

ELA Scientific Milestones and Highlights

Since its official beginnings in 1968, the Experimental Lakes Area (ELA) has been an international leader in aquatic ecosystem science. The following are some of the highlights of this proud history, listed in approximate chronological sequence.

1967

Technicians Tom Cleugh and Brian Hauser from the Freshwater Institute survey more than 400 small lakes in a wilderness area east of Lake of the Woods in northwestern Ontario. This initial helicopter survey provides information for selecting the Experimental Lakes Area research watersheds.

Dr. Jack Vallentyne continues to assemble an international team of researchers at the Freshwater Institute in Winnipeg to address the eutrophication problem, with the planned ELA as a site for controlled, ecosystem-scale, experimental studies.

1968

ELA field research begins, under a multidisciplinary team of scientists based at the Freshwater Institute in Winnipeg. Scientists have been recruited from Canada, U.S.A., Britain, Italy, Norway, Sweden, Poland and Japan.

The new ELA operating agreements, between the Fisheries Research Board of Canada and two forestry companies, Dryden Paper and Ontario-Minnesota Pulp and Paper, provide unique natural laboratories dedicated to experimental research.

Under the leadership of Dr. David Schindler, approximately 40 small lakes north of Dryberry Lake, northwestern Ontario, are monitored from a temporary field camp at Lake 132.

1969

The permanent field station on Lake 239 becomes operational. A year-round meteorological station is established which provides daily meteorological data on a range of parameters. It eventually becomes a key reference station for many national and international climate and atmospheric pollution monitoring networks.



Workers install a field laboratory at the ELA field station in the spring of 1969, the first year of operation for the present field station.

First ELA whole-lake fertilization experiment begins in Lake 227. It quickly demonstrates that additions of phosphorus and nitrogen, without carbon, can cause eutrophication of a boreal lake.

1970

Radium addition to Lake 227 to measure gas exchange between lake and atmosphere. This demonstrates that carbon dioxide from the atmosphere can diffuse into lake water rapidly enough to provide carbon source for eutrophication. It also marks the beginning of a long and profitable collaboration with the Lamont Doherty Geological Observatory of Columbia University.

Experimental carbon additions, along with phosphorus and nitrogen, begin in Lake 304. This demonstrates that added carbon does not enhance algal growth beyond that caused by phosphorus and nitrogen additions.

Studies in experimental mesocosms investigate the environment impacts of DNA, touted as a possible substitute for phosphate in detergents.

1971

Five cabins are constructed to provide on-site living accommodations for families of researchers, thereby encouraging scientists and other researchers to spend more time at the ELA. Dining facilities are enlarged to accommodate the increased numbers of researchers.

First special volume of research papers from the ELA published in the *Journal of the Fisheries Research Board of Canada*, Volume 28(2).

1972

A "permanent" laboratory building and a new 8-bedroom residence are opened, greatly improving the available facilities and accommodations for researchers.

Experimental injection of phosphorus, nitrogen and carbon to the deep waters of Lake 302 North. This demonstrates that deep injection of nutrients can minimize eutrophication effects.

1973

Double-basin eutrophication experiment [C, N, & P versus C & N only] begins in Lake 226. Aerial photographs of the lake following nutrient additions vividly show surface bloom only in basin receiving phosphorus, thereby demonstrating the essential role of phosphorus in promoting eutrophication. These photographs have a clear impact on the public, on legislators and on other decision makers.

Second special volume of ELA research papers published in the *Journal of the Fisheries Research Board of Canada*, Volume 30(10)

1974

Delegates to the 19th Congress of International Limnological Society, meeting in Winnipeg, pass a resolution calling for regulation of phosphorus inputs to lakes as a control for eutrophication. Passage of this resolution is spurred by visual evidence from ELA Lake 226 Experiment

Background studies begin in preparation for first whole-lake acidification experiment, five years before "acid rain" becomes a hot topic in North America.

