

IH305: Causes of and temporal and spatial variation in coral mortality in Indonesia

Dan Exton

Scleractinian corals are the ecosystem architects for complex and highly valuable coral reef ecosystems. They therefore provide the foundations on which the highly diverse associated communities thrive. In particular, the high degree of structural complexity (or topographic diversity) formed by coral growth provides high microhabitat diversity, and thus the range of niches available to other organisms. However, corals exhibit notoriously slow growth rates, even under optimal conditions, with many colonies growing by only a few centimetres per year. Therefore a complex reef system is the result of many thousands of years of Scleractinian growth through the laying down of calcium carbonate skeletons via calcification.

This means that any factors which negatively impact coral growth, both in the present and in the future, can have devastating consequences for the ecosystem as a whole and, in severe cases, can lead to a phase shift to an alternative stable state. This results in a dramatic decline in overall biodiversity and productivity, with major implications both for biological and ecological functioning and socioeconomic value for local communities. Unfortunately, coral reefs are under threat from a host of factors, and are considered amongst the most threatened ecosystems on the planet. This is enhanced by the fact that, even where recovery to a healthy reef is possible, slow coral growth rates mean recovery times are high.

One of the most well publicised threats to corals is coral bleaching, whereby corals undergo a visible loss of pigmentation. Bleaching occurs in response to environmental stress, and can lead to coral death. In extreme cases, such as the mass bleaching event of 1998, whole reef systems can be devastated. However, bleaching is also a natural response to changes in environmental conditions and, in many cases, corals are able to recover from episodes of bleaching. In the Wakatobi Marine National Park, for example, this sub-lethal bleaching is associated with seasonal changes in environmental conditions. It simply represents a natural coping strategy employed by corals to alter their physiology in response to natural variations in factors such as temperature and light. Further research is needed to explore patterns of natural sub-lethal bleaching versus thermally induced mass bleaching, including interspecific variability in susceptibility, as well as differences in tolerance levels between con-specifics from sites of varying habitat quality.

Coralivory is a natural process on reefs whereby coral tissue is consumed by organisms from the coralivore functional guild. This includes a number of fish groups such as parrotfish, and represents an intermediate disturbance on reefs which, if kept at natural levels, actually helps maintain a diverse and healthy. However, more destructive consumption of live coral comes from the Crown-of-Thorns starfish (*Acanthaster planci*). These organisms are naturally found on reefs at very low population densities, but can sporadically undergo population outbreaks capable of destroying large areas of reefs. Drivers of these outbreaks are not fully understood, although a number of studies have proposed a genetic cue. More recent work has also highlighted the role of increased food availability, in the form of phytoplankton density, in stimulating outbreaks. In the Wakatobi, the occurrence of Crown-of-Thorns has been increasing in recent years, and research into distribution patterns and related coral mortality rates are greatly needed to quantify the level of threat to reefs in the area, and help inform conservation managers.

Corals are covered by a layer of mucus, which naturally contains a complex microbiological community which are beneficial to the coral. However, like all animals, corals are also susceptible to infectious diseases in the form of pathogens, which can lead to coral death. Increased water temperatures have been shown to lead to higher incidences of coral disease, particularly on reefs with high coral density. This raises important questions regarding the future of disease prevalence in response to predicted changes in climate, where the incidence of thermal anomalies is expected to rise. Students could collect valuable data on the distribution and severity of different coral diseases in the Wakatobi, as well as comparing disease prevalence at sites of varying habitat quality. This could help to identify environmental and community factors which affect the susceptibility of corals to disease. Another aspect of this project could be to explore taxonomic variation in disease susceptibility to identify those corals most at risk.

As well as exploring these causes of coral mortality spatially, in terms of variations between sites of different habitat qualities, temporal studies could also be carried out. By using data sets from previous years, in addition to new data collection, temporal trends in the impacts of these threats could be assessed. This will help to identify whether threat levels are increasing, and help to inform conservation managers to allow them to tailor their efforts to the particular needs of reefs in the area. Many threats can also occur sporadically, such as thermal anomalies and coralivore outbreaks, meaning temporal research is important in identifying these phenomena.

Reading List

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