ANNUAL REPORT
1972-1974

In 1974, the University of Wisconsin celebrated a birthday. For 125 years, the university has been in the business of educating students, conducting needed research and and offering its expertise and services to the people of Wisconsin.

Although the University of Wisconsin Sea Grant College Program can't claim this longevity as yet, it can claim this tradition. Though the program will only celebrate its seventh birthday in June of 1975, its achievements to date... (continued on page 1)

Covering the Period September 1, 1972 - August 31, 1974

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The University of Wisconsin Sea Grant College Program is sponsored by the National Oceanic and Atmospheric Administration's Office of Sea Grant, U.S. Department of Commerce, and by the state of Wisconsin.

Introduction

...HAVE LARGELY REFLECTED THE UNIVERSITY'S LONG STANDING EXCELLENCE AND THESE ACHIEVEMENTS WERE INSTRUMENTAL IN MAKING THE UNIVERSITY OF WISCONSIN THE NATION'S SIXTH SEA GRANT COLLEGE IN SEPTEMBER OF 1972.

Operated as a system-wide university program, the Sea Grant Program has led the way in affecting significant and far-reaching changes in the university's approach to environmental problems. By combining the diverse functions of research, education and public service under one unified operation, the Sea Grant Program has brought an unprecedented array of university talent to bear on Great Lakes problems and marine affairs in general.

This report covers Sea Grant activities from September 1, 1972 through August 31, 1974, and delves specifically into what has been accomplished during that time. Over this two-year grant period more than 100 UW faculty members and nearly 300 graduate and undergraduate students have been involved in the program. More than 100 Sea Grant projects have been carried out on seven UW campuses — Madison, Milwaukee, Green Bay, Parkside, Superior, Extension and the two-year Marinette campus — and at the Medical College of Wisconsin.

The research discussed in this report grew out of an extensive planning effort which took place during the summer of 1971. From a comprehensive and penetrating study of Sea Grant objectives and Great Lakes problems, seven research subprograms were developed and initiated during the 1972-73 grant year — Biological Resources and Microcontaminants; Geo-Environmental and Mineral Resources; Electric Power; Water Quality; Green Bay; Ports and Commerce and Policy Studies. The following grant year — 1973-74 — represented basically a continuation of these subprograms with some new thrusts in the areas of coastal zone management, erosion, aquaculture and diving. These new directions grew out of progress in strong research programs and out of new areas of need which had, in the meantime, emerged on the state and local scene. Supporting the research efforts during these two grant years have been strong subprograms in advisory services and education.

The progress of projects in these individual subprograms is well covered in the following report. Perhaps more important, though, has been the steadily increasing interaction of Sea Grant investigators with state and federal agencies, industries, other universities and the general public. Though the program has not grown appreciably in size during the past two years, it has grown exponentially in terms of outside interaction, coherence and responsiveness to local, state and national research needs.

This is because the Sea Grant College Program has provided the flexibility for researchers to move across campus or disciplinary barriers and work together to solve marine-related problems. In so doing, it has created the climate for coastal zone work; acted as a liaison between state agencies, university units and other groups; raised public consciousness of the Great Lakes and their resources; provided people, through its educational programs, who have been hired by agencies and industry; and taken the leadership in research, anticipating certain research needs — like those for new products from underutilized Great Lakes fish species or coastal zone management research — long before other groups have even channeled their energies in those directions.

As a result of this activity, the state and university commitment to the Sea Grant Program remains strong. The state legislature has continued to match the federal grant with a special appropriation so that the full 50 percent matching requirement is being met by programmable funds. In addition, industry and private support for the program has continued to increase, generating in total far more than the 50 percent matching funds required by the federal government.

In general, the past two years have been the most productive ones in the history of the University of Wisconsin Sea Grant College Program. It may be a history which goes back only seven years, but with continued progress like that reflected in this report, Sea Grant in Wisconsin has a promising future.

Biological Resources

The fisheries of the upper Great Lakes are in difficult straits. Commercially valuable fish stocks are declining while demand for fish is rising, along with the worldwide need for food. Meanwhile, a growing and vocal Great Lakes sports fishing community is competing with the commercial fishermen for the available fish and are commanding increasing attention and favor from state regulatory agencies.

As for the fish stocks themselves, they continue to suffer under the stranglehold of the exotic saltwater species, namely the sea lamprey and alewife, which invaded the lakes more than 20 years ago. There is evidence that the parasitic sea lamprey is once more increasing in numbers, and alewives continue to comprise more than 90 percent of the biomass of Lake Michigan.

Like a pall hanging over this whole scene, is the continuing problem of water pollution which threatens to damage both the sports and commercial fisheries, not to mention the fragile lake ecosystem.

With these circumstances has come a more pressing need for better scientific information on which to base management decisions. Over the past two years, Sea Grant scientists have proven responsive to this need and have made great progress:

- in developing new management practices to handle the stocks of sports fish — trout and salmon — which are being planted in increasing numbers in the Great Lakes.
- in offering alternatives for the faltering commercial fishing industry by coming up with new food products which could be manufactured from presently underutilized Great Lakes species; and by devising a walleye and perch aquaculture operation which may offer a new source of fish for the upper Midwest.
- in developing techniques to better assess the fish resources of the lakes — presently unknown in any quantitative terms — and to better understand the population dynamics of the lake.
- in determining the occurrence of micro-contaminants in Lake Michigan and their effects on the lake's biological resources as well as their possible effects on man.

The Taming of the Salmon

One of the most notable Sea Grant successes of the past two years has been the salmon imprinting project. The imprinting techniques developed by UW researchers have now been adopted for management purposes by the Wisconsin Department of Natural Resources.

Commercial fishing for whitefish on Lake Michigan's Green Bay.

UW-Madison scientists, under the direction of A.D. Hasler, Ross Horrall and Jon Cooper, have been studying salmon migration for many years to find out how fish find their home streams after migrating across long distances. Within the past two years, the team has proven Hasler's hypothesis that salmon rely on odors to guide them to their home stream once they are in the region of the home river. They have since gone on to apply that knowledge to fish management practices.

Their method involves imprinting young, hatchery-reared salmon to synthetic chemical odors and then drawing them back years later as spawning adults to any desired location simply by adding small amounts of the imprinting chemical to the water. Once lured there, the fish can be harvested by sports or commercial fishermen or stripped of spawn for the hatchery.

Other experiments in the field and in the laboratory further support the conclusion that the fish are being attracted back to the "artificial" odor. In one experiment, the fish were exposed to a variety of test odors including rose oil, distilled water and creek water, as well as the imprinting chemical. Electroencephalogram (EEG) readings revealed that the responses of the experimental fish were most intense when they were tested with the imprinting chemical odor. The control fish did not respond to this odor.

So far, this imprinting experiment has been successfully carried out with both salmon and trout. During the spring of 1972, the scientists exposed 18,200 young fish to the imprinting chemical and left an additional 20,000 fish unexposed to serve as a control group. They then released the fish at three different points along the Lake Michigan shore.

In the fall of 1973, 1,485 imprinted fish returned as spawning adults to Oak Creek in south Milwaukee, an artificial home stream to which the imprinting chemical had been added. In contrast, only 163 control fish returned.

Impressed by these experiments, the Wisconsin Department of Natural Resources (DNR) has decided to use the imprinting technique in their fish management operations.

Last spring, with the help of Wisconsin scientists and students, the DNR planted 100,000 imprinted trout and salmon. They plan to go into full-scale imprinting operations by the spring of 1976.

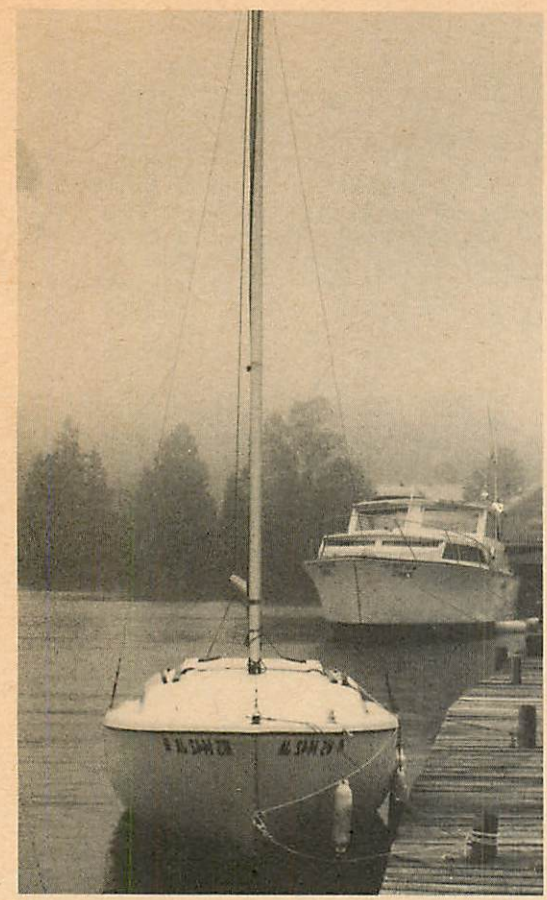
The DNR expects to save substantial amounts of money using this technique. With it they can draw the lake trout and salmon, which do not reproduce naturally in the Great Lakes, back to any site they chose in order to collect fish eggs and milt for the hatchery. This technique eliminates the need for constructing costly holding ponds ($7,500 and up) and for policing those holding ponds already in existence.

Imprinting will also enable the DNR to spread the sports catch out along more areas of Lake Michigan's shoreline. Currently, it is concentrated in only a few areas. In fact, last summer when fishing was poor off the breakwater in Manitowoc, Wisconsin, the DNR simply gave the water a shot of imprinting chemical and the fishing picked up right away.

The application of this imprinting technique is not confined to the Great Lakes, however. Chemical imprinting could be carried out on any coast which boasts an abundance of salmon and, as a result, this project has attracted international attention.

In 1974, salmon imprinting was the subject of two, half-hour television programs produced by the U.S. Information Agency and broadcast in 84 countries. Independent of this, a film crew from a major Japanese television station came to Wisconsin last fall to make a documentary film about Hasler's life and research. The salmon research team has also been invited to the Baltic Sea to do tracking and imprinting studies there.

Japanese filmmakers shoot footage of U.W. imprinted salmon which have returned to spawn in an "artificial" home stream in the course of making a documentary for Japanese television on the life and research of UW—Madison limnologist Arthur D. Hasler.



For the Sportsmen

Developing a new, more efficient stocking procedure for the DNR is not the sole extent of recent Sea Grant activities relating to the Great Lakes sports fishing industry.

Since many of the decisions being made in the management of this fishery revolve around the industry's economic impact on the state and local communities, several UW economists and recreation experts have been looking at sports fishing from that point of view.

Robert Ditton and William Strang recently completed an in-depth analysis of the charter boat fishing industry along Wisconsin's Lake Michigan coast, in which they characterized charter boat operators and their customers — i.e. their numbers, background, economic status, etc. — and analyzed the industry's success so far. They found that, to date, it has been a great success from the sports fishing community's point of view but has not proven financially successful for the operators, who make barely enough money to cover their expenses each year. This information has already been used by the sports fishing industry and the state in deliberations over sports fishing management policies.

In a broader study of sports fishing, economist Douglas Booth is in the process of surveying a random sample of Lake Michigan sportsmen to ascertain the relative size of the sports fishing community: the background and economic status of its members; and how much they spend each year in their quest for the big salmon and lake trout. Though his findings are as yet preliminary, Booth has already supplied some information to sports fishing groups and the state DNR.

Another kind of information important to the sportsman deals with the basic questions of how and where to catch fish and what to do with them once they are caught. In this respect, the Sea Grant Program has produced several very popular public information booklets during the past two years — among them, "Getting the Most From Your Great Lakes Salmon," "Ice Fishing," "The Fish of Lake Michigan," "Fish Filleting" and "Fish and Seafood — Dividend Foods." In all, over 25,000 of these publications were distributed in 1974 alone, and they continue to be in great demand for sports shops, fishing clubs and conferences.

Sucker Sticks and Great Lakes Sardines

But the sportsmen aren't the only ones who have commanded the attention of Sea Grant scientists at the University of Wisconsin.

A concerted effort has also been made to relieve the beleagured commercial fishing industry. One way has been to try and offer the fishermen alternatives to the traditionally harvested fish stocks in the lakes by developing new fish products from presently underutilized species.

UW-Madison food scientists David Stuiber and Robert Lindsay have managed to concoct several good-tasting fish products from the bony, oily alewife. They found that smoked canned alewives and certain sardine-like alewife products were the best. When canned like sardines — a distant relative of the alewife — alewives were found to be as good or better than several products now on the market.

Though there are still problems to overcome with off-flavors and soft textures in some of the canned and pickled products, Stuiber and Lindsay believe that the alewife could be processed competitively with sardines on the marketplace today.

The scientists have also been working with suckers and burbot. Neither of these fish are as abundant as the alewife in Lake Michigan, but both exist in numbers which could support a commercial fishery. The food scientists have converted these fish into frozen fish sticks and fillets as well as canned, smoked and pickled products.

Alewives being commercially harvested for use in fish meal and cat food. Sea Grant food scientists have now developed several good tasting products for human consumption from these ubiquitous fish.

In taste tests, consumers gave many of these products high ratings and judged them comparable to commercially available products. Despite its ugly appearance, burbot, in particular, offers great promise. In fact, many commercial fishermen prefer fresh burbot to any other Great Lakes fish, including the delicate whitefish. At Stuiber's urging, one Great Lakes fish processor is now hoping to implement a trial burbot processing operation during the summer of 1975.

Both Stuiber and Lindsay agree that the major obstacle yet to overcome is marketing and public acceptance of these new fish products. Nevertheless, in carrying out this research over the past four years, they have laid the groundwork for commercial operations and have anticipated the needs of the commercial fishing industry as well as the interest of agencies like the National Marine Fisheries Service and the Upper Great Lakes Regional Commission in harvesting underutilized species.

Down on the Perch Farm

University of Wisconsin food scientists have also been anticipating the future demands of the consumer. Under the direction of Harold Calbert, an interdisciplinary research team at the UW-Madison has been successfully growing perch and walleye pike under controlled conditions in the laboratory.

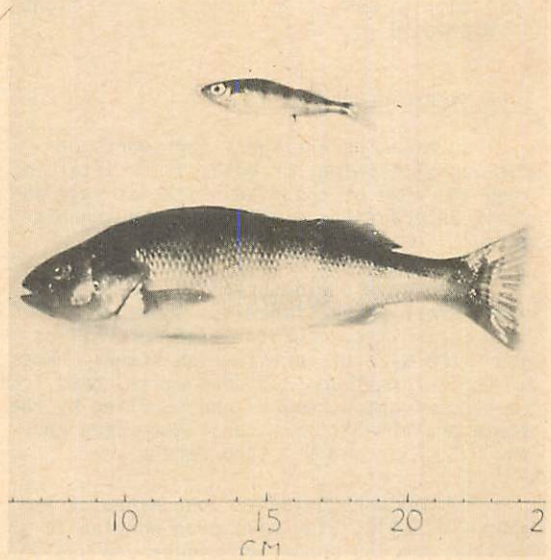
Fed a special diet and kept in a controlled thermal and photic environment, perch grow ten times faster than their counterparts in nature, achieving marketable size in nine to 11 months. In the wild, this growth normally takes from three to four years.

Walleye take longer to grow — 18 to 24 months — but this is still far less time than they require in their natural environment.

Calbert reports that the experimental fish have a firm white meat and a delicate flavor; they aren't fishy tasting like some wild walleye and perch.

Aquaculture also offers the advantage of complementing the commercial perch and walleye fishery by putting fresh fish on the market when natural supplies are down.

