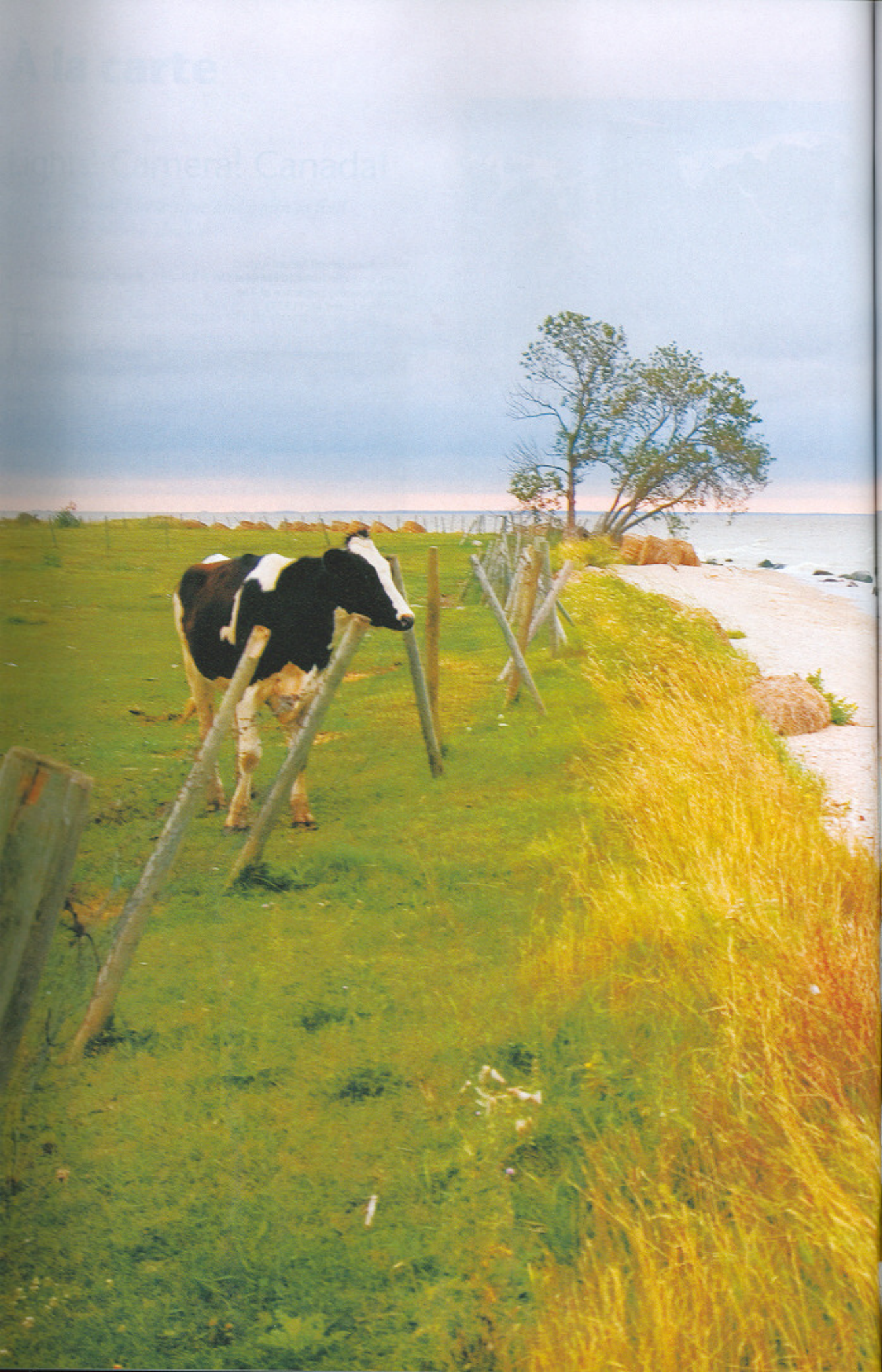


Forgotten lake

Over 30 years, Lake Winnipeg has developed the worst algae problem of any major lake in the world. So why is science so late in coming to the rescue?

