1980
Annual Report

Sea Grant Program

University of Minnesota

Contents

Introduction

It's great to be aboard as a member of the Minnesota Sea Grant team. From the leadership in the administration and the Graduate School to the work of the faculty investigator in the lab and extension agent in the field, Minnesota has the talent to continue to grow into a full-scale Sea Grant College.

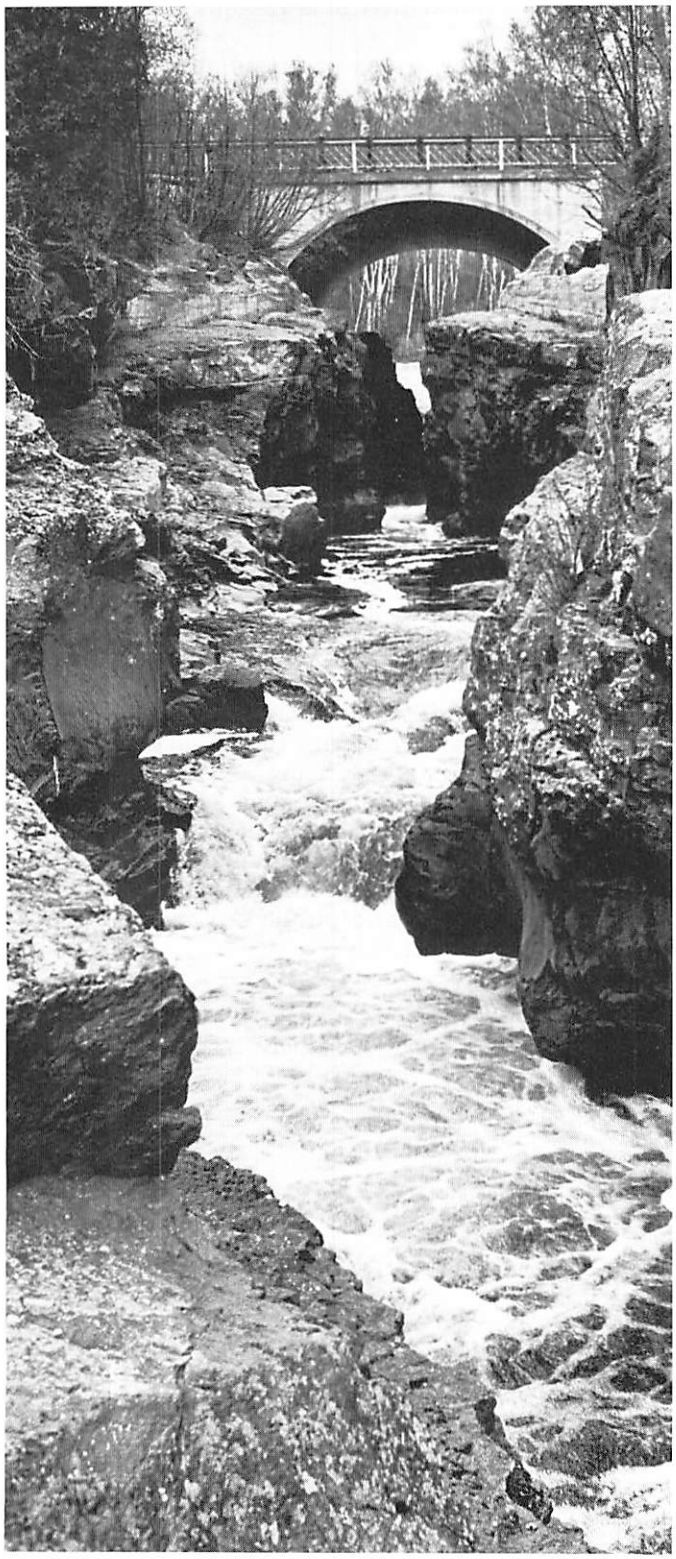
Dale Baker initiated the projects described in this report and deserves credit for guiding a fledgling research program. Traditionally, Sea Grant research requires three years to mature, thus our first applied findings arrived this year, ready for dissemination to the user community. Already our communicators have developed report and reprint series.

This, our third year of organized research, saw a sizable portion of our state matching obligation coming from the legislature; we were supported by a $100,000 legislative special. State support is vital to our operation and required by the federal government.

In future years, we look forward to a productive alliance between the Sea Grant Program in the Department of Commerce, the University and the State of Minnesota in solving some of the state's and nation's marine problems.

Donald C. McNaught
Director

Sea Grant: Applying Work in the Lab to Work on the Shore



A professor and his students wait in the cold dusk, at the mouth of a clear stream rushing into one of the largest freshwater lakes in the world. They wait to catch fish which they will later analyze under a microscope, through a computer, behind a desk, in laboratories 200 miles from the lake.

A recreation and tourism specialist confers with business people in Tofte, Silver Bay, Grand Marais: people who earn their livings from Lake Superior and its adjacent Minnesota shoreline.

An engineer spends solitary and intense hours perfecting a research model used to conduct a study that will ultimately indicate ways to improve the lake's water quality.

As an interdisciplinary program based at the University of Minnesota-Twin Cities as well as Duluth, Sea Grant is complex. It deals with such diverse areas as Lake Superior's fisheries, recreational use of Lake Superior, water safety, marine education and training, and coastal and lake processes. It integrates the work of prominent scientists with that of people who run fisheries, deal in bait or construct life preservers. The extension and research components of Sea Grant cooperate so that work in university laboratories is applied to work on the shore.

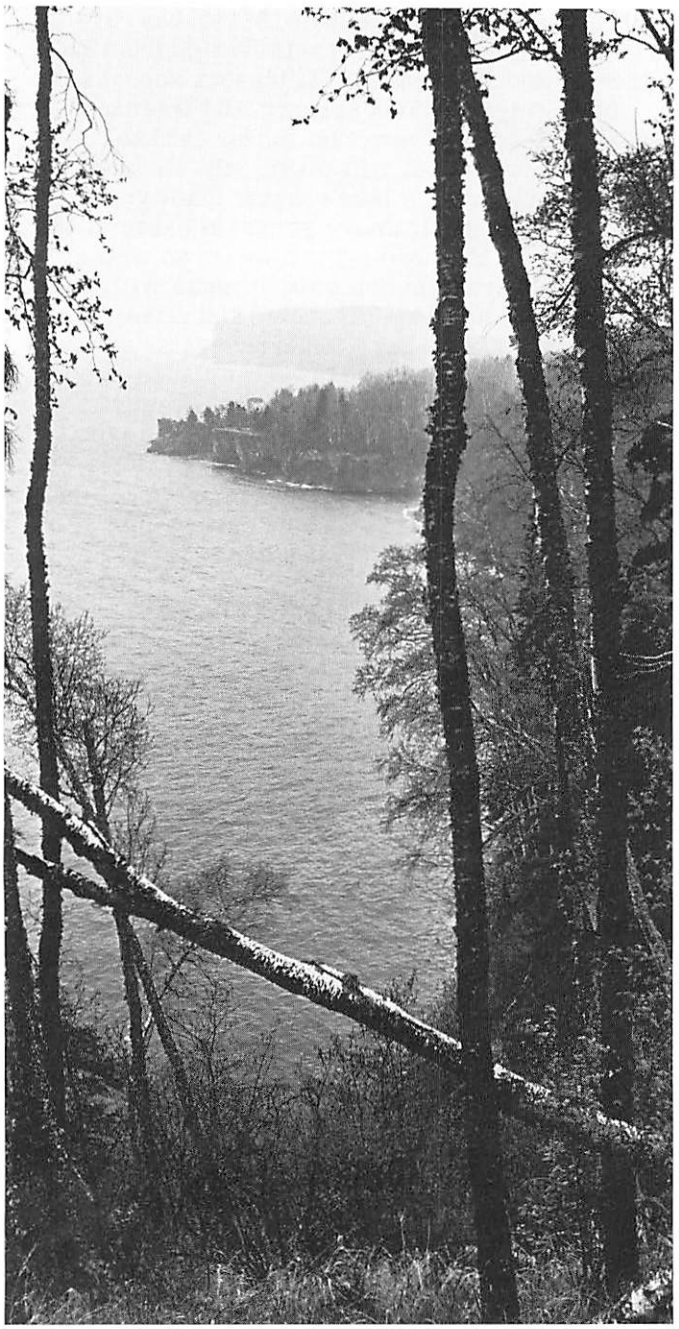
Although Minnesota's Sea Grant Program is only finishing its third year as an effort which combines research and extension activities, it is maturing, growing and having an impact in the arenas of research, industry and education.

In 1980, Minnesota Sea Grant's research division broadened to encompass more projects in more areas. As its third year as a comprehensive research and extension program ended, so did some projects which had originated in 1977, 1978 or 1979. By the end of 1980, Sea Grant researchers had concluded studies of population characteristics of the smelt and the sea lamprey; they had evaluated the effects of coal storage on the lake; they had investigated the need for additional harbors of refuge on the North Shore and studied the economics of recreational fishing.

Sea Grant's extension program reached a diversity of audiences through special courses, camps, publications, demonstrations and stories in the mass media. Its individual agents continued to work intensively with people who fish commercially on Lake Superior, tourists, resort owners, North Shore residents and

educators throughout the state. Innovations, added to already proven programs, served as extension's aides in helping the lake's many users enjoy and utilize its resources more effectively.

In summer of 1980 a new, permanent director for Minnesota Sea Grant moved to the Twin Cities to assume his duties. Donald C. McNaught, a Great Lakes zooplankton ecologist, came to the University of Minnesota from the State University of New York at Albany and immediately began work furthering Sea Grant's development, cohesion and relationship with other university programs.



Focus on the Lake

Minnesota Sea Grant's work centers around a lake that encompasses approximately ten percent of the world's fresh water, a lake that is uniquely pristine, yet needs to be carefully guarded against the encroachment of alien substances from which it is ill-equipped to defend itself.

Lake Superior, in its vastness, its effect on the surrounding land, and its marine environment is properly considered one of America's seas. Its shore is part of the United States' "fourth sea coast." The lake shares similarities with the other seas of the world; yet, it is unique in many respects—not only from the oceans, but also from the other Great Lakes.

