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SCIENCE

# Vast and Pristine, Russia's Lake Baikal Is Invaded by Toxic Algae

By RACHEL NUWER NOV. 14, 2016

LAKE BAIKAL, Russia — Yury Azhichakov set out early by bike for Senogda Bay, his favorite beach, on the northwestern shore of Lake Baikal in Siberia. The world's oldest, deepest and most voluminous lake, Baikal holds 20 percent of the planet's unfrozen freshwater. It is often described as the world's cleanest lake.

As Mr. Azhichakov discovered, that is no longer the case. Senogda's once pristine sands were buried under thick mats of reeking greenish-black goo.

“This stuff stretched far into the distance, for several kilometers,” said Mr. Azhichakov, 61, a retired ecological engineer. “The beach was in terrible condition.”

The muck, scientists have discovered, follows mass algal blooms at dozens of sites around Lake Baikal's 1,240-mile perimeter. Confined to shallow water and shores near towns and villages, the problem seems to stem from an influx of untreated sewage — the result of inadequate wastewater treatment.

Algal blooms threaten iconic freshwater bodies around the world, including the Great Lakes, Lake Geneva, and Lake Biwa in Japan. But Lake Baikal is especially precious: a World Heritage site home to more than 3,700 species, more than half found nowhere else.

“People are dumping sewage, waste and rubbish around the lake, creating pretty appalling conditions in some places,” said Anson MacKay, an environmental scientist at University College London.

Runoff from fertilizers and other pollutants leads to so-called eutrophication, an excessive growth of algae. These blooms eventually deplete the water of oxygen, suffocating aquatic plants and animals.

Russian scientists had assumed that Lake Baikal is simply too vast to suffer such a fate, but recent growth in tourism and development seem to be changing the calculus.

“We have a saying in Russia: A clever person is trained on the mistakes of others,” said Oleg Timoshkin, a biologist at the Russian Academy of Science’s Limnological Institute in Irkutsk, 40 miles from Baikal’s southwestern shore. “Unfortunately, we’re now repeating the mistakes of so many other countries.”

Dr. Timoshkin and his colleagues have found that *Spirogyra*, a type of green algae that had rarely grown in Lake Baikal’s shallow zones, accounts for the outbreaks.

In Severobaikalsk, Mr. Azhichakov’s town, the researchers traced *Spirogyra* blooms to locations downstream of the town’s wastewater facility, as well as to an illegal sewage dumping site.

The researchers also found little difference in phosphorus and nitrogen content — indicators of synthetic detergents and fecal material — in treated and untreated water entering the lake. And, as it turned out, Russian Railways had been adding industrial-grade waste to the town’s sewage system, overwhelming it.

Despite remedial action, high levels of phosphorus and nitrogen in Severobaikalsk’s wastewater persist even today, and fecal bacteria in treated wastewater have turned up at various sites around Lake Baikal. Dr. Timoshkin’s team is trying to figure out which nutrients are fueling *Spirogyra*’s growth.

*Spirogyra* smothers other species of algae, and thousands of empty snail shells — gastropod cemeteries, as Dr. Timoshkin calls them — regularly wash up alongside

the blooms. But the damage is more extensive than that.

Underwater forests of native Lake Baikal sponges have begun dying off. In nearly 90 dives around the lake, researchers have found that 30 to 100 percent of sponges are affected in a given area. The green stalks — some a century old — are turning a dull brown, reminiscent of cattails.

The cause of death is unknown, although Dr. Timoshkin and his colleagues suspect that pathogens from sewage may be causing disease outbreaks, or that the influx of nutrients is causing symbiotic algae to vacate the sponges.

Without intervention, the researchers believe that the environmental damage will worsen. Algal blooms, for instance, can produce neurotoxins that are harmful to fish and crustaceans — and the humans who consume them. Last year, the largest algal bloom ever recorded shut down the crab and clam fisheries along the West Coast of the United States.

Along Lake Baikal, some locals say they can no longer drink water from their taps during blooms. Fishermen complain of *Spirogyra* tangling in their nets.

“Will Baikal be able to attract the same amount of tourism, which is a major part of the economy, if tourists show up and see a green lake?” said Ted Ozersky, a limnologist at the University of Minnesota Duluth.

