the country (see text box for some examples).

For these councils to be effective, several elements must be in place. First, effective leadership and direction from relevant federal and state agencies is crucial. Second, there must be continuity in service by council members to foster effective and knowledgeable leadership. Equally important is continuity in program funding. Delegates recognized that, in the absence of compelling economic or environmental problems, sustaining the interest and energy necessary to operate regional councils may be difficult. In addition, questions of authority must be answered—are the councils to act in an advisory or authoritative role? Councils also must be formed around a manageable region. For example, the Gulf of Mexico watershed likely is too large.

The Atlantic States Marine Fisheries Commission (ASMFC) was cited as an example of an appropriate starting point—it is much stronger than the Fishery Management Councils. ASMFC has an ecosystem-based orientation with a collaborative structure and legal authority. While oversight by NOAA Fisheries provides a safety net for the commission, the latter holds ultimate responsibility. Commissions also are able to weather local politics better and are more attuned to ecosystem issues. Limits placed on allowable total catch are separated from allocations of individual catch limits, unlike the management process within many fisheries management councils.

The ideal commission would have structure and authority like ASMFC, supplemented with the authority to influence decisions impacting habitats, watersheds, and airsheds.

Lessons from Commissions and Councils

Delegates recognized the importance of managing coastal resources based upon regional or ecosystem boundaries. To accomplish this, regional commissions should be established. Delegates observed that no commission or council currently exists that has the breadth of jurisdiction or authority necessary to properly manage coastal resources. They did however recognize that elements of existing councils or commissions could be used as a basis for development of a properly focused commission. Some examples of existing commissions and councils appear below.

The structure and authority of the **Atlantic States Marine Fisheries Commission** (ASMFC) was particularly appealing to delegates. ASMFC is a congressionally chartered interstate compact agency formed in 1942, by 15 Atlantic states—Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. The commission assists in managing and conserving coastal fisheries resources in state waters through the development of interstate fishery management plans that rely on state authorities for implementation. Federal legislation in 1984 and 1993 made compliance with the plans, which was originally voluntary, enforceable by giving the Secretary of Commerce authority to close a state's fishery upon recommendation of the ASMFC. Three commissioners represent each state: the director of the state's marine fisheries management agency, a state legislator, and an appointee of the governor. However, each state only has one vote. The Commission focuses on responsible stewardship of marine fisheries resources. It serves as a forum for the states to collectively address fisheries issues under the premise that as a group, using a cooperative approach, they can achieve more than they could as individuals. For more information, visit http://www.asmfc.org.

In **Oregon**, locally organized, voluntary, non-regulatory watershed councils can be established to improve local conditions. While state legislation provides guidance, local government ultimately decides on the formation of councils. The councils must represent all interests in the basin. Watershed councils work across jurisdictional boundaries and across agency mandates to look at the watershed more holistically. The council can be a forum to bring local, state, and federal land management agencies and plans together with local property owners and private land managers. Local watershed councils develop and implement projects to maintain and restore the biological and physical processes in the watersheds for the sustainability of their communities. Councils often identify landowner participants for important projects, develop priorities for local projects, and establish goals and standards for future conditions in the watershed. Education projects are undertaken to inform people about watershed processes and functions. While these councils have no authority, delegates saw them as an opportunity to educate and engage the community. For more information visit: http://www.oregon.gov /OWEB/WSHEDS/wsheds_councils_ overview.shtml.

River basin commissions, like the **Interstate Commission on the Potomac River Basin** (ICPRB), have been formed by congress to work across state lines. ICPRB was established in the 1940s to enhance, protect, and conserve the water and land resources of the Potomac River Basin. Commissioners represent Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia, and the federal government. Each jurisdiction established its own rules for appointment of commissioners. The commission has no regulatory authority. It was formed in the belief that cooperation rather than regulation is the appropriate method of achieving goals. In that spirit, the ICPRB has worked to build partnerships among governments, businesses, non-profits and concerned citizens in order to increase efficiency, reduce duplication of efforts, and leverage resources to improve Potomac water quality. Field biologists monitor and assess stream habitat and biota, and work to integrate the monitoring efforts of the basin jurisdictions. Education projects and assistance in state total maximum daily load (TMDL) programs also is offered. For more information visit: www.potomacriver.org. Other interstate commissions with varying degrees of enforcement and regulatory authority include Delaware River Basin Commission, Great Lakes Commission, Interstate Environmental Commission (NY, NJ, CT), Ohio River Valley Water Sanitation Commission, Susquehanna River Commission, and New England Water Pollution Control Commission.

Establishing effective regional governance that takes into account the complexity and interconnectedness of natural systems will require consideration of local watersheds, river basins, and near-shore marine systems. Developing a structure that incorporates elements of each of the above examples will be necessary.

The Future of Integrated Coastal Management and Governance

Dr. Richard Spinrad, Assistant Administrator, National Oceanic and Atmospheric Administration's National Ocean Service, was the featured dinner speaker. Below is a summary of his presentation on the future of coastal resource management and how federal, state, and local partners can work together toward coastal solutions.

The diversity of pressures on the oceans and coasts parallel the diversity of the community of coastal ocean users (e.g., shipping, tourism, fishing, energy, construction, government, defense, and non-governmental organizations). The National Ocean Service (NOS) and NOAA already have begun to determine how they can best serve their constituents and respond to future needs. Through the Ocean Futures Roundtables, constituents share their recommendations with the NOAA Ocean Council and NOS officials.

NOAA, with its diverse mission areas in ecosystems, commerce and transportation, weather and water, and climate, will be an integral part of future ocean and coastal governance. Through its strategic plan, NOAA will achieve its missions to:

- Monitor and observe the land, sea, atmosphere, and space to create an observational and data collection network that tracks Earth's changing systems.
- Understand and describe how natural systems work together through investigation and interpretation of information.
- Assess and predict the changes of natural systems and provide information about the future.
- Engage, advise, and inform individuals, partners, communities, and industries to facilitate information flow, assure coordination and cooperation, and provide assistance in the use, evaluation, and application of information.
- Manage resources to optimize benefits to the environment, the economy, and public safety.

NOAA already has taken a significant step to address the need for a more unified approach to ocean and coastal issues within the agency—the formation of the NOAA Ocean Council, which includes representatives from across NOAA and coordinates all NOAA ocean and coastal interests.

Utilizing Integrated Management

NOS's mission to become a global leader for integrated management of the ocean will be accomplished through a new focus on requirements for resource management; new partnerships to coordinate federal investments in ocean and coastal management; taking an integrated and multidisciplinary approach to framing needs, and defining those needs in terms of management applications; and aiming to be a global leader and demonstrating that leadership relative to public policy and technical programs.

Integrated management is cross-sectoral, involves multiple objectives and balance, is intergovernmental, considers the land-ocean interface, is cross-disciplinary, cross-functional, and focuses on governance. The U.S. Commission on Ocean Policy developed fundamental principles for integrated management. These include: 1) a consideration of ocean-land-atmosphere connections; 2) implementing regional approaches to ecosystem based management; 3) utilizing multiple-use management; and 4) employing best available science and information.

Implementing this vision requires coordination of efforts, partnerships, capacity building, and technology transfer; bringing science and technology to management; and having management needs define future directions.

NOAA, coastal states, and other federal agencies already are engaged in the coordination of ocean and coastal activities including partnerships on brownfields and portfields, remote sensing for land-use change and shoreline change and delineation, oil spill assessment and remediation, and hazards mitigation.

Coordinating training and capacity building for coastal managers also is underway. The National Estuarine Research Reserve system works with Sea Grant to provide up-to-date scientific information and skill-building opportunities to coastal managers at the site level. The NOAA Coastal Services Center provides training in a range of technical and process skills.

NOAA along with its partners is bringing science and technology to management. This requires:

- Involving coastal managers in a dialogue with scientists to help shape priorities for policy-driven research.
- Asking the right kinds of questions—from the perspective of users—to ensure the utility of products and supporting technologies.
- Moving research results to operational, value added context.
- Creating a process for evaluation and assessment of effectiveness.
- Providing data and decision-support information.

