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MICHIGAN SEA GRANT COLLEGE PROGRAM  
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# sea grant in the great lakes

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# **sea grant in the great lakes**

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# sea grant in the great lakes

Wetlands preservation...fishing rights and regulations...municipal sewage treatment costs...toxic substances in trout...tourism and energy shortages...the Great Lakes present a myriad of difficulties for citizens and public officials throughout the midwest. Sea Grant Programs in New York, Ohio, Michigan, Wisconsin and Minnesota are working on these problems with research, advisory services and education as their tools.

Unlike many other university-associated programs, Sea Grant research is explicitly designed to meet problems in the community. Once the research is completed, Sea Grant field agents, communications specialists and educators deliver results where they are needed. In turn, when problems show up along the Great Lakes shores, or in the vast waters of the lakes themselves, program directors assign researchers to search for solutions. Sea Grant projects are funded through the National Oceanic and Atmospheric Administration in the U. S. Department of Commerce. Additional monies are contributed by state legislatures and private industry.

In this publication we have summarized current Sea Grant efforts throughout the Great Lakes. It isn't easy to shrink them all into a few pages, but major trends and common problems link the work in all the states. In fact, because so many problems ignore state boundaries, the programs have formed a talent-sharing Great Lakes Sea Grant Network. The Network makes the strengths of one program available throughout the region, and avoids duplication of efforts.



# fisheries

Though not as vigorous as it once was, the commercial fishery of the Great Lakes is still a vital source of freshwater fish, whitefish, perch, walleye, carp, alewives, lake trout and other species are still harvested from the Lakes' waters. At the same time, a multi-million dollar sport fishing industry has developed on the lakes.

The common aim of all five of the Great Lakes Sea Grant programs has been to foster the use of the fish resources of the Great Lakes. This has meant developing better commercial fishing methods and new uses for Lake fish; investigating the food webs of the Lakes' ecosystems; examining special fishery problems which effect the productivity or quality of various species (see Toxic Substances); analyzing the social and economic impact of the Great Lakes fishing industries; and providing advisory services to fishers, management agencies and the general public.

In northern Lake Michigan, whitefish are the big commercial fish crop. The population dynamics of this fish are complex. Sea Grant researchers in both Michigan and Wisconsin cooperated to gather data on populations that move throughout the area. Advisory agents have provided these data to both commercial fishers and management agencies, fostering better understanding between the two groups.

Lake trout are perhaps the most prized upper Great Lakes catch. Despite state and federal stocking programs, however, they fail to thrive in Lake Michigan. To help understand this problem, a Wisconsin Sea Grant investigator is following the success of two strains of hatchery trout. He is trying to identify factors influencing fish



spawning and homing...key problems with lake trout. Michigan Sea Grant biologists are examining the competition between young salmon and trout during the critical period they spend in spawning streams. In New York, the emphasis is on documenting the movements and population data of salmonid fish in general.

Midwesterners have always loved the succulent yellow perch, a favorite of both sport fishers and consumers who create an ever-growing demand for the fish. Ohio Sea Grant researchers are studying the life history of an important perch parasite. Meanwhile, Michigan and Wisconsin scientists have deployed teams to locate and study natural perch spawning areas in southern Lake Michigan and Green Bay. This research will help fish management agencies protect spawning areas and encourage new perch populations in spots similar to natural spawning areas.

The rainbow smelt is important to sport and commercial fisheries in Lake Superior. Minnesota Sea Grant is trying to describe smelt population dynamics and to assess the status of spawning stocks. Wisconsin is working with Minnesota and with commercial fishers to find improved commercial catch methods and to evaluate stock assessment techniques.

All the above species-oriented studies are essentially population dynamics and stock assessment work. They are filling gaps of knowledge identified by state and federal fishery management agencies, as well as by the commercial fishing industry. Often, the projects provide objective information critical for settling controversies between management agencies, and sport and commercial fishers.

Michigan, Wisconsin, Minnesota and New York Sea Grant economists are working together to develop overall estimates for the relative values of the sport and commercial fisheries. These models should aid policy makers in finding the right balance of the two fisheries in the Great Lakes.

Of course, once the fish are caught, the problems become food science issues rather than harvesting issues. Commercial fish



processing research is important in the New York, Ohio and Wisconsin Sea Grant programs. New York and Wisconsin pioneered the development of nutritious, palatable and economic convenience products from under-used fish of the Great Lakes. They haven't stopped there, however; researchers have left their labs and worked with commercial food processors to get their new ideas into the industry. The products are tested in grocery stores and institutions on a mass scale. New York has developed pet food products made of the wastes from fish processing.

Ohio Sea Grant, noting the extensive, under-fished populations of freshwater drum in Lake Erie, has developed processing methods for this hitherto unmarketable fish.

Wisconsin Sea Grant is continuing its longstanding relationship between their food science researchers and commercial fishers. Currently, the program is emphasizing improvement of fish packaging techniques. Michigan Sea Grant has made a big effort to educate commercial fishers on the importance and economic advantages of sanitary fish handling on board boats and in shipping.

Natural fish populations cannot always meet market demands for high quality fish. Both the New York and Wisconsin Sea Grant programs are developing aquaculture systems for yellow perch and walleye. Wisconsin has aided several private aquaculturists in establishing perch farms and is continuing to work on methods of maintaining ideal growing conditions for reliable crops of fast-growing strains. They are now looking at other species which may hold promise for Midwest aquaculture. Another aquaculture project is a little unusual: Minnesota Sea Grant's research on a system to grow leeches for fishing bait.

Aquaculture research has made Sea Grant programs well known all over the country. In general, it is a growing field, especially since many natural waters have become overfished or polluted. For this reason, New York Sea Grant has recognized a need for veterinary specialists who could treat aquatic animals. Thus, Sea Grant has helped Cornell's Veterinary School establish an "Aqua-vet" program.



# toxic substances

Of all the problems in the Great Lakes region, none has raised more concern or confusion than contamination of the Lakes with toxic chemicals like PCBs and petroleum products.

Sea Grant scientists are trying to clear up questions along every step of the way from manufacture to human consumption. How did the chemicals get into the Lakes? What happens to them once they are there? How do they get into the food chain? What effects do they have on living creatures including humans? What chemicals may prove to be bad actors in the future?

To learn to deal with these chemical hazards, scientists must do some basic work on where they come from and how they travel in the Lakes. Michigan, Minnesota, New York and Wisconsin are all studying these questions. Wisconsin and Michigan are measuring different aspects of atmospheric inputs of various chemicals. Minnesota is checking to see if there is seepage from coal storage areas adjacent to the Duluth-Superior harbor. New York is tracking Mirex attached to the sediments in Lake Ontario. Michigan is looking at sediment movements in rivers and harbors and release of PCBs from sediments, and also at PCBs traveling in the microlayer between the atmosphere and the water of the Lakes.

