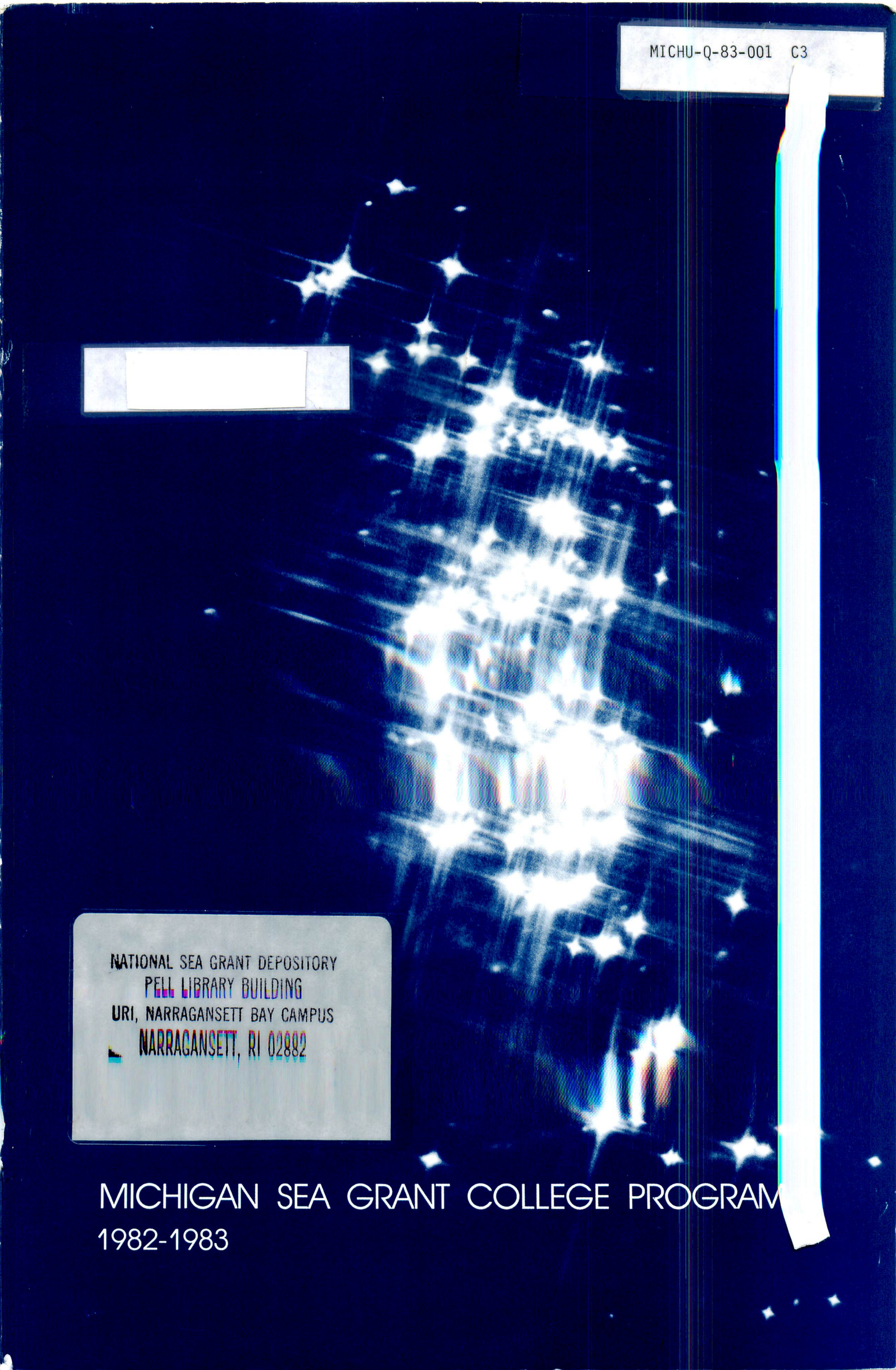

MICHIGAN SEA GRANT COLLEGE PROGRAM

1982-1983

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MICHU-SG-86-100

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INTRODUCTION

INTRODUCTION

The years 1982-83 were years of both celebration and rededication for Michigan Sea Grant. In September 1982 The University of Michigan and Michigan State University were awarded Sea Grant College status by the Secretary of Commerce, Malcolm Baldrige. The college status award recognized the maturity of the Michigan Sea Grant program and its achievements and sustained excellence in fostering the wise development of Michigan's Great Lakes resources. College status is the highest level of achievement possible for a Sea Grant program. Celebration of this achievement was coupled with rededication to high standards.

Another award went to a Sea Grant-supported student. Each year the Sea Grant Association recognizes students who have shown excellence in their Sea Grant research. In 1982, Yathirajula M. Haidu of Michigan State University received Honorable Mention for his Sea Grant work on stability changes in mechanically deboned carp (Cyprinous carpio) during frozen storage. This work was done on a 1981 project headed by James Price and Lawrence Dawson, both of the Food Science and Human Nutrition Department at Michigan State University.

In 1982-83 Michigan Sea Grant sponsored research projects on coastal resources, education, fisheries, recreation and tourism, toxic substances, marine transportation, water quality, and water safety. Educational programs provided professional and in-service training to students, commercial fishermen, shipbuilders, and other members of the marine business community and the general public. Marine advisory service agents brought Sea Grant's research and education efforts to people who could directly apply them; they provided technical assistance on tourism development, water safety, marina management, community waterfront development, and fishery practices. Michigan Sea Grant engaged in cooperative projects with other Sea Grant programs, particularly those in the Great Lakes region, and with other agencies.

This report covers Michigan Sea Grant activities during 1982-83. Program activities are divided into four major sections: Research, Marine Advisory Service, Communications, and Administration. Budgets and other additional information are presented in the appendices.

The Research section covers projects that were completed in 1982 or 1983 or that continued through these years to be completed in subsequent years. Entries list principal investigators, time span each project covered, and project number. Completed projects also list students supported by the project, their thesis if it was based on their Sea Grant research, and their place of employment if they have completed school; publications and presentations resulting from the project; and organizations that contributed to the project through supplemental funding, in-kind services, and other forms of cooperation.

The subsection Highlights presents a cross-section of projects that received widespread attention or that had national or regional impact. Another subsection, Program Development, describes projects that arose during the funding period and were financed by discretionary program development funds.

RESEARCH

Highlights
Completed Projects
Program Development
Continuing Projects

Highlighted here are a cross-section of 1982-83 completed projects that received widespread attention or that had regional or national impact during the 1982-83 time period.

The Role of Groundwater and Other Factors in Bluff Slumping

Coastal erosion along the Great Lakes has resulted in public and private costs through loss of property, damage to structures, construction of protective devices, and recovery expenditures. An estimated two-thirds of Great Lakes shoreline property owners have experienced some type of erosion damage.

One common form of shore erosion is bluff slumping--the undermining of the bottom or toe of a coastal bluff and the subsequent collapse of the upper portions. Although the effects of bluff slumping are often substantial, including the loss of property and homes and other structures, there had been little opportunity for researchers to share information with the public on the role of groundwater seepage and other geologic, hydrologic, and engineering factors affecting Great Lakes bluff stability. Thus, this project was conceived to improve the management of coastal hazards by increasing both professional and public knowledge of the factors that affect bluff stability.

Two workshops and two publications were planned. The first workshop, co-sponsored by Michigan Sea Grant and the U.S. Geological Survey, was for engineers, geologists, hydrologists, and others who specialize in slope stability. Held in Romulus, Michigan, the workshop assessed the current scientific and technical knowledge of bluff slumping and its mitigation and determined further research and data collection needs. A proceedings was published and has been distributed to more than 200 professionals.

The second workshop, held in Grand Haven, Michigan, in September 1982, was designed for homeowners and community planners, and focused on use and protection of back-shore slopes and on shoreline defenses. To complement the workshop, a consumer's guide was published. The guide discusses how to recognize bluff stability problems, ways of preventing or solving them, and where to get professional help. Nine hundred copies of this guide were distributed by the fall of 1985.

R/CE-4
1982

Principal Investigators:
John H. Judd, Ph.D., Great Lakes Research Division, The University of Michigan
Donald H. Gray, Ph.D., Department of Civil Engineering,
The University of Michigan

Publications:
Bluff Slumping: Proceedings of the 1982 Workshop, MICHU-SG-82-901
Bluff Slumping and Stability: A Consumer's Guide, MICHU-SG-82-902

Contributor:
U.S. Geological Survey

Development and Emplacement of University-level Education Programs for the Production of Work Boats

Traditionally, most of the educational programs in vessel production have been oriented toward the merchant ship sector of the industry, ignoring the production process associated with small vessels, such as work boats (tug boats, fishing vessels, etc.) and specialty craft. This project was designed to fill that gap by providing educational programs for the work boat industry. As a result, six textbooks were prepared and a short course for the boatyard industry was held in June 1983. Entitled "Microcomputers and the Boatyard," the course was designed to enable the work boat industry to take advantage of state-of-the-art technology. The course included an analysis of the production systems presently employed in the U.S. shipbuilding industry as they apply to the small boatyard. It also provided an introduction to the possibilities and limitations of using microcomputers in the boatyard.

The benefits of this project were two-fold. First the intensive short course on work boat production techniques and microcomputers provided an opportunity for boatyard managers, engineers, and supervisors to become familiar with advanced boatyard technologies. Second, development of the short course resulted in the establishment of a knowledge base that can be used by ship production engineers and schools of naval architecture. The six texts on small boatyard technologies have been distributed throughout the industry and are used in courses on ship/boat production at The University of Michigan's Department of Naval Architecture and Engineering.

E/CCD-4
1982-83

Principal Investigator:
Howard M. Bunch, Ph.D., Naval Architecture and Marine Engineering,
The University of Michigan

Publications:
Advanced Boatyard Technologies, MICHU-SG-84-600
Microcomputer Basics, MICHU-SG-84-601
Microcomputer Operating Systems and Languages, MICHU-SG-84-602
Microcomputer Business Applications, MICHU-SG-84-603
Microcomputers and Design Aids, MICHU-SG-84-604
Microcomputers and Production Control, MICHU-SG-84-605

Students Supported:
John Duclos, M.S. Employed by Bath Iron Works
Kevin Mitchell, M.S. Employed by Michigan Wheel Corp.
Aogu Tuskamoto, M.S. Employed by Exxon International, Inc.
Robert Scher, M.S. Now pursuing Ph.D.
Paul W. Vickers, M.S. Now pursuing Ph.D.

Contributors:
Halter Marine, Inc., New Orleans, Louisiana
Bollinger Machine Shop and Shipyard, Inc., Lockport, Louisiana
Delta Shipyard, Houma, Louisiana
Progressive Shipbuilders and Fabricators, Houma, Louisiana
University of Southern Florida, Tampa Springs
Yacht Design Institute, Blue Hill, Massachusetts
Bay Area Marine Institute, San Francisco

Underwater Technology Education

The expansion of interest in and need for the wealth of resources in the ocean is making it increasingly important to advance the technology that will permit safe operations in the hostile environment of the sea. The development and utilization of advanced underwater technology begins with the education of engineering and naval architecture students.

This project provided for updating and expansion of an underwater technology course at The University of Michigan, first developed with Michigan Sea Grant funding in 1970. Twenty-three lectures, including outlines, slides, and support documents were prepared or revised. The lectures cover the technical history of diving, human performance underwater, the various diving systems, and underwater tools and activities.

The lectures were modified for use as educational programs for general public and industrial audiences. These programs cover surface-supplied diving, hyperbaric chambers, bell-saturation diving, remote controlled vehicles for underwater inspection and recovery and atmospheric pressure diving systems.

A series of examinations covering different diving situations were prepared as an outgrowth of this work. These exams will be used in University of Michigan courses on diving and underwater research methods.

The project provided special educational opportunities to several students who helped to research and write eight lecture support papers as special projects. One student, who has earned a national reputation as an expert in decompression, began his decompression work under this project.

The project produced six Michigan Sea Grant publications. Some have been reprinted in national diving publications, and demand has twice required the reprinting of one ("New No Decompression Tables...", see below).

E/CCD-5
1982-83

Principal Investigator:
Lee H. Somers, Ph.D., Department of Atmospheric and Oceanic Science,
The University of Michigan

Students Supported:
Karl Huggins, B.S. candidate
Bonnie Schwan, M.S. candidate
Mark Dahmer, M.S. candidate
Matt Strum, M.S. candidate
Sidhu Kanwaldeep, M.S. candidate
Kurt Forsberg, M.S. candidate
Bruce Branham, M.S. candidate
Milton Ennis, M.S. candidate

Publications:
Compact Surface-Supplied Diving System for Scientific and Recreational Divers, MICHU-SG-84-304
Scientific Saturation Dive: Living and Working Under the Sea, MICHU-SG-84-302
Ambassadors of the Sea: Share Your Experiences, MICHU-SG-84-301
Doppler Evaluation of Multi-Level Dive Profiles, MICHU-SG-84-300
Mathemathical Evaluation of Multi-Level Diving, MICHU-SG-81-207
New No-Decompression Tables Based on No-Decompression Limits Determined by Doppler Ultrasonic Bubble Detection, MICHU-SG-81-205

Contributors:
Hydro-Products, San Diego
Oceaneering International, Houston

Evaluation of an Artificial Reef as a Fishery Management Method for Lake Michigan

In the fall of 1980, an artificial reef was constructed of large limestone blocks in Lake Michigan near Muskegon, Michigan. Called Hamilton Reef, the reef was constructed by the Michigan Department of Natural Resources to concentrate fish, especially yellow perch, and to improve angler catches in this generally barren sand area. Hamilton Reef was the first artificial reef placed in the Great Lakes as a fishery management tool.

This Michigan Sea Grant study was conducted to evaluate the reef's effectiveness in concentrating fish, to describe the colonization of periphyton invertebrates and forage fishes on the reef, and to evaluate the overall success of such reefs.

Gill netting samples revealed that the reef did concentrate fish, most of which were yellow perch. However, it was discovered that the reef, which was placed in an area subject to cold water upwellings, failed to hold fish during those upwelling periods when the water temperature dropped below 15°C.

In addition it was discovered that the Muskegon River breakwall probably served as a competitive site preferred by yellow perch. The study suggested that in the future, reef materials might be added in perpendicular or parallel lines to the breakwall areas rather than in deeper water offshore.

The reef was well-colonized by invertebrates and forage fish. However, growth of periphyton was scant because of low light intensity. It appeared that Hamilton Reef may be too deep for effective primary production.

Although angler success on the reef was marginal during the first three years, it was expected to improve when anglers learned where and when to fish.

The study concluded that artificial reefs in the Great Lakes can be effective concentrators of fish, but should be constructed of large, high density materials and located in carefully selected sites.

