ELA UPDATE

Newsletter of the Experimental Lakes Area

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What's Inside?

Research to Protect Fish Habitat and Lake Ecosystems

ELA Update

April 2002

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 ninth year that one or more such newsletters has been produced and distributed.

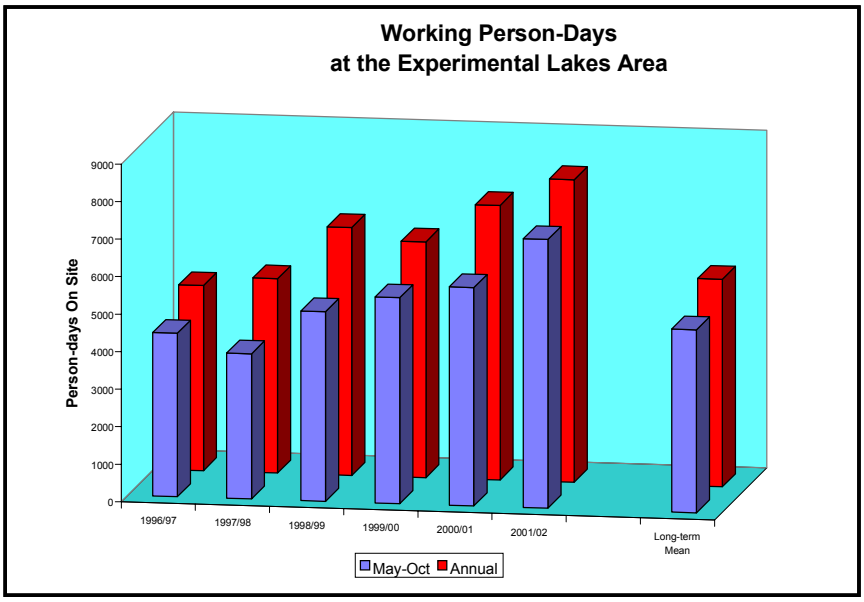
The **cover photo** of this edition shows an aerial view of ELA Lake 658. It is the site of the METAALICUS study (see page 3), which involves the largest team of researchers ever assembled for an single research project at the Experimental Lakes Area.

These small ELA lakes have small populations of larger fish species. By live-trapping and tagging them, then returning these fish to the lake, we can study their recruitment, growth, and survival without reducing their numbers. Public angling in these lakes would reduce these populations and make interpretation of our studies very difficult. For this reason, angling is prohibited in many of the designated research lakes.

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.

ELA Research Activities at an All-time High

As the Experimental Lakes Area enters its 35th field season, the facility is experiencing the most activity ever. In 2001, field station accommodations were often stretched to their limits as researchers from across North America worked on a number of projects, both new and old. This resulted in record numbers of people on site (see the graph below). All indications are that on-site activities in 2002 will also be at, or near, record levels.



Most of this increased activity can be attributed to three major experimental studies. One of these, the Flooded Upland Dynamics Experiment, or FLUDEX, has been ongoing for several years, and is examining the production of methyl mercury and greenhouse gases in flooded, upland sites. A new experiment in 2001 is testing the effects of trace amounts of synthetic estrogen on the reproduction of invertebrates, amphibians, and fish.

Another new study is examining the linkages between the mercury that falls from the sky and the toxic methyl mercury found in many fish. Dubbed METAALICUS (Mercury Experiment To Assess Atmospheric Loading In Canada and the United States), this study is the largest and most costly single experiment ever undertaken at the ELA. Researchers from DFO, the U.S. government, several private companies, and at least six Canadian and U.S. universities are participating. This study alone represented about one-third of the total activity in 2001.

All three studies are continuing in 2002. In addition, background work is expanding in preparation for the next new ELA experiment, scheduled to begin in the spring of 2003. This project will investigate the impacts of a commercial aquaculture operation on a lake ecosystem.

Does the Mercury Contamination in Fish come from the Air?

All across Canada, even in remote lakes, large, predatory fish contain high concentrations of toxic methyl mercury. The *Guide to Eating Ontario Sport Fish,* produced by the Ministry of Environment, which gives consumption advisories for hundreds of lakes across the province, indicates that mercury is responsible for 99% of the advisories listed for inland lakes. Humans eating too much of these fish run the risk of mercury poisoning. What is the source of this mercury, particularly in remote lakes? Is it naturally occurring in the soils and bedrock, or are human activities to blame? Researchers at the ELA are attempting to answer this important question.

