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Local scientists help the remote atoll of Ulithi restore its marine habitat

Many of the male parrotfish fish found in the Ulithi atoll were once female.

They are among several species in the coral reef-ringed waters that are sequential hermaphrodites, meaning they change sex during their lifetime.

With more than 200 miles of reef, Ulithi is one of the world's largest atolls, or circles of coral reef that enclose a lagoon. Its sapphire and emerald waters are punctuated with dozens of diminutive islets, each with a halo of bright beach around a verdant center. Four of the islands are inhabited, with a population of just 400 to 600 on the most crowded, Falalop. (As home to Ulithi's high school, Falalop's population

balloons during the school year.)

Although supply ships occasionally arrive with goods like white rice, sugar, and canned meat, residents rely heavily on fishing for their diet.

The Humphead Wrasse, which can transition from female to male around age 9, is another sex-switching swimmer that, along with parrotfish, the people of Ulithi consume.

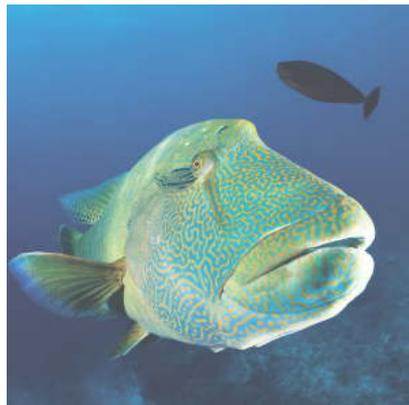
Both are herbivorous and play a critical role in maintaining the health of the surrounding coral reefs. But after years of fishing for the larger of these types of fish—which, unbeknownst to the locals meant taking only the males—these important fish populations are comprised mostly of juveniles, and the Humphead Wrasse is seriously overfished.

"When you spearfish only large parrotfish, you're taking all of the males out of the population," explains Nicole Crane, a Santa Cruz-based marine biologist and professor of biology at Cabrillo College. Crane is the leader of a five-scientist team working with residents of the atoll through the Ulithi Marine Conservation Project.

In Ulithi, Peter Nelson, a fisheries biologist also based in Santa Cruz and a member of Crane's group, applies his marine ecology and fisheries science background to examining what the loss of these species means for the wider reef environment.

"Parrotfish help manage the algae that grow on these reefs," Nelson says. "A certain amount of algae is good, but when those herbivorous fishes are removed from the community, the algae begins to shade out and cover the coral and the coral dies as a result. The result can be catastrophic for some of these reefs."

After learning from the scientists about the hermaphroditic nature of these species, fishermen altered their practices in order to leave some of the larger, male specimens in the mix. These are the sorts of questions



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the Ulithi Marine Conservation Project is addressing.



The remote, isolated and sea-surrounded community in Micronesia has seen its reef and fish habitats deteriorate in recent years, partly because of their own actions (such as overfishing), but also due to factors outside of their control, such as effects that are most likely due to climate change.

Through the American nonprofit Oceanic Society, which has a sea turtle conservation project in Ulithi, leaders on Falalop invited Crane, a senior conservation scientist with the organization, to their island in 2010 to discuss the problems they faced. They expressed a desire to understand what was happening to

Falalop has an airstrip that the U.S. Navy helped build during World War II. Photo Courtesy of Nicole Crane

their reefs and restore their troubled fish populations. Back in Santa Cruz, Crane assembled her dream team of fellow scientists (some of whom aren't local) and a conservation project was born. The scientists have been back every summer since.

When recruiting the group—all of whom offer their services on a volunteer basis—Crane sought people with a variety of complementary specialties (such as genetics, molecular biology and reef restoration) who shared in her belief that the project should be community led.

"I did not want to bring a plan, I did not want to tell them 'Here's the process I will be using with you'—I didn't want to do any of that," Crane says. "I wanted to have them drive it."

This makes for an adaptive management approach in which the scientists listen extensively to the locals, study the issues at hand, and make suggestions, which the community chooses if, when and how to implement.