BY ALLAN CASEY PHOTOGRAPHY BY THOMAS FRICKE

Lake Winnipeg plunges to 60 metres at its deepest point but is otherwise a shallow inland sea. Farms, such as this dairy operation near Gimli, Man. (PREVIOUS PAGES), ring its southern shoreline.

THE SHIP IS MUCH TOO BIG for the tiny wooden dock, but the MV *Namao* is determined to make landfall. Though the mighty Saskatchewan River has been tamed by a hydroelectric dam here in Grand Rapids, Man., the current is still plenty fast as the runoff from much of the Canadian prairie squeezes through a narrow channel before spilling into the north end of Lake Winnipeg. The captain deftly spins the ship around and drifts her down to the pier, as some of the local fishermen unloading their pickerel catch stop to watch. They've seen this old Coast Guard vessel a hundred times before, but she looks different in her new livery of bright blue paint. The deckhands see they have an audience and want to look sharp, though they've sailed together for only a few days. They make a neat job of docking, but the paint is so fresh, they can't keep some of it from grinding off as they come alongside. Two women walking on the road stop, and one reads aloud the words on the vessel's topsides: "'Lake Winnipeg Research Consortium.' That's good!"

For the people who live on the shores of the tenth largest freshwater lake in the world, the *Namao* symbolizes hope for a vast, and threatened, aquatic ecosystem. Perhaps science can rescue this inland sea from problems they have been noticing for years. But so far, it is science on a shoestring. The 34-metre government-surplus ship was diverted from the scrap pile to offer first aid to a lake that has almost been forgotten. Funding for this voyage was cobbled together, catching the little vessel in dry dock with her paint still wet. And those aboard realize all too keenly that the *Namao*'s mission is as much about public relations as it is about water samples and plankton hauls.

Lake Winnipeg has been a source of mystery and speculation for years. Commercial and aboriginal fishermen sometimes found their nets clogged with brown algae, though their annual pickerel catches were on the rise. E. coli swimming bans became more frequent on the many beaches that line the lake's southern shores. And the great flood of 1997 was rumoured to have unleashed contaminants. Then, in 1999, a trial cruise of the *Namao* revealed a blight of toxic algae spreading across the remote North Basin of the lake, and satellite images showed the full extent. Comparisons with the polluted state of Lake Erie 30 years ago began to circulate in the provincial media, and an infamous headline appeared in the *Winnipeg Free Press*: "Lake Winnipeg Dying?"

I've come to the northern reaches of the lake to see whether the *Namao* (Cree for "sturgeon") can shed light on the ecological challenges here. It turns out that the lake's problems are serious but tragically common. Perhaps the deeper mystery is why, in the backyard of two of the

Its mission stated in bold letters, the MV *Namao* (ABOVE and OPPOSITE) lowered its gangway to visitors, including Amanda Serediuk and her mother Maureen of Winnipeg (RIGHT), while docked at Gimli in August. Inviting the public aboard was part of an effort by the Lake Winnipeg Research Consortium (LWRC), which runs the vessel, to inform people about its research program and explain the causes behind the lake's deterioration.

BOTTOM: ALLAN CASEY

Chemist Mike Stainton (LEFT) has studied a range of problems plaguing many Canadian lakes, from acid rain to endocrine disrupters. His current work on the *Namao* (ABOVE, arriving in Gimli) probes Lake Winnipeg's eutrophication.

Canadian government's most prestigious lake-science facilities, Lake Winnipeg went unstudied for nearly 30 years. And why, even now, the critical environmental science needed to protect Canada's sixth Great Lake depends on an underfunded charity organization, a hand-me-down boat and government scientists working on their holidays.

