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Abundance and distribution of potentially threatened or endangered Hawaiian coral species predicted by model

Honolulu, HI – Researchers from the University of Hawaii – Manoa (UHM) School of Ocean and Earth Science and Technology (SOEST) developed species distribution models of the six dominant Hawaiian coral species around the main Hawaiian Islands including two species currently under consideration as threatened or endangered. They found the order of coral abundance (from highest to lowest) around the main Hawaiian Islands to be Porites lobata, Montipora patula, Pocillopora meandrina, Montipora capitata, Porites compressa, and Montipora flabellata.

Abundant corals in a shallow Hawaiian lagoon.
Credit: Keoki Stender

Environmental factors (wave energy, shape of the seafloor, water clarity, depth, rugosity (roughness of the seafloor), geological island age, and organic sediment content) are known to influence Hawaiian reefs. However, this is the first study to systematically examine the influence of these factors on the distribution and abundance of coral species across the entire seascape of shallow reefs in the main Hawaiian Islands (MHI).

"Average wave height and maximum wave height were the most influential variables explaining coral abundance in the Hawaiian Islands," reported Erik Franklin, lead author of the study and Assistant Research Professor at the UHM Hawaii Institute of Marine Biology. "Our models also identified

relationships between coral cover and island age, depth, sunlight, rugosity, slope, and aspect (direction a slope faces)."

In general, coral cover was predicted to be highest in primarily wave-sheltered coastlines and embayments. Reefs with highest cover were concentrated in Kaneohe Bay on Oahu; the wave-sheltered reefs of Molokai, Lanai, Maui, and Kahoolawe; and the Kohala coast of Hawaii.

To construct the species distribution and abundance models, researchers integrated field surveys for corals (data provided by the US National Park Service and US National Oceanic and Atmospheric Administration) with environmental data of wave exposure (data provided by UHM Department of Ocean and Resources Engineering), benthic geomorphology, and sunlight from 2000 to 2009.

Regional-scale mapping of coral species from these models provide a framework for population modeling and marine spatial planning of Hawaiian coral reefs. The geographic characterization of coral reefs would benefit greatly from the improved coral distribution and abundance information generated from coral distribution models. Data from these models can be incorporated into marine conservation plans or used for threat assessments to reefs.

"For example," Franklin says, "our results were recently used in the management plan review process of the Hawaiian Islands Humpback Whale National Marine Sanctuary as they considered the distribution and abundance of animals other than whales."

One advantage of this integrative, modeling approach is that researchers are able to consider a broader range of areas than field surveys alone and, therefore, can provide a truer picture of total abundance. "We were most surprised at the high relative abundance of *Montipora patula* which is currently under consideration for listing as a threatened or endangered species," reported Franklin. Montipora flabellata, the other coral species under consideration as a threatened or endangered species, was not as abundant as the other five species.

Franklin and colleagues are in the process of extending the modeling approach to include additional marine species in Hawaii such as reef fish and include additional environmental variables to try to improve the predictive capacity of the models. Ideally the results will continue to inform marine resource management in the Hawaiian Islands.

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E C Franklin, P L Jokiel, M J Donahue (2013). *Predictive modeling of coral distribution and abundance in the Hawaiian Islands*. Marine Ecology Progress Series, 481:121-132; doi: 10.3354/meps10252.