In support of the fish-raising studies, engineers have developed a closed water supply system which filters and recirculates most of the water used in the aquaculture operation. Such a system, which conserves thermal energy and water, is necessary if Midwest operators are to be competitive with aquaculture businesses in the southern United States.



Perch raised using Sea Grant aquaculture techniques (bottom) grow four to five times faster in five months than perch grown under more natural conditions (top).

In a related project, scientists have been attempting to propagate perch and walleye artificially. Control over reproduction would allow fingerlings to be supplied year-round to aquaculture operations. So far there has been some success in inducing perch to spawn in the laboratory earlier than they would spawn in their natural cycle.

Finally, economists are taking a look at the commercial feasibility of the UW aquaculture operation. Production costs — including the costs for feed, fingerlings, heat, water, labor and facilities, as well as market demand, need to be known in order to estimate what kind of return could be expected from an investment in aquaculture.

The researchers feel that perch and walleye aquaculture will prove economically feasibile. At least, the potential market for home grown fish is enormous. Consumer demand for yellow perch and walleye has risen about 15 percent in the last ten years while harvests on the Great Lakes, the main commercial source, have fallen about 50 percent. Last year, Wisconsin residents alone consumed half of the 40 million pounds of perch harvested from Lake Erie's waters.

Under the right conditions, aquaculture could become a major new Wisconsin industry. Commercial interests in the state consisting of a fish processor, a local feed processor and manufacturer, and a food freezer company have jointly funded Calbert's team to set up a demonstration unit on the outskirts of Madison. This facility will test the feasibility of the aquaculture system on a small commercial scale. If the pilot project should prove successful, there is enough interest on the part of state farmers and investors to make fish farms a common sight in Wisconsin.

Lake Michigan Census

In managing a fishery for sports or commercial fishing, or both, it is vital to know the size of the fish stocks as well as their interactions with other lake inhabitants.

Despite the widespread interest in the upper Great Lakes fisheries, there is surprisely little quantitative information about the size of certain fish stocks. Most of the information that does exist comes from commercial catch records and sampling by the state Departments of Natural Resources and the U.S. Fish and Wildlife Service.

UW-Madison zoologist John Magnuson and geophysicist C. Clay have been working to further develop sonar techniques and apply them to the Lake Michigan fisheries to better assess their stocks. Knowing the absolute abundance of Lake Michigan's preponderant population of alewives, for example, will enable agencies to formulate more reliable stocking policies for predators and better harvest policies for both alewives and their predators.

During the summer of 1974, Magnuson's groups ran transects across Lake Michigan at night to obtain sample sonar data for biomass analysis. Data recorded on magnetic tape was then fed into a computer and analyzed to get the relative abundance of fish scanned. The scientists are now in the process of converting this relative abundance to absolute numbers.

This is just one of several projects over the past few years which have come up with important information concerning the fish populations and other biological resources of Lakes Michigan and Superior. Other Sea Grant scientists have:

- identified two important whitefish spawning grounds off the Door County Peninsula in Lake Michigan. This information has proven useful to the state DNR, which is presently evaluating the likely environmental impact of a development proposed for one of these areas.
- pinned down the food requirements, eating habits, growth rates and energy budgets of both the alewife, Lake Michigan's most abundant species, and the smelt. This information is not only vital to a clearer understanding of the ecosystem dynamics of Lake Michigan, but could also provide some signal of impending fish die-offs or provide insight into those die-offs that have occurred in the past.
- came up with the first detailed description of the vertical distribution of phytoplankton biomass, rates of primary production and nutrient concentrations for Lake Michigan. Studies have shown dramatic increases in phytoplankton biomass between 20 and 30 meters depth during periods of thermal stratification. Scientists are currently evaluating the contribution of this deep-living community to the overall productivity of Lake Michigan.
- reviewed historical data and records in an attempt to discover what factors may be responsible for the success or failure of reproduction in lake trout and whitefish in Lakes Michigan and Superior. Some preliminary observations have already been made with regard to the stocked lake trout which have failed to reproduce in Lake Michigan. Indications are that future plantings of hatchery-reared lake trout yearlings should be made on historic lake trout spawning reefs and shoals, rather than at shore sites as is the present practice.

Scientists, sportsmen, commercial fishermen, state regulatory agencies and the public are united on one thing, at least, when it comes to the Great Lakes fishery — it is in their common interest to see that the lakes are not polluted and that the fish, themselves, are free from harmful contaminants.

Unfortunately, this has not always been the case. One troublesome contaminant that has found its way into Lake Michigan is polychlorinated biphenyls (PCBs). This ubiquitous industrial pollutant — commonly used in plasticizers, flame retardants and insulating materials — has been found in some Lake Michigan fish species. In 1971, Wisconsin's Governor Patrick Lucey ordered a halt to commercial fishing of some Lake Michigan fish because they contained high levels of PCBs.

Today, PCBs remain a problem. One DNR scientist recently reported that PCB levels in the flesh of some lake trout and salmon are as high as 50 parts per million (ppm) — ten times the level recommended as safe for human consumption by the U.S. Food and Drug Administration. Because of their presence in the lake, PCBs have attracted the attention of several UW Sea Grant scientists over the past two years.

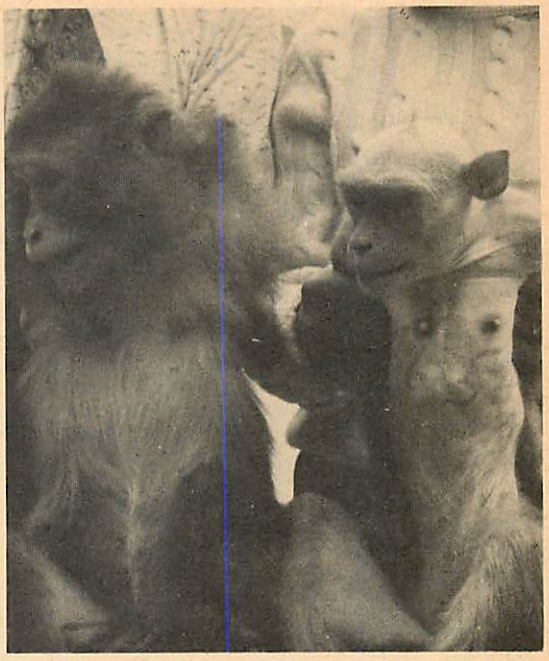
One team at the Medical College of Wisconsin in Milwaukee has been looking at how the fish take in these chemicals, metabolize and eliminate them. Their results have been somewhat startling.

They reported that salmon and trout contain PCBs at 100,000 to a million times the concentration found in the waters surrounding them and that the fish are able to take up these compounds directly from the water in a very short period of time. Fish take PCBs in through the gills, fins and skin and act as sinks for these harmful contaminants. Also, according to the scientists, while quick to pick up PCBs, the fish are very slow to eliminate them, making recovery from PCB contamination a lengthy process.

But PCBs apparently do not adversely affect the fish themselves. The problem is that PCBs are not so harmless when it comes to man. To get a better knowledge of just what effects PCBs may have on humans, and at what levels of consumption, the Sea Grant Program has been funding a project under James Allen, a pathologist with the UW-Madison Medical School and the Regional Primate Research Center.

Allen has been feeding PCBs to monkeys and monitoring their effects. The results of his experiments hold some clear implications for humans who have metabolic pathways similar to those of the monkey.

Initially, Allen found that animals kept on a diet that included very high concentrations of PCBs (300 and 5,000 ppm) for three months suffered swollen eyelids and lips, acne, hair loss, weight loss and discharges of puss from their eyes. Particularly ominous was a thickening of stomach walls in view of the known association between chronic irritations of the stomach and cancer. Many of these animals eventually died when kept on prolonged PCB diets.



Monkeys fed steady diets containing 2.5 ppm PCBs (left) and 5 ppm PCBs (right) both show toxic effects.

In more recent studies, Allen reduced these concentrations to as low as five and 2.5 ppm. Still, the monkeys suffered severe health problems, producing visible effects such as loss of hair or acne lesions within one or two months. These monkeys also showed reduced rates of conception. The young that were born to mothers on PCB diets were small and had PCB levels in their own fat tissues which were close to the levels found in their mothers. Allen also found that detectable levels of PCBs persisted in infants and adults for more than a year and a half following exposure.

According to Allen, PCBs are toxic to primates over a wide dose range. Although the possibility of man consuming a steady diet containing these concentrations of PCBs is remote, Allen feels these data do point out that only small amounts of PCBs are required to produce toxicity and that a safe level of consumption has not yet been established for these compounds.

He adds that, since PCBs are known to accumulate in the tissues of exposed animals, continuous exposure to even minute quantities may be sufficient to eventually cause toxic effects.

Given the threat PCBs could pose to man via the lake's organisms, it is important to assess the occurrence and fate of these contaminants in the lake.

UW-Madison water chemist David Armstrong has been evaluating the changing levels of PCBs in Green Bay waters. He notes that levels in 1970 and 1971 showed a decline, coinciding with reduced use of PCBs in the Green Bay watershed. His samplings during the fall of 1974 showed that PCB levels in water had continued to decline slightly.

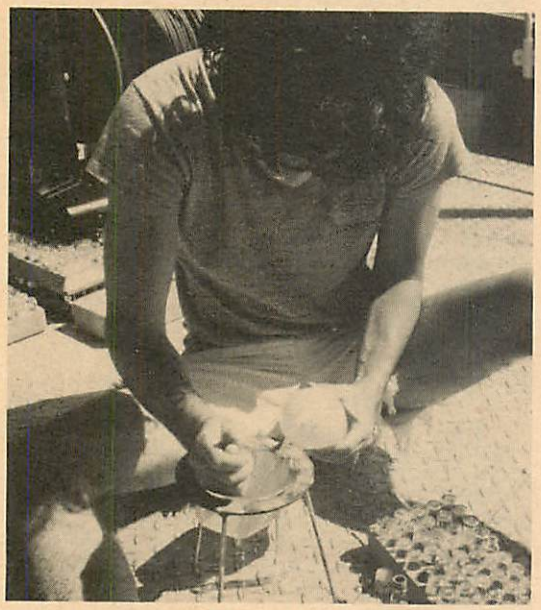
Just as significant for the future is the fate of PCBs in lake sediments. Present indications show very little degradation of PCBs in sediments, under either aerobic or anaerobic conditions, according to Armstrong. If the lake sediments do not turn out to be a true sink and do not permanently trap PCBs, or if dredging should physically roil up the lake bed, this persistence of PCBs in sediments could mean future contamination of the aquatic environment.

Other Lake Contaminants

Armstrong has also been looking at the persistence and fate of another troublesome compound, DDT, in lake sediments. He has found that DDT apparently breaks down if the receiving sediments are anaerobic. However, an equally troublesome derivative, DDE, can be introduced into the lake or develop from DDT in aerobic sediments. And DDE, in contrast to DDT, appears to be stable under any conditions — an undesirable persistence that underscores the reasons why widespread use of DDT as a pesticide has been banned.

A third project of Armstrong's has probed just as deeply into pollution, even through only skimming the surface of Lake Michigan. He has found a thin film or microlayer frequently covering the lake surface which concentrates various contaminants — trace metals, organochlorine compounds and phosphorus. There is concern that water, air and sunlight could induce chemical reactions among these contaminants, complicating their effect on the lake's ecosystem. Also, microscopic organisms, many of which thrive at the water's surface, might ingest these concentrated pollutants and, when eaten, pass them on to fish and birds.

Armstrong has been taking samples in Lake Michigan's southern basin and near the mouths of the Milwaukee, Chicago and Grand Rivers. The organic surface microlayer comes up clinging to a fine wire screen dipped over the boat's side and is then analyzed for such pollutants as PCBs, trace metals, DDT and other degradation products.



A UW—Madison student tests water samples collected on Green Bay during the course of water quality research.

Harboring Pollutants

Prime sources of contamination — whether of lake sediments, water column or surface microlayer — are, of course, the heavily polluted harbors. Alfred Beeton, associate senior scientist of UW-Milwaukee's Center for Great Lakes Studies, is measuring their environmental impact. An extended sampling program at five stations in Milwaukee Harbor and two in Lake Michigan proper has verified major differences between the harbor and open waters. Inorganic nutrients, such as nitrogen and phosphorus, are two to ten times higher in the harbor. Despite this disparity in nutrient concentrations, Beeton reports a remarkably uniform phytoplankton biomass and related carbon-fixing photosynthesis throughout both harbor and nearshore regions of the lake.

As a collateral achievement, Beeton has been able to trace the natural currents through the harbor and into the open lake by registering the natural fluorescence of these tributary waters in the samples being collected.

Ranging further afield on another research project, Beeton commandeered what he terms "a vessel of opportunity." On board the railroad ferry running regularly between Milwaukee and Ludington, Michigan, his students took water samples every seven to ten days throughout the year. Their objective was to calculate the rate of "energy fixation," as measured by the uptake of C^{14}. Sampling along this path revealed that inshore productivity (rates of photosynthesis) was three to five times higher than offshore productivity.

"We have a huge mass of very high quality water about ten miles out in the lake," Beeton observes, "whereas near shore we have concentrations of phosphorus, various toxic materials and the kinds of algae that became dominant in Lake Erie."

This nearshore area, which is very important to our use, is where the most rapid deterioration has been, he notes.

To understand these and other water quality trends on the Great Lakes requires reliable data — both from current and historical sources. Beeton has now completed a major review of and report on sources of hydrographic and meteorological data on the Great Lakes. The report lists data sources, availability of data, position of water intake or meteorological station, period of record for data, etc. The report is meant to inform scientists of data sources already in existence and encourages them to use these sources where appropriate to their research.

Off the Lake and into the Laboratory

It isn't necessary to go out into the heaving seas of Lake Michigan in order to study all aspects of Great Lakes pollution. UW-Madison physiologist Edward Bittar has been looking into another toxic pollutant — methyl mercury — without leaving the laboratory.

Believing that the living cell is ultimately the basis for studies of pollution effects, Bittar has been investigating the single-celled muscle fiber of the lowly barnacle. These giant cells are especially appropriate for examination, being large enough to be micro-injected with "tracers" to track chemical reactions within the cell.

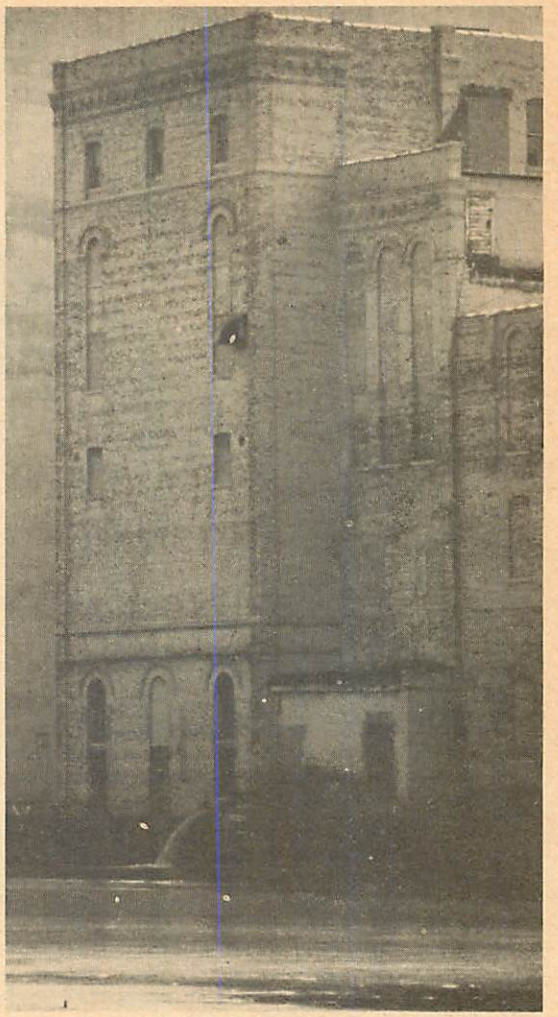
Bittar has found that minute amounts of methyl mercury can inhibit the active extrusion of sodium and produce ultra-structural changes indicative of damage to mitochondria and plasma membranes. The human blood stream, says Bittar, contains trace amounts of methyl mercury nearly sufficient to cause some of these effects, making the amounts added to man's environment that much more critical.

