IN28 Bioerosion and biological agents of coral mortality

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Reef building corals are the key ecosystem architects that produce the complex physical structure that provides habitat for the many thousands of species inhabiting reefs. On a healthy reef system coral recruitment and colony growth is greater, or at least in balance, with processes that cause mortality or erode corals. Many different species do actively erode corals (bioerosion) and many more can cause coral mortality. Bioerosion is one of the main drivers structuring a coral reef and has the potential to remove high quantity of carbonate. By removing carbonate substrates bioeroders have a negative influence on the carbonate budget of the reef, especially those reefs with limited growth (e.g. light-limited reefs and sedimented reefs). Bioerosion can also lead to coral disease which is usually cause by a consortium of microbes that can spread across a colony. Research within the Wakatobi have documented past incidences of bioerosion and recorded disease prevalence. There is now a need to examine how these processes have changed in time particularly as reefs in the region have shown a steady decline in coral biomass and have recently been impacted by a thermal anomaly (the 2016 El Niño). Understanding the balance of growth and reef loss is pivotal for conservation and the development of effective management strategies.

Numerous different species of animals, algae and microbes threaten reef building coral species. The extent of this threat is largely dictated by environmental conditions. Research is required to determine the extent of threat caused by different agents of coral mortality such as corallivorous fish and invertebrates, bioeroders, actively competing benthic taxa as well as increased microbial activity resulting in coral disease. Crown of thorns starfish (*Acanthaster planci*) are corallivores and voracious predators of coral reef ecosystems, spending approximately half their lifetime feeding. An individual adult is able to feed continuously for up to 9 hours at a time by extruding its stomach inside-out over coral polyps. Despite this a healthy coral reef with around 50% coral cover can sustain between 20-30 individuals ha^{-1}. However outbreak densities of up to 1000 ha^{-1} can destroy a reef system in months, which has been observed at multiple locations on the Great Barrier Reef, the Red Sea and throughout the Indo-Pacific. These outbreaks have been purported to be linked to declines in environmental quality (eg increased nutrients) and a decline (most often through overexploitation) of predators of the crown of thorns starfish such as the giant triton (*Charonia tritonis*), the titan triggerfish (*Balistoides viridescens*), the humphead wrasse (*Cheilinus undulates*) and numerous pufferfish species. There is a need to assess the abundance of *A planci* on reefs of the Wakatobi and the impact they are having across different reef sites.

Bioeroding organisms can lead to coral mortality as well as decreases in the physical integrity of coral colonies. Several fish species, particularly of Parrotfish, actively remove coral substrate while feeding on the algae attached to the reef (external bioeroders). In most reef systems Parrotfish play extremely important functional roles, for example by removing algae that may otherwise overgrow or outcompete corals for space. However they are also capable of removing large amounts of carbonate from the system which on reefs where growth is limited may have a significant impact on long term reef conditions. Research is required to understand the extent of fish bioerosion on reefs within the Wakatobi. Bioerosion is also an internal process and many species of invertebrates are active bioeroders. Internal erosion plays

an important role in weakening coral reef structure particularly on reefs in highly sedimented environments where calcification is limited. Sedimentation appeared to influence not only rates of bioerosion but also the structure and diversity of macroborers community. Despite the important function played by borer organisms in structuring coral reef, their role is not well understood and often not taking in to account when assessing coral reef health. Therefore there is a need to understand the biodiversity and abundance of bioeroding invertebrates on reefs within the region and to determine whether their impact varies across environmental gradients (across reef sites and zones).

All forms of bioerosion break the surface tissue of corals. Under certain conditions this break can lead to the onset of coral disease, particularly in environmentally stressed systems. Studies in 2007 demonstrated a diverse but low prevalence of disease in the Wakatobi. However, like other reefs around the world, over the past 10 years the reefs in the region have been further stressed by changes to the ecological balance (eg brought about by exploitation of key fish groups), and by changes to environmental conditions. The most extreme of these environmental changes was witnessed in 2016 when one of the biggest El Niño ever recorded devastated the worlds reefs causing mass thermal bleaching and mortality. When corals are environmentally stressed they can become more susceptible to disease. Consequently, and along with other agents of coral mortality, there is now a need to examine the disease prevalence of across the reefs of the region which can be compared to past studies. There is a potential for a range of dissertation research projects within this topic. Dissertations could take a holistic view and examine all aspects of biological agents of reef mortality or could focus on bioerosion or disease. Results can be compared to previous data to determine changes over time.

Reading list

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