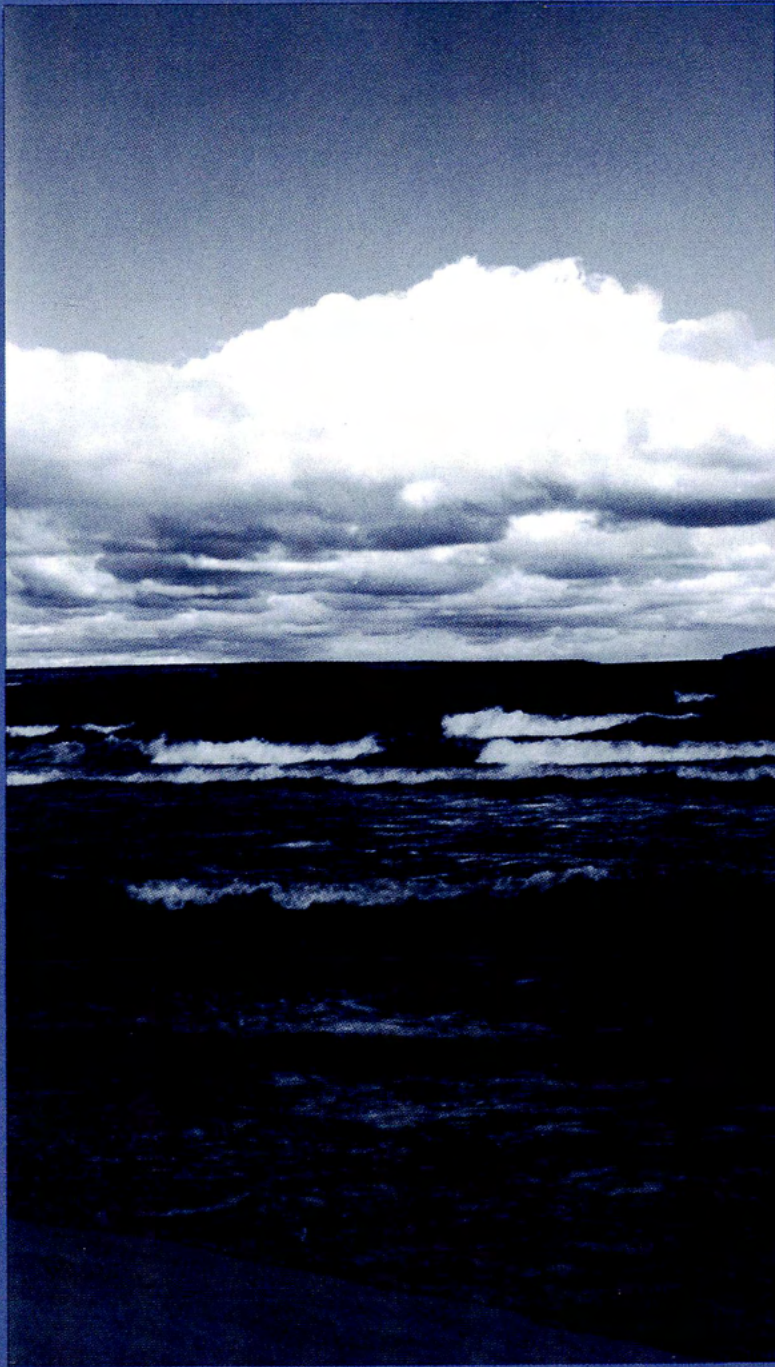


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Michigan Sea Grant College Program  
1990-1995 Long-Range Plan

MICHU-Q-90-002

## 1990-1995 Long-Range Plan

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## Michigan Sea Grant's Approach to the Great Lakes Challenge

The United States Congress created the Sea Grant College Program in 1966 with the charge to promote wise use of coastal, marine, and Great Lakes resources. The success of Sea Grant has surpassed almost everyone's expectations, as economic returns from Sea Grant sponsored research and outreach activities have vastly exceeded expenditures. The continuing challenge is to improve the use of aquatic resources while maintaining or restoring a high quality aquatic environment. The key to overall success of Sea Grant has been the autonomy given each program to approach problems in its state or region. This approach has considerable merit because it has allowed Sea Grant to achieve its goals in such diverse environments as the Great Lakes and the marine coast simultaneously.

Michigan Sea Grant plays a central role in fostering wise use of Great Lakes resources. No other state in the Great Lakes Basin occupies so prominent a position in relation to the Great Lakes as Michigan. Four of the five Great Lakes touch Michigan shores; Michigan has over 3200 miles of coastline; the diversity of coastal types in Michigan is unmatched by any other state; Michigan jurisdiction covers over 40,000 square miles of lake bottom, an area almost equal to the state's land area. The geographic relationship of Michigan to the Great Lakes forms the foundation for many ties between the state and the aquatic environment. The entire state's commerce is driven by the abundant supply of fresh water. Recreation, tourism, heavy industry, shipping, and farming all rely on ample, high quality water.

The challenge to Michigan Sea Grant and the Great Lakes comes from two directions: wise use of the aquatic resource and protection/restoration of water quality. The Great Lakes possess an abundance of resources. Since the first European settlers reached the basin in the early 1800s, a series of exploitations have reaped fortunes in lumber, minerals, and fisheries. The harvest continues today, but with emphasis on tourism, recreational fishing, farming, and heavy industry.

However, Great Lakes resources face a severe challenge from declining environmental quality. Overfishing, pollution, and invasion or introduction of exotic species has permanently altered the Great Lakes food web. Pollution has rendered many Great Lakes locations unfit for most uses. Finally, coastal development has caused the loss and/or degradation of many critical habitats, placing further pressure on the remaining resources.

All of these issues put a premium on the ability to mitigate problems and plan wise use of the Great Lakes. Michigan Sea Grant sees its primary goal as one of focusing research talents on the challenge of managing the world's largest source of surface fresh water. However, research conducted in isolation will not suffice. The outreach activities of Michigan Sea Grant distinguish it from other research programs. Frequent contact with the "Great Lakes public" is an essential link to completing the task of addressing the challenge. Materials prepared by the Communications staff, which present research findings in a readily understood fashion, are an equal partner to the research itself. Those materials serve as a primary vehicle to heighten awareness of both Michigan Sea Grant and important issues facing the Great Lakes. The other essential link is the contact made with the public by the Extension Agents. These agents serve as the personality behind the ideas, concepts, and goals of Michigan Sea Grant. They provide thousands of concerned citizens and coastal businesses with answers to their questions and with solutions for their problems.

## The Long-Range Planning Process

The need for planning arises from the enormous variety of issues confronting use of Great Lakes resources. Given limits on the ability of Michigan Sea Grant to address all of these issues, priorities and goals are necessary to achieve sustained success while at the same time meeting the needs of the region. In addition, the priorities must include a sense of what is important on a national scale, so that talents can be used to address problems that affect the nation as well as the region. Given the highly dynamic nature of the resource needs of the Great Lakes Basin, the planning process must recognize a limit to the length of its validity and the need for regular renewal. This Long-Range Plan is the increment in that renewal for 1990-1995.

The research planning process used to develop this plan followed four major steps. First, the Michigan Sea Grant staff reviewed the program in 1988 with assistance from several groups, such as the program's Policy Committee. Certain major issues, such as coastal processes, were added to the areas of emphasis within the program at that time. Second, a newly created Research Advisory Committee met with the Michigan Sea Grant management team to identify specific foci for research under major topics. These foci were refined and honed over several months and were used to guide the call for proposals for the 1989-91 funding cycle. Third, the response from the research community to this call and the decisions determining the nature of the research to be conducted during this funding cycle were used to further refine this Long-Range Plan. Fourth, the Long-Range Plan was further refined and updated at a retreat of the Michigan Sea Grant management team and staff, Research Advisory Committee, and External Advisory Committee in January 1990.

A similar process was used to develop long-range goals for the outreach portion of this plan. Desired areas of focus were identified by Michigan Sea Grant staff. The outreach staff then met several times to develop foci and priorities under the major topics. The programming areas were then sharpened to match

the realities of staff, budget, and time. The 1989-91 funding cycle proposals from both Extension and Communications drew heavily on this planning process. These proposals were subjected to external peer review to provide additional feedback on the success of the planning process. Thus, the phylogeny of the outreach portion of the Long-Range Plan paralleled that of the research portion.

The format of this Long-Range Plan achieves three things. First, the general suite of problems or issues for research, communications, and extension is identified and the research or programming foci that matches those problems or issues is specified. Second, current Michigan Sea Grant research or outreach activities that match the foci are listed. Opportunities that exist within the identified foci but outside of the current activities are indicated. Third, a time-table is presented for addressing these opportunities.

### Evolution of Michigan Sea Grant

Michigan Sea Grant research and outreach activities will continue to evolve over the next five years in response to the evolution of Great Lakes problems and issues. Thus, the Long-Range Plan will gradually become obsolete. By 1995, the general research topics and outreach programs will still be relevant, but the foci will need updating. For this reason, a finite time period accompanies each identified research opportunity and program area. Some initiatives will continue beyond 1995 while others will give-way to new demands. For example, when the planning process began in 1988, high Great Lakes water levels were an enormous problem. One year later, lake levels had fallen below long-term averages, and lower levels became the issue. Both research and outreach are poised to respond to these types of shifts in Great Lakes concerns.

## Research

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## Coastal Processes

In the past decades, the Great Lakes have experienced cycles of high water levels and severe storm waves which have resulted in serious shoreline erosion. In addition, natural variability in wind patterns and storm tracks alter the effects of shoreline structures, causing erosion in what may once have been accretionary zones, and vice versa. In the winter, ice cover can protect the coast under some conditions and increase erosion in others. These physical phenomena and their effects have produced increased interest in the process of shoreline evolution. This has revealed the need for a strong, coordinated research effort aimed at a better fundamental understanding of Great Lakes coastal processes.

Extreme fluctuations in lake levels (both high and low) create a number of issues pertinent to coastal engineering and erosion. To establish coastal construction control lines, or set-back limits, it is necessary to clearly differentiate between encroachment, recession, and erosion, which are problems in period of high levels. Shoreline encroachment refers to the effect of water level rise with no reshaping of the land or movement of sediment. Coastal recession is the landward translation of the shoreline profile with no net loss of sediment. Coastal erosion indicates translation accompanied by net loss of sediment. Coastal flooding also becomes important with rising water levels. In addition, structural overtopping during high water levels is a primary concern of coastal designers.

The public unfortunately tends to react primarily from the belief that a coastal problem exists only during periods of high water levels, and that the problem ceases as the water level decreases. There are, however, concerns with lower water levels that may be just as important in the long-term: shoreline withdrawal, coastal progradation, structural overtopping, and restrictions to harbor and coastal navigation. Structural response becomes an issue with falling levels as the water depth near structures changes from the optimum effective depth. Coastal navigation becomes hazardous as water levels fall.

Perhaps most importantly, recent research indicates that erosion does not always stop during falling water levels, but actually continues at a slower rate.

To assess Great Lakes coastal processes research needs, the subject should be considered on both temporal and spatial scales. Scales of temporal variability for the Great Lakes cover daily, seasonal, decadal, and long-term changes. Daily variations are those produced by storms, and possess a great deal of vertical change in a very short time. The annual/seasonal cycle is on a time scale equally familiar to the general public. Ice effects are important here. Decadal and long-term temporal variations in the Great Lakes are least understood. C. E. Larsons' work on long-term variations certainly warrants further research in that his data indicates that, even though recent lake levels have been at record highs on an intermediate time scale, these may be well below the maximum indicated by the long-term variations.

With respect to vertical variations in water levels, future ocean sea level rise due to global warming has become a national concern. In examining the scale of vertical change, however, the Great Lakes variations are an order of magnitude larger than those anticipated on the ocean coasts. The nation should understand the potential impacts of ocean level rise, and Great Lakes coastal processes research can contribute to an understanding of these effects, recognizing that different time scales will be present. The dramatic fluctuations on the Great Lakes warrant attention both due to the widespread regional impact and to the unique opportunity the Great Lakes provide to help us better understand the shoreline processes that will result from oceanic sea level rise.



The specific research objectives for this subprogram have evolved from the following meetings of Great Lakes coastal processes and coastal geology practitioners and researchers.

- The Great Lakes Coastal Erosion Research Needs Workshop. This workshop was held at The University of Michigan under Michigan Sea Grant sponsorship in the summer of 1987 to begin the development of research in this area within the Great Lakes Sea Grant Network, and in the Michigan Sea Grant College Program in particular. This working-level workshop was attended by 37 representatives of universities, state and federal agencies, and one private consulting firm. The final report of this workshop was issued by Michigan Sea Grant in April, 1988.
- A meeting to coordinate Great Lakes coastal processes experiments, held at The University of Michigan in March, 1988. The first year of these experiments involved representatives of the U.S. Army Coastal Engineering Research Center and Corps of Engineers, University of Washington, The Ohio State University, The University of Michigan, and the State of Michigan. Coordinated experiments were conducted at New Buffalo and Big Sable Point, Michigan, in the fall of 1988.

The following goals and objectives have been established for the Michigan Sea Grant Coastal Processes subprogram.

## Topic I: Nearshore Hydrodynamics

### □ Current Status within the Great Lakes Basin

Nearshore hydrodynamics drive coastal sediment transport processes. Nearshore waves and currents are, however, not adequately understood. Sediment transport is caused by wave/current-induced motions that initiate bed and suspended load. The ambient currents then transport the sediment as long as it remains in suspension. To accurately describe and predict this transport, the nearshore hydrodynamics must be well understood.

Deep water wave spectra modeling is reasonably well predicted for the Great Lakes through modeling efforts by the Great Lakes Environmental Research Laboratory (GLERL) and others, with the aid of the NOMAD buoy system. Likewise, the transition of monochromatic waves as they approach gently sloping beaches is well in hand through the U.S. Army Corps of Engineers' RCP wave model. There is not, however, an adequate capability for predicting the change of deep water wave spectra as they enter the local bathymetric conditions along the Great Lakes shoreline. Understanding of these local nearshore wave spectra is needed for the development of shoreline change prediction models.

Present predictive theories for the current structure of the nearshore zone employ assumptions that are often invalid in the Great Lakes and/or produce (at best) qualitative predictions. Present longshore current theories usually neglect the wind stress at the surface to facilitate analytical solution. This assumption is usually justified by requiring a wave climate dominated by sea swell. In the Great Lakes, however, the wave climate is dominated by rapidly changing, locally-generated seas. In such situations, wind stress has been proven to be important both as a primary and a secondary factor in driving nearshore currents in large enclosed basins.

