Discovery of lonely tortoise doubles known members of 'phantasticus' species

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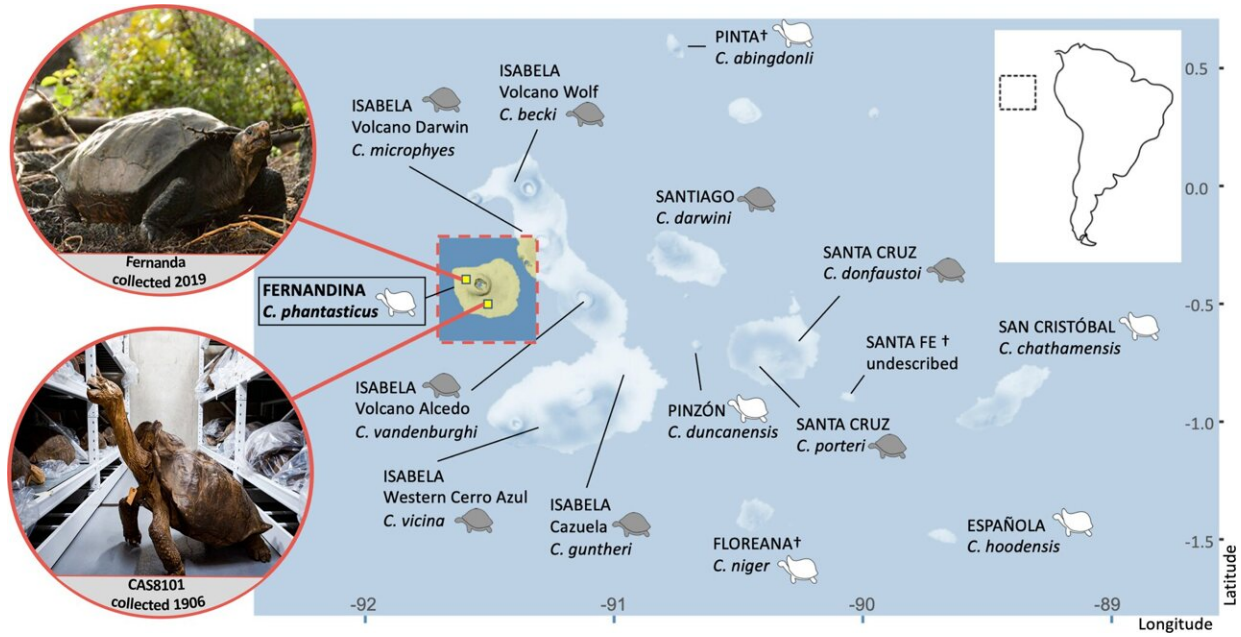

Map of the Galapagos Archipelago, indicating the approximate locations on Fernandina Island where the Chelonoidis phantasticus individuals were found in 1906 and 2019. Island names are in capital letters, species names are in italics. Tortoise icons indicate the morphology of the species, either domed (gray), saddleback (white), or semi-saddleback (indicated with both icons present). Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL. Image of Fernanda by Lucas Bustamante Galapagos Conservancy, image of the historical specimen Kathryn Whitney California Academy of Sciences. Credit: *Communications Biology* (2022). DOI: 10.1038/s42003-022-03483-w

The discovery in 2019 of a lone small female tortoise living on one of the most inaccessible islands of the Galapagos Islands has baffled evolutionary biologists. Only one other tortoise, a large male discovered in 1906, has ever been found on Fernandina Island, an isolated island on the western edge of the iconic archipelago.

A comparison of the genomes of Fernanda (as researchers call the recently discovered 50-year-old tortoise) and the 20th century male specimen now housed at the California Academy of Sciences, revealed that the two animals are closely related, doubling the number of known members of Chelonoidis phantasticus, Yale University researchers report on June 9 in the journal *Communications Biology.*

But the discovery has raised many more questions.

"Vast amounts of the genomes are similar between the two animals, but the process that explains how this happened we just don't know," said Adalgisa Caccone, a senior research scientist and lecturer in Yale's Department of Ecology & Evolutionary Biology and senior author of the study. "This also shows the importance of using museum collections to understand the past."

It is believed that there are 15 distinct species of giant tortoise on the Galapagos Islands, according to Galapagos Conservancy, a U.S.-based nonprofit.

The new finding clearly shows that the two tortoises found on Fernandina Island belong to their own lineage and are closer in relation to each other than to any other species of Galapagos tortoises, the numbers of which have been reduced by 85% to 90% since the early 19th century, largely due to the arrival of whalers and pirates who killed them for food.

"The finding of one alive specimen gives hope and also opens up new questions as many mysteries still remain," said Caccone, a member of Yale's Faculty of Arts and Sciences. "Are there more tortoises on Fernandina that can be brought back into captivity to start a breeding program? How did tortoises colonize Fernandina and what is their evolutionary relationship to the other giant Galapagos tortoises?"

The tortoises of Fernandina Island were believed to have been driven to extinction by volcanic eruptions on the island, including approximately 25 in the last two centuries. Areas of vegetation, scientists have theorized, were reduced by lava flows.

The Galapagos National Park and the Galapagos Conservancy plan to scour the island of Fernandina for relatives of Fernanda in hopes of preserving the species. The presence of additional tortoise scats and tracks suggests they may find more animals on the island, Caccone said. If more tortoises are found, she said, conservationists could start a captive breeding program.

Deciphering the evolutionary relationship between the two Fernandina tortoises might be trickier. For one thing, they look very different. The male specimen has a large and protruding carapace characteristic of saddleback tortoises, while Fernanda has a smaller, smoother shell. Caccone thinks that this shape difference is possibly due to stunted growth as a result of limited food options.

And while the genomes of the two animals are very similar, researchers discovered differences within the mitochondria, the energy-producing portion of cells that are passed down maternally. Since mitochondrial DNA is inherited from the mother, Caccone said it is possible that Fernanda is a hybrid, the progeny of a Chelonoidis phantasticus male and a C. nigra female, a now extinct species from the island of Floreana, the larger neighbor of Fernandina. Humans are known to have moved

different tortoise species, such as C. nigra, between the Galapagos islands—including to Isabela island, where many hybrids between the endemic species C. becki and the extinct C. nigra have been found. It is possible that a C. nigra female similarly found its way to Fernandina and mated with a male from C. phantasticus, leaving its mitochondrial DNA to all her descendants.

Caccone thinks that the male now housed in the California museum is probably a true representative of the original species. But to solve this new puzzle, she said, more tortoises from Fernandina need to be found.

Evolutionary biologists will work on these and other questions in coming years.

"These tortoises are the largest cold-blooded terrestrial herbivore on Earth and have a very important ecological role," Caccone said. "So protecting them is important not only because of their iconic status but also because they are an important agent of ecosystem stability in the Galapagos.

"There is still a lot we don't know, and what we learn will provide guidance to help protect them and with them the fragile and unique place on Earth they call home."

More information: Evelyn L. Jensen et al, The Galapagos giant tortoise Chelonoidis phantasticus is not extinct, *Communications Biology* (2022). DOI: 10.1038/s42003-022-03483-w

Provided by Yale University

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