One compound deliberately released into the lake environment is the lampricide 3-trifluoromethyl-4-nitrophenol, better known as TFM.

Pharmacologist John Lech has been testing sea lamprey and lake trout to compare the uptake and metabolism of TFM, using also the more resistant species, such as sunfish and bass. He has made considerable progress toward understanding the mechanism of its selectivity.

In the continued use of TFM to control the sea lamprey in the Great Lakes, there is concern about its ecological effects. Lech says there's no evidence so far that TFM is detrimental to the environment. The amount of TFM released is carefully controlled and is distributed only at carefully selected spawning sites. Toxicological studies sponsored by the Great Lakes Fishery Commission and the Department of Interior indicate that TFM is safe as a lampricide and has been registered with the federal government for this use.

Lech and his colleagues at the Medical College of Wisconsin are also interested in Bayer 73 — a compound which, in very small amounts reinforces the lethal potency of TFM. Canadian authorities, using Bayer 73 compound as a synergist, have been able to cut the dosage of TFM almost in half and still maintain its selectivity for lamprey. Lech feels that an understanding both of TFM and alternative control agents is vital to the continued success of lamprey control programs.



The Milwaukee River carries contaminants into Milwaukee Harbor, which is the focus for several Sea Grant water quality research projects.

Mineral Resources

A diver aids the UW Sea Grant minerals research team in their search for gold and other precious metals in the Bering Sea, off the coast of Alaska.

During the past two years, the Geoenvironmental and Mineral Resources research subprogram, under the direction of UW-Madison geologist J. Robert Moore, has been directed toward developing the technology for more efficient underwater mineral exploration and extraction. It has also been involved to some extent in assessing the legal and environmental ramifications of underwater mining.

Since the program began, major accomplishments have included the discovery and mapping of mineral resources in three areas of the upper Great Lakes — manganese nodules in Lake Michigan's Green Bay; sand and gravel deposits along Lake Michigan's western coast; and copper deposits off the Keweenaw Peninsula in Lake Superior. These discoveries will become regionally significant, it is felt, as U.S. mineral resources on land near depletion.

Last year geologist Robert Meyer assumed direction of mineral exploratory work being done in Lake Superior adjacent to the Keweenaw Peninsula — renowned since 1840 for its rich copper deposits. The scientists reasoned that the peninsula's mineral deposits probably extended out under the lake floor adjacent to presently or historically productive sites on land.

Meyer's team looked in particular for two classes of deposits — in situ vein and disseminated deposits and placers. These all require different exploratory approaches because of their dissimilar modes of occurrence.

Results, so far, have highlighted several target areas for final phases of the research project. The researchers have also discerned a correlation between copper values in surficial sediments and the offshore trend of the underlying greenstone. Other research accomplishments include locating and assessing the mineral potential of several sublake faults in the Keweenaw region.

In addition to having initiated and coordinated this minerals program on the Great Lakes, geologist J. R. Moore has been mapping and sampling the ocean floor off the Bering Sea Coast of Alaska. In the process, he has obtained assistance from such mining interests as NOMECO, ASARCO, Inlet Oil, Goodnews Bay Mining, Callahan Mining, Pinnacle Exploration, Platinum Commercial, Amuedo and Ivey, American Placer Gold and Chandler Mining companies. These concerns have contributed substantial grants, logistical support and aid in kind for the research.

In working on marine placers, Moore has focused on gold and platinum deposits in the Bering Sea. His team has logged data taken during more than 1,000 miles of tracking in the potentially rich tin, chrome, gold and tungsten areas of Alaska's coastal waters. And they set up over 350 sediment dredging stations in placer areas and analyzed their samples from these areas for metal concentrations.

The low and high energy placer data developed in this research have aided commercial mining operations in the region. Preliminary analysis, for example, has shown some concentrations of gold in beach sands. In fact, gold was in evidence both in high energy offshore deposits and in low energy bay deposits. Significant findings were made in Grantleg Harbor, Tuksuk Channel and near Golovnin.

Moore's research team has also completed a model for pre-mining environmental surveys based on a pilot survey conducted at Chagvan Bay in Alaska. Portions of the model have been tested on Lake Superior. A biologist working with the geologists is developing the biological aspects of the survey to assess the impact of mining activities on the aquatic biota. The combined research will help establish exploration guidelines and safeguard urban areas, pleasure beaches, estuaries and other ecologically sensitive areas against disruptive mining activities.

Also of interest to the underwater mining industry is Moore's research on marine manganese nodules. Knowing the relationship between the nodule nucleus and the composition and grade of ore in the crust can greatly benefit the mining companies which process the nodules. Such knowledge can result in techniques to enhance ore grade and can simplify the mining process by enabling the selective harvest of nodules with the smallest nuclei and least complex mineral composition.

Moore's research team has devised an initial system of micro-chemical analysis capable of separating several metals from the iron and gangue nodule material. This system was made compatible with micro-analysis systems such as electron probes and the scanning electron microscope.

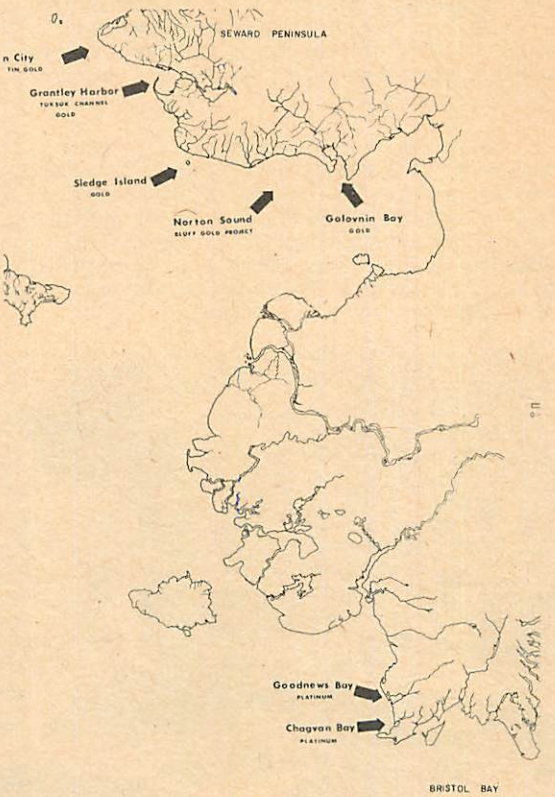
Underwater placers contain less concentrated ores than the nodules and thus present a problem when it comes to waste and tailing disposal. The cleanest possible mining technology would avoid the cumbersome transport of ore to a surface or land-based refinery by processing the ore right on the lake or ocean bottom. For this reason UW Sea Grant researchers have investigated the use of underwater hydrocyclones. On land, these machines can separate the various elements of placer material by weight using centrifugal force. Adapted for underwater use, the hydrocyclone could concentrate heavy minerals and pump them to the surface while rejecting the lighter waste materials and leaving them on the bottom.

To test this theory, a hydrocyclone has been adapted in the laboratory with industry support. Several problems remain in converting it for use under water, but if the problems can be surmounted, the project will contribute significantly to cleaner underwater mining.

Care must be exercised in mining the ocean floor, but materials and processes near the shore are also vulnerable to abuse. The rivers of sand borne along by littoral currents are particularly susceptible to man's intrusions.

A Sea Grant research project, headed by UW-Green Bay geologist John Pezzetta, has studied this phenomenon along Lake Michigan's western shore. The specific objective was to determine the effect that large outfalls of

Sea Grant's Mineral Research team at work along the Alaska coast surveying frozen bays and inlets.



Sites in Alaska's Bering Sea where Sea Grant scientists have explored or are exploring for underwater mineral deposits.

cooling water from two power generating plants would have on the lake bed. It was theorized that this interruption of normal sand flow could prevent the replenishment of beaches downstream. So far, Pezzetta's research reveals no environmental harm in this respect or any significant change in nearby erosion rates.

This investigation has also turned up new areas where sand has been deposited by the force of the discharges into the lake. These may be good sources of sand and gravel. With proper controls on development, such sites could be a boon for one of Wisconsin's biggest resource industries.

Results of Sea Grant minerals research are being shared informally with other universities and industry and disseminated through research publications and presentations at scientific conferences. Most noteworthy in this regard have been the annual Underwater Mining Institutes, sponsored by the UW Sea Grant College Program and the UW-Extension since 1970. Held in Milwaukee the past five years, these international conferences have brought industrial leaders together from around the world to discuss the oceans and the prospects for tapping the vast mineral resources that lie beneath them. Underwater mining concerns represented at the meeting held last May were Kennecott Copper Corporation, Lockheed, Deepsea Ventures and the Nome Oceanographic Mining and Exploration Company.

The UW Sea Grant Program has also benefited from these mining institutes. They have been instrumental in netting valuable industrial support for Sea Grant projects and in pointing university research in a practical direction — directions which will help answer the nation's needs as it looks to its lakes and oceans for mineral resources.

UW—Madison students prepare geological samples from Alaska for analysis.

Recreational diving is becoming a popular sport along the Great Lakes coast.

Man has always been challenged by the sea. He has tried to conquer it with his increasingly sophisticated technology and feats of engineering and to harvest its resources for his benefit. But the sea remains a forbidding and alien environment for man who must rely on a ready source of oxygen for his survival. Even with scuba gear and diving suits, man can move and work under water only with great difficulty; in some ways, he can work more easily in space than he can under the waters of his own planet.

Since 1968, UW-Madison mechanical engineer Ali Seireg has been working on new diving equipment that will enable man to move more easily under water.

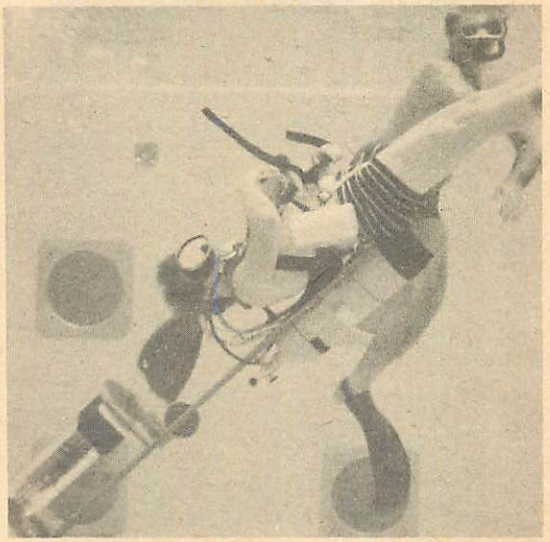
Working from mathematical models of the forces, which act on a diver working under water, Seireg and his students have developed a diver orientation device which can maintain a diver at a given position and depth with no lateral drift. The device conserves the energy of the diver who, under ordinary conditions, must constantly work to maintain his position in the water.

The orientation device has three major components. A head gear or diver's helmet allows the diver to automatically control his spatial orientation. With this equipment an underwater worker can position himself in any orientation and vertical position — even upside down. Tested repeatedly and shown to be workable at shallow depths, this head gear should prove to be a great boon to divers working to repair or maintain ship hulls and coastal structures.

To maintain the diver's depth, Seireg and co-workers have designed an inflatable vest which keeps the diver if needed at within one-inch of his desired depth. To prevent lateral drifting, they have added a third device — a "yaw orientation propellor." These small propellors are attached to each side of the diver's air tanks. A sensing mechanism distinguishes water current movements around the tanks and activates the propellors to correct the diver's position if he starts to drift sideways.

Seireg's group has also developed a logical extension to this orientation system — an underwater glider. Like wings fastened onto the diver's back, lightweight aluminum extensions enable the diver to fly through the water — moving horizontally and vertically at the same time and gliding up and down under water, much as he might glide in air.

Although it limits the diver's progress to the safe vertical velocity of one foot per second, the glider system nas several compensating features. It can be used with Seireg's other orientation devices and can be adapted for use on any underwater device.



Scuba divers test Seireg's underwater diver orientation device.

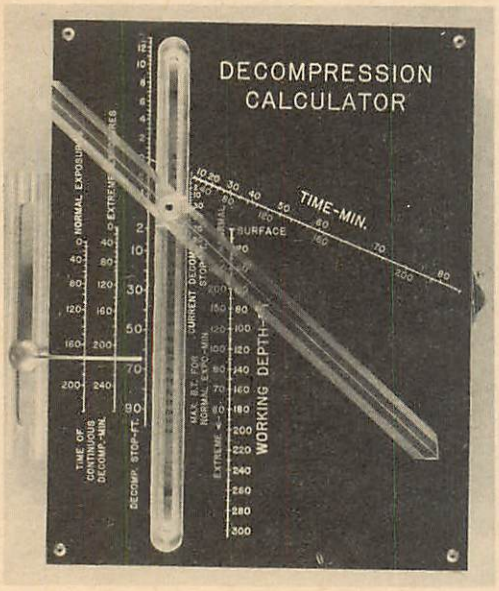
In his research, Seireg has not limited himself to specialized equipment for working divers. He is also designing and building some useful devices for the sports divers who are rapidly increasing in numbers around the country.

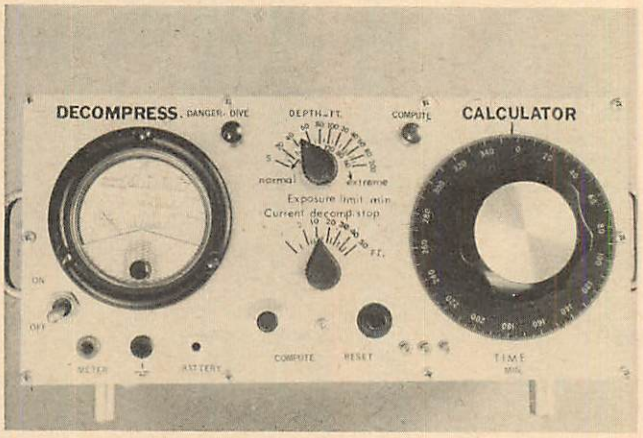
The scuba diver must carefully plan his dive in order to surface safely and avoid decompression problems. This is normally done through the tedious use of standard decompression tables and lengthy computations. But Seireg has now designed a decompression calculator which operates like a simple slide rule to determine how a diver going to a certain depth with a given air supply should stage his ascent. Seireg believes there is less chance for human error using the calculator.

Another small computerized device developed by the UW research team will, given the diver's time spent under water and depth, plot his ascent to the surface and activate a signal to tell him when it is time to go up. This has been designed such that, if the diver should lose consciousness, the device, attached to an inflatable vest, will take him up automatically on a safe decompression schedule. He envisions that it might eventually be miniaturized and worn on a diver's wrist like a watch.

As if these diving aids weren't sufficiently innovative and exciting, Seireg is now at work with other UW scientists on new projects — designing and building a portable decompression chamber for underwater emergencies and investigating the feasibility of an artificial gill system. He also has in mind a system in which the diver's expelled oxygen would be used to power a small motor and heating system.

Seireg's research has heavily involved both graduate and undergraduate students in the mechanical engineering department, who build many of the models and prototypes of the diving gear. In conjunction with this has been the initiation of a new course on scuba instruction at the UW-Madison. The course, discussed under the education section of this report, is taught by an experienced professional diver who also works with Seireg's team on the research and testing of new underwater equipment.





The decompression calculator developed by Sea Grant diving researchers. At left, the hand calculator and at right, the computerized version.