An unplanned experiment (forest wildfire) provides opportunity to demonstrate effects of forest fire on small boreal watersheds.

1975

A reduction in the ratio of nitrogen to phosphorus added to Lake 227 demonstrates that nitrogen-fixing blue-green algae can dominate the algal community and capture additional nitrogen from the atmosphere. These nitrogen fixing algae cause eutrophic surface blooms on lakes.

Radio-tracer studies in several ELA lakes quantify the rapid rates of horizontal mixing and the extremely low rates of vertical mixing through the thermoclines (temperature discontinuities) of these small lakes.

Studies of chemical concentrations and diffusion rates at the sediment/water interface of these lakes identify the importance of this zone to chemical cycling within lakes.

A two-week experimental field course is held at the ELA for about 20 selected graduate students from North America and Europe. Many of these students have since gone on to direct major research and management programs in aquatic sciences around the world.

1976

First whole-lake acidification (sulfuric acid) experiment begins in Lake 223. It quickly demonstrates the inherent natural buffering capacity of these lake systems, as more acid than anticipated is needed to lower the pH.

1977

Whole lake radio-tracer study delineates the cycling pathways and fate of metals within lakes and their biota.

1978

Whole-lake radio-carbon addition in Lake 226 delineates the cycling pathways of carbon within the lake ecosystem.

1979

Internal generation of alkalinity by sulphur bacteria in the sediments of Lake 223 is identified. Eventually, this is shown to be a characteristic of lakes in other parts of the world as well. It demonstrates the ability of lakes to recover naturally from moderate acidification.

Disappearance of species from acidified Lake 223 at pH levels above 5.5 alerts researcher to the fact that lake acidification can have serious impacts at relatively high pH.

1980

Another wildfire provides a second stage of the forest fire effects experiment in the Lake 239 watershed. A relatively minor and short-term effect is observed in the lake. Stream effects last two to three years.

Third special volume of ELA research papers is published in *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 37(3).

1981

Increasing pelagic algal productivity is observed in acidified Lake 223 as pH drops to 5.0. This shows that lake acidification does not result in immediate oligotrophy.

Other species have disappeared from Lake 223 and both lake trout and white suckers have ceased successful reproduction in the lake.

1982

Photograph of starving lake trout in Lake 223 (pH 5.1) vividly demonstrates that even moderate acidification can have a profound effect on the lake food chain and on the top predator species.

The second major lake acidification experiment begins in Lake 302. The south basin receives controlled additions of sulfuric acid, while the north basin receives approximately equivalent additions of nitric acid.

1983

Lake trout and white sucker populations in Lake 223 are not reproducing and are in danger of extinction if acidification continues at present level (pH 5.1).

Eutrophication recovery studies in Lake 226 indicate that the lake has quickly returned to water quality conditions similar to pre-fertilization.

A new ELA agreement is signed between Fisheries and Oceans (Canada) and the Ontario Ministry of Natural Resources. This agreement supercedes the original 1968 agreements between Canada and the local forestry companies.

1984

Decision is made, using Lake 223, to simulate the effects of a reduction in sulphur emissions to the atmosphere. Controlled recovery of Lake 223 begins. pH is permitted to rise to 5.4. Internal alkalinity generation causes pH to rise rapidly as acid input is reduced. White suckers resume reproduction. Adult lake trout regain a major food source and their condition improves markedly.

Information about ELA experimental acidification studies begins to attract media attention. *The Nature of Things* and *Nova* do television segments on ELA acidification research.

1985

Experimental acidification of the Lake 239 wetland continues. Simulated acid rain is periodically sprayed over the wetland. Effects on vegetation and water chemistry are monitored. The potential is discovered for acidified wetlands to rel cause acidification of downstream lakes during high flows.

David Schindler is awarded the prestigious Hutchinson Medal by the American Society of Limnology and Oceanography for his contributions to aquatic science.

