

With the longest coral reef system in the Western Hemisphere, Belize's coastal waters offer rich aquatic habitat, protect the shoreline from tropical storms, and support the country's tourism and commercial fishing industries.

"CORAL REEF, BELIZE" BY LAURETTA BURKE, WORLD RESOURCES INSTITUTE, FLICKER (CC-BY-NC-SA 2.0); THINKSTOCK /GETTYIMAGES

By
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A 'Blue Economy' for Belize

A MODELING PROGRAM HELPS COASTAL ZONE PLANNERS
PUT A PRICE TAG ON NATURAL RESOURCES.



WHEN THE GOVERNMENT OF BELIZE started work on a major coastal zone development plan in 2010, some groups wanted new ports to be built in the poorest areas of the country to stimulate economic development and jobs. Others wanted to see the coastline remain in its natural state. The debate could have escalated into a fight. Then planners and researchers crunched the numbers. Using a risk-assessment program that evaluates the impacts of development on ecosystems, they determined that constructing the ports at the targeted locations would mean the removal of mangrove forests that were protecting the coastal areas from storms. The result would be more flooding and property damage in the years to come. Across the country, in fact, approving a plan of heavy development would reduce the amount of land protected from storms from the current 340 square kilometers (131 square miles) to 220 kilometers (85 square miles) by the year 2025. But under careful management and planned development, that protected area would actually increase slightly, to 350 square kilometers (135 square miles). The value of avoided storm damage: about \$4 billion, compared to about \$2.5 billion with uncontrolled development. “We were able to see what the future might look like,” says Amy Rosenthal, formerly a senior scientist at the World Wildlife Fund who provided technical support to the Belizean government through an effort called the Natural Capital Project. “That informed the public debate, and they decided not to go with a new port, and to go with alternative infrastructure instead.”

ASSESSING HABITAT RISK FROM HUMAN ACTIVITIES TO INFORM COASTAL AND MARINE SPATIAL PLANNING:
A DEMONSTRATION IN BELIZE

Katie Arkema, a lead scientist with the Natural Capital Project, explains how her team used ecosystem services assessment to inform Belize's coastal planning process: <https://youtu.be/FUemFTY1d9w>

VIDEO

It's a first

Natural Capital Project is not its own entity, but a partnership of four organizations: WWF, the Nature Conservancy, the Institute on the Environment at the University of Minnesota, and Stanford University's Woods Institute for the Environment. To do the analysis in Belize, the project's researchers used their open source software—a suite of modeling tools called InVEST—to calculate the monetary value of natural resources and the “services” provided by coastal ecosystems. Funding for the Belize work was provided by Google via the Tides Foundation, the Summit Foundation, and the Gordon and Betty Moore Foundation.

Natural Capital Project has previously used its software to help communities with modeling in oth-

SOFTWARE

InVEST is a suite of open-source software models that can help planners map and assess the value of ecosystem services. Developed by the Natural Capital Project at Stanford University, the software includes 17 models to analyze both marine and terrestrial environments, including coastal protection, aquaculture, wildlife habitat, water quality, and recreation. For a free download, online training, and discussion forums, visit naturalcapitalproject.org/InVEST.html.



Without careful planning, expanding tourism and building new ports to stimulate the Belizean economy would require the removal of mangrove forests, which protect coastal areas like northern Ambergris Caye from tropical storms.

er parts of the world, and was introduced to planners in Belize through a mutual connection at the WWF.

A paper on the methodology and its implementation in Belize was published last year in the journal *Environmental Research Letters*, and the software is available to all as a free download.

There's a growing interest worldwide in ecosystem services assessment, the science of calculating what environmental resources are worth in dollars and cents—from providing food, to purifying the water and air, to enticing tourists with beautiful scenery. In the past, many communities couldn't quantify the value of those services until they were lost. That happened in Louisiana, when the removal of wetlands over the course of decades left vast coastal areas more vulnerable to storm damage and flooding during Hurricane Katrina in 2005.

The Belize effort is the first time an ecosystem services assessment methodology has been used to craft a coastal zone plan, says Katie Arkema, lead author of the paper and a Stanford University scientist working with Natural Capital. “This is something that's been called for again and again, but it really hasn't been done in the way that we did it in Belize, in a very quantitative way,” she says.

