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Rapid drying of large, deep lakes in the karst mountains of the Lacandon Forest, southern Mexico

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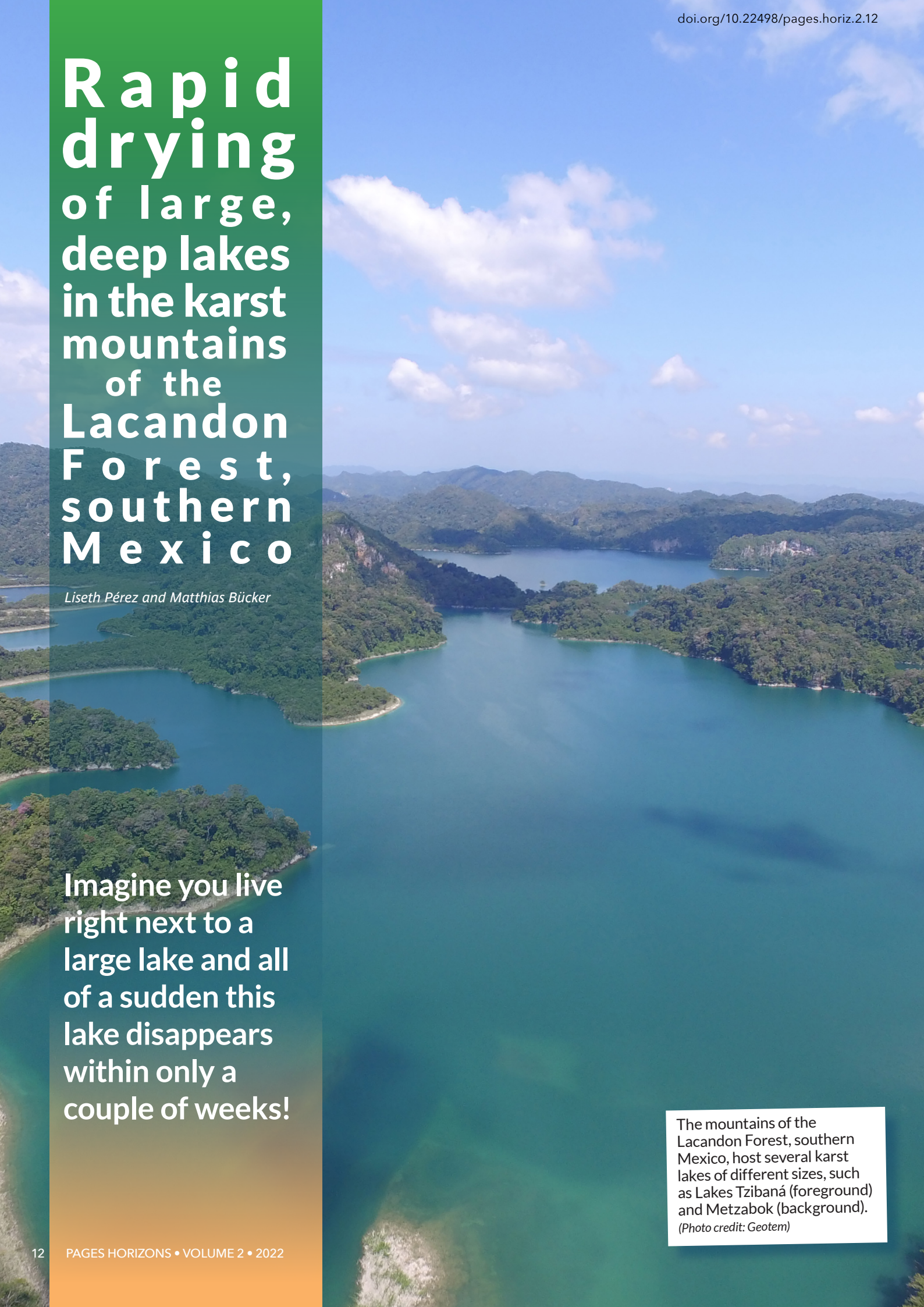
Imagine you live right next to a large lake and all of a sudden this lake disappears within only a couple of weeks!



The mountains of the Lacandon Forest, southern Mexico, host several karst lakes of different sizes, such as Lakes Tzibaná (foreground) and Metzabok (background). *(Photo credit: Geotem)*

In July 2019, this happened to the Lacandones, indigenous Maya communities living in the Lacandon Forest, a remote rainforest in southern Mexico.

Water levels in Lakes Metzabok and Tzibaná declined dramatically within a two-week period in July 2019. Lake Metzabok dried completely *(photo credit: Johannes Hoppenbrock).*

The Lacandon Forest does not only give the local Maya communities a home, but is one of the world's most important biodiversity hotspots. This means that there is an incredible variety of animals and plants inhabiting the rainforest. Moreover, the Lacandon Forest also hosts many small and large lakes, many of which are connected by underground conduits. Both the lakes and the conduits originate from the dissolution of the carbonate rock constituting the subsurface in this area. This type of landscape is known as karst. Karst lakes Nahá, Metzabok and Tzibaná, which are some of the largest and deepest in the Lacandon Forest, have a high water quality, which implies that toxic substances and pollutants in the water are absent.