ELA acidification studies are intensively documented and receive considerable attention at the International Symposium on Acidic Precipitation, held in Muskoka, Ontario. Eight ELA research papers are published in the symposium proceedings (*Water, Air and Soil Pollution*, Volume 30).

A paper by Schindler *et al.*, published in *Science*, Volume 228, documents the long-term ecological effects of acidification in Lake 223.

1986

Ongoing acidification studies in Lake 302 demonstrate that both sulfuric and nitric acids are potent acidifiers of lakes. Nitric acid is shown to be approximately 70% as effective as sulfuric acid. This is important because nitric oxide emissions (mainly from automobiles) are still increasing, while sulphur oxide emission levels seem to have stabilized.

1987

David Schindler, ELA Scientific leader, presents the Edgardo Baldi Memorial Lecture at the 23rd Congress of the International Association of Theoretical and Applied Limnology (SIL), held in New Zealand. The lecture is entitled *Experimental studies of chemical stressors on experimental ecosystems*.

Experimental additions of cadmium to Lake 382 are initiated. The aim is to test the efficacy of the existing water quality guideline of 0.2 parts per billion, and to determine the pathways by which cadmium moves and is bioconcentrated within the ecosystem.

Two long-term monitoring studies are underway to assess the efficacy of extrapolating results from small ELA headwater lakes to larger lakes elsewhere. One, the Northwest Ontario Lake Size Series, is designed to test compare lake ecosystem functions over time in a range of lake sizes. The second, the Lake Flushing Series, is designed to test ecosystem variability over time in a range of ELA lakes with differing water flushing rates. Both studies are planned to span 10 years.

Fourth special volume of ELA research papers published in the *Canadian Journal of Fisheries and Aquatic Sciences* (Volume 44, supplement 1).

1988

Dr. David Schindler testifies at various legislative and judicial hearings in Canada and the United States. His documented descriptions of the severe impacts of moderate acidification on the Lake 223 ecosystem alert many decision makers to the fact that acid rain can devastate lake systems at pH levels previously believed to be acceptable.

Schindler's testimony attracts much media attention to ELA research activities. Coverage appears on NBC's *Today Show*, on CNN, On CTV, in *US News and World Report*, in the *New York Times*, the *Toronto Globe and Mail* and the *Toronto Star*, the *Ottawa Citizen*, and the *Winnipeg Free Press*.

Lake 302 South is acidified to pH 4.5, the most acidic condition experimentally induced in an ELA lake. Fish and many other species have been eliminated from the lake basin. The food chain is now dominated by bacteria, algae, and insects.

Controlled recovery from acidification continues in ELA Lake 223. Chemical recovery is rapid but biological recovery is mixed. Lake trout are now successfully reproducing, but some of the eradicated species have not yet reappeared in the lake.

1989

David Schindler is awarded the prestigious **Naumann-Thienemann Medal** by the International Association of Theoretical and Applied Limnology. This is the highest award that can be bestowed internationally for outstanding contributions to limnology.

Experimental injections of several organic toxicants to free-ranging fish in Lake 260 examines the chronic effects on fish of these persistent substances and demonstrates a new technique in whole-lake experimental research.

Fish kill in acidified Lake 302 South is attributed to toxicity from algae in the lake. This event, and a similar event in Lake 302 North in 1993, led to a research project that has identified the toxin producers as bacteria associated with blooms of dinoflagellate algae.

David Schindler resigns from Fisheries and Oceans and moves to Alberta as Killam Professor of Ecology at the University of Alberta. Dr. Ray Hesslein is interim Scientist-in-charge of the ELA.

1990

Schindler *et al.* publish a paper in the journal *Science* (Volume 250), which examines limnological changes in the Lake 239 watershed in response to measured climatic warming over the previous 20 year period of detailed record. The paper is one of the first to document real ecological change in response to short-term climate change and identifies specific potential responses of boreal lakes to widely predicted climatic warming.

Dr. Robert Hecky is appointed Scientist-in-charge of the ELA.