A WIRY FELLOW IN ORANGE FLEECE comes up the gangway. Mike Stainton, a chemist with the federal Department of Fisheries and Oceans (DFO), co-authored the 1999 satellite maps that made Lake Winnipeg's algal blooms national front-page news. With 34 years in, he is among the longest-serving scientists on the federal payroll anywhere. That does not necessarily make him a Government Man.

"Canada has spent more money understanding Lake Malawi and Lake Victoria in Africa than it has on Lake Winnipeg," he says after helping me bring my gear aboard. "I am sure the public thinks someone is minding the store,

Nutrients from a vast drainage basin (MAP) empty into the lake, creating algal blooms that are visible in satellite images (LEFT). Technician Daryl Halliwell (BELOW) labels samples in *Namao*'s on-board lab.

but the kind of work we are doing on this ship is extremely low budget."

In our conversations over the next three days, Stainton will also prove adept at prying the lid off the workings — and failings — of state-funded lake science. But right now, he departs for the field laboratory and hands me over to science coordinator Claire Herbert, who is responsible for assigning the scientists everything from bunks to lab time. Her own specialty is algal toxins. A slight dynamo, she is also a certified deckhand, muscling hawsers around winches on the stern deck alongside a lot of big fellows from Gimli and Selkirk. Doing double duty leaves one more bunk available for a scientist. Herbert is one of the most promising and dedicated young researchers working on Lake Winnipeg, but this may be her last cruise.

"Every time I work here I lose money," says Herbert, who has done the equivalent of a master's degree twice over on Lake Winnipeg yet can't find any funding to "work up" her data for publication. "If I wanted to work in Africa," she echoes Stainton, "I could get funding." Federal agencies spend millions studying that continent's Great Lakes.

Like all ships, the *Namao* is a floating community, a microcosm of the aboriginal and Icelandic fishing cultures that line the shores. She is the last big ship on Lake Winnipeg, and the crew is devoted to her. On the foredeck, I meet Dwayne Swaffer, who fishes the lake from one of the ubiquitous Gimli skiffs that, together, haul in $20 million

Lake Winnipeg drains some 950,000 square kilometres, from British Columbia to Ontario and parts of four states — home to 6.6 million.

MAP: STEVEN FICK/CANADIAN GEOGRAPHIC; SOURCES: NATURAL RESOURCES CANADA, ENVIRONMENT CANADA; SATELLITE IMAGE: NASA, UNIVERSITY OF MARYLAND, GREG MCCULLOUGH

annually in whitefish and pickerel. Captain Mervin Sinclair and mate Walter Lea are third-generation lake mariners whose ancestors worked all the big vessels that now sit on the lawn at the Selkirk Maritime Museum. Bosun Kelly Cooke, who works the deck alongside his twin brother Wesley and refitted the cabin woodwork during 12-hour days over the summer, leads me on a ship lover's tour, from the steering gear to the fo'c'sle. Down in the spotless engine room, assistant engineer John Dunn beamingly writes down the specifications of the four diesel engines he caters to, since he can't be heard over the roar. Sleep-deprived chief engineer Dan Richmond prowls the decks at all hours looking for mechanical trouble and delivers stern warnings about flushing anything non-approved down the heads.

