

Earthworms from Corsica, France

Daniel Fernández Marchán¹, Sylvain Gérard², Mickaël Hedde², Rodolphe Rougerie⁴, Thibaud Decaëns³



¹ Depto. de Biodiversidad, Ecología y Evolución, Facultad de Ciencias Biológicas, Universidad Complutense de Madrid, José Antonio Novais, 2, 28040, Madrid, Spain

² Eco&Sols, INRAE, IRD, CIRAD, SupAgro Montpellier, Montpellier, France.

³ CEFE, Univ Montpellier, CNRS, EPHE, IRD, Montpellier, France

⁴ Muséum national d'Histoire naturelle, Institut de Systématique, Evolution, Biodiversité, UMR 7205 ISYEB, MNHN, CNRS, EPHE, Sorbonne Univ, Univ Antilles, Paris, France

Introduction

The earthworm fauna of Corsica is relatively well known thanks to the sampling efforts of Michaelsen (1926), Cernosvitov (1942), Pop (1947), Bouché (1972), Qiu & Bouché (1998a,b) and Szederjesi (2021). Combining the different sources, the total of earthworm species previously recorded from Corsica is 36. Despite these past studies, we are still lacking in understanding the distribution of species across the island, and it is also likely that new surveys may lead to the discovery of new taxa for the Island and for science.

In the context of the program Our Planet Reviewed ("La Planète Revisitée", coordinated by the Muséum national d'Histoire naturelle, Paris - MNHN), we sampled several sites already studied by Bouché (1972) and Qiu & Bouché (1998a,b), as well as some previously unsampled sites of potential interest. The current work aims at providing an updated overview of the earthworm fauna of the island, integrating DNA barcoding as a powerful biodiversity survey tool.

Materials and methods

31 localities were sampled across the island of Corsica (quantitatively and/or qualitatively)

Identification of the specimens in three steps:

-Adult specimens were assigned to **morphospecies** according to external (and if necessary, internal) morphological characters

-**DNA barcoding** (Centre for Biodiversity Genomics at the University of Guelph, Canada, Ontario), COI
-**Morpho-anatomical and genetic information** were combined in order to a) confirm assignment of morphospecies to previously described species or cryptic lineages, and b) confirm the status of other species-level lineages as undescribed species new to science.

Integrative species-level lineage delimitation: ASAP and Barcode Gap Analysis.