1991

Dr. David Schindler, scientific leader of the ELA from 1968 to 1989, is presented with the inaugural Stockholm Water Prize by the Queen of Sweden for a "substantial contribution ... to the conservation of the world's water resources". This prize is intended as an aquatic science equivalent to the Nobel Prize.



Dr. David Schindler, Scientific Leader of the ELA from 1968 until 1989, receives the first-ever Stockholm Water Prize from the Queen of Sweden in 1991. The ELA is internationally recognized for its leadership in aquatic environmental science.

Background studies begin in preparation for the Experimental Lakes Area Reservoir Project (ELARP), a large experimental study of wetland flooding. Lake 979 is selected as the experimental reservoir site; Lake 632 as the reference site. The study will investigate in detail mobilization of methyl mercury in the reservoir and releases of greenhouse gases to the atmosphere in response to flooding of wetland vegetation. The CBC includes coverage of the ELA study in a documentary on hydro electricity.

1992

Controlled recovery of acidified Lake 302 South is initiated, following 4 years at pH 4.5. Chemical recovery is slower than previously observed in Lake 223, perhaps indicating that the internal alkalinity generation mechanisms have been damaged by the prolonged period during which the lake was maintained at the lower pH.

The water control structure for the ELARP flooding of Lake 979 is constructed and detailed background monitoring continues in the two wetland systems. Researchers from more than a dozen agencies, universities and corporations are participating in the study.

Interest in ELARP and other ELA studies attracts more media attention. Coverage of research activities appears on the Nature of Things, in Nature Canada and the Canadian Geographic magazine, and in several newspapers. The Imperial Oil Review publishes a biographical article on David Schindler.

Development of an integrated electronic database management system for ELA long-term data sets is underway. This is intended to facilitate preservation of these priceless data sets and access to the data.

1993

Flooding of the 979 Reservoir is initiated. Almost immediately, methyl mercury concentrations in the reservoir increase dramatically. Similarly, emissions of carbon dioxide and methane to the atmosphere from the areas of flooded vegetation increase markedly. These highly significant changes persist until the reservoir level is reduced in the fall. These results bring into serious question the environmental "cleanliness" of many northern hydro reservoirs.

Additions of cadmium to Lake 382 are terminated in response to a change in Ontario Government policy. The lake, which had never been subjected to cadmium concentrations in water above the 0.2 parts per billion guideline, continues to be monitored. No population effects have yet been observed, although concentrations have risen in the sediments and in some organs of some lake species.

Initiatives are underway to facilitate linkages and comparisons of the long-term ELA data sets with similar data collected at other North American research sites during the past two decades. This will enhance the value of these data for predictive purposes. The ELA is selected as one of the first nodes within the newly created Canadian Environmental Monitoring and Assessment Network

Lake 227 receives additions of phosphorus fertilizer for the 25th consecutive year. New studies are underway to examine in greater detail the chemical balances and food chain pathways of this much-studied ecosystem.

A new operating agreement for the ELA is signed (October) between Canada and Ontario. This agreement establishes a tri-partite (DFO, OMNR, OMOE) Management Board, and formally identifies Ontario as a full partner in ELA operations.

1994

The ELA Database Management System becomes operational and loading of more than a million records of data gathered over a quarter century begins. The existing system is designed to archive most of the long-term core data sets, including physical measurements, water chemistry, and much of the ELA biological information on algae, invertebrate populations, and fish.

Flooding of the 979 reservoir for a second season produces virtually identical results to those observed in 1993. Levels of both methyl mercury and greenhouse gases increase markedly during flooding.

No acid is added to Lake 223 for the first time since experimental acidification began in 1976. The pH has now returned to natural levels. Many of the biota have also recovered completely, but other species that were originally present have not yet re-colonized the lake. Either reproducing individuals have not been able to re-enter the remote lake or the original ecological niches

occupied by these species have been taken over by other species and the original species have been unable to compete successfully.

