

March 1999

In February, the University of Minnesota's limnologists gathered in Siren, Wisconsin, for the first *liMNology* symposium. *LiMNology*, an initiative supported by the Graduate School, recognizes the scope and diversity of limnological work at the University and aims to increase the interaction between the numerous disciplines that focus their efforts on studying the structure and function of inland waters.

"When I went to grad school here in the eighties, there were not many gatherings of aquatic scientists. There wasn't a real good sense of community, little interaction beyond department borders," said Bob Sterner, associate professor and Department Head of the St. Paul campus' Department of Ecology, Evolution and Behavior.

Limnology is fundamentally an interdisciplinary field, with major components contributed by biological, geological, physical and chemical sciences. Sterner and his colleagues Kerry Kelts and Tom Johnson, both directors of key research facilities, share a desire to crosscut the boundaries of their disciplines. Kelts leads the Geology and Geophysics Department's Limnological Research Center (LRC); Johnson is director of the Large Lakes Observatory (LLO) in Duluth. Together, the three founded *liMNology*.

Naturally, pointed out Sterner, one force driving *liMNology* is to generate funding for graduate education. "What we have in Minnesota is great students, great researchers, and great programs. What aquatic scientists often don't have is support for students with interdisciplinary curricula and research projects."

Interdisciplinary projects are usually low on departmental priority list. Departments focus on core disciplines such as biology, chemistry, geology, and physics because it is the research in these core sciences that brings in grants and ascertains the academic laurels of a department. If students work on interdisciplinary projects, they may fall between the cracks of departmental domains where they may have difficulty finding stipends.

However, fundamental issues in aquatic matters usually demand an interdisciplinary approach and for people who are able to look beyond disciplinary boundaries. For example, Johnson, Kelts and other *liMNology*-geologists look at lake sediments as indicators of past climate and landscapes. To decrypt the code of these sediments, they need information from other lake sciences. "Modern" scientists such as plankton ecologists and aquatic chemists can provide these missing pieces of information.

It is not only lake researchers asking for a more holistic science. Some speakers at the meeting emphasized that *liMNology* needs also must include streams, wetlands, and landscape-water relationships. The study of biological communities within a stream span the disciplines of chemistry, geology, biology, and hydrology.

Funding for the *liMNology* initiative currently comes from the University of Minnesota's Graduate School. The *liMNology* program is also looking to generate considerable support from a new National Science Foundation (NSF) program called Integrative Graduate Education and Research Training (IGERT). The NSF program focuses on the training of Ph.D. students who are preparing for academic careers. However, according to Johnson, *liMNology* also needs to look at how to prepares students for career paths outside academia.

"What can we do for a student who wants a nine-to-five job taking care of Moose Lake?" is a question Johnson wants *liMNologists* to ask themselves. Johnson believes that limnologists are needed to solve "real world" water-related problems and sees a gap in the employment statistics. "Why do all those towns [in the state] with lake problems hire engineers instead of limnologists?" asked Johnson. It is hoped that *liMNology* will be helpful in filling in the gap.

Innovations are needed to make future *liMNologists* competitive. One suggestion is to offer curricular internships with agencies such as the EPA, the Natural Resources Research Institute in Duluth, or even in the U.S. Congress. Suggestions on how to train *liMNology* students will also be welcomed from state agencies such as the DNR and MPCA.

In order to succeed, *liMNology* not only needs innovative ideas, but it must also attract continuous funding beyond the IGERT program. This funding will most likely come from national agencies. For this reason, *liMNology*'s founders want it to be enticing to national and even international investigators. According to Kelts, the interest could be maintained by what he calls "global *liMNology*." His vision is to "work on lakes in Minnesota, while having global significance in mind." Kelts intends to work on fundamental issues such as global climate change, but he also wants to see limnologists from around the world coming to learn about new technologies in Minnesota.

LiMNology carries high hopes, but it is still an infant. "You want to see this as the ground floor. We are standing at a ramp, looking up," said Sterner.

Ideas and suggestions for the future of liMNology from within and outside the University community are welcomed. LiMNology has a website at <http://www.limnology.umn.edu>. The program secretary is Sue Julson (612) 624-4238.