Additionally, present longshore current theories either neglect turbulence or use oversimplified, inaccurate turbulence models. Recently, more accurate turbulence models have been developed that provide promise in helping to model the complex, turbulent nearshore zone. Moreover, the bottom stress, which is the single most important parameter in determining initiation of sediment movement, is presently modeled as a constant drag coefficient in a "Chezy Law" formulation. The value of this coefficient must be estimated through an empirical method. Small variations in this coefficient radically change the bottom stress. To more accurately determine the bottom stress, wave/current interaction boundary layer techniques should be employed.

- **Current Michigan Sea Grant Research** None.

- **Michigan Sea Grant Research Opportunities**

**Goal:**

**Improve understanding of Great Lakes nearshore wave spectra.**

**Objective:**

- **Develop models to predict local shallow water wave spectra from incident deep water wave spectra and local bathymetry.**

To effectively predict local shoreline change, it will be necessary to predict the wave spectra incident on the shoreline stretch in question, considering local bathymetry and geography.

**Goal:**

**Improve understanding of Great Lakes nearshore currents.**

**Objective:**

- **Develop a predictive theory for Great Lakes nearshore currents.**

To effectively predict local shoreline change, it will be necessary to predict the nearshore currents and associated bottom stress. This effort must be coordinated with well-designed field and laboratory experiments.

- **Time-Table for Research**

**Next Five Years** - Improvements will be needed early in this period in order to support the goals under Topic II.

**Beyond Five Years** - Continue improvements in initial modeling and understanding if this is shown to be needed.

## **Topic II: Prediction of Shoreline Change**

- **Current Status within the Great Lakes Basin**

Research is critically needed to improve the ability to predict change of a local shoreline on a multi-year scale. This capability is ultimately needed in a practical, user-friendly form so that shoreline managers can assess the effects of proposed shoreline protection and navigation structures. To reach this level of routine capability, new modeling techniques must be developed, refined, and validated. These techniques will need to be applicable to Great Lakes wave climate, beach slopes, and beach types, and the structures expected on the Great Lakes.

At present, several models exist which predict changes in the vicinity of coastal structures as well as at open boundaries. These models are numerous and, to name only the principal examples, include the on/offshore models of Kriebel & Dean and Larson & Kraus, the shoreline models of Hanson & Kraus and Perlin, and the three-dimensional models of Perlin & Dean, Fleming, and Swart. The overriding problem with all these present models is their inability to effectively predict quantitative changes in the nearshore region. This inability results from inadequate

knowledge of both the nearshore hydrodynamics and the resulting sediment transport processes.

A two-pronged effort is required to provide progress toward predicting quantitative changes in the nearshore region. First, models must be developed that make better use of empirical knowledge of sediment transport as input to continuity relations to predict shore evolution. Concurrently, models must be developed which use the governing equations of hydrodynamics to predict the flow field in the nearshore region and thus drive the sediment movement as predicted by exceedance of critical values of the shear stress.

#### ❑ **Current Michigan Sea Grant Research**

Two studies were initiated in 1989 within Michigan Sea Grant. The first is studying the geology and the onshore and offshore stratigraphy of the Lake Michigan shore and their influence on erosion and bluff stability. This will provide geological input to the second study, which is developing more accurate models for predicting shoreline evolution and sediment transport along both undisturbed coastlines and those with man-made structures.

#### ❑ **Michigan Sea Grant Research Opportunities**

##### **Goal:**

**Improve the ability to predict Great Lakes shoreline change on a local scale.**

##### **Objectives:**

▪ **Develop improved numerical models which use empirical relations and continuity of sediment volume to model nearshore bathymetric and topographical changes.**

Since longshore bars occur along much of the Great Lakes shoreline, they need to be incorporated into the cross-shore profile formulation. Implicit in this

formulation is the requirement that the on/offshore sediment transport relationships used in this model facilitate non-monotonic beach profiles. The models for the distribution of the sediment transport across the surf zone must be improved and specialized to the Great Lakes. In order to include a nearshore wave spectrum input, a relationship between wave spectrum and the ensuing sediment transport must also be developed.

▪ **Develop improved numerical models which predict sediment transport using the hydrodynamic equations of motion and the critical shear stress approach to modeling nearshore bathymetric changes.**

Improvements in the incipient movement criterion for sediment particles, including the effects of the nonlinearities of shallow water waves, bottom slope influences, and the effects of wave-current interaction are needed.

#### ❑ **Time-Table for Research**

**Next Five Years** - A next generation of improved models with reasonable effectiveness in making quantitative predictions should be possible within this period.

**Beyond Five Years** - Continue efforts to achieve a fundamental understanding of the processes involved and include these results in the modeling as appropriate.

### **Topic III: Great Lakes Water Level Variation**

#### ❑ **Current Status within the Great Lakes Basin**

The Great Lakes coastlines experience water level variations as much as an order of magnitude greater than that predicted for the ocean coasts due to global warming. These level fluctuations result in corresponding changes in coastal erosion, recession, and flooding. The Great Lakes water levels have been systematically monitored since the

1860s. This record illustrates seasonal fluctuations following natural cycles of precipitation, runoff, and evaporation, as well as longer-term fluctuations reflecting random and climatic variability. To more fully understand the potential for lake level variability, research has been undertaken to examine prehistoric lake levels and to link this with paleoclimatological data. This avenue of research is in its developmental stages and warrants further effort.

To accurately predict variations in water levels, several factors governing these fluctuations must be understood. On a regional scale, precipitation, runoff, evaporation, ice retardation, aquatic growth, meteorological disturbances, crustal movement, dredging, diversions, consumption, and flow regulation are important influences. New scientific approaches to the modeling and prediction of these factors may contribute toward an improved ability to predict lake levels.

#### □ Current Michigan Sea Grant Research

A study was started in 1989 to investigate the paleoclimatic implications of late Holocene lake level fluctuations in the Lake Michigan basin. This project is studying sediment cores in Lower Herring Lake (once part of Lake Michigan) to estimate, using new and independent techniques, the water-level fluctuations in Lake Michigan over the past 4,000 years.

#### □ Michigan Sea Grant Research Opportunities

##### Goal:

Improve our understanding of and ability to predict short- and long-term water level changes in the Great Lakes.

##### Objective:

- Pursue opportunities where the Michigan Sea Grant researchers can provide unique contributions to this understanding and predictive capability.

#### □ Time-Table for Research

**Next Five Years** - Specific contributions from Michigan Sea Grant research to the understanding of water level changes should occur during in this period.

**Beyond Five Years** - Specific opportunities for contributions from Michigan Sea Grant research to this understanding should continue over time.

### Topic IV: Effects of Ice on Great Lakes Coastal Processes

#### □ Current Status within the Great Lakes Basin

The seasonal variations of the Great Lakes coastlines range from exposed bluffs, dunes, and beaches through ice-locked shorelines. Almost all of our knowledge of coastal processes has been gained during open-water conditions. The coastal environment, however, receives a large portion of its stress during periods of severe winter storms coupled with coastal ice formation, cover, and breakup, for which our knowledge of coastal processes is minimal. These processes may affect the coastline for up to one quarter of the year. To more fully understand Great Lakes coastal evolution and to establish sound resource management and engineering policies regarding coastal processes, it is necessary to better understand the impact of ice on nearshore hydrodynamics, sediment transport, and coastal structures.

The economic losses sustained by the nearshore zone due to the impacts of ice has been estimated to be quite large. Efforts have qualitatively defined nearshore ice processes in a variety of coastal environments; however, there is a lack of adequate fundamental, quantitative research addressing the mechanics and dynamics of the processes responsible for nearshore losses. A comprehensive, well-coordinated program of analytical formulation, field data collection, and numerical predictive modeling is needed to enhance our understanding of ice effects.

❑ **Current Michigan Sea Grant Research** None.

❑ **Michigan Sea Grant Research Opportunities**

**Goal:**

Improve quantitative understanding of the effects of shore ice on nearshore hydrodynamics, sediment transport, and coastal structures.

**Objectives:**

▪ **Develop predictive models for the impact of shore ice on nearshore hydrodynamics.**

To effectively predict local Great Lakes shoreline change it will be necessary to predict the effects of shore ice on nearshore hydrodynamics. These models must be carefully correlated with field observations.

▪ **Develop predictive models for the impact of shore ice on sediment transport and shoreline change.**

To effectively predict local Great Lakes shoreline change, it will be necessary to include the effects of shore ice.

❑ **Time-Table for Research**

**Next Five Years** - The development of predictive models for the impact of shore ice is a difficult task which will likely require many years of evolving research. To support the above goals, however, an initial understanding and a resulting modeling effort will be needed in order to begin to include ice effects in the long-term predictive capability.

**Beyond Five Years** - The need for additional research in this area is expected to continue throughout this period.

## Economics and Policy

The Great Lakes Basin ecosystem is so large and complex that managing its resources requires an understanding, not of only the physical and biological properties of the system, but of the human and social dimensions of economics and policy formation. Both aspects of the system must be studied to form policies that allow for wise management and responsible use of all resources. This becomes especially true as competing demands for Great Lakes resources become more intense.

For example, the Great Lakes shoreline is extensively used. Hundreds of communities ranging in size from Detroit, with one million people, to small villages, with only several hundred people, are found along Michigan's shore. The coastal area provides an estimated 200 million person-days of recreation and tourism activity annually. These activities account for approximately \$5 billion in direct spending each year.

The businesses that have developed within coastal areas are directly dependent upon natural resources such as beaches, wetlands, fisheries, and aesthetic seascapes. Increasing demand and competition from coastal residents, real estate developers, and the tourism industry for these highly valued but finite resources have raised important questions concerning the rapid transformation and allocation of natural and cultural resources. The rising demand for coastal properties has caused their values to increase to a point where water-dependent businesses are displaced, changing the character and identity of the community. In addition, coastal wetlands are being destroyed at an alarming rate, despite legislation intended to protect them.

Great Lakes policies determine how resources are allocated among diverse interest groups, and how recreational use will co-exist among other coastal resource uses such as business and commercial development, shipping and commerce, commercial fishing, and Native American fishing rights. A balance must be achieved so that small coastal communities and urban centers can accommodate a variety of uses and changing demands.

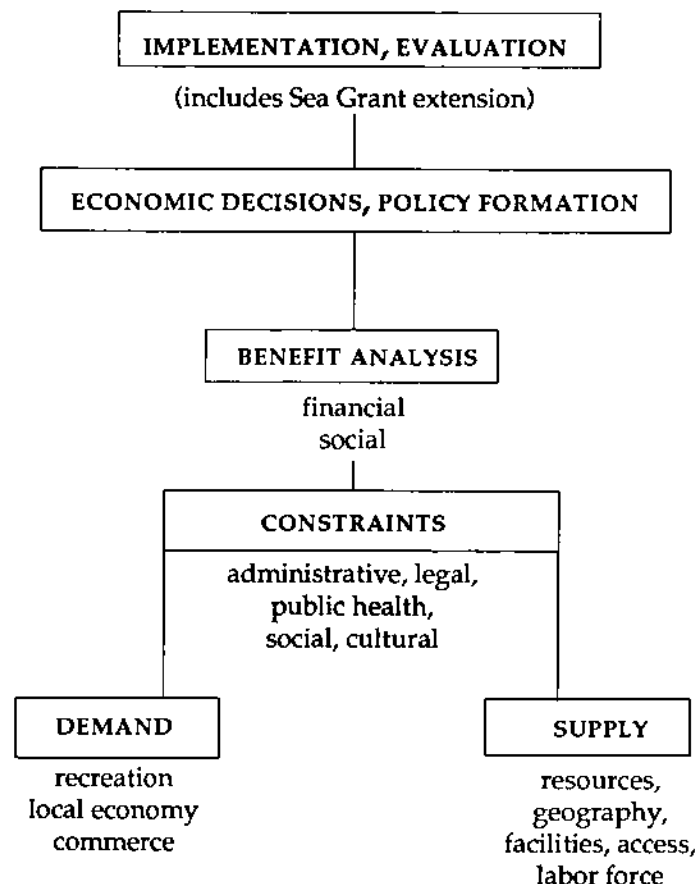
The Michigan Sea Grant economics and policy subprogram is multifaceted, drawing upon many experts, including economists, sociologists, psychologists, geographers, lawyers, engineers, and natural scientists. This subprogram encompasses the social dimension of the other subprograms, with most of its projects being tied to or incorporating, the efforts and findings of other subprograms.

Some of the important objectives under consideration are:

- Develop measures of the benefits and costs associated with allocating coastal resources to alternative uses.
- Provide a scientific basis for the enhancement and preservation of natural, cultural, and aesthetic assets.
- Measure the full value derived from coastal areas, including nonmarket and nonconsumptive uses as well as market-oriented activities.
- Understand the behavior, preferences, and choices of coastal users and the compatibility of each user with others.
- Determine factors affecting the demand for and supply of coastal goods and services.
- Assess the primary and secondary socio-economic impacts of development on coastal communities and resources.
- Develop policies that may serve to reduce conflicts that arise over Native American fishing rights.

The approach to these objectives is shown schematically in the figure on page 14. The diagram shows that the research must build upon an understanding of the interactions of supply and demand. Once this understanding is gained, researchers must assess the constraints—legal, administrative, political, biological, and socio-economic—that intervene in the supply/demand model. The feasibility of general economic and policy relationships are successfully filtered through the mesh of real

## Great Lakes Economics and Policy Subprogram General Framework for Research



world constraints. Beyond this broad framework lies the task of assessing the benefits of a specific policy or the relative benefits of competing decisions. For example, if a demand exists and the supply is available with few constraints, do the benefits offset potential financial and nonfinancial costs? The final aspect of economic and policy research addresses the interactions of supply, demand, constraints, costs, benefits, and the political infrastructure to develop a model for policy formation.

More complete understanding of the issues will be gained as research moves from the interactions of supply and demand through constraints to benefit analysis. The economics and policy subprogram will encourage projects to move through these levels to gain a higher understanding of the issues. The subprogram will emphasize, however, that research at the demand/supply end of the conceptual model is a necessary precursor to studies further into the framework.

## Topic I: Demand and Supply Interactions

### □ Current Status within the Great Lakes Basin

Although the resources of the Great Lakes Basin are vast, there is still a finite limit to their extent. Since the arrival of European settlers in the nineteenth century, the history of resource utilization has more often than not been characterized by overexploitation and/or resource degradation. In many instances resources were permanently lost, while in a few cases there has been a return to more balanced ecosystems.

