HU296: Assessing the impact of mangrove degradation on their functionality in Honduras

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Mangroves are a taxonomically diverse set of halophytic, salt tolerant, plant species. Comprised of 54 species in 20 genera and 16 families mangrove species have adapted over time, through convergent evolution, to survive the harsh environmental conditions of (sub) tropical coastlines. Though found globally across the tropical latitudes mangrove forests tend to be limited, locally to low energy coastal areas such as estuaries and inter-tidal zones, where the physical environment is less severe. Adaptations to this highly stressful environment have resulted in mangrove species possessing morphological characteristics which make them structurally and functionally unique.

The association of mangroves with these areas of low energy has resulted in their frequent occurrence within close proximities to coral reef and sea grass systems, which act as physical buffers of oceanic currents and waves, so decreasing the erosive energy of the water and creating ideal environments for mangroves by promoting the depositional of sand and other suspended matter. Equally so, coral reefs benefit from this apparent connection as the functional ability of mangroves to disrupt freshwater discharge promotes favourable water quality conditions for coral.

Perhaps one of the most striking adaptations for many of the mangrove species is their complex root structure which is an adaptation to the anoxic soil conditions typical of inter-tidal sediments. These vast networks of roots allow the mangrove to maximise respiration and atmospheric nutrient uptake while also promoting sediment stabilisation. The extension of mangroves root structures into the intertidal and sub-tidal environments has resulted in the provision of both marine and terrestrial habitats for a wide diversity of fish and invertebrate species. Studies into the habitat utilisation, particularly as nurseries, of mangroves by reef fish species have found that the biomass of particular fish increased by 42% where interconnectivity between mangrove and coral reef ecosystems occurred. The results of studies such as these illustrate the importance of mangroves for social and economic activities, such as subsistence fishing and tourism, in addition to highlighting their ecological value.

Mangrove ecosystems are recognized to be amongst one of the most productive in the world as well as one of the most threatened tropical ecosystems. Over the last 50 years it has been reported that there has been a 35% decrease in global mangrove coverage. The global loss of mangrove coverage, like so many other ecosystems, originates from overexploitation as a result of the anthropogenic disturbance factors of extraction, land reclamation and pollution.

The island of Utila, located off the coast of Honduras, is situated within the Mesoamerican barrier reef is one of the most prosperous parts of Honduras, largely due to a thriving dive tourist industry. Over the last three decades the dive industry on the island has undergone massive growth resulting in the rapid expansion of the island population in addition to the development of dive centres, hotels, restaurants

and housing. Development has largely been unregulated, or done so with little consideration for the marine environment. Utila is dominated by mangrove systems, with 70% of the island covered in mangroves or associated wetlands, which are an integral part of the marine ecosystem, performing valuable functions such as providing nursery habitats for reef fish, sequestering pollution, stabilising sediment and mitigating coastal erosion. However, the mangrove systems are being severely impacted by the development on the island, especially with large areas being destroyed to make way for building hotels and housing. This poses a major threat to both future economy of Utila as with fewer mangroves available to sequester and stabilise suspended material (both organic and inorganic) tidal flushing into the reef system will begin to smother and kill the coral and associated flora and fauna. This would ultimately result in the consequent reduction in the number of dive tourists visiting Utila. It is therefore in the interest of Utila to conserve and sustainably manage its mangroves, and other connected marine ecosystems in order to protect the local biodiversity and thus secure its economic future.

While there exists a vast body of literature documenting the function, structure, ecology and threats to mangroves there remains little in the way of interpreting the sub-lethal effects of human activity on these systems. Given that it is important that Utila continues to develop and that this will inevitably impact mangrove system health, it is highly important to assess how much damage can be done to a system before its important functions are disturbed. Within this area there is scope for a wide variety of projects. Projects will involve surveying three of Utila's mangrove lagoons, each with a differing level of anthropogenic disturbance. Firstly, Oyster Bed Lagoon; this lagoon itself experiences a moderate degree of physical disturbance manifested in boat traffic and dredging for access to the resorts and for transporting building materials respectively. The second is Big Bite Pond, due to its close proximity to the main settlement on Utila, East Harbour the mangrove coverage is reducing as they are felled and cleared to make room to accommodate the increasing resident and tourist populations of the town. Much of the western side of the lower part of the lagoon has been completely cleared to build dive shops and centres to meet the high demand for recreational diving on the local reefs. As a direct result of the increased popularity of dive tourism the lower lagoon and canal are now subject to frequent water disturbance from increasingly busy boat traffic. The third lagoon, Rock Harbour is located on the relatively remote northern shore. Due to its remoteness Rock Harbour is relatively pristine and so makes for an appropriate control for comparisons of disturbance between the other lagoons.

By quantifying the health of the mangroves and identifying potential differences in the data sets collected for each lagoon hypotheses can be formulated and tested to investigate whether anthropogenic activity around the lagoons is having a negative impact on mangroves and their functioning. Environmental data, such as water quality and sediment characteristics, in conjunction with surveys of the invertebrate and fish communities of each lagoon can also be collected to further strengthen the data set.

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