Nature signals SOS—long-term research, short-term extremes uncover clues to survival

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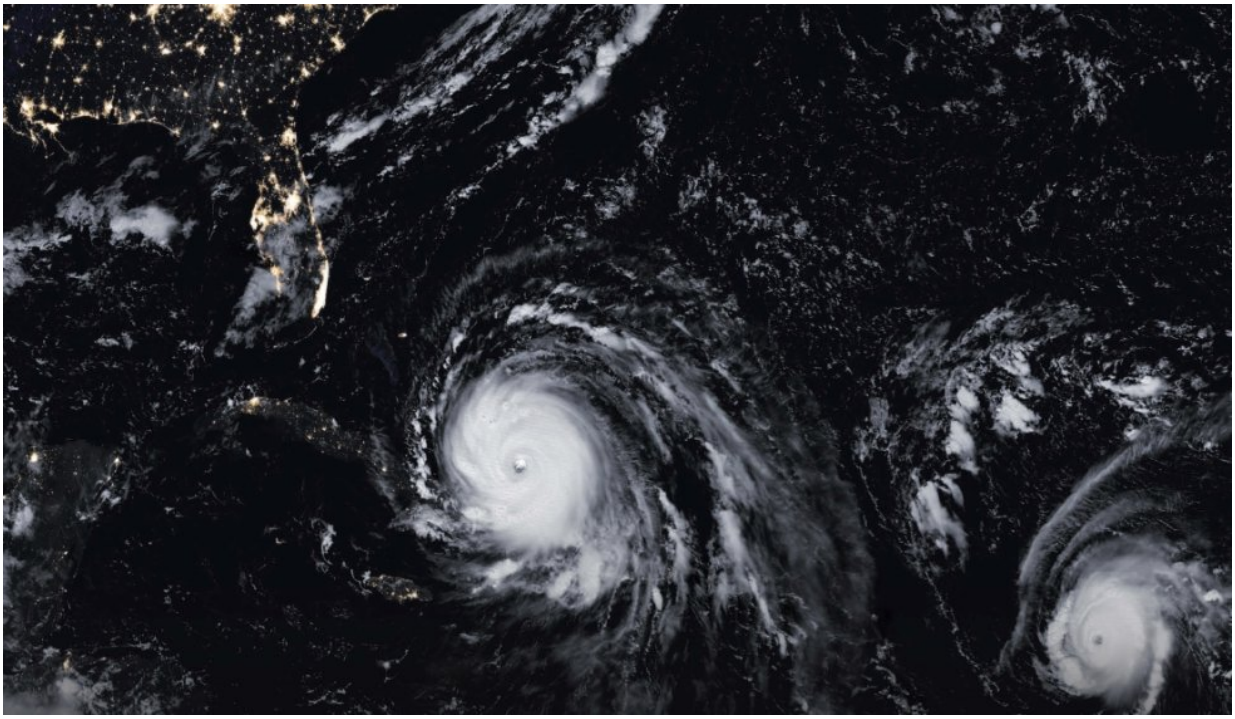

Credit: Florida International University

When extreme weather strikes, nature endures devastation but also reveals secrets to its resiliency. Researchers in FIU's College of Arts, Sciences & Education are investigating the clues that plants, animals and ecosystems leave behind in moments of suffering and recovery. What

they find could offer solutions to protecting nature from long-term changes happening to the planet.

Hugh Willoughby knows a thing or two about extreme climate events. Throughout his career, the FIU research meteorologist has own more than 400 missions into the eyes of storms for the National Oceanic and Atmospheric Administration. Among those was 1989's Hurricane Hugo, which ravaged the Leeward Islands, Puerto Rico and parts of the southeast United States.

"The Caribbean will be the best predictor of climate change," Willoughby said.

Since 2015, data shows energy is increasing in these storms, but there's not enough data to establish a trend. The 2017 hurricane season may change all that. Willoughby says data from recent major storms, including hurricanes Harvey, Irma and Maria, could prove Caribbean temperatures are on the rise. It will take months of data collection and review before scientists can say for sure. But if Willoughby is right, the Caribbean could serve as a barometer for the rest of the world.

Other subtropical and tropical regions are offering clues of their own. In 2005, hurricanes Katrina, Rita and Wilma attacked South Florida and the Gulf region. In 2008, subtropical China was hit with a devastating cold spell followed by a major drought. In 2010, South Florida suffered its own cold spell. And in 2011, one of the most pristine and untouched coasts in world—Shark Bay, Australia—experienced drastic changes after temperatures reached historic highs.