In Wisconsin, researchers calculated that Great Lakes receive, per unit area, a far greater load of petroleum compounds than the oceans. They are surveying the petroleum hydrocarbons in sediments



and bottom-dwelling creatures in harbors in Lake Michigan and Lake Superior.

Chemicals do not remain the same once they enter the Lakes. Do they change into more harmful compounds? How does fish digestion alter them? Wisconsin researchers are looking for these answers.

Besides attaching to sediments, some chemicals work their way into the living creatures of the Lakes and eventually into the human food chain. How do PCBs and heavy metals affect zooplankton and phytoplankton, the tiny creatures that are the food supply to many Great Lakes fish? Are there some fish which are more resistant to chemical contamination than others? How long do the chemicals remain in the fish? Wisconsin and Michigan are trying to find out.

What happens to other animals that eat these fish? Michigan and Wisconsin researchers have shown severe reproductive effects in mink and monkeys fed diets of contaminated fish. A New York researcher is looking for similar evidence in prairie voles fed Lake Ontario salmon. She is trying to distinguish the effects of Mirex from other substances like PCBs.

Evidence of contaminant effects on primates closely related to humans has raised great concern in the Great Lakes community about effects on humans. In direct response to a request from the county and state health departments, Wisconsin researchers are measuring PCB content of blood and breast milk of women in the Sheboygan County area, where fish in local waters are severely contaminated. Will there be differences between women who eat a lot of fish and those who don't?

In Ohio, Sea Grant personnel are helping regulatory agencies evaluate analyses of fish contamination.



But contaminant questions raise not only science and health issues, but also political and economic concerns. Addressing some political aspects is a Michigan researcher studying how the Environmental Protection Agency will implement the Toxic Substances Control Act and the implications for major interest groups including the chemical industry, the government and consumer groups.

An economic issue is the investment in fishery resources and related businesses in the region. What will happen to them as a result of contamination? Michigan commercial fishers are unwilling to risk fishing for underused species until they know the fish will pass federal standards so a Michigan Sea Grant researcher is currently analyzing carp for contamination. She also provided the pioneering work on fish cleaning and cooking methods that help fish eaters reduce their ingestion of chemicals.

These very practical measures, which every angler and cook in the region can use, have been widely disseminated through the Sea Grant advisory service in each Great Lakes state.

Are there other ways to reduce exposure to contaminants, perhaps through regulatory measures on the fisheries? A Wisconsin researcher is creating a model which may reveal fishery management options that would reduce exposure of fish and ultimately, of people, to PCBs.

There are 3,000 chemicals already in use in the Great Lakes Basin and hundreds of new chemicals are introduced each year. On which should we spend limited research dollars to safeguard the environment and residents of the Great Lakes? A Michigan researcher is using the chemical, physical and toxicological characteristics of chemicals to try to predict the sort of compounds which are apt to cause environmental hazards. This "dragnet" for future chemical problems will help scientists and regulatory agencies set priorities for research and action on chemicals needing immediate attention.



# green bay

In many ways, Green Bay and its watershed are a microcosm of both the promise and the problems of the nation's waterways. With its wealth of aquatic resources, the Bay is the most productive area in Lake Michigan. Its commercial fishery is the largest in the Lake, and the marshes on its western shore represent at least 80 percent of Wisconsin's Great Lakes wetlands. At the same time, Green Bay suffers from industrial and municipal wastes, eutrophication, resource depletion and lakeshore development pressures.

The Wisconsin and Michigan Sea Grant Programs are working together to understand Bay problems and to improve decision-making for its future. Michigan is assessing the influence of both the open waters of Lake Michigan and the highly polluted waters of the Fox River on the Bay's water quality. Wisconsin is looking at organic pollutants in the Fox River in two projects. In one project investigators are checking the river to see how many of the Environmental Protection Agency's "most hazardous chemicals" have shown up in its waters.

In several coordinated research projects in the Green Bay basin, Wisconsin is supporting studies of biological production in its coastal marshes, fish population dynamics, nonpoint source pollution, arsenic contamination, food web characteristics of Bay waters and the use of remote sensing techniques to estimate the impact of land development.

Sea Grant Extension agents, together with a number of researchers working on the Bay, sponsored town meetings in both Wisconsin and Michigan to bring the people living along Green Bay up-to-date on the conditions of the water body. They discussed wiser use of the Bay's resources and ways to enjoy its improving condition.



# water safety

The chilly waters of the Great Lakes, all 95,000 square miles of them, are not without hazards. Training people using the Lakes, and developing ways to treat accidents that occur when they do, is another area of interest at Sea Grant.

In Minnesota researchers are shivering in their boots for science in a study of the effects of alcohol and exhaustion on hypothermia--the progressive and dangerous cooling of the body's core. This information will be invaluable to those who play or work in the cold water everywhere. Minnesota will set up a center to answer questions about hypothermia. This research is partially funded by the largest water safety equipment manufacturer in Minnesota.

Michigan Sea Grant, which pioneered the work on survival of persons who appear drowned in cold water, is now pioneering a mass education effort about cold water survival. The program aims at teaching all rescue personnel, emergency room physicians and parents of young children about treatment of these victims. (See Advisory Service) Michigan's research and public information about cold water drowning has already saved many lives. This new effort anticipates continuation of this success.

While many of us are content to merely speculate on what goes on under the surface of the Great Lakes, 40,000 scuba divers are making first-hand observations. Many other divers dive for research or



commercial operations. Sea Grant's primary concern for all these divers is safety.

Michigan has developed an underwater diving safety instructor training program to upgrade safety training of diving instructors. Michigan also operates a hyperbaric chamber used to treat diving accidents and other crippling and life-threatening diseases.

Much of diving safety and medicine depends on a fundamental knowledge of how diving affects physiology. Physicians, nuclear medical specialists, chemical engineers and veterinary medicine specialists are all part of a Wisconsin team trying to unravel the inter-relationships between diving and changes in body chemistry and functioning. What are the effects of high pressure to which divers are subjected? The goal of the project is to develop safer decompression procedures. Often there are spin-offs from diving research for conventional medicine. Wisconsin researchers anticipate some insights for treating pulmonary diseases from this work.

A related study is underway at Michigan where researchers are looking at the special physiology of women to see how diving affects them. Does the standard information--developed by the U. S. Navy for healthy, strapping young men--apply equally well to women? The doctors undertaking this study want to know the differences, if any, that menstruation, pregnancy and birth control make to the recovery of women from the stresses of diving.

