The end of Darwin's nightmare at Lake Victoria?

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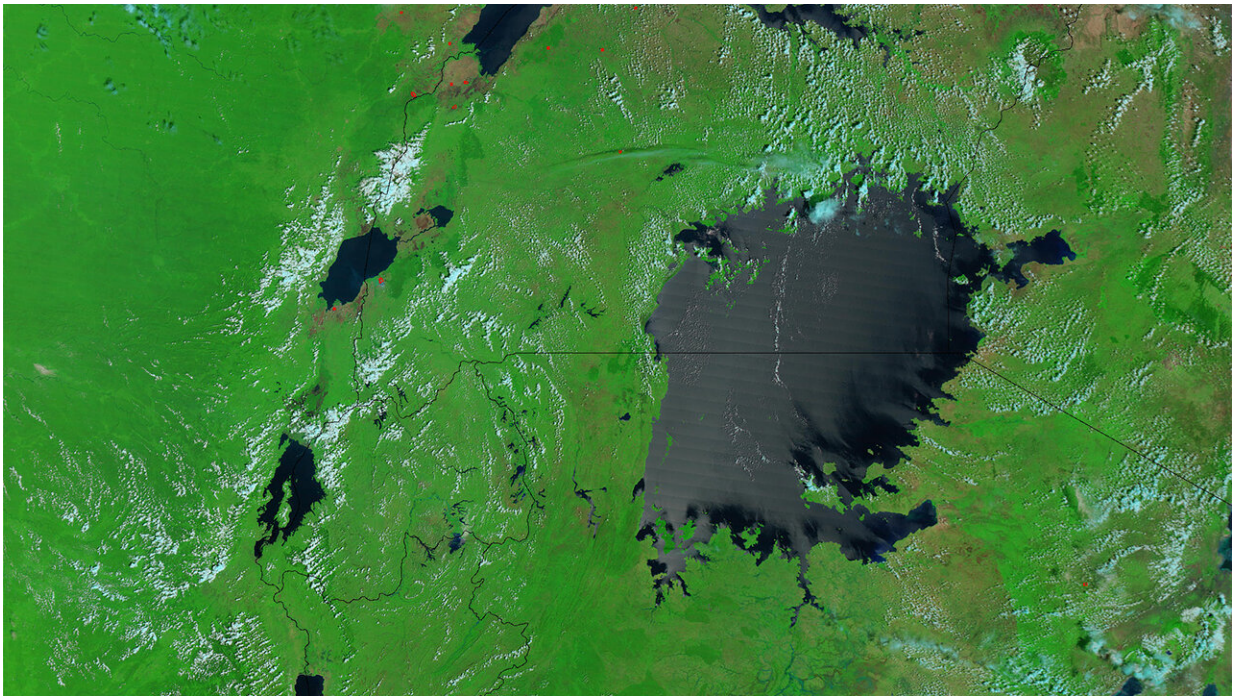

Lake Victoria is the largest of the African Rift Lakes, as seen from space (https://visibleearth.nasa.gov/)

Lake Victoria, which came under the spotlight in 2004 by the documentary "Darwin's Nightmare," is not only suffering from the introduction and commercialisation of the Nile perch. A study lead researchers from the University of Liège (Belgium) has highlighted other worrying phenomena, particularly climatic ones, which have an equally

important impact on the quality of the lake's waters.

Located in East Africa, just south of the Equator, Lake Victoria is the source of the Nile and is the largest tropical lake in the world. With a surface area of 68,800 km^2 (twice the size of Belgium), it is considered to be one of the largest water and fishery resources in East Africa, supporting more than 47 million people in the three neighbor countries (Uganda, Tanzania and Kenya).

Lake Victoria is best known to the general public following the release of the 2004 documentary "Darwin's Nightmare," which focuses on the environmental and social effects of the Nile perch fishing industry. Voracious predator that can grow up to two meters long and weigh 200kg, the Nile perch is the largest freshwater fish. Its introduction into Lake Victoria in the 1950s and its population explosion in the 1960s gradually wiped out the native fish species living in the lake, causing a major ecological disaster. Today, the Nile perch population remains ubiquitous but has declined slightly due to overfishing, allowing some species to partially recover.

What is less well known but equally damaging to the ecosystem—and perhaps interacting with the presence of the Nile perch—is the general water quality of the lake.

"This declined sharply between the 1960s and the 1990s due to eutrophication, which is caused by increased inputs of nutrients (nitrogen and phosphorus) into the water bodies (rivers and lakes) as a result of increased human activities in the catchment area (intensive agriculture with fertilizers or domestic wastewater) resulting from population growth and economic development, explains Alberto Borges, FNRS Research Director at the Laboratory of Chemical Oceanography from the University of Liege. "This eutrophication leads to a significant development of micro-algae (phytoplankton). In particular,

cyanobacteria, blue-green micro-algae, can be problematic for human health as some forms are toxic. Moreover, the excess phytoplankton biomass (the organic matter from these algae) cannot generally be transformed by the rest of the food web." This excess remains unused and stagnant at the bottom of the lakes, creating a phenomenon of anoxia, the absence of oxygen in the bottom waters of the lakes. This leads to the degradation of the ecosystem."

Since the 1990s, no large-scale study of the water quality of Lake Victoria had been undertaken. It was within the framework of the LAVIGAS project—funded by the FNRS and led by Alberto Borges—that a research team was able to study the biomass and composition of phytoplankton as well as the nutrient status of the lake during three scientific missions (2018 -2019). "This study shows that the phytoplankton biomass has decreased by about seven times compared to the 1990s," says the researcher, "and that the species composition has also changed in a subtle way." What seems to be good news for the environment of Lake Victoria may only be so on the surface.

Paradoxically, the quantity of nutrients remained comparable to that of the 1990s. This is because in addition to nutrients, phytoplankton (like all plants) also need light to grow. In lakes, the amount of light for phytoplankton obviously depends on the solar radiation at the surface of the lake, but also on the depth of the water on which the phytoplankton cells reside. This depth, known as the mixing layer, depends mainly on the intensity of the wind. If the wind is intense, the depth of the mixing layer is greater, and the phytoplankton cells spend less time near the surface where the light is more intense, and do not develop as well. The work shows that current weather conditions are windier than in the 1990s, so the depth of the mixed layer is greater and phytoplankton growth less intensely than in the 1990s. The weaker winds of the 1990s were related to the prevailing conditions of El Niño, a natural oscillation in global climate that originates from the large-scale atmospheric

circulation over the Pacific Ocean and affects climate worldwide.

"This complex story shows that the established climate regime in the Pacific Ocean (El Niño) affects the ecology of a lake in Africa, on the other side of the planet. More specifically, it shows that the growth of phytoplankton—and therefore the rest of the food chain—in large tropical lakes responds to eutrophication in a complex way and is strongly modulated by climate," says Alberto Borges. "This means that the current improvement in water quality in Lake Victoria may only be temporary, and that conditions could deteriorate again in the future if vertical mixing in the lake decreases due to reduced wind intensity (a new period of prevailing El Niño conditions) or due to continued climate warming."

More information: Loris Deirmendjian et al, Limnological changes in Lake Victoria since the mid-20 th century, *Freshwater Biology* (2021). DOI: 10.1111/fwb.13780

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