While "pristine" is among the most common adjectives used to describe Lake Superior, its clear, cold waters are far more devoid of aquatic life than are the less pure Great Lakes to the east. In fact, some of the pollutants dumped into the other lakes provide nutrients for sustenance of marine life.

Lake Superior's shoreline is composed of some of the oldest rock on the surface of the earth: rock that does not leach nutrients into the water. Its immensity, especially its depth, does not allow the lake to soak up energy from the sun in the same quantities that smaller and shallower bodies of water do. Lack of heat and nutrients have limited growth of populations of organisms, from tiny plants to the largest fish.

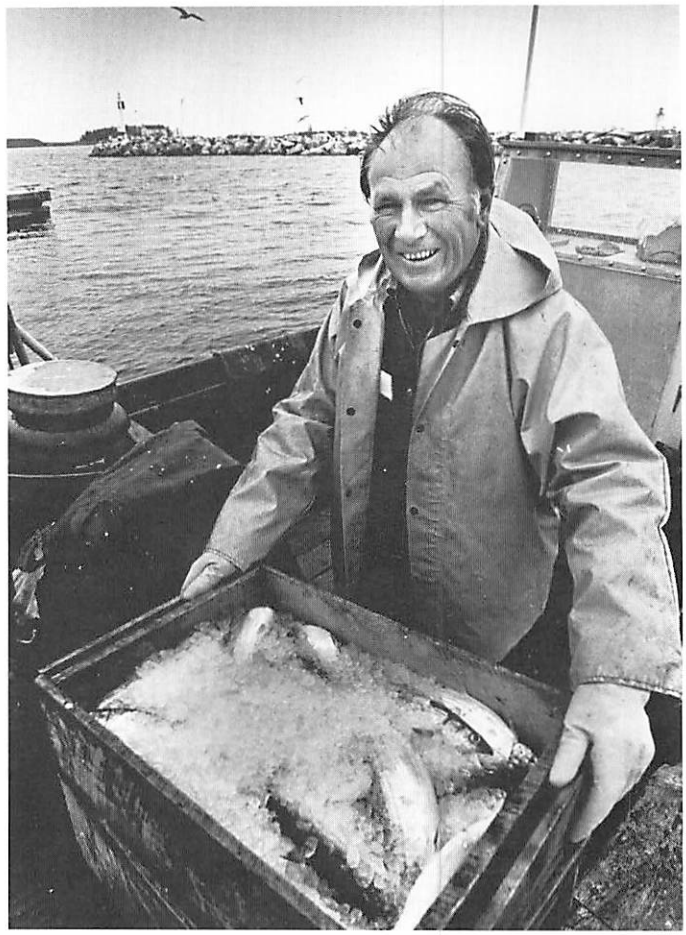
The lake's uniqueness from and similarities to other seas make it an invaluable source for researchers. Its magnetic appeal as a resource for tourism and its utilization as a commercial resource provide fertile ground for interaction between the private and public sectors through Sea Grant extension.

The Minnesota Program: Responding to Our Needs

Minnesota's Sea Grant Program developed as a response to the needs of residents, industries, tourists and business people that use Lake Superior and its Minnesota shoreline. The program stemmed from the Marine Advisory Service, a public outreach effort formed in 1974 at the University of Minnesota, Duluth. It became a full-scale Sea Grant program in 1977 when it added a director and a small research component to complement and expand upon its extension services. Sea Grant researchers are based at both the Twin Cities and Duluth campuses, and the administrative office is located on campus in St. Paul. The program is under the jurisdiction of the Graduate School and its Dean, Warren E. Ibele.

Minnesota Sea Grant is part of a national network of Sea Grant programs, created by an act of Congress in 1966 as a comprehensive effort designed to help people understand and manage coastal resources throughout the United States. Its name reflects the Land Grant System, after which it was patterned as a base from which to conduct research, extend the results of research to the general citizenry and train future generations to work on water-related issues.

Most Sea Grant programs across the nation are based within colleges or universities of participating states; up to two-thirds of their funding comes from the federal government, and the remaining one-third or more is provided by a mixture of public and private sources within the states.

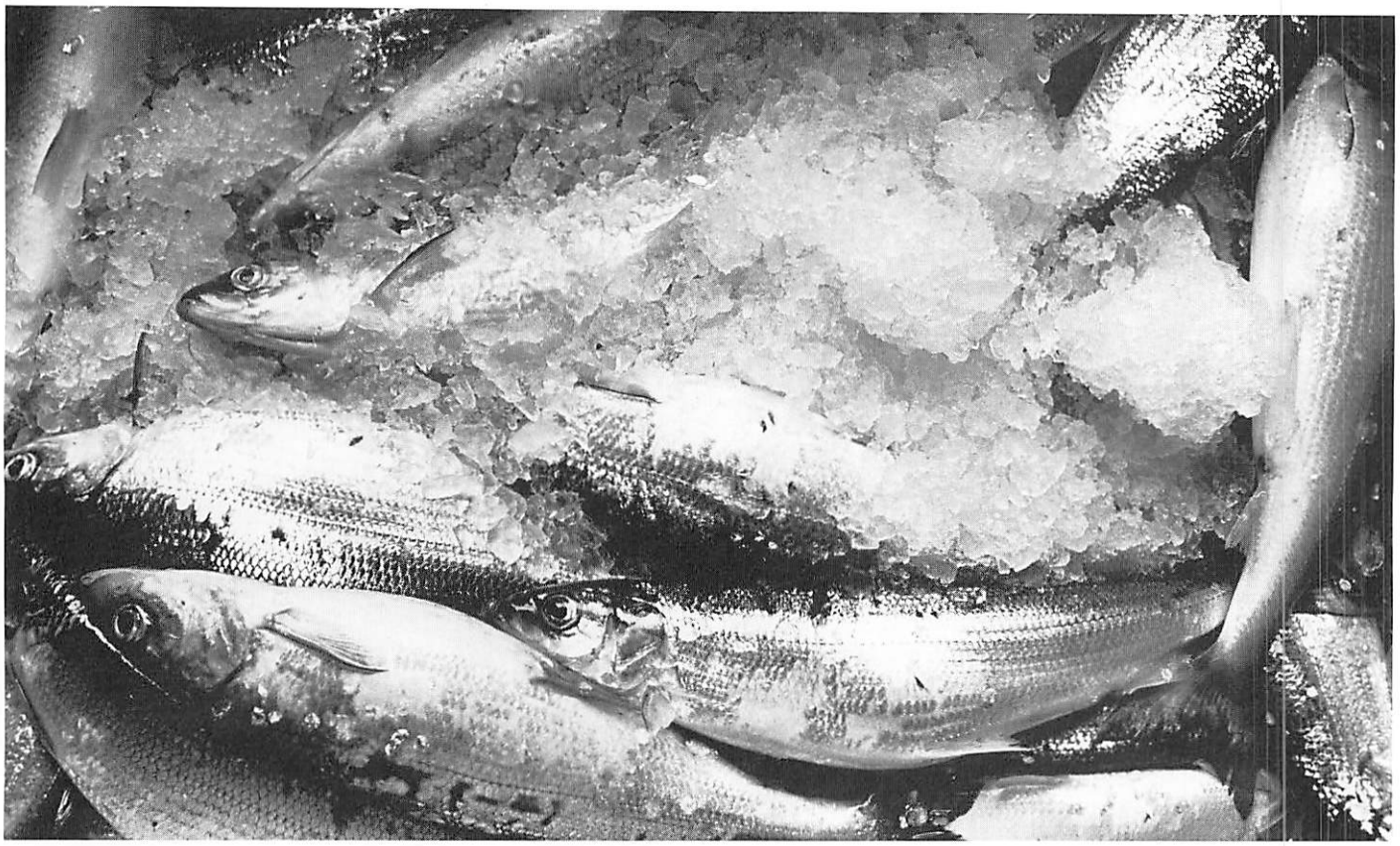


Tom Eckel, Grand Marais-based commercial fisherman, displays his catch.

Research: Core of a Dynamic Program

Research is central to Minnesota Sea Grant's program: research that analyzes problems, then posits solutions; research that helps conserve what already exists—and fosters improvement; research that results in tangible benefits to a diverse community, including commercial fishermen, mining companies, the tourism industry, residents of Duluth and the North Shore, and a company that specializes in the design and production of life preservers. Through the interaction of Sea Grant's research and extension areas, research projects are responsive to the needs of constituent communities.

Each research project proposed for funding from the Minnesota Sea Grant program must outline its tangible impact upon the community. Such an impact may be economic. It may be sociopolitical or environmental. It may be educational. The following section discusses the breadth of research taking place through Minnesota's Sea Grant Program, outlining the ways each research effort is affecting its community.



Fisheries: Enhancing the Lake's Yield

Minnesota Sea Grant's research effort matured in 1980 as some of its earliest projects ended and others began. The Fisheries and Aquaculture "Subprogram"—one of the program's most important research components from the very beginning—showed vital results from the maturing process in 1980.

A significant development, according to subprogram coordinator Dr. George R. Spangler, was that for the first time, the fisheries area began to have a common theme: the biological productivity of Lake Superior. Most of the fisheries research projects dealt in some way with enhancing the lake's productivity or with taking advantage of what Lake Superior is capable of producing.

Productivity is a major issue for both commercial fishermen and tourists who come to Lake Superior to fish. The lake is relatively poorly endowed with nutrients and is thus a poor producer of plankton, the tiny organisms upon which larger animals, such as fish, must feed in order for their populations to thrive and grow. Other factors which led to the present low yield of fish from Lake Superior may have included intensive exploitation by fishermen through the mid-20th century, local problems of pollution and the introduction of exotic (and competitive or parasitic) species such as the sea lamprey.

In 1979-'80, Minnesota Sea Grant also funded an aquaculture project dealing with an issue of concern to the state's freshwater fisheries: the problem of raising bait leeches so that they are available throughout the fishing season and marketing them so that the natural population is not depleted through overharvesting.