Great Lakes Shipping and Boating

Despite the inaugural promise of the St. Lawrence Seaway, the ports and hinterlands of the Great Lakes, just 16 years later, face strong challenges to their future. Revolutionary cargo systems, new freighters too large to get through the Seaway system's locks or sidle up to its docks and rival modes of modern transport like the unit-train — all these and more have dimmed the hopes for a continued flourishing trade on the Great Lakes.

To meet these challenges, economists and port experts in the UW Sea Grant Program have pursued an integrated research and advisory program related to Great Lakes ports and commerce.

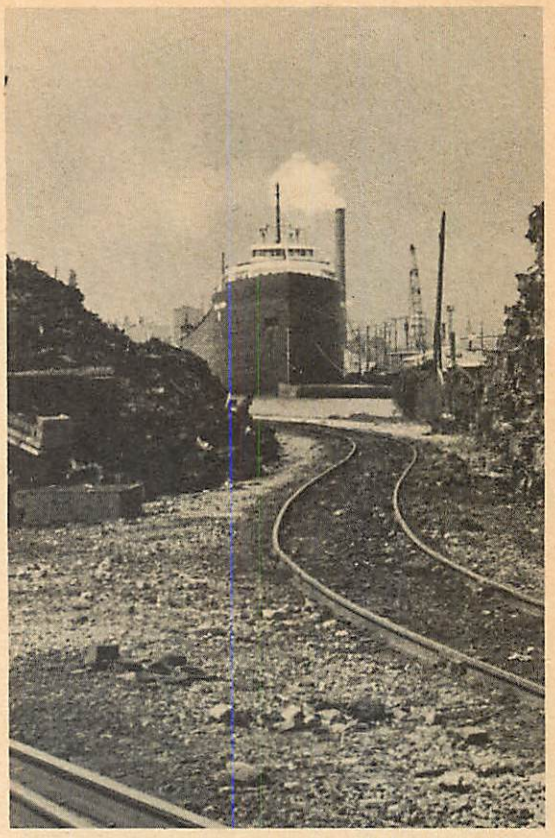
The high watermark of this subprogram was a conference held in the fall of 1973, which brought international attention to bear on port problems both at home and abroad.

Held in Milwaukee under the aegis of the U.S. Department of Transportation and the UW-Milwaukee, the conference on "Port Planning and Development" attracted over 100 international shipping executives and port directors, and government and industry leaders from the U.S. and Canada. Its purpose was to establish stronger liaison and communication between the public, ports, government, the shipping industry and universities.

Participating were such leading spokesmen as John Busterud of the Council on Environmental Quality; John Hazard, former Assistant Secretary of Transportation; and longshore labor leaders Thomas Gleason and Harry Bridges. Speaking from the rostrum and the floor were port officials from Seattle, San Francisco, Galveston, New York, New Orleans, Baltimore, Amsterdam, Antwerp and London — as well as from many of the ports on the Great Lakes.

Perhaps the bluntest challenge to representatives from the Great Lakes region was expressed in the forceful cockney accent of Thomas "Teddy" Gleason, president of the East Coast's International Longshoremen's Association. He warned that the Great Lakes ports could, in effect, be left high and dry unless substantial investments were soon made in modern facilities to handle containerized cargo, now going overland to East Coast ports via train and truck for shipment abroad.

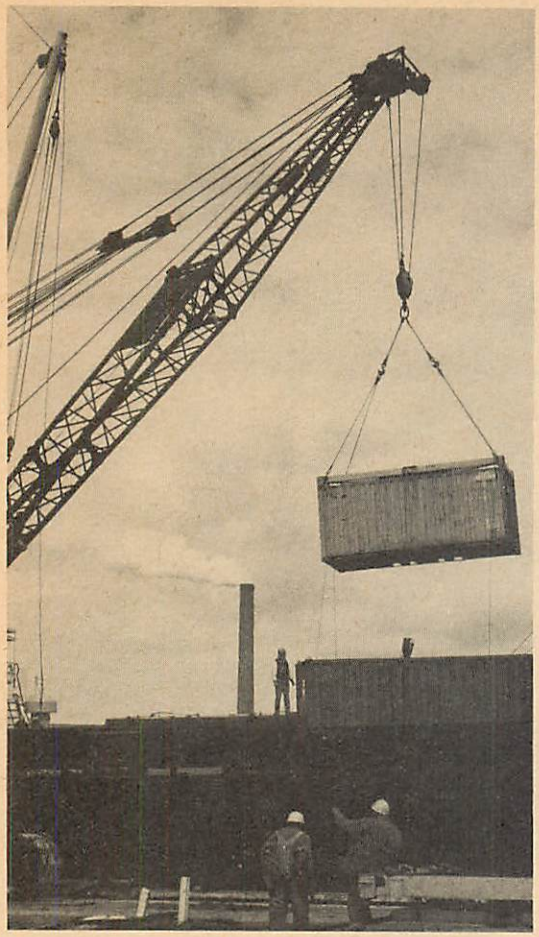
To understand and cope with such challenges has been the aim of UW ports and commerce research since it began in 1971 under the direction of UW-Milwaukee economist Eric Schenker and former Milwaukee port director Harry C. Brockel, now with the UWM's Center for Great Lakes Studies.



Milwaukee Harbor.

As a result of their research on changing technology and the Seaway and the impact of containerization on the Great Lakes transportation system, Schenker and Brockel believe that the trend may be toward the development of strong regional port facilities and toward more interlake commerce and fewer overseas vessels. They also feel that bulk commodities, like grain, coal and iron ore, are the future of Great Lakes shipping, while general cargo volume will continue to decline or remain static. They cite many reasons for these trends.

While natural constraints exist, like winter shutdowns of Great Lakes ports due to ice, purely economic forces are also coming increasingly into play. The economy of increased size has been perhaps the greatest challenge to the Seaway system. Supertankers built today can no longer negotiate its locks and harbor depths. And cargo handling is no longer a piecemeal loading operation from warehouse to ship's hold. Increasingly, general merchandise is being assembled in huge boxcar-size containers, often at depots remote from any port. This "containerization," although cutting time and costs for the shipper and the skipper, require new and expensive loading equipment and substantial dock space. The investments even for major ports are immense and highly speculative in view of the general decline in Great Lakes shipping activity.



Unloading containerized cargo in Milwaukee Harbor.

"Not every port can justify giant and costly container terminals, nor 300-ton cranes, nor major trade centers, nor promotional offices throughout the world," says Brockel. "Many American ports would be well advised to take off the rose-colored glasses, critically analyze their economic horizons and financial capacity and seek to do the best job possible within a realistic framework."

To know and understand this framework requires accurate and up-to-date information. For this reason, the Sea Grant investigators recently purchased the 1970 U.S. Foreign Trade Tapes.

"These import-export tapes mark the first time an origin/destination (O.D.) study has been made in the U.S. since 1956. Heretofore, all the Army Corps projections for the St. Lawrence Seaway have been based actually on 1956 data," says Schenker.

The O.D. tapes codify information about each ship entering and moving through the Seaway system. This includes the number, size, type and national flag of each ship; the cargo and its valuation; and the ship's duration in each port.

Using this detailed and up-to-date information, Sea Grant investigators have defined and classified 45 Great Lakes ports according to the types of ships and cargoes they accommodate. They have also examined how these and other ports are organized and administered. So far, their studies have uncovered the need for regional organization and port planning, but have found that most Great Lakes ports are not equipped to take this approach. By looking at regional port development in other coastal areas, the scientists are hoping to identify an organizational structure that might be applied successfully in this region and thus encourage regional port coordination.

Like ships and cargo, maritime problems do not all remain in port. UW-Milwaukee engineer William Garvey has been modelling the movement of cargo vessels in the Great Lakes and through the St. Lawrence River.

Garvey and his associates have developed a simplified and reasonably accurate model of traffic through the Seaway system. The model will allow shippers and Seaway officials to examine the system's capacity, simulate alternative management policies and then analyze them. Using the model, for example, they could simulate the enlarging of certain canals or the building of new ones and then evaluate what impact this would have on the Seaway traffic pattern. Sophisticated knowledge of transportation systems has also proven necessary to a related Sea Grant study of unit train commerce in the Great Lakes region and its competitive impact on Great Lakes commerce.

Based on various techniques, another UW-Milwaukee scientist, meteorologist Karl Bayer, is looking at the possibility of developing methods to forecast the winter ice closedown date and the spring opening date of the St. Lawrence Seaway. The task is exceedingly difficult and Bayer may eventually conclude that long-range ice forecasting — on the order of 30 to 40 days in advance — is not feasible given the present state-of-the-art. However, he and his co-workers are trying at least to identify previously unexplored but promising methods of making such a forecast.

To transmit the results of their research on Great Lakes commerce and related issues, Sea Grant economists and engineers not only publish reports but also present their findings at conferences and industry gatherings throughout the world. In 1973, alone, they gave invited presentations to the Eighth Conference of the International Association of Ports and Harbors in Amsterdam; an International Transportation Conference in Belgium; the Association of American Geographers in Eau Claire, Wisconsin; and the First World Conference on Water Resources in Chicago.

Most of this ports and commerce research has now been completed. Schenker and Brockel are compiling results into a comprehensive final report on the program. They expect the report to explore new port technologies and trends in depth and provide some new insights into these subjects that will not only ease but enhance the changing course of Great Lakes commerce.

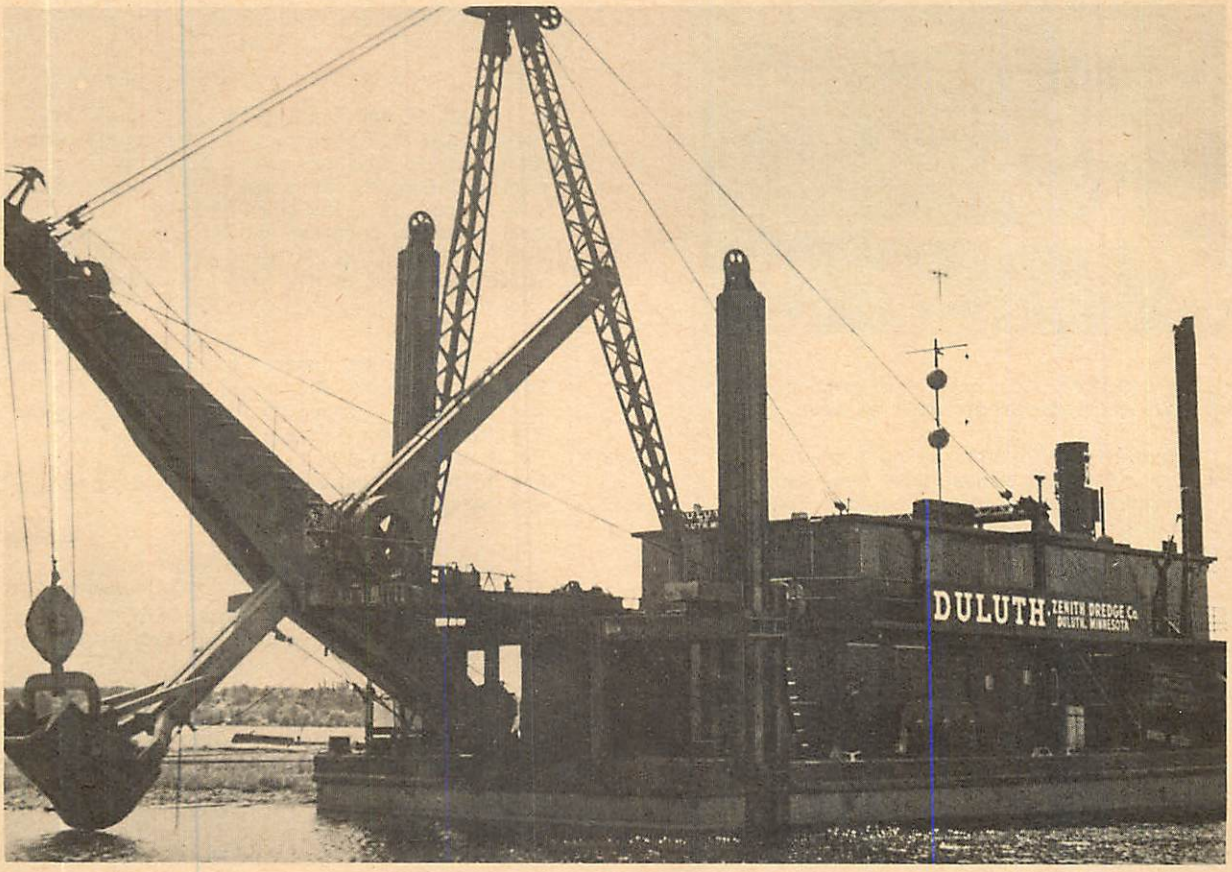
Other Sea Grant research in the ports and commerce area has focused less on traffic systems and cargo technologies and more on the specific engineering and environmental problems troubling both large ports and small marinas.

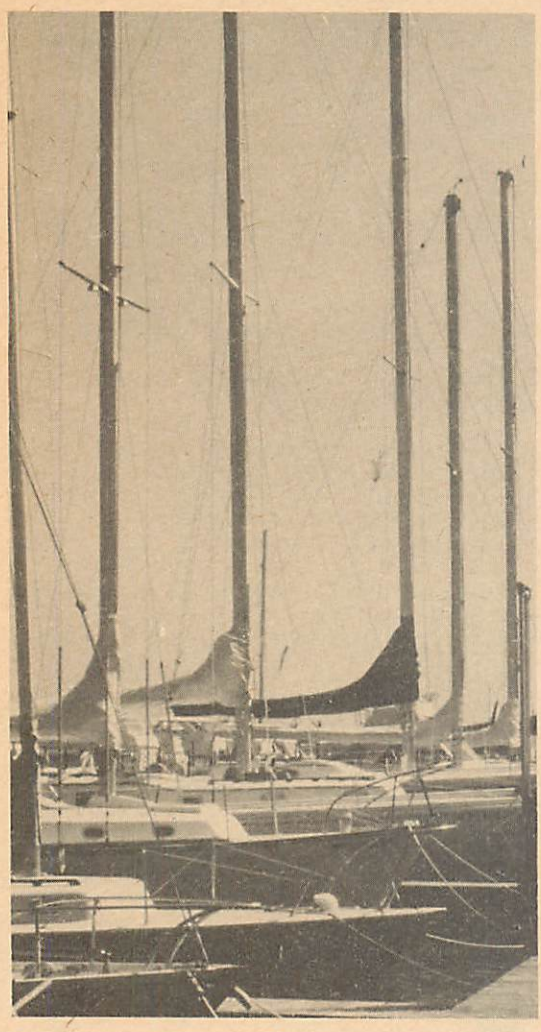
The U.S. Army Corps of Engineers will fill in a diked-off area of Milwaukee Harbor with harbor dredge spoils — the 53-acre site will eventually become a recreational park when completed.

Meanwhile, UW-Milwaukee civil engineer Gabor Karadi has been chemically analyzing the dredge spoils and evaluating the corps' plan in light of laboratory studies and his analysis of other dredge disposal projects in the Great Lakes region. He gives the plan a good chance of success, concluding that: solid and dissolved pollutants in the dredge spoils will precipitate out in the diked landfill and will not remain a contaminant problem; excess water draining out of the diked area through sand filters will be cleaner than the receiving waters of the harbor; and sediments placed in the diked area can be distributed so as to dry and settle more quickly, becoming firm enough to support building activity. This problem of soft fill has plagued many other harbor fill projects.

Karadi believes the results of this study should facilitate more effective dredge disposal in other lake harbors, now that open lake dumping has been banned by the Environmental Protection Agency.

