

## IH278: Competition between hard coral species, Indonesia

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Although often overlooked as a resource, competition for space is an important process helping to determine coral reef community structure. As a highly limited resource, space competition between benthic organisms, particularly Scleractinian corals, macroalgae and sponge, is often fierce. Corals are interesting as they exhibit extremely slow growth rates (often only a few centimetres per year), yet are vital to the success of reef systems due to their role as ecosystem architects. The complex reef structure which supports the highly diverse and productive communities found in coral reef ecosystems is formed by the laying down of calcium carbonate skeletons by successive generations of hermatypic coral colonies. This complex 3D structure provides a wealth of microhabitats for fish and invertebrates to occupy, thus driving biodiversity, and the persistence of corals is vital if this is to be maintained. Space competition studies tend to focus on coral-macroalgae interactions, but corals themselves can compete with one another for reef space.

Scleractinian coral colonies have been shown to employ eight distinct competitive interactions, including both direct and indirect mechanisms. Indirect competition takes place when there is no physical contact between the competing colonies, whereas direct competition involves tissue contact between them. The most common example of indirect coral competition is overtopping, whereby those species with more complex 3D morphological structures (such as branching and tabulate growth forms) grow into the space above another colony. This reduces the light availability for the understory colony, thus reducing its photosynthetic capacity and subsequently its growth and potentially survival. Colonies lacking such a complex structure (such as encrusting and massive growth forms) engage in direct competition as their tissues come into contact, with overgrowth a common example, which smothers the underlying colony. Corals also develop sweeper tentacles on their colony margins which are close to other sessile organisms for use in direct aggression. Their growth has been shown to be stimulated by recognition of competitor tissues, with no growth identified in response to non-competitive stimuli.

In certain cases, one colony may successfully outcompete another, and ultimately displace a neighbouring coral on the reef. This is particularly the case for indirect competition, as the lack of physical contact limits any retaliation by the understory colony. However, in the case of direct competitive interactions, other results may arise. Direct competition can lead to a 'standoff', whereby growth simply ceases along the margin of contact. However, in more complex competitive interactions, temporal reversals can take place, whereby the 'upper hand' alternates between the two competitors. In one continuous study over a 20 month period, frequent reversals were observed between common Caribbean corals via repeated cycles of attack by the aggressor, followed by retaliation by the wounded colony. This would lead to an increase in the inter-colony distance, at which point active competition was found

to cease temporarily until the competitors grew back into proximity, at which point the cycle of direct competition re-initiated.

Although research generally focuses on competition between established Scleractinian colonies, it is important to realise that the impacts of competition in fact begin at the larval stage. For propagules to develop into adult colonies, they require space to settle. However, particularly on a healthy reef system, benthic space is often already occupied. Established adults therefore have the opportunity to pre-empt one another's larvae. This could be particularly important in the case of indirectly competing species, as it provides underlying corals with an opportunity to prevent overtopping species from settling nearby.

Coral interaction research is carried out via observations, typically repeated to gauge temporal changes in competitive behaviour and rates of the various mechanisms. Particular care needs to be taken when categorising competitive interactions, as short term studies of the interaction between specific colonies may lead to competitive reversal being misidentified as outcompetition, due to whichever colony is in an aggressive cycle at the time appearing to be 'winning'. Similarly, if observed during a period of retreat (which is typically only a few millimetres in distance), the interaction could be misinterpreted as a 'standoff' unless a suitable spatial scale is used. Projects could focus on a particular competitive mechanism, or look at the interactions between specific growth forms or genera. There is also the possibility to study differences between intra- and interspecific competition.

### **Reading List**

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