In research that points to insights for effects of diving on human fetal development, Michigan researchers are looking at how diving pressures affect sheep ewes and fetuses. Wisconsin researchers are studying susceptibility of the test animal fetus to decompression sickness. There is currently very little information on the critical issue of diving safely when pregnant.



# recreation

Over 1,000,000 recreational boats ply Great Lakes waters, everything from six-foot sail boats to fifty-foot sloops, from speed boats to charter fishing boats. "How can the research and advisory skills of Sea Grant help make Great Lakes boating pleasant and safe--even profitable?"

Minnesota and Michigan Sea Grant programs are looking at recreational boating patterns, where, when and how people use boats on the Great Lakes. They want to determine whether more boating facilities are needed, how they might fit in with other local needs, and how best to work through systems to satisfy boaters and other residents. Minnesota's study focuses on harbors and will be used by the Army Corps of Engineers to plan boating facilities, and by the Minnesota Department of Natural Resources to plan parks.

Michigan's researchers are looking at economic aspects. They will develop economic models for local officials to use in judging how facilities will affect the economy of their communities.

After docking facilities are built, will they hold up in ice-clogged Great Lakes waters? Wisconsin Sea Grant is finding out how to build structures that will hold up under ice conditions.

Boating isn't the only major recreation for the Great Lakes. The Great Lakes draw millions of tourists. New York Sea Grant researchers are working with local communities to help them determine potential tourist attractions, help them decide what kinds of data they need



to assess the economic potential, and steer them to pertinent information on which to base decisions about tourism development.

Other attractions that are getting some attention are historic shipwrecks. Wisconsin Sea Grant is evaluating the feasibility of developing underwater parks in which divers could explore designated wrecks. Pinpointing wrecks, assessing potential tourist traffic, and exploring management aspects are all parts of the study.

Because recreation is Michigan's second largest industry, Michigan Sea Grant is developing a strategy to guide future recreation research within the program. Michigan's 3200 miles of coastline present diverse recreational areas, from urban waterfronts to isolated sand dunes. Michigan is currently setting priorities for a cohesive approach to recreation research.

Advisory Services in New York, Minnesota, Wisconsin and Michigan work with marina managers in communities and also hold annual conferences to update them on the latest business practices, government regulations and technical information.

Advisory Service personnel in all states work with tourists. Agents set up programs on everything from fish preparation to dune ecology at parks. New York has published a guide to scenic trails.

In New York and Michigan, Advisory Services persons have written weather/climate guides for shoreline visitors. These booklets tell the tourist what to expect all seasons of the year. They outline wind, temperature and precipitation patterns, and provide a seasonal key to local activities.

To attract visitors to Lake Superior, Wisconsin has published a guide to more than 113 scenic and historic sites around its shores. These points of interest are keyed to a fold-out map and are accompanied by essays on the region's resources and colorful past.



# transportation

To keep the Midwestern economy moving, ships transported over 213 million tons of cargo through the Great Lakes and the St. Lawrence Seaway in 1978. Grain, iron ore, coal, limestone and general goods rode the waters in larger and larger ships. How are ship transportation needs changing on the Great Lakes?

Michigan Sea Grant has put together a team to look into the technical problems of Great Lakes transportation. One study is evaluating a path control system for ships, a system which guides ships by computer through narrow channels. Another project examines how these systems can affect ship size in relation to channel width. Is it possible that with the development of new ship control systems we can eliminate some of the need for changes to the shores and channels?

Another Michigan study looks at how shipping affects the shoreline of a narrow channel, in this case, the St. Marys River. These studies will clarify whether we should deepen and widen Great Lakes channels and will also stimulate ship designers to consider maximum cargo with minimum environmental damage.

Wisconsin is studying another aspect of ship design. Researchers there are examining hull vibration and stresses. This study was conceived after the tragic sinking of the Edmund Fitzgerald where, it is now believed, the hull broke apart.

Wisconsin is also discovering the most effective routes for international trade on the Great Lakes and how these international goods spread into the 19-state hinterland served by the Great Lakes.

Sea Grant programs in the Great Lakes are working on several aspects of Great Lakes transportation, from ship design to shoreline problems to routes and ports. These varied approaches and projects will help us plan the transportation uses of the Great Lakes in concert with other uses.



# coastal concerns

With about 10,000 miles of Great Lakes coastline, Sea Grant programs around the Lakes have much territory and many problems to cover. This year researchers are working on erosion, wetland resources, and legal problems.

Wisconsin Sea Grant is conducting an engineering analysis of what factors influence erosion. The study considers climate, ground water, vegetation, wave action and lake levels. Another Wisconsin project analyzes how vegetation can slow erosion. New York Sea Grant is looking at the ways currents move sediments near coastal structures. These studies will give us a better understanding of how shores erode and how we can work toward dealing effectively with erosion.

Ohio Sea Grant is looking into flooding on Lake Erie. They are working on forecasting the destructive storm surges which flood the shores of Lake Erie.

Another shore concern is wetlands. Wetlands resources are subject to many competing uses in the Great Lakes region and are the subject of many controversial plans and laws. How are decisions on wetlands made? Michigan Sea Grant is examining the way public policies on wetlands are developed. Wisconsin is looking at it from an economic perspective. They are identifying economic incentives and barriers to coastal wetland protection. These studies will help local decision makers resolve some of the competing use problems.

New York Sea Grant has created a center for legal information on coastal issues. They also support a coastal law program to research such issues as recreation liability, Great Lakes shipping, and coastal management issues. The program publishes The Sea Grant Law and Policy Journal which analyzes legal aspects of coastal problems.



# education

Nearly everyone in Sea Grant is an educator. Everyone, from the researcher in a highly technical field to the advisory agent at a town meeting, intends to apply research findings to Great Lakes problems. However, Sea Grant programs have several projects under the traditional definition of education. A team of curriculum developers in Michigan is creating five major teaching units about the Great Lakes for middle school students. Last year, 800 students in the state tested the materials under a rigorous pre-publication evaluation program. The first unit, a month-long interdisciplinary course, The Sea Lamprey in the Great Lakes, is an in-depth study of biological, economic, political and environmental problems that accompanied the invasion of the Lakes by the lamprey. This unit will be published in the Spring of 1980, with units on Great Lakes shipping, cities, water quality and fisheries coming up.

In Ohio, teaching materials oriented to Lake Erie problems have already been published. Teacher training courses were taught this summer and curriculum development has moved from a science to a social studies focus.

4-H youth and leaders are getting in on Great Lakes education too. Children in coastal communities are learning about the Great Lakes;



examples are: Minnesota's lakeshore day camp experiences and Great Lakes Heritage Days in downtown Detroit.