Arkema notes that assessing the value of ecosystems and modeling the impacts of development allows for a more evidence-based planning process. “A lot of times, that's been an ad hoc process, where you have these emerging uses and new stakeholders who haven't worked together in the past,” she says. What's needed, she adds, is “a methodical way to work through the problem.”

Dollar value

Being able to attach a dollar value to natural resources provides a helpful tool to decision makers who might want to protect the environment, but need a strong argument they can present to constituents or higher-ups, says Rosenthal. That's especially true for someone like a finance minister, who may not have an environmental background.

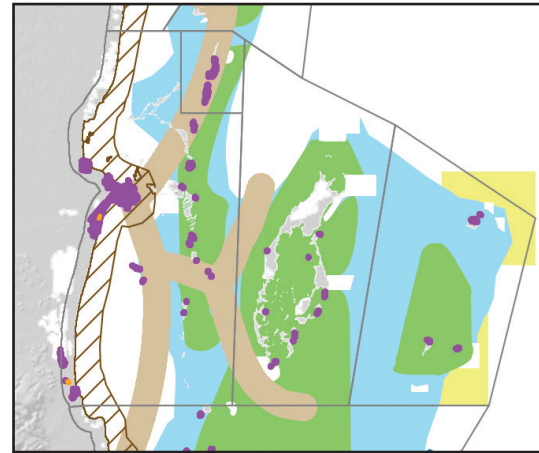
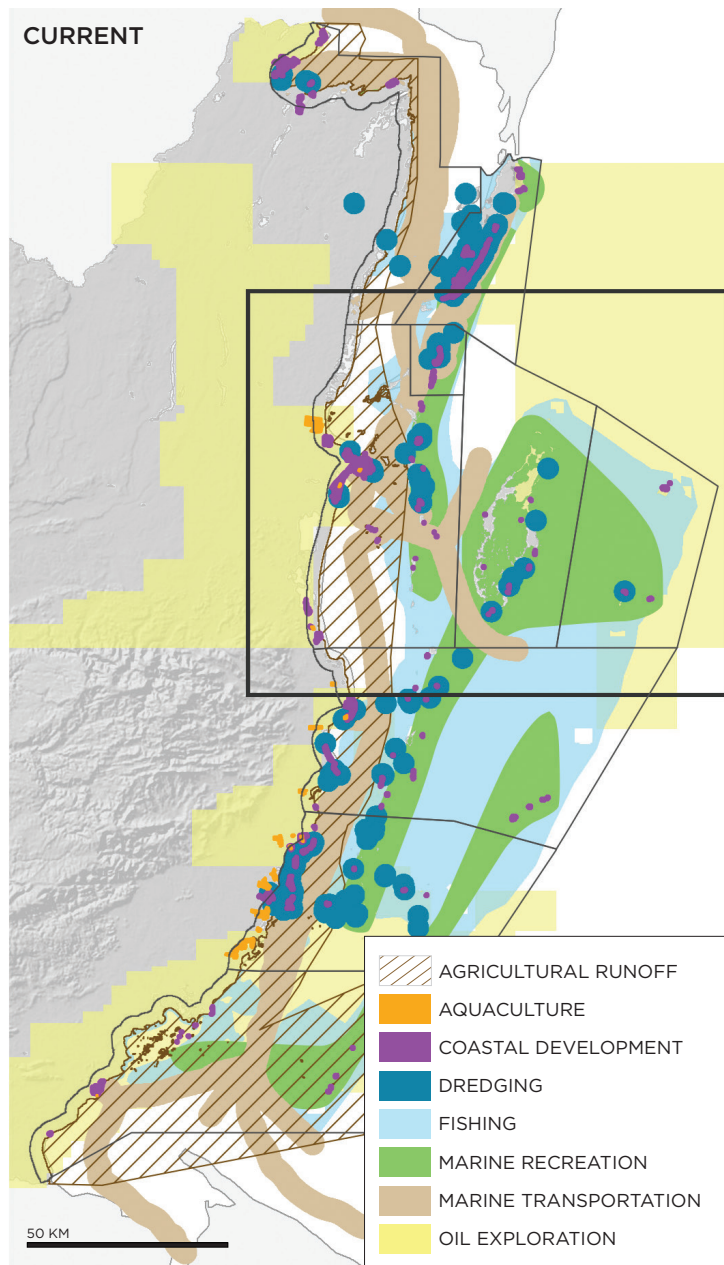
“They'd say, ‘I can't make a decision based on how pretty it is—I've got to look at jobs, revenue, or GDP,’” she says. “Nature has value, but because it doesn't show up on a balance sheet we often ignore it or are not even aware of it.”

