



Annual Progress Report, 1999

Programmatic Accomplishments and Benefits Achieved

University of Wisconsin Sea Grant College Program

Anders W. Andren, Director

Institution/Grantee: University of Wisconsin Sea Grant Institute

**Federal Grant Nos.: NA46RG0481
NA86RG0047**

Report Period: October 1998-November 1999

First printing: November 1999

Revised edition: January 2000

Compiled, edited and designed by

Stephen C. Wittman, Assistant Director for Communications

Contributors:

Mary Lou Reeb, Assistant Director for Administration & Information Technology

Daniel Marklein, Finance & Grants Administrator

Allen H. Miller, Assistant Director for Advisory Services

Delphine Skinner, Assistant to the Director

Elizabeth White, Editor

Richard Hoops, Earthwatch Radio Producer/Editor

John Karl, Science Writer

Linda Campbell, Communications Program Assistant

Cover by **Tina Yao**



This work was funded by the University of Wisconsin Sea Grant Institute under grants from the National Sea Grant College Program, National Oceanic & Atmospheric Administration, U.S. Department of Commerce, and from the State of Wisconsin. Federal Grant No. **NA46RG0481**, Project No. **C/C-1**. Pub. No. **WISCU-Q-00-001**.

University of Wisconsin Sea Grant Institute

Goodnight Hall, 2nd Floor

1975 Willow Drive

Madison, WI 53706-1177

USA

Phone (608) 262-0905

Fax (608) 262-0591

World-Wide Web www.seagrants.wisc.edu

CONTENTS

Introduction 1

Project Progress Report Summaries

Core Program

Administration Subprogram 3
 Advisory Services Subprogram 4
 Communications Subprogram 5
 Education Subprogram 6
 Living Resources Subprogram 7
 Estuarine & Coastal Processes Subprogram 8
 Microcontaminants & Water Quality Subprogram 9
 Aquaculture & Seafood Technology Subprogram 11
 Policy Studies Subprogram 12
 New Initiatives Subprogram 13
 Biotechnology Subprogram 14

National Sea Grant Strategic Investments and Enhancements Projects

Marine Biotechnology 15
 Nonindigenous Species – Zebra Mussels 16

Appendices

1. Program Funding from All Sources 19
2. Organizational Units and Departments Involved in the UW Sea Grant College Program 21
3. Projects Supported 23
4. Comprehensive List of Publications and News Releases 27
5. Students and Fellows Supported 31
6. Program Awards 33
7. Outreach Activities
Advisory Services Workshops, Symposiums and Conferences 35
Communications Outreach 37
Education Workshops 37
Advisory Services Partnerships 39
Communications Partnerships 43
“Earthwatch Radio” Stations & Partners 45
Education Partnerships 47

INTRODUCTION

When a project is included in the University of Wisconsin Sea Grant College Program omnibus proposal for federal funding, it is approved for a specific period of time, usually from one to three years. No research or education project is permitted to run more than four years without the project proposal being resubmitted for peer review. Proposals for new, short-term special outreach projects are treated the same as new research and education projects, and they must have peer review ratings competitive with those for research proposals to be eligible for funding.

An in-depth progress report detailing progress toward meeting project objectives is required for all research and education projects scheduled to continue into the next biennial grant cycle. Continuation of funding is dependent upon submission of a satisfactory progress report.

Specifically, we request that investigators describe their progress toward meeting each project objective and, where possible, to document it with letters or other evidence. They are also asked to describe ways in which project results to date have been communicated to others (e.g., conference presentations, contacts with agencies and other researchers, meetings with user groups, etc.) and to list all publications and theses, degrees granted and/or students trained as result of the project. We also require a detailed justification of any major shifts in project emphasis or significant budget changes.

These progress reports are reviewed and evaluated by the appropriate subprogram coordinator(s) and UW Sea Grant Institute staff, and kept on file at the institute. *Subprogram coordinators do not participate in any way in the progress evaluation of their own projects.* Continuing projects are not subjected to external review unless the project is making insufficient progress toward its objectives, or its focus has changed significantly from the originally approved work plan. Continued funding for these projects also depends on sufficient funding of the overall Wisconsin Sea Grant program. Summaries of those reports are presented herein.

In addition to formal reports, project progress is also monitored and reported through periodic thematic area debriefings between project investigators and UW Sea Grant outreach and management staff. Also, Communications Office staff regularly contact and meet with project investigators and students in connection with producing program reports, fact sheets, news releases, radio programs, World-Wide Web sites and other means of documenting and communicating the progress and results of all UW Sea Grant research, outreach and education projects.

In-depth progress reports are also required each biennium for UW Sea Grant's ongoing core program projects in Advisory Services, Communications and Education, summaries of which are likewise included in this report and presented first. Detailed information on core program efforts in Advisory Services, Communications and Education subprograms is kept at the UW

Sea Grant Institute's administrative offices at UW-Madison, and in accordance with the program evaluation process outlined by the National Sea Grant Office (NSGO), these projects are subject to intense review every four years (next in connection with the NSGO Program Assessment Team visit in 2001 and the 2002-04 omnibus proposal submission).

Lastly, a brief annual progress report is required for projects that won't continue into the next grant cycle, pending submission of a detailed project completion report within six months of the termination date of the project. Those reports also are included here.

The appendices to this report contain all of the suggested annual progress report content outlined in the NSGO's *Policy Document on the Implementation of Program Evaluation Procedures in the National Sea Grant College Program, Section 4: Ongoing Program Assessment and Progress Reporting* (April 20, 1998, draft) to satisfy U.S. Department of Commerce Standard Terms and Conditions for Grants requirements.

PROJECT PROGRESS REPORT SUMMARIES

Core Program

Administration Subprogram

Program Development (M/SGA-1)

Anders W. Andren, Sea Grant Institute, UW-Madison

Travel support was provided for principal investigators and project researchers to attend scientific conferences and/or to present papers based on Sea Grant-supported research (R/LR-76, R/LR-63, R/MW-79, C/C-3). Funding was provided to augment research projects to conduct a comparative year assessment for estimating larval yellow perch abundance in Lake Michigan (R/LR-75); to begin study of the influence of *El Niño* on the spring phytoplankton bloom in Lake Michigan (R/EC-6); and to conduct clean sampling and clean, low-level measurements of trace metals (R/MW-77). Additional support was also provided for outreach projects to develop underwater video segments for the Web (C/C-3) and to modify the site characterization module of the RemSim contaminated sediments remediation simulation model (A/AS-1). Partial funding was provided for a computer network tape backup system (M/SGA-2) and printer (A/AS-1). We also provided funding for a yellow perch research workshop (R/LR-75) and travel support for a faculty member to participate in a yellow perch stocking workshop (A/AS-1). We also funded three research projects – one studying the mitigation of the consequences of stress in yellow perch aquaculture (R/AQ-33-PD), one focusing on the early life history of perch (R/LR-74-PD) and one examining the prediction and prevention of stress responses in recreational scuba divers (R/NI-29-PD).

Program Management (M/SGA-2)

Anders W. Andren, Sea Grant Institute, UW-Madison

During 1999, we (1) continued to refine program administrative processes according to the NSGO's new procedures; (2) continued our matrix approach of integrating thematic areas with traditional subprograms to more effectively manage information flow for research, outreach and education; (3) organized and hosted three workshops in 1999 to facilitate transfer of thematic area project results among researchers, outreach personnel and constituent groups; (4) competed successfully in national Sea Grant National Strategic Initiatives on non-indigenous species, Knauss Marine Policy Fellowships, and Industrial Fellowships; (5) created a program-wide Information Technology group that will coordinate Web-based information flow; (6) cosponsored an international workshop with the U.S. Environmental Protection Agency aimed at transferring state-of-the-art research results on the behavior of metals in aqueous environments to industry and state and federal government units; (7) drafted strategic and implementation plans in connection with developing UW Sea Grant's 2000-02 omnibus proposal; (8) participated in Oregon Sea Grant's Electronic Systems Workshop for enhancing its "Making a Difference" Program Accountability System and Web-Based Proposal Submission Management System, and initiated development of a similar (modified) system for the UW Sea Grant College Program; (9) moved the UW Sea Grant Institute to roomier new quarters on campus, formed a new Aquatic Sciences Center (which houses the UWSGI and Water Resources Institute), and integrated financial, personnel and Information Technology activities; and (10) a member of the UWSGI staff (Wittman) was selected for a special internship with UW-Madison Chancellor's Office to prepare publications and assist with media relations for university sesquicentennial events at six locations around the state.

Ship Time (M/SGA-3)

Anders W. Andren, Sea Grant Institute, UW-Madison

This project provided ship support to the following continuing and terminating projects: R/LR-75, R/LR-76, R/EC-6, R/MW-78, A/AS-1.

Advisory Services Subprogram

Advisory Services: Program Coordination and Field Offices (A/AS-1)

Allen H. Miller, Sea Grant Institute, UW-Madison

The year's highlights include relocating UW Sea Grant's Advisory Services field offices to bring our specialists closer to their clientele. Our water quality specialist was moved to Green Bay for involvement on projects to clean up Lower Green Bay and the Fox River, one of 43 Great Lakes "areas of concern" identified by the International Joint Commission, and our fisheries specialist was moved to Manitowoc to be closer to the Lake Michigan sport and commercial fishing industry. Prestigious awards were presented to five Advisory Services staff members during the year (*see Appendix 6*). We initiated a two-year project to collect data on yellow perch aquaculture in recirculating systems, and programs were organized to present information on natural hazards and breakwaters at international conferences in Cleveland and Madison. Teacher workshops on global environmental change were held in Ashland, Manitowoc and Lake Geneva, and the workshop material was converted into a Web-based, distance education workshop. Conferences in support of the "Sustainable Green Bay Initiative" were organized, attracting more than 140 invited participants and 400 members of the general public. Monitoring equipment was provided, training sessions were managed, and a database was created to manage and report stream data to the Wisconsin Department of Natural Resources (currently, more than 1,500 students, teachers and adult volunteers routinely monitor nine Green Bay and Lake Michigan tributaries).

WATERS: Wisconsin's Aquaculture Technology Education and Research Services (A/AS-39)

Fred Binkowski, Great Lakes WATER Institute, UW-Milwaukee

To date, we have responded to 246 telephone and mail requests for aquaculture information. This included providing specific technical information, resource guides, bibliographies, fact sheets and technical bulletins. In cooperation with state government and commercial aquaculture, we were responsible for developing the technical program and assisting in organizing the annual state aquaculture conference. The 1999 conference in Green Bay attracted more than 750 attendees. At 1998 conference in Eau Claire, Wisconsin Gov. Tommy Thompson presented the keynote address, "Aquaculture is Agriculture," and announced the formation of a Blue Ribbon Task Force on Aquaculture, and the project principal investigator (Binkowski) was invited to serve on it. Technical on-site activity continues to be an important component of this outreach project by providing critical services to the industry regarding water quality; offering instruction on "best management practices" for pond aquaculture; demonstrating the application/operation of water quality testing; assisting in the set-up and providing technical advice on Recirculating Aquaculture Systems; advising on aquaculture effluent issues; and working with the Wisconsin Department of Public Instruction in developing secondary education aquaculture curriculums. We have presented several specialized workshops and classroom/hands-on training sessions on intensive aquaculture. Within the framework of this project, we will continue to emphasize the question/answer and problem-solving component and also focus on developing the hands-on training, which provides the maximum benefit for aquaculture clients.

Applications of Geographic Information Systems to Coastal Zone Management: Building Local Capacity (A/AS-40)

Stephen Ventura, Land & Information Computer Graphics, UW-Madison

We have worked closely with state and local government officials on the application of geographic information systems (GIS) to coastal management issues. These GIS applications can be thought of as illustrative "teaching models" that utilize local government databases to demonstrate how GIS can be applied to specific coastal issues. The initial models applied GIS to shoreland management for an inland lake in northern Wisconsin, coastal hazards issues on Lake Michigan, and agricultural riparian buffer areas to reduce nonpoint source pollution of the Pigeon River, a Lake Michigan tributary. Since November 1998, we have assisted county officials with development of a floodplain management application in Ozaukee County, an urban nonpoint source pollution application using data from Marquette, Michigan, and a land use planning/growth management application in Door County. Several coastal GIS demonstrations and training courses have been conducted, including a day-long "Shoreland and Coastal Management Using ArcView" course in May attended by 6 people, a day-long

“Shoreland Management Using ArcView” course in October attended by 10 people, a day-long “Land Use Planning Using ArcView” course held in November in Door County attended by 15 people, and a half-day “Arc Explorer” course held in Racine County in November (*see Appendix 7*). An “Urban Nonpoint Source Pollution Modeling Using ArcView” course was scheduled for December. Shoreland management and coastal erosion courses have been placed on-line as part of the project’s World Wide Web site (www.lic.wisc.edu/coastgis), and the training instructions and data sets have had more than 150 “hits” so far in 1999. Assistance was provided to officials from several coastal counties (Racine, Ozaukee and Door Counties in particular), as well as to UW Sea Grant staff. Several presentations on coastal GIS research were made at state and national workshops and conferences in 1999.

Transferring Sea Grant Zebra Mussel Research and Outreach Results to the Nation Using a World-Wide Web Server (A/AS-43)

Allen H. Miller, Sea Grant Institute, UW-Madison

This project just began October 1, 1999, so we have no significant progress to report at this time.

Communications Subprogram

Communications Office and Subprogram Coordination (C/C-1)

Stephen Wittman, Sea Grant Institute, UW-Madison

During the past year, we produced six institute newsletters (circulation ~1,000), three formal publications, six administrative documents, five fact sheets, and 15 news releases (*see Appendix 4*). More than 122,000 customized “Zebra Mussel Watch” cards were sold to other Sea Grant programs and various state and federal agencies. The Communications Office purchased reprints of 20 science journal articles resulting from UW Sea Grant-supported projects and distributed a total of 9,564 copies of all publications, about 75 percent of which were in response to requests. Publication sales during the year recovered \$15,109. Communications staff assisted in the scripting, recording and distribution of more than 240 “Earthwatch” radio programs in cooperation with the UW-Madison Institute for Environmental Studies (*see C/C-2 below*). We created and continued to expand and enhance our “Fish of the Great Lakes,” “Wisconsin’s Great Lakes Shipwrecks” (*see C/C-4*), “Gifts of the Glaciers” and “Earthwatch” Web sites. As of July 1999, these and other Communications Web sites were averaging a total of more than 300,000 hits per month – an average of nearly 10,500 hits per day. These hits resulted from a total of 27,000 individual user sessions per month (about 875 per day) averaging nearly 15 minutes each. Nearly 20 percent of users were repeat visitors. On behalf of the Great Lakes Sea Grant Network, we also arranged for and helped host an exhibit at the International Joint Commission’s Great Lakes Environmental Expo Sept. 24-25 in Milwaukee. During 1999, the Communications Office also organized three thematic area meetings involving researchers, outreach staff, resource managers and the interested public to facilitate the transfer of UW Sea Grant research results (*see Appendix 7*).