Resources exploitation has often been exacerbated by an imbalance between supply and demand. An early case of this problem was the destructive lumbering activities throughout the massive pine forests of upper Michigan. The early exploiters never recognized that the incredible demand for lumber should be tempered because of finite supplies. As a consequence, the land was denuded of a valuable commodity that has yet to return to presettlement conditions. Similar scenarios can be repeated for fish stocks, terrestrial wildlife, and, to some degree, waterfowl.

While appreciation of aquatic and regional resources is considerably more sophisticated today, supply and demand interactions remain only vaguely understood. This confusion comes from several directions, including inexact resource inventories, poor definition of demand curves, and lack of knowledge regarding the value of resources to the residents of the basin. In effect, resource-based industries have been reacting to demand rather than integrating supply with demand. Michigan Sea Grant perceives this shortcoming as an important research priority.

### □ Current Michigan Sea Grant Research

A study is being conducted that will determine what Lake Michigan anglers expect from both present and future salmonine fisheries. Knowledge of those expectancies will yield information on future angler demand for this important family of sport fish.

### □ Michigan Sea Grant Research Opportunities

#### Goal:

**Develop a better understanding of factors affecting supply of and demand for critical Great Lakes resources.**

#### Objectives:

- **Develop a better understanding of factors which motivate people to use Great Lakes resources.**

Residents of the Great Lakes Basin have a large variety of resources at their disposal. Selection among these resources, particularly for recreation, has a major impact on coastal development. A better understanding of the factors affecting choice is invaluable for rational planning of coastal development.

- **Develop methods to estimate the relationship between supply and demand. These methods should include economic analysis of both market and nonmarket goods.**

An individual's selection for use of a particular type and location of aquatic resource is predicated on both supply and demand. Analysis of this relationship can be approached from both economic and noneconomic perspectives. Currently, consumer response to various coastal resources as supplies change is difficult to predict. Studies are needed to link supply and demand through a mechanism such as the demand curve.



- **Determine the importance of the interaction between supply and demand for important Great Lakes resources.**

Utilization of aquatic resources shifts as demand outstrips supplies or as supplies exceed demand. For example, shifts in species targeted by recreational fishers is very much driven by catch expectations. These highly dynamic interactions are extremely important to resource utilization. Yet, relatively little is known about the social and economic factors which drive these interactions.

#### **Time-Table for Research**

**Next Five Years** - Determine demand curves for a variety of Great Lakes resources.

**Beyond Five Years** - Relate demand curves from different resources to determine if a general trend exists.

## **Topic II: Constraints**

#### **Current Status within the Great Lakes Basin**

External to supply, a variety of constraints may arise which suppress normal resource-based economies. Those constraints may be physical, such as restricted access to water, or perceived, such as contamination of fish from toxic substances. In either case, the constraints result in an unanticipated reduction in demand. Further, the relaxation of a constraint may lead to exploitative use of a natural resource or to the recognition of another and unexpected constraint. Finally, some constraints, such as the restriction of fishing in designated areas, may be politically driven.

Most constraints are not forecast, but are recognized only as they come into play during the development of a resource-based industry. An example is the series of constraints that have affected the recreational walleye

fishery in Saginaw Bay. This fishery has declined for a variety of reasons, such as overfishing and pollution. As stocks plummeted and catches declined, severe constraints on enjoyment of the fishery were engendered by the very low yield per effort. A further constraint was concern about the possibility of toxic contamination of the fishery. These two constraints were removed in the early 1980s as water quality improved and the public was assured that toxic accumulation was not a problem with these relatively short-lived fish. As the Saginaw Bay community looked forward to the economic rewards of the newly rejuvenated fishery, an unexpected problem arose because of limited boat launching sites. This caused excessive delays, which reduced time for walleye fishers on the water. This example shows how supplies that are now high and demand that is intense can be frustrated by a constraint. Yet, a relatively simple study could have predicted the lack of enough boat-launching facilities.

The above example illustrates the need to uncover important constraints before they restrict resource use or access. As a trend emerges, a mechanism should be available to reveal constraints that may thwart it. Michigan Sea Grant research will be directed, not at uncovering all possible constraints, but at developing protocols for regional and local entities to use in examining their own resource-related constraints.

#### **Current Michigan Sea Grant Research**

A present study will analyze the constraints imposed on Great Lakes anglers by fish consumption advisories; in particular, how the advisories change angler behavior and the economic consequence of those changes.

## □ Michigan Sea Grant Research Opportunities

### Goal:

Develop a better understanding of how real and/or perceived constraints and choices can influence supply and demand for Great Lakes resources.

### Objectives:

- Identify key constraints and their relative importance to demand and supply.

Aquatic resource utilization can be affected in unexpected ways by various physical, economic, or institutional constraints. In many instances these constraints can effectively suppress the use of an otherwise desirable resource. The nature of these constraints as they affect coastal and aquatic resources should be identified.

- Define the level of interaction among key constraints.

In many cases more than one constraint may operate on a key resource. Removal of one constraint may lead to frustration as other constraints unexpectedly arise. An understanding of the level of interaction among constraints is lacking, but is required to avoid continual problems in resource development and utilization.

- Estimate how the presence or lack of critical information affects choices for use of Great Lakes resources.

A major constraint to resource utilization may be as much perceived as real. For example, certain fisheries may be underutilized because of fears about toxic contamination. In other cases, underutilization may be result from limited access to fishing sites. In the first case critical information can effectively remove the constraint. The degree to which the lack of this information affects choices is unknown, yet it is

undoubtedly an important element in resource utilization.

- Determine if institutional arrangements play a large role in influencing resource use choices.

Institutional actions, such as restrictions placed on resource utilization, can play a major role in the choices governing coastal development. Often the institutions operate with limited knowledge of the consequences of their actions and/or the actions of other institutions. A deeper understanding of institutional arrangements would provide a better appraisal of the effect these organizations have on consumer choices.

## □ Time-Table for Research

**Next Five Years** - Develop protocols for revealing constraints associated with Great Lakes resources.

**Beyond Five Years** - Using the new protocols, predict constraints to wise use of Great Lakes resources

## Topic III: Integrating Supply, Demand, and Constraints

### □ Current Status Within the Great Lakes Basin

Supply, demand, and constraints all contribute toward the decisions of how to develop and use natural resources. While all of these factors may contribute toward voluntary selection of resource utilization, they are rarely studied as interrelated entities. Rather, supply and demand relationships tend to emerge from economic studies, while constraints receive more attention from a social and/or policy context. In practice, supplies may operate on demand only in the absence of major constraints.

The Great Lakes Basin is an ideal environment in which to study the interrelation of supply, demand, and

constraints. Inventories of many of the resources have been developed, and study of these resources is tractable because of their finite size. While marine resources share some of these same attributes, the much larger resource pool makes study difficult. Supply and demand for many Great Lakes resources is approximately known and some constraints identified. Michigan Sea Grant believes that an integrated approach to supply, demand, and constraints may be possible for the first time as these quantities become better understood with more study. As a result, this topic is a high research priority for future Michigan Sea Grant funding.

**Current Michigan Sea Grant Research** None.

**Michigan Sea Grant Research Opportunities**

**Goal:**

Integrate supply, demand, and constraint factors into a dynamic model for a specific recreational activity and/or locale.

**Objective:**

- **Conduct dynamic benefits/costs analyses of supply, demand, and constraints.**

Integrated analysis and modeling of supply, demand, and constraints is a new and relatively unexplored tool for evaluating economic and policy infrastructures in coastal development. This approach should be employed as a new technique in economic and policy research.

**Time-Table for Research**

**Next Five Years** - Make initial attempts to integrate supply, demand, and constraints.

**Beyond Five Years** - Develop integrated models of supply, demand, and constraints.

## **Topic IV: Conflict Resolution Surrounding Native American Great Lakes Issues**

**Current Status within the Great Lakes Basin**

One particularly difficult Great Lakes policy issue is the establishment of equitable fishing rights in the Great Lakes. Westward expansion by European settlers and their descents displaced many Native Americans from their homelands. Eventually treaties were negotiated where peaceful co-existence was the primary objective. These treaties address numerous elements of life in Great Lakes Basin, including fishing rights. Some of these treaties contained rather vague and imprecise language by today's standards. Consequently, they have been left to a variety of legal interpretations.

During the first half of the 20th century, numerous commercial fisheries of the Great Lakes collapsed. These collapses led to development of management strategies in order to preserve the fisheries. Included in those strategies are restrictions on gear type, season, and location for harvest. However, Native American fishers began to exercise their fishing rights, which in some cases fall outside of the management strategies imposed by the Great Lakes states. This has led to numerous conflicts, often temporarily settled in the courts. A carefully planned analysis of the conflict issues must be based on a scientific understanding of the fisheries involved. It also must be based on the Native American perspective, relevant treaties, and on U.S. and Canadian law. This analysis could then lead to a possible resolution of some of the conflicts surrounding Native American fishing in the Great Lakes.

□ **Current Michigan Sea Grant Research** None.

□ **Michigan Sea Grant Research Opportunities**

**Goal:**

**Contribute to a resolution of conflict concerning the harvesting of Great Lakes fishes that allows both Native American and other commercial fishers to exploit but not over-exploit the resource.**

**Objectives:**

▪ **Independently review current harvests of fish that are the target of Native American and commercial fishers.**

Determine if current methods and yields of both groups are reasonable given the status of the fisheries. In some cases, the resource will not support much more pressure and may collapse if conflicts are not resolved.

▪ **Review the treaties in relation to the present understanding of the fish stocks.**

Irrespective of the language of the treaties, they must be reviewed in context of contemporary fish stocks. All parties may have to adjust their fishing methods to secure a more permanent solution.

▪ **Attempt to resolve conflicts surrounding this issue.**

Develop and/or arbitrate solutions to the current conflicts that allows as many groups as possible to continue a livelihood. Solutions should be fair and attempt to address the vagueness of previous treaties. Part of the effort will include identifying the appropriate venue for bringing parties together.

□ **Time-Table for Research**

**Next Five Years** - Review the nature of the disputed resource and develop conflict solutions.

**Beyond Five Years** - Contribute to a proactive rather than a reactive solution to the conflicts.

## Environmental Studies

A concept currently dominant in studies of the Great Lakes is the "ecosystem approach." Loosely defined, the ecosystem approach consists of recognition that all aspects of the environment are interrelated. In the case of the Great Lakes, interrelations consist of linkages or connections among the air, water, and sediment found above, in, and below the drainage basin of each lake. These linkages become especially apparent when considering the pathways of critical pollutants, which often become concentrated by natural processes after they enter the ecosystem. In effect, the finite nature of the ecosystem has been recognized, and sensitivity to that concept must drive research and management of Great Lakes resources.

Two high priority research topics under the environmental studies subprogram demonstrate the importance of the ecosystem approach in Great Lakes studies. The first topic involves competing management strategies for the Great Lakes. One strategy would improve water quality by reducing nutrient inputs from both point and nonpoint sources. These reduced nutrient inputs will lower algal growth and enhance water quality. In contrast, intense pressure is exerted for higher yields from the commercial and recreational fisheries. Fish yields benefit to some degree by improved water quality. But, diminished algal productivity can cause eventual shifts in the forage fish base and dramatically affect the production of carnivorous fishes. The issues that must be addressed are the connections between nutrient control, the forage fish base, and fish yields.

Another topic of importance to the Great Lakes is the presence and effect of toxic substances. Although the pathways of toxic substance movement and accumulation vary among different chemicals, they appear to follow a general pattern of atmospheric deposition or run-off, sorption to particles, accumulation in the sediments, movement into the food web, and bio-accumulation in top carnivores. The unknown or unpredictable aspects of this process are the level of bio-accumulation in each

species and the stress caused by the presence of the toxic materials. The critical link in this case is the movement of toxic substances attached to particles.

Recent research in the Great Lakes has shown that the links among what was previously considered distant and/or separate compartments are stronger than presumed in the past. For example the atmosphere is, in some cases, the primary source of toxic substances and nutrients reaching the Great Lakes. Sediment reworking is a major mechanism for releasing buried materials back into the water column. Thus, a primary purpose of the environmental studies subprogram is to explore these links and develop a more comprehensive understanding of ecosystem structure and function in the Great Lakes.

Recently, the Great Lakes food web has been destabilized by numerous invasions of exotic species. Historically, inter-basin exchange of species among large lakes was rare, allowing the evolution of different food webs among the large lakes of the world. But, anthropogenic intervention has caused numerous exchanges of freshwater species and promoted the invasion of salt-water species. These organisms, which primarily arrive through canals and from ballast water in large ships, have completely altered the structure of the Great Lakes food web. Today, the food web is comprised primarily of non-indigenous species, with the rate of invasions increasing.

Many of the ecosystem issues given high research priority by Michigan Sea Grant fall into both the environmental studies and living resources subprograms. These are the issues that deal with structure and function of the food web, viability of habitats, and movement of substances among aquatic biota. Therefore, the environmental studies and living resources subprograms are carefully coordinated.

Ecosystem studies can be extremely broad in regard to the subject matter addressed. Most Great Lakes topics could be included under this umbrella. Michigan Sea Grant encourages diversity of study, but has designated four topics as high priority for the next five years. These four topics are:

- food web structure, plasticity and stability, especially for the forage fish base and the lower levels (smaller organisms) of the food web;
- value of critical habitats for the health and survival of dominant and important species of the Great Lakes;
- fate and effect of toxic substances in relation to the most abundant and/or important species in the basin. A review of the current status and research opportunities for each of these three topics is given below.
- invasion of the Great Lakes by exotic species from other freshwater environments and from salt-water.

### Topic I: Food Web Structure and Stability

#### □ Current Status within the Great Lakes Basin

The Laurentian Great Lakes of North America represent a set of highly perturbed and managed ecosystems. While the vast size of these lakes provides a degree of buffer against “micro-management,” they have received more than their share of human impact. These impacts began in the early nineteenth century with the intense exploitation of resources by early European settlers. The pattern of exploitation continued into the twentieth century along with an unprecedented variety of pollution. The consequence of these actions was degradation of an environment that had supported rich and diverse freshwater fisheries. Pressures on the fishery were exerted from both the top and bottom on the food web. So-called “bottom-up” pressure included excessive algal growth from eutrophication. “Top-down” pressure was most notably exerted

from overfishing and invasion of exotic species into the lakes. These environmental pressures peaked about 1960, with wholesale changes in the structure of much of the Great Lakes food web.

