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Editorial: Ecological and behavioral traits of apex predators in oceanic insular ecosystems: advances and challenges in research and conservation

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Editorial on the Research Topic
Ecological and behavioral traits of apex predators in oceanic insular ecosystems: advances and challenges in research and conservation

Island ecosystems can be highly sensitive to anthropogenic and natural disturbances due in part to their unique ecology and biogeography as well as their high levels of endemism (Russell and Kueffer, 2019). Remote archipelagos surrounded by pelagic environments are often hotspots for biodiversity, providing unique habitats to a wide array of taxa (Chandelier et al., 2023). Within these oceanic hotspots, apex predators fulfil a pivotal ecosystem service by maintaining the structure and function of marine and terrestrial habitats (Figure 1), serving as indicators of ecosystem health, and mitigating the effects of climate change on communities and systems (Pearson et al., 2023). Within marine and island systems, apex predators include animals from several taxonomic groups (e.g., mammals, fishes, reptiles, birds, cephalopods), many of which are threatened by varying levels of human-induced pressures including but not limited to overfishing, pollution, marine traffic, marine litter, and climate change (Queiroz et al., 2019; Sequeira et al., 2019; Alves et al., 2022). Nevertheless, remote insular or oceanic environments tend to be understudied and face numerous logistical challenges compared to, for example, coastal habitats.

This Research Topic aimed to advance our understanding of the ecological and behavioral traits of apex predators that inhabit, permanently or temporarily, marine waters adjacent to remote or small islands. The collection of 13 papers from 76 authors comprises a broad taxonomic representation of apex predators spanning cetaceans (including delphinids, beaked whales, and great whales), seals, sea turtles, sharks, manta

FIGURE 1
A group of apex predators, the short-beaked common dolphin *Delphinus delphis*, feeds on a school of small epipelagic fish in the insular oceanic waters of the Azores. © Nuno Sá.

rays, marlins, and seabirds. Through 11 original research papers and two reviews, it addresses broad temporal (i.e., decadal datasets) and spatial scales – both horizontally, by covering the major ocean basins, and vertically, by targeting species inhabiting the epi-, meso-, and bathy-pelagic zones, as well as the aerial (i.e., seabirds) and terrestrial ecosystems (i.e., seals and penguins).

The contributing papers of this Research Topic fill knowledge gaps on the behavior, ecology, habitat use, population parameters, foraging, breeding, and conservation of apex predators in insular oceanic habitats through state-of-the-art, multidisciplinary and, in some cases, novel techniques. The resulting information contributes to the discussion of four main findings, as discussed below.

Studies of behavioral, population, and spatial ecology of apex predators in oceanic systems are challenging and require long-term data sets

Addressing social and ecological processes or demographic parameters, such as the relationships between individuals in social structures or the mechanisms driving habitat selection and movement, are key components for ecosystem-based management (Badenas et al.; Borja, 2014). These studies often require longitudinal information at the individual and community ecology levels, preferably on a decadal scale (Gusmao et al.; Setyawan et al.). Such data are, however, difficult to obtain for most pelagic predators due to their highly dynamic nature and the constraints (i.e., time, logistics, and costs) associated with surveying oceanic habitats (Guillemin et al.; Palacios and Cantor). Oceanic islands can, however, offer somewhat easier access to the pelagic environment, and the use of citizen science and platforms of opportunity has proven reliable in obtaining long-term scientific data for reduced financial costs, as exemplified in this Research Topic for cetaceans, turtles, and manta rays (Badenas et al.; Courtin et al.; Ferreira et al.; Dellinger et al.; Setyawan et al.).

Multimethodological approaches provide robust results for studying the biological and ecological traits of apex predators in oceanic systems

Enhanced management of anthropogenic threats can benefit wildlife (as well as humans) when addressed with an interdisciplinary approach (Lent, 2015). In this Research Topic, Palacios and Cantor identified priorities for ecological research on cetaceans in the Galápagos region along five topical areas, and suggested a broad suite of methodological approaches. Moreover, Medrano et al. assessed the breeding phenology, population connectivity, and niche differentiation of two allochronic populations of the Cape Verde storm-petrel (*Hydrobates jabejabe*) through four distinct methodologies, while Reinhold et al. presented a novel application of stable isotope and trace element techniques to identify the source colony of little penguins (*Eudyptula minor*) predated by long-nosed fur seals (*Arctocephalus forsteri*).

Oceanic islands are a hotspot for apex predators

Oceanic islands appear to constitute areas with a high density of apex predators (Vandeperre et al., 2014), likely due to the island mass effect, which is linked to nutrient and biological impacts (Caldeira and Reis, 2017; Chandelier et al., 2023). The two review papers included in this Research Topic support that supposition, describing a high diversity of cetaceans in the Galápagos region (Palacios and Cantor) and a high diversity of marine megafauna species (comprising mammals, turtles, and fish) in Macaronesia (McIvor et al.). In addition, Afonso et al. combined acoustic and satellite telemetry to show the preference for coastal nurseries adjacent to oceanic islands by juvenile smooth hammerhead sharks (*Sphyrna zygaena*).

Islands within networks of Marine Protected Areas provide positive conservation impacts when combined with ecosystem-based approaches

Highly or fully marine protected areas (MPAs) can mitigate overfishing, climate change, and other human-induced pressures (Sala et al., 2021). Here, Setyawan et al. demonstrated the positive impact of a suite of long-term conservation efforts on increasing the abundance of reef manta rays (*Mobula alfredi*) in the Raja Ampat network of MPAs, and how informative its results can be if combined with an ecosystem-based approach. Such an approach was also used by Fariñas-Bermejo et al. to investigate potential changes in the ecosystem and the impact on predators associated with prey decline, and by Gusmao et al. to analyse the trait diversity of nesting seabird assemblages.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

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

Publisher's note

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