More than 50% of Socotra's reptiles, still undiscovered

Details Category: Projects 14 Apr 2016

A study led by CSIC scientists unveils that over 50% of reptile species in Socotra Archipelago, Yemen, could be unknown. The result comes out from the sequencing of the gene 'COI', which is common to all animals. The technique, the so called DNA barcoding, enables cheap and quick identification of species.

The Socotra Archipelago, four small islands in the Indian ocean and nowadays belonging to Yemen, is one of the most difficult to access and distinct archipelagos in the world. Considered the 'jewel' of biodiversity in Arabia, the Socotra Archipelago was designated a UNESCO World Heritage Natural site in 2008 because of its high level of endemic species. The long isolation period from continental Arabia (around 20 million years ago) together with its topography and its high ecological and climatic diversity, create an exclusive and spectacular endemic fauna and flora found nowhere else on earth.

Socotra's topography and high ecological and climatic diversity, create an exclusive and spectacular endemic fauna and flora. In the pictures, mountains, desert and beach of Socotra. Autor: Salvador Carranza.

Socotra has nearly 700 endemic species, including 35% of its 825 plant species and 95% of its more than 100 land snail species. Of vertebrates, there is only one endemic species of mammal, 6 of birds, and many reptiles. Reptiles are an essential part of the ecosystem, as predators of insects as well as prey for birds. There are 31 species of reptiles, 29 of them endemic. Some species live in very restricted habitats, such as the endemic gecko Hemidactylus dracaenacolus, which only lives on the endemic Dragon's blood tree (Dracaena cinnabari). Both are critically endangered species.

Now, a work led by CSIC scientists and published in the journal PLOS ONE, unveils that over 50% of reptile species in Socotra could be still undiscovered. The work is a result of sequencing a small part of the mitochondrial gene cytochrome oxidase (COI) in a large number of samples from the Socotra Archipelago.

Since 2010, the team led by **Salvador Carranza**, senior researcher at the Institute of Evolutionary Biology (CSIC-UPF) in Barcelona, has conducted several expeditions to Socotra in order to collect samples of all known species and localities. For each sample, they have sequenced a small region of the COI gene and then compared it among each other. This gene is shared among all animals, since it is linked to essential life functions. It has enough variation to allow discrimination between species.

This gene, points out Carranza, has a very fast evolution rate. This means that when two populations of animals split up, stopping mating and reproducing, the gene differentiates and evolves quickly. Such differences allow us to distinguish different species.

UNEXPECTED CRYPTIC DIVERSITY

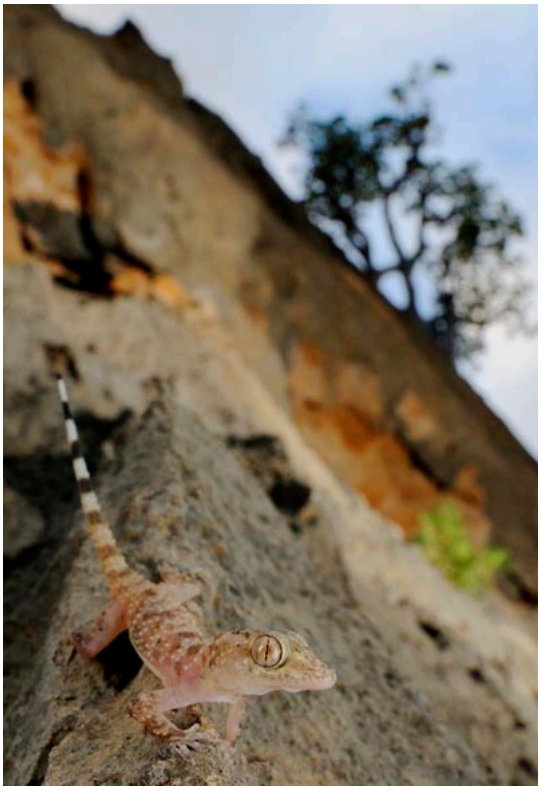
Santiago Montero-Mendieta, formerly at the Institute of Evolutionary

Biology and now PhD student at the Estación Biológica de Doñana in Sevilla, explains that "the COI gene, similarly to other small genetic markers, can be a cost-effective proxy for specimen identification and species discovery. Nevertheless, he says, if it is used alone is not the ideal tool for inferring the evolutionary history of species. "We think that Socotra's reptile taxonomy should be revised using an integrative framework, including the use of several genetic markers (mitochondrial and nuclear) as well as ecological and morphological data", he says.