Understanding viruses in Lake Superior - effects of ultraviolet (UV) light investigated

For the first time, scientists are looking at the abundance of viruses in one of the Great Lakes. Minnesota Sea Grant researchers Randall Hicks, associate professor and head of the University of Minnesota Duluth's (UMD) Department of Biology, and Mark Tapper, a UMD graduate student, recently completed a study that begins to address how global climate change may affect viruses in the waters of Lake Superior. Because of the difficulty of identifying and counting these microscopic particles, little is known about the abundance of viruses or how various environmental factors affect them.

"We wanted to determine how many dormant viruses infect bacteria in the lake so we would have some idea of what the potential problems might be if UV light does increase as a result of thinning of the ozone layer," said Hicks. "Some types of UV light can damage DNA and also can cause dormant viruses to become active. If there are many dormant viruses, we might see major impacts on bacterial populations and, in turn, nutrient cycling and food webs," said Hicks.

Hicks and Tapper collected water samples from Lake Superior in the spring, summer, and fall of 1993, then counted the number of free viruses in the water samples. They also exposed other water samples to UV light in order to activate and count dormant viruses.

They concluded that less than 7.5 percent of the bacteria in the samples contained dormant viruses. Even if all these dormant viruses were triggered, this level of infection does not appear to be a significant threat to bacterial populations.

But that doesn't mean the research is done. As Hicks explained, "We're better able to see and recognize more viruses now that we have better technology for observing them." To build a more complete and accurate picture of the universe of aquatic bacteria and their viruses, researchers will have to study other freshwater lakes as well as the oceans. This Sea Grant-funded research has already stimulated similar studies in coastal oceans in other parts of the world.

The results of this research project were published in the January 1998 issue of the journal *Limnology and Oceanography*. To find out more, you can order a reprint of the article, "Temperate Viruses and Lysogeny in Lake Superior Bacterioplankton," from Minnesota Sea Grant by calling (218) 726-6191.

Minnesota Sea Grant News Release

WRRI funds five University grants

Five University of Minnesota research projects were selected for funding in the 1999 competitive grants competition sponsored by the Water Resources Research Institute and the USGS. The five studies address issues of primary concern in Minnesota: nutrient fluxes from agricultural watersheds, quality of drinking water, and the remediation of degraded waters.

Assessing the effects of endocrine disrupters from a St. Paul sewage treatment plant on sperm viability and testicular development in fish. It is believed that estrogenic compounds, more commonly known as endocrine disrupters, influence the development of reproductive organs and their function. 17 β -estradiol is a suspected endocrine disrupter found in the effluent of the Metropolitan Sewage Treatment Plant (MSTP) and is believed to be the cause of adverse effects on the fertility of male fish in the Mississippi River. **Peter Sorenson**, professor, **Heiko Schoenfuss**, research associate, and **Ira Adelman**, professor and head, Department of Fisheries and Wildlife, and **Deb Swackhamer**, associate professor, Department of Environmental and Occupational Health, were awarded a grant to determine the effects of 17 β -estradiol exposure on sperm viability in laboratory fishes as well as in wild fish both upstream and downstream from the MSTP effluent in the Mississippi River to determine if sex reversal is occurring.

An investigation of the factors affecting removal of *Cryptosporidium* and *Giardia* from drinking water supplies by granular media filtration. *Giardia* and *Cryptosporidium* are pathogenic protozoa commonly found in drinking water supplies obtained from surface sources. Their removal from water is highly dependant on the performance of filters. **Raymond Hozalski**, assistant professor, Department of Civil Engineering, was awarded a grant to compare particle removal in "clean" filters and in filters containing biofilm to determine if the presence of biofilm aids in the removal of these protozoa.

Investigation of a novel biomolecule active in the degradation of common groundwater contaminants. Elemental iron (Fe⁰) has recently been investigated as an alternative *in situ* support of anaerobic organisms capable of dehalogenation. During the incubation of the methanogen *M. thermophila* with Fe⁰, it was discovered that the organism excreted a biomolecule capable of the rapid transformation of many common groundwater contaminants. **Paige Novak**, assistant professor, Department of Civil Engineering, was awarded a grant to study the excreted catalyst produced by *M. thermophila* in order to explore its use in bioremediation.

