

SHORT COMMUNICATION

FILLING THE GAPS: FIRST RECORD OF *ZONITES* MONTFORT, 1810 FROM PAROS ISLAND (CYCLADES, AEGEAN, GREECE)

LEONIDAS MAROULIS^{1,2*}, KONSTANTINOS PROIOS³, MOISIS MYLONAS^{1,2},
KATERINA VARDINOYANNIS², KOSTAS A. TRIANTIS³

¹Biology, University of Crete, Greece (e-mail: leomaroulis@gmail.com);
LM  <https://orcid.org/0000-0002-9399-8417>

²Invertebrates (excl. arthropods), Natural History Museum of Crete, Greece;
KV  <https://orcid.org/0000-0001-7368-0965>

³Biology, National and Kapodistrian University of Athens, Greece;
KP  <https://orcid.org/0000-0001-7545-5892>, KT  <https://orcid.org/0000-0003-2737-8890>

* corresponding author

ABSTRACT: *Zonites* Montfort, 1810 is recorded for the first time from Paros island. As only an old shell was found, the reasons that the populations of this threatened, endemic land snail of the Aegean seem to be declining should be investigated.

KEY WORDS: *Zonites*; land snails; islands; biogeography

Islands have a remarkable amount of the world's biodiversity for their area (WHITTAKER & FERNÁNDEZ-PALACIOS 2007), and land snails are among the better-studied groups of invertebrates on islands (CAMERON et al. 2013, PROIOS et al. 2021). Specifically, the Aegean islands have long attracted the interest of malacologists (e.g., FUCHS & KÄUFEL 1936, MYLONAS 1982, VARDINOYANNIS 1994, TRIANTIS 2006), resulting in substantial documentation of their terrestrial malacofauna, which numbers 419 species (VARDINOYANNIS & MYLONAS 2019). At the same time, the genus *Zonites* Montfort, 1810, holds a special place in the Greek malacofauna, as 17 of the 23 species occurring are endemic to Greece. In general, the genus is distributed in the north-eastern part of the Mediterranean region, widely distributed in the Aegean and Peloponnese, but absent from the northern Cyclades and the northern Aegean islands (Fig. 1) (RIEDEL 1992, KORNILOS et al. 2009). Nevertheless, the fact that the entire genus *Zonites* has been utterly absent from Paros posed a long-lasting puzzle to malacologists, given that: a) *Zonites*

is distributed in the southern Greek mainland and most Aegean islands, and *Z. pergranulatus* Kobelt, 1878 is distributed in south-eastern Cyclades and Astypalaia (Fig. 1), and so there was no reason from a biogeographical point of view for its absence from Paros; b) Naxos and Paros were united – forming a “mega-island” – and were only separated at around 8,000 BP (KAPSIMALIS et al. 2009); c) The malacofauna of Paros and Naxos, two of the largest islands of the Cyclades group, has been well and systematically surveyed (MYLONAS 1982), and there are numerous suitable habitats for *Z. pergranulatus* in Paros (e.g. calcareous substrate in shrubland vegetation); d) *Z. pergranulatus* is a large-sized snail that is unlikely to be missed in well-organised sampling.

In December 2021, we visited Paros to re-survey the malacofauna of the island and sampled land snails from twenty localities, including numerous stations with suitable habitats for *Zonites*. Overall, only one – very old, probably subfossil – shell of *Z. pergranulatus* was discovered (Fig. 2). It was found near an old stone wall in abandoned cultivations, close to the

