

# OUR COASTAL SEAS *What Is Their Future?*



The Environmental Management  
of Enclosed Coastal Seas  
*Summary of an International Conference*

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# OUR COASTAL SEAS

## *What Is Their Future?*

The Environmental Management  
of Enclosed Coastal Seas

*Summary of an International Conference*

Edited by

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A Maryland Sea Grant Publication  
College Park, Maryland



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DR. IAN MORRIS  
1938-1988

## DEDICATION

On a fine spring evening in 1985, the late Ian Morris, then Director of the University of Maryland's Center for Environmental and Estuarine Studies, was entertaining a group of colleagues and others on the front porch of his home in Cambridge, Maryland. Dr. Morris, himself a noted marine biologist, was one of those rare scientists who could engage researchers, politicians, and private citizens in the same conversation.

At the time, Maryland had only recently joined its neighboring states and the U.S. Environmental Protection Agency in an ambitious program to restore and protect the Chesapeake. Significant expenditures were anticipated to underwrite major new commitments of manpower and professional resources for research, policy development, and regulation enforcement. Indeed, a new multi-jurisdictional administrative structure had recently been put together to formalize the involvement of managers, scientists, and citizens in the policy making process.

Dr. Morris, keenly aware that the Chesapeake was not the only threatened coastal sea in the world, challenged his friends by asking a simple question: "How do they do these things in other countries? Surely we could learn something from their successes, and from their failures."

Silence followed, leaving only the night sounds of summer, tree frogs, the crickets, and the questioning hoot of a distant owl. Then, Dr. Morris spoke again: "Well, if others are not looking into this, perhaps we should!" The conversation became more animated as darkness progressed. By the end of that evening, the group had outlined what became known as the Coastal Seas Governance Project.

Over the next two years, this project conducted site visits to the Chesapeake Bay, the Baltic Sea, the North Sea, and the Seto Inland Sea of Japan. Site visit teams included scientists, agency heads, elected officials, and at times an environmental writer.

They met their counterparts for frank, informal discussions in places like Annapolis, Stockholm, Helsinki, Gdansk, Rotterdam, London, and Kobe. It was on the last site visit in 1988 that Ian Morris met Governor Toshitami Kaihara of Japan's Hyogo Prefecture. Their new friendship was instantaneous, based as it was on a common interest in promoting the exchange of information to improve coastal seas' management worldwide. Dr. Morris encouraged Governor Kaihara to pursue his own plans to convene an international forum specifically dedicated to this purpose. The theme was to become "Environmental Management of Enclosed Coastal Seas." EMECS was born.

Tragically, Ian Morris died in June 1988 at age 49 before the fruits of his vision were fully realized — only one preliminary report of his project was released. Governor Kaihara carried the vision forward by organizing and hosting the first conference, EMECS '90, in Kobe, Japan. This milestone was the first time managers, researchers, citizens, and writers from around the world formally came together to share their programs, opinions, and recommendations for more effective management of their increasingly threatened coastal waters. EMECS '90 was attended by more than 1,000 participants from more than 40 nations. At the close of this first conference, David A.C. Carroll, representing Governor William Donald Schaefer, accepted the baton and announced that the State of Maryland U.S.A. would host EMECS '93 in Baltimore on the shores of Chesapeake Bay.

From Dr. Ian Morris's simple question — and from his lifetime of dedication to marine science and the marine environment — has grown an international network of those concerned with the health and well-being of coastal seas worldwide. For this reason, we dedicate this summary of the 1993 EMECS conference to his memory.



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# *Declaration Of Principles*

*from the Second International Conference  
on the Environmental Management of  
Enclosed Coastal Seas (EMECS '93)*



We, the participants of the second EMECS Conference, thank Governor Toshitami Kaihara for his vision in initiating this international forum with the first EMECS Conference in 1990. We also thank Governor William Donald Schaefer for inviting us to Baltimore and for hosting the second Conference on the shores of the beautiful Chesapeake Bay. We believe that EMECS has proven its value as a stimulating forum for sharing information and ideas on issues of great concern to us all.

We affirm that EMECS is dedicated to the following principles:

- facilitating the international exchange of scientific information, including advances in research and modeling of coastal phenomena;
- fostering understanding among policy makers and researchers of the motivations and interests of citizens which are essential to the implementation of sound policy;
- improving communication and cooperation across the increasingly important science-policy interface;

- building upon common commitments to protect coastal seas because of their importance as places of physical beauty and cultural and historic meaning;
- providing a venue for exchange of technology useful to solving problems of coastal seas; and
- pursuing new approaches to governance informed by our concern for ecosystems that cross the jurisdictional boundaries that mankind has imposed.

We agree that EMECS must be committed to pursuing these principles into the Twenty-first Century, and we hope they will guide the organization and participation of future EMECS Conferences. In addition, we welcome Governor Kaihara's intention to establish an international EMECS center in Kobe, Japan, to pursue ongoing efforts to protect and maintain our precious coastal seas and their irreplaceable natural resources.

Finally, we enthusiastically endorse the generous offer of Sweden to host EMECS '97 in Stockholm as consistent with our recommendation that future EMECS conferences should take place on various sites representing coastal seas around the world.



*As Agreed  
by the Attendees of EMECS '93*

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**FOREWORD BY  
GOVERNOR WILLIAM  
DONALD SCHAEFER**

It is clearly no coincidence that a major international conference on coastal seas would be held on the shores of Baltimore's Inner Harbor. A major port since the nation's early days, Baltimore has built on its tradition of commerce and discovery to become an exciting portal into the Chesapeake Bay region's rich future. With the construction of the new Columbus Center for marine science and biotechnology joining the famed Baltimore Aquarium and the Maryland Science Center, Baltimore has created one of the most exciting blends of science and water in the world.

The Environmental Management of Enclosed Coastal Seas Conference (EMECS '93) grew out of a close and productive relationship between the State of Maryland and the Hyogo Prefecture of Japan, home of Kobe, a port city much like Baltimore. Kobe lies on the shores of the Seto Inland Sea, a body of water rich in both commerce and culture, as is the Chesapeake Bay. Like the Chesapeake, the Seto Inland Sea provides a wealth of seafood, while also serving as a protected waterway for shipping and industry. And as in the Chesapeake, citizens and government leaders there are determined to strike the best balance between economic growth and environmental stewardship.

The first contacts with Kobe and the Hyogo Prefecture came through the University of Maryland, as part of an international study of coastal seas management. Scientists and policy analysts were curious about whether or not programs in other countries were similar to the one which was then developing here in the Chesapeake region. Happily, they discovered counterparts in Japan, in Sweden and in a number of other countries who were asking many of the same questions. One of the most active leaders

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was Toshitami Kaihara, Governor of the Hyogo Prefecture, who helped to focus attention on these important coastal areas. The result was the first EMECS Conference, held in Kobe, Japan in 1990. At that time I instructed my representative to invite the assembled scientists, resource managers, political leaders and others to join us in Baltimore for the second EMECS Conference.

The second conference, EMECS '93, was a great success. Representatives from more than forty different nations attended the meeting to share information about the management of coastal seas. Their papers, reports and panels remind us that coastal seas are among the most valuable ecosystems on the planet. Water bodies that are partially contained and yet connected to the world's oceans — the Chesapeake Bay, the Seto Inland Sea, the Baltic — serve as productive nursery grounds and habitat for fish and shellfish, while also functioning as strategic locations for ships and ports. As conference presenters made clear, these bodies of water also serve another purpose. They provide a wonderful "sense of place," a rich center of focus for a way of life and for a culture rooted to these places where the sea intertwines with the land.

The summary of this meeting should serve as a celebration of these coastal seas, and a waypoint along an interesting journey that I hope will lead to many more such meetings. Those of us who live and work in the Chesapeake watershed feel that we have created an admirable model for ensuring the wise management of our own coastal sea. We hope that others will learn from our experiences here, and we must ourselves remain open to learn from other countries and continents. The world's coastal seas deserve no less from all of us.

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**WELCOME FROM  
GOVERNOR  
TOSHITAMI KAIHARA**

Ladies and Gentlemen, it is a great privilege for me to be able to be here with you to attend EMECS '93.

First of all, I would like to express my appreciation to Governor Schaefer of Maryland, the Maryland State Government and the University of Maryland for their tremendous efforts that have made EMECS '93 a reality.

Japan is a nation that is made up of four main islands and numerous smaller ones. Three of these four main islands – Honshu, Shikoku and Kyushu – serve as the boundaries for an inland sea called the Seto Inland Sea. This inland sea covers nearly three times the area of Chesapeake Bay. It is dotted with countless islands and has a scenic beauty that rivals that of the Aegean Sea.

As Japan's industrial areas bordering this inland sea expanded, environmental pollution likewise increased, to the point that in the 1970s a real danger existed of the Inland Sea becoming a "dead sea." To cope with the crisis, local governments in the coastal regions established the Governor's and Mayors' Conference on the Environmental Protection of the Seto Inland Sea. Since that time, this organization has worked with the Environmental Agency of Japan to establish regulations for landfills and factory waste water and to facilitate the disposal of household effluent. These efforts have enabled the crisis to be averted, and halted the decline in water quality.

However, the coastal area bordering the Seto Inland Sea is home to 34 million people. In order to both preserve the environ-



ment and still ensure an affluent lifestyle for these people, many problems must still be overcome in many different areas, including government, economics, science and technology and education.

Faced with these problems, in 1987 Professor Ian Morris and other people from the University of Maryland visited me for an exchange of views. It was at that time that I became aware of how important it was for different regions facing the same problems of preserving and utilizing the environment of enclosed coastal seas to share effective knowledge, technologies and information and pool their efforts to find solutions to these problems. Subsequently, I recommended that an international conference be held for this purpose.

Fortunately, this proposal was endorsed by many people, and EMECS '90 was held in 1990 in the city of Kobe in Hyogo Prefecture, the Prefecture of which I am Governor. More than one thousand delegates came from 42 countries to attend the conference. Among the many significant achievements of their coming together was a consensus that strong political commitment and an approach to coastal management that involves all concerned parties will be needed in efforts to preserve enclosed coastal seas, as expressed in the Seto Inland Sea Declaration adopted at the conference.

Subsequently, in order to best utilize the achievements of EMECS '90, we moved ahead with plans to create an international network. This was intended to support the Research Institute for the Seto Inland Sea, made up mainly of people involved in related research, and to facilitate the exchange of information between researchers studying enclosed coastal seas.

Since 1990 we have also welcomed relevant government officials from developing countries for research aimed at the transfer of technologies for the environmental management of enclosed coastal seas. These international activities on the part of Hyogo Prefecture have attracted a great deal of interest from researchers and organizations in nations concerned about enclosed coastal seas around the world, and the fruits of the network have been growing steadily.

The Agenda 21 adopted at the Earth Summit held in Rio de Janeiro, Brazil is still fresh in my memory. It calls for new approaches to marine and coastal area management and development, at the national, subregional, regional and global levels, approaches that are integrated in content and are precautionary and anticipatory. It also gave several examples of program areas for these efforts.

Therefore I think it is very significant that following the success of EMECS '90 researchers, government officials and citizens groups working to preserve the environmental of enclosed coastal seas around the world have come together at EMECS '93 to deepen ties and find ways to deal with the many problems related to the preservation of the environment and the appropriate use of enclosed coastal seas, in order to pass on the bounties of these seas to the next generation.

It is my hope that the EMECS conferences, first held in 1990 and now in 1993, will continue to be held on a regular basis, and that they will continue to contribute to the environmental management of enclosed coastal seas.

For this purpose, I feel that it would be helpful to set up an organization of international character and dimension to serve as the wellspring for promoting future EMECS conferences and for encouraging international efforts in the environmental management of enclosed coastal seas. Moreover, it seems to me that the incentive to do so has become stronger in recent years.

Therefore, speaking on behalf of Hyogo Prefecture, I would like to express our intention to establish, with the cooperation of all the participants gathered here today and other relevant individuals and organizations, what I am tentatively calling the International EMECS Center in the city of Kobe in Hyogo Prefecture of Japan.

The International EMECS Center would, in theory, further expand on the activities that Hyogo Prefecture has taken a leading role in promoting since EMECS '90. It is my hope that during the term of EMECS '93 we will be able to obtain an understanding and recognition of the benefits of establishing such an organization on

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the part of the scholars, governmental officials, citizens groups and international organizations participating in this conference, and to achieve worldwide support to serve as a base for this endeavor.

In closing, I would like to again thank Governor Schaefer, the State of Maryland and the University of Maryland for all that they have done to ensure the success of EMECS '93.

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## PREFACE

This collection of summaries captures some of the major points discussed at EMECS '93, held in Baltimore, Maryland. This is not a proceedings — many of the presenters were asked to participate in free-wheeling discussions, rather than to read technical papers. Instead, this summary offers condensed nuggets of the presentations and discussions that took place during the conference's fifty-four concurrent sessions. These summaries will no doubt whet the appetite for more information, and those wishing to follow up on topics of interest can contact the range of presenters listed in the back of this book.

Of special note were the efforts to bring together scholars, citizens and decision makers from differing disciplines. As thinker and author Mark Sagoff noted, it was unusual for such a conference, largely technical in nature, to be “colonized” by that exotic species known as philosophers. In fact EMECS '93 offered an entire track on philosophical topics relevant to coastal seas management — as well as sessions on the role of the humanities and a collection of videos about coastal seas — and the full papers commissioned specifically for this part of the conference will appear under separate cover.

EMECS '93 was truly a cooperative effort. A Steering Committee comprised of representatives from environmental and science organizations from around the world helped to devise a creative program for the gathering. Financial support for this ambitious meeting came from the Hyogo Prefecture, Japan; the State of Maryland, U.S.A.; the U.S. National Oceanic and Atmospheric Administration; the U.S. Environmental Protection Agency; the Chesapeake Bay Trust; the United Nations; the Center for Global Partnership; and a number of other organizations.

Special thanks are due to the Hyogo Prefectural Government, centered in Kobe, Japan, and to the Governors and Mayors Conference for the Protection of the Seto Inland Sea, for their leadership in supporting the ongoing EMECS effort, and for their establishment of an International EMECS Center in Kobe. Special thanks are also due to the many citizens of the Chesapeake Bay region who helped stage EMECS '93, especially at the University of Maryland — at the Coastal and Environmental Policy Program, the Center for Environmental and Estuarine Studies, the School of Public Affairs, and the Maryland Sea Grant College; at the Maryland Department of Natural Resources; at the Maryland Department of the Environment; and of course at the Office of the Governor.

There are too many individuals to thank in such a brief space, but among those who labored particularly hard to stage the EMECS conference were: Dorothy Peterson, who coordinated conference logistics; Wayne Bell, Jack Greer, Mark Sagoff, Stacy VanDeveer and Anatheia Brooks, University of Maryland; Helene Tenner, Maryland Department of Natural Resources; David Carroll, Secretary, Maryland Department of the Environment; and Cecily Majerus, Office of the Governor. We would also like to recognize Ellen Frites Wagner, whose involvement was instrumental in the early planning of the conference, but then was forced to retire due to the serious lung disease that would tragically claim her life. We remember her fondly. Finally, the conveners of EMECS would like to thank Governor William Donald Schaefer for his leadership and his commitment to this international effort to understand, manage and protect coastal seas, including the fabled but threatened Chesapeake Bay.

### **Where to Find Additional Information:**

EMECS: An International Network. For a list of scholars, scientists and policy experts working in the field of coastal seas management, write the International EMECS Center, Kenryu Building #2,

Kaigandori-6, Chuo-ku, Kobe 650 Japan; the University of Maryland Center for Environmental and Estuarine Studies, Box 775 Cambridge, MD 21613 USA; or the Stockholm Centre for Marine Research, Stockholm University, S-106 91 Stockholm, Sweden.

*The Challenge of the Madrigal Sea.* A 37-minute video documenting the lively debate that took place at EMECS '93 over the fate of the mythical Madrigal Sea. Write Maryland Sea Grant, 0112 Skinner Hall, University of Maryland, College Park, MD 20742 USA. Price: \$24.95.

*Saving the Seas: Values, Scientists and International Governance.* A collection of essays commissioned for EMECS '93 covering philosophical and policy dimensions of coastal seas management. For information contact the Maryland Sea Grant College (above) or the Institute for Philosophy and Public Policy, 300 VanMunching Hall, University of Maryland, College Park, MD 29742 USA.

*Coastal Seas' Governance: An international project for management policy on threatened coastal seas.* Morris, Ian and W. H. Bell. 1988. *Maryland Law Rev.*, 47:481-496. This paper reports the results of the original coastal seas governance project.

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# PHILOSOPHY AND POLICY

## INTRODUCTION

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A unique feature of EMECS '93 was the inclusion of a philosophy track in what would have otherwise been a meeting of scientists and managers. This track focused on the issue of "a sense of place" and attracted scholars who drew attention to issues other than physical, chemical and biological ones. In this section, expert panels focused on the phenomena of place and community as driving forces in setting and changing policy. They also wrestled with such issues as national sovereignty and transnational policies, focusing on nongovernmental as well as governmental influences.

Taking the long view, panelists addressed the issue of landscape integrity and the whole ecosystem approach. They discussed systems approaches to coastal zone management, and compared places as different as Java, the Baltic Sea and the U.S. Great Lakes. They also addressed the nature of scientific communities and their contribution to policy, touching on how decisionmakers make policy in the face of scientific uncertainty.

Because of the philosophy contribution, a central EMECS theme became "the power of place." The brief summaries which follow are given much fuller expression in a book commissioned in conjunction with EMECS '93, *Saving the Seas: Values, Scientists and International Governance*, edited by L. Anatheia Brooks and Stacy D. VanDeveer.



## NATIONAL SOVEREIGNTY AND TRANSNATIONAL POLICIES

*James Rosenau, Chair (USA)*

### ■ International Regimes and Private Interests in Environmental Issue Areas

*Virginia A. Hausler (USA)*

Corporations have much more capital to invest than do governments, and institutions influence how this capital may more effectively be channeled towards environmental concerns. Yet corporations are the neglected partners when non-state institutions are examined, and they are often merely the targets of enforcement. The time may be ripe to convince corporations to “go green,” since doing so creates markets at no extra cost, and it now is perceived as “the right thing to do.” International organizations can support corporations in this trend by increasing environmental education, harmonizing national environmental policies, reducing business risks from change, providing incentives for change, and mediating between state needs and the market in order to move from prohibitions to cooperation.

### ■ State “Sovereignty” and International Cooperation for Enclosed Coastal Seas Protection

*Stacy D. VanDeveer (USA)*

State sovereignty is frequently viewed as an impediment to sound environmental policy. Sovereignty is a socially and historically constructed norm which continues to evolve, and today sov-

ereignty is often seen as an external quality based on recognition by other states rather than an internal quality based on civil society. Both nongovernmental organizations (NGOs) and states review the environmental records of other states, and this outside pressure runs counter to the idea of the state as the sole actor within its borders. This trend, which goes beyond environmentalism, is growing, and environmentalists do not necessarily need to deal with one unitarian state. Three strategic approaches for environmentalists to take toward the norms of state sovereignty are: (1) They don't have to let the state represent them; (2) citizen and professional groups can raise issues to the international level, using interest group politics, i.e., joining together for common interests across national lines; (3) environmental groups can confront different sovereignties, realizing that states have different institutional capabilities (e.g., although there may be agreements to protect a sea, one country may have less ability to enforce rules than another). The key is to account for the differences in any strategy. Our failure to take the evolution of state sovereignty into account may hamstring supra-national regimes created to protect coastal seas.

*Ken Conca, Commentator (USA)*

States and corporations are not as inflexible as might be assumed, yet both have been considered impediments to environmental management. It is important to note the heterogeneity of corporations, individuals and sectors, and to include these actors along with states in determining international environmental regimes. Turning to states, a single action may affect both the inward and outward function of sovereignty — for example, when states create environmental regulations the scope of their responsibility expands; thus sovereignty itself may increase.

In discussion it was observed that real corporate behavior can differ markedly from theory. Corporations now experience the environment as a key factor in capital flow, and informal compliance by corporations often anticipates regulation. Cultural shifts also affect members of corporations, since both workers and management

are also part of the general public. Corporations closer to the ultimate consumer will change first, while raw materials suppliers will be slowest to change in response to cultural shifts. If, however, corporations are seen as laggards, then international legislation is appropriate.

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## INTERNATIONAL ISSUES, INTEREST GROUPS, AND POLICY MAKING

*Virginia A. Hausler, Chair (USA)*

### ■ Global Civil Society and Protection of the Global Environment

*Ronnie D. Lipschutz (USA)*

There is a strong focus on science leading environmental management, but science may prove to be the easier part of the task. Modeling social phenomena is much more difficult, and is key to true environmental change. We can even say that environmental degradation is a social-institutional phenomenon, since it is due to aggregated impacts from institutional actions. We cannot rely on global management because the issues are too complex, as well as location-specific, and most nations lack the capacity to enforce effective policies.

Global environmental organizations exist, but there is resistance from local groups to accept external suggestions, even though some knowledge and techniques can be used in many places equally well. Restoration will most likely succeed when it is grounded in global civil society — a transnational system of rules, norms and practices oriented around a large number of disparate actors.

## ■ Intellectual Leadership, Political Leadership, and International Policy Making

*Craig Murphy (USA)*

Similarities are shared between successful leadership on environmental issues and successful international institutions. Relatively effective international institutions all deal with problems arising out of the industrial system, particularly the effects of long-term capital investment decisions. Ultimately, the goal of international regimes is to change the direction of investment for all companies, and to increase focus to the long-term. This redirection can be accomplished through: (1) intellectual leadership, often by scientists, to explain problems and solutions, (2) sponsorship of stakeholders' conferences to create an international regime, and (3) benefactors (who are often the sponsors) paying for regime institutional start-up. One problem confronting international business is the opportunity cost of lost development due to environmental agreements. Historically this problem has often been solved by regimes which act as "first movers" to create domestic incentives, making it less costly for polluters to reduce emissions abroad than in their home country.

## ■ Enlarged Citizen Skills and Enclosed Coastal Seas

*James N. Rosenau (USA)*

There are many transformations in citizenship today, including the skills revolution, crises of authority, and changes from a state-centric government to a globally-oriented one. In addition, there is tension between integration or universalism on the one hand, and fragmentation or localization on the other. These two tensions are integrated in the concept of "framegration."

There are four types of citizenship, based on the priority attached to self versus that attached to society. These are the apathetic, the self-centered, the altruistic and the democratic citizen. These citizenship types react to four types of environmental issues,

based on whether there are environmental "goods" or "bads" produced, and whether these are distributive or redistributive. Overall, citizenry is not likely to become involved in an environmental issue unless it perceives a redistributive "bad" such as the worsening of chronic pollution. The political process has short-term horizons, while environmental problems require long-term solutions, and these conflicting foci lead to the complexity of solving environmental problems by political means.

Discussion indicated that strict dichotomies are unacceptable; rather, we need top-down enforcement concurrent with civil society. Fragmentation, or nationalism, should not be conflated with "sense of place," since similar conditions may produce differing results, so that specific circumstances outweigh any predictive ability. There can be a tension between collaboration and resistance, when external elites with a global environmental view conflict with residents with a strong sense of place. It was questioned whether or not we should continue contrasting regulation with citizen action, and if there is something between universalism and localism.

## PLACE, LOCALITY, AND COMMUNITY

*M. Gordon Wolman, Chair (USA)*

### ■ Environmental Values, the Coastal Context, and a Sense of Place

*Stephen R. Kellert (USA)*

A large percentage of the population is concentrated along the coastlines, and materialist explanations only partially account for this popularity. Social, spiritual and other non-commodity values abound at the shore. Biophilia, the innate love of and need for nature which we all feel, is at the center of the concept of place. Nature has many values in our lives, including: (1) utilitarian, (2) ecological/scientific, (3) aesthetic, (4) naturalistic (a day at the beach is the most popular activity in the U.S.), (5) dominionistic, (6) moralistic, and (7) negativistic ones. For all of these reasons we feel that coastal environments must be saved.

The greatest problem is degradation. When nature suffers, we lose the places that anchor our collective memory. Restoration efforts generally emphasize the utilitarian, at the expense of the ecological value of coastal seas, because economics does not adequately take other values into account.