Under the Sustainable Fisheries Initiative, ELA provides hydrological support for a Province of Ontario experimental study near Atikokan Ontario. This study is investigating the impacts of current Ontario forestry practices on lake trout lakes in the boreal shield. Another study being conducted at the ELA is investigating the impacts of nitrogen fertilization of upland forests and the downstream impact on boreal lakes.

Two special series of research papers are published in the *Canadian Journal of Fisheries and Aquatic Sciences* to commemorate the 25 Anniversary of the Experimental Lakes Area. The first [Volume 51(10)] consists of 9 papers summarizing 25 years of experimental eutrophication studies in Lake 227. The second [Volume 51(12)] consists of 8 papers on natural lake processes.

1995

A new experimental reservoir study is initiated in Lake 226 under funding from the Sustainable Fisheries Initiative. The lake water level is reduced by some 2 metres in January and by an additional meter during the winter of 1995/96. This is intended to simulate winter drawdown in many northern hydro reservoirs. Effects on the well-studied lake whitefish population and on other components of the ecosystem are being monitored.

Background studies are continuing in preparation for a proposed northern pike habitat manipulation study in Lake 191, also under the Sustainable Fisheries Initiative. The purpose is to investigate the effects of nearshore vegetation removal on pike populations.

The Northwest Ontario Lake Size Series is brought to a conclusion following 10 years of field sampling. As anticipated, both similarities and differences have been observed across the lake size series. The final results are being prepared for publication.

A third series of ELA research papers commemorating the 25th Anniversary is published in Volume 52 (10) of the *Canadian Journal of Fisheries and Aquatic Sciences*. This 8-paper series focuses on contaminants research at the ELA.

A paper by Schindler *et al.*, published in *Nature*, discusses the role of lake acidification in exposing aquatic organisms to increased levels of harmful UV-B radiation, and concludes that this may be a more serious threat to aquatic ecosystems than ozone-thinning. The paper, based on experimental research observations at the ELA, attracts considerable media attention, particularly in the light of announced major cutbacks in federal funding of ELA experimental research.

1996

A paper by Sellers *et al* in the British journal, *Nature*, reports on ELA research showing the photodegradation of methylmercury in lakes. It attracts media attention in the U.S. and Canada.

Bob Hecky is awarded the Hutchinson Medal by the American Society of Limnology and Oceanography for his outstanding contributions to aquatic science over the previous decade.

Bob Hecky transfers to Environment Canada at the Canada Centre for Inland Waters in Burlington. Ray Hesslein assumes Bob's role as Scientist-in-charge of the ELA.

1997

DFO's targets for reductions in freshwater science are reached. The loss of approximately one-third of freshwater science staff at the Freshwater Institute over a two-year period leaves gaps in the "in-house" ecosystem expertise on which the ELA can call. With new experiments in the planning stage, the participation in ELA research of external "partners" becomes increasingly vital to future success.

A paper, published in *Environmental Science and Technology* (Vol. 31: 1334-1344) by Kelly *et al.*, summarizes the major results of the 5-year ELA Reservoir Project, a multi-disciplinary study of the effects of flooding wetland vegetation. The paper documents major increases in production of methyl mercury, and the greenhouse gases, carbon dioxide and methane, in response to flooding of the wetland vegetation. It recommends that any new reservoirs be designed to minimize the land area flooded and to minimize the flooding of wetlands.

DFO renews its commitment to the ELA program by allocating funds for the construction of several replacement buildings at the ELA field station. Scheduled for replacement over the next three years are the workshop complex, the station manager's residence, and most of the laboratory and office facilities. A primary emphasis in this facility renewal is energy efficiency and conservation.

1998

The new workshop complex and manager's residence are completed and the old buildings removed from the site.

Dr. John Rudd assumes the role of Scientist-in-charge of the ELA. Dr. Ray Hesslein becomes Senior Scientist.

A new Upland Flooding experiment is authorized and receives funding from Manitoba Hydro. Construction begins on three artificial reservoirs in the Roddy Lake and Lake 239 watersheds.

