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RECEIVED 24 February 2025

ACCEPTED 26 March 2025

PUBLISHED 24 April 2025

CITATION

Ávila SP (2025) Commentary: Sharks in Cabo Verde, Canarias, Madeira and Azores islands: species richness, conservation status and anthropogenic pressures.
Front. Mar. Sci. 12:1582463.
doi: 10.3389/fmars.2025.1582463

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Commentary: Sharks in Cabo Verde, Canarias, Madeira and Azores islands: species richness, conservation status and anthropogenic pressures

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KEYWORDS

marine biogeography, Macaronesia, Webbnisia ecoregion, Azores ecoregion, Cabo Verde biogeographic subprovince, marine ecoregions

A Commentary on

Sharks in Cabo Verde, Canarias, Madeira and Azores islands: species richness, conservation status and anthropogenic pressures

By Varela, J., Santos, C. P., Nunes, E., Pissarra, V., Pires, S., Ribeiro, B. P., Vieira, E., Repolho, T., Queiroz, N., Freitas, R., and Rosa, R. (2025). *Front. Mar. Sci.* 12:1490317. doi: 10.3389/fmars.2025.1490317

Introduction

It was with great interest that I read a recent article by [Varela et al. \(2025\)](#). These authors studied the sharks from the different Macaronesian archipelagos and I endorse my compliments to the authors for their study and sound data on shark diversity and the threats affecting them, and on the most appropriate management and conservation strategies. However, I herein express my concerns regarding their use of well-defined terms, such as “marine ecoregions”, and, especially, their definition of a supposed “Macaronesia marine ecoregion”.

Macaronesia as a biogeographic unit: a terrestrial versus a marine point of view

There has been a long dispute by terrestrial island biogeographers concerning the use of “Macaronesia”. The concept of a biogeographic entity called “Macaronesia” and encompassing the Azores, Madeira, Selvagens, Canaries and Cabo Verde archipelagos is valid for the terrestrial vegetation, in particular for the vascular plant geobotany (see a recent review by [Fernández-Palacios et al., 2024](#)). However, an opposite view has been

expressed by Sunding (1979); Vanderpoorten et al. (2007); Rivas-Martínez (2009) and Rivas-Martínez et al. (2014, 2017), and it is not supported for terrestrial animals (Wunderlich, 1991; Machado, 1992; Fernández-Palacios et al., 2024). A Macaronesian biogeographic unit has been advocated mostly by terrestrial botanists [e.g., Engler (1879, 1910, 1914), Dansereau (1961); Sunding (1973); Bolós (1996); Santos Guerra (1977, 1999)], and although multiple studies have been published, the analysis of data is usually biased as only some families/groups of the whole terrestrial native flora and/or fauna are selected to highlight the similarities among the Macaronesian archipelagos. For example, Beyhl et al. (1995) stated that the floristic components of Macaronesia were the coastal succulent scrub and the laurel forest, but they rejected the Macaronesia biogeographic unit because of the different origins of the flora.

Morrone (2001 and references therein) showed that endemics have been used as the primary biogeographic dataset in terrestrial studies aiming to establish natural biogeographic areas. The basic assumption is that areas sharing unique taxa are more related to each other than to areas lacking these taxa. The focus of this comment is not to test the coherence of Macaronesia as a terrestrial biogeographic unit. However, Fernández-Palacios et al. (2024) provided a table that allows an analysis of the shared endemic genera of Macaronesian vascular plants based on their geographic distribution (see Table 1). PAST version 3.18 (Hammer et al., 2018) was used to select the best combination of dissimilarity measure and agglomeration method, by calculating the cophenetic correlation value between the region's distance matrix and the dendrogram representation (Sokal and Rohlf, 1962). Figure 1 clearly shows a biogeographic pattern that is very similar to the obtained by Freitas et al. (2019) for the shared endemic marine organisms, with Canaries and Madeira clustering together and forming the core of what they called the “Webbnesia” marine ecoregion (see below). Cabo Verde is set apart from the remaining Macaronesian archipelagos and, consequently, the shared endemic genera of Macaronesian vascular plants do not support the use of Macaronesia as a coherent biogeography unit. Still, I miss a quantitative analysis of the terrestrial native species, with large multitaxa geographic distribution datasets (including continental regions) to test this hypothesis. Moreover, these taxa should have different mobility abilities in order to test the congruence of results among different phyla.