Through its global vision for leadership, NOAA will continue to share its expertise and capacity in marine and coastal science and management, and work proactively with all partners. This will involve local, national, and international efforts that are only bolstered by information that supports decision making—information that is possible through science and technology.

Related Recommendations from the Commissions: Governance

Pew Oceans Commission

- Enact a National Ocean Policy Act to protect, maintain, and restore the health, integrity, resilience, and productivity of our oceans.
- Establish regional ocean ecosystem councils to develop and implement enforceable regional ocean governance plans.
- Establish a national system of fully protected marine reserves.
- Establish an independent national oceans agency.
- Establish a permanent federal interagency oceans council.
- Separate fisheries conservation and allocation decisions.
- Implement ecosystem-based planning and marine zoning.
- Develop an action plan to address nonpoint source pollution and protect water quality on a watershed basis.
- Identify and protect from development habitat critical for the functioning of coastal ecosystems.
- Institute effective mechanisms at all levels of government to manage development and minimize its impact on coastal ecosystems.
- Redirect government programs and subsidies away from harmful coastal development and toward beneficial activities, including restoration.
- Revise, strengthen, and expand pollution laws to focus on nonpoint source pollution.
- Create a flexible framework to address emerging and nontraditional sources of pollution, such as invasive species and noise.

U.S. Commission on Ocean Policy

- Establish a National Ocean Council in the Executive Office of the President, chaired by an Assistant to the President.
- Create a President's Council of Advisors on Ocean Policy.
- Improve the federal agency structure by strengthening NOAA and consolidating federal agency programs according to a phased approach.
- Develop a flexible, voluntary process for creating regional ocean councils, facilitated and supported by the National Ocean Council.
- Create a coordinated management regime for activities in federal offshore waters.
- Strengthen coastal and watershed management and the links between them.
- Set measurable goals for reducing water pollution, particularly from nonpoint sources, and strengthen incentives, technical assistance, enforcement, and other management tools to achieve those goals.
- Reform fisheries management by separating assessment and allocation, improving the Regional Fishery Management Council system, and exploring the use of dedicated access privileges.
- Accede to the United Nations Convention on the Law of the Sea to remain fully engaged on the international level.
- Establish an Ocean Policy Trust Fund, based on unallocated revenues from offshore oil and gas development and new offshore activities, that is dedicated to supporting improved ocean and coastal management at federal and state levels.
- EPA, NOAA, and other appropriate entities should increase assistance and outreach to provide decision makers with the knowledge and tools needed to make sound land use decisions that protect coastal water quality. State and local governments should adopt or revise existing codes and ordinances to require land use planning and decision making to carefully consider the individual and cumulative impacts of development on water quality, including effects on stormwater runoff.
- Congress should develop new statutory authority, similar to the Atlantic Coastal Fisheries Cooperative Management Act, to support and empower the Gulf States and Pacific States Fisheries Management Commissions. All interstate management plans should adhere to the national standards in the Magnuson–Stevens Fishery Conservation and Management Act, and the federal guidelines implementing these standards. States should participate in the development of the guidelines to ensure they are applicable to interstate plans.
- Congress should re-establish an Office of Technology Assessment to provide it with objective and authoritative analyses of complex scientific and technical issues.

Building Solutions: Information Technology and Science Capacity

Understanding coastal resources, the impacts that they face, and the success of existing efforts is crucial to implementing effective governance strategies. Information technology and science provide part of the basis for this understanding. However, there are significant barriers to the use of these tools. Margaret Davidson, director, NOAA Coastal Services Center, described these barriers, cited examples of current efforts to overcome them, and speculated about future solutions.

Some of the barriers to data sharing, integration, and communication include: 1) the sheer volume of data that currently are being collected, 2) real or perceived security issues, and 3) the complexity that accompanies regional integration of data. Finally, technology gaps between data users and providers can frustrate cooperative efforts. While universities and federal agencies typically have access to faster computers and greater bandwidth, local governments and community groups make due with older computers and dial-up Internet connections. The volume of available data and the complexity of data models can clog computer systems, leaving these worthwhile tools inaccessible. Being cognizant of these differences and designing data systems accordingly is a crucial step toward engaging all data users.

Developing information technology standards also is necessary for effective communication. Standards allow data users and producers to communicate regardless of where they are on the technology curve. Further, they minimize data integration time and costs, and permit data operations under known conditions. Some effort at standardization already has been made through several organizations including the International Standards Organization (ISO), American National Standards Institute (ANSI), and the Federal Geographic Data Committee (FGDC).

The U.S. Office of Management and Budget (OMB) has sponsored an initiative to enhance government efficiency and improve citizen services in the area of geospatial information—Geospatial One-Stop (http://www.geo-one-stop.gov). The initiative is designed to facilitate the sharing of geospatial information, improve planning for future data investments, expand collaborative partnerships to help leverage investments and reduce duplication, and collaborate on the development and implementation of standards that encourage sharing and use of best practices and advance implementation of the National Spatial Data Infrastructure. This effort includes a web-based portal for access to maps and data, and a data investment marketplace where federal agencies are required to provide information regarding their planned data acquisitions allowing state and local governments the opportunity to find projects in their area and potentially combine resources. Inclusion of coastal and ocean data is necessary to make this a true one-stop shop.

Congress, in fiscal year 1997, established the National Oceanographic Partnership Program (NOPP). The program facilitates new interactions among federal agencies, academia, and industry; increases visibility for ocean issues on the national agenda; and achieves a higher level of coordinated effort and synergy across the broad oceanographic community. This collaboration brings together the public and private sectors to support large, comprehensive projects, promote the sharing of resources, and foster innovative community-wide advances in ocean science, technology, and education. The current focus of NOPP is the development of an integrated, sustained ocean observing system.

An Integrated Ocean Observing System (IOOS) has the potential to benefit every congressional district. Constant data streams from various data sources can be used to assess both national and regional trends. Incorporating terrestrial and atmospheric observing systems would expand modeling capabilities and provide a better understanding of coastal impacts and opportunities for earlier response to potential crises.[5] Regional associations are crucial to the implementation of IOOS (for a regionally based observing system see the case study on the Gulf of Maine Ocean Observing System). Such associations would oversee and manage the design and sustained operation of integrated regional observing systems to address local societal needs, establish regional geographic bound-

aries, obtain and disperse funds to operate and improve the regional systems, and ensure the timely dissemination of quality-controlled data and information. A demonstration of the IOOS concept and its data sharing and access capabilities is available at http://www.openioos.org. See the accompanying text box for information on USGS's contribution to the IOOS.

Other efforts to integrate and provide access to data are occurring from both inside and outside government. Such efforts include the NOS Data Explorer (http://oceanservice.noaa.gov/dataexplorer), Ocean Planning Information System (http://www.csc.noaa.gov/opis), Gulf of Maine Ocean Data Partnership (http://gmbis.iris.usm.maine.edu/Partnership.asp), Coastal Data Information Program (http://www.cdip.ucsd.edu), USGS National Map (http://nationalmap.usgs.gov), and Interagency Coastal and Ocean Mapping efforts (http://www.ocean.us).

Scientific literacy and capacity in all communities, from the general public to policymakers, also is crucial to finding and implementing coastal solutions. Important first steps have been taken, but expanded coastal education is necessary.

The Centers for Ocean Sciences Education Excellence (http://www.cosee.net) is a network of seven regional centers that act locally and regionally, as well as dream, think, and act nationally to 1) promote development of effective partnerships among research scientists and educators, 2) disseminate effective ocean sciences programs and best practices that do not duplicate but rather supplement existing resources, and 3) promote a vision of ocean education as a charismatic, interdisciplinary vehicle for creating a more scientifically literate workforce and citizenry.

