Co-existing mangrove-coral habitats have a new global classification system

June 15 2022

At least 130 species of corals are known to live in the four identified habitat types where corals closely coexist with mangroves. Credit: Jorge Alemán, Smithsonian Tropical Research Institute

On any given day between 2016 and 2019, Heather Stewart could be

found snorkeling in between mangroves in the Bocas del Toro archipelago along Panama's Caribbean coast. For years she visited these forests at the interface between land and sea, trying to understand what drove corals to grow inside them. Corals and mangroves often grow near each other in tropical coastal environments, but finding them sharing the same habitat appeared to be an evolutionary trait that deserved an explanation.

The former doctoral fellow at the Smithsonian Tropical Research Institute (STRI), and now Mangrove Restoration Postdoctoral Associate at the University of the Virgin Islands, explored 29 sites where mangroves and corals co-exist in Bocas, and found that the corals fared best in large, flooded mangrove forests with high levels of seawater flow. Meanwhile, areas with large amounts of freshwater inflow or higher levels of human impact—land development and pollution—were unsuitable for corals.

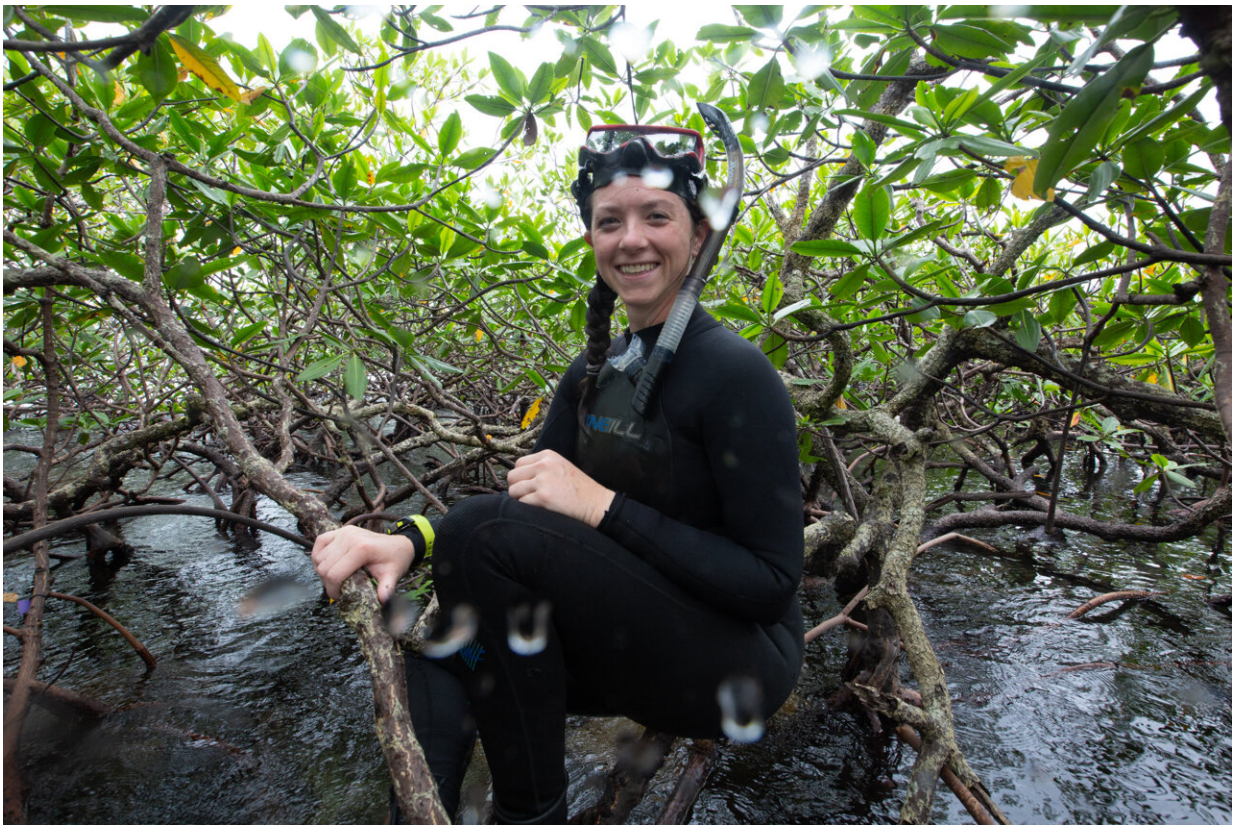
Mangrove-coral associations are not unique to Bocas del Toro or the Caribbean. Although not extensively studied, corals live in mangroves in tropical oceans in other parts of the world, including the Red Sea, Indian Ocean, and South Pacific. With this in mind, a group of researchers that included Stewart and other scientists from STRI, the University of Miami, Santa Fe College and the University of Florida set out to create a system to classify co-existing mangrove-coral (CMC) habitats around the world. They reviewed scientific studies and identified the main characteristics and conditions occurring in these ecosystems.

