WATER

The Global Coastal Zone

DIPLOMATIC PLANET INTERVIEW WITH

Dr. Thomas C. Malone

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Introduction - The coastal zone is that boundary between earth, water and sky that concentrates the most continuous rhythms of change and, arguably, the most diversity of nature's forces and interactions - and in which life flourishes and fluctuates.

The concentration and attractiveness to our activities of life, work and play continue to impose additional burdens on the coastal environment.

We address the challenges of understanding these dynamic elements and the consequences poorly even though the risks are huge and the rewards are fundamental to our future !

The Global Coastal Zone

Environmental Issues and Strategies

DPlanet: We thank you for this opportunity to look at environmental issues from your perspective and to relate your viewpoint to the issues faced by the policy and decision makers in government and in business. There are two underlying questions that we would ask you to address: (1) What are the environmental issues that impact the formulation and implementation of environmental policy today and how might these evolve over the next 10 years? (2) How should corporations be adjusting their strategies based on your view of current and future issues?

Dr. Malone: I am comfortable with the first question, but I'm not with the second. Since I have no real experience in the corporate world, it would not be appropriate for me to be giving my opinions on how corporations should be adjusting their strategies. I can speak to environmental issues that are or are likely to have significant impacts on the private sector.

DPlanet: Let's start with the activities at your facility - part of the University of Maryland Center for Environmental Studies (UMCES).

Dr. Malone: UMCES is a rather unique organization as it is an autonomous research unit within the University of Maryland system, composed of three laboratories: The Horn Point Laboratory, which I direct; the Chesapeake Biological Laboratory directed by Dr. Kenneth R. Tenore; and the Appalachian Laboratory directed by Dr. Louis F. Pitelka.

UMCES employs 75 faculty whose work emphasizes basic research that is increasingly being used to address applied problems in the environment.

We are not only unique in how we are institutionally organized within the State, but we are unique in that we have a faculty that has the collective expertise to address environmental issues from coastal drainage basins and estuaries to coastal waters and the oceans. We cross that boundary between activities on land and the activities on water in ways that very few other institutions can do.

Focusing on Horn Point, the laboratory that I direct: We employ about 130 scientists, technicians, students and support staff, We have an annual budget of about $7 Million and of that, roughly 60% comes from state and federal grants, with the other 40% coming from our Maryland State appropriation.

The programs that we have at Horn Point span a broad spectrum of basic and applied research on the role of the oceans in global climate change and nutrient cycles, aquatic food webs, the biogeochemistry of aquatic systems, the restoration of habitats and ecosystems, aquaculture, and the effect of nutrient enrichment and habitat loss on the goods and services provided by coastal ecosystems.

The flavor of this research is given by describing three of our ongoing, interdisciplinary team projects: One of our research programs, sponsored by the National Science Foundation (NSF) as part of their Land-Margin Ecosystem Research (LMER) program, focuses on how the physical features associated with water circulation and mixing in the Chesapeake Bay influences the relationships between the nutrients coming into the Bay and the productivity of the Bay in terms of fish harvest and other measures of productivity.

In essence, the questions we pursue are - "Why is the Chesapeake Bay so productive, and what processes control how nutrients coming into the Bay are transferred and transformed into living resources ?".

This LMER project is a collaboration with the faculty at our Chesapeake Biological Laboratory and with Old Dominion University in Virginia. The lead researchers are Drs. Walter Boynton, Mike Roman, Ed Houde and Bill Boicourt.

A second program, CISNet (Coastal Index Site Network) is funded by the EPA (Environmental Protection Agency), NASA (National Aeronautical and Space Administration), and NOAA (National Oceanic and Atmospheric Administration) . The issue here is the many changes that are occurring in the coastal zone that impact the environment, local and regional economies, and the quality of life.

We don't understand the causes and consequences of these changes, and, in many cases, we don't even know the details of the patterns of change themselves.
CISNet consists of a set of approximately ten index sites around the country that are intended to conduct monitoring and research on the relationship between land use activities in coastal draining basins and the changes in the water quality and living resources in the waters into which they drain.

Thomas C. Malone, Ph.D.
At the time of this interview, Dr. Malone was Laboratory Director of the Horn Point Environmental Laboratory (HPL) located on the banks of the Choptank River in Maryland's Eastern Shore, near the city of Cambridge.

Dr. Malone served (1998 thru 2000) as President of the American Society of Limnology and Oceanography (ASLO) - one of the leading international associations for environmental research on lakes, rivers, groundwater, estuaries and oceans.

Dr. Malone's Field of Study is Biological Oceanography, and he holds the rank of Professor.