In 1980 new researchers joined Minnesota Sea Grant's fisheries and aquaculture program efforts, finding it particularly appealing to study Lake Superior as a model marine environment, easier to study than the ocean yet more complex than a small lake. "We regard the Great Lakes as much simpler biological systems than the oceans," Spangler said. Studying Lake Superior, "gives us the opportunity to study processes, helps us to understand biological productivity, allows us to answer questions that are not answerable in the more complex aquatic ecosystems of the oceans." He added, "We couldn't hope to see in smaller systems the population processes that are applicable to much larger systems."

Choreographing Fish Reproduction

Artificial fish propagation is a delicate and difficult business, but an important business in a state that considers fishing important.

Traditionally, artificial propagation has involved hand-stripping ripe females and males in order to unite the sperm and eggs. If the process were not done speedily, it would fail to produce the maximum number of fertilized eggs—and, ultimately, hatched fry.

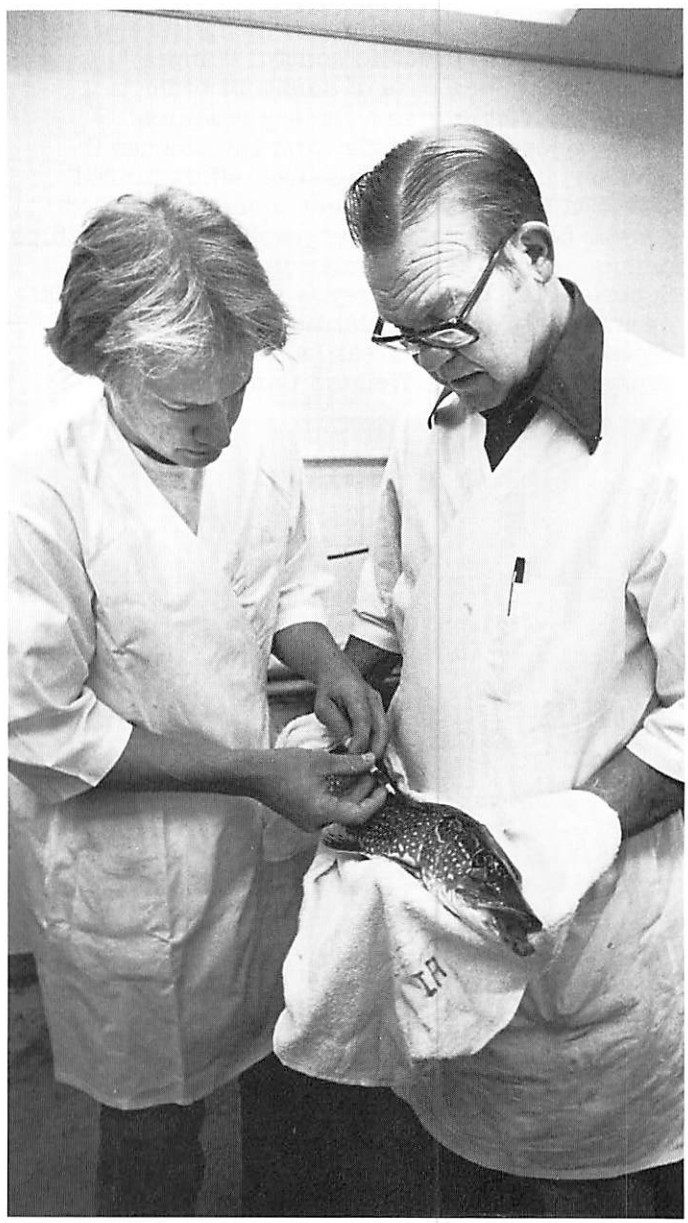
A persistent problem in the scenario has been that of one sex ripening before the other, with a resulting decrease in the hatch of certain fish species. A secondary concern has been the seasonal nature of the business. Artificial fish propagation has been dependent upon utilizing ripe fish, and since fish are only ripe at certain times of the year, hatchery personnel and facilities have not always been used as efficiently as may be possible.

The Minnesota Department of Natural Resources (DNR) submitted the problem of sexes ripening at mismatched times to the university as one of its top priorities for researchers to tackle. For three years, Dr. Edmund F. Graham and his assistants have been confronting the problem, using the tools of cryopreservation or freezing of sperm and egg, and extender systems, dilutants that can extend the life of sperm up to several days. Such systems are particularly useful when the female fish ripens a short time after the male—a particularly frustrating situation in the hatchery.

In spring of 1980, DNR worked with the extender system developed in Graham's laboratory. The results were encouraging for the hatcheries at Waterville and Rush Lake, the two facilities which tried out the new system. Staff at the Waterville hatchery estimated that up to 75 percent of the millions of walleye eggs they fertilized that spring were fertilized by using extended semen. Approximately half of the muskie eggs at the Rush Lake hatchery were fertilized with extended semen, which appeared to perform as well as undiluted semen.

Graham and his research associates hold out even greater hopes for success with frozen gametes, which enable sperm and fertilized eggs to be stored for indefinite periods of time for future use. Cryopreservation of gametes could keep hatcheries busy year-round producing young fish. The process would allow greater numbers of fish to be available for stocking, potentially allowing the DNR to replenish Lake Superior's fish populations. It would also allow for cross-breeding, experiments which might lead to strengthening the fish populations that inhabit the lake.

A tour of the cryopreservation laboratory reveals tanks of liquid nitrogen, holding samples of frozen gametes at −196° C. A computer-controlled freezer reduces the rate at which gametes are cooled to 0.1° C per minute. Once the gametes are cooled to approximately −40° C, they are placed directly in the liquid nitrogen for long-term storage. A slide, slipped under a microscope, shows motile rainbow trout sperm on an attached television screen. A small wet lab includes brood stock fish from which sperm and ova are collected, and new hatch—born from cryopreserved cells.



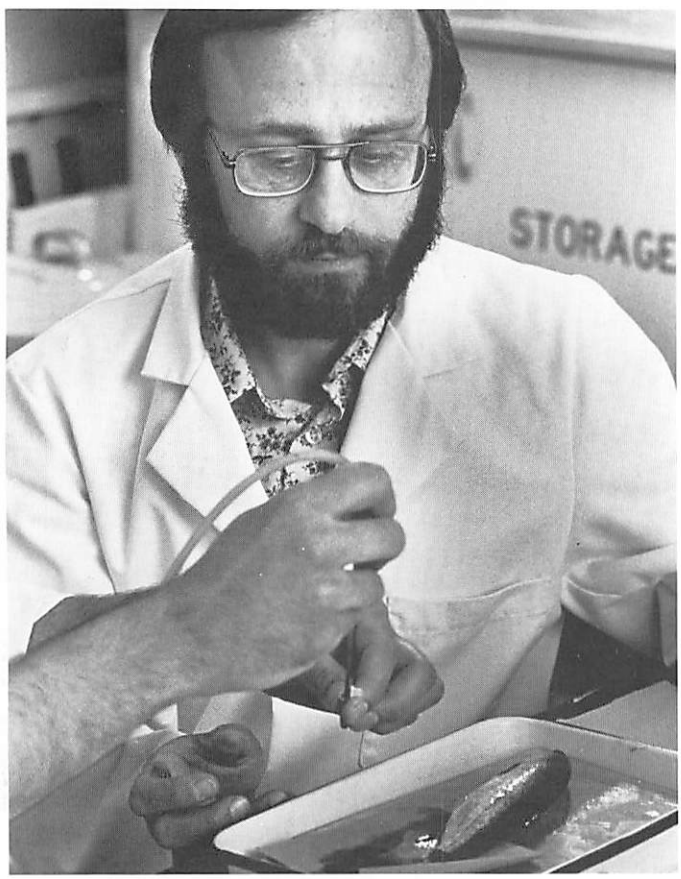
Alan Erdahl, research assistant, and Dr. Edmund Graham, inject a fish with progesterone, a hormone used to speed up the maturation process.

Analyzing Smelt and Lamprey Populations

Because of the previous decline in Lake Superior's fish populations and the relatively small populations of fish in the lake today, Sea Grant has funded studies to deal with the causes of the decline or with ways of preserving and enhancing the fish populations that dwell in the lake.

Two fisheries studies completed in 1980 studied genetic variability in smelt and sea lamprey populations. Both studies recommended that a "stock management approach" be used in dealing with the populations: in the case of the sea lamprey, in order to control it more effectively; in the case of smelt, in order to ensure its viability as a fishery resource.

Dr. George R. Spangler and Dr. Charles C. Krueger, in a one-year research effort funded with Sea Grant development money, identified genetic differences and geographical relationships among sea lamprey populations in Lake Superior. The sea lamprey, a predator of fish, is an invader from the Atlantic Ocean. It gained access to the upper Great Lakes following construction of the Welland Canal in the nineteenth century. Since the mid-1950s, the governments of Canada and the United States have cooperated in an intensive lamprey control program, mainly using chemical toxicants to kill the parasite.



Dr. Ira Adelman watches the work of a research assistant.

The researchers explain that the Great Lakes Fishery Commission now believes that more intensive lamprey control is necessary to allow full recovery of decimated fish stocks in the Great Lakes. Adequate biological information about the lamprey is essential for the development of alternative control methods and integration of management programs.

Through such studies as Spangler and Krueger's, management agencies have new tools to help them structure new strategies for controlling the lamprey. By identifying separate lamprey populations and learning how the populations relate to each other geographically, the researchers were able to suggest some new methods for dealing with the predator. For example, Spangler and Krueger suggested that sea lamprey control shift from individual streams to population regions, so that the rate of reestablishment following chemical treatment would be minimized. They also suggested that agencies should avoid planting new stocks of fish that might migrate within the lake, inadvertently carrying the parasitic lamprey with them and into new population regions.

In a three-year project concluded in 1980, Dr. Ira R. Adelman, Dr. Charles C. Krueger and Donald Schreiner, a fisheries graduate student, discovered that at least three separate populations of the abundant and commercially and recreationally important smelt may exist along the Minnesota shoreline. In studying the population characteristics of smelt in western Lake Superior, the researchers looked at age, size, sex ratio, growth rate and mortality rate of the fish, as well as analyzing and identifying individual smelt populations.