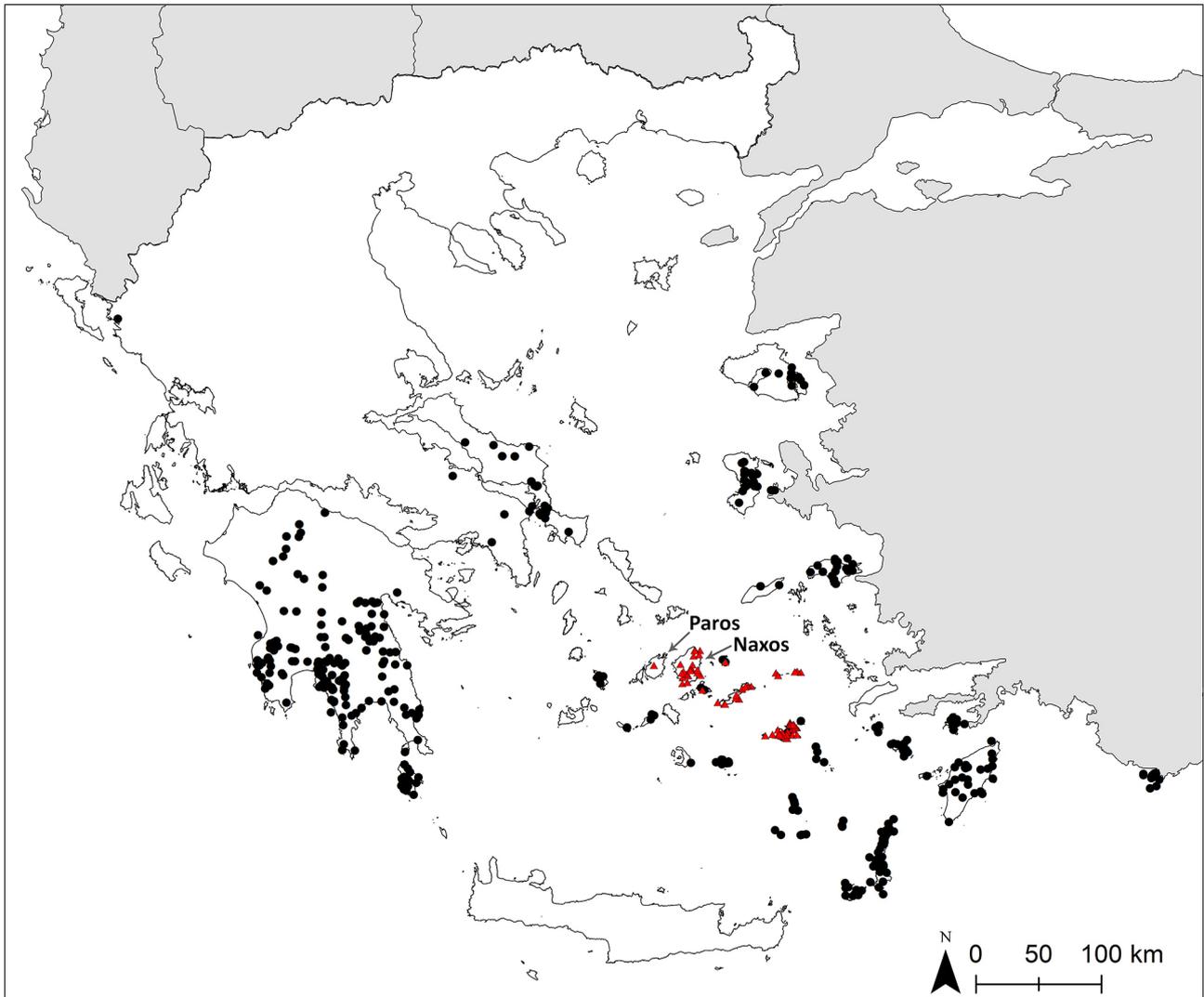


Fig. 1. The distribution of *Zonites* in Greece: red triangles depict the distribution of *Z. pergranulatus*, black circles indicate the distribution of all the other *Zonites* species

Thapsanon monastery (37°04'09.5"N, 25°10'41.2"E); a small but not active quarry is a few meters behind the stone wall. This specimen constitutes the first and only known record of *Z. pergranulatus* from Paros. Since only one subfossil shell of *Z. pergranulatus* was found after extensive sampling, there is a considerable possibility that this species is now extinct from the island. So, this short communication mainly aims to confirm the (past) occurrence of this threatened endemic land snail in Paros. However, as a result, the original puzzle is reformulated, and a new question is raised. "Why is *Z. pergranulatus* (likely) extinct from Paros, while at the same time its populations seem to thrive in Naxos, a similar adjacent island?" This

question is of particular interest, as pinpointing the underlying mechanisms and processes that influence extinctions of land snails at local to regional spatial scales could substantially impact our understanding of the current extinction crisis, and this is a topic of an ongoing study.

