

THE RECENT HISTORY OF CORAL REEFS AND THEIR ENVIRONMENT IN TANG KHEM BAY, PHUKET, THAILAND - AN EXAMPLE OF CORALS LIVING IN A POTENTIAL CLIMATE CHANGE REFUGE?

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ABSTRACT: Tang Khem Bay is a sheltered bay on the south eastern tip of Phuket which has been exposed to several natural and man-made changes over the last 40 years. It is fringed by extensive intertidal reef flats (~200 m wide) with shallow reef slopes, while the central sandy bay supports extensive seagrass beds. Living corals inhabit the reef flats from the shoreline to the reef edge and over the shallow reef slopes. Over 30 scleractinian coral species have been recorded on both the reef flats and slopes, with coral cover values as high as 70% on the outer reef flats during periods of optimal growth.

These reefs have been frequently monitored and have shown remarkable resilience in the face of man-made and natural stresses. The reef flat corals are living in physically extreme conditions, being subject to a maximum of 4 h aerial exposure during spring tides (3–4 m tidal range) when they are also exposed to high solar radiation and temperature fluctuations of up to 15°C over a 24 h period. Their responses include behavioural (strong tissue retraction) and physiological (heat-shock protein production, up-regulation of antioxidant enzymes) responses with the majority of corals hosting thermo-tolerant zooxanthellae (genus *Durusdinium*: formerly clade D1a). The reef flats and slopes are also found in extremely turbid and nutrient-rich waters (suspended load ~20 mg l⁻¹) where the annual seawater temperatures range between 29–31°C.

In recent years the reefs have been adversely affected by dredging activities during build of the Phuket deep-water port (1986–1987), lowered sea levels as a result of the climatic influences of the Indian Ocean Dipole (1998), disturbances during hotel development (1999–present) and both solar and temperature-induced bleaching (loss of coral symbiotic algae), with the most extreme temperature-induced bleaching event occurring in 2010. Over the period 1980–2010 the calcification rate of one of the major reef-building coral *Porites* spp. has declined by 20% as a result of rising background sea temperatures. Yet the reefs continue to survive and intertidal corals have recovered from many of the environmental disturbances, assisted in part by rising sea levels due to climate change, and land subsidence following the 2004 Sumatran earthquake. On the reef slope marked changes in the coral species/genus composition have been noted in recent years resulting in a decline in the dominance of massive *Porites* spp. and an increasing abundance of branching *Pocillopora* - perhaps, in part, a result of the reversal in bleaching susceptibilities of these species.

However, there must be concern for reefs bordering a coastline that has seen extensive port and hotel development in recent years, and where plans are in place for future building work and associated activities. The reefs of Tang Khem Bay, which appear to have so far escaped the fate of many others in the rest of the world as a result of climate change, are an important resource of physiologically robust corals, providing a thermal refuge with the potential for colonisation of other reef sites nearby. Indeed, their reef slopes boast a significantly higher coral cover than other monitored reef sites in the locality, with healthy branching coral colonies that are infrequently seen at locations nearby. Such resilience would be jeopardised by any additional man-made stresses, making this area worthy of special protection.

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