Today, the Great Lakes ecosystem is recovering, but in a manner that takes little precedent from the past. Many exotic species are firmly entrenched in the Great Lakes and comprise the backbone of the food web. Fishing pressure is controlled, but is also manipulated by ambitious stocking programs. Water quality has improved to the degree that significant reductions in algal production have been recorded in the past few years. The future of the Great Lakes food web is an important, yet difficult to predict, unknown. The stability of that food web appears to balance on a few key forage fish species, such as the emerald shiner, rainbow smelt, and alewife. Yet, recent studies have shown dramatic shifts in patterns of abundance of these species. The cause of those shifts remains speculative. The consequences of those shifts to other parts of the food web require investigation.

Patterns of forage fish abundance suggest that a rapid decline in alewife biomass in Lake Michigan accompanied a noticeable increase in water clarity. The increase in water clarity was attributed to the positive effects of reducing nutrient inputs, most notably phosphorus, which in turn lower algal growth. But, the association between water quality and alewife abundance is derived only from correlation and not cause and effect. Other equally plausible hypotheses have been suggested. Michigan Sea Grant believes that this type of research is of fundamental importance to the health of the Great Lakes ecosystems and is a high priority.

### □ **Current Michigan Sea Grant Research**

Alewife stocks, which form an important element of the forage base for many large carnivorous fishes, including the Pacific salmon, have declined precipitously in recent years. Michigan Sea Grant is presently studying alewife survival rates to determine whether the population is compensating for its currently reduced abundances and what its chances are for increasing.

### □ **Michigan Sea Grant Research Opportunities**

#### **Goal:**

**Develop an ecosystem approach to the study of the forage fish base in selected areas of the Great Lakes. These studies would entail a deeper understanding of certain elements of the food web and of the chemical and physical factors controlling those elements.**

#### **Objectives:**

- **Determine the distribution and abundance of essential components which support the forage fish food base in critical areas of the Great Lakes.**

The forage fish of the Great Lakes play a critical role in maintaining the stability of the Great Lakes food web. The annual trends in abundance of those fish have undergone large changes in the recent past. Studies are needed to relate other components of the food web to the forage base. These studies are intended to include all species in the food web, not just other fish species.

- **Relate key limnological processes to abundance and distribution of forage species.**

Physical, chemical, and geological processes in the Great Lakes often drive the dynamics of the food web. Linkages among certain events such as the thermal front and the spring phytoplankton bloom are only approximately understood. These studies would strive to expand the knowledge of those events and identify new linkages.

### □ **Time-Table for Research**

**Next Five Years** - Determine what will be the trends in the forage fish base in the Great Lakes based on recent changes to the food web.

**Beyond Five Years** - Estimate the long-term survivability of the forage fish base in view of the rapidly shifting structure of the food web.

## **Topic II: Critical Habitats**

### □ **Current Status within the Great Lakes Basin**

Destruction of critical habitats, particularly in the coastal estuarine environment, looms as one of the major threats to health of all aquatic ecosystems. This problem, shared by both freshwater and marine environments, has proven particularly difficult to mitigate. Habitat degradation is not a new problem, but has many forms and thus requires a variety of research approaches.

Habitat destruction is a consequence of the encroachment of human settlement adjacent to water. In the Great Lakes Basin, severe habitat destruction began with intense lumbering activities, which included alteration of the watersheds by clear-cutting of the forest. Habitat destruction continued throughout the nineteenth and twentieth centuries from unchecked development, rapid industrialization, and more recent urbanization. The removal of critical units of landscape such as coastal wetlands placed considerable stress on the riparian flora and fauna. Added to those stresses were the degradation of overall water quality in the Great Lakes and the change in the drainage basin from primarily forested land to open farm land.

Today, the integrity of the units of landscape is recognized, and legislation attempts to preserve the more valuable entities. However, in most cases the value of the unit of landscape is inferred from rather meager databases.

For example, submerged reefs are known to provide prime spawning habitat. Yet, the actual density-dependent relationship between spawning success and areal extent of reef is rather poorly understood. Similar cases can be made for coastal wetlands, shallow rivers and streams, and dunes. Development pressures have been intensifying in the recent past and current patterns show no decline in development activities. These factors provide the incentive for detailed studies of the relationship among critical habitats and key species in the Great Lakes food web.

❑ **Current Michigan Sea Grant Research** None.

❑ **Michigan Sea Grant Research Opportunities**

**Goal:**

Develop a better understanding of critical habitats that may have a profound effect on the recruitment of certain fish species and/or their forage base. Habitats such as wetlands, which are being lost at high rates, will constitute high priority research areas.

**Objectives:**

▪ **Develop a better perception of the role that wetlands play in overall productivity of the Great Lakes, including the growth and development of selected fish species.**

Great Lakes coastal wetlands have been identified as critical biological habitats. Because these areas are being permanently removed from the region, their importance is increasing. Studies are needed on the tie between wetland functions and the survival and productivity of Great Lakes fishes. These studies may be broad in scope and cover all wetland functions.

▪ **Relate chemical and physical processes to the overall productivity of the Great Lakes and the recruitment success of key fish species.**

Certain physical, chemical, and geological processes play a crucial role in overall productivity of the Great Lakes. Often, study of these processes is a useful surrogate for measuring a related biological process. Studies are needed to determine why certain nonbiological processes are essential to overall productivity of the Great Lakes.

▪ **Investigate the top-down versus bottom-up hypotheses of trophic dynamics.**

Recent studies of the food web in the Great Lakes have yielded contrasting views of factors controlling the structure of this web. One contrast is the top-down hypothesis versus bottom-up hypothesis. Studies to reveal when and where each hypothesis prevails are needed.

❑ **Time-Table for Research**

**Next Five Years** - determine the value of a few critical habitats, especially wetlands, to overall ecosystem productivity, structure, and function; develop models of ecosystem function based on the understanding derived from habitat studies.

**Beyond Five Years** - undertake studies of other critical habitats in a similar fashion to earlier studies; refine and verify models developed earlier of ecosystem function.

### **Topic III: Toxic Substances**

❑ **Current Status Within the Great Lakes Basin**

One of the major concerns facing the Great Lakes is the accumulation of toxic substances in the environment. The Great Lakes have a history of extensive industrialization that includes most forms of heavy manufacturing and chemical production. An abundance of resources, including fresh water, was instrumental in this history of industrialization.



The industrial base that made the Great Lakes region prosper has not been without its costs. Over the past century, contaminated effluents have carried thousands of exotic substances into the waters of the Great Lakes. In some instances enormous amounts of these materials were released into the environment. Recently these materials have been recognized as highly toxic and persistent. In some cases the degradation products of the material released are even more toxic and persistent than its precursor. The consequence has been contamination of many areas of the Great Lakes.

The varied nature of the compounds released into the environment and their capricious behavior once released have presented a major research challenge to environmental scientists. Transport of these materials over long distances has revealed the importance of atmospheric inputs to the Great Lakes. Bio-accumulation by top carnivores has shown the fallacy of the "dilution approach" used in the first half of the twentieth century. Finally, the mobility of these toxic substances once in the environment has caught almost everyone off guard.

The Great Lakes region has become a focus of national attention regarding toxic materials. Considerable efforts have been mounted to detect, monitor, and mitigate severe contamination. Yet much remains to be done, especially in developing a better understanding of the impact of toxic materials on aquatic flora and fauna. Michigan Sea Grant views this topic as a high research priority.

#### □ **Current Michigan Sea Grant Research**

Two research projects are currently underway regarding the effects of exposure to toxic substances. One is determining the effects of maternal exposure of rainbow trout to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) on reproduction.

The other project is investigating the immune response in Great Lakes fish eaters. This study, conducted in conjunction with the Michigan Department of Public Health, is determining if a cohort of fishers who eat a large amount of Great Lakes fish suffer any health effects in contrast to a non-fish eating cohort.

#### □ **Michigan Sea Grant Research Opportunities**

##### **Goal:**

To link the study of toxic substances to specific elements of the food web that may be at risk due to high exposure. This approach would be tied explicitly to the ecosystem approach described earlier and used to greatly reduce the types of compounds and organisms under study.

##### **Objectives:**

- **Study those toxic materials known to exist in dangerous quantities in the Great Lakes.**

A systematic approach to study toxic materials in the Great Lakes Basin is needed. Studies restricted to the most abundant and/or toxic materials would include investigation of the pathways, sources, and sinks for these toxicants. Those materials with basin-wide distribution will take priority over locally distributed toxicants.

- **Focus studies on those organisms, including humans, known to be at risk from toxic materials. The guiding principle for choice of organisms to study will come from the probable pathways of toxic materials identified from previous research.**

Because toxic materials differentially affect organisms, studies will be oriented toward those at the highest risk. This would include organisms at the higher trophic levels and/or important in the movement of toxicants. Those organisms found throughout the basin will be given priority over those found locally.

#### □ Time-Table for Research

**Next Five Years** - determine what constitutes the high risk groups, estimate their exposure, and begin to determine the consequences of that exposure.

**Beyond Five Years** - develop more sophisticated models of exposure to specific toxic substances.

### Topic IV: Exotic Species

#### □ Current Status within the Great Lakes Basin

The large lakes of the world vary considerably in their age from a few thousand to hundreds of thousands of years old. Historically, these lakes occupied disjoint basins which greatly restricted exchange of species between the lakes. Only where the lakes were interconnected, such as the Laurentian Great Lakes, was inter-lake species exchange common. The net result was that very different and often unique flora and fauna evolved in each lake.

Recent human activity has generally perturbed this status. Canals, irrigation systems, large merchant ships, and bulk shipping have all provided a mechanism for unintended exotic species invasions. In the Great Lakes this has resulted in numerous invaders, with the most recent, such as the zebra mussel (*Dreissena polymorpha*), having severe impacts on the structure of the food web. The Great Lakes has also been the subject of several intentional invasions to develop new fisheries or "stabilize" the food web.

Today the Laurentian Great Lakes have a food web comprised mostly of exotic species. Although many invaders have not survived upon release into the lakes, a few have survived spectacularly, often exploiting unoccupied niches or awaiting opportunities to flourish. Two notable recent examples are the zebra mussel and the white perch (*Morone americana*). The zebra mussel population is undergoing an unprecedented expansion as the organism

exploits what was previously an unoccupied niche. The white perch have grown rapidly of late as they exploit the changing ecosystem structure in Saginaw Bay.

#### □ Current Michigan Sea Grant Research

Two studies were started in 1989 which investigate the effect of *Bythotrephes cederstroemi*, a recent invader from Europe. This species of zooplankton, sometimes called the spiny water flea has caused a major impact on the food web of all the Great Lakes in that it affects other zooplankton and the forage fish base. One study is investigating the invader through field studies and development of a plankton dynamics model. Another study is investigating the same species through laboratory studies of its consumption by several different species of forage fish.

#### □ Michigan Sea Grant Research Opportunities

##### Goal:

To determine the impact that recent invasions of exotic species has had or will have on the Great Lakes food web. This research can be both reactive, by examining recent invasions, and proactive, by looking at probable future invaders.

##### Objectives:

- Determine the impact that recent invaders have had on the food web.

The food web in many parts of the Great Lakes has been greatly altered by the invasions of *Bythotrephes cederstroemi* and the zebra mussel. The final nature of the food web after these invasions stabilize is unclear, and detailed study is required to understand the relevant species interactions.

▪ **Examine the suspected source of many of the recent invaders, predict possible future invaders that would have a major impact on the Great Lakes ecosystem, and develop protocols to prevent such invasions.**

Very little can be done to control an exotic species once released into the Great Lakes. With research and regulation, it may be possible in the future to prevent the most damaging invasions.

☐ **Time-Table for Research**

**Next Five Years** - Evaluate the impact that a few key exotic species such as *Bythotrephes cederstroemi*, the zebra mussel, and white perch will have on the food web.

**Beyond Five Years** - Develop and suggest protocols to prevent or reduce the rate of invasions.

## Living Resources

Over the past 150 years, Great Lakes fishery resources have been altered through exploitation, degradation of habitat, and the introduction or invasion of exotic species. Fortunately, much has been done in the last two decades to check, reverse, or compensate for this degradation. In recent years, sport fishermen have enjoyed one of the most spectacular fisheries ever created. Sport fishing is, in fact, a \$1 billion business in the Great Lakes, largely due to the revitalization of the walleye fishery in Lake Erie (probably due to improved water quality and reduced commercial fishing pressure), the introduction by the states and Canada of stocks of coldwater salmonids, including coho, chinook, and Atlantic salmon, and the reintroduction of lake trout. The Great Lakes also support a commercial fishery for lake trout, whitefish, chub, smelt, yellow perch, white bass, and other species.

However, much remains to be done. Stocks of important sport and commercial fish in the Great Lakes are presently undergoing considerable change. Alewife populations may be declining due to predation by the introduced salmonids. If this is so, there is concern about whether the salmonids will adjust to other forage species, such as chubs, or whether a decline in the alewife population would result in a decline in salmonid growth. Thus, some shifts in the kinds and amounts of salmonid species being stocked may be necessary. Efforts by the states, provinces, the Great Lakes Fishery Commission, and the U. S. Fish and Wildlife Service to rehabilitate lake trout stocks in the Great Lakes are largely unsuccessful so far.

On the positive side, lake herring stocks in Lake Superior are increasing in abundance after suffering a near collapse. A recent agreement between the Native American tribes and the Michigan Department of Natural Resources (MDNR) to insure equitable use of the resource by Native Americans, licensed commercial fishermen, and sport fishermen should lead to improved management of fish populations. Water quality improvements, such as in Saginaw Bay and Green Bay, are leading to improved fish stocks.

While commercial fishing for some species is improving, current commercial yields of fish from many areas of the Great Lakes are still substantially below historic levels. Commercial fishing enterprises which formerly relied on larger, high-market-value fish such as lake trout and blue pike, now often depend on other species, such as smelt and alewife, once considered of low value but now in significant demand for various uses.

In addition to their direct value, the Great Lakes fisheries have great value as models of managed fisheries systems for scientific study. This value extends nationally and globally. The Great Lakes fisheries are large enough to mimic the ocean fisheries, but small enough to facilitate better and more thorough sampling designs. Thus, the Great Lakes fisheries can serve as models supported by field research employing statistical sampling techniques.