At the college level, significant numbers of graduate students aid researchers in projects, thus gaining firsthand experience in their professional fields. Such assistance provides support for graduate education in New York, Wisconsin, Ohio, Michigan and Minnesota.

Michigan, Minnesota, Wisconsin, Ohio and New York all have Sea Grant Extension agents helping educators in many ways. The agents help locate Great Lakes curriculum materials for teachers, write newsletters and refer them to Great Lakes experts. To support this effort, Wisconsin has published and distributed to 6th-9th grade teachers an "Educator's Guide to Great Lakes Materials," which evaluates more than 100 books, films, maps and pamphlets concerned with the Great Lakes. For the students themselves, Wisconsin has widely distributed "Earthbeats." The two tabloid issues deal in a variety of articles and ways with the Great Lakes and with energy issues.

The Great Lakes Sea Grant Network took on one joint project this year: co-sponsorship of the 1979 Annual Meeting of the National Marine Education Association in Milwaukee. It was the first time this group of educators met outside an ocean coastal state and focused on the importance of fresh water and the Great Lakes. The meeting was hosted by the Wisconsin Sea Grant Program and the University of Wisconsin-Milwaukee Great Lakes Research Facility. Planning was led by Michigan Sea Grant and shared among Sea Grant educators in other Network states.



# advisory services

He rolled up his sleeves, sharpened his filleting knife, and with a deft flick of the wrist, he showed a meeting of extension home economists how to make a bony "trash" fish into a tasty dish.

Over the last year, this agent and the twenty other men and women who are field agents for Sea Grant advisory services in the Great Lakes area have been helping residents of Great Lakes coastal communities put into action for themselves the results of Sea Grant research.

The advisory service is the part of the Sea Grant program which extends the research and information of Sea Grant and other Great Lakes organizations to the various users of the Great Lakes--from the marina owner, to a 4-H member, to a solitary beach walker.

Modeled on the Cooperative Extension Service/Land Grant system, some Great Lakes Sea Grant programs have formal relationships that tie them into Extension Networks already established in the state. Some states even call it Sea Grant Extension. But whatever the name, the job is always to link people who have Great Lakes problems and interests with Sea Grant expertise on the campuses and throughout the state.

Whether they are working on fisheries, marine education, shoreline erosion, marine business problems, recreation opportunities or just creating awareness and appreciation of the Lakes, the men and women



of the Sea Grant Advisory Service in each state are responding to Great Lakes residents and their concerns.

In all areas of Sea Grant research, advisory agents carry forward the results and help put them into practice--through personal and immediate interaction with people where they live, work, and play.

Sometimes this means demonstrating a proven technology like special vegetation plantings to control erosion in New York. Interaction with the public can also occur at an aquaculture facility on the outskirts of Madison, Wisconsin where prospective perch growers can see first-hand what to expect should they undertake such a venture.

Sometimes advisory service means working on a one-to-one basis, like the Michigan agent who donned his Sea Grant T-shirt, plunged into the chilly waters of Lake St. Clair and helped a marina operator install a floating tire breakwater (FTB). The FTB is an engineering device perfected for the Great Lakes by New York Sea Grant. It is affordable by even a small marina, and widely known in the trade through the efforts of advisory service agents in the region.

Other fishery work in Great Lakes states includes gear improvements for fishers in Wisconsin, and Michigan, and basic courses on fish biology to help fishers in Wisconsin, Michigan and Minnesota understand the basis for fishery regulations better.

In Ohio this year, an extension agent sat down in the middle of a volatile situation--a meeting of sport and commercial fishers. He didn't stumble onto it unaware, however. He called it in the first place. Agents in Wisconsin, Michigan and New York are also working on easing tensions between sport and commercial fishers.

Sometimes field agents turn to communications staffers in each program to help handle another major part of their work--creating



awareness of Great Lakes, their potential, and the services available through Sea Grant programs. In Wisconsin this has taken the form of a radio show and newspaper column, Earthwatch. In Minnesota a one minute radio show tells people of recreational opportunities along the North Shore. Michigan also has an in-depth Great Lakes commentary radio show distributed state-wide. Ohio, Michigan, New York and Minnesota publish newsletters for their Great Lakes audiences. News releases, magazine articles, films and slide shows are also part of the "awareness arsenal" available to agents. Thousands of copies of hundreds of different publications are distributed by the programs each year.

Sometimes agents find they can work with a network of agents in other states to stretch their program dollars. For example, agents in Minnesota, Wisconsin and Michigan got together to assemble a comprehensive guide to boat launching sites all along the Lake Superior shore. The Michigan and Wisconsin agents in the Green Bay region do much cooperative programming.

For all their earnest efforts on behalf of Great Lakes people, sometimes agents find that the information they want just doesn't exist. Then the agents carry this news back to the campus; this often stimulates research projects to fill information voids. For example, a Minnesota agent found that much sought-after information on who uses the Lake Superior fishery and what facilities they would like to see developed did not exist. So he worked with University of Minnesota-Duluth researchers and representatives from sport fishing groups, the Coast Guard, the Department of Natural Resources, and other interests to survey participants of a sport fishing derby to assemble that information. It is being used to plan future fishery development in the region.

Responding to people and their Great Lakes interests with the right talents, techniques and knowledge--that is what Sea Grant advisory agents in the Great Lakes Region are all about.



# great lakes information

Great Lakes Information is one of a national network of coastal information centers. It has access to computer data and bibliographic bases, libraries, agencies and knowledgeable individuals. Staffers will sort through the welter of possible sources to locate specific information needed and put users in contact with appropriate sources. The service is available to anyone--public, private, industrial, government, etc.



# **program activities**



Summary of  
Michigan Sea Grant's Research Program on the Great Lakes

ADVISORY SERVICE

Objective: Advisory service is responsible for transferring the knowledge developed in the research program to users who need it and alerts researchers to problems and opportunities in the field. Campus specialists provide a major knowledge base for the advisory agents located in coastal communities.

COMMUNICATIONS

Objective: writing and production of publications; assistance to researchers and advisory personnel; development of audio-visual materials; public information liaison with media; distribution of publications and materials.

EDUCATION

Great Lakes Environment: A Curriculum Package

Objective: development of five interdisciplinary junior high teaching units about the Great Lakes: topics are the sea lamprey, Great Lakes fisheries, water quality, shipping and cities.

Organization and Development of an Integrated Aquatic Science Curriculum

Objective: coordinating aquatic science course offerings at The University of Michigan; development of recruiting materials for undergraduates.



Great Lakes Limnology Course

Objective: development of curriculum for course at The University of Michigan; laboratory and research cruises, large lake sampling methods, summer 1979 at The University of Michigan Biological Station at Pellston.