R/GLF-13
1981-83

Principal Investigator:
Niles R. Kevern, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Students Supported:
William E. Biener, M.S. "An Evaluation of an Artificial Reef Placed in Southeastern Lake Michigan: Fish Colonization." Employed in private business
Stephen R. VanDerLaan, M.S. "The First Artificial Reef in the Great Lakes: An Evaluation." Employed by Michigan Department of Natural Resources

Publications and Presentations:
Conference on Artificial Reefs in the Great Lakes, June 1983
"A Preliminary Evaluation of an Artificial Reef in Lake Michigan"
27th Annual Conference on Great Lakes Research, May 1984
"An Evaluation of the First Artificial Reef in the Great Lakes"

Contributors:
Michigan Department of Natural Resources
Muskegon Sports Fishing Association

Information Networks and Great Lakes Recreation: Implications for Increasing Tourism in Michigan

As Michigan's economy retrenched in the wake of the recent recession, tourism gained added significance as a major means to improve the image of the state and attract increased revenues. Resource managers, tourist organizations, communities, and businesses needed a clear understanding of how tourists receive information about the state's vacation/recreation opportunities, so that useful, relevant information could be channeled effectively to those tourists.

This study identified what kind of people are visiting Michigan vacation sites and what type of information networks and linkages are used by them to make travel decisions. A total of 1389 vacationers were surveyed to establish the decision-making process within each travel group and to collect essential background information such as point of origin, length of stay, whether the individuals were first-time or repeat visitors, purpose of the visit, and type of lodging used.

A central part of the study focused on analyzing informal information networks and how they operate in conjunction with the more formal tourism information systems. Informal networks are composed of family, friends, or acquaintances. Formal networks include the mass media (newspaper, brochures, television, radio).

Despite their acknowledged importance, informal networks have received little systematic examination, so the study attempted to quantify some of the processes and dynamics involved in these informal, "word of mouth" information networks.

Evaluation of survey data showed that most visitors used friends or other members of their traveling group as sources of information prior to beginning their trips. The chief information sources upon arrival at a destination were employees of the place of lodging and chance observation while walking or driving in the area.

Study results are being used by community planners, resource managers, tourist groups, and businesses to better direct their efforts to attract and serve Michigan visitors. The principal investigator has been invited by many of these groups to outline the study's findings and to make recommendations to local areas based on those areas' unique circumstances. These efforts have enabled communities to better assess their tourists and their attendant needs, identify tourist types that could be attracted with more or different promotion, and to tailor services and attractions to the type of tourist each community attracts.

R/R-6
1982-83

Principal Investigator:
Maureen H. McDonough, Ph.D., Department of Park and Recreation Resources, Michigan State University

Students Supported:
Cheryl Dyer, Ph.D. candidate
Cathy Eckstein, M.S. candidate, "Communication Networks of Visitors to Recreation Locations Along the Great Lakes: Implications for Increasing Tourism"
Charlotte Young, M.S. candidate
Suzanne Prichard, B.S. candidate

Publications and Presentations:
Information Networks and Promoting Tourism in Michigan, Michigan Tourism Topics, 1983
Association of Interpretive Naturalists, 1984
"Tourism Information Networks: Implications for Interpretation"

Contributor:
Agricultural Experiment Station, Michigan State University

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

Boating in Michigan continues to occupy a key niche within the state's 10-billion dollar tourist industry. Accurate, up-to-date data about Michigan boating is essential for good planning and management of the economic and aesthetic developments related to this expanding industry.

This Michigan Sea Grant study has resulted in a comprehensive compilation of boater information. The study's far-reaching boater survey has provided data on boater spending patterns (who spends how much for what), boating use, and energy consumption. Researchers have also developed a refined, updated mathematical model for predicting future boating patterns. This model may also be adapted for use in other types of recreation studies.

The survey revealed that most boating revenue is generated by expenditures made on ancilliary goods and services, such as lodging, food, and fuel, rather than boat purchase, repair, storage, or fees. This finding has important implications for communities in developing strategies for improving retail trade and developing support services for the boating public.

Further, the study analyzed specific spending patterns of the various types of boaters. Owners of large boats spend more on marina and boat maintenance services, while spending by owners of small boats generates more revenue for retail businesses such as food stores, sport shops, and lodging facilities. This information is helping community planners, businesses, and governments decide what type of development to undertake, depending on the type of revenue desired in their areas.

The Michigan Department of Natural Resources, Waterways Division, will use the study's data to help plan funding allocations for marina development and for other boating facilities. The MDNR will also take advantage of the work to streamline its own boating surveys and thereby reduce its costs of data collection and better focus its studies.

R/R-2
1980-82

Principal Investigator:
Daniel J. Stynes, Ph.D., Department of Park and Recreation Resources, Michigan State University

Students Supported:
David Safronoff, Ph.D. candidate, "Supply Measures in Reduced Form Models: A Study of Michigan Boaters"
Daniel Spotts, Ph.D. candidate
Gene Brothers, Ph.D. candidate
David Feltus, Ph.D. candidate

Publications and Presentations:
1980 Michigan Recreation Boating Survey, MICHU-SG-82-202
Michigan Great Lakes Recreational Boating: Synthesis of Current Information, MICHU-SG-82-203
Spending Patterns and Economic Impacts of Michigan Boat Owners, MICHU-SG-83-210
Trends in Recreational Boating, MICHU-SG-82-302. Reprinted from Proceedings 1982 Michigan Tourism Symposium
Supercalc Program for Estimating Boater Spending. Available from the principal investigator
1980 National Outdoor Recreation Trends Symposium "Trends or Methodological Differences?"
Eastern Economics Association Meeting, 1982 "Market Segmentation in Recreation and Tourism"

Contributors:
Agricultural Experiment Station, Michigan State University
Michigan Boating Industries Association
Law Enforcement Division, Michigan Department of Natural Resources

The Role of *Mysis relicta* in the Transport of PCBs in the Lake Michigan Ecosystem

Recent evidence suggests that Great Lakes organisms which are affected by PCBs and other toxic chemicals also contribute to the chemicals' persistence in lake waters by passing contaminants along through the food chain. Without this biological recycling, more of the toxic contaminants would settle to the bottom of the lakes and remain there.

This study investigated biological recycling by examining the transport of toxic chemicals by the tiny opossum shrimp, *Mysis relicta*. Opossum shrimp are an important component of fish diets and are abundant in the Great Lakes. Because they migrate vertically each day, the shrimp can transport toxic substances between the sediment and surface water.

The study discovered that different toxic substances behave differently in the opossum shrimp. For example, it was found that PCBs do not bioaccumulate in the shrimp with age, but rather are efficiently excreted and/or inefficiently assimilated. However, DDE does appear to accumulate in the shrimp with age.

In addition it was discovered that *Mysis relicta* recycles contaminants in several ways, including ingesting contaminated sediments and migrating to the surface; ingesting contaminated surface plankton and migrating to the bottom; producing fecal pellets which sink to the bottom; passing contaminants on to predatory fish; and releasing contaminants upon molting or death.

This study has provided new information on toxic organic contamination in invertebrates and will be of use to researchers in developing mathematical models of contaminant cycling in fish communities and in the ecosystem as a whole. Also there has been a great deal of interest in the study's characterization of particulate flux. Oceanographers have been engaged in such research for a number of years, but similar studies have not been conducted in fresh water systems. Thus the study has provided new insights into the transport of compounds of general interest to limnologists, such as silica flux. Michigan Sea Grant is funding two follow-up studies: one on further characterization of particulate flux in Lake Michigan and another on toxaphene compartition and recycling in Lake Michigan.

R/TS-14
1981-1982

Principal Investigators:
Marlene S. Evans, Ph.D., Great Lakes Research Division,
The University of Michigan
Clifford P. Rice, Ph.D., Great Lakes Research Division,
The University of Michigan

Students Supported:
Rebecca M. Glover, M.S. candidate
Ralph W. Bathelt, M.S. candidate

Publications and Presentations:

PCBs and Other Toxicants in Mysis relicta, MICHU-SG-82-309
Reprinted from Hydrobiologia, Vo. 93, 1982

The Composition of Particulates in Lake Michigan Using S.E.M. and Light Microscope Techniques, Micron, Vol. 12, No. 3, 1981

American Society of Limnology and Oceanography, 1981
"PCBs and Other Toxic Organics in Mysis relicta"

American Society of Limnology and Oceanography, 1982
"Particulate Flux in Southeastern Lake Michigan in Summer-Autumn 1980: The Role of Zooplankton"
"Characterization of Particulate Biogenic Silica Flux in Southeastern Lake Michigan"
"PCBs and Other Organic Contaminants in Lake Michigan Particulates--Mysids, Plankton, Abiotic Matter"

Fourth Midwest Water Chemistry Workshop, 1981
"Particulate and Silica Flux and Composition in Offshore Lake Michigan: Possible Role of Zooplankton in Differential Transport of Biogenic Silica"
"Characterization of the Flux of Particulate Material in Southeastern Lake Michigan: Summer-Autumn, 1980"
"Potential Movement of Toxic Organics by Mysis relicta"

International Association for Great Lakes Research, 1982
"Fractionation of Chlorinated Hydrocarbon in Mysis relicta"

Contributor:

Great Lakes Environmental Research Laboratory

COASTAL RESOURCES

The primary objective of the Coastal Resources subprogram was to gain a better understanding of wetlands ecology, so that future policy and management decisions could be well-informed. A coordinated research program was planned, with complementary individual projects. The Pentwater Marsh, a typical Lake Michigan riverine marsh, was chosen as the focus of these studies. The studies investigated the uses of wetlands by fish in all life stages and by waterfowl, and the ecological processes that control energy flow and nutrient cycling.

Avian Response to Wetland Vegetative Cycles

In this three-year study, avian communities at Pentwater Marsh on Lake Michigan and Shiawassee National Wildlife Refuge near Lake Huron were studied to determine their response to wetland vegetative cycles and water level fluctuations.

The study found that as open water areas decreased, both the number of bird species and the population density increased. These findings are at odds with the results of previous studies of prairie potholes, where the greatest species diversity and population density occurred when there was 50 percent open water. Apparently there are different mechanisms regulating breeding bird communities in the more permanent Great Lakes coastal wetlands.

The study also revealed the importance of submersed plant communities to breeding marsh birds. There were more breeding species in wetlands with submersed plants than in those without submersed plants. However, the areas without submersed plants were much better habitats for herons during mid-to-late summer.

The study's findings have been incorporated into management guidelines by the Shiawassee Refuge. Other refuges, the Michigan Duck Hunters Association, Michigan Department of Natural Resources, and the Audubon Society and other ornithological groups are using the findings to advance marsh management theory and practice. The results will be made widely available as a chapter in "Coastal Wetlands," the published proceeding of the First Great Lakes Coastal Wetlands Colloquium.

R/CW-9
1979-83

Principal Investigator:
Harold H. Prince, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Students Supported:
Douglas A. Reeves, M.S.. candidate
Rick Rusz, M.S. candidate
Mark Sargent, M.S. candidate

Presentations:
Eighty-eighth Michigan Academy of Science, Arts, and Letters
"Avian Responses to Wetland Vegetative Cycles"
First Great Lakes Coastal Wetlands Colloquium, November 1984
"Avian Communities in Controlled and Uncontrolled Great Lakes Wetlands"

Distribution, Productivity, and Energy Relationships of Adult Fish in the Pentwater Marsh

The objectives of this study were to identify the seasonal and temporal distribution and habitat use of adult fish in the marsh and to estimate the productivity and bioenergetics of yellow perch (Perca flavescens).

Warm-water fish species were the most abundant. Cold-water species (salmonids) generally used the marsh only during fall migration. Diets of most fish were comprised mainly of macroinvertebrates, especially Amphipoda. Some large fish, primarily northern pike, were piscivorous, consuming mainly yellow perch. Diet and predation caused yellow perch in the marsh to exhibit a lower average age and slower growth rates than yellow perch in the open lake. Findings have been used by sport fishermen and by the Michigan Department of Natural Resources in evaluating marina permit applications for Pentwater Lake.

R/CW-14
1983

Principal Investigator:
Charles R. Liston, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Students Supported:
Daniel C. Brazo, Ph.D. candidate,
"Distribution and Abundance of Ichthyoplankton in Nearshore Lake Michigan near Ludington and Potential Immigration from a Tributary Marsh"
Greg Wright, B.S. Employed by U.S. Army Corps of Engineers, Detroit District
Doug Threloff, B.S. Employed by U.S. Fish and Wildlife Service, Ludington

Publications and Presentations:
Great Lakes Coastal Wetland Colloquium, 1984
"Importance of a Great Lakes Coastal Marsh to Fisheries Resources"
Mid-West Fish and Wildlife Conference, 1985
"Population Size, Productivity, and Diet of Several Species of Fish in Pentwater Marsh on Lake Michigan"

Contributor:
Agricultural Experiment Station, Michigan State University

Bluff Slumping (see Highlights)

EDUCATION

In 1982-83, the Education subprogram shifted its emphasis from K-12 to professional, adult, and college education. The major exception to this was the completion of a middle school curriculum based on the Great Lakes fishery (see Communications). A seminar for water resources students and development of a course in underwater technology were the major contributions to college education. A short course and textbooks on work boat production were a significant contribution to industry.

Distinguished Lecture Series

To stimulate and maintain interest in marine research among the faculty and students at Michigan universities, this project was established to provide a series of outstanding lectures on marine-related topics by scientists, educators, government officials, and industrialists. Funding constraints required the termination of this project after only two presentations; one at The University of Michigan and one at Michigan State University. Faculty and students from these two universities and from neighboring universities, and scientists from state and federal agencies attended these lectures.

E/GLE-8
1983

Principal Investigator:
Alfred M. Beeton, Ph.D., Great Lakes and Marine Waters Center,
The University of Michigan

Great Lakes Seminar

This seminar for University of Michigan water resources students was designed to give participants a well-rounded and in-depth understanding of Great Lakes environmental and policy issues. Guest lecturers from industry, government, and research organizations were invited each year to present various sides of major issues.

Based on the lectures and their own research, the students produced video tape documentaries. In all, six video tapes on Great Lakes topics of continuing interest were produced. Tape production proved to be an effective technique for teaching graduate research seminars. The exercise provided students with valuable research and video production experience and with important contacts. The video tapes have been distributed at cost to a variety of government, private, and educational groups.

E/GLE-7
1981-83

Principal Investigator:
Jonathan W. Bulkley, Ph.D., School of Natural Resources,
The University of Michigan

Students Supported:
Henry H. Sprague, III, M.S.,
"Videotape: Its Educational Value in Water Resources Management."
Employed by U.S. Environmental Protection Agency
Virginia C. Welford, M.S.
"The Great Lakes Seminar: An Experiment in Educational Videotape."
Employed by State of Arizona, Water Quality Group
Ted Starbuck, M.S. candidate
Carol Leedorn, M.S. candidate
Gary Sydow, M.S. candidate
Lynn Zimmerman, M.S. candidate

Publications:
Video Tapes:
The Great Lakes/St. Lawrence Seaway: Shipping Competition
Winter Navigation on the Great Lakes
Tolls on the Seaway
The Great Lakes: Our Joint Heritage
Toxics in the Great Lakes
The Risk Assessment of Toxics in the Great Lakes Region
Graduate Education in Water Resources: An Innovative Approach,
MICHI-SG-83-311. Reprinted from American Water Resources
Association Bulletin, December 1983

Work Boat Production (see Highlights)

Underwater Technology Education (see Highlights)

GREAT LAKES FISHERIES

The Great Lakes Fisheries subprogram emphasized basic fishery biology and management, with particular emphasis on the ecology of native Great Lakes species and on the maintenance and rehabilitation of their populations. Lake trout, lake whitefish, lake herring, and yellow perch were the subjects of several studies. In addition, introduced species were studied: the population dynamics of pink salmon and the food habits of Pacific salmonids. In the field of aquaculture, dietary supplements for rainbow trout were investigated and an aquaculture development program was initiated.