Nonpoint Education for Municipal Officers (NEMO) programs educate local land-use decision makers about links between land use and natural resources protection (http://nemo.uconn.edu). A major objective of NEMO is to demonstrate the effectiveness of using remote sensing and GIS technologies to inform and enhance educational programs linking local land-use decisions to water quality issues.

Coastal America, a unique partnership of federal, state and local agencies and private organizations, established a network of Coastal Ecosystem Learning Centers (http://www.coastalamerica.gov). The network combines the resources of federal agencies with marine educational centers to educate and involve the public in protecting coastal ecosystems.

Findings and Recommendations

Sharing and integrating data are efficient means of utilizing limited funding, research capacity, and political capital. Yet, significant barriers impede these efforts. Data users (and potential users) and providers must work together to overcome these impediments.

Overcoming Impediments to Sharing and Increasing Access

Agency cultures and structures often inhibit sharing—the aggregation of resources is used as a strategy for gaining power. Proprietary attitudes and a lack of incentives can limit cross-agency cooperation. Some see their data selfishness as a means of protecting their budget. Delegates suggested that government managers should be rewarded for collaborating. In places where collaboration is sought, a lack of interoperability among government IT departments complicates collaboration efforts. Legislation or a commitment from the executive branch may be necessary to overcome current reluctance and motivate agencies to commit funding and personnel to collaboration efforts. A recent Government Accountability Office[6] report mirrored delegates' concerns.

For the most part, entities collecting water quality data are either not coordinating their efforts or have experienced difficulty in doing so. These entities have faced several key barriers: (1) data collected for different organizations are geared toward serving different purposes, (2) inconsistent methods are used to obtain samples and interpret their results, (3) data collectors are unaware as to which entities collect what types of data, and (4) low priority for data coordination, as shown in a lack of support for national and state councils that have been established to improve coordination. These difficulties have not only perpetuated gaps and duplication of effort but have also complicated efforts to synthesize data from different collection efforts in a way that would provide decision makers with a more comprehensive picture of an area's water quality.[7]

Other impediments include a fear of inaccuracies and a lack of universal standards for determining the quality of data. Regional variations in terminology also can hamper collaboration. Developing standards in terminology, classifications, and sampling and monitoring methods would allow development of a national framework. Such a framework also should be developed for ecological indicators and eco-classifications. In the future, data would need to be collected and provided under these standards. All public entities (e.g., state and local governments, universities) and those receiving public funding should comply with these standards and make all available data accessible. Private interests also should be encouraged to participate.

A forum of representatives from federal agencies, state and local government, universities, private industry, and community organizations should be convened to discuss the development of standards and opportunities for data sharing. Concrete goals, deadlines, and a means of accountability should be developed. To avoid duplication of ex-

Federal Contributions to the IOOS Backbone: USGS Monitoring Programs

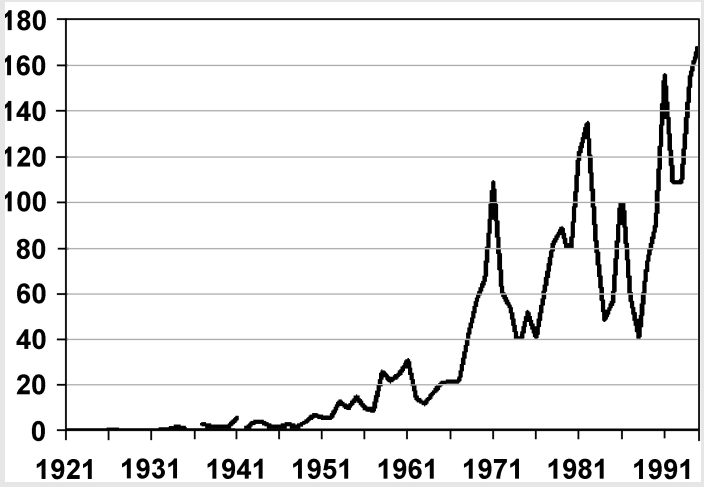

Figure 1. Number of USGS streamgages with 30 or more years of record discontinued each year, 1921-1995.

Efforts are underway to develop a sustained Integrated Ocean Observing System (IOOS) that will make more effective use of existing resources, new knowledge, and advances in technology. IOOS should serve as a unified, comprehensive, cost-effective approach for providing the data and information required to:

- Improve the safety and efficiency of marine operations,
- More effectively mitigate the effects of natural hazards,
- Improve predictions of climate change and its effects on coastal populations,
- Improve national security,
- Reduce public health risks,
- More effectively protect and restore healthy coastal marine ecosystems,
- Enable the sustained use of marine resources.

The U.S. IOOS, a component of the Global Ocean Observing System (GOOS), will consist of two elements: a global, open-ocean element, and a coastal element focused on observations, products, and services needed within estuaries to the edge of the EEZ.

The coastal component is a national effort concerned with the effects of the ocean-climate system and human activities on coastal ecosystems, living resources, and the quality of life in the coastal zone. The component is conceived as a federation of regional observing systems nested in a federally supported national backbone of observations, data management, and modeling. The federally supported suite of core observations reflects the reality that common requirements for data and data processing transcend state and regional boundaries, and provides a basis for achieving economies of scale. However, much remains to be done to ensure that these efforts are sustained, integrated, and provide data to users in a timely manner.

The U.S. Geological Survey (USGS) will provide many key data sets to the IOOS national coastal backbone. Such data sets will be crucial to measuring freshwater inflows to coastal estuaries and potential contaminants entering the ocean due to activities upstream. However, many of USGS's key monitoring programs have struggled to sustain existing systems with reduced funding.

National Streamgage Program

Since 1889, USGS has operated a streamgaging network to collect information about the nation's water resources. The program is designed to provide a continuous, well-documented, well-archived, unbiased, and broad-based source of reliable and consistent water data. A significant portion of the existing streamgages monitor coastal watersheds and basins that flow into oceans or coastal waters. Using nationally consistent protocols, these gages measure streamflow necessary to compute water, sediment, or chemical flux into coastal waters.

The real resources available to operate the streamgaging network (funds from all sources, adjusted for inflation) have been relatively static, particularly since 1992. Investments also have been made in new technology to replace outdated equipment and to meet the demand for real-time data. The net result is a decline in the total number of stations and a commensurate decline in the attainment of federal goals.

The crucial goal of monitoring long-term changes has seen significant changes. Recognizing the nation's concern over long-term environmental change, as driven by potential global climate change and regional land use change, the decline in the streamgaging network is troubling.

The availability of information from gages with over 30 years of data is valuable. First, additional years of record provide ever-improving accuracy of estimates of stream-flow characteristics, such as the magnitude of extreme infrequent floods or low flows. Second, factors such as agricultural practices, urbanization, groundwater development, or climate change require longer time frames to fully appreciate impacts.

Figure 1 shows the number of long-record stations that have been discontinued in each year since 1921. Up

through 1965, the number was generally no more than about 20 per year (typically about one percent of the total number of long-record stations). Since then, there have been three periods during which discontinuation of stations has accelerated. The losses in the middle 1990's show about four percent of the long-record streamgaging stations being discontinued each year. Much of the loss of long-term stations in recent years is attributable to the need for funding agencies to support current-use stations instead of long-term stations and USGS's inability to fund those stations solely with federal appropriations.

National Water Quality Assessment Program (NAWQA)

The NAWQA Program is the primary source for long-term, nationwide information on the quality of streams, groundwater, and aquatic ecosystems. During its first decade (1991-2001), NAWQA completed assessments on 51 major river basins and aquifers across the nation. During its second decade, NAWQA plans to reassess 42 of the 51 study units. These assessments provide baseline data and information on the occurrence of pesticides, nutrients, volatile organic compounds, trace elements, and radon in water.