Another Sea Grant project has been concerned with the problem of designing safe harbors for small boats — harbors that are protected from the short, pounding waves of the lakes as well as from harbor oscillations or "basin sloshing" caused by longer waves. UW-Madison engineers Peter Monkmeyer and Ted Green have constructed a harbor model in the laboratory and have used it, in conjunction





with a computer, to simulate wave conditions and make accurate predictions of wave action.

Preliminary results using a small, rectangular-shaped harbor have been good and Monkmeyer is now working on more complicated harbor shapes. In their studies of wave decay, the scientists have discovered that buoyant water injected on the harbor bottom will successfully dampen harbor oscillations by creating bottom turbulence. They have also worked with surface films and artificially-induced convection currents to repress wave action in the laboratory.

Along with wave action, ice presents one of the strongest challenges to Great Lakes marina designers. In winter, changing water levels during ice cover tend to pull or jack marina pilings upward and/or damage docks; ice flows carried by wind forces or water currents damage dock and pier structures; and heavy wet snows sink floating docks which support covered slips. UW-Parkside engineers John Zarling and Lon Ruedisili have provided marina operators and designers with technical information related to the prevention and suppression of ice formation and the design and construction criteria to withstand ice forces. This information takes the form of an annotated bibliography, listing 400 references on marina engineering related to ice. It is complemented by a companion volume dealing with water problems in marina design. Both have been published as UW Sea Grant advisory reports and widely distributed.

As part of this project, UW-Extension engineer Allen Wortley has actually been working on ice problems in the field. During the past few years, he has developed methods of constructing piers so they can remain in the lake all winter. His specially-designed piers can withstand the stress of ice and are already in use at the Madeline Island marina in Lake Superior. Wortley's marina projects, begun before he joined the Sea Grant Program in 1973, were given the Wisconsin Civil Engineering Achievement of the Year Award in 1971.

Wortley and Zarling are continuing their marina-lake ice studies and have established an 11-member advisory committee, comprised of marina designers, developers and owners, to advise them on research priorities. They have also put together two UW-Extension engineering institutes on "Dock and Marina Design," which were held in May 1973 and January of 1975.

Corrosion is another enemy of marina and harbor structures and this engineering problem is being tackled by UW-Milwaukee engineer Y.A. Chang. Knowledge of corrosion fatigue is of great utility to those concerned with the designing, building or maintenance of underwater structures.

Chang has tested common construction types of steel for corrosion under varying laboratory conditions, finding that these steels corrode most seriously immediately below the mud-line.

Steel pipes were experimentally planted at two sites in Milwaukee Harbor which Chang is monitoring for corrosion. He will correlate these results with his laboratory tests to develop quantitative relationships which can be used to predict the life expectancy of marine structural materials.

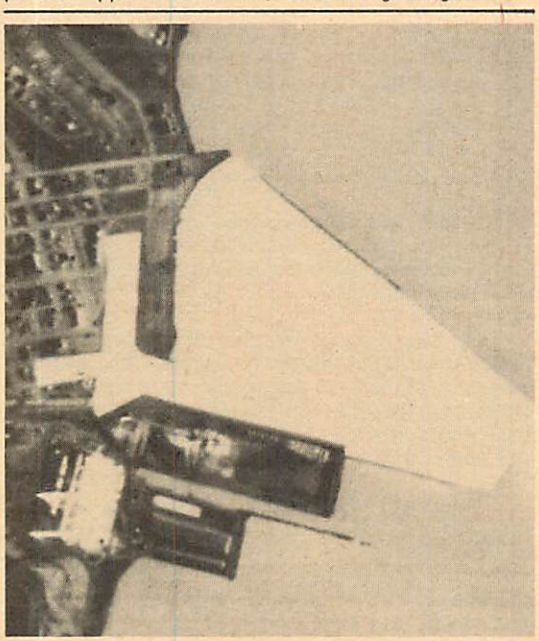
A controversial issue affecting the Great Lakes is the siting of power plants along their shores. As the largest source of cool water and the greatest heat sink in the interior United States, the Great Lakes — particularly Michigan and Ontario — have been singled out as sites for concentrated development of electric power generation.

On Wisconsin's Lake Michigan shoreline seven major power plants now discharge enormous quantities of cooling water into the lake. The Point Beach Nuclear Plant, alone, discharges almost 700,000 gallons per minute from its two outfalls — at temperatures up to 20°F hotter than the receiving lake waters.

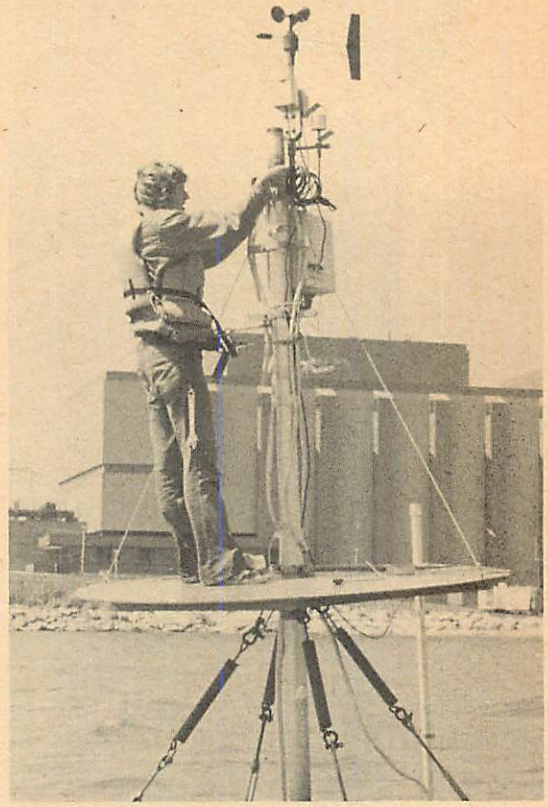
The effects of waste heat from plants like Point Beach have aroused much speculation and stimulated extensive research.

A major UW Sea Grant project has sought to learn the physical dimensions of the hot water plumes being dumped into the lakes. With airborne, heat-sensitivie scanners, data on full-scale thermal plumes over many types of lake conditions have been collected and correlated with ground measurements taken simultaneously. On film, which also can be digitally processed, Sea Grant scientists have captured an accurate picture of the plume as it interacts with the lake.

The "thermal scanner," attached to the belly of a DC-3 airplane, registers long wave radiation from the earth's surface. The plumes appear as white, billowing images that darken as they cool down to the water temperature. Radiating up to four or five miles out into the lake, they are comprised at times of a series of concentric thermal waves some 200 feet apart.



An infrared image showing the surface water temperature of the thermal plume from the coal-fired Port Washington power plant.



A student services the instrument tower used to monitor the air-sea interactions in the thermal plume of the Point Beach Nuclear Plant.

Under the direction of UW-Madison engineer Theodore Green III, the Sea Grant research team has so far collected data from over 100 flights. This research represents a cooperative effort between the state Department of Natural Resources, three Wisconsin utilities and the university. The DNR supplies the plane and the utilities pay for the flight time and the essential scanning equipment. The rest of the bill is footed by Sea Grant and National Aeronautics and Space Administration.

The DNR is currently using this information to set thermal mixing zones for each individual utility which discharges warm water into Lake Michigan. Green has testified at these hearings.

So far, this and related biological research within the plume itself have not revealed serious environmental damage resulting

from these heated discharges. Yet Green remains cautious, believing that no one can be sure about long-term effects, especially if the number of plants along the shore should increase dramatically, as is forecasted.

The information gained from this project can also be applied to determine how a river will mix with cooler, receiving lake or ocean waters and thus how the pollutants it may carry will be dispersed.

A closely related project has relied on more conventional aerial photographs to measure small-scale lake currents which affect plume or pollutant dispersion.

With time lapse photography, Sea Grant researchers were able to measure and track the paths of numerous floating targets or drogues in the Point Beach plumes. The photos were then analyzed and fed into a computer, along with data from ground surveys. This yielded velocity vectors of the floating targets and has led to a better understanding of the rate and manner in which thermal plumes mix with receiving water bodies. This technique has proven accurate, quick and economical.

While these studies have been concerned with the physical aspects of thermal plumes, others have concentrated on the effects these plumes may have on the surrounding aquatic life.

- Using sonar devices, as well as gill nets and trawls, scientists have assessed the number and distribution of fish in the plume. Summer samplings have turned up mostly alewives and very small numbers of lake, brown and rainbow trout and carp.
- Two mathematical models for the distribution of fish in the plume have been developed, one considering temperature distribution through a region and another dealing with fish migration. These models will increase understanding of how fish distribute in a thermally-varying environment.
- Attaching tiny, ultrasonic transmitters to homing salmon, scientists released the fish below the plume and tracked their progress through it as they headed north to their home streams to spawn. In following the salmon's signals, the scientists found that most of the fish upon reaching the heated discharge from the Point Beach plant repeatedly turned back or veered at right angles to circumvent the plume. Fish migrating further out from shore were able to swim under the heated water which floats like a thin layer on top of the colder lake waters.
- In related work, Sea Grant investigators have been doing laboratory studies to determine which temperatures certain species of fish prefer and which extremes — hot or cold — they avoid. Corroborating the salmon tracking studies, researchers have found that the coho do avoid warmer water temperatures, though other fish studied, like the bluegill, seem to prefer them. While no significant number of thermal deaths among fish in the plumes has been found, the team is concerned about the long-term effects of heated water on fish growth, reproduction, disease resistance and mobility.

In their study of electric power, Sea Grant scientists haven't confined themselves to descriptions of the plumes and their effects. They have also looked at the political and social aspects of energy production and power plant siting.

One such study is being done by UW-Madison lawyer Donald Large. He is recommending changes in Wisconsin law and policy affecting the consumption of electric power and the siting of power plants. A draft of his report has been supplied to the Wisconsin Public Service Commission and state legislators who have been involved in debate over a power plant siting bill. The bill died in the 1974 sessions but is expected to be reintroduced in the 1975 sessions.

Another Sea Grant project has examined just how knowledgeable such public leaders and their constituents are when it comes to making decisions about nuclear power. John Ross of the Institute for Environmental Studies at the UW-Madison surveyed community leaders and citizens living nearby the Point Beach Nuclear Plant to see how well informed they were about nuclear power. He discovered that the group was poorly informed about the subject, answering less than one-third of the questions put to them correctly.

On the other hand, he found that those closely associated with nuclear power — critics as well as utility officials — were well informed in this regard.

Based on these studies, Ross has offered some suggestions that would improve the flow of energy information to the public. He would like to see: greater coordination between state and federal agencies in the nuclear power plant licensing process; an agency created within the state to serve as an objective energy information-education center for citizens; more in-depth coverage of siting issues by local and regional media; and greater use of public meetings and informal hearings at the community level in the early planning stages of power plant siting.

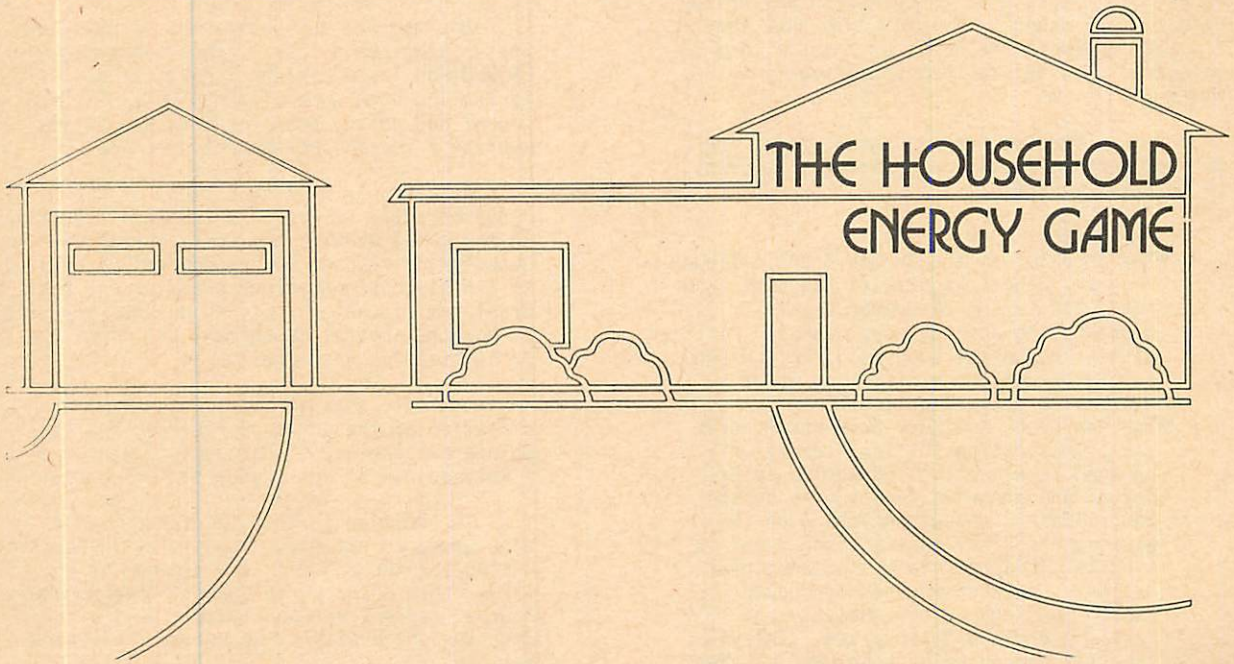
If the public is poorly informed about how energy is produced, they are also poorly informed about what happens to it after it is produced. Many people do not fully realize how much energy they themselves use or how they use it. They also are unaware of just how much energy and money they could save by employing certain simple conservation measures.

In the process of working on gaming research on power plant siting in cooperation with the Wisconsin Public Service Commission, UW-Madison specialist Tom Smith came up with a game which helps heighten public awareness of energy use in the home.

The "Household Energy Game," self-contained in a 20-page booklet, graphically illustrates how much energy the player and his family use in the course of a year as compared to the average U.S. family.

The player calculates his energy budget by marking off a given number of squares for each of his energy uses — for home heating, transportation, home appliances, etc. Then he can proceed to the second half of the game and calculate how much energy he can save by employing any of the more than 50 energy saving measures described in the booklet. When he has finished the game, he will have a better idea of how energy is used in the home, and how much energy and money can be saved through energy conservation.

The game is being widely used by schools, utilities, citizens groups and private businesses. In fact, two Wisconsin fuel oil companies have each purchased 2,000 copies of the game to distribute to its customers.



The Wisconsin Coastal Zone

In June 1974, the federal Office of Coastal Zone Management awarded the state of Wisconsin $208,000 to begin developing a coastal management program for its 620 miles of coastline along Lakes Superior and Michigan.

Besides playing an integral part in its initial planning, the UW Sea Grant Program has been designated as a research arm of the Wisconsin Coastal Zone Management Development Program. The Sea Grant Program is helping to provide both conceptual planning and technical expertise. It is also coordinating university research and other activities such that they respond better to the needs of coastal zone management and relate more specifically to state activities.

Within the Sea Grant Program, there are many projects directly or indirectly relevant to coastal concerns.

In addition:

- The director of the UW Sea Grant College Program, Robert Ragotzkie, has been appointed to the 26-member Coastal Coordinating and Advisory Council. Its duties are to set program direction and advise the governor of Wisconsin on matters of coastal policy.
- The Sea Grant Advisory Services Program and Communications Office are actively engaged in education and public information and programs relating to coastal zone affairs. About one-third of the Wisconsin's first coastal zone grant is tied to public participation and information. UW-Extension has conducted public meetings on the coastal zone in nearly every county involved. Television has been used by both UW-Extension and Sea Grant to disseminate information on coastal issues, and Sea Grant researchers have actively participated in a series of Sea Grant sponsored Educational Telephone Network lectures on coastal issues. Other projects involve the use of slide shows, newsletters, press releases and booklets to reach the public.