Examination of Spawning and Incubation Requirements and Reproductive Biology of Lake Trout in Relation to Reestablishment of Self-Sustaining Stocks in the Great Lakes

The failure of stocked lake trout to reproduce in most areas of the Great Lakes continues to baffle biologists and diminish fisheries potential in the region. This study examined several plausible causes of reproductive failure, including insufficient egg production, maladaption of present genetic stocks, deterioration of egg incubation habitat, and predation. Spawning and incubation habitat were also examined on artificial reefs to determine their suitability as spawning and nursery grounds.

Extensive measurements of chemical parameters (pH, dissolved oxygen, etc.) failed to show any substantial deterioration of the egg incubation habitat in fall. However, ammonia levels in the egg environment were elevated over those observed one meter above the reef. Examination of potential predators of eggs and fry revealed only a few lake trout eggs in the stomachs of round whitefish. The study also documented the timing and temperature history of egg incubation, hatching, and swim-up of larval lake trout in inshore southern Grand Traverse Bay.

These results will provide fisheries resource managers with information on lake trout spawning requirements. Enhanced trout stocks should boost sport fishing and related businesses in the Great Lakes.

R/GLF-11
1982-83

Principal Investigators:
David Jude, Ph.D., Great Lakes Research Division, The University of Michigan
John Dorr, Ph.D., Great Lakes Research Division, The University of Michigan

Student Supported:
James Wojcik, Ph.D. candidate

Publications:
Discovery of the Asiatic Clam, Corbicula fluminea, in Lake Michigan, MICHU-SG-84-310. Reprinted from Journal Great Lakes Research, 10:329-331
Benthic Community Structure and Composition Among Rocky Habitats in the Great Lakes and Keuka Lake, New York. Journal Great Lakes Research. In Press
Science for the 80's, University Center, Michigan, March 1984
"Changes in Fish Population--Reproductive Problems"

RECREATION AND TOURISM

The Recreation and Tourism subprogram focused on the economic impact of boating and fishing and on marketing methods. Once economic impact studies revealed the value of tourism to Michigan communities and the Michigan economy, the logical next step was to investigate methods for attracting tourists. To do this, a better understanding of the tourism market was needed. Thus, studies of tourist information networks, tourists' perceptions of recreational areas, and tourism market segments were undertaken.

Economic Impact of Angling for Great Lakes Fish in Michigan

This study grew out of a local conflict in Alcona County over whether the economic value of fall sportfishing and the associated influx of anglers to the county outweighed the drawbacks such as traffic jams, littering, and trespassing. It was discovered that the economic impact far exceeded expectations. State and out-of-state anglers brought in $1.3 million during the 1980-81 fishing season, and contrary to local belief, most of the expenditures were made in retail establishments such as restaurants, motels, and grocery stores, rather than in bait and tackle shops.

The findings prompted similar studies in other Michigan counties, selected to represent all regions of the state. Cities, counties, sportman's clubs, and individual businessmen have used the study's findings to help determine the feasibility of developing public facilities and embarking on various business ventures. The findings will also be used eventually to develop a statewide picture of sportfishing economic impacts. Increased understanding of who anglers are, where they fish, and where they spend their money is expected to continue to help local communities develop better tourism promotion strategies and help the Michigan Department of Natural Resources institute more viable fish stocking programs.

R/R-5
1982-83

Principal Investigator:
Daniel Talhelm, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Student Supported:
Scott Jordan, Ph.D. candidate

Publications and Presentations:
The Economics of Sport Fishing in Alcona County, MICHU-SG-82-204.
Similar report on the other eight counties studied, available
from county extension offices
International Association for Great Lakes Research, 25th Annual Conference,
Sault Ste. Marie, Ontario, May 1982, "Economics of Sport Fishing
in Alcona County"
Michigan Association of Chartercaptains, Tustin, Michigan, April 1983
"Economics of Charter Fishing in Michigan"

Contributors:
Michigan Department of Social Services
Michigan Department of Natural Resources, Land Resources Programs Division
Cooperative Extension Service, Michigan State University
Ottawa County Board of Commissioners
Muskegon County Board of Commissioners
Several other local city governments and associations

Images and Perceptions of the Great Lakes: Implications for Tourism in Michigan

This two-year study was conducted to determine which areas of Michigan are perceived as recreational "hot spots" by tourists and how these perceptions influence travel decisions and recreational preferences. More than 600 tourists at Michigan Travel Information Centers were surveyed.

Michigan ranked high among other Great Lakes states for its recreational opportunities. Of the eight distinct recreational regions in Michigan identified by tourists, seven were located along the Michigan coastline and differed somewhat from those areas promoted by state government and tourism agencies. It was also found that out-of-state travelers were less able than Michigan residents to identify specific recreational sites.

Results will be used by local and regional tourism businesses to develop cooperative tourism promotion strategies and to improve tourism in less well-known recreational areas. The study's development and application to tourism research of cognitive mapping techniques represent an advance in tourism research methodology.

R/R-7
1982-83

Principal Investigator:
Joseph Fridgen, Ph.D., Department of Park & Recreation Resources,
Michigan State University

Students Supported:
Cynthia Deale, Ph.D. candidate, "Auto Travelers' Images of Tourism and Recreation Regions in Michigan: An Exploratory Study"
Marci Clark, M.S. candidate, "Auto Travelers' Perceptions of Lake Huron, Lake Michigan Coastline"
Edward Udd, Ph.D. candidate
David B. Klenosky, M.S. candidate
John Incledon, M.A. candidate
William Norman, M.S. candidate
Carol Pancner, M.S. candidate
Jennifer Dively, B.S. candidate
Julian Fraser, B.A. candidate
Amy Koblin, B.A. candidate

Publications and Presentations:
Cognitive Maps of Tourism Regions in Michigan, Michigan Tourism Topics, Spring/Summer, 1983
Profile of Visitors to the Menominee Tourism Information Center, Menominee County Tourism -- Summer 1983
Proceedings of Applied Geography Conferences, 1983
"Cognitive Maps of Tourism in Michigan"

Contributors:
Agricultural Experiment Station, Michigan State University
Menominee Area Chamber of Commerce
MJT, Inc. Menominee
Michigan Department of Transportation

Tourism Market Segmentation

Tourism agencies and firms in Michigan are recognizing that recreational products and services must be tailored to specific market segments to meet the variety of preferences and needs of Great Lakes tourists. This study examined the size and importance of different segments of the tourism market and evaluated alternative methods for segmenting these markets within four broad segmentation categories: 1) socioeconomic, 2) product-related, 3) physiographic, and 4) geographic. A number of recommendations for segmentation studies were then advanced. Results are providing businesses, communities and state travel offices with recommendations for more clearly defined tourism planning and development strategies and have already been incorporated into some State of Michigan and other marketing strategies.

R/R-8
1983

Principal Investigators:
Daniel J. Stynes, Ph.D., Department of Park and Recreation Resources, Michigan State University
Edward Mahoney, Ph.D., Department of Park and Recreation Resources, Michigan State University

Student Supported:
Hideo KiKuchi, Ph.D. candidate, Michigan State University

Publications and Presentations:
Spending Patterns and Economic Impacts of Michigan Registered Boat Owners, MICHU-SG-83-210
Marketing Tourism, Journal of Physical Education, Recreation and Dance, April 1983
Tourism Market Segmentation, Leisure Today, April 1984
Eastern Economists Annual Conference, April 1983
"Market Segmentation in Recreation and Tourism"

Contributors:
Cooperative Extension Service, Michigan State University
Agricultural Experiment Station, Michigan State University
Rocky Mountain Forest and Range Experiment Station

Great Lakes Boating (see Highlights)

Information Networks (see Highlights)

TOXIC SUBSTANCES

The Toxic Substances subprogram focused on the behavior of organic toxicants in the Great Lakes, particularly the pesticide toxaphene. The several toxaphene studies were designed to complement one another. In-lake transport of PAHs and PCBs was also studied. Other studies sought to improve qualitative measures of the sublethel effects of toxic substances on Great Lakes life. Two looked at measurable physiological changes in fish and one at refined analytical procedures.

Development and Refinement of Standard Methods for Wildlife Toxicology

The biological effects and environmental fate of toxic substances is a growing concern as toxic substances proliferate. To help develop standard methods of testing wildlife response to toxins, the U.S. Environmental Protection Agency (EPA) passed funds through Michigan Sea Grant for this project. Working largely with mink and European ferrets, the study developed test protocols for carnivores. The U.S. EPA and the American Society for Testing and Materials Committee E-47 on Biological Effects and Environmental Fate are reviewing the results for possible incorporation into their standards. The study also looked at the effects of photoperiod on avian dietary tests and found that photoperiod has little or no effect on test results.

R/T-16
1983

Principal Investigator:
Robert K. Ringer, Ph.D., Pesticide Research Center,
Michigan State University

Students Supported:
William J. Breslin, Ph.D., "Photoperiodic Effects on the Avian Dietary LC_{50} in Bobwhite and Mallards"
Employed by Dow Chemical Toxicology Research Lab
Thomas C. Hornshaw, Ph.D., "Development of Dietary LC_{50} and Reproduction Test Protocols Using Mink and Ferrets as Representative Mammalian Carnivores" Employed by Illinois EPA, Office of Chemical Safety

Presentations:
Society of Toxicology Meeting, 1984
"Toxicity of Thiram to Mink and European Ferrets"
"Development and Validation of Dietary LC_{50} Test Protocols for Wildlife Mammalian Carnivores Using Mink and Ferrets"
Society of Toxicology Meeting, 1983
"Toxicity of Sodium Monofluoroacetate (Compound 1980) to Mink"
Michigan Regional Chapter of Society of Toxicology, 1984
"Toxicity of Thiram to Mink and European Ferrets"

Wildlife Toxicology Workshop, 1984, Portland, Oregon
"An Evaluation of Three Potential Indicators of Chronic Toxicity in Birds"
"Mammalian Wildlife (Mink and Ferret) Reproduction Test"
"Mammalian Wildlife (Mink and Ferret) Dietary LC_{50} Test"
"Photoperiod Effects on the Avian Dietary LC_{50} with Bobwhites (Colinus virginianus) and Mallards (Anas plathyrhynchos)

The Investigation of Ocular and Neural Lesions Observed in Rainbow Trout (Salmo gairdneri) Following Exposure to Organophosphate Esters

A group of commonly used agricultural chemicals called organophosphates (OPs) have been shown to be acutely toxic to man and animals. One of the effects is known as "organophosphate-induced delayed neurotoxity" which involves an initial OP insult to the body resulting in a physical reaction eight to fourteen days later. This study was conducted to investigate, through the use of electrophysiological techniques, what transpires between exposure and the onset of clinical symptoms.

Electroretinograms were recorded from rainbow trout after treatment with DEF and TOCP. Results suggest that OPs act directly on the noncholinergic photoreceptor. The action may be exhibited at the level of the membrane or may be affecting the metabolism of the photoreceptor. It was also found to be distinct from any antichloinesterase activities of organophosphates.

R/TS-19
1982-83

Principal Investigator:
Jack R. Hoffert, Ph.D., Department of Physiology,
Michigan State University

Student Supported:
William D. Kreft, M.S. candidate, "The Effects of Selected Organophosphates on the Electrophysiological Properties of the Teleost Retina"

Publication:
Action of Organophosphates in the Electroretinogram of Rainbow Trout, MICHU-SG-85-305. Reprinted from Experimental Biology, Vol. 44, 1985

Contributors:
National Eye Institute
Agricultural Experiment Station, Michigan State University

Transfer Mechanisms of PAHs in Great Lakes Zooplankton

Polynuclear aromatic hydrocarbons (PAHs) have increasingly entered the environment from incomplete fossil fuel combustion and manufacturing processes. Little is known of the transfer kinetics between PAHs and zooplankton, but it does appear that the stress put upon zooplankton populations by PAH compounds could be altering basic structural and functional features of plankton communities in the Great Lakes.

This study was designed to research the transfer kinetics of a single PAH, anthracene, within and between representative Great Lakes zooplankton and contaminated water. The transfer kinetics of several zooplankters were investigated. The study found that anthracene accumulation for pelagic rotifers was exponential. Depuration response curves were also exponential. There was no metabolism or breakdown of the anthracene in the rotifers or in the water during any of the experiments.

The data is the first available using zooplankters in large lakes in temperate America. The data will be used by agencies (such as the Great Lakes Environmental Research Laboratory) that are developing numerical models to simulate and predict toxic organic dynamics in the Great Lakes.

R/TS-22
1982

Principal Investigators:
James A. Bowers, Ph.D., Great Lakes Research Division,
The University of Michigan
Clifford P. Rice, Ph.D., Great Lakes Research Division,
The University of Michigan

Student Supported:
Joann Cavaletto, M.S. candidate, Eastern Michigan University

Transport of PCBs by Mysis relicta (see Highlights)

TRANSPORTATION

The Transportation subprogram projects for 1982-83 were selected in response to research needs identified in workshops and meetings around the Great Lakes area. Studies covered ship design (ice strengthening and propulsion systems), towing tank design, and coal shipment.

Feasibility of Moving Western Coal Through a Transhipment Point on Lake Michigan

Because of strict sulphur content standards set forth by the U. S. Environmental Protection Agency, many electric generating plants in the Midwest depend on low sulfur coal from western deposits. The coal is moved by unit trains to Superior, Wisconsin, then transhipped to Great Lakes bulk carriers for transport through the Soo Locks to a final destination. Because the Soo Locks restrict vessel size, impose time delays, and are closed in winter because of ice, several alternative routes have been suggested.

Five alternative routes from the Powder River Basin to transhipment points on the western shore of Lake Michigan, from where vessels would not have to transit the Soo Locks, were examined. The alternatives were narrowed to two: the one presently operating from Superior, Wisconsin, and one not yet built at Escanaba, Michigan. The costs of building and operating the new facility and the costs of moving coal from both transhipment points to various ports on the Great Lakes were examined.

It was concluded that the current system is the most economically feasible: $16.52/ton for transport from the Powder River Basin through Superior to Buffalo, New York, compared to $17.19/ton for transhipment through the proposed facility at Escanaba. It was recommended, however, that the establishment of a Lake Michigan transhipment facility should be considered as an alternative to the expansion of the Soo Locks.

R/T-11
1981-82

Principal Investigator:
Howard M. Bunch, Ph.D., Naval Architecture and Marine Engineering, The University of Michigan

Student Supported:
Paul W. Vickers, M.S. candidate

Publication:
Feasibility of Moving Western Coal Through a Transhipment Point Located on Lake Michigan, MICHU-SG-82-206

Ice Strengthening of Great Lakes Bulk Carriers

Winter navigation on the Great Lakes is often hazardous and costly, requiring additional reinforcement to ships' hulls. Unique ship design features have been developed, but never adequately studied for their effectiveness.