Within IOOS, such assessments and the raw data can be used to determine discharge measurements, chemical analysis, sediment concentrations, and particle size distributions for suspended and bed-load sediment. It provides a long-term understanding of surface—and ground-water characteristics and their relation to natural features and human activities, and related changes over time. The National Research Council observed:

The water quality trend and cause-and-effect analyses that are the primary emphasis of Cycle II of NAWQA are inherently long-term databases, requiring long-term support. There is simply no other way to answer such questions as, Is the quality of water across the nation getting better or worse? This committee, and nearly all users of NAWQA with which it has interacted, recommend that NAWQA do more, not less—yet NAWQA has already exceeded its resources; NAWQA's resources have not grown to keep pace with annual inflation, and it has had to significantly redesign for Cycle II. While NAWQA has done an exemplary job of downsizing to 42 planned study units for Cycle II, it cannot continue to downsize and still be considered a national water quality assessment.

USGS is just one agency providing necessary data to the IOOS backbone, but it illustrates the need for continued budgetary support. Coastal ecosystems are subject to focused impacts from land, sea, and air. This underscores the importance of continuing, and improving, observing systems designed to measure the influences of water and associated materials from the land to the sea.

Sources:

National Research Council, 2002, *Opportunities to Improve the USGS National Water Quality Assessment Program.* http://books.nap.edu/catalog/10267.html.

Ocean.US, 2003, *An Integrated and Sustained Ocean Observing System (IOOS) for the United States: Design and Implementation.* http://www.ocean.us.

USGS, 2005, *The National Water-Quality Assessment Program—Informing water-resource management and protection decisions.* http://water.usgs.gov/nawqa.

USGS, 1998, *A New Evolution of the USGS Streamgaging Network: A Report to Congress.* http://water.usgs.gov/nsip.

isting efforts, a dynamic database of key activities underway in data standards, inventories, classifications, and frameworks should be created.

Delegates recognized the promise of an integrated ocean observing system, but acknowledged the need to first inventory and catalogue existing databases. A "Library of Congress" for data should be established with a commitment of the necessary funding and personnel for implementation and maintenance. A central site for data, information on who collects it, and what databases contain what information is necessary. Rescuing legacy data from older archive systems and paper files is crucial. Data from "non-traditional" sources—including NEPA reviews and grants databases—also should be made available.

A culture of linked portals, openness, and interoperability must be fostered. Web developers need to incorporate usability into database design so they are friendly and easy to use. Data collectors need to consider how others may use their data, and make it available as a multi-user data set.

Concerns about the decreasing availability of discretionary funding, including continued funding for monitoring and research programs, further illustrates the value of collaboration. Consistent funding for data collection and maintenance is crucial as data becomes more valuable the longer it is collected.

Understanding and Fulfilling Data Needs

With increasing pressure on available funding for natural resources agencies, data collection efforts must be properly focused to utilize scarce resources. Educating the public on data and how it is used by agencies—and could be used by the public—to make decisions, could lead to greater support. Gathering data in a more human-focused way also may help. Restoration projects were seen as a means for en-

gaging the public by demonstrating the success of science in their neighborhood and as a return on investments.

Better mechanisms are needed for scientists to determine which issues are most important and deserve more attention. Performance indicators or measures that build upon efforts of the Heinz Center should drive collection efforts.[8] Once these metrics are established, the data necessary to measure progress towards those goals must be determined. A national and regional ecosystem framework for performance (or a scorecard) can assist in tying decisions to goals.

While current data collection technology adequately measures chemical and physical properties,[9] an urgent research and development effort is needed to advance technologies to collect biological and habitat data. Recognizing the complexities of coastal ecosystems, including connections to actions on the land and in the atmosphere, scientists and decision makers require increasing amounts and types of data to understand and model these systems. Ocean science needs better landscape-level science and planning to include synergistic effects, multi-stressor issues, and matters of scale.

Local government planning in watersheds needs to be considered. Collected information and future plans need to be incorporated into information systems to allow understanding of the effects of plans in the aggregate. Local land use decisions need to be available for analyzing and processing into dynamic local output scenarios.

Delegates recognized several specific data deficiencies. Needs include:

- Habitat data for fish from the top of the watershed out to the continental shelf,
- Data on populations, particularly in wetlands, including tools to measure populations and their movements,
- High-resolution mapping of submerged aquatic vegetation,
- Economic data on costs of environmental degradation and the value of resources,
- Better understanding of nutrient, surface and groundwater flow,
- Stream flow, bathymetric, estuary, and topobathy mapping,
- Data on de-nitrification in wetlands, including tools to measure the effects of riparian and so-called "isolated" wetlands on downstream biologically available nitrogen.

Related Recommendations from the Commissions: IT and Science

Pew Oceans Commission

- Require bycatch monitoring and management plans as a condition of fishing.
- Develop and implement a comprehensive national ocean research and monitoring strategy.
- Double funding for basic ocean science and research.
- Improve the use of existing scientific information by creating a mechanism or institution that provides independent scientific oversight of ocean and coastal management.

U.S. Commission on Ocean Policy

- Double the nation's investment in ocean research, launch a new era of ocean exploration, and create the advanced technologies and modern infrastructure needed to support them.
- NOAA and the National Science Foundation should lead an expanded national ocean exploration program, with additional involvement from the USGS and the U.S. Navy's Office of Naval Research. Public outreach and education should be integral components of the program.
- Implement the national Integrated Ocean Observing System and a national monitoring network.
- The National Ocean Council (NOC) should develop a national ocean and coastal infrastructure and technology strategy, including detailed plans for funding and implementation, to support science, resource management, assessments, enforcement, and education.
- Congress should amend the National Oceanographic Partnership Act to establish Ocean.IT as the lead federal interagency planning organization for ocean and coastal data and information management. Ocean.IT should consist of representatives from all federal agencies involved in ocean data and information management.
- NOAA and the U.S. Navy should establish an ocean and coastal information management and communications partnership to generate information products relevant to national, regional, state, and local operational needs.
- Ocean.IT should work with developers of the National Virtual Ocean Data System and other innovative data management systems to implement a federally-supported system for accessing ocean and coastal data both within and outside the national data centers.
- The President should convene an interagency task force to plan for modernizing the national environmental data archiving, assimilation, modeling, and distribution system with the goal of creating an integrated Earth environmental data and information system.

Mobilizing and Empowering Communities

Actions throughout a watershed ultimately affect the coasts. Local communities have the greatest opportunity to address these issues, but they need the necessary knowledge and ability to actively engage. Michael Orbach, director of the Duke University Marine Laboratory and professor of marine affairs and policy, defined communities and the steps necessary to include all essential parties in coastal decision making.

A community is a group of people with shared interests, perceptions and values—it need not be focused in a particular place. The scientific community must look beyond the biophysical environment, and interact with human constituents and organizations interested in public policy and management in order to implement effective ocean governance. Developing a governance structure involves compromise by each community—human behavior must change and a trade-off between the biophysical environment and the sociocultural environment must exist.

In establishing these community-based governance structures, it is important to understand the role of science. Science is objective, reliable, and valid—it is non-normative and can only reveal what will or may happen following a given decision, but will not reveal how to behave. Governance is based in human values and includes decision-making and advocacy—it is normative and recommends what should occur. Science can inform governance, but decisions must be based on human values.

In order to engage all members of the coastal community—based on the definition of community above—the coasts must be defined broadly. The broadest definition would stretch from the upper reaches of a watershed out to the edge of the exclusive economic zone (EEZ).[10] To effect change within an area, the human coastal community must include not only those who live on the coast, but also all those who live in the greater watershed. By explaining to people that they are members of the coastal community by virtue of their presence in a particular watershed, the sphere of influence increases. However, steps also must be taken to empower them to solve coastal resource issues. Regional approaches—particularly across state or international jurisdictional boundaries—may be necessary, as natural resource issues typically do not correspond to political boundaries.