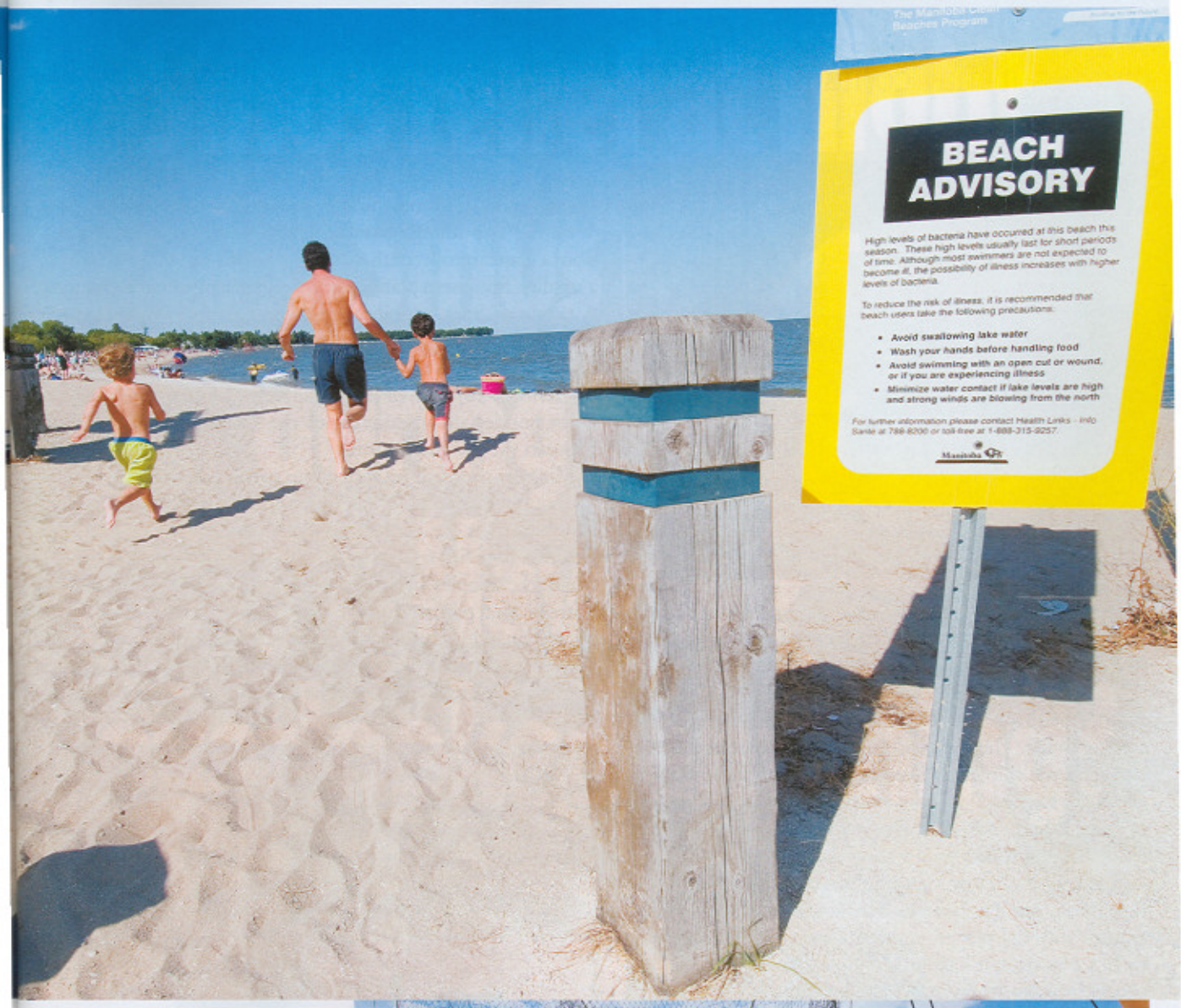
Flushing toilets are just one source of Lake Winnipeg's main problem — eutrophication, the scientific term for an overabundance of nutrients in aquatic ecosystems. The culprits are nitrogen and phosphorus. Both elements are vital to cell function; to plants, they are key nutrients, or fertilizer. Human activity creates them in such excess that they become major groundwater pollutants. Phosphorus issues from dishwashers in Calgary and lawn fertilizer in Saskatoon, while nitrogen flows from the sewers of Winnipeg and from 20 million livestock and 24 million chickens and turkeys being raised on farms and ranches from the Rockies to South Dakota — mainly via the Red River. Manitoba Hydro's dams, which export $380 million to $500 million worth of electricity annually, compound the problem by controlling flow and preventing the surplus nutrients from travelling downstream.