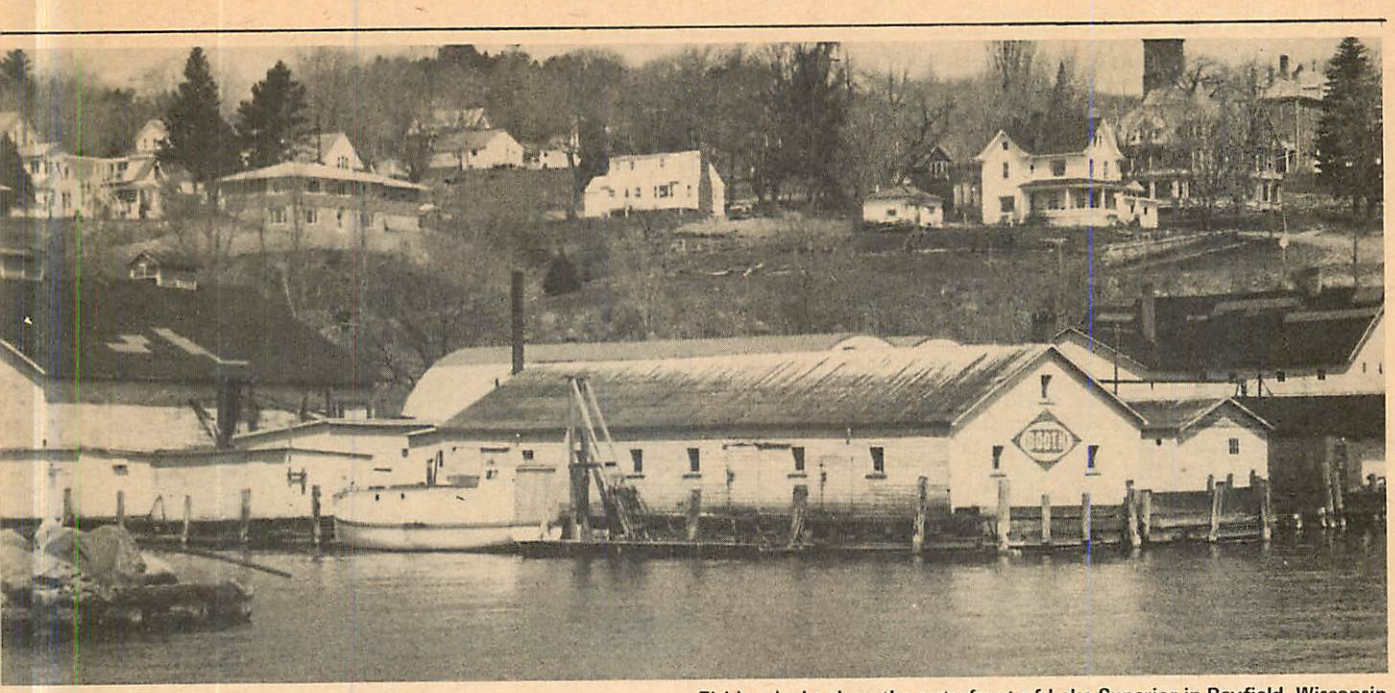
Even before the state received its grant, the UW Sea Grant Program had become very active in coastal zone issues.

One man who has done a lot of thinking and writing about coastal zone management is UW-Madison law professor Zigurds Zile. Zile is dealing with some of the pivotal institutional and policy problems involved in implementing a coastal management program.

As a result of Zile's study of the "environmental imperatives and legal constraints" in the management of the coastal land of Lake Superior, a 48-page memorandum was circulated to the Wisconsin Governor's Office and Sea Grant administrators, laying out his analysis of how the coastal management act might apply to the state's coastline.

Not only does it provide a useful explanation of the act's provisions, but it points out the act's shortcomings and some likely points of resistance to implementation.

In addition to this memorandum, Zile also wrote an article, "A Legislative-Political History of the Coastal Zone Management Act of 1972," that appeared in Coastal Zone Management Journal and delivered a lecture on the topic over the university's Educational Telephone Network.



Fishing docks along the waterfront of Lake Superior in Bayfield, Wisconsin.

To incorporate all aspects of his study — the coastal problems of Lake Superior, the implementation of the law within Wisconsin's specific institutional situation and opportunities for improving the law — Zile is writing a book on the topic.

A related work that is a spinoff of Sea Grant-sponsored research is Zile's study of the land resource management powers of the International Joint Commission, published by the UW-Water Resources Center in 1974.

Policies and Problems

The future of the coastal zone will depend upon the translation of research, data gathering, planning and policy setting into appropriate management decisions, and thus, the setting of realistic standards for coastal land use management — standards like those governing building and development in the coastal zone, or shoreland conservancy.

Unfortunately, many such standards are based on armchair speculation rather than on technical studies and hard information. To put these decisions on a sounder footing, UW-Madison investigators John Ross and Jon Kusler have been identifying technical information needs for coastal zone standard setting in Wisconsin and suggesting research priorities. In the process, they have examined regulatory standards now in effect in other coastal states, exploring the rationale for these through questionnaires and interviews, becoming familiar with other research and literature pertaining to standard setting and identifying important gaps in this research. They have also looked at existing standards in Wisconsin to see on what they are based. As a result of this work, Ross and Kusler have prepared several reports which will be used by the Wisconsin Coastal Zone Management Development Program and made available to other coastal zone groups. The reports are expected to be published this summer.

One standard which had been set prior to the state's coastal zone program pertains to phosphorus removal from the Lake Michigan watershed. The order, instituted in 1969 by the Wisconsin Department of Natural Resources specified that all point sources of 2,500 population equivalent capacity or more discharging into the watershed must have removed 85 percent of their phosphorus effluents by the end of 1972. UW-Madison engineer Erhard Joeres has been examining the impact of that order on the communities involved.

Most communities did not meet the order until late 1973, allowing a good case study of the dynamics of compliance. Joeres has taken an inventory of investments associated with the necessary changes at 55 wastewater treatment plants in Wisconsin, considered cost-efficient alternative policies and studied the implications of an emerging state requirement of specifying maximum allowable effluent concentrations. Joeres also completed a cost analysis of phosphorus removal for 14 Wisconsin communities.

This information will assist the DNR and the agencies of other states bordering on Lake Michigan in estimating the success of

their regulatory policies and in anticipating problems communities might face in complying with future effluent standards that are set.

The Assets of Coastal Communities

Different kinds of coastal zone issues — of aesthetics and historic preservation — have captured the attention of landscape architect William Tishler and his associates.

Areas of great scenic, cultural and historical significance are being destroyed or altered as a result of new recreation development, changing land use patterns and the decline of the commercial fishing industry.

Wisconsin's coastal communities possess a rich heritage of historical buildings and landmarks, shaped by the interaction of man and the waterfront environment. Along the coast, Wisconsin's earliest settlements were built, and here patterns of development formed communities with high aesthetic appeal.

Tishler, continuing a project initiated with Robert Ditton, now with Texas A & M University, is identifying buildings, structures, designs, textures and materials which are characteristic of the coastal zone.

The design and motif proposals developed under the project will be used extensively to guide restoration and development along Lake Michigan's shores, and will gear in well with historic resource surveys being conducted by the state Department of Administration and the State Historical Society.

Tishler was also involved with a similar, now classic study of Bayfield, a Wisconsin community along Lake Superior.

Some small coastal communities are being studied for a different reason by UW-Milwaukee planner David S. Sawicki.

Sawicki has been analyzing the processes of "decline" in traditional economic and urban planning terms, as well as in the subjective view of local residents and communities. The study has concentrated primarily on Marinette, Wisconsin and has been carried out in conjunction with the city administration and economist James E. Berry at the UW-Marinette campus.

A survey conducted of a cross-section of Marinette residents has been completed and the results describing Marinette's decline, due largely to a continuing centralization of population in larger metropolitan areas, have been presented to local organizations and government. Although complete data are still lacking, the project has encouraged local planning to proceed on a sounder basis than before.

At the present time the research team is developing a game simulation to aid local decision makers in the development of urban policy.

Another Sea Grant project meant to promote sounder planning, turns out to be a game — WALRUS (Water and Land Resource Utilization Simulation). WALRUS was born at the University of Michigan and adopted — and adapted — by UW-Madison scientist John Steinhart and specialist Tom Smith.

Steinhart and his team have revised the player's manual to streamline the game and make it easier to play. Used to promote citizen understanding of and participation in the process of coastal zone planning and policy formation, WALRUS demonstrates graphically the beneficial or detrimental impacts of various land use management decisions on aquatic resources and illustrates the trade-offs involved in all such decisions.

Steinhart's group has played WALRUS with over 30 state and university groups, including the DNR, League of Women Voters, state planners, civic leaders in Green Bay and others. They have provided consultation on simulation/gaming to other campus departments and to Sea Grant investigators at the University of Hawaii and Texas A & M University and have gone on to develop several of their own games relating to energy use and power plant siting.

Flooding and Erosion

One major problem of the Wisconsin coastal zone has been shoreline flooding and erosion. In recent years, water levels of the upper Great Lakes have risen to record

highs. In 1974, for example, Lake Michigan was close to two feet above its long-term average and these high levels are continuing into 1975.

These levels, combined with wave action and groundwater seepage, have been causing severe property damage along much of the shore. The total damage in the fall-spring storm period of 1973 is estimated to have cost property owners and taxpayers some 15 million dollars.

This recurrent ordeal of shoreline flooding and erosion requires not only some immediate relief, but also long-range solutions. The UW Sea Grant Program has, therefore, developed a comprehensive group of projects investigating the extent, causes and nature of these dynamic shore processes.

During the summer of 1974, Sea Grant geologists began taking a geographical and geological inventory of Wisconsin's Lake Michigan shoreline — from Rock Island off the tip of the Door County "thumb" south to the Wisconsin-Illinois state line. The purpose is to identify and map those stretches vulnerable to erosion in this 225-mile stretch of coastline. At the same time, researchers hope to determine the "recession rates" — that is, the average yearly inroads erosion is making on any given unit of shoreline.

Another approach has been aerial mapping. This is designed to provide an accurate and comprehensive estimate of erosion rates through a computerized processing of aerial pictures, past and present.

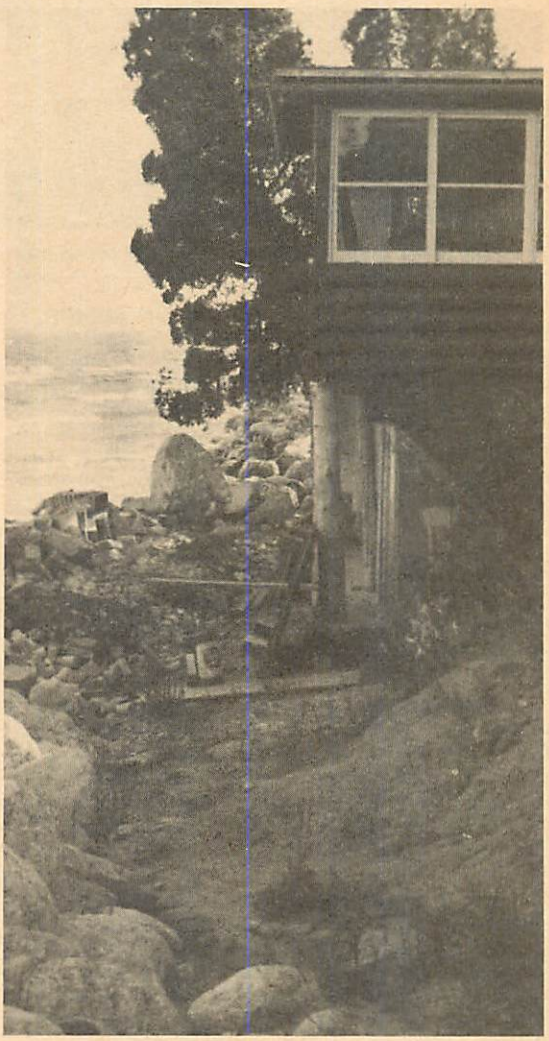
The occurrence and severity of erosion depends, of course, on various conditions. Two important factors are the type of soil involved and the action of winter ice.

One Sea Grant project is concerned with the precise role which shore ice plays in breaking up shore materials. Although ice is an apparent buffer against wave action, water freezing in the upper sediment destroys the sediment's cohesive bonding. Then as the ice thaws, this weakened material can run off with the melted ice or be eventually washed out by wave action and the grinding impact of ice floes.

With respect to soil characteristics, clay bluffs — and other land forms and materials subject to slumping into the lake — are being studied on the Lake Michigan shoreline. In the process, Sea Grant scientists are investigating the principal mechanisms of slumping and slope instability. A map of these high risk areas should serve as an important guide to prospective buyers or builders.

Sea Grant researchers at the UW-Superior's Center for Lake Superior Environmental Studies, directed by Albert Dickas, have been looking at the effects of red clay erosion at the lake's western end. The UW-Superior scientists are assessing the quantities and nature of the sediments washing into Lake Superior in this "red clay province" in order to understand the chemical and sedimentary influences of the eroded materials on the lake environment. More than an aesthetic problem, red clay can clog gravel beds necessary for the hatching of trout eggs and reduce the amount of dissolved oxygen in the water. Turbidity also has effects on the growth and survival of aquatic life.

Donald Bahnick, a chemist at the center, has measured and analyzed the water quality and total sediment loading of seven major streams and the section of Lake Superior in the Superior-Cornucopia red clay region of the state.



Erosion and high lake levels on Lake Michigan have taken their toll on this summer home in Oostburg, Wisconsin.

Wisconsin's Lake Superior shoreline is plagued by red clay erosion from shore bluffs and tributary streams.

The effects of red clay on the growth, survival and feeding behavior of larval herring are being investigated by UW-Superior biologist William A. Swenson in cooperation with the Environmental Protection Agency's National Water Quality Laboratory at Duluth, Minnesota. Laboratory and field studies are aimed at finding red clay effects on larval herring distribution in Lake Superior.

These and related studies — including phosphate and metal-ion exchange studies of clays — will provide information for predicting the deleterious effects of erosion and sedimentation.

Even before Sea Grant investigators had become actively involved in research on the erosion problem, many of them were involved in advising the public, government agencies and other interested parties on shore erosion and lake level problems and on what could or could not be done about them.

One subject of great concern in Wisconsin has been the International Joint Commission's regulations of the lake levels of the upper Great Lakes. The IJC has been trying to lessen the damaging impact of high water in Lake Michigan by holding back water in Lake Superior. This has afforded some relief to Lake Michigan property owners at the expense of those living along Lake Superior and has emerged as a very controversial and politically sensitive issue in the state. The Sea Grant College Program has been called on by the Governor's Office to keep abreast of these proposals, reviewing new ones as they come out and advising the governor on their possible ramifications so he can decide what position regarding them would be in the best interests of the state.

Gregory Hedden, director of Sea Grant Advisory Services, was actively involved with shore erosion issues during 1972-74. He has been working very closely with the U.S. Army Corps of Engineers, which is responsible for shoreline protection on the Great Lakes, and with the Great Lakes Basin Commission.

Hedden has been involved in organizing, sponsoring and participating in many workshops and conferences in cooperation with these agencies. Many of these have been geared towards giving assistance to Wisconsin shoreline property owners. Hedden also serves on the Great Lakes Basin Commission's Standing Committee on Shore Erosion. He is also a member of the committees on shore erosion and lake levels of the state's Coastal Zone Management Development Program.

In addition to sponsoring workshops and advising on erosion matters, the Sea Grant Program has also conducted a vigorous public information campaign on lake levels and

erosion, including: preparing an advisory report on procedures to get permits to construct shoreline structures in the state of Wisconsin; distributing publications prepared by other organizations such as the Corps of Engineers and the Lake Michigan Federation; sending out newspaper releases on the subject; producing radio programs and public service erosion spots; and producing a 30-second television erosion spot which was shown on coastal stations in Wisconsin, Illinois and Indiana during the late summer of 1974.