We know that humans are burning large quantities of coal and other fossil fuels, which contain trace amounts of mercury. During the combustion of these fuels, the mercury is released to the atmosphere and gradually drifts downwind with weather systems. Eventually, it falls back to earth. Everywhere on the planet, we can measure mercury falling from the sky. However, until now it has not been possible to demonstrate whether a clear link exists between the mercury falling from the sky and the mercury found in fish. If such a linkage can be proven, regulators in both Canada and the United States are prepared to require large combustion facilities to remove this mercury at the source, before it is released to the atmosphere. However, this would cost billions of dollars to carry out, and there is understandable reticence to proceed without direct evidence that such action would reduce mercury levels in fish. The ELA is the ideal place to look for this evidence.

A research team from Fisheries and Oceans Canada, plus six universities, three U.S. government agencies, and several private companies, has been assembled to carry out this investigation. This team includes experts on mercury in both aquatic and terrestrial environments. The study has been named METAALICUS, an acronym for the Mercury Experiment To Assess Atmospheric Loading in Canada And the United States. After three years of planning, collecting background information, and conducting pilot studies, the team received final approval to proceed with the main experiment in 2001.

Beginning last May, ELA researchers applied minute amounts of new, traceable mercury to small Lake 658 and to the land draining into this lake. Because the instruments used for detecting this special mercury are so sensitive, very little of it need be used. A fraction of a teaspoonful was diluted in hundreds of litres of water, then sprayed from a crop duster aircraft over the forested upland surrounding the lake. An even smaller amount was sprayed over a small wetland draining into Lake 658. Another fraction of a teaspoonful was added directly to the surface of the lake at regular intervals over the course of last summer. A similar amount of this mercury will be added in 2002.

A "crop-duster" type aircraft applies a dilute solution of new mercury to the forested upland around Lake 658 in May 2001. In concentrated form, the total mercury experimentally added to the watershed would fit in a thimble.

Using sophisticated instruments called mass spectrometers, the scientists, who come from across

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Tara Trinko, a technician from Wisconsin, samples Lake 658 for mercury content. The mercury levels are so low that samplers must wear "clean" clothing and gloves to avoid introducing any contamination that would ruin the samples.

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North America, are tracing the movement of this newly deposited mercury through the ecosystem and into the food web of the lake. Because this form of mercury does not normally occur in nature, any found in the Lake 658 food web, including in the fish, will have come from the experimental additions. If this newly deposited mercury is found in the fish of Lake 658, it will be clear evidence that mercury from the sky can rapidly become toxic mercury in fish.

In effect, the experiment is simulating what would fall on this small system if it could be moved to New Brunswick for two or three years. Compared to the amount of mercury already present in northwestern Ontario watersheds, the amount being experimentally added is very small.

Because so little of this new mercury is being added, we expect that none will be detectable downstream. Nonetheless, the researchers are monitoring downstream to ensure that no impacts occur.

We should begin to see definitive results from this study within the next year.

We Can't Do it Alone!

Fisheries and Oceans Canada has many partners for conducting research studies at the ELA. Here is a list of most partners in 2002.

Ont. Min. of Natural Resources
Ont. Ministry of Environment
Environment Canada
Univ. of Alberta
Univ. of Manitoba
Okanagan University College
Univ. of Quebec
Univ. of Regina
Univ. of Saskatchewan
Univ. of Toronto
Trent University
University of Waterloo
Manitoba Hydro
Hydro Quebec
Ontario Aquaculture Association
Tetra Tech Inc.
Flett Research
LimnoTech
U.S. Environ. Protection Agency
Oak Ridge National Laboratory
Nat. Acad. of Science, Maryland
United States Geological Survey
University of Maryland
University of Wisconsin
Electric Power Research Inst.
Chemical Manufacturers Assoc.

What Causes Male Fish to Produce Eggs?

Downstream from some urban centres, particularly in heavily populated parts of Europe, fisheries scientists have been discovering male fish that are producing eggs rather than sperm. What on earth could be causing this to happen? A new ELA experimental study, headed by research scientist, Dr. Karen Kidd, is investigating this phenomenon.

Many natural life processes, including reproduction, are controlled by chemical substances called hormones. Many chemicals produced by humans are similar to, and can mimic, natural hormones. One such chemical, ethynylestradiol, or EE2, is a synthetic estrogen used in birth control pills, where it is intended to mimic natural estrogen. Women who use the birth control pill excrete this estrogen in their urine. Unfortunately, it is not broken down in most sewage treatment systems. As this estrogen is released from treatment plants, low concentrations build up in downstream waterbodies. In these waterbodies, male fish are being feminized, and some are actually producing eggs.

The ELA study is designed to simulate these low estrogen concentrations in a natural lake that is not subject to other human contaminants. Beginning in May of 2001, the research team began adding estrogen to ELA Lake 260 in order to maintain a minute concentration of about 6 parts per trillion in the lake water. This treatment will be continued in 2002.