Feasibility of controlled drainage for mitigating nutrient loss from tile drainage systems in south central Minnesota. Recent data suggest that the Upper Mississippi River Basin contributes more than one-half of the total nitrate-N load in the entire Mississippi while contributing less than one-fourth of the total water. Intensive row crop production that is dependent on artificial drainage systems is the leading contributor to nitrate load. In order to reduce nutrient loadings into the Mississippi, it is imperative that strategies be developed to mitigate the effects of these drainage systems. **Gary Sands**, assistant professor, Department of Biosystems and Agricultural Engineering, **David Mulla**, professor, Department of Soil, Water, and Climate, and **Lowell Busman**, Extension educator, were awarded a grant to develop a facility for controlled drainage research and demonstration and provide an initial assessment of the controlled drainage's feasibility in south central Minnesota.

Characterizing the fate of nitrogen fertilizer to improve nitrogen use efficiency in irrigated potato production. Potato crops in central Minnesota are highly dependant upon nitrogen fertilizers. These fertilizers are highly soluble, and nitrate leaching into the groundwater is high. **Carl Rosen**, professor, **Michael Russelle**, professor, **Satish Gupta**, professor, Department of Soil, Water, and Climate, were awarded a grant to evaluate the efficiency of urea-based POC N fertilizers in reducing nitrate, to increase tuber yield and quality in a glacial outwash soil under irrigated potato production in central Minnesota, and to determine the fate and recovery of N from POC urea in comparison to conventional urea fertilizers using the ¹⁵N-enrichment method.

GIS labs continue efforts in water resources

Two of the University of Minnesota's largest Geographic Information Systems (GIS) laboratories, the Soil and Landscape Analysis Laboratory (SLAL) and the Forest Resources GIS and Remote Sensing Laboratory (RSL) are expanding their efforts in the field of water resources. Use of GIS has grown rapidly in recent years, offering several advantages that allow a more comprehensive approach to water resources planning and research.

SLAL, directed by Soil, Water, and Climate professor Dr. Jay Bell, is the largest soils GIS lab in the United States. The lab maintains spatial databases of natural resource information from numerous research sites and state-wide databases of soil, topographic, and land-cover information at multiple scales.

The lab is home to several water-related projects including a soil erosivity study in which researchers use GIS to generate computerized maps and data files that show where soil losses and erosion occur along the Minnesota River Basin. Data on rainfall and soil erosion are entered into a GIS and erosion sensitivity is determined. The project illustrates how automated methods provide a quick and inexpensive means to assess erosion potential. Researchers have expanded the soil erosivity project, using GIS to look at the spatial variance of soil properties at differing scales.

GIS has given land-use managers the ability to use many sources of digital information to examine natural resource management issues at varying spatial scales. As the scales of data change, managers get different perspectives on the same information. Because of generalizations made as scales become smaller, the same area of land may appear to have very different characteristics. Therefore, the scale is an important consideration when using GIS.

The University of Minnesota's Forest Resources GIS and Remote Sensing Laboratory, directed by Forest Resources professor Dr. Marvin Bauer, combines satellite imagery and aerial photographs with GIS technology. The largest water-related project associated with this lab uses satellite imagery to estimate trophic conditions in Twin Cities lakes.

Protecting and monitoring lake water quality in the Twin Cities is a major concern for many local and state agencies. In order for these agencies to make decisions regarding these resources, they need comprehensive regional water quality databases. However, the large number of lakes in the metropolitan area makes this task time consuming and expensive. Remote sensing data from satellite images incorporated into a GIS produces accurate water quality information in a cost-efficient way for regional water quality assessments. This project is an example of how this technology may greatly reduce the effort and associated costs of assessing the lake water quality in the metropolitan area.