Therefore, the lakes are exceptional natural resources for the native Mayan inhabitants as they provide them with water and fish, and attract tourists – as well as scientists. As aquatic ecosystems, the karst lakes of the area are complex and highly dynamic.

Our team has been monitoring the lakes of the Lacandon Forest since 2013 to track environmental variables such as water temperature, conductivity, acidity, and dissolved oxygen. We have also studied how aquatic animals and plants evolve over time. To get an idea of what happens in the caves and underground conduits below our feet, we have also used geophysical methods on the lakes, which helped us to create images of the layers and structures in the subsurface.

In July 2019, when the local Lacandones observed that water levels in Lake Tzibaná declined dramatically by about 30 m and Lake Metzabok dried up completely, we organized emergency field work. We expected this sudden drying to have profound environmental impacts and to cause a loss of aquatic biodiversity and genetic diversity, which we wanted to document and describe.

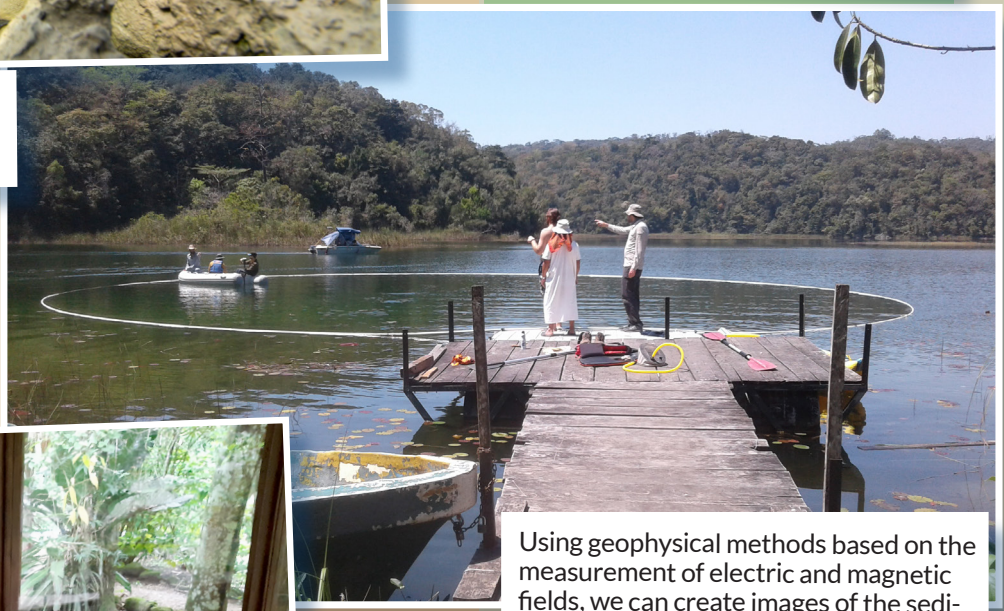
During a two-week field study in October 2019, we evaluated the hydrological and ecological effects of the sudden drying, using a variety of methods. We collected and analyzed samples of water, surface sediment and short sediment cores (a tube of mud) from what remained of the water bodies. At Lake Metzabok, we observed the beginning of the transition from an aquatic (water-based) to a terrestrial (land-based) habitat. Grasses and spiders rapidly colonized cracks in the dry sediment and the lakebeds that were now above water. The profound water decline exposed delta sediments in the southern part of Lake Tzibaná where the Nahá River enters. A delta refers to a landform created by build-up of sediment, when rivers enter a slower-moving water body, such as lakes.

We studied the exposed delta deposits and short sediment cores from remnant waters to infer the recent environmental history of the lake, and to find out whether such rapid lake desiccation events had happened before or might eventually happen again in the future.

We have been monitoring Lake Nahá since 2013. We measure environmental variables and collect water and sediment samples for analysis in the laboratory (photo credit: Geotem).

Lacandones are native Maya inhabitants, most of whom live in remote areas of the karst mountains of Chiapas, Mexico (photo credit: Liseth Pérez).

Single fish were sometimes observed in the few remnant waters of Lake Metzabok (photo credit: Daniel Ochoa).



Using geophysical methods based on the measurement of electric and magnetic fields, we can create images of the sediment layers covering the lake bottom. (photo credit: Liseth Pérez).

Live microscopic aquatic organisms reacting sensitively to environmental change were identified and counted in our field laboratory in Nahá (photo credit: Liseth Pérez).

The desiccation event was exploited by some terrestrial species. Plants rapidly colonized the exposed lake bed (photo credit: Daniel Ochoa).

Short sediment cores and delta deposits were retrieved from Lake Tzibaná to infer the past environmental history and to identify episodes of previous lake level change (photo credit: Liseth Pérez).

Lower lake levels of Lake Tzibaná allowed us to sample and analyze the delta sediments deposited during the past ~1000 years (photo credit: Liseth Pérez).

We used geophysical methods to screen the sediment layers on the dried-out lake floor. Here, one of our masters students operates a seismic device, which registers very small vibrations of the ground and works similar to an ultrasonic device (photo credit: Matthias Bücker).

Our team studied the sudden desiccation event that occurred in 2019 in lakes of the Lacandon Forest. This extraordinary event highlights the need for future interdisciplinary studies to understand the past and future environmental and social impacts of such changes in these lakes (photo credit: Daniel Ochoa).

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Related publications:

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