In this study, ten ships that were strengthened for winter operation were examined for structural damages in reinforced and non-reinforced areas. Where ice damage occurred, the affected areas and extent of repairs were described. The results represent a comprehensive guide to state-of-the-art ice strengthening techniques which can be used by ship designers and operators in determining the most economical strengthening methods.

R/T-9
1981-82

Principal Investigator:
Movses J. Kaldjian, Ph.D., Naval Architecture and Marine Engineering,
The University of Michigan

Student Supported:
William R. Reid, Jr., M.S. candidate

Publication:
Ice Strengthening of Great Lakes Bulk Carriers, MICHU-SG-82-200

Multivariable Control of Diesel/Controllable Pitch Propeller Propulsion Systems

Many recently built Great Lakes vessels utilize diesel propulsion with controllable-reversible pitch propellers. These control systems link together the previously separate engine speed control governor and the propeller pitch controller. These systems are difficult to adjust and expensive to maintain.

This study was conducted to analyze the feasibility and advantages of using microprocessor-based multivariable controllers for propulsion of Great Lakes bulk carriers. To develop a better understanding of the present control systems, the causes of limit cycles were studied. It was found that the limit cycles were a direct result of the active load control feature that couples the pitch control to the engine governor. The limit cycles were characterized and the dependence of these characteristics on the various parameters in the control system were demonstrated. Control system models were developed and analyzed, providing insight into the effectiveness of the models and of analytical methods.

Based on this study, work is continuing on the application of modern multivariable control methods to the development of improved control systems for Great Lakes bulk carriers. Also, some of the results are being used in Naval Architecture and Marine Engineering classes at The University of Michigan.

R/T-15
1983

Principal Investigator:
Michael G. Parsons, Ph.D., Department of Naval Architecture
and Marine Engineering, The University of Michigan

Student Supported:
James Yin-Chin Wu, Ph.D. candidate, "Application of Multivariable Integral Control to Marine Diesel/Controllable Pitch Propulsion Systems"

Contributors:
Institute of International Education
Interlake Steamship Company

WATER SAFETY

Michigan Sea Grant's water safety projects were mainly carried out by the Marine Advisory Service during 1982-83 (see Marine Advisory Service). One research project studied the effects of hyperbaric exposures on fertility and pregnancy.

The Effects of Hyperbaric Exposures on Menstruation, Fertilization, and Pregnancy

A recent increase in the number of women divers and the scarcity of research regarding the effects of hyperbaric pressure on fertility and reproductive functioning prompted this series of studies. Findings suggest that exposure to hyperbaric pressure has little effect on ovulation and the menstrual cycle.

Fetal development in sheep, which have reproductive systems similar to humans, was not affected, except in cases of too rapid decompression. In these cases all fetuses died of decompression sickness. Since rapid decompression is sometimes unavoidable when an emergency ascent is necessary, diving while pregnant presents serious risks to the fetus. In addition, although grown female offspring that had been pressurized while in utero were able to give birth, litter size and birth weights were somewhat diminished.

These studies will be used by physicians and diving instructors to alert women to the dangers of diving during pregnancy.

R/WS-2
1979-1982

Principal Investigators:
J. Robert Willson, M.D., Department of Obstetrics and Gynecology, The University of Michigan
Martin J. Nemiroff, M.D., Department of Internal Medicine, The University of Michigan

Students Supported:
William B. Blessed, M.D. candidate
Eliot Wenz, B.A. candidate

Publications:
Effect of Repeated Hyperbaric Exposures on the Menstrual Cycle: Preliminary Study, MICHU-SG-84-306
Hyperbaric Exposure During Pregnancy in Sheep: Staged and Rapid Decompression, MICHU-SG-83-303. Reprinted from Undersea Biomedical Research

WATER QUALITY

The Water Quality subprogram addressed a number of pollution-related topics. Two focused on Lake Erie, which was reported to be recovering from previous severe pollution. Scientific documentation of these changes was needed. Green Bay, Wisconsin, a heavily used area, was also singled out for study. A study aimed at better understanding of particulate flux in the lakes and a study to assist a Rural Clean Water Project were also undertaken.

Assessing Consequences of Nutrient Enrichment in Lake Erie with Sediment Bioassay

Little information is available on historical changes in the nutrient chemistry of Great Lakes waters. Historical data on total phosphorus concentrations are very limited. The only useful historical data on silica concentrations are those from Lake Michigan.

This study performed a preliminary assessment of nutrient changes in Lake Erie through sediment core analysis for phosphorus and silica.

The results indicated that Lake Erie first suffered the effects of nutrient enrichment about 100 years ago, with an increased effect about 40 years ago. The study found that available phosphorus is a better measure of enrichment than total phosphorus. The study also found that biogenic silica, which is an index of diatom production, is an even better measure of nutrient enrichment, because it is recycled at slower rates than phosphorus. This information is being used to support conclusions from other sediment core studies in Lakes Michigan and Ontario.

M/PM-3
1983

Principal Investigator:
Claire L. Schelske, Ph.D., Great Lakes Research Division,
The University of Michigan

Students Supported:
Charles D. Campbell, M.S. candidate
Teresa Newberry, M.S. candidate

Presentations:
Fourth International Symposium on Paleolimnology, Austria, September 1985
"Biogenic Silica Accumulation in Sediments as an Index of Eutrophication in the Laurentian Great Lakes"

Contributor:
Great Lakes Environmental Research Laboratory

Effects of Water Quality Changes on the Benthos of Western Lake Erie

Water quality in Lake Erie has undergone dramatic changes during the past 100 years. Most noticeable, the level of nutrient loading has increased around the mouths of the Detroit, Maumee, and Raisin Rivers. However, through efforts stemming from the 1972 and 1978 U. S.-Canadian Water Quality Agreements, loadings to the lake have been greatly reduced. Because benthic macrofauna are one of the best biological indicators of environmental change, a series of stations through western Lake Erie were sampled in 1930, 1961, and again in 1982 to compare changing conditions. The 1982 sampling was conducted by Michigan Sea Grant in cooperation with the Great Lakes Fishery Laboratory, U. S. Fish and Wildlife Service .

Between 1930 and 1961, conditions deteriorated. By 1982, changes in the benthic populations revealed that conditions had improved, especially around the mouths of the three rivers. However, conditions in the open lake had continued to degrade. It appears that this region is still showing the effects of increased enrichment of the sediments. It is expected that improvement will occur in the future when the effects of reduced nutrient loading reach farther into the lake.

R/ER-14
1982-83

Principal Investigator:
John H. Judd, Ph.D., Great Lakes Research Division,
The University of Michigan

Contributor:
Great Lakes Fishery Laboratory, U. S. Fish and Wildlife Service

Publication:
Great Lakes Are Recuperating Ten Years After The Water Quality Agreement, Coastal Oceanography and Climatology News, 1982 4(2):21-22

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

The heavily polluted Fox River flows into Green Bay, Wisconsin, contributing large amounts of anthropogenic materials to the southern end of the bay. In this study, investigators examined how these pollutants affect phytoplankton production and determined the nutrient dilution and redistribution caused by the exchange between river and Lake Michigan water in the bay. It was discovered that diatoms associated with eutrophic or warm, nutrient-rich waters were more abundant in the southern end of the bay where nutrient loading of nitrogen and phosphorus from the river was most extensive. The study also revealed that predator-prey interactions among zooplankton communities are significant in in situ enclosure experiments. This finding will be valuable for analysis of any future enclosure experiments.

R/ER-8
1980-1982

Principal Investigators:
Alfred M. Beeton, Ph.D., Great Lakes and Marine Waters Center, The University of Michigan
Ruth Holland Beeton, Ph.D., Department of Atmospheric and Oceanic Science, The University of Michigan
James A. Bowers, Ph.D., Great Lakes Research Division, The University of Michigan

Contributors:
Argonne National Laboratory
Escanaba Community College
Wisconsin Sea Grant Institute

Throughout 1982-83 Michigan Sea Grant made discretionary use of program development funds to support projects that addressed critical needs or responded to unique opportunities that arose after project funding had been decided for those years. Most of these projects continued into the next funding cycle. These are described in the Research section of this annual report under the appropriate subprogram. Those projects that were completed with program development funds are discussed below.

Update of Laboratory Limnological Methods Manual

A "Limnological Methods Manual," printed by Michigan State University and used in the senior level limnological methods course required revision. Under this project, about 60% of the manual was updated, with two sections completely rewritten. The updated manual now provides this course in the Department of Fisheries and Wildlife with the most current information and methodology.

Principal Investigator:
Niles R. Kevern, Ph.D., Department of Fisheries and Wildlife, Michigan State University

Student Supported:
Craig Spencer, Ph.D. candidate. Employed by University of Montana

Evaluation of Double-Crested Cormorant Deterrents in Lake Superior Pound Nets

Following controls on the use of DDT and other toxins, the Great Lakes cormorant population has made a comeback and has again become a problem for commercial fishermen by preying on fish caught in pound nets. Michigan Sea Grant joined Wisconsin Sea Grant and others in a 1983 study to test different means of keeping the birds away from nets. Michigan Sea Grant diving expertise and underwater television camera capabilities were tapped to record fish and bird behavior. Lake Superior water temperatures that summer were unusually high, driving the whitefish away from the nets set in traditional spots. Thus, no conclusive findings were made.

Principal Investigator:
David J. Jude, Ph.D., Great Lakes Research Division, The University of Michigan

Student Supported:
James Wojcik, Ph.D. candidate

Abundance and Production of *Mysis relicta* in the Great Lakes

Mysis relicta, or the opossum shrimp, is an important component of the food chain in the Great Lakes, and feeds on a variety of zooplankton and phytoplankton, depending on the time of day and year and plankton abundance. A better knowledge of mysid production rates would aid understanding of the quantitative relationships involved in the mysid's feeding patterns.

This project undertook to test the "size-frequency method" of calculating secondary production of Mysis relicta. Most other methods require identifying and tracking cohorts, but this is difficult with Mysis because reproduction occurs throughout the year and cohorts cannot be easily followed. Existing data from five Great Lakes studies of Mysis relicta populations were analyzed. The results provide a basis for scaling trophic interactions of Mysis. They also showed that night sampling with vertical net hauls is the best technique for quantitative studies of Mysis relicta.

Principal Investigator:
Alfred M. Beeton, Ph.D., Great Lakes and Marine Waters Center,
The University of Michigan

Student Supported:
Daniel W. Sell, Ph.D. candidate

Publication:
Size-Frequency Estimates of Secondary Production by Mysis relicta,
MICHU-SG-28-308. Reprinted from Hydrobiologia, 93, 69-78 (1982)

Distribution of Benthic Organisms in Attached Filamentous Algae

Sampling was conducted in Lake Michigan and the results combined with data from Lakes Ontario, Erie, and Huron to determine the distribution of benthic organisms within different species of attached algae. The purpose was to determine 1) if the same species of benthic organisms are present throughout the lakes, and 2) if the species distribution is even across the lakes or if different areas of the lakes produce specific grouping of organisms. The results showed that most species are common across all the lakes, but small areas within the algae community can have single-species benthic communities, especially where the algae community is discontinuous.

Principle Investigator:
John H. Judd, Ph.D., Great Lakes Research Division, The University of Michigan

Presentation:
International Association of Great Lakes Research, 1983
"Great Lakes Distribution of Benthic Organisms in Attached Algae"

The Role of the Great Lakes in Michigan's Economic Recovery—A Workshop

This workshop responded to the fact that the economy of Michigan has suffered because of its reliance on automobile manufacturing and other heavy industry. Many experts think that the abundant water resources of the Great Lakes could be an important factor in Michigan's long-term economic recovery. A workshop in April 1983 drew together Great Lakes area decisionmakers to identify ways in which water could contribute to economic recovery. Participants gained useful insights into the linkages among ecomonic, environmental, and quality-of-life factors.

Principal Investigator:
Daniel Talhelm, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

COASTAL RESOURCES

Abundance, Distribution and Ecological Relationships of Larval and Juvenile Fishes in the Pentwater Marsh on Lake Michigan

With the continuing loss of Great Lakes wetlands to development, it is vital to know the effects on wetland habitat and populations. However, it is difficult to sample wetlands with conventional techniques because of shallow water, dense vegetation, and unstable substrates.

Thus, for the first phase of this study, three types of gear for collecting larval fish were tested for sampling efficiency. Preliminary findings suggest that the pull net is good for shallow areas only and that in other areas the drop net or a combination of drop net and dip net may be the only feasible methods. Based on these results, gear and sampling methods were developed to determine the temporal and spatial changes in species composition, the abundance of larval and juvenile fish, and their food habits.

R/CW-13
1982-85

Principal Investigator:
Charles R. Liston, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Nutrient Cycling and Hydrologic Processes in Great Lakes Coastal Marshes

The value of marshes in maintaining water quality and quantity has started to be recognized and quantified over the last several years. It is clear that marshes can significantly affect water quality and can act as a filter for many of the nutrients or toxicants that cause eutrophication or other pollution problems. But nutrient dynamics within marshes are not well enough understood to allow prediction of the amounts and quantities of materials that can be removed in the short term. This study was undertaken to 1) quantify nutrient, sediment, and hydrologic inputs into a river mouth marsh and to quantify outputs of these parameters from the marsh; 2) quantify productivity and uptake and release of nutrients by marsh vegetation over annual cycles; and 3) quantify changes in water, sediment, and soil water chemistry within the marsh over annual cycles.

R/CW-13
1981-84

Principal Investigator:
Thomas M. Burton, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

GREAT LAKES FISHERIES

Aquaculture Development Program for Michigan

This program was designed to coordinate the activities of Michigan Sea Grant researchers and the Michigan Department of Natural Resources in aquaculture-related problem solving. Cooperative problem identification, coordinated research, and support of an aquaculture research laboratory have been the means for promoting a strong commercial aquaculture industry in Michigan and other Great Lakes states.

So far, researchers have developed a technique for identifying gas bubble disease in salmonids and a practical synthetic diet for walleyes.

R/A-1
1983-86

Principal Investigator:
Donald L. Garling, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Development of a Management Model for Lake Superior Lake Herring Stocks

Lake herring has traditionally been the backbone of the Lake Superior fishery. In the mid-1960s, many Lake Superior herring stocks collapsed due to over-harvest and subsequent recruitment failures, draining Michigan's Upper Peninsula of millions of dollars and hundreds of jobs.

This study was designed to develop a population dynamics model of lake herring to predict the effect of commercial fishing on population dynamics and prevent future catastrophic collapses. In addition, the model is expected to provide a basis for rehabilitation and management of Lake Superior herring. Early research has focused on recruitment failure and has revealed important factors regarding the relationship between sex ratio and recruitment success.

R/GLF-14
1982-86

Principal Investigator:
Stephen H. Bowen, Ph.D., Department of Biological Sciences,
Michigan Technological University

Effects of Dietary Steroid Hormone Supplements in Rainbow Trout Culture

It is believed that the addition of dietary hormone supplements may reduce the time required to raise rainbow trout. This would be advantageous in the Great Lakes area, where seasonal water temperatures limit the length of the growing season. This study was designed to describe the interactions between protein/energy intake and steroid hormone levels on growth promotion. So far, it has been found that anabolic-anrogenic steroids increase growth, appetite, and feed conversion.