### ■ “Saving” Places: the Management of Enclosed Coastal Seas

*Mark Sagoff (USA)*

The values listed by Professor Kellert conflict with one another; how can we resolve this? If we think in terms of use values, our coastal seas have three uses — as sewers, as liquid highways and as

potential oil and gas exploration areas — none of which depends upon keeping the water clean. Therefore we must have other, primarily non-economic, reasons to want to preserve our seas.

We need to understand the distinction between “nature,” which we value for its own sake, and “environment,” which consists of natural resources having instrumental value. We often think of transient objects as valuable for their utility, and when we have used them up, we throw them out. But we value permanent objects for the cultural heritage they represent, precisely because they are invaluable (that is, have no value). This is true of antiques and whales as well as places. We need to remember that places are continually created, not merely restored. We need to discover how to join place and economy so that we may save nature while we use the environment sustainably.

### ■ Managing the Unmanageable

*Michael Thompson (UK)*

Is money spent by one nation to clean up another one aid or trade? It may, as in the case of Sweden and Poland, begin as aid, and become trade as conditions improve. This example points to the complexities of the social systems which underlie environmental policy making, complexities which Newtonian science often ignores. We must construct a new approach to problem solving, to reach the four basic types of environmental attitudes. These are: (1) individualists who consider nature robust and benign, (2) fatalists for whom nature is capricious and thus accept whatever occurs, (3) hierarchists who find nature perverse and full of surprise, and (4) egalitarians who view nature as fragile and in need of our protection. People with these attitudes can find evidence to support their view of nature, but each view will yield different predictions, and thus there will always be a group surprised by what actually occurs in the world.

## ETHICS OF INTEGRITY AND THE ECOSYSTEM APPROACH

*Laura Westra, Chair (Canada)*

### ■ The Concept of Landscape Integrity in Everglades Restoration Efforts

*Robert Ulanowicz (USA)*

Efforts to encourage the recovery of the wood stork, an endangered species native to the Florida Everglades, highlight that entire landscapes need to be kept intact if species which use more than one subset of an ecosystem are to survive. Wood storks depend on intermittent wetlands overlaying karst (thus enabling prey species to find underground refugia during the dry season) for food during much of the year. During the dry season they switch to wetlands which normally are flooded too deep for them to forage. As the water regime of the Everglades has been altered by man, the intermittent wetlands have been drained or remain dryer for longer periods, while the deep sloughs often are dry for part of the year as well. This has led to a decline in the availability of prey, and thus fewer stork chicks are fledged. Clearly, both types of wetlands need protection if the wood stork is to recover.

### ■ Integrity and Fragility: Human Values and the Material System

*Timothy F. H. Allen (USA)*

Observers with preconceived values define the structure of that which they observe, and because some things do not fit into this observational framework, they are, in effect, not seen. The observer has a responsibility to pick a relevant observational frame-



work, that is, to look for the relevant aspect, or subsystem, of an ecosystem. The choice of scale of observation is of utmost importance as well. Sustainability and integrity do not matter until people become part of a specific ecosystem, because people usually remove the environmental context and replace it with a human one. The resulting systems are fragile and rather simple, and although they may seem sustainable, given a long enough time frame they are unsustainable, as history clearly shows. Early agricultural societies, such as the Sumerians, are a good example of this.

### ■ Thermodynamics and Ecosystem Development

*James J. Kay (Canada)*

Ecosystems are dissipative structures which arise out of complexity. Ecosystem health is defined as the ecosystem's ability to maintain its level of organization and persist through time. In response to change, ecosystems may not alter at all, or may backtrack and then regain a previous level of organization, collapse, or decline to a lower level of complexity. All of these changes represent a loss of integrity.

Complex systems are nonlinear, hierarchical, have multiple steady states, may not be stable, and possess internal causality. Ecosystem health includes maintaining the capacity to respond to future perturbations (hence the importance of diversity). For these reasons and others, current reductionist and mechanistic approaches to ecosystem policy are inadequate. Society cannot manage ecosystems — it can only manage its own interaction with ecosystems, and science cannot substitute for ethical judgment.

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## UNDERSTANDING REGIONAL ENCLOSED SEAS

*Rafal Serafin, Chair (Poland)*

### ■ Systems Approaches to Coastal Zone Management in Bali, Indonesia

*Drew Knight (Canada)*

Coastal Bali's complex mosaic of ecosystem types supports diverse economic activities without the benefit of an overall unified management scheme. This has led to conflicting mandates between user groups and to widespread environmental deterioration. The Bali Sustainable Development Project was created to enhance growth, stability and equity on the island through an appropriate balance among its major economic sectors of agriculture, tourism and small-scale business. The first five-year planning cycle runs from 1994 to 1999.

A systems approach uses scoping techniques such as roundtables and workshops to identify targets for development, followed by modeling and integrated resource surveys (using GIS, remote sensing and applied social and biotic surveys) to produce an integrated resource management framework. This framework includes marine parks and protected areas, biosphere reserves, coastal area management planning, redevelopment and restoration, linked management and both top-down and bottom-up planning.

### ■ Ecosystem Management in Java, the Baltic Sea and the Great Lakes

*Patrick Lawrence (Canada)*

The management of enclosed seas calls for a human ecological approach based on principles of coastal ecosystem management

over entire watersheds. The ABC Resource Survey method consists of remote sensing paired with ground surveys to collect, synthesize and interpret information in order to identify key issues and areas of concern for future conservation and development measures. A review of this method in three case studies — the Segara Anakan estuary in Java, Indonesia; Ustka, along Poland's Baltic coast; and the shore of Long Point, Lake Erie — revealed the range of potential difficulties and challenges of information gaps, poor data quality, lack of effective monitoring, uncoordinated management arrangements, and inconsistent enforcement of land-use policies which can occur under a mosaic of institutional and management arrangements. ABC Surveys take two years on average and cost roughly \$50,000. Their recommendations are fairly general, but they are based on sustainable development and conservation along with increased communication and education about coastal ecosystems.

### ■ Managing Enclosed Coastal Water Bodies and International Information Exchange

*Jens Sorensen (USA)*

Enclosed Coastal Water Bodies (ECWB) include everything from seas down to canals and salt ponds. Along with small island states and "mega deltas" they are systems which need concentrated management efforts to provide organized training programs which are replicable anywhere, and to create and share an international information exchange network (initially a database and newsletter). An interactive database for managing ECWB could consist of discrete modules including: the type of ECWB and its system processes, planning methodologies, implementation strategies, issues that motivate program creation, governance arrangements, stakeholder involvement, and monitoring and evaluation methods. If such an exchange is to occur, we need to standardize and adopt a common framework, as well as a format for the fields of data to include in the program.

## SCIENTIFIC COMMUNITIES AND THEIR CONTRIBUTION TO POLICY

*Donald F. Boesch, Chair (USA)*

### ■ The Enhancement of Scientific Knowledge of the North Sea Through the North Sea Task Force

*Jean-Paul Ducrottoy (UK)*

The objective of the North Sea Task Force was to carry out work in a reasonable time frame leading to dependable, comprehensive statements about the physical and ecological conditions and effects of human activities in the North Sea. It accomplished this through: (1) coordination of sub-regional level modeling, and publication of Quality Status Reports for the monitoring master plan, (2) the creation of a North Sea database and bibliography, and (3) coordinated field studies on the impact of fishing, protection of endangered species and the development of a warning system for serious pollution. Following several years of activity, the group was successful to a large extent, but the Paris Conference has ended the regional approach as impracticable.

### ■ Scientific Communities and Multiple Paths to Environmental Management

*Peter M. Haas (USA) (presented for Peter Haas by Stacy VanDeveer)*

There are two different models of international environmental cooperation evident in the North and Baltic Seas on the one hand, and the Mediterranean Sea on the other. A neoliberal institutional model fits the former two seas, and an epistemically-informed bar-

gaining model fits the latter. The models vary in their expectations about stimuli to collective action, the role of consensual knowledge in international cooperation, the extent of learning likely to occur, and in the scope and strength of the jointly developed regime.

Since behavior patterns vary due to a region's political characteristics, without the involvement of an epistemic community efforts are likely to be driven by domestic politics. Actions of epistemic communities will follow well-publicized disasters, since this permits normal bureaucratic channels to be sidestepped, and governments are likely to impose demanding changes for industry if there is powerful domestic support for environmental protection. Without such support, collective efforts will simply confirm status quo measures. With epistemic community involvement, policy styles will be more technical, and are likely to endure longer and be more economically efficient, although they may be less easily enforced.

### ■ **Compelling Knowledge: What Makes Science Useful to Policy?**

*Shiela Jasanoff (USA)*

How does scientific knowledge contribute to public policy? One view is that politics always takes precedence over science. Another viewpoint has scientific knowledge swaying political action. But where does the power of science come from? There is considerable evidence that when science is aligned with policy there are cultural factors which may play significant roles in the knowledge of power. In order to influence public policy, science needs to acquire moral as well as cognitive authority. But when issues are not tied to a rescue and an associated institution, it becomes more difficult for scientists to take sides on an issue. The resource itself may give authority to those who claim to know it best. Scientists, in this context, become the guardians of local knowledge of the resource, and gain a kind of custodial right to speak compellingly on its behalf.

It is possible to be an advocate of a cause and still maintain the objectivity of a scientist, but the political, cultural and social contexts in which scientific information is presented can have a profound effect on how information is regarded or acted upon. Policy will be made more often where scientists give results that resonate with the types of knowledge that are already accepted and founded on moral precepts and the conventional wisdom of the public.

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## IS ECOLOGY A BASIS FOR ACTION?

*Timothy F. H. Allen, Chair*

### ■ The Role of Conservation Biology in Managing Marine Biodiversity

*Daniel S. Simberloff (USA)*

Global management theory is not ecologically adequate. Rules from conservation biology, such as the 50-500 law (50 individuals are needed at a minimum to prevent inbreeding depression, and 500 to prevent genetic drift) and island biogeography theory, have led to the abandonment of several functioning refuges which did not conform to these rules. In addition, the theory of corridor linkages between refuges will probably fail, since the corridors are not actually adequate for the needs of species expected to use them. There is no evidence that core and buffer areas work. Minimum viable population sizes may be calculated, but then unprotected habitat may be altered so that it cannot support the calculated optimal population. Invasions by exotic species are widespread in the marine environment; they're just hidden from our view and can conveniently be forgotten, since we have no useful theory to predict which ones will cause problems.

Ecosystem management, sustainable development and multiple-use are givens in the policy arena, but they are merely hypotheses in science. The null hypothesis, for example, "what policy would maintain the present species richness and diversity, while fostering ecotourism in coral reefs" is never asked; instead policy makers ask "what is the smallest area you need to protect in order to maintain both some diversity and some tourism?" In such cases, one can not have highly diverse coral reef, and ecotourism too.

### ■ There Is No Science-Free Management

*Stuart L. Pimm (USA)*

Managers can play a role in endangered species protection, but they need advice from ecologists. Yet there are three problems with ecology's contribution to this issue: (1) there is an inherent limitation on predictability in chaotic systems, and the long-term is necessarily less knowable than the short-term, (2) even if societies behave in a linear fashion, indirect effects of ecosystem perturbations frequently overwhelm direct effects, and (3) the scale of ecological studies tends to be too brief in time and too small in space, whereas the needs of conservation biology are for understanding long-term viability over large areas. As the science of ecology improves, so will management policies, but at present academic ecology often funds small-scale ecological studies that do not necessarily fit real-world management needs.

### ■ Making Environmental Policy in the Face of Scientific Uncertainty

*Robert J. Wilder (USA)*

Good science legislation has gone by the wayside as political issues such as jobs and energy have taken precedence. The role of science in policy formation needs to increase, yet as legislators look to scientists for support, the latter are reluctant to enter the political arena for fear of losing credibility. Scientists need to adopt a

more adversarial attitude and be less objective. The present trends in policy formation are that as the environmental movement gains further legitimacy, we will become even more protective of coastal ecosystems, and require even more information about them. In the end, the issues of biodiversity and ecosystem processes will trump any political considerations.

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## FEASIBILITY OF ECOSYSTEM RESTORATION

*Stuart L. Pimm, Chair (USA)*

For many habitats, we have no alternative to restoration, but while the pieces may all be there, instructions are missing. One must decide for each site what the goal of the restoration is — is it to maximize biological diversity, protect a specific endangered species, or achieve a greater measure of ecosystem function?

### ■ **Ecosystem Restoration: Is the Goal to Recover the Garden of Eden?**

*Robert H. Nelson (USA)*

Can we say what restoration means operationally and whether it is desirable? Can it be justified on anything other than theological principles? Restoration often takes the "original state" of the area in question as its goal, but what is that state — what the area looked like 5, 50 or 500 years ago? We restore to a state for which we have data. The idea is not operational, nor is intrinsic value at play, since the transformational value from some human value system is always involved. This recalls the religious inspiration of nature felt by most people, whereby we must recover the natural condition of the paradisaical garden. In short, the justification for restoration is not an operational concept but a poetic, theological one.



## ■ Does an Ounce of Prevention Equal a Pound of Cure?

*James Thomas (USA)*

Three terms are often confused: protection of sites which now exist, preservation through management of desired functions, and restoration to pre-disturbance conditions at a specific site. Can we afford not to consider restoration because we are losing habitats rapidly? Is it feasible? We had better ensure that it is.

Natural recovery of systems is possible. If a system fails, then we have to discuss other options such as restoration of the habitat to allow species to move back into an area. We are, however, still at a trial-and-error stage in enhancing restoration and deciding how to intervene in ways that are as natural as possible. There is still too little monitoring of restored areas, and habitat restoration is still too site-specific — rather than, for example, addressing entire watersheds. Clearly larger areas are harder to restore than smaller ones, but our goal should be to restore all the way up the watershed, not just in one pond or slough.

## ■ Measuring the Value of Restored Coastal Ecosystems

*Richard F. Ambrose (USA)*

What is the value of lost habitat compared to restored habitat? We need to measure values of lost habitat (by measuring a comparable area if there are no pre-disturbance records from the area in question) and compare that to what we now have. Neither the U.S. Army Corps of Engineers nor the U.S. Fish and Wildlife Service's wetland restoration parameters are comprehensive enough. "Value" means relative worth, utility or importance; it is the capacity to satisfy some need or desire. Thus ecological value means the capacity to satisfy the needs (i.e., critical ecosystem functions) of the ecosystem. Several examples of these include support of fish,

plants, insects, invertebrates, community structure and strategic linkage to other ecosystems.

This value would best be described by a number — a ratio of ecosystem function before the restoration to that after the restoration. This would provide a currency which can be compared from one ecosystem to another, clearly for policy and management use alone. The higher the ratio the greater the level of success achieved. The focus should be on ecosystem function and valuation which can be used as a framework for measuring success of a restoration project. Certain ecosystem functions are sure to change over the course of a restoration, but similar functions are found in less complicated ecosystems and recent restorations.

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## HOW TO DEFINE MANAGEMENT GOALS

*Lynton K. Caldwell, Chair (USA)*

### Open Discussion Session

We have heard about commissions, coalitions, recommendations, scientific research and the like, but where are the results? In spite of all the good intentions, we still hear reports of degradation and disaster. Has little really changed, or is it simply too early to see results? Is our real goal simply to manage pollution and to find compromises between conflicting users?

Time and again, the failure of implementation appears to occur at the institutional level. Management goals, however defined, do not rise above the least common political denominator. Governments almost everywhere seem to say that reforms are necessary to save our seas, and that they intend to honor agreements to that end; yet funds are not appropriated and needed institutional ar-

rangements are not created. Territorial sovereignty is still the law of nations.

Yet there are rays of hope. The environmental movement is only thirty years old; better information will be increasingly available in future. It takes time to develop appropriate research methods and goals. We have considerable information even now, although it is not yet fully accessible. Many experiments are underway, which cannot yet be evaluated.

Laura Westra mentioned that we need an ecosystem approach; we need to achieve ecosystem integrity. Mark Sagoff questioned whether science or politics ought to set the goals. As Peter Thacher reminded participants, we have found that goals must be quantifiable, reviewable, and based on popular participation. An ecosystem approach per se is not always the best way to achieve goals. Further, it is important to move quickly while an issue is on the public agenda and before it flags. Robert Wilder countered that there are windows of opportunity for quantifiable goals, but that an ecosystem approach is a necessary framework. The will of the community should drive decision making, but the public needs help to clarify its own goals.

# CITIZEN INVOLVEMENT

## INTRODUCTION

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**P**olicy may be influenced by science and implemented by resource management, but it begins with citizens, with their concerns, their choices, their determinations, their inspirations. One panelist quoted the American conservationist Aldo Leopold: "No important change in ethics was ever accomplished without an internal change in our intellectual emphasis, loyalties, affections and convictions." In this section panelists addressed the role of the media, especially as viewed from the perspective of citizen activists and others involved in environmental issues. They also explored the role of the humanities — for example, how writers are able to express widely felt emotions, teaching us the stories of places.

This section also examined the role of citizen committees, such as those that help to advise managers in the Chesapeake Bay region, and the role of nongovernmental organizations, including the extremely successful Chesapeake Bay Foundation. Also discussed are private sector initiatives, including the influence of the fishing industry (e.g., in Australia) and the variety of public interests in the coastal zone (e.g., in the Caspian Sea region).

In an effort to examine the connection between public awareness and decision making, panelists looked at the examples of the North Sea, the Gulf of Mexico, and the Northwest U.S. Panelists specifically addressed the need for accurate and reliable information, and one presenter addressed the role of citizen participation in a country such as Japan, with its traditionally hierarchical society. The role of public education also figured in this matrix of information delivery, and speakers addressed the need for changing environmental behavior and instilling an environmental ethic. The focus fell on the need to move from awareness to involvement, from knowledge to action.

## ROLE OF THE MEDIA

*Susan Stranahan, Chair (Philadelphia Inquirer, USA)*

*Frances Flanigan (Alliance for the Chesapeake Bay, USA)*

*Paul Levy (Massachusetts Institute of Technology, USA)*

*Bud Ward (Environmental Health Center, USA)*

This panel discussed the role of the media from the perspective of citizen activists who work with it. All agreed that scientific uncertainty and risk assessment in policy making are thorny issues, and that in order to avoid crisis situations and subsequent dramatic coverage, the press and the public need to be informed of issues from the beginning. This said, it is not the media's primary obligation to educate the public, but to inform it. The press does have an educational component, however, and should ensure that reporters and editors understand the scientific background of coastal issues. Citizen groups should recognize that their job is to provide information to both the public and the press. The press needs to be cultivated and informed of upcoming issues, while reporters aren't under deadline pressures. It is important to foster good working relationships with members of the local press.

The media sometimes loses perspective on issues. For example, some environmental issues of critical importance, such as the high levels of nutrients in eutrophied coastal waters, are not seen as headline news, while other issues receive heavy coverage when, in fact, they are not as serious a threat to the environment. Some questions concern values rather than scientific data, but they may not be presented that way. Misperceptions and misinformation are a constant worry, and in some nations, there may be pressure not to print environmental news. The creation of the International Federation of Environmental Journalists is a positive new development.

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## HUMANITIES AND COASTAL SYSTEMS

*Tom Horton, Chair (USA)*

One purpose of engaged writers is to tell us about the problems faced by our environment. At first glance this seems the purview of scientists alone, but writers can better express our emotional attachment and love for places. Writers make this love of the places where we live real. Wilderness may be spectacular, but human interest is bound to inhabited places, and the world's coastlines are remarkably inhabited. Cousteau made a distinction between instruction — learning how to do things — and education — learning how to behave. Writers can help us learn how to behave now that increased coastal development further stresses this fragile environment.

### ■ Imagining the Sea: From Science to Sensibility

*Robert Finch (USA)*

“No important change in ethics was ever accomplished without an internal change in our intellectual emphasis, loyalties, affections, and convictions,” wrote Aldo Leopold. And today, although we have seemingly infinite environmental information, we still treat the environment as we did earlier. The central question for nature writers is how we come to love the environment. Science and the arts are not adversaries — each can inform the other. For example, the marine biologists Rachel Carson and John Teal, and the nature writers William Warner and Henry Beston all wrote literary language incorporating science into narrative, and drew the reader into their world and their love of the sea and shore. Selections from the works of these four authors illustrate how writers can help us come to love the environment by “storying places.”

## ■ Music and the Sea

*Tom Goux (USA)*

Mr. Goux, a popular musician, sang six songs about the sea, from an early American whaling song to a modern song about our love of the whale. Singing songs about people and their relationship to the sea is another way to story places and foster our love for specific coastal areas through art and its emotional impact.

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## CHESAPEAKE BAY: ROLE OF THE CITIZEN

*Frances Flanigan, Chair (USA)*

*Timmerman Daugherty, Changing the Regulatory Culture (USA)*

Maryland's Department of the Environment is working to change its organizational culture to incorporate increased citizen input. Problem solving strategies are being developed through participation and avoidance of adversarial positioning. Negotiation requires stakeholders to distance themselves from entrenched positions, but combativeness has been woven into the regulatory and legal systems and it takes time to change them. Keeping in mind that the public includes the business community and environmentalists, as well as local community organizations, we try to involve broad-based participation to work towards pollution reduction goals. The public has a tremendous stake in environmental governance; providing all groups with a voice has never been more important.



## ■ We the People — the Maryland Coastal and Watershed Resources Advisory Committee

*Andy Meyer (USA)*

In 1976 the National Coastal Zone Management Act authorized the creation of the Coastal and Watershed Resources Advisory Committee in Maryland. Its 100 members include representatives from business, civic and conservation groups, universities, and federal, state, regional and local government agencies. Their task, mandated by law, is to advise the state on coastal issues including oil and gas leases, marina planning, ocean dumping, shore erosion, tributary water quality and nontidal wetlands management.

The Committee's strengths include its: (1) wide network of contacts, (2) informal way for government and citizens to meet, (3) information clearinghouse, (4) long-term approach, beyond what politicians can be expected to undertake, and (5) ability to keep issues on the political agenda. On the other hand, its weaknesses include: (1) inability to resolve issues due to the balanced nature of the group, (2) the long-term commitment required of members, (3) need for staff support, (4) difficulty of defining issues that can actually be resolved, (5) lack of perception by government agencies that the committee is a partner, (6) and the need to maintain the social aspect of meetings to foster networking.

## ■ Pennsylvania and the Chesapeake Bay Commission

*George Wolf (USA)*

Seven years ago the President of the Alliance for the Chesapeake Bay approached the agricultural sector in Pennsylvania to initiate education on the Bay's problems and how agriculture was related to those problems. The regulation of fertilizer and promotion of no-till farming did not begin to solve the problem of excess nutrients in tributaries; the real problem was the management of

animal waste. Pennsylvania worked to create a comprehensive nutrient management program for six years, and its law can now serve as a benchmark for the rest of the country because the farmers' committee takes responsibility for the legislation directly affecting agriculture.

Once agricultural by-products were seen as a resource rather than as waste, then feed companies, livestock breeders, agricultural clubs and farm equipment companies all began testing improved ways of reducing waste before it begins. Now, as the Chesapeake Bay Program continues to move up the watershed, we need to look beyond just agriculture. Domestic septic tanks, for example, are a major source of loading which have yet to be addressed.

### ■ “Save the Bay” — The Role of Non-Governmental Organizations

*Ann Powers (USA)*

The Chesapeake Bay Program has been a model of intersectoral cooperation, and one major player has been the Chesapeake Bay Foundation, which, with over 85,000 members, is one of the largest NGOs in the world. The issues involved in restoring the Bay are too complex for there to be clear-cut heroes and villains, but without careful attention citizens, here defined as all those who are not connected with any other organization, may be left out of the debate. Perhaps NIMBY (not in my back yard) is the purest form of democracy. The U.S. Resource Conservation and Recovery Act provided money for citizens to hire their own experts to ensure full citizen participation in cleaning up contaminated locations. Water Quality 2000 also brought all stakeholders together to define goals and how to achieve them, which ensured that everyone knew each other's positions. Legal standing is essential; without it citizens may not be taken seriously.

## PUBLIC STAKE IN GOVERNANCE

*Kathleen Ellett, Chair (USA)*

### ■ Achieving Results Through Private Sector Initiative

*Michael Eckhart (USA)*

The Chesapeake Bay has experienced a striking reduction in oyster harvests, and its benthos is degraded even compared to other unhealthy bays. Why should we care? Partially because it is our place in the world, and we want to feel good about it, and about its beauty. So, a central question becomes, how can we combine a clean, efficient cogeneration power plant with an ecological contribution to the Bay? One private sector initiative is the Clear Bay Project which would provide power to public utilities and to the Clear Bay Ecology Center, a not-for-profit hatchery and research center. The Center, in turn, would release oyster spat to the Bay, thus increasing the oyster population by 100%, resulting in improved water clarity.

