INDONESIA DISSERTATION/THESIS PROJECT

Testing the deep reef refuge hypothesis for mesophotic reefs in the Wakatobi Marine Park

Prof James J. Bell | Victoria University of Wellington University

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Mesophotic coral ecosystems (MCEs), which occur between ~30 and 150 metres depth, are increasingly recognised as important components of coral reef systems. Although largely unexplored in many parts of the world, including the Wakatobi Marine National Park (WMNP), these deeper reef habitats can support diverse benthic and fish assemblages, and may offer a degree of protection from some of the acute stressors that affect shallow reefs. As shallow reefs across the Indo-Pacific continue to face degradation from overfishing, sedimentation, and ocean warming, there is growing interest in whether MCEs could act as refugia for reef-associated species, a concept formalised as the deep reef refugia hypothesis (DRRH).

The DRRH proposes that mesophotic reefs could serve as ecological reservoirs for species affected in shallower zones, supporting recovery or persistence of biodiversity and ecological functions across the reefscape. For the DRRH to hold true, however, there must be overlap in species composition between shallow and deep reefs, connectivity (e.g. adult migration or larval movement) between depths, and evidence that mesophotic habitats and species are less impacted by stressors. While the hypothesis is compelling, evidence for its support is mixed, with outcomes differing between regions and taxa.

In Indonesia, coral reefs host exceptionally high levels of biodiversity, yet many reefs, particularly in accessible or fished areas, have experienced declines in key reef species and ecological functions. In WMNP, the abundance of large reef-associated fish species is generally low on shallow reefs, likely due to long-term fishing pressure. However, little is known about what occurs deeper on the reef slope. Mesophotic habitats in the Wakatobi are poorly documented, and their potential role as ecological refuges remains untested. While these deeper habitats may be less accessible to fishers, they could still be vulnerable to warming, sedimentation, nutrient loading, and other forms of stress.

This project proposes to assess the biodiversity, structure, and ecological significance of mesophotic reef fish communities in WMNP. It will test key predictions of the DRRH by examining whether there is overlap between shallow and deep reef fish assemblages, and whether mesophotic communities support fish species that are rare or absent in shallower zones.

The project may focus on several areas, including:

1. Testing the deep reef refugia hypothesis in the Wakatobi. This project will directly test the DRRH by evaluating the extent of species overlap between shallow and mesophotic reef communities in the Wakatobi. Using the baited remote underwater video (BRUV) camera footage, projects might quantify depth-generalist species, estimate differences in size distributions, and examine whether deeper reefs host larger-bodied individuals than shallow ones, potentially indicative of reduced fishing pressure. BRUVs are an ideal tool for this purpose, offering a standardised and non-destructive method to sample fish assemblages (although only for species attracted to bait). This analysis would provide an explicit test of the DRRH in this region and could help clarify whether deep reefs are functioning as refugia, or if they are ecologically isolated.

2. Spatial and temporal variation in mesophotic fish communities. BRUVs will be deployed in the Wakatobi to investigate fish communities from shallow reefs (10–30 m) down to mesophotic depths (>100 m). This will allow comparisons of species richness, size structure, and community composition across different sites experiencing different environmental conditions. The project could also use data collected in 2025 to assess temporal variation in mesophotic communities, and how this varies between shallow and deep reef fish communities. The resulting data will provide critical insights into whether mesophotic reefs support distinct or overlapping communities at different locations, and also help establish baselines for future monitoring of MCEs.

This work will provide a comprehensive baseline for mesophotic reef communities in the Wakatobi, and will contribute valuable insights into the validity of the deep reef refugia hypothesis in one of the most biodiverse marine regions on the planet.

Recommended reading:

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