Belize passed a coastal zone management act in 1998, calling for a comprehensive plan to manage development in and around the country's shoreline and barrier reef, the longest barrier reef in the Western Hemisphere, and a UNESCO world heritage site. But, for lack of resources, no further steps were taken to draft and implement a plan at the time.

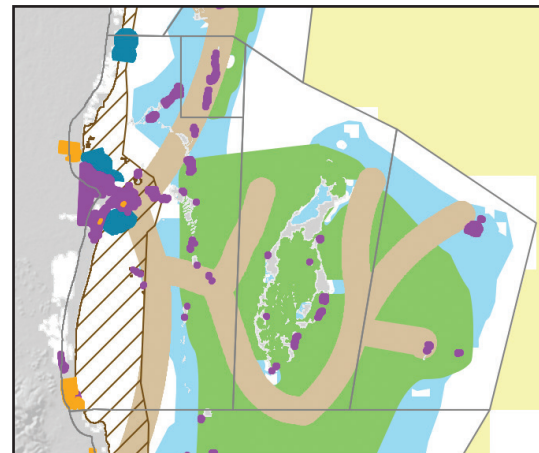
Eleven years later, the government made a renewed push to complete the plan and put it into action. Planners with Belize's Coastal Zone Management Authority and Institute worked with researchers

Three Zoning Scenarios

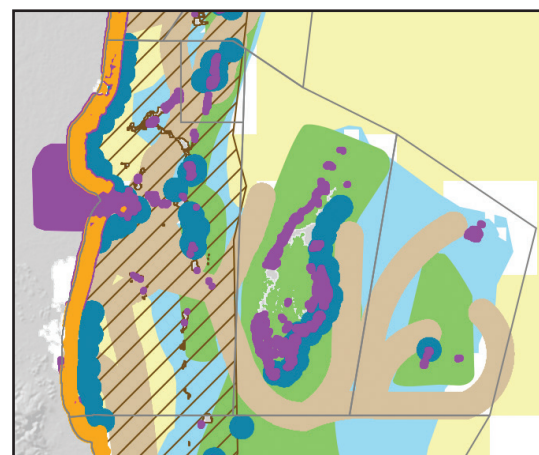
To assess the combined risk to habitats from multiple ocean uses, the Natural Capital Project mapped the current distribution of coastal and ocean activities and then developed three scenarios (conservation, informed management, and development) for zoning those activities in the future. Using this model, the team was able to estimate ecosystem risk under the current and three future scenarios. This graphic and more information about the project are available in "Assessing habitat risk from human activities to inform coastal and marine spatial planning: a demonstration in Belize," a research paper by Katie Arkema and others, published in *Environmental Research Letters*.



CONSERVATION



INFORMED MANAGEMENT



DEVELOPMENT

at the Natural Capital Project and the World Wildlife Fund, who provided technical and scientific support. The long-term goal was to develop a plan for the management of all the coastal waters owned by Belize, as well as all development three miles inland from the shoreline.

Rosenthal says one of the team's first steps was to identify the

natural resources that were most valuable to stakeholders. High on the priority list were the country's spiny lobster fishing, the ecotourism industry, and coastal protection from storms.

The Natural Capital team met regularly with planners and stakeholders to gather data as well as local knowledge that might contribute to their calculations. For example, the team ended up

adjusting coastal maps to reflect coral beds that were well known to local residents but had never been documented by scientists.

"It's a small country, and people care about the environment," Arkema says. "There's a lot of information wrapped up in people's experiences."

The CZMAI then drafted a first version of the management plan. By applying the data within the model they had developed, Arkema's team showed how the plan would affect different ecosystems over time. They also tested several other plans to compare outcomes.