Earthwatch Public Service Radio Program (C/C-2)

Richard Hoops, Sea Grant Institute, UW-Madison

The “Earthwatch Radio” project produced 10 two-minute programs on science and the environment every two weeks during 1999 and distributed them to more than 100 radio stations (*see Appendix 7*). More than half of the programs deal with atmospheric or water-related subjects such as global climate change and marine and Great Lakes research. Our sources included personnel from various offices of the National Oceanic & Atmospheric Administration (NOAA), Wisconsin Sea Grant, and other Sea Grant programs in the Great Lakes region and elsewhere. The “Earthwatch” Web site was substantially redesigned during 1999 and is now featuring online audio in the most recent format available from RealNetworks™ which distributes RealPlayer™ one of the most commonly used programs for receiving online audio. The project principal investigator (Hoops) gave a presentation about online audio during the Sea Grant network’s biennial national conference in June 1999, and contacts have been made with NOAA’s Great Lakes Environmental Research Laboratory in Ann Arbor, Mich.,

to work together on joint radio ventures. Legal action initiated in 1998 to obtain trademark protection of the name "Earthwatch" continued during 1999 and is close to resolution.

Sailing through Death's Door: Multi-Media Site Guides to Wisconsin's Lake Michigan Shipwrecks (C/C-3)

Jefferson Gray, Underwater Archeology, State Historical Society of Wisconsin
John Karl, Sea Grant Institute, UW-Madison

Since the project's start on March 1, 1999, two shipwrecks, the *Niagara* and the *Frank O'Connor*, have been added to the project's Web site, "Shipwrecks of Wisconsin" (www.seagrant.wisc.edu/shipwrecks). This material includes text about the ships' history, final voyage, wreck history, current condition, and preservation. It also includes historical and modern underwater images and a map of the site. The preparation of similar information on three more wreck sites — the *Louisiana*, *Pilot Island* and *Hetty Taylor* — is nearly completed. We also prepared material for producing dive guides for each site. The project developed a CD-ROM version of the Web site that was featured in the well-received children's exhibit, "Shipwrecked," at the Wisconsin Maritime Museum in Manitowoc from May to August 1999. The Web site was enhanced with a series of pages called "Notes from the Field" (www.seagrant.wisc.edu/Shipwrecks/Notes_from_the_Field). These included near-daily postings of photographs and commentary from a team of archaeologists as they researched and mapped a wreck in Sturgeon Bay, Wis. Twelve public presentations on Wisconsin's shipwrecks were given to schools, diving associations, and other groups.

Education Subprogram

Special Marine Education Projects (E/E-1)

Mary Lou Reeb, Sea Grant Institute, UW-Madison

UW Sea Grant Institute was awarded the 1999 Wisconsin Society of Science Teachers Friend of Science Award. We participated in UW-Madison's 150th anniversary by providing funding for 12,000 educational post-cards for distribution to the general public at the February 1999 Anniversary Community Concert and 300 educational fish posters for distribution to local centers primarily serving the minority community. Project funds were used to provide partial support for the "Recent Advances in Limnology and Oceanography Seminar Series" (E/E-31-SE) at UW-Milwaukee and travel support for graduate students to obtain field research experience in "Problems in Oceanography" course (E/E-34-SE). We also provided travel support for UW Sea Grant graduate student Jeffrey Ripp, who began his Dean John A. Knauss Marine Policy Fellowship on February 1, 1998 (E/E-33). Support was provided for two UW Sea Grant "Graduates of Distinction" seminar series lectures in 1999 (John Raglin, Indiana University, and Stephen Brandt, NOAA Great Lakes Environmental Research Lab), and we provided in-kind support for the "Madison JASON Project" and its Web site. Praised as a national model by JASON Project organizers, "Madison JASON" last year involved about 3,000 students and 39 elementary and middle schools in 15 Madison-area communities. We solicited and received funding from two private corporations (Electronic Data Systems and Alliant Energy Foundation) for scholarships for needy students to participate in Madison JASON. The project principal investigator (Reeb) serves as co-chair of JASON Project Network sites, coordinating the JASON Project with other academic/industry/state agency science education initiatives in Wisconsin.

Sea Grant Industrial Fellowship: ATR-Based Photocatalytic Drinking Water Systems (E/E-32)

Marc Anderson, Water Chemistry Program, UW-Madison

Several methods of using titanium dioxide photocatalytic oxidation to destroy organic contaminants have been explored. Optical microscopy using polarized and nonpolarized light was tested for characterizing TiO₂ coating. Electron microscopy was assessed for characterizing the coating and determining its thickness. One method explored was the TEM of a sample prepared by ultramicrotomy. TEM studies were carried out at an accelerating voltage of 75 to 100 kV. Additional testing was accomplished using an AMRAY field emission TEM and

imaging at 1 to 2.5 kV. UV spectral analysis revealed that acrylic processing condition and additives in the acrylic cause light intensity transmitted through different acrylics to range from 5 to 75 percent over the same light wavelength. A visible light microscopy study of the TiO₂ coating surface showed interference patterns in areas where the coating was flawed. The amount and intensity of damage caused by flaws in the acrylic surface observed with light microscopy and electron microscopy increased as the coating thickness increased. Cracks were also observed to radiate in a circular pattern around any coating flaw. The number and magnitude of cracks increased with increased coating thickness.

Living Resources Subprogram

Early Life History of Yellow Perch (R/LR-74-PD)

Fred Binkowski, Great Lakes WATER Institute, UW-Milwaukee

Most work on this project was completed as of August 1997 (prior to the current reporting period). Work since then and continuing through April 2000 entails caring for the captive Lake Michigan perch broodstock acquired for the project. During the past year, we organized a conference, hosted by the S.C. Johnson Wax Fund, called "The Decline of Yellow Perch in Lake Michigan" that was held June 12, 1999, in Racine, Wis., at which results from this project and other research concerning yellow perch were presented.

Recruitment Mechanisms in Yellow Perch (*Perca flavescens*): Interactions Among Growth, Condition, and Predation (R/LR-75)

Fred Binkowski, Great Lakes WATER Institute, UW-Milwaukee

The first two of this project's five objectives have been accomplished: (1) We have traced the distributions of size, growth, condition, and relative mortality of young-of-year yellow perch in southern Lake Michigan. Data from a gill net survey conducted off Milwaukee indicated a highly variable pattern of spawning activity in 1998 and a smooth progression of spawning throughout the 1999 season. Time to hatching was faster in 1998 (~14 days) than in 1999 (~21 days) due to warmer bottom water temperatures in 1998. Larval surveys were conducted in both years. Peak hatch dates were 12 June 1998 and 17 June 1999. (2) We have quantified the spatial and temporal overlap in sizes of perch and potential predators in southern Lake Michigan. The decline in catches after perch reached 8 mm total length suggests larval perch likely leave the nearshore surface waters shortly after they initiate feeding. In 1999, extensive gill net sampling for potential predators of perch in early life stages produced mostly alewives. No yellow perch were found in any alewife stomach. We are currently conducting serial sacrifice experiments to determine the residence time of larval yellow perch in alewife stomachs. The third objective has been partially completed: we have begun to quantify the causes and consequences of variability in condition and the effects of size and condition on predation vulnerability in laboratory experiments. Maternal effects were found in both eggs and larvae of yellow perch, and a number of trials were conducted to determine probability of capture of individual prey of differing condition.

Application of Microsatellite and Mhc Markers to Stock Identification in Lake Superior Lake Trout (R/LR-76)

Ruth Phillips, Biological Sciences, UW-Milwaukee

We have successfully used microsatellite and Mhc markers to help assess the stock structure of lake trout in Lake Superior. Our results indicate that the lean and siscowet morphotypes are reproductively isolated and that lake trout in Lake Superior are divided into separate assemblages or stocks that should be managed separately. Two papers have been submitted on this work, and one has been accepted pending submission of an acceptable revision. Presentations on the research were made at the Coastwide Salmonid Genetics Meeting in Missoula, Mont., in June and at UW Sea Grant's Lake Superior Thematic Area Workshop in Superior, Wis., in September. A workshop on *Salvelinus* genetics -- attended by principal investigators from the major trout genetics laboratories in Wisconsin, Michigan and Ontario -- was held October 1-2, 1999, at UW-Milwaukee. Recommendations

of the workshop included standardization of microsatellite loci for *Salvelinus* species, that funding be sought for mapping projects for *Salvelinus* species including production of crosses to examine quantitative trait loci (QTLs) for important traits, and that Canadian and U.S. scientists coordinate lake trout population genetics studies, including those using historical samples. Finally, it was proposed that the participants form a Great Lakes and East Coast Salmonid Genetics Group similar to the successful Coastwide Salmonid Genetics Group, which has been very important in fostering communication between U.S. and Canadian fisheries scientists on the West Coast. This group would hold meetings every two years, with the next meeting to be held in Michigan in 2001.

Causes and Impediments of Lake Trout Recovery in Lake Superior (R/LR-77)

Michael Hansen, College of Natural Resources, UW-Stevens Point

The lake trout assessment database was assembled and converted from length-based catches to age-based catches. This entailed re-coding catches from more than 2,500 individual gill net lifts using age-length keys that were developed by the agencies. This phase of the research took more time than was expected, in part because there were many more data errors than expected. The project principal investigator (Hansen) published an analysis of the effect of gear saturation on gill net catches of lake trout (*North American Journal of Fisheries Management* 18[4]: 847-853), which was used to correct gill net catches for varying numbers of days the nets were fished. Modeling initially focused on Michigan waters of Lake Superior, so data for this jurisdiction were re-coded first. Preliminary results for Michigan management areas suggest that wild lake trout are contributing greatly to contemporary recruitment of wild lake trout in each area, in contrast to previous analyses. Progress on this research was initially presented to the Lake Superior Technical Committee in January 1999 in Marquette, Mich., and further progress will be presented to the Lake Superior Technical Committee in August 1999 in Marquette.

Fisheries and Food Web Dynamics in Lake Superior (R/LR-78)

James Kitchell, Center for Limnology, UW-Madison

The project has been staffed by two postdoctoral researchers (Doran Mason, now an assistant professor at Purdue University, W. Lafayette, Ind., and Tim Johnson, now a Research Biologist with Ontario Ministry of Natural Resources, Wheatley, Ont.), plus a graduate student (Chris Harvey) and the principal investigator (Kitchell). Accomplishments to date are expressed as five publications, two papers in press, and two manuscripts currently in review. Important among those are the evidences of co-authorship with agency personnel as indicative of the collaborative efforts we have established and are now bringing to print. A total of 11 presentations were made by project personnel at national or regional meetings plus invited colloquia at universities. Our graduate student (Harvey) was selected to represent the Great Lakes region and give two presentations in November 1999 in Gilleleje, Denmark, at the Young Scientists Conference on Marine Ecosystems Perspectives, organized by the International Council for Exploration of the Sea (ICES).

Estuarine & Coastal Processes Subprogram

Recruitment Decline of Yellow Perch in Green Bay, Lake Michigan: Evaluation of Environmental Influences and Predation (R/EC-5)

Fred Binkowski, Great Lakes WATER Institute, UW-Milwaukee

Substantial progress has been made toward project objectives. By the end of the current year's funding, we will have completed the quantitative and qualitative examination of field sample specimens and begun the data analysis phase of the project. This project continues to be a collaborative effort between UW Sea Grant, Wisconsin Department of Natural Resources, the Michigan and Illinois/Indiana Sea Grant programs, and the multi-state Yellow Perch Task Group. During the 1999 field season, five types of gear were used, which significantly enhanced our sampling effort to assess the 1999 year class of yellow perch in Green Bay waters of Lake Michigan. A total of 309 individual samples was collected within Little Tail Point of Green Bay, in addition to bay-wide index station trawling. It appears that the 1999 year class of yellow perch is much weaker as

compared to 1998. Preliminary indications are that the pelagic larval abundance appears to be similar to last year; however, demersal abundance was much higher in 1998 than in 1999, indicating that a problem occurred after peak larval abundance in 1999. The reduced demersal stage abundance does not appear to be linked to predation, since there is a lack of young-of-the-year yellow perch in predator stomachs. Analysis of larval condition and available plankton may provide answers as the analysis continues.

Net Heterotrophy/Autotrophy in Coastal and Offshore Lake Michigan (R/EC-6)

Russell Cuhel, J. Val Klump and Carmen Aguilar, Great Lakes WATER Institute, UW-Milwaukee

An intensive study of productivity parameters during the spring and summer of 1998 established features of the El Niño event that were consistent with predictions of early warming and decreased annual productivity inshore. Gradients from inner harbor to offshore stations demonstrated that the outer harbor of Milwaukee is an extremely effective nutrient removal system. Heterotrophy was dominant in harbor waters, whereas phototrophy controlled carbon productivity, with strong seasonality. Phytoplankton responded rapidly to changes in phosphorus availability resulting from physical forcing, while progressions of bacterial activity were more gradual. Carbon dioxide partial pressures were supersaturated up to three-fold in the inner harbor area, consistent with rate measurements. In winter, the entire water column outside the harbor area was at equilibrium with the atmosphere. Although more than 25 cruises have been undertaken to date, the culmination of the project awaits the last year's simultaneous application of the techniques established during the initial period of the project.

