

The authors provide a satisfactory response to reviewers, and the revised version is improved.

REPLY: We thank the editor for his positive comments on the revised version.

Yet the authors themselves express that “We understand that this paper reads like an introduction to a much larger project and the beginning of a long story on island vulnerability, but applying this framework without explaining why it is needed, what are the main questions, limits, implications with policies would be premature. “

Thus I would strongly suggest the authors to attempt a new revision that perhaps will minimise this impression and most importantly will clearly outline what makes this vulnerability assessment so different for insular systems. For instance the authors in the conclusion mention that their detailed framework lays the foundations to understand and predict island biodiversity vulnerability to global change changes, whereas in lines 624 they say: “The vulnerability framework developed here could be used to increase the fundamental knowledge on biodiversity vulnerability (Step 1-3) but has also4) and to guide the potential to help implementing implementation of biodiversity conservation policies (Step 45, Box 2). “ In the second statement like in many places in the text one fails to understand what makes this framework distinct for insular vs mainland systems.

REPLY: Although we have improved our MS in the previous revision by clarifying the objectives of the framework based on the constructive reviews received, we acknowledge that further clarifications may be necessary. First of all, the framework has been built upon previous existing frameworks, and is also born out of the acknowledgment that a low percentage of those existing frameworks are applied to islands (< 30%), and when so, they are a mere translation of frameworks applied to mainland systems. Consequently, these frameworks fail to adequately capture the complexity and specificities of insular biota.

We have now added a specific section in the introduction about this issue (L112-127): ‘*Since the emergence of climate change vulnerability assessments, the vast majority of those assessments have been designed for, and applied to, mainland ecosystems. When extended to islands, these frameworks are often mere adaptations of those developed for mainland systems. This approach is particularly problematic, as it fails to account for the unique complexities and specific characteristics of insular biota. Consequently, our knowledge of the vulnerability of insular ecosystems and species is incomplete and results most likely in an underestimation of their global vulnerability. Here, our objective is to introduce an adapted framework that addresses the limitations of existing approaches by incorporating the idiosyncrasies of island biota. This framework is (i) specifically designed to quantify the vulnerability of terrestrial insular biota to multiple threats and aims to capture the distinct challenges posed by the unique attributes of insular ecosystems, such as the island syndrome, the isolated nature of islands, and their high levels of endemism (see also Figure 1A) and (ii) to provide improvements of existing vulnerability frameworks that are not specific to island ecosystems (e.g., the inclusion of multiple threats and dimension of diversity).*’

Specifically, our framework takes into account markers of insular syndromes and adaptations (e.g. bird flightlessness and mammal dwarfism, phylogenetic endemism) that increase species’ sensitivity to global changes (Zizka & Chase, 2023), but also markers that are important for adaptive capacity in islands such as dispersal ability of species or the geographic isolation of islands as well as, island size, which restricts island populations range size, and consequently their carrying capacity, increasing sensitivity and limiting adaptive capacity (Fernández-Palacios et al., 2021).

Besides, the overwhelming majority of applications incorporate only one threat (e.g., climate change), while the global drivers of biodiversity loss operate in conjunction (on both islands

and mainland), needing a framework acknowledging the multifaceted nature of global changes. To date, there is no vulnerability assessment that includes multiple threats and markers of sensitivity or adaptive capacity at the functional and phylogenetic levels. This is also one of the strong improvements that our framework offers compared to existing ones. L127-1130

As a consequence, our main objective is (1) to provide a framework that adapts the existing ones to insular systems by including the idiosyncrasies of islands and (2) to provide improvements of existing vulnerability frameworks that are not specific to island ecosystems (e.g., the inclusion of multiple threats and dimension of diversity). L121-127

I would suggest to remove the word new from the framework as it is not really new.

REPLY: We have now removed the word « new » from the ms and explained that this framework is an adaptation of current existing frameworks by (i) providing crucial markers specifically designed for island biota and (ii) including new steps and markers (phylogenetic and functional markers) that are important to improve current assessments.

Instead it is distinct, or specific and this specificity should be clearly explained.

REPLY: The terminology "specific," "adaptation," and "improvement" is now being employed to refer to the framework.

Explained in the terms of scales (what is a scale this framework refers to now and relevant discussion with the reviewers)

REPLY: We are not completely sure to understand the comment of the editor here as we already explained the scales that could be considered in the framework here (L260-264): ‘For example, broad-scale assessments (e.g., at the global extent or among several archipelagos) contribute to strategic planning and to establish a common baseline of vulnerability information (e.g., IPBES assessments), while local-scale assessments (e.g., within archipelagos or group of islands) are appropriate for informing site-level management decisions.’

If the editor referred to the difference in scale with mainland it is thus important to note that island ecosystems are generally smaller than mainland ecosystems, and this difference in scale limits the distributional range and population size of island biota, which are crucial for the sensitivity and adaptive capacity of a given population to anthropogenic threats. However, scale alone does not explain all differences in vulnerability between both types of ecosystems (see section “*The uniqueness of insular biota enhances their vulnerability to threatening processes*”). Thus, a method designed for mainland ecosystems may underestimate the vulnerability of island ecosystems of similar size.