In each of these scenarios, FIU had researchers who have been working in these areas for decades. They have been monitoring conditions, wildlife and plant life. Armed with years' worth of long-term research data, they were able to assess how these isolated weather events

impacted their areas. They witnessed catastrophic losses. But they also witnessed stories of adaptation and survival. It's on these moments researchers are focusing with the hopes of developing new methods of conservation and giving policy solutions to mitigate climate change.

Credit: Florida International University

South Florida cold spell

When temperatures in South Florida dropped below 50 degrees for several consecutive days in 2010 and as low as 35 degrees, FIU scientists knew there would be consequences for plants and animals in the Florida Everglades. They were right.

For nearly two decades, FIU has led the National Science Foundation's Florida Coastal Everglades Long Term Ecological Research Program (FCE-LTER) in collaboration with other universities and partnering organizations across the United States. With substantial monitoring and research data at their fingertips, they were able to assess conditions for many species once temperatures returned to normal. Native, temperate

plants and animals fared well. Non-native, tropical ones did not. The results were consistent across many species including mangroves, bees, crocodiles and more. Some took years to recover.

"This short but extreme cold event mimicked the effects of a strong tropical storm or hurricane. The short-term consequences were different but the long- term conclusions were similar," said Evelyn Gaiser, lead principal investigator of the FCE-LTER and executive director of the School of Environment, Arts and Society.

Snook, a popular gaming fish, offered a particularly unique insight. Sensitive to temperature changes, snook should not have survived the cold spell. Yet many were able to shelter in pockets of deep, fresh water that insulated them, said Jennifer Rehage, ecologist with the FIU Southeast Environmental Research Center in the Institute of Water and Environment. The takeaway for scientists: Freshwater flow in the Everglades is critical for fish to survive extreme temperatures.

"The risks to these species are especially high when they are unable to move to more hospitable environments, " said John Schade, program director in the National Science Foundation's Long Term Ecological Research Network, which funded the research. "In a world where extreme climate events are becoming more common, studies like this are critical to our ability to manage the fisheries we need to feed growing human populations."

Credit: Florida International University

South China cold spell and drought

In 2008, botanist Hong Liu was watching closely as temperatures started to drop around the Yachang National Orchid Nature Reserve in China. Housed within its 54,000 acres were 29 species of delicate and mostly endangered orchids. The nearly 1,000 flowering plants were relatively new there, having only been moved two years prior by Liu and other orchid conservationists. The orchids' native habitat was to be flooded as part of a large-scale hydropower project along the Hongshui River and the assisted migration was the only chance to save many of the species.

The concept of assisted migration is new and somewhat controversial. It is largely untested and can come with a high price tag. In the case of Yachang, the land is protected but sits at a higher elevation and is not an exact match of the transplanted orchids' native habitat. When temperatures hit the second lowest ever recorded for the region, Liu feared it would be too much for the rare flowers.

Amazingly, the orchids proved largely resistant to the extreme climate event. While some plants did not survive, only one species was wiped out entirely by the cold. When a record-setting drought hit the region a short time later, not a single orchid died. Liu continues to study the orchids at Yachang. It will be years before the assisted migration can be deemed a success, but she is hopeful the orchids will continue to thrive. If they do, assisted migration might become a little less controversial.

Western Australia heat wave

Across the globe, in the pristine waters of Shark Bay, Australia, a 10-week-long heat wave in 2011 dealt a harsh blow to the 1,853 square miles of seagrass beds in the region as well as the animals that rely on them for food and shelter. Populations of scallops and manna crabs were so adversely affected that shing of those species was halted.

Marine scientist Mike Heithaus has been studying life in the waters of Shark Bay for more than 20 years. During the heat wave, he and his team observed the hottest temperatures on record in the bay. Along with FIU seagrass biologist James Fourqurean, the research team began an immediate assessment of conditions for plant and animal life. At the FIU study sites, at least 70 percent and as much as 90 percent of seagrasses were wiped out. Today, they are still struggling to recover.

"We wanted to know how much the ecosystem might recover over a few years," said Rob Nowicki, a researcher at Mote Marine Laboratory who conducted much of the fieldwork as a marine sciences doctorate student in the Heithaus lab. "If you take a punch and get up quickly, you're ready for the next punch. But our study has suggested this system took a punch and, in the short term, it has not gotten back up."

If relatively pristine ecosystems like Shark Bay can be this drastically impacted by an extreme climate event, Heithaus and others warn this

raises major concerns for areas already damaged by human activity. It also heightens the urgency for international conservation programs and global policy. The researchers continue to study the waters of Shark Bay and other areas throughout the world, working closely with local governments and international governing bodies.

Provided by Florida International University

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