He earned his Ph.D. from Stanford University .

UMCES Summary
The University of Maryland Center for Environmental Science (UMCES) is the foremost institution for environmental research within the University System of Maryland and is a world leader in the science of coastal environments. The Center's faculty members include scientists, engineers, and economists who work together in a truly transdisciplinary community. UMCES has made many essential scientific contributions to the restoration efforts of the Chesapeake Bay and participates in research all over the world.

Over 12,000 students, teachers, and parents annually participate in the Horn Point Environmental Education program. Through field trips arranged by their schools, K-12 students and teachers can experience the programs activities that take advantage of the campus' 850 acres of woodland, shoreline, fields, and wetlands.

Source: www.umces.edu

This effort includes the Maryland Department of Natural Resources, and the EPA's Chesapeake Bay Program. The lead researchers are Drs. Bill Boicourt, Jeff Cornwell, Larry Harding and Court Stevenson.

A third program is funded by the EPA and is the Multi-Scale Environmental Ecosystems Research Center (MEERC). The goal is to learn how to extrapolate the information learned from experiments conducted in test tubes in the laboratory to what actually happens under natural conditions in the field.

That is a very big issue in terms of knowing how to interpret an experiment that usually involves a very simplified interaction in terms of the kind of interactions that occur in natural ecosystems. One example would be, if you have an experiment that looks at the impact of mercury on an organism's growth in a test tube, we know it does not have the same effect on the same organism in the natural environment. So we have to learn how to scale up those small scale, test tube observations to the whole system.

All three of these programs are multi-year, multi-Million dollar programs, which involve between 10 and 20 scientists, students and technicians - and are truly interdisciplinary projects. The land-margin program (LMER) has been going on for approximately ten years, the index site program is in its first year of a three year proof of concept study, and the EPA MEERC program is in its 8th year of funding.

The length of time that these programs are on-going reflects the fact that the government agencies have realized that you cannot answer these questions within a one or two year time-frame.

Current Focus and Activities

DPlanet: What background and events brought you to Horn Point and how have the types of science, the areas of expertise changed within your profession ?

Dr. Malone: My background is in oceanography. I was recruited from Brookhaven National Laboratories, where I was working on problems related to nutrient enrichment of coastal waters and the role of coastal ecosystems in the global carbon budget.

When I came to HPL, I broadened my work to include the ecology of estuaries which requires knowledge of both terrestrial and oceanic influences. I found this to be both challenging and fun, and most of my work since coming to HPL has focused on the effects of anthropogenic activities on coastal ecosystems, which is arguably one of the most important environmental problems that we face in terms of both the impacts of people on the environment and the effects of consequent changes in the environment on people.

However, by far the biggest change and challenge in my career occurred 10 years ago when the President of UMCES died unexpectedly, and I was asked to step into that position in an acting capacity - for a year and a half. This required a rapid transformation from an academic research scientist in the classic sense, i.e., from being happily engaged in basic research to becoming an administrator, something that I had studiously avoided throughout my career.

Since then, administrative duties have dominated most of my professional life. This also resulted in my becoming involved in issues of environmental and resource management at both the State and Federal level.

I was surprised by the extent to which environmental management, which is really "people management", is responsive rather than proactive and the extent to which environmental policies are driven by politics with little concern for the scientific basis of such policies. This was perhaps naive on my part, but it refocused my agenda on bridging the gap between scientific knowledge and public perception and developing a "World Weather Watch" type approach to monitoring and predicting environmental changes in the coastal zone.

I am currently President of the American Society of Limnology and Oceanography, a non profit society with about 4000 members. The society promotes the exchange of ideas and information between its members using conferences and workshops. We publish a technical journal, and we are beginning to actively promote the more effective use of scientific information in the formulation and implementation of environmental policy. That effort is trying to bridge the gap between the world of scientific knowledge and public perceptions.

My other major activity, in addition to directing Horn Point, is my role as Chairman of a United Nations panel that is developing guidelines for the design and

implementation of a global, coastal ocean observing system, referred to as C-GOOS, which is the coastal component of the Global Ocean Observing System (GOOS).

In 1992, the UN Conference on the Environment and Development (UNCED), held in Rio, called for the establishment of a global observing system which had operational goals to enable effective and sustained management and utilization of marine environment and natural resources, and to develop a capacity to predict future changes with a known level of certainty.

The "GOOS" was initiated in 1992 as part of an integrated global observing strategy that the UN is sponsoring through its member countries that includes, in addition to the Global Ocean Observing System, the Global Climate Observing System, and the Global Terrestrial Observing System.