Explained in differences between mainland and insular

REPLY: We want to clarify one important point, which is that our aim is not to make a mainland-island comparison on vulnerability frameworks. Our framework builds upon already existing vulnerability frameworks developed for mainland systems, and enhances these existing frameworks by adding specificities tailored for islands. In the end, this framework has the ambition to combine island specificities with **general improvements to existing frameworks** that could also prove useful for continental assessments. Here we provide a few examples of why our improvements cannot be reduced to an opposition between mainland and islands:

- Taking into account multiple threats (or taxa) in the same framework is currently not done neither on islands nor on mainland. Thus, we cannot state that this is only important for islands, as mainland systems are also exposed to multiple threats and could benefit from this addition we are doing here.
- Similarly, to consider markers of sensitivity or adaptive capacity at species or community level (redundancy, phylogenetic endemism etc.) is very important for insular biota, given the low redundancy on island, but it could also be important to consider those markers on mainland assessments, particularly for fragmented landscapes which resemble archipelago-like systems.
- Another example is the Step 4 about the uncertainty, this step is important irrespective of whether the assessment is conducted on islands or on mainland.

We feel that focusing only on the difference between island and mainland frameworks would shift away from our objectives: (1) building on existing frameworks to add specificities tailored for islands and (2) improve the steps with additions that could potentially serve for all vulnerability frameworks, either applied on islands or mainland. This is now explicitly mentioned in the concluding remarks (L444-449): ‘Besides, this framework has the ambition to combine island specificities with improvements to existing frameworks that could also prove useful for continental assessments, which include the consideration of multiple threats, markers that reflect phylogenetic and functional diversities, and an uncertainty step that is crucial for all types of vulnerability assessments.’

Explained in differences to the 231 insular studies.

REPLY: This seems already covered by this paragraph in the ms but we added a last sentence to further emphasize the differences (L214-230) : *Using this definition, a recent review showed that among the 741 studies assessing climate change vulnerability, the majority focused on mainland systems, with less than one third (n = 231) including islands (de los Ríos et al., 2018) (see Table S2 for examples) and only 136 studies associated with a specific insular country. Although this would be representative of the small land surface area occupied by islands (6.7%), it falls short in terms of biodiversity representativeness, as island’s biodiversity represents 20% of biodiversity worldwide, with 50% of threatened and 75% of known extinctions (Fernández-Palacios, Otto, et al., 2021). These island vulnerability assessments are often geographically and taxonomically restricted towards high income countries (e.g., Australia, the UK, and the USA account for 60% of studies on insular biota) and plants (49% of studies) (Figure 1B), respectively. In addition, the large majority of vulnerability assessments do not consider the influence of multiple threats (but see Santos et al., 2021; Sousa et al., 2021; Ureta et al., 2022), which are likely to act together, interact with and be exacerbated by climate change (e.g., habitat loss, overexploitation, biological invasions), potentially leading to synergistic impacts (Leclerc et al., 2018). Note that these geographic, taxonomic, or conceptual biases occur in both mainland and insular assessments (see also (de los Ríos et al., 2018). L230-233: ‘Finally, those assessments do not take into account the specificities of insular biota (e.g., phylogenetic endemism, geographic isolation of islands, population size, etc.) that make them more likely to be vulnerable to global changes, neither they consider other dimensions of diversity’.*

Explained in trait-based vulnerability assessments (functional and phylogenetic) vs species-level markers.

REPLY: In the literature, trait-based vulnerability assessments are based on ecological traits or life history traits of the species (sensitivity or adaptability only, but no exposure) (e.g., Table 1 of Willis et al 2015 for a brief review) and they are often compared with correlative or mechanistic approaches (Foden et al., 2018, see also Pacifici et al., 2015). But those approaches neither mention functional nor phylogenetic markers in the assessments. Here, we provide markers that go beyond the trait-based markers, which also include population size, range size, etc. Also, the former refers to community-level analyses that represent distinct facets of biodiversity, whereas the latter uses information at the species level to produce a community-based average trait value and its variability, which can be later combined with other markers to calculate sensitivity.

To achieve this I suggest a restructuring:

1. You could start by State of the art of vulnerability assessments on insular biota so that Vulnerability is clearly defined and the comparison to mainland vulnerability assessment and previous work is more clear.
2. Then you can present the section on uniqueness in relation to the different dimensions of vulnerability.
3. Add a table to highlight the differences/novelities to the mainland framework.

