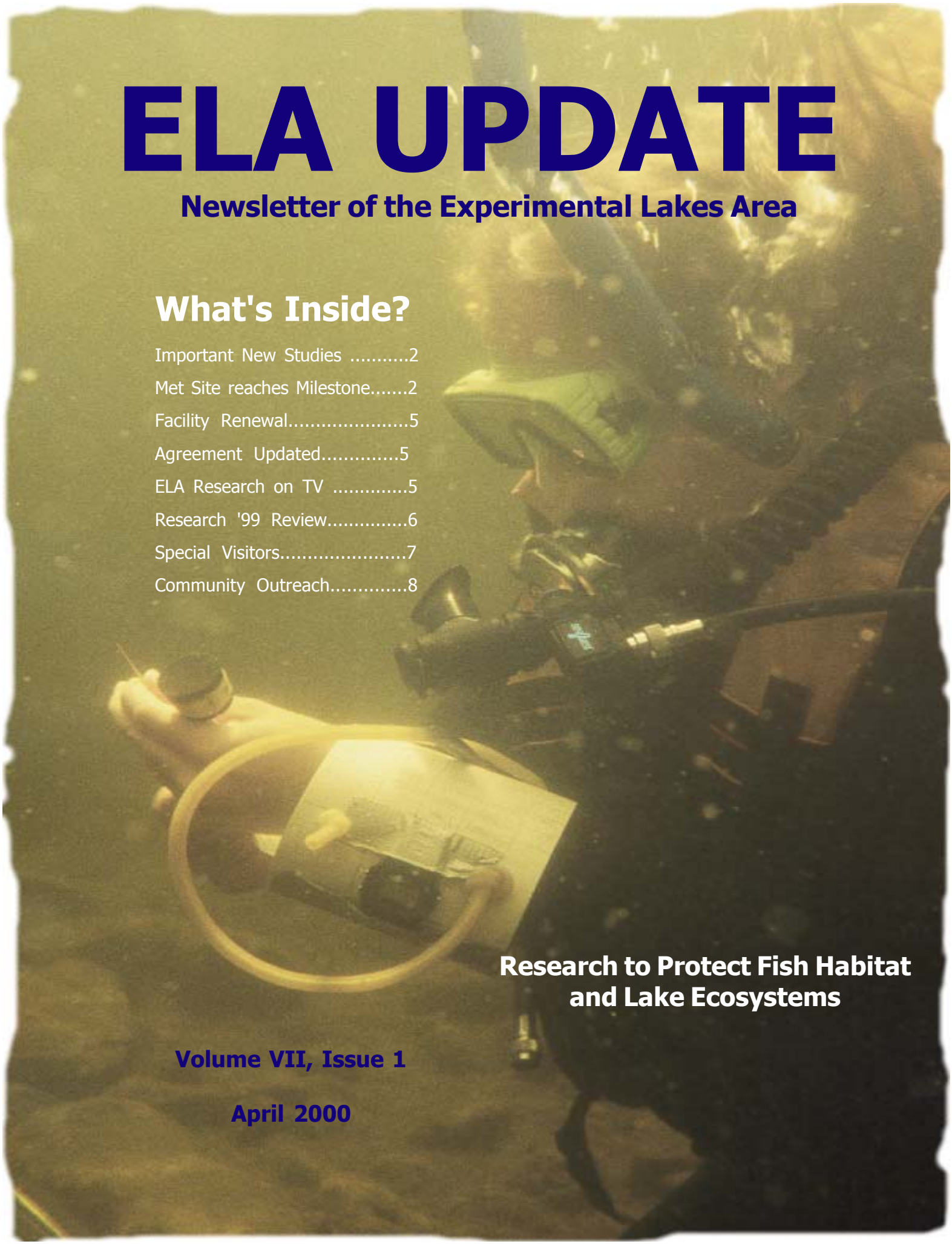
ELA UPDATE

Newsletter of the Experimental Lakes Area

What's Inside?



Research to Protect Fish Habitat and Lake Ecosystems

Volume VII, Issue 1

April 2000

ELA Update

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As part of our ongoing efforts to keep the interested public informed about our research projects and related activities at the Experimental Lakes Area, we present this newsletter. Formerly known as *ELA News*, this is the seventh year that one or more such newsletters has been produced and distributed.

ELA Update is produced by John Shearer, with support from other ELA researchers in the Environmental Science Division of Fisheries and Oceans Canada, Winnipeg. Its production is mandated under the terms of the Canada-Ontario agreement for the ELA.