Flushing toilets are one source of Lake Winnipeg's main problem — eutrophication, an overabundance of nutrients in aquatic ecosystems.

Lake Winnipeg drains some 950,000 square kilometres, from British Columbia to Ontario and parts of four states — home to 6.6 million people. Hugging the edge of the barely sloping prairie, every square metre of the lake represents a drainage area of 40 square metres, the largest surface-to-drainage ratio of any major lake in the world. Larger than Lake Ontario and almost equal in size to troubled Lake Erie ("A late Great Lake?" Sept/Oct 2003), Lake Winnipeg is currently the most eutrophic of the world's major lakes.

When all that nitrogen and phosphorus enters, the whole food chain profits temporarily, from the zooplankton that eat algae to insects, jackfish, bald eagles and herons. Yet add too much, and the ecosystem can collapse, and the rate at which humans are currently dumping nitrogen and phosphorus into the lake is putting the biological pedal to the metal. When the artificial bloom of life dies, it sinks to the lake bottom where decomposers take over, using up the lake's oxygen in the process and creating persistent deoxygenated areas, or dead zones. Eutrophication is a familiar problem seen worldwide, infamously appearing in Lake Erie 35 years ago — and the damage is still visible.

Eutrophication upsets the food web a little differently in every lake. Here on Lake Winnipeg, it seems to be favouring several species of neurotoxic cyanophytes. They may sound like villains from a space epic, but these blue-green algae are rightful occupants of the lake, along with whitefish and mergansers. It's a question of numbers.



Manitobans flocking to the beaches of Lake Winnipeg's South Basin, such as this one in Gimli (ABOVE), are occasionally met with bacterial warnings, a nasty side-effect of sewage and animal waste entering the lake. Students Zexi Wang (RIGHT, at right) and Dan Rheault help guide a trawler net into the lake to trap fish, such as the wide-eyed walleye Wang cups (OPPOSITE). The lake's walleye fishery is the largest in North America.

The chlorophyll-rich mass looks almost appetizing, like pesto, though it may contain enough toxic cyanophytes to lay you low.

When the cyanophyte population explosion became visible from space, covering vast areas of the North Basin in a green shroud, it was universally alarming.

DAWN COMES ALL TOO EARLY, signalled by the ship's engines roaring to life. The mess isn't big, so the crew eats first and then gets the ship away from her berth in Grand Rapids, while the scientists get eggs, toast and coffee. For the rest of the 12-hour day, however, everyone works together. I'll be helping collect plankton samples.

It is a workplace of stunning beauty in the light of the rising sun, one rarely seen. The southern shores are the familiar summer playground for Winnipeggers, who flock to beaches from Victoria Day to Labour Day. But the treacherous North Basin, which has scant few harbours to escape the dangerous waters that can blow up, is not for waterskiing. Even the largest yachts sailing out of Gimli don't come much north of Berens Island.

As we steam out to open water, Stainton shows me the experiments that operate continuously during the cruise. A boom bolted to the ship's bow picks up surface water before it is disturbed by the hull. Most of the scientific apparatus appears to hail from a hardware store — lengths of garden hose and fittings, plywood housings, even bits of bicycle inner tube. Among the basic measurements of interest to lake scientists are water temperature, clarity, pH, conductivity and levels of key elements, such as oxygen.

As we approach the first sampling stop of the day, well beyond sight of shore, the deck becomes a hive of activity. With the ship idling forward, a large trawl net is lowered from a crane to collect fish species at the surface. Meanwhile, a smaller, fine-mesh plankton net is cast from the stern rail. A tangle of lines, umbilical hoses and sample bottles are readied on deck. When the trawl nets come aboard, the crew drops anchor, and the sondes head over the side. A collective term for any kind of sensing apparatus dropped into the water, sondes allow sampling of the entire water column between surface and bottom.

Minnow-sized fish get sorted into species, including perch and sauger. Some trawls net a good-sized pickerel or two, whose entrails are kept for examination while the fillets are saved for a fish fry — the *Namao*'s only job perk. On the afterdeck, samples of mud are being hauled up from the bottom and painstakingly separated from the host of microscopic decomposer species that lives down there.

