doi.org/10.22498/pages.horiz.1.36

Lake mud detectives

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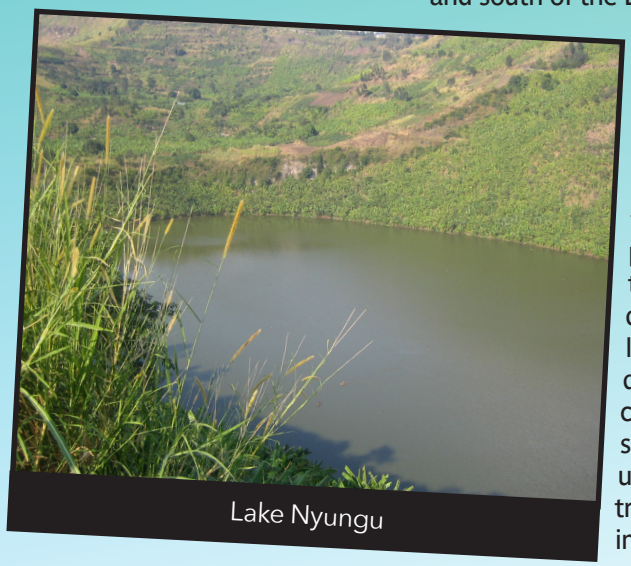
Lake Nyungu in Uganda provides important water resources to local communities, but faces increasing pressure from human activities. To learn more about how to take care of Lake Nyungu and how to best help the communities living nearby, we asked ourselves a couple of questions: how has the lake and the surrounding environment changed in the past due to human activities? Can we predict how the lake will respond to current pressures?

HUMAN IMPACTS ON LAKE NYUNGU

Unfortunately, Lake Nyungu is under increasing pressure from human activities, such as the clearance of natural vegetation near the lake to create space for growing crops. These crops are essential for feeding local communities. This has led to the land surrounding the lake becoming more easily eroded, so during periods of heavy rainfall large amounts of soil are washed into the lake. This threatens the ability of the lake to provide drinking water and support fishing, which is an important protein source for nearby communities.

By understanding how Lake Nyungu responded to human activities in the past, we can predict how the lake will react to current and future pressures. This will help local communities to manage the lake and surrounding area in such a way that will continue to protect the lake and the resources it provides in the future.

Monitoring of the crater lakes (water pH, salinity, and oxygen content) and the climate they experience (temperature and rainfall) began 30 years ago. To find out about how the lakes have responded to environmental change even further into the past, we have to use a natural record of the lake and its surrounding environment.


Lake Nyungu

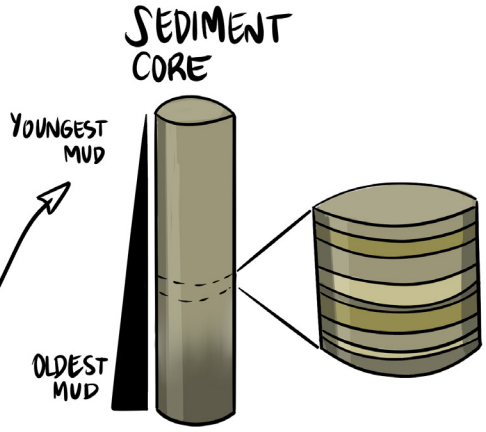
TROPICAL LAKES

Forty percent of the world's lakes are located within tropical latitudes (between 23.5° north and south of the Equator). However, tropical lakes have not been studied as much as lakes in other parts of the world. Seasons, which affect the mixing patterns of lakes, are less pronounced in the tropics compared to temperate regions. This means that tropical lakes function differently to lakes in higher latitudes, so may respond differently to environmental change. We hope our research will help improve our understanding of how other tropical lakes in Africa are impacted by humans.

Traveling back in time

Sediment (mud) cores are our natural record of the lake's past conditions and the surrounding environment. They can date back hundreds or even thousands of years!

Layers of sediment build up on the bottom of the lake over time, recording what the environment was like when they formed.



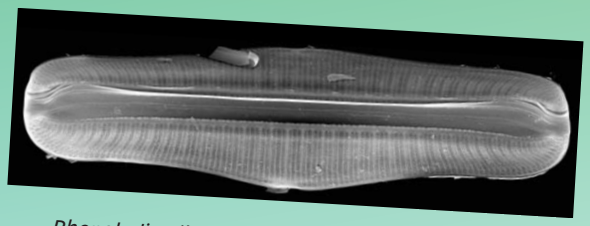
We work out how old the sediments are by measuring how radioactive the mud is at several depths down the core.

