# Estimating the feeding habits of corals may offer new insights on resilient reefs

October 18 2018

Credit: CC0 Public Domain

Researchers at Scripps Institution of Oceanography at the University of California San Diego and colleagues have found that corals living in more productive waters take advantage of the increased food availability. The findings, published in the journal *Current Biology* on October 18, reevaluate scientific understanding of how corals survive and could aid predictions on coral recovery in the face of climate change.

Coral reefs grow in what are considered oceanic deserts where warm, clear waters are generally less nutrient-rich than colder waters. Previously researchers have tied coral survival to symbiotic algae that live within corals. The algae are provided with shelter and nutrients in exchange for carbohydrates. It is estimated that these algae can supply some corals with up to 95 percent of their daily energy needs.

Scripps scientists found, however, that corals living in waters with higher chlorophyll concentrations get more of their energy from feeding on plankton and other microorganisms, suggesting some corals are less reliant on their algae-which could have implications for coral resilience. Chlorophyll concentration is an important proxy for marine nutrients, acting as an indicator for the amount of phytoplankton in the surface waters of the ocean. Phytoplankton are the base of most marine food webs and the prey for zooplankton, a favorite food of corals.

"This paper is the first to provide robust evidence for such a simple premise—that corals eat more where there is more food," said Michael Fox, a recent Ph.D. graduate of Scripps and lead author of the study. "It's quite shocking that it's something research hasn't focused on, as we tend to think of corals more as plants instead of animals."

As intuitive as it sounds, the scale of coral feeding is something that coral reef ecologists have been unable to examine over the past 30-40 years due to a lack of sufficient data and technology. Fox was able to come to his findings by analyzing differences in isotopic signatures of carbon between corals and their symbiotic algae from coral specimens collected in the central Pacific Ocean. Stable isotopes-variants of chemical elements containing different numbers of neutrons-are commonly used in biological research to track metabolic processes.

Fox started by separating coral and algal cells in a laboratory. This allowed him to analyze the isotopic composition of each and compare them. If the coral in question was deriving more of its food from the algae, its isotopic signature would resemble that of its plant tenant. On the other hand, corals that were eating mostly plankton had isotopic values more similar to that of its planktonic prey.

Using satellite measurements of chlorophyll concentrations across the world's oceans, Fox and his team found that most coral collected from chlorophyll-rich waters were consuming greater proportions of plankton. Across the central Pacific, there is huge variability in nearshore phytoplankton, with concentrations of chlorophyll greatest along the equator and declining to the north and south. Fox then pulled together published satellite measurements and isotopic data from 11 other locations from around the world, finding a strikingly strong relationship between chlorophyll in the ocean and the feeding strategy of reef corals.

"This is not just something that's happening in the central Pacific, it's a pattern that holds on coral reefs across numerous ocean basins, from the Red Sea to the Caribbean," Fox said. "What we now have is a map of potentially more resilient coral reefs. If these corals are relying more on planktonic food, perhaps they can recover from coral bleaching events faster."

How much-and what-corals eat is a critical knowledge gap in coral biology and it is essential for understanding how corals are likely to persist in a warming ocean. Numerous laboratory studies have shown that if corals are fed they are more capable of surviving the stress associated with warming ocean temperatures and decreasing ocean pH. Feeding can also increase the reproductive capacity of corals, which is key to repopulating reefs that have suffered high levels of coral mortality.

But determining these feeding strategies on a global scale has been both logistically and economically challenging; to build such a model would require traveling to many reefs, collecting and processing many coral samples, and then solving the challenge of measuring primary production at each of the study sites. Now, satellite technology is helping coral scientists.

"We wanted to develop a method that would allow people to predict coral feeding strategies for their reef system without having to do all this themselves, so we turned to satellite technology to help us," said Gareth Williams, associate professor at Bangor University in the UK and co-author of the study. "We worked out that you can predict coral feeding strategies in the field from satellite-derived estimates of primary production. We can effectively predict coral feeding from space."

Massive coral bleaching events have swept through large swaths of reefs around the world, most notably the 2016 event on the Great Barrier Reef, which lost 30 percent of its shallow water corals. When waters warm too much, the relationship between the algae and their coral host breaks down. Corals then expel the algae, losing both their color and potentially their main food source. If the corals can survive long enough without the algae and the water temperature returns to normal, corals can regain them. Those corals that are able to eat more or have access to more food have a better chance at surviving and recovering from bleaching than those relying mostly on their algae.

"Our study is the first to take our understanding of coral feeding outside of the lab and show that global patterns of food availability likely influence the health and resilience of coral populations around the world," said Jen Smith, a coral scientist at Scripps and co-author of the study. "It is exciting to know that corals have a lot more food flexibility than we previously thought and this flexibility could help them ride out the climate change storm that is seemingly inevitable."

Recovery patterns from bleaching events can vary by region, suggesting that some areas are more resilient than others. This study and the work described above lays the foundation to begin more detailed investigations into the possibility that reefs in more productive areas have a greater capacity for recovery from disturbance than reefs in other regions.

**More information:** Michael D. Fox et al, Gradients in Primary Production Predict Trophic Strategies of Mixotrophic Corals across Spatial Scales, *Current Biology* (2018). DOI: 10.1016/j.cub.2018.08.057

Provided by University of California - San Diego