Predictive models of mobile oceanic predator (MOP) hotspots in the Eastern Indian Ocean

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Summary

Landscape heterogeneity has been documented as a significant driver of wildlife aggregations (**'hotspots'**) in terrestrial systems, but whether similar clustering effects occur in the marine environment is less clear. Mounting evidence however suggests that areas of abrupt, non-uniform seafloor topography (or **'bathymetry anomalies'**) - such as submarine canyons or seamounts - may attract, and constitute key habitats for, a variety of **mobile oceanic predators (MOPs),** including numerous mammal, seabird, reptile, elasmobranch and teleost species (Fig. 1). In this study, we will test the strength of association between seabed complexity and large predators, and build predictive models to forecast the location, extent, persistence and seasonality of three types of MOP aggregations:

1. **Diversity** hotspots (with unusually high concentrations of species),
2. **Abundance & distribution** hotspots (which host significant fractions of one or more populations),
3. **Behaviour/movement hotspots** (sites of intense use, or where individuals spend disproportionate amounts of time).

Fig 1. Mobile oceanic predators (MOPs)
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The challenge

Fig 2. Humpback whales approaching an oil rig
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With rapid human population growth and rarefying resources on land, demands for sea space and access have flourished in recent years, creating recurring ocean **co-use conflicts between MOPs and humans** (Fig. 2). This is especially true around bathymetry anomalies, which are **being heavily exploited** and have become the focus of large-scale commercial fishing and seismic exploration activities. Yet our knowledge of these seabed features and the faunal assemblages they harbour is very limited, and this raises important questions regarding the **ecological impacts of industrial developments** in these regions.

Identifying wildlife hotspots as priorities for conservation planning and ocean zoning has emerged as a pragmatic strategy of optimally managing these conflicts.

A solution: modelling MOP hotspots

By examining the physical and biological drivers behind three types of MOP aggregations, key areas for large vertebrate predators will be identified.

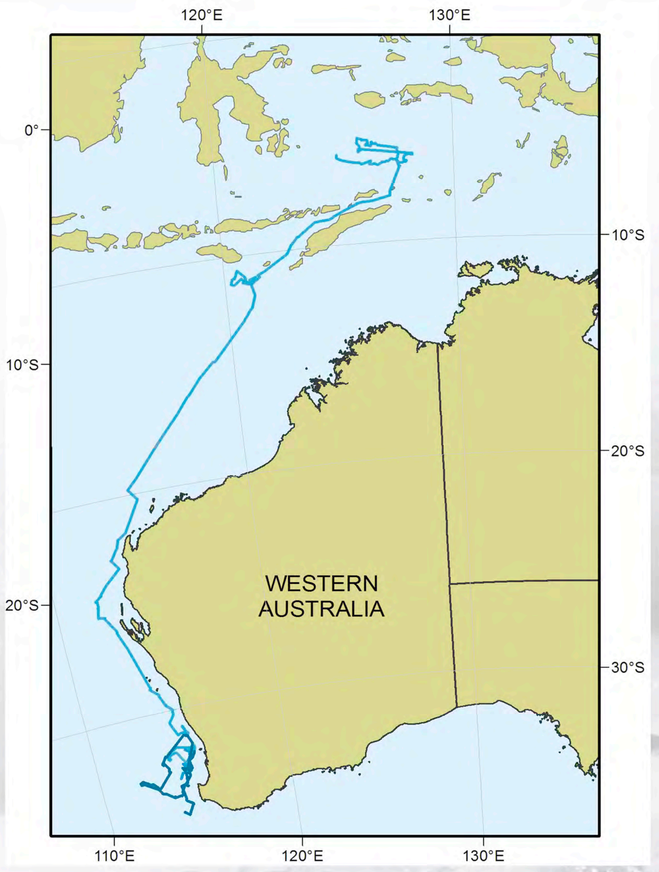

Fig 3. Example track of a pygmy blue whale satellite tagged in the Perth canyon in 2009

Source: Gales *et al.* 2010. Satellite tracking of Australian humpback *(Megaptera novaeangliae)* and pygmy blue whales *(Balaenoptera musculus brevicauda)*, IWC report SC/62/SH21, 9 p.

1 Hotspot 1: Diversity and species richness

Model taxon: Teleosts and elasmobranchs
Hypothesis: The diversity of fish and sharks is higher near bathymetry anomalies.
Field method: Baited remote underwater camera systems (BRUVS).
Analysis: Video processing, boosted regression trees and additive modelling.

2 Hotspot 2: Abundance and distribution

Model taxon: Cetaceans (+ seabirds and turtles)
Hypothesis: Cetaceans show habitat preferences for bathymetry anomalies.
Field method: Vessel-based line transect surveys.
Analysis: Distance sampling and spatial generalised additive modelling (GAM).

3 Hotspot 3: Movement and activity

Model species: Pygmy blue whales *(Balaenoptera musculus brevicauda)*
Hypothesis: Pygmy blue whales make use of bathymetry anomalies whilst migrating.
Field method: Satellite telemetry (Fig. 3).
Analysis: Switching state-space modelling and fractal analyses.

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