Fiji's Living Rock

Georgia Tech researchers facilitate an ambitious project to support reef conservation, economic development, and medical research in the South Pacific

By Hilda J. Brucker

The scenic Southern coast of Viti Levu, Fiji's biggest island, is bordered with mangrove swamps, sugar cane fields, tropical forests and a handful of lush resorts. Between these lie tiny, traditional villages where Fijians dwell in thatched cottages called *bures* and practice a form of communal lifestyle that revolves around the *qoliqoli* – the expanse of beach, ocean and reef that fronts each village and is recognized by law as its exclusive fishing ground. One such village is Tagaqe. Here, as in other Fijian villages, the sea and reef are essential sources of food and income.

Fiji's fishing grounds also hold a special significance for Mark Hay, a marine biologist at the Georgia Institute of Technology. Hay is one of a growing number of researchers who believe the key to curing cancer -- or any other of the world's devastating diseases – may be awaiting discovery not in the laboratory, but in the coral reefs of the South Pacific. A grant from the National Institutes of Health (NIH) is now funding Hay's search for potential drug compounds in reef organisms off the coast of Tagaqe. But the real heart and soul of the project is the unique partnership that's developed between the researchers who believe there are compelling reasons to conserve the reef and the Tagaqe islanders who must make a living from it, sometimes damaging the reef and depleting resources in the process.

Remedies from the reef

Hay first developed an interest in the outdoors during his Kentucky childhood, far from the ocean. It wasn't till graduate school, when he started diving, that his lifelong fascination for sea creatures took hold. Eventually, his research came to focus on the chemical compounds produced by aquatic life forms under certain circumstances – when necessary, many otherwise helpless organisms can "switch on" the ability to manufacture toxins that make them unpalatable to hungry predators. First studied by biologists, these chemical defenses have also caught the attention of medical science. When isolated, some of the compounds show the ability to combat bacteria or viruses, reduce inflammation, or inhibit tumor growth, making them potential stepping-stones to the miracle drugs of this century.

"None of these compounds evolved to cure cancer, they evolved for biological reasons," explained Hay. "Corals, seaweeds and sponges that are stuck on a reef can't run if something is after them, so they solve ecological problems with chemical methods." As scientific interest in these chemical responses has grown, the practice of "bio-prospecting" for new cures is expanding. Like the rain forests, tropical coral reefs are particularly desirable hunting grounds because huge numbers of unstudied life forms exist there. More importantly, many are motionless or sluggish species that are able to survive only through the good grace of the biologically active molecules nature has bestowed on them – molecules that a team of chemists probably couldn't conjure up in their wildest dreams.

Hay was primarily interested in going to Fiji to collect samples of reef organisms, which would be analyzed for bioactivity back in the lab at Georgia Tech. But as an ecologist, he also had a keen interest in preserving Fiji's reefs. When reef habitats disappear, so do the organisms that live there, taking with them any disease cures they might hold. Conservation becomes more complicated, however, when it's impossible for locals to make a living without exploiting reef resources – and on Fiji, the islanders were breaking up their own reefs to harvest a profitable product called "live rock," for sale to the aquarium supply industry.

Conservation versus commerce

Live rock is the calcium carbonate skeletons of dead coral, which has been colonized by pink to reddish-colored coralline algae and other beneficial organisms. After being pried up from the edges of the reef with crowbars and floated to shore on rafts, most Fijian live rock will end up in the United States. It's used in saltwater aquariums, not only to form an attractive reef base for exhibits, but also because the algae act as a biological filter, neutralizing waste products from fish and helping to keep the water clean.

The live rock trade is a thriving industry – a Fiji-based aquarium supply company, Walt Smith International, employs hundreds of full-time workers, and an estimated 50 percent of Air Fiji's business comes from flying live rock out of the country. But it's also becoming clear to many of the stakeholders that environmental damage is being done. "The villagers themselves don't necessarily even like this harvesting of live rock," said Hay. "But they have to get some income and there's not many ways they can do it. They know they're destroying their reef, which disadvantages their children. They're not averse to some way to stop this, but they also need money. You know, they've got to feed their families."