R/A-2
1983-85

Principal Investigator:
Donald L. Garling, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Food Habits of Salmonids in Lakes Michigan and Huron

This project is one of several Great Lakes Sea Grant Network projects to study the impact of salmonid predation on the forage base in the Great Lakes. Alewife have been the predominate forage for Great Lakes predators for several decades. Since the introduction of Pacific salmon, alewife abundance has declined. This decline may lead to increased diversity of other forage species and should appear in predator diets. The project's objectives are to determine if there are changes in salmonid diets in Michigan Great Lakes waters. A sampling program was designed to monitor diets of angler-caught salmonids. Data collection began during the 1983 fishing season.

R/GLF-18
1983-84

Principal Investigators:
Niles Kevern, Ph.D., Department of Fisheries and Wildlife,
Michigan State University
James Diana, Ph.D., School of Natural Resources,
The University of Michigan

Movement, Growth and Mortality of Yellow Perch in Saginaw Bay

Yellow perch (Perca flavescens) is an important sport and commercial fish species in the Great Lakes, including the heavily used Saginaw Bay. The present condition of Saginaw Bay perch stocks is unknown, leading to uncertainty in establishing regulations.

This study will determine the movement patterns of perch, assess perch mortality due to sport and commercial fishing, and analyze the growth and feeding of perch

at different locations in the bay. The results will provide a characterization of Saginaw Bay yellow perch that can be used by the State of Michigan to determine commercial fishing license policy and fishery management procedures.

R/GLF-17
1983-85

Principal Investigator:
James S. Diana, Ph.D., School of Natural Resources,
The University of Michigan

Population Dynamics and Yield Potential of Lake Superior Pink Salmon (Onchorhynchus gorbuscha)

Pink salmon were introduced to the Great Lakes in 1956, and their populations have increased dramatically, especially in Lake Superior. Concern has arisen over the salmon's impact on the ecosystem and the commercial and sport fishery. This six-year study seeks to understand the pink salmon's population dynamics and yield potential so that the fish can be effectively managed. Fall adult spawning runs and spring fry outmigration are being sampled on several Lake Superior tributaries. Sampling is expected to expand to Lake Huron tributaries.

R/GLF-15
1981-86

Principal Investigator:
William W. Taylor, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

Whitefish Stocks in Northern Lake Michigan

Lake whitefish support the largest commercial freshwater fishery in North America. Increasing harvest and the characteristic vulnerability of whitefish stocks to variations in year class strength have raised concerns about possible over-harvest and decline.

This study of the biological characteristics of whitefish stocks has identified discrete whitefish stocks in Lake Michigan and estimated abundance, growth rates, mortality, age composition, and length-weight relationships. Development of a computerized model to predict yield and stability of the stocks under differing fishing intensities, gear types, and regulations is nearly complete. Research on early life histories is planned.

R/GLF-16
1981-84

Principal Investigators:
William W. Taylor, Ph.D., Department of Fisheries and Wildlife,
Michigan State University
Niles R. Kevern, Ph.D., Department of Fisheries and Wildlife,
Michigan State University

TOXIC SUBSTANCES

Lysosomal Enzyme Release Assay as a Measure of Stress in Fish

This research is an effort to develop the LERA (lysosomal enzyme release assay) into a useful tool for indicating xenobiotic-induced stress in fish. In addition, the study will determine environmentally safe levels of anthracene and cadmium. Once determined, the effects of these toxicants will be correlated with the LERA to develop a method for rapidly determining environmentally safe levels.

R/TS-21
1982-1984

Principal Investigator:
John P. Giesy, Ph.D., Pesticide Research Center,
Michigan State University

Studies on the Composition and Photochemistry of the Polychlorinated Components of Toxaphene in the Great Lakes

This study was designed to improve procedures for detecting toxaphene residues in water, air sediments, and tissue samples from Great Lakes animal life. In addition, the effect of sunlight on toxaphene will be examined to pinpoint photochemical changes and their toxicological and environmental significance. The results will provide information on the exact composition of toxaphene entering the Great Lakes.

R/TS-25
1983-1985

Principal Investigator:
Matthew J. Zabik, Ph.D., Pesticide Research Center,
Michigan State University

Studies on the Toxicological Significance of Toxaphene Residues in the Great Lakes Ecosystem

There is still controversy about whether chlorinated terpene residues in the Great Lakes are related to toxaphene, which is believed to enter the lakes through atmospheric fallout. This study was developed to discover whether these residues are related to toxaphene; if they come from atmospheric pollution; whether their differing characteristics from those of toxaphene can be attributed to metabolic changes in fish or microbial organisms; and whether they pose health hazards to people who eat fish.

R/TS-24
1983-1984

Principal Investigator:
Fumio Matsumura, Ph.D., Pesticide Research Center,
Michigan State University

Toxaphene Compartition and Recycling in Lake Michigan

This study was designed to examine toxaphene in plankton, shrimp and fish samples, and map out contaminant pathways in the Great Lakes. So far, it has been found that toxaphene compounds are present in lake organisms and that their concentrations vary according to the host organism's level in the food chain. The results will be used to develop numerical methods to describe these shifts and will contribute to the understanding of the pathways of other toxic compounds through the Great Lakes.

R/TS-26
1983-1985

Principal Investigators:
Marlene Evans, Ph.D., Great Lakes Research Division,
The University of Michigan
Clifford P. Rice, Ph.D., Great Lakes Research Division,
The University of Michigan

TRANSPORTATION

An Investigation of Low Speed Ocean Engineering Experiments Conducted in Finite-Dimension Tanks

The research and design problems associated with the platforms and vehicles used in offshore operations are tremendous. Often, scale models are tested in large tanks. However, the reflection of waves off the tank wall back to the model can cause large experimental errors. The purpose of this project is to develop a theory for correction of side wall reflective effects. Theoretical predictions will then be compared with actual experimental results. So far, the mathematical boundary value problem of a body oscillating between two vertical walls has been formulated. Also, some model experiments have been performed and have shown a transient behavior not previously expected.

R/T-16
1983-84

Principal Investigator:
Armin W. Troesch, Ph.D., Department of Naval Architecture
and Marine Engineering, The University of Michigan

WATER QUALITY

Characterization of Particulate Flux in Southeastern Lake Michigan

This study was designed to determine the influence of biological processes in the transport of nutrients and toxicants in the Great Lakes. The data obtained will be used to test the hypothesis that biogenic silica fluxes in the water column can be predicted from known changes in soluble silica concentrations. In addition, sediment trap collections of biogenic silica, total and organic carbon, and organic nitrogen will be used to study the relationships between settling rates and recycling rates of these nutrients in the water column.

R/ER-16
1983-84

Principal Investigators:
Marlene Evans, Ph.D., Great Lakes Research Division,
The University of Michigan
Claire Schelske, Ph.D., Great Lakes Research Division,
The University of Michigan

Study of the Effect of a Rural Clean Water Project in the Saline Valley

Eutrophication of the Great Lakes continues to be a major problem caused by the input of phosphorous to the lakes from industrial, municipal, and agricultural sources. The Saline Valley Rural Clean Water Project, located in Monroe and Washtenaw Counties of Michigan, was established to provide long-term financial and technical assistance to landowners in applying conservation practices. The Sea Grant study was initiated to help the Soil Conservation Service, Michigan Department of Agriculture, and other state and county agencies develop a water quality monitoring program for the project. An initial finding suggests that discharges of pollutants are heaviest when storms cause runoff and streamflows to be heavier. Thus, most heavy nutrient loadings occur during late winter and early spring.

R/ER-12
1982-84

Principal Investigators:
Ruth Holland Beeton, M.S., Department of Atmospheric and Oceanic Sciences, The University of Michigan
John H. Judd, Ph.D., Great Lakes Research Division,
The University of Michigan

MARINE ADVISORY SERVICE

INTRODUCTION

An alert and vital advisory service is a critical element in any Sea Grant program because it is a two-way channel of communication--bringing the problems of resource users to the attention of researchers for solution, and returning the results of research to those clientele.

This is especially true for the Michigan Sea Grant Program which serves a coastal region of more than 3200 miles and includes four of the five Great Lakes. The diversity of the lakes and their shorelines, the variety of business, industrial, recreational and other uses and the complexity of Great Lakes resource issues offer almost endless challenges for the educational and communication skills of the program's Marine Advisory Service (MAS).

Marine advisory services of the Michigan Sea Grant Program were coordinated by The University of Michigan prior to 1977-78. The program then consisted of several projects at both The University of Michigan and Michigan State University plus one field agent. During 1977-78, MAS management was transferred to MSU, where it was integrated into the established Cooperative Extension Service (CES). Sea Grant continues to support specialists on both campuses. During 1982-83, the MAS marked its fifth year of operating through CES. Its program leader and two of its five agents completed their fifth years of service.

STAFF

Program Leader: The MAS Program Leader, Dr. Eugene F. Dice, was located at MSU, where he worked closely with the Associate Director of the Michigan Sea Grant Program and served on the Sea Grant Management Team. He was also directly responsible to the Assistant Director of Extension for Natural Resources and Public Policy. He provided program direction and professional development opportunities for the team of five field agents.

Field Staff: The five field agents had coastal districts ranging from 7 to 15 counties. They responded to the needs of their specific districts and participated in team approaches to statewide challenges. Each had at least a master's level of education in an appropriate field and was thus capable of analyzing problems in a scientific way, communicating with research staff about the needs of clientele, and providing leadership for the MAS team in specific areas. All were located in Cooperative Extension Service offices.

Working within the existing Cooperative Extension network, the field agents developed effective, efficient means of distributing MAS programs and events. MAS agents were often either hosted by or assisted with major activities by their Extension colleagues.

AGENT	DISTRICT	LOCATION
Charles Pistis	SOUTHWEST	Grand Haven
Stephen R. Stewart	SOUTHEAST	Mt. Clemens
John C. McKinney	NORTHWEST	Traverse City
John Schwartz - 1982 Jon P. Peterson - 1983	NORTHEAST	Tawas City
Ronald E. Kinnunen	UPPER PENINSULA	Marquette

Specialists: Campus specialists in several appropriate fields were designated to serve the needs of the MAS. Campus specialists do not traditionally receive Sea Grant salaries, but Sea Grant funds are used to support development of activities that are significant to both Sea Grant and the university department which employs the specialist. Listed below are the specialists and their Sea Grant projects.

SPECIALISTS	AFFILIATION	PROJECT
Steven Kinzel	Environmental Conservation Education, MSU	4H
Donald Garling	Fisheries and Wildlife, MSU	aquaculture
Niles Kevern Lois Thieleke	Fisheries and Wildlife, MSU Extension Home Economist, MSU	underutilized fish species
Alden Booren	Food Science and Human Nutrition, MSU	fishery sanitation and processing
Lee Jacobs	Crop and Soil Science, MSU	fish waste application as fertilizer
Lawrence Libby Stanley Thompson Eugene Dice	Agricultural Economics, MSU Agricultural Economics, MSU MAS Program Leader, MSU	port development and shipping
Eckhart Dersch	Resource Development, MSU	coastal management guidelines—publications and workshops
Lynn Corson	Community Development Programs, MSU	community leadership training in hazardous material accidents
Lee Somers	Atmospheric and Oceanic Science, UM	dive safety, rescue team organization and training, dive shop management training

External Advisory Committee: This group was drawn from a variety of backgrounds and clientele groups and was representative of the mixture of interests and perspectives present among Great Lakes resource users. Members are listed in Appendix D. Increasing involvement of External Advisory Committee members in program activities was an objective of the MAS for these years. Initial achievement of this objective was evident in several areas. For example, advisory member Howard Alexander hosted a special training tour for MAS agents through his division's environmental laboratories at Dow Chemical Company. Larry Karnes, of the ports division of the Michigan Department of Transportation, encouraged his superiors to participate in the Sea Grant Transportation Framework Committee, formed to organize interest in a broadened Sea Grant program in transportation and shipping. Another member, Wesley Myllyla, helped lead a multi-department state government search for feasible sites to develop a pulp mill and port in the economically depressed Upper Peninsula.

COMPLETED PROJECTS

Marine Vocational Shortcourses: Employees of the billion dollar boat and marina industry are often required to do jobs for which they are not specialists--repairing such items as fiberglass bodies and electrical, refrigeration, and air conditioning systems. For three years beginning in 1981, MAS offered a series of five short courses through a vocational education center in southwest Michigan. Evaluations by participants indicated that the material presented was very useful. In 1982, a marine refrigeration course was offered. Participants reported increased returns averaging $500 on the purchase of refrigeration equipment, and all participants adopted service for marine refrigeration as an additional income generator. In 1983 the last course of the series, marine air conditioning, provided the training necessary to qualify one participating marina as the only certified service center in the state for a particular brand of air conditioning.

Agent--Pistis

Underutilized Fish Species: Due to budget constraints, the position of a home economics specialist who disseminated information about underutilized fish species, particularly to potential institutional users, was discontinued, although agents and other specialists continued the educational process in the context of their other work. Drs. Kevern and Booren were particularly active in this respect, and agent Stewart provided substantial assistance to a Detroit fisheries wholesaler in developing processing and marketing procedures for underutilized species supplied by area commercial fishermen.

Agent--Stewart; **Specialists**--Kevern; Booren; Thieleke

Marina Managers: The recreational boating inudstry is a billion dollar business in Michigan, and it now has an industry association. However, for several years, the Marine Advisory Service provided one of the few sources of continuing education and professional development for people in the marina and marine dealer business, through its annual marina managers' conference. This conference, co-sponsored in 1982 and 1983 by the Michigan Boating Industries Association, attracted an average of more than 100 attendees. The 120 participants in the 1983 conference rated the program 3.5 out of 4 in terms of overall quality. More importantly, 84% reported that they would be incorporating knowledge they gained from the program into their businesses. When comparing this meeting to other related programs they had attended, participants ranked it between slightly better to much better.

During this period, agent Stewart discontinued his newsletter, Dockside Lines, due to production constraints, while agent Pistis initiated Water's Edge to serve the industry.

Agents--Pistis, Stewart, McKinney

Charterboat Captains: The charterboat fishing industry in Michigan expanded rapidly during this period and reached a level of more than 600 licensed vessels by the end of 1983. To serve the needs of this group, particularly those of the large number of inexperienced captains, the Marine Advisory Service used a variety of educational tools.

First, an annual statewide meeting continued to offer research and regulatory information to the clientele. Ninety captains attended the 1983 meeting.

Second, the Great Lakes Troller, a newsletter published by Pistis for the charter captains, was used to deliver relevant information, particularly to new captains. In addition, Pistis used three special mailings to reach new charter captains and, as a result, 53% of them requested to be placed on the mailing list. Sixty-eight percent of those had further contact with Sea Grant programs by participating in educational events or requesting additional information. A Sea Grant agent in Wisconsin requested that 28 captains from her state be placed on the Troller mailing list. Eighty-seven percent of the captains participating in an evaluation of the newsletter said it was their primary contact with Sea Grant MAS.

Other contacts with this group included helping to develop a new regional charter captains' association in the Frankfort area, facilitating more satisfactory arrangements for captains to take Coast Guard licensing exams, and enlisting the cooperation of captains in obtaining samples for Sea Grant salmonid diet research.