Underwater Education Workshop

Objective: training of new university level recreational and scientific diving instructors; upgrading current instructors; training university dive safety officers; additional training in surface-supplied diving and hyperbaric chamber operation.

WATER SAFETY

Coldwater Drowning and Near-Drowning in the Great Lakes and Inland Waters of Michigan

Objective: documentation and analysis of coldwater submersion accidents; dissemination of research results; study of near-drowning medical complications

The Effect of Hyperbaric Exposure on Menstruation, Fertilization and Pregnancy

Objective: study of effects of hyperbaric conditions on maternal and fetal circulations in pregnant sheep; focus on nitrogen metabolism; study of effects of hyperbaric exposures on human menstrual cycle



## RECREATION

### Michigan Great Lakes Recreational Boating Demand, Supply, Marketing, Economic Impact

Objective: development of preliminary forecasts of future boating supply; participation, demand, and economic impact of recreational boating on Michigan's Great Lakes

## GREAT LAKES TRANSPORTATION

### Path Control System for Surface Ships in Channels

Objective: initial steps in design, development of a path control system for large bulk carrier ships in channels

### Effects of Control Systems on Optimization of Ship Size for Navigation in Restricted Waters of the Great Lakes

Objective: documentation of costs associated with increased channel dimension for restricted passages in the Great Lakes; determination of benefits associated with optimally-sized vessels moving through restricted waters under different control systems

### Shoreline Effects of Vessel Transit of the St. Marys River

Objective: hydrodynamic model of shoreline effects of vessels moving through problem areas of the St. Marys River; consideration of both water and vessel systems

### Great Lakes Marine Transportation

Objective: development and planning for Great Lakes Transportation subprogram; identification of people, facilities, funding, and student work-study opportunities



GREAT LAKES FISHERIES

Evaluation of Small-Mesh Trap Nets for the Harvest of Round Whitefish  
(Prosopium cylindraceum), an Underutilized Species

Objective: three papers on research findings: catch statistics, trap net construction, contaminant analyses, and age and growth of round whitefish

Identification of Current Spawning Grounds and Prediction of  
Potential Spawning Areas for Yellow Perch in Southeastern Lake Michigan,  
with Estimates of Associated Early Recruitment

Objective: contrast natural and man-made spawning grounds; relate spawning and early larval fish concentrations to survival, growth, and recruitment; "model" probability of spawning occurrence and level of early recruitment with key parameters; relate study insights to fishery management

Compensatory Response of Lake Trout and Lake Whitefish to Exploitation

Objective: construct a life history model to simulate compensatory response of fish to levels of fishing; determine the magnitude of compensation generated by changes in life history parameters

Competition Between Juvenile Salmon and Trout in Great Lakes Spawning  
Streams

Objective: investigate emergence time, body size at emergence, growth and microhabitat use, best interspecific competition under controlled conditions in existing stream aquarium

Developing a Model Commercial Fisheries Statute for the Great  
Lakes States

Objective: develop a model statute for commercial fisheries management in Great Lakes states; provide alternate provisions, as necessary, for states having legal peculiarities



### Increasing the Economic Value of Michigan Commercial Fishery Through the Utilization of Carp

Objective: improve efficiency of separating flesh from bone; evaluate stability of fresh, frozen, and processed products and investigate control of undesirable changes through antioxidants, etc.; determine composition of fish flesh and products; develop or improve products from flesh, such as fish sausage

### PCBs, DDT Compounds and Dieldrin Levels in Carp

Objective: determine relationship between size of carp and levels of environmental contaminants; determine seasonal variability of environmental contaminant levels in Saginaw Bay carp

### Renewed Use of Underutilized Species of Great Lakes Fish for Animal Feed

Objective: to determine if underused species could again be fed to animals; investigate procedures for extracting PCBs from fish; establish guidelines for use of fish as feed; compare toxicity of metabolized forms of PCBs with toxicities of commercial Aroclors

### Fishery Economics and Marketing

Objective: to understand bioeconomics of sport and commercial fishing; evaluate management options and sport/commercial trade-offs; understand angler choices, expenditures, and use through market analysis

## TOXIC SUBSTANCES

### Contribution of Surface Microlayer to Air/Water Exchange of Organic Pollutants

Objective: characterize PCBs, total organic matter, and total lipid matter in Lake Michigan surface films; partitioning of PCBs between particulate and dissolved phase; routes of PCBs interchange between atmosphere and Great Lakes waters and effect of surface microlayers in interchange



Sorption of Polychlorinated Biphenyls on Suspended Solids and Their Distribution and Differential Accumulation in Rivers, Harbors and Lakes

Objective: to determine exchange dynamics between PCBs and suspended solids for waters and sediments of the Great Lakes; sedimentation and vertical transport of solids and their PCBs burdens; develop, verify, and calibrate an advection-dispersion transport model of spatial and temporal dispersion and distribution of PCBs with solids

Release of PCBs From Sediment

Objective: investigate exchange rates of PCBs between sediment and overlying water, potential correlation with sediment characteristics, biological mixing, atmospheric loss; incorporate into a model to predict PCBs flow through the Great Lakes

Uptake, Accumulation and Removal of Polychlorinated Hydrocarbons (PCBs) by Great Lakes Phytoplankton and Zooplankton

Objective: PCBs effects on algal growth; chlorophyll production and photosynthesis; mechanisms of PCBs uptake and removal; PCBs effects on productivity and species composition of natural phytoplankton assemblages; zooplankton PCBs bioaccumulation from water and feeding on contaminated phytoplankton

Early Assessment of Potential for Environmental Toxicity of Pollutants in the Great Lakes

Objective: to develop two-stage system for assessing environmental hazard of new or unstudied organic compounds; initially select through physical, chemical, and toxicological literature; second stage, measure critical chemical and biological parameters



### Implementation of the Toxic Substances Control Act

Objective: monitor EPA process for drafting regulations under TSCA; lay interpretations of rules and regulations; evaluate differential impact on major interest groups

### COASTAL ZONE RESOURCES

#### Coastal Wetlands in Conflict: A Joint-Space Approach for Evaluating Management Alternatives

Objective: identify issues and constituencies in coastal wetland regulation and control; set priorities and review tradeoffs; identify alternatives; evaluate management strategies from perspective of each interest group; identify "most acceptable" management strategy

#### Public Policies Affecting the Management and Protection of Michigan's Coastal Wetlands

Objective: identify and evaluate public policies on wetlands; work with Coastal Zone Management staff, agents, County Extension Directors, regional planning and development agencies and others to develop and analyze policies recommended as a model for state and local governments