LONELY ISLANDS

An airstrip runs from one side of Falalop nearly to the other—a concrete belt dividing an otherwise lush green isle. The prominent feature is a reminder of the atoll's long history of colonization—the runway was built by the Japanese, who controlled the islands after the Germans and, before them, the Spanish—as well as its military past. In the fall of 1944, toward the end of World War II, the U.S. Navy overtook Ulithi without opposition from the Japanese. Renovating the airstrip was one impact the Navy had on the islands during the occupation that followed, when it used the atoll as a strategically significant staging area. The large floating naval base readied ships for battles in Iwo Jima, Leyte, and Okinawa, and was also the site of a successful Japanese Kaiten attack—a manned suicide torpedo—on the USS Mississinewa. The American vessel "burned, exploded and sank, the first victim of this newly introduced Japanese suicide weapon," according to the Naval Historical Center.

After the war, Micronesia became a United Nations Trust Territory under the trusteeship of the United States. Locals who had been temporarily relocated from Ulithi returned, but the mark of war remains even today—from the still-operational airstrip on Falalop to sunken warships resting on the seafloor.

"The floating base moved on, and Ulithi, which had had a temporary population the size of Dallas and had been the master of half the world for seven months, shrank to little more than a tanker depot," explains an account on the website for the now-decommissioned USS Laffey, laffey.org. "Once again, it became a quiet, lonely atoll."

Today, Ulithi is part of Yap, the westernmost state in The Federated States of Micronesia, which came to be as an independent political entity in 1986. Yap is comprised of Yap Proper, a cluster of islands that serve as the



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more populated capital (where someone from Ulithi would need to travel if they wanted to use the Internet), and the sparsely



The Ulithi Marine Conservation team. From left to right: Michelle Paddack, Avigdor Abelson, Giacomo Bernardi, Nicole Crane, and Peter Nelson. Photo Courtesy of Nicole Crane

inhabited, widely dispersed Outer Islands, which include the Ulithi atoll. This far-flung locale is culturally and linguistically different than Yap Proper and is governed autonomously with its own, distinct tribal structure made up of a web of reef owners, clan leaders, chiefs and religious heads.



A fisherman on Falalop with his catch. Photo Courtesy of Nicole Crane

Ulithi's position as an independent and solitary society makes it both harder and easier to do conservation work there, explains Crane. She hit some political walls when first attempting to secure funding for the conservation work—a task that has remained difficult.

"The Outer Islands are outside of the political loop [and] the funding loop, and so they are largely ignored," she says. "The aid goes to the main islands and often doesn't come much farther. They are pretty much left to their own devices."

Crane discovered that the region's few banks and NGOs were improbable avenues for getting resources to Ulithi.

"The response I got was 'It's not going to work. You're not going to get anything done. Those people don't want conservation, and we need it more here on the main island,'" she recalls being told. "Each time I applied for grants that way I couldn't get the funding. There is really very little mechanism right now for funding these communities."

Steering her way around these murky bureaucratic waters, Crane was able to secure funding from American organizations, such as the University of California Pacific Rim Research Program and the U.S. Office of Insular Affairs. (A Santa Cruz company, Bucci Sunglasses, donated some shades for people on the island.) Once that piece of the puzzle was in place, the conservation work became exceptionally easy.

Autonomous and overlooked, Ulithi has "essentially no red tape," in Nelson's words. The scientists can make a recommendation and, if they choose to, locals can implement them immediately. This instantaneous conservation is nearly unheard of in the field. It took more than 20 years of government negotiations and meetings for reef conservation proposals Crane worked on in Belize, for example, to be adopted.

Locals are now monitoring fish and coral and collecting fisheries data on all fish caught, which includes measuring, clipping for genetic testing and checking the sex.

As the scientists departed from Falalop last year, they presented their suggestions to the community. Soon after returning home, Crane received an email from local leaders explaining that they had decided to enact the severest recommendations. These included closing two-thirds of the island to fishing for six months, a prohibition on net fishing, and a ban on spear fishing at night (a practice that led to the plight of the male parrotfish).

This eager cooperation is a breath of fresh air for Nelson, who knows from his work in California how strained the relationship between fishermen and scientists can be. He serves as the executive director of the Santa Cruz-based organization Collaborative Fisheries Research West (CFR West), which tries to change the traditional top-down relationship between scientists and fishermen that often leaves "fishermen feeling like they've gotten the raw end of the deal." It engages fishermen as equals in the conservation

process, collaborating on everything from formulating the questions that will be explored and designing the experiments to interpreting results.