A basic goal of fisheries managers is to manage fish populations on a self-sustaining basis. Hatchery rearing and stocking of fish is expensive by comparison and is used as a supplemental tool. However, because of habitat constraints, water quality degradation, contaminants, and often unknown problems, stocking to maintain fish populations has become a heavily relied-upon practice. This practice is by necessity and not by choice. Due to the increase in hatchery supported populations, problems have occurred in hatchery programs. These problems are usually related to disease and to the production of physiologically inferior fish resulting from unnatural rearing conditions. Research is needed to identify pathogenic organisms, to develop treatments, and to identify improved hatchery rearing conditions.

While there are many other areas of living resources that require research, Michigan Sea Grant is presently focusing on fish and fisheries as top priorities. Further, Michigan Sea Grant emphasizes research on natural fish populations over that on aquaculture or hatchery problems. Sea Grant's goals and their related objectives are presented in order of decreasing priority.

## Topic I: Year-Class Strength, Recruitment, and Yield

### □ Current Status within the Great Lakes Basin

Michigan Sea Grant has taken its direction, and will continue to do so, from recommendations in *Fishery Ecology, Some Constraints That Impede Advances in Our Understanding*, made by the National Research Council and published in 1980 by the National Academy of Sciences. In essence, the publication highlights the need to better determine the biotic and abiotic factors that influence year-class strength in early life history stages (egg, larvae, and juvenile), and subsequently to define processes that link staged year-class strength with recruitment and catchable yield of harvestable populations. This research must consider single species first and then build into community-based systems. The ultimate goal is the development of improved stock recruitment models with better predictive powers.

Presently, in the Great Lakes fisheries and globally, difficulties in maintaining balanced fish stocks and in providing stable or increased catches of fish and fishing opportunities arise largely from difficulty in predicting the harvestable surpluses and allocating them to competing users. For fish stocks of concern, management techniques must be based on the best scientific research available. Thus, studies designed to increase understanding of fish recruitment patterns and the subsequent development of models to predict yield are desirable goals.

Michigan Sea Grant already has a firm basis of such research to build upon. Over the past several years Sea Grant has funded a study of lake whitefish stocks in Lake Michigan. The study has provided managers with a greatly improved ability to predict the recruitment and the potential yield of lake whitefish two to three years in advance of harvest. The ramifications of this study will be widespread, as the lake whitefish is the largest freshwater commercial

fishery in North America. In addition, the completed study will provide one of the most detailed sets of information on fish population dynamics available to scientists and managers in the published literature.

A several-year Michigan Sea Grant study to develop a management model for Lake Superior lake herring stocks has provided information useful for rehabilitation and management of these fish throughout their range. Populations of this species have almost disappeared elsewhere. A study of the population dynamics and yield potential of Lake Superior pink salmon and another study on yellow perch growth and mortality in Saginaw Bay add to Michigan Sea Grant's strength in this area of research.

Using the expertise gained in these studies, Michigan Sea Grant will move forward in the study of other economically important fish species. Species for study will be selected where the data are expected to be particularly valuable in improving the ability to model and predict stock recruitment. Both sport and commercial species will be studied. Close coordination with the Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, and the Great Lakes Fishery Commission will be pursued so that Sea Grant research will be complementary with other programs.

Species important in the Great Lakes include, but are not limited to, lake trout, chinook, coho, and pink salmon, rainbow trout (steelhead), yellow perch, walleye, bloater (chubs), alewife, smelt, lake whitefish, and lake herring. Many of these species are under investigation by such agencies as the Great Lakes Fishery Commission, Wisconsin Sea Grant, and the Michigan Department of Natural Resources. Michigan Sea Grant plans to focus on those species where it can make the greatest contribution.

□ **Current Michigan Sea Grant Research**

Presently, Michigan Sea Grant is funding projects on lake whitefish, pink salmon, yellow perch, walleye, alewife, and lake sturgeon. The lake whitefish studies are nearing completion with the investigation of some food web relationships. The program to study pink salmon population dynamics and yield potential is at midpoint. Studies of the population dynamics of yellow perch and walleye in Saginaw Bay are in the early-to-middle phases. A study of alewife survival rates and recruitment began in 1989, as did research into the early life history of lake sturgeon.

□ **Michigan Sea Grant Research Opportunities**

**Goal:**

Improve stock recruitment models for predicting yield of economically important species.

**Objectives:**

- **Identify and determine the influence of biotic and abiotic factors on the year-class strength of early life history stages of selected fish species.**

Species selected include yellow perch and walleye, chinook, coho, and pink salmon, and the forage species alewife and smelt. Studies on the important percids, should concentrate on factors limiting natural reproduction and growth rate, such as availability of food. Saginaw Bay can serve as a typical locale for such studies, because the walleye population in the Bay is sustained by stocking and the yellow perch grow very slowly. Early life history information on salmon is needed and should focus on food habits and the factors influencing mortality of fry, larvae, and juvenile stages. Information on recruitment of alewife and smelt, the major prey species for salmon, is critical to understanding community dynamics.

- **Evaluate the role of habitat in the survival and growth of important fish species.**

Failure of species to reproduce is often caused by inadequate spawning or nursery areas. Contaminated sediments, especially in Saginaw Bay, are suspected of causing mortality of eggs and fry and failure of benthic organisms to provide a food source. In some cases lack of suitable spawning areas is a limiting factor. Studies will address the influence of habitat on spawning and benthic food production, especially for walleye and yellow perch in Saginaw Bay. The role of artificial structures (e.g., reefs) in supplementing limited natural habitats for spawning and food production will also be studied.

□ **Time-Table for Research**

**Next Five Years** - Build on present walleye and yellow perch studies with emphasis on physical habitat and contaminant factors; continue to develop studies on smelt and alewife with probable emphasis on climatic factors and zooplankton food relationships. Focus research on early life history mortality of chinook, coho, and pink salmon. Evaluate several existing artificial reefs for their effectiveness and evaluate areas proposed for reef construction in an effort to better define the parameters to be considered in the effective siting and construction of reefs.

**Beyond Five Years** - Refine research on the early life history of economically important fish species based on findings of initial studies, with the long-term goal of developing predictive recruitment models. Models will be tested using historical data of populations, where available, and climate records. Evaluations of habitat improvements, both natural and artificial, as related to fish populations will be made with an emphasis on Saginaw Bay and constructed reef sites.

## Topic II: Aquaculture

### □ Current Status within the Great Lakes Basin

Presently the salmon fishery in Lake Michigan is in the third year of decline. The fishery in 1989 had a recreational catch approximately 20 percent of that in 1986. The economic impact of this decline is very serious, and many charter boat businesses are failing. There are many questions about the causes of the decline and no answers. Most scientists suspect that the reasons relate to early life history stages and may involve direct mortality factors of predation or food supply; however, causes may also be hatchery related. Bacterial kidney disease (BKD) has been identified as being involved and very likely is contracted in the hatchery rearing process. Inferior fish with low resistance or immunology due to inbreeding or other genetic factors may be a problem. Timing of planting may be a factor, and crowding in hatcheries may also be a factor. These questions must be answered and need research. Much of the research can be related to aquaculture techniques, nutrition, and genetics.

The United States Department of Agriculture now administers five regional aquaculture centers. One is located in the North Central Region, which includes the Great Lakes area. The emphasis of research in the centers is on the culture of fish for human food production. To avoid duplication of effort, the Michigan Sea Grant College Program will support research that emphasizes fish culture that relates to management needs in the area of recreational or commercial fisheries.

### □ Current Michigan Sea Grant Research

Because of lack of funds and the research emphasis on natural fish populations, there are no funded projects in aquaculture.

### □ Michigan Sea Grant Research Opportunities

#### Goal:

Develop innovative fish culture (aquaculture) strategies that complement fishery management needs in recreational or commercial fisheries.

#### Objectives:

- Determine the potential for genetic manipulation in fisheries management strategies. Genetic manipulation could include isolation and control of genetic growth factors; triploidy or polyploidy manipulations for growth and reproduction control; and selection of genetic strains to improve disease resistance or vigor.
- Determine if various factors in hatchery systems can cause physiological conditioning that may adversely affect fish when stocked in natural waters. Research could include defining optimal oxygen concentrations, determining indicators of crowding stress (e.g., blood parameters such as distribution of serum proteins) and experimentation with time of stocking.

### □ Time-Table for Research

**Next Five Years** - Research should address possible genetic roles that could be involved in the chinook salmon decline, including initial defining of the genetic history of the present stocks. Oxygen regimes and hatchery loadings of fingerlings should be evaluated regarding stress relationships and economic feasibility.

**Beyond Five Years** - Hatchery conditions must be optimized. Reliable stress indicators should be identified. Bacterial kidney disease should be researched to determine its actual role in mortality.

# Marine Transportation and Engineering

Marine transportation is vital to the economy of the Great Lakes Basin. The movement of iron ore, grains, and other bulk commodities is particularly important. The large diesel-powered Great Lakes ore carriers present numerous technical challenges and problems, some of which are unique, and others which are identical to those associated with large ocean-going vessels. There are three, large-ship shipyards in the region and there is growing activity in recreational craft design and manufacturing. The State of Michigan has more registered recreational water craft than any other state in the nation.

Michigan Sea Grant's university constituency includes The University of Michigan's Department of Naval Architecture and Marine Engineering. This is one of only three programs in the United States which awards bachelor through Ph.D. degrees in this important marine field. This department has graduated a large portion of the naval architects and marine engineers who have entered the design and research activities of the nation's marine transportation and offshore oil and gas industries in the past decades.

The Marine Transportation and Engineering subprogram began as the Great Lakes Transportation Subprogram in the mid-1970s. It was created to bring the knowledge and expertise of Michigan's academic community to bear on the technical problems and needs of the Great Lakes marine transportation industry. Examples of research during this initial period include (1) the ice strengthening of Great Lakes bulk carriers, (2) the engineering feasibility of automatic path control for ships operating in the restricted waters of the Great Lakes system, and (3) alternative routes for the movement of western coal in order to avoid the constraints of the Soo Locks.

Beginning in 1983, in specific response to encouragement from the National Sea Grant Office, activity was broadened to include the research and education needs of the ocean transportation industry and the offshore oil and gas industry. Accordingly, during the Michigan Sea Grant College Program

long-range planning meetings in the summer of 1985, the name of the subprogram was changed to Marine Transportation and Engineering. Examples of the more generic research in this second period include (1) the study of the use of multivariable integral control systems for the control of diesel/controllable pitch propeller ship propulsion, (2) the development of graphics and applications software which support the simultaneous use of multiple graphics devices in the interactive development of ship hull designs, and (3) the development of a systems approach for the finite element analysis of elasto-hydrodynamic stern bearings.

Also in 1983, specific activities in offshore engineering were undertaken in response to the growing interest of the offshore oil and gas industry in naval architecture graduates and in research in the offshore applications of naval architecture. Michigan Sea Grant approved program development funding which resulted in the formal creation of The University of Michigan/Sea Grant/Industry Consortium in Offshore Engineering in 1985. This consortium undertakes a cooperatively directed program of research, education, and curriculum development focused on the engineering needs of the offshore oil and gas industry. Michigan Sea Grant was a charter member of this Consortium and has provided continuous support for its research through three, two-year "projects" during the 1985-1991 period.



## Topic I: Engineering Design of Recreational Craft

### □ Current Status

The design and production of recreation power and sail craft is an important, growing commercial activity in the Great Lakes region. As mentioned previously, the State of Michigan has more registered recreational water craft than any other state in the nation. The fundamental understanding of many areas of the design, ergonomics, powering, and dynamics of these craft, however, lags far behind our understanding of the corresponding technology applicable to large-displacement vessels. This has been due to both (1) the inherently more difficult problems associated with these smaller craft and (2) the focus of almost all marine research resources and effort on the problems of large-displacement vessels. Research is needed to reduce this serious gap in advanced engineering technology.

Most larger planing craft operate in the partial-planing regime. Powering of these vessels is not well understood due to the complex flow conditions and the close interaction between the hull and the propulsor. The separation of the analyses of the hull and the propeller traditionally used in large ship design is not applicable in this case. Further, due to the relatively small size and mode of operation of these vessels, rigorous analysis of their motions and seakeeping is much more difficult than it is for larger, displacement vessels. Their behavior involves significant nonlinear effects. The transverse and course stability of high speed planing craft needs to be treated in a rigorous, dynamic sense. The state of marine hydrodynamics and computational power should now permit significant advances in these areas. Much of this can capitalize on the advances made through the past decades of U.S. Navy-funded research on the comparable aspects of displacement vessel hydrodynamics.

### □ Current Michigan Sea Grant Research

Two projects are underway to begin work toward Michigan Sea Grant's goal in this area. One study is developing an improved method for predicting the resistance of planing craft. The second is developing an improved understanding of the seakeeping and dynamic analysis of high-speed planing craft.

### □ Michigan Sea Grant Research Opportunities

#### Goal:

Develop an improved fundamental understanding of the engineering design aspects of recreational craft.

#### Objectives:

- Develop an improved understanding of the resistance and propulsion of large planing craft, particularly in the partial-planing regime.

Advanced methods for the rigorous, integrated analysis of the hull and propulsor need to be developed to support the more efficient and rational design of these craft.

- Develop a rigorous understanding of the seakeeping and dynamic stability of high-speed planing craft.

Advanced, rigorous methods for the analysis of the seakeeping and stability of these craft need to be developed to support the efficient design of safer craft.

- Develop a university/Sea Grant/industry consortium in recreational craft engineering.

The development of a recreational craft engineering consortium similar to the University of Michigan/Sea Grant/ Industry Consortium in Offshore Engineering would provide industry input to this effort, generate additional research support from the most immediate beneficiaries of these improved methods, and ensure rapid technical transfer of the new methods.

**☐ Time-Table for Research**

**Next Five Years** - Develop a coordinated suite of rationally based design methods for planing craft suitable for use on advanced engineering workstations.

**Beyond Five Years** - Continue the refinement of these methods and extend the seakeeping effort to include sailing craft.

**Topic II: Offshore Engineering Research and Education**

**☐ Current Status**

The University of Michigan/Sea Grant/Industry Consortium in Offshore Engineering has been underway since 1985. Michigan Sea Grant was instrumental in the creation of this Consortium. It has been successful in bringing together university researchers and graduate students to address research problems of importance to the offshore industry. The communication, feedback, and guidance provided through the industrial members on the Consortium Executive Committee ensure that important industrial research needs are addressed. The Consortium has educated six doctoral students during its the first four years and is currently supporting four additional doctoral students. Michigan Sea Grant has provided support for about one-third of the research undertaken by the Consortium. The eight industrial and non-Sea Grant governmental participants in the Consortium have provided the remaining two-thirds of the support for the research during this period. The University of Michigan has provided matching support for the research and has provided full support for the curriculum development aspects of the Consortium.