Four new staff positions are made available for staffing by young scientists. This is the first major commitment to staff rejuvenation in decades. Dr. Karen Kidd is hired as the first of these scientists.

David Schindler, long-time ELA scientific leader, is awarded the **Volvo Environmental Prize** for his "pioneering work in overfertilization and acidification". Dr. Schindler shares this 1998 award with Professor Malin Falkenmark of Sweden. The prize, worth 1,500,000 SEK, was presented in Brussels on October 27th, 1998.

Construction begins on the first phase of a new laboratory complex at the ELA field station.

1999

Three new scientists, Dr. Paul Blanchfield, Dr. Vince Palace, and Dr. Cheryl Podemski, are hired to work with the ELA research team.

The first phase of the new laboratory complex is completed and commissioned. This structure houses new chemistry laboratories, a mercury "clean room", several other laboratories, and a sample receiving area.



Initial phase of the new laboratory complex nears completion, spring 1999.

The Upland Flooding project begins experimental flooding in three small, manufactured reservoirs.

Background and pilot studies begin in preparation for a whole lake experiment using an endocrine disrupting compound, a synthetic estrogen.

Background studies and pilot experiments begin in preparation for a proposed mercury addition to a lake and its watershed.

2000

An amended agreement between Canada and Ontario for the operation of the E.L.A. is signed. It officially took effect on February 15, 2000, and updates the agreement originally signed in 1993.

The ELA receives the Morley Thomas award from the Meteorological Service of Canada in acknowledgement of 30 consecutive years of daily meteorological monitoring using volunteer staff. The ELA met station, installed in June, 1969, is now classified as a long-term meteorological station. Ken Beaty, who has supervised the site virtually since its inception, accepted the award on behalf of the dozens of volunteer observers who have participated over the three decades.

Lake 658 is selected as the candidate site for the proposed mercury addition (METAALICUS) experiment. Background studies of this lake are conducted, in conjunction with more pilot experiments.

Construction of the second phase of the new laboratory complex begins in November. This construction phase also sees the 1972 main laboratory converted to a residence, and the removal of several old trailer bunks and labs.

2001

Dr. R.A. (Drew) Bodaly succeeds Dr. John Rudd as the Scientist-in-charge and Section Leader of the Experimental Lakes Area.

The second phase of the new laboratory complex is completed. The former main laboratory is converted to a residence.



The newly completed main laboratory complex, summer 2001.

METAALICUS (Mercury Experiment To Assess Atmospheric Loading In Canada and the United States) receives final regulatory approval from Ontario and enters its main experimental phase with additions of traceable new mercury to Lake 658, the upland, and the wetland. New mercury added to the lake is detected in the fish by year-end.

The EDC (Hormone Mimic) researchers begin to add trace amounts (6 parts estrogen per trillion parts water) of a synthetic estrogen to Lake 260. By fall, the fish in the lake are showing physiological effects.

Dr. John Rudd receives Fisheries and Oceans Canada's highest award, the *Prix d'excellence*, for his contributions to DFO over the years.

On site research activity totals more than 7500 person-days, by far the most active year ever at the ELA.

2002

Full-scale baseline studies are underway in preparation for a planned aquaculture experiment in Lake 375.

METAALICUS, FLUDEX and EDC experiments continue, resulting in activity levels comparable to 2001.

Reproduction by fathead minnows in Lake 260 is clearly impaired by minute concentrations of synthetic estrogen in the water.

2003

An Experimental Lakes Area foundation ("Friends of the ELA") is established and application made for charitable status.

Dr. Ken Mills succeeds Dr. Drew Bodaly as Section Leader and Scientist-in-charge of the ELA.

A Cage aquaculture experiment begins with 10,000 rainbow trout placed in a large cage located in Lake 375.

The Flooded Upland Dynamics Experimental study (FLUDEX) is completed after five years of seasonal flooding. The three reservoirs are decommissioned and removed, and the areas rehabilitated.