These three efforts are sponsored by the Intergovernmental Oceanographic Commission (IOC), the United Nations Environmental Programs (UNEP), the World Meteorological Organization (WMO), and the International Council of Scientific Unions (ICSU).

An example of the impact of these programs was recently demonstrated by the sensor arrays that were deployed in the oceanic tropical Pacific (NOAA's TOGA-TAO Array). These instruments and the global scale assimilation models developed to forecast climate changes on regional to global scales provided the data and tools required to predict the development of El Nino and its global effects on climate.

Comparable Facilities and Institutions

DPlanet: Where are the other major Centers, or groups, that are engaged in similar activities ?

Dr. Malone: It would be difficult to provide a comprehensive list, as there are a variety of institutions that are involved in these issues from different perspectives.

However, UMCES is one of the few institutions in the world that has the mix of expertise within its own faculty to address environmental issues in the coastal zone, from drainage basin to the open ocean.

There are a couple of institutions that I would highlight, in the US - the Institute of Ecosystems Studies, which is a part of the Carry Arboretum in Milburn, New York - that is Directed by Gene Likens, and the Ecosystems Center of the Marine Biological Laboratory in Woods Hole directed by John Hobby.

On the international level, one of the Centers that we interact with is the National Environmental Research Institute in Denmark, which has taken a similar strategy in terms of developing a faculty that can do trans-disciplinary research, ranging from the problems of terrestrial ecology, to drainage basin studies, and to more classical oceanography in coastal waters and beyond. This list is certainly not inclusive.

Global Collaboration

DPlanet: Is there much collaborative work done between your Center and those other program centers that you mentioned? Can you quantify that exchange? Is it

done primarily through the exchange of Study Reports and publishing of data, or are there direct interactions and contributions that occur?

Dr. Malone: The extent to which environmental science depends on teams of scientists has increased over the past twenty years. Much of the research in environmental studies was done by individuals or small groups of scientists focused on specific, disciplinary problems.

More and more we have begun to realize that most environmental problems are very inter-disciplinary and that we cannot understand them, or even ask the right kinds of questions, unless we take a more inter-disciplinary or trans-disciplinary approach.

Once you get to that realization, you move into teams of scientists, ten to thirty individuals who are working on the same project. A good example is the research conducted in recent years on how biological activity in the oceans influences the exchange of CO2 across the air-sea interface and hence global climate change.

Almost all of the research that I have been engaged in has involved groups of scientists who have come together to solve problems by integrating physical, chemical, biological and geological perspectives. Today there is a greater emphasis on team research and collaboration between institutions, and it is increasing.

Focal Points for Environmental Research

DPlanet: Are there dominant schools of thought which predetermine the focus areas for these research efforts?

Dr. Malone: Most people engaged in scientific research, particularly people who have spent a lifetime in a particular pursuit, tend to be somewhat biased in their perception of what the important problems are.

For example, in oceanography, there has been a tendency to emphasize the global significance of the open ocean with relatively little attention given to the coastal zone which encompasses coastal drainage basins and coastal waters.

Likewise, scientists working on environmental issues on land, have tended to emphasize the importance of terrestrial processes. Consequently, problems in the coastal zone have not received the attention they deserve. There is certainly a good agreement on what the important problems are -- global climate change, water and air quality, biodiversity and habitat loss.

However, the global significance of the changes occurring in the coastal zone has not been appreciated until recently. For example, the debate over the effects of human activities on global climate has shifted from whether or not change is occurring at an accelerated rate to one of how increases in green house gasses will play out in terms of the magnitude of change and the regional effects of change.

Top Environmental Issues

To attempt to enumerate the top issues or problems being investigated, a little background is required: The combustion of carbon fuels and how that impacts on climate and the cycles of carbon and nitrogen on a global scale is acknowledged as

one of the central issues faced by today's society. Given the central nature of this issue, it is difficult to separate it from other issues such as coastal eutrophication or the quality of the air we breath and the water we drink -- they're all inter-related. The major problems that we are facing should be viewed in the context of inter-relationships rather than as a list of independent problems.

We know that human activities are effecting the ecosystems upon which our standard of living and, indeed, our survival depend. We need to simply think of ecosystems as being the places in which we live and work. They are systems upon which our livelihoods, our quality of life, and our economies are ultimately dependent.

In this regard, there are two fundamental and interrelated questions, and they are necessarily, very broad: First, - How are human activities changing the ecosystems on which we depend? -- and second, - How will these changes effect the standard of living and quality of life for future generations? This second question is the one that we do not always ask and one that we are all too ignorant about.