**☐ Current Michigan Sea Grant Research**

Michigan Sea Grant is currently supporting its third successive, two-year "project" to provide continuing partici-

pation in this Consortium. Research projects currently supported by the Consortium address the redundancy and reliability of offshore structures, improved methods for processing position information for the dynamic positioning of drill ships and platforms, and an improved understanding of the stability of multi-legged mooring systems in deeper waters.

**☐ Michigan Sea Grant Research Opportunities**

**Goal:**

Continue Michigan Sea Grant's activity in offshore engineering education and research.

**Objective:**

▪ Continue Michigan Sea Grant's participation in The University of Michigan/Sea Grant/Industry Consortium in Offshore Engineering.

Michigan Sea Grant was instrumental in the creation of the Consortium. Its participation is likewise critical to the continued strength of this program.

**☐ Time-Table for Research**

**Next Five Years** - Continue participation in this effective, high-leverage program.

**Beyond Five Years** - Re-evaluate the continued need for Michigan Sea Grant participation.

**Topic III: Reliability, Efficiency, and Safety of Marine Diesel Propulsion Plants, Ships, and Marine Craft**

**☐ Current Status**

Over the past ten years, this subprogram has undertaken a series of projects in this area, primarily emphasizing marine diesel propulsion plants. These Michigan Sea Grant projects have made significant contributions toward the improved reliability, efficiency,

and safety of Great Lakes and ocean-going marine diesel propulsion plants. Follow-up research is now being supported by the U. S. automobile industry in order to extend Michigan Sea Grant-developed analysis methods to automotive engines. Further, this Michigan Sea Grant research has contributed significantly to the strength of the principal program for advanced graduate education and research in marine engineering in the United States.

□ **Current Michigan Sea Grant Research**

Michigan Sea Grant currently has underway a project to study the complicated dynamics leading to vessel capsizing. This study is expected to allow the systematic prediction of the effects of water on deck, thus leading to safer designs for fishing vessels and other small ships.

□ **Michigan Sea Grant Research Opportunities**

**Goal:**

Enhance the reliability, efficiency, and safety of ships, other marine craft, and marine diesel propulsion plants.

**Objective:**

- Pursue research opportunities that will contribute toward this goal as they are presented.

□ **Time-Table for Research**

This is expected to be a continuing activity.

## Saginaw Bay Research Institute

The Saginaw Bay Drainage Basin is the largest in the state, covering a land area of approximately 8,072 square miles. The Bay is one of Michigan's finest natural assets, providing a variety of recreational and industrial resources and many services for Michigan residents. Water from Saginaw Bay supplies 45 drinking water distribution systems, serving over 300,000 people. The Bay also supports commercial fisheries and recreational fisheries and other types of recreation. Nearly 50 percent of Michigan's 750,000 registered boats are located within 100 miles of Saginaw Bay, and 80 percent of Michigan's population live within one hour's driving time. The basin also assimilates the flows of 67 municipal waste-water treatment facilities as well as hundreds of industrial waste treatment systems.

These multiple uses have resulted in environmental conflicts that have not been resolved by current management strategies. Municipal and industrial discharges and agricultural run-off from the Saginaw Bay watershed have contributed pollutants to the Bay that have changed its ecology dramatically. Sediment composition has been altered by a host of manmade chemicals, and increased turbidity has altered the natural aquatic system. Although progress has been made in improving the quality of Saginaw Bay while the region continues to support the industrial base, future progress will be more difficult and costly because the remaining problems are more refractory than those solved in the past. A variety of tools, including new research, is needed to achieve further progress.

The pace of development within the Saginaw Bay has accelerated in the recent past and the area economy is diversifying, undergoing a transition from major reliance on manufacturing to greater reliance on natural resource-based recreational industries. This new focus on Saginaw Bay resources has heightened concern over a number of environmental issues, including loss of coastal wetlands, accumulation of toxins in sediments, eutrophication, and non-point sources of contamination. Thus, local communities, as

well as state agencies, are showing an interest in assessing and monitoring the natural and economic value of the Saginaw Bay Drainage Basin.

The Michigan Sea Grant College Program has recognized and long held to the principle that the economies of Great Lakes coastal regions are tied directly to the status of their coastal environments. Accordingly, Michigan Sea Grant has supported research and outreach activities in the Saginaw Bay area over its 20-year lifespan. This involvement has tended to wax and wane over the years depending upon the research opportunities and funding potential. Now, Michigan Sea Grant will support the heightened interest shown by the private and public sectors in the quality of the Saginaw Bay environment by coordinating a research subprogram with a sole focus on Saginaw Bay.

This subprogram, entitled the Saginaw Bay Research Institute (SBRI), has a focus that goes beyond research to include education and demonstration projects on Saginaw Bay and its watershed. Headquartered at Saginaw Valley State University, the SBRI objectives are achieved through partnerships between Saginaw Valley State University, other state universities, state and federal agencies, bi-national commissions, local governments, and the private sector. The SBRI operates under the umbrella of Michigan Sea Grant.

The SBRI will have three main thrusts for the next five years: research, education, and outreach concerning Saginaw Bay and the important rivers in the watershed. The initial thrust will be toward research, especially in wetlands ecology, impacts of toxic substances, and the food web structure. Education and outreach will utilize the research findings to enhance the overall understanding of the Saginaw Bay system.

## Topic I: Saginaw Bay Research

### □ Current Status

Saginaw Bay in many ways represents a microcosm of the Great Lakes. The Saginaw Bay system is comprised of a large variety of different environments that range from pristine to heavily polluted. The Bay supports one of the finest recreational fisheries in the Great Lakes and one of the remaining large commercial fisheries. Recreational opportunities are numerous, yet the region supports an impressive industrial and agricultural base. These various uses have taken a large toll on the system, with the lower Bay and Saginaw River declared by the International Joint Commission as one of the 42 Areas of Concern in the Great Lakes. The Bay is also suffering from several exotic species invasions, particularly white perch (*Morone americana*), and is expected to serve as the ideal habitat for the zebra mussel (*Dreissena polymorpha*).

Given the variety of uses of the Saginaw Bay system, the opportunities for human exposure to the numerous in-place pollutants are large. The recreational and commercial fisheries provide a possible pathway for toxicant exposure, as do drinking water intakes and bathing beaches. Clearly a prime research objective for Saginaw Bay is the fate and effect of toxic materials already in the environment. A second research priority will be the impact of exotic species on the Saginaw Bay food web. One such species, the white perch, is estimated to account for 60%-70% of the fish biomass in the Bay and has affected the more desirable species, such as walleye and yellow perch. Another invader, the zebra mussel, is expected to rapidly colonize Saginaw Bay. Finally, the Saginaw Bay region supports one of the best stands of natural Great Lakes coastal wetlands. These important but rapidly disappearing systems require a deeper understanding so that proper management can prevent their complete disappearance from the Great Lakes Basin.

### □ Current Michigan Sea Grant Research

Two studies of Saginaw Bay fish populations are presently underway. One study is seeking to determine why the yellow perch population of Saginaw Bay is in such a poor state. Researchers are investigating perch population density and the composition of the perch diet. The other study is Investigating factors such as currents and pollution in Saginaw Bay tributaries to determine why stocked walleye do not reproduce naturally in the Bay.

### □ Michigan Sea Grant Research Opportunities

#### Goal:

Expand the base of research on Saginaw Bay and hence the understanding of this ecosystem, with particular emphasis on fate and effect of toxic substances, exotic species invasions, and wetlands.

#### Objectives:

- Develop a better understanding of the fate and effect of toxic materials as they move from the lower Saginaw River into the adjoining Bay.

The lower Saginaw River continues to serve as a source of toxicants to the Bay through the movement of in-place pollutants. A major flood in October 1986 caused a complete mixing of the top 50 cm of the sediments in the river, hence renewing the release of materials.

- Examine the role that exotic species have played and will play in the structure and function of the Saginaw Bay food web.

Several exotic species form an important, if not the dominant, element of the Saginaw Bay food web. Other invasions are expected in the near future. A major recreational fishery depends on a stocking program. These factors result in a highly manipulated food web that may be rather unstable and subject to large changes in composition and abundance in the future.

- Evaluate the role that coastal wetlands play in the overall ecology of Saginaw Bay, particularly in the growth of young-of-year fish.

The wetlands of Saginaw Bay are known to support a rich flora and fauna. However, the ability of wetlands to exchange critical nutrients and to function as a nursery area for small fish is not fully appreciated. Research is required to decipher how the wetlands interact with open Bay waters and what seasonal changes occur in wetland functions.

## Topic II: Saginaw Bay Extension Outreach

### □ Current Status

Michigan Sea Grant maintains a strong interest in the growth and development of the Saginaw Bay watershed. Two field agents divide the coastal area among their jurisdictions, with one of those agents based in Tawas City. The area is predicted to be entering a period of rapid growth based on the natural resources of the region. The walleye fishery brings numerous fishers to the region, and the assessment is that many more would come with the appropriate new facilities. However, perhaps no other coastal area in Michigan requires such a carefully planned program of growth. Some areas remain intensely polluted and require careful clean-up. Heavy industry, including automobile manufacturing and chemical production, continues to have a major presence in the Saginaw Bay Basin. Agriculture also is a major factor in the watershed. All of these factors speak toward a careful coordination of growth and research to develop the best possible development strategy for the region.

### □ Saginaw Bay Extension Outreach Opportunities

#### Goal:

Combine research results with regional needs to help produce a high-quality plan of development for the Saginaw Bay Basin.

#### Objective:

- Ascertain the probable direction of future growth and determine how the resources of the region can be best used without degradation and/or over-exploitation.

The region will suffer heavy pressure for economic growth that will rely more heavily on the natural resource base. That base must be protected and in some cases improved. Some resource management questions must be answered to provide the basis for rational decision-making. The program of Saginaw Bay research will help provide the information for developing the best plan of growth.

### □ Time-Table for Outreach

**Next Five Years** - Develop a sense of the growth patterns in the Saginaw Bay Basin and determine how those match the current natural resource base.

**Beyond Five Years** - Help local and regional governments produce master plans for growth in resource-based activities that will protect and improve the natural resources of Saginaw Bay.

## Topic III: Saginaw Bay Education Outreach

### □ Current Status

The Saginaw Bay Basin provides a rich diversity of environments encompassing urban to completely undeveloped. This interesting collection of habitats is

found within 100 miles of Michigan's population center—the metropolitan Detroit area. Saginaw Bay also serves as a microcosm of the many different environments found throughout the Great Lakes and supports one of the major last stands of intact wetlands. This unique system offers many educational opportunities that are not fully utilized. Many different educational units ranging from primary schools to state universities are found in the basin. These units will increase their focus on environmental issues in the future, and Saginaw Bay will be part of that activity.

☐ **Saginaw Bay Education Outreach Opportunities**

**Goal:**

Increase public awareness and understanding of the Saginaw Bay ecosystem through materials and programs aimed at a better overall understanding of Great Lakes issues.

**Objective:**

▪ Develop materials and programs focused on Saginaw Bay and based on recent research findings from the region. These materials can serve as the basis for both educational programs and development plans.

A large body of research results have arisen from Saginaw Bay studies. More results are expected to arise in the future. These should provide the raw material for materials and programs aimed at a better informed general public within the Saginaw Bay Basin.

☐ **Time-Table for Outreach**

**Next Five Years** - Compile the numerous studies from Saginaw Bay and develop a comprehensive understanding of the results to date. These materials should serve as the basis for publications about the region.

**Beyond Five Years** - Track new research and development in the Saginaw Bay Basin and continue to expand and enhance the educational materials concerning the region.

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## Michigan Sea Grant Extension

The mission of Michigan Sea Grant Extension (SGE) is to enhance and facilitate the wise use of the Great Lakes through the education of resource users and managers. This is a challenging mandate, especially considering the size and complexity of Michigan's Great Lakes resources. Michigan has the second longest coastline in the United States (nearly 3,300 miles), and approximately half its territory is Great Lakes bottomland (40,000+ square miles). Virtually the entire state lies within the Great Lakes Basin, and nearly every Michigan citizen relates to or depends upon the lakes in some way, either for drinking water, food, livelihood, residence, or recreation.

The extent and diversity of clientele is another challenging aspect of the SGE mission. The program has served charter boat captains, commercial fishers, marina owners (public and private), professional resources managers, shoreline property owners, local and regional planners, public officials, tourism business people, citizen organizations, recreational boaters, divers and swimmers, emergency medical technicians/hospital personnel, homemakers, anglers, and 4-H and youth groups and their leaders/teachers. Because there is competition among groups and individuals for available resources, part of the Sea Grant Extension program's challenge includes educating various interests about each other and promoting communication, cooperation, and collaboration when appropriate.

Since 1977 SGE has operated in conjunction with the Natural Resources and Public Policy programming area of Michigan State University's Cooperative Extension Service. Each of the five Michigan Sea Grant field agents, located in Extension offices in strategic cities, serves an average of eight of Michigan's forty-one coastal counties. The Cooperative Extension Service philosophy of "helping people put knowledge to work" has heavily influenced SGE, which has gained national recognition for its programming approach.

SGE draws heavily on the planning process used by other elements of the Cooperative Extension Service. Each Sea Grant agent conducts an annual assessment to ascertain his clientele's needs. This assessment leads to the identification of key individuals who can assist each agent and the program as a whole in reviewing extension efforts for relevancy, timeliness, content, and format. The culmination of this planning process is the preparation of an annual plan of work by each agent, identifying key objectives, and designing a strategy to accomplish them. All plans contain an element of flexibility to allow for unforeseeable developments that require an expeditious response.

By this process, and by participation in portions of Michigan Sea Grant's long-range planning process, SGE has identified five major programming areas for 1990-1995: Coastal Community Development, Coastal Business Management, Great Lakes Resources Management, Water Safety, and Public Relations. The text below provides for each area a situation statement, one or more goals, and appropriate objectives for the planning period.

## Programming Area I: Coastal Community Development

### □ Current Status

There are hundreds of communities along Michigan's Great Lakes shoreline. They range in size and character from Detroit, a major metropolitan center of nearly four million people along the Detroit River, to medium-sized communities on Lakes Huron and Michigan, to the small fishing villages and former mining towns of the Upper Peninsula.