It would cost \$12 million per year to undertake this plan, with half of the funds going to produce oyster spat. In addition to funding (which might come from government support as well), the public sector would need large measures of dedication, involvement, integrity and commitment to the public good to see the project through. The public has concerns, such as the use of consensus democracy, rigid committee structures, the consumption of scarce environmental funds by project infrastructure, and lack of belief in the feasibility of the project. To counter these concerns, the sponsors need to be bold and define their real goals.

### ■ Cook Inlet Regional Citizens Advisory Council

*Karl Pulliam (USA)*

The Exxon Valdez oil spill galvanized citizen action, yet surprisingly little of this action took place in Cook Inlet, Alaska. There are legally mandated citizen advisory councils, but only for oil pollution, not for any other industry. Emotions clouded initial cooperative efforts, and made listening difficult. It was found most effective to pick people with a stake in governance, and it seems that citizens can work in three arenas: with the federal government, with the state government, and with the oil industry. At the federal level one must keep in mind the immense distance — both geographically and mentally — between Washington D.C. and Alaska. There seems to be no effective way to fund monitoring locally. At the state level, districts have become more active, holding elected officials accountable. Citizens have the most effect at the industry level with “access agreements,” whereby board members have access to industry officials in order to voice their concerns.

### ■ Commercial Fishing Industry Makes a Stand on Australian Coastal Zone Issues

*Duncan Leadbitter (Australia)*

Following copious evidence of fish contamination, the commercial fishing industry founded an organization called Ocean Watch. The Australian coastal and estuarine areas have the highest species diversity and volume of catch, and, as elsewhere, such coastal areas are under agricultural and development pressures that lead to changes in both habitat and water quality. For example, mangrove forests have been drained and waters in such areas have become more acidic. Besides the economic loss due to declining yield, there is widespread public concern over the reputed contamination of fish, leading to lower public demand for this commodity.

Ocean Watch was set up in New South Wales in 1989 by a coalition of members of the fishing industry, wholesalers and the marketing authority to provide problem-specific information and advice to both the industry and the general public through seminars, the media, and political lobbying about environmental issues affecting the future of fishing. These efforts improve wider community support for improved coastal zone management.

### ■ Government as Guardian of the Public Trust

*W. Tayloe Murphy, Jr. (USA)*

Virginia Delegate Tayloe Murphy spoke about the dramatic change he has witnessed in his Chesapeake Bay state, and how this saddens us due to our attachment to the Bay and its history. The doctrine of the public trust holds that it is the government's duty to protect public resources, to manage them for the public now and in the future. It is time to put this doctrine to use, but the public cannot sit by and assume the government will fulfill its pledge. As the population of a region grows, so do conflicts, and two messages should be kept in mind. First, everything we do has a cost. We must look for the hidden costs of our actions, the costs in the future. What we are paying now are "old bills" with compound interest from past development. Second, the tragedy of the commons is a valid metaphor for coastal resources. If all individuals act to their personal advantage, they will collectively destroy the commons, the Bay. We are too numerous in number and activity to overlook the commons problem any longer.

The final comment of this session noted that there is tension between trying to get an arrangement from the government to achieve a stated objective, on the one hand, and making this effort accessible to citizens throughout the affected area, on the other.

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## COMPETING VALUES AND INTERESTS

*Sarah Chasis, Chair (USA)*

### ■ A Federal and State Perspective on Resolving Competing Uses in the Coastal Zone

*Trudy Coxe (USA)*

The public knows how to blame large polluters; it has yet to understand and take responsibility for its own small-scale actions. In Boston Harbor, for example, the construction of water treatment facilities which will result in cleaner water has also resulted in higher rates for homeowners. Was this financial burden equitably distributed? How clean must the water of Boston Harbor be to be "clean enough"?

Several aspects of coastal management need improvement. First, we need a clear vision of what we want our coastlines to be. Next, management decisions need to be made for entire watersheds. Third, the public and decision makers need to understand that transportation choices have an incredibly large impact on the aquatic environment. Fourth, the split between national and private funding needs to be reconsidered. For example, if the U.S. Army Corps of Engineers spends \$140 million for flood control projects, is it fair that private individuals do not generally pay for the purchase of flood insurance? Lastly, the paradoxical legal and regulatory impediments to alternative technologies need to be abolished so that the state can fulfill its mandate to link state expenditures to these technologies in order to solve environmental problems.

## ■ The Variety of Public Interests in the Coastal Environments of the Northern Caspian Sea

*Tatiana A. Glushko (Russia)*

Once there were two countries; now four former Soviet states, and Iran border the Caspian Sea. Following a decline in sea level during the first part of this century, the sea level has been rising since 1978 for unknown reasons. The rising waters have resulted in increased pollution, fisheries declines, and inundation of agricultural lands and nature reserves. The northernmost portion of the Caspian Sea is shallow and surrounded by low-lying lands, so it has been most affected by this change. A management plan is needed to remedy this situation; and it must include all the bordering nations, not only those on the northern shore which are currently most affected, if it is to be successful.

## ■ Stakeholders in Benin: Competing Values of Citizens and Private Interests

*Mathias K. Pofagi (Benin)*

The short coastline of Benin has undergone severe erosion in recent years, partly as a result of sand quarrying, and partly because of harbor construction in nearby countries, including Ghana, Nigeria and Togo. Benin's ports serve as shipping outlets for a large hinterland, including Burkina Faso, Mali and Niger. In addition, weak environmental practices in Benin and its neighbors may have harmed fisheries. Clearly, environmental problems do not respect the area's national boundaries. Furthermore, environmental concerns remain a relatively low priority compared to the provision of adequate food and water to the population. Benin has nevertheless created a Ministry of Environment, although it has been unable to fund it.

The panel concluded that both the natural and human sources of environmental stresses know no national boundaries. In addi-

tion, "media" boundaries (of land, water, and air) are more apparent than real: the coast is not land or water, but both, each affecting the other, and what happens deep inland can have effects far offshore. We all need to understand that the activities of our daily lives can, in the aggregate, stress the coastal environment as much as do single major point sources. Our governments need to find ways to encourage economically and culturally viable alternatives to our inadvertently harmful activities.

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## POLITICAL ACTION AND GOVERNANCE

*Lee A. Kimball, Chair (USA)*

The chair listed five areas of interest for the session: (1) public awareness of the nature and magnitude of actions, (2) the need for well-grounded information and analysis, (3) understanding of the political process and government mandates, (4) public resource limitations, and (5) the role of community, state, national and global leadership.

### ■ The North Sea

*Gerard Peet (The Netherlands)*

Although North Sea NGOs have participated in lobbying the government and educating the public, only recently have they achieved observer status in the policy process. How effective can they be if they cannot vote or make proposals? The answer is that they can indeed be effective, depending upon certain of their qualities. The primary one is the quality of the proposals put forth by the NGO, while a close runner-up is the quality of the individual members of the group. Other important factors include the group's



size, the quality of its information, and the achievement of something tangible.

In the North Sea case, public awareness of the problems of intensive, incompatible uses of the sea began in the 1970s. Germany took the lead to solve these issues with the first Ministerial Conference of 1984 and its use of the precautionary principle. The resulting North Sea Task Force held meetings in many of the member nations. Although there has not been a continuous progression, the NGO community has had its moments of participation in the process. At the second Ministerial Conference, the NGO community was well prepared and participated in the final report, and at the fourth Conference NGOs were permitted to read an opening statement. By mid-1993 they were allowed full observer status. This participation has led to playing a significant role in shaping international agreements, although the issue of enforcement needs further exploration.

### ■ A Business Council for Sustainable Development in the Gulf of Mexico

*Andrew Mangan (USA)*

The Business Council for Sustainable Development was established by a group of Mexican and U.S. corporate leaders to seek a balance between development and environmental protection in the Gulf of Mexico region. The group has held business group meetings, participated in negotiations for the North American Free Trade Agreement, worked with the U.S. Environmental Protection Agency's Gulf of Mexico Program, and sponsored the introduction of environmental bills in the U.S. Congress. It promotes sustainable development ventures and cooperation and exchange of new technologies, as well as technology transfer between developing and less developed countries. The group is not intended to be "the voice of industry" for the region, yet it intends to be a strong player in regional sustainable development.

### ■ Politics, Science and Public Participation in Estuarine Pest Management

*Michael E. Colby (USA)*

Willapa Bay in Washington State has very productive oyster beds, which are threatened by the spread of cord grass (*Spartina alterniflora*) introduced from the Chesapeake Bay. This plant could fill up all available habitat within the next 15 years, now that it has begun to reproduce sexually. Another problem species affecting the oyster beds include the endemic burrowing shrimp, whose populations have dramatically increased due to mismanagement of the salmon fishery and the timber industry. Local task forces with members from various stakeholder groups, government agencies and business leaders were set up to tackle each of these "pests." Their job is to communicate with local public groups and to write environmental impact assessments with the overriding goal of enhancing the diversity and productivity of the intertidal bay, and ensuring the continuance of the oyster fishery.

Ensuing discussion raised the following points: (1) few public groups avoid the dispute resolution process, (2) interest groups will not be considered in the policy process unless the issue is highly politicized, in which case coalition building is important, and (3) it would be useful to compare case studies with interest groups where leadership was present, versus where it was not.

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## CITIZENS AND INFORMATION: A CRITICAL INTERFACE

*Ann Pesiri Swanson, Chair (USA)*

### ■ Ignorance in a Sea of Knowledge

*John D. Costlow (USA)*

For many years the policy community has raised questions regarding the ability of researchers, citizens and political leaders to communicate at the same level. A key point brought about by these questions is that science does not mean anything unless it can be communicated to lay people and political leaders in a format which affords them a level of understanding. Much of this problem is due to our inability to synthesize raw data provided by scientists into "knowledge." Our societies possess a tremendous amount of data; however, the specialization of the sciences over the last three decades has meant that much of this data is not synthesized into facts, and thus gaps in our knowledge plague decision makers.

Additionally, there are gaps in the communications sequence between decision makers. At each step of the sequence "knowledge" is what needs to be communicated, not data. Consequently, new developments such as geographic information systems, which have the capability of visually synthesizing myriad bits of data, offer great promise to decision makers and the public to achieve greater understanding of the key problems our societies face.

### ■ Information for Environmental Decisions: the Public Necessity

*Mark B. Lapping (USA)*

Scientists are frustrated by the decision making process. There is no magic formula for providing the public with information, and decision making is a dynamic process in any case. Decision makers must understand what genuinely concerns people, and the policy process must be accessible to constituent groups. Such groups will invariably judge the policy process by their experience at open meetings, and any perceived failure to keep the public informed will lead to further antagonism. One of the key concepts that decision makers and scientists need to understand is that uncertainty must be acknowledged. The concept and level of uncertainty in a given scenario must be explained to the public, or conflicts will arise which may question the very basis of scientific information.

### ■ Citizen Responses to Development in the Seto Inland Sea Region

*Harvey A. Shapiro (Japan)*

Although citizen movements to protect coastal seas began roughly a quarter century ago, they did not catch on as quickly in Japan's historically authoritarian society, where democracy is still in its infancy, citizens feel a duty to obey authority, and there are no requirements for citizen participation. The Japanese had three options to protect the Seto Inland Sea: (1) not try at all and let nature take its course, (2) fight for compensation after environmental damages, and (3) organize direct action citizen movements. Between Scylla and Charybdis, they chose the straight and narrow course of direct action.

In summary, there were several findings in this panel. First, effective environmental decision making is a dynamic process involving constant communication and planning both from the top

down and the bottom up. Second, scientific data is not enough. The actual concerns of the populace must be identified and addressed. Third, active citizen involvement leads to greater understanding and more appropriate response to the array of available choices. Fourth, information, although temporal and ephemeral, must be available throughout the decision making process so that community concerns can be addressed at any time. Fifth, uncertainty must be acknowledged. Lastly, it is ultimately the public — not the government — which must decide what is acceptable.

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## HOW CAN ENVIRONMENTAL EDUCATION MAKE A DIFFERENCE?

*Gary Heath, Chair (USA)*

The major focus of environmental education these days should be behavior. We should be concentrating on the locus of control, success in behavior modification, teaching action skills for improved involvement, and environmental sensitivity. In order to shape behavioral change we must place greater emphasis on knowledge of the basic environmental content.

### ■ The Public School Perspective

*Karen Cifranick (USA)*

Cifranick uses the Hungerford and Volk model in her high school classes to emphasize local land use and wildlife problems. Students are encouraged to pick topics in those areas which interest them personally, to research their topic and then do something to help solve the perceived problem. Students are also taught to write grant proposals and raise funds to implement their solutions. Students end up contacting local leaders, ecologists and environ-

mentalists, and affecting their parents. In Maryland the effectiveness of this approach is reviewed by a state program, and it has been shown to match at all grade levels.

### ■ International Environmental Education

*Lundie Spence (USA)*

Spence, a Sea Grant educator in North Carolina, works with elementary to high school teachers, in the international marine debris project that is overseen by the International Center for Marine Conservation. This project is active on all those levels of education and community which instill in children a sense of the international scope of their own actions. The clean-up effort involves joining community-based activities and reporting data to the U.S. Environmental Protection Agency and the Coast Guard. This data is then compiled into an international publication.

### ■ What is the Role of Undergraduate Institutions in Environmental Education?

*Donald A. Munson (USA)*

Munson, a professor at Washington College, believes that environmental topics ought to be taught in all undergraduate disciplines. Science majors can be too detail oriented, and may fail to develop a philosophy and aesthetic of nature, while liberal arts majors frequently lack any scientific understanding of environmental and ecological issues. More multi-disciplinary classes taught between departments in a holistic fashion are needed. After information has been disseminated, instructors should encourage individual participation in environmental issues. Exposure to the issues, coupled with a true appreciation of the environment, will produce involved and concerned citizens and future civic leaders.

## DEVELOPING AND MAINTAINING CITIZEN STEWARDSHIP

*William C. Baker, Chair (USA)*

As we investigate and maintain citizen stewardship, we need to define it. One saying we often hear is "we have not inherited the earth from our parents, we hold it in trust for our grandchildren." Another analogy contrasts the earth as a hotel versus the earth as a campsite. In a hotel we do not concern ourselves with how the room gets clean; in a campsite our goal is to leave the site cleaner than we found it. Clearly to want to do this, we need to have a sense of place, a love for our land.

### ■ **Gulf of Maine Council on the Marine Environment**

*Melissa Waterman (USA)*

The Gulf of Maine Council was established in 1989 by the states of Maine, New Hampshire and Massachusetts, and the provinces of New Brunswick and Newfoundland when they convened to discuss a range of issues — the plight of marine mammals, the sublethal effects of pollution on fish and public health, habitat protection, and public education about just what exactly comprised the watershed of the Gulf of Maine. The Council has 15 members who developed a ten-year action plan for the Gulf, along with a water quality monitoring plan. There are several issue areas the council intends to address: (1) public education to link marine issues with the more encompassing ecosystem concept, (2) promotion of the name and image of the Gulf of Maine, and (3) legal and financial differences between NGOs in the U.S. and Canada. Political concerns about the future, and declining fisheries have dri-

ven the process, and citizen involvement is not particularly strong. Although Maine has a public school requirement for environmental education, the other states and provinces do not, and there is also disparity in funding for the program.

### ■ Developing Citizen Stewardship Through Environmental Education

*Donald R. Baugh (USA)*

Education is the key component for achieving behavioral change and for developing an environmental ethic, which is expressed not only in our actions, but in our feelings and thoughts as well. In order to know how things affect people in their own region, being outdoors is an important part of this education, as is instilling a sense of empowerment. The Chesapeake Bay Foundation's mission is precisely to make these connections, and it does this through the public and private school systems with teacher training, hands-on field experiences, and an in-classroom environmental curriculum based on local issues which develop critical thinking and decision-making skills. Almost forty thousand students and adults participate each year in Foundation learning experiences.

A sustainable environment can only be achieved by an environmentally educated public. Education such as that offered by the Foundation is critical to developing strong citizen support and ensuring that we have a broad environmental ethic instilled throughout our society over the next 50 to 100 years.

During the discussion period adult education was emphasized. Getting adults to participate in field work is an excellent tool to broaden their minds. When education and social engineering run into direct conflict, people tend to stick with what they already know. Knowledge is not necessarily action; educators face the challenge of trying to get individuals to think for themselves and have a real connection with an issue.



# GOVERNANCE

## INTRODUCTION

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**P**olicy makers, resource managers and scientists may use the same terms but will likely mean different things by them. In this section, participants offered new models for thinking about governance. Peter Brown offered one new paradigm, where people think less of "correcting market forces" and more of the "fiduciary duties" to the beneficiaries of the public trust, working to secure human rights and to protect the productivity of the biosphere. One speaker, Mitsuru Nakayama, described how such shifts in attitude are relevant in Japan.

Governance may be logistically and conceptually difficult in seas that cover large regions and different jurisdictions. Accordingly, panels examined the role of "Large Marine Ecosystems," defined as more than 200,000 square kilometers in size. Panelists discussed the difficulty of managing such large ecosystems, e.g., in the Northeastern U.S., in the Baltic, and in the Seto Inland Sea. One session focused on the Chesapeake Bay as a potential model for coastal seas governance, given its multi-state/federal partnership and its stated goals for reducing nutrients and toxic loads into the estuary. Still other sessions focused on "integrated coastal management" and on the challenge of multiple jurisdictions.

Panelists analyzed the United Nations Regional Seas Programme, UNCED, and specific cases in Poland, Italy, Russia, Sweden, the U.S. and elsewhere. A final session suggested that market forces can be used to address governance issues and to help bring about the mitigation of ecological losses in coastal seas.

## LEGAL ISSUES IN COASTAL SEAS GOVERNANCE

*Nobuo Kumamoto, Chair (Japan)*

### ■ State Legitimacy and Enclosed Coastal Seas

*Peter G. Brown (USA)*

Policy makers (generally with a legal background) and managers (with a scientific background) may use the same terminology of governance, but their definitions and degree of precision do not necessarily coincide. Neo-classical economics posits that it is the duty of governments to correct market failures, which are often caused by the inadequate valuation given to future costs/benefits (discounting) and the transaction costs/benefits not borne by those engaged in a market exchange (externalities). Contingent valuation techniques assume that all goods should be marketed, but many balk at "marketing" a clean environment, and say such techniques depend upon ordinary citizens, thus downplaying the role of scientific expertise. Another problem comes from the neo-classical paradigm's indifference to the scale of activity, or the effect of population growth on the demand curve.

A more promising approach to governance is that found in John Locke's *Second Treatise on Civil Government*. Briefly, those who govern have fiduciary duties to the beneficiaries of a public trust, including to (1) protect the biosphere's potential productivity (the stewardship compact), (2) secure human rights, (3) keep the values of citizens separate from those as consumers, and (4) keep markets efficient. Thus scientists who create policy can show that distribution according to merit is preferable to that determined by market forces alone.

## ■ Leasing and Licensing Policies in Coastal Marine Areas

*Paul Munro-Faure (UK)*

The value of coastal areas and the sea bed have risen due to increased demand, which appears unrelenting due to continued growth of economies and human population. At the same time environmental pressures have become more evident. These areas are largely owned and managed by national governments who lease them to tenants/users, and thus there is an inherent conflict between the state's duty to regulate and price resource allocation, and its position as landlord of the area being regulated. This complicates the market valuation of coastal areas, and thus the equitable development of such areas.

In the example of Bulgaria and its coastline on the Black Sea, there is an added difficulty of an economy in transition to market orientation in a new democracy. Bulgaria feels pressure for private coastal development, partially alleviated by the Odessa Declaration, which provides policy guidance in integrated coastal zone management (ICZM) to Black Sea riparian states. Utilizing ICZM, it is anticipated that growth will occur, but with minimal damage, and that rent will be charged in order to avoid the problem of the commons, thus ensuring the future of the resource.

## ■ Environmental Rights in Japan

*Mitsuru Nakayama (Japan)*

In Japan the different users of the seas are often in conflict: factories wish to discharge effluent where fishermen wish to pursue their catch; transport engineers wish to build bridges on promontories where citizens have traditionally enjoyed the beautiful natural vista. Until now these conflicts have generally been won by development interests rather than environmental interests, as is borne out by the issuance of government permits for such developments.

In order to correct this imbalance, it should be understood that the coastline is land held in the public trust, and that there are specific constraints and responsibilities on the government (trustee) in undertaking development. To this end, the environmental rights of citizens must be developed in Japan. This concept specifies that every citizen has a right to a high-quality environment, including healthful and beautiful natural areas, water, air and land. Changes in the environment from such conditions would need to permit citizen access to the planning process, so that competing values and interests would all be fairly represented.

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## MANAGEMENT OF LARGE MARINE ECOSYSTEMS

*Kenneth Sherman, Chair (USA)*

### ■ A Regional Approach to Marine Resources Management

*Lewis M. Alexander (USA)*

Large Marine Ecosystems (LME) are defined as over 200,000 km<sup>2</sup> in area and have unique bathymetry, hydrography and productivity characteristics. Of the 49 LME worldwide, nine are in North America. The Global Environment Facility now has LME programs in the Yellow Sea and the Gulf of Guinea. LME fisheries systems can be affected by natural perturbations, pollution, predation or overfishing, and the management objective of LME is to maintain a stable or increasing biomass of fish by mitigating these negative effects. The relative importance of fisheries to national economies, and their perceived link to ecosystem health, motivates a nation's willingness to manage LME both at home and within international programs.

## ■ Overcoming Sectorization: An Obstacle in Mitigation of Stress in LME

*Danny L. Elder (Switzerland)*

The seas have traditionally been an open access resource, a suitable course when population pressure and fishing technologies were both low. Eleven international marine conventions now focus on pollution, dating back to the 1972 Stockholm Conference on the Human Environment. Twenty years later overfishing and loss or alteration of habitat are pressing concerns, and they must be addressed in a proactive fashion. Work to alleviate stresses to LME must be a continual process: drafting a coastal zone management plan is not enough — it must be updated to reflect current progress and problems. Following UNCED's Agenda 21, Chapter 17, coastal states are now anticipated to develop and implement coastal zone management plans by the year 2000. Yet fish stocks and many LME do not respect political boundaries. Once we realize that there is no public other than all affected actors, we should be able to work together across national and disciplinary boundaries to improve implementation and refinement of management plans for LME.

## ■ Quantifying Contaminated Loadings into the Northeast LME

*Norbert A. Jaworski (USA)*

The watersheds of the Northeast Shelf LME encompass an area of 478,000 km<sup>2</sup> and support a population of about 55 million people. It has been possible to quantify the loading for total organic nutrients and heavy metals from point and nonpoint sources for the five drainage basins comprising the region. The observed amounts are comparable in scale to those of the Rhine River in Europe, except that European primary treatment plants do not re-

move as much heavy metal. The quality of this data clearly shows that watersheds are important to LME health.

Discussion touched upon several important points: (1) Differential reproduction of elasmobranch (e.g., shark and ray) and gadoid (e.g., bony) fish species plus high harvesting rates of the latter have led to their economic extinction. If we increased fishing pressure on elasmobranch species, would gadoids increase? (2) If we look at LME from the viewpoint of the catchment area, and ask what elements are manageable, it is clear that only people, not ecosystems, are manageable. (3) Monitoring protocols need to be uniform in order to compare studies from one LME to another.

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## MODELS AS TOOLS FOR MANAGEMENT AND DECISION MAKING

*Bengt-Owe Jansson, Chair (Sweden)*

The 1970s have been called the golden age of modeling, while in the 1980s we moved from quantification to qualification. In the 1990s are models still useful to explain scientific knowledge to managers, politicians and the public?

### ■ Nutrient Load and Trophic Status of the Gulf of Riga, Baltic Sea

*Andrew Andrushaitis (Latvia)*

The Gulf of Riga is a good system for model trials due to its limited hydrology. It is shallow, has poor exchange with the Atlantic Ocean and exhibits a seasonal thermocline. The Gulf is highly productive compared to elsewhere in the Baltic, but nitrogen and phosphorus inputs have increased so that there are clear

indications of eutrophication, including deteriorating recreational conditions, herring decline, change in plankton and benthic meiofauna composition and intense summer blooms of cyanobacteria. The entire watershed must work to reduce both nitrogen and phosphorus simultaneously or negative perturbations may affect the entire system.