In what concerns the marine realm, Ávila (2000: 104), his Figure 1 was the first to show, using a quantitative analysis based on checklists compiled for the shallow-water marine molluscs (gastropods and bivalves), that Cabo Verde was not biogeographically related with the remaining Macaronesian archipelagos, a situation previously noticed by Wirtz (1994). Again, in a quantitative study by Almada et al. (2001), his Figure 2 who used a small dataset of just 44 blennioid fishes from the NE Atlantic (including the Macaronesian archipelagos), Cabo Verde did not cluster with any of the Macaronesian archipelagos. A larger dataset of 2,605 reef fishes was used by Floeter et al. (2008), their Figure 4, who also came to a similar conclusion. Thus, all the authors that quantitatively analysed marine datasets of coastal

TABLE 1 Archipelagic distribution of the 45 Macaronesian endemic vascular plant genera (modified from Fernández-Palacios et al., 2024).

Genus	AZO	MAD	SEL	CAN	CAB
<i>Aichryson</i>	1	1	0	1	0
<i>Allagopappus</i>	0	0	0	1	0
<i>Argyranthemum</i>	0	1	1	1	0
<i>Atalanthus</i>	0	0	0	1	0
<i>Babcockia</i>	0	0	0	1	0
<i>Bencomia</i>	0	0	0	1	0
<i>Bethencourtia</i>	0	0	0	1	0
<i>Bystropogon</i>	0	0	0	1	0
<i>Ceballosia</i>	0	0	0	1	0
<i>Cedronella</i>	0	1	0	1	0
<i>Chamaemeles</i>	0	1	0	0	0
<i>Chrysoprenanthes</i>	0	0	0	1	0
<i>Dicheranthus</i>	0	0	0	1	0
<i>Dendriopoterium</i>	0	0	0	1	0
<i>Gesnouinia</i>	0	0	0	1	0
<i>Gonospermum</i>	0	0	0	1	0
<i>Heberdenia</i>	0	1	0	1	0
<i>Isoplexis</i>	0	1	0	1	0
<i>Ixanthus</i>	0	0	0	1	0
<i>Kunkeliella</i>	0	0	0	1	0
<i>Lactucosonchus</i>	0	0	0	1	0
<i>Marcetella</i>	0	1	0	1	0
<i>Melanoselinum</i>	0	1	0	0	0
<i>Monizia</i>	0	1	0	0	0
<i>Monanthes</i>	0	0	1	1	0
<i>Musschia</i>	0	1	0	0	0
<i>Navaea</i>	0	0	0	1	0
<i>Neochamaelea</i>	0	0	0	1	0
<i>Normania</i>	0	1	0	1	0
<i>Parolinia</i>	0	0	0	1	0
<i>Pericallis</i>	1	1	0	1	0
<i>Phyllis</i>	0	1	0	1	0
<i>Picconia</i>	1	1	0	1	0
<i>Pleiomeris</i>	0	0	0	1	0
<i>Rutheopsis</i>	0	0	0	1	0
<i>Schizogyne</i>	0	0	1	1	0
<i>Semele</i>	0	1	0	1	0
<i>Sinapidendron</i>	0	1	0	0	0

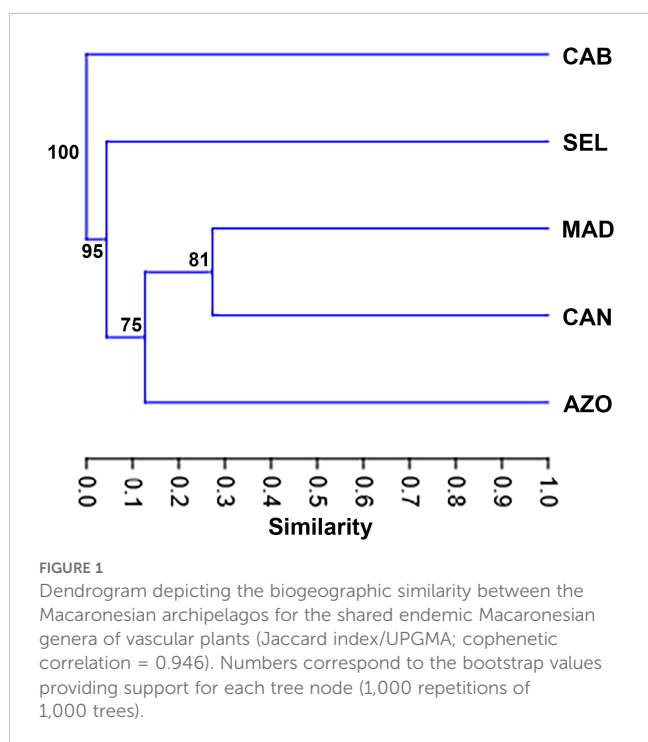
(Continued)