Microcontaminants & Water Quality Subprogram

Impact of Contaminants on Sexual Development and Reproduction of Amphibians in Great Lakes Ecosystems (R/MW-76)

William Karasov, Wildlife Ecology, UW-Madison

(1) *Sexual development of captive leopard frogs—positive control studies*: Positive control studies were performed in which larvae were exposed to doses of 17 β -estradiol or vehicle (EtOH), or raised in undosed, dechlorinated water and measured for body size and weight, various organ weights, and histologic analysis of gonads and functional biomarkers. Sex ratios depended on levels of estradiol-17 β . The resultant data validated the procedures and are useful in statistical power analyses for planning further experiments. We are currently measuring plasma vitellogenin of leopard frogs as an indicator of exposure to xenobiotic estrogens. (2) *Dose-response studies*: Exposure to PCB 126 at concentrations 100x to 1,000x higher than the concentration of total PCBs in the Fox River or Green Bay reduced survivorship, caused edema, and slowed growth in both leopard frogs and green frogs. (3) *Sexual development of eggs raised in field enclosures*: Ten clutches of leopard frog eggs were collected from an uncontaminated site and raised in outdoor enclosures at two contaminated sites and two uncontaminated sites in the Green Bay ecosystem. When at least one forelimb emerged, tadpoles were brought into the laboratory and then sampled at metamorphic climax. Significantly more males were found at the contaminated sites than at the uncontaminated sites. (4) *Effect of contamination on wild females' egg viability*: In another experiment, egg clutches from a contaminated site and an uncontaminated site were collected and raised in the laboratory. Hatchability and survivorship was lower in eggs from the contaminated site. There was no significant difference in sex ratios between the sites.

Watershed Export and Speciation of Trace Metals in the Lake Superior Basin (R/MW-77)

David Armstrong, Water Chemistry Program, UW-Madison

William Sonzogni, State Laboratory of Hygiene, UW-Madison

This project is investigating key factors controlling the fluxes and speciation of metals (Pb, Hg, Cd, Cu, Zn, Ag, Cr, As, U) in representative watersheds of Lake Superior. Data collected on concentrations, stream flow, watershed characteristics, and water chemistry are being used to develop GIS-based estimates of metal loadings and particle partitioning for the U.S. portion of the Lake Superior Basin. We have demonstrated that seasonal factors, such as spring snow melt and organic colloid production in summer months, not only impact metal loading

but also have a controlling influence on metal speciation. Research on metal speciation is continuing. We have also evaluated the use of ultrafiltration (3, 10, and 100 kD) for speciation of metals into “dissolved,” colloidal, and particulate size fractions for both mercury and other metals and have submitted two manuscripts reporting our findings. A principal finding is that the colloidal fraction is highly significant for many metals. Colloidal metals are related in part to colloidal organic carbon, suggesting that the binding of metals to colloidal organic carbon is important in controlling speciation and transport. However, relationships to other factors, such as the association of lead with colloidal iron, show that other factors are also important. We have also developed and applied other approaches for speciation, including Chelex (cation exchange) for measuring “available” metal fractions and their binding constants, DEAE (anion exchange) for isolating dissolved organic carbon (DOC) and DOC-associated metals, and use of metal stable isotopes for measuring reactive metals pools associated with colloids and particles. Investigations of potentially important ligands show sulfide levels in streams exceed levels of many metals, indicating that metal binding to sulfide could control aqueous phase trace metal concentrations. Some of our recent results are contained in the following publications, manuscripts, and theses: “A critical evaluation of tangential-flow ultrafiltration for trace metal investigations in fresh water systems: Part I-Methods and applications to organic carbon, Part II-Total mercury and methyl mercury” (Hoffmann, Babiarz, Shafer et al., submitted to *Environ. Sci. Technol.*); “Watershed influences on mercury transport to Lake Superior” (Hurley, Cleckner, and Shafer, *Verh. Internat. Limnol.*, in press); and “Evaluation and applications of an ultrafiltration technique for speciation of organic carbon and trace metals” (Galdo-Miguez, 1999, M.S. thesis in Water Chemistry, UW-Madison).

Changes in Patterns of PCB Contamination in Surficial Green Bay Sediments over the Past Decade: Applications to Sediment Remediation (R/MW-78)

David Armstrong, Water Chemistry Program, UW-Madison

David Edgington, Great Lakes WATER Institute, UW-Milwaukee

This project involves measuring the increase in the amount of PCBs in Green Bay sediments due to transport of contaminated sediments over the past decade from the Fox River. Our assessment is based on measurements of PCB congeners and radionuclides in Green Bay sediment samples collected from various locations and depths in summer 1998. We have collected sediment samples from eight stations in Green Bay. Each station provided 15 PCB samples representing one-centimeter intervals between the sediment surface and 15 centimeters deep; thus, 120 PCB samples were collected. Samples were also collected for radionuclide analysis. Entire cores were sectioned for these analyses, and this produced approximately 500 sediment samples. Concentrations of PCBs in the sediment sections from each station will be used to determine the mass of PCB at each depth, station, and in the bay. Data from radionuclide samples will be used to establish time of deposition of the various sediment depths. By combining these two data sets, it will be possible to determine the amount of PCB added to the bay in the last decade. Analysis of all samples for Pb-210 (one of two radionuclides of interest) is now complete, and CS-137 and PCB analyses will be completed by the end of this year. Initial PCB measurements indicate that PCBs are present in surficial Green Bay sediments at concentrations comparable to 10 years ago. We have provided this information to the Wisconsin DNR for consideration in their assessment of remediation of PCB-contaminated sediments in the Fox River. Preliminary examination of current sedimentation rates in Green Bay, calculated from Pb-210 data, suggest that sedimentation rates have increased in the bay over the last decade. We expect to complete our final project report in March 2000.

Degradation of Organic Contaminants in Sediments via Subcritical Water Extraction and Photocatalytic Oxidation over Supported Nanoparticulate Metal Oxides (R/MW-79)

Marc Anderson, Water Chemistry Program, UW-Madison

Accomplishments to date include construction of four annular photocatalytic reactors, physical characterization of several catalyst support materials, determination of relative UV light transmittance for each of the support materials, development of a coating protocol for coating silica gel with a thin-film of TiO₂, and development of a protocol for determining the coating efficiency. Four annular photocatalytic reactors with annular dimensions ranging from ~3 to 12 mm have been constructed and tested during blank runs. A range of catalyst support materials — including a commercial silica catalyst support and several brands of glass beads and chromatography-grade silica gel — were characterized for particle size, surface area, and pore size distribution. UV light penetration studies on the uncoated support materials demonstrated that the chromatography-grade silica gel transmitted UV light (~365 nm) better than the other support materials. Measurement of UV light

penetration through various size fractions of the silica gel revealed increasing transmittance with increasing size fraction, a result that is in part due to better packing of the smaller-size silica gel particles. We have also developed a protocol for coating silica gel using an aqueous based TiO₂ sol. This protocol involves mixing the silica gel with TiO₂ sol that has been diluted to an appropriate volume to allow for even coating and then evaporating the water using a rotary evaporator. TiO₂ coating efficiencies of ~50% (based on the initial mass of TiO₂ added) have been determined for this coating protocol. The mass of TiO₂ in the coating was determined by digesting the coated silica gel in concentrated acid and measuring the concentration of Ti using both spectrophotometric and ICP analytical techniques. Currently, UV light transmission through both the coated and uncoated silica gel supports is being measured as a function of penetration distance using the four annular reactors. Several TiO₂ loadings are being investigated. The light transmission data will then be compared to kinetic data for the degradation of a model organic compound. From this data, we hope to develop a kinetic model that incorporates UV bulb intensity, TiO₂ loading, and the annular dimensions of the reactor.

Aquaculture & Seafood Technology Subprogram

Steroid Regulation of the Stress Response and Immune Function in Salmonid Fishes (R/AQ-31)

Terence Barry and Jeffrey Malison, Food Science, UW-Madison

We have documented the tissue distribution of cortisol-metabolizing activity in rainbow trout and coho salmon. We found that high cortisol metabolic activity was unevenly distributed among tissues, cortisol metabolism was higher overall in rainbow trout than coho salmon, and sexually mature fish had lower overall cortisol metabolism than immature fish. We also found that physiological concentrations of 17 α ,20 β -dihydroxy-4-pregnen-3-one (17,20-P) inhibited total cortisol metabolism in tissues of both rainbow trout and coho salmon, suggesting that fish may be more vulnerable to the harmful effects of stress at spawning when levels of 17,20-P are high. Testosterone and 11-ketotestosterone reduced the cortisol stress responses in salmonid fishes compared to control fish, but had no effect on "free" cortisol levels. Estradiol-17 β had no effect on total or free cortisol levels. Studies are currently underway to evaluate the effects of 17,20-P on free cortisol. Immunological endpoints are being analyzed by our collaborators from the USGS in Washington state. We also established a collaborative research effort with scientists at the University of Washington School of Fisheries and the National Institute of Water and Atmospheric Research in New Zealand to study endocrine mechanisms regulating the post-spawning death of chinook salmon. Presentations of project results were made to the World Aquaculture Society, Second International Congress on the Biology of Fish, and the Endocrinology Reproductive Physiology Symposium, and another paper is in preparation. The project has provided support to five students.

Conversion of Fish Processing Waste and Underutilized Fish into Value-Added Protein Hydrogel (R/AQ-32)

Srinivasan Damodaran, Food Science, UW-Madison

Improvements in the method of making a protein-based hydrogel have been made. Fish protein, extracted from fish muscle at pH 12.0, was modified with ethylenediamine tetraacetic dianhydride (EDTAD). The extent of modification of lysine residues was in the range of 70-80 percent. The modified protein was precipitated and pH 4.6 and recovered by centrifugation and lyophilized. A 10 percent solution of the lyophilized EDTAD-modified protein was reacted with glutaraldehyde at pH 9-10 to cross-link the protein. The gel was cured overnight. One portion of the cured gel was air dried at 35-40°C in an oven. Another portion of the cured gel treated with anhydrous ethanol for three hours, during which time water from the gel was extracted into the ethanol solvent. The dehydrated gel was then air dried at room temperature. Examination of swelling properties of the fish protein hydrogel showed that ethanol treatment prior to drying of the gel markedly improved the rate and extent of water uptake compared to that of the control. For instance, an 80 percent modified sample treated with ethanol absorbed about 250 grams of water per gram of dry gel within 5 hours, whereas the same gel without ethanol treatment absorbed only about 160 grams of water per gram of dry gel during the same time. Furthermore, whereas the ethanol-treated sample was odor free, the control sample had a strong fishy odor. The

ethanol treatment has the following advantages: (1) it dehydrates the gel and thereby eliminates the need or drastically reduces the time needed for drying, and the ethanol can be recovered and reused in the process; (2) it causes denaturation of proteins in the cross-linked gel and thereby improves the swelling properties of the gel, and (3) it extracts low molecular weight off-flavor compounds from the gel and thereby improves its acceptability. A patent disclosure on the process has been made to Wisconsin Alumni Research Foundation.

Mitigation of the Consequences of Stress in Yellow Perch Aquaculture (R/AQ-33-PD)

Jeffrey Malison, Food Science, UW-Madison

We have conducted studies to determine the extent to which (1) selected fish culture procedures affect the growth and stress responses of yellow perch, and (2) yellow perch acclimate to potentially stressful husbandry procedures. Perch were reared under one of three different lighting spectra: blue (405-530 nm), red (600-750 nm), or full spectrum (380-750 nm). For each lighting spectra, fish were reared under one of two disturbance levels: one in which the fish were exposed to 2 to 4 daily routine disturbances which typify intensive tank culture conditions, such as casting shadows over the tank, sham tank siphoning, and dissolved oxygen measurement ("disturbed"), or a second treatment in which such disturbances were minimized ("undisturbed"). The disturbed fish gained less weight and length, and they had a significantly lower condition factor than the undisturbed fish. In addition, after 84 days the disturbed fish showed no signs of acclimation to the frequent disturbances. The fish under red and full spectrum light gained more length than those under blue light. At some but not all times during the study, baseline cortisol levels were higher in the disturbed than in the undisturbed fish. These results demonstrate that yellow perch growth can be significantly affected by disturbance level and lighting conditions. These factors should be taken into consideration when developing culture strategies to maximize the growth of yellow perch reared under intensive culture. Also, methods of producing stress-resistant perch should be explored. A paper based on this research, "Effects of lighting spectrum and disturbance level on the growth and stress responses of yellow perch (*Perca flavescens*)," is in press (A.B. Head and J.A. Malison, *Journal of the World Aquaculture Society*).

Use of Fish Oil for the Production of Nutraceuticals Containing Omega-3 and Conjugated Linoleic Acid Residues (R/AQ-34)

Charles Hill, Chemical Engineering, UW-Madison

In the past year, considerable progress has been made in studies of the kinetics of the hydrolysis of corn oil to produce a stream rich in linoleic acid. One paper describing the overall kinetics of the hydrolysis reaction as it occurs in a hollow fiber reactor has been accepted for publication in *Biotechnology and Bioengineering*. A second paper describing the selectivity aspects of the lipase-catalyzed hydrolysis of corn oil is in the final stages of preparation for submission to *Biotechnology and Bioengineering*. In addition, a paper describing the process technology for production of a feedstock containing a high concentration of linoleic acid has been presented at the 1999 annual meeting of the Institute for Food Technologists.

Policy Studies Subprogram

Sustainability, Uncertainty and the Management of the Lake Superior Fisheries (R/PS-51)

Richard Bishop, Agricultural and Applied Economics, UW-Madison

The project has largely completed its efforts on a theoretical framework within which to consider the problem of sustainable fisheries management under uncertainty in Lake Superior. Some of this work appears in a paper (*Aestimum*, 37 [1]) that clarifies the concept of the safe minimum standard (SMS) of conservation and explores why the concept has failed to gain wider acceptance among mainstream economists. Further advances, which provide a welfare theoretic foundation for the SMS by using tools from decision theory, are contained in a draft paper (currently undergoing revisions). Together with an earlier effort that considers the problem of sustainability using concepts from the law on trusts (*Ecological Economics*, 31 [1]), the project has made significant progress on two aspects of the problem of managing for sustainability that have been little addressed:

(1) great uncertainty surrounds the consequences of management decisions; and (2) acting on behalf of future generations may affect the manner in which choices should be made. Efforts to test these ideas in simulation exercises, using a version of ECOSIM that was parameterized by Professor James Kitchell, UW-Madison, are continuing. Likewise, interviews continue to be conducted with Lake Superior fisheries scientists and managers to assess how actual management decisions compare with the theoretical framework.

Interseasonal Comparisons of Static and Dynamic Economic Models of Recreational Salmonid Fishing on Lake Michigan (R/PS-52)

R. William Provencher and Richard Bishop, Agricultural and Applied Economics, UW-Madison

This project has developed a theoretical framework for examining the question of whether angler reactions to intraseasonal variations in fish catch can be used to determine the economic value of long-run interseasonal changes in fish catch, as might arise, for instance, from a policy to increase the stocking of salmonids in Lake Michigan. To examine this issue empirically, data concerning the fishing trips taken throughout the season by a random sample of 350 anglers were collected by the UW-Madison Survey Research Center. This data collection effort was successfully completed in mid-October 1999 and is now being prepared for statistical analysis. Anglers in the sample are also being queried via mail questionnaire about their seasonal expenditures and other demographic characteristics. This data collection effort will be completed by the end of 1999. Statistical analysis of the data will begin within the next month.

