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Life

Clear thinking

Experimental Lakes Area one of most unusual outdoor labs in the world

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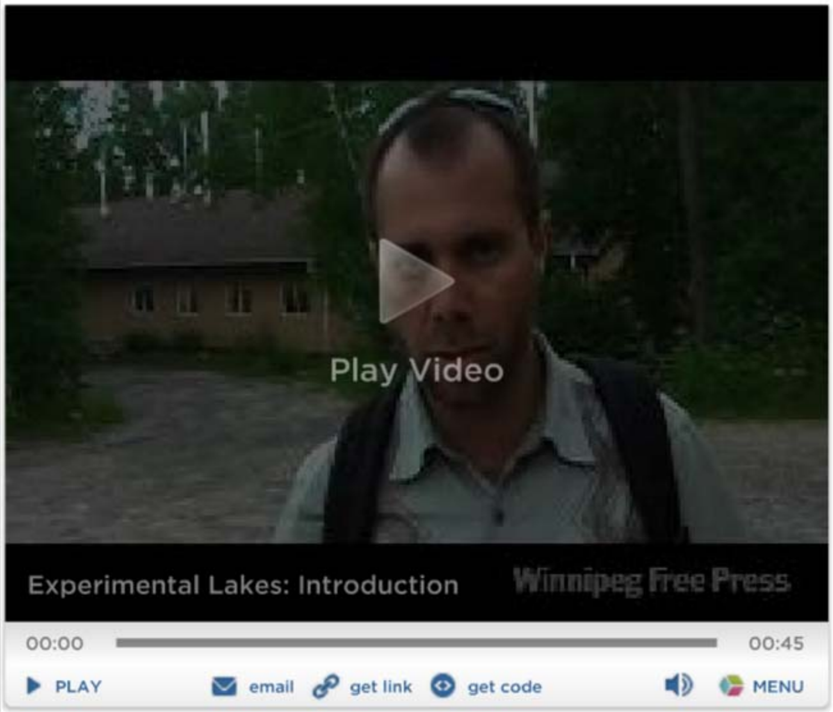
RAWSON LAKE, Ont. -- For 40 years, biologists and chemists in a quiet corner of the Canadian Shield have been conducting some of the most aggressive freshwater science on the planet.

VIDEO: Experimental Lakes: Introduction



They've added phosphorus to pristine bodies of water to cause artificial algae blooms. They've poured acid into lakes to see what happens to the fish in them.

They've hired crop dusters to spray cliffs with mercury, used birth-control drugs to change the gender of minnows and even built a replica fish farm in the middle of nowhere, complete with 10,000 live rainbow trout.

Welcome to the Experimental Lakes Area, one of the most unusual outdoor laboratories in the world, where entire bodies of water are manipulated over years or even decades in the name of freshwater science.

"We use these lakes the way medical researchers use white mice," says Mike Paterson, the scientist-in-charge at the ELA, a sprawling expanse of boreal lakes about 50 kilometres east of Kenora.

Since 1968, researchers based out of the federally-funded Freshwater Institute in Winnipeg have been messing around with pristine lakes to see how entire ecosystems respond to pollutants from both industrial and household sources.

In the 1970s, their early work with algae blooms led to a near-global ban on laundry detergent containing phosphorus, the chief culprit in the nutrient loading that's led to low-oxygen "dead zones" in lakes around the world.

In the 1980s, they proved the U.S. energy industry wrong by demonstrating the harmful effects of acid rain on underwater food chains, eventually leading to new emission standards for airborne pollutants.

Early in this decade, they found that birth-control drugs can interfere with fish reproduction, a discovery that has implications for municipal waste-water treatment across the developed world.

Ongoing experiments with mercury and freshwater aquaculture could lead to more legislation, while future research is planned for the effects of brominated flame retardants, noxious chemicals that persist in the watershed long after they're used to fight fires. But that won't happen until a pilot project in a mesocosm -- that is, a self-contained experiment within an experimental lake SEmD proves it safe.

While there are hundreds of lakes in the Experimental Lakes Area, scientists have permission to alter only 58, provided they allow them to return to their natural states eventually.

At any given time, full-blown experiments are underway on a mere four or five of the area's lakes, while two or three are recovering from earlier experiments. Fishing is not allowed on any of the active lakes, though canoeists routinely paddle through the region.