Dr. Bauer is also the director of RESAC (Upper Midwest Regional Earth Science Center), which has recently received funding from NASA to extend the efforts of projects such as the Twin Cities remote sensing project to greater Minnesota, Wisconsin and Michigan.

The SLAL and RSL are part of the Environmental Resources Spatial Analysis Center (ERSAC). ERSAC was established in 1995 to develop a unified computing environment for research on spatial analysis and modeling of natural resources and the environment. Currently, the Center comprises nine departments from five colleges. Made possible from a grant from the National Science Foundation, ERSAC has enhanced research productivity for individual researchers, decreased duplication of effort within departments, and increased collaboration among faculty within the University.

Cost-benefit analysis of water quality regulations

The Minnesota Pollution Control Agency (MPCA) is interested in taking a closer look at the costs of implementing water quality standards in the state of Minnesota and at the associated benefits of those standards. To achieve this goal, they have developed a policy initiative to develop a cost-benefit model for analyzing water quality standards.

The MPCA has hired Carl Phillips from the University of Minnesota, Patrick Welle from Bemidji State, and Tetratech EMI, a Chicago-based consulting firm, to investigate the costs associated with developing a model that can be applied to any watershed at any scale to assist in the evaluation of proposed policies. Their report describes the theory of cost-benefit analysis, explains the usefulness of a cost-benefit analysis, and helps insure the reliability of cost-benefit analyses by defining the parameters. The investigators have proposed a plan to create a GIS-based model and have estimated the costs to range from \$3.5 million to \$4.5 million.

The results of this investigation have been presented to the legislature and the proposed project is now awaiting approval. If the initiative is approved, the MPCA will be able to use this model to decide on how to achieve the greatest environmental protection at the least cost.

Request for Proposals

The National Sea Grant is requesting proposals for their nationally competitive grant programs and fellowship programs for fiscal year 1999. The deadline for pre-proposals is April 5, 1999. Draft announcements are available at www.oar.noaa.gov/admin/website.html.

The grant programs are: *Aquatic Nuisance Species Research and Outreach and Improved Methods for Ballast Water Treatment and Management*, which supports projects that (a) prevent and control non-indigenous species invasions in all U.S. marine waters and the Great Lakes and (b) improve ballast water treatment and management; *Sea Grant Technology Program*, which supports applied research and development projects that facilitate the transfer of new products and processes related to the development of marine resources; *Sea Grant Industry Fellows Program*; *Dean John A. Knauss Marine Policy Fellowship*; and *National Sea Grant College Federal Fellows Program*.

New flood-control initiative in the Red River Basin

A strategy aimed at preventing 10-year floods in the Red River Basin in northwestern Minnesota has been devised by a group of state, federal, environmental, and agricultural groups. The initiative proposes spending up to \$250 million in local, state, and federal money over the next 15 years on projects such as stream-channel restoration and set-back dikes to slow down water that drains into the Red River.

Supporters of the initiative believe that along with preventing 10-year floods, the various projects will also lessen the impact of many of the larger floods that sometimes hammer the basin. The DNR has proposed that up to \$9 million be included in the state's budget for fiscal year 2000 to fund the effort.

High nitrate concentrations found in Minnesota aquifers

A study conducted by the Minnesota Pollution Control Agency (MPCA) has shown that the aquifer underlying agricultural lands in the St. Cloud area has a nitrate concentration exceeding the 10mg/L standard for safe drinking water. Scientists from the MPCA sampled 37 locations covering non-irrigated and irrigated agriculture, sewered and un-sewered residential, commercial-industrial, and undeveloped land-use areas in an attempt to determine the impacts of land use on groundwater quality. Inorganic chemicals, volatile organic compounds, and pesticides were also measured. The results, which are available in the MPCA report "Water Quality in the Upper Fifteen Feet of a Shallow Sand Aquifer in a Variable Land-use Setting," will help resource managers predict how land-use decisions affect the aquifers.