The answers to these questions, or the lack of answers, will have a huge impact on how we manage, or do not manage, human activity in our attempt to sustain healthy ecosystems and the resources that they support. Scientific knowledge will also determine the effectiveness of actions taken to mitigate natural hazards and to promote safe and efficient marine based operations.

The Coastal Zone Focus

My own bias is that, if we are to develop meaningful answers to these questions in a timely fashion, we must pay more attention to what is happening in the coastal zone. I base this on the reality that the combined effects of climate and human activities on the environment will be most pronounced in coastal ecosystems for several reasons.

First, the coastal zone is unique in that it is the only place that is simultaneously subjected to inputs of energy and materials from the land, from the sea, from the air and from people. That has significant consequences when we begin to think of the effects of the interplay between global climate and human activity in our coastal zone.

Second, ecosystem goods and services are concentrated in the coastal zone.

The effort to develop systems by which the value of living resources can be assessed in ways that are meaningful in the long term has intensified in recent years. One of these analyses estimated the value of ecosystem goods and services to be about $30 Trillion dollars, about 40% of which is concentrated in the coastal zone.

Regardless of the accuracy of these figures, it is clear that we need to learn how to manage ecosystems as investments where the interest earned is equivalent to the sustained productivity of the system, e.g., monetary values can be assigned to seagrass beds based on the fisheries they support or to wetlands based on their capacity to mitigate flooding.

This also speaks to a question you have termed "Valuable Incentives", to wit, "If the value of the water system was used to measure the value of land within that system today, would we not give credits to good upstream managers that they could trade for exclusive licenses over the downstream productivity?"

Third, the number of people living in the coastal zone is increasing rapidly. Currently, about 50% of the world's population lives within 120 miles of the coast. By the year 2010 it is estimated that more than half of the U.S. population, some 130 Million people, will live within 50 miles of the coastline.

Coastal Zones - Increasing Concentrations of People and Activities
Within 25 years, current projections are that 75% of the entire Earth population will live within 120 miles of the coast. This region accounts for only 10% of the total land area on the Earth.

Land use practices, our ability to control contaminants, and the susceptibility of our populations to natural hazards, like hurricanes, earthquakes and coastal flooding, indicate that the risks to large segments of our population will increase as the number of people living in the coastal zone increases.

It doesn't take too much imagination to realize that this place where interactions between people, land, ocean and atmosphere are most intense will also be the place where environmental issues will be most controversial and have the greatest impact on human society in the absence of scientific understanding.

Coastal Zone - Stressed Out
The rapid increase in population density is stressing coastal ecosystems in several different ways. These include the physical restructuring of the environment through various land-use practices, alteration of fresh water flow patterns, dredging etc.; nutrient mobilization and over enrichment of coastal waters with Nitrogen and Phosphorus; chemical contamination of air, soil and water; exploitation of living resources; and introductions of exotic species.

These stresses are causing profound changes in the capacity of coastal ecosystems to support living resources and the quality of life. They are making the coastal zone more susceptible to natural hazards, more costly to live in, and of less value to the national economy.

The symptoms of stressed ecosystems include (1) oxygen depletion, harmful algal blooms, and chemical contamination of organisms; (2) shellfish bed closures and fish kills; (3) loss of habitats and biodiversity; and (4) declines in living marine resources. Although each of these indicators of stress tends to occur on local to regional scales, they are not limited by national borders, to particular regions, or to specific ecosystems.

They are occurring in coastal waters world-wide - they are globally ubiquitous, and they indicate profound changes in the capacity of coastal ecosystems to support living resources and the quality of life.

Of course anthropogenic stresses and these symptoms of environmental change must be considered in the broader context of large scale weather patterns and global climate change. It has become abundantly clear in recent decades that the weather can have an enormous impact on the magnitude of both anthropogenic stresses and their symptoms.

Stress Compounded by Global Climate Change

This problem will be compounded by global climate change depending on how it plays out over the next few decades.

For example, during the next 100 years, rising sea level (SL) may inundate large areas of coastal wetlands and significant portions of dry land less than 20 inches above sea level. In many areas, wetlands and beaches may be squeezed between advancing sea level and engineered structures.

Rising SL will also raise the base for storm surges and substantially increase the size of the 100 year flood plain. Assuming that current development trends continue, flood damages incurred by properties subject to SL rise are projected to increase by as much as 50% for a 12 inch rise and by over 100% for a 35 inch rise. In addition, saltwater is likely to intrude further inland and upstream, threatening drinking water supplies.