Some of these communities are taking full advantage of their coastal locations to obtain economic growth. Among the most successful ventures are developments featuring charter fishing, shoreline boardwalks, cultural facilities, bottomland preserves, and natural areas. Other communities are seeking assistance to improve their situation both economically and environmentally through waterfront development that emphasizes recreation and tourism. Some communities, however, continue to neglect their aquatic resources, ignoring the potential for development and associated economic benefits.

Successful waterfront development in urbanized locations means finding new uses for old structures, while in rural areas it often involves developing new infrastructure, facilities, and services. For most medium-sized communities, waterfront development requires a mix of new and refurbished facilities. A carefully planned, phased approach will yield maximum benefits while minimizing the potentially negative consequences of unplanned development. Essential to this process are professional and lay leaders who understand the unique aspects of their local resources, who can apply proven principles of planning, and who can create a climate of cooperation. Thus, human resources are as necessary for successful waterfront development as financial and physical assets.

Increasing tourism is often one purpose of development, and a few Michigan coastal communities have become national or regional tourist destinations. However, although Great Lakes coastal communities enjoy a comparative advantage in attracting tourists, not all of them are situated to develop a tourism-based economy. Some economically depressed regions have historically been oversold on the potential benefits of tourism and do not understand the risks involved in the business or the factors that are outside local control.

SGE has assisted many communities with leadership training, comprehensive planning for waterfront revitalization, and tourism assessment/development/organization. As a result, at least half-a-dozen communities have incorporated waterfront revitalization into their planning documents, and several of them have received funding for construction and renovation projects. Numerous local tourism councils have been formed with Sea Grant support and guidance. However, there are dozens of counties and hundreds of communities that still need this assistance if they are to compete in today's competitive tourist market place.

### □ Sea Grant Extension Outreach Opportunities

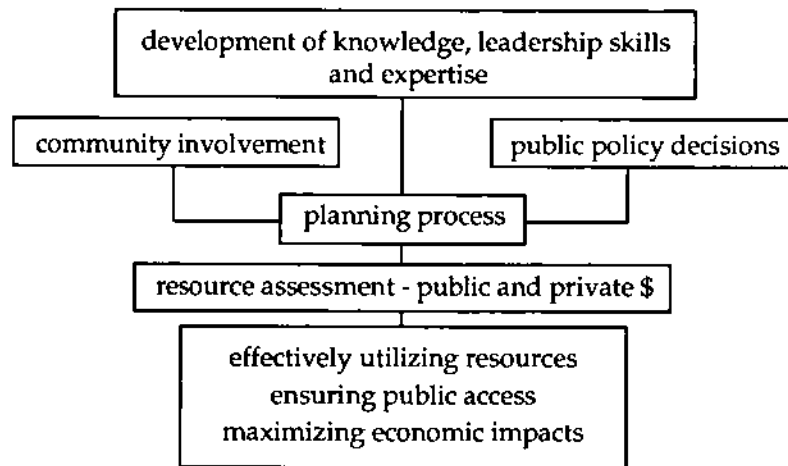
#### Goal:

**Cultivate the economic potential and water-related competitive advantage of coastal communities through strengthening community leadership and organizations.**

#### Objective:

##### ▪ Waterfront Revitalization and Development

Assist coastal communities in recognizing their unique characteristics and in capitalizing on their waterfront assets through a comprehensive integrated planning process, as follows:



- **Time-Table for Outreach** - SGE anticipates that community development will continue as a major thrust for the next five years. There is a continuum of community development in Michigan, with some communities now benefiting from waterfront development efforts started five to seven years ago. The lessons learned by those communities will be used to guide others just recognizing the potential of their waterfronts.

**Objective:**

- **Coastal Tourism Organization and Development**  
Extension agents will assist in the creation of local tourism councils and in the development of coordination in coastal areas where none currently exists. Regional approaches to enhancing tourism will be encouraged, where appropriate, by supporting the collection, analysis, and dissemination of baseline information to assist in tourism marketing and planning.
- **Time-Table for Outreach** - SGE anticipates that efforts to develop regional approaches to tourism marketing will continue in all regions of the state over the next two years,

and will remain a major SGE program thrust in the northern Lower Peninsula and the Upper Peninsula. The collection, analysis, and dissemination of baseline information on various segments of the tourism market will continue for the next five years and then be reduced and discontinued as organizations recognize the value of such information and assume responsibility.

## Programming Area II: Coastal Business Management

### □ Current Status

There are tens of thousands of coastal-related and/or aquatic resource-based businesses in Michigan. Most are small-to-medium-sized family-owned operations, but their collective impact on the economies of coastal communities is sizeable. For example, a single charter boat is likely to generate up to \$41,000 per year in local direct and indirect spending. Michigan's nearly 1,000 charter fishing vessels have a total impact of approximately \$21 million in the coastal communities where they dock. Other businesses with particular ties to aquatic resources are dive charters, sail charters, marinas, commercial fishing, and aquaculture.

To be productive and to compete effectively in today's rapidly changing business climate, many owners and managers of water-related enterprises need to increase their business planning, decision-making, and management skills. Among the decisions faced by these business people are: whether to enter, expand, or diversify a particular business pursuit; how much to charge for goods and services; what types of tax, insurance, regulatory, and legal constraints affect their business; how to manage operations for maximum profit; and whether and when to divest themselves of certain assets or to leave the business entirely.

❑ **Sea Grant Extension Outreach Opportunities**

**Goal:**

Assist coastal businesses in identifying and clarifying business goals and objectives, in increasing their efficiency in achieving them, and in maximizing and demonstrating the economic impact of their business on the community.

**Objective:**

▪ **Charter Fishing**

To maintain an economically viable industry, the charter boat captains in Michigan should increase their scientific knowledge, business understanding, and profitability while maintaining the ecological integrity of the fishery.

- ❑ **Time-Table for Outreach** - SGE will continue its series of regional workshops that highlight topics of concern for the industry. This effort will continue at a maintenance level over the next five years. SGE is assisting in the coordination of a small, cooperative research program funded jointly by Michigan Sea Grant and the charter boat industry. In the next five years SGE will develop and facilitate an applied research effort to focus on problems of interest to Michigan's charter boat industry.

**Objective:**

▪ **Charter Sailing**

Sea Grant agents will utilize the results of the Great Lakes Network charter sailing survey to ascertain the needs of the charter sailing industry and the potential for Sea Grant involvement in the development of this profession.

- ❑ **Time-Table for Outreach** - In the first year, SGE will analyze the results of the charter sailing survey. If needs are identified, a committee of charter operators will be formed to develop a workshop to address their industry's concerns.

**Objective:**

▪ **Marinas**

Develop among the owners and managers of small marinas a greater awareness and understanding of issues that affect their businesses, promote their professional development, and assist them in their interface with policymakers and regulatory agencies.

- ❑ **Time-Table for Outreach** - Most of the larger marinas in the state have been using information and educational programs from SGE for as many as 10 years. Many of the small marina operations have not had that opportunity. In the next four years SGE will conduct regional programs around the state to help meet the needs of this group.

**Objective:**

▪ **Commercial Fishing**

Assist commercial fishing businesses in developing value-added aspects of their operations, such as retailing and custom processing.

Promote greater understanding of commercial fishing operations among recreational anglers.

Promote product quality assurance and develop fish waste utilization methods that will enhance the economic viability of the industry.

- ❑ **Time-Table for Outreach** - With settlement of the fishing treaty question, greater emphasis during the next five years will be placed on aiding Native Americans as many of them move into commercial fishing. Continued conflict between sport and commercial fishing will need to be addressed for at least the next three years.

**Objective:**

▪ **Aquaculture**

Help create aquaculture opportunities for established Great Lakes species, continue to help prospective

aquaculturists evaluate the feasibility of their proposed business ventures, and assist with their professional development.

- **Time-Table for Outreach** - The opportunities to assist this developing industry have never been better. SGE will work with potential growers and develop demonstration projects where appropriate. This effort will continue beyond five years.

### **Programming Area III: Great Lakes Resources Management**

#### □ **Current Status**

The Great Lakes Basin ecosystem is so large and complex that managing its resources requires a basic understanding of various aspects of the system. A coordinated approach is required to make decisions about the important policy issues and to develop practical problem-solving strategies. Among the most critical issues facing the basin for the next decade are: water quality, fluctuating water levels, exotic species introductions, and fisheries management.

Water quality is an overriding issue in the Great Lakes Basin. The importance of this issue was stressed by the governments of the United States and Canada when they recently updated a major international agreement committed to protecting Great Lakes waters. This agreement contains provisions for developing, approving, and implementing "Remedial Action Plans" for some forty-two "Areas of Concern." In each of these areas pollution problems are of such severity, complexity, or duration that they inhibit beneficial uses of the resource. The State of Michigan is responsible for ten of these areas, and plans are currently being developed to address the issues involved.

Another concern is the large fluctuation of Great Lakes water levels. Accelerated erosion, exacerbated coastal flooding, and structural damage resulted from elevated water levels that occurred from late 1984 through early 1987. Problems in navigation, marina operation, and wetland and fisheries management occur when levels decline drastically, as in late 1987 and early 1988.

Ballast water introductions of exotic species into the Great Lakes ecosystem is causing great concern to the region. Species such as the zebra mussel have the potential of costing the state millions of dollars as well as drastically altering the ecological dynamics of the system.

Perhaps the most valuable of all the Great Lakes resources, the fisheries, are dynamic and subject to varied forces and influences. These range from accidental or purposeful introduction of exotic species, such as the sea lamprey or pink salmon, to the decision that Native Americans' right to fish certain waters for prized species is pre-eminent over the rights of sport fishermen and state-licensed commercial operations. In addition, concerns about bioaccumulation of toxic substances in certain fish species have prompted public health advisories that caution various groups of people about fish consumption.

These and many other Great Lakes resource-related issues face Michigan residents in the foreseeable future. An informed public, as well as public and private decision-making, will determine how well the state responds to each situation.

□ **Sea Grant Extension Outreach Opportunities**

**Goal:**

Increase awareness and understanding of the dynamics and interrelationships of Great Lakes living and nonliving resources among user groups and enhance the ability of user groups to anticipate and adapt to resource changes.

**Objective:**

▪ **Water Quality**

Create an awareness of the interrelationship of water quality and the coastal economy and an understanding of the legislative and regulatory framework in which water quality issues are decided.

- **Time-Table for Outreach** - Water quality issues remain some of the most important concerns affecting the long-term value of the Great Lakes. Program emphasis will continue to focus on the value of good water quality as the Remedial Action Plans for Michigan's ten Areas of Concern are debated.

**Objective:**

▪ **Water Levels, Shore Erosion, Coastal Flooding, and Diversions**

Prepare shoreline property owners to adapt to the dynamics of water levels, erosion, and flooding.

- **Time-Table for Outreach** - The emphasis of this major program area varies with water levels. As levels increase, there is concern over coastal erosion and flooding. As they drop, channel dredging and bank stabilization become important concerns. SGE will continue to address the issues that arise during both periods, addressing short-term remedial actions and long-term solutions.

**Objective:**

▪ **Exotic Species Introductions**

Help communities understand the impacts and actions necessary to cope with the present situation. Support and assist the Great Lakes Fishery Commission in the effort to control unplanned introductions in the future.

- **Time-Table for Outreach** - The concern over the zebra mussel, spiny water flea, and ruff will continue as they make their way through the lakes. As new information and research becomes available SGE will continue to make these findings available to concerning audiences. These concerns, by most observers calculations, will extend beyond 1995.

**Objective:**

▪ **Fisheries**

Help fish eaters understand contaminants and fish consumption advisories.

Help those interested in habitat enhancement appreciate both the biological and economic aspects of the issue.

- **Time-Table for Outreach** - Concern over the safety of eating Great Lakes fish will persist during the next five years. SGE will focus on the human health effects (both positive and negative) of eating fish. As new research becomes available SGE will make the findings available to fish consumers.

SGE will help communities interested in artificial reef development for the next three years. By then Sea Grant research may be able to define the value of these structures in the Great Lakes.

## Programming Area IV: Water Safety

### □ Current Status

Michigan, perhaps more than any other Great Lakes state, has a large riparian population. The state leads the nation in the number of recreational boats, (more than 700,000 registered craft) has the busiest commercial waterway in the country (Detroit River), has 100,000 second homes located on the Great Lakes coast, and has numerous recreational facilities. Water safety is clearly important to Michigan residents.

However, water-related accidents have recently claimed approximately 100 lives per year. A surprising number of people are woefully unprepared to prevent or to respond to water accidents. Of the hundreds of thousands of boaters and millions of anglers and swimmers recreating on Michigan's Great Lakes waters, a substantial percentage know very little about protecting themselves or their families from drowning. Also, much of this activity is not supervised by lifeguards or people skilled in water rescue. Among the water safety issues of concern are drown-proofing, hypothermia, cold water near-drowning, recreational diving, and professional rescue and recovery operations.

Another factor which makes water safety a concern for the state is the low water temperatures of the Great Lakes and many inland lakes and streams. This condition persists year-round, creating a constant threat of hypothermia for those who are careless. Hypothermia is the general lowering of the body's core temperature significantly below its norm. Cold water accelerates this process, robbing the body of heat 25 times faster than air of the same temperature. The threat to boaters and others on or about the Great Lakes is significant, especially during the spring, summer and fall, when people falsely assume that the water is as warm as the air temperature.

This cold water, however, can actually benefit drowning people who might die except for the chilling effect that the water produces on body functions. The cold water can slow pulse and pulmonary functions to the minimum required for survival and thus improve the chances of recovery from a drowning situation. Training of search and rescue personnel to recognize and respond to this condition is vital.

The recreational sport diving industry has expanded in Michigan, particularly in Great Lakes waters, and diving activity is dispersed along an extensive coastline. The growth of diving and the development of underwater preserves in cold, deep, Great Lakes waters has created concern about the ability to prevent and deal with diving accidents. Generally, these concerns now focus on the lack of: (1) divers' knowledge about the conditions they encounter in the Great Lakes; (2) responders' knowledge about dive accident treatment; (3) well-defined strategies for managing accident situations; and (4) training of divers and emergency medical personnel.

Water rescue and recovery operations require highly skilled divers, swimmers, and well-trained emergency medical personnel. Assessing conditions accurately, assigning personnel appropriately, and exercising judgment and self-discipline in complex and traumatic situations are significant aspects of successful efforts. Training in the best rescue skills, techniques, and strategies is crucial for law enforcement and medical personnel.

### □ Sea Grant Extension Outreach Opportunities

#### Goal:

**Reduce the incidence and severity of water-related accidents through preventive education, and enhance rescue response and treatment.**



**Objective:**

▪ **Water Accident Prevention**

Increase the prevention of water-related accidents among groups of recreational water users such as swimmers, boaters, and fishers by publicizing accident prevention materials and promoting participation in educational programs.