Analysis of Persistence and Change in Apostle Island Boating 1975-1997 (R/PS-53)

Thomas Heberlein, Rural Sociology, UW-Madison

Preliminary analysis of data collected in 1997 has been completed. Since 1975, there has been no change in the percentage of visitors to the Apostle Islands who view the area as a wilderness (it has been about 63% throughout the years). However, over this same period of time visitors have come to perceive more "human effects" and more "environmental damage." This suggests that the meaning of wilderness in people's minds is broad enough to accommodate a certain amount of use. Interestingly, the increasing awareness of human effects is not due to changes in the boating populations, nor to major changes in use levels along the lakeshore. Current work will disentangle the possible combined effects of facility development and changing societal definitions of wilderness. Data to address these questions continued to be collected through the summer of 1999.

New Initiatives Subprogram

Diver Health and Safety: Minimizing Decompression Risk (R/NI-27)

Rudolf Tass Dueland, Veterinary Medicine, UW-Madison

This project's overall goals continue to be the better understanding of decompression injury and the improvement of the health and safety of the nation's divers, particularly recreational scuba divers. On June 28, 1999, decompression sickness (DCS) risk predictions were presented in a paper at the Undersea and Hyperbaric Medical Society's meeting in Boston, Mass. Humans and the UW sheep model show remarkably similar decompression outcomes. These findings indicate a 1.5 to 3 percent DCS risk to humans diving to the U.S. Navy's no-stop limits and exceed the acceptable risk for most recreational scuba divers. The results validate the UW sheep model for testing potentially high-risk diving. Our Sea Grant-Navy collaboration also produced a landmark paper that integrates sheep and human responses in a new decompression model to predict human DCS in dives too risky for human testing (*Journal of Applied Physiology*, June 1999). A project principal investigator (Dr. Charles Lehner) was invited to represent the United States in the U.S.-Japan conference in diving physiology (UJNR) at Tokyo in December 1999. He will present two papers, including a report on the potential risk to scientific divers undergoing emergency escape from a saturation habitat (e.g., the 46-foot deep *Aquarius*, located off Key Largo, Fla.). Recent findings from our repetitive diving study using the UW sheep model point to the potential risk of disabling dysbaric osteonecrosis (DON) in scuba divers performing repetitive dives if they develop limb bends and do not have recompression treatment within 8 hours. During a visit to

our lab, National Sea Grant Office Director Ronald Baird mentioned that Puerto Rican lobster and conch divers may sustain DON like Maine scallop divers do. This serendipitous remark prompted a collaborative study of lobster and conch divers in Puerto Rico, involving researchers at the University of Puerto Rico (Dr. Lopez) and Harvard University (Dr. Ferrigno). A grant from the Italian diving community will fund bone scans of 10 divers for DON, similar to our Maine scallop diver study. With Dr. Michael Lang, Dr. Lehner co-chaired a conference, "Reverse Dive Profiles Workshop," held at the Smithsonian in October 1999, which was sponsored by the Smithsonian Institution, Diver's Alert Network, American Academy of Underwater Sciences, Diving Equipment Manufacturers Association, and *Dive Training* magazine. This conference gathered the world's experts in decompression modeling, diving physiology and dive computers, and focused on dive safety and DCS risk when diving deeper late rather than early in the day's diving. These workshop proceedings, edited by Lang and Lehner, will be published by the Smithsonian in early 2000.

Erosion Information System in Support of Coastal Zone Management and Science (R/NI-28)

Frank Scarpace and Alan Vonderohe, Civil & Environmental Engineering, UW-Madison

This project will develop an effective, state-of-the-art methodology to estimate and periodically re-estimate recent and long-term coastal bluff recession rates with a minimum amount of uncertainty and error; it also will develop a prototype geographic information system (GIS) application and associated databases for coastal bluff recession rate analysis. During 1999, we presented two papers at national meetings. In addition, the Wisconsin Department of Transportation and Department of Administration have shown significant interest in this technology and have indicated that they will contribute funding and in-kind support in the coming year.

Prediction and Prevention of Stress Responses in Recreational Scuba Divers (R/NI-29-PD)

William Morgan, School of Education, UW-Madison

Hardware, instrumentation and methodology were tested during pilot work for this research. The current project builds on a recently completed 10-year longitudinal study of 94 experienced scuba divers and a survey of 95 students five years after they completed a scuba course. That research was completed in May 1999, and three papers directly related to the focus of the current research have been prepared for publication. A manuscript has been accepted, pending revision, by the *International Journal of Clinical and Experimental Hypnosis* on a comparison of the anti-anxiety and metabolic effects of hypnosis and autogenic relaxation. Another manuscript has been accepted, pending revision, by *Anxiety, Stress and Coping* on the demonstrated lack of relationship between a diagnosis of panic disorder and the occurrence of panic attacks during physical activity. A third paper is in review by the *Journal of Applied Physiology* on hypnotic manipulation of effort senses during dynamic exercise.

Biotechnology Subprogram

Identification of the Endogenous Ligand for the Aryl Hydrocarbon Receptor (R/BT-11)

Richard Peterson and Margaret Clagett-Dame, School of Pharmacy, UW-Madison

The goal of this project is to identify the endogenous ligand for the aryl hydrocarbon receptor (AhR). In the past year, we made significant progress in isolating what we believe to be one of the ligands for the AhR from porcine lung and obtained a preliminary low-resolution mass spectrum. However, the initial low-resolution mass spectrum did show the presence of contaminants that prohibited us from going further with high resolution. Therefore, we introduced another chromatographic step, which is essentially an HPLC purification using an octadecyl silane column and an acetonitrile/water solvent system. We collected in 90% yield the biological activity in approximately 2-3 fractions. These were used to continue our structural identification work. These fractions had the identical ultraviolet absorption spectrum as the earlier fractions. When each fraction was examined individually, the biological activity exactly correlated with the ultraviolet absorption spectrum. This endogenous AhR ligand has an absorption max of approximately 297 nanometers and another at 397 nanometers. The peak fraction gave a low-resolution mass spectrum. However, no contaminating materials were

found, and we proceeded with high-resolution mass spectrometry. High-resolution mass spectrometry showed the molecular ion to have a formula weight of $C_{18}H_{12}N_2O_4$. Other fits by varying the nitrogen and oxygen were not as successful as the fit of $C_{18}H_{12}N_2O_4$. The presence of a C13-containing fragment differing by one mass unit is also obvious. The fragments at 292 and 266 fit very well with the structure. At least one oxygen exists as a carbonyl (ketone or aldehyde). We examined the HPLC fractions on either side of the biologically active peak and found none of these fragments present and, in fact, the mass spectra of these fractions were free of identifiable fragments, illustrating that we have isolated a pure ligand from natural sources for the AhR. The absence of halogen isotopes completely eliminated the concern that we may have isolated a halogenated aromatic hydrocarbon environmental contaminant with AhR agonist activity. Instead, we are virtually certain that we have isolated the endogenous ligand in pure form. Now having available to us significant quantities of pure ligand with a determined empirical formula, only a limited number of structures can be drawn that would be compatible with the empirical formula. Currently, we are reacting the isolated compound with derivatization agents to determine the presence of functional groups and have found that there are no hydroxyl or amino groups present, which limits even further the number of possible formulae that can be written. The next step will be to reduce the isolated ligand with borohydride. If there are carbonyl functions (and the mass spectrum suggests that there is at least one), this reagent should produce alcohol groups that can be silylated. In the meantime, we will continue purifying material from porcine lung to stockpile sufficient quantities for running high-resolution nuclear magnetic resonance spectra in the 750 MHz instrument available in the UW-Madison Department of Biochemistry. We believe that by the time the current grant ends, we should know the structure of the endogenous AhR ligand and begin chemical synthesis. In summary, we (1) now have a pure isolated endogenous AhR ligand; (2) we have excluded all possible halogenated environmental contaminants; and (3) we are progressing with the structural determination.

Developmental Toxicity of Dioxin in Zebrafish (R/BT-12)

Richard Peterson and Warren Heideman, School of Pharmacy, UW-Madison

Funding for this project just began September 1, 1999, so we have no significant progress to report at this date.

National Sea Grant Strategic Investments and Enhancements Projects

Marine Biotechnology

Ah Receptor-Mediated Developmental Toxicity in Zebrafish (R/MW-58)

Richard Peterson and Warren Heideman, School of Pharmacy, UW-Madison

During the past year, we have characterized zebrafish AhR2 and isolated a clone encoding a second zebrafish AhR (zfAhR1). The work showing the zfAhR2 sequence, ligand binding and transactivation properties as well as the pattern of expression was recently published (*Biochimica Biophys Acta*, 1444: 35-48, 1999). We also isolated and compared two AhR clones from rainbow trout. These clones represent two AhR genes in trout, and they encode AhRs with distinct transactivation properties. Our experiments show that these AhRs prefer different enhancer elements, indicating that these proteins may regulate different sets of genes [*J. Biol. Chem.* 274:15159-15166, 1999]. We have also shown that the fish receptors are less responsive to mono-ortho PCBs than the human AhR. This may explain differences in potency values for these compounds in causing toxicity in fish and mammals [*Toxicol. Appl. Pharmacol.* 159:41-51, 1999]. We isolated 3 ARNT cDNAs from zebrafish encoding 3 different ARNT2 proteins. These cDNAs appear to arise by alternative splicing and encode ARNT proteins with striking differences in transactivation properties. This work is being submitted for publication. Lastly, we have identified a "developmental window" of time during which zebrafish are markedly sensitive to TCDD. This time extends from approximately 4 days post-fertilization to about day 15. Before this time, TCDD exposure produces few toxic effects, and after this period zebrafish become progressively resistant to TCDD. Understanding this temporal pattern of sensitivity may help to identify unique processes that occur

during this period in development that are critically affected by AhR agonists to cause mortality. This work also is being submitted for publication.

The Production of Fast-Growing, Sterile Walleye Hybrids Through Genetic and Endocrine Technologies (R/BT-10)

Jeffrey Malison, Food Science, UW-Madison

Development of methods for producing monosex female walleye hybrids (walleye female x sauger male) are nearly completed at UW-Madison. Two year-classes of reproductively mature Spirit Lake (Iowa) strain female walleyes and Mississippi River strain saugers have been produced. The saugers were treated as juveniles with 17α -methyltestosterone in order to induce partial sex inversion in the females. Methods to induce triploidy in a high percentage of hybrid walleye have been successfully developed. Hydrostatic pressure shocks of 8,000 psi initiated 5 minutes after fertilization for a duration of 24 minutes resulted in triploidy induction rates of virtually 100 percent of the hybrid walleye eggs tested. Triploid and diploid hybrid walleye and diploid purebred walleye were produced in the spring of 1998. Studies comparing the growth, performance and reproductive development of these three fish strains are currently underway. Two manuscripts describing this research were recently submitted.

Nonindigenous Species – Zebra Mussels

The Effect of Zebra Mussel Infestation in Inland Lakes on Pelagic Benthic Coupling (R/LR-63)

David Edgington, Russell Cuhel and Jerry Kaster, Great Lakes WATER Institute, UW-Milwaukee

Several perturbations suggestive of intensified zebra mussel activity were observed in 1998-99. An occurrence of floating algal accumulations was reported in August 1999 but persisted for less than five days. For the second year in a row, three additional significant features persisted: (1) The intensity of the deep chlorophyll maximum (DCM) was greatly reduced. In pre-1998 years, the chlorophyll concentration at 10-15 meters (bottom of the temperature gradient zone) was 50-200 μ g/L and accounted for 85-95 percent of total algae. In both 1998 and 1999, maximum values rarely reached 10 μ g/L, though the same organism was still present. (2) Nearshore rooted plant species changed in 1998-99 from a milfoil-dominated to a broadleaf-dominated assemblage more reminiscent of pre-zebra mussel years. It is unlikely that this is causally associated with DCM reduction, because the rooted plants grow in the portion of the lake less than four meters deep. Water clarity has not changed systematically: Secchi depths average five meters in summer and indicate a typically clean but not sparkling habitat. (3) Deep-water anoxia has been much less pronounced in 1998-99: oxygen was still present in the deep bottom water (25m) until early September, whereas early oxygen depletion at shallower depths (15m) was formerly the rule (mid- to late July). Much lower oxygen consumption in the basins is likely the result of lower organic sedimentation, which in turn is consistent with mussel-induced export of open-water plankton to shallow-water pseudofeces depositional zones. An associated phenomenon was a very muted production of hydrogen sulfide, which was undetectable above 25 meters during either year. Strong H_2S was common in August at 17-20 meters in previous years. This change also may be ascribed to lower organic sedimentation, though mostly through a lack of oxygen depletion. Finally, deep-water ammonium build-up has become seriously muted, with bottom samples containing 30-50 μ M rather than the normal 200 μ M of late summer before 1998. Ammonia production is less closely linked to anoxia and more directly dependent on organic input than sulfate reduction, further supporting diversion of organic matter to inshore areas. Taken together, these observations strongly indicate decreased sedimentation, an expected consequence of mussel feeding activity but also a possible outcome of early stratification and decreased overall productivity due to El Niño. Based on the appearance of empty shells expected at the end of the five-year life cycle and the presence of tiny mussels on colonized surfaces, survival, growth, and recruitment are occurring in the zebra mussel population. However, many seemingly ideal habitats remain uncolonized, and there has been little or no change in plankton abundance or water clarity. Most of the observed changes might be due to two El Niño-type years in a row (i.e., late, thin ice with early ice-out and rapid stratification). A more typical hard winter would be a great benefit in establishing cause-and-effect relationships regarding zebra mussels.