The scientists studied the fish and other creatures in this lake for two or more years prior to beginning the estrogen additions. They are continuing to monitor populations of algae, invertebrate animals, frogs, and fish in the lake to determine if the low estrogen concentration will begin to have effects on their normal condition, and particularly on their ability to reproduce successfully.

Technician, Kasia Dyszy, adds estrogen solution to Lake 375. This process is repeated regularly to maintain a target concentration of 6 parts estrogen per trillion parts lake water. Half of the estrogen breaks down every two weeks.

Photo: Karen Kidd

Research '01 Review

The METAALICUS and estrogen studies (see pages 3 and 5), were not the only research projects at the ELA in 2001.

Dr. Drew Bodaly and his team were continuing to flood upland forest and wetland sites to simulate and investigate the effects of reservoirs in the Boreal Shield. Dr. Michael Turner was continuing to investigate the long-term, natural recovery of experimentally acidified Lake 302. Dr. Ken Mills and his team were following the recovery of fish populations that were impacted by removing half the rooted aquatic vegetation ("weeds") from Lake 191. Small groups from Okanagan University College and the University of Regina were looking at other aquatic issues. Other researchers continue to use the ELA's long-term monitoring records to understand the implications and predict the impacts of climatic change.

In addition, DFO scientists began to collect baseline data on Lake 375 and two other lakes in preparation for a proposed aquaculture study, which, if approved, will commence in 2003.

Here are a few of the highlights from major studies.

FLUDEX

This study is investigating how the flooding of upland vegetation and soils can affect production of both methyl mercury and greenhouse gases. It attempts to simulate what happens along the edges of large hydro reservoirs that flood boreal forest.

Three small reservoirs have been constructed on forested upland sites. For the third year, these reservoirs were continuously flooded from June to October, 2001. While production of both methyl mercury and greenhouse gases continued, the rates of production now seem to be dropping off.

A fourth season of flooding is planned for 2002, with researchers continuing to monitor these systems. Major funding for this project comes from Hydro Quebec, and from Manitoba Hydro, which is already using knowledge gained to assist in planning for its future projects.

The Importance of Aquatic "Weeds"

Most cottage and home owners with shoreline property find large aquatic plants to be a nuisance. They wind around boat propellers and can tangle the legs of swimmers. Often, such plants are referred to as "weeds" and removed from the nearshore areas.

However, as an ongoing study at the ELA shows, these "weeds" can be important habitat for certain fish species and other aquatic animals. The removal of these plants in large numbers can dramatically alter the balances of fish populations. When we removed half the nearshore plants in Lake 191, the number of pike in the lake dropped significantly. At the same time, numbers of perch and pumpkinseed skyrocketed. Now, after several years of recovery by the plants, the population of pike seems to be recovering. We will continue to monitor the lake to determine the final results of this study.

Acidification Recovery

While acid rain no longer attracts much media attention, it continues to be a serious problem for many lakes in eastern Canada. At the ELA, with support from Environment Canada, we continue to follow the natural recovery of lakes that we experimentally acidified during the 1970's and 1980's. The information being gained is invaluable for managers trying to assess the future of thousands of lakes in acidified regions.

Our studies show that acidified lake ecosystems can recover naturally, if we stop the input of acid. However, it can take many years, particularly if a lake ecosystem has been badly damaged. Biological recovery is very complex, and the resulting food web will probably differ from that present prior to acidification.

Freshwater Aquaculture

Around the world, many natural fish populations are declining and the fisheries that depend on these populations are in trouble. This has led to increased interest in aquaculture, or fish farming. Most aquaculture is conducted in marine systems, but there is an expanding interest in freshwater aquaculture in some of the Great Lakes, and potentially in smaller inland lakes.

While regulators recognize that aquaculture can have adverse impacts on lakes, they do not have enough specific information to establish appropriate regulations for the environmentally safe operation of this industry. A new study at the ELA is intended

to provide some of this information.

Coordinated by DFO's Dr. Cheryl Podemski, in close cooperation with the Ontario Aquaculture Association, the study will involve the installation of a caged aquaculture facility in Lake 375 at the ELA. This facility will be run by a commercial operator, using standard commercial techniques and guidelines. DFO and partner researchers will monitor the facility, watching for possible impacts on the lake ecosystem, including native fish populations.

The cage aquaculture facility is expected to operate for two years, but monitoring will continue for a longer period.

Long-Term Monitoring

While it does not involve the attention grabbing experiments that many of the other ELA studies do, our Long-Term Ecological Monitoring (LTER) project has become an important part of the ELA research program. Headed by Susan Kasian, our database manager and chief data analyst, the LTER project has been formalized in recent years.