Fathead minnow population in Lake 260 is on verge of collapse because of reproductive failure attributed to estrogen additions.

2004

Charitable status is obtained by the "Friends of the ELA" foundation.

The METAALICUS study undertakes mercury additions for a fourth year. Results are now indicating that new mercury from the lake is entering the food web.

The Cage Aquaculture study is undertaking second year of experimental operation.



Rainbow trout harvest, 1 November 2004

EDC study begins post-addition monitoring phase.

Experimental Lakes Area undergoes an internal audit and review within DFO.

Major rehabilitation of Pine access road, including resurfacing with crushed gravel, is completed

2005

The Canada-Ontario Agreement for the ELA undergoes some minor revisions and is renewed by its signatory partners (DFO, OMNR, OMOE).

Funding is allocated for two new accommodations buildings to replace badly deteriorated trailers and frame buildings.

The METAALICUS study continues mercury additions for a fifth year in the Lake 658 watershed. Mercury isotope added directly to the lake water now represents a significant portion of total mercury in L658 fish.

A pulse mercury addition to the Lake 222 outflow stream is conducted.

The Cage Aquaculture study continues for the third year.

2006

Dr. Michael Paterson succeeds Dr. Ken Mills as the Scientist-in-charge of the ELA. Dr. Susan Cosens succeeds Terry Shortt as Manager of the Environmental Science Division, of which the ELA is a part.

Two new accommodations buildings, containing a total of 19 bedrooms, replace the Fourplex, Duplex, and the original Bunk 1 trailer bunkhouse. The original kitchen/dining structure (recently used as a fish lab) was also removed from the site.

A modern telecommunications system, consisting of a dedicated microwave link providing high-speed internet with e-mail and VOIP phones, is installed. An upgraded two-way VHF field radio system is installed, providing remote data collection capabilities.

METAALICUS continues with its sixth year of mercury isotope additions at L658. Cage Aquaculture completes a fourth year of fish farm operation. The ELARP study conducts a major survey program in the 14th year of seasonal flooding at L979.

DFO Real Property signs an agreement with DFO Science to manage and operate the ELA field station facility and associate infrastructure.

Negotiations are underway between DFO Science and Environment Canada Science and Technology to create an agreement that would see EC partner with DFO in funding the core ELA operations. In addition to funding assistance, EC would bring a broad research mandate that could be addressed by ELA studies.

2007

A formal agreement is finalized between Fisheries and Oceans Canada's Science Branch and Environment Canada's Science and Technology Branch to share operating costs of the ELA facility and the science support operations. This enables Environment Canada scientists to become more directly involved with research at the ELA.

A research paper in the *Proceedings of the National Academy of Science* by Kidd *et al.* documents the collapse of the fathead minnow population in ELA Lake 260 in response to minute concentrations of synthetic estrogen in the lake water. This marks the first documentation of fish population effects from hormonal mimics.

Cumulative Milestones

Over 39 years of research activities at the ELA, more than 115 graduate students from more than 20 universities and many countries have conducted experimental field research leading to completion of doctoral and masters degrees in the environmental sciences. A significant number have continued their careers at the ELA. In addition, hundreds of undergraduate students have received training in ecosystem science while serving as research assistants at the ELA. Dozens of these individuals have gone on to senior research and resource management positions around the world.

More than 50 ecosystem-scale, experimental studies have been carried out on a variety of topics ranging from eutrophication to acidification, to toxic and persistent chemicals, to biomanipulation and aquaculture.

The [comprehensive research findings](#) from the ELA have been published in hundreds of journal papers, symposium proceedings, technical reports and graduate theses.

A unique, comprehensive, long-term database of physical, chemical and biological information on boreal lake ecosystems has been assembled. This database documents both natural variation of non-manipulated lake ecosystems and the systemic responses to stressors of lake ecosystems

undergoing controlled manipulations. Both components of this database include detailed, continuous records of more than three decades in duration.
