New study reconstructs the skull of ancient Cretan hippo

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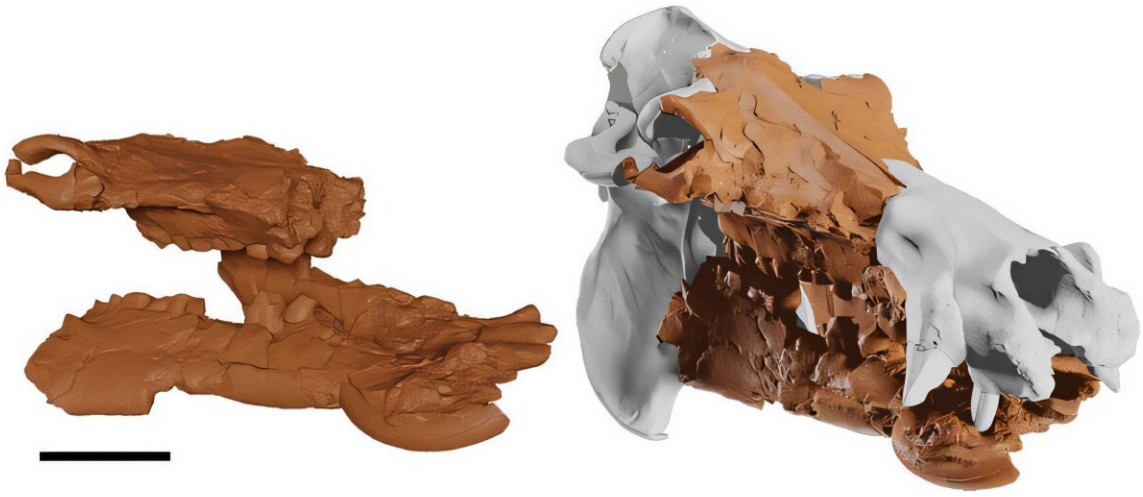

Hippopotamus creutzburgi skull before reconstruction (left) and after (right). Credit: Gerakakis and Makris 2024.

A study by researchers Nikolaos Gerakakis and Prof. Dimitrios Makris has successfully reconstructed the skull of an extinct dwarf hippopotamus that once roamed the island of Crete, using innovative 3D digital imaging techniques.

The research, which has been published in *Digital Applications in Archaeology and Cultural Heritage*, provides the first complete skull

reconstruction of Hippopotamus creutzburgi, offering new insights into this unique island species.

During the Pleistocene, the genus Hippopotamus spread to many islands, including Cyprus, Madagascar, Malta, Sicily, and Crete. One such hippopotamus species was H. creutzburgi.

Gerakakis says, "Hippopotamus creutzburgi lived on Crete during the Early-to-early Middle Pleistocene. During cold phases of the Pleistocene, sea levels were significantly lower, and the geography of the Aegean, influenced by tectonics, was narrower than today.

"It is hypothesized that a herd of H. antiquus, the ancestor of H. creutzburgi, traveled from the Peloponnese—where fossil remains of H. antiquus have been found—to Crete.

"Hippos do not float in freshwater; during locomotion, they maintain contact with the ground, typically with only one foot at a time, and experience prolonged unsupported intervals. This behavior suggests their specific weight is slightly higher than that of freshwater. However, in salt water, they might have been buoyant.

"Juveniles, which make up a significant portion of a hippopotamus herd, likely had higher survival rates than adults if swept into the sea, potentially allowing them to establish a viable population on Crete."

Once on the island, the ancestors of H. creutzburgi grew smaller, following the "island rule" hypothesized by biologist Van Valen, in which large animals become smaller and small animals may become bigger under certain circumstances upon arriving on an island.

H. creutzburgi remained on the island until their extinction, the exact reasoning for which is not certain.

"As for their extinction, several hypotheses exist, including physical catastrophes, another cold event, illness, food scarcity, or competition with deer that arrived on Crete in the late Middle to Late Pleistocene. Ongoing research aims to determine the exact causes," says Gerakakis.

Despite going extinct, many of their remains became fossilized on the Katharó plateau, which is known for being rich in fossil remains. However, many of them are poorly preserved, fragmented, worn, and flattened, making reconstruction of the vertebrate animals they represent difficult.

Not only are the fossils of H. creutzburgi badly preserved, but they are also highly fragmentary, as no complete skull has ever been recovered of the species. Thus, the size, shape, and form of the species' skull are a matter of speculation.

Using four fossil remains excavated between 1998 and 2002, Gerakakis and Prof. Makris set out to digitally reconstruct the skull of this extinct dwarf hippo species using a photogrammetry approach.

Gerakakis elaborates on the methodology used, "For the flattened cranium; we employed a virtual approach in Blender (a computer graphics software) that would have been destructive if applied to the actual specimen. The cranium was segmented into several pieces, which were repositioned anatomically.

"For guidance, we adapted the retrodeformation methodology of De Vries et al. (2022), which utilizes Blender's armature system. However, the complexity and extensive deformation of the mandible required us to innovate further. We designed a 'spider-like' exoskeleton with 23 armatures, enabling precise retrodeformation. Standard, undistorted specimens served as references throughout the process."

Using these techniques, the researchers could digitally reconstruct the entire skull of H. creutzburgi, filling in the blanks using a modern model of a hippopotamus skull.

They found that H. creutzburgi's morphology was similar to that of African Hippopotami, H. antiquus, and dwarf Malagasy hippopotami. With its size likely coming close to dwarf Malagasy hippopotami or a juvenile male African Hippopotamus.

The research team says this digital reconstruction can be printed and used for museum exhibitions, such as a planned future exhibition at the Katharó plateau.

Additionally, steps have been taken to publish a reconstruction of the entire H. creutzburgi skeleton says Gerakakis, "Most skeletal elements of H. creutzburgi have been discovered, although vertebrae and ribs are relatively scarce.

"A digital reconstruction of the entire skeleton has already been completed. A physical reconstruction of the entire skeleton, based on the digital model, was created by the Laboratory of Vertebrate Paleontology at the National and Kapodistrian University of Athens with the assistance of two conservators (Prof. George Lyras, Nikolaos Gerakakis, Maria Tsanidou, and Konstantina Kouveli). The corresponding scientific paper is currently in preparation."

More information: Nikolaos Gerakakis et al, Digital reconstruction of flattened skulls: The case of Hippopotamus creutzburgi, *Digital Applications in Archaeology and Cultural Heritage* (2024). DOI: 10.1016/j.daach.2024.e00379