

Death on the Great Lakes

The large-scale die-offs of Ontario's water birds have left researchers struggling to find ways to stop what has become an annual tragedy.

By Conor Mibell



Aquatic birds litter the Georgian Bay shoreline in the aftermath of a food poisoning epidemic

On a blustery weekend in late October of last year, George Peck, along with many other Ontarians, watched in horror as thousands of dead ducks, loons and grebes washed up on one of the province's most popular beaches. When a friend brought seven dead ducks collected from the Georgian Bay shores of the Collingwood area to him, Peck, a local veterinarian and a Royal Ontario Museum ornithology research associate, decided to visit Wasaga Beach and witness the grisly scene first-hand. As he walked the shoreline, he saw hundreds of long-tailed ducks, red-necked and horned grebes, and common loons within a mere half kilometre. All had been washed ashore "in perfect shape" by strong north-west winds.

"It was like they'd died only hours before I saw them," says Peck. "I heard that the count was about 6,000 bodies before local officials stopped keeping track. Eventually, they started picking them up in a garbage truck."

Shortly after Peck's shocking experience, the Ontario Ministry of Natural Resources (MNR) confirmed that Type E botulism was responsible for the massive die-off. It turns out that the phenomenon has occurred annually since an outbreak on the southeastern shore of Lake Huron in 1998, resulting in the deaths of nearly 100,000 waterbirds on Lakes Huron, Erie and Ontario over the past 13 years.

Botulism is a naturally occurring bacterium that proliferates in the absence of oxygen and in decaying animal matter. "It's part of the putrefaction process, nature's way of

dealing with dead organisms," says John Cooper, a spokesperson in MNR's fish and wildlife services. But botulism also causes a lethal type of food poisoning that moves up the food chain from contaminated zebra and quagga mussels to round gobies and mollusc- and fish-eating ducks and aquatic birds. It attacks the nervous system and paralyzes its host, ultimately causing drowning or suffocation. It kills gulls, terns and cormorants, bottom-dwelling fish such as sturgeon, and terrestrial scavengers, including crows and bald eagles. (People rarely contract Type E botulism because cooking kills the toxin and bacteria spores.) Since many of the afflicted migrating waterfowl, loons and grebes gather and feed in water far from shore, some of the lifeless birds sink without a trace, while others drift with the winds, washing ashore in waves of carcasses like those that littered the beaches of Nottawasaga Bay last October and November. As a result, Cooper says, getting an accurate casualty count is almost impossible.

The botulism deaths seem to be directly related to a suite of environmental challenges that are altering the ecology of the Great Lakes: invasive species, encroaching development, and warmer water temperatures due to climate change. "I can go out every week from July until early December and there's not a single beach on Lake Ontario that doesn't have dead birds on it," says Tyler Hoar, an Oshawa-based wildlife biologist who has performed surveys of botulism events for the Canadian Wildlife Service. "There's nothing anyone can do to stop it when an outbreak happens."



The epidemic has proven revelatory in two important ways. First, it shows that large numbers of migrating aquatic birds rely on the Great Lakes as critical foraging areas and habitat. More broadly, it is bringing into focus the myriad ways in which ecosystems are connected. In September, Hoar observed dead white-winged scoters and red-necked grebes on his weekly field surveys, which range along the Lake Ontario shore from Toronto's east end to Prince Edward County, near Belleville. Scoters and grebes breed in the boreal forest of northern Ontario and stop over on the Great Lakes en route to the east coast in the fall. Hoar watches the first waves of common loons start washing ashore in October, as Ontario's iconic waterbird migrates from breeding lakes on the Canadian Shield to its wintering grounds on the U.S. Atlantic and Gulf of Mexico coasts. Then, throughout November, he documents the deaths of thousands of Arctic-breeding long-tailed ducks, a species that spends the winter on Lake Ontario.

The Canadian Cooperative Wildlife Health Centre, which has its Ontario/Nunavut branch at the University of Guelph, lists 22 avian species, including greater scaups, red-breasted common mergansers, goldeneyes, great blue herons and semipalmated sandpipers, among the affected birds. "So many breeding birds are getting hit," says Hoar. "It makes you wonder about the long-term effect on populations." Botulism's killing tide finally ebbs when the first ice crusts the shoreline in December. But questions linger in its wake, as do worries

about the inevitability of the deadly cycle beginning again the following summer.

