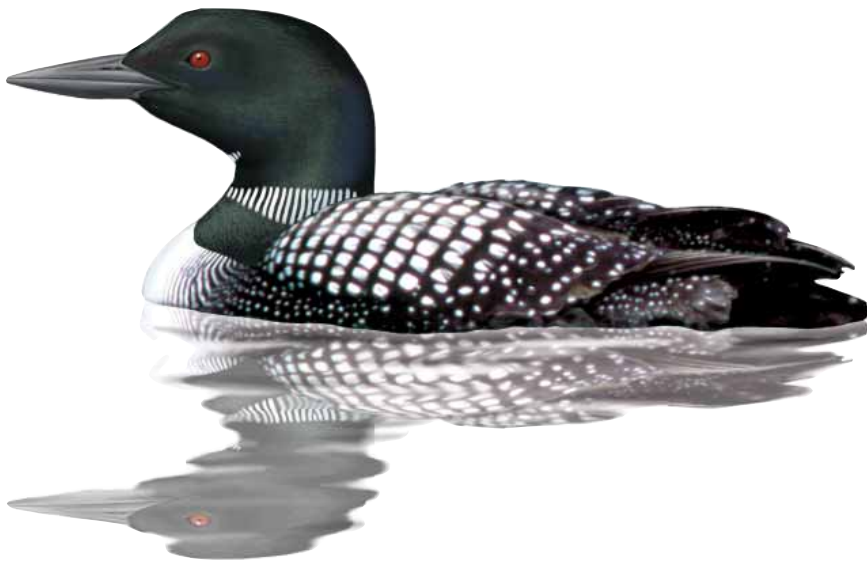




Birch trees and sandstone cliffs along Lake Superior, Pictured Rocks National Lakeshore, Michigan © Carr Clifton/Minden Pictures



Loon

and other birds of the Great Lakes

Change is under way in the Great Lakes, the source of 84 percent of North America's fresh water and more than 20 percent of the world's supply. It is a progressive sweeping change that threatens to greatly transform the ecosystems of these inland seas by warming their waters and supplanting native species with harmful invasives. And it is a change that ultimately may threaten the viability of the common loon and dozens of other birds that depend on the lakes.

Many people see invasive species as the primary challenge in restoring lakes Superior, Michigan, Erie, Huron and Ontario, and the national parks of the Great Lakes experience these challenges firsthand. But equally challenging is climate change, for its impact is felt throughout the Great Lakes region on native and non-native species alike.

Many impacts of climate change — shorter winters, precipitation changes, decreasing duration of ice cover, increasing annual average temperatures that are boosting the temperature of the lakes — are already obvious. These changes affect the native fish and birds that call the Great Lakes home. Loss of winter ice jeopardizes reproduction of native whitefish by exposing eggs to the effects

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of winter storms. Coldwater species such as coaster brook trout, found at **Pictured Rocks** and **Apostle Islands** national lakeshores and **Isle Royale** National Park in Lake Superior, are declining and will continue to do so as lake temperatures rise.

In recent years, tens of thousands of birds have perished from botulism that is erupting in the lakes, and which some scientists believe is partly a result of climate change. Species impacted include the common loon, Minnesota's state bird; mergansers, which summer and winter on portions of the lakes; Double-crested cormorants, which migrate through the region and summer on the lakes; and even the piping plover, an endangered shorebird that summers on

portions of the lakes. Climate change and invasive species impact all levels of the food chain, beginning with an "invader" from Russia.

Zebra and Quagga mussels, shellfish species from Eastern Europe, arrived in the lakes via ballast water dumped by ocean-going ships. The issue with these mussels is that they multiply rapidly and act as millions of tiny water filters in the lakes. The increasing clarity of the water, combined with the lowering lake levels and warming waters, has fostered an environment that has spurred more and more *Cladophora* blooms. Although this alga is native to the Great Lakes, its recent growth spurts are highly atypical. The algae flourish, creating piles of rotting organic matter that

provide the perfect environment for Type E botulism bacteria to thrive. Mussels eat organic matter containing the toxin, concentrating it in their bodies.

Dispersing this poison are Round Gobies, yet another invasive species. These fish came to the Great Lakes from the Black and Caspian seas via ballast water in the mid-1990s. They've managed in their new home quite well, numbering in the billions in Lake Erie alone.

The gobies dine on the mussels as well as the decaying algae and become carriers for the botulism. Then waterfowl — loons, cormorants, and mergansers as well as songbirds, raptors and other fish-eating birds — feast on the dying gobies that float to the surface or wash ashore, ingest the botulism, and die. From 1999 to 2006 an estimated 70,000 birds were killed by this toxic diet. About 3,000 dead loons and cormorants washed up on the beaches at **Sleeping Bear Dunes National Lakeshore** in 2006 alone.

So while the invasive mussels and gobies have gotten much of the attention for their role in this massive bird die-off, climate change may be a key driver. If there were no botulism toxin, there would be no die-off, and climate change is creating conditions — warmer waters, lower lake levels, and possible seasonal increases in nutrient levels — more favorable to the bacteria that make the toxin.

By themselves, invasive agents are a serious threat. Combined with climate change, however, they become devastating. Warming waters tied to climate change stress native cold- and cool-water fish populations while making the Great Lakes' habitat more conducive to non-native warm-water species, such as the common carp. These invasive fish, found at **Indiana Dunes National Lakeshore** near Chicago, then compete with the native fish for food. In all the Great

Lakes, longer duration of summer stratification will rise, increasing the risk for oxygen depletion and formation of "dead zones" for fish.

SOLUTIONS

Battling aquatic invasive species while coping with climate change will require a variety of solutions. They include further controlling phosphorous runoff that feeds algae growth, as well as tighter ballast-water regulations on ocean-going ships to control the spread of non-native species. There is also a need for physical barriers to prevent non-native species from reaching the Great Lakes via surrounding canals and waterways along with an intensive invasive species management program.

Complementing these lake-specific approaches would be an overall effort to reduce greenhouse gases that lead to global warming. The Great Lakes national parks have already shown leadership by exercising their authority to keep ballast dumping outside of park waters and by adopting "climate friendly" strategies, which include reduction of carbon-fueled park vehicles and public outreach and education.

We Can Safeguard Birds of the Great Lakes from Climate Change

Stop contributing to climate change

The ecological health of the Great Lakes and their bird populations could decline even further if we fail to reduce carbon dioxide pollution and climate change that is warming the water, aiding the spread of a toxin deadly to birds, and reducing the availability of fish.

Reduce and eliminate existing harms that make birds more vulnerable to climate change

By better controlling invasive species and polluted runoff we can retard the spread of algae and toxins, which will improve the health of the Great Lakes and help birds cope with the additional stresses wrought by climate change.

Adopt "climate smart" management practices

Understanding how climate change interacts with existing environmental stresses such as pollution and invasive species will help resource managers throughout the Great Lakes region identify and implement more effective strategies for improving the health of bird populations.