- **Time-Table for Outreach** - Water accident prevention programs will continue with the providers of educational programs such as the Red Cross, Sheriffs Departments, Coast Guard Auxiliaries, and Power Squadrons. Working with the providers of these programs will reach a far larger audience than individual programs by agents.

**Objective:**

▪ **Cold Water Near-Drowning and Hypothermia**

Continue to educate recreational water users and leaders of law enforcement and emergency medical personnel in the basic concepts of prevention and treatment of these water accidents. Provide professionals with more specialized training as appropriate.

- **Time-Table for Outreach** - These programs continue because of the importance of this information, but at a lower maintenance level. These efforts will highlight present changes in protocols and new information. These efforts will have to continue at this level, because of changes taking place and the turnover in emergency personnel. Other organizations are slowly beginning to take on the educational role allowing SGE to reduce effort in this area.

**Objective:**

▪ **Water Accident Rescue and Response**

Continue to educate professional rescue personnel about appropriate strategies and skills for managing search and recovery situations and other water-related emergencies.

- **Time-Table for Outreach** - Very little information from other sources is available for this audience. SGE efforts in this area will have to provide the needed information for the next several years. As this group gains sophistication they will reach out to national organizations for education and SGE will withdraw its efforts.

**Objective:**

▪ **Diving Accident Prevention and Management**

Increase awareness of accident prevention and management strategies and safe diving practices among recreational divers and dive instructors.

- **Time-Table for Outreach** - Diving continues to grow in popularity in Michigan due to the development of State Bottomland Preserves. Because of the hazard in Michigan's colder, deeper waters, safety and accident prevention are critical. This effort will continue until certification agencies provide high quality and accurate information.

## **Programming Area V: Public Relations**

### □ **Current Status**

The State of Michigan is becoming increasingly aware of its relationship to and dependence upon the Great Lakes for its environmental and economic future. SGE has developed close working relationships with many clientele and continues to assess Michigan's needs for Great Lakes information and technical assistance. SGE is becoming widely recognized and highly respected for its ability to help the state understand and meet its Great Lakes challenges. In order to sustain effective outreach, to maintain quality programming, and to grow with the increasing demands for services, SGE must maintain its visibility and cultivate positive and productive relationships with public and private officials.

☐ **Sea Grant Extension Outreach Opportunities**

**Goal:**

Develop greater lines of communication between Michigan Sea Grant and clientele.

**Objective:**

▪ **Cooperative Ventures**

Establish working relationships and cooperative ventures with public officials, corporations, and foundations that can enhance Michigan Sea Grant's potential to accomplish its mission

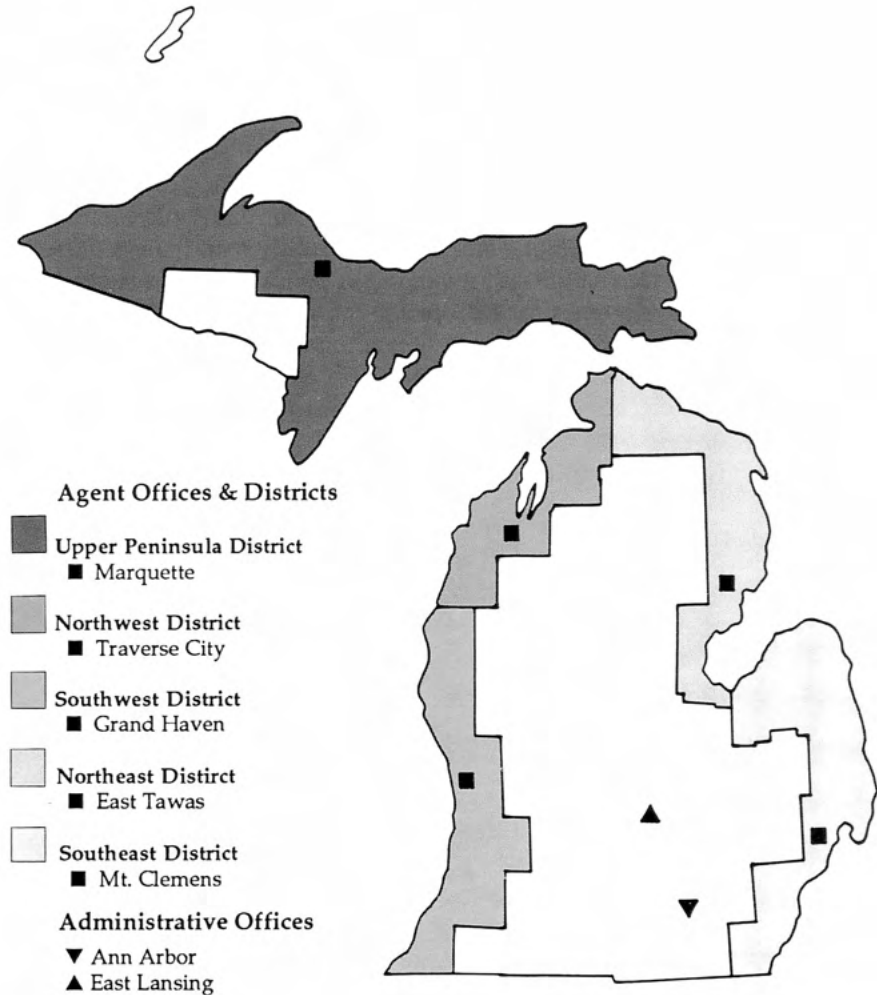
- ☐ **Time-Table for Outreach** - SGE will continue to look for opportunities for joint ventures that meet our long range plans.

**Objective:**

▪ **Marketing the Program**

Gain public recognition for Sea Grant's accomplishments and benefits through effective media relations and appropriate publicity and promotion.

**Time-Table for Outreach** - SGE will continue this as an ongoing effort through 1995.



# Michigan Sea Grant Communications

The Communications long-range plan is directed toward improving current efforts and developing appropriate new initiatives that will ensure fulfilling Sea Grant Communications mission and goals. The mission of Michigan Sea Grant Communications is: increase appreciation of and support for Michigan Sea Grant's role in enhancing Great Lakes assets and solving Great Lakes problems through research and outreach; increase awareness among Great Lakes resources users, policy-makers, educators, and other appropriate audiences of Great Lakes assets, issues, problems, and solutions; and increase recognition of the need for good management of the Great Lakes.

One of the most significant aspects of this plan is improved marketing. Through a formal market study and consultation with program administration, researchers, and agents, the communications staff will gain greater insight into program and communication priorities, as well as the public perception of Sea Grant and its need for Great Lakes materials. This will enhance communicators' ability to set priorities and to produce materials in the most appropriate media and formats.

Other high priorities for the staff will be to secure additional resources through outside cooperative support and to continue to improve the effective use of its financial resources. Recent efforts by the Communications staff has yielded good success in joint publication ventures. These ventures primarily involve document preparation by Sea Grant staff followed by sharing of publication costs among several state and federal agencies.

## Programming Area I: Research

### □ Current Status within the Great Lakes Basin

Abstracts of all journal articles and publications resulting from Sea Grant sponsored research are submitted to the National Sea Grant Depository and appear in Sea Grant Abstracts. Research quarterly reports compiled by Communications keep the National Sea Grant Office informed of important research results and activity. Media referrals, news releases, editing, graphics, publicity and other assistance are provided for any Sea Grant supported work.

### □ Sea Grant Communications Outreach Opportunities

#### Goal:

Increase understanding, awareness, and support of the results of Sea Grant research among target audiences through use of appropriate outreach strategies.

#### Objectives:

- Consult with researchers and Sea Grant Extension agents to ascertain the market for Sea Grant research information, then determine suitable formats and effective delivery systems for all groups, especially those not reached by professional literature.
- Translate Sea Grant research information into formats that meet the special needs of each identified audience. The emphasis will be on technical reports, brochures/booklets/bulletins, and audio/visual materials to be distributed or used with displays at conferences and workshops. Among the topics being considered for general audience bulletins are: coastal processes, wetlands, toxic substances, and exotic fish species.

- Share the results of Michigan Sea Grant research and publicize the accomplishments of researchers through appropriate media outlets. These outlets include other organizations' newsletters, local and regional newspapers, magazines, specialty publications, and broadcast.

- Expand opportunities for publication or broadcast of Sea Grant information by establishing and nurturing additional media outlets through personal contact and through the use of tip sheets.

- **Time-Table for Outreach** - Establish a system for periodic consultations coinciding with the proposal cycles. Endeavor to have the requests and transferral of information become an accepted and integral part of the Michigan Sea Grant College Program within the next five years.

## **Programming Area II: Extension**

- **Current Status within the Great Lakes Basin**

Communications staff provides media, broadcast, print, and display support to Sea Grant Extension (SGE) agents. Communicators and agents have met to begin discussions on mutual concerns and ways to enhance all areas of interaction.

- **Sea Grant Communications Outreach Opportunities**

### **Goal:**

Improve the relevancy and effectiveness of Communications products and support for Michigan Sea Grant Extension by developing systematic and effective communications with Sea Grant Extension agents. This interaction will occur on a regular basis with periodic meetings and conference calls.

### **Objective:**

- Involve SGE agents in Communications planning so that they may express their priority needs for products and other support. Agent perspectives will be solicited on relevancy, sources of information, publication support, content and form, and marketing strategies.

### **Goal:**

**Enhance Sea Grant Extension programming by improving production support for materials useful to the agents in their planning and leading of special programs, their consultation with clients on an individual basis, and their participation in other outreach opportunities.**

### **Objectives:**

- Produce materials for agent use with clientele, including printed matter, displays, and audio/visual materials, with agent input during the production phases.
- Assist with the production and marketing of agent-authored publications, including editing and design as needed and overseeing the process of distribution through the Sea Grant and Cooperative Extension Service systems.

### **Goal:**

**Increase awareness and use of agents as sources of Great Lakes information and assistance among coastal clientele, the media, and other target audiences, thus enhancing agent effectiveness and public support for Sea Grant Extension.**

### **Objectives:**

- Increase promotional assistance for agents' educational and public relations activities through news releases, brochures, and other appropriate means.

- Enhance media awareness of agents as Great Lakes resource people by listing them as local contacts on research news releases when appropriate and by helping agents educate the coastal media as to the breadth and depth of their expertise on Great Lakes issues and the Michigan Sea Grant College Program.

- Publicize agent accomplishments and benefits among state and federal policymakers and other influential audiences.

- Examine ways to help all target audiences become more aware of Sea Grant Extension as a resource. This is vital for the many individuals who engage in activities on the coast but do not reside in an agent district.

- **Time-Table for Outreach** - Within this five-year period institute regular meetings and conference calls between Communications staff and Sea Grant Extension Agents. Determine areas where capabilities and needs meet and where the mesh can be improved. After a period of two years, analyze through surveys of agents and their clientele the effectiveness of communications products and ascertain areas needing additional efforts.

### **Programming Area III: Marketing and Production**

#### □ **Current Status within the Great Lakes Basin**

Through the use of a newspaper clipping service Communicators were able to measure the types of materials and information most frequently used. This will lead to more targeted marketing efforts. Coded order forms also help establish the effectiveness of our attendance at special events. Efforts to establish cooperative publication projects with other organizations have been successful.

#### □ **Sea Grant Communications Outreach Opportunities**

##### **Goal:**

Achieve greater efficiency and effectiveness in producing and marketing Michigan Sea Grant materials.

##### **Objectives:**

- Analyze the market for Sea Grant communications products of various types. Solicit assistance from a marketing class or from individual students. Utilize the resulting information in developing new products and promoting materials in new markets.

- Continue to improve Sea Grant's ability to produce quality materials in greater volume and with increased efficiency by monitoring changes in communications technology and utilizing those advances where appropriate and possible.

##### **Goal:**

Investigate and institute ways to increase support for production of Communications materials.

##### **Objective:**

- Contact agencies, institutions, corporations, and foundations that share the interests and objectives of Michigan Sea Grant in order to develop additional resources for Michigan Sea Grant projects.

- **Time-Table for Outreach** - Develop with a marketing professor a proposal to analyze the effectiveness of Sea Grant products. This project will be conducted in early 1990 and will establish guidelines for the continued analysis of new materials. The Communications staff will continue to initiate cooperative ventures with other organizations and determine the cost effectiveness of these efforts.

## Programming Area IV: Networks

### □ Current Status within the Great Lakes Basin

Communications staff members have developed significant ties with several organizations, resulting in a number of successful cooperative events. A Communications staff member is serving on the National Communicators' Executive Board until 1991 and two members participate in regular conference calls with the Great Lakes Sea Grant Network. Communication Staff helped sponsor and attended a United States and Canadian Great Lakes regional communicators conference held by the Great Lakes Commission. Follow-up activities will enhance efforts to work cooperatively on Great Lakes-related communications projects.

### □ Sea Grant Communications Outreach Opportunities

#### Goal:

Develop a well-informed citizenry by working with other organizations to coordinate, develop, and disseminate Great Lakes information.

#### Objectives:

- Keep up-to-date on the missions and activities of other Great Lakes organizations to ascertain Michigan Sea Grant's relative position in the overall situation. Discuss with other organizations areas where Great Lakes information needs are not being met.
- Consult with MSG administration, agents, and researchers and the Great Lakes Sea Grant Network to ascertain what materials Michigan Sea Grant could develop to meet information needs. Produce and share materials that best fit Michigan Sea Grant's program priorities.

- Assist Great Lakes environmental writers and reporters in understanding how scientists assess and interpret environmental risks, such as eating contaminated fish. A workshop providing for interchange between scientists and media representatives could be one means for preparing the media to report accurately on research and advisories concerning the Great Lakes.

- Identify areas where National Sea Grant priorities and Michigan Sea Grant priorities can best be coordinated. Where possible these areas should correlate with previously established Great Lakes issues as determined by the program.

- Time-Table for Outreach - Efforts to meet the above objectives will occur on a continuing basis. Continue to initiate or respond to requests for other cooperative ventures. At the end of the 1989-91 proposal cycle staff will analyze these efforts and determine areas where cooperative efforts are especially cost effective and beneficial to Michigan Sea Grant and others.



The Michigan Sea Grant College Program is a cooperative Great Lakes research, extension, and education program of The University of Michigan and Michigan State University. Funding is from the National Oceanic and Atmospheric Administration, U. S. Department of Commerce, and from the State of Michigan.

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