The **cover photo** of this edition shows a SCUBA diver working in an ELA lake. SCUBA diving is one of the special techniques used by ELA researchers to observe and sample the lakes. The ELA field station is fully equipped to support SCUBA diving operations and several of the ELA staff are qualified SCUBA divers. The photo was provided by Dr. Michael Turner, one of these divers.

ELA Met Site Turns "30"

Last year, the ELA meteorological station, better known as the "met site", quietly reached the age of 30. Significantly, this means that the station is now considered an official long-term monitoring site by the Meteorological Service of Canada (MSC). The met station has operating continuously, under the leadership of Ken Beaty, since June, 1969. Data are used by ELA researchers and contributed to the national climatological database. On May 23, Ken and the ELA will be receiving a special award from the MSC to commemorate this milestone.

Important New Experimental Studies

Over the decades, the ELA has become internationally-known for its ability to conduct unique experimental studies on a "whole-lake" scale. In the 1970's, we fertilized lakes and showed how phosphorus control was key to preventing excessive algal growth. Through the 1980's, we experimentally acidified lakes and examined how even moderate acidification can seriously impact fish populations.

Eventually, the experimental additions of fertilizer and acid were stopped. These experimental systems have been permitted to gradually recover and return to natural conditions. Often, as much has been learned from observing the recoveries as from doing the experiments.

During the 1990's, ELA researchers have focused on studying the adverse environmental effects of reservoirs. These studies are ongoing and we will continue to monitor these affected systems as they recover.

Now, as we enter another decade, much of the research effort at the ELA will be shifting to two exciting new experiments that have attracted considerable international interest and participation. Pilot studies for these experiments are underway, and the whole-lake phases of the studies are planned to begin in the spring of 2001.

Chemicals that Mimic Natural Hormones

Hormones are natural chemicals that control reproduction and other vital body functions. We humans share many hormones with other animals. We also have manufactured many chemicals that are remarkably similar to certain natural hormones. Unfortunately, when some of these manufactured chemicals find their way into natural ecosystems, they can mimic hormones and disrupt normal life processes, including reproduction.

Synthetic estrogens, used in birth control pills, are being released from sewage treatment facilities into rivers and lakes. There is strong evidence to suggest that these synthetic hormones are adversely affecting the reproductive abilities of both male and female fish in many of these systems. However, we need to study this phenomenon under more controlled conditions in the absence of other potential stressors.

Low Concentrations of Estrogen

Lake 260 at the ELA has been selected for this study. In May of next year, we hope to begin adding small quantities of a synthetic estrogen, 17a-ethynylestradiol or EE2, to the water of this small lake. This synthetic hormone can affect animal reproduction even when it is present at very low concentrations. We propose to maintain a concentration of approximately 10 to 20 parts of EE2 per billion parts of water in the mixed layer of Lake 260 during the open-water season. Even at these low levels, we anticipate that the estrogen will begin to affect some of the fish and other species. The

Dr. Vince Palace collects eggs from a lake trout in preparation for their use in laboratory pilot studies supporting the estrogen addition experiment (photo by Doug Allan).

estrogen will gradually break down in the lake water, so continuous slow addition will be necessary to maintain the target concentration.

While the estrogen concentration is being maintained, researchers will monitor many aspects of the lake ecosystem. In particular, they will study both invertebrate and fish populations in the lake to determine if there are any effects of the EE2. Some researchers will look at the physiology, or internal chemistry, of these animals, while others will study the populations to see if reproductive problems are affecting recruitment of new individuals.

Multidisciplinary Team

In order to study the many physical, chemical and biological components of the lake ecosystem and its food web, a team of specialists has been assembled. Dr. Karen Kidd from the Freshwater Institute in Winnipeg is coordinating the study. Other Freshwater Institute scientists participating include Dr. Vince Palace, Dr. Cheryl Podemski, Dr. Ken Mills, and Dr. Paul Blanchfield. Non-DFO scientists include Dr. Karsten Liber from the University of Saskatchewan, Dr. Glen Van der Kraak from the University of Guelph, Dr. David Graham from the University of Kansas, Dr. Scott Brown and Dr. Mark McMaster from Environment Canada. Several graduate students will also be working on the project.

Pilot Studies

During 1999 and 2000, the research team has been conducting pilot studies, both in laboratories and in enclosures or "limnocorrals" (lake corrals) within Lake 260. These pilot studies enable the researchers to perfect their techniques and to accurately estimate how much of the EE2 they will need to add once the whole-lake experiment begins.