Agents--Pistis, McKinney, Schwartz/Peterson, Stewart, Kinnunen

Bottomland Preserves: Michigan Sea Grant research formed the foundation for Michigan's legislation enabling the designation of Great Lakes bottomlands of geological and historical significance as preserves. However, it was evident that considerable commitment and investment by local communities would be necessary to the successful implementation of the law, since it made no provisions for state financing or preserve management. Therefore, several MAS agents were involved in preserve-related efforts during 1982-83. Kinnunen served as an advisor to the Alger Underwater Preserve Committee in Munising. Schwartz and Peterson supported Alpena community efforts to enhance the development of the Thunder Bay Preserve. Stewart became involved in initiating the proposal to designate a preserve off the Thumb in Lake Huron. He contacted more than 50 people in the process of researching, providing information for the preliminary proposal, redefining the proposed preserve boundaries, and devising diving accident and other management strategies for the preserve. By the end of 1983, the agents were planning a statewide program to be presented during Michigan State University's Agriculture and Natural Resources Week in the spring of 1984.

Agents--Kinnunen, Schwartz/Peterson, Stewart; **Researcher**--Donald Holecek, Park and Recreation Resources, MSU; **Specialist**--Lee Somers

Water and Diving Safety: Again, Sea Grant research formed the basis for an extensive MAS effort to inform Michigan residents about both cold water near-drowning and hypothermia, safe diving practices and dive rescue/accident management.

Dr. Martin Nemiroff's pioneering Sea Grant research in treating both drowning and hypothermia led to a major effort to train emergency medical and hospital personnel. By 1982-83 MAS agents had reached thousands of this target audience. The original students had begun to teach the Sea Grant material to others and were relying less directly on the agents for instruction, although still obtaining printed materials and expert guidance from them.

Both professional and recreational divers benefitted from the Sea Grant-sponsored research into safe diving practices, led by Dr. Lee Somers. In 1982-83, as recreational divers began to use both bottomland preserves and non-preserve areas of the Great Lakes more, Somers and MAS agents created programs and materials to meet their needs. A 90-minute voice tape and slide presentation on "Diving Accident Management;" a workshop with the Michigan State Police Training Academy on Diver Stress Recognition, Prevention and Management; a presentation on "Hydrolab Saturation Diving for Science" at the Great Lakes Shipwreck Conference, and in-lab training for representatives of dive equipment manufacturers were all produced or presented. Schwartz conducted dive rescue training in his district.

Agent--Schwartz; **Specialist**--Somers; **Students**--Harry Gillin, Barbara Walunas, Lauranne Bernia, Dan Hendrix, Marvin Skinner (all from UM)

Fish Waste Disposal: In 1982 the community of Ludington became acutely aware that it was succeeding in attracting people to sportfishing there. The volume of waste from this activity was overloading available disposal systems and creating a public nuisance, if not a health hazard. Using the principle that "one person's trash might be another one's treasure," MAS agent Pistis and campus specialist Dr. Lee Jacobs accepted the challenge of helping this community solve its problem. Pistis helped devise a more satisfactory fish cleaning station to reduce public exposure to the "waste." Jacobs' objective was to examine and demonstrate the feasibility of applying the waste as fertilizer to one or more field/garden crops. During these first two years the engineering and methodology for field application of the waste and monitoring the results were put in place, the first series of nutrient content analyses were recorded, and Department of Natural Resources tests for toxic substances were completed. The first year focused on the technical feasibility, while the second year explored the economic feasibility.

Meanwhile, a similar situation unfolded in the Mackinaw City area in conjunction with a commercial fishery operation. It is expected that the results of Jacobs' work will be applicable to that situation as well.

Agents--Pistis, Kinnunen; **Specialist**--Jacobs

Great Lakes Commercial Fisheries: During this period the commercial fishing industry in Michigan realized its need for improving procurement, processing and promotion/marketing practices. (Earlier Sea Grant research had helped the industry develop new gear and catch strategies.) MAS agent Kinnunen planned a Great Lakes Commercial Fisheries Workshop at Mackinaw City to provide instruction on preserving fish quality and on improving packaging and marketing, and to provide special training on the use of LORAN C by commercial fishing boats. Stewart worked to develop producer/buyer contacts in the Saginaw Bay region.

Kinnunen continued to serve this clientele group with his newsletter, Commercial Fisheries Newsline, conveying research results, regulatory developments, and other news of professional interest.

Agents--Kinnunen, Stewart; **Specialist**--Booren

Aquaculture: Specialist Garling and agent Kinnunen began to explore the full dimensions of the aquaculture industry in the state and to develop possible programming for it. Meanwhile, Garling was accessible to clientele by contact with MAS agents.

Agent--Kinnunen; **Specialist**--Garling

Great Lakes Transportation: The economic recession that plagued the state during this period prompted a closer look by MAS at the extent to which Great Lakes shipping is an underutilized transportation medium. A shipping framework committee comprised of representatives from various state, regional and federal agencies held a seminar on the subject in 1982 and subsequently produced a proceedings entitled "Is Great Lakes Shipping an Underutilized Economic Resource?" Another instructional publication titled "Grain Transportation on the Great Lakes-St. Lawrence Seaway" was printed in early 1983 and was used in southeast and southwest Michigan to provide agri-business, shipping, and state government interests with workshops utilizing the publication. Another publication, "Great Lakes Shipping, Transportation and Markets for Michigan's Forest Products: A Preliminary Economic Inquiry," was also produced under this project and is used by industry and by resource management agencies.

Agent--Stewart; **Researcher**--Daniel Chappelle, Resource Development, MSU; **Specialists**-- Dice, Thompson, Libby; **External Advisory**--Karnes; **Student**--Rebecca Johnson, Ph.D. candidate, "Effects of User Fees on Great Lakes Grain Exports." Employed by Oregon State University.

Pulp Mill Feasibility: The interest in making greater use of the shipping capability of the Great Lakes commercial fleet and in enhancing the development of economically depressed areas of the state led to exploration of the feasibility of a new pulpwood processing mill and port in the Upper Peninsula. External Advisory Committee member Myllyla was very influential in encouraging a feasibility study. Agent Kinnunen mobilized National Oceanic and Atmospheric Administration researchers at the Great Lakes Environmental Research Laboratory in Ann Arbor to examine the environmental impacts of such a facility and arranged other necessary contacts.

Agent--Kinnunen; **Researcher**--Guy Meadows, Department of Atmospheric and Oceanic Sciences, UM; **Specialists**--Dice, Libby, Thompson;
External Advisory--Myllyla

Hazardous Materials: Substantial volumes of hazardous substances and wastes are transported throughout Michigan, creating a risk of contaminating the Great Lakes and inland waters in case of spills. Specialist Lynn Corson initiated a project to inform and educate leaders in coastal communities about this risk and to assist them in developing emergency response plans. The project was well received in the cities where it was presented, and the number of participating communities was expanded through the end of 1983. The MAS supported this endeavor and facilitated local contacts.

Agent--Pistis; **Specialist**--Corson

Public Policy Training: Citizens often become frustrated when attempting to deal with various levels of government in natural resource and public policy issues. MAS supported the creation of resource materials to assist agent efforts to educate and train citizens in accessing the political/legislative process. By the end of this period a publication and a slide set about citizen participation were nearly completed and agent training in the use of the resource materials completed.

Agent--Stewart; **Researcher**--Peter Kakela, Resource Development, MSU

Youth Education: Most agents were active to some degree in outreach to young people. They spoke with a number of junior high and high school classes, local 4H groups, Girl Scouts and others about substantive Great Lakes issues and about marine technical, professional, and scientific career opportunities. Stewart also served on the Natural Resources and Enviroment Education developmental committee for CES.

Agents--Stewart, McKinney; **External Advisory**--Mincemoyer

NEW PROJECTS

Fishery Economics: With the successful implementation of a salmonid stocking program in the state, Michigan anglers began to have a significant economic impact on numerous communities on the Great Lakes coast. Measuring this impact became a focus of Sea Grant research during 1982-83, and MAS assisted the research effort considerably. Agents helped establish local arrangements for data collection and followed up by organizing local meetings to review the results with businesspeople and local public officials. As a consequence of the studies, numerous communities have begun to exhibit a change of attitude toward the anglers who frequent the nearby fisheries. Instead of viewing sportfishing as a nuisance or minor economic influence, local officials and business interests began to welcome the activity and to create or upgrade facilities to accommodate it.

Agents--Schwartz/Peterson, Pistis, McKinney, Stewart, Kinnunen;
Researchers--Daniel Talhelm, Scott Jordan, Fisheries and Wildlife, MSU.

Commercial Fishing Depth Charts: The commercial fishing industry needed charts of Great Lakes fishing grounds detailing depths of 90 feet and less. Agent Kinnunen facilitated the necessary contact with the National Oceanic and Atmospheric Administration and a cartographer at Northern Michigan University to develop these charts.

Agents--Kinnunen

Commercial Fish Processing Feasibility: Processing and marketing commercial fish products is a challenge for the industry in Michigan, scattered as it is over three of the Great Lakes and in different port areas. MAS agent Kinnunen worked with representatives of the Michigan Fish Producers Association and other appropriate officials and specialists to explore the feasibility of locating a fish processing facility in the eastern Upper Peninsula. An aspect of the feasibility study provided by MAS was determination of the commercial catch of fish within various radii of different potential plant locations.

Agent--Kinnunen; **Specialists**--Booren, Kevern; **Student**--Lisa Harris

Fish Disease Diagnostic Laboratory: Approximately 75 commercial game fish aquaculture facilities in the state were surveyed by agent Kinnunen to determine their needs for a fish disease diagnostic program. The detailed survey helped create a picture of the current status of Michigan's private aquaculture industry. Kinnunen also met with state, federal and university personnel concerning the implementation of such a program and secured laboratory space for the potential project at the Upper Peninsula Extension Center.

Agent--Kinnunen; **Specialist**--Garling

Coastal/Waterfront Development: With as much and as varied coastline as Michigan has it is small wonder that communities around the state have different views of its significance and value. Some cities and towns seem to ignore their relationship with the coast, while others make maximum use of their situation. Beginning in 1982-83, MAS became involved in several significant undertakings to help local communities evaluate their coastal position and develop plans.

One excellent example of how Sea Grant research was extended through the MAS to a community in search of itself occurred in the city of Grand Haven. Economic impact research conducted by Sea Grant provided the foundation for Grand Haven's plans to expand its public marina, to develop special dockage and other facilities for its growing charter fleet, and to reconstruct its waterfront into a substantial attraction for tourists. MAS agent Pistis was highly involved in this process.

Using information developed by Michigan Sea Grant's subprogram in recreation and tourism, MAS agents helped with the development of local leadership for coastal recreation and tourism. John Schwartz worked with resource personnel at MSU and the Michigan Tourist and Convention Bureau to develop and operate a continuing series of leadership and business training workshops for a multi-county area. With assistance from a local tourist business committee, 10 weekly workshops were organized. These included exchanging promotion and management ideas with a tourism association in Canada. A final event in this series was a tour of hospitality industry facilities on Canada's Lake Huron shore. More than 30 managers participated in some or all of the workshops.

In northeast lower Michigan, Schwartz helped local business organizations develop a promotional publication explaining the sport fishery and advising anglers about species, tackle, accommodations, and locations. This was the first time many of these communities had attempted regional advertising.

Pistis heped the Allegan County government apply successfully for a $1,000 grant to develop a tourism marketing strategy. Pistis was appointed to the county committee created to pursue expanded tourism planning and development. An additional grant of $3,200 was allocated to the project by the Michigan Department of Commerce.

Pistis also conducted two tourism hospitality workshops in Ottawa and Allegan Counties. Seventy-four percent of the approximately 80 attendees then taught the information to others, and 77% indicated that they had applied the information directly in their operations. Finally, in December of 1983 creation of an Ottawa Area Tourism Council was approved by the County Board of Commissioners. Creation of this entity provided a more secure foundation for further tourism work.

Agent--Pistis

Coastal Erosion: Erosion of coastal property is a condition that many property owners find difficult to understand and accept in their enthusiasm to place structures in the closest possible proximity to the water's edge. Because the Michigan shoreline and the erosion rate are quite variable, there are no uniform and almost no simple solutions to maintaining stability. This makes the educational challenge of the Sea Grant agent even greater.

Property owners in several Lake Huron shoreline counties were offered special instruction in coastal erosion management. These were among the 1,000 Michigan owners located in high risk erosion areas. Property owners met in discussion groups led by state and local experts coordinated by the Sea Grant and county extension agents.

Pistis presented three shore erosion workshops reaching 100 realtors in Ottawa, Berrien, and Mason Counties in the hope that this information could be transferred to prospective buyers of shoreline property.

Agents--Pistis, Stewart, McKinney

Sea Grant 4H Great Lakes Camp: In 1982 MAS and 4H decided to co-sponsor a Great Lakes Resources Camp at Beaver Island in Lake Michigan. MAS agents visited the facilities and created appropriate curricula for 13-15 year olds. Then the 4H Fisheries and Wildlife Specialist was tapped to make the camp part of state 4H programming. In the summer of 1983, 50 young people and staff participated in the first full-fledged camp. The teens were offered such learning options as wildlife, wetlands, Great Lakes ecology, history and shipping, forestry, wildflowers, dune and beach ecology, fish, birds, aquatic insects, amphibians and aquatic plants. The response was enthusiastic, and plans were begun for a 1984 camp.

Agents--Stewart, McKinney; **Specialist**--Kinzel

INTERNATIONAL OPPORTUNITIES

As part of Michigan State University and Cooperative Extension international outreach, Sea Grant agents have the opportunity to enlarge their professional perspectives and contribute their skills and experience to a developing nation by participating in an international assistance project. In 1982, McKinney went to the Central American country of Belize (formerly British Honduras). He met counterparts and lived with families in the country as part of this month-long experience. He met with representatives of the Fisheries Ministry, field officers who did some extension work, the Fish Cooperative Management Committee, and the fishermen. He visited four fishing cooperatives to discuss problems, including the transition within the fishery, exports, and extension efforts. He also encountered commercial agriculture, 4H and Family Living representatives. His stay with a Belizian family and other experiences during the trip helped him understand the situation in that country, and he offered Belizians some insight into how extension might assist their efforts to become truly independent.

Agent--McKinney

SEA GRANT NETWORK

Michigan Sea Grant's Marine Advisory Service hosted agents from other MAS programs in the Great Lakes Network at an in-service professional training conference in April, 1983. Twenty out-of-state agents participated, along with Michigan's field staff. The theme, "Economic Impacts of Tourism in Coastal Communities" provided an excellent opportunity for presentation of Sea Grant research, interaction among agents on common interest projects, and contact with staff from the National Office of Sea Grant.

Agent--McKinney

PROFESSIONAL DEVELOPMENT

All agents were involved in the Annual CES block in-service education, and Peterson particpated in the CES Phase I and Phase II orientation sessions.

Pistis participated on the steering committee of the national Urban Fishing Symposium, which was held in Grand Rapids in October, 1983. Sponsored by the American Fisheries Society, the program was designed to educate fishery managers and educators about urban fishing programs. It was attended by specialists from throughout the United States and Canada. Pistis also participated in the formation of the Great Lakes Sea Grant Agents Association and became its first treasurer.

