After Hurricane Irma, soundscape reveals resilient reef ecosystem

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A new study from North Carolina State University reveals that the soundscapes of coral reef ecosystems can recover quickly from severe weather events such as hurricanes. The work also demonstrates that non-

invasive monitoring is an important tool in shedding further light on these key ecosystems.

Soundscape ecology is a relatively new way for researchers to keep tabs on a variety of habitats without direct interference. In underwater habitats like coral reefs, soundscapes allow continual monitoring of an ecosystem that is difficult to access. By deploying underwater microphones, or hydrophones, researchers can get an acoustic picture of the types of animals in the ecosystem, as well as their behavior patterns.

Kayelyn Simmons, a Ph.D. student at NC State, used soundscapes and underwater mapping to monitor two different reef sites in the Florida Keys from February to December 2017. She deployed and collected eight hydrophones every three months between the two sites: a pristine reef located at Eastern Sambo, and a fishing site located at Western Dry Rocks.

Hurricane Irma struck the Florida Keys as a Category 4 storm in September 2017. Simmons was able to retrieve two of the hydrophones—one from each site—in December. Unfortunately, the hydrophone retrieved from Western Dry Rocks had been compromised by the storm, rendering its post-storm data unusable.

"Prior to the hurricane, we were able to determine what the 'normal' sound patterns were in each habitat, so we knew what the baselines were in terms of species and behavior," Simmons says. "You can tell which species are present based on where their sounds are on the frequency band. Similarly, the amount of noise from each species can give you an idea of their numbers. So the soundscape is a good way to measure abundance and diversity."

Each study site had the same species present. For example, snapping shrimp, with their high frequency "Rice Krispies in milk" popping

noises, were active in the periods between dusk and dawn; while grunts, grouper and snapper, with sounds in the lower frequency bands, were mainly active during the day. The hydrophones also captured spawning activity during the full moon.

Simmons analyzed the sound captured by the surviving Eastern Sambo hydrophone and discovered that even though the reef suffered physical damage from the hurricane, the residents and their activity levels began returning to normal approximately 24 to 48 hours after the storm passed.

"The acoustic energy exposure for the reef was as loud as a small boat circling in one spot for two weeks," Simmons says. "So we didn't record any fish noises during the four-day period that Irma came through due to acoustic masking from the storm. However, the snapping shrimp were back to pre-storm sound levels within 24 hours. The fish noises on the lower frequency were back within 72. And on the next full moon we heard normal spawning behavior.

"Overall, the research shows that the coral reef soundscape was resilient and able to recover from the storm quickly."

The work appears in *PLOS ONE*.

More information: Kayelyn R. Simmons et al, Hurricane impacts on a coral reef soundscape, *PLOS ONE* (2021). DOI: 10.1371/journal.pone.0244599

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