The scientists anticipate that they will need to add estrogen to the lake for two or three open-water seasons. Once the effects of the additions are understood, the additions will be stopped and recovery of the lake to natural conditions will be monitored.

Linking Mercury in Fish to Atmospheric Fallout

Throughout northwestern Ontario, and in many other parts of the world, surveys indicate that most older, predatory fish are contaminated with methyl mercury. Even fish from remote lakes, far from any apparent sources of mercury, have accumulated significant quantities of this toxic chemical. How do these fish become contaminated?

Scientists know that large quantities

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of mercury are being released into the atmosphere by the burning of coal and other fossil fuels. The minute mercury particles can remain airborne for days as they drift downwind. Eventually, however, the mercury falls to earth, either with rain and snow, or as dry precipitation. Some of it may land in northwestern Ontario, on forested areas, or on wetlands, or on the surfaces of lakes and streams.

However, scientists cannot say with certainty that this mercury falling from the air is the same mercury that is transformed to toxic methyl mercury and finds its way into the food chain of lakes and rivers. Many natural soils also contain small amounts of mercury. Perhaps the mercury contaminating fish is coming from the soils in the drainage basins of the lakes.

Governments in the United States and Canada would like to reduce mercury contamination of fish, and are recommending that emission controls be placed on the smokestacks of large power plants to remove mercury before it is released to the atmosphere. While this seems like a wise requirement, it would cost billions of dollars to implement, and there is no scientific certainty that this measure would have any effect on the mercury contamination of fish. Before implementation of this costly initiative, a special experiment should be carried out to test whether mercury falling from the air actually finds its way into fish. The Experimental Lakes Area is the best place in the world to do this experiment.

The ELA Advantage

Mercury is falling from the air at the ELA, but the amount falling is much lower than in eastern North America or Europe. Over the past decade, scientists have been studying how the mercury in small watersheds at the ELA is methylated by bacteria and moves into the food web. This experience, combined with the decades of background information collected on ELA lakes and watersheds, makes ELA the ideal site for seeking the vital link between mercury deposition and the methyl mercury in fish. Now, ELA scientists have gathered a large, international research team dedicated to examining whether the source of this mercury can be linked with certainty to the burning of fossil fuels and atmospheric fallout.

This scientific team is planning a unique experimental study called METAALICUS (Mercury Experiment To Assess Atmospheric Loading In Canada and the United States). It will be conducted in the watershed of ELA Lake 658, beginning in the spring of 2001. The research team is proposing to spray tiny quantities of three different chemical forms of mercury from the air on to different portions of this small (60 ha) watershed. These different chemical forms can then be distinguished using a sensitive laboratory instrument (a mass spectrometer), and can be traced as they move through the ecosystem.

Tracing the Missing Link

In the ELA experiment, one form of mercury will be sprayed over the forested part of the watershed. A second form will be sprayed on a small wetland draining into the lake. The third form of mercury will be sprayed directly on the lake surface. The total mercury experimentally added in a year to the whole Lake 658 watershed will be less than 35 grams, or about a teaspoonful. This added mercury will increase the natural loading of mercury to the lake by about four times, raising it to levels similar to those in eastern North America. We anticipate that these additions will be repeated for three years, after which they will cease. Monitoring will continue after the additions cease, however.

The scientific team will carefully monitor the movement of mercury within the treated forest, wetland and lake, tracing the formation of methyl mercury and its movement into and up the food chain of the lake. Eventually, we expect to see some of the added mercury reaching the fish and becoming concentrated in their bodies. Using the mass spectrometer, we will be able to tell whether any of the methyl mercury in the fish came from mercury that we sprayed on the watershed, and, if so, from which portion(s) of the watershed it came.

International Effort

Because of the importance of this experiment, funding is being provided by a number of governmental and non-governmental sources in both Canada and the United States. The research team consists of scientists from the Freshwater Institute (Fisheries and Oceans Canada), from several Canadian universities (Alberta, Trent, Toronto), from government agencies in the U.S. (United States Geological Survey, Academy of Natural Sciences, Oakridge National Laboratory), from the University of Wisconsin, and from a large private consulting firm (Tetra Tech). An international advisory panel for the study consists of senior scientists from Sweden, the U.S. and Canada. Dr. John Rudd of DFO and Reed Harris of Tetra Tech Inc. are coordinating the METAALICUS study team.