With millions of waterfowl migrating through the Great Lakes each spring and fall, it's easy to see how habitat changes and something as insidious as food poisoning could wreak widespread havoc. The majority of Ontario's breeding population of more than 50 species of ducks, geese, swans, loons and grebes winter on the Atlantic coast, making Lakes Huron, Erie and Ontario "continentally significant" staging areas on the flyway, says Scott Petrie, the executive director of Long Point Waterfowl, a nonprofit, nongovernmental research organization. Agricultural fields, coastal wetlands and open water are migrants' roadside rest stops: Here the birds refuel and recuperate during the long flight south. In the spring, staging areas are critical in preparing aquatic birds for successful breeding; in the fall, such areas allow birds to acquire the energy stores needed to complete their long-distance flights. Accordingly, the birds are attracted to these sites for their rich food sources and protection from predators, as well as the sites' proximity to the flight path.

Common loons are a good example of how migrating aquatic birds use the Great Lakes. Loons are among the first to depart their wintering grounds on the Atlantic coast in the spring to head north, where breeding pairs will typically claim the same territory year after year. "There's huge selection pressure for loons to get back to their territory quickly



Tyler Hoar with the Canadian Wildlife Service says that when a botulism outbreak occurs, “there’s nothing we can do to stop it.”

to claim it,” says Doug Tozer, an aquatic surveys biologist with Bird Studies Canada, a nonprofit organization, based in Port Rowan on Lake Erie, that conducts bird research and public education. “They want to be there right after ice-out. The Great Lakes are a good one-stop shop to park, refuel and wait until the ice melts on lakes in, say, Algonquin Park, because the water’s open.”

While fish eaters such as loons and mollusc eaters such as long-tailed ducks mostly inhabit open water, shallow-diving ducks, for example goldeneyes, buffleheads and mergansers, find respite in coastal wetlands and near shore habitats. (These critical inshore habitats have come under significant threat from development and sprawl.) Petrie estimates that 85 to 90 percent of coastal wetlands on the lower Great Lakes have disappeared. Large portions of remaining habitat are preserved in provincial parks such as Long Point, Rondeau, Turkey Point and Presqu’île. He says duck hunters have played a huge role in conserving waterfowl habitat, particularly around Lake St. Clair, a shallow body of water between Lakes Erie and Huron. “If hunting ended tomorrow, virtually all of the wetlands associated with Lake St. Clair would become vegetable gardens,” says Petrie, who estimates that most of his organization’s \$600,000 operating budget comes from duck hunters. “Migrating ducks have depended on these wetlands for thousands of years. Yet we continue to degrade them with industrial [activity], invasive species and direct drainage.”

Wind turbines rarely kill waterfowl directly, says Petrie, but they do take up critical habitat that’s already in short supply. He’s calling for tighter regulations on wind-farm projects to keep them a minimum of two kilometres from waterfowl staging areas. He is also concerned about the inroads non-native mute swans are making in southern

Ontario. These aggressive competitors have been shown to best waterfowl species for food in places such as the Chesapeake Bay area of the U.S. Atlantic coast and are increasing in number in the Great Lakes watershed. Canadian Wildlife Service waterfowl biologist Jack Hughes adds that yet another hazard for waterfowl are fluctuating water levels on Lake Huron, which cause important marsh habitat, characterized by patches of open water and emergent vegetation, to dry up, making it less suitable for such birds.

There are some positive developments. Initiatives such as duck stamps, which earmark a portion of waterfowl hunting-licence fees for habitat conservation programs, and the North American Waterfowl Management Plan, an international agreement to preserve wetland and upland habitat that Canada and the United States signed in 1986 and Mexico signed in 1994, have made great strides in stabilizing populations, says Hughes. Meanwhile, cleanup campaigns sanctioned by the binational Great Lakes Water Quality Agreement at so-called Areas of Concern – Nipigon Bay at Lake Superior and Lake Ontario’s Bay of Quinte to name two – have launched long-term projects to restore historical habitat. Invasive species, such as zebra mussels – a new, plentiful food source – have played a role in bolstering populations of scaup, scoters and long-tailed ducks, says Hughes. As well, climate change has enabled these same species to winter on the Great Lakes, truncating fall migrations. “The ducks seem to have adapted to disturbance,” says Hughes. “Anywhere that wetlands have been degraded, we’re seeing fewer ducks, but there have been no huge declines in numbers.”