ACKNOWLEDGEMENTS

This study was funded by the General Secretariat for Research and Technology (GSRT) and the Hellenic Foundation for Research and Innovation (HFRI), under the HFRI Support of Faculty Members (DEP) and Researchers (GA. number HFRI-FM17-488).



Fig. 2. The shell of *Z. pergranulatus* Kobelt, 1878 that was found on Paros island. Scale bar 10 mm

REFERENCES

- CAMERON R. A. D., TRIANTIS K. A., PARENT C. E., GUILHAUMON F., ALONSO M. R., IBANEZ M., de FRIAS MARTINS A. M., LADLE R. J., WHITTAKER R. J. 2013. Snails on oceanic islands: testing the general dynamic model of oceanic island biogeography using linear mixed effect models. *Journal of Biogeography* 40: 117–130.
<https://doi.org/10.1111/j.1365-2699.2012.02781.x>
- FUCHS A., KÄUFEL F. 1936. Anatomische und systematische Untersuchungen an Land- und Süßwasser-schnecken aus Griechenland und von den Inseln des Ägäischen Meeres. *Archiv für Naturgeschichte, Zeitschrift für Systematische Zoologie* 5: 541–662.
- KAPSIMALIS V., PAVLOPOULOS K., PANAGIOTOPOULOS I., DRAKOPOULOU P., VANDARAKIS D., SAKELLARIOU D., ANAGNOSTOU C. 2009. Geoarchaeological challenges in the Cyclades continental shelf (Aegean Sea). *Zeitschrift für Geomorphologie Supplementary Issues* 53: 169–190.
- KORNILIOS P., POULAKAKIS N., MYLONAS M., VARDINOYANNIS K. 2009. The phylogeny and biogeography of the genus *Zonites* Montfort, 1810 (Gastropoda: Pulmonata): Preliminary evidence from mitochondrial data. *Journal of Molluscan Studies* 75: 109–117.
<https://doi.org/10.1093/mollus/eyp003>
- MYLONAS M. 1982. The zoogeography and ecology of the terrestrial molluscs of Cyclades. PhD Thesis, University of Athens, Athens.
- PROIOS K., CAMERON R. A. D., TRIANTIS K. A. 2021. Land snails on islands: building a global inventory. *Frontiers of Biogeography* 13: e51126.
<https://doi.org/10.21425/F5FBG51126>
- RIEDEL A. 1992. The Zonitidae (sensu lato) (Gastropoda, Pulmonata) of Greece. *Fauna Graeciae V. Hellenic Zoological Society*, Athens.
- TRIANDIS K. A. 2006. Biogeography and ecology of land snails and isopods on islands of Aegean Sea in relationship to environmental heterogeneity and area. PhD Thesis, University of Crete, Heraklion.
- VARDINOYANNIS K. 1994. Biogeography of land snails in the south Aegean island Arc. PhD Thesis, University of Athens, Athens.
- VARDINOYANNIS K., MYLONAS M. 2019. Land gastropods' view of the Aegean. Key islands and key species. *Proceedings of the International Congress on the Zoogeography and Ecology of Greece and Adjacent Regions* 14: 164.
- WHITTAKER R. J., FERNÁNDEZ-PALACIOS J. M. 2007. *Island Biogeography. Ecology, evolution and conservation*. 2nd ed. Oxford University Press, Oxford.

Received: July 15th, 2022

Revised: August 23rd, 2022

Accepted: September 17th, 2022

Published on-line: October 21st, 2022