The existing coastal community must engage in three important processes to bring a new direction to coastal governance. Analysis is necessary to examine the potential need for perceptual or behavioral change. Social and biophysical science must be involved in the analysis. Facilitation involves bringing people together and helping them to understand and discuss relevant information. Good facilitators are necessary—they need not be scientists, but must not be advocates. One of the most important processes in empowering communities is providing information and letting the community discuss and decide. Following analysis and facilitation, advocacy is necessary. However, this requires a very specific set of expertise.

Utilizing these three processes, communities and constituencies need to be clearly identified—some may be place-based, others may be communities of common interest. Their attitudes, perceptions, and values must be evaluated in detail to understand why they harbor particular thoughts. These communities then must be engaged in facilitation and consensus building exercises. This allows community members to recognize, from their own point of view, that problems exist, and there is no single solution. Evaluation of their newly formulated goals and commonly developed alternatives help lead to a viable conclusion. Finally, an effective advocacy campaign must be promoted.

Both social and cultural analysis is necessary to develop coastal solutions. Coastal issues are not the sole burden of those living nearest to the coast—everyone lives in a coastal watershed and they should recognize how they impact the coasts and how the coasts impact them.

Findings and Recommendations

Recognizing the critical importance of individual participation, delegates discussed the means of achieving this participation along with how citizens can best be prepared to participate.

Engagement and Empowerment

Involving the local community may be either an impediment or an accelerant to progress. Good communication and education are essential—policy makers and scientists must listen, build trust, and communicate openly. Both place-based and common-interest com-

munities must be engaged. There is a great need for more one-to-one, personal, and focused initiatives to preserve coastal areas. Coastal solutions must be both bottom-up and top-down. They must be a mix of local and national efforts and include nontraditional groups.

Designing a governance structure that encourages citizen involvement would require a division of labor within communities and partnerships of citizens and government. Questions of how to share power were raised—including whether communities should play an advisory or authoritative role. Local watershed councils, the Atlantic States Marine Fisheries Commission, and incentive-based volunteer projects were cited as potential models (see text box, page 13).

Beyond the scientific education effort and necessary information transfer discussed below, citizens must be willing to take action. Some delegates believed that a potential crisis, or at least a common identifiable interest, would be necessary to effect behavioral change. The historic and complementary recommendations of two commissions are not enough to create political will to implement necessary social change!

Behavioral change requires the ability to make informed choices, to affect or influence outcomes, and tools to address issues of concern. Knowledge of alternatives and potential impacts, along with clear objectives and cost and benefits of a given proposal also are crucial.

Scientific Education

Community involvement in coastal decision-making is important, but educated participation is most effective. The professional and scientific community has a responsibility to provide the tools, education, and technical assistance that citizens need to become active and effective participants. Options, opportunities, and a fair assessment of relevant trade-offs also should be offered.

The public at large generally is disconnected from science. One possible driver is the coverage of science in the popular media—disagreements within the scientific community are presented as if all positions are equally valid. Scientists also must be more engaged at the community level. Delegates cited the need for charismatic scientists who engage the public—modern Aldo Leopolds.

Obtaining accurate pictures of current public knowledge will require greater participation by social scientists. Also, science education needs significant improvement to foster future scientific information capacity. Such education efforts must include a greater emphasis on the interrelatedness of resources—the land, air, and sea are all part of one system. Connecting individual actions to environmental impacts also are important. Instilling a common vocabulary will allow for greater information delivery and acceptance by making scientific terms useful and intelligible.

Improved scientific and environmental literacy will increase interest and grassroots efforts in governance at the local, state, regional, and national levels. Educational programs specifically designed for citizens upstream from the coast should be created. The campaign should include information about why people should care about coastal issues, including the impacts that poor development choices have on water quality, coastal habitats, marine life health, and taxes (disaster relief, restoration efforts, etc.).

Town meetings may be a good educational start on particular coastal issues, but getting relevant stakeholders together may be difficult. Making greater use of scientific surveys may help.

Related Recommendations from the Commissions: Community Empowerment

Pew Oceans Commission

- Broaden ocean education and awareness through a commitment to teach and learn about our oceans, at all levels of society.

U.S. Commission on Ocean Policy

- Improve ocean-related education through coordinated and effective formal and informal efforts.
- Congress should amend the National Oceanographic Partnership Act to add a national ocean education office (Ocean.ED) with responsibility for strengthening ocean-related education and coordinating federal education efforts.
- Ocean.ED should promote partnerships among government agencies, school districts, institutions of higher learning, aquariums, science centers, museums, and private marine laboratories to develop more opportunities for students to explore the marine environment, through virtual means and hands-on field, laboratory, and at-sea experiences.
- Ocean.ED, working with other appropriate entities, should promote existing mechanisms and establish new approaches for developing and delivering relevant, accessible information and outreach programs that enhance community education.

Case Study: The Gulf of Maine

The Gulf of Maine is a highly dynamic marine ecosystem that extends from Cape Sable, Nova Scotia, Canada to Cape Cod, Massachusetts. Its watershed encompasses 70,000 square miles, and 85 million people are within a day's drive. It has a diversity of habitats, which provide refuge to a variety of organisms, from benthic dwelling worms and clams to marine mammals and sea birds. Twenty-nine plant and animal species are listed as threatened or endangered. The Gulf is impacted by 2000 point source dischargers including wastewater treatment plants, industrial facilities, and power plants. The multi-jurisdictional Gulf watershed (three states and two provinces plus numerous local governments) faces significant challenges to coastal resource management and conservation. However, the Gulf of Maine community has shown leadership in implementing a cooperative approach to protecting its coastal resources. Cooperation has extended to governance, information technology and science capacity, and community empowerment.

Lessons in Governance

David Keeley, formerly Maine's top planner, provided an overview of the Gulf of Maine along with governance challenges. He also described the formation and activities of the Gulf of Maine Council on the Marine Environment.

The campaign to establish the Gulf of Maine Council spanned several decades and numerous barriers. Trade disputes between the U.S. and Canada, and a border dispute in the Gulf adjudicated by the World Court strained political relations in the region. Also, compared to other environmentally impacted areas, the Gulf of Maine was in good condition. This good fortune slowed people's acceptance that a proactive trans-boundary program was needed. Fisheries issues were at the fore and organizations like the New England Fisheries Management Council were busy.

In the late 1970's and early 1980's, the three states in the region adopted coastal zone management programs. Aided by a rich tradition of regional cooperation, program managers met three to four times a year to talk and share experiences. These discussions quickly revealed the need of having Canadians at the table. In 1989, a Governor's and Premier's Agreement on Conservation of the Marine Environment was executed. The agreement established the Gulf of Maine Council on the Marine Environment, and called for the development of five-year action plans. The Council's work was implemented through the efforts of state and provincial governments. Eventually, the federal governments of Canada and the U.S. were invited to participate.

The Council was formed by the governors and premiers, but includes state and provincial cabinet officials along with gubernatorial appointed non-governmental organization (NGO) representatives. Federal agencies also participate. Committees involve 250 additional people representing all interests in the region.

Council focal areas include coastal and marine habitat protection, toxics in the marine food chain, and sustainable maritime activities. Within these focal areas, 51 actions or projects are being implemented, including environmental monitoring, sea floor mapping, habitat restorations, the *Gulf of Maine Times,* state of the environment reporting, and sustainable maritime activities. The Council also must be highly entrepreneurial in securing its $2 million annual budget.

Three key lessons can be learned from the Gulf of Maine Council on the Marine Environment. First, focus on regional needs that are shared by all partners. Issues that require collaboration or cooperation should be emphasized. Issues that are ubiquitous but do not require a regional response should be handled through other appropriate programs. Priority setting should be inclusive, and adequate time should be provided to allow priorities to emerge. Initial tasks should be achievable—quick successes build momentum. Lasting and productive relationships are crucial. Focus on a small number of priorities and prepare a plan or strategy to achieve them. Targets should be bold and visionary. Adopt measurable goals, create baselines, and track progress, thus producing accountability. Limited resources force wise choices.