It now focuses primarily on five lake ecosystems; namely Lakes 114, 224, 239, 373, and 442. These are natural lakes which have never been experimentally manipulated. The data collected, now for up to 33 years in duration, are used to assess natural variability and effects of climatic change, and as references for the experimental studies.

More detailed summaries of ELA research activities in 2001 and previous years are available on line at *www.umanitoba.ca/institutes/fisheries/resact.html*.

Lake 239, or Rawson Lake, has been monitored as a reference system since 1969. The meteorological site (lower left) and field station are in the basin..

Federal/Provincial Management Board Oversees ELA Operations

The Experimental Lakes Area is operated by Fisheries and Oceans Canada, from the Freshwater Institute in Winnipeg. However the ELA operations are subject to a Canada/Ontario Memorandum of Agreement. The current version of this agreement was implemented in 1993, and amended in 2000. A joint federal/provincial management board is appointed to oversee the ELA operations and ensure that they meet the terms and conditions of the agreement.

The parties represented on this board include Fisheries and Oceans Canada (DFO), the Ontario Ministry of Natural Resources (MNR), and the Ontario Ministry of Environment (MOE). Currently, the Board is chaired by John Shearer of DFO. Other DFO representatives are Dr Drew Bodaly and Terry Shortt from the Freshwater Institute. The senior MNR representative is Bob McColm, District Manager in Dryden. Other MNR representatives are Tom Mosindy and Barry Corbett from the Kenora District. Scott Ellery from Ontario Parks also sits on the Board. MOE's senior representative is Dave Hollinger from the Northern Ontario regional office in Thunder Bay. Dr. Keith Somers, from the Dorset Environmental Research Centre, and either Drew Stajkowski or John Barr from the Kenora office also represent MOE.

Among the primary responsibilities of the Management Board is to review research proposals for new, ecosystem-scale, experimental studies, and to either approve or reject them. All three agencies must be convinced that a new study is scientifically important and that it will not cause irreversible harm to the environment. Otherwise, it will not be approved. The Government of Canada (DFO) must ensure that any manipulated study site returns to a healthy, natural state within a ten-year period after a manipulation ends. Otherwise, action must be taken to rehabilitate the site.

Community Outreach

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

ELA Open House Planned

We are planning an "open house" event at the ELA for persons in the Kenora/Dryden region. The event would be held on a Saturday in early September. Buses would transport people from Dryden/Vermilion Bay and from Kenora to the ELA in the morning, returning in the afternoon. ELA staff would provide demonstrations and site tours for the visitors. If you are interested in participating, contact John Shearer (see below, right).

Public Tours and Talks

In August, 2001, Junior Rangers from Kenora and Dryden toured the ELA under the guidance of longtime staffer, Ken Beaty.

On September 20 and 21, teacher Richard Zuk and a group of his senior students from Springfield Collegiate in Oakbank, Manitoba, visited the ELA. They had an opportunity to do some lake sampling and analyze their samples in the lab.

A long-planned visit to the ELA by members of the Dryden Conservation Club also came to pass in September. Sandy Chalanchuk and Doug Allan were able to give the group a demonstration of live trapping and tagging of fish (see photo, this page). The group also toured the station and some of the accessible field sites.

Eric Sallow, who teaches at Queen Elizabeth High School in Sioux Lookout, brought a group of his senior students to the ELA in October. The following day, a busload of students from Beaverbrae Secondary School in Kenora, led by teacher Rob Madden, arrived on a day tour. Both groups were able to tour the field station and see a few of the research sites close to the road.

Doug Allan (left) explains a fish tagging demonstration to a tour group from the Dryden Conservation Club

Web Site Use Continues to Grow

The ELA web site (see the URL, above) contains a wealth of information about the Experimental Lakes Area, its history, facilities, and activities. During the past year, the level of visitation to this web site has continued to increase steadily, an indication that more and more people are finding something of value at the site. While some of the information is technical, much is suitable for a general audience.

An Electronic Newsletter

With the increasing number of people who are connected to the Internet , we have made our *ELA Updates* available via electronic means. While we will continue to provide a paper newsletter to those who are not "wired", anyone wishing to assist us in saving paper and postage can receive the same information electronically.

This issue of *ELA Update* is now available, in colour, in Adobe PDF format on our ELA web site. You must have the free Adobe Acrobat Reader installed on your computer. Just go to the ELA newsletters page (*www.umanitoba.ca/institutes/fisheries/newsletters.html)*, then click on the appropriate hot link.

If you no longer wish to receive the paper version of *ELA Update*, please send an e-mail message to John Shearer (ShearerJ@dfo-mpo.gc.ca) indicating this. You will be removed from our mailing list but can still access the electronic version on the web.

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