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Julie Cohen

Why Species Matter

UC Santa Barbara doctoral candidate Caitlin Fong travels to French Polynesia often but not for vacation. She goes there to study a coral reef ecosystem influenced by human impacts such as overfishing and nutrient pollution.

Her work focuses not only on biological changes but also methods scientists use to determine within-group group responses to ecological processes. The findings are published in ESA Ecology, a journal of the Ecological Society of America.

Fong and Peggy Fong, a professor in UCLA's Department of Ecology and Evolutionary Biology, conducted a study assessing the usefulness of functional form groups often used by community ecologists. The researchers examined the practice of grouping species with homogenous responses to major ecological forces as well as predicting group responses in established conceptual models.

They found that the two commonly used models for grouping coral reef macroalgae — the relative dominance model and the functional group model — failed to consistently generate groups that responded uniformly to experimental manipulations of key ecological processes.

"A lot of times, functional group forms are defined based on morphology and phylogeny," said Caitlin Fong, "but they are defined without empirical testing." Morphology comprises the specific structural features of organisms while phylogeny deals with their evolutionary relationships.

As an undergraduate, Caitlin Fong visited Moorea in 2010, just months after tropical cyclone Oli hit western French Polynesia. The storm was the final blow to the coral reef, already made vulnerable by an invasion of crown-of-thorns starfish, a coral predator.

“The reef had been subjected to a variety of stressors that caused the loss of coral dominance,” she explained. “In fact, researchers think that increased fishing and changes in land use have resulted in reefs worldwide shifting from coral to macroalgae-dominant states.”

The scientists conducted an experiment that controlled herbivore abundance and nutrient supply to see how those two forces interacted to shape macroalgae communities. They found that functional form groups were not able to capture the dynamics of what was happening on these reefs, particularly as they transitioned from coral to macroalgae dominance.

“It’s not only important that things are shifting,” Caitlin Fong said, “but when macroalgae is abundant, it seems logical to consider the species traits of the dominant spaceholders.” She worked with the area’s four most dominant species: Dictyota bartayresiana, Padina boryana, Galaxaura fasciculata and Halimeda opuntia.

“I’ve actually been back to Moorea every two years and the shift to these fleshy species of macroalgae has been even more extreme,” she noted. “In 2010, Padina was a lot more contained in space but now it has carved a large part of the back reef area where we work.”

The results showed that inappropriate functional form groupings altered the ability to detect important controlling factors. Scale also seemed to affect the detection of ecological processes. “This may be because different ecological processes act at different scales,” Caitlin Fong said. “The resultant loss of information, in turn, masked strong interactions between herbivory and nutrients that were not included in the models.”

The research attributes the limitations of existing models of functional form dominance to the rapid and catastrophic changes in ecosystems caused by humans, which have been documented worldwide. “We postulate that functional-group models may need to be reformulated to account for shifting baselines,” she concluded. “If you don’t want to lose ecological resolution, you need to ensure that

the defined groups that you use are true groups as opposed to arbitrary groups without underlying assumptions.”

About UC Santa Barbara

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