The researchers suggested that in order to manage the fish populations for maximum benefit, management should be directed at the separate populations, ensuring each one's likelihood of thriving in the lake. "Identifying separate populations of fish is important if you want to be able to develop a good management program," Adelman said. "There might be differences in adaptability to stress, in growth and in reproduction rates among the groups of fish. If these differences were not taken into account, one group might be overfished, another underfished—the overall genetic variability might be reduced."

Detailed data on the separate smelt populations will help management agencies decide how many smelt can safely be harvested each year and where harvesting can be done.

Bringing Up Bait Leeches

The lowly leech may be singularly unattractive to many people—but not to the person who fishes for Minnesota's famed walleyes. The dark, ribbon-like animal is comparable to the earthworm in its position in the ecosystem; and, like the earthworm, makes good bait. In fact, the ribbon leech is the bait of choice for most walleye fishermen, especially during the summer months.

Each spring, bait dealers harvest as many leeches as possible from Minnesota's ponds and lakes. The annual harvest nets upwards of 65 tons and brings in millions of dollars; each pound of leeches can cost as much as $15, making the animals a highly expensive form of protein.

The harvest typically occurs without much consideration of future availability of leeches from the same waters, and is guided by the desire of the dealer to get the maximum number of leeches as quickly as possible. Not only does such harvest without management often lead to a decrease in the number of adequately-sized leeches the following year, but once the animals are trapped, frequently the dealer can not keep them alive through the summer fishing season.

In 1979-'80 Dr. Hollie L. Collins, his colleague Linda L. Holmstrand, and UMD graduate student Jeff Denny, began to determine the effects of such unplanned harvesting and to discover if leeches could be cultured in semi-controlled environments such as ponds and in controlled laboratory settings. In their first year of Sea Grant funding, they found that they were indeed able to keep leeches alive in controlled environments, and in fact, were able to achieve leech reproduction in the laboratory and stimulate reproduction out of the natural phase.

They also determined the damaging effects of overharvesting in a natural environment. Through intensive harvesting of Rock Hill Pond on campus at UMD they discovered that the population of leeches in the pond dropped dramatically in the months following the harvest. They also discovered that those leeches that were harvested the following year tended to be too small to make adequate bait.

As one of the first Minnesota Sea Grant aquaculture research projects, the bait leech study promises results of significant economic value to the small business owners who deal in bait. It will also provide valuable data to such regulatory agencies as the Department of Natural Resources that need to know scientific information about the proper ways to harvest and manage bait leeches. Recreational fishermen will benefit through greater and season-long availability of their bait of choice for catching walleyes.

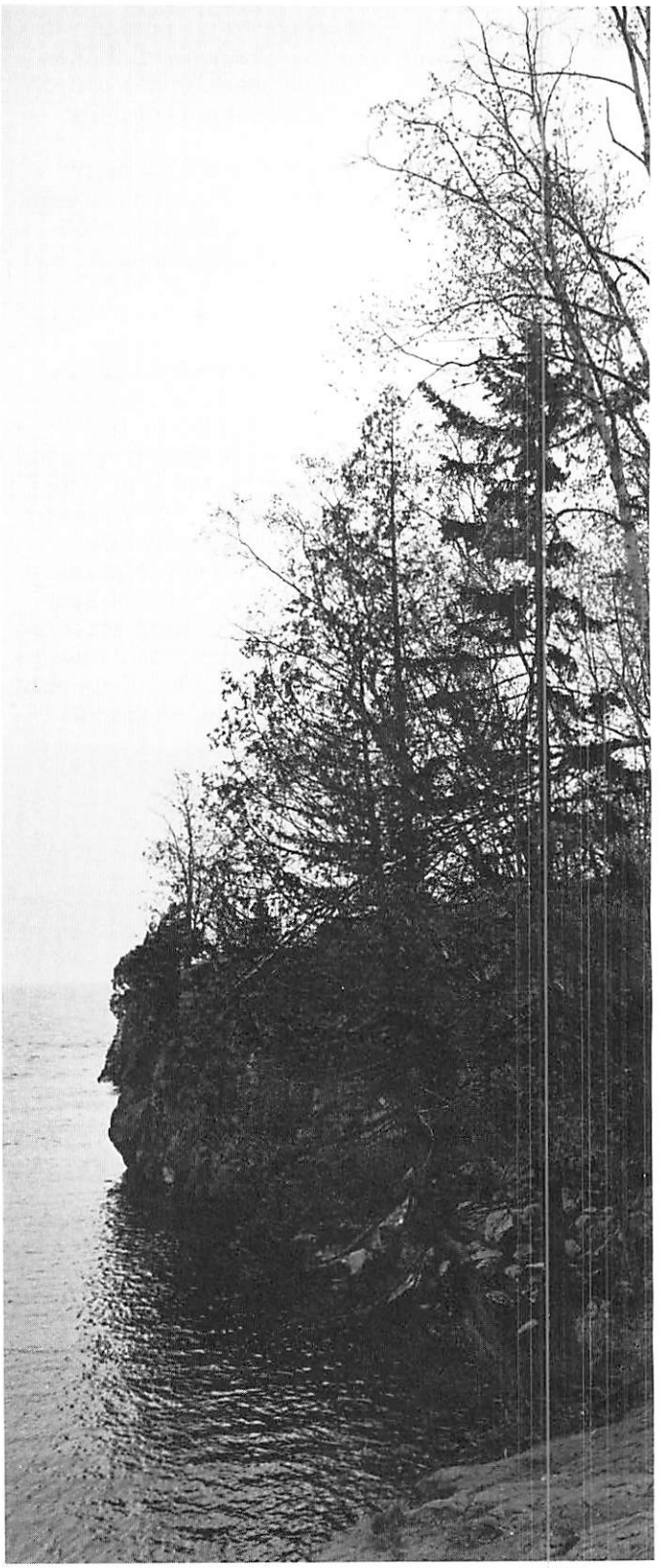
David Gilbertson, Jeff Denny, Linda Holmstrand and Dr. Hollie Collins collect leeches from a pond on UMD's campus.

Studying a Changing Coastal Environment

Lake Superior, as the Great Lake least influenced by humans, is "the closest thing we have to a large pristine lake in the United States," said Dr. Thomas C. Johnson, coordinator of Minnesota Sea Grant's Coastal and Environmental Processes Subprogram. Nevertheless, he emphasized, in order to protect its purity, it is absolutely necessary to have data about processes which affect the lake.

In spite of its relative cleanliness, some developments affecting Lake Superior should be of genuine concern, Johnson said. Taconite tailings deposited at Silver Bay have posed a serious threat to the environment and the health of the North Shore population. Microcontaminants, such as PCBs (polychlorinated biphenyls), have found their way from the atmosphere into the lake and its fish; some of the larger fish in the lake have concentrations of PCB that exceed management expectations. Tributaries to Lake Superior are particularly vulnerable to the effects of acid rain because of the lack of limestone in the drainage basin, although, Johnson added, Lake Superior's huge volume protects it against "going acid."

"From the state's standpoint," Johnson said, "Lake Superior is a tremendous natural resource in terms of its beauty and its potential for tourism. In order to protect it, we need scientific information." Such agencies as the Environmental Protection Agency, Minnesota Pollution Control Agency, Department of Natural Resources and the U.S. Army Corps of Engineers should benefit from scientific information provided through Sea Grant-funded projects in the Coastal and Environmental Processes research area.



Analyzing Potential Contamination From Coal and Chloroorganics

The Duluth-Superior Harbor is heavily traveled and heavily used. Not only is it the most active harbor within Lake Superior, but it is also ranked first among harbors of the Great Lakes in terms of tonnage transferred through its port facilities. Now, the harbor has become even busier. As the need for coal has grown to meet the United States' energy requirements, so has the shipping industry required to transport it from the west to the more heavily populated regions of the country.

For two years, through Sea Grant, Professors Robert M. Carlson and Ronald Caple have evaluated the effects of coal storage in the harbor on commercial and sport fishing in the nearby area. They were particularly concerned that the huge piles of coal awaiting passage on Twin Ports' docks were affecting water quality through leaching of PAHs (polynuclear aromatic hydrocarbons), known carcinogens. The researchers found, however, that intrusion of PAH from leaching was negligible.

PAH clings onto the coal, Carlson and Caple discovered, and so might other chemical compounds in the harbor. Coal, they speculated, might serve the same role as a charcoal filter: filtering out foreign substances from the surrounding environment, then holding onto them.

Directly across from the coal piles in the harbor sits a modern, new facility treating both regional sewage and wastes from industrial paper mills. The researchers turned their attention toward the potential interplay between the piles of coal and the Western Lake Superior Sanitary District (WLSSD) treatment plant. Their particular concern was whether the treatment plant was effectively handling chloroorganics used extensively in paper mill operations. Chloroorganics, compounds of carbons containing atoms of chlorine, typically do not degrade rapidly in the environment; some chloroorganics are potentially toxic to marine life and unhealthy for human consumption.

At the same time, Carlson and Caple wanted to study the close-to-immediate effect the new treatment plant had on the clean-up of the nearby St. Louis estuary. The estuary, a natural environment vitally important to at least 36 species of fish, as well as numerous varieties of birds, other animals and plants, had had severe pollution problems since the early 1900s when paper mill effluent began to affect its water quality. Fish failed to thrive in the estuary because of insufficient oxygen in the water; those that remained tasted bad because of the chemically-laden environment. WLSSD, which began operation in the winter of 1978-'79, immediately improved the estuarine habitat for fish populations. More fish moved into the estuary, and those fish that lived there began to taste better to fishermen who returned to the estuary in droves to catch walleye.

Yet, Carlson and Caple found in their research that the source of the taste and environmental problems may only have been relocated downstream from the estuary, closer to the mouth of the WLSSD treatment plant.