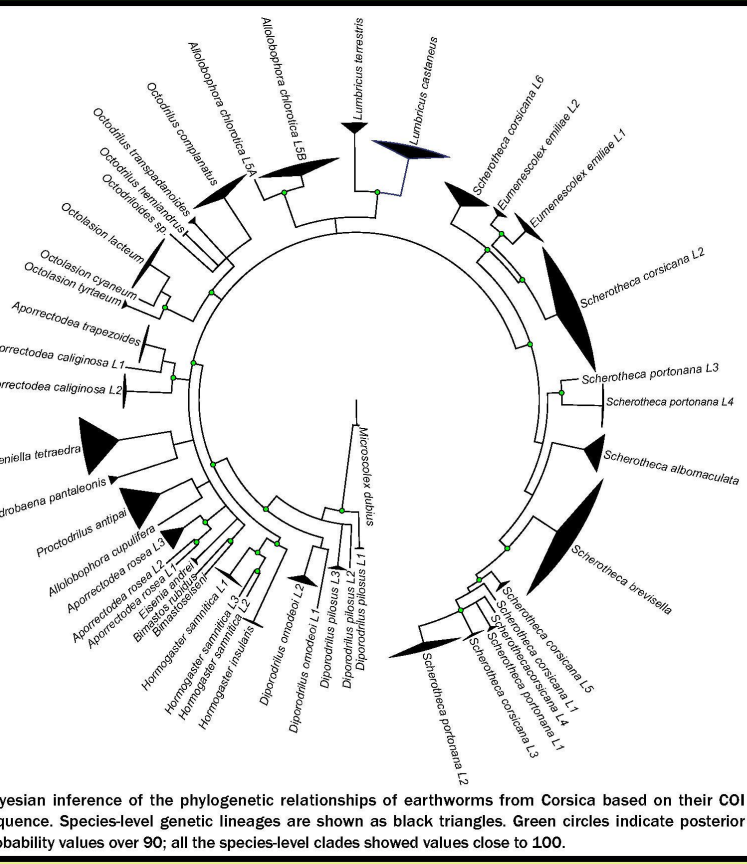
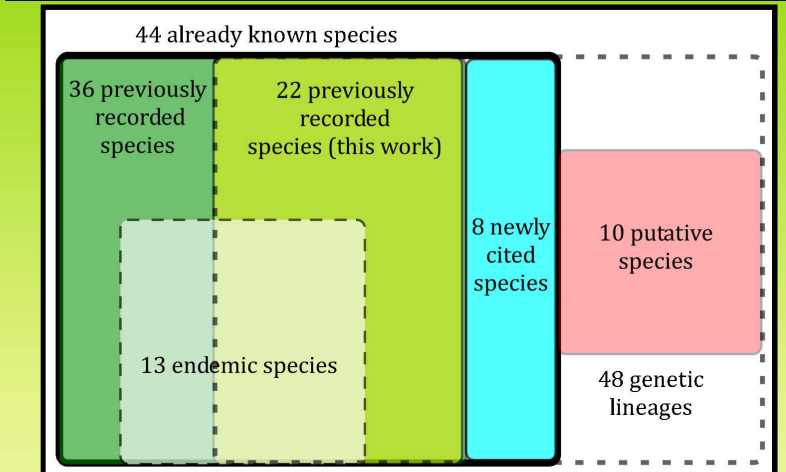
ASAP hypothesis which showed closest correspondence with morphospecies was chosen.

Fine-tuning: if morphological differences were found between two genetic clusters considered as a single species by ASAP, they were split; when two genetic clusters delimited by ASAP displayed genetic divergence below 9%, they were combined.

Retained genetic lineages with no morphological differences: "cryptic lineages"; no morphological differences: species putatively new to science



Some examples of endemic earthworm species sampled in Corsica and their habitats (to their right): a) *Scherotheca portonana* L4; b) alpine pasture at Col de Vergio; c) *Scherotheca albomaculata*; d) open Mediterranean chaparral at Sainte-Lucie de Porto-Vecchio; e) *Eumenescolex emiliae* L1; f) Pinus laricio forest at Zonza; g) *Hormogaster insularis*; h) *Quercus suber* open wood at Volpajola.



Bayesian inference of the phylogenetic relationships of earthworms from Corsica based on their COI sequence. Species-level genetic lineages are shown as black triangles. Green circles indicate posterior probability values over 90; all the species-level clades showed values close to 100.

Results and conclusions

Remarkable species diversity of earthworms in the island of Corsica, higher than Bosnia-Herzegovina (28), Czech Republic (34) or Algeria (35)

Importance of **genetic diversity assessment** to accurately reflect the **taxonomic diversity** of earthworms: cryptic lineage identification +discovery of new species

45.5% of the known species corresponded to **cosmopolitan species**: slightly lower than other Mediterranean islands such as Cyprus (55.5%)
Oc. hemiandrus, *Oc. transpadanoides* and *Octodriloides* sp.: introduced from Italy by anthropochory or by natural dispersion due to the proximity of the Tuscan archipelago.

Endemism rate of 29.5%, higher other Mediterranean islands f.e. Hyères archipelago (13.3%). Balearic Islands and Sardinia also possess a potentially high level of endemism (5 and 9 endemic/near-endemic species). Considering **species-level genetic lineages**, endemism rate in Corsica increases to **48%** (as in Balearic Postandrilus). Unusually high endemism levels in Corsica, Balearic Islands and Sardinia can originate in their **paleogeographic history**.

More comprehensive work on the earthworm communities of Mediterranean islands is needed to understand the roles of **paleogeography**, **island size**, **distance to the continent**, **environmental factors** and **biotic interactions** in their actual species diversity.