HO26 Exploring abiotic factors as drivers of a unique Caribbean coral reef ecosystem

Dr Dan Exton, Operation Wallacea

The exact structure and appearance of a coral reef can vary in different areas of the world and based on differing environmental conditions and anthropogenic impacts acting upon them. However, one of the most common images of a coral reef is the clear blue water surrounding it; an image which is more often than not accurate. The photosynthetic processes present on reefs, most importantly by symbiotic microalgae called zooxanthellae which live within coral tissue and drive some of the ecosystem's most vital processes, makes high light availability an important component of reefs, making clear water advantageous. Scleractinian corals, the ecosystem architects of complex reefs, also thrive in low nutrient, or oligotrophic water, which limits macroalgal growth rates and helps corals to dominate the benthic community. Clear water is a common symptom of low nutrient availability through inhibition of phytoplankton growth. Finally, corals are particularly susceptible to the effects of sedimentation, where particles settle onto the reef and smother coral polyps, meaning reefs struggle to survive in sites with high sediment loading, for example near to riverine outputs or where land runoff is high.

Clear water was therefore considered a pre-requisite for ecosystem health, and management targeted such locations in order to maximise success. However, in recent years, there has been increasing evidence that non-clear, or turbid, water could also provide a suitable environment for healthy coral reefs, and in some instances even represent a beneficial alternative to clear water sites for long term coral survival. One of the major current threats to Scleractinian corals is thermally induced bleaching. Although increased temperature is the main driver of this form of bleaching, high light stress is also known to play an important role, and therefore the reduced light quantity and quality caused by reduced water clarity is believed to provide a useful buffer against thermal bleaching. This has been supported by the discovery of several reefs in turbid water, where significant coral communities were thriving. An example of this was in the Seychelles where, after the 1998 El Niño event caused mass coral bleaching mortality in the region, large colonies of thermally sensitive coral species were found successfully inhabiting turbid lagoons. An important consideration is the difference between turbidity and sedimentation, two terms which are often confused. Turbidity refers to sediment in suspension within the water column, whereas sedimentation describes the process of sediment deposition onto the reef itself, which creates the impact of coral smothering.

The majority of Honduran coral reefs are representative of the Caribbean region; located in clear water sites and with declines in Scleractinian coral cover leaving a regional average of approximately 23%. They have also suffered varying extents of macroalgal overgrowth, with the most heavily impacted sites demonstrating macroalgal cover of over 50%. The reef system of Tela Bay, however, boasts a significantly higher Scleractinian coral cover, with some sites approaching 70%, amongst the highest in the entire Caribbean. However, historical fishing pressure has led to a complete collapse in the reef fishery of the bay, making fish abundance and biomass low in contrast to such a healthy benthic community. In many locations, such an extreme level of overfishing would inevitably lead to the replacement of hard coral with macroalgae, and an eventual phase shift to an algal dominated system. In Tela Bay, however, macroalgal cover is extremely low (<5%), a phenomenon which can almost certainly be attributed to the unusually high population density of the sea urchin *Diadema antillarum*, a Caribbean keystone species which under natural conditions provides the majority of herbivory on a reef. A disease-led mass mortality of approximately 98% throughout the entire Caribbean in 1983, followed by minimal recovery, has left most reefs severely lacking the herbivory required to keep macroalgal growth in check, but Tela represents a unique hotspot of *D. antillarum* density and ecosystem service provision.

Students on this project will focus on investigating patterns in reef health on the reefs of Tela Bay, and on improving our understanding of the factors which have allowed the benthic community to remain so healthy despite a severe lack of fish. Specific projects could focus on coral species distribution patterns on the reefs, or on the extent of coral recruitment under current conditions. These projects could be tied into environmental data used to describe the abiotic factors impacting on the system, and attempt to identify the drivers of the high coral cover present in the area. This is a broad topic with a range of potential project directions, but will require SCUBA diving in order to collect data. Data will be collected predominately via a range of transect techniques, and could link with other dissertation projects to help develop a more holistic approach to research in Tela Bay.

Reading List

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