Add Human Activities to the Variables

Last but not least, we know very little about how human activities are altering coastal ecosystems and how these changes will affect the quality life for future generations. Of central importance is how land-use practices are affecting coastal ecosystems.

Let me give two examples, the Pfiesteria bloom in a small tributary of the Chesapeake Bay in 1997 and the current debate over saving Salmon in the Northwest US. The 1997 Pfiesteria event in Chesapeake Bay occurred on a small tributary to the Bay located on the Eastern Shore.

It caused a small fish kill of menhaden (estimated at 30,000 fish), and, more importantly, appeared to be a public health problem (lesions, short term memory loss in 5-10 people). Because this event, and others like it in North Carolina occurred in estuaries that have drainage basins which support major hog and chicken industries, most of the public -- except of course farmers who grow hogs and chickens and use their manure as fertilizer -- concluded that manure from hog and chicken farms is the source of the problem.

There is no scientific evidence that this is in fact the case. Even so, retail sales of fish in Maryland dropped by 50% for the next 2 months regardless of where the fish came from and despite the fact that the fish affected, menhaden, are not sold for human consumption. The Maryland legislature reacted by passing laws that regulate the use of chicken manure, despite the lack of any evidence that chicken manure is the source of the problem.

It may very well be that the storage of animal wastes and their use as fertilizer are sources of the problem, but the local economy was adversely affected by uninformed

public reaction and major decisions were made in the absence of hard scientific information.

The second example is the Salmon industry in the Pacific Northwest of the US. You may be aware of the problem, and a 1999 article in Time magazine highlighted the issues which are, as you might expect, somewhat controversial. In brief, the decline of the salmon industry has been a hot issue for many years.

The federal government used the Endangered Species Act to place 7 species of salmon and 2 species of trout on the threatened and endangered species lists. Saving these fish from extinction will require major social and economic sacrifices. These include (1) catch limits for commercial and sport fisheries will be lowered to reduce fishing pressure on existing stocks; (2) the re-engineering or removal of dams to reduce fish mortalities and increase the rate at which adults are able to return to their spawning grounds; (3) limit logging and eliminate it from land immediately adjacent to rivers and streams to reduce topsoil erosion and sediment transport; (4) reducing freshwater diversions for public consumption and farming and recycling water for golf courses; (5) reducing nutrient inputs from cities, farms, golf courses, and home lawns and gardens; and (6) reducing inputs of toxic chemicals from industries, farms, cities and home use.

Clearly, the social and economic costs of these measures will be substantial and could have been mitigated had the impacts of human activities been more fully understood and appreciated earlier.

Land Use Regulations is One Response

These examples highlight the central importance of land-use in terms of both population density and the ways in which we use the land in coastal drainage basins. If we are going to prevent or mitigate these kinds of situations in the future, we need to know a lot more about how coastal ecosystems work and how human activities impact on them.

We need to have sufficient understanding to make informed decisions based on the pros and cons of realistic scenarios of economic and environmental benefits and impacts for different management options (including no management), and we need to be able to make these decision before environmental catastrophes have occurred, not after.

Resources for Understanding

DPlanet: Where are the resources for broadening the research or for providing some of these causal relationships results that you feel are needed before you can shape public opinion and shape the policy for regulatory decision ?

Dr. Malone: This is a multifaceted question. In terms of public opinion, there is a gap between scientific knowledge and public perception that must be addressed now. The scientific community has become too isolated from the public at large and from the political process.

This is not so much an issue of resources but of will on the part of scientists, the media, the public, and our elected officials to bridge the gap. In regard to resources, two parallel efforts are needed.

First, we must make more effective use of current resources. Environmental research and monitoring are funded for various reasons by many federal and state agencies. Funding is fragmented among agencies resulting in redundant, incomplete and piecemeal programs. Thus, although there are many measurement programs in place, no single program enjoys the level of support to be sufficiently comprehensive and sustained to address problems in the coastal zone in a cost effective manner.

We are working with blinders on. Coastal systems are complex and we do not have adequate knowledge of the patterns of variability and change the characterize them. When it come to coastal waters, the scarcity of observations of sufficient duration, spatial extent, and resolution and the lack of real-time data transmission, assimilation and visualization are major impediments to understanding and forecasting the effects of human activities on the environment and the effects of environmental changes on people.

Immediate Needs

There is an immediate need to design and implement comprehensive, multidisciplinary, and sustained monitoring programs in coastal waters.

We need to reduce redundancy and organize ourselves to achieve a more comprehensive approach, a systems approach to our environment. We can be more cost effective.