Meanwhile, it's my job to reel in the plankton net and coax its catch into fussy little bags. The resulting chlorophyll-rich

A technician contemplates Manitoba's inland sea (TOP). Daryl Halliwell (RIGHT) holds a filter that has trapped microscopic particles, such as algae, plankton and sediments, from water samples.

'The lake simply reflects the environment it drains. If you put a molecule of fertilizer on your farm, you are changing the lake.'

mass looks almost appetizing, like pesto, though it may contain enough toxic cyanophytes to lay you low. All the bagged and bottled samples are carried down a narrow hatch to the field laboratory in the ship's main hold. Some are stored in a bank of refrigerators for later study, while others need immediate processing. The tiny, makeshift lab is cozy for two, and someone has sawn a map of Lake Winnipeg in the plywood door. Everything is then squared away on deck, the anchor is hoisted, and it's off to the next stop, one of about 65 sites the group would like to be able to sample at least three times a year — if it had the money.

During lulls, Stainton finds me at the stern rail and offers instalments of his views on what is happening to Lake Winnipeg. "The lake simply reflects the environment it drains," he says, looking out at the grey expanse. "If you put a molecule of fertilizer on your farm, you are changing the lake. Sixty percent of the water flow is already controlled by dams, and the lake is heavily managed in other ways. So what are the relationships between inputs and results?"

For Stainton, the problem is that the relationships have not been properly studied. He has some blunt criticisms for the federal government, including the agency that employs him. "Our department is totally focused on liability. One has the impression that it will be in less trouble if it doesn't have any data. It is better to say, 'We didn't study that.' All this is different than in the generation when I was first hired on."

Dying cells of toxic blue-green algae created a turquoise hue along the southeastern shore of Lake Winnipeg in 2005.

KAREN J. SCOTT

Battling blue-greens

Algal blooms are a sure sign that man-made nitrogen and phosphorus are polluting groundwater, and Lake Winnipeg's blooms of blue-green algae are so large, they can be viewed from space. Yet scientists — and politicians — are just beginning to understand the complex role of these remarkable one-celled creatures in Manitoba's greatest lake.

Blue-greens, or cyanobacteria, can bloom in the presence of too much nitrogen. But just like the nitrogen-fixing legume family of terrestrial plants, including beans, blue-greens can tap into atmospheric nitrogen, which constitutes 78 percent of the air we breathe, and convert it for cellular use. So blue-greens are both a symptom and a cause of nutrient overloading in the lake — they feed off nitrogen pollution only to add more of their own. The question is, How much?

"I'm trying to measure something that has never been measured on Lake Winnipeg before," says Len Hendzel, a veteran of DFO specializing in algal physiology. According to his calculations, cyanobacteria pulled over 11,000 tonnes of nitrogen into the lake over a 100-day research period in 2004. It is a vital statistic, given that the City of Winnipeg, due to regulatory requirements of the province, is planning an upgrade to its wastewater collection and treatment program to remove nitrogen and phosphorus. Much of the $1.2 billion cost — about $1,700 per urban citizen — addresses nitrogen removal.

Scientific studies strongly suggest that the money could be better spent. Removing phosphorus alone has been shown to be a successful and cheaper solution elsewhere in the world. Hendzel explains that the lake's cyanobacteria can fix nitrogen in any amount, replacing the equivalent of Winnipeg's annual nitrogen output in just 14 to 20 days.

"Blue-greens can replace any nitrogen removed from anthropogenic sources," he says. "It just shows the futility of trying to take nitrogen out of the system. You take it from Peter, and Paul gives it right back."

Steve Ashton, Manitoba's first Water Stewardship Minister (Christine Melnick took over the post in September), says that if the lake's ecosystem is to survive, levels of human-produced phosphorus and nitrogen must be dialed back to pre-1970 levels. This means a 10 percent reduction in phosphorus and 13 percent reduction in nitrogen from current levels. It may cost billions.