Assessing the Risk of Whirling Disease Becoming Established in the Great Lakes: Field and Laboratory Evaluation of a Novel Polymerase Chain Reaction Diagnostic Assay (R/LR-80)

Daniel Sutherland, Biology & Microbiology, UW-La Crosse

The main purpose of this study has involved surveying salmonids from Lakes Superior and Michigan and from tributary streams of these lakes for the presence of *Myxobolus cerebralis* (Mc), the etiologic agent of salmonid whirling disease (WD). Half heads from 432 salmonids were examined using the Hedrick PCR assay, and the other half of each head was processed using the more classic modified plankton centrifuge diagnostic method. Another 154 salmonids collected from Lake Michigan in summer 1999 are currently being processed using PCR. At sites where fish were caught, sediment samples were also collected, screened for all invertebrates, tubificid oligochaetes in particular. (The only known intermediate host for *M. cerebralis* is *Tubifex tubifex*.) Collection sites included Lake Michigan at Sturgeon Bay and Cleveland, Wis.; several tributaries, and multiple sites on Lake Superior's Chequamegon Bay and one tributary (Brule River). Fish species examined include 105 brook, 38 lake, 74 brown and 77 rainbow trout; 33 steelhead, and 31 coho and 74 chinook salmon. Twenty-three of 30 brook trout from the Manistee River and 26 of 30 brook and 4 of 7 brown trout from the Au Sable River tested positive for WD in 1998; in 1999, 29 out of 34 brook and 2 of 13 brown trout from the Au Sable River were infected with Mc. The Au Sable and Manistee rivers represent the closest known whirling disease foci to Wisconsin. Preliminary results from late 1999, however, indicate significant expansion within Michigan in the range of WD beyond the Manistee and Au Sable rivers. Fish from Wisconsin waters continue to test negative for *M. cerebralis*. Oligochaete cultures from the Au Sable and Manistee rivers and Coulee Region (near La Crosse, Wis.) streams have been established. Live *T. tubifex* from Spring Coulee Creek were sent to the University of California-Davis for a genetics study to determine relatedness of this oligochaete throughout North America. Evidence gained from the mitochondrial DNA 16S rRNA gene indicates that *T. tubifex* from Coulee streams belong to a clade that is susceptible to infection with Mc. Preliminary analyses of the oligochaete community structure of selected sites in Wisconsin indicate that *T. tubifex* dominates the Coulee Region streams, whereas tributary streams of Lakes Michigan and Superior harbor diverse oligochaete communities (high diversity of species and low relative abundance of *T. tubifex*). These findings correlate well with prior studies that indicated that *T. tubifex* is an oligochaete that does not compete well in established communities, but rather flourishes in recently disturbed habitats and/or marginal habitats (such as many Coulee trout streams). Based on our findings to date, it appears that if and when WD is introduced into Wisconsin trout waters, it will become established.

Transferring Sea Grant Zebra Mussel Research and Outreach Results to the Nation Using a World-Wide Web Server and Compact Disks (A/AS-41)

Allen H. Miller, Sea Grant Institute, UW-Madison

Since 1997, the Sea Grant Nonindigenous Species (SGNIS) Web site has been broadened to include *all* of the National Sea Grant College Program's research and outreach products on *all* aquatic nonindigenous species. Products from state and federal agencies and other organizations were also added to the site, and a section for K-12 students was developed. Due to the large amount of international use, a language translator was also added. More than 233 investigators have provided information in 150 research reports and 103 educational items (outreach products). The site currently houses 45 completed research findings, 21 ongoing research abstracts, 87 research and outreach papers in two proceedings of past international conferences (1994, 1995), 39 issues of six newsletters, a 67-slide graphics library, 15 general publications, 13 training materials, and three distribution maps (zebra mussel, ruffe and goby). Links are currently provided to 14 related aquatic non-indigenous species sites of other federal, state, provincial, or regional organizations (e.g., the U.S. Geological Survey's Nonindigenous Aquatic Species Geographic Information System, the Great Lakes Information Network, and the Ontario Federation of Anglers and Hunters). All aquatic nonindigenous species sites of individual Sea Grant programs are linked as well. Site use has increased steadily – 474,083 file transfers from more than 91 countries were recorded in 1998 (about 1,300 per day). The site is a global source of information with significant transfers to Taiwan, Poland, Germany, Australia and the United Kingdom, as well as Canada. Use of the suffixes on users' addresses provides an indication of the types of users, showing that SGNIS information is extensively used by commercial interests (about 30%+) as well as the research/education community.

**APPENDIX 1
Program Funding from All Sources**

<i>University of Wisconsin Sea Grant Institute Support (October 1998-November 1999)</i>				
Agency/Donor	Date of Award Acceptance	Purpose	Amount	Period of Support
NOAA-Sea Grant	9-Apr-99	Sea Grant/Clack Corp. Industry Fellowship	\$30,000	9/1/98-8/31/99
Clack Corporation, Windsor, Wis.	11-Jun-99	Industry Fellowship Industrial Match	\$30,000	9/1/98-8/31/99
NOAA-Sea Grant	9-Apr-99	Dean John A. Knauss Marine Policy Fellowship	\$36,000	2/1/99-1/31/00
NOAA-Sea Grant	9-Apr-99	FY 2000 Omnibus	\$1,833,102	3/1/99-2/29/00
NOAA-Sea Grant	9-Jul-99	Program Development Supplement for R/NI-29	\$10,000	3/1/99-2/29/00
State of Wisconsin	1-Jul-99	FY 1999-2000 State Support	\$1,600,000	7/1/99-6/30/00
NOAA Coastal Services Center	27-Aug-99	Update of the 1997 Coastal GIS Bibliography	\$4,971	7/20/99-7/30/00
NOAA-Sea Grant	5-Nov-99	Transferring Sea Grant Zebra Mussel Research and Outreach Results to the Nation Using a World-Wide Web Server – Wisconsin Budget (1999-2000 Aquatic Nonindigenous Species competition)	\$57,184	10/1/99-9/30/00
Total Support:			\$3,601,257	

APPENDIX 2

Organizational Units and Departments Involved in the University of Wisconsin Sea Grant College Program, 1998-99

University of Wisconsin System

Great Lakes Wisconsin Aquatic Technology & Environmental Research Institute

University of Wisconsin-Madison

Agricultural Economics
Aquaculture Research Center
Arboretum
Biotechnology Center
Biotron
Center for Biology Education
Center for Limnology
Civil & Environmental Engineering
College of Agricultural & Life Sciences
College of Engineering
College of Letters & Science
Elvehjem Museum of Art
Environmental Remote Sensing
Food Science
Geology Museum
Graduate School
Institute for Environmental Studies
Land Information & Computer Graphics Facility
Law School
Mechanical Engineering
Medical School
Oceanography & Limnology Graduate Program
Radiology
Research Animal Resources Center
Rural Sociology
Sea Grant Institute
School of Education
School of Natural Resources
School of Pharmacy
School of Veterinary Medicine
Space Place
State Laboratory of Hygiene
Surgical Sciences
Water Chemistry Program
Water Resources Institute
Water Resources Management Program
Water Science and Engineering Laboratory
Wildlife Ecology
Zoology

University of Wisconsin-Green Bay

Natural & Applied Sciences
Sea Grant Advisory Services

University of Wisconsin-La Crosse

Biology & Microbiology

University of Wisconsin-Manitowoc

Sea Grant Advisory Services

University of Wisconsin-Milwaukee

Aquaculture Institute
Biological Sciences
Geosciences
Graduate School
Sea Grant Advisory Services
University Center for Continuing Education

University of Wisconsin-Stevens Point

College of Natural Resources

University of Wisconsin-Superior

Sea Grant Advisory Services

Marquette University

Biology

Medical University of South Carolina

Biochemistry & Molecular Biology

Purdue University

Illinois-Indiana Sea Grant College Program

Rensselaer Polytechnic Institute

Darrin Freshwater Institute

State Historical Society of Wisconsin

Underwater Archeology

U.S. Fish & Wildlife Service

La Crosse Fish Health Center

U.S. Geological Survey

Upper Mississippi Science Center

University of Michigan

Sea Grant College Program

University of Minnesota

Sea Grant Program

University of Texas-Austin

Marine Science Institute

University of Vermont

School of Natural Resources

Woods Hole Oceanographic Institution

Biology

APPENDIX 3

Projects Supported

(including Program Development Projects)

LIVING RESOURCES

R/LR-75 — Recruitment Mechanisms in Yellow Perch (*Perca flavescens*): Interactions Among Growth, Condition and Predation (Fred Binkowski, UW-Milwaukee)

R/LR-76 — Application of Microsatellite and Mhc Markers to Stock Identification in Lake Superior Lake Trout (Ruth Phillips, UW-Milwaukee)

R/LR-77 — Causes and Impediments of Lake Trout Recovery in Lake Superior (Michael Hansen, UW-Stevens Point)

R/LR-78 — Fisheries and Food Web Dynamics in Lake Superior (James Kitchell, UW-Madison)

MICROCONTAMINANTS & WATER QUALITY

R/MW-75 — Maternally Transmitted Mercury: Effects on Embryo and Larval Fish Survival, Growth and Feeding Behavior (Mark Sandheinrich and Ronald Rada, UW-La Crosse) *NOTE: This project ended December 31, 1998, and a project completion report has been forwarded to the National Sea Grant Office.*

R/MW-76 — Impact of Contaminants on Sexual Development and Reproduction of Amphibians in Great Lakes Ecosystems (William Karasov, UW-Madison)

R/MW-77 — Watershed Export and Speciation of Trace Metals in the Lake Superior Basin (David Armstrong and William Sonzogni, UW-Madison)

R/MW-78 — Changes in Patterns of PCB Contamination in Surficial Green Bay Sediments over the Past Decade: Applications to Sediment Remediation (David Armstrong, UW-Madison, and David Edgington, UW-Milwaukee)

R/MW-79 — Degradation of Organic Contaminants in Sediments via Subcritical Water Extraction and Photocatalytic Oxidation over Supported Nanoparticulate Metal Oxides (Marc Anderson, UW-Madison)

AQUACULTURE & SEAFOOD TECHNOLOGY

R/AQ-31 — Steroid Regulation of the Stress Response and Immune Function in Salmonid Fishes (Terence Barry and Jeffrey Malison, UW-Madison)

R/AQ-32 — Conversion of Fish Processing Waste and Underutilized Fish into Value-Added Protein Hydrogel (Srinivasan Damodaran, UW-Madison)

R/AQ-34 — Use of Fish Oil for the Production of Nutraceuticals Containing Omega-3 and Conjugated Linoleic Acid Residues (Charles Hill, UW-Madison)

ESTUARINE & COASTAL PROCESSES

R/EC-5 — Recruitment Decline of Yellow Perch in Green Bay, Lake Michigan: Evaluation of Environmental Influences and Predation (Fred Binkowski, UW-Milwaukee)

R/EC-6 — Net Heterotrophy/Autotrophy in Coastal and Offshore Lake Michigan (Russell Cuhel, J. Val Klump and Carmen Aguilar, UW-Milwaukee)

BIOTECHNOLOGY

R/BT-9 — Bacteria and Their Extracellular Polymers in Settlement and Antifouling (James Maki, Marquette University) *NOTE: This project ended May 31, 1999, and a project completion report has been forwarded to the National Sea Grant Office.*

R/BT-10 — The Production of Fast-Growing, Sterile Walleye Hybrids Through Genetic & Endocrine Technologies (Jeffrey Malison, UW-Madison)

R/BT-11 — Identification of the Endogenous Ligand for the Aryl Hydrocarbon Receptor (Richard Peterson and Margaret Clagett-Dame, UW-Madison)

R/BT-12 — Developmental Toxicity of Dioxin in Zebrafish (Richard Peterson and Warren Heideman, UW-Madison)

POLICY STUDIES

R/PS-51 — Sustainability, Uncertainty and the Management of the Lake Superior Fisheries (Richard Bishop, UW-Madison)

R/PS-52 — Interseasonal Comparisons of Static and Dynamic Economic Models of Recreational Salmonid Fishing on Lake Michigan (R. William Provencher and Richard Bishop, UW-Madison)

R/PS-53 — Analysis of Persistence and Change in Apostle Island Boating 1975-1997 (Thomas Heberlein, UW-Madison)

NEW INITIATIVES

R/NI-26 — Prediction of Adherence, Health Status and Diving Accidents in Recreational Scuba Divers: A Ten-Year Longitudinal Study (William Morgan, UW-Madison) *NOTE: This project ended May 31, 1999, and a project completion report has been forwarded to the National Sea Grant Office.*

R/NI-27 — Diver Health and Safety: Minimizing Decompression Risk (Rudolf Tass Dueland, UW-Madison)

R/NI-28 — Erosion Information System in Support of Coastal Zone Management and Science (Frank Scarpace and Alan Vonderohe, UW-Madison)

ADVISORY SERVICES

A/AS-1 — Advisory Services: Program Coordination and Field Offices — Madison Office (Allen Miller, UW-Madison – *core program*)

A/AS-39 — WATERS: Wisconsin's Aquaculture Technology Education and Research Services (Fred Binkowski, UW-Milwaukee)

A/AS-40 — Applications of Geographic Information Systems to Coastal Zone Management: Building Local Capacity (Stephen Ventura, UW-Madison)

COMMUNICATIONS

C/C-1 — Communications Office and Subprogram Coordination (Stephen Wittman, UW-Madison – *core program*)

C/C-2 — Earthwatch Public Service Radio Program (Richard Hoops, UW-Madison – *core program*)

C/C-3 — Sailing through Death's Door: Multi-Media Site Guides to Wisconsin's Lake Michigan Shipwrecks (Jefferson Gray, State Historical Society of Wisconsin, and John Karl, UW-Madison)

EDUCATION

E/E-1 — Special Marine Education Programs (Mary Lou Reeb, UW-Madison – *core program*)

E/E-32 — Sea Grant Industrial Fellowship: ATR-Based Photocatalytic Drinking Water Systems (Marc Anderson, UW-Madison)

PROGRAM MANAGEMENT

M/SGA-1 — Program Development (Anders Andren, UW-Madison – *core program*)

M/SGA-2 — Program Management (Anders Andren, UW-Madison – *core program*)

M/SGA-3 — Ship Time in Support of Sea Grant Research Projects (Anders Andren, UW-Madison – *core program*)

PROGRAM DEVELOPMENT

R/AQ-33-PD — Mitigation of the Consequences of Stress in Yellow Perch Aquaculture (Jeffrey Malison, UW-Madison)

R/LR-74-PD — Early Life History of Yellow Perch (Fred Binkowski, UW-Milwaukee)

R/NI-29-PD — Prediction and Prevention of Stress Responses in Recreational Scuba Divers (William Morgan, UW-Madison)