Pistis was honored with the Outstanding Marine Advisory Service Agent Award presented annually by the Great Lakes Network to an agent who has developed significant excellent programming. He attended Sea Grant Week in Houston, Texas, to receive the award and to participate in professional activities there.

Newsletters: MAS agents successfully used the newsletter medium to reach different clientele groups with current information pertinent to each group's business interests.

Dockside Lines -- Stewart. Served the substantial marine trades group in southeast Michigan.

Great Lakes Troller -- Pistis. Reached the rapidly expanding charterboat industry. Mailing list grew from fewer than 300 to 600.

Water's Edge -- Pistis. Established ongoing communication with the growing marine trades clientele group in southwest Michigan.

Commercial Fisheries Newsline -- Kinnunen. Served commercial fishing interests.

Bulletins: "Grain Shipments in the Great Lakes," "Is Great Lakes Shipping an Underutilized Economic Resource?" and "Great Lakes Shipping, Transportation, and Markets for Michigan's Forest Products: A Preliminary Economic Inquiry" were produced to stimulate interest in improving the economic opportunities achievable by water transport.

Media: Although there was no staff to develop media contacts and coverage for MAS during this period, the MAS agents were familiar with media in their districts and generated coverage through their own efforts. Nearly all print and broadcast formats were utilized with varying degrees of satisfaction and success.

COMMUNICATIONS

In 1982-83 Communications' objectives were to:

Create awareness of Great Lakes and marine resources and of Michigan Sea Grant.

Participate in Great Lakes and national Sea Grant networks.

Produce and disseminate information about the Great Lakes.

Provide communications services to all parts of the program.

CREATING AWARENESS

Communications created interest in the program in Michigan and elsewhere through press releases and other materials that were picked up by newspapers both in the Great Lakes and across the nation, by regional and national news coverage; in several magazines, such as Field and Stream, Michigan Out-of-Doors, Boating Industries, and Michigan Natural Resources Magazine; and by "Michigan Outdoors" and other Michigan TV programs.

The program's newsletter, Upwellings, was reactivated in April 1983 after being out of print in 1981 and 1982. With a new focus and format, the eight-page quarterly focused on Michigan Sea Grant activities and also highlighted significant Great Lakes issues and events. Upwellings reached about 4,500 individuals representing government, industry, the media, educational institutions, environmental organizations and other groups, and interested individuals. With this diverse readership, the newsletter complemented the agents' marine advisory service newsletters, which reached specific audiences.

For local, regional, and nationwide distribution, Communications prepared ten press releases, a brochure describing the Michigan Sea Grant program, and five fact sheets describing Michigan Sea Grant projects that resulted in economic benefits, other achievements, and the Communications program. To target its audiences better, Communications compiled specialized media lists.

Communications continued to improve Michigan Sea Grant's visibility at exhibits and conferences through the use of a portable display unit that had been purchased and designed in 1981. The design could be altered with ease to suit the situation. Uses of the display in 1982-1983 included a national Urban Fishing Symposium in Grand Rapids, an International Joint Commission-Great Lakes Governors meeting in Indianapolis, and the 1983 Michigan Technology Fair in Ann Arbor (also see below).

PARTICIPATING IN SEA GRANT NETWORKS

Communications participated in national display opportunities, such as OCEANS '82 and '83, and, with the other Great Lakes programs, produced a Great Lakes Sea Grant display for Sea Grant Week and for the 1983 International Association for Great Lakes Research Conference. Communications distributed a pamphlet on the

sea lamprey prepared by the Wisconsin Sea Grant Institute, and distributed Kitchi Gami Cookery, a Minnesota Sea Grant book of fish recipes produced in cooperation with Michigan Sea Grant and Wisconsin Sea Grant. Communications began participating with Wisconsin Sea Grant in providing ideas, information sources, and script review for their film production, The Greatest Lakes. The Great Lakes Sea Grant programs also worked together to produce a fact sheet describing the salmonid diet study conducted around the Great Lakes by several Sea Grant programs. Michigan Sea Grant wrote and designed this fact sheet. The Michigan Sea Grant Communications Coordinator was elected in 1983 to be the Great Lakes Regional Representative on the national Communicators Steering Committee.

A fact sheet describing Michigan Sea Grant was written for inclusion in the "1983 National Sea Grant College Program Resource Book." One of the "achievement" fact sheets mentioned above under "Creating Awareness"--on cold water near-drowning--was also used in the Resource Book. An article about yellow perch was written for Sea Grant Today that described all Great Lakes Sea Grant research on this important lakes fish.

PRODUCING INFORMATION

Michigan Sea Grant Communications produced 26 publications in 1982-83 on the following topics: coastal resources, remote sensing, recreation and tourism, diving, transportation, economics, and education. In addition Communications produced 14 program publications: seven fact sheets, two Upwellings, two People and Projects, an annual report, a publications catalog, and a program brochure. Two articles, one on yellow perch and one on toxaphene, were written for publication in outside magazines.

In 1982 Michigan Sea Grant began to place greater emphasis on printing research results in appropriate professional journals rather than as Sea Grant technical reports. Consequently, 38 articles were published in journals on the following topics: remote sensing, recreation and tourism, diving, fisheries, aquatic biology, toxic substances, transportation, economics, and education. Communications paid for journal page charges and reprints. Communications also advertised and distributed the reprints.

Communications produced the second in its recreational weather guide series, Lake Huron Recreation and Weather. An editor traveled the Lake Huron coast, and additional information was acquired from research and correspondence. Weather information was acquired from Richard DeAngelis of the National Oceanographic Data Center. The guide features weather over water and land, water and land recreational activities, winter safety, and an extensive directory to additional information. The guide received praise, such as this from the Tawas Area Chamber of Commerce, "...this is the best-written and most informative booklet published about the Lake Huron shoreline which is available at no charge to the public." The 56-page guide has enjoyed wide distribution through Michigan's Highway Travel Information Centers, the Michigan Travel Bureau, cooperative extension offices, and regional tourist associations and chambers of commerce.

Encouraging the use of outside publishers helped cut printing costs. The proceedings of a 1981 U.S.-Canadian symposium on PCBs, cosponsored by Michigan

Sea Grant, was published by Ann Arbor Science in 1983. Communications provided editorial assistance and announced the book's availability, but Sea Grant was spared production and distribution expenses. Also Communications provided some assistance to Professor Karl Lagler in his revision of Fishes of Isle Royale. At little cost to Sea Grant, the publication became an official Sea Grant book, with a MICHU number and appropriate credits. Distribution is handled by the Isle Royale Natural History Association.

In a related effort, Communications encouraged publication of technical material in layman's terms. For example, the principal investigator for the project on ice strengthening of Great Lakes ships was encouraged to submit an article that was printed in Seaway Review. The results of the program's toxaphene research were tailored for publication in Sea Grant Today, Coastal Ocean Pollution Assessment News, and The Riparian.

For the research project on the economic impact of Great Lakes recreational boating, Communications printed several products that were in great demand but did not contain the kind of information appropriate for journal publication. One lists Michigan marinas; another synthesizes information in Michigan Great Lakes recreational boating; a third reports the results of a Michigan recreational boating survey.

Communications also helped students in the education subprogram project, Great Lakes Seminar, to format their videotape production in a marketable form. Communications suggested dividing the first tape into four tapes on different subjects and edited the script. These revisions qualify the tapes for wider usefulness by advisory service personnel and interested groups.

In another educational effort, Communications finalized and printed the second unit in the Great Lakes Curriculum. With the unit complete except for editing and production, a part-time editor with an environmental education background was hired to complete the unit. This unit, Great Lakes Fishing in Transition, is a collection of classroom and field trip activities and two filmstrips that teaches the history of fishing on the Great Lakes, a wide variety of skills, such as budgeting, map-reading, and laboratory procedures, and the interrelatedness of natural science with economics, politics, and social science. The unit contains material for four or five weeks of classroom activity. It joins its companion unit, The Sea Lamprey Story, as a major contribution to Great Lakes education in the classroom. Great Lakes Fishing in Transition has been sold throughout the Great Lakes Basin and outside the region to schools, teachers' associations, libraries, nature centers, aquariums, and state and federal natural resource agencies.

DISSEMINATING INFORMATION

In 1982-83, Communications distributed 23,678 publications. This number does not include the advisory reports distributed from the Cooperative Extension Service Bulletin Office at Michigan State University or from the marine advisory service offices.

To improve the efficiency and reliability of the distribution process, the publications inventory and distribution records were computerized to the extent possible on the office's word processing equipment. The standard distribution list for publications was trimmed by relying more on publication announcements to inform many on the list of new publications. Communications also prepared a catalog of Michigan Sea Grant publications from 1976-1982 that helped generate interest in and requests for Sea Grant publications.

Communications also received requests for photographs and slides. To augment the files, Communications negotiated a contract with the Great Lakes Commission in which Sea Grant provides storage space for the Commission's photographs and slides in exchange for permission to use them in Sea Grant publications and displays. Requests for photographs came from the National Sea Grant Office, other Sea Grant programs, researchers, advisory agents, a TV station, and the public.

PROVIDING COMMUNICATIONS SERVICES TO THE PROGRAM

Communications and Administration worked closely in new efforts to assemble benefits and accomplishments and to obtain progress and final reports on research projects. Communications assisted in proposal preparation, and prepared 1982 and 1983 directories of Michigan Sea Grant research and researchers (People and Projects). Communications also produced invitations and the program for the April 1983 ceremony conferring college status on Michigan Sea Grant.

Communications also assisted in a special effort to bring property owners up-to-date on bluff slumping control along Great Lakes shores (see Bluff Slumping... under Highlights): the office prepared the proceedings of a Sea-Grant sponsored workshop for technical experts and produced a popular bulletin for shore property owners based on the state-of-the-art papers and other materials.

Artificial Reefs in the Great Lakes Conference

This conference, sponsored by Communications, was held in response to growing interest in building reefs to improve fishing. Although artificial reefs have been used successfully in warmer climates, conference attendees concluded that winter ice and year-round cold weather would limit the reefs' effectiveness in the Great Lakes, except in sheltered areas and the warmer waters of Lake Erie.

As part of this project, a book entitled, "Artificial Reefs: Marine and Freshwater Applications" was published. This 600-page book was the first attempt in the United States to survey and summarize state-of-the-art artificial fishing reef technology and marine and freshwater ecosystems.

Principal Investigators:
Niles R. Kevern, Ph.D., Department of Fisheries and Wildlife, Michigan State University
Frank M. D'Itri, Ph.D., Department of Fisheries and Wildlife, Michigan State University

Publication:
Artificial Reefs: Marine and Freshwater Applications

COMMUNICATIONS STAFF

	1982	1983
Communications Coordinator	Suzanne Tainter	Lillian Jarman
Public Information Officer	Sandra Gregerman	----------
Editor	Nancy Hilary (part-time)	Gus Medina (part-time)
		Martha Walter
Production Supervisor/Artist		Millie J. Flory
Secretary	Marilyn Eisley	Marilyn Eisley
Distribution Clerk	Yvonne Boyer	Yvonne Boyer

ADMINISTRATION

ADMINISTRATION

Michigan Sea Grant is administered by a cooperative alliance between The University of Michigan and Michigan State University. A team of administrators from these two universities oversees program operations. This Management Team is comprised of a Director and an Assistant Director at The University of Michigan and an Associate Director and a Marine Advisory Service Program Leader at Michigan State University. The Management Team deals with planning, requests for funds, initial decisions on program direction, and personnel. The Assistant to the Administrator and the Communications Coordinator serve as ex-officio members.

The Management Team receives guidance from the Policy Committee (Appendix C), which consists of vice presidents, deans, and other senior administrators from The University of Michigan and Michigan State University, and representatives from major Great Lakes agencies. This committee deliberates regarding overall policy and program direction for Michigan Sea Grant. The External Advisory Committee (Appendix D) provides counsel to the Management Team, Marine Advisory Service, and subprogram coordinators. Individuals on this committee represent interest groups and businesses that use the results of Sea Grant research.

University faculty participate as subprogram coordinators to help plan and oversee research activities, promote dissemination of research findings and encourage and assist faculty members in preparing proposals. The subprogram coordinators are appointed by the Management Team, with the approval of the Policy Committee. Each subprogram has two coordinators, one from Michigan State University and one from The University of Michigan. A yearly retreat provides an opportunity for all members of the program to work together on program direction.

During 1982-83, the Administration worked to improve coordination throughout the program. More interaction between researchers and the marine advisory service was developed. Also, stronger leadership by subprogram coordinators, leading to more coordination within and among the research subprograms was encouraged. An effort was made to urge additional faculty to participate in Sea Grant projects. Administration worked with Communications to improve the collection and reporting of accomplishments and benefits and progress and final reports. The acquisition of personal computers enhanced the compatibility of Michigan Sea Grant with the national Sea Grant communications network (SGNET).

During 1982-83 Michigan Sea Grant director, Alfred M. Beeton, served as President-Elect of the Sea Grant Association, as a member of the Council of Sea Grant Directors, as Interim Board Member of the National Association of State Universities and Land Grant Colleges, and as Chairman of the Marine Sanctuaries Committee to recommend marine sanctuaries in the Great Lakes to the National Oceanic and Atmospheric Administration. Associate Director Niles R. Kevern served as a member of the Great Lakes Fishery Commission's Board of Technical Experts. Assistant Director John H. Judd served for a year in the National Sea Grant College Program Office. In his absence, Philip A. Meyers served as Acting Assistant Director. Dr. Meyers had just completed serving as Acting Director while Dr. Beeton was away on sabbatical.