"If you haven't flushed a toilet or taken a shower in the last six months, you're not part of the problem," says Ashton, borrowing a line from one of his speeches. Manitoba's longest-serving MLA admits that much of the nutrient pollution in Lake Winnipeg originates outside the province, but says that Manitoba cannot expect support from the rest of North America if its own house isn't in order.

"Action, not finger pointing," says Ashton, "is what's needed."

A.C.

The grain bins on Roy Sigurdson's dairy farm near Hnausa, Man., offer a bird's-eye view of Lake Winnipeg. His family has worked the land here for 118 years.

STAINTON CAME WEST from Hamilton, Ont., to Winnipeg in 1968 as part of the greatest mobilization of lake scientists in history. The Freshwater Institute was established in Winnipeg in 1972 by DFO, one of many government agencies eager to study an exploding environmental crisis on the Great Lakes. The best minds in limnology — from the Greek "limnē," for lake — were recruited from countries such as Japan, the United States and Germany. It was a time when government research was entrepreneurial, says Stainton, and aggressive managers defended the need to do aquatic research, and science set the agenda.

He worked at the Experimental Lakes Area field station north of Kenora, Ont., an internationally renowned outdoor "laboratory" of 58 small lakes. Stainton helped tackle one looming Great Lakes ecological problem after another: nutrient overload, acid rain, endocrine-disrupting compounds, the impact of aquaculture and invasive species.

The Freshwater Institute was hardly alone at the time. The then newly created Environment Canada built its own National Water Research Institute in Burlington, Ont., and commissioned the *Limnos*, a custom 45-metre research vessel dedicated to studying the Great Lakes.

Under the terms of the Great Lakes Water Quality Agreement signed by Richard Nixon and Pierre Trudeau in 1972, American agencies responded in kind. The Great Lakes cause has been worthy but expensive — $11 billion and counting just for Lake Erie. Both countries have since sent their limnologists to aid troubled lakes all over the world.

But on Lake Winnipeg, federal research spending was practically zero. As a junior scientist, Stainton made the last research cruise on the lake back in 1969 aboard the MV *Bradbury*, which has long since become a museum piece in Selkirk. Federal scientists would not venture onto the lake again for 29 years.

Over time, Stainton watched as government agencies began to reel in their borders of influence, the administrative gaps opening up among them. He and many other scientists question the role played — or not played — by the 6,500 employees of Environment Canada. Because Lake Winnipeg lies wholly within provincial boundaries,

Veteran lake scientist Al Kristofferson, on the bridge of the *Namao*, is managing director of LWRC. He has personal reasons for dedicating his time to Lake Winnipeg: his Icelandic forebears made a living from the lake, and as a child, he swam and fished along its shores.

Last year, the Coast Guard donated the *Namao* outright, on condition that the ship be painted any colour but red.

its management is Manitoba's responsibility, but Environment Canada is legally obliged to provide the scientific basis necessary for provinces to make good management decisions.

"The environment department budget has shrunk to half what it was when it burst on the scene in 1973," says Greg McCullough, a physical geographer at the University of Manitoba. "I think most of the work done on Lake Winnipeg has been done by DFO, and those people have had to do it almost surreptitiously." He works with Stainton to create maps based on satellite images of the lake. Their funding actually comes from the Canadian Space Agency (CSA). "The CSA really has little interest in Lake Winnipeg," says McCullough. "It is promoting the use of satellites in environmental science."

Looking out over the wild North Basin as a red sun sets, Stainton talks about the need for accountability and action. "What I always ask people is, Whose responsibility is the lake? Environment Canada? The DFO? The four provinces? The three states? The City of Winnipeg? Ultimately, it is a partnership you are left with. That's why we formed the Consortium."