TABLE 1 Continued

Genus	AZO	MAD	SEL	CAN	CAB
<i>Spartocytisus</i>	0	0	0	1	0
<i>Sventenia</i>	0	0	0	1	0
<i>Tinguarra</i>	0	0	0	1	0
<i>Todaroa</i>	0	0	0	1	0
<i>Tornabenea</i>	0	0	0	0	1
<i>Vieraea</i>	0	0	0	1	0
<i>Visnea</i>	0	1	0	1	0

species reached to the conclusion that Cabo Verde does not cluster with the remaining archipelagos of the Macaronesia geographic region, being an independent biogeographic unit.

Spalding et al. (2007) coined the term “marine ecoregions”. In his seminal and highly cited work, he divided the Temperate Northern Atlantic realm in six biogeographic provinces. One of these, the Lusitanian biogeographic province, was further subdivided into three marine ecoregions: the South European Atlantic Shelf, the Saharan Upwelling, and a group formed by the Azores, Madeira and Canaries archipelagos. To our knowledge, and in contrast with the well-defined and biogeographically supported Cabo Verde marine ecoregion of Spalding et al. (2007), no one has ever formally described a “Macaronesia marine ecoregion” which, according to the paper by Varela et al. (2025), seems to refer to the Azores, Madeira and Canaries archipelagos (presumably also Selvagens). Therefore, we suggest that caution should be exercised when using the term “ecoregion”.



Later, a large team of marine biologists used a multitaxon approach for the definition of biogeographic ecoregions within the Macaronesian archipelagos and a larger dataset with a total of 7,492 species (3,737 of which reported for the Macaronesia). These authors were able to demonstrate that the Azores ecoregion was separated from the Webbnesia ecoregion (a term coined in deference to the British botanist Phillip Barker Webb (1793-1854), and that includes the Madeira, Selvagens and Canaries archipelagos), with Cabo Verde standing alone again, in this case, as an individualized marine biogeographic subprovince (see Freitas et al., 2019).

In another paper, Melo et al. (2023) has shown that the biogeographical relationships among the Macaronesian archipelagos during the warmer period of the Last Interglacial (also known as MIS 5e, i.e., the Marine Isotopic Stage 5e), were different from those we know today. Although the pattern is not as clear as the one Freitas et al. (2019) were able to determine for their multitaxon analysis of the recent marine flora and fauna, during the MIS 5e, Canaries and Cabo Verde clustered into a single biogeographic unit (in the case of the bivalve species), Madeira clustered with Selvagens (for gastropod species) and the Azores formed, again, an isolated marine ecoregion (for gastropod species; cf. Melo et al., 2023, their Figure 2).

Discussion

In my opinion, and from a strictly marine point of view, “Macaronesia” should be used as an informal term and with a restricted geographical value or under a political/sociological framework. The discussion above illustrates our efforts to add an effective and valuable contribution to the use of the most comprehensive marine biogeographic data on the Macaronesian archipelagos. Finally, I would like to stress that, under a marine perspective and for the present times, there is no support for a “Macaronesia biogeographic region”, in contrast to the statement by Varela et al. (2025): pp. 2. In its place, and based on the most taxonomically integrated study to date, using a biogeographical quantitative analysis of primary data, we reach to the conclusion that the once called Macaronesia biogeographic region has no scientific support and should be replaced by the Azores ecoregion, the Webbnesia ecoregion, and the Cabo Verde biogeographic subprovince (cf. Freitas et al., 2019).

Author contributions

SA: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. FCT/2023.07418 CEEECIND research contract with BIOPOLIS (<https://doi.org/10.54499/2023.07418.CEEECIND/CP2845/CT0001>). This work also benefited from FEDER funds, through the Operational Program for Competitiveness Factors – COMPETE, and from National Funds,

through FCT (UIDB/50027/2020, POCI-01-0145-FEDER-006821, UIDB/00153/2020, LA/P/0048/2020).

Acknowledgments

SÁ acknowledges FCT/2023.07418 CEEECIND research contract with BIOPOLIS (<https://doi.org/10.54499/2023.07418.CEEECIND/CP2845/CT0001>). I thank the Regional Government of the Azores (M1.1.a/005/Funcionamento-C-/2016, CIBIO-A; M1.1.A/INFRAEST CIENT/A/001/2021 - Base de Dados da PaleoBiodiversidade da Macaronésia).

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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