Peer Community In Ecology

# Provincial-island endemism adds to our understanding of the geographical distribution of species

***Werner Ulrich*** *based on peer reviews by* ***Paulo Borges*** *and 1 anonymous reviewer*

Hudson T. Pinheiro, Luiz A. Rocha, Juan P. Quimbayo (2025) Scales of marine endemism in oceanic islands and the Provincial-Island endemism. bioRxiv, ver. 2, peer-reviewed and recommended by Peer Community in Ecology.
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Many ecological, evolutionary, biogeographic studies on animals and plants have focused on endemism (e.g. (Crisp et al., 2001; Kier et al., 2009; Matthews et al., 2024, 2022; Qian et al., 2024). Ecological hotspots were first defined on endemic species (Myers et al., 2000). Nevertheless, despite the fact that the concept of endemism is crucial in biogeography and also in palaeontology there is still no stringent definition of endemism and very different concepts of endemism are used. It is another example of a concept that tries to define the undefinable (Darwin, 1859). 'Definitions' are either based on geographic and genetic isolation (Myers et al., 2000; Qian et al., 2024) or founded in geometric approaches that define restricted range sizes (Kinzig and Harte, 2000). Often, an ad hoc concept is used to cover taxon specificity and the habitats studied.

Pinheiro et al. (2025) focus on species restricted to oceanic islands and rightly remark that these work as cradles for species origination and also as museums that contribute to lineages persistence. However, they also notice that in the case of islands any definition of endemism from species occurring only on single islands would be too narrow. Rather, endemism shows a spatial scaling with an increasing number of species occurring of multiple islands. In this respect they introduce the concept of provincial-island endemism and study the importance of single and multiple-island endemic species to island biodiversity

Pinheiro et al. (2025) use data from 7,289 fish species associated with reef environments of 87 oceanic islands and 189 coastal reefs around the world. A strong negative correlation appeared between the number of endemic species and the number of islands they occur. This relationship directly translates into our assessment of whether an archipelago is rich or poor in endemics. Pinheiro et al. (2025) explicitly demonstrate this with

the examples of the Hawaiian Islands and Rapa Nui. They conclude that biogeographers need to clarify whether they deal with single-island or multiple island endemics. We can adapt this distinction to terrestrial and freshwater habitats and differentiate between single and multiple restricted areas and water bodies, for instance rivers, lakes, alpine valleys, mountains, or deserts.

Of course, the idea that endemism patterns are scale dependent is not new. Daru et al. (2020), Graham et al. (2018), or Keil et al. (2015) already noticed the importance of spatial scale and Townsend Peterson and Watson (1998) introduced the partly equivalent concepts of weighted spatial and phylogenetic endemism that also contain the scaling component. Pinheiro et al. (2025) add to this by providing a sound analysis of the strength of the scaling component. They argue that fish endangerment categories and fishery limits might change when considering multiple island endemics.

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# Reviews

## Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.1101/2024.07.12.603346
Version of the preprint: 1

### Authors' reply, 20 March 2025

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### Decision by Werner Ulrich, posted 17 October 2024, validated 17 October 2024

Dear Dr Pinheiro

Thank your for your patience during the first round of review. I had considerable problems to attrakt two experts in the field for review. I have now received these reviews. The second referee is satisfied but wrote a very short evaluation. The first referee has made some very valuable recommendatons and comments. I agree with him. Therefore I invite you to resubmit a revisd version that point for point adresses the comments of the first referee.

Kind regards

Werner Ulrich

### Reviewed by Paulo Borges, 24 September 2024

The study presented in the manuscript addresses an important research question and provides significant insights into the marine endemism on oceanic islands. The authors have conducted a comprehensive and well-designed review.

However, the data used of the analyses will be vey useful to the readers of this manuscript to perform additional analyses. I undertsand that Data is curated by the senior author of this study JPQ (quimbayo.j.p@gmail.com), who is currently performing a data paper (in preparation). It will be important that this Data paper is published first and the authors add here the Link to the Data repository.

Moreover, I think that to this manuscript needs some additional Biogeographical analyses to have more interesting readership. As it is with only some descriptive Graphs and proportions of Single Island Endemics is quite poor.

I suggest performing at least some Beta Diversity analyses. The data can be analysed using Q-mode analysis, a statistical technique that focuses on understanding the relationships between objects—in this case, regions (archipelagos)—by examining their characteristics or descriptors, such as the species (taxa) found in each region. This approach contrasts with R-mode analysis, which instead explores the relationships between the descriptors themselves (e.g., taxa), based on how they are distributed across the objects (archipelagoes).

In essence, Q-mode seeks to compare the regions with one another, while R-mode compares the species distributions across the regions.

In Q-mode, a key tool for understanding these relationships is the use of similarity coefficients, which are employed to measure the degree of association between different archipelagos. The authors can use binary data (presence/absence of species). By focusing on binary data, similarity coefficients can provide a clear picture of how similar or dissimilar regions are based on which species they share.

Non-metric multidimensional scaling (NMDS) or principal component analysis (PCA) can be used to visualize and assess the relationships between different archipelagos based on their species composition. NMDS is particularly well-suited for presence-absence data because it uses rank orders of distances rather than raw data

## Reviewed by anonymous reviewer 1, 13 October 2024

This preprint is a well written piece that fits all the recommendations issued by the journal. In my opinion, it is recommendable for publication and I do not have any major comments.

Title and abstract

Does the title clearly reflect the content of the article? X Yes, [ ] No (please explain), [ ] I don't know

Does the abstract present the main findings of the study? X Yes, [ ] No (please explain), [ ] I don't know

Introduction

Are the research questions/hypotheses/predictions clearly presented? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Does the introduction build on relevant research in the field? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Materials and methods

Are the methods and analyses sufficiently detailed to allow replication by other researchers? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Are the methods and statistical analyses appropriate and well described? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Results

In the case of negative results, is there a statistical power analysis (or an adequate Bayesian analysis or equivalence testing)? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Are the results described and interpreted correctly? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Discussion

Have the authors appropriately emphasized the strengths and limitations of their study/theory/methods/argument? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY

Are the conclusions adequately supported by the results (without overstating the implications of the findings)? [ ] Yes, [ ] No (please explain), [ ] I don't know DOES NOT APPLY