Facility Renewal Continues

The ELA field station has operated for 31 years. When the facility was originally constructed, few envisioned the impact that the ELA program would have on freshwater research. Many of the buildings were mobile trailers with a relatively finite life expectancy. Three decades later, the original facilities are being replaced or upgraded to meet current requirements.

In 1999, the first phase of a new laboratory complex was completed. This building now houses the water chemistry laboratories, a "clean room" laboratory for measuring extremely low levels of mercury contamination, and several other laboratories. At present, architects and engineers are completing the final plans for phase two of this complex. This will add more biological laboratories and field offices , bringing the total size of the building to approximately 630 m^2. An unfinished lower level will provide much needed storage space and the possibility of future labs for fish researchers.

A view (left) inside the chemistry laboratory in phase I of the new complex as it neared completion last year. These new facilities meet all current health and safety standards and will greatly improve our capacity to continue doing "world class" science at the Experimental Lakes Area.

Discovery Channel Crew Visits ELA

Last September, a crew from the Discovery channel visited the ELA to shoot footage for a segment of their science magazine program, *@discovery.ca.* The segment aired in early October.

The item focused on work conducted at the ELA over the past decade to examine the effects of flooding caused by reservoir creation. In Canada, most of our large northern reservoirs are constructed primarily for hydroelectricity generation. Some of them, particularly those in the Precambrian Shield, flood large areas of forested land and wetland. We know that flooding caused by reservoirs can increase the production of both methyl mercury and greenhouse gases. Scientists at the ELA have been working to understand these processes and to quantify the potential negative impacts of reservoir creation.

The Discovery Channel segment highlighted this ELA research, with particular focus on the ELARP and FLUDEX studies. These studies have experimentally flooded wetland and forested upland systems at the ELA and are producing information that is now becoming of interest worldwide.

Joint Agreement Updated

The ELA operates under a joint agreement between Canada (Department of Fisheries and Oceans) and Ontario (Ministries of Natural Resources and Environment). A tripartite management board oversees the operation and is responsible for ensuring that the research and other operations are conducted according to the terms of the agreement and all applicable legislation and regulations. This agreement has just been updated to better reflect current operating requirements.

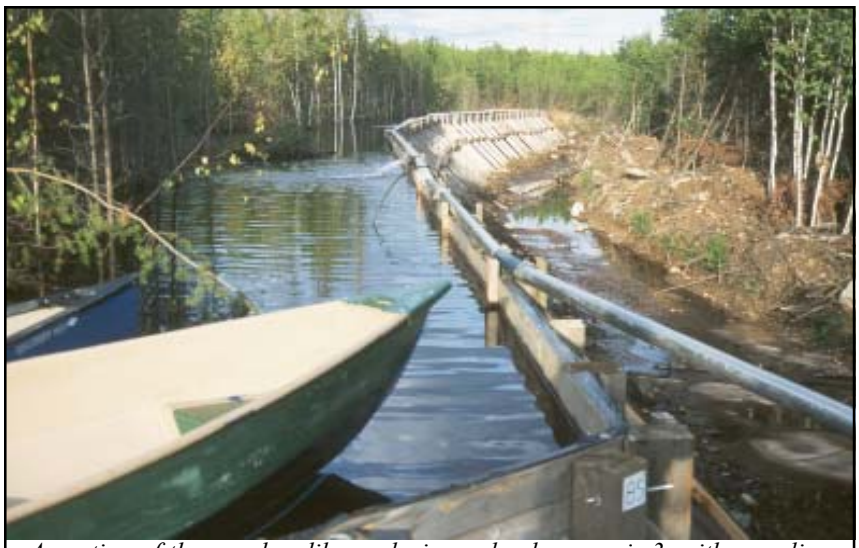
As part of this agreement, Canada must ensure that experimentally-manipulated ecosystems recover to natural conditions after the manipulations are discontinued. If natural recovery is expected to take longer than ten years, Canada must employ remediation measures to augment this recovery. For this reason, we continue to monitor experimental systems after the experiments end. Our experience to date shows that these lakes have an amazing ability to recover once the manipulation stresses are removed. In almost every instance to date, the systems have recovered to natural conditions within a few years.

Research '99 Review

1999 was a busy year at the Experimental Lakes Area. Approximately 300 different individuals visited the site during the year and logged over 7000 person-days of on-site activity. Several dozen research projects were underway, ranging from monitoring of lake recovery from acidification to graduate student thesis research on ultraviolet light impacts to pilot studies on hormone mimics to experimental flooding of ridge-top forest. A few of the major projects are summarized below. For a more complete summary of these projects, you can consult the ELA web site at *www.umanitoba.ca/institutes/fisheries/ELARes99.html*.