From a purely economic perspective, exporting live rock is advantageous to Fiji. So if it could just be cultured in live rock "farms" away from the reefs, scientists thought, it could become both a lucrative and sustainable product. In his grant application to the NIH, Hay proposed that this be done in tandem with bio-prospecting for potential new drug compounds – and he believes it was this environmental focus that convinced the

NIH to award him the grant. Once the funding was secured, it was just a matter of working out the details in Fiji.

Synthetic substitute

Fijians have a distinct culture and way of doing things, based on centuries of tradition. Scientists can often seem like a separate breed, with their sweeping logic and unassailable truths. In Tagaqe, the two groups were looking for common ground – but how do you bridge the gap that separates science from social customs, reason from ritual?

"You in fact do it sitting around drinking *kava* with the chief," said Hay, referring to the slightly narcotic beverage that's extracted from a local root. "You have to go through a lot of ceremonial stuff and basically get introduced to each other, build up some trust. And then they say, 'Yeah, you can go diving here,' or they say 'No, you can't.' And if they say you can't, you need to leave. And this is felt very strongly."

Hay is a weathered, sandy-haired man who puts you instantly at ease. He's a natural communicator, effortlessly articulate, adept at explanation by way of analogy. His voice is measured and steady, every bit the trademark of an objective scientist, though his passion for his work is evident in his face as he talks. It's not hard to imagine him sitting cross-legged on the floor with a Fijian chief and his advisors during a kava ceremony, the gourd being passed, the bitter liquid going down, the details being worked out one by one as an alliance is forged.

Although his own diplomatic skills are strong, Hay feels that the participation of colleague Bill Aalbersberg from the University of the South Pacific was key to the success of the cross-cultural negotiations. An American scientist, Aalbersberg had been in Fiji since the '70s and had become an integral part of a local village, even being adopted by a Fijian chief. "Here we've got this guy who totally speaks our language; he totally speaks their language. He's totally trusted by both sides and we sit around and talk about this and it's a great idea, everyone's happy with it," recalled Hay. He noted that biologist Terry Snell and international affairs expert Kirk Bowman, both professors at Georgia Tech, also served as negotiators.

The first phase of the project came off without a hitch. A crop of lightweight pumice blanks were threaded on metal cables and suspended in the large open areas of the reef. In just seven months the stone was sufficiently colonized by algae and ready for harvest. Studies so far show the cultured product is just as effective at purifying aquarium water as real live rock. "It might sound complex, but this is really simple," said Hay. "Biology happens very quickly in the ocean. You're growing stuff on rocks. I mean, we spend billions of dollars every year trying to *keep* marine organisms from growing on things we put in the water, right?"

Executives at Walt Smith International have agreed to buy the synthetic live rock and market it as an eco-friendly product to aquariums around the world. The new Georgia Aquarium, scheduled to open in Atlanta this month, has confirmed it will use the cultured

live rock in its exhibits, as part of its mission to contribute to conservation efforts. In Tagaqe, villagers kept half the profits from the first harvest and reinvested the rest to start another crop. Already, other villages have expressed interest in starting similar projects. "This is sustainable, it makes income for the village and they seem to be quite happy with it," said Hay. "That immediately convinces lots of other people to give it a try. So if this can be sort of a market driven thing that promotes conservation, great."

Meanwhile, Georgia Tech researchers continue to study the samples collected from the Fijian coral reef, and have found several new molecular structures worth pursuing past the test-tube level. Will the reef conservation and economic development promoted in Fiji lead to a miracle cure somewhere down the line? Only time will tell. But even as research, development and clinical trials stretch out over decades, it's reassuring to know we can find ways to work with and for nature, preserving marine resources for discoveries further down the line.

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