In 40 years, the only research project that's ever been turned down by Ontario's Ministry of Natural Resources was an early 1990s plan to add PCBs to one lake. While the Ontario government understood the value of the scientific research, the optics were simply too negative, Paterson says.

Learning from that experience, ELA researchers held community consultations in Kenora and Dryden, Ont. before they began adding small amounts of mercury to Lake 658 in 2000. Some northwestern Ontario residents remain suspicious of the scientific work, even though the ELA may actually be better known as a paddling destination.

"When people get excited about what we do here, I have to remind them that we, as a society, have deliberately polluted hundreds of thousands of lakes. We (the Freshwater Institute) manipulate 58 and allow them to return to their natural state," Paterson says.

But at the same time, the ELA researchers also wish more people were aware of their work, not just in Winnipeg, where most of them live during the winter, but in Ottawa, where their primary financial backers at the federal Department of Fisheries and Oceans reside.

Despite the scientific discoveries made at the ELA over the decades, the Freshwater Institute and its field station face periodic threats of being closed down by a federal government that does not always understand why a department with "oceans" in its name needs a freshwater field station.

That facility, which straddles scenic Rawson and Boundary lakes, costs only about $300,000 a year to operate. But that doesn't include salaries for a staff of 30 to 60 scientists, field workers and laboratory technicians, never mind their research activities, which are funded by the DFO, Environment Canada, American environmental agencies as well as private industry organizations.

The ELA is also threatened by brain drain: Many of the scientists who conducted pioneering work at the field station have retired in recent years and more are slated to follow.

"I really fear what might happen in the next 10 years, because people who had a big role to play are all reaching retirement age and I think it's questionable whether they'll be replaced, and if they are, whether they will be with people of comparable quality," says David Schindler, a University of Alberta ecologist who co-founded the ELA.

But for now, work continues as usual at the station, which includes a scientific building with 12 laboratories, a hilltop weather station and a machine shop capable of maintaining the fleet of 100 motorboats and 20 all-terrain vehicles required for getting around the ELA.

There's also a mess hall staffed by restaurant-industry vets, a sandy beach for recreation and separate residences for young university students, senior scientists and also staffers with families (the latter in a compound called "Suburbia," a series of cabins on the edge of the field station).

Researchers typically work five-day weeks from May to November, but some data must be gathered or analyzed seven days a week.

"I love this job because you get to be outside," says Joanne Mallord, a field worker and Red River College student, as she takes a motorboat ride across Winnange Lake on the way to a mercury-monitoring chore on Lake 658.

Most of the field and lab work involves mundane, repetitious tasks, such as taking water samples in lakes where there's active research. In recent years, some of the drudgery has been alleviated by solar-powered equipment that gathers data at remote locations and transmits that information to the field station via radio transmitters.

In fact, one of the weirdest aspects of the ELA is the fact solar panels, hydrological measuring devices and other pieces of technical equipment sit out in the middle of the Canadian Shield. Unlike in Eastern Canada or the U.S., where scientific equipment can get vandalized in the field, ELA researchers think nothing of leaving expensive gear in the middle of the bush.

"I've been here 17, 18 years, and I don't remember anything being stolen," says Paterson, standing outside a shack at Lake 375, the site of an aquaculture experiment where the movements of about 50 native fish are monitored using implanted radio transmitters and solar-powered relays.

The movement of each fish shows up as a squiggly line on a pair of laptop computers. Blips that don't move probably represent dead fish (divers in neoprene will eventually retrieve the $600 transmitters), while fish that appear to have swum out of the lake and into the forest were probably caught and consumed by osprey or bald eagles.

The actual purpose of this experiment is to see how native fish react to 10,000 captive rainbow trout raised in a 10-cubic-metre aquaculture cage in the north end of the lake in 2007.

"The government has no data on the effects of freshwater aquaculture. There's a real demand for this sort of research," he says, noting it could occur only at the ELA, where every experiment potentially involves 10,000 plant, animal and protist species in a living, breathing lake, as opposed to one or two in a sterile lab.

"What makes this place unique is the whole-lake manipulation. Nobody else does that."