FLUDEX

The largest and most spectacular research study underway last year at the ELA was FLUDEX, or FLooded Upland Dynamics EXperiment. Three diked enclosures had been constructed the previous year (see ELA NEWS, volume VI(1)), each designed to impound about 0.7 ha (almost 2 acres) of water at depths up to 2 metres. What makes these enclosures unusual are their locations atop a granite ridge separating Lake 239 from Roddy Lake. In May of 1999, these enclosures were sealed to the bedrock and a diesel-powered water pump was installed at Roddy Lake. Beginning in mid-June, the pump was started and water was forced uphill to begin filling the three enclosures and flooding the soils and forest cover contained within them. The concept is to simulate the edges of large northern reservoirs where flooding invades forested upland areas.



A portion of the wooden dike enclosing upland reservoir 3, with sampling boats floating on the reservoir surface. The water at this location is approximately two metres deep. The pipe running along the top of the dike carries water pumped from nearby Roddy Lake to keep the reservoir filled.

The pump was operated nonstop until early October, maintaining water levels and continuously flushing the new reservoirs. Coordinated by Dr. Drew Bodaly, a team of researchers from DFO, the Universities of Alberta, Waterloo, Manitoba and Wisconsin, and the United States Geological Survey monitored the physical, chemical and biological processes in these experimental systems. Many of them focused on measuring the production of methyl mercury and its movement into the food webs of these reservoirs. Others measured the production and release of carbon dioxide and methane, both greenhouse gases, from the decomposition of flooded vegetation and soils. While results are still preliminary, it appears that flooded upland forest sites are able to produce significant amounts of both methyl mercury and greenhouse gases. The flooding and monitoring will continue for at least two more seasons to determine whether this pattern continues or abates with time.

Much of the funding for this study has been provided by Manitoba Hydro, with assistance from Hydro Quebec, the Environmental Science Strategic Research fund of DFO, and NSERC.

Climate Change and UV Radiation

David Schindler was the longtime head of the ELA and is now Killam Professor at the University of Alberta. For several years now, his students have been studying the impacts of climate warming and increased ultraviolet

radiation (UVR) on small lakes and streams at the ELA. During the summer of 1999, students Marguerite Xenopoulos, Suzanne Tank, and Rod Hazewinkle carried out a variety of experiments to examine the impacts and interactions of climate change and UVR on the plankton and other aspects of boreal lake food webs. It is now clear that the combined effects of several stressors (*e.g.* climate warming, UVR and acidification) can greatly increase the level of impact on these ecosystems. Schindler has publicized widely these results

Another group of researchers from the University of Winnipeg are also carrying out an experimental study to investigate the impacts of UVR on the near-surface communities. This study is expected to continue for at least one more year.

Acidification Recovery

For many years, researchers at the ELA conducted experimental studies of lake acidification. The last of these studies, which we began in 1982, involved gradual lowering of the pH in the south basin of Lake 302. By the early 1990's the lake had been at pH 4.5 for several years, and much of the food web had been damaged or altered. We then began a gradual recovery of this system, reducing or eliminating the acid being added and allowing natural recovery to proceed. By 1999, the lake pH was at 6.1 and a special allocation of funds from Environment Canada allowed us to continue monitoring the recovery. Some fish species have returned to the lake, and it is slowly regaining its health. While funding for this work remains difficult to obtain, many questions remain about the ability of lakes in eastern North America to recover from the stresses of acid rain.

Special Visitors to the ELA

Workshop on Algae

Last fall, we welcomed more than 30 scientists from various parts of the world who arrived at the ELA for a week-long workshop on algae, particularly blue-green algae, or Cyanophytes. Between September 11th and 16th, these folks collected algal samples from every imaginable water body and wet spot within hiking distance of the ELA field station. The group included some of the world's top authorities on freshwater algae, plus students eager to learn from these experts. Since their visit, these scientists have been busy writing research papers to describe some of the new species they discovered in northwestern Ontario.

First Nations Students

Immediately after the algologists left, we welcomed the 1999 class from the Centre for Indigenous Environmental Resources in Winnipeg. The dozen First Nations students from across Canada spent two weeks at the ELA participating in a hands on course on environmental monitoring. Dr. Trish Sellers and Ian Davies, both former ELA researchers, were the primary instructors. Sonny Flett, from northern Alberta, provided instruction on traditional knowledge. Barry Corbett from Kenora plus ELA staff Mike Stainton, Ken Beaty and Mark Lyng, also instructed the students.

