Researcher developing triage for ecosystems

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COLUMBIA -- Brian Helmuth doesn't study whether the global climate is changing. It is, but that's another story.

It's not his business to figure out how civilization is affecting the planet's weather or whether anything meaningful can be done to mitigate the various environmental effects of cramming 6.3 billion human beings onto one blue and green planet.

Instead, Helmuth and his assistants can be found slogging around marshes and other intertidal zones, recording the internal temperatures of the kinds of marine animals that never show up on a Shem Creek menu.

So why would NASA give a guy like that $1 million?

The answer is as bleak as it is pragmatic. Helmuth, an associate professor of biological and marine sciences, and his colleagues at the University of South Carolina are designing software that converts raw satellite data into practical advice for natural resource managers. The topic: Which marsh ecosystems have a chance of surviving changes in the global climate?

"This would let us answer the question, 'Where do we expect to see the most deaths in the next few years?' Really, at this point, we're at the triage state," said Helmuth. "It's already starting."

'HOT SPOTS'

When you think about it, life as a barnacle along a rocky Pacific shoreline is actually pretty stressful. When the tide comes in, its body temperature drops. When the tide goes out, it shoots back up again. Most animals adapt to one environment. Intertidal animals must adapt to two.

Helmuth's studies on Pacific Coast intertidal communities (environments between the high tide and low tide marks) showed that the internal temperatures of some species can swing from 40 degrees to 95 degrees Fahrenheit within just a few hours. In comparison, a fluctuation of just 7 degrees is life-threatening to human beings.

Since the animals Helmuth studies already are pushing the limits of their heat tolerances, increases in their body heat generally are associated with higher fatality rates. Most already are under stress from pollution, Helmuth said, but "what really starts to kill them off is when the tide goes out."

One might think that this would be worse news for South Carolina marshes than it is for North Carolina marshes. Only it doesn't work that way.
"When you look at the (animal temperature) data, these bizarre, nonintuitive patterns emerge," Helmuth said. "The intuitive pattern is that things are always hotter south of the border. But one of our hottest spots is in Puget Sound."

So why the variations in local temperatures? It turns out there are all sorts of relevant factors, wave action, tide timing and cloud cover among them. Figuring out why subtle differences produce such distinct results in highly complex systems is a job for computer modelers.

The model being perfected by the USC team runs on the same basic formulas that an architect might apply to designing an air-conditioning system for a new office building. "We've been doing it using buoys and weather stations, and we're able to get within a degree and a half ... of the animal temperatures."

That's encouraging, but impractical on a larger scale. To make the models fast, cheap, reliable and portable, scientists must rewrite their formulas to make use of satellite data. In a sense, the USC scientists are recyclers, giving new value to old data sources.

"I'd classify this in the 'promising' category and potentially in the 'of considerable value' category," said Paul Sandifer, a NOAA senior scientist at the Hollings Marine Lab on James Island and a member of the U.S. Commission on Ocean Policy.

TRIAGE TOOL

Helmuth's three-year, $1 million grant from the National Aeronautics and Space Administration is a modest little program, but it dovetails nicely with a USC colleague's new $2.5 million remote-sensing grant from the National Oceanic and Atmospheric Administration.

Both projects share the same goal: to build practical, "conservation by design" tools for decision-makers. With limited resources, officials faced with tough choices need good, inexpensive information that cuts through the clutter.

The bad news is that environmental and climatic changes are occurring all around us. The less-bad news is that, given the right information, resource managers may be able to preserve and heal some borderline ecosystems.

Heat alone doesn't kill animals in the intertidal zones. Everything from nutrient levels to rates of water flow can put stress on an animal's health. The more stress, the higher the fatality rate. Reduce the stress on a biome and more animals survive.

The reality, of course, is that there isn't the money or time to save everything.

"Now we can ask, 'Is this a site that's so far gone that we should move someplace that has hope?' " Helmuth said. "The real utility may be in identifying places that are very close to their limits and preventing them from going over into catastrophe."

Venkat Lakshmi, a hydrologist on the project, said the project should produce results that are 90 to 95 percent accurate, a tool that could be used to predict the outcomes of various levels of climate change. "Once you make your model work for the present circumstances, you can use it for 'what if?' scenarios."

The next steps for Helmuth are applying what he has learned out West to the South Carolina coast, error-checking the models and educating people about the changes now occurring to our planetary climate and environment.

That last part might be the most daunting.

"It's very difficult for the general population to perceive this," Helmuth said. "It's tough to see the change. But I have (coral reef) sites in Belize that I've been watching for 12 years that are now parking lots. It's easy to sound like Chicken Little, but on the other hand, we see this stuff every day in our work."