### COOPERATIVE NETWORK PROGRAM

#### Influence of Lake Michigan and Fox River Waters on the Water Quality of Green Bay

Objective: establish field and laboratory procedures; survey literature; make a reconnaissance survey and preliminary field studies to test experimental design



Summary of  
University of Minnesota Sea Grant's Research Program  
on the Great Lakes

MARINE EDUCATION AND TRAINING

Superior Experience; See the Inland Sea

Objective: to introduce youth 4-H leaders to Lake Superior and its resources thereby providing a corps of trained youth who will provide learning experiences in their home counties; to sponsor a series of "Sea Camp" experiences--a Lake Superior day camp for ages 8 - 13--in eight communities on the North Shore

Sea Grant Traineeship Program

Objective: to provide graduate level opportunity for training in marine-related sciences; stipends will support nine students working on Sea Grant Research

COASTAL AND LAKE PROCESSES

An Evaluation of Possible Detrimental Effects by the Introduction of Organic and Second-order Organics on Commercial and Sport Fishing in Lake Superior

Objective: to determine environmental impacts of new coal handling facility and sewage treatment plant in Duluth/Superior harbor through trace analysis of chloro-organics in fish stocks

Microcontaminant--Air, Water, Sediment, Biota Interactions in Lake Superior

Objective: to determine the concentrations of chlorinated hydrocarbons and polynuclear aromatic hydrocarbons in Lake Superior and determine how they are transformed and transported in the lake



### Sedimentation in Duluth/Superior Harbor

Objective: to determine sedimentation sources, rates, pathways and sites of deposition in Duluth/Superior harbor

### SEA GRANT EXTENSION PROGRAM

#### Minnesota Sea Grant Extension Program

Objective: to provide extension education programs in Marine Recreation, Commercial and Sport Fishing, Marine Trades, Coastal Engineering and Marine Education for user groups in the coastal area; to provide a link between Sea Grant research and user groups for identification of research needs and application of research results

### RECREATIONAL USE OF LAKE SUPERIOR

#### The Recreational Demand for Development of Harbors of Refuge in Western Lake Superior

Objective: to determine boater use patterns and satisfaction levels with existing harbors of refuge in order to plan adequately future facilities

### WATER SAFETY

#### Immersion Hypothermia

Objective: to determine the physiological responses of the human body to immersion in cold water. Response to various parameters such as fatigue and alcohol consumption will be observed.



LAKE SUPERIOR FISHERIES

Population Characteristics and Stock Identification of Western Lake Superior Smelt

Objective: to determine population dynamics of smelt and to identify discrete populations in western Lake Superior in order to facilitate stock assessment and management

Role of Fatty Acids in the Reproduction of Fish

Objective: to investigate the function of unusual polyunsaturated fatty acids present only during the reproduction of freshwater fish. This project has possible application to the breeding and management of fish

Preservation of Gametes of Freshwater Fish

Objective: to discover conditions necessary for leech reproduction in the wild and to develop aquaculture methods for leech production. This is aimed at encouraging the bait industry in Minnesota.



Summary of  
New York Sea Grant's Research Program on the Great Lakes

PHYSICAL RESOURCES

Coastal Currents and Sediment Transport on Great Lakes Shoreline

Objective: to develop predictive model of Great Lakes coastal currents and sedimentation patterns; assess impacts of man-made coastal structures on these processes

COASTAL DEVELOPMENT ACTIVITIES

Intensive Culture of the Walleye

Objective: to assess technical feasibility of establishing commercial walleye cultivation for public and private development

Development of Design Criteria for Floating Tire Breakwaters

Objective: to develop better design criteria for floating tire breakwaters using lab tests of conventional and "improved" models exposed to regular and wind-generated waves

Engineering Studies on the Use of Floating Tire Breakwaters in Severe Wave Climate

Objective: field study of the efficiency of a floating tire breakwater at Barcelona Harbor, NY; development of a micro-processor unit to quantify efficiency of FTB in altering incident wave height and direction

Tourism Development Studies on the Great Lakes

Objective: to identify the best tourism market areas along New York's Great Lakes/ St. Lawrence River shoreline; assess alternatives to shoreline communities for promoting these areas



Determining Movement Patterns of Salmonids to Aid Sport Fishing and Stock Assessment

Objective: to use tracking methods to determine seasonal and diurnal movements of salmonids in Lake Erie

An Energy Impact Model for New York Water-Related Recreation Activities

Objective: to examine the relative effect of increasing energy costs on tourism and other water-related recreation activities in New York

Assessment of Great Lakes Non-Salmonid Sport Fishing Demand

Objective: to derive regional demand curves and estimates of socio-economic benefits from recreational fishing for major non-salmonid species of New York's Great Lakes

Lake Ontario Bottom Features and Sport Fishing Potential

Objective: to identify known productive sport fishing sites in the nearshore water of Lake Ontario and those natural features and characteristics of these sites which serve as fish attractants

AIDING COASTAL DECISION-MAKING

Problems in Coastal Law

Objective: to identify and examine legal issues raised in the formulation and implementation of public policies for the regulation of activities in the coastal region

Lake Ontario Bottom Sediment-Mirex Relationships

Objective: to examine geochemistry and physical transport of Mirex in Lake Ontario; assess role of bioturbation in vertical migration/mobilization of Mirex



Reproduction and Tissue Response in Prairie Voles Fed Mirex and Lake Ontario Coho Salmon

Objective: to document the effects of a chronic diet of Mirex and Lake Ontario coho salmon on reproductive success in prairie voles; develop better information about the potential effects of consuming Lake Ontario salmonids

PROJECTS IN SUPPORT OF ADVISORY SERVICE ACTIVITIES

Development of a Coastal Structures Construction Manual

Objective: to develop a manual that will provide coastal contractors with better design and construction criteria and will offer effective construction inspection guidelines

EDUCATION

Development of a Comprehensive K-12 Marine Education Program for New York State

Objective: to develop curricular materials on a state-wide basis for New York's elementary and secondary schools



Summary of  
Ohio Sea Grant's Research Program on the Great Lakes

MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT

Market Development for Underutilized Lake Erie Fish Species  
Including New Packaging Techniques

Objective: development of markets and methods of marketing products for human consumption from freshwater drum and other underutilized species; testing remains from filleted yellow perch for use as a minced fish product; assess effectiveness of controlled atmosphere packaging of fish under field conditions

Optimal Bluff Erosion Abatement Strategies for Lake Erie

Objective: preliminary identification, design, and evaluation of optimal cost and construction effective bluff erosion prevention strategies

MARINE ENVIRONMENTAL RESEARCH

Preliminary Development of an Operational Lake Erie Storm Surge  
Flood Forecasting Program