RECONSTRUCTING THE PAST

Clues about the lake's past are preserved in the lake sediment (mud). These clues are called **environmental proxies**. By analyzing these clues in the lab, we can build up a picture of the lake's environment hundreds and even thousands of years ago, like detectives at a crime scene working out what happened from a few clues left behind.

Diatoms, tiny single-celled algae, are one kind of environmental proxy. They are about a hundredth of a millimeter (about 0.0004 inches) in diameter – this is approximately the width of a human hair! They photosynthesize and live in all water bodies on Earth. Their cell walls are made from silica (glass), a structure that can be preserved for millions of years. The types of species found in the sediment can give us clues about the lake and wider environment when the diatoms were alive; for example, some diatom species thrive in cold water, whereas other diatom species prefer warmer conditions.

This is a diatom species called *Rhopalodia gibba*. It lives in lakes and other water bodies that are alkaline (where the lake water pH is greater than 7). When this species is found in high abundances, we can tell that the environment has been disturbed by humans. This is because farming can cause more nutrients to be washed into the lake, which causes more algae to grow than usual, and changes the chemical composition of the lake (such as pH, salinity, and oxygen content).



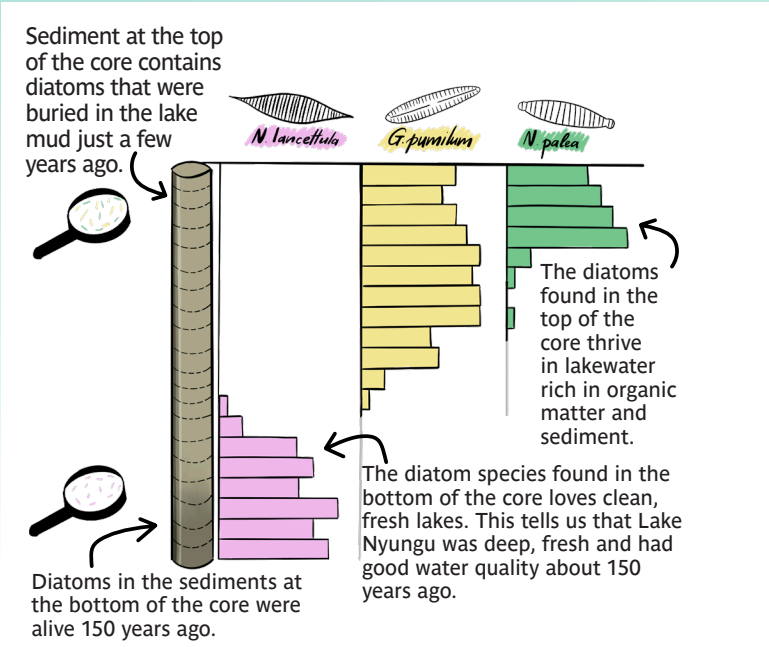
Rhopalodia gibba (photo from Wang et al. 2010)

Lake Nyungu diatom record

We took a sediment core from Lake Nyungu and looked at how the species of diatoms present in the core have changed over the last 150 years.

The diatom species *N. lancettula* loves clean, fresh lakes, whereas *G. pumilum* and *N. palea* thrive in dirty lake water that contains a lot of organic matter and sediment. The major shift in diatoms species in the sediment core from *N. lancettula* at the bottom of the core to a combination of *G. pumilum* and *N. palea* at the top of the core suggests that the water quality of Lake Nyungu has declined over the past 150 years.

The diatom record, combined with a number of other environmental proxies from the sediment core, suggests that the change in water quality is because more sediment is being washed into the lake from the surrounding area. This is a result of vegetation being cleared from the area around the lake to make room for growing crops. The removal of vegetation means the surrounding area is less stable, so soil is more easily washed into the lake.



LOOKING AFTER LAKE NYUNGU FOR THE FUTURE

Our results show that removal of vegetation in the catchment has led to a decline in water quality at Lake Nyungu over the last 150 years. By restoring the catchment to what it was like before humans had a significant impact, water quality at Lake Nyungu will improve.

Helping local communities implement sustainable land management practices and replanting natural vegetation on the land surrounding the lake will improve the water quality and make sure that the local communities have access to clean water and fish from Lake Nyungu. This helps to achieve the United Nations' Sustainable Development Goals 2 (zero hunger) and 6 (clean water and sanitation) in the area.

Things to think about...

Which of these diatom species do you think we also found in the lakes that haven't been affected by humans?

What else do you think could affect lake water quality? Could climate change be important?