### ■ Possibilities of Reducing Nutrients Through the Support of Models

*Herwig Lehmann (Germany)*

Using the River Vechte, a tributary of the IJsselmeer section of the North Sea, as a case study, the river's nutrient and heavy metal load was estimated using different potential treatment models for the entire watershed. This area was divided into four water agencies across two nations which were monitored biweekly for several years. Land use and soil information was collected for the investigation area, along with surface and groundwater data. Nitrogen was found to be primarily from nonpoint sources, while phosphorus varied, but was mainly from point sources.

Useful results of the model include identification of relatively small areas responsible for large nutrient concentrations, simulations of land-use type based on actual data and designation of target level reductions for different land-uses which then can be monitored.

### ■ Management of Seto Inland Sea Using a Long-Term Simulation Model

*Masao Ukita (Japan)*

This nutrient load model divides the Seto Inland Sea into eight sections, each with two water and two sediment layers. Phosphorus movement in the upper sediment layer has been monitored for thirty years, and dissolved oxygen and chemical oxygen demand



simulations are undertaken. The model can be combined with fishery statistics, results of user surveys, and economics to provide information such as the chemical oxygen demand level for greatest fish catch biomass, and the relationship between chemical oxygen demand, nitrogen and phosphorus which should be maintained as they decline for maximum benefits to be achieved. This, in turn, will aid in abatement cost projections, comparing the efficiency per unit effort expended, and thus help in the essential step of setting goals.

### ■ The Gulf of Maine RMRP: Moving toward Ecosystem Simulation and Prediction

*David W. Townsend (USA)*

The U.S. Congress mandated the Regional Marine Research Program (RMRP) in 1991 to undertake planning and research to safeguard water quality and ecosystem health along the coasts. The regions are based on ecosystem boundaries, and provide for high-quality science in coordination with regional management authorities. The Gulf of Maine RMRP's ten-year goals include simulating all known ecosystem functions and modeling them under normal and various stress conditions. Specific projects follow the transit times and paths of chemical inputs, for example, and utilize previous data as well as advanced technologies. These modeling activities not only integrate many research approaches and provide an overall perspective, they reinforce the idea of community, and help show the roles that science, management and the public can all play in formulating and solving coastal sea problems.

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## CHESAPEAKE BAY: A MODEL FOR COASTAL SEAS GOVERNANCE?

*William S. Burns, Chair (USA)*

### ■ Controlling Eutrophication in the Chesapeake Bay: What Are the Options and Costs?

*Arthur J. Butt (USA)*

The Chesapeake Bay is a long shallow estuary with a 166,000 km<sup>2</sup> watershed which is balanced between urban and rural land-use and covers parts of several states. It is stressed by toxic inputs, and by nutrients which have led to hypoxic or anoxic conditions in the lower strata during summer. There are two ways of solving the problem of nutrient enrichment: "bottom-up" and "top-down." The bottom-up approach controls nutrients at their source, including both point sources (sewage plants, agricultural processing plants) and nonpoint sources (farms, storm water runoff). The top-down approach begins with the consumers of the nutrients — fish and shellfish — to utilize or absorb more of the nutrients, as would occur with the re-establishment of filter-feeding oysters.

Over the last decade \$186 million has been spent on the Bay to control nutrients, compared to \$29 million for top-down management. The oyster program has not been particularly effective to date, and new approaches such as reefs, sanctuaries and aquaculture are needed to encourage oyster production. A balance must be met between top-down and bottom-up management in order to clean the Bay.

### ■ The Chesapeake Bay Program: Can it Help Save Your Bay?

*Michael Hirshfield (USA)*

The Chesapeake Bay Program is comprised of representatives from all the Bay-area states, the District of Columbia and the federal government. It was created following the 1983 Chesapeake Bay Agreement with the intent of formulating objectives beyond those of the U.S. Clean Water Act. The Program is consensus-based, and has a modest budget. Its only quantitative commitment is to reduce nutrients by 40 percent by the year 2000, but the monitoring, fisheries management plans, and toxics reduction strategies are equally far reaching.

The major strength of the Program is that with consensus between state actors, low funding achieves significant objectives. On balance, however, there may not always be consensus, and enforcement and accountability are weak, especially due to the large number of separate committees. Currently the Program is attempting to institutionalize certain of its goals and define appropriate methods of ecosystem-wide management.

### ■ Integrated Coastal Management (ICM) and the New Governance: Who's on First?

*Jerry R. Schubel (USA)*

ICM is experiencing a renaissance due to the impetus towards sustainable development, and increases in the scientific understanding and modeling of coastal systems. ICM works through a goal-oriented approach, after surveying an entire water body and all parameters which influence it. It is driven by environmental quality issues rather than by technological ability. The Chesapeake Bay Program is a test case of the ICM approach, and it will be interesting to see how well it achieves its stated objectives over the next decade.

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## THE CHALLENGE OF MULTIPLE JURISDICTIONS

*Biliana Cicin-Sain, Chair (USA)*

By definition many problems of coastal seas management involve multiple jurisdictions. Yet there have not been many analytical or comparative studies of the effectiveness of regional management mechanisms.

### ■ A Comparative Assessment of Regional International Programs to Control Land-Based Marine Pollution: the Baltic, Mediterranean and North Seas

*James M. Broadus (USA)*

A multidisciplinary team studied features of these three seas to identify factors influencing the effectiveness of their management. The Baltic Sea is an enclosed body with slow water exchange receiving pollutants mainly from Poland and Sweden. The 1974 Helsinki Convention regulates pollution control; there are major disparities between the economies to the north and south, but resources are concentrated to "hotspot" areas. The North Sea's waters exchange once every year or two and the circulation pattern carries pollutants from Great Britain to the European coast. The North East Atlantic Convention of 1978 is the major pollution regulation. The Mediterranean Sea is the largest of the three bodies, and it has a slow turnover rate and a north-south dichotomy. Major polluters are Egypt, Spain and Italy. UNEP's Mediterranean Action Plan is the major player in regulation.

Due to differences in hydrology and inputs, pollution control is least effective in the Baltic (which is in a crisis situation), moderately so in the North Sea, and most effective in the Mediterranean

Sea. However governance is most effective in the Baltic, and least effective in the Mediterranean. There are also similarities between the three seas: in almost case policy objectives are diffuse, while with each sea there are specific lead countries in enforcement.

### ■ The Baltic Region in Terms of International Relationships

*Stanislawa Bukowicka (Poland)*

The Baltic states consider theirs to be an open sea. For this reason political and economic considerations of cooperative management are of the utmost importance. However the global level is too broad, and the national level too narrow to achieve the objective of improving the conditions of the Baltic Sea. Management at the regional level is sorely needed. To this end, a new sort of international relationship is developing, alongside profound changes in many of the Baltic states. The Baltic's entire watershed ought to be included in any such efforts, for essential long-term ecological and economic health to be achieved.

### ■ The UN Regional Seas Programme: How Does It Measure Up?

*Michael A. Jacobson (USA)*

An evaluation of the UN Regional Seas Programme should be based on the achievement of program goals. At present there are twelve action plans, nine marine environmental conventions and twenty-one protocols, which can be taken as one measure of the Programme's success. One hundred thirty nations participate in the Programme, as do fifteen UN organizations and twelve other international organizations. Employing organizational process evaluations, as well as outcome evaluations, it can be seen that although numerous reports are drafted, monitoring and ex-post evaluation programs are inadequate, and thus documented environmental improvements are weak. Often the conventions do not address the

key problems faced by a regional sea, the protocols are too narrowly focused, or remain unratified, and funding remains inadequate.

Monitoring and evaluation would be useful for guiding future implementation, and outcome evaluations are critical to determining program success. Environmental assessments and management actions must be structured to provide outcome-related information, so that all successes and failures are documented.

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## NEW CONCEPTS IN COASTAL SEAS GOVERNANCE

*James M. Broadus, Chair (USA)*

### ■ The U.S. Approach to the Management of Enclosed Seas

*Robert W. Knecht (USA)*

The National Estuary Program currently is considering plans for the environmental management of twenty-three estuaries. The program for the Chesapeake Bay was the first to begin, and like the Chesapeake, Puget Sound, San Francisco Bay and Narragansett Bay also experienced serious declines in fisheries, loss of wetlands, reduced freshwater inflows, saline intrusion, increased population growth and nonpoint-source pollution, as well as the complexities of multiple jurisdictions. There are two main approaches to solving these problems: create a new management and regulatory body specifically for the enclosed sea; or bring together all existing management authorities into a voluntary transjurisdictional coalition.

An example of the first option is the San Francisco Bay Conservation and Development Commission, created 30 years ago by state legislation. An example of the second option is the multi-state Chesapeake Bay Program. Keys to the success of voluntary

associations include: (1) clearly articulated goals, (2) continued political support, (3) systematic monitoring programs, (4) NGOs with public support, (5) active scientific research, (6) incorporation of federal CZMPs, and (7) an effective data-sharing system. The main questions include: (1) will funding be forthcoming, (2) will individual agencies stay committed to programs, and (3) will the goals and programs last long enough to achieve all objectives?

### ■ Sustainable Development on Poland's Baltic Coast: The Case of Ustka

*Rafal Serafin (Poland)*

Poland has undergone impressive political and economic change since the 1989 revolution. Its 400 km coast is largely undeveloped, with industries concentrated in small coastal towns. The small harbor town of Ustka — a microcosm of the entire country — is used as a case study of coastal management in Poland. Now that planning is no longer centralized, how can the various stakeholders — the tourist industry, shipbuilders, the fishermen and fish processing industry to name a few — ensure that their actions do not infringe upon the uses others wish to make of the coast? Several ministries have jurisdiction over Ustka's various activities, which might compound the problem. Local people therefore have formed an association that meets on a regular basis to attempt to resolve issues of property rights, conflicting mandates, and strengthening the local economy. Today, the town drives the future of coastal management in the area. In this context, how can an overall Baltic Europe coalition be devised?

### ■ Waste Prevention Audits of River Basins

*Boyce Thorne-Miller (USA)*

The precautionary principle states that if insufficient scientific evidence is available to make a policy conclusion, then policy ought

to err conservatively and take appropriate steps to prevent suspected harm. This principle was adopted in the London Convention of 1972, which banned incineration at sea and the dumping of low-level radioactive waste. Dredging at sea is still a problem, and the London Convention's new Waste Assessment Framework addresses it by mandating waste prevention audits which would: (1) identify hazardous substances in dredge spoil, (2) identify their sources, (3) analyze reduction methods, (4) undertake economic analysis of the problem, and (5) implement and monitor a waste reduction plan for each site. If dredge material is uncontaminated, it may be used for many purposes, but if it is contaminated it must first be cleaned. This can cause hardships to ports, which must dredge on an infrequent but regular basis to maintain channels. Thus, specific protocols such as river basin waste prevention audits need to be enacted.

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## CONCEPTS OF INTEGRATED MANAGEMENT

*William M. Eichbaum, Chair (USA)*

There are six major problems in coastal areas: (1) the environment is always complex, (2) human sources of disruption are also complex, (3) management systems are often weak, and always fragmented, (4) research support will continue to be limited, (5) there is a high degree of uncertainty about problems and their solutions, and (6) human population pressures on coastal resources will continue to increase.

This session will focus on a number of these problems, beginning with the concept of "sustainability."



### ■ Sustainable Development and Integrated Management of Enclosed and Semi-Enclosed Coastal Seas

*Biliana Cicin-Sain (USA)*

Among the numerous definitions of "sustainable development" current today, many promote equity and higher quality of life through environmentally appropriate development. As for "integrated management," there are five ways management can be integrated when referring to coasts: (1) among industrial sectors, (2) over the land/water interface, (3) among levels of government within a nation, (4) between nations, and (5) among disciplines. As specified in UNCED Agenda 21, Chapter 17, coastal zone management should be considered a holistic approach.

To implement integrated coastal management, we need to ask what is to be managed, what functions are included, who should perform these functions, which social and cultural values are to be considered, and what this means in terms of a continuous, dynamic decision-making process. Of course, not every interaction between different sectors is problematic and in need of management, but this conceptual framework needs to be synthesized and compared to tailor specific approaches to a particular effort. In the case of the Mediterranean Sea, where countries have agreed to protocols on numerous topics, sustainable development through integrated management may be difficult to achieve.

### ■ The Prospects for a Baltic Europe: The View from Poland

*Rafal Serafin (Poland)*

Management and research on the Baltic Sea have been underway for twenty years with multilateral cooperation. However, the region still needs much more research on aspects of the ecological system and how to improve the management system. Furthermore,

Poland — the main polluter of the Baltic Sea — has not yet been involved in regional management. The Baltic Sea Joint Comprehensive Program aims to assess national management programs, and plan for future actions. Assessment of effectiveness can be achieved by observing key variables and trends.

Earlier, there was no political commitment by the Polish government to join research in the Baltic area due to political constraints. In addition, there was contextual fragmentation and an inability to perform joint research, and problems were not clearly or properly defined. The renegotiated Helsinki Agreement now considers land-based as well as sea-based problems. Funding is a major issue, as Poland has very little foreign capital. The nation is not ready to join the European Union or NATO in the near future, and again, this limits funding capability. What is needed is a mechanism to integrate the institutions which already exist, along the lines of the Great Lakes Ecosystem Charter — to make the ecosystem the focus of concern. A “Baltic Europe Charter” could clarify existing symbols, guide future conduct and serve as a vision for the desired future.

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## COASTAL SEAS GOVERNANCE AFTER UNCED

*Peter S. Thacher, Chair (USA)*

### ■ Management of the Mediterranean from the Med Plan to Agenda 21 and Beyond

*Adalberto Vallega (Italy)*

UNEP's Mediterranean Action Plan (MAP) of 1976 is the basis for present governance of the Sea. The six Barcelona Convention Protocols aim to prevent pollution of the Sea from various sour-

ces, although the sixth convention, for the prevention of pollution by transboundary movements of hazardous wastes, is unlikely to be ratified. UNCED Agenda 21, Chapter 17 aims to encourage sustainable development and integrated coastal management with equity as an ethical goal, and thus, it requires changes in the Barcelona Convention and various of its Protocols. What should be done to force these changes?

MAP's Priority Action Plans need to be strengthened to address ecosystem integrity and economic efficiency. In terms of social equity, political freedom (especially for minority groups) should be guaranteed. Finally, a handbook for sustainable coastal management, and a database for the various programs are needed to increase MAP efficiency.

### ■ The Black Sea: An Environmental and Ecological Profile With a View Towards UNCED

*Frank J. Gable (USA)*

The Black Sea is the largest anoxic sea in the world, with roughly 90% of its volume devoid of oxygen. The Sea suffers from severe pollution from air, land and water, loss of biodiversity and reduced ecosystem function. The new Global Environmental Facility (GEF), created at the UNCED meeting, has a program for the Black Sea which was developed in response to a request by Turkey to the World Bank. It is a fundamental step towards regional management of the Sea, as it will provide baseline information for investments. Countries on their own cannot adequately address the scientific and management issues, and it is anticipated that GEF will facilitate communications between countries bordering the Sea, just as it helped in fostering the Convention on the Protection of the Black Sea Against Pollution, signed in July 1993 by six nations.

## ■ Caspian and Aral Seas: Present State and Management Problems

*Gnady Golubev (Russia)*

Sound environmental management of enclosed seas is not feasible unless watersheds and river systems are considered. This complicates management because such lands are under the sovereignty of differing nations. The Caspian and Aral Seas are under severe pressure. Water entering the Aral Sea has been severely curtailed due to irrigation extraction, leading to collapse of the fishing industry as waters receded and became saltier. The Caspian Sea, on the other hand, has risen two meters in the last 15 years. This also has led to economic losses, as coastal infrastructure were designed for the previous, lower shoreline. In both cases, there has been a loss of faith in scientific predictions, as neither outcome was anticipated.

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## ECOLOGICAL ECONOMICS AND MANAGEMENT DECISIONS

*Robert Costanza, Chair (USA)*

## ■ Ecosystem Approach to the Management and Restoration of the Great Lakes

*Anthony Friend (Canada)*

The Canadian-U.S. International Joint Commission, created by the 1909 Boundary Waters Treaty, was instrumental in incorporating an ecosystem approach in the Great Lakes Water Quality Agreement (GLWQA), last amended in 1987. From a socio-economic perspective, several suggestions have been successfully incorporated in the GLWQA, including: (1) weight of evidence

(precautionary principle) is sufficient to initiate remediation, (2) zero discharge of persistent toxics is the best policy to mandate, (3) state of the environment reports are useful for analyzing sustainable resource use and ecosystem health, (4) remedial action plans for restoration of specific areas can be successful if developed with full stakeholder participation, and (5) the concept of sustainable fisheries can alleviate competition between sport and commercial fishermen.

The GLWQA experience has shown that an institutional framework which transcends jurisdictional boundaries can indeed be established, and that an analytical framework to integrate economic activity within ecosystem functions and carrying capacity can be developed.

### ■ Shifts in the Ecological Economic Interface of the Baltic Sea Region

*AnnMari Jansson (Sweden)*

The assimilation capacity of the Baltic Sea was exceeded over a quarter century ago, and the situation has only deteriorated since then. In part this is due to a narrow focus on fisheries regulation (International Baltic Sea Fishery Commission) and pollution monitoring (Helsinki Commission). But these international conventions, which focus on the sea itself, cannot be an answer on their own. Improvement of the Baltic Sea's ecological conditions will come only from a major restructuring of the industrial production system in the entire Baltic watershed — from economic, technical and political change in every nation which affects the airshed and watershed of the Baltic. Ecological economics offers an approach to solving specific environmental problems in the region by reducing the scale of human activities to a level which the Baltic's assimilative capacity can absorb.

## ■ Using Market Forces to Manage the Ecology of Enclosed Coastal Seas

*Dennis M. King (USA)*

Nowhere have economic market forces been so powerful and resulted in more ecological disruptions than in coastal areas. Yet, with our increased knowledge, market forces can be used as a tool to manage coastal ecosystems, and as management's focus expands to cover entire ecosystems, the potential for such forces increases. The market system can, if it incorporates incentives, serve as a tool for making suitable allocations of scarce economic resources to meet competing ecological goals, and to reduce and distribute risk.

One clear area wherein the market system can contribute is that of mitigation measures to offset the loss of ecological features or functions of coastal seas. Past mitigation has been unsuccessful not due to any inadequacy of restoration science, but due to economic disincentives which restrained mitigation efforts and did not assist in making ecological choices. Private mitigation banks and fee-based mitigation systems may be ways to work with current economics to achieve environmental goals.



**SCIENCE AND RESEARCH**

## INTRODUCTION

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**I**n this section panelists address some of the major research questions facing coastal seas — such as the effects of over-nutritication on fishery health and abundance — and the connection between science and policy. A key issue is scale: panelists point to the importance of addressing an entire watershed when considering environmental processes connected with coastal seas. For studying the larval behavior of some organisms, however, such as oysters or other invertebrates, the relevant scale can range widely — from a few centimeters to hundreds of kilometers.

In these panels scientists raise important questions about the role of ecosystem models and the need for identifying key indicator species that will reveal changes in coastal sea health. Without such models and indicators, managers may expend large amounts of resources without noticeable effect. On the other hand, scientific information does not necessarily initiate adequate management actions. For example, Tom Malone estimates that in the case of the Chesapeake Bay, changes in management generally lag about ten years behind scientific findings. Often a major catastrophe or other event is needed to spur action.

Among the countries discussed in this section are Brazil, Sri Lanka, Sweden, Japan and the United States. Panelists discussed specific research programs and their effect on policy questions in relation to such issues as eutrophication, “red tide” algal blooms, changes in salinity and fresh water inflow, and conflicts between users — such as exist between herring fishermen and the petroleum industry in the North Sea.

In discussions many agreed that science is an essential part of setting wise management strategies, but that there must be appropriate and accessible ways for science to fit into management planning and decision making. And even with accessible science, some



complex challenges. This gets at the heart of the matter, since there was general agreement that to restore and protect coastal seas decisionmakers must address such underlying issues as population growth and the accompanying pressure on land use.

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## CHALLENGES TO SCIENCE: SCALE, SIZE AND COMPLEXITY

*Thomas C. Malone, Chair (USA)*

### ■ A Brief Review of Possible Effects of Anthropogenic Inputs to Fisheries of Coastal Marine Waters

*Andrew Bakun (Italy)*

Since considerable biological production occurs within coastal areas and inland seas it is important to classify these bodies of water. The Marine Catchment Basin (MCB) includes not only the water body but its entire watershed, and thus all sources of input. Concern with anthropogenic effects on marine systems should be channeled towards policy or management at the MCB scale. Problems such as eutrophication are caused by increased nutrient runoff and by increasing population pressure along coastlines. Physical oceanic processes, such as the Coriolis effect, may contribute to the concentration of pollution from riverine sources, depending upon the marine area's geography. Increased nutrients in MCB affect many different processes, cycles and food webs. From the perspective of fisheries, there are many crucial questions. What portion of this nutrient increase winds up in fish? What processes control this amount? Will it be possible to restore the productivity of fisheries in seas which have experienced collapse due to eutrophication?

## ■ Aligning Biological and Management Scales for Marine Conservation

*Patricia M. Mace (USA)*

When focusing on larval transport for the purpose of determining the proper size for coastal protected areas, there are three basic questions to address: (1) can the scales be estimated, (2) what are they, and (3) what are their implications for management strategies? Scientists don't know where many species of marine invertebrates live for certain stages of their life cycle. It is difficult to determine larval ranges, and many forms are at the mercy of currents. The scale of how long and where exactly larvae are in the plankton layer can be answered relatively well by current hydrodynamic models. The scales range from centimeters to hundreds of kilometers. Physical factors such as hydrodynamic patterns, winds, and tides are all important considerations in determining these scales.

Unfortunately, many management practices are issue-based rather than science-based, driven within political jurisdictions. Clearly nature doesn't operate within these dictates at all times, and the longest possible transport range should be considered for species range management considerations. In the ongoing debate over the optimum size of protected areas, it is clear that management scales are not in line with biological scales. Often these areas are not large enough, but as we have seen, there are also many issues other than size to consider.

## ■ When Ecology Doesn't Play Straight, How Can Responsibility and Cost Be Allocated?

*Frieda Taub (USA)*

Ecosystems may appear to be complex, but that is not all; systems often behave in counterintuitive fashion. Increased nutrients typically mean increased phytoplankton, but when nutrients are

not the limiting factor management becomes problematic: one can spend lots of money to reduce nutrients, and see no difference in the phytoplankton level. Seasonality plays a large role in the productivity of many systems, although the factors are multiple. In fact, subsystem behavior might not be sufficient to predict total system behavior. Our crucial question then becomes: what level of complexity should be used in our models? Are models ever realistic enough and can they really predict nature? Perhaps our goal should not be to mimic nature, but rather to mimic natural processes, since we need to develop methods of assessing modeling skill, so as to give managers confidence.

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## CHESAPEAKE BAY: THE ROLE OF SCIENCE

*Clifford W. Randall, Chair (USA)*

### ■ Turning the Chesapeake Bay Restoration Program towards a Focus on Results Using Environmental Indicators

*Kent Mountford (USA)*

Once management goals have been established, indicators must be identified which can be easily understood by managers and the public. The Chesapeake Bay Program's indicators package is an example of a successful monitoring scheme. It aims to release data in a timely fashion, cover the entire system, have a framework which mimics the system, and be visually interesting and readily understood by any interested party. The key steps to development of the package included: (1) hold a brainstorming session by a multi-disciplinary team to develop original ideas, (2) narrow field of priorities using an hierarchical system, such as that of the U.S.

Environmental Protection Agency, (3) turn raw data into information by selecting best indicators of system health, (4) define format for visual presentation, including tracks to gather data into meaningful groupings, rather than presenting data without any interpretation, (5) add quantifiable environmental restoration goals to data charts to provide context, and (6) update data charts and indicators constantly to improve accuracy and comprehension by the public.

Sample results of the Program's indicators package show that the program is ahead of its goals, waste water discharges are increasing faster than the population, forests are declining throughout the watershed, aquatic vegetation is increasing, oysters are decreasing dramatically, and crabs are beginning to decline.