Second, maintain continuity in staffing, commitment, and leadership. A proactive agenda that causes people at the right level to participate should be developed. Recognize that inertia and culture often impede progress. Develop programs to overcome these obstacles. Create and nurture champions. Steadfast commitment by staying the course

will pay off. Develop and monitor indicators of commitment including contributions of staff time and money, participation in meetings, and realignment of agency priorities with the regional plan.

Finally, build capacity and empower others to act. Promote networking, sharing of people, ideas, and products through many forms including roundtables, forums, and exchanges. Provide help and funds to those who can help implement the common agenda (e.g., community-based stewardship, adaptive management, co-management, etc.). Educate the public and celebrate successes and achievements. Be patient, progress can come slowly, and building relationships takes time.

To expand these lessons to establishment of a national ocean governance structure, Keeley recommends incubating a network of bottom-up ecosystem councils within a federal framework with robust stakeholder participation. Federal agency coordination must be improved substantially, and there must be increased investment in management, science, monitoring and observing, information delivery, and capacity building.

Solutions through IT

Tom Shyka, program specialist, Gulf of Maine Ocean Observing System (GoMOOS), discussed the formation of a regional observation system and lessons to be learned.

Numerous industries and users depend upon the Gulf of Maine, including fishing, aquaculture, shipping, recreational boating, the military, research and monitoring, and search and rescue. Gulf issues include fisheries management, harmful algal blooms, coastal development, offshore development, endangered species, security, and climate change. These diverse users and issues revealed a need for a sustained system for measuring and predicting conditions in the Gulf of Maine.

GoMOOS was established to provide data and information for the public and private sectors to solve practical problems, predict events, and further understand natural systems in the Gulf of Maine. The system is viewed as a coastal analog to the National Weather Service, and is designed to be consistent with the coastal components of the Integrated Ocean Observing System (IOOS).

Within the IOOS structure, regional systems (like GoMOOS) would provide information to meet state and regional goals with the necessary resolution, scale, and variables. The national system would add satellite remote sensing opportunities, reference and sentinel stations, links to a global module, and implement data standards and exchange protocols.

GoMOOS has been evolving since its implementation. It began as a research project to understand the Gulf, but has evolved into a utility project to facilitate research. The initial science-based organizational model has given way to a non-profit corporate model. The system also no longer counts researchers as its primary users—a diverse group of users depends upon its data.

GoMOOS serves the entire region and is viewed as a public service utility. It was incorporated as a nonprofit entity with multi-sector membership including universities, port authorities, industry, government, and non-profits. The governing board of directors is elected from the membership.

Data on the Gulf is acquired through buoys that provide near real-time oceanographic and meteorological conditions, satellites that give a big picture view of the region, models that forecast circulation, temperature, salinity, and waves, and high frequency (HF) radar that shows hourly maps of surface current.

Data products are developed through the identification of users' needs. One overarching need is to share and integrate data across organizations and address the organizational and institutional issues related to sharing data. Such issues include data storage in different formats, limited connectivity between data sets, no standard way to discover the existence of data, difficulty in integrating data from different sources, and dealing with unique policies and procedures within each institution.

The Gulf of Maine Spatial Data Project was designed to address some of these data sharing issues. It is a cooperative agreements program between the Federal Geographic Data Committee (U.S.) and GeoConnections (Canada) to create an environment for data sharing based on adopted international standards. Desired outcomes include accessing and integrating data in real time from multiple sources, addressing dynamic resource management issues using shared spatial data, and ensuring that the widest range of potential users of spatial data have access for their specific application.

GoMOOS identified several necessary steps in developing its role. First, identify partners and potential data sources. Second, implement data interoperability standards. Third, develop a portal for sharing and integrating data. Fourth, develop a demonstration tool that uses data for a specific issue. Finally, document project issues and solutions.

When implementing a system like GoMOOS, it is important to recognize what information technology can and cannot do. It is only a tool, and information does not necessarily equal knowledge. Such a system requires organizational support for development, support, and maintenance. It also requires a commitment across institutions to share data. Information technology can enhance information sharing and lead to better decision making. Institutions can implement existing

interoperability standards for spatial data to allow for dynamic access to information needed for decision-making. Community involvement is needed in the development of new standards. Finally, institutional barriers can be overcome by commitment to a long-term partnership and working together to develop joint information technology solutions.

Community Involvement in Scientific Projects

Benjamin Neal, marine programs officer, Island Institute, examined collaborations of fishermen, scientists, and the community in the Gulf of Maine region. The Island Institute is a membership-based community development organization focusing on the Gulf of Maine, particularly the fifteen year-round island communities off the Maine coast. They provide services directly to communities and through research and publications.

Three case studies illustrated the importance of community involvement and how to engage local resource users. The Penobscot Bay Project examined larval lobster transport mechanisms by combining satellite data with local knowledge to sustain the lobster fishery. It was an innovative collaboration among the federal government, the state of Maine, fisherman, and NGOs. Remote sensing technology was applied to a complex marine resource issue. A cooperative, ecosystem-based approach that can serve as a prototype for effective fisheries management was developed. Fishermen played a key role in data collection and analysis. Project outcomes included: 1) an ecological characterization captured in a GIS database and made widely available; 2) adoption of data and techniques by the Maine Department of Marine Resources; 3) cooperation among fishermen, scientists, and managers in development of a predictive model; and 4) development of an ecosystem orientation for a wide range of coastal management issues. The Penobscot Bay Project laid the groundwork for future collaborative efforts including the Gulf of Maine Ocean Observing System (GoMOOS) and the Gulf of Maine Fisheries Research Cooperative.

A cod and haddock spawning mapping project used information acquired through interviews with fishermen. The information gathered was compiled into a series of GIS maps and analyzed to make hypothesis about the collapse of the fishery. The results suggest why some resource management strategies concerning these species may have failed. Outcomes include an understanding of the complexity and importance of near-shore spawning patterns, utilization of the data by the Maine Department of Marine Resources to institute a five-year seasonal spawning closure, and preservation of historic information for future management issues such as designating marine protected areas.

Finally, the Northeast Regional Cod Tagging Program was designed to improve understanding of cod movement in the Gulf of Maine and provide new information on essential habitat and behavior with the ultimate goal of expanding the information base for Atlantic cod. Fishermen are given financial incentives to return fish tags to the project coordinator. Lessons learned include the need for local knowledge in efficiently finding fish for research, applied projects invoke a strong interest by local resource harvesters, and ecosystem or even population scale fisheries fieldwork requires longevity.

Neal provided some conclusions for effective coastal solutions in the Gulf of Maine. Funding and monitoring systems are most effective over a long time scale. Spatially fine scales and species interactions must be taken into account. Local organizations, educational institutions, fishermen, and communities can provide an effective research and management network. Cooperation is key.

Endnotes

1 Myers, Ransom A. and Boris Worm, "Rapid Worldwide Depletion of Predatory Fish Communities." *Nature* 423, 280 - 283 (15 May 2003); doi:10.1038/nature01610.

2 A watershed includes all land area that drains into a particular body of water. Watersheds can be large (the Mississippi River watershed covers the majority of the central U.S.) or small (Rock Creek's watershed in Washington, D.C. covers several square miles, but is a subset of the Potomac River watershed). For more information, including finding watershed addresses, visit the Watershed Information Network, http://www.epa.gov/win.

3 For an in-depth examination of nonpoint source water pollution and recommendations for action, please see RNRF's Special Report, " Congress on Nonpoint Source Water Pollution: Options and Opportunities," *Renewable Resources Journal*, Volume 20, Number 4, Winter 2002–2003.

4 Hypoxia is a condition where dissolved oxygen levels drop below 2 mg/L causing a significant reduction in the amount of biota that can survive in the area.

5 One relevant scenario is the development of hypoxia predictions. As understanding and data availability increases, earlier predictions are possible. Improvements in the winter snow melt forecast leads to earlier information on in-stream flows. This information can be passed to federal, state, and local officials who can work with farmers to prevent nutrient runoff. Plans can be developed on how and when to apply fertilizer, thus sav-

ing farmers money and helping prevent hypoxia.

