**Identifying global functional diversity hotspots shifts and expands conservation priorities of marine megafauna**

Marine megafauna have important ecological roles in the oceans yet many species are globally threatened. Functional diversity provides a lens to comprehend variation among species’ ecological roles and the consequences of their potential extinction. Recent work has provided a global level perspective on marine megafauna functional diversity and species-level contributions. However, as pending anthropogenic pressures (e.g., deep-sea mining expansion) and conservation actions (e.g., UN’s 30 by 30) hold both risk and opportunity for megafauna conservation, it is imperative to develop a spatially-resolved view of marine megafauna functional diversity. Here we report a new global assessment of marine megafauna functional diversity and species-level contributions, wherein we identify global functional diversity hotspots, and reveal the threatened species upholding diversity within these regions of special conservation interest.

Hotspots: novel functional richness hotspots, many falling outside of species richness hotspots. Identified functional redundancy ‘cold spots’: unsurprisingly these were towards the poles where there were fewer species, but these species occupied more functional space than expected and thus these were even cooler – and more vulnerable – than expected.

[HOTSPOTS LOCATIONS, AND OVERLAP]

After identifying these hotspots, we next want to know which threatened species are most important for holding up these special areas of functional diversity. We show that species that are unremarkable in the global assessment, emerge as key species in supporting functional richness and redundancy locally, and – despite the cosmopolitan ranges of many MMF species – different sets of species emerged as key across different hotpot regions and across functional richness and functional redundancy hotspots.

[REGIONAL SPACES, LISTS AND DISSIMILARITY IN HIGH FUSE SPECIES ACROSS REGIONS]

Functional richness and redundancy can be decoupled from species richness in marine megafauna – leading to identification of novel hotspots and notably complementarity between functional richness and redundancy hotspots.

Global functional prioritisation lists can overlook those species that are locally vital and supporting globally important areas for functional diversity and local and regional ecosystem functions and services. When we look across these hotspots, we greatly expand the number of species that warrant urgent conservation attention.

Ultimately, we deliver revised and localised lists of marine megafauna species contributing inordinately to functional diversity within the most functionally diverse and vulnerable regions of the world’s oceans.

Figures:

Conceptual figure showing the links between species richness, functional richness, and functional redundancy. Emphasise that these are not inevitable and show the deviations possible; also indicate how high functional richness can reduce redundancy. Also consider introducing IUCN status and species functional contributions to prepare reader for FUSE. Also show a scenario of low vs. high turnover across functional hotspots. John to do.

Fig. 2 as is

Fig3-4 Cata designed to emphasise differences in sets of FUSE species across hotspots of both types and the final list of species, and how some species contribute to one vs. many.

Cata: Something like this for Fig 3, and Fig 4 the same but for redundancy. Animal shapes are supposed to show the top FUSE species that are unique to each province. For the functional spaces, we only need to show one volume (A1 vs A2), but more provinces (I propose 6), highlighting one species per province, which should match those from the map. Finally, for the lollipop plot with all top species, we propose to colour the dots according to IUCN status, arrange it by number of provinces (from high to low or viceversa) and indicate somehow (here using a globe shape) which species are in the global list of top 10 species.

Diagram

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