ADMINISTRATIVE STAFF

Director:	Alfred M. Beeton
Associate Director:	Niles R. Kevern
Assistant Director:	John H. Judd
Acting Director:	Philip A. Meyers (7/82-12/82)
Acting Assistant Director	Philip A. Meyers (1/83-8/83)
Marine Advisory Service Program Leader:	Eugene F. Dice
Assistant to the Administrator:	Nancy S. Garneau
Secretaries:	Carole Fletcher Terry Waters
Accounting Clerk:	Sonya Little

APPENDICES

A. Program Activity Budgets
B. Publications
C. Policy Committee
D. External Advisory Committee

PROGRAM ACTIVITY BUDGETS

1982 ACTIVITY BUDGET SHEET
(Summary Totals by Sea Grant Activities)

	NOAA Grant Activity	Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living Resources, other than Aquaculture	34,272	31,411
SOCIO-ECONOMIC AND LEGAL STUDIES		
Marine Recreation	234,789	59,078
MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT		
Resources Recovery and Utilization	31,500	- 0 -
	25,335	- 0 -
MARINE ENVIRONMENTAL RESEARCH		
Research and Studies in Direct Support of Coastal Management Decisions	58,513	14,833
Ecosystems Research	34,023	10,670
Pollution Studies	115,533	- 0 -
MARINE EDUCATION AND TRAINING		
College Level	38,955	- 0 -
Other Education	5,000	- 0 -
ADVISORY SERVICES		
Extension Programs	238,000	122,310
Other Advisory Service	83,695	103,905
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	92,422	162,379
Program Development	71,963	42,715
TOTAL	**$1,064,000**	**$547,301**

1983 ACTIVITY BUDGET SHEET
(Summary totals by Sea Grant Activities)

	NOAA Grant Funds	Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living Resources, other than Aquaculture	$40,044	28,461
SOCIO-ECONOMIC AND LEGAL STUDIES		
Marine Recreation	179,601	53,253
MARINE ENVIRONMENTAL RESEARCH		
Research and Studies in Direct Support of Coastal Management Decisions	38,352	18,949
Ecosystems Research	60,017	- 0 -
Pollution Studies	73,482	30,631
MARINE EDUCATION AND TRAINING		
College Level	- 0 -	- 0 -
Other Education	9,164	3,240
ADVISORY SERVICE		
Extension Programs	231,492	139,023
Other Advisory Service	97,546	82,840
PROGAM MANAGEMENT AND DEVELOPMENT		
Program Planning	11,544	6,902
Program Administration	70,790	104,317
Program Development	80,868	30,828
TOTAL	**$1,000,000**	**$522,444**

PUBLICATIONS

PUBLICATIONS RESULTING FROM RESEARCH IN 1982–83*

COASTAL RESOURCES

Bluff Slumping: Proceedings of the 1982 Workshop
Michigan Sea Grant College Program
MICHU-SG-82-901

Bluff Slumping and Stability: A Consumer's Guide
Suzanne Tainter
MICHU-SG-82-902

EDUCATION

Graduate Education in Water Resources: An Innovative Approach
Henry H. Sprague III, Richard Block, and Jonathan W. Bulkley
MICHU-SG-83-311

Microcomputers in the Boatyard: Advanced Boatyard Technologies
Paul W. Vickers, John Ducios, edited by Robert Scher
MICHU-SG-84-600

Microcomputers in the Boatyard: Microcomputer Basics
Kevin Mitchell, edited by Robert Scher
MICHU-SG-84-601

Microcomputers in the Boatyard: Microcomputer Operating Systems and Language
John G. Jessup, Paul Vickers, edited by Robert Scher
MICHU-SG-84-602

Microcomputers in the Boatyard: Microcomputer Business Applications
Howard M. Bunch, Robert M. Scher, and Paul W. Vickers
MICHU-SG-84-603

Microcomputers in the Boatyard: Microcomputers and Design Aids
Robert M. Scher
MICHU-SG-84-604

Microcomputers in the Boatyard: Microcomputers and Production Control
Paul W. Vickers, edited by Robert Scher
MICHU-SG-84-605

GREAT LAKES FISHERIES

Discovery of the Asiatic Clam, Corbicula fluminea, in Lake Michigan
David S. White, Michael H. Winnell, and David J. Jude
MICHU-SG-84-310

*Some of these were published in 1984 and 1985.

Effect of Food Abundance on Larval Lake Whitefish (Coregonus clupeaformis Mitchill), Growth and Survival
W. W. Taylor and Mark H. Freeberg
MICHU-SG-85-301

Population Dynamics and Stock Differentiation of Lake Whitefish in Northeastern Lake Michigan with Implications for Their Management
Paul Scheerer and William W. Taylor
MICHU-SG-85-308

Simulation of Harvest Strategies for a Fluctuating Population of Lake Whitefish
Peter Jacobson and William W. Taylor
MICHU-SG-85-309

Size-Frequency Estimates of Secondary Production by Mysis relicta in Lakes Michigan and Huron
Daniel W. Sell
MICHU-SG-82-308

RECREATION AND TOURISM

Cognitive Maps of Tourism Regions in Michigan
Joseph D. Fridgen, Edward Udd, Cindy Deale
MICHU-SG-84-311

1980 Michigan Recreational Boating Survey
Daniel Stynes, David Safronoff and David Feltus
MICHU-SG-82-202

Michigan Great Lakes Recreational Boating: A Synthesis of Current Information
Daniel J. Stynes and Donald F. Holecek
MICHU-SG-82-203

Spending Patterns and Economic Impacts of Michigan Registered Boat Owners
Daniel J. Stynes, Gene L. Brothers, Donald F. Holecek, and Dave Verbyla
MICHU-SG-83-210

Michigan Marinas
Joseph Fridgen, Mary Taber, and Gary Gillings
MICHU-SG-82-600

Recreational Boat Owners Response to Energy Constraints
Joseph D. Fridgen
MICHU-SG-82-301

Trends in Recreational Boating in Michigan
Daniel J. Stynes
MICHU-SG-82-302

Economic Impacts of Sport Fishing in Alcona County
Scott W. Jordan and Daniel R. Talhelm
MICHU-SG-82-204

Economics of Sport Fishing in Muskegon County
Scott W. Jordan and Daniel R. Talhelm
MICHU-SG-83-202

Michigan Tourism Symposium: Reflections and Recommendations
Donald F. Holecek, Daniel J. Stynes, Joseph D. Fridgen, and Lewis W. Moncrief
MICHU-SG-82-311

TOXIC SUBSTANCES

Lysosomal Enzyme Release in the Bluegill Sunfish (Lepomis macrochirus Rafinesque) Exposed to Cadmium
Donald J. Versteeg and John P. Giesy
MICHU-SG-85-302

The Photoenhanced Toxicity of Anthracene to Juvenile Sunfish (Lepomis spp.)
James T. Oris and John P. Giesy
MICHU-SG-84-312

Solar Radiation-Induced Toxicity of Anthracene to Daphnia pulex
P.M. Allred and J.P. Giesy
MICHU-SG-84-313

Evaluation of the Toxic Components of Toxaphene in Lake Michigan Lake Trout
J. W. Gooch and F. Matsumura
MICHU-SG-85-303

Action of Organophosphates on the Electroretinogram of Rainbow Trout
W.D. Kreft, J. Russell Hoffert and P.O. Fromm
MICHU-SG-85-305

Toxicity of Sodium Monofluoroacetate (Compound 1080) to Mink and European Ferrets
Hornshaw, R. W. Ringer, and Aulerich
MICHU-SG-85-310

Feeding Great Lakes Fish to Mink: Effects on Mink and Accumulation and Elimination of PCBs by Mink
T.C. Hornshaw, R.J. Aulerich, and H.E. Johnson
MICHU-SG-83-300

PCBs and Other Toxicants in Mysis relicta
Marlene S. Evans, Ralph W. Bathelt and Clifford P. Rice
MICHU-SG-82-309

TRANSPORTATION

Ice Strengthening of Great Lakes Ships
Movses Kaldjian and William Reid, Jr.
MICHU-SG-82-200

Feasibility of Moving Western Coal Through a Transhipment Point Located on Lake Michigan
Howard McRaven Bunch and Paul William Vickers
MICHU-SG-82-206

WATER SAFETY

Doppler Evaluation of Multi-Level Dive Profiles
Karl E. Huggins
MICHU-SG-84-300

New No-Decompression Tables Based on No-Decompression Limits Determined by Doppler Ultrasonic Bubble Detection
Karl E. Huggins
MICHU-SG-81-205

Mathematical Evaluation of Multi-Level Diving
Karl E. Huggins and Lee Somers
MICHU-81-207

Ambassador of the Sea: Share Your Experiences
Bonnie Kay Schwan
MICHU-SG-84-301

Scientific Saturation Dive: Living and Working Under the Sea
Bonnie Kay Schwan and Lee H. Somers
MICHU-SG-84-302

Compact Surface-Supplied Diving System for Scientific and Recreational Divers
Lee H. Somers
MICHU-SG-84-304

Effect of Repeated Hyperbaric Exposures on the Menstrual Cycle: Preliminary Study
J.R. Willson, W.B. Blessed, and P.J. Blackburn
MICHU-SG-84-306

Hyperbaric Exposure During Pregnancy in Sheep: Staged and Rapid Decompression
J.R. Willson, W.B. Blessed, and P.J. Blackburn
MICHU-SG-83-303

1982-83 PUBLICATIONS RESULTING FROM EARLIER RESEARCH

COASTAL RESOURCES

Assessment of Wetland Resources: Manual for a Workshop
John G. Lyon and Charles E. Olson, Jr.
MICHU-SG-83-600

Seasat Imagery for Detection of Coastal Wetlands
John Grimson Lyon
MICHU-SG-82-310

GREAT LAKES FISHERIES

Diver and Underwater Television Observations of Fish Behavior in a Great Lakes Commercial Trap Net
Thomas L. Rutecki, Philip J. Schneeberger, and David J. Jude
MICHU-SG-83-308

An Energy Budget for Northern Pike (Esox lucius)
James S. Diana
MICHU-SG-83-309

Gilling in Trap-Net Pots and Use of Catch Data to Predict Lake Whitefish Gilling Rates
Philip J. Schneeberger, Thomas L. Rutecki, and David J. Jude
MICHU-SG-82-312

A Profile of the Michigan Commercial Fisherman
Craig K. Harris
MICHU-SG-82-205

RECREATION AND TOURISM

A Model of Michigan's Tourism System With Implications for Research
Donald F. Holecek
MICHU-SG-82-314

Economic Impact of an Annual Tourism Industry Exposition
William C. Gartner and Donald F. Holecek
MICHU-SG-83-305

Management Guidelines for Underwater Preserves
Donald F. Holecek and E. Thomas Smiley
MICHU-SG-82-201

Aquatic Park Symposium Proceedings
E. Thomas Smiley and Donald F. Holecek
MICHU-SG-82-900

Lake Huron Recreation and Weather Guide
Martha Walter, Nancy Hilary and Richard DeAngelis
MICHU-SG-82-102

TOXIC SUBSTANCES

Examination of the Surface Microlayer of Lake Michigan Using Scanning Electron Microscopy
Diane Lazinsky, Karen Erstfeld, Clifford P. Rice and Linda Sicko-Goad
MICHU-SG-83-310

Fractionation of Hydrophobic Organic Materials in Surface Microlayers
Philip A. Meyers and Orest E. Kawka
MICHU-SG-83-301

Enrichment of PCBs in Lake Michigan Surface Films
Brian J. Eadie and Karen M. Erstfeld
MICHU-SG-83-302

Predictability of PCBs in Carp Harvested in Saginaw Bay, Lake Huron
Mary E. Zabik, Cynthia Merrill, and Matthew J. Zabik
MICHU-SG-82-303

PCBs and Other Xenobiotics in Raw and Cooked Carp
Mary E. Zabik, Cynthia Merrill, and Matthew J. Zabik
MICHU-SG-82-304

A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish
Milagros S. Simmons, Janet A. Sweetman, Timothy J. Miller and David J. Jude
MICHU-SG-83-304

Sorption of Hydrophobic Compounds by Sediments, Soils and Suspended Solids -- Part I: Theory and Background and Part II: Sorbent Evaluation Studies
I --Thomas C. Voice and Walter J. Weber, Jr.
II --Walter J. Weber, Jr. Thomas C. Voice, Massoud Pirbazari, Gary E. Hunt, and Dory M. Ulanoff
MICHU-SG-83-306

Effects of Pentachlorobiphenyl on Growth of Nutrient Enriched Phytoplankton from Lake Michigan
C. Kwei Lin and Milagros S. Simmons
MICHU-SG-82-300

TRANSPORTATION

Pressure Signatures of Great Lakes Bulk Carriers in Shallow Water and Restricted Channels
Robert M. Scher
MICHU-SG-83-200

OTHER 1982-83 PUBLICATIONS

ADVISORY

Is Great Lakes Shipping an Underutilized Economic Resource?
Marine Advisory Service
MICHU-SG-82-500

Great Lakes Shipping, Transportation and Markets for Michigan Forest Products: A Preliminary Economic Inquiry
R. B. DenUyl
MICHU-SG-82-500

Grain Transportation on the Great Lakes-St. Lawrence Seaway
Stanley R. Thompson and Rebecca L. Johnson
MICHU-SG-82-501

Fishes of Isle Royale
Karl Lagler
MICHU-SG-81-212

Fish in Lake Michigan: A Distribution of Selected Species
Lawrence Sommers, Cymbria Thompson, Suzanne Tainter, Leslie Lin and J. Michael Lipsey
MICHU-SG-81-600

Kitchi Gami Cookery
Minnesota Sea Grant Extension Program
MICHU-SG-82-104

PROGRAM

Michigan Sea Grant Publications 1976-1982
Sandra Gregerman and Yvonne Boyer
MICHU-SG-82-101

Michigan Sea Grant Annual Report 1977-1981
Michigan Sea Grant College Program
MICHU-SG-83-105

Great Lakes Fishing in Transition
Leslie Lin, Augusto Q. Medina, Paul Nowak, and William Stapp
MICHU-SG-83-400

Keeping the Great Lakes Great Brochure
Michigan Sea Grant College Program
MICHU-SG-83-100

People and Projects at Michigan Sea Grant
Michigan Sea Grant College Program
MICHU-SG-82-100

People and Projects 1983
Michigan Sea Grant College Program
MICHU-SG-83-101

Upwellings--Quarterly Newsletter
Vol. 5, No. 1, Spring 1983 Great Lakes Recreation An Economic Plus
Vol. 5, No. 2, Summer 1983 Getting The Jump on Toxaphene
Michigan Sea Grant College Program

POLICY COMMITTEE

EXTERNAL ADVISORY COMMITTEE

POLICY COMMITTEE 1982-83

James Anderson	Dean, College of Agriculture and Natural Resources Michigan State University
John Cantlon	Vice-President for Research Michigan State University
James Crowfoot 1983 only	Dean, School of Natural Resources The University of Michigan
James Duderstadt 1983 only	Dean, College of Engineering The University of Michigan
Carlos Fetterolf	Executive Secretary Great Lakes Fishery Commission
James Fish	Executive Director, Great Lakes Commission
George Gamota 1983 only	Director, Institute of Science and Technology The University of Michigan
Robert Hess 1982 only	Director, Highway Safety Research Institute The University of Michigan
William Johnson 1982 only	Dean, School of Natural Resources The University of Michigan
Richard Lewis 1982 only	Dean, College of Business Michigan State University
Lois Lund	Dean, College of Human Ecology Michigan State University
William Marks 1983 only	Assistant Deputy Director Environmental Protection Bureau Michigan Department of Natural Resources
Charles Overberger	Special Assistant to the President The University of Michigan
Richard Remington 1982 only	Dean, School of Public Health The University of Michigan
John Scott 1982 only	Michigan Department of Natural Resources
Alfred Beeton	Director, Michigan Sea Grant College Program Ex Officio

EXTERNAL ADVISORY COMMITTEE 1982-83

Howard Alexander	Dow Chemical Company
William Carlson	Carlson Fisheries
Barbara Clark 1982 only	Upper Peninsula Environmental Coalition
Bob Core	West Bay Boat Works
Terry L. DeRosia 1982 only	Medical Emergency Technician
Karen Eppinger 1983 only	Vice-President, Eppinger Tackle Company
Robert Giesler 1983 only	President, All Seasons Marine, Inc.
Larry Karnes	Michigan Department of Transportation
John Mahler	Owner, Blue Horizon Court Motel
Nancy Mincemoyer	Michigan Department of Education
Wesley Myllyla	American Dairyman's Association of Michigan, Inc.
Steve Otterbein 1982 only	Representative, Michigan Charter and Sportfishing Industry
Walt Olmstead 1983 only	Blue Water Charterboat Service
John Reynolds	Consumers Power Corporation
John Robinson 1982 only	Michigan Department of Natural Resources
C. Peter Theut	Maritime Attorney
Ralph Wilcox	President, Michigan Fish Producers Association