Metrics

The effects of development on Belize's natural resources alone were striking. Under a plan of uncontrolled development, the country's coral reefs would drop from the current 1,460 square kilometers (563.7 square miles) to just 160 (61.7 square miles), according to the World Resources Institute. Strict conservation with minimal development would increase the reef coverage to 2,230 square kilometers (861 square miles). But a plan of "informed management"—protecting ecologically important areas, while increasing development in less sensitive areas—would still result in an increase, to 1,830 square kilometers (706.5 square miles).

When the researchers added economic data to the model, they could show the effects of those approaches on lobster catch. Belize's spiny lobster industry is of critical importance, since it's the country's only major nonsubsistence, commercial fishery. In 2010, lobster fishermen hauled in a 520,000-pound catch, valued at around \$8 million.

"Under a scenario of heavy development, where there wasn't any conservation of habitat, they would lose a huge percentage of that catch," Rosenthal says—cutting production to just 80,000 pounds of lobster, worth \$1.5 million, by the year 2025. Informed management would increase the catch to 680,000 pounds, for revenue of \$10.5 million over the same period.

When it came to tourism and recreation, annual visitor spending on ocean tourism was predicted to rise from \$115 million in 2010 to \$356 million in 2025 under the informed management plan. That was a much greater increase than the projected \$160 million in annual spending that would result from either the heavy development or conservation scenarios.

Having that data "helped (stakeholders) to make better decisions," Rosenthal says. "Some of these things were already understood, they just needed a clearer, more quantitative way to talk about it."

Chantalle Clarke-Samuels, director of the CZMAI, says the assessments provided by Natural Capital's model offered a "robust science basis" for the coastal planning process, one that took into account not only the long-term health of the country's ecosystems, but also the need for social and economic development in Belize.

"We wanted to ensure that the plan, through management interventions, would ensure the continued delivery of (ecosystem) services for the benefit of people, and that it could help bolster the national economy by prioritizing investments in sustainable development," she wrote in an email.

Having a clear methodology also made it easier for the plan to gain acceptance across many interest groups, she notes. "The process was actually a refreshing one for both the public- and the private-sector agencies, especially since they were an integral part

of the process," she says. "Through the establishment of regional coastal advisory committees and national consultation meetings, these stakeholder groups were actively engaged every step of the way."

Stakeholder outreach included public presentations and meetings throughout the country, and the formation of an advisory committee that included representatives from many different interest groups.

Final plan

The panel agreed on the informed management scenario for the final plan, saying it would help create a "blue economy" for Belize by reducing the area of habitat at risk of degradation by 20 percent, while tripling the lands designated for coastal development and tourism infrastructure, doubling the area for marine aquaculture, and holding steady the area for lobster fishing.

The legislation has completed a legally mandated public review period and is now awaiting approval by the Belizean legislature. Clarke-Samuels says the CZMAI board of directors is "optimistic for a mid-year endorsement."

"There's no opposition to it, so we have our fingers crossed," says Rosenthal.

Natural Capital's InVEST modeling system has previously been used to map and value ecosystem services in a variety of communities worldwide, including parts of Colombia; Vancouver Island, Canada; and Sumatra, Indonesia. The software system currently offers 17 different models suited to terrestrial, watershed, and marine ecosystems, including assessments like carbon storage, crop pollination, soil loss protection, and recreation.

While specialists with Natural Capital and its partner agencies will provide hands-on technical support for certain projects, planners can download and use the models on their own. Natural Capital also offers an annual training symposium on its methodology and the use of its software, as well as online tutorials and discussion forums on its website, naturalcapitalproject.org.

One example of a community that has used the InVEST system with minimal support from Natural Capital staff is the Chiloe archipelago in southern Chile. The program has been used to protect scenic and wildlife areas, rural farming, and wetland bird habitats from the impacts of a planned wind farm and urban sprawl.

"We've been providing them with a little advising on the technical end, but they've been running the models on their own," Arkema says.

She says one reason her team worked so closely with the planners in Belize was to help them build their capacity to run models on their own, so that they can continue to use the methodology for future development scenarios and share information with other planning agencies throughout the region.

She hopes the program's success in Belize will inspire other communities with fragile natural resources to consider using ecosystem services assessment as a tool in the planning process.

"I think it's important for planners to understand that by using this framework and keeping track of different activities and the potential risk for these ecosystems, there's the potential for a win-win situation, where we're reducing risk, but still allowing these activities to occur by shifting or relocating them," she says. ■

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