

Coral's addiction to 'junk food'

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Over two hundred million humans depend for their subsistence on the fact that coral has an addiction to 'junk food' - and orders its partners, the symbiotic algae, to make it. This curious arrangement is one of Nature's most delicate and complex partnerships – a collaboration now facing grave threats from climate change.

The symbiosis between coral – a primitive animal – and zooxanthellae, tiny one-celled plants, is not only powerful enough to build the largest living organism on the planet, the Great Barrier Reef but also underpins the economies and living standards of many tropical nations and societies who harvest their food from the reefs or have developing tourism industries.

The issue of whether the partnership is robust enough to withstand the challenges of climate change is driving a worldwide scientific effort to decipher how corals and their symbiotic algae communicate with one another, says Professor David Yellowlees of the ARC Centre of Excellence for Coral Reef Studies (CoECRS) and James Cook University.

“It's an incredibly intricate relationship in which the corals feed the algae and try to control their diet, and the algae in turn use sunlight to produce “junk food” – carbohydrates and fats – for the corals to consume.

“Where it all breaks down is when heated water lingers over the reef and the corals expel the algae and then begin to slowly starve to death. This is the bleaching phenomenon Australians are by now so familiar with, and

which is such a feature of global warming.”

The challenge for scientists is to understand the ‘chemical conversation’ that goes on between the corals and zooxanthellae, the genes which control it – and to explore whether corals which lose their primary partners can survive using other algae or must inevitably die.

Prof Yellowlees and Dr Bill Leggat will shortly release a new review of the current state of knowledge about the metabolism of the coral symbiosis in the journal *Plant Cell and Environment*.

“Coral symbiosis takes place mainly in clear, clean nutrient-poor waters where food is so scarce the corals need a partner to help feed them.

“We know for example the corals provide carbon as CO₂ which is processed by the algae to reprocess into carbohydrates and fats using energy from sunlight, so they can feed. It’s a beautiful recycling process.

“The corals control the diet of the algae, to ensure it produces what they need. You could say they farm the algae, much as we farm crops.

“And the algae serve as the junk food chefs, providing the corals favourite food to order.”

“Researchers in the Centre of Excellence are trying to understand the chemical and genetic basis for the conversation that goes on between a coral and its particular algae, and to establish whether, if it loses its algae in a bleaching event, it can establish the same relationship with a different strain of algae.

“In other words, how robust this symbiotic system is and whether it can withstand shocks from warming, ocean acidification, changes in sunlight levels and other likely impacts from human activity.

“The bottom line here is the survival of the Great Barrier Reef and coral reefs the world over.”

Five times in the Earth’s history corals have been wiped out, or very close to it, suggesting they are highly vulnerable to changes in ocean conditions, Prof. Yellowlees says. Some of these past events were probably triggered by past global warming and ocean acidification.

Some scientists have speculated whether corals in crisis can be given a helping hand by humans in the form of new symbiotic algae reared for the purpose – but these are very hard to grow outside of their coral hosts, and Prof Yellowlees is doubtful this is a practical solution to major bleaching events affecting thousands of square kilometres of reef.

More likely, he feels, is that cryptic strains of algae which currently play little role in the symbiosis but are present in corals may be able to take over the role of junk food chef and keep the corals going on their preferred diet. To what extent this can happen is not yet known.

Source: ARC Centre of Excellence in Coral Reef Studies

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