But, while this is an improvement over the customary interaction between fishermen and scientists, Nelson says the potential for change is much greater in Ulithi.

"In many ways, the concepts and the application [between CFR West and the Ulithi project] is almost indistinguishable, but the environment is very different," says Nelson, who also has an adjunct position with UC Santa Cruz. "This isn't a for-profit enterprise, they are fishing for their lives. This is how they put food on the table. Another important difference is the fact that no one is telling them 'you must look at your catch of this fish or we will fine



Scientist Giacomo Bernardi pictured with a large colony of lobe coral. Photo Courtesy of Nicole Crane

you.' Instead, the emphasis is coming from their recognition that their catches are a small fraction of what they used to be."

He is currently seeking funding to bring a group of California fishermen to Ulithi, most likely in 2015. He believes they could share knowledge with Ulithi fishermen on how to diversify techniques, while also having their eyes opened to the possibilities that surface when fishermen are on board with conservation

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"Here, even in the best of situations, there is still a tremendous amount of resistance in local fishing communities to the establishment of [marine protected] reserves up and down the coast," he says. "For Californian fishermen to see these fishing communities establish these marine reserves themselves, and ideally be able to see that it can directly benefit the fisheries, could be really persuasive and really make a difference here on the West Coast."

The Ulithi project is unique amongst conservation efforts for another reason. Rather than only doing straightforward data collection, the team also conducts extensive interviews and gets to know the community. Crane says this particular undertaking wouldn't work without also incorporating the qualitative explanations behind the quantitative data.

For example, while it is correct to say that Ulithi does not export fish, there is a less simple story beneath the surface.

"If you look at statistics, they don't export anything," says Crane. "But if you talk to them, you realize there are other things going on that are really important to understand." Family relationships are strong in Ulithi, and many relatives live on different islands. It is customary to send gifts to family, and a common gift is fish. "So they are shipping out fish to relatives on other islands, including some more populated ones like Hawaii and Guam," she explains.

Crane, who did her second degree in science education, is enjoying this in-depth social sciences method. This is a full-circle return to the humanitarian work she was raised around—her parents, both Americans, worked across the world to combat hunger. She was raised, among other places, in the Middle East (she was born in Afghanistan), Nepal, and Central Africa. All the while, the family spent a lot of time aboard a boat, with her sailor father at the helm. At one point, the family temporarily lived on their boat in Greece after being evacuated from the Black September War in the Middle East.

Her diverse upbringing has come in handy while working in Ulithi.

"I do understand, having lived and grown up in many different cultures, that you have to be a bit careful to not say 'this is how we're going to do things,' and instead listen," she says.

BUMPY SEAS

A host of problems faced by many of the world's small islands may be attributed to climate change.

For instance, on top of grappling with sea level rise and bigger storms, Ulithi's islands are experiencing unprecedented erosion.

"Those islands are simply disappearing," says Crane.

According to the Center for Ocean Solutions, there has been a drastic spike in coastal erosion (a natural process) in the last two decades, and it's expected to worsen as the sea level rises and storm severity and frequency increases.

Ocean acidification is another harmful reality in Ulithi, making certain corals soft and chalky to the point that they crumble when touched. Although beneficial for humans, the fact that the ocean has absorbed around 525 billion tons of carbon dioxide from the atmosphere, according to the Coral Reef Alliance, is dangerous for marine organisms like coral.



Fish is integral to life on Falalop as residents gather for a meal.

And there are other effects of human carelessness taking a toll on Ulithi.

Man-made flotsam drifts from elsewhere to Ulithi's shores, accumulating in heaps on the uninhabited islands. Single flip-flops and empty water bottles arrive as uninvited tokens of far-away societies, coming to

rest on a once-pristine landscape otherwise untouched by civilization. Residents sometimes collect incoming trash on the inhabited islands, but, without any municipal collection service, they are then stuck with figuring out what to do with it.

"They can ship it off island, which they do, but that's not always simple," explains Crane. "Some islands burn it, and the plastic smoke isn't doing them any good, either."