But invasive species and climate change are double-edged swords, scientists warn. In bringing on botulism epidemics that now linger for up to six months of the year, they could have irrevocable devastating effects on aquatic birds. More

than a decade of annual die-offs on the Great Lakes has illustrated the deadly consequences when migrating waterfowl, loons and grebes descend on traditional staging areas to feast on toxic prey.

Since 1998, University of Guelph veterinary pathologist Doug Campbell has examined botulism-killed birds by the garbage-bag load for the Canadian Cooperative Wildlife Health Centre, an organization with regional laboratories across the country that study wildlife health and disease, searching for an answer to the botulism epidemic. Researchers know that Type E botulism thrives in relatively warm, oxygen-depleted waters that contain an excess of decomposing “protein substrates,” or carcasses, says Campbell, but they can’t pinpoint exactly how it enters the food chain.

One popular theory is that massive communities of filter-feeding zebra mussels concentrate the spores and thus catalyze outbreaks. MNR’s Cooper points out that the locations of botulism events have matched the spread of zebra mussels and round gobies in the Great Lakes. These two species were first discovered in Lake St. Clair and the St. Clair River in 1988 and 1990 respectively, and are among the dozens of aquatic freeloaders carried from Europe to North America by ocean-going cargo ships and discharged into the St. Lawrence Seaway in ballast water. An individual zebra mussel is capable of producing a million eggs in a spawning season, a figure that explains how this small organism managed to spread so quickly throughout the lower Great Lakes and many inland bodies of water in southern Ontario. MNR invasive species biologist Jeff Brinsmead says that goby populations spiked in parallel with those of zebra mussels in a predator-prey relationship known as an “invasional meltdown,” whereby one exotic species facilitates the establishment of another. By the time the first botulism die-off was reported in Lake Huron in 1998, zebra mussels and round gobies were widespread throughout Lakes Huron and Erie.

Mollusc eaters like long-tailed ducks appear to be poisoned by consuming contaminated zebra mussels and closely related quagga mussels, another invasive species that arrived in Lake Ontario via ships’ ballast around the same time as the zebra mussel. Campbell suspects that round gobies pick up the bacteria by consuming zebra mussels. Gobies live on the lake bottom and can change their coloration to escape predators. But once poisoned, they swim erratically, says Cooper, and the pronounced black stripes that appear on their bodies make these fish even more conspicuous. “Now we have a fish that’s obviously struggling and easily seen,” explains Cooper. To a deep-diving bird, contaminated gobies are easy targets and so are devoured in disproportionate numbers.

Researchers have put forth various theories about the annual die-offs. Some point out that blooms of blue-green algae, a deadly toxin that also proliferates in oxygen-poor environments, affect aquatic birds. Others note that entanglements in commercial fishing nets can cause life-threatening injuries. But Campbell has all but dismissed these hypotheses. The sheer number of species affected makes it possible to rule out viruses like encephalitis, because they tend to be specific to certain species. Campbell’s lab has

Invasive species

A common trait most of the 185 invasive species known to inhabit the Great Lakes basin share is the ability to rapidly oust native flora and fauna. Since their arrival in 1988, zebra mussels have all but eliminated the lower lakes’ native mollusc population of freshwater clams. Because zebra mussels and quagga mussels, a similar invasive species that’s capable of living in deeper water than the zebra mussel, forage by filtering up to a litre of water per day, they also decimate native populations of diporeia. This small, shrimp-shaped zooplankton typically comprises 70 percent of the biomass in lake-bottom sediments and is an important food source for whitefish and sculpin.

In less than five years, zebra and quagga mussels have caused diporeia populations to crash, effectively short-circuiting the aquatic food chain, says Geoff Peach, coastal resources manager at the Lake Huron Centre for Coastal Conservation, a Goderich-based nonprofit organization. “We haven’t seen things play out yet, but it’s pretty obvious that when you take out the base of the food chain, the effects are felt all the way up.”