6 The U.S. General Accounting Office (GAO) changed its name to the Government Accountability Office in 2004.

7 GAO, *Watershed Management: Better Coordination of Data Collection Efforts Needed to Support Key Decisions*. June 2004. GAO-04-382, pg. 6.

8 The Heinz Center for Science Economics and the Environment, *The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States*. 2002. Cambridge University Press. www.heinzctr.org/ecosystems.

9 This focus on chemical and physical characteristics is largely due to its ease of collection and historical importance in economic endeavors.

10 The EEZ extends up to 200 nautical miles beyond the coastal boundary. Within the EEZ, various rights and responsibilities are given to state (0-3 nautical miles offshore, 0-9 for Florida, Texas and Puerto Rico) and federal agencies (3-200 nautical miles offshore). For a comprehensive explanation, see "Primer on Ocean Jurisdictions: Drawing Lines in the Water," U.S. Commission on Ocean Policy Final Report, page 41.

Next Steps

Over the past two years, people who care for the coasts (shouldn't that be everyone?) have witnessed the first comprehensive reviews of coastal and ocean policy in more than 30 years. It happened because the need is great and the risk of loss is certain. The coasts and oceans have never been under greater pressure—and it's more than they can sustainably bear.

And what a challenging time it is for our greatest common resources to suffer such threats. The United States, historically a world leader in many endeavors, faces unprecedented deficits and, thus, little discretionary funding to meet coastal and ocean program needs. The tragedy of deficits has been compounded by the loss of U.S. Senator Fritz Hollings' leadership. He was for many years the champion of coasts and oceans. His successor in mission is not yet apparent.

So what will become of the commissions' work—the many excellent findings and recommendations? Many delegates to the RNRF congress have observed that President Bush's response, an initiative to be directed by the Council on Environmental Quality, is not a substantive step toward resolving the threats faced by coasts and oceans.

Clearly, more must be done and advocates are needed. Will commissioners of the Pew Oceans Commission and the U.S. Commission on Ocean Policy continue their efforts on behalf of the coasts and oceans? Will they be encouraged and joined by leaders in state and federal government? Will the professional, scientific, and educational communities more actively join the debate? Finally, will champions on Capitol Hill emerge?

An obvious need and first step is to organize and coordinate efforts on behalf of the coasts. A forum should be convened and include federal and state agency leaders; ocean commission members; and representatives of professional, scientific, educational, community, academic, and industry organizations. Forum outcomes could be a strategic plan to implement recommendations of the commissions, and to support funding for ocean and coastal science and management.

The case for action is compelling.

Appendix A: List of Delegates

D'Anne Albers
Executive Director
Friends of the Sea Otter
Pacific Grove, CA

Sarah Ball**
Masters Candidate
Virginia Tech
Silver Spring, MD

Jon Bartholic
Director, Institute of
Water Research
Michigan State University
East Lansing, MI

Joy Bartholomew
Executive Director
Estuarine Research Federation
Port Republic, MD

Michael Beck
Senior Scientist
The Nature Conservancy
Marine Initiative
Santa Cruz, CA

Gary Brewer
Associate Regional Executive
for Biology
U.S. Geological Survey
Kearneysville, WV

Mark Bundy
Assistant Secretary,
Chesapeake Bay
Maryland Department of
Natural Resources
Annapolis, MD

Barry Burgan
Senior Marine Biologist
U.S. EPA
Washington, DC

Mark Burrows
Physical Scientist
International Joint
Commission
Detroit, MI

Ralph Cantral
Chief, National Policy &
Evaluation Division
NOAA–National Ocean
Service
Silver Spring, MD

William Chappell
Fisheries Management
Specialist
NOAA–National Marine
Fisheries Service
Silver Spring, MD

Colleen Charles
Assistant Program
Coordinator, Terrestrial,
Freshwater, & Marine
Ecosystems
U.S. Geological Survey
Reston, VA

Gib Chase
The Coastal Society
Northborough, MA

Ryan Colker
Director of Programs
Renewable Natural Resources
Foundation
Bethesda, MD

Michael Connor
Executive Director
San Francisco Estuary
Institute
Oakland, CA

Daryl Covey
Field Support Team Leader
NOAA
Norman, OK

Dave Cross
National Fisheries Program
Leader
USDA Forest Service
Washington, DC

Margaret Davidson*
RNRF Board of Directors
Director, NOAA Coastal
Services Center
Charleston, SC

Robert Day
Executive Director
Renewable Natural Resources
Foundation
Bethesda, MD

Patty Doerr
Legislative Associate,
Natural Resources Committee
National Governors'
Association
Washington, DC

Kellie Donnelly
Counsel
Senate Energy and Natural
Resources Committee
Washington, DC

Alan Farmer
Deputy Director, Water
Management Division
U.S. EPA Region 4
Atlanta, GA

Bart Fischer
Analyst, Natural Resources
& Environment
Government Accountability
Office
Washington, DC

Christine Fletcher
Hutton Program Assistant
American Fisheries Society
Bethesda, MD

Kristen Fletcher
Director, Marine Affairs
Institute
Roger Williams University
Law School
Bristol, RI

Warren Flint
Principal
Five E's Unlimited
Washington, DC

Peter Folger
Outreach Group Manager
American Geophysical Union
Washington, DC

Sarah Gerould
Bureau Program Coordinator,
Contaminant Biology Program
U.S. Geological Survey
Reston, VA

Mary Glackin
Assistant Administrator,
Program Planning
& Integration
NOAA
Silver Spring, MD

Joseph Gordon**
National Coordinator,
Marine Conservation
Education Program
National Environmental Trust
Washington, DC

Albert Grant
RNRF Chairman
Potomac, MD

John Haines
Coastal & Marine Geology
U.S. Geological Survey
Reston, VA

Dawn Hamilton
Executive Director
Coast Alliance
Washington, DC

Troy Hartley
Outreach Director,
Northeast Consortium
University of New Hampshire
Durham, NH

Timothy Hennessey*
Department of
Political Science
University of Rhode Island
Kingston, RI

Marc Hershman
School of Marine Affairs
University of Washington
Seattle, WA

* Working Group Chair

** Working Group Recorder

Nadine Hitchcock
Manager, San Francisco Bay Area Conservancy Program
California Coastal Conservancy
Oakland, CA

Stephen Jordan
Chief, Ecosystem Assessment Branch, Gulf Ecology Division
U.S. EPA
Gulf Breeze, FL

David Keeley
State Planner (retired)
Maine State Planning Office
Augusta, ME

Dennis King
Research Professor, University of Maryland, Center for Environmental Science
Solomons, MD

Victor Klemas
Director, Center for Remote Sensing
University of Delaware
Newark, DE

Jonathan Kramer
Director
Maryland Sea Grant College
College Park, MD

Alan Lewitus
President, Southeastern Estuarine Research Association
Charleston, SC

Jennifer Linn
Drise Fellow
U.S. EPA
Washington, DC

Tony MacDonald*
Executive Director
Coastal States Organization
Washington, DC

Susan Mangin
Fish & Wildlife Biologist
U.S. Fish & Wildlife Service
Arlington, VA

Anne Miglarese
President & CEO
EarthData Holdings, Inc.
Washington, DC

Ben Neal
Marine Program Specialist
Island Institute
Rockland, ME

Corey Niles
Sea Grant Fellow, Office of Senator Maria Cantwell (WA)
Washington, DC

Andy Nyman
Assistant Professor, School of Renewable Natural Resources
Louisiana State University
Baton Rouge, LA

Michael Orbach*
Director, Marine Laboratory
Duke University
Beaufort, NC

Lawrence Pettinger
RNRF Board of Directors
American Society for Photogrammetry and Remote Sensing
Reston, VA

