INDONESIA DISSERTATION/THESIS PROJECT

Barrel sponge ecology and ecosystem roles on transitioning reefs in the Wakatobi

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Barrel sponges are among the most ecologically important organisms found on tropical coral reefs. Often referred to as the "redwoods of the reef" due to their large size, great age, and structural complexity, barrel sponges, particularly *Xestospongia* spp, can reach over a metre in diameter and persist for decades or even centuries. They are important filter feeders, capable of pumping tens of thousands of litres of seawater daily, which not only supports their nutritional requirements but also plays a critical role in nutrient cycling. Their large, vase-like structures provide essential habitat for a wide range of reef organisms, including cryptic invertebrates, juvenile fishes, and mobile predators. Despite their vital functional roles, barrel sponges remain understudied compared to reef-building corals, even as they emerge as dominant features on increasingly degraded reefscapes.

In the Indo-Pacific, and particularly within the Wakatobi Marine National Park in Southeast Sulawesi, Indonesia, there is evidence that barrel sponges are becoming more abundant, especially on reefs impacted by sedimentation and other forms of anthropogenic stress. These shifts suggest that barrel sponges may be key “winners” on future reefs, capable of persisting under environmental conditions that are increasingly unfavourable for many coral species. Understanding the population dynamics, ecological roles, and community associations of barrel sponges is critical for predicting how these ecosystems will function in the future.

This project could focus on several areas, including:

1. **Characterising the size-frequency structure and growth rates of barrel sponge populations** across multiple reef sites in the Wakatobi. This would involve quantifying sponge height, diameter, and estimated volume to assess age structure and growth potential. Comparisons with earlier studies would help evaluate whether barrel sponge populations are increasing in abundance and size. It could also be possible to incorporate photogrammetry into this project to apply recently developed methods to evaluation sponge volume and subsequently estimate the population-level impacts of these sponges on the water column. This would would help model ecosystem-level effects of sponge dominance.

2. **Documenting the fish and invertebrate communities associated with barrel sponges**, particularly those using them for shelter, nursery habitat, or feeding. Visual surveys, deployed camaera, and close-up observations could be used to identify resident fauna and estimate their dependence on barrel sponge. These data would provide important insights into the role of barrel sponges as ecosystem engineers on transitioning reefs.

3. **Exploring spatial and environmental drivers of barrel sponge distribution**, such as depth gradients, exposure, turbidity, or proximity to human settlements. Projects could investigate whether certain environmental conditions favour barrel sponge proliferation, and whether these trends correspond with areas of coral decline.

Collectively, this research would build a comprehensive understanding of barrel sponge ecology in the Wakatobi and help clarify their role in shaping the structure and function of reefs in a changing climate. As coral reef systems continue to transition away from traditional coral dominance, it will be increasingly important to focus on these resilient and influential organisms.

Recommended reading:

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