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Drastic Desertification

Over the past 10,000 years, climate changes in the Dead Sea region have led to surprisingly swift desertification within mere decades. This is what researchers from the University of Bonn and their Israeli colleagues found when analyzing pollen in sediments and fluctuations in sea levels, calling the findings 'dramatic.' They are presented in the current issue of the international geosciences journal "Quaternary Science Reviews," whose print version is published on 23 August.

The Dead Sea, a salt sea without an outlet, lies over 400 meters below sea level. Tourists like its high salt content because it increases their buoyancy. "For scientists, however, the Dead Sea is a popular archive that provides a diachronic view of its climate past," says Prof. Dr. Thomas Litt from the Steinmann-Institute for Geology, Mineralogy and Paleontology at the University of Bonn.

Using drilling cores from riparian lake sediments, paleontologists and meteorologists from the University of Bonn deduced the climate conditions of the past 10,000 years. This became possible because the Dead Sea level has sunk drastically over the past years, mostly because of increasing water withdrawals lowering the water supply.

Oldest pollen analysis

In collaboration with the GeoForschungsZentrum Potsdam (German Research Centre for Geosciences) and Israel's Geological Service, the researchers took a 21 m long sediment sample in the oasis Ein Gedi at the west bank of the Dead Sea. They then matched the fossil pollen to indicator plants for different levels of precipitation and temperature. Radiocarbon-dating was used to determine the age of the layers. "This allowed us to reconstruct the climate of the entire postglacial era," Prof. Litt reports. "This is the oldest pollen analysis that has been done on the Dead Sea to date."

In total, there were three different formations of vegetation around this salt sea. In moist phases, a lush, sclerophyll vegetation thrived as can be found today around the Mediterranean Sea. When the climate turned drier, steppe vegetation took over. Drier episodes yet were characterized by desert plants. The researchers found some rapid changes between moist and dry phases.

Transforming pollen data into climate information

The pollen data allows inferring what kinds of plants were growing at the corresponding times. Meteorologists from the University of Bonn took this paleontological data and converted it into climate information. Using statistical methods, they matched plant species with statistical parameters regarding temperature and precipitation that determine whether a certain plant can occur. "This allows us to make statements on the probable climate that prevailed during a certain period of time within the catchment area of the Dead Sea," reports Prof. Dr. Andreas Hense from the University of Bonn's Meteorological Institute.

The resilience of the resulting climate information was tested using the data on Dead Sea level fluctuations collected by their Israeli colleagues around Prof. Dr. Mordechai Stein from the Geological Services in Jerusalem. "The two independent data records corresponded very closely," explains Prof. Litt. "In the moist phases that were determined based on pollen analysis, our Israeli colleagues found that water levels were indeed rising in the Dead Sea, while they fell during dry episodes." This is plausible since the water level of a terminal lake without an outlet is exclusively determined by precipitation and evaporation.

Droughts led to the biblical exodus

According to the Bonn researchers' data, there were distinct dry phases particularly during the pottery Neolithic (about 7,500 to 6,500 years ago), as well as at the transition from the late Bronze Age to the early Iron Age (about 3,200 years ago). "Humans were also strongly affected by these climate changes," Prof. Litt summarizes the effects. The dry phases might have resulted in the Canaanites' urban culture collapsing while nomads invaded their area.
"At least, this is what the Old Testament refers to as the exodus of the Israelites to the Promised Land."

Dramatic results

In addition, this look back allows developing scenarios for potential future trends. "Our results are dramatic; they indicate how vulnerable the Dead Sea ecosystems are," says Prof. Litt. "They clearly show how surprisingly fast lush Mediterranean sclerophyll vegetation can morph into steppe or even desert vegetation within a few decades if it becomes drier." Back then, the consequences in terms of agriculture and feeding the population were most likely devastating. The researchers want to probe even further back into the climate past of the region around the Dead Sea by drilling even deeper.

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