National Sea Grant Strategic Investments and Enhancements Projects

MARINE BIOTECHNOLOGY

R/MW-58 — Ah Receptor-Mediated Developmental Toxicity in Zebrafish (Richard Peterson and Warren Heideman, UW-Madison)

R/BT-10 — The Production of Fast-Growing, Sterile Walleye Hybrids Through Genetic and Endocrine Technologies (Jeffrey Malison, UW-Madison)

NONINDIGENOUS SPECIES – ZEBRA MUSSELS

R/LR-63 — The Effect of Zebra Mussel Infestation in Inland Lakes on Pelagic Benthic Coupling (David Edgington, Russel Cuhel and Jerry Kaster, UW-Milwaukee)

R/LR-80 — Assessing the Risk of Whirling Disease Becoming Established in the Great Lakes: Field and Laboratory Evaluation of a Novel Polymerase Chain Reaction Diagnostic Assay (Daniel Sutherland, UW-La Crosse)

A/AS-41 — Transferring Sea Grant Zebra Mussel Research and Outreach Results to the Nation Using a World-Wide Web Server and Compact Disks (Allen Miller, UW-Madison)

A/AS-43 — Transferring Sea Grant Zebra Mussel Research and Outreach Results to the Nation Using a World-Wide Web Server (Allen Miller, UW-Madison)

APPENDIX 4

Comprehensive List of Publications and News Releases

(including distribution figures and recovery of funds through sales)

Quantity	Publication No. and Title
200	WISCU-G-98-003 "Web Sites for Information about Storms, Big Waves and Water Levels with an Emphasis on the Great Lakes" by Philip Keillor
750	WISCU-G-98-004 "Yellow Perch Update" by John Karl
150	WISCU-G-99-001 "Wisconsin Aquaculture Resource Guide" by Allen H. Miller
100	WISCU-G-99-002 "Reaching the World by Radio" by Richard Hoops
100	WISCU-G-99-003 "Our Lake Superior Initiative" by Stephen Wittman
100	WISCU-G-99-004 "Supporting Superior Science" by Stephen Wittman
200	WISCU-G-99-005 "Science in Public Service" by Stephen Wittman
1,100	WISCU-Q-99-001 "UW Sea Grant Institute 1998-2000 Program Directory & Mid-Biennium Report" by Elizabeth Seaman, editor; John Karl, writer
250	WISCU-R-98-008 "Consequences of Prey Fish Community Dynamics on Lake Trout (<i>Salvelinus namaycush</i>) Foraging Efficiency in Lake Superior" by Doran M. Mason, Timothy B. Johnson and James F. Kitchell. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> , 55(5):1273-1284, 1998
300	WISCU-R-98-009 "A Method for Measuring in situ Oxygen Consumption Rates of Freshwater Gastropods" by Curt L. Elderkin, Daniel W. Schneider, James A. Stoeckel and Dianna K. Padilla. <i>Journal of the North American Benthological Society</i> , 17(3):338-347, 1998
200	WISCU-R-98-010 "Phytoplankton Spatial and Temporal Distributions in Green Bay, Lake Michigan, Prior to Colonization by the Zebra Mussel (<i>Dreissena polymorpha</i>)" by Bart T. De Stasio and Sumner Richman. <i>Journal of Great Lakes Research</i> , 24(3):620-628, 1998
200	WISCU-R-98-011 "Current Concentrations of PCBs in Lake Michigan Invertebrates, a Prediction Test, and Corroboration of Hindcast Concentrations" by Leland J. Jackson, Stephen R. Carpenter, Jon Manchester-Neesvig and Crag A. Stow. <i>Journal of Great Lakes Research</i> , 24(4):808-821, 1998
200	WISCU-R-98-012 "Gill-Net Saturation by Lake Trout in Michigan Waters of Lake Superior" by Michael J. Hansen, Richard G. Schorfhaar and James H. Selgeby. <i>North American Journal of Fisheries Management</i> , 18:847-853, 1998
200	WISCU-R-98-013 "Physical Factors That Limit the Distribution and Abundance of <i>Dreissena polymorpha</i> (Pall.)" by Alexander Y. Karatayev, Lyubov E. Burlakova and Dianna K. Padilla. <i>Journal of Shellfish Research</i> , 17(4):1219-1235, 1999

1999 Wisconsin Sea Grant Progress Report

- 200 WISCU-R-99-001 “2,3,7,8-Tetrachlorodibenzo-p-dioxin Alters Cardiovascular and Craniofacial Development and Function in Sac Fry of Rainbow Trout (*Oncorhynchus mykiss*)” by Michael W. Hornung, Jan M. Spitsbergen and Richard E. Peterson. *Toxicological Sciences*, 47:40-51, 1999
- 200 WISCU-R-99-002 “Estimating the Probability of Long-Distance Overland Dispersal of Invading Aquatic Species” by Lucy A. Buchan and Dianna K. Padilla. *Ecological Applications*, 9(1):254-265, 1999
- 200 WISCU-R-99-003 “Rates of Decrease of Polychlorinated Biphenyl Concentrations in Five Species of Lake Michigan Salmonids” by E. Conrad Lamon III, S.R. Carpenter and C.A. Stow. *Canadian Journal of Fisheries and Aquatic Sciences*, 56(1):53-59, 1999
- 300 WISCU-R-99-004 “Effect of Genistein on the Growth and Reproductive Function of Male and Female Yellow Perch (*Perca flavescens*)” by Kinarm Ko, Jeffrey A. Malison and Jess D. Reed. *Journal of the World Aquaculture Society*, 30(1):73-79, 1999
- 200 WISCU-R-99-005 “A Mixed-Order Model to Assess Contaminant Declines” by Craig A. Stow, Leland J. Jackson and S.R. Carpenter. *Environmental Monitoring and Assessment*, 55(3):435-444, 1999
- 300 WISCU-R-99-006 “Two Forms of Aryl Hydrocarbon Receptor Type 2 in Rainbow Trout (*Oncorhynchus mykiss*): Evidence for Differential Expression and Enhancer Specificity” by Christian C. Abnet, Robert L. Tanguay, Mark E. Hahn, Warren Heideman and Richard E. Peterson. *Journal of Biological Chemistry*, 274(21):15159-15166, 1999
- 250 WISCU-R-99-007 “History and Archeology of the Great Lakes Steamboat *Niagara*” by John O. Jensen. *Wisconsin Magazine of History*, 82(3):198-230, 1999
- 300 WISCU-R-99-008 “Predicting Risk of Decompression Sickness in Humans from Outcomes in Sheep” by Robert Ball, Charles E. Lehner and Erich C. Parker. *Journal of Applied Physiology*, 86(6):1920-1929, 1999
- 150 WISCU-R-99-009 “Influence of Ortho-Substitution Homolog Group on Polychlorobiphenyl Bioaccumulation Factors and Fugacity Ratios in Plankton and Zebra Mussels (*Dreissena polymorpha*)” by Eric J. Willman, Jon B. Manchester-Neesvig, Cecilia Agrell and David E. Armstrong. *Environmental Toxicology and Chemistry*, 18(7):1380-1389, 1999
- 200 WISCU-R-99-010 “Effects of High Rearing Densities and Loading Rates on the Growth and Stress Responses of Juvenile Rainbow Trout” by Lynne S. Procarione, Terence P. Barry and Jeffrey A. Malison. *North American Journal of Aquaculture*, 61(2):91-96, 1999
- 200 WISCU-R-99-011 “Direct Effect of Ammonia on Three Species of North American Anuran Amphibians” by Mariana B. Jofre and William H. Karasov. *Environmental Toxicology and Chemistry*, 18(8):1806-1812, 1999
- 200 WISCU-R-99-012 “Ontogenetic and Seasonal Patterns in the Energy Content of Piscivorous Fishes in Lake Superior” by Timothy B. Johnson, Doran M. Mason, Stephen T. Schram and James F. Kitchell. *Journal of Great Lakes Research*, 25(2):275-281, 1999
- 200 WISCU-R-99-013 “Whole-Fish Versus Filet Polychlorinated-Biphenyl Concentrations: An Analysis Using Classification and Regression Tree Models” by James F. Amrhein, Craig A. Stow and Clay Wible. *Environmental Toxicology and Chemistry*, 18(8):1817-1823, 1999
- 150 WISCU-R-99-014 “Transactivation Activity of Human, Zebrafish and Rainbow Trout Aryl Hydrocarbon Receptors Expressed in COS-7 Cells: Greater Insight into Species Differences

in Toxic Potency of Polychlorinated Dibenzo-*p*-dioxin, Dibenzofuran, and Biphenyl Congeners” by Christian C. Abnet, Robert L. Tanguay, Warren Heideman and Richard E. Peterson. *Toxicology and Applied Pharmacology*, 159:41-51, 1999

- 15,000 Great Lakes Fish postcards
- 15,600 Madison JASON X bookmarks

“Zebra Mussel Watch” cards

- 7,900 Michigan version (reprinting)
- 42,300 Minnesota version (reprinting)
- 7,600 Nebraska version (new)
- 8,500 New York version (reprinting)
- 8,100 Oklahoma version (new)
- 40,800 U.S. Coast Guard version (reprinting)
- 7,400 Vermont version (reprinting)

122,600 Total – seven versions

UW Sea Grant Administrative Documents

- 1998 Annual Report to the National Sea Grant Office*
- FY99 Omnibus Proposal for Continuing Federal Sea Grant Funding*
- UW Sea Grant College Program Strategic Plan*
- Program Implementation Plan, 2000-02*
- FY2000 Omnibus Proposal for Continuing Federal Sea Grant Funding*
- 1999 Annual Report to the National Sea Grant Office*

News Releases (October 1998-November 1999)

Date Issued	Release Headline
12-18-98	Lake Michigan’s Yellow Perch Remain Scarce
12-18-98	UW-Madison Student Wins Knauss Fellowship
2-19-99	Shipwrecks Preserve Rich Wisconsin History
3-8-99	Local Students Embark on Virtual Expedition to Peruvian Rainforests
3-18-99	UW Sea Grant Receives \$1.9 Million Federal Grant
4-21-99	UW Sea Grant Receives Friend of Science Education Award
5-11-99	Questions on Great Lakes Fisheries? Call UW Sea Grant!
5-29-99	Special Yellow Perch Conference Open to Public
5-26-99	Follow the Rules of the Road for a Safe Memorial Day Weekend on the Water

1999 Wisconsin Sea Grant Progress Report

6-12-99	Top Suspects Cleared in Yellow Perch Decline
7-7-99	What Caused the Big Alewife Die-Off in Lake Michigan?
8-2-99	Aquaculture Offers New Promise for Tribal Fishing Industry
8-31-99	Don't Get Carried Away on Labor Day
9-3-99	Anglers Play Vital Role in Monitoring Advance of Exotic Species
11-17-99	UW Student Addresses International Gathering of Ocean Scientists (Chris Harvey)

Publications Distribution (October 1998-September 1999)

3,215	Science Journal Reprints
3,056	Public Information Publications & Products
1,965	Publications from Other Sea Grant Programs
1,246	Advisory Services Publications
<u>82</u>	<u>Technical Reports</u>
9,564	Total (not counting "Zebra Mussel Watch" cards)

A total of **\$15,109** was recovered through the sales of publications and other communications products during the October 1998-September 1999 period.

APPENDIX 5 Students and Fellows Supported

Students Supported

During the past year, support was provided via research and project assistantships and part-time employment to:

20 Graduate students
36 Undergraduate students

Degrees Awarded

Four UW Sea Grant project-related theses were completed during 1998-99, resulting in the awarding of three Master's degrees and one Ph.D.:

Master's Degrees

Paula Souik, Food Sciences & Environmental Toxicology, UW-Madison, fall 1998
Prof. Sun Fun Chu, project R/BT-2

Chad Hammerschmidt, Biology & Microbiology, UW-La Crosse, spring 1999
Prof. Mark Sandheinrich, project R/MW-75

Michele Rosenshield, Zoology, UW-Madison, spring 1999
Prof. William Karasov, project R/MW-73

Doctorate Degree

John McPeak, Agricultural & Applied Economics, UW-Madison, summer 1999
Prof. R. William Provencher, project R/PS-49

Fellows Supported

Dean John A. Knauss Marine Policy Fellowship

Jeffrey J. Ripp, M.S. graduate, Water Resources Management Program, UW-Madison
Committee on Resources, U.S. House of Representatives, Washington, D.C., 1999

Christian Lenhart, M.S. graduate, Water Resources Management/Landscape Architecture, UW-Madison
Office of Habitat Conservation, National Marine Fisheries Service, Silver Spring, Md., 2000

Sea Grant Industrial Fellowship

Paul Check, Ph.D. candidate, Department of Civil & Environmental Engineering, UW-Madison
Clack Corporation, Windsor, Wis., 1999-2001

APPENDIX 6 Program Awards

Award Title: 1999 “Friend of Science Education” Award

Recipient: UW Sea Grant Institute

Presenter: Wisconsin Society of Science Teachers (WSST)

Location/Date: WSST Annual Meeting in Lake Geneva, Wis., on April 23, 1999.

Purpose of Award: “This award is given to recognize outstanding contributions to the support of science teachers and science education by individuals, groups, corporations, foundations, and others outside the science education community. The committee recognized the University of Wisconsin Sea Grant Institute as an active supporter of science education in Wisconsin for over 30 years. Especially noted were the efforts of (Madison) JASON Project, Global Change Education and Operation Pathfinder.”

Staff Awards

Four UW Sea Grant Advisory Services personnel were recognized by their peers with these awards in 1999:

- ◆ The Wisconsin Land Information Association, a 700-member association of GIS professionals, recognized Advisory Services director **Allen H. Miller** for his sustained service in the development of GIS systems in Wisconsin. He was further honored when the association named this new award after him, calling it the “Allen H. Miller Sustained Service Award.”
- ◆ **David Hart**, UW Sea Grant’s GIS specialist and a doctoral student, was the recipient of the 1999 Walter B. Jones and NOAA Excellence Awards for Coastal and Ocean Resource Management for “Excellence in Coastal and Marine Graduate Study.” Hart was recognized for his efforts at teaching the application of GIS to local government personnel, support to the state’s Coastal Management Program and Division of Emergency Government, and his assistance to the NOAA Coastal Services Center.
- ◆ **David Hart** and UW Sea Grant Coastal Engineering Specialist **Philip Keillor** were recognized by the Wisconsin Coastal Management Program “for the outstanding contribution made to the state as part of the Coastal Hazards Work Group.”
- ◆ Marine Safety and Education Specialist **James Lubner** was one of 10 recipients of the 1999 “Outstanding Educational Program Team Award” from the American Distance Education Consortium (ADEC). The award was given to “recognize the ‘Exotic Species Day Camp’ for innovation and excellence in the development and delivery of credit or noncredit programs with consideration given to both technological and pedagogical innovation.”