In assessing the treatment plant's impact, they found that while it removed many chloroorganics and other chemicals from the immediate estuary, the plant continued to transmit and even produce new chemicals. The immense quantities of chloroorganics used in paper mill bleaching processes could not be fully degraded by the treatment plant. In addition, the plant created a discharge of additional chloroorganics by using chlorine as a disinfectant in the treatment process.

Contamination of a Dynamic System

Lake Superior is constantly changing. The lake changes with the seasons and the weather. It responds to human-created influences. The changes may be dramatic, or practically invisible. Transformations in the lake might involve tons of sediment, or they might involve chemicals measured in the water according to parts per trillion.

Dr. Steven J. Eisenreich is studying the lake as a dynamic system. He is developing a model predictive of the changes in concentrations of organic chemicals within the lake system in response to "inputs" or "outputs." Using new analytical techniques, he is studying minute concentrations of microcontaminants: how they arrive in Lake Superior; how they move about and accumulate in the water; and how they leave the lake. Using PCB as a tracer, Eisenreich is looking at how other microcontaminants interact with air, water, sediment and organisms.

In 1980, Eisenreich reported on his Environmental Protection Agency and Sea Grant-funded research to the International Joint Commission's Great Lakes Science Advisory Board, which has subsequently made extensive use of his project's data. His report developed an assessment of airborne organic contaminants affecting the Great Lakes Basin.

"We have toxic problems in the Great Lakes—many of which we haven't even discovered yet," Eisenreich said. "We are unsure of how the lakes are responding." Through the

creation of his conceptual "dynamic" model and collection of data, he is attempting to analyze Lake Superior's response.

Although it is clear that microcontaminants primarily enter Lake Superior through atmospheric deposition, other sources include municipal and industrial effluents and tributary inflows. Once chlorinated hydrocarbons are in the lake, how do they behave? Do they later leave the lake? Eisenreich is studying such processes as biodegradation. He is analyzing possible removal mechanisms including water to air transfer, accumulation in sediments and flow of microcontaminants with the water into the lower lakes via the St. Mary's River.

Eisenreich is also asking how long the removal process takes. If, for example, input of PCBs is restricted, how long might it take for a resultant decreased concentration of the chemical in the lake's fish?

The microcontaminants that Eisenreich studies are carcinogenic. Some are toxic to fish or other marine life; some have a detrimental effect on biological processes such as photosynthesis.

"Lake Superior," Eisenreich said, "is particularly susceptible to contamination from both organic and inorganic pollutants. It exists in a dynamic balance, but that balance is fairly fragile." The lake, he added, is "so pristine that the removal methods which exist in other lakes are not operating as efficiently in Lake Superior." For example, in Lake Erie, which teems with algae, PCBs are capable of attaching themselves to the plants and sinking into the sediment. PCB concentrations in Lake Superior are not dissimilar from those in southern Lake Michigan—an area bordered by one of the largest cities in the country and considerable industrial development. Eisenreich explained, "More PCBs are entering southern Lake Michigan—but more are also being removed."

He anticipates that the results of his Sea Grant-funded research may lead to appropriate managerial responses from the federal government, as well as from the Departments of Natural Resources of the states bordering Lake Superior. Regulatory agencies may use the information to identify sources of pollution and stop discharge of microcontaminants into the lake, and health agencies may use it to assess potential health problems to humans resulting from consumption of contaminated lake products.

Dr. Steven Eisenreich

Uncovering the History of Harbor Sedimentation

The Duluth-Superior Harbor sits at the head of the Great Lakes' chain of harbors. From it go tons of iron ore, grain and coal—natural products of the western and midwestern United States—on ships bound for the East.

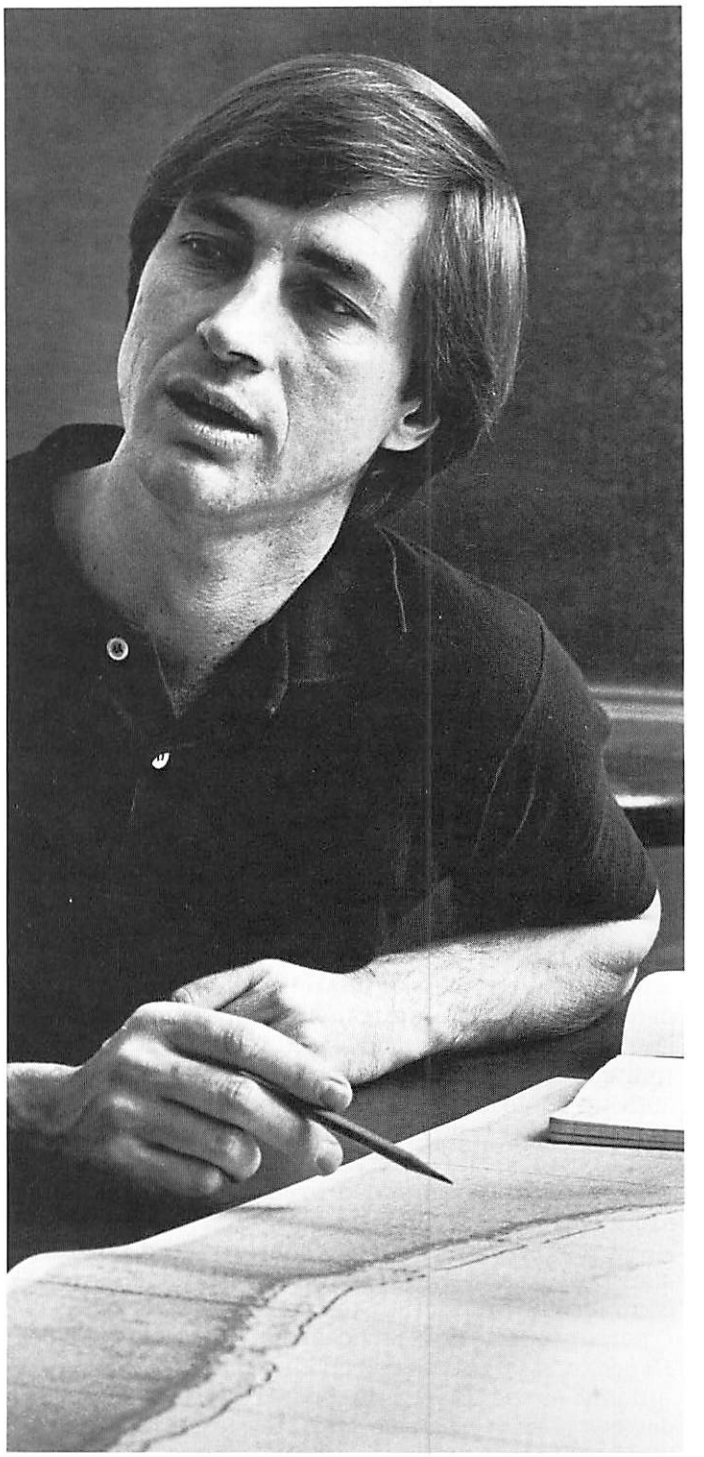
The harbor, which has served its important role for decades, requires active maintenance and expansion by dredging in order to ensure that the biggest vessels have adequate water depth to allow their passage.

Thomas C. Johnson and David G. Darby, geology professors at the University of Minnesota, Duluth, recognized some of the concerns facing the shipping industry and agencies such as the U.S. Army Corps of Engineers involved with managing the harbor. For example, some sediment is polluted with heavy metals; therefore, disposal of the sediments dredged in creating shipping channels is a major concern. Cost of dredging in the future is an issue. Choice of areas in the harbor that are the most logical as shipping channels is another issue.

In order to manage the dredging process more effectively, agencies need information about sedimentation in the harbor area of Lake Superior. Johnson and Darby's objective has been to understand the processes most important for distribution of sediments within the harbor.

The researchers have analyzed sedimentation in the harbor from the end of the last ice age some 9,500 years ago through the present by utilizing a variety of complex techniques. They collected samples of surface sediment and analyzed them for grain size, clay mineralogy and organic carbon content. They have conducted seismic reflection profiling to measure the thickness of the layers of sediment underlying the harbor. The process involves emitting shock waves from a sparker towed behind a research vessel; the wave bounces off sediment underlying the harbor, and the time required for the "echoes" to return indicates the thickness of sediment layers. The technique reveals the location of old river channels as well as sediment thickness, thus giving clues about the history of the sedimentation. The researchers have also pulled together data from other studies conducted by engineering firms who have bored into the harbor bottom to obtain sediment samples for foundation studies.

Johnson and Darby first received developmental funds through Sea Grant in 1978-'79. This year marked the first of full project funding: a year in which the researchers have completed most of their analyses of harbor sediment and have begun to see patterns in the distribution of sediment related to the surrounding environment.



Dr. Thomas Johnson

Learning About the Body's Reaction to Cold

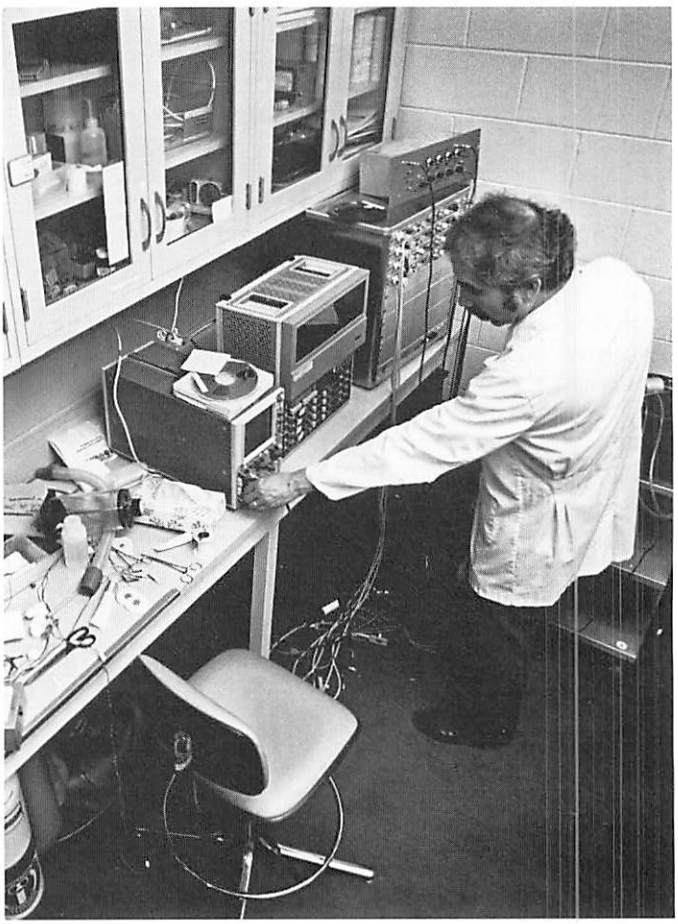
Lake Superior and Minnesota have in common temperatures frequently described as frigid. Even hardy Northerners frequently hesitate to swim in Lake Superior's waters, for swimming is not only uncomfortable but possibly dangerous. Hypothermia, or lowering of internal body temperature, is cited as a major contributing factor in a large proportion of drownings in cold bodies of water. It is becoming a cause for increasing concern as more people use Lake Superior for recreation and as the Great Lakes' commercial shipping season is extended into the colder months.

