Testimony Before the United States Commission on Ocean Policy: Application to the Great Lakes

By

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I would like to take this opportunity to inform you about the importance of ocean sciences and the essential role of partnerships in advancing research, education, and development of public policy in the Great Lakes. I am Dr. Gordon Fraser, President of the Northeastern Association of Marine and Great Lakes Laboratories (NEAMGL). NEAMGL is a regional association of the National Association of Marine Laboratories (NAML), a nonprofit organization of approximately 120 member institutions that encompass a variety of academic, research, and public service programs. Our members serve as unique "windows on the sea," providing information on the rich environmental mosaic of coastal habitats and offshore oceanic regions as well as the Great Lakes. We represent an extraordinarily diverse range of laboratories, from the maor oceanographic institutions, to a variety of coastal laboratories, to remote field stations.

NAML was created 16 years ago when a core group of laboratory directors recognized that there was much to be gained through the sharing of experience when dealing with the complex array of problems presented by laboratory, field station, and shipboard operations. Since then, the value of the NAML alliance has more than proved itself and resulted in the current national and regional organizations and their expansive membership. We communicate frequently, meet regularly, and provide a network for problem solving and capacity building. These activities have demonstrated the unique strengths of the NAML partnership and our capacity for working together towards goals that benefit the oceanic and Great Lakes research, education, and outreach communities as a whole. Many of our laboratories have very strong ties to the community, and effective relationships with the general public and legislators have evolved from long histories of information-sharing and public service. Thus, the NAML and NEAMGL network goes beyond the conventional boundaries of academia and government agencies, and meshes with the private sector and public communities in a variety of ways. We believe that these linkages are increasingly vital as we address the scientific and management issues so important to the future of the Great Lakes.

Dr. Madilyn Fletcher, President of NAML, has already provided testimony to this Commisson concerning the need to:

* ensure that ocean and coastal policy decisions are based on sound science;
* invest in the infrastructure of our nations' coastal and laboratories;
* sustain and integrate observations of our coastal and marine waters; and.
* invest in ocean and coastal science education.

These themes are as applicable to the coastal waters and deep oceans of the world, as they are to the Great Lakes. There are, however, issues that perhaps are more critical to the Great Lakes because of their unique setting, relatively short histories, and the rapidity with which anthropogenic change can occur and persist in the Great Lakes. The Great Lakes contain about 25% of the world's fresh water and represent a tremendous resource for the mid-west and northeastern United States and Canada. The lakes serve as a source of food and water, an avenue for transportation and trade, and a place for recreation. Transportation and shipping along the lakes played a key role in bringing a number of cities in the mid-west and northeast to prominence, and even today the lakes play a critical role in the economic health of the northeast. For example, 22% of the nation's GNP (gross national product) is generated in the Great Lakes region, as well as 25% of the nation's industrial output, and in recent years, the region has produced close to $120 billion in exports annually. In addition, there are currently over 40 million people living in the Great Lakes basin, nearly 16%. Effective management of the lakes thus has a direct impact on the lives of a significant number of people, and on the economic health of the country in general.

Despite the importance of the lakes to the people in the basin and to the United States and Canada as a whole, we understand only a small part of how the lakes function as an ecosystem. The specific economic, political, cultural and quality-of-life relationships between the lakes and the people around their shores also are not well known. There are numerous local, state, and federal agencies that have programmatic or regulatory responsibilities for aspects of the lakes, but they deal only with parts of the overall problem of understanding the ecological balances that control the physical, chemical and biological behavior of the lakes.

A defining aspect of the Great Lakes today is that they are in a state of rapid flux due to physical, chemical, biological and cultural changes occurring throughout the basin. Much of what we knew of the lakes even 10 years ago is no longer applicable today. There are new concerns with exotic, non-indigenous species, possible long-term climate changes, fluctuations in water levels, atmospheric deposition of chemicals transported
from other parts of the world, and changes in land use in contributing watersheds, to name a few. These factors all impact the lakes separately and in consort, with consequences that are difficult to predict and are often unforeseen. Efforts to control eutrophication, for example, have been very successful over the past few decades, but they appear to have had adverse effects on sport fish populations by reducing food sources at the base of the food chain. Other issues of concern involve sediment and water quality, with possible contamination and bioaccumulation in the food web leading eventually to considerations of exposure and risk to human health. Only with an integrated approach of research and study in the lakes can we hope to develop the most informed and rational management decisions.

The Great Lakes Research Consortium, a group of sixteen colleges and universities in New York with research interests in the Great Lakes recently provided funding to commission eight respected researchers in various aspects of Great Lakes research to provide insights into seven issues that are emerging now, and will become of

paramount importance over the next decade. These include:

Great Lakes Fisheries

Within the last 200 years, overexploitation, habitat destruction, the arrival of exotic or non-indigenous species, and water quality degradation from environmental contaminants have brought about significant changes to the species composition of the Great Lakes, especially in Lakes Erie and Ontario. Research is needed on the life cycle of invasive species and the potential interactions with native, as wells as established nonnative communities. Studies are also needed to understand the cause and effect relationships of contaminants in fishes and the effects of contaminants on reproduction, egg development, fry emergence and larval survival.