### ■ Science and Management of Nutrient Loadings to Coastal Ecosystems

*Thomas C. Malone (USA)*

The results of the case study on nutrient loadings in the Chesapeake Bay reveal a relationship between research and management in coastal zone eutrophication. Comparison of chronologies over the 1965-1992 period reveals a lag of about 10 years between scientific discovery and management action and illustrates the significance of major environmental events and public involvement in overcoming management inertia. These lags appear to reflect factors ranging from poor definition of the problem and a lack of consensus within the scientific and management communities to the uncertainties inherent in the prediction of ecosystem behavior, the paucity of cost-effective and socially acceptable solutions, and polarization between the scientific and management communities.

Factors which helped overcome this inertia include major catastrophes, such as Hurricane Agnes (1972), and major events, such as the Chesapeake Bay Study (1977-1983), plus consensus building and economic incentives. Although new scientific information rarely initiates management action, the availability of objective, independent information is essential to effective environ-

mental management, and to the setting of policies that lead the way and make things happen.

## ■ What Science Can Do For Policy

*William M. Eichbaum (USA)*

It is not enough to know what scientists think about a subject to see changes in management and governance. Usually science does not have “the” answer; we accept this, since the goal of science is to search continually for truth, to point in the right direction. What is needed are mechanisms by which science can fit into the decision making process more effectively. Science provides a “tool box,” a knowledge set to understand a problem, and to monitor and evaluate it, but advocacy science is needed as well. Scientists should advocate for needed changes and actions, rather than passively provide data. Communication between scientists and policy makers is important; this cannot be stressed enough. Are monitoring results reaching managers effectively? Are we asking scientists to answer the right questions? We are certainly shirking the difficult questions, such as how we might modify land use and strengthen conservation efforts.

Subsequent discussion agreed that control efforts will fail unless land management and population control are effectively addressed. Regulations are based on what technology is economically acceptable rather than what is technologically achievable.

## EUTROPHICATION OF COASTAL SEAS

*Fredrik Wulff, Chair (Sweden)*

The effects of eutrophication on coastal seas can be manifest in many different ways, depending on the characteristics of the specific region. This is clearly illustrated in the following case studies. However, in order to develop a management strategy for these polluted systems it is necessary to understand the flows and processes that control concentrations and organic production. Extensive time series of monitoring data for nutrient budgets were used in all three case studies, as they are useful in the development and verification of dynamic eutrophication models and to set priorities for further scientific studies.

### ■ Plankton Responses to Nutrient Loads in the Tidal Fresh Potomac River Estuary

*Steven E. Bieber (USA)*

The upper Potomac River estuary has been affected by excessive nutrient loading, primarily from major point sources such as the Blue Plains waste water treatment plant. One persistent and significant water quality problem resulting from these highly eutrophic conditions was the occurrence of large cyanobacteria blooms, which were most likely the cause of both low dissolved oxygen levels and reductions in submerged aquatic vegetation in the estuary. Since 1988 there has been a drastic reduction in phosphorus loadings to the upper estuary. That year also marked the complete cessation of cyanobacteria blooms and a tenfold decline in total primary productivity. There is a clear correlation between phosphorus loadings and cyanobacterial biomass which is important for water quality management in this ecosystem.

## ■ A Fjord Model for Evaluating Measures Against Eutrophication

*Birger Bjerkgeng (Norway)*

A dynamic simulation model for deep fjords has been developed and adapted to the inner Oslo fjord, which receives sewage from about 800,000 Oslo metropolitan residents. Since 1984, chemical sewage treatment plants have removed 90-95% of the phosphorus input. The model divides the fjord both horizontally into basins, and vertically into layers. Phytoplankton is divided into diatoms and flagellates, both controlled by light, temperature, nitrogen and phosphorus, with the addition of silicate for diatoms. Other organisms along the food chain are included, as are empirical descriptions for particulate sinking and degradation under different oxygen regimes.

The model is driven by watershed runoff, weather, and deep sea influx. Various parameters can be changed to model the effects of nitrification and denitrification in treatment plants, or sewage discharge effects at different water layers. Although only approximate representations of the real system can be achieved, the model is useful to improve management decisions about nonlinear long-term effects of changes to the actual fjord system.

## ■ Transport and Budget of Nutrient Elements in Kastela Bay

*Ilija Vukadin (Croatia)*

Kastela Bay is a semi-enclosed coastal bay in the Adriatic Sea which behaves as a dilution basin due to industrial and urban freshwater inflow. Studies were undertaken of nutrient content, transport and cycles, and of hydrographic parameters. Exchanges beyond the system were also studied, such as atmospheric input and fixation, water exchange with the open Adriatic, loss of material by sedimentation, and nitrification and denitrification processes.



On the basis of these results, Kastela Bay may be categorized as a very eutrophic area with its eastern part suffering from extremely high eutrophication.

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## ARE TOXIC ALGAL BLOOMS GETTING WORSE?

*Edna Graneli, Chair (Sweden)*

The death of over a hundred people in Japan this year due to paralytic shellfish poisoning made world headlines. Is this happening more often these days, or does it just get more press coverage?

### ■ Recurring “Brown Tide” Blooms: A New Phenomenon or Only New to Science?

*Elizabeth M. Cospser (USA)*

“Brown tides” look like mud, and inhibit light from penetrating the water. Caused by the alga *Aureococcus anophagefferens*, brown tides destroy tourism and contaminate shellfish, but they are a relatively short-term phenomenon. They represent a species shift in the phytoplankton, although the total phytoplankton biomass remains relatively constant. This shift is caused by elevated salinity (in turn due to reduced rainfall and lower ocean flushing), high organic nutrient load, and trace element chelators. Ciliate zooplankton do not graze as readily on *Aureococcus*, and iron and selenium levels quickly rise, leading to conditions favorable to a virus which is the ultimate cause of the disease.

This is a new phenomenon to science. Brown tides may be enhanced by the sodium citrate found in laundry detergents, as it serves as a strong chelator and is detectable at low levels in waters where brown tides have occurred. Detergents without phosphorus

or sodium citrate will not fuel *Aureococcus*, and therefore will stop the recurrence of brown tides.

### ■ The “Phantom Dinoflagellate”: A Widespread and Significant Threat to Fisheries

*Alan Lewitus (USA)*

*Pfiesteria piscimorte*, first discovered in 1991, is known as the “phantom dinoflagellate” because it has up to fifteen different life forms, and, if not identified quickly, will evolve to another, harder-to-identify stage. The vegetative cell form, which is fairly rare, is responsible for fish kills as it destroys fish epithelium. *Pfiesteria* prefers high inorganic and organic phosphorus levels, and is a response to eutrophication. It has been found from Pensacola, on the Gulf of Mexico, up to the Delaware Bay, in sites with low dissolved oxygen. To respond to this threat, we need better detection, as well as an understanding of the organism’s temperature, salinity, and nutrient tolerances, and its trophodynamics and natural predators.

### ■ Scientific Research to Counter Red Tide Outbreaks in The Seto Inland Sea

*Tomotoshi Okaichi (Japan)*

The first red tide in the Seto Inland Sea occurred in 1957. Following this alarm, a seven million dollar study was undertaken to study the effects of pollutants, the ecology of enclosed waters, and basic research into the responsible organisms. *Chattonella antiqua* was discovered to be the dinoflagellate which led to these large-scale dieoffs of shellfish and finfish. The economic effect on the aquaculture industry was catastrophic. Initial research revealed that oceanographic conditions and chemical oxygen demand were both normal, while nitrogen and phosphorus were slightly elevated due to both land-based runoff and aquaculture itself. It was deter-

mined that keeping nutrient levels low by frequently moving aquaculture cages in the sea would allow natural predators to keep the organism under control.

Red tide outbreaks have been controlled by the regulations in the Special Measures for Conservation of the Environment of the Seto Inland Sea, industrial conversion, consolidation of municipal and industrial waste water treatment, increased public awareness and the research sponsored by the government and universities.

### ■ Harmful Algal Blooms and Toxicity in the Sea: A Global Increase?

*Theodore J. Smayda (USA)*

There is evidence both for and against a global epidemic of algal blooms. Nutrient limitations usually have depressed populations of causative organisms, but in the Sea of Cortez, the Wadden Sea, the Seto Inland Sea and Norwegian Fjords, to name just a few locations, blooms (called sea foam) have led to the temporary closure of shellfish industries. Fish, marine mammals and people have also been affected by the wide range of toxic organisms, or toxins produced by organisms themselves harmless. These organisms have begun to spread from their original areas, and are leading to significant fisheries losses. Long-term data sets also show that in a given location red tides are more frequent than in the past.

Outbreaks are caused by cultural eutrophication from runoff, plus high levels of sunlight, frontal zone development and upwelling. We cannot ignore the effects of watershed management in controlling red tides. Although increased surveillance led to an increased awareness of the problem, as nutrient inputs have increased, they often are channeled into harmful organisms. There is overall consensus that harmful algal blooms are indeed on the upswing.

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## RESEARCH IN CHANGING COASTAL WATERS

*Summa Amarasinghe, Chair (Sri Lanka)*

### ■ Modern Regression of the Aral Sea: Desertification of Former Sea Beds and Problems of Preventing Ecological Catastrophes

*Vladimir S. Zaletaev (Russia)*

The unique ecological catastrophe of the Aral Sea basin stems from mistaken strategies for using land and water resources in the region. Over the last twenty years development policies have diverted 95 percent of the inflow from the Amu-Darya and Syr-Darya Rivers for irrigation, resulting in an average sea level 16 m lower than that in 1961. The former sea bed has extremely underdeveloped soil structure, and thus does not retain water adequately for cultivation or any other economic use. It is recommended that impounded water be supplied to the river deltas to conserve the remaining bits of this ecosystem, and to allow for succession from sea to marsh to field, which would increase soil fertility and structure.

### ■ Salinity Evolution in Guanabara Bay between 1980 and 1990

*Leticia M. Mayr (Brazil)*

Trends and causes of temperature and salinity changes were investigated and an attempt was made to correlate them with water quality. Guanabara Bay's salinity at each water layer declined over the ten-year study period, suggesting that Bay circulation is restricted by a reduced exchange with the open Atlantic. More highly pop-

ulated areas exhibit greater salinity and water quality declines than elsewhere, and have reached critical levels. The watershed of Brazil's Guanabara Bay is one tenth that of the Chesapeake Bay, yet the population inhabiting the watershed of the former is significantly larger. In addition Guanabara is an extremely shallow water body. Dissolved oxygen levels have fallen, and methane levels are increasing although fishery production is still high. The most urgent problem is caused by unregulated landfills, which increase sedimentation levels.

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## RESEARCH AND GOVERNANCE ON JAPANESE COASTAL SEAS

*Tohru Morioka, Chair (Japan)*

This session made it clear that hydrodynamics, biological monitoring and assessment, and fishery management each have significant roles in establishing the scientific basis for marine conservation. Major recommendations include: (1) providing quantitative environmental indicators which are visual and comprehensible for land reclamation projects, (2) developing systematic and consistent monitoring techniques for anoxia and eutrophication, (3) assessing the long-term effects of sedimentation and metal and nutrient concentrations in inflow, (4) monitoring standing biomass and species diversity in addition to harvested fish, (5) integrating individual significant results into a more relevant set of schemes, surveys, and simulation models, and (6) collaborating with researchers in other disciplines.

## ■ The Impact of Large-Scale Reclamation on Estuarine Systems in Osaka Bay

*Keiji Nakatsuji (Japan)*

Osaka Bay, which is shallow at the end farthest from its narrow straits, is beset by environmental difficulties, including water pollution. Since 1970 the government has instituted a recovery program for the Bay. A three-dimensional baroclinic water flow model of the Bay is a useful tool for evaluating the effects of different waterfront reclamation schemes. Numerical simulation indicates that residual circulatory flow and the tidal front would be influenced by large-scale land reclamation, as this would lead to lessened mixing in the shallowest (innermost) sections of the Bay.

## ■ The Recovery of the Benthos Environment in Dokai Bay

*Naoko Ueda, (Japan)*

Dokai Bay was once called "the dead sea" due to its complete lack of aquatic organisms following chemical industry pollution in the 1960s. In the early 1970s the Bay was dredged and environmental conditions have improved since then, to the point that various organisms have now returned to Dokai Bay. However, in the shallower areas low oxygen levels still lead to benthic community losses, and excessive nutrients generate phytoplankton blooms. For further recovery to occur, total nutrient loads must be reduced.

## ■ Biomass-Based Diversity Index Related to Water Quality and Fishery Resources

*Takeshi Goda (Japan)*

The beautiful, productive Seto Inland Sea is a typical enclosed sea and thus is vulnerable to pollution. In this study the values of a biomass-based diversity index were computed from fisheries statistics.

Generally, the computed diversity index biomass (DI<sub>mass</sub>) became higher as the weights from each fish species captured became more equal. DI<sub>mass</sub> tends to be lower where physical and chemical water quality factors are lower, and fish prices are generally higher in areas of higher DI<sub>mass</sub>. The study showed that DI<sub>mass</sub> is an important index for the management of enclosed seas.

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## COASTAL FISHERIES AND COASTAL POLLUTION

*Alasdair McIntyre, Chair (United Kingdom)*

Most commercial species are under intense fishing pressure and are rapidly approaching, if not already at, their sustainable limits. Since the bulk of fisheries occur over the continental shelves, with nurseries and spawning areas in coastal waters, it is critical to understand the effects of toxics, pathogens and urban growth on fisheries.

### ■ Estuarine Biota and Environmental Quality in Chesapeake Bay Tributaries

*Stephen J. Jordan (USA)*

Problems of scale and complexity relate directly to the choice of environmental quality indicators, especially for eutrophication. Four different spatial scales were analyzed, and results indicated that fish assemblages, as measured by bottom trawls, can be a diagnostic tool of the relative health of areas such as tributaries. Another measurement, the ratio between carnivorous and planktivorous fish, can also be applied at a different spatial scale, that of the single sampling station. Other indicators do exist, and include such things as submerged aquatic vegetation, and dissolved oxygen levels. Their usefulness is, in part, a function of the level of scale

that one wishes to consider. For the benthos overall, biomass measurements are more useful indicators than species richness or diversity. Dissolved oxygen versus diversity seems to be a powerful way of predicting degraded versus non-degraded areas.

### ■ Herring and Hydrocarbon Conflicts in the North Sea

*Cornelia Pasche (USA)*

Herring are coastal demersal fish which spawn in benthic areas heavily impacted by the oil and gas industry in the North Sea. In addition to the historical fishing pressure on herring, interactions with the industrial uses of their grounds may affect stocks, as is evidenced by obvious stress shown in ulcers, delayed spawning and mutations. The Oslo and Paris Conventions are international laws which deal with pollution prevention and land-based sources of pollution, respectively, for the North Sea. Both rely on the precautionary principle which states that absolute scientific proof is not required to reasonably determine a causal relationship, and to institute policy accordingly.

### ■ Modeling Brown Shrimp Production in the Mobile Estuary

*Richard K. Wallace (USA)*

Mobile Bay on the Gulf of Mexico is fed by two main rivers, and a strong relation between river discharge and brown shrimp landings has been detected. A model using eight measures of physical parameters — such as wind direction, water temperature, and rainfall — against shrimp landings found the most significant regression to be against river discharge volume. Predictions of shrimp catch based on this model have not been particularly good, however — possibly because as the river inflow increases, water conditions become too fresh for shrimp to thrive.



Note: Discussion following the presentations compared the similarities and differences in these three case studies. The Chesapeake is affected by eutrophication, Mobile by salinization, and the North Sea by multiple use conflicts. Multiple stresses exist in each area, and care must be taken to choose the appropriate biotic, abiotic or anthropogenic factors to study for specific fishery populations. Indices for measuring stock conditions will be different in each specific sea. When integrating over space, fish assemblages may be useful, while temporal integration may call for benthic indicators. More generally, there is a current effort to develop biological criteria for describing estuarine health.

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## INTERACTIONS BETWEEN COASTAL SEAS AND OFFSHORE ECOSYSTEMS

*Kenneth R. Tenore, Chair (USA)*

### ■ Environmental Conditions of Mediterranean Waters Affected by the Nile Estuary

*Massoud A. H. Saad (Egypt)*

Nile River water reaching the Mediterranean has been drastically reduced by impoundments along the river. Water characteristics were measured to investigate the influence of estuarine water on both the estuary and the near shore. Water quality indicators tracked included dissolved oxygen, salinity, temperature, acidity and turbidity. Turbidity decreased seaward, and was highest in winter, when the maximum outflow was recorded. Temperature was seasonal, as expected. The only alarming value was salinity, which showed distinctive regional variations and increased with depth three separate times during the year.

## ■ Carbon Flux From Eutrophied Tokyo Bay to the Pacific Ocean

*Tetsuo Yanagi (Japan)*

The organic carbon flux from Tokyo Bay to the Pacific Ocean is estimated to be around 260 tonnes per day. This is in addition to 156 tonnes per day from atmospheric deposition. This study observed chemical oxygen demand, nutrient levels, sedimentation rates and carbon cycling processes in order to devise a carbon budget and estimate primary productivity (recycling and resuspension were excluded). According to the results for Tokyo Bay, if we assume that five percent of the world's coastal seas are as eutrophic as it is, and that the flux from bay to ocean is generally only one third of Tokyo Bay's rate, then 1.12 gigatonnes of carbon per year would be transported from eutrophic coastal seas to the open ocean. This may account for a large measure of the "missing sink" in global carbon budgets.

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## IMPORTANCE OF MONITORING TO EFFECTIVE GOVERNANCE

*Brock Bernstein, Chair (USA)*

## ■ Cooperation Between Universities and Water Authorities on Phytobenthic Monitoring in Finland

*Saara Bäck (Finland)*

Increasing pollution in the 1970s led to increased incidences of eutrophication, such as algal blooms. In order to better understand the causative factors of this problem, physical, chemical and biological parameters of the Baltic Sea need to be monitored. Ex-

perience elsewhere has shown that it is essential that monitoring results be standardized for comparison with results from other locations. By late 1992 the different monitoring groups, including the Nordic Council of Ministers, HELCOM, different country ministries and universities, had signed an agreement, created monitoring guidelines, and identified twenty vegetation observation transects. District Water Authorities are undertaking quick pollution assessments, university scientists are working on long-term effects and changes, and the Finnish coast guard is providing various free services. In the opinion of all parties involved in this monitoring effort, early objectives have been achieved. Monitoring methods have been reevaluated and multinational cooperation has developed.

### ■ New Monitoring Programs: How to Increase the Level of Understanding

*Bossee Norrman (Sweden)*

As has been mentioned previously, during the 1970s monitoring was not widely incorporated into management. As monitoring programs were created, data proliferated without any infrastructure or coordination between different programs. Following the 1993 revision of the national marine monitoring program in Sweden, there are now three centers for marine research, associated with the universities of Göteborg, Stockholm and Umeå. In addition to undertaking marine research, education and information, these universities coordinate monitoring programs at different levels, including national, regional, and local in order to answer questions posed by authorities at any level.

The Swedish EPA will pay for a national database which would facilitate the generation of annual environmental status reports through data group analyses. Yet problems remain, including the lack of data, the size of the overall areas to be covered, and the need for further cooperation.

## ■ Using Monitoring Information to Help Manage California Coastal Water Quality

*Craig J. Wilson (USA)*

California is a highly developed state with multiple intense uses for its limited freshwater. This has led to a decrease in total freshwater flow to estuaries, and to a change of condition of these waters. Although monitoring data has been collected in the state since the 1950s, management goals were often vague and monitoring results were not particularly useful to solving specific local problems. To resolve this difficulty, a number of innovative new programs have evolved in the state. The Bay Protection and Toxic Cleanup Program, for example, is a major coastal protection program which depends upon monitoring to identify areas where toxic pollutants impact aquatic life or human health. Monitoring activities in general serve as a link between the public and environmental scientists, since it is often felt that scientists don't deliver "results" as needed for policy making.



## CASE STUDIES

## INTRODUCTION

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**I**n order to examine and compare science and governance in specific coastal seas, this section focused on a number of places which have lessons to teach about past programs and future plans for coastal management. The coastal seas represented here include the bodies of water originally studied in the comparative project which helped lead to the EMECS conference: the Chesapeake Bay, the Seto Inland Sea of Japan, the North Sea and the Baltic Sea. Additional case studies focus on the Gulf of Mexico and Bay of Campeche, the Mediterranean Sea, the Southeast Asia Coastal Seas, the Black and Caspian Seas, and the North American Great Lakes.

Virtually every coastal sea examined faces serious problems, ranging from depletion of fishery stocks to destruction of essential habitat, such as coastal wetlands. Some areas have put in place comprehensive programs to protect and restore fisheries and habitat, while other areas are just beginning to devise ways of dealing with such problems. In the Chesapeake Bay, for example, an impressive multi-state program is in place, but as panelists noted, the public that funds such an effort expects to see identifiable goals and quantifiable results. In the Chesapeake Bay, the North Sea and the Baltic Sea researchers have found that nutrient levels need to be cut more or less in half, and this requires considerable cooperation and expenditure by multiple jurisdictions in each case.

In the Mediterranean Sea, certain areas, such as the Venice Lagoon, are particularly degraded. An independent analyst identified five Mediterranean cities as regional hot spots deserving immediate attention, e.g., from the Environmental Programme for the Mediterranean, created by the World Bank and the European Investment Bank. In Turkey, primary tourist sites are on the Mediterranean and Aegean coasts, but 80 percent of the country's total

fish catch comes from the Black Sea, where harbors and a coastal highway have disturbed the natural dynamics of the shoreline.

The North American Great Lakes have faced a number of problems and provide an especially powerful example of the effects of human exploitation since their "discovery" by Europeans several hundred years ago. Once pristine, the lakes became the scene of heavy industrialization and other uses, with ecological concerns taking a back seat until the 1960s. Since that time, momentum has gathered and waned at intervals, but a strong international commitment has helped to solidify a commitment to sustainable use of the Great Lakes.

As one panel noted, the ecological integrity of the Great Lakes will ultimately depend on commitments to social equity, cultural dignity and economic sustainability. The same could almost certainly be said for all the coastal seas.

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## CHESAPEAKE BAY: THE CHESAPEAKE BAY PROGRAM

*William Matuszeski, Chair (USA)*

### ■ Establishment and Application of Goals Within the Chesapeake Bay Program

*Richard Batiuk (USA)*

The Chesapeake Bay Program is a consensus-based state-federal partnership directed towards Bay restoration and protection which is now ten years old. The Chesapeake Bay Commission was established in 1980, and a Bay Agreement was drawn up in 1983, and last amended in 1992. The 1983 Bay Agreement is a brief statement recognizing the decline in living aquatic resources, identifying the need for cooperative remediation and protection measures, and establishing an executive council and a liaison with the U.S. Environmental Protection Agency. In 1987 a second Bay Agreement recognized the Bay's importance beyond regional boundaries and committed members to managing the Bay as an integrated system. It mentioned that the productivity, diversity and abundance of living resources are the best measures of the Bay's condition.

Program goals included no net change in wetland area, and called for increases in aquatic vegetation, fisheries stocks, and waterfowl. Both point and nonpoint sources of pollution would be reduced, with a nutrient reduction goal for the year 2000, to be re-evaluated based on modeling research. The 1992 Amendments reaffirmed this 40 percent reduction goal, introduced a permanent cap on nutrient loading after 2000, heightened the importance of tributaries in the Agreement (and developed strategies for restoring them) and identified bay grass restoration as a measure of progress.



The 1993 Executive Council Directives established a numeric goal for the mandated Bay grass restoration, and established five- and ten-year goals to open blocked spawning passage for migratory fish.

Future goals must be comprehensible by the public, quantifiable, and linked back to decision making and management. The program itself needs to continue to be accountable, to “lock-in” broad commitments, and to translate habitat needs into pollution abatement.

### ■ **Quality Assurance: The Key to Successful Environmental Measurement Programs**

*Claudia P. Walters (USA)*

In order to make the best use of monitoring and moneys spent thereon, we need to “monitor the monitors” with quality assurance tools. Data is often not comparable if it is collected by different polities — for example citizen groups versus chemists in a toxicology lab — or if it is collected for different purposes. Ways of making these different data sets integrated are extremely important, and due to the advancement of technology, it should be possible for similar methodologies and tools to be more widely utilized. Documentation with a minimum of key elements is integral to data evaluation.

