INDONESIA DISSERTATION/THESIS PROJECT

Understanding causes and consequences of regime shifts on Indo-Pacific coral reefs

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The decline of corals on reefs globally has created opportunities for other organisms, as the space once occupied by corals is colonised by alternative benthic taxa. While this "free" space is most commonly reported to become colonised by algae, there are increasingly reports where the space created by coral declines is occupied by other invertebrates rather than algae. These so-called regime shifts have important consequences for the overall function of coral reefs, altering trophic pathways, ecological interactions, and overall reef productivity.

The potential biological groups identified as likely “winners” on future coral reefs include sponges, soft corals, and ascidians. These groups have distinct life histories and functional roles, and are generally more tolerant of environmental stressors than scleractinian corals. Sponges, some of the oldest extant metazoans, contribute to reef function through processes such as bioerosion, nutrient cycling (via filter feeding), and provision of structural habitat. Soft corals (octocorals) can rapidly colonise disturbed substrates, may exhibit resistance to thermal stress and sedimentation, and can form dense canopies that alter local hydrodynamics and light regimes. Ascidians, both solitary and colonial forms, are efficient suspension feeders, often thrive in nutrient-enriched or turbid conditions, and can compete effectively for space on degraded reefs. Recent experimental and field-based evidence has shown that all three groups, sponges, soft corals, and ascidians, are generally more resilient to impacts such as sedimentation, nutrient enrichment, and warming than reef-building corals. Their relative resistance supports the persistence and potential dominance of these groups on future reefs.

Given that shifts to non-coral dominated reefs are already occurring in many locations, there is an urgent need to understand the ecological implications of these changes, especially given the reliance of tropical coastal communities on reef-derived ecosystem services. Importantly, a number of earlier studies in the Wakatobi have reported that reefs once dominated by hard corals are now increasingly colonised by sponges, soft corals, and ascidians. Although some studies have specifically examined sponges at these sites, most reefs are still considered to be in transitional states. These Wakatobi reefs are typically found in more sediment-laden environments, and while many sponge species inhabit these areas, barrel sponges (*Xestospongia* spp.) and *Lamellodysidea herbacea* are particularly common and appear to have increased in abundance over time. Similarly, various soft coral genera (e.g., *Sarcophyton*, *Sinularia*) and colonial ascidians (e.g., *Didemnum*) are becoming increasingly prominent in benthic assemblages.

This project could focus on several areas, including:

1. **Examining changes in the abundance of key sponge, soft coral, and ascidian species over time**, using access to previously published information. This project could involve collecting new abundance data from multiple sites in the Wakatobi and comparing it with historical data for key species (e.g., *Xestospongia*, *L. herbacea*, dominant soft corals, and colonial ascidians) to evaluate broader patterns of faunal turnover.

2. **Exploring niche plasticity and trophic interactions of reef fish associated with invertebrate-dominated reefs**. Projects could investigate differences in fish assemblages and feeding behaviour on reefs dominated by sponges, soft corals, or ascidians versus those dominated by scleractinian corals. This would provide insight into shifts in energy pathways and food web structure as reefs transition to non-coral states.

3. **Assessing changes in topographic complexity and refuge availability** on reefs where sponges, soft corals, or ascidians dominate. Earlier work in the Wakatobi has suggested that sponge-dominated reefs may have fewer small refuges for juvenile fish than coral-dominated ones. This project could extend such assessments to include soft corals and ascidians, examining how their different morphologies influence habitat complexity and the implications for associated fish communities, especially in terms of fish size structure and juvenile abundance.

Recommended reading:

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