Terrestrial species such as the common reed, an exotic beach plant that originated in Europe and Asia and grows up to five metres in height, are also causing widespread destruction. Peach says once-diverse coastal wetlands on Lake Erie have become common reed monocultures. On Lake Huron, common reed effectively forms a barrier that eliminates sand movement in dunes and threatens endangered native species such as pitcher thistle. Perennially low water levels in Lake Huron have provided plenty of prime habitat for the reed, says Peach, increasing its rate of dispersal across a swath of coastline from Sarnia to Tobermory and into Georgian Bay.

Reining in the invaders is challenging. Peach’s organization offers landowners and municipalities tips on eradicating the common reed – a process that involves intense manual labour or the use of powerful herbicides. However, “On the scale of the Great Lakes, we’re never going to get rid of invasive species,” says Brinsmead. “Once they’re here and established, a population can never be eradicated.”

Visit the website of the Lake Huron Centre for Coastal Conservation to download resources about controlling the spread of invasive species: www.lakehuron.ca.

Conor Mihell



Zebra mussels may be a catalyst for widespread outbreaks of food poisoning.

performed more than 1,000 post-mortems on birds suspected to have been killed by botulism. These examinations involve looking for signs of disease, studying the digestive system to determine what the bird was eating, and evaluating overall body condition. “The pattern with botulism is that the birds are well muscled and fat, and there’s very little evidence of injuries or other disease,” Campbell notes. “They’re almost always in really good body condition, probably because they’re migrating.”

Common loons have been particularly hard hit. According to the New York State Department of Environmental Conservation, an estimated 10,000 loons died in botulism events on Lake Erie between 2000 and 2003. On Lake Ontario, wildlife biologist Hoar has recorded annual averages of up to three dead loons per kilometre of shoreline on the weekly surveys he’s conducted since 2008. Bird Studies Canada’s Tozer believes loons have become harbingers of botulism outbreaks because they home in on abnormal prey while feeding and “inadvertently pick out all the fish that have the toxin.”

Populous species of waterfowl with high rates of reproduction, long-tailed ducks would be one such species, may be able to weather the death toll, but Tozer worries about the effect of botulism on Ontario’s loon population. Estimated at 97,000 breeding pairs, the province’s loons are far from endangered. But the species’ long lifespan makes the birds

more vulnerable because of their slow reproduction rate. According to the U.S. Fish and Wildlife Service, common loons live up to 30 years; during this span, a breeding pair produces only four or five successful offspring.

Tozer’s number crunching suggests that the reproductive success of the Canadian loon population is decreasing, probably because of a combination of factors. Hunting and shoreline development have wiped out loons from historical breeding habitat on the Great Lakes; methyl mercury, another aquatic neurotoxin that occurs in flooded areas such as reservoirs and increases in concentration as it moves up the food chain, has been shown to alter loon behaviour, hindering breeding success and decreasing long-term survival; cottage lots and powerboats have destroyed nesting sites on Canadian Shield lakes; and the lingering effects of diminished fish stocks due to acid rain continue to ripple through loon populations. “The viability of the breeding loon population in Ontario and Quebec is vital to the long-term health of the Common Loon,” concluded a 2004 U.S. Fish and Wildlife Service assessment report. “This large population is at a crossroads because of several large-scale threats.”

According to Tozer, botulism may be a tipping point. “A few thousand deaths here and there may not seem like a big deal,” he says. “But all these impacts are chipping away at loon populations. It’s a serious concern.”

Counting loons

Thirty years ago, the Canadian Shield lakes around Sudbury were ground zero for an environmental issue that threatened to eradicate common loon populations across Canada. As acid rain wiped out fish in lakes that once provided nesting habitat for breeding loons, the surrounding hills no longer echoed with the loon’s haunting yodels and wails. About the same time, Bird Studies Canada piloted the Canadian Lakes Loon Survey, a volunteer project that encouraged cottagers, campers and residents to record the number of adult and immature loons on Ontario lakes. The effort was aimed at giving biologists a better idea of loon distribution and of this species’ preferred habitat and tolerance for development. Most importantly, the surveys offered scientists annual reports on reproductive success.