Duluth's University of Minnesota campus serves as home for a Hypothermia Laboratory developed by Dr. Robert S. Pozos, physiology professor at UMD's Medical School. Minnesota Sea Grant funding has enabled Pozos and several of his colleagues to develop the lab and conduct research quantifying the human body's response to cold. First funded in 1978-'79, the project's second year has allowed Pozos to develop data dealing with shiver: how do different people shiver? Why do some people not shiver at all? Why do different people shiver in different parts of their bodies? How do external variables, such as alcohol, dress, or fatigue, affect people's responses to the cold?

Although hypothermia has long been recognized as an important factor in cold-related deaths, seldom has it been studied so thoroughly in such an extensive facility designed specifically for hypothermia research. The young Hypothermia Lab, housed in UMD's Medical School, includes an immersion tank, a treadmill and an environmental chamber, along with digital monitors, a spirometer and other data-gathering equipment designed for testing individuals' responses to cold. All subjects who sign up to go through the intensive experimental regimen undergo extensive physical testing before they are immersed in either cold water or air. As an added precaution, physicians are always nearby during testing.

Pozos' research project has produced not only significant data, but also innovative designs for commercial production of life preservers ("personal flotation devices" or "PFDs"). Hypothermia Lab research has directly influenced the design of several types of flotation devices sold by Stearns Manufacturing Company, St. Cloud, Minnesota, including special PFDs for the handicapped. Minnesota Sea Grant's investment in hypothermia research has led to production of new types of PFDs which have contributed to total national sales of approximately $15 million for Stearns Manufacturing. In 1979-'80, the U.S. Coast Guard allocated Pozos funds through Sea Grant to support the analysis of life preservers for the physically handicapped. In addition, the Hypothermia Lab at UMD is an Underwriters Laboratory approved testing site for PFDs.

Through Hypothermia Lab research such as Pozos', hypothermia may cease to be a mystery with which rescue workers are ill-equipped to deal. Data derived through Sea Grant funded research will ultimately indicate the least harmful ways to warm up subjects experiencing hypothermia. And, those who use the cold waters for commerce or recreation will be more aware of protecting themselves against potential dangers they face in working or playing on the water.



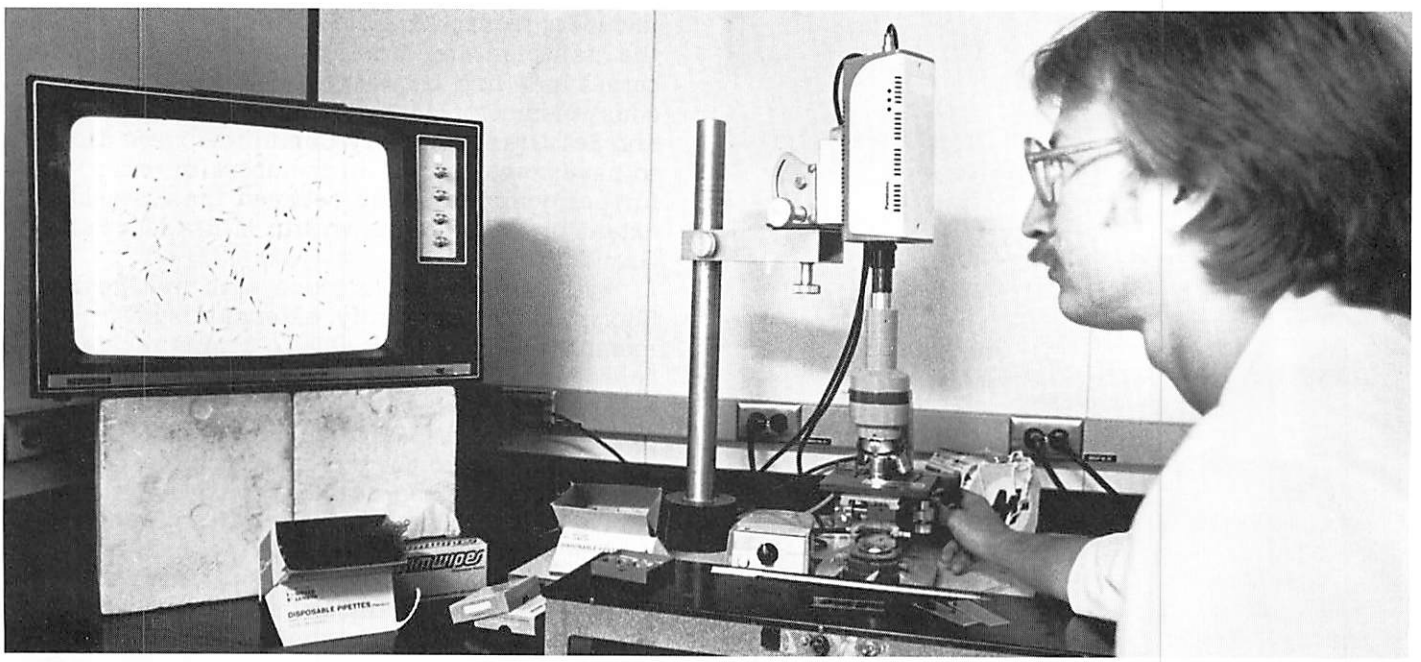
Dr. Robert Pozos adjusts the equipment in the Hypothermia Laboratory.

Students' Work Enhances Sea Grant Research

Among those who have benefited directly from Sea Grant funding for research projects are graduate students who have had the opportunity to work as trainees with principal investigators. Through stipends and tuition waivers granted by the Graduate School, trainees have the freedom to concentrate full-time on their research and training. Their work has enhanced many Sea Grant research projects. The efforts of graduate student trainees, guided by professionals in such fields as animal physiology, hypothermia research, geology and fisheries biology, have allowed many research projects to progress with greater speed, greater breadth and fresh ideas.

The national Sea Grant Association has recognized the quality of Minnesota Sea Grant's trainees. The association awards 14 students per year special recognition for meritorious research; Minnesota is one of 28 Sea Grant programs across the country. In two years, Minnesota trainees have received three awards—an unusually high number for one program. In 1979, David Erdahl, a Ph.D. candidate training under Dr. Edmund Graham, received the prestigious award. The association recognized two Minnesota students in 1980: Charles Landmesser, a Ph.D. candidate training under Dr. Thomas Johnson, and Paul Iaizzo, a master's degree student working with Dr. Robert Pozos.

David Gilbertson, undergraduate assistant, collects leeches for use in the laboratory.

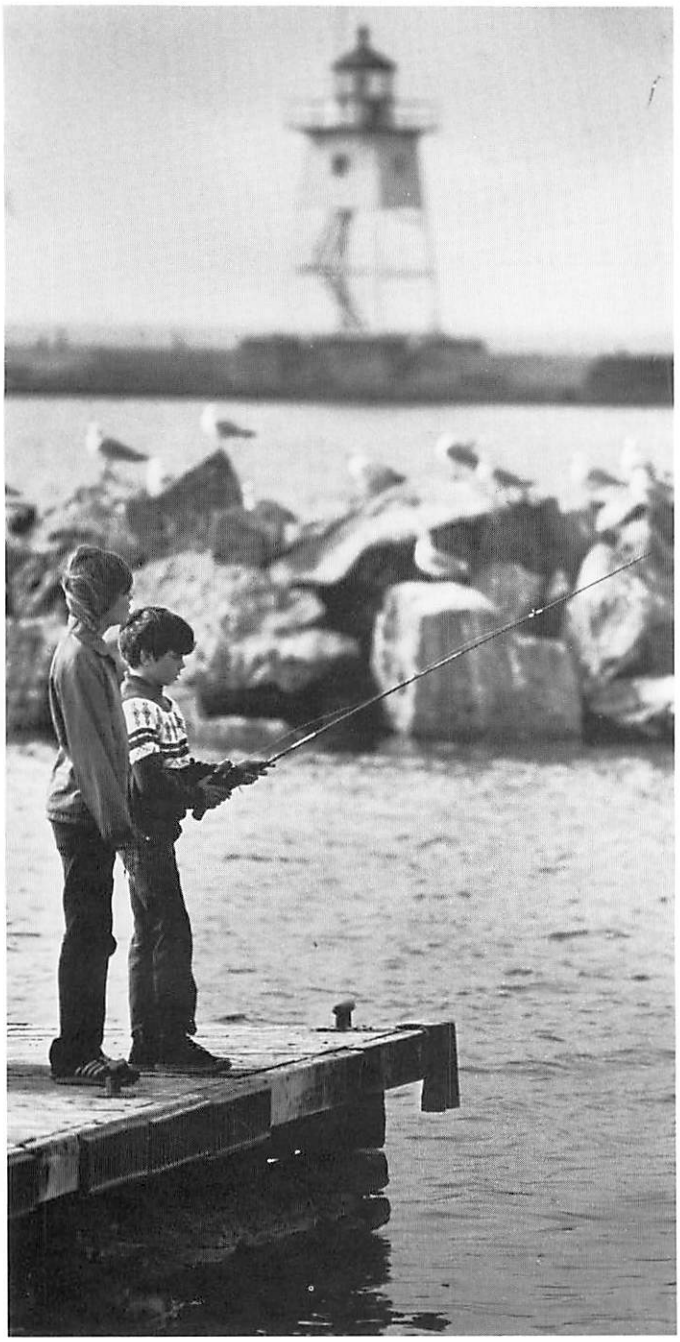


David Erdahl, research assistant, observes motile sperm on a television screen connected to a microscope in the cryopreservation lab.