Objective: identify cost effective forecasting strategies for storm-induced flooding and establish the forecasting program within the western basin of Lake Erie

SOCIO-ECONOMIC AND LEGAL STUDIES

Dry Rack Boat Storage: Potential Energy Savings

Objective: to determine if dry rack storage has the potential to reduce the total fuel consumption of the boat owners that now trailer their boats over the highway to the boat launching area



## MARINE RESOURCE DEVELOPMENT

### The Life Cycle, Transmission, and Pathology of Eustrongylides tubifex, a Common Nematode Parasite of Yellow Perch and Waterfowl in Lake Erie

Objective: determination of the life cycle of the nematode parasite Eustrongylides tubifex, a pestilent parasite of yellow perch and other Lake Erie fishes and waterfowl

## MARINE EDUCATION AND TRAINING

### Oceanic Education Activities for Great Lakes Schools (OEAGLS)

Objective: development of education materials to create greater interest and student involvement in the Great Lakes Region by providing them marine education through examples which are more familiar to them

### Baseline Studies for Marine and Great Lakes Education

Objective: fifth and ninth grade students are subjects of a survey designed to obtain measures of students' knowledge about the oceans and Great Lakes, and their participation in water-oriented activities. Information will be used to help structure a marine and Great Lakes awareness program for state schools



Summary of  
University of Wisconsin Sea Grant's Research Program  
on the Great Lakes

LIVING RESOURCES

Impact of Nutrient Recycling on Lake Michigan's Nutrient Budget

Objective: analysis of contributions of nitrogen, phosphorus and carbon excreted by zooplankton to Lake Michigan's nutrient supply

Great Lakes Zooplankton Key and Monograph

Objective: a definitive list, history, abundance estimates, trophic relationships and distribution of zooplankton in Lakes Michigan and Superior

Food Requirements, Growth and Metabolism of Young Alewives

Objective: investigation of the amount of energy derived from food used by alewives in growth over time and at controlled temperatures

Optimizing Yield From Western Lake Superior Commercial Fisheries Through Smelt Stock Assessment

Objective: smelt population study and development of equipment and techniques for a year-round offshore commercial smelt fishery

Recreational and Commercial Fishing in Wisconsin's Lake Michigan Waters

Objective: the economics of commercial fishing and development of a social/economic profile of recreational fishermen



### Alternative Management Strategies for Minimizing PCBs in Lake Michigan Fishes

Objective: an examination of the effectiveness, costs, and benefits of different fish management practices aimed at minimizing the amount of PCBs in Lake Michigan fish harvested for human consumption

### Competition for Resources Among Planktivorous Fishes in Lake Michigan

Objective: an investigation of the seasonal divisions of habitat resources among planktivorous fishes and how this affects the distribution of the food fish that prey on them

### Economics of Rehabilitating the Lake Michigan Fishery: A Case Study

Objective: an assessment of the costs and benefits of sea lamprey control and salmonid stocking programs for all of Lake Michigan (being done in cooperation with the Michigan Sea Grant Program)

## AQUACULTURE

### Development of Aquaculture Systems for Cool Water Fish Species

Objective: development of year-round perch reproduction, optimum feeding regimes and ideal water conditions to produce yellow perch and other cool water food fish in manmade environments

### Energy Requirements of Yellow Perch

Objective: an examination of the effects of body weight and water temperature on the efficiency of feed conversion and growth of yellow perch



Evaluation of Water Reuse Systems for Yellow Perch Aquaculture

Objective: comparisons of the efficiency, energy consumption and water quality of three water treatment and recycling systems designed for perch aquaculture

Perch Aquaculture Systems Study

Objective: development of a fish growth model and a production cost model to provide realistic estimates of the cost and economic feasibility of a commercial perch aquaculture operation

GREEN BAY

Biological Production in Green Bay Coastal Marshes

Objective: systematic sampling of the biota of three wetlands to examine the effects of natural water level changes and human-caused perturbation

Dynamics of Herbivore Populations and First-Year Yellow Perch in Lower Green Bay

Objective: an investigation of the feeding interactions among phytoplankton, zooplankton and juvenile perch to assess the growth and abundance of perch in the bay

Vital Statistics and Population Structure of the Wisconsin Whitefish Fishery of Lake Michigan

Objective: whitefish tagging and enzyme studies to determine the age distribution, abundance and migrations of this important commercial species in Green Bay and northern Lake Michigan

Dynamics of Sucker Populations of Green Bay and Adjacent Waters of Lake Michigan

Objective: an assessment of the potential for a sustained commercial sucker harvest in the Green Bay region



Factors Influencing the Reestablishment of Self-Sustaining Stocks of Lake Trout in Lake Michigan with Special Reference to Green Bay

Objective: a study of lake trout population history, three genetic strains of trout and historic spawning reefs to see how a naturally reproducing lake trout population might be restored to Lakes Michigan and Superior

Fate of Arsenic Deposited in Green Bay by the Menominee River

Objective: an investigation of how arsenic contamination from a major point source is distributed and assimilated in the waters and sediments of Green Bay

Remote Sensing of the Green Bay Watershed to Estimate the Impact of Land Development on the Bay's Water Quality

Objective: development of a digitized, multi-spectral aerial imagery technique to assess nonpoint source pollution in the Green Bay watershed

Nonpoint Source Pollution in Green Bay and its Implications for Water Quality Management

Objective: an analysis of current land use practices and alternative policies to reduce sediment and nutrient runoff from rural areas

Water-Mass Structures and Exchanges in Green Bay, Lake Michigan

Physical-Chemical Characteristics and Dynamics of Green Bay, Lake Michigan

Objective: the physical and chemical dynamics of Green Bay as a base for in-lake ecosystem modeling



MICROCONTAMINANTS AND WATER QUALITY

Air Pollution Input of Organic and Inorganic Substances to Lake Michigan Water

Objective: an analysis of air and rainwater samples from Lake Michigan to determine the sources and proportion of contaminants in the Lake deposited by the atmosphere

Petroleum Hydrocarbons in the Sediments and Benthos of Lakes Michigan (Indiana Harbor) and Superior (Duluth Harbor)

Objective: measurements of the distribution and concentrations of hydrocarbons in the sediment and benthic organisms of these two petroleum-polluted harbors

Evaluation of Processes Controlling the Trace Metal Status of Southern Lake Michigan

Objective: an evaluation of the input of lead, zinc, copper, chromium, tin, bromine and nickel from Lake tributaries, their movement through the Lake and sediment, and their interaction with plankton and other aquatic life

On-Site Heavy Metal Analysis Using Anodic Stripping Voltammetry

Objective: development of an improved, electronic method for detection and on-site measurement of trace metal ions in water

