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RESEARCH

A NOT-SO-GREAT LAKE

For two decades, huge blue-green algal blooms have been plaguing Manitoba's Lake Winnipeg. Visible from space, the blooms signal an overabundance of phosphorus and nitrogen running off a watershed that drains nearly a million square kilometres, from the Rockies to northern Minnesota.

The sources are obvious and are massive in scale: the rise of industrial farming and livestock production, a hydroelectric dam network on northern Manitoba's Nelson River that has limited natural nutrient outflow since the mid-1970s, widespread depletion of the watershed's marshlands, plus a deluge of sewage, fertilizers and detergents from growing towns and cities. The underlying problem, however, is that fewer than 30,000 people actually have to live with the noxious beards of green scum that sporadically wash ashore as a result of the lake's eutrophication.

Although water-quality concerns and the threat of aquatic dead zones have spurned debate (mostly over *potential* paths to nutrient reduction), there hasn't been much scientific data to anchor solutions. But in the five years since *Canadian Geographic* reported on this knowledge gap ("Forgotten lake," Nov/Dec 2006), research has flourished and a foundation for diagnosing the lake's health has started to materialize.

The *Journal of Great Lakes Research*, a Michigan-based quarterly that focuses on the planet's largest lakes and watersheds, will publish the first major wave of peer-reviewed findings this fall in a special issue dedicated to Lake Winnipeg. Most of that content aims to simply characterize modern conditions in the watershed, to inform future trends and observations and to turn the severity of eutrophication — and any evidence toward curbing it — from speculative to specific.

A solid early-21st-century record of actual phosphorus and nitrogen cycles and the prevalence of three phytoplankton groups in the lake's south and north basins has been produced, complemented by modelling of possible reduction strategies. Large nutrient contributors have been pinpointed, such as sprawling livestock densities in the Red River valley's eastern subcatchment, and the nutrient content created by various crop types has been documented. Scientists are also getting a handle on the lake's food-web structure, the surrounding wetlands are being quantified, and it appears that Lake Winnipeg's shallow depth and turbid nature may downgrade its susceptibility to dead zones, wherein thick, decaying blooms enable bacteria to choke the oxygen out of deeper water, which can't circulate or benefit from photosynthesis.

A blue-green algal bloom washes ashore on Lake Winnipeg's Grand Beach.

The Manitoba government is also publishing a much-anticipated "state-of-the-lake" report this summer. One chapter, authored by local toxicity expert Brian Kotak, brings the present-day hazards of algal blooms into focus. His team's lake-sampling work has found unsettling concentrations of a liver toxin called microcystin during heavy blue-green blooms. Microcystin is at high-risk level at 20 micrograms or more per litre of water, according to the World Health Organization. "Measurements along the west side of Lake Winnipeg go anywhere from 39 to more than 300 micrograms per litre," says Kotak, adding that recreational exposure — swallowing algae-laden water, as opposed to skin contact — is what poses a real danger to humans.

Discovery

Biologist Peter Leavitt of the University of Regina, who studies Lake Winnipeg's historical composition by analyzing layers of sediment, puts the emerging science into context. "The lake is far worse than, or at least every bit as bad as, the Great Lakes were at the height of their problems in the 1960s," he says. "Back then, we changed our laws with respect to phosphorus and we changed all the waste-water plants in most of the major cities. So why aren't we doing it here?"

The answer is complicated. A fisheries boom has mirrored the nutrient surplus, for one thing. Livestock farming, especially swine, and the crops that sustain it are big, vital industries too. And while solutions can be actively demonstrated,

Research vessel MV *Namao* plays a key role in studies on Lake Winnipeg, helping scientists assess the state of the lake.

including a range of small-scale wetland-creation projects, the sheer size and complexity of the watershed presents a hefty challenge.

More important, the frame of reference for crafting an appropriate remedy hasn't existed before. As of 2011, we know that while Lake Winnipeg is very much alive, it is evidently quite sick, and it's time to start buying prescriptions.

Eric Rumble

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