In addition, UW Sea Grant Communications Science Writer **John Karl** was awarded a fellowship to participate in the 1999 Great Lakes Environmental Journalism Training Institute at Michigan State University.

Also, our set of **Wisconsin’s Lake Superior Shipwrecks Dive Guides** won “The People’s Choice Award for Innovative Products” in the Sea Grant Week ’99 Publications Contest.

APPENDIX 7

Outreach Activities

Advisory Services Workshops, Symposiums and Conferences

Global Environmental Change Workshop

Date: November 10-12, 1998

Location: Northern Great Lakes Visitors Center, Ashland, Wis.

Attendance: 4 middle school teachers, 1 high school teacher, 3 college level educators, and 4 nonformal educators

Boater Education Workshops

Date: January 26 through May 18, 1999 (four courses)

Location: S. Milwaukee Yacht Club, Wauwatosa East High School, and Maple Grove School, Greenfield, Wis.

Attendance: 165 adult and youth boaters

Global Environmental Change Workshop

Date: March 18-20, 1999

Location: UW-Manitowoc

Attendance: 3 middle school teachers, 5 high school teachers, 7 college-level educators (UW colleges) and 1 nonformal educator

Sustainable Green Bay Initiative Conference

Date: March 1999

Location: Green Bay, Wis.

Attendance: nearly 400 invited guests

Volunteer Training Session

Date: April 1999

Location: Maywood Environmental Park, Sheboygan, Wis.

Attendance: 30 citizen volunteers

Wisconsin Society of Science Teachers (workshop on Global Environmental Change)

Date: April 23, 1999

Location: Lake Geneva, Wis.

Attendance: 9 teachers and 1 spouse

"Shoreland and Coastal Management Using ArcView" course

Date: May 6, 1999

Location: Madison, Wis.

Attendance: 6 people

Special Yellow Perch Conference

Date: June 12, 1999

Location: Racine, Wis.

Attendance: about 150

"Focus on the Great Lakes" Workshop

Date: June 22-24, 1999

Location: Schlitz Audubon Center and UW Great Lakes WATER Institute, Milwaukee, Wis.

Attendance: 24 teachers

1999 Wisconsin Sea Grant Progress Report

Great Lakes WATER Institute's "Aquanaut" Program

Date: June 28-July 1 and August 16-19, 1999

Location: Milwaukee, Wis.

Attendance: 6 teachers and 24 students

"Field Learning on Lake Michigan" Workshop

Date: July 19-23, 1999

Location: Milwaukee Maritime Center, Milwaukee, Wis.

Attendance: 26 educators

First International Symposium on Monitoring Breakwaters

Date: September 10, 1999

Location: Pyle Center, UW-Madison campus

Attendance: 43 engineers and scientists from six countries

"Shoreland Management Using ArcView" Course

Date: October 15, 1999

Location: Madison, Wis.

Attendance: 10 people

Teacher Training Session

Date: October 28, 1999

Location: Green Bay, Wis.

Attendance: 11 high-school teachers

"Land Use Planning Using ArcView" Course

Date: November 4, 1999

Location: Sturgeon Bay, Wis.

Attendance: 15

State Training for Project JASON

Date: November 6 and 14, 1999

Location: Madison (Milwaukee via compressed video), Wis.

Attendance: 175 teachers

"Arc Explorer" Course

Date: November 17, 1999

Location: Sturtevant, Wis.

Attendance: 12

Sustainable Green Bay Initiative Working Conference

Date: November 1999

Location: Green Bay, Wis.

Attendance: 70

"UW-Madison on the Road" Day of Discovery

Date: November 17, 1999

Location: Neville Public Museum, Green Bay, Wis.

Attendance: 800 K-12 students

"Urban Nonpoint Source Pollution Modeling Using ArcView" Course

Date: December 16, 1999

Location: Madison, Wis.

Attendance: 8

Communications Outreach

Great Lakes Research and Outreach Partnership Meeting

Date: March 8-10, 1999

Location: Great Lakes Environmental Research Laboratory, Ann Arbor, Mich.

Attendance: Over 50 GLERL researchers/staff and Great Lakes Sea Grant Network Extension and Communications staff

Safety at Sea Thematic Area Workshop

Date: April 19, 1999

Location: Goodnight Hall, UW-Madison campus

Attendance: 12 (researchers/students; UW Sea Grant Advisory Services and Communications staff; program managers)

Contaminated Water & Sediment Remediation Thematic Area Workshop

Date: May 20, 1999

Location: Goodnight Hall, UW-Madison campus

Attendance: 23 (researchers/students, WDNR personnel, UW Sea Grant Advisory Services and Communications staff; program managers)

Lake Superior Thematic Area Workshop and Public Meeting

Date: September 21, 1999

Locations: Rothwell Student Center, UW-Superior campus; Barkers Island Inn & Conference Center

Attendance: 42 at workshop (researchers/students; Minnesota & Wisconsin DNR, U.S. EPA and U.S. Fish & Wildlife personnel; Minnesota and Wisconsin Advisory Services and Communications staff), and 22 at public meeting.

International Joint Commission's Great Lakes Environmental Exposition

Date: September 24-25, 1999

Location: Midwest Express Center, Milwaukee

Attendance: 1,200 (general public); an estimated 250 visited our Great Lakes Sea Grant Network exhibit.

Education Workshops

In addition to the educational outreach conducted through Advisory Services and Communications, the following workshops were coordinated directly through the UW Sea Grant Education subprogram:

Madison JASON

Teacher Professional Development Course

Date: November 9, 26 and 30

Location: Hoyt School

Attendance: 10

Teacher Professional Development Conference

Date: November 14, 1998

Location: Grainger Hall, UW-Madison campus/Aldo Leopold Nature Ctr., Monona, Wis.

Attendance: 68 teachers

Teacher Technology Training Session

Date: January 20, 1999

Location: Whitehorse Middle School, Madison, Wis.

Attendance: 30 teachers

Telepresence Global Conference

Date: March 9-12, 1999

Location: BioPharmaceutical Technology Center Institute, Fitchburg, Wis.

Attendance: 1,800-plus students and their teachers

Teacher Professional Development Conference

Date: November 6, 1999

Location: The Pyle Center, UW-Madison campus

Attendance: 102 teachers

“UW Sea Grant Graduates of Distinction” Sesquicentennial Seminars

Dr. John S. Raglin, professor, Dept. of Kinesiology, Indiana University

Topic: “Interaction of Anxiety, Mood States and Exercise Above and Under Water”

Date: April 30, 1999

Location: Natatorium, UW-Madison

Attendance: 30 students, faculty and academic staff

Dr. Stephen Brandt, director, NOAA Great Lakes Environmental Research Laboratory

Topic: “Spatial Processes in Fish Ecology”

Date: November 5, 1999

Location: Noland Zoology Building, UW-Madison

Attendance: 75 students, faculty, staff and public

“Recent Advances in Oceanography and Limnology” Seminar Series

These UW Sea Grant-supported lectures were held Thursday evenings at the UW-Milwaukee Great Lakes WATER Institute, 600 E. Greenfield Ave, Milwaukee. Open to the public, attendance at each seminar averaged 25-30 people. Seven advanced undergraduate students and seven graduate/special students were enrolled in the course in 1999.

Robert Jeske, professor, Dept. of Anthropology, UW-Milwaukee

Topic: “The Way It Was: Pre-settlement Conditions in Southeastern Wisconsin and the Lake Michigan Basin”

Date: January 28, 1999

Joy Zedler, Aldo Leopold Professor of Restoration Ecology, UW-Madison

Topic: “The Restoration of Coastal Wetlands: Surprising Outcomes and Their Explanation”

Date: February 11, 1999

David Krabbenhoft, U.S. Geological Survey

Topic: “Mercury Contamination of the Florida Everglades: What Happens When Wetlands and People Meet?”

Date: February 25, 1999

Li Wang, Wisconsin Dept. of Natural Resources

Topic: “Impact of Urbanization on Stream Quality: Is Restoration Possible in Developed Watersheds?”

Date: March 11, 1999

Richard Marzolf, U.S. Geological Survey

Topic: “The Colorado River Flood: An Experiment in Restoration”

Date: April 1, 1999

Michael Hansen, UW-Stevens Point

Topic: “Lake Trout Restoration in Lake Superior”

Date: April 15, 1999

Will Wawrzyn, Wisconsin Dept. of Natural Resources; **Tim Ehlinger**, Biological Sciences, UW-Milwaukee; **James Rienartz**, UW-Milwaukee Field Station, and **Larry Boyer** and **Rose Chmielewski**, Graef, Anhalt & Schlemmer engineering consulting

Topic: Panel discussion of active restoration projects in the area.

Date: April 29, 1999

Advisory Services Partnerships

Aldo Leopold Center, Madison
 Alpine Farms, Sheboygan Falls
 American Planning Association
 Land-Based Classification Standards Project
 Ashland Area Development Corporation, Ashland
 Barker's Island Marina, Superior
 Bay Area Community Council, Green Bay
 Bay Port Aquaculture Systems, Inc., West Olive, Mich.
 Bayfield County
 Bay-Lake Regional Planning Commission, Green Bay
 Bennett Academy of Ski and Scuba, Milwaukee
 Boudin's Fisheries Inc., Ashland
 Boutin Fishing Company, Bayfield
 Brown County
 Conservation Alliance
 Harbor Commission
 Homebuilders Association
 Land Conservation Department
 Planning Department
 Port and Solid Waste Department
 Canadian Ministry of Environment
 Case Western Reserve University
 Department of Geological Sciences
 City of Appleton
 Department of Utilities, Wastewater Division
 City of Ashland
 Marina
 City of Bayfield
 City of Green Bay
 Chamber of Commerce
 Mayor's Office
 Metropolitan Sewerage District
 Planning
 Public Schools
 City of Manitowoc
 Public Works Department
 City of Milwaukee
 Police
 Public Schools
 City of Superior
 City of Washburn
 Marina
 City of Wauwatosa
 Clean Water Action Council
 Coastal Planning and Design, Inc., Green Bay
 Coastal Services Center, NOAA, Charleston, S.C.
 Coastal Zone Foundation
 Dean Vegetable Company, Green Bay
 Door County
 East Central Wisconsin Regional Planning, Oshkosh
 Everett Fisheries, Inc., Port Wing
 Federal Geographic Data Council
 National Shoreline Data Standard Working Group
 Bathymetric Subcommittee
 Fish Creek Aquaculture Development Center, Ashland
 Fishing Charters of Racine, Racine
 Fort James Corporation, Green Bay
 Fox Cities Convention & Visitors Bureau, Appleton
 Fox-Wolf Basin 2000, Green Bay
 Freedom High School, Freedom
 Friends of the Branch River, Manitowoc
 Great Black Creek Fish Company, Black Creek
 Great Lakes Commission
 Great Lakes Information Network
 Great Lakes Fish Distributors
 Great Lakes Fishery Commission
 Great Lakes Indian Fish and Wildlife Commission,
 Odanah
 Great Lakes Panel on Aquatic Nuisance Species
 Great Lakes Sea Grant Network
 Great Lakes Sport Fishermen
 Green Bay Duck Hunters Association, Green Bay
 Halvorson & Son Fisheries, Bayfield
 Hamline University, St. Paul, Minn.
 Center for Environmental Education
 Havenwoods Environmental Awareness Center,
 Milwaukee
 Heart-of-Valley Metropolitan Sewerage District,
 Kaukauna
 Illinois-Indiana Sea Grant Program
 Inland Sea Society, Washburn
 International Association for Great Lakes Research
 International Joint Commission
 Great Lakes Regional Office, Windsor, Ontario
 John G. Shedd Aquarium, Chicago, Ill.
 Kaukauna Electric Commission, Kaukauna
 Kenosha Charter Boat Association, Kenosha
 Lake Pewaukee Lake District, Pewaukee
 Lake Michigan Federation, Chicago, IL
 Lake Michigan Lakewide Management Plan Forum
 Lake Superior businesses in Wisconsin
 110 businesses, Superior to Hurley
 Lake Superior herring fishers
 10 licensed commercial fishermen
 Leech Lake Band of Chippewa, Leech Lake, Minn.
 Local Emergency Planning Committee, Green Bay
 Lower Fox River Dischargers Association, Green Bay
 Lower Green Bay and Fox River Remedial Action Plan,
 Green Bay
 Madeline Island Ferry, Bayfield
 Madison Metropolitan School District
 Manitowoc County
 Land and Water Conservation
 Maywood Environmental Center, Sheboygan