The U.S. Environmental Protection Agency’s quality assurance program can provide guidelines for monitoring activities, including: (1) the Chesapeake automated monitoring system software which allows computer data to be standardized for evaluation, and thus minimizes human errors, (2) a trans-media working group (readings for air are often differently measured than for water, for example), (3) a data analysis investigation tracking system which can coordinate split sample programs, (4) a methods manual, and (5) database conversion packages.

## ■ The Chesapeake Bay Water Quality Model and Nutrient Reductions

*Robert V. Thomann (USA)*

The Chesapeake Bay Water Quality Model attempts to track the effectiveness of nitrogen and phosphorus reduction in controlling the growth of plankton, given specific anoxic dissolved oxygen levels. The worst area seems to be the head or neck of the Bay where plankton is produced in the hypolimnion, settles to the benthos and its decomposition utilizes much of the oxygen. In order to reduce plankton, it has been shown that nitrogen removal is much more efficacious than removal of phosphorus, partly because phosphorus is never the limiting element for growth except in the upper mid-Bay. This model is useful for managers because it provides scientific understanding and support for expensive policy decisions, and can accurately predict the outcome of different nutrient control actions on Bay water quality.

## ■ Impact of 1990 Amendments to the Clean Air Act on Chesapeake Bay Water Quality

*Lewis C. Linker (USA)*

The Chesapeake Bay Watershed Model and the Three-Dimensional Water Quality Model have been utilized to determine if water quality in the Chesapeake Bay has improved following the 1990 Amendments to the U.S. Clean Air Act. Atmospheric nutrient deposition has been estimated to account for a substantial percentage of all nitrogen in the Bay, and transport models should help quantify exactly what the percentages of nitrate and ammonia are, and which land-based changes would reduce these inputs. Such modeling increases the opportunity for whole system management, and reduces isolation between disciplines.

## GULF OF MEXICO

*Alejandro Yanez-Arancibia, Chair (Mexico)*

### ■ The Regional Program of Ecology, Fisheries and Oceanography of the Gulf of Mexico

*Alejandro Yanez-Arancibia (Mexico)*

The most compelling threat to the Gulf of Mexico ecosystem is the degradation of the coastal emergent wetlands, which are primary areas of fisheries production. The value of these wetlands is of international importance and requires immediate remedial action. The causes of their degradation lie in anthropogenic change, such as the development of navigation canals, pipelines, and levees, and in the effluent of the major drainage systems feeding the Gulf. While the Gulf of Mexico's ecological integrity is also threatened by many other concerns, creating a model management process which addresses equity issues is possible. The United States, Mexico and Cuba bound the Gulf, and each has layers of governmental jurisdiction. However, new transboundary programs such as those described below are being implemented between them, and the future holds the promise of intense cooperation.

### ■ Coastal Sciences into Policy Making: Case Studies in Campeche State, Mexico

*Jose Luis Rojas Galaviz (Mexico)*

Campeche State and its coastal waters are undergoing intense development and utilization by the fisheries, shipping, agriculture, livestock, highway construction, and tourism sectors. These economic activities need regulation in order to maintain the productivity of the Gulf over the long term. The role of the Regional Pro-

gram of Ecology, Fisheries and Oceanography of the Gulf of Mexico (EPOMEX) is to provide an integrated science-based plan for the ecological management of sustainable growth for the State through the integration and analysis of existing information and the establishment of future research priorities.

### ■ The Gulf of Mexico Program

*Douglas A. Lipka (USA)*

The U.S. Environmental Protection Agency instituted the Gulf of Mexico Program five years ago to address complex problems which cross political boundaries. A Partnership for Action agreement has been signed which pledges to tackle the following ten problems: (1) slow down wetland loss, (2) increase seagrass beds, (3) improve fisheries sustainability, (4) protect human health by reducing nutrients, pathogens and toxics, (5) increase safe shellfish beds, (6) ensure all beaches are swimmable, (7) decrease beach refuse, (8) improve habitat for wildlife, (9) expand public environmental education, and (10) reduce shoreline erosion.

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## THE BALTIC SEA

*Harald-Adam Velner, Chair (Estonia)*

The political changes in Eastern Europe since 1989 made it possible to adopt a new convention for the Baltic Sea which included not only the sea itself, but its entire watershed. In 1992 nine contracting parties initiated a Joint Comprehensive Action Program to run until 2042. This was also the first time representation from the European Union and international financial institutions participated in Baltic Sea deliberations. The estimated cost for the Program to clean up roughly 100 major "hot spots" — for the first twenty years alone — is US\$ 25 billion.

## ■ Scientific Coordination and Management of Baltic Research

*Ingrid Jansson (Sweden)*

Phosphorus and nitrogen loads to the Baltic Sea need to be reduced by 50 percent. Since the need for investments is enormous, particularly in Eastern Europe, it is imperative to set priorities so that real, cost-effective improvements in water quality can be achieved. Clearly, to do this entails understanding the factors controlling large-scale processes in the system, yet our ability to do so is limited. One current project, "Large-scale Environmental Effects and Ecological Processes in the Baltic Sea," combines models of biogeochemical cycles in order to predict future outcomes of different load levels. In 1995 results of the next step, which looks at nutrients plus certain toxic substances, will be presented.

Results of the second Baltic Sea Pollution Load Compilation show that there are still unresolved problems. Further transnational cooperation is essential to their solution. Remaining tasks include: elaboration and implementation of the unified pollution load control program in each contracting party, and improved ability to compare monitoring results and ensure their accuracy.

## ■ The Baltic Sea Environmental Program's Pre-Feasibility Study of the Kaliningrad Region, Russia

*Hans Olav Ibrekk (Norway)*

The Kaliningrad region feasibility study is an example of the new Baltic Sea Joint Comprehensive Program. The Kaliningrad region of Russia is situated between Lithuania and Poland, isolated from the rest of the nation. It is very industrialized and has a population of 80,000. Seven sources of pollution (out of roughly 200) were determined to be the most critical "hot spots" and remediation measures have been proposed for each of them. Implementation of the program should reduce nitrogen and phosphorus by roughly 40

percent and 70 percent respectively, at a cost of US\$ 270 million. Further reductions can only be achieved by action in the agricultural and livestock sector, and by the construction of municipal sewage treatment plants.

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## THE NORTH SEA

*Jean-Paul Ducrotoy (United Kingdom)*

### ■ The North Sea Declaration: Analysis of Measures to Reduce Nutrient Inputs

*Jon Lasse Bratli (Norway)*

The London Declaration specified that a reduction to 50 percent of 1985 level nutrient inputs should be achieved by 1995. Analyses carried out by Norway's State Pollution Control Authority attempted to find alternatives which achieved this in the most cost-effective fashion, and which produced the greatest possible improvement in water quality. It was determined that meeting the 50 percent reduction goal while not improving local water quality was the least expensive alternative. An alternative measure in which almost all local water quality goals would be met but at a slightly higher cost, was also proposed. Surveys indicate that the Norwegian populace would be willing to pay higher sewage taxes in order to achieve the second of these options and thus fulfill the requirements of the Declaration.

### ■ Benthic Community Structure Studies as Management Tools for the North Sea

*Carlo Heip (The Netherlands)*

The North Sea is a dynamic environment with widely varying physical characteristics. The International Council for the Explo-

ration of the Sea was instituted in 1986 in order to investigate whether the Sea could be subdivided into areas with coherent biological characteristics. This led to the North Sea Benthos Survey, which looked at the benthic fauna in over 200 stations. Results of the Survey, published in 1992, demonstrated that the benthic fauna is composed of northern cosmopolitan species, which show a weak gradient by latitude with density increasing northward. In almost all stations, nematodes were the dominant meiofauna, while copepod diversity and density decreased with increasing latitude. The existence of these gradients should be studied further to provide the background against which anthropogenic changes act. The North Sea Task Force, which proposed to undertake such studies, should be continued in order to better understand the impact of fishing.

### ■ The Wadden Sea: an Example of Successful Shared Governance of a Shallow Coastal Sea

*Peter R. Burbridge (United Kingdom)*

As a result of differences in geology the coastline of the North Sea is varied. The Wadden Sea, which is mainly intertidal, is an enclosed coastal sea of high biological interest, serving as the spawning, nursery and feeding grounds for many commercial species of fish and for millions of migrating waterfowl. Pollution resulting from intensive coastal use threatens this productivity, and the three bordering nations, Denmark, Germany and the Netherlands, have joined forces to establish a Joint Declaration on the Protection of the Wadden Sea. This has resulted in changes to harmonize existing management-related legislation in the three nations, and to a set of guiding principles on a comprehensive ecosystem approach to planning. Complete resolution of all issues cannot be achieved, however, without the cooperation of other European nations.

Discussion focused on the need for a holistic approach to coastal sea issues, including integrated coastal zone management. Such

management must extend beyond the coastline itself to include land-based as well as marine inputs. Monitoring and research programs should reflect this new perspective, and comprehensive and extended review of newly acquired information should be undertaken. It was felt that the North Sea Commission, created in 1990, could continue some of the research programs originally undertaken by the North Sea Task Force.

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## SETO INLAND SEA OF JAPAN

*Takeshi Goda, Chair (Japan)*

### ■ Water Exchange and Transport in Strait-Basin Type Estuaries

*Taketi Fujiwara (Japan)*

Strait-basin estuaries, which have narrow straits and wide basins, are one of two main geomorphologic types of estuaries, the other being the wide-mouthed funnel type. The Seto Inland Sea is an example of a strait-basin estuary. Tidal currents are swift in the straits but sluggish in the basin proper. Relations between current dynamics, sediment transport and the distribution of benthic fauna are linked and can be roughly modeled. The tidal-jet and tidal vortex carry vorticity from the strait into the basin, and then form basin-wide circulation patterns which transport sediments. Consequently, benthos distribution is also governed by this flow structure, as nutrients fall with the sediments. Understanding this interrelationship is essential to managing enclosed coastal seas.



## ■ Measures for Environmental Conservation in the Seto Inland Sea

*Hideaki Koyanagi (Japan)*

The Seto Inland Sea is both valuable in terms of natural resources, and threatened by anthropogenic change. Subsequent to the Interim Law for Conservation of the Environment of the Seto Inland Sea, enacted in 1973 and revised in 1978, specific measures have been taken to improve the quality of the sea, and much progress has been made over the intervening twenty years. The main measures include: (1) the Basic Plan for Environmental Conservation of 1978, (2) the permit system and environmental impact assessment requirement for plant effluent discharge, (3) reductions in total chemical oxygen demand to improve water quality, (4) reductions in phosphorous to decrease eutrophication, (5) conservation of natural shoreline areas, and (6) adding environmental considerations to land reclamation procedures.

## ■ Coastal Zone Governance and Environmental Policy

*Kenichi Nakagami (Japan)*

The coastal zone is perhaps the most fruitful area for sustainable development studies in political science. The study of management models for residential and resort development led to the introduction of a sustainability index for such development. A comprehensive evaluation system for large-scale development was evaluated. In addition, different governance policies, including environmental policy, industrial policy, land policy and regional policy were scrutinized for consensus. The significance of governance within the coastal zone environmental planning is fundamental for understanding the behavior of stakeholder groups. It is difficult to demonstrate sustainability quantitatively, but background factors which promote it are covered in more detail in the full version of this paper.

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## SOUTHEAST ASIAN COASTAL SEAS

*Peter Burbridge, Chair (United Kingdom)*

### ■ Ten Years of Nearshore Pollution Control in China

*Jinhui Guo (China)*

If one includes its islands, the Chinese coastline extends over 22,000 km. Studies of waste water treatment options have concluded that primary treatment of municipal waste water and primary and selected secondary treatment of industrial waste water combined with deep marine disposal utilizing bubble diffusers offers the most suitable treatment for low-cost water quality improvement. Currently there are sixteen such marine waste water projects, with a 8.3 million tonne daily capacity. This represents 16 percent of the total wastewater discharge load into Chinese coastal waters. Monitoring has shown that both nitrogen levels and chemical oxygen demand improve along nearshore waters with this treatment combination. Secondary treatment is for waters contaminated with oil, while contaminants which are potentially toxic, including heavy metals, are not treated in this fashion.

### ■ Lessons for Integrated Coastal Zone Management: the ASEAN Experience

*Louise Fallon Scura (Guatemala)*

The Association of Southeast Asian Nations (ASEAN) has roughly 85,000 km of coastline along relatively shallow seas. The region is characterized by a variety of political, cultural, religious and economic systems, but population growth and economic growth

are common to member states. The ASEAN Marine Science Program has contributed to the integrated planning and management of the region, and four main lessons have been learned to date: (1) research should be directed to specific management questions, (2) management principles need to be better understood in order to ensure that all issues are adequately addressed in the management process, (3) key stakeholders must be involved in any policies, and (4) building political and scientific constituencies is important to the management process.

Discussion elicited interesting conclusions, including the fact that coastal areas need to be pragmatically defined to encompass all relevant management issues. Management plans should be proactive rather than reactive, and integrated coastal zone management must be long-term and interactive. Participants discussed whether UNCED Agenda 21 Section 17 priorities were appropriate to developing nations and if so, if assistance was being directed to the highest priority objective, which, it was felt, was public education for coastal area residents and officials to increase their awareness of sustainable development issues.

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## MEDITERRANEAN SEA

*Adalberto Vallega, Chair (Italy)*

### ■ Taking Advantage of Free Energy to Restore a Balanced Environment

*Alberto G. Bernstein (Italy)*

The Northern Adriatic suffers from frequent algal blooms which affect fishing and tourism. It is the shallowest area of the Mediterranean, and is highly influenced by land-based inputs. The Venice Lagoon has been particularly degraded, and is now dystrophic.

Studies are underway by a local NGO-government consortium to demonstrate that reconstructed tidal flats, created from dredge material, can increase the tidal flow, and thus the level of dissolved oxygen in the Lagoon. This relatively uncomplicated technique holds promise to radically improve water quality in Venice Lagoon and the entire Adriatic.

### ■ **The Environmental Programme for the Mediterranean and Municipal Environmental Audits**

*James A. Dobbin (USA)*

As part of the Environmental Programme for the Mediterranean, created by the World Bank and the European Investment Bank to complement the Mediterranean Action Plan (MAP), independent consultants have developed a GIS database and conducted a strategic regional assessment of the Mediterranean Basin. As part of the Municipal Environmental Audit Project component of the Programme, five cities were identified as regional hot spots, meaning that their use of the sea was heavy and conflicting, and that they deserved immediate targeting of the first available Programme funds.

### ■ **MedCoast: An Initiative for Rational Management of Mediterranean Coastal and Sea Resources**

*Erdal Ozhan (Turkey)*

In order to enable the MAP to maximize its coordinating functions and confer increasing functions and responsibilities to local institutions, collaboration from existing research and educational institutions should be stimulated. One such example is the Med-Campus project, launched by MedCoast '93, which will provide a graduate program and certificate program in coastal zone management in the Mediterranean and Black Seas. MedCoast '93 was the first international conference on the Mediterranean coastal envi-

ronment, organized by the Eurocoast Association. This new conference series is sponsored by 16 national and international organizations, and drew well over 100 papers for the first conference. Future conferences will be held biannually in order to increase communication and cooperation between Mediterranean environmental scientists.

### ■ Implementation of Integrated Coastal Management in Mediterranean Developing Countries

*Arsen Pavasovic (Croatia)*

Integrated Coastal Area Management (ICAM) programs in the Mediterranean basin should be consistent with sustainable development principles and, most particularly, with the guidelines provided by Chapter 17 of Agenda 21, and adopted by the Eighth Ordinary Meeting of the Contracting Parties of the Barcelona Convention, held in October 1993. The MAP should provide not only guidelines on how ICAM programs are to be created, but also a framework of goals to which all states should conform. To optimize its role, MAP should (1) stimulate states to adopt national guidelines and carry out ICAM programs, (2) coordinate these programs, and (3) check them for consistency with established principles and guidelines.

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## THE BLACK AND CASPIAN SEAS

*Jack Archer, Chair (USA)*

### ■ The Black and Caspian Seas: Marine Environmental Degradation

*David G. Aubrey (USA)*

The Black Sea is connected to other waters through the Bosphorus Strait, while the Caspian Sea is a landlocked, though marine, lake. Both seas lie along major climactic boundaries, are affected by tributary pollution and nonpoint pollution, and have had significant fisheries. Contrasts between the two seas are also revealing. The Caspian Sea experiences large swings in water levels due to its landlocked position, and the sea-level is rising alarmingly. Eutrophication and exotic species invasions are serious concerns in the Black Sea, while they are a minor problem in the Caspian Sea. Clearly regional cooperation at all levels will be necessary to tackle these environmental problems. One such measure is the Cooperative Marine Science Program for the Black Sea, a non-governmental cooperation designed to provide scientific input to assist in natural resource management.

### ■ The Romanian Black Sea Coastal Zone

*Petre Gastescu (Romania)*

The Romanian Black Sea coastal zone consists of low wetlands in the north, and sandy beaches in the south, which are abraded by harsh waves. The large number of water works — embankments, ports, levees — have drastically altered the natural water regime, as has the reduced flow of the Danube River. Although the Danube

Delta Biosphere Reserve was created in 1990 to protect estuarine species, natural landscapes and archaeological sites, the pace of development along the shore and its major tributaries is overwhelming. For this reason the Institute for Geography, along with the Urban Project Institute in Bucharest are studying the promotion of legislation for management of the Reserve, and the entire region.

### ■ Bulgarian Black Sea Coast Sustainable Development: Problems and Potential

*Tsveta Kamenova (Bulgaria)*

Following the changes in Eastern Europe, Bulgaria has had to rethink its Black Sea Coastal Zone Development and Protection policy. As the nation strives to achieve a market economy based on sustainable development, a framework has been needed during the transition period, during which the institutions of democracy have not been reliable, and the economy has not been thriving. A long-term action plan for Black Sea coastal management and development is needed, and, with the assistance of foreign donor institutions, such a plan is being devised to coordinate national, local and private interests in the development process.

### ■ Medcoast: Management Issues of the Turkish Black Sea Coastal Zone

*Erdal Ozhan (Turkey)*

The Turkish Black Sea coast is mainly rural, with only three cities larger than 100,000 inhabitants. The coast is very narrow, since mountains abut against the shore in many locations. Nonetheless, farming is important for residents in the narrow coastal plains. Although Turkey's tourism industry is centered along the Mediterranean and Aegean coasts, there is some ecotourism on the Black Sea coast, due to the number of migratory birds in the wetlands, and the numerous small protected ecological sites. The Black Sea

is economically most important for Turkey as a source of fish — 80 percent of the country's total fish catch is from the Black Sea. Yet fishing harbors, and a coastal highway, have disturbed the dynamic shoreline equilibrium, and have caused local erosion.

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## THE NORTH AMERICAN GREAT LAKES

*Henry A. Regier, Chair (Canada)*

*Ron Shimizu (Canada)*

*Sally Lerner (Canada)*

*George Francis (Canada)*

*Robert E. Ulanowicz (USA)*

Several hundred years ago, European intruders perceived the Great Lakes basin as a cornucopia of natural wealth in a healthful, pleasant geographic and climatic setting. By the 1960s much of the natural wealth — forests, soils, fish — had been badly overexploited and major water, coastal and inland areas had been reduced to ecological travesties. The forms of industry and commerce that had been the proximate agents of the ecosystem debasement had become technologically obsolete, economically inefficient and socially unacceptable.

In retrospect, a reorientation toward sustainable development occurred here as a joint result of numerous coordinated reform activities beginning in the 1960s. Ecological, socio-cultural and economic reforms have been continuing concurrently ever since. The 1980s brought some devolution of responsibility from the national level to local levels of government. The anti-reform efforts of national politics during this decade were generally unsuccessful in the Great Lakes Basin, but did act to slow the rate of its progress. By



the end of the decade, impetus from the international level of environmental policy helped coalesce the various separate initiatives begun in the 1960s. Commitments to social equity, cultural dignity, economic sustainability and ecological integrity are beginning to gel in the 1990s; a commitment to ecosystem integrity involves all of these.

This melding of reforms is occurring at a time when global environmental threats are replacing local ones. We need to identify visions and policy guidelines which are realistic for today's Great Lakes ecosystem.

## SPECIAL PROBLEMS

## INTRODUCTION

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Coastal seas have suffered particularly from such nuisances as exotic species, animals as diverse as the periwinkle, the ship worm and the zebra mussel. Many of these — such as the zebra mussel in the United States — have made their way across the oceans and around the world on board ships, often carried in ballast water. Current efforts to exchange ballast water in mid-ocean should help curtail this onslaught.

On the other hand, the culture of nonindigenous aquatic species can also mean big business, as in Chile's large aquaculture industry. Resource managers are focusing on proper precautions to allow a thriving industry while guarding against unwanted escape into the natural environment. In fact, as the aquaculture industry continues to grow worldwide, the issue of pollution resulting from culture facilities will also grow. Panelists note that not only the industry but also governments, scientists, consumers and financial institutions will all share a concern that aquaculture remain "ecologically benign."

Other panels in this section deal with the special issues of modeling and of approaching coastal seas management on a watershed basis. Approaching coastal seas management on a national basis formed the subject of a panel on the National Estuary Program (USA). Still other panels addressed the issue of reclaiming antiquated urban areas for recreational and other uses, and contrasted the differing approaches and cultures found in Japan and the United States.

One issue addressed by a special panel focused on economics and coastal seas restoration. In a study conducted in Osaka Bay, Japan, one economist concluded that the willingness to pay of potential swimmers did not match the cost of waste treatment needed to improve water quality. Another study, in the Chesapeake Bay, is

examining the least cost method of reducing nutrients in each tributary to fulfill a commitment already made by the participating states to reduce nitrogen and phosphorus by 40 percent. As was made clear in one panel, we have much still to learn about the relation between marine ecosystems and values, and the ways these are translated into economic preferences — and the economic research that attempts to understand and predict human behavior.

## THE PROBLEM OF NONINDIGENOUS SPECIES

*Frederick G. Kern, Chair (USA)*

### ■ Introduction of Exotic Species for Chilean Aquaculture: An EIA Study

*Adolfo P. Alvial (Chile)*

Chilean aquaculture is big business. Chile is the world's second largest salmon exporter; both tonnage and export values have grown geometrically in recent years. European turbot, catfish and white sturgeon are new fish species proposed for aquaculture that are now in the experimental stages. The shellfish and crustacean industries began in 1905 and grew dramatically in the 1970s. At present both native and exotic species are being tested, including abalone. Chile's environmental conditions and native seaweed seem particularly suited to that mollusk, according to theoretical models developed by Chilean universities. The California red abalone, and the Japanese abalone are two exotics under consideration. Environmental impact assessments and clear terms of reference were required before this project could begin, even though there is a vast difference between introducing an exotic species in the wild and introducing it into captive cultivation. It was agreed that quarantines were necessary, and that spawn would be held in captive tanks until larvae settled and reached a minimum diameter, at which time they could grown out in open sea containers without the risk of escape.

## ■ Ecological Roulette: The Invasion of Exotic Species in Enclosed Coastal Seas

*James T. Carlton (USA)*

Barnacles have fouled San Francisco Bay since the 1850s, Europeans introduced periwinkles to New England in colonial times — completely transforming the coastline — and shipworms made their way around the world with the first explorer's wooden vessels. The ubiquity of marine biological invasions needs no comment. Yet, the zebra mussel situation has brought the issue of ballast water, and the thousand-or-so species which may be carried therein, to the fore once again. Zebra mussels block pipes, clog turbines, cause millions of dollars in damage, and outcompete native mussel species leading to possible extinctions.

Although world ports may already be homogenized, field trials are presently underway to take on and release ballast water in mid-ocean, where conditions are less amenable to any hitchhikers. It is anticipated that toxic algal blooms and related diseases will decline following this measure.

## ■ United States Aquatic Nuisance Species Task Force

*David Cottingham (USA)*

The zebra mussel caught the attention of the U.S. Congress, which authorized six agencies to form an Aquatic Nuisance Species Task Force, and report back to Congress in January 1994. Three general areas were studied: (1) shipping protocols, (2) ballast water exchange, and (3) biological studies of specific potentially invasive species. Today, the U.S. assumes that any exotic brought into the country will escape, and will cause ecological problems; policy will follow accordingly. Of course, the vast majority of such introductions are inadvertent. This makes monitoring and identifying problem species difficult.