Extension: Meeting the Needs of Coastal Constituencies

Sea Grant Extension, formed in 1974 as the Minnesota Marine Advisory Service, is the oldest segment of Minnesota's Sea Grant Program. Like the research component, however, it continues to grow and develop as it responds to the needs of the various communities that tour, live, or work on the North Shore and Lake Superior.

The extension effort is staffed according to specific program areas. Its agents deal with fisheries (both commercial and recreational), coastal engineering, tourism, recreation and marine trades, and marine education. Its communications staff creates publications, audiovisuals and public relations programs in order to further awareness of Lake Superior and coastal resources, marine-related issues and specific Sea Grant projects.



Extension, administratively part of the University of Minnesota's Continuing Education and Extension Division and Agricultural Extension Service as well as Sea Grant, is perfectly placed to reflect the needs of many different communities and deal with their concerns. Each staff member serves as an educator for his or her constituency: formal continuing education programs have included an intensive five-day fishery biology course for commercial fishermen and the design and initiation of a marine education course offered at UMD. Some extension programs, such as those involving demonstrations of fixing fish, have had Sea Grant agents work directly with Agricultural Extension Service home economists.

The extension component of Minnesota Sea Grant is based on the Duluth campus of the University of Minnesota—a logical site for a program that needs to interact daily with the Lake Superior coastal community. A nine-member Advisory Council, composed of three members from each shore-fronting county, helps the staff plan and develop new programs and serves as a link between the staff and its constituencies. The Extension Advisory Council and Sea Grant Advisory Committee were designed to have some overlap in members in order to further communication between the research and extension components within Minnesota Sea Grant.

By being directly in touch with the North Shore "user" community, extension staff members are uniquely able to communicate concerns to Sea Grant researchers with specific areas of expertise enabling them to gather data to address the issues. In turn, research results can come back to the community in a straightforward and usable way through the efforts of extension's agents and communicators.

The past year marked growth in several program areas as two new agents in the important fisheries and tourism/recreation components settled into their jobs and a new program area, coastal engineering, became part of extension. Jeffrey Gunderson and Thomas Mack, the two new agents, had joined Sea Grant

Lawrence, the Talking Lake Trout, addresses a group of children. (Photo courtesy the Janesville Gazette.).

extension in early 1979; this year marked the first full year in which they were able to do comprehensive year-round program planning. Bruce Munson, marine education agent, continued to develop programs in his area, serving children and teachers through a variety of methods.

Ryck Lydecker, extension communicator, reached new audiences for Sea Grant through the creation of a series of fact sheets, slide-tape shows and three publications dealing with varied topics, from boat launching to cookery. Lydecker joined the National Oceanic Atmospheric Administration of the U.S. Department of Commerce late in the year, and Nancy Berini came to Sea Grant Extension as its new communicator.

Dale Baker, director of extension, had served as acting director of the entire Sea Grant program at Minnesota for two years. Once Donald McNaught arrived as director in June 1980, Baker was able to devote all of his attention once again to extension and begin developing coastal engineering—his academic specialty—into an extension program component.

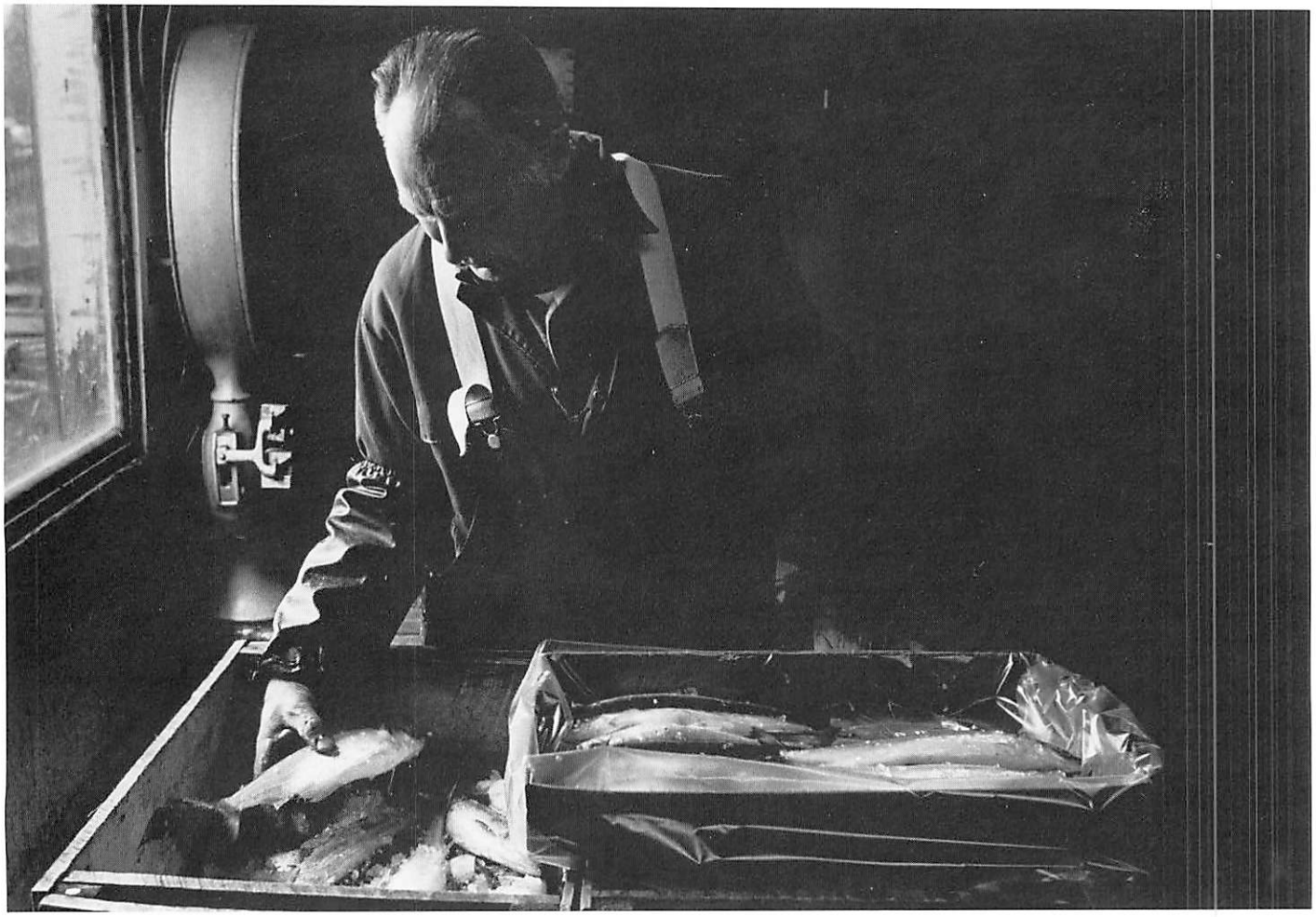
Reaching Many Publics

Sea Grant Extension reached tens of thousands of Minnesotans in 1979-'80 through such varied means as "Lawrence the Talking Lake Trout," conferences and classes, and the more conventional media of newsletters, newspaper articles, radio and television.

"Lawrence," a five-foot long fiberglass lake trout with electronic innards, talked to more than 100,000 people at the Minnesota State Fair about fish, the Great Lakes, and, particularly, Lake Superior. He also began traveling around the country talking to other groups, accompanied by a videotape which explained how to set him up and use him as an educational vehicle.

The Seiche, quarterly newsletter for Sea Grant, had new company in the form of **Superior Advisory Notes,** fact sheets serving audiences in boating, fisheries, marine trades and education. The communications staff also published **A Boater's Guide to Lake Superior Launch Ramps,** a booklet; **Fish Tails,** a species identification flyer; and **Kitchi Gami Cookery,** a Great Lakes Sea Grant project created in cooperation with the South Saint Louis County Extension Office. The cookbook included 50 freshwater fish recipes collected from homemakers in Minnesota, Wisconsin and Michigan; extension home economists kitchen tested each recipe.

Thomas Mack, tourism/recreation agent, was "on the air" several times each week during the summer months. His radio show, "The Lake Superior Recreation Report," broadcast by two Duluth-area stations, evolved from a calendar of events format into both a listing of activities and a description of different types of recreational activities or consumer tips. The radio stations estimated that Mack's show reached more than 40,000 listeners each week.



In addition to airing the show in the Duluth area, Mack sent his scripts to other stations throughout the state and to local newspapers.

Each of the agents spent considerable time conferring with individuals over the year: Mack worked on a one-to-one basis with resort and lodging businesspeople; Jeffrey Gunderson, fisheries agent, went out with commercial fishermen trying the Sea Grant-developed monofilament trapnet; Bruce Munson, marine education agent, worked with teachers through university educational methods classes and inservice training programs, explaining how to integrate marine-related topics into their curricula. Gunderson and Munson put on numerous demonstrations of "fixin' fish," showing people throughout the state how to handle and prepare freshwater fish, including pickling pink salmon.

Sea Grant Extension evolved into a significant community resource for slides and black and white photographs on marine-related subjects. By 1979-'80, the program had a bank of slide/tape programs on hand, one of which received particular recognition during the year. "A Living from the Lake," a history of commercial fishing produced in cooperation with the Minnesota Fish Producers Association and the Northeast Minnesota Historical Center, was selected for inclusion in the oral history archive at the University of California, Berkeley. Dr. Willa Baum, a nationally prominent historian, cited the program as a particularly good example of the use of oral history.

Fishery Biology Course

For five intensive days in mid-winter, fishermen from Minnesota and Wisconsin studied the subject of their trade in a fishery biology course developed cooperatively by the two states' Sea Grant Programs.