Crane is looking into partnering with The Clean Ocean Project, which is also headquartered in Santa Cruz, to get a plastic-to-fuel converter to Ulithi that could alleviate the plastic waste problem while also creating economic stimulus and a source of fuel for their own purposes.

Despite the fact that small island nations are "on the front lines," in Crane's words, the impacts of climate change and the growing problem of ocean pollution aren't things the people of Ulithi contributed to or have much power to change. That, says Crane, will be up to people in parts of the world that are responsible for those problems.

"But while they are waiting ... [there are] local steps that can help buy them time, so to speak, and help keep their reefs from declining too quickly," she says.

With the aid of Crane and her team, the community of Ulithi is taking stock of what problems their own actions have created and how they can curb the damages. Coral reefs are quick to decline but slow to recover, and the goal is to maintain a strong, healthy reef that can act as a buffer from the changes that locals cannot control while ensuring a healthy stock of fish for food.

Although it may not come as a surprise, the scientists have found a strong signature between where people live on the islands and deteriorated health of the reefs.

"In Ulithi, just like everywhere else, human impact takes multiple forms," explains Giacomo Bernardi, a professor of evolutionary biology at UCSC and a member of the Ulithi project. (He is also Crane's husband.) "But the main ones are human waste and overfishing. If these impacts are removed, [and] if it is not too late, the reef may bounce back to health."

To achieve this, the project's key approach is to bring Ulithi's traditional practices back in vogue. Until recently, when motorized boats and other modern conveniences arose, locals relied on a wide variety of fishing methods that were actually very sustainable. Long before "marine protected area" was a buzzword in ocean management, the people of Ulithi would cease fishing in certain areas, rotate where fishing took place, and ban fishing of particular species, says Crane.

"Those are effective in combination with other traditions," says Crane. "For example, if someone dies, as a tribute they often close that person's fishing grounds for a period of time. And when there is a celebration

ceremony, they will often choose a less-fished area that has really healthy fish populations and go there because they need a lot of fish for their ceremony."

The ticket to improving their reef health is to draw on skills and knowledge that already exist in the culture, but have not been passed down to recent younger generations.

"They are really excited about the fact that, at least to all appearances, their traditional approaches seem to be very effective," says Nelson. "The realization that by reviving some of these they have the potential to restore their fisheries really resonated with them."

ON THE HORIZON

The scientists are still analyzing data from Falalop's first year of implemented conservation measures, but Crane says that early evidence points to signs of reef stabilization.

"This is actually huge because that's a really short time to see any change in marine management," she says.

Their research has resulted in the much-needed development of a new method for studying rugosity, or how bumpy coral is, which was always a "thorn in the side of scientists," says Crane. The team has also discovered a new fish and a new coral species. And, considering the deep waters off of Ulithi are a "seldom-sampled place," Bernardi says it is likely that there are other new species waiting to be discovered.



Photo Courtesy of Nicole Crane

"This is a general trend all over the world, where we are slowly understanding that the diversity of the ocean is likely to be much greater than once thought," he says.

These initial results from Falalop's efforts are just the beginning. This past summer, two more of Ulithi's four inhabited islands, Asor and Mogmog, enlisted the scientists to launch their own conservation projects. The team has given their recommendations to both newly recruited communities.

The fourth and last of the lived-on islands, Fedraey, invited the scientists to come and discuss conservation over the summer and are interested in having them return next year to implement a project.

An unexpected result of the conservation work has been that the islands are communicating and collaborating more. A proposal to close off an area to fishing, for example, may mean asking permission of the reef owner who resides on another of the islands. "Fish is the source for everything for them," says Crane, "so it's not too far off to think that a fisheries project would be the thing that draws people together."

The most significant outcome so far, however, has been that an isolated, often-ignored community now has hope that they can—with some work—perhaps save their precious paradise.

"One effect we can point to that's exciting is the growing recognition within these communities that there is a potential solution to their problem," says Nelson. "It's a sociological effect that we're seeing so far. And if anything gets us to that [desired] biological effect, it'll be that shift in cultural perception and that recognition that we can do something about this."

Learn more about the Ulithi Marine Conservation Project at ulithimarineconservation.ucsc.edu.

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