In subsequent discussion, it was questioned whether the theoretical models for Chilean aquacultural introductions were adequate, and it was implied that actual experimental research was required. The issue of state or regional versus national regulation of foreign shipping ballast brought several responses: the U.S. coast guard should enforce national regulations, but local agencies should not hesitate to tell foreign ships that local regulations will be enforced. On another topic, genetically modified organisms are indeed considered novel exotics by the Aquatic Nuisance Species Task Force.

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## MODELING COASTAL LANDSCAPES FOR RESEARCH AND PLANNING

*James Dobbin, Chair (USA)*

### ■ Landscape Modeling for Estimation of Environmental Impacts on Estuaries: An Application for the Patuxent Estuary of the Chesapeake Bay

*Edward B. DeBellevue (USA)*

This detailed GIS case study, called the Patuxent Landscape Model, has divided the Patuxent River's 2,400 km<sup>2</sup> watershed into 0.4 km<sup>2</sup> cells and calculates exchange flows between adjacent cells, downstream, and to the atmosphere. This model should permit quantification of the environmental impacts of different land use practices along the river. The Spatial Modeling Workstation is being used, which combines several software programs and data bases, including the General Ecological Model, GIS, and spatial modeling,

all in the Macintosh environment. The General Ecological Model is capable of tracking 21 state-variables such as the flow and/or storage of nitrogen, inorganic soil particles and dissolved oxygen. The software is state-of-the-art, and the package is very promising.

### ■ A Coastal Land Cover Classification System for Use with GIS

*Victor Klemas (USA)*

NOAA's Coastwatch Change Analysis Project will monitor the coastal zone, from the uplands to seabeds, every two to five years. It will rely on remote sensing data and other techniques to monitor change and provide information on the current status of the coasts' ecological resources. The Project has devised a land cover classification system for uplands, wetlands and submerged illuminated habitat which will be useful to manage fisheries habitat and living marine resources. The system is compatible with other data bases in use by other government branches, and can be accessed through GIS.

### ■ GIS for Coastal Zone Management in the Philippines: Relevance and Constraints

*James N. Paw (Philippines)*

The foundation of a GIS capability for the Lingayen Gulf in northwestern Philippines is an important step towards the management of spatial information. This, in turn, will ensure that integrated coastal zone management (ICZM) plans remain responsive to the changing needs of the region. The present ICZM plan addresses conflicting uses, especially those in the fisheries sector, but it does not adequately consider mainland industrial development pressures. A pilot project on the use of GIS is underway, with a zonation scheme. While much data is available, it has been difficult to capture it onto the GIS system. Technical, organizational



and management issues which appear to be fairly widespread around the world have proven constraining.

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## AQUACULTURE AND POLLUTION: AN EMERGING CHALLENGE

*Reginal M. Harrell, Chair (USA)*

### ■ Shrimp Farming: A Coastal Crisis

*Charumas Chareonpanich (Japan)*

*Sukhum Poothong (Thailand)*

The world fisheries catch has begun to stabilize at around 100 million metric tonnes annually, while the global demand for seafood has continued to increase. A likely source of supply for the difference between stabilized catch and increasing demand for fish protein is through aquaculture, or farming the sea. Aquaculture of open oceans or enclosed coastal seas is not new; it was practiced in Roman times. However, large-scale global aquaculture is a new phenomenon which parallels the decline in natural fisheries. Associated with this increase is concern over pollution from aquaculture's waste products. It is not yet clear what overall impact aquaculture may have on surrounding waters and environmental communities.

Concerns — both real and unfounded depending upon location — center on a number of topics. First, there is the destruction of coastal wetlands, including mangrove swamps and tidal marshes, for development of production facilities. Next there is the issue of excessive nutrient loading from feeding practices and wastes from

high-density operations. Lastly, there is the risk of accidental or even intentional release of exotic species, including exotic diseases and genetic inflow leading to loss of local type. Responsibility for insuring that a developing global aquaculture effort remains ecologically benign lies not only with the industry itself, but with governments, scientists, consumers and financial institutions. Governments and scientists should evaluate the pre-operation value of coastlines to properly site operations. Consumers should demand high quality products produced under optimal conditions, and financial institutions are responsible for requiring environmental protection in the design of facilities they finance.

By its very nature, successful aquaculture depends on abundant, accessible, clean water. Simple procedural changes, such as moving mobile facilities like cages or net-pens, or using settling basins for land-based operations, can minimize ecological impacts of concentrated nutrients. Newer technologies in bioremediation with natural organisms such as *Capitella* sp. I, show promise of mitigating environmental impacts of many open water aquaculture operations.

## THE WATERSHED APPROACH TO COASTAL SEAS PROTECTION

*Michael S. Haire, Chair (USA)*

### ■ Solutions for Dredging and Agriculture Impacts on Estuarine Wetlands

*Peter Grenell (USA)*

Two of California's major industries, maritime transport and agriculture, threaten the environmental health and natural resources of the San Francisco Estuary. First, the maritime industry's practice of dredging to keep a major harbor open necessitates the siting of an alternative dredge fill location which will not harm the wildlife of the nearby estuaries. Such systems are extremely sensitive to fill material. One demonstration project will use non-contaminated dredged material to restore former tidal marsh to functioning wetland, thus achieving two goals at once. Second, the wine-grape agricultural sector has been particularly harmful to receiving waters due to heavy pesticide use, soil erosion and water consumption patterns. Economically and environmentally sound alternative growing practices are being tested in a pilot project which would allow growth of the wine-grape industry while maintaining estuarine health.

## ■ Protected Areas in Enclosed Sea Management

*Geraldine M. McCormick-Ray (USA)*

Protected areas are remnant patches of the coastal area, both on land and sea, which have been set aside to preserve some aspect of the pre-development environment. In the Chesapeake Bay, for example, protected areas have been created independently by numerous mandates, and authorities at local, state, federal and private levels. Yet if such areas are all linked in a network for research and monitoring, they can tell us a lot more about the Bay's ecosystem and its resources than they can singly. Each protected area could benefit from collective experience and information sharing and ultimately advance conservation and management of coastal ecosystems. A network of protected areas in other coastal systems would also benefit from this approach.

## ■ Control of Land-based Sources of Pollutants in the Adriatic Sea: Scientific Evidence and Management Options

*Velimir Pravdic (Croatia)*

Successful pollution abatement depends upon an integrated policy and decision making processes. The Adriatic Sea is a complex case study, since it is small (140,000 km<sup>2</sup>), shallow (170 m average depth), and bounded by five nations with widely different levels of economic development. Inputs from often heavily industrialized watersheds via the river systems govern water quality in the Adriatic and its estuaries. More knowledge about the estuarine transformation systems for pollutants is needed. Suspended particulates, kinetic interactions and flocculation and sedimentation rates need to be quantified in order to determine individual estuaries' carrying capacity for pollutants. Until such knowledge is available, management options depend on the precautionary principle and risk tolerance criteria.

## ■ Application of Water Quality Modeling in Maryland's Management Strategies

*Robert M. Summers (USA)*

Since the 1970s Maryland has had a comprehensive water quality monitoring program and has developed an increasingly sophisticated series of water quality models for watersheds and estuaries. The Patuxent River Watershed was used as a case study to explain the different models. The Patuxent River had earlier been designated by the U.S. Environmental Protection Agency as a national demonstration site for pollution management and control, since it flows past the national capitol and is influenced by the intensive growth of the Washington-Baltimore metropolitan area. For the last three decades this growth has led to increased non point and point-source pollution.

The currently utilized watershed model is based on the Hydrologic Simulation Program-Fortran, which includes continuously simulated time variable land processes, hydrologic, sediment transport and eutrophication components. In addition it includes seasonal variations, and a two-layer mass transport pattern. This model has been used in the evaluation of different pollution management strategies for the Patuxent, ultimately leading to a nutrient pollution control strategy for the watershed.

## CHALLENGING TRADITIONAL COASTAL DEVELOPMENT

*Harvey A. Shapiro, Chair (Japan)*

### ■ “Ecopolis Plan” of the Kobe City Coastal Area, Japan

*Motohiko Murakami (Japan)*

Kobe City has a population of 1.5 million people living on 544 square kilometers. Since 1868 the southern part of the city, facing Osaka Bay, has been an international port. As in many port cities around the world, changes in shipping, transportation and industry over the last century have led to the abandonment of older port facilities in favor of modern ones, and this has meant that less of the coastline in the city is accessible for recreational use by citizens. The city has devised an “Ecopolis Plan” to alleviate this situation by conserving and utilizing portions of the existing waterfront, at the same time that measures to enhance water quality and coastal ecology are reinforced.

### ■ The Chesapeake Bay Critical Area Program: State and Local Government Partnership

*Patricia J. Pudalkewicz (USA)*

Maryland's Chesapeake Bay Critical Area Protection Program was enacted in 1984 and a Critical Area Commission was soon appointed to regulate growth along the shores of the Chesapeake Bay. Sixty local jurisdictions participate in the Program, the first of its kind in the nation. It was felt that water quality and natural habi-

tat in the Bay would not improve without specific measures to mitigate alterations within the watershed, and development density, water permeability, and forest cover were all determined to be important factors in saving the Bay. The Program has been successful, both in educating local officials and planners, and in preserving wetlands, forests and agricultural lands, and endangered species habitat. It has become an accepted part of the planning process in every jurisdiction, and shows that the state and local governments can work together.

These two presentations revealed the importance of the cultural context in understanding the challenge of traditional coastal development. Murakami's presentation explained that the Japanese prefer a controlled nature, seen in their preference for artificial beaches rather than for restored or protected natural ones, while Americans seem to prefer "wild" nature and plan to preserve bits of it. The geographical and population context is also important: In Japan, a country with high population density, it is seen as good for the economy to fill the seacoasts with dredge spoil islands, while in the U.S. growth can occur without such landfill and thus it is an unpopular option. The two countries share an orientation to the sea, but from different perspectives: in Japan people look to the land from the sea, and give preference to land-based activities, while in the U.S. the sea, or at least the local aquatic system, is seen as the focus of activity. Lastly, the two countries have differing political environments. In Japan there is no guaranteed right of citizen participation or access to information, while in the U.S. both of these rights are guaranteed and backed by a long democratic tradition.

## MOVING TOWARD NATIONAL ECOLOGICAL PROTECTION IN THE USA

*Robert Wayland, Chair (USA)*

*Richard Lindthurst (USA)*

*Michael Crosby (USA)*

*Darrell Brown (USA)*

Environmental protection over the last two decades has shifted from technology-based controls applied at a national scale to risk-based approaches using ecosystem health as an endpoint. In coastal areas, this shift has resulted in management programs which address bays, harbors and estuaries currently experiencing significant threats. These water bodies and their watersheds are targeted by a coordinated effort of federal, state and local agencies which aims to preserve, restore, and protect their uses and resources. This risk-based approach to coastal management is firmly grounded in the need to link science and policy for developing solutions to environmental problems.

For example, the policy decision of precisely which watersheds to target for action depends on scientific information about the relative threats faced by each specific watershed. Once a watershed is targeted, sound science is essential for establishing management priorities between the various uses and resources. These priorities then drive the allocation of resource protection measures. Lastly, when management actions are in place, sound science, including monitoring, provides a way to measure ecosystem health, and, concomitantly, the very effectiveness of the management program.

Three federal level examples were provided by the speakers. First, the U.S. Environmental Protection Agency (EPA) initiated the Environmental Monitoring and Assessment Program in 1990



to assess and document the status and conditions of the nation's ecosystems, to develop innovative methods for anticipating problems before they reached a crisis, and to assist in answering questions about the long-term effectiveness of regulatory programs. Second, the National Estuarine Research Reserves Program of the National Oceanic and Atmospheric Administration focuses on the collection of basic research and assessment information critical for effective estuarine management. Finally, the EPA's National Estuary Program integrates scientific information, management authority, and the public will. All three programs are on the cutting edge of ecological protection efforts for coastal seas in the U.S.

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## ECONOMIC CHALLENGES TO GOVERNANCE

*James C. Cato, Chair (USA)*

This session presented a useful contrast. One paper was general and focused on emerging economic and ecosystem valuation issues, one reported on an actual economic valuation study, and the last reported on the actual implementation of a plan to reduce bay pollution.

### ■ Measuring Economic Values for Marine Resource Restoration and Enhancement

*Walter J. Milon (USA)*

In measuring economic values for restoration, we have three major concerns: the relations between marine ecosystems and values, the changing paradigms in modeling versus economic values, and the way these changes can be translated into economic research. Hazards to marine ecosystems can reduce or end ecosystem

services. Traditionally, the effect of most hazards has focused on species and on environmental functions. Newer concerns include ecosystem stability and system resilience, or health. Less economic work has been done on these new concerns, in spite of their growing importance. There are several ways to estimate indirect use and non-use or passive values for these ecosystems. Most such studies have focused on the preferences users have for specific short-term benefits, but now, as seen in the case studies of the Indian River Lagoon and Florida Bay, they have begun to address long-term effects of restoration.

### ■ Recreation Value in Enclosed Coastal Seas in Terms of Willingness to Pay for Water Quality Improvement

*Yoshinobu Kido (Japan)*

Osaka Bay, Japan, cannot be used for swimming due to the eutrophication caused by pollution. Sewage treatment plants could increase water quality to levels appropriate for swimming beaches, yet they are costly. In order to estimate the willingness of Osaka residents to pay for this improvement, it was necessary to measure their desire for swimming beaches. This benefit could be compared to the estimated costs of such public works. Ten sites were investigated and both the travel cost and the contingent valuation method were used to derive estimates. It was determined that the cost of sewer modification to improve Osaka Bay's water quality was much greater than the value citizens place on such improvements for swimming.

### ■ Cost Analysis for Nitrogen Control Strategies in the Chesapeake Basin

*Lynn R. Shuyler (USA)*

This presentation reviewed the long-term project in the Chesapeake Bay to lower the nutrient load from land-based sources.

The Chesapeake Bay Agreement set a 40 percent nitrogen reduction goal, and to meet it, a several-year study of the sources of nitrogen runoff by sector was undertaken. The cost of nitrogen control per sector was estimated simultaneously. The least cost/most achievable method is being used to set a maximum amount of nitrogen input per tributary. This method considers environmental equity, and cost equity among sources. Each state around the Chesapeake Bay is involved in developing an implementation strategy for each Bay tributary.

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## COMMITTEES IN COASTAL MANAGEMENT PROGRAMS

*Steven J. Nelson, Chair (USA)*

### ■ Science and the Policy-making World: The Protection of Species and Habitats on North Sea Coasts

*Jean-Paul A. Ducrotoy (U.K.)*

The North Sea Task Force based its policy advice on sound scientific knowledge. Although a wealth of information exists, few comprehensive ecosystem-level studies have been undertaken. Therefore, a review of this information on marine and coastal habitats could provide the basis for solving many management problems in the North Sea. Such a review covered bird populations, cetaceans, the marine benthos, marine flora, and inventories of protected areas along the North Sea coasts. This should facilitate a shift from a pollution-driven coastal management approach to one with a wider variety of concerns, including the protection of individual species and habitats.

### ■ Integrating Science into Coastal Environmental Management: The Chesapeake Bay Experience

*Steven J. Nelson (USA)*

The Chesapeake Bay Program chartered its Scientific and Technical Advisory Committee (STAC) through the 1983 Chesapeake Bay Agreement. STAC's mission is to provide technical guidance and communication for managers and citizens responsible for environmental implementation programs. A decade later, STAC achieves these objectives through a formal review of relevant scientific programs, pro-active recommendations to guide science policy, focused research planning, and the publication of literature reviews, workshops/conference proceedings, and technical white papers.

STAC members are appointed by governors and regional administrators and facilitate much of the informal networking behind policy decisions. STAC's task is made more difficult as it is at the interface between the long-term scientific peer-review process and short-term management implementation schedules.

### ■ Science and Management Planning for Galveston Bay, Texas

*Frank Shipley (USA)*

Galveston Bay is home to a vast petrochemical industry, one of the largest ports in the world, and 3.5 million residents. The Galveston Bay National Estuary Program was created in 1990 to address problems resulting from pollution, development and over-use of estuarine resources. A STAC was established to advise the Program's Management Committee as the latter sought to identify specific estuarine problems, conduct a scientific program to determine status, trends and causes, and to create a comprehensive management plan for the Bay ecosystem.

The STAC has undertaken over 30 projects to fulfill this mandate, and the following needs have been recognized in science-

management interactions: (1) managers must tell scientists which questions to address, (2) scientists should realize they need to address a perturbed ecosystem, (3) data must be presented at an appropriate scale for management, (4) results must be presented in a readily accessible format, and (5) monitoring programs need to be directly linked to management objectives.

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## COASTAL FORUM: RESOLVING OUR COASTAL CONFLICTS

*In order to explore the dynamic tensions and conflicts present in the management of most coastal seas, the EMECS planning committee used a generic fictional sea to stage an open and often heated debate among stakeholders. They called their fictional place the Madrigal Sea.*

The Coastal Forum was called in an effort to save the once beautiful Madrigal Sea from a fate of pollution, depleted fish stocks, and the loss of the silvery hued Madrigal seal. The Madrigal Sea is an enclosed sea, surrounded by the coasts of six different countries. These nations differ in many ways — economically, culturally, and ideologically — and each has different priorities and uses for their shared sea. The northern countries are relatively undeveloped, with forested hinterlands and a large fishery. The southern countries, on the other hand, are heavily industrialized and this economic discrepancy plays a large role in the debate. A Compact for management has been in place for the last five years, but there is heated debate about whether the Compact is fulfilling its intended purpose: the preservation of the Sea.

Representatives from government and industry, the environmental field, citizen activists and the fishing industry were called together to discuss options for managing the Madrigal Sea. Can these individuals put their differences aside, and come together for the common goal of saving the Madrigal Sea in a fashion that satisfies the interests of all parties?

After much discussion on the merits of industry and of fishing as lifestyles, and even on saving the sea for purely ethical reasons, it was agreed that there was a common interest at stake. Through the barrage of words it finally became clear that each constituency at the conference table was in some way dependent on the Madrigal Sea. Using this interest as common ground, the panel came up with a set of suggestions to strengthen the existing Compact and to protect the Sea. These suggestions included: (1) creating a Madrigal Sea-wide NGO closely associated with the media to keep public attention focused on the issue, (2) setting integrated, objective standardized research and monitoring techniques, (3) writing legal frameworks with targets, timetables and strong reporting and monitoring components, and (4) obtaining financial support through a restoration and compensation fund, originally financed by the wealthier southern countries.

Special thanks to the following policy experts who participated in this debate:

Dr. Biliانا Cicin-Sain  
University of Delaware, USA

William Eichbaum, Esq.  
World Wildlife Fund, USA

Professor Robert Knecht  
University of Delaware, USA

Professor Nobuo Kumamoto  
Hokkai Gakuen University, Japan

Mr. Duncan Leadbitter  
Ocean Watch, Australia

Dr. Roger E. McManus  
Center for Marine Conservation, USA

Dr. Mark Sagoff  
University of Maryland, USA

Dr. Frieda Taub  
University of Washington, USA

The roundtable debate was conceived by Ms. Helene Tenner, Maryland Department of Natural Resources, and the Madrigal Sea and its inhabitants were created by Dr. Jack Greer, University of Maryland Sea Grant.

# CONFERENCE PARTICIPANTS



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## COUNTRIES REPRESENTED

EMECS '93 drew more than 500 participants from the 40 countries listed below. For a complete directory of the names and addresses of conference attendees and other members of the EMECS network, write: International EMECS Center, Kenryu Building #2, Kaigandori-6, Chuo-ku, Kobe 650 Japan.

<b>Australia</b>	<b>Kuwait</b>
<b>Bahrain</b>	<b>Latvia</b>
<b>Benin</b>	<b>Mexico</b>
<b>Brazil</b>	<b>The Netherlands</b>
<b>Bulgaria</b>	<b>Norway</b>
<b>Canada</b>	<b>Peoples Republic of China</b>
<b>Chile</b>	<b>Philippines</b>
<b>Colombia</b>	<b>Poland</b>
<b>Croatia</b>	<b>Romania</b>
<b>Egypt</b>	<b>Russia</b>
<b>Estonia</b>	<b>Saudi Arabia</b>
<b>Finland</b>	<b>Slovakia</b>
<b>Germany</b>	<b>Sri Lanka</b>
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<b>India</b>	<b>Sweden</b>
<b>Indonesia</b>	<b>Switzerland</b>
<b>Israel</b>	<b>Thailand</b>
<b>Italy</b>	<b>Turkey</b>
<b>Japan</b>	<b>United Kingdom</b>
<b>Korea</b>	<b>United States</b>

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## CONFERENCE PRESENTERS

Satoshi Akagi	Particulate and Dissolved Components in Sea Water of Omura Bay
Kazuaki Akai	Water Quality Improvement in Enclosed Coastal Seas by Using UTSURO
M. Salim Akhter	Heavy Metal Concentrations in the Sediments from the Arabian Gulf coast of Bahrain
Saleh Al-Muzaini	Air Flotation for Treatment of Industrial Wastes Discharged to Coastal Area
Lewis M. Alexander	LME's: A Regional Approach to Marine Resources Management
T.F.H. Allen	Integrity and Fragility: Human Values and the Material System
David L. Allison	Reauthorization of the Magnuson Act: An Opportunity for Public Involvement in Management of Public Resource
Adolfo Alvia	Introduction of Exotic Species for Chilean Aquaculture: An EIA Study
Summa Amarasinghe	Chair, Session D5 — Research in Changing Coastal Waters
Richard F. Ambrose	Measuring the Value of Restored Coastal Ecosystems

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Gunars Andrushaitis	Nutrient Load and Trophic Status of the Gulf of Riga, Baltic Sea
Jack Archer	Chair, Session E9 — Black and Azov Seas
D.G. Aubrey	Black and Caspian Seas: Marine Environmental Degradation
J.S. Azar Garcia	Coastal Sciences into Policy Making: Study Cases in the State of Campeche, Mexico
Saara Back	Cooperation between the Universities and Water Authorities on Phyobenthic Monitoring in Finland
William C. Baker	Chair, Session B10 — Developing and Maintain Citizen Stewardship
Andrew Bakun	Marine Catchment Basins and Areas of Riverine Influence on Coastal Fishery Ecosystems
Thomas A. Barnard Jr.	Science and Wetlands Management: The Virginia Model
James F. Bascom	Florida Current Profile at Miami Central Outfall
Vija Basko	Governance in the Riga City to Protect the Baltic Sea
Richard Batiuk	Establishment and Application of Goals within the Chesapeake Bay Program
Donald R. Baugh	Developing Citizen Stewardship through Environmental Education

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- Brock Bernstein      Chair, Session D10 — Importance of  
Monitoring to Effective Governance
- Alberto Bernstein      To Restore a Balanced Environment,  
Pushing Downhill is Easier
- Steven Bieber      Plankton Responses to Nutrient Loads in  
the Tidal Fresh Potomac River Estuary
- Birger Bjerkgeng      Fjord Model for Evaluating Measures  
Against Eutrophication — A Case study
- Eleanor A. Bochenek      Barnegat Bay Watch: A Volunteer  
Monitoring Program
- Donald F. Boesch      Chair, Session A7 — Scientific  
Communities and their contribution to  
policy
- A.V. Botello      Gulf of Mexico, Pollution and  
Environmental Impact: Diagnosis and  
Trends
- Ceferino V. Botones      A New Hope for San Miguel Bay
- Jon Lasse Bratli      The North Sea Declaration — Analysis of  
Measures to Reduce Nutrient Inputs
- James M. Broadus      A Comparative Assessment of Regional  
International Programs to Control Land  
Based Marine Pollution: The Baltic,  
North Sea, and Mediterranean
- Drew C. Brown      The Use of Stress Protein Expression in  
Environmental Assessment

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| Peter G. Brown         | State Legitimacy and Enclosed Coastal Seas   |
| Stanisława Bukowicka   | The Baltic Region in Terms of International Relationships  |
| Peter Burbridge        | The Wadden Sea: An Example of Successful Shared Governance of a Shallow Coastal Sea                              |
| William S. Burns       | Chair, Session C4 — Chesapeake Bay: A Model for Coastal Sea Governance?  |
| Arthur J. Butt         | Controlling Eutrophication in Chesapeake Bay — What Are the Options and Costs?                                   |
| J.F. Caddy             | A Brief Review of Possible Effects of Anthropogenic Inputs to Fisheries of Coastal Marine Waters                 |
| Lynton K. Caldwell     | Chair, Session A10 — How to Define Management Goals  |
| Jon Capacasa           | Developing and Environmental Indicators Package for the Chesapeake Bay Program                                   |
| James T. Carlton       | Ecological Roulette: Invasion of Exotic Species in Enclosed Coastal Seas   |
| James C. Cato          | Economic Challenges to Governance  |
| Charumas Chareonpanich | Functional Roles of a Deposit-Feeding Polychaete, <i>Capitella</i> sp. I, on the Purification of Bottom Sediment |