THE FOUNDING of the Lake Winnipeg Research Consortium (LWRC) in 1998 marked the beginning of better times for these waters. Reluctantly, I disembark the ship at Mathesons Island, leaving a lakeshore busy with bald eagles and migrating water birds for the busy pavements of Winnipeg, LWRC's administrative base.

"We formed this group to facilitate research," says Al Kristofferson, managing director of LWRC, an eclectic group of scientists and citizens who are all concerned with the lake's health. "We have the tenth largest freshwater lake in the world in our backyard, and we knew virtually nothing about it."

The genesis of LWRC came after a 1998 expedition looking into possible contamination by PCBs, heavy metals and other ground-based pollutants from the great Red River flood a year earlier. It brought federal scientists onto the lake for the first time in almost three decades, including Stainton and Alex Salki, another DFO biologist. They measured plankton populations and found that they had mushroomed. It was a clear sign of eutrophication, but virtually all DFO funding was going to Kenora's Experimental Lakes Area, and no further study was in the offing.

"We were doing Lake Winnipeg research on discretionary time or even volunteer time," recalls Salki. So he, Kristofferson and Stainton, all veteran lake scientists, took matters into their own hands.

Grandly calling themselves the Lake Winnipeg Research Consortium, the three decided to bring science back to the lake. That required a sturdy boat, and fate presented one. The Canadian Coast Guard ship *Namao* had become a surplus asset for DFO since her job of maintaining navigation buoys had been handed over to the private sector. LWRC promised to recruit money and researchers to the lake if the Coast Guard would only lend it the ship.

The answer was yes, and somehow LWRC has done what officialdom at three government levels could not do. Scientists, cottage owners, farmers, commercial fishermen and municipalities all joined. Kristofferson is not surprised. "An objective group like the Consortium," he says, "which doesn't have any axes to grind and isn't in anybody's pocket,

'I swam in the lake as a kid and fished from the dock. I guess it gets into your blood, and I feel a certain sense of responsibility.'

makes all the sense in the world." LWRC has canvassed the $600,000 a year needed to operate the *Namao* from public and private purses. "Just because you sponsor us doesn't mean we are willing to run interference for you," says Kristofferson. Manitoba Hydro is a major contributor, even though LWRC members have openly implicated its dams on the Saskatchewan and Nelson rivers as contributing to Lake Winnipeg's difficulties.

Government support has been increasing. Last year, the Coast Guard, under the direction of DFO, donated the *Namao* outright, on condition that the ship be painted any colour but red. No buyer was likely to be found in any case. DFO was the first federal agency to buy research time on the *Namao*, and Environment Canada has contributed $120,000 so far to do likewise.

Kristofferson continues to work full-time for DFO but is now on assignment with LWRC. His ties to the lake go deep, and he will continue to devote himself full-time when he retires. "My great-grandfather immigrated to Canada from Iceland and kept his family alive by fishing on Lake Winnipeg," he says. "So did my grandfather. I swam in the lake as a kid, and I fished from the dock. I guess it gets into your blood, and I feel a certain sense of responsibility."

Perhaps LWRC points the way to the future for ecological monitoring, management and stewardship in Canada. It may be that nimble citizen-led mobilizations can do a better job than unwieldy state bureaucracies acting alone. If so, do we need more such groups? Great Bear and Great Slave lakes are even larger than Lake Winnipeg and are similarly unstudied. How much do we know about Reindeer or Athabasca?

They may all be far enough from people and industry to be out of harm's way. But, then, that was the perception of Lake Winnipeg 15 years ago.

Allan Casey is a Saskatoon-based writer. He is currently working on a book on Canada's lakes to be published by GreyStone Books in 2008. Photographer Thomas Fricke lives in Winnipeg.

To comment, e-mail editor@canadiangeographic.ca.
Visit www.canadiangeographic.ca/web/nd06.

ALAN CASEY

Sandbags, here lining the Gimli shore, are occasionally seen around the lake, since its shallow slope makes flooding a concern in high-water years.