The course included lectures, laboratory work, special evening programs and the chance to meet colleagues. It covered such topics as lake productivity, species interaction, the stock concept of fisheries management and more. Those who attended the course gave it high marks. "The whole thing was great," commented one fisherman. Another said, "It provided an excellent and comprehensive review of fishery

biology along with new concepts in biology and management." Still others said a highlight was the opportunity to meet other people in the same business. Because of its success, staff decided to run similar programs in future years.

Camps Designed for Learning—and Fun

Two special summer camps, one a day camp and the other an overnight camp, involved hundreds of kids from throughout Minnesota. Designed to meet the needs of completely different groups of children, the two camps, planned and organized by Bruce Munson, marine education agent, dealt with different themes as well.

Sea Camp, which served approximately 42 children per week for eight weeks, was designed in 1980 to teach predominantly low-income children from surrounding areas about the Native American heritage and the North Shore. The children learned about Indian legends treating Lake Superior and its coastal area. They made driftwood floats based on the movie, "Paddle to the Sea," in which a canoe floats through the Great Lakes to the Ocean. Each float had attached to it a cloth tag with a return address; a few floats returned to Duluth had traveled as far as Grand Portage. Approximately 19 percent of the children who attended Sea Camp were from minority groups. The camp was cosponsored by 4-H.

"A Superior Experience," a one week overnight camp held at Duluth's College of St. Scholastica, brought in 61 4-H junior leaders from throughout the state to learn about the role of Lake Superior and the Duluth-Superior Harbor in connection with the Minnesota economy. The theme of the camp was Lake Superior as a focal point, drawing the natural resources of Minnesota together for commerce.

Munson also developed and coordinated a one-week program on limnology and aquatic careers for American Indians in 1980. The program was designed as a summer school course taught through the Little Red School House in Duluth, an alternative high school for Native Americans.

Stabilizing the Dunes

A spit of land juts into Lake Superior, forming a natural barrier for the Duluth-Superior Harbor. The piece of land, locally known as Park Point, is large enough to have a residential community enjoying the beauty of the locale—but also witnessing erosion of Park Point's dunes.

Sea Grant Extension, in cooperation with the Soil Conservation Service, Duluth Department of Parks and Recreation, Agricultural Extension Service and Park Point Association, initiated a dune stabilization project in 1979-'80. The project's aim is to plant various types of vegetation in order to find out which varieties are able to stabilize the dunes.

Once the planting is completed, the various types of vegetation will be monitored to see which could be recommended for full-scale community planting. The plants will be evaluated not only for their ability to stabilize the environment, but also for their beauty, cost and degree of maintenance necessary to keep them healthy and hardy. As local residents develop an understanding of various types of vegetation and their abilities to stabilize the dune, they will assume full responsibility for the project. Sea Grant thus fulfills its role of enabling residents of the coast to help themselves through increased awareness and understanding.

Fiscal Year 1980 Budget Summary

For fiscal 1979-80, 51 percent of the Minnesota Sea Grant Program was funded by the national Office of Sea Grant (NOAA, Department of Commerce), 14 percent by the Minnesota State Legislature, 27 percent by University of Minnesota matching dollars, and 8 percent by U.S. Coast Guard pass-through funds.

	NOAA Office of Sea Grant	Pass-Through Funds	State Legislative Special	University Match
Research	$122,408	$54,987	$ 31,279	$112,771
Education	59,648		3,670	10,669
Extension	122,864		31,982	62,393*
Program Management and Development	50,078		33,069	7,000**
Subtotal	$354,998	$54,987	$100,000	$192,833
Great Lakes Network	6,000			4,701
Total	$360,998	$54,987	$100,000	$197,534

*Contribution of Graduate School

**Includes salary support from the Agricultural Extension Service and Continuing Education and Extension

Research Projects

Title	Investigator(s)	Support: NOAA Sea Grant Funds	Support: Legislative & University Match	Status
Population Characteristics and Stock Identification of Western Lake Superior Smelt	Ira Adelman	$ 5,432	$ 7,900	Completed
The Role of Fatty Acids in the Reproduction of Fish	Robert Glass	10,454	5,514	Completed
Preservation of Gametes of Freshwater Fish	Edmund Graham	7,300	26,910	Ongoing (year 2)
Bait Leech, **Nephelopsis obscura**, Culture and Management	Hollie Collins	11,177	9,404	Ongoing (year 1)
Immersion Hypothermia	Robert Pozos	24,150	20,613	Ongoing (year 2)
An Evaluation of the Possible Detrimental Effects by the Introduction of Organic and Second-Order Organics on Commercial and Sport Fishing in Lake Superior	Ronald Caple; Robert Carlson	8,726	17,489	Completed

The Recreational Demand for Development of Harbors of Refuge in Western Lake Superior	Leo McAvoy, Jr.	3,163	3,231	Completed
Microcontaminant—Air, Water, Sediment, Biota Interactions in Lake Superior	Steven Eisenreich	13,122	13,927	Ongoing (year 1)
Sedimentation in Duluth-Superior Harbor	Thomas Johnson; David Darby	7,314	8,124	Ongoing (year 2)
Genetic Identification of Sea Lamprey Populations in Lake Superior	George Spangler	10,907	9,833	Completed
Early Life History and Identification of Larval Coregonine Fishes in Western Lake Superior	James Underhill	13,663	14,875	Ongoing (development)
Evaluation of the Efficacy of Personal Flotation Devices for Physically Handicapped Individuals	Robert Pozos	[54,987]*	[18,339]*	Completed
Spatial and Temporal Patterns of Habitat Utilization by Young-of-Year Walleye in the Duluth-Superior Estuary	Jack Hargis; Philip DeVore	7,000	6,230	Ongoing (development)
Total		$122,408	$144,050	

*U.S. Coast Guard Pass-through Funding—not included in total

Minnesota Sea Grant Staff—1979/80

Director—Donald C. McNaught
Acting Director (until June 1980) and Extension Director—Dale Baker
Marine Education—Bruce Munson
Marine Recreation—Thomas Mack
Fisheries—Jeffrey Gunderson
Public Information (Extension)—Ryck Lydecker, Julianne Agnew, Nancy Berini
Public Information (Management Program)—Linda Camp, Roberta Berner
Secretaries—Judith Goetzke, Judith Zomerfelt
Accounts Assistant—Sandra Glantz
Secretarial Assistant—Barbara Odden

Minnesota Sea Grant Committees—1979/80

Council

Robert L. Heller, Provost, University of Minnesota, Duluth
William F. Hueg, Jr., Deputy Vice President and Dean, Institute of Agriculture
Warren E. Ibele, Dean, Graduate School
Henry Koffler, Vice President, Academic Affairs
C. Peter Magrath, President, University of Minnesota

Advisory Committee

Roland Abraham, Director, Agricultural Extension Service
Charles Burrows, Chief of Fisheries, Minnesota Department of Natural Resources
Richard Caldecott, Dean, College of Biological Sciences
Kenneth A. Carlson, Vice President, Minnesota Power and Light Company
Keith Huston, Director, Agricultural Experiment Station
Warren E. Ibele, Dean, Graduate School
Lenore Johnson, County Commissioner, Lake County
Thomas Kalitowski, Chairman, Minnesota Water Planning Board
Bruce Kerfoot, Past President, North Shore Resort Keepers' Association
Harold Miller, Dean, Continuing Education and Extension
Donald Mount, Director, Environmental Research Laboratory
George Rapp, Dean, College of Letters and Science
Thomas Scott, Director, Center for Urban and Regional Affairs
Stanely Sivertson, Owner, Sivertson Bros. Fisheries
Roger Staehle, Dean, Institute of Technology

Extension Advisory Council

Eugene Bergman, Past President, Lake Superior Steelhead Association
Edwin Drill, Owner, Knife River Marina
Blaine Fenstad, Member, Board of Directors, North Shore Association
Janet Green, Member, Duluth Township Planning Board
Virginia Hills, Member, N.E. Minnesota Environmental and Economic Council
Lenore Johnson (**ex-officio** member), County Commissioner, Lake County
Carl Odmark, Owner, Cascade Lodge, Grand Marais
Kenneth Olson, Commissioner, Cook County
Bruce Simons, Member, Cook County School Board and Manager, Lutsen Resort
Stanley Sivertson, Owner, Sivertson Bros. Fisheries

New Publications Available

The materials listed are available free of charge except where noted. Contact:

Sea Grant Extension Program
109 Washburn Hall
University of Minnesota
Duluth, MN 55812
(218) 726-8106

or

Sea Grant Program
435 Animal Science/Veterinary Medicine
University of Minnesota
1988 Fitch Avenue
St. Paul, MN 55108
(612) 373-1708

General Publications

Kitchi Gami Cookery ($1.00)
A Boater's Guide to Lake Superior Launch Ramps ($1.00)
Fish Tails (an identification guide to Lake Superior trout and salmon species)
Fishing the St. Louis River (guide to rules, regulations, harbors and boat launch sites)

Superior Advisory Notes

PCBs in Western Lake Superior—Can We Eat the Fish?
Getting a Grip on Marine-Related Insurance
North Shore Weather Wisdom

Reprint Series

Preservation of Gametes of Freshwater Fish
Cryo-Preservation of Spermatozoa of the Brown, Brook and Rainbow Trout
High-Pressure Liquid Chromatographic Determination of Hypoxanthine in Refrigerated Fish

Research Reports

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

Genetic Identification of Sea Lamprey, Petromyzon marinus, Populations from the Lake Superior Basin

Application of Controlled Atmospheric Storage to Extending the Shelf Life of Whole Processed Fresh Fish

The Seiche

(A quarterly newsletter published by Sea Grant Extension providing information about the Minnesota coast of Lake Superior.)

A report on the University of Minnesota Sea Grant Program for the period October 1, 1979 to September 30, 1980, published by the Minnesota Sea Grant Program, 435 Animal Science/Veterinary Medicine, University of Minnesota, 1988 Fitch Avenue, St. Paul, Minnesota 55108.
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