Efi Foufoula-Georgiou (St. Anthony Falls Laboratory) was awarded grants from National Science Foundation and NASA. A NSF grant will fund the investigation of a probabilistic framework for assessment and interpreting quantitative precipitation forecasts from storm scale models. The first of the two NASA-funded projects will focus on subgrid scale precipitation variability over the Mississippi River Basin, and the second will investigate the spatio-temporal organization and space-time downscaling of tropical rainfall. In addition to receiving the grants, **Foufoula-Georgiou** was appointed Editor of the *Journal of Hydrometeorology*, a new publication of the American Meteorological Society. She was also appointed a member to the National Academy of Sciences National Research Council committee on risk-based analysis in flood damage reduction studies, and was invited by NOAA to serve on 1999-2000 advisory proposal review panel.

Robert Sterner (Ecology, Evolution, and Behavior) and **Erik Brown** (Large Lakes Observatory) have received a \$340,000 grant from the NSF to research trace metal limitations of phytoplankton productivity. The project is a collaborative effort with Rutgers University and Bowling Green University and will include combined immunological, geochemical, and growth assay approaches in Lake Superior.

In March, **Gerald J. Niemi** and **Subhash C. Basak** (Natural Resources Research Institute) attended "Symposia Series: Reducing the Environmental Impacts of Toxic Chemicals in Asian Economies" in Dhaka, Bangladesh, and Calcutta, India. The meetings focused on the impact of toxic chemicals and pollutants on public health, ecology and the environment in the Bengal Basin. **Niemi's** presented his paper, "Impact of Toxic Chemicals on Water, Public Health, Environmental Health, and Economic Welfare." **Basak**, who has discovered that there is no data on contaminants in the Ganga watershed, spoke on the role computer models of chemicals have in reducing the cost of environmental hazards.

Mike McDonald has resigned as director of the Minnesota Sea Grant to become director of the US Environmental Protection Agency's nationwide Environmental Monitoring and Assessment Program (EMAP) in North Carolina. **Jeff Gunderson** has been named acting director in his absence. **Gunderson** was also elected to the National Sea Grant Extension Program Executive Committee as an at-large member. This group acts as the steering committee for Extension activities within Sea Grant and serves as a liaison between Extension program leaders, other formal Sea Grant groups, and external groups.

Sara Tjossen has resigned as assistant director of the Institute for Social, Economic, and Ecological Sustainability (ISEES) to join the Department of History at the University of Washington in Seattle.

The Institute for Social, Economic, and Ecological Sustainability (**ISEES**) hosted a workshop for the Minnesota-Stanford-Wisconsin McArthur Consortium research network on *Water and Conflict* in January. ISEES also held an Adaptive Ecosystem Assessment Science Teacher's Workshop that focused on simulation modeling of larger rivers.

The Forest Resources Council has funded a two-year effort to continue the examination of the effects of forest management in riparian zones. **Jim Perry** (Forest Resources), **Ray Newman** (Fisheries and Wildlife), **Carl Richards** (Natural Resources Research Institute) and **Lucinda Johnson** (Natural Resources Research Institute) are among the primary investigators. **Perry** also represented the College of Natural Resources in Senegal in February. A team of six professors from the University traveled to Senegal to write a proposal for *Agricole*, an integrated agroforestry and community development project potentially to be funded by the World Bank.

George Host and **Richard Axler** (Natural Resources Research Institute), **John Barten** (Suburban Hennepin Regional Park District), **Cindy Hagley** (Minnesota Sea Grant), **Bruce Munson** (UMD Department of Education), and **Christopher Owen** (Apprise Technologies, Inc.) have been awarded a major grant through the EPA's Environmental Monitoring for Public Access & Community Tracking (EMPACT) program. The two-year project, known as Lake Access, is an effort to provide real-time and historic data and interpretive information on lake water quality to citizens in the Hennepin Parks and the Minnehaha Creek Watershed District. The Minnesota Science Museum will provide complementary support to Lake Access through its watershed science programs.