REPLY: We appreciate the editor's suggestion; however, we believe that restructuring the manuscript to include a direct comparison between mainland and islands, or to change the order of our framework presentation, would detract from the primary objectives of the paper. Specifically, we provide a framework that is tailored for application to insular biota, mainly because islands are under-represented in vulnerability assessments, even though they contribute disproportionately to global diversity and are at the same time heavily affected by several drivers of global change. Including a comparison table between mainland and island contexts is, in our view, outside the scope of this paper and does not align with its objectives. In fact, some steps (e.g., step 1, 3, 4) of the framework could also be applied to mainland frameworks and would not be useless in this context, though we do offer specific markers and steps dedicated to insular systems. Our intent is thus not to compare, but rather to highlight and address the specificities of island biota.

Additionally, restructuring the manuscript as suggested would disrupt the logical flow of the discussion. Presenting the limitations of the current frameworks without first establishing the unique characteristics and vulnerabilities of island ecosystems could confuse the reader. These are those specificities that frame and justify why the limitations of the ongoing framework are problematic. By addressing the uniqueness of insular biota upfront, we create a more coherent narrative that leads to our critique of existing framework and then offer persuasive arguments to build an adapted framework specifically designed for insular biota, consistent with the ms' objectives. We also hope that our new section in the introduction better emphasizes the novelty of our framework and will convince the editor of the need of such framework.

We believe the current structure provides a clear and logical progression, we have now expanded sections' titles to be more explicit on that:

1. *The uniqueness of insular biota enhances their vulnerability to threatening processes*

2. *State of the art of vulnerability assessments and their limitations when applied in insular context*
3. *An adapted framework for assessing the vulnerability of island biota*

In Figure 2. Markers in bold font represent the markers specifically designed for insular biota. why not just show these ones? Make this scheme specific to the insular case.

REPLY: Other markers (not in bold) such as thermal tolerance, dispersal capacity, and population size are important to state the species' vulnerability, independently of their occurrence on islands or mainland. This sentence has now been added in Figure 2 legend. We do not think it would make sense to remove those markers as they are important for insular biota also, and for any biota for which a vulnerability assessment is conducted.

4. Perspective title needs to be renamed. An insular-specific trait-based vulnerability assessment?

REPLY: The title has been revised to: An adapted framework for assessing the vulnerability of island biota to multiple threats

5. Highlight in each step what is the particularity to islands (cross reference to previous sections)

REPLY: We understand there is confusion between a framework that could only be applied to island systems, which would exclude mainland diversity from the analyses and even make the opposition between island and mainland systems. We are sorry if we haven't been clear on this, but we do not wish to oppose our island vulnerability framework against vulnerability frameworks tailored for mainland, as stated in responses above.

Here are some examples illustrating why this issue is more nuanced than a simple dichotomy between island and mainland:

-Step 1: We suggested to (i) include multiple threats (which is new but not specific to islands), to take into account the biogeographic status of species (especially endemism, which is particularly relevant for islands, but could also concern mainland)

-Step 2: We already covered extensively in the ms the markers specifically designed for islands, and we also provided markers that are not used in the current framework but offer important information on species' vulnerability and we also expand this information with Table 1 (but again, those markers for functional redundancy are not considered in current assessment but they are relevant for both island and mainland). This is a mix of markers specifically designed for islands and others that could be useful for both island and mainland but are not yet considered.

-Step 3: How to compute vulnerability metrics and their components is relevant for both island and mainland.

-Step 4: Again, this is not a step that is currently present in the framework, yet conducting robustness analyses, maps of ignorance, or comparing with alternatives measures is key and should be associated with any framework on vulnerability (islands or not).

-Step 5: We selected some policies among CBD that focus on island systems, but the idea to consider a step 5 with the inclusion of policy-relevant conservation actions is important for all kinds of contexts.

In Table 2 there are only 4 markers at community level presented. I don't understand community vs species level markers. This should be distinct in the vulnerability analysis. You could be specific what level this framework refers to

REPLY: Based on the scope and objectives of the vulnerability assessment for insular biota, particularly the biodiversity component (see Step 1 - Figure 2), the markers to be included depend on the level of biological organization being assessed (Step 1 and the data availability), whether it is at the population, species, or community level, or a mix of several levels.

This was clarified here : There are many different relevant markers associated with species' vulnerability to threats. Those markers may vary in type (e.g., ecological or demographic) and organization level (e.g., population, species, community, or ecosystem) and could be considered simultaneously in the framework or separately.

Box 1: I don't see its utility- You could remove it.

REPLY: This box reflects some of the complexities and specificities of island biota with the case of honeycreepers in Hawaii that justified some of the markers we decided to include in the adapted framework. For instance, the example of honeycreepers highlights (i) the importance to consider multiple threats that jointly act on this biota, (ii) the insular syndrome characteristics (restricted ranges, small population sizes, high endemism), (iii) the importance to consider markers at both species and community levels (e.g., the morphospace showing the non-random distribution of species extinct or at risk of extinction and thus the importance to consider functional rarity or redundancy as markers of sensitivity at the community level). We have now included this explanation in the box to better emphasize its relevance.

Box 2 might need renaming : The impact/ use of an insular vulnerability framework for multiple policies?

REPLY: We have now renamed Box 2.

by [Vasilis Dakos](#), 26 Nov 2024 16:59

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