"We believe it is important to have a global classification system for co-existing mangrove-coral habitats because for nearly a century these systems have been known to exist, but were largely ignored by the scientific community," said Stewart. "Now with all the threats corals face from ocean warming and acidification to pollution and sedimentation, corals are becoming more susceptible to diseases. Thus,

there is greater interest in potential refugia to aid in the future of coral survival."

Their analyses, recently published in the journal *PLOS One*, pinpointed four types of habitats where corals co-exist with mangroves: in lagoons, along creeks, along the fringe of the mangroves, or completely under the shade of the mangrove canopy. These habitats are also quite diverse, with about 130 species of corals living in them.

"Going back to the historic literature in search of CMC descriptions helped us understand the holistic view that we needed to classify the systems," said Rafael Araújo, co-author of the study and Senior Research Associate in the Department of Marine Biology end Ecology of the University of Miami's Rosenstiel School of Marine & Atmospheric Science. "We were inspired by early classification systems of mangrove forests and corals, and tried to adapt their simplicity in our own classification. We wanted the types to be specific enough to draw a distinction between them, but also simple enough that they could be applied in the field with ease."



Former STRI doctoral fellow Heather Stewart explored 29 places where mangroves and corals coexist in Bocas del Toro and found that corals fared best in large, flooded mangrove forests with abundant seawater flow. Credit: Jorge Alemán, Smithsonian Tropical Research Institute

Although the four CMC types exhibit variations in environmental conditions, they share certain similarities: a connection to the open ocean or open channels within the mangrove assemblage, limited freshwater input, clear water and conditions for the corals to remain submerged through all stages of the tidal cycle.

Ensuring coral survival is crucial for the health of the oceans, as they are home to about a third of all marine species. Mangroves are equally important habitats that serve as nurseries for thousands of species,

maintain water quality, and protect coastal environments from erosion and storms. They are also some of the most susceptible ecosystems to climate change and human impact, so understanding these alternative habitats where they co-exist may have long-term implications for their conservation and management.

"CMC habitats are unique and offer possibilities for conservation of key species and ecosystems," said Jennifer Wright, co-author of the study, who conducted her master's research at STRI, and is Assistant Editor of the *Bulletin of Marine Science*. "Improving our understanding of where these habitats occur and how the corals and mangroves interact is essential to determine the role CMC habitats will serve for coral survival and protecting the health of our oceans."

The authors went even further and created a model to predict where other CMC habitats may occur globally. Their simulation suggested that these communities may be common throughout the tropics, with a majority likely occurring in the Pacific Ocean. Future studies should target these locations in order to gain more insight into the dynamics of different CMC habitat types and the environmental conditions driving their establishment.

"There are greater differences in the environmental conditions among co-existing mangrove-coral habitat types than between some CMC habitats and shallow reef habitats," said Stewart. "It is by identifying the CMC type and collecting information on these environmental variables that we can determine how mangroves may function as a life raft for some species of corals."

"This paper is also a call to other scientists to seek and document as best they can co-existing mangrove-coral associations," said Araújo. "As more information becomes available, we will better understand the environmental conditions that make these systems thrive. As such, we

hope to see many more descriptions of CMC habitats in the literature, and how these new occurrences fit into our classification."

More information: Heather A. Stewart et al, Novel coexisting mangrove-coral habitats: Extensive coral communities located deep within mangrove canopies of Panama, a global classification system and predicted distributions, *PLOS ONE* (2022). DOI: 10.1371/journal.pone.0269181

Provided by Smithsonian Tropical Research Institute