Second, there is no question that measuring the right properties on relevant time and space scales will exceed current expenditures. There is a clear need for new technologies at all levels from measurements to modeling.

While my own bias is that the largest single source of funding for research and monitoring will come from government agencies who have the responsibility in these arenas, there will be an increase in demand for new types of instruments that will allow us to better sense the environment, both in situ and remotely. The weather service is a good example of this. We began to take weather forecasts seriously when the global network of monitoring stations and satellites began to provide real-time, continuous feedback for assimilation models to nowcast and forecast weather patterns. Without the combination of remote and in situ observing systems and without the assimilation models that have been developed over the years to generate visual images of weather patterns and forecast how they will change, we would not be able to make the predictions that we make today.

In this regard, we are in the dark ages when it comes to visualizing and predicting patterns of change in coastal ecosystems. We need to design and implement equivalent types of monitoring systems in place for the coastal zone. This is especially true for biological and chemical properties.

Right now most of our monitoring networks are limited to temperature, salinity, and current velocity. The big expansion and the big need will be in the arena of biological and chemical properties. We are on the verge of being able to make operational measurements of dissolved oxygen, carbon dioxide, inorganic nutrients, and chlorophyll with in situ sensors. But we need to be able to monitor harmful algal blooms, fish migrations, bacterial activity and other attributes in a more timely fashion.

This is the next step and there will be increased research and development activity in these areas over the next five years.

Global Monitoring Systems are Essential

These issues underscore the need for a Global Ocean Monitoring System. Ocean observing systems should be end to end with user needs being a major driving force. Up to now, most monitoring and research has been conducted by researchers who spend a lot of time talking to each other. The research is published in peer reviewed journals, and, if the publication rate is high enough one is promoted and is granted tenure. There has not been a strong motive to entice scientists to communicate outside of their own community.

On the other end of the spectrum there are user groups that we know need better information, such as the shipping industry which needs accurate forecasts of water depth in ports and harbors; land-use planners who want to know how various land-use decisions will play out in terms of the environment and local economies; or for a tourist industry that would like to know when a harmful algal bloom will occur and how to mitigate its effects.

These two ends of the chain of activities that link measurements to information products need to be more closely tuned to each others capabilities and needs. As this occurs, I believe coastal observing systems will begin to produce information that is useful to the private sector and that there will an increase in investments equal to the increase in these new demands.

Cross Border Regulations

DPlanet: Do you see the regulations moving up from local to national to international levels? Will there be policy pronouncements and cross-border regulations between regions, between countries?

Dr. Malone: What we will see is more along the lines of international agreements. The recent Tokyo agreement and the 1992 agreement in Rio are important steps in this direction. I would be surprised if these are transformed into regulatory agreements in the near future, but they do portend and changes in how people and governments perceive and react to the environment. it moves into the actual regulation stage.

I hold out a lot of optimism for action by consensus approach as a new environmental ethic emerges in nations across the globe.

The agreement to reduce nitrogen and phosphate loading in the Chesapeake Bay by 40% in the year 2000 was an agreement between the five states that constitute the Chesapeake Bay watershed. The implementation of the actions to achieve those goals has been primarily through agreements and tax incentives as opposed to regulations.

I hope that such an approach will succeed in the international arena.

Impact on Business

DPlanet: What do you see as the direct impact on business that this information can have?

Dr. Malone: We have touched on two aspects of this. First, how efforts to protect the environment, to sustain living resources, to mitigate natural hazards, etc. will effect industry and land use in general, and secondly, how changes in coastal regions will effect the economy on local, national and international scales.

An immediate impact of the growing concern for and awareness of environmental changes in coastal waters will be increases in the demand for new technologies in two general categories. One is sensory technology and the second is mitigation technology.

In regard to sensory technology, there is going to be great demand for technology and better instrumentation that can detect, visualize and predict environmental patterns and change and their consequences.

The most immediate and certain needs are in situ measurement technologies that can detect biological and chemical properties. This demand will include the development and enhancement of systems for real time, cost effective assimilation of this data and improved assimilation models for nowcasting and forecasting current and future conditions based on these observations.

In terms of mitigation technology, we will need to improve our performance on restoring habitats and mitigating human impacts including oil spills. We need better prediction systems for natural and anthropogenic hazards and their impact. We need more effective methods for restoring wetlands, seagrass sea beds or reefs and other habitats that are created by living organisms.

Responding to These Impacts

DPlanet: Assuming that business enterprises, especially public companies, must change or evolve their business strategies based on your research results and your analysis of those results -- As these companies review their business strategies, what principles or awareness should they add to their thinking processes? Should they be moving their critical infrastructure outside of the coastal zone to avoid these costs and hazards? Is that the ultimate conclusion, the responsible, economics-based decision?