“We get information on the number of young that pairs of loons are producing,” says Bird Studies Canada aquatic surveys biologist Doug Tozer. “If an immature loon makes it to six weeks old, its chance of surviving goes way up. This information is a good metric of reproductive success.”

The survey is designed to be easy for people to complete. Key observations include the number of loon pairs, chicks and immature loons at the end of the summer. Tozer says the survey data have helped researchers understand how the species’ 30-year lifespan influences its population size. Even today, with the recovery of acid-tainted lakes, environmental damage done three decades ago continues to affect Ontario’s loon population, says Tozer. “What we’re seeing is that birds [on acidified lakes] reproduce at a much lower rate. The lag time could be quite long before we start seeing a reduction in numbers and a retraction in the breeding population.” If Tozer’s hypothesis that loon populations are decreasing is correct, the volunteers will be the first to detect the change.

For more information about the Canadian Lakes Loon Survey, visit www.birdscanada.org/volunteer/cills.

C.M.

Common loons have been especially hard hit by feeding on toxic fish.



PHOTO RON ERWIN

Habitat and oil spills

An aquatic bird's breeding success on its summer grounds is directly related to the quality of its wintering habitat. The majority of waterbirds that breed in Ontario spend their winters on the Atlantic coast, from Newfoundland to the tip of Florida, and along the coastline of the Gulf of Mexico. Michael Schummer, a scientist at Long Point Waterfowl, describes the winter season as "survival mode" for aquatic birds. Sufficient food to maintain body fat and refuge from predators are equally important to ensuring that birds are in top condition for the spring migration and summer breeding season.

While catastrophes like the 2010 Deepwater Horizon oil spill in the Gulf of Mexico receive lots of press, Tom Moorman, Gulf States-based director of conservation planning for Ducks Unlimited, says chronic habitat loss is "a more insidious threat." Almost 40 percent of Louisiana's Gulf Coast wetlands have been lost due to drainage flood control and oil and gas exploration. In comparison, the effects of the Gulf oil spill have been relatively benign. Moorman says only one patch of marginal wetland habitat on the Louisiana coast was compromised, and most of the oil had dissipated before offshore waterfowl arrived in the winter of 2010.

Meanwhile, protecting habitat continues to be a challenge. U.S. authorities have implemented "no net loss" policies to ensure that developers invest in new wetland habitat to compensate for areas lost to development. These measures have helped maintain a steady quantity of waterfowl habitat in most wintering areas, says Schummer. The problem is that such policies rarely consider the quality of habitat. "There's a big difference between a pond stuck in the middle of a suburban development that's used by Canada geese and the odd mallard, and a productive wetland," notes Schummer. "As a result, we seem to be seeing steady decrease in the quality of waterfowl habitat."

C.M.

Climate scientists describe the Great Lakes as sentinels of global warming. Summer water temperatures on Lake Superior, for instance, have increased 2.5 degrees Celsius since 1980. Similar trends, as well as decreasing ice coverage in winter, have been detected on all the Great Lakes. As the waters warm, researchers agree that Type E botulism events will become more protracted, and aquatic invasive species may spread to other parts of the region, increasing the extent of outbreaks.

The media coverage generated by last year's die-off on Georgian Bay might mark a turning point in the public's appreciation of the role the Great Lakes play in supporting aquatic birds and the complex relationship between native and non-native species, climate change and disease. But perhaps the greatest problem with these outbreaks is that the public and waterfowl experts alike can do little to address botulism. At best, we can minimize the spread of exotic species like zebra mussels and round gobies, says the MNR's Cooper, and push our governments to support measures that abate climate change.

For some biologists and veterinarians, the phenomenon of avian botulism is morbidly fascinating. It's a perfect storm of climate, human actions and the converging life histories of native and non-native species – and is terribly disturbing. "When I come upon an accumulation of dead bodies on a beach, I shake my head," says Hoar. "It's really discouraging for someone who loves nature." 

*Regular contributor **Conor Mibell** has also written about black bears and wood turtles for ON Nature magazine. He is a free-lance adventure travel and environmental journalist based in Sault Ste. Marie.*

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