Socotra islands raise questions about species evolution. "In a small dry non-tropical island like this, we did not expect to find such high genetic diversity. However, we unexpectedly found high levels of cryptic diversity within the reptiles of the Socotra Archipelago", says Salvador Carranza.

> **"In a small dry non-tropical island like this, we did not expect to find such high genetic diversity"**

As Carranza explains, although many reptile species are morphologically indistinguishable to the human eye, they are actually genetically different. "This is called 'cryptic biodiversity'. Species that we believe they are the same, but actually they are not. It has to be taken into account that apart from the physical aspect, animals have other ways of differentiation, like the smell, which are unnoticed by us".



The study shows that what is was believed to be just one species, Hemidactylus inintillectus (pictured) could be actually compose of seven species. Author: Fabio Pupin.

The work, the first to analyze in detail the reptiles of these islands, claims that up to 54% of Socotra may be still undescribed. "Considering that currently a third part of Socotran reptiles are threatened, the results of our work could have major implications for species conservation", adds **Raquel Vasconcelos**, postdoc researcher at the CIBIO-InBIO, Portugal.

Access to Socotra islands is extremely difficult. By sea, these islands are virtually inaccessible during six months every year, due to the monsoon winds. There are very few commercial flights, which started in 1998. The geopolitical situation in the zone is complicated and in the last year the airspace has been closed for civil air transport. All these factors would explain how little is known about Socotra and its biodiversity, and the few scientific expeditions until now.

Now, experts fear that non-controlled human impact could increase, with the expansion of tourism, the introduction of new exotic species and resource exploitation, therefore endangering its biodiversity.

The results of this research will be useful to control reptile biodiversity and to establish priorities for its protection. "Our main goal is to generate a biodiversity atlas for the Socotra reptiles, and to offer with it a useful tool for their quick specimen identification and management", says Carranza.

Chamaeleo monachus, another of the reptile species from Socotra. Author: Salvador Carranza.

Some species live in very restricted habitats, such as the endemic gecko Hemidactylus dracaenacolus (right, author: Fabio Pupin), which only lives on the endemic Dragon's blood tree, Dracaena cinnabari (left, author of the picture: Salvador Carranza). Both are critically endangered species.

DNA BARCODING: HELPING TO PROTECT BIODIVERSITY

This study is an example of 'DNA barcoding', a cheap and fast technique to identify different species. In the near future, scientists expect that all known biodiversity on Earth will be inventoried. The 'DNA barcoding' will imply to have universal genetic markers - approved by the Barcode of Life international consortium- with which it will be possible to identify any species by analyzing a small sample, such as feathers, skin, blood, or even feaces.

'DNA barcoding' will make possible to identify any species by analyzing a small sample, such as feathers or feaces, without harming the animal

The technique can help to protect biodiversity in different aspects, as it will contribute with evidences and legal tools in doubtful cases. As Carranza explains, in border controls, there are many confiscations of smuggled animals or objects made with skin or fur of protected animals. In non-obvious cases: how can it be proved that the species is legally protected? Carranza also talks about pet-shops where animals very similar to endangered species are commercialized. Sometimes, points out, they could be selling endangered species. He personally received the request of a public agency to analyze animal samples in order to determine if a shop was selling an endangered amphibian species or not. Once the analysis was done, they could legally impose the sanction.

A great advantage of 'DNA barcoding' is that it is possible to make an analysis of any kind of sample, without harming the animals. It enables identification in any stage of an animal's life cycle. "This means", says Salvador Carranza, "that it is possible to identify an amphibian at any of its first stages, as egg or larva. "It is very difficult to differentiate amphibian species at the egg stage. With 'DNA barcoding', identification can be done with a simple and quick lab test".

Unexpectedly High Levels of Cryptic Diversity Uncovered by a Complete DNA Barcoding of Reptiles of the Socotra Archipelago. Vasconcelos, Raquel; Montero-Mendieta, Santiago; Simó-Riudalbas, Marc; Sindaco, Roberto; Santos, Xavier et al. (2016) PloS One. vol. 11 (3) p. e0149985
http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0149985