Dr. Malone: For the most part, private enterprise is driven by short term profit and tends to focus on getting the resources needed as cost effectively as possible to produce the products that people want. That focus is narrow and nearsighted.

I think for long term survival and long term profitability, and some industries are looking at this - the insurance industry is probably the most obvious. Long term impacts of climate change, exploitation of resources, and land-use practices must be a part of the equation. The auto industry is clearly beginning to think longer term in terms of the costs of fuel and of air and water pollution. I do think that those industries that begin to incorporate this kind of ecological thinking into their long range plans are most likely to survive the next 50 years.

From my viewpoint, the design and implementation of coastal observing systems needed to nowcast and forecast environmental changes that impact the safety and well being of people living, working and playing in the coastal zone must begin immediately. The observing system that allowed us to detect and predict the last El Nino is the first part of this global observing system.

These are Significant Economic Impacts

In terms of the economic aspects of that, the ability to forecast the 1997-98 El Nino is fueling a small but growing market of what is called weather hedging, which is a form of insurance for losses from weather and climate change. Some economists estimate this weather hedging as a $70 - $100 BILLION industry. My point is that we need to learn how to make similar types of forecasts of major events such as

harmful algal blooms and anoxia as well as more chronic problems such as the sustainability of a fishery.

Governmental Intervention

DPlanet: Do these solutions have to come from the regulatory side once the results are at a level of confidence that effects can be predicted and can be mitigated or reduced ? Is government intervention the right remedy?

Dr. Malone: I would argue that government regulations should be the default of last resort. My experience suggests that a more effective approach is to create a format in which all of the stakeholders involved can exchange views, learn new perspectives, and get to know "the other guys."

In this way, environmental and economic concerns can often be reconciled. This is difficult, as the environmental issues are often seen as being in opposition to the economic interests. However, in the long run, these kinds of approaches are likely to be most successful.

Greater Impact - Higher Burdens?

DPlanet: On the practical - philosophical side, as coastal regions become more highly regulated -- through land use and planning mechanisms -- the costs of those land holdings or the tax and permit burdens of those holdings do increase. Then you bring into these equations the mortgage and insurance industries as you address the liability issues that arise for the holder or the user of land that may have downstream effects. Is there a fair value balance that occurs as between the economics and the use of the land - will that balance occur naturally in a free market environment or is it overridden by government intervention? The premise is that the upstream property that can inflict some burden on downstream property has a cost premium or a value discount applied to that upstream land through taxes, regulations and restrictions, and there is a balancing of the economics as that land becomes more expensive to operate. Does this balancing start with government regulation?

Dr. Malone: If that process is allowed to occur naturally then one role of government is to promote this type of thinking, the group approach to solutions as opposed to solutions by regulation. Regulations are always going to be needed.

Let me suggest, however, that if there is one singular issue that needs to be highlighted, it is the need to develop the knowledge required to formulate realistic scenarios for the impacts, economic and environmental, of various environmental policies on human activities from land use practices, to the exploitation of resources and energy consumptions. If you cannot avoid the problems that these coastal ecosystems are going to face, then at least you can mitigate the problem and its effects.

It is instructive to look at the kind of planning that has gone into Portland, Oregon where, ten or twenty years ago the inner city, the transportation and infrastructure issues were being addressed. They developed a strategy that revitalized the down town area, revived the transportation system, and placed a limitation on the types and locations of the new development that could occur within a zone around the city.

The consequences of those actions are that there are many citizens that benefit from an improved environment, but the cost of property has skyrocketed. If we had knowledge of the kinds of problems that had developed, before they developed, I would argue that this type of planning could have been accomplished in a less costly fashion.

The Union of Science and Advocacy

DPlanet: How do you unite the science information that you want to gather with the public advocacy, the will, the desire and then the tools that are necessary to implement the decisions that arise from the science that you can provide.

Dr. Malone: To me, your question poses two issues.

First, the science community must do a much better job of getting the information out. I was first interested in this problem when I realized that the formulation of environmental policy is often done in a scientific vacuum.

Our community has to do a better job in getting information that is relevant to many of these issues to the public and to their elected politicians in ways that they can understand and make use of it. This has to be done so that the public and the lawmakers can see the connection between this understanding and how that knowledge might effect the decisions they have to make.