The Green Bay Blues

One particular area of the Wisconsin coastal zone has received a lot of attention from the UW Sea Grant Program — Green Bay. Green Bay is a long, narrow cul-de-sac pinched off from Lake Michigan by the Door Peninsula along the lake's western shore. As is the case in Lake Erie, heavy concentrations of people, industry and agriculture in the Green Bay region have taken their toll on the bay's water quality. Particularly troublesome has been the Fox River, which flows into the lower bay through the city of Green Bay and carries with it farmland runoff, as well as wastes from the many industries and sewage plants sited along its shores.

A considerable amount of information on the Green Bay/Fox River system has been collected by Sea Grant investigators over the past six years, particularly with regard to the bay's water quality.

Greg Hedden (center), director of Sea Grant Advisory Services, plays the WALRUS game, (Water and Land Resource Utilization Simulation), with a group of professors, planners and civic leaders from the Green Bay area.

In one project, UW-Madison biochemist Robert Burris and University of Illinois botanist Larry Vanderhoef found that the annual summer algal blooms have been getting thicker and spreading farther north up the bay.

In 1971, the bloom stretched 15 miles, in 1972 it went to 20 miles and over the past two years it has continued to spread.

According to Burris and Vanderhoef's study, the apparent growth in size of the nitrogen-fixing algae indicates that the total phosphorus input into the bay is increasing. The southern bay is on the verge of becoming totally eutrophic, they report.

Even if all the man-made nutrient inputs — particularly phosphates — were stopped, it would be at least five years before there was some significant improvement in the water quality of the Fox River, Vanderhoef claims. This is because the bottom sediments already contain a large reservoir of nutrients.

This eutrophication study is just one of many Green Bay projects which have been funded by the Sea Grant Program since it began its multidisciplinary study of the bay in 1969. In the course of that study, scientists have:

- studied the water quality of the Fox River and lower Green Bay in great detail, sampling for dissolved oxygen, nutrient levels, turbidity and other water quality indicators at stations throughout the area.
- mapped the bottom of Green Bay by means of seismic profiling, and thus revealed heavy sediment deposition in some parts of the bay and previously uncharted manganese nodule deposits in the northern reaches.
- attempted to better predict the bay's possible recovery rate from pollution by studying sediments as a source or sink for nitrogen in the overlying waters.
- examined activity at the port of Green Bay and made predictions on its future in light of Great Lakes shipping trends.
- conducted a survey on recreational use patterns on Green Bay and compared the present situation with past history. The conclusion reached: Green Bay, because of its roughness and turbidity, is not looked upon as a recreational resource by those living along its shores, nor is it likely to be in the near future even if drastic improvements were to be made in its water quality.

More recently, Sea Grant investigators have sought to pull some of this information together through the development of models which can be employed to predict water quality trends.

One computer model simulates the impact of nutrients such as phosphorus on the phytoplankton population of the bay. And a hydrodynamic model has been devised which will be used to predict the movement of water masses within the bay system. This model, developed in a project under Harold Day at the UW-Green Bay, has already been considered for use in assessing the potential impact of flooding from high water whipped by high velocity northeast winds.

Day and co-investigators are also assessing the complex problems of managing the Green Bay/Fox River system. This system includes several cities and counties, as well as various regional agencies with some overlapping jurisdictions.

Cooperation among these regional groups is considered essential to proper watershed management. Day has held meetings with all the various groups concerned with Green Bay and has helped them establish a close working relationship. In order to generate a clearer understanding of the complex interaction of water uses in the Fox Valley, Day has conducted a public information program, making data on political, economic and physical aspects of the Fox River Valley available to a wide audience. One outcome of this effort is a multicolored map of the Green Bay region, which graphically displays water quality data, information on population density and its impact on the bay and hydrographic data for the bay and Fox River. Over 5,000 copies of this map have so far been distributed to schools, city officials, citizen groups and others in the region.

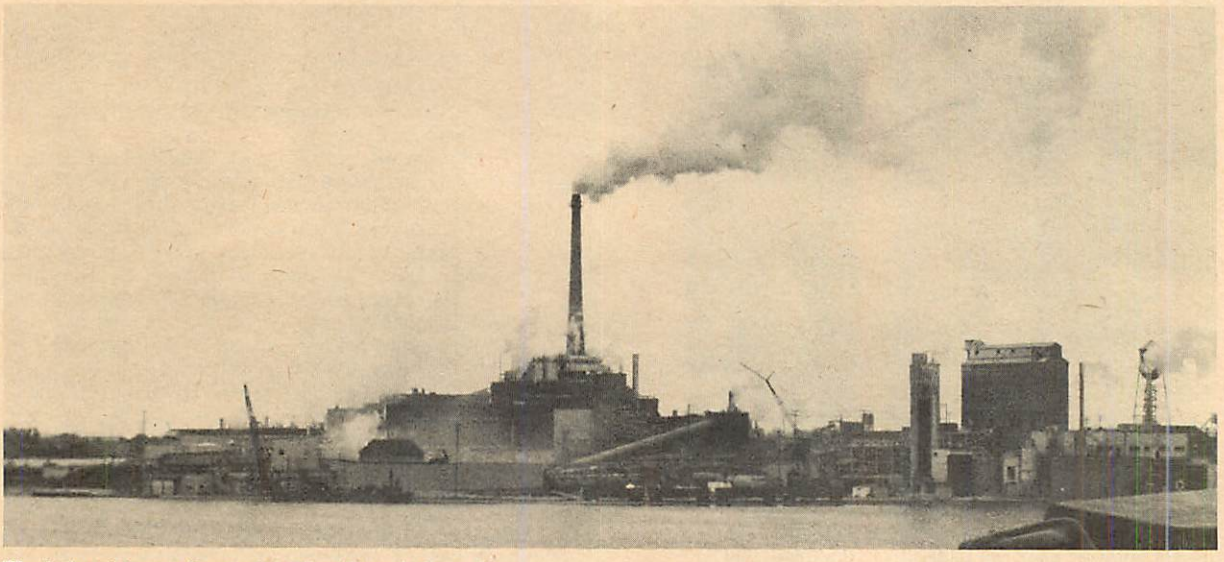
In related studies, UW-Green Bay scientists have looked at the politics of water quality management in the Green Bay region and have predicted what impact improved water quality might have on the economy of the area if it could be achieved.

The Sea Grant Program is now winding down its comprehensive study of the bay and a report on research conclusions will be issued in May of 1975. The 100-page report, prepared by John Ross, Jean Lang and Gerard Bertrand of the UW-Madison's Institute for Environmental Studies, also contains historical information on Green Bay use patterns and presents the status of what is presently known about the bay as a result of Sea Grant and other research investigations.

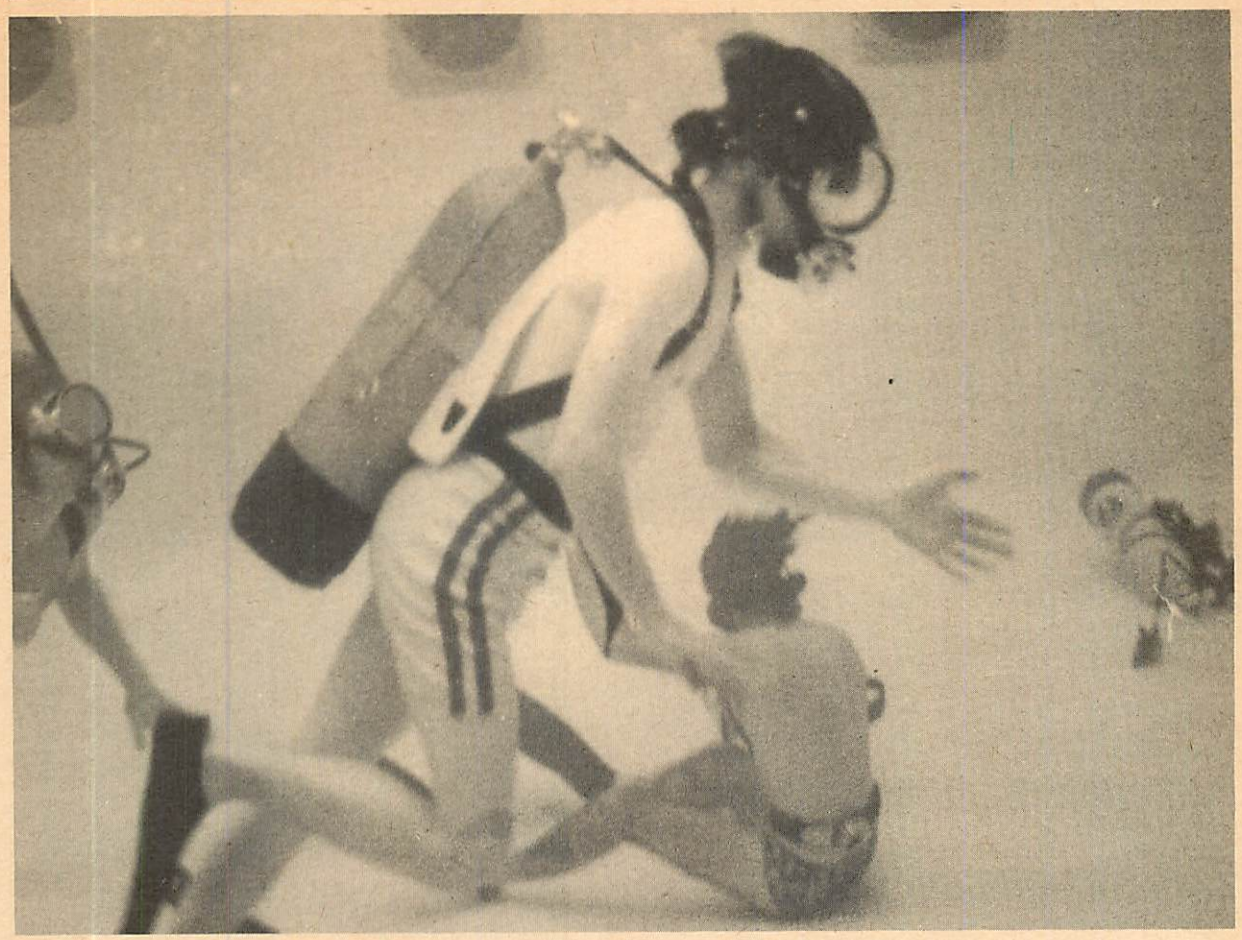
The report also contains recommendations forfurther research that is needed on Green Bay. Among suggested topics for future study are:

- fluctuating water levels and an identification of areas flooded or drained at various water levels and under various weather conditions.
- an evaluation of the flooding of the littoral zone along the bay's western shore and its effect on the bay's productivity.
- an evaluation of the possible dilution of pollutants by the increased volume of water presently in the bay due to high precipitation rates in recent years.
- verification of the physical condition of the bay as predicted by the various models that have been developed.

Whether any or all of these projects will be undertaken under Sea Grant or other auspices in the years to come, Green Bay will undoubtedly continue to be the focus for intense research activity. An area of high population density along Wisconsin's Lake Michigan shore, Green Bay is a conspicuous microcosm of coastal zone problems and conflicting uses. As such, it is in need of those studies which will help the region cope with these varying problems.



The industrial waterfront of the Fox River in Green Bay.



Dave Engeseth's UW—Madison scuba class practicing with their equipment underwater.

Education is an integral part of the UW Sea Grant Program involving over 100 graduate and 85 undergraduate students within the University of Wisconsin System.

Within the last year, these numbers have been considerably augmented with a new Sea Grant-supported course in scuba diving which began during the summer of 1974. Sixty students (the maximum) enrolled in the fall 1974 semester and nearly that number remain on waiting lists. The course is designed to lead to national diver certification for those with a recreational or research interest in the underwater environment.

In addition, the scuba instructor is working with UW Sea Grant engineers on the development of advanced underwater diving equipment.

At present the university's physical education department is evaluating the Sea Grant scuba training course with the intention of making it a permanent part of the curriculum. Already the instructor has found that students taking his course have been influenced by it and are interested now in combining their vocations with their new-found avocation.

Other education projects with more specialized appeal seek to enhance the knowledge and skills of educators, communicators and government officials in marine problems and issues.

One Sea Grant project has supported two interns — either graduate students or law students — in state government to give them experience in how marine-related policies are formulated and carried out. During 1974, one intern, specializing in environmental issues, served as an administrative assistant in the Governor's Office.

The second worked with the Wisconsin Public Service Commission in its Bureau of Environmental and Energy Systems and is now employed full-time in the state's Department of Administration. These positions have also served to strengthen the liaison between the UW Sea Grant Program and state officials.

For the aspiring marine journalist, financial assistance has been provided to graduate students specializing in investigative reporting of marine-science news for newspapers, T.V. and radio. While working with the UW Sea Grant Communications Office and the university's science writing program, one writer prepared feature articles and news releases on marine-related research topics, wrote environmental scripts for radio and contributed to several Sea Grant publications and communication projects. This student was recently offered a job with the National Fisherman but turned it down to finish a Ph.D. degree in mass communications.

The most important educational audience of the UW Sea Grant Program is the graduate and undergraduate students interested in pursuing careers in the marine sciences. Most Sea Grant support for education comes through graduate assistantships and undergraduate jobs but there are also a variety of courses and other educational opportunities offered.

UW Sea Grant support makes possible an annual field trip to the University of Georgia's Marine Institute on Sapelo Island. This week of research on the warm Georgia coastline is required for the 15 members accepted into the UW-Madison graduate course, "Problems in Oceanography." For "oceanographers" a thousand miles inland, the productive ecosystems of this barrier island offer a stimulating array of fresh and saltwater environments for sharpening individual research skills and learning about interdisciplinary collaboration.

Though this is essentially an educational experience, some of the Sapelo Island projects have made valid contributions to research. A study on amino acids in sea water has been published. A more recent project, which will appear as a Sea Grant technical report, is a study of "rhomboid ripple marks," the rare wave patterns imprinted on beaches at Sapelo Island and on those of Oregon and Denmark. When preserved in sedimentary rock, such usually ephemeral patterns can reveal much about the geological history of the region — its beach slope at the time of formation, the wind and wave characteristics along the shore, and the type and mixing of its sand sediments.

Another specialized educational experience has been a two-week summer course on fish disease. Covering a wide range of health factors — viruses, bacteria, fungi, parasites, tumors and nutrition — the course is one of the few in the country to cover the important area of fish physiology and disease.

A broader educational audience has been addressed through the medium of the state's Educational Telephone Network (ETN). The Sea Grant Program has sponsored six ETN lectures per year on Sea Grant research and coastal zone problems — these are broadcast to the counties in Wisconsin and on 18 UW campuses where the audience is able to exchange information and question speakers. These ETN outlets are also available to the general public. Most costs for the program are borne by UW-Extension. However, Sea Grant's Advisory Services Division provides the slides and other informational materials sent to the ETN stations.

Student collects plankton samples as Professor Jim Kitchell looks on during an oceanographic field trip to Sapelo Island, Georgia.

There have been other special projects in education sponsored by the Sea Grant Program over the past two years including special lectures by visiting marine scientists and special Sea Grant research assistantships for outstanding students.

From the foregoing description, it is clear that the "education" subprogram within Sea Grant undertakes a combination of missions — imparting scientific information to the students, giving UW students the opportunity to apply what they've learned and gain experience in the field and in the laboratory, and conveying more general information on Great Lakes resources and related issues to other educational audiences and the public.

Advisory Services

"How can I get my sick octopus to eat?"

"What kind of capital investment do I need to raise perch in my empty dairy barn?"

"My garage is falling into Lake Michigan — what can I do?"