University of Minnesota Ph.D. candidate, **Susan Solarz**, was awarded the prestigious Dean John A. Knauss Marine Policy Fellowship by the National Sea Grant College Program for her work on the control effects native weevils have on Eurasian watermilfoil. The Knauss Fellowship was established in 1979 to provide unique educational experiences to students who have an interest in marine or Great Lakes resources and in national policy decisions affecting those resources. Solarz' Ph.D. co-advisors are Water Resources faculty **Ray Newman** and **Anne Kapuscinski** from the Department of Fisheries and Wildlife. **Kapuscinski**, also the director of ISEES, has been asked to serve on the editorial board on the on-line journal Conservation Ecology. She is currently on sabbatical leave. **George Spangler** (Fisheries and Wildlife) is acting director of ISEES in her absence.

Elise Ralph (Large Lakes Observatory) received a two-year grant from the McKnight Foundation to study the dynamics of fronts in large lakes.

April 7. **JoAnn Burkholder**, professor at North Carolina University, will give a seminar in the Twin Cities on her work on harmful algae blooms. Burkholder has been a key researcher in determining how the highly toxic alga, *Pfseisteria*, functions. Her work is the topic of *And the Waters Turned to Blood*. For further information, contact Jim Cotner at (612) 625-1706.

April 9. **Arsenic and Drinking Water: The Human Health Effects**. University of Minnesota Morris, Morris, MN. Sponsored by the University of Minnesota Extension Service and the University of Minnesota Water Resources Center. Arsenic has been detected in about two-thirds of Minnesota's groundwater. Speakers at this conference will be addressing the potential human health risks associated with arsenic in drinking water and the alternatives that can be used to ensure the safety of municipal and private drinking water supplies. Contact Tracy Thomas at (612) 625-2282.

April 26-28. **Lake Erie at the Millennium**. University of Windsor; Windsor, Ontario, Canada. This conference will bring together leading researchers on Lake Erie to summarize changes that have occurred in the last 10 years, anticipate trends into the next 3-5 years, and address the most pressing questions facing Lake Erie decision makers. Contact: Jan J.H. Ciborowsk at (519) 253-3000 ext.2725 or E-mail: cibor@uwindsor.ca

April 26-30. **Ninth International Zebra Mussel and Aquatic Nuisance Species Conference**. Duluth Entertainment Convention Center, Duluth, MN. This conference is considered the most comprehensive international forum for expert results of research, outreach, and technological developments in the biology, ecology, control and management, and impacts of marine and freshwater aquatic nuisance species. Contact: Doug Jensen at (218) 726-8712 or E-mail: djensen1@d.umn.edu.

May 25-28. **Current Issues In Great Lakes Benthic Science**. Duluth, MN. Sponsored by The North American Benthological Society. There will be both a plenary session and special sessions devoted to current issues in Great Lakes benthic science. The Society is seeking speakers for special sessions on topics including fate and transport of contaminants; biomonitoring; nutrient and carbon cycling in sediments and the water column; conserving/preserving regional habitats. Contact: Andy Casper at (315) 268-3834 or E-mail: casperaf@clarkson.edu.

August 5-8. **The 1999 Midwest Environmental Education Conference: At the Crossroads**. Stillwater, MN. Sponsored by the Minnesota Association for Environmental Education, the conference will feature speakers, concurrent sessions, exhibits, and field trips. The theme, "At the Crossroads," represents the many challenges in environmental education as we move into the new millennium. For further information, visit the state calendar website at www.seek.state.mn.us/cal/calendar.cfm.

Calls for papers

Vegetation of the Upper Mississippi and Illinois River system: status, management, and ecological linkages. September 21-22, 1999. Radisson Hotel, La Crosse, WI. This conference will highlight water-related research in the Upper Midwest on river and floodplain vegetation as well as collateral work that describes the relationship and importance of floodplain vegetation in the ecosystem. **Abstracts are due by May 1, 1999**. Space will also be provided for posters. For information on how to submit abstracts for papers or posters, contact Ron Rada at (608) 785-8221.

Oct 13-15. **The Midwest Groundwater Conference**. St. Paul, MN. Hosted by the Minnesota DNR. The conference will provide an opportunity for groundwater scientists from different states to meet and discuss mutual problems in the mid-west and summarize results of field data. **Abstracts are due on June 25, 1999**. For further information, contact James Lundy at (800) 657-3864 or E-mail: jim.lundy@pca.state.mn.us.