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ELA'S GREATEST HITS

Some of the discoveries made at northwestern Ontario's Experimental Lakes Area, where freshwater scientists manipulate entire bodies of water to see how ecosystems react to pollution and environmental change:

EUTROPHICATION

Timeline: 1967 to present

The problem: In the 1960s, freshwater lakes around the world were covered in algae scum, oxygen levels were plummeting and fish were dying off. Scientists suspected human activities were responsible but weren't sure exactly which nutrients affected lakes.

What ELA scientists did: Researchers added phosphorus, nitrogen and carbon to small lakes to see how algae responded. One body of water, Lake 227, has now been studied for almost four decades.

What they found: Phosphorus turned out to be the key culprit in eutrophication. Adding the nutrient to lakes led to massive blooms of blue-green algae, which died off and deprived lakes of oxygen as they decomposed. Blue-greens were found to be able to get all the nitrogen they needed from the air, which suggests it's more crucial to remove phosphorus from wastewater. Carbon did not prove to be a culprit at all.

Changes as a result of ELA research: Beginning in the 1970s, governments passed legislation banning phosphorus from laundry soap. Dish detergent legislation is becoming common now.

ACIDIFICATION

Timeline: 1976 to 2004

The problem: In eastern North America, fish and other aquatic species were disappearing from freshwater lakes. Scientists surmised industrial pollution was to blame, but power companies argued fish could withstand acidified environments, based on experiments in which fish lived inside tanks with acidified water.

What ELA scientists did: Researchers added acid to lakes to see how the whole ecosystem, not just big fish, responded.

What they found: In freshwater lakes, acid kills off the small organisms that fish eat, collapsing the food chain from the bottom up. The damage took place at much lower levels of acidification than industry expected.

Changes as a result of ELA research: Power plants, smelters and other factories were forced to reduce sulfur dioxide and nitrogen oxide emissions.

ESTROGEN DISRUPTION

Timeline: 2001 to 2004

The problem: Scientists found that male fish were turning into females after being exposed to estrogen and estrogen-mimicking chemicals in municipal wastewater, presumably from birthcontrol pills. So they wanted to know if the pillpolluted wastewater could threaten the survival of entire fish populations.

What ELA scientists did: Researchers added the same synthetic estrogen found in birth-control pills to a lake and watched what happened to the fathead minnow population.

What they found: Minnows became practically extinct, as male fish began producing eggs and eggs laid by females did not develop properly.

Changes as a result: Municipalities across North America are being advised to employ charcoal filters at sewage-treatment plants to remove estrogen and estrogen mimics from wastewater.

MERCURY CONTAMINATION

Timeline: 2000 to present

The problem: Fish in freshwater lakes all over North America have become contaminated with methylated mercury, a toxic metal that can cause intellectual disabilities in humans who consume too much of it. Scientists knew coal-fired power plants were the key culprit but weren't sure how the mercury from the smokestacks found its way to fish.

What ELA scientists did: Over the space of seven years, researchers added tiny amounts of mercury to a small lake, as well as an adjacent wetland and the rocky cliffs above.

What they found: The mercury added straight to the lake quickly found its way into fish, while the mercury sprayed on the cliffs and wetland did not appear at all. This suggested airborne pollution is the key culprit for fish contamination.

Changes as a result of ELA research: Governments have more scientific ammo as they consider forcing coal-fired power plants and smelters to install mercury scrubbers.

FRESHWATER AQUACULTURE

Timeline: 2003 to present

The problem: Freshwater fish farms are touted as a solution to the worldwide protein shortage and the disappearance of fish and seafood from oceans and seas. But very little research has been conducted about the effects of aquaculture on freshwater lakes.

What ELA scientists did: Researchers placed a 10-square-metre rainbow trout cage, identical to those used at fish farms, inside a small lake. They then raised 10,000 rainbow trout and monitored the effects on naturally occurring fish in the rest of the lake, as well as on bottom-dwelling invertebrates and the water quality in general.

What they found: Natural fish avoided the fishfarming cage, while most escapee rainbow trout quickly died off. But the farm did raise nutrient levels in the lake, primarily due to waste from the captive fish that smothered the lake bottom below the cage.

Changes as a result of ELA research: Still to come, as researchers have removed the model fish farm and are watching to see how the lake recovers.

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