Future Climate Change

Global warming will undoubtedly cause changes in regional weather patterns and characteristics for the Great Lakes region, and research is needed in determining how those changes will influence lake levels, water quality, and ecosystem functioning. Of special importance is the need to understand how changes in frequencies and intensities of phenomena with multi-season to multi-year time scales impact microclimates around the lakes and affect lake levels. We must also understand how frequencies, intensities, and tracks of synoptic scale weather systems will impact coastal communities and the contributing watersheds in the basin.

Watershed Hydrology and Biogeochemistry

The way water moves through watersheds and entrains contaminants has a direct impact on the quality of Great Lakes waters. Climate change and anthropomorphic changes in land use, especially, will impact watershed dynamics and responses in unforeseen ways, and anthropogenic influences, such as urban development, will continue to affect watershed response While much is known about the driving mechanisms behind water flow and solute transport, much more research is needed to understand how hydrological and biogeochemical cycles are coupled and how the connections and feedbacks between watershed ecosystems and the lakes function.

Social Science and the Concept of Sustainability in the Great Lakes

Physical, biological, and chemical processes do not act in isolation of human dynamics in the Great Lakes. Because of the enclosed nature of the Great Lakes and the population density in its drainage basin, any concept of sustainability must consider how the economic and social aspects of human populations interact with nature. However, the knowledge base underpinning the societal aspects of the ecosystem is smaller and weaker than the other three supports for sustainability. Social research should provide good economic information that would fit into the cost-benefit analysis used to decide environmental issues. We must also address the institutional and behavioral side of governance in order to understand how institutional decisions have shaped the environment; and how social dynamics have shaped the decision-making process. We also have barely begun to examine the interrelationships between Great

Lakes environmental management regimes and systems designed to govern international trade and to document of the actual and potential areas of conflict and congruence at the level of formal institutions and laws.

Food Web Dynamics

Bacteria and plankton form the base of the aquatic food web. Much of the large-lake limnology for the past 25 years has dealt with supply of nutrients to these organisms, how they have been impacted by contaminants, and how they are connected to fish communities. These will still be major issues, but emerging issues include how global climate change will affect nutrient sources and cycles in watersheds and coastal regions, how exotic species may alter the functioning of the food web, and finally, the occurrence of harmful algal blooms and the source of botulism toxins in the waters.

Health Issues in Great Lakes Area of Concern (AOC's)

The Great Lakes and their contributing watersheds still bear the legacy of contamination from our industrial past. Water, sediments, and the plants and animals that inhabit the basin are all contaminated to some extent. These contaminants have degraded our water supplies, limited consumption of our commercial and game fish, and impacted use of our wildlife resources. Some of the potential health outcomes for humans from environmental contamination include malignant neoplasms, endocrine system dysfunction, autoimmune disorders, and infectious diseases and toxins. Research is needed in understanding the linkages between environmental contaminants and these chronic diseases and adverse health outcomes.

Chemical, Hydrodynamic and Ecosystem Models

Research and management efforts in the Great Lakes for the past forty years have used mathematical models to synthesize knowledge of the processes and overall system behavior of the Great Lakes within particular problem domains. Because the lakes are so large, it is rare that an opportunity has arisen for a coordinated, comprehensive program of research and monitoring to be undertaken on a given lake. These mathematical models, therefore, have served as the repository of our knowledge of large lakes behavior relative to topics like nutrient cycling and eutrophication, toxic chemical transport and fate, and fish production. In doing so, models have helped guide the research and data collection efforts to fill gaps in our understanding of these systems. Perhaps the most recognized contribution of these models has been their use to guide management decisions within the Great Lakes basin.

Critical research objectives include development of multi-media models to link air, water, and land processes, basin-wide models to compute the transport and fate of pollutants of concern in the lakes as a connected hydrologic system, aquatic ecosystem models to address such issues as nutrients, trophic transfer of chemical contaminants, toxics cycling and bioaccumulation, exotic species, and fisheries production and dynamics, and models to assess impacts of global warming and water level control on lakes. Critical needs to accomplish these objectives include computer hardware and software, training for modelers, and funding for development of large, coordinated, multi-

disciplinary, multi-institutional, research programs that have policy and management value.

In closing, NEAMGL would like to express its strong support of the U.S. Commission on Ocean Policy; and the important undertaking with which this Commission is now engaged. We offer our enthusiastic support and would welcome the opportunity to provide assistance in any way we can. Our laboratories can provide you with a wealth of information and access to the grassroots community, and we stand ready to provide assistance as you work to ensure the long-term welfare of our nation's oceans, coastal resources, and the Great Lakes.