In 2014, Dr. Timoshkin testified before the Duma, Russia's Parliament, about Lake Baikal's problems. Earlier this year, he and his colleagues also published their findings in *The Journal of Great Lakes Research*. They are calling for an immediate ban on synthetic detergents and for help from the federal government in reforming sewage facilities around the lake.

But such fixes will probably be slow to come.

Some government officials and academics insist that the problems are caused by climate change, not pollution; others blame mud volcanoes, or even say that Lake Baikal's eutrophication is a lie made up by scientists to gain funding. Russia's Ministry of Natural Resources and the Environment has yet to formally acknowledge that the lake's health is in question at all.

“One of the tragedies of Baikal is that top-level, senior scientists who are themselves never on a field expedition mistakenly believe that the lake can never be eutrophied because it is too huge, too pure and full of too much water,” Dr. Timoshkin said. “It’s an easy idea to have, but it’s wrong.”

Even as federal aid stalls, some people are attempting to address the problems where they live, organizing beach cleanups and trying to find ways to put the thousands of pounds of washed-up *Spirogyra* to use as fertilizer or material for making traditional Siberian paper.

Marina Rikhvanova, an award-winning environmental activist in Irkutsk who helped raise initial awareness about the *Spirogyra* outbreaks, persuaded a local investor to fund a plan for a prototype sewage treatment plant. “More and more people with various specialties and interests are working together for the lake,” she said. “This, at least, is a source of optimism.”

Eutrophication, however, is not the only threat to Lake Baikal.

Mongolia is planning to build up to eight hydroelectric dams on the Selenga River and its tributaries, the source of 50 percent of Lake Baikal’s surface water. Despite hearings and protests in Russia and Mongolia, the Mongolian government — which imports around 8 percent of its energy from Russia and 12 percent from China — argues that the dams will help achieve energy independence and cut back on coal use.

Some experts think there must be a better way. Mongolia can technically produce around 100 gigawatts of power from wind and solar in their part of the Gobi Desert alone — about 90 times the country’s current capacity, said Eugene Simonov, an international coordinator with the nonprofit Rivers Without Boundaries Coalition.

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“Instead, the plan is to first build dams, then to develop a huge capacity to produce thermal energy from coal, then to build the next generation of big dams to offset the negative effects of coal on the climate and then, finally, to use some of the proceeds to build true renewables.”

Researchers predict that Mongolia’s dams would have significant ecological effects on Lake Baikal, including disrupting the flow of water and sediment into the lake, effecting the quality of breeding sites for birds and fish, and blocking migration routes.

“This is likely to be yet another step toward biotic homogenization, where widely distributed, cosmopolitan species like pike increase while unique endemic species like taimen lose ground,” said Olaf Jensen, an aquatic ecologist at Rutgers University. “It’s kind of the ecological equivalent of Starbucks replacing the local bodega.”

Heeding such warnings, China, which is funding the largest of the projects, in July froze all dam construction until Mongolia and Russia jointly assess potential effects on the lake. “This is important, but just a small step in the right direction,” Dr. Simonov said.

In October, however, Russian and Chinese tourism firms announced intentions to invest \$11 billion in developing new hotels, attractions and infrastructure around the lake — a plan that Marianne Moore, an aquatic ecologist at Wellesley College, called “chilling.”

“Even if the project is tightly regulated by the government, I’m unsure whether the coastal zone could be developed sustainably without harming it,” she said. “Nutrient pollution from human waste and shoreline erosion will be enormous problems.”

Overshadowing the threat of pollution and dams, however, is climate change, the effects of which are already being felt at Lake Baikal. Summer surface waters lake-wide have warmed about two degrees Celsius since 1977, and winter ice cover has decreased in duration and thickness compared with a century ago.

Plankton species associated with warm water have also increased in summer months. “The question that many ecologists are asking now is whether the endemic, cold-loving species will be able to adapt and persist if warm-loving species begin increasing in abundance,” Dr. Moore said.

Another unanswered question is how the triple stressors of pollution, dams and climate change might combine to produce even greater effects on the lake. As Dr. Moore said, “Correcting the problems that we do have control over will help the lake respond as best it can to climate change.”

But that first requires acknowledging that Lake Baikal is “absolutely ill,” Dr. Timoshkin said.

“Will we Russians be able to show the world that Baikal can avoid the common fate of so many other lakes? That is a question I ask from the bottom of my heart.”

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