Provincial Resource Managers

In early October, the ELA hosted a working meeting of the Northwest Ontario Fisheries Task Group. Fisheries biologists from across the region had an opportunity to visit the ELA, tour some of the research sites, and hear talks by ELA staff. The meeting provided an excellent opportunity to share ideas and discuss possible future collaboration.

At the same time, Ontario members of the ELA Management Board met at the ELA to tour the site and discuss new research initiatives. Frank Wilson, the OMOE Director for Northern Ontario, also attended and participated in the site tours.

Participants in the international workshop on algae held at the ELA in September. The group included scientists from Austria, the Czech Republic, France, Germany, Italy, Russia, Spain, Sweden, the U.S, and Canada.

Community Outreach

Visit ELA on the Web: www.umanitoba.ca/institutes/fisheries

Home and Leisure Show

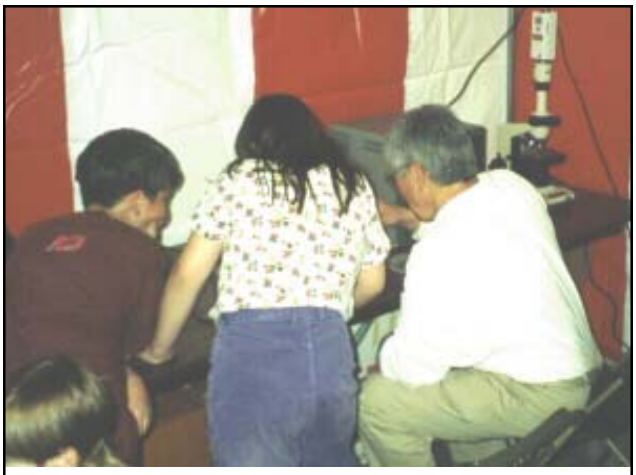
ELA staff will be hosting a booth at the annual Home and Leisure Show in Kenora, April 14-16. If you are attending, stop by and say hello. We plan to have interactive displays illustrating some of what we do. Unfortunately, the dates for this show conflict with the Dryden Sportsman's Show. We hope to have at display booth in Dryden next year.

Public Information Meetings

We recognize that the work we do at the ELA is often poorly understood, or even misunderstood, by those who are not scientists. At the same time, we realize how important it is for members of the Canadian public, and particularly residents of northwestern Ontario, to know more about our research and the potential benefits that can come from it. Therefore, we are always looking for ways to improve communications with our local community in the Kenora/ Dryden region.

For this reason, we are arranging two public information meetings for late May of this year, and are inviting all interested members of the public to attend if they can do so. The first of these meetings is scheduled for Wednesday, May 24th, in Dryden. It will be held in the banquet room at the Riverview Lodge between the hours of 6:00 pm and 9:00 pm. The following evening, Thursday, May 25th, we will be holding a similar event in the Cascade Room of the Lakeview Inn, also between 6:00 pm and 9:00 pm.

Each of these evenings will be run with an "open house" format. Interested members of the community may drop by at their leisure to view displays and talk with ELA researchers about their work. We will be highlighting three major research projects: the upland flooding (FLUDEX) study, the estrogen addition (Hormone MIMIC) study, and the mercury addition (METAALICUS) study (see also article beginning on page 2).



Alex Salki (right) helps young visitors at an ELA display to identify tiny aquatic animals by using a microscope.

Of course, some of you may wish to actually visit the ELA and see first-hand some of what we are doing. While we don't have any full-time tour guides, we do attempt to accommodate requests for group tours whenever possible. For Example, we are planning to host a visit by the Kenora Bass Club in May and a visit by the Dryden Local Citizens Advisory Committee is also planned. If you belong to a group that would like a tour, please contact John Shearer at the address below.

High School Activities

John Shearer, ELA Senior Biologist, instructed at a workshop for students from Kenora, Dryden and Red Lake who are planning to participate in the Envirothon competition this spring. The workshop was held at Blue Lake Park last September. John provided several interactive displays on aquatic ecosystems and gave the students an opportunity to try some sampling equipment.

In early October, Kathy Boone from Dryden High School brought a busload of science students to the ELA for a day tour. Following an introductory talk, the students toured the field station , the weather station, and one of the experimental reservoirs constructed for the upland flooding (FLUDEX) study.

Anyone wishing to learn more about the ELA is invited to contact

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