Jennifer Rahn
Assistant Professor
Baylor University
Waco, TX

Gus Rassam
Executive Director
American Fisheries Society
Bethesda, MD

Mac Rawson
Director
Georgia Sea Grant
Athens, GA

Susan Roberts
Director, Ocean Studies Board
National Academies
Washington, DC

Howard Rosen
RNRF Board of Directors
Society of Wood Science and Technology
Silver Spring, MD

Cynthia Sarthou
Executive Director
Gulf Restoration Network
New Orleans, LA

Karen Schuckman
Senior Vice President
EarthData Technologies
Frederick, MD

Eric Schwaab
Resource Director
International Association of Fish & Wildlife Agencies
Washington, DC

Mia Sealey**
Research Associate
Environmental Council of the States
Washington, DC

Ilga Semeiks
Environmental Analyst
Government Accountability Office
Washington, DC

Bob Shavelson
Executive Director
Cook Inlet Keeper
Homer, AK

Tom Shyka
Program Specialist
Gulf of Maine Ocean Observing System
Portland, ME

Willis Sibley
Past-President
Society for Applied Anthropology
Shady Side, MD

Alan Sielen
Visiting Scholar, Ocean Studies Board
National Academies
Washington, DC

Richard Spinrad
Assistant Administrator
NOAA–NOS
Silver Spring, MD

Adrienne Sponberg
Director of Public Policy
American Society of Limnology & Oceanography
Washington, DC

Larry Standley
Hydrologist/Soil, Air & Water Program Lead
Bureau of Land Management, Alaska State Office
Anchorage, AK

Barry Starke
RNRF Vice-Chairman
Earth Design Associates
Casanova, VA

Deanna Stouder
Assistant Director, Watershed, Fish & Air
USDA Forest Service
Washington, DC

Jenny Hernandez Thompson
Sea Grant Fellow
Office of Congressman Frank Pallone Jr. (NJ)
Washington, DC

Carolyn Thoroughgood
Dean, College of Marine Studies
University of Delaware
Newark, DE

Paul Ticco
Coastal Training Program Coordinator
Waquoit Bay National Estuarine Research Reserve
Waquoit, MA

Cristophe Tulou
President
Center for SeaChange
Arlington, VA

Jack Waide
Program Coordinator-Terrestrial, Freshwater & Marine Ecosystems
U.S. Geological Survey
Reston, VA

Laura Walko**
Communications Specialist
NOAA–Office of Habitat Conservation
Silver Spring, MD

Michael Weinstein
Director
New Jersey Sea Grant
Fort Hancock, NJ

Brian Weitz
Sea Grant Fellow
Senate Commerce Committee
Washington, DC

Kay Weston
Program Analyst
NOAA–Fisheries Service
Silver Spring, MD

Jeffrey Zinn
Specialist, Natural Resources
Congressional Research Service
Washington, DC

Appendix B: Congress Program

Congress On Building Capacity for Coastal Solutions

Monday,
December 6, 2004

9:00 am–9:05 am
Welcome and Opening Remarks
Albert A. Grant, RNRF Chairman

9:05 am–9:20 am
Congress Context and Goals
Margaret A. Davidson, Conference Committee Chair; Director, NOAA Coastal Services Center

9:20 am–9:50 am
Introduction to the Nation's Coasts: Findings from the Pew and U.S. Oceans Commissions
Christophe Tulou, President, Center for SeaChange and former Executive Director, Pew Oceans Commission

9:50 am–10:10 am
Discussion/Questions

10:10 am–10:35 am
The Complexities of Coastal Governance
Timothy Hennessey, Professor, Department of Political Science, University of Rhode Island

10:35 am–10:55 am
Discussion/Questions

11:15 am–11:40 am
Building Networks for Solutions: Information Technology and Science
Margaret Davidson, Director, NOAA Coastal Services Center

11:40 am–12:00 pm
Discussion/Questions

12:00 pm–12:25 pm
Mobilizing and Empowering Communities
Michael Orbach, Director, Duke University Marine Laboratory

12:25 pm–12:45 pm
Discussion/Questions

1:45 pm–2:15 pm
Case Study:
Gulf of Maine—Governance
David Keeley, State Planner, Maine State Planning Office

2:15 pm–2:35 pm
Discussion/Questions

2:35 pm–3:05 pm
Case Study: Gulf of Maine—Information Technology
Tom Shyka, Program Specialist, Gulf of Maine Ocean Observing System

3:05 pm–3:25 pm
Discussion/Questions

3:45 pm–4:15 pm
Case Study: Gulf of Maine—Community Empowerment
Ben Neal, Marine Program Specialist, Island Institute

4:15 pm–4:35 pm
Discussion/Questions

6:30 pm–8:30 pm
The Future of Coastal Management
Richard Spinrad, NOAA Assistant Administrator, Ocean Services and Coastal Zone Management

Tuesday,
December 7, 2004

9:00 am–9:35 am
Regional Ecosystem Assessments... from Planning to Action
Michael Beck, Senior Scientist, Marine Initiative, The Nature Conservancy

9:35 am–10:00 am
Discussion/Questions

10:00 am–10:10 am
Explanation of Working Group Procedures
Ryan M. Colker,
RNRF Director of Programs

10:30 am–4:00 pm
Working Group Sessions

4:00 pm–4:35 pm
Discussion of Necessary Next Steps and Concluding Remarks
Robert Day,
RNRF Executive Director

Appendix C: Background Materials Bibliography

In advance of the congress, delegates were provided with a notebook of background materials. These materials featured reports and information items from federal and state agencies and recognized authors and organizations on topics to be discussed at the Congress. Many delegates commented on the usefulness of the information and the fact that it had not previously been assembled in a cohesive manner. A bibliography of these items along with internet sites (where available) is provided below.

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About RNRF

Purposes

The Renewable Natural Resources Foundation (RNRF) was incorporated in Washington, D.C., in 1972, as a nonprofit, public, tax-exempt, operating foundation. It was established to:

- Advance sciences and public education in renewable natural resources;
- Promote the application of sound scientific practices in managing and conserving renewable natural resources;
- Foster coordination and cooperation among professional, scientific and educational organizations having leadership responsibilities for renewable natural resources;

  and
- Develop a Renewable Natural Resources Center.

The foundation represents a unique, united endeavor by outdoor scientists to cooperate in assessing our renewable resources requirements and formulating public policy alternatives.

Membership

RNRF's members are professional, scientific and educational organizations interested in sustaining the world's renewable natural resources. The foundation is governed by a board of directors comprised of a representative from each member organization. The directors also may elect "public interest members" of the board. Board members are listed on page 5. Individuals may become Associates for an annual contribution of $50 or more.

Programs

RNRF conducts national meetings, public-policy round tables, policy briefings and leadership summits. It also conducts an annual awards program to recognize outstanding personal, project, and journalistic achievements. These activities are supplemented by international outreach activities and internships. More information about RNRF's programs is available at www.rnrf.org.

Renewable Resources Journal, first published in 1982, promotes communication among RNRF's represented disciplines. The journal is provided to the governing bodies of RNRF member organizations, members of the U.S. Congress and committee staffs with jurisdiction over natural resources, federal agencies, and universities. Tables of contents of all volumes of the journal are available at RNRF's website.

Center Development

The Renewable Natural Resources Center is being developed as an office and environmental center for RNRF's members and organizations with related interests. The Center is located on a 35-acre site in Bethesda, Maryland, where lawns and forested buffers provide an exceptional work environment. The site is the former family estate of Dr. Gilbert H. Grosvenor, of the National Geographic Society.

The master site plan for the Center contemplates the construction of approximately 283,000 square feet of office space—including a 16,500 square foot conference and common-services facility. The Center currently has approximately 52,500 square feet of office space.

RENEWABLE RESOURCES JOURNAL
Renewable Natural Resources Foundation
5430 Grosvenor Lane
Bethesda, Maryland 20814 USA

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