If these questions sound strange, they are. But they are also typical of the questions constantly directed towards Sea Grant Advisory Services personnel.

The Advisory Services Program is basically the service arm of the UW Sea Grant Program. Here, the results of Sea Grant research efforts are widely disseminated to interested groups, including private industry, government agencies, other universities and the general public. This is done in various ways — through conferences and workshops, technical publications, news releases, feature articles, films and the work of field agents.

Over the past two years, Sea Grant has supported extension agents in fisheries, water quality, home economics and recreation. In turn, these Advisory Services specialists feed back into the research projects by letting investigators know of outside interests in their work and of emergency problem areas that are in need of research support.

Thus, research and advisory services are inextricably tied together in the UW Sea Grant Program — in fact, many field agents also have research projects while many research investigators also carry out advisory services activities. Because of this close relationship much of what can be considered "advisory services activities" are included under other sections of this report.

Sea Grant fisheries specialist David Stuiber (second from right) talks with Michigan commercial fisherman Bill Carlson (right) and John Carr, head of the Great Lakes region's National Marine Fisheries Service (left).

Perhaps the major thrusts in recent years have been in the areas of fisheries and shore erosion. In both instances, Sea Grant has responded to current Great Lakes problems and to cries for help from shoreline property owners and the state's commercial fishing industry. In fact, the Advisory Services Division can take much of the credit for inspiring and initiating the shore erosion and aquaculture research projects which Sea Grant is now sponsoring.

Specific achievements under advisory services have been numerous, ranging from holding workshops for beleagured shoreline property owners in Milwaukee; to preparing booklets for the sportsman and homemaker on how to cook salmon or buy seafood; to scheduling marine-related lectures over the Educational Telephone Network; to simply advising a distraught animal-lover about what to do for his sick octopus.

Illustrative of the success of these varied efforts has been Sea Grant's increasing visibility in the state and the region. Advisory Services personnel and research investigators are more involved than ever before in serving on state agency advisory committees, helping to draft policies and legislation, working with private industry and in various other kinds of outreach activities.

Communications

One major tool for carrying out advisory services activities is communications. The Sea Grant Communications Office has supported advisory services and research activities in many ways: through the publication of technical and advisory reports, the distribution of reprints of journal articles written by Sea Grant investigators; the handling of publicity on research projects and conferences; and the reporting of program progress to the National Sea Grant Office and others.

Over the past two years, the communications office has also provided a major input in the area of public information and education. Through newspaper features, radio programs, television spots and educational films, information about the Great Lakes and their resources have been disseminated to a broad audience.

Forty-four Sea Grant publications have been issued over the past two years (see list) and more than 45,000 copies of these and previous publications have been distributed, many of them to individuals who have written in requesting them. The public information booklets — among them, "Getting the Most From Your Great Lakes Salmon," "Our Great Lakes," "Ice Fishing," "Fish of Lake Michigan," and "Fish and Seafood — Dividend Foods" — have proven to be the most popular. Many

of these have been written up and advertised in national magazines such as Sports Afield, Outdoor Life, Science and others.

Perhaps the most successful project of the communications office has been Earthwatch. Earthwatch is a daily two-minute public affairs radio program about the Great Lakes and the environment. The program was started in September of 1972 with just 12 radio stations. It has expanded such that, today, over 100 stations — commercial and educational — throughout the Midwest carry the program.

Produced in cooperation with the UW-Madison Institute for Environmental Studies, Earthwatch received a citation from the Wisconsin Natural Resources Foundation, Inc. in May of 1974 for its achievements. The program has since spawned similar programs at other universities and has inspired several related UW communications projects. A book, Earthwatching, has been published which contains a compilation of Earthwatch scripts from the first year and a half of programming. Also, a weekly newspaper column, Earthwatch/Wisconsin was begun in January of 1973 and is now being distributed by United Press International in the state and around the Midwest. The column has even turned up as far away as Long Island and New Jersey.

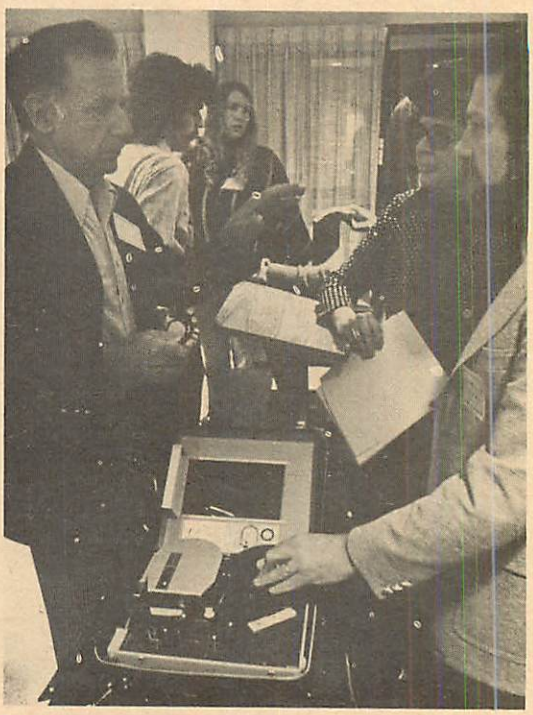
Filming "The Last Fishermen."

Other Sea Grant Communications Office activities have included the production of public service announcements for radio and television which have been aired throughout the upper Great Lakes region; several half-hour radio specials; and two documentary films.

The film, Salmon Story, is a 28-minute color documentary which was judged by the American College Public Relations Association to be the best film documentary produced by an American university in 1974. The film has been shown over television stations in Wisconsin, Illinois, Michigan and Indiana and has been in demand for showing by sports clubs, research groups and citizens groups. A second Sea Grant film, The Last Fishermen, is now being finished and will soon be released. It concerns the commercial fishermen of the Great Lakes; their history, lifestyle and current problems.

In late May of 1974, the University of Wisconsin Sea Grant Program cohosted a national meeting of Sea Grant editors and communicators in conjunction with Texas A & M University. Over 40 people from throughout the U.S. attended the four-day meeting, out of which grew much closer ties between and talent sharing among the individual Sea Grant programs. That meeting also gave rise to a national communications committee to help Sea Grant institutions and the national office with their communications efforts.

In all, communications and advisory service activities in the UW Sea Grant College Program have covered a broad spectrum over the past two years and the expectation is that that spectrum will grow even broader as the Sea Grant Program continues to expand in substance and increase in visibility.



Sea Grant communicators engaged in discussion during the May workshop.

PUBLICATIONS - 1973-1974

Annual Report: University of Wisconsin Sea Grant College Program, 1971-72, **WIS-SG-73-113.**

Our Great Lakes, UW Sea Grant Communications Staff, **WIS-SG-73-114.**

Ice Fishing, Warren Downs, **WIS-SG-73-115.**

Earthwatching, Anthology of scripts, Sea Grant and the Institute for Environmental Studies, **WIS-SG-73-116.**

Fish Filleting, Charlotte Dunn, **WIS-SG-74-117.**

Fish and Seafood — Dividend Foods, Charlotte Dunn, **WIS-SG-74-118.**

Getting the Most From Your Great Lakes Salmon, C.E. Johnson, D.A. Stuiber, R.C. Lindsay, **WIS-SG-74-120.**

Fish of Lake Michigan, Warren Downs, **WIS-SG-74-121.**

Investigation of the Sediments and Potential Manganese Nodule Resources of Green Bay, Wisconsin, J.R. Moore, R.P. Meyer and C.L. Morgan, **WIS-SG-73-218.**

The Role of Unilateral State Action in Preventing International Environmental Injury, Richard B. Bilder, **WIS-SG-73-219.**

Magnetic and Seismic Reflection Surveys of Lake Superior, Carl P. Brzozowy, **WIS-SG-74-220.**

Sedimentation Off the Kewaunee Nuclear Power Plant, J.M. Pezzetta, **WIS-SG-74-221.**

The Emerging Right of Physical Enforcement of Fisheries Measures Beyond Territorial Limits, Richard B. Bilder, **WIS-SG-74-222.**

Scour and Deposition — Changes in Sedimentation Around a Nuclear Power Plant, Martha H. Kohler, J.R. Moore, **WIS-SG-74-223.**

Sedimentation and Scour Off Nuclear Power Plants, M.L. Kohler, J.R. Moore, **WIS-SG-73-331.**

Significance to Eutrophication of Spatial Differences in Nutrients and Diatoms in Lake Michigan, R.E. Holland, A.M. Beeton, **WIS-SG-73-332.**

Exploitation of Ocean Minerals Resources — Perspectives and Predictions, J.R. Moore, **WIS-SG-73-333.**

Recreational Uses of Green Bay: Bay/Non-Bay Users Compared, R. Ditton, T. Goodale, **WIS-SG-73-334.**

The Economic Merits of Extending the St. Lawrence Seaway Navigation Season, E. Schenker, D. Smith, **WIS-SG-73-335.**

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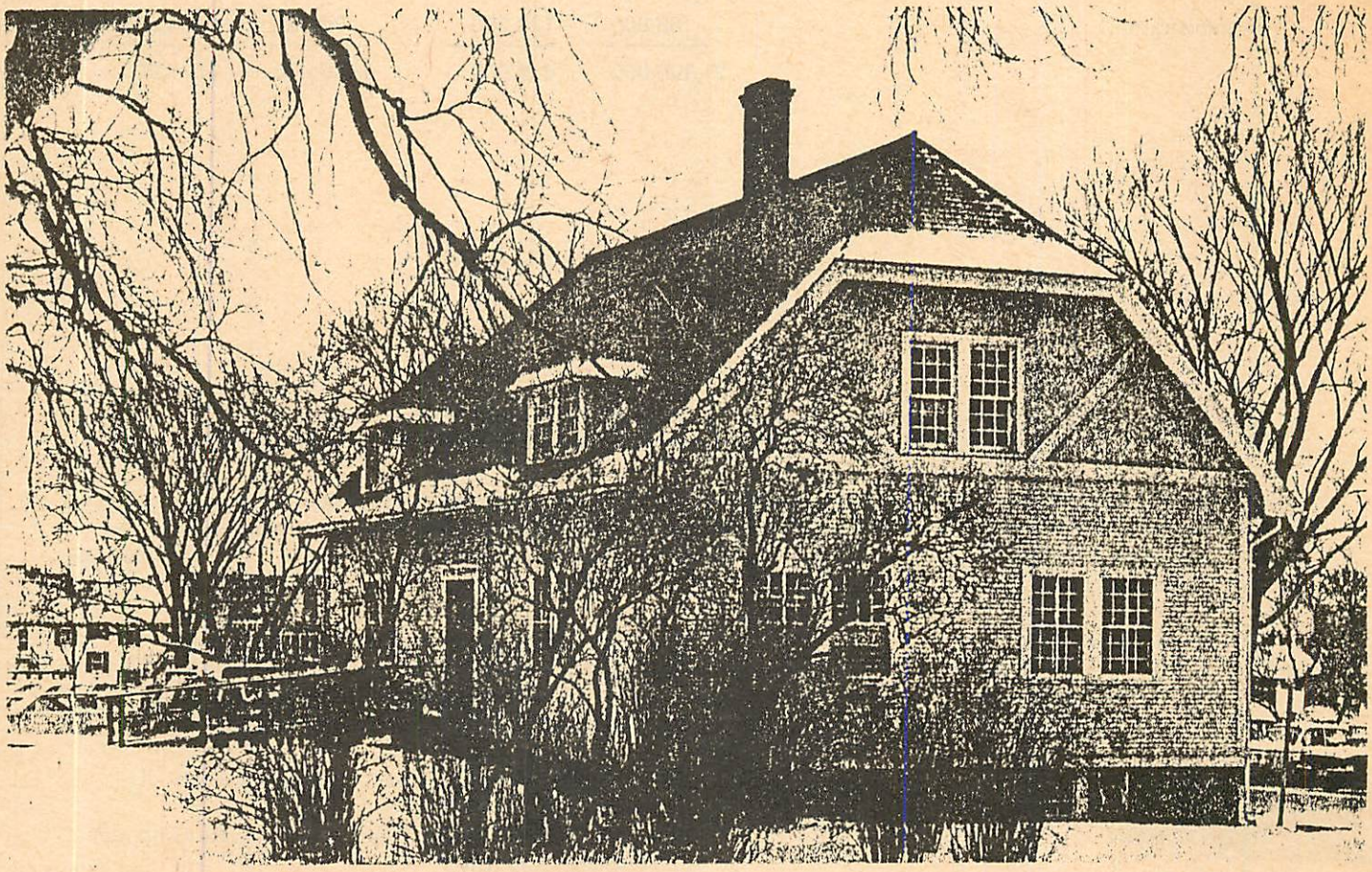

Program Budget

	9/1/72 – 8/31/73		9/1/73 – 8/31/74	
	NOAA	UW	NOAA	UW
Biological Resources & Microcontaminants	$ 92,800	112,300	$100,896	$ 47,482
Water Quality	88,100	13,300	30,203	24,316
Green Bay	111,500	8,900	47,524	20,182
Ports and Commerce	174,000	22,200	104,042	72,346
Electric Power	129,700	80,200	97,739	55,149
Policy Studies	140,800	74,800	102,018	59,467
Geo-Environmental and Mineral Resources	101,800	76,700	93,297	60,688
New Applications	17,800	12,500	37,144	25,389
Advisory Services	141,800	46,200	138,201	56,508
Education	12,900	28,700	38,938	13,640
Administration	88,800	124,200	94,998	64,833
	$1,100,000	600,000	$885,000	$500,000

University of Wisconsin Faculty Involvement in State and National Marine Affairs

Beyond numbering annual accomplishments, another indication of the achievements of a Sea Grant College Program is the extent to which its investigators are involved in professional organizations or are acting in an advisory capacity to state and federal government agencies. University of Wisconsin faculty members were very active in this regard during 1974. Some selected examples:

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University Corporation for Atmospheric Research
Sea Grant-Land Grant Association Joint Committee

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Chairman, Marine Mining Panel, National Academy of Engineering
Chairman, Marine Geology Panel, American Association of Petroleum Geologists

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ALFRED BEETON Assoc. Director, Center for Great Lakes Studies, UWMKE	Treasurer, American Society for Limnology and Oceanography Chairman, Research Advisory Board, Wisconsin Department of Natural Resources
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A.D. HASLER Director, Laboratory of Limnology, UWMSN	Director, The Institute of Ecology President, International Association for Ecology Editorial Board, *Science* Magazine
HARRY BROCKEL Lecturer, Center for Great Lakes Studies, UWMKE	Advisory Panel, Office of Coastal Zone Management, NOAA American Association of Port Authorities (Past President)
ERIC SCHENKER Assoc. Director, Center for Great Lake Studies, UWMKE	Chairman, Panel on Future Port Requirements of the U.S., National Academy of Sciences Great Lakes Pilotage Advisory Board
GREGORY HEDDEN Director, UW Sea Grant Advisory Services	Great Lakes Basin Commission Standing Committee on Shore Erosion
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JOHN STEINHART Assoc. Director, Marine Studies Center, UWMSN	Environmental Fellowship Committee, Rockefeller Foundation Governor's Ad Hoc Advisory Committee on Energy

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D. Armstrong - UWMSN

Pesticide-Sediment Interactions in Green Bay
D. Armstrong - UWMSN

Surface Microlayer-Microcontaminant Interactions in Lake Michigan
D. Armstrong - UWMSN

Studies on the Metabolism and Phamacology of the Lampricidal Agent 3-Trifluoromethyl-4-nitrophenol (TFM)
J. Lech - Medical College of Wisconsin–Milwaukee

Application of Odor Imprinting to Salmon Management in Lake Michigan
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M.J. Melancon - UWMKE

Response of Primates to Polychlorinated Biphenyls
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Food Processing of Underutilized Great Lakes Fish Species
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