1999 Wisconsin Sea Grant Progress Report

McDonald Lumber & Warehousing Co., Green Bay
Medford School District, Medford
Metropolitan Interstate Commission, Duluth, Minn.
Michigan Natural Features Inventory Project
Michigan Sea Grant Program
Michigan State University
Department of Fisheries and Wildlife
Milwaukee County
Community Right-to-Know Subcommittee
Emergency Planning Committee
Minnesota Sea Grant Program, Duluth
Mississippi-Alabama Sea Grant Program
Morey's Fish Company, Motley, Minn.
Neville Public Museum, Green Bay
National Association of State Universities & Land Grant Colleges
National Water Research Institute, Environment Canada, Hamilton, Ontario
Navarino Neighborhood Association, Navarino
North American Lake Management Society
Northern Great Lakes Visitors Center, Ashland
Northland College, Ashland, Wis.
Sigurd Olson Environmental Institute
Northwest Wisconsin Regional Planning Commission, Spooner
Ohio Department of Natural Resources
Thousand Islands Environmental Center, Kaukauna
Oneida Environmental Services Program, Oneida
Outagamie County
Land Conservation
Planning and Zoning
Ozaukee County
Land Information Office
Paragon Aquaculture, Oshkosh
Pewaukee School District, Pewaukee
Pigeon River Priority Watershed WAV, Sheboygan
Purdue University
Racine County
Planning and Zoning
Red Lake Band of Chippewa, Red Lake, Minn.
Rufus King High School, Milwaukee
Sailboats, Inc., Superior
Saint Louis River Remedial Action Plan, Duluth, Minn.
Salmon Unlimited, Racine
Sheboygan County
Land and Water Conservation
Slinger Middle School, Slinger
SODA Farms, Princeton
South Shore Yacht Club, Milwaukee
Southeast Michigan Coalition for Occupational Safety & Health
St. Lawrence River Institute of Environmental Sciences
St. Norbert College, DePere
Benchmarks Project
Project COAST
Ocean Voyagers Program
SUNY Buffalo
Great Lakes Program
Sustainable Green Bay Action Team
Creating a Dialogue/Vision
Creating/Enhancing the Green Infrastructure
Developing a Multi-Model Transportation System
Improving Community Planning and Design
Improving Water Quality
Revitalizing Downtown
Strengthening Intergovernmental Cooperation
Strengthening Neighborhoods and Social Services
Transforming the Economy
Town of Hobart
U.S. Army Corps of Engineers
Chicago District
Sanitary-Ship Canal Barrier Project
Detroit District
U.S. Coast Guard Marine Safety Office, Milwaukee
Eastern Wisconsin Area Committee
U.S. Congress, Representative Mark Green
U.S. Department of Agriculture
Natural Resources Conservation Service
Natural Resources Damage Assessment
North Central Regional Aquaculture Center
U.S. Department of Commerce, NOAA
GEWEX Continental-Scale International Project)
Great Lakes Environmental Research Laboratory
National Weather Service
Office of Global Programs
Ohio River Forecast Center
National Undersea Research Program
U.S. Department of the Interior
Bureau of Indian Affairs
Federal Geographic Data Committee
Fish and Wildlife Service, Ashland & Green Bay
Geological Survey
National Park Service, Apostle Islands National Lakeshore, Bayfield
U.S. Environmental Protection Agency
Region 5 Office, Chicago
Great Lakes Region National Program Office
U.S. Navy
Naval Oceanographic & Meteorological Command
University of Michigan
Center for Great Lakes and Aquatic Sciences
Department of Ocean Engineering
University of Wisconsin Colleges
Fox Valley
Manitowoc
Marinette
Waukesha

University of Wisconsin System
Great Lakes WATER Institute
Aquaculture Institute

University of Wisconsin-Extension
Area Water Quality Education Specialists
Solid & Hazardous Waste Education Center
Water Action Volunteer Program

University of Wisconsin-Green Bay
Department of Public & Environmental Affairs
Natural and Applied Sciences
Outreach and Extension

University of Wisconsin-Madison
Department of Civil & Environmental Engineering
Environmental Remote Sensing Center
Department of Geology and Geophysics
Institute for Environmental Studies
Land Information & Computer Graphics Facility
State Cartographer's Office

University of Wisconsin-Milwaukee
Aquonaut Program
Center for Great Lakes Studies
JASON Project

University of Wisconsin-Stevens Point

University of Wisconsin-Superior
Center for Economic Development

Washington Sea Grant Program

Winnebago County
Land Conservation Department

Wisconsin Center for Environmental Education

Wisconsin Commercial Fisheries Association

Wisconsin Conservation Congress

Wisconsin Department of Administration
Coastal Management Program
Natural Hazards Advisory Committee
Office of Land Information Services
Land Council Technical Working Group
Small Business Clean Air Assistance

Wisconsin Department of Agriculture, Trade & Consumer Protection
Governor's Blue Ribbon Task Force on Aquaculture
Wisconsin Aquaculture Industry Advisory Council

Wisconsin Department of Commerce

Wisconsin Department of Natural Resources
Big Bay State Park
Boating Safety Program
Fishery Management Office
Fox River Remediation Advisory Team
Geographic Management Units
Lower Fox Partnership
Door County Stewardship Council
Milwaukee River Partnership
Lake Superior Partnership
Fox-Wolf Basin Partnership
Lake Superior Basin Advisory Committee
Lake Superior Management
Nonindigenous Species Task Force
Northeast Region Water Division
Park Naturalists
Shoreland Zoning Unit

Wisconsin Department of Public Instruction

Wisconsin Department of Transportation
Harbor Assistance Program

Wisconsin Division of Emergency Government

Wisconsin Environmental Education Board

Wisconsin Farm Federation Bureau, Madison

Wisconsin Governor's Northern Office, Hayward

Wisconsin Land and Water Conservation Board

Wisconsin Maritime Museum, Manitowoc

Wisconsin Society of Science Teachers

Wisconsin State Historical Society
Marine Archeology Committee

Wisconsin State Laboratory of Hygiene

Wisconsin State Legislature
Sen. Margaret Farrow
Rep. Dan Vrakas

Communications Partnerships, 1999

Eastman Kodak Co. (Argentum Conference publications)

Great Lakes Commission

Great Lakes Information Network (advisory board)

Great Lakes Sea Grant Network

Illinois-Indiana Sea Grant (network exhibit at IJC Great Lakes Environmental Expo)
Michigan Sea Grant (yellow perch fishery research workshop; *Zebra Mussel Watch* cards)
Minnesota Sea Grant (Lake Superior thematic area workshop; ANS identification cards)
New York Sea Grant (*Zebra Mussel Watch* cards)

International Joint Commission (Great Lakes Environmental Expo; Great Lakes Communicators meeting)

Lake Champlain Basin Program (*Zebra Mussel Watch* cards)

National Oceanic & Atmospheric Administration

Great Lakes Environmental Research Laboratory (Great Lakes Research & Outreach Partnership meeting)

National Sea Grant Network

Alaska Sea Grant (*Water Wise* boating safety book)
California Sea Grant (ANS ballast water forums proposal)
Louisiana Sea Grant (ANS ballast water forums proposal)
Maine-New Hampshire Sea Grant (*Marine Science Careers* publication)
Maryland Sea Grant (ANS ballast water forums proposal)
Michigan Sea Grant (ANS ballast water forums proposal)
Minnesota Sea Grant (ANS baitfish industry outreach proposal)
Oregon Sea Grant (“Making a Difference” program accountability system)
Sea Grant Association (Sea Grant Week '99 online audio workshop)
Sea Grant Communicators National Steering Committee (regional representative; radio task force)
Sea Grant National Media Relations Office (ANS ballast waters forums proposal; news releases; sources to answer media queries)

Native Fish Conservancy (photographs for “Fish of the Great Lakes” Web site)

Nebraska Game & Parks Commission (*Zebra Mussel Watch* cards)

Oklahoma Department of Wildlife Conservation (*Zebra Mussel Watch* cards)

Shedd Aquarium (photographs for “Fish of the Great Lakes” Web site)

State Historical Society of Wisconsin

Underwater Archeology Program (Wisconsin’s Great Lakes shipwrecks project)

U.S. Coast Guard (*Zebra Mussel Watch* cards)

UW-Madison

Chancellor's Office (UW-Madison sesquicentennial program)
Institute for Environmental Studies (“Earthwatch Radio” program)
Office of News & Public Affairs (“UW-Madison on the Road” sesquicentennial project; news releases)
Speakers Bureau (speakers for service clubs)
UW Press (proposal to update/reprint *Fishes of Wisconsin*)

Wisconsin Department of Natural Resources (drawings for “Fish of the Great Lakes” Web site)

“Earthwatch Radio” Stations & Partners

(260 two-minute science & environmental news programs per year)

CALIFORNIA

Armed Forces Radio and TV, March AFB
KOFX-FM, Oakland

COLORADO

KGNU-FM, Boulder
KDUR-FM, Durango

FLORIDA

WKLN-FM, St. Augustine

IOWA

KCCK-FM, Cedar Rapids
KROS-AM, Clinton
KALA-FM, Davenport
KDPS-FM, Des Moines
KCMR-FM, Mason City

IDAHO

Environmental News Network, Sun Valley

ILLINOIS

WILY-AM, Centralia
Illinois Radio Reader, Champaign
WPCD-FM, Champaign
WEPS-FM, Elgin
WVKC-FM, Galesburg
WDCB-FM, Glen Ellyn
WGEL-FM, Greenville
West Central Illinois Radio Info Service,
Macomb
Radio Information Service, Mount Carmel
WVJC-FM, Mount Carmel
WPNA-AM, Oak Park
WTJK-AM, Rockton
WCCI-FM, Savanna
WSQR-AM, Sycamore

INDIANA

WJHS-FM, Columbia City
WPSR-FM, Evansville
Northeast Indiana Radio Reading Service,
Fort Wayne
WEEM-FM, Pendleton
WPUM-FM, Rensselaer
WHLY-AM, South Bend

MAINE

Web of Life Audio Productions (WERU-
FM), Bar Harbor
WMEB-FM, Orono

MICHIGAN

WATZ-AM, Alpena
WLEW-AM, Bad Axe
WAUS-FM, Berrien Springs
WDTR-FM, Detroit
WKAR Radio Talking Book, East Lansing
WJMS-AM, Ironwood
WUPX-FM, Marquette
WKJC-FM, Tawas City
WNMC-FM, Traverse City
WTCM-AM, Traverse City
WPHS-FM, Warren

MINNESOTA

KASM-AM, Albany
WTIP-FM, Grand Marais
KFAI-FM, Minneapolis
KVSC-FM, St. Cloud
KSRQ-FM, Thief River Falls
KWOA-AM, Worthington

MISSISSIPPI

WMUW-FM, Columbus

MONTANA

KMSM-FM, Butte

NEW MEXICO

KENW-FM, Portales

NEW YORK

WYSL-AM, Avon
WBSU-FM, Brockport
WEOS-FM, Geneva
WHRU-FM, Hempstead
WLVL-AM, Lockport
WPOB-FM, Plainview

OHIO

WCRS Reading Service, Akron
WZIP-FM, Akron
WATH-AM, Athens
WKHR-FM, Chagrin Falls
WCSB-FM, Cleveland
WDPS-FM, Dayton
WHSS-FM, Hamilton
WXTS-FM, Toledo

PENNSYLVANIA

WESA-AM, Charleroi
WESS-FM, East Stroudsburg
WPEB-FM, Philadelphia

1999 Wisconsin Sea Grant Progress Report

WPGA-FM, Philadelphia
WNAE-AM, Warren
WCLH-FM, Wilkes-Barre

SOUTH CAROLINA

WSBF-FM, Clemson

TEXAS

KAZI-FM, Austin
KVRX-FM, Austin
KEOS-FM/, College Station
KSHU-FM, Huntsville

WASHINGTON

World Exploration Society, Vancouver
KWCW-FM, Walla Walla

WISCONSIN

UW-Madison
Institute for Environmental Studies
WHA Radio Studio
WBEV-AM, Beaver Dam
WBCR-FM, Beloit
WBEL-AM, Beloit
WBSD-FM, Burlington
WCFW-FM, Chippewa Falls
WTKM-AM/WTKM-FM, Hartford
WIPZ-FM, Kenosha
WGLR-AM/WGLR-FM, Lancaster

WORT-FM, Madison
Goetz Radio Networks, Marshfield
WMSE-FM, Milwaukee
WOCO-AM/OCO-FM, Oconto
WSUP-FM, Platteville
WDDC-FM, Portage
WQPC-FM, Prairie Du Chien
WSHS-FM, Sheboygan
WCSW-AM, Shell Lake
WDOR-AM/WDOR-FM, Sturgeon Bay
KUWS-FM, Superior
WTRW-AM, Two Rivers
WRIG-AM, Wausau

CANADA

CKUT-FM, Montreal-QUEBEC
CKMS-FM, Waterloo-ONTARIO
CAPR, Sydney-NOVA SCOTIA
CHMR-FM, St. John's-NEWFOUNDLAND
CJSR-FM, Edmonton-ALBERTA

TAIWAN

International Comm. Radio Taipei, Taipei-ROC

SHORTWAVE

Radio for Peace International (Miami)

Education Partnerships

Besides the educational partnerships listed under Advisory Services and Communications, the following partnership activities were coordinated directly through the Education subprogram.

UW-Madison

Chancellor's Office – Acted as a partner in the UW-Madison 150th anniversary by designing an educational postcard and fish poster and by providing 12,000 postcards for distribution to the general public at the February 7, 1999, Anniversary Community Concert, as well as 300 fish posters for distribution to local centers primarily serving the minority community.

Madison JASON Partners & Schools

The Madison JASON Project is designed to excite and engage middle school students and their teachers in science and technology and to provide professional development for their teachers. About 90 teachers and more than 3,000 students in 39 schools in the communities of Arlington, Baraboo, Columbus, Cross Plains, DeForest, Madison, Middleton, Monona, Montello, Mount Horeb, Oregon, Stoughton, Sun Prairie, Verona and Windsor participated in this project from October 1998 to November 1999.

Participating Schools

Abundant Life Christian School
 Baraboo Middle School
 Cherokee Heights Middle School
 Columbus Middle School
 Country View Elementary School
 Crestwood Elementary School
 DeForest Middle School
 Eagle Point Elementary School
 Elvehjem Elementary School
 Glacier Creek Middle School
 Hamilton Middle School
 J. F. Kennedy Elementary School
 Leeds Elementary School
 Leopold Elementary School
 Lincoln Elementary School
 Madison Memorial High School
 Mendota School
 Montello Jr. High School
 Mr. Horeb Intermediate Center
 Netherwood Knoll Elementary School
 O'Keeffe Middle School
 Patrick Marsh Middle School
 Prairie View Middle School
 Randall Elementary School
 Sacred Hearts School
 Sandhill School
 Savanna Oaks Elementary School
 Sennett Middle School
 Shorewood Hills Elementary School
 St. James School
 St. Peters School
 Stephens Elementary School
 Sugar Creek Elementary School
 Toki Middle School
 Verona Area Middle School
 Whitehorse Middle School
 Windsor Elementary School

Wingra School
 Winnequah Middle School

Community Partners

Aldo Leopold Nature Center
 Alliant Energy Foundation
 Bethel Horizons Nature Center
 BioPharmaceutical Technology Center Institute
 EDS Corporation
 Henry Vilas Zoo
 International Crane Foundation
 Madison Art Center
 Madison Children's Museum
 Madison Metropolitan School District
 NBC 15
 Olbrich Botanical Gardens
 Promega Corporation
 Wisconsin Department of Natural Resources,
 MacKenzie Environmental Center
 Wisconsin State Historical Society
 WKOW-TV

University Partners

Lawrence University
 University of Wisconsin-Madison
 Arboretum
 Biotron
 Center for Biology Education
 Elvehjem Museum of Art
 Land Information & Computer Graphics Facility
 Geology Museum
 Space Place
 University of Wisconsin-Milwaukee
 University Center for Continuing Education

National Partners

JASON Foundation for Education

