

IH304: Reef building coral morphology across environmental gradients and consequences for reef architecture: from the corallite to the colony, Indonesia

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The structure of a coral reef is a result of the laying down of calcium carbonate skeletons over generations by Scleractinian corals. This is achieved through the process of calcification, which is a light enhanced process. This results in a highly complex 3D structure, providing the wide ranging microhabitats required to support a highly diverse associated community of fish and other fauna. For this reason, corals are described as ecosystem architects.

However, light quantity and quality can vary enormously on a reef, both between and within sites, thus influencing calcification rates. At any particular site, light will vary with depth due to light attenuation, both in terms of its intensity and its quality. Between sites, environmental factors such as turbidity also act to alter the light environment in which the corals exist. Turbidity refers to the loss in water clarity associated with suspended particles in the water column. This diminishes light availability for the corals as suspended particles absorb a proportion of the light energy before it reaches the reef.

Corals exist in a symbiotic relationship with a group of microalgae known as zooxanthellae. The zooxanthellae are found within their coral hosts, and provide energy to the coral via photosynthesis. Additionally, however, the cnidarian coral host is able to actively feed on particles in the water column through heterotrophy.

This means that Scleractinian corals have two methods of nutrition available to them. Although particular species and genera tend to favour one specific method, and are suitably adapted to that role, there is evidence of some plasticity amongst some corals. This refers to the structure of individual corallites within the colony, which can be modified to optimise their nutrition either for heterotrophy or autotrophy.

By increasing corallite width and intercorallite distance whilst decreasing corallite depth, corals are able to optimise their morphology for photosynthesis under high light conditions. By reversing these changes, they are able to optimise their morphology for heterotrophy under low light conditions. In some cases, corals on turbid reefs are 10-20 times more heterotrophic than con-specifics on more pristine reefs.

On a larger scale, coral colonies exhibit a range of morphologies ranging from boulder-like massive structures, to intricate branching ones. Many coral genera are able to grow in multiple growth forms, and there is evidence demonstrating that the dominant growth form at a particular site or optical depth is driven by the environmental conditions found there, particularly light. This aspect of coral morphology is particularly relevant to the diversity and abundance of associated reef fauna. More complex growth forms such as branching, tabulate and foliose corals provide an increased number and variety of microhabitats.

Projects in this field could look at changes in coral morphology over time, and how they relate to changes in the fish and macroinvertebrate communities. This would make use of both new data sets and existing data from previous years. Alternatively, inter-site comparisons could be performed to assess spatial patterns. Specifically, students could investigate the effects of turbidity and depth on the corallite and colony morphology of common Scleractinian coral

genera. They could also assess how colony morphology of the overall coral community varies with changing light environments.

Colony morphology will be examined using *in situ* observations using SCUBA diving or snorkelling. Due to the small size of corallites, as well as to maximise data collection, corallite analysis will be performed using underwater photography, with dimensions measured remotely in the laboratory using image analysis software. This will allow corallite size, shape and arrangements to be analysed.

Reading List

Anthony, K.R.N., Fabricius, K.E. (2000). Shifting roles of heterotrophy and autotrophy in coral energetics under varying turbidity. *Journal of Experimental Marine Biology and Ecology* **252(2)**: 221-253

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Todd, P.A., Sidle, R.C., Lewin-Koh, N.J.I. (2004). An aquarium experiment for identifying the physical factors inducing morphological change in two massive scleractinian corals. *Journal of Experimental Marine Biology and Ecology* **299(1)**: 97-113