Response of Daphnia Populations to Long-Term Cadmium Exposure

Objective: investigation of the short and long-term effects of cadmium on Daphnia, a representative zooplankton of Lake Michigan

Accumulation, Distribution and Elimination of PCBs in Yellow Perch Fed a Contaminated Ration

Objective: an examination of the effects of PCBs-contaminated alewife meal on yellow perch to determine if Lake Michigan alewives can safely be used as a food source for perch aquaculture



### Effect of Spawning on Distribution and Elimination of PCBs in Lake Michigan Fish

Objective: observation of the levels and elimination of PCBs in adult fish transferred to their eggs and the resulting fry

### Response of Primates to PCBs

Objective: examination of the effects on rhesus monkeys of low levels of PCBs in the diet to better understand the effects of PCBs on humans

### Biotransformation of Substituted Phenols by Fish and Aquatic Microorganisms

Objective: an evaluation of some of the possible sources and effects of pentachlorophenol (PCP), a common wood preservative, on fish

### PCBs Levels in Human Fluids: Sheboygan Case Study

Objective: an investigation of the PCBs levels in the breast milk and blood of Sheboygan residents, the effects of PCBs on infant health and the relationship between PCBs levels in humans and their ingestion of sport fish from Wisconsin waters

### Invitational Workshop on the Analysis of Toxic Organic Compounds in the Great Lakes

Objective: an opportunity for scientists involved in the analysis of toxic organic compounds in the Great Lakes to inspect the data and methodology of other scientists, to exchange information, and to reach consensus on the best analytical techniques

### Responses of Primates Fed Dioxin-Contaminated Fish Oil

Objective: an evaluation of the potential danger to humans posed by the consumption of fish contaminated with dioxin as determined by its effect on monkeys



An Assessment of Selected Priority Organic Pollutants in the Lower Fox River and Green Bay

Objective: an investigation of the types of chemicals that might be expected to appear in these waters, methodology for detecting them, and identification of priority chemical pollutants

An Assessment of Pathways of Chemicals in the Lower Fox River/Green Bay

Objective: an evaluation of and an attempt to improve and generalize the procedures currently used to predict the fate of selected chemicals in the Fox River and Green Bay

POLICY STUDIES

Ocean Policy and Natural Resource Strategy

Objective: an exploration of the many ocean resources issues confronting the world and possible solutions both within and and outside the framework of the Law of the Sea conference

Great Lakes International Trade: Hinterland Served and Shippers' Route Options

Objective: a study of the origin and destination of Great Lakes maritime trade, shipping costs and markets, and optimum cargo routes to analyze the strengths and weaknesses of Great Lakes ports

Assessing an Underwater Park Preserve for Wisconsin's Great Lakes Waters

Objective: an inventory of shipwrecks along Wisconsin shores and exploration of ways to protect and develop them as underwater parks



### Cultural Continuity: The Sea Islands Afro-Americans

Objective: documentation of the evolution of an Afro-American culture indigenous to the remote barrier Sea Islands off the South Carolina coast and its adaptation to modern farming and fishing

### Transferable Discharge Permits: Implementation Studies

Objective: creation of a simulation model of industry's reaction to the opportunity to purchase and sell pollution permits, an assessment of its effects on water quality and the likelihood of violations of water quality standards

### Economic Incentives and Barriers to Coastal Wetlands Protection

Objective: an analysis of the economic incentives to drain wetlands for agriculture and how they might be overcome through partial or full compensation to landowners

## GEOLOGICAL AND MINERAL RESOURCES

### Detailed Analysis of Factors Influencing Shoreline Erosion on the Great Lakes

Objective: analysis of various environmental factors influencing coastal erosion for use in determining remedies to erosion of high bluff areas along Lakes Michigan and Superior

### Geophysical Assessment of the Hydraulic Connection Between Lake Michigan and the Groundwater Aquifers on its Western Boundary

Objective: investigation of magnitude of the hydraulic connection between Lake Michigan and the surrounding aquifers with special emphasis on the heavily pumped region of southeastern Wisconsin

### Stratigraphy and Geotechnical Properties of Glacial Deposits Along the Shoreline of Lakes Michigan and Superior

Objective: testing of the variability of shoreline material for the development of bluff retreat models and assessments of the mechanics of slope failure, to result in a map of hazard areas



OCEAN ENGINEERING

Impulsive Response and Resonance of Great Lakes Ships

Objective: mathematical modelling of the responses of ship hulls to wave action resulting in resonating vibrations and structural failure--a suspected cause of Great Lakes shipwrecks

Development of Underwater Devices

Objective: design and development of improved snorkels, air regulators and other novel devices to aid divers function and work underwater

Ice Engineering for Small-Craft Harbors

Objective: creation of a "Design Manual for Northern Small-Craft Harbors"--practical information about ice behavior, dock design recommendations and evaluations

DIVING PHYSIOLOGY

Physiology of Diving

Objective: investigation of cardiovascular and respiratory effects of immersion on humans; special animal studies, focusing on gas exchange in bone and on decompression in fetuses, are being carried out using a hyperbaric chamber

Fetal Responses to Decompression

Objective: a determination whether standard decompression tables--designed for men--are suitable for use by pregnant women and investigation of fetal disposition to decompression sickness

NEW APPLICATIONS

Response of Lake Superior to Net Basin Supplies and Great Lakes Water Levels to Climate Variations

Objective: an assessment of the influence of climate on long-term fluctuations in water levels of the Great Lakes



## EDUCATION AND ADVISORY SERVICES

### Advisory Services Director's Office

Objective: delivery of information and assistance to groups and individuals requiring Sea Grant expertise, planning and operation of conferences and workshops, quick response to short-term Great Lakes problems

### Sea Grant Advisory Services Field Agents and Activities

Objective: Institute representatives at Washburn, Sister Bay, Green Bay and Milwaukee provide local educational and informational programs on Great Lakes matters, and provide a local interface with the entire Sea Grant program

### Sea Grant Communications

Objective: dissemination of research and general interest information about Sea Grant and the Great Lakes through films, publications, press releases, radio programs and special exhibits

### Earthwatch Public Service Radio Program and Newspaper Column

Objective: an award-winning daily, two-minute environmental radio program carried by more than 100 radio stations in six Great Lakes states, and a more regionally oriented weekly newspaper column carried by 80 papers, mostly in Wisconsin

### Food Science and Fish Program

Objective: technical assistance to the fishing industry, advice to sports fishermen and consumers on the handling and preparation of fish, and the development of new food products from underutilized fish species

### Special Education Programs

Objective: assistantships to students engaged in Sea Grant research, development of new university courses in limnology and oceanography, and special lecture/film series on campuses around the state



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