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Pleistocene desiccation of Lake Tana, the source of the Blue Nile

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Lake Tana, Ethiopia's largest lake, is the source of the Blue Nile, a river of key importance to the origin of ancient Egyptian and eastern Mediterranean civilisations, and critical to current sustenance of northeast African states. Although 2000 km shorter than the White Nile, high summer discharge of the Blue Nile contributes more water to the main Nile below their confluence at Khartoum, and a vastly greater proportion of transported sediment. Prolonged low Nile flows affected ancient Egyptian society, notably during the collapse of the Old Kingdom at 4.2 cal ka, when drought also occurred over much of SW Asia and the Middle East. Despite the Blue Nile's significance, very little is known about the Late Quaternary history of its headwaters, in marked contrast to the wealth of information about the history of Lakes Victoria and Albert, at the headwaters of the White Nile.

Seismic survey, combined with palaeoecological core data from Lake Tana, shows that the lake was dry at $\sim$17 cal ka. Shallow water and *Cyperus* swamp occupied the central part of the lake basin between 16.7 and 15.5 cal ka. Seasonal stream inflow was initially exceeded by water loss through evapotranspiration from swamp vegetation. Open-water evaporation from the closed, shallow lake caused a rise in salinity as it refilled, followed by an abrupt return to freshwater conditions at 14.6 cal ka, when the lake surface reached the level of the Blue Nile outflow. Simulations of Lake Tana's response to varying precipitation emphasize the severity of drought required to desiccate the lake, and suggest that the peat and shallow-water sediments at the base of the

central core were formed when rainfall was at most 40% that of the present day.

Lake Victoria, the source of the White Nile, was also dry until 15.2 cal ka. Modern base flow of the White Nile began with a sudden overflow from Lake Victoria at ca 14.5 cal ka. The main Nile was therefore almost dry until 14.6 cal ka, when Lake Tana overflow added to seasonal runoff from headwater tributaries of the Blue Nile, shortly before resumption of flow in the White Nile.

Desiccation of the White and Blue Nile headwaters coincides with Heinrich event 1, when icebergs flooded the North Atlantic, and disrupted the Atlantic conveyor that exports heat northwards from tropical waters. We also present seismic reflection evidence for at least three earlier Late Pleistocene desiccation events in Lake Tana, strongly suggesting that severe and widespread drought has affected North and East Africa in response to episodic meltwater influx to the North Atlantic. If current global climate change causes the Greenland ice sheet to disintegrate, similar catastrophic drought in tropical Africa may follow.