

One of the largest ever land mammals evolved into extinct dwarf elephant

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Reconstruction of an almost complete dwarf elephant skeleton found in the same cave, the Puntali cave. Credit: Archives of the Gemmellaro Geological Museum

An extinct species of dwarf elephant experienced a weight and height reduction of 8,000kg and almost two meters after evolving from one of

the largest land mammals that ever lived, a new study has confirmed.

The island-dwelling Sicilian dwarf elephant *Palaeoloxodon cf. mnaidriensis*—which it is thought may have become extinct about 19,000 years ago—was just 15% of its original body mass by the time its dwarfing process was complete

The study, involving Nottingham Trent University, the University of Potsdam in Germany and the Natural History Museum, used combined molecular and [fossil evidence](#) to define the minimum and maximum dwarfing rate of the species.

The team found that the less than 2m tall dwarf elephant reduced in weight and height by a maximum 200kg and 4cm per generation.

Because of their insular and isolated environments, evolution on islands is a process which can lead to a variety of extreme changes in a short timeframe, including dwarfism and gigantism and is often referred to as 'evolution in action.' To put the extent of the size reduction of the dwarf elephant into context, it would be comparable to modern humans dwarfing to approximately the size of a Rhesus monkey.

As part of the work the team successfully recovered ancient DNA from dwarf elephant remains from Sicily's Puntali Cave, with an estimated age of between 175,000 and 50,000 years.

Many island dwarfs and giants are now extinct and measuring the rate of change in extinct animals from fossils alone can be challenging due to the incompleteness of the fossil record. And molecular dating using ancient DNA to measure the rate of evolutionary change is hampered by the fact they often existed on islands with warm climates in which DNA does not survive well.

To overcome the challenge of DNA degradation, the researchers analyzed a piece of petrous bone—part of the skull that contains the organs of the inner ear—which is known to preserve DNA better than other parts of the skeleton.

By combining the DNA and fossil evidence the researchers were able to determine that this specific Sicilian elephant's mitochondrial, or maternal, lineage diverged from the straight tusked elephant *Palaeoloxodon antiquus* from Neumark Nord (Germany), which stood at almost 4m tall with a weight of ten tons.

Palaeoloxodon antiquus lived on the European mainland between 800,000 and 40,000 years ago and the team believes it will have colonized Sicily some time between 70,000 and 200,000 years ago. Colonization probably occurred during periods of cold climate when sea levels were lower, exposing land bridges that the elephants could have utilized to colonize the islands.

It is thought that the dwarfing process at the earliest began once the Puntali elephant diverged from its mainland relative.

Using the estimated age of the Puntali elephant fossil, the size and mass of the straight-tusked elephant, and the estimated start of the dwarfing process, the team was able to calculate size and body mass reduction rate per year and per generation.

The study, which is published in the journal *Current Biology*, also involved the University of York, the University of Iceland, the University of Palermo and the University of Cambridge.

"By combining ancient DNA with paleontological evidence we can show the timing of observable evolutionary changes with greater accuracy," said Dr. Axel Barlow, an expert in palaeogenomics and molecular

bioscience in Nottingham Trent University's School of Science and Technology.

He said: "The magnitude of dwarfing resulting from this rapid evolutionary process is truly striking, resulting in a loss of body mass of almost 85% in one of the largest ever terrestrial mammals. As the descendants of giants, the extinct dwarf elephants are among the most intriguing examples of evolution on islands."

Dr. Victoria Herridge, an evolutionary biologist based at the Natural History Museum London, said: "It's such an achievement to successfully sequence an ancient mitochondrial genome from a Sicilian dwarf elephant, and to finally have DNA from a southern European straight-tusked elephant.

"It opens the door for more studies of this kind, and with it the chance to finally crack one of the big mysteries of evolutionary biology: why [elephants](#) evolve to be so small on islands."

Dr. Johanna Paijmans, a research fellow in the Department of Zoology at the University of Cambridge, said: "This is a really exciting example of the power of multidisciplinary studies. Only through combining multiple lines of evidence we were able to gain a better understanding of the dwarfing process of this iconic species."

The dwarf elephant remains are kept in the Gemmellaro Museum (University of Palermo) where the specimens were sampled.

Dr. Giulio Catalano, a postdoctoral researcher in the STEBICEF Department at the University of Palermo, said: "With this exciting study we shed new light on the complex evolutionary history of dwarf elephant species lived in Sicily in the Pleistocene."

More information: Sina Baleka et al, Estimating the dwarfing rate of an extinct Sicilian elephant, *Current Biology* (2021). [DOI: 10.1016/j.cub.2021.05.037](https://doi.org/10.1016/j.cub.2021.05.037)

Provided by Nottingham Trent University

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