The other issue is whether there is a need for more applied research. The distinction between applied and basic research is a "red herring" - a misrepresentation and an attempt to misdirect the debate on these issues. As far as I am concerned, there is only one kind of research and that is good research. The only difference between basic and applied research is that applied research is driven by the need for knowledge for a particular purpose while basic research is driven by hypothesis.

Very often, the research itself is identical. But the final destination of the information can be very different. Scientists as a group need to be more familiar with the information needs of for people and institution responsible for the management of the environment and natural resources and for the ways in which we use the ocean. Whether it is the sea state s outside of New York Harbor or the nutrient loading in San Francisco Bay, there is a critical need to have better information, delivered in a more timely fashion so that it can feed into the lifecycles of the human process.

High Level of Community Involvement

DPlanet: Can you challenge the public advocacy groups to look for or to apply more of this type of information or to act as a conduit for this type of information - is there a role they can play in working directly with your Center or comparable Centers?

Dr. Malone: Yes, and we attempt to do this now. On a regular basis, we work with organizations such as the Chesapeake Bay Foundation or the Center for Marine Conservation, and we provide testimony and advice to various government agencies and elected officials. More needs to be done to get the science information into these groups and to get them to use it.

There is, of course, an inherent conflict, as these advocacy groups press their particular perspective, or agenda, on each issue. The role of the science community is not to advocate on a particular issue, but to provide the objective information required to make a reasonable decision.

We also need to put more effort into communicating directly with the public to work towards a more informed electorate and legislative system. This effort has improved, but the scientific literacy of our elected officials is not as high as it should be.

Global Issues - Local Crises

DPlanet: We have spoken in macro terms, state and federal policy and groupings - and yet most change has occurred in reaction to "micro" events - alga blooms, consumers' two month boycott of fish. Is it a necessary element that there has to be an immediate challenge, like the Exxon Valdez oil spill, like an industrial dumping of PCBs, or chicken manure as a water resource contaminant? Can you accomplish more taking on micro issues, or can you bring in a macro view, a systems view to this debate?

Dr. Malone: The problem is that the macro level has to get down to the micro level. There is a saying that 'all politics is local'. I think that is true of environmental issues as well. We can talk in terms of regional and national issues but the local relevancy is the key element.

In terms of the examples that you gave, my response is that we are in a firefight mode, and we are in this crisis mode because we do not understand these systems well enough to anticipate or predict changes in advance. We can't make predictions that can be taken seriously by anyone. As a consequence, all of our environmental regulations, and most of the activities of NGOs are responsive - a reflex to some environmental catastrophe. Whether it is a red tide or an oil spill, we are responding to catastrophe.

It doesn't take too much imagination to realize that at some point we have to get ahead of that reactive curve. At some point we have to be able to anticipate and mitigate those types of catastrophes instead of responding to them. Having said that, it is clearly important that we do respond, and do so in the kind of system that allows all of the advocates and interests to respond, in an informed manner.

Global Monitoring Versus Local Needs

DPlanet: I am trying to be somewhat contentious with you, since there is so much focus on micro events, where can one see and appreciate the level of effect that a global monitoring system, that talks more to natural events, would have?

Dr. Malone: The global monitoring system is being designed to detect and predict both anthropogenic and natural events. Understanding and predicting change on local to regional scales requires both a global perspective, as in weather forecasting, and a comparative perspective, as in medicine where the diseases are successfully diagnosed and treated through comparative analysis of many individuals from different regions.

Long Term Vision for HPL
DPlanet: What will HPL look like in ten years ?

Dr. Malone: My vision of Horn Point in ten years is a laboratory where our research scientists are more actively involved in local and regional community affairs as it relates to environmental issues and how they impact peoples' lifestyles, and how these issues impact on how people use the environment. I think that the faculty will have to be more involved with the regulatory agencies and help them to tune the environmental policy to particular locations and regions. So I see an expanding role for outreach activities that interact with and communicate with people outside of the science community.

The National Agenda
DPlanet: Is there a National Agenda today ?

Dr. Malone: No. There is no National Agenda. The role that Coastal Labs could play is important but there is no comprehensive approach to address these issues. There is a clear need for locally relevant, nationally credible and coordinated policies.

The knowledge base that the Global Monitoring System will provide, the good research that can be conducted using this knowledge base, the need to get this information disseminated, and the need to make decisions and take actions by an informed public - will make the National Agenda, and the Global Agenda, responsive to the local ecosystems.

These 'ecosystems' are, after all, the places where we all live, work, and play. These 'ecosystems' are, after all the air we breathe, the water we drink, the food we eat and the habitats that we grow, work and play in -- and that our offspring will grow, work and play in.

DPlanet: Thank you (DWA).

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