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| Sarah Chasis           | Chair, Session B5 — Competing Values and Interests   |
| Biliana Cicin-Sain     | Sustainable Development and Integrated Management of Enclosed and Semi-Enclosed Coastal Seas |
| Walter F. Clark        | Water-Use Planning and Zoning for Enclosed Coastal Seas                                      |
| Helidoro Conto Garcia  | Utria Creek: Sanctuary of Fauna and Forest   |
| Elizabeth M. Cospers   | Recurring Brown Tide Blooms: New Phenomenon or Only New to Science?                          |
| Robert Costanza        | Chair, Session C10 — Ecological Economics and Management Decisions                           |
| John D. Costlow        | Ignorance in a Sea of Knowledge  |
| David Cottingham       | United States Aquatic Nuisance Species Task Force  |
| Trudy Coxe             | A Federal and State Perspective on Resolving Competing Uses in the Coastal Zone              |
| Michael Crosby         | Linking Science and Policy in the Estuarine Research Reserves Program                        |
| Timmerman T. Daugherty | Changing the Regulatory Culture  |
| Tudor Davies           | Chesapeake Bay: A Model for Coastal Sea Governance?  |

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| Donald DeAngeles      | Ethics of Integrity and the Ecosystem Approach Session  |
| Edward DeBellevue     | Landscape Modeling for Estimation of Environmental Impacts on Estuaries: With and Application for the Patuxent Estuary of the Chesapeake Bay  |
| Alan Desbonnet        | Development of a Multiple Use Vegetated Buffer Policy for the Coastal Zone  |
| Alan Desbonnet        | Environmental Monitoring of Cook Inlet, Alaska through a Citizens Advisory Council  |
| James A. Dobbin       | Environmental Program for the Mediterranean (EPM) and Municipal Environmental Audits  |
| Russell S. Donnelly   | Socio-Environomics  |
| Jean-Paul A. Ducrotoy | Science and the Policy-Making World: The Protection of Species and Habitats in the North Sea Coastal Margins<br><br>The Enhancement of Scientific Knowledge of the North Sea through the North Sea Task Force |
| Do Hoai Duong         | The Status of Water Coastal Area's Environment and Marine Monitoring Problem in Vietnam   |
| William M. Eichbaum   | Integrated Coastal Management   |

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| Danny Elder      | Overcoming Sectorization: An Obstacle in the Mitigation of Stress within Large Marine Ecosystems |
| Kathleen Ellett  | Involvement of Volunteers in Watershed Management of Chesapeake Bay                              |
| Robert Finch     | Imagining the Sea: From Science to Sensibility   |
| Frances Flanigan | Chair, Session B3 — Chesapeake Bay: The Role of the Citizen                                      |
| William B. Fleck | Brackish-Water Intrusion from the Chesapeake Bay, Annapolis, Maryland                            |
| Paul M. Foer     | A Plea for Eco-Media to Cover Eco-Problems   |
| George Francis   | Towards Preventative Measures with Natural Areas in the Great Lakes Basin                        |
| Anthony Friend   | Ecosystem Approach to the Management and Restoration of the Great Lake Basin's Ecosystem         |
| Tateki Fujiwara  | Water Exchange and Transport in Strait-basin Type Estuaries                                      |
| Masatomi Funaba  | Minamata in Global Environmental Issues  |
| EJ. Gable        | The Black Sea: An Environmental and Ecological Profile with a View towards UNCED                 |



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Petre Gastescu	The Romanian Black Sea coastal zone
Joan Giordano	APES and GIS
Tatiana A. Glushko	Variety of Public Interests in the Coastal Environments of the Northern Caspian Sea in View of the Sea-level Rise and New Political Situation
Takeshi Goda	Chair, Session E5 — Seto Inland Sea  Biomass-based Diversity Index Related to Water Quality and Fishery Resources
Carole R. Gonzalez	Are There Salinity Stress Proteins?
Edna Graneli	Chair, Session D4 — Are Toxic Algal Blooms Getting Worse?
Peter Grenell	Solutions for Dredging and Agriculture Impacts on Estuarine Wetlands
Peter Haas	Scientific Communities and Multiple Paths to Environmental Management
Michael S. Haire	The Watershed Approach to Coastal Sea Protection
Reginal M. Harrell	Aquaculture and Pollution: Biological Issues versus Economic Potential
Daniel Hartman	Israel's and the Gaza Strip Coasts: CZM and Earth-Science Aspects
Peter M. Hass	Scientific Communities and Multiple Paths to Environmental Management

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- Takeshi Hata                      Preservation of Coastal Water by Sustainable Development Strategies of River Water
- Virginia Haufler                    International Regimes and Private Interests in Environmental Issue Areas
- Gary Heath                         Chair, Session B9 — How Can Environmental Education Make a Difference?
- Carlo Heip                         Benthic Community Structure Studies as Management Tools for the North Sea
- E. Lamere Hennessee             Part II, Zinc Enrichment of Bottom Sediments Around a Dredged Material Containment Facility
- Eric Hildebrand                    Maryland's State Water Quality Advisory Committee — A Model for Public Participation
- James M. Hill                      Interpretive Techniques for Assessing Trace Metal Levels in Estuarine Sediments
- Michael Hirshfield                The Chesapeake Bay Program: Can it Help Save Your Bay?
- Thomas Horton                    Chair, Session B2 — Humanities and the Coastal Systems
- Akira Hoshika                     The Role of Particulate Matter in Materials Transport in Osaka Bay, Seto Inland Sea, Japan

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| Hans Olav Ibrekk    | Norwegian North Sera Action Program<br>— Local Need for Pollution Abatement<br><br>Baltic Sea Environment Program.<br>Pre-Feasibility Study of the Kaliningrad<br>Region, Russia |
| Michael A. Jacobson | The U.N. Regional Seas Programme: How<br>Does It Measure Up?   |
| Tassilo Jager       | Rearing of Freshwater Fish Larvae in<br>Illuminated Net Cages  |
| AnnMari Jansson     | Shifts in the Ecological Economic<br>Interface of the Baltic Sea Region  |
| Bengt-Owe Jansson   | Chair, Session C3 — Models as Tools for<br>Management and Decision-making  |
| Sheila Jasanoff     | Compelling Knowledge: What makes<br>Science Useful to policy?  |
| Norbert Jaworski    | Quantifying Contaminated Loadings into<br>the Northeast Large Marine Ecosystems  |
| Guo Jinghui         | Nearshore Pollution Control of China in<br>Ten Years   |
| S.J. Jordan         | Estuarine Biota and Environmental<br>Quality in Chesapeake Bay Tributaries   |
| Tsveta Kamenova     | Bulgarian Black Sea Coast Sustainable<br>Development-Problems and Potentialities   |
| See W. Kang         | The Water Quality Control in<br>Masan-Jinhae Bay, Korea  |

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- Kaoru Kashima      Diatoms at Coastal Lagoons in Japan:  
Their Historic Changes during Five  
Hundred Years
- James Kay            Emergent Complexity
- Stephen Kellert      Environmental Values, the Coastal  
Context, and a Sense of Place
- Frederick G. Kern    The Problem of Non-Indigenous Species
- Ahmed Khattab        Jordanian Coastline Protecting on the  
Red Sea
- Yoshimobu Kido      Chair, Session D7 — Research and  
Governance on Japanese Coastal Seas
- Recreation Value in Enclosed Coastal Sea  
in Terms of Willingness to Pay for Water  
Quality Improvement
- Lee A. Kimball        Chair, Session B7 — Political Action and  
Governance
- Dennis M. King        Using Market Forces to Manage the  
Ecology of Enclosed Coastal Seas
- Victor V. Klemas      A Coastal Land Cover Classification  
System for Use with Geographic  
Information
- Robert W. Knecht    The U.S. Approach to the Management  
of Enclosed Seas
- Drew Knight           Systems Approaches to Coastal Zone  
Management in Bali, Indonesia

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| Yoshinari Kobuke   | Long-term Loading of Organic Pollutants from Urban Streams and Its Effects on Coastal Sea Environment   |
| Kunio Kohata       | Comparison Among Organic-Matter Parameters Observed in Tokyo Bay  |
| Toomas Kokovkin    | Environment and Management on the West-Estonian Islands   |
| Yukio Komai        | Relationship between Bottom Sediment and Sinking Particles in the Osaka Bay, the Seto Inland Sea, Japan |
| Hideaki Koyanagi   | Measures for Environmental Conservation in the Seto Inland Sea  |
| Majorie P. Kraus   | Virus Toxicity in Shellfish Waters  |
| Ronald M. Kreitner | Protecting the Chesapeake Bay through Regional Growth Management Policy                                 |
| Nubuo Kumamoto     | Chair, Session C1 — Legal Issues in Coastal Sea Governance  |
| Ain Laane          | The second Baltic Sea Pollution Load Compilation  |
| Mark B. Lapping    | Information for Environmental Decisions: The Public Necessity   |
| Duncan Leadbitter  | Commercial Fishing Industry Makes a Stand on Australian Coastal Zone Issues                             |
| Chan-Won Lee       | Causes of Coastal Water Pollution and Characteristics of Sediments in Jinhae Bay, Korea                 |

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- Stuart Lehman**      Using Synoptic Water Quality Surveys to Target Nutrient Management Programs
- Maryland's Targeted Watershed Project: Integrated Watershed Management
- Herwig Lehmann**      Possibilities of Reducing Nutrients under Support of Models
- Sally Ann Lentz**      Pollution and the Precautionary Principle
- Sally Lerner**      Constituency-Building: The Role of Environmental Non-governmental Organizations
- Sally Lerner**      Constituency-Building in the Great Lakes Basin: The Role of ENGOs
- Thomas M. Leschine**      Water Quality Governance for Puget Sound: A Collective Choice Perspective
- Paul Levy**      Role of the Media Session
- Alan Lewitus**      The Phantom Dinoflagellate a Widespread and Significant Threat to Fisheries
- Richard Lindthrust**      The Environmental Monitoring and Assessment Program (EMAP)
- Lewis C. Linker**      Application of the Chesapeake Bay Water Quality Models to Determine the Impact of the 1990 Amendments of the Clean Air Act on Chesapeake Bay Water Quality

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Douglas Lipka	The Gulf of Mexico Program
Ronnie Lipschutz	Global Civil Society and Protection of the Global Environment
Shengping Long	Models of Coastal Development and Management of Northern Hangzhou Bay
Patricia M. Mace	Aligning Biological and Management Scales for Marine Conservation
Robert E. Magnien	Response of the Patuxent Estuary to Nutrient Controls
S.J. Malcolm	Estimating the Flux of Nutrients into the Western North Sea
Thomas C. Malone	Science and Management of Nutrient Loadings to Coastal Ecosystems
Vladimir O. Mamayev	Ecological Consequences of the Sea-Level Rise in the Black Sea
Andrew Mangan	A Business Council for Sustainable Development in the Gulf of Mexico
Concepcion Marcos-Diego	Land Capability for Aquaculture in the Mar Menor (Murcia, SE of Spain)
Harold G. Marshall	Dinoflagellate Blooms in the Lower Chesapeake Bay
Osamu Matsuda	Effects of Low Oxygen and Hydrogen Sulfide on Crab Population
Shiro Matsunashi	A Eutrophication Model for Enclosed Coastal Sea

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- Masaji Matsuyama** Numerical Experiments of Upwelling,  
Relating to Aoshio in Toyko Bay
- William Matuszeski** Chair, Session E1 — Chesapeake Bay:  
The Chesapeake Bay Program
- Leticia M. Mayr** Salinity Evolution in Guanabara Bay  
(Brazil) between 1980 and 1990
- Salinity Changes in Guanabara Bay, Rio  
de Janeiro, Brazil
- M. G. McCormick Ray** Protected Areas in Enclosed Sea  
Management
- Alasdair McIntyre** Chair, Session D8 — Coastal Fisheries  
and Coastal Pollution
- Andy Meyer** We the people: The Maryland Coastal  
and Watershed Resources Advisory  
Committee
- David R. Miller** Technological Advances in Mapping the  
Florida Keys Marine Sanctuary
- J. Walter Milon** Measuring Public Preferences and  
Economic Values for Marine Resource  
Restoration and Enhancement
- Marian Mlay** Concepts of Integrated Management
- Shigeru Montani** Impact of Marine Fish Cage Farming on  
Enclosed Coastal Sea Environments
- Tohru Morioka** Towards Environmentally Sound  
Development in Osaka Bay Area



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|                       | Recreation Value in Enclosed Coastal Sea in Terms of Willingness to Pay for Water Quality Improvement.         |
| Paul Munro-Faure      | Leasing and Licensing Policies in Coastal Marine Areas   |
|                       | What is the Role of Undergraduate Institutions in Environmental Education                                      |
| Motohiko T. Murakami  | Ecopolis Plan of the Coastal Areas of Kobe City, Japan   |
| Craig Murphy          | Intellectual Leadership, Political Leadership and International Policy Making                                  |
| W. Tayloe Murphy, Jr. | Government as the Guardian of the Public Trust   |
| Kenichi Nakagami      | Coastal Zone Government and Environment Policy   |
| Hiroshi Nakanishi     | Research on the Management of Seto Inland Sea using a Long-term Simulation Model of Water and Sediment Quality |
| K.T. Nakatsuji        | The Impact of Large-scale Reclamation on Estuarine System in Semi-enclosed Osaka Bay, Japan                    |
| Mitsuru Nakayama      | Environmental Rights in Japan  |
| Naoko Ueda            | Recovery of Marine Bottom System of a Bay adjacent to a Heavy-Chemical Industrial Area in Japan                |

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- Gordon Nelson      Ecosystem Management in Java, the  
Baltic Sea and the Great Lakes
- Understanding Regional Enclosed Seas for  
Ecosystem Management: International  
Studies
- Robert H. Nelson      Ecosystem Restoration: Is the Goal to  
Recover the Garden of Eden?
- Steven Nelson      Integrating the Scientific Community  
into Coastal Management and Decision  
Making: The Chesapeake Bay Experience
- Bosse Norrman      New Monitoring Programs for the Marine  
Environment: How to Increase the Level  
of Understanding
- Judith F. Nowak      Monitoring Seagrass Distribution and  
Abundance in Chesapeake Bay Using  
GIS
- Tomotoshi Okaichi      Scientific Researches as the Base of the  
Countermeasure to Red Tide Outbreaks in  
the Seto Inland Sea
- Koji Omori      Limitations of Total Quantity of Matter in  
a Coastal Ecosystem
- Erdal Ozhan      Management Issues of the Turkish Black  
Sea Coastal Zone
- MEDCOAST: An Initiative for Rational  
Management of Mediterranean Coastal  
and Sea Resources

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William Panageotou	Application of Dredged Sediment Studies to the Management of Overboard Disposal Sites
Cornelia Pasche	Herring and Hydrocarbon Conflicts in the North Sea
Arsen Pavasovic	Implementation of Integrated Coastal Management in Mediterranean Developing Countries
James N. Paw	Geographic Information Systems for Coastal Zone Management in Lingayen Gulf, Philippines: Relevance and Constraints
Gerard Peet	Political Action and Governance: The North Sea
Stuart Pimm	Chair, Session A9 — Feasibility of Ecosystem Restoration
Mathias K. Pofagi	Benin: Stakeholders Citizens and Private Interests: Competing Value Interests
Sukhum Poothong	Shrimp Farming: A Coastal Crisis
Ann Powers	Save the Bay — The Role of Non-Governmental Organizations
Velimir Pravdic	Control of Land-based Sources of Pollutants in the Adriatic Sea: Scientific Evidence and Management options
Patricia J. Pudalkewicz	Chesapeake Bay Critical Area Program: State and Local Government Partnership

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- He Qiang**                      Semienclosed Coastal Sea's  
Environmental Protection Technology  
for Refinery Wastewater
- Stanislaw Radwan**            Ecological Possibility of Fishery Usage  
(utilization) of The Coal Mine Waters
- Clifford W. Randall**           Chair, Session D2 — Chesapeake Bay:  
The Role of Science
- Urve Ratas**                    Ecological monitoring on the Low Shores  
of Estonian Islands
- Henry Regier**                The Great Lakes Basin: From Pristine to  
Degraded to Rehabilitated
- A Coherent Vision for the Great Lakes -  
St. Lawrence River Basin Ecosystem
- Natural/Cultural Ecosystems of the  
Great Lakes Basin: Degradation and  
Rehabilitation
- An Ecosystem Approach to the Great  
Lakes - St. Lawrence River Basin
- Enrique Reyes**                An Ecological Economic Simulation  
Model of Laguna de Terminos, Mexico
- Ronald B. Roldan**            The Philippine Fisheries Sector Program
- James N. Rosenau**            Enlarged Citizen Skills and Enclosed  
Coastal Seas
- The Delicacies of Governance and the  
Complexities of the Environment

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| Massoud A.H. Saad   | Environmental Conditions of the Mediterranean Coastal Waters Directly Influenced by the Fresh Water Discharge from the Principal Estuary of the Nile |
| Mark Sagoff         | Saving Places: The Management of Enclosed Coastal Seas   |
| R. Santhanam        | Impact of Thermal Power Plant's Fly Ash on the Mangrove Fauna and Flora of Tuticorin bay, Southeast Coast of India                                   |
| Jerry Schubel       | Integrated Coastal Management and the New Governance: Who's on First?  |
| David B. Scott      | Modification of Local Sea Floor Environments by Aquaculture Operations: Temporal Changes Reflected by Benthonic Foraminifera                         |
| Louise Fallon Scura | Lessons for Integrated Coastal Zone Management: The ASEAN Experience   |
| Masahiko Sekine     | Importance of Considering Fish Behavior in Coastal Sea Ecological Modeling   |
| Rafal Serafin       | Sustainable Development on Poland's Baltic Coast: The case of Ustk   |
| Harvey A. Shapiro   | Citizen Responses to Development in the Seto Inland Sea Region   |
|                     | Chair, Session F5  |
|                     | Challenging Traditional Coastal Development  |

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- Louis E. Sherman      Demonstration: Use of Marineskimmer Boats to Clean up the Environment in Near-shore Coastal Waters
- Kenneth Sherman      Chair, Session C2 — Management of Large Marine Ecosystems
- Montani Shigeru      Impacts of Marine Fish Cage Farming on Enclosed Coastal Sea Environments
- Ron Shimizu      Evolving Institutional Arrangements for Great Lakes Management
- Frank Shipley      From Pollution Control to Ecosystem Integrity in Great Lakes Governance
- Frank Shipley      Science and Management Planning for Galveston Bay, Texas
- Lynn R. Shuyler      Cost Analysis for Nitrogen Control Strategies in the Chesapeake Basin
- Daniel Simberloff      The Role and Conservation Biology in Managing Biodiversity
- Theodore J. Smayda      Harmful Algal Blooms and Toxicity in the Sea: A Global Increase?
- Larry Smith      Taking Management Costs Seriously: A North American Great Lakes Case
- Jens Sorensen      The Management of Enclosed Coastal Water Bodies: The need for a Framework for International Information Exchange
- Frank Steimle      Artificial Reefs for Habitat Loss Mitigation: Delaware Case Study

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| Cynthia A. Stenger | Vision of a Balanced Ecosystem for Chesapeake Bay  |
| Susan Stranahan    | Chair, Session B1 — Role of the Media<br>Role of the Media   |
| Kunio Sugino       | Analysis for Organohalogen Compounds Formed during Seawater Chlorination   |
| Robert M. Summers  | Application of a Water Quality Modeling System in the Development of Management Strategies for the Restoration of the Patuxent Watershed Estuary, Maryland |
| Ann Pesiri Swanson | Chair, Session B8 — Citizens and Information: A Critical Interface   |
| Shunji Takeshita   | Predictive Factors for Aoshio Occurrences in Toyko Bay   |
| Frieda Taub        | When Ecology Doseen't Play Straight, How Can Responsibility Be Allocated?  |
| Kenneth R. Tenore  | Chair, Session D9 — Interactions Between Coastal Seas and Offshore Ecosystems  |
| Daniel E. Terlizzi | The Zebra Mussel Threat in Maryland: Promoting Action Through Awareness  |
| Peter S. Thacher   | Chair, Session C9 — Coastal Seas Governance after UNCED  |
| Chua Thia-Eng      | Management of the Shallow Coastal Seas in ASEAN: Lessons learned   |

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- Robert V. Thomann      The Chesapeake Bay Water Quality  
Model and Nutrient Reductions
- James P. Thomas        The Viewpoint of a Practitioner of  
Restoration
- Michael Thompson      Managing the Unmanageable
- Boyce Thorne-Miller    Waste Prevention Audits of River Basins
- Marion Trykaza         Balancing Environment and  
Development: Challenges, Opportunities,  
and Plans for the City of Gdansk
- Hiroaki Tsutsumi        Biological Treatment of Organically  
Polluted Sediment Deposited on the  
Marine Bottom
- Monthip S. Tubucanon   Fate and Distribution of PCB's from used  
Capacitor Storage around the Chao  
Phraya Estuary, Thailand
- Saburo Uchiyama        Analytical Study on Human Health and  
Environment using Remote Sensing  
Information
- Naoko Ueda             Recovery of Marine Bottom Environment  
of Dokai Bay, Japan
- Masao Ukita             Estimation of the Amenity Value of  
Hakata Bay
- Adalberto Vallega      From the Mediterranean Action Plan to  
the Mediterranean Agenda 21



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Stacy VanDeveer	State Sovereignty and International Cooperation for Enclosed Coastal Sea Protection
Harald-Adam Velner	Chair, Session E3 — Baltic Sea
Edna Villanueva	Turning the Tide on Trash: A Learning Guide on Marine Debris
Peter R. Vogt	Shoreline Erosion along Chesapeake Bay Calvert Cliffs
Ilija Vukadin	Transport and Budget of Nutrient Elements in Kastela Bay (Adriatic Sea)
Robert E. Wall	The Gulf of Maine RMRP: Moving Toward Ecosystem Simulation and Prediction
Richard K. Wallace	Modeling Brown Shrimp Production in the Mobile Bay Estuary
Claudia P. Walters	Quality Assurance: The Key to Successful Environmental Programs
Shinichi Wano	Water Environment in Oofunato Bay along the Sanriku Rias-type Coast Line
Philip Warburg	Protecting the Gulf of Aqaba
Bud Ward	Role of the Media Session
Robert Wayland	Moving Toward National Ecological Protection
Laura Westra	Chair, Session A4 — Ethics of Integrity and the Ecosystem Approach

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Robert Jay Wilder	Making Environmental Policy in the Face of Scientific Uncertainty
Michael D. Willinsky	Survival of Aquaculture Cages in Offshore Environments
Craig J. Wilson	Using Monitoring Information to Help Manage California Coastal Water Quality
George B. Wolff	Chesapeake Bay: Role of the Citizen
M. Gordon Wolman	Chair, Session A3 — Place, Locality, and Community
Fredrik Wulff	Chair, Session D3 — Eutrophication of Coastal Seas
Tamiji Yamamoto	New Experimental Approach to Nitrogen Release from the Marine Sediments
Shiro Yamashoji	The Rapid Detection of Toxic Compounds by New Cytotoxicity Test
Tetsuo Yanagi	Carbon Flux from Eutrophicated Tokyo Bay to the Pacific Ocean
Alejandro Yanez-Arancibia	Chair, Session E2 — Gulf of Mexico and Caribbean Sea
Leonid Yarmak	Black and Azov Seas Session
Hideichi Yasuda	Structures of Longitudinal Mass Flux in Tidal Basins
Jerzy Zaleski	Prospects for a Baltic Europe: The View from Poland

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V.S. Zaletaev

Modern Regression of the Aral Sea:  
Desertification of the Postaquatic  
Territory and Problems of Preventing  
Ecological Catastrophes

Zhu Ziaoquin

Comprehensive Treatment and Control  
of Water Environment of City by System  
Engineering Method