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**UOG: Cycad size and habitat contribute to plant's survival  
when confronted with invasive species**

A long-term study on Guam and Micronesia's native and threatened species of cycad plant has revealed factors that contribute to the plant's ability to survive in the face of invasive species.

Research out of the Western Pacific Tropical Research Center at the University of Guam and College of Micronesia-FSM shows that the *Cycas micronesica* population in Guam declined to 4% of its population size from 2005 to 2020 following the introduction of the non-native scale insect, *Aulacaspis yasumatsui*, in 2003, and the cycad-eating butterfly, *Chilades pandava*, shortly thereafter. Of the few cycads that survived or survived the longest, plant size and habitat traits were key.

"Guam's *Cycas micronesica* was the most abundant tree on Guam two decades ago, but then an onslaught of non-native insect herbivores invaded the island and initiated sweeping mortality," said Adrian Ares, associate director of the Western Pacific Tropical Research Center.

The plant variety is also found on the Northern Mariana Island of Rota, the Federated States of Micronesia island of Yap, and Palau, though the two invasive herbivores are not present in Yap or Palau.

In establishing 120 permanent plots where the plant grows in Guam in 2005 and examining them over 15 years, the researchers found that 100% of seedlings were killed by 2006 and 100% of juvenile plants were killed by 2014. The persisting plants were larger individuals that possessed substantial stored resources.

“The means by which the invasion of an island by a non-native herbivore can wreak such havoc is actually two-fold,” said Murukesan V. Krishnapillai, a research scientist at the College of Micronesia-FSM and one of the authors of the study. “First, the native tree that is attacked by the new pest has spent millennia evolving without a comparable herbivore and, therefore, possesses few defensive strategies. Second, the pest has escaped from its own native habitat, where it co-evolved with natural enemies, and, therefore, the new island environment contains no natural enemies to tamp down the pests’ population growth.”

The study also illuminated two other spatial factors that have influenced the plant population’s response to the non-native insect herbivore threats. First, the populations in Western localities have exhibited much higher mortality than the populations in Eastern localities. Second, the plants within large contiguous forests have exhibited less damage than plants within forest fragments.

The long-term nature of the study, which Ares said is rare in contemporary academia, and the use of benchmarking starting in 2005 were crucial in understanding how rapidly threats can devastate island tree populations.

Knowing that plant size and habitat traits influence cycad susceptibility to non-native threats can now inform conservation management decisions.

“Conservationists need developing knowledge like this to craft the most appropriate mitigation strategies and identify where available funds should be spent,” Ares said.

The study concluded that the only high priority activity to conserve the *Cycas micronesica* species where the scale and butterfly are present is to establish a complex integrated biological control program under the direction of scientists with international expertise.

The study is published in the May 2020 issue of *Diversity*, a peer-reviewed journal published by MDPI.

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**PHOTO CAPTION**

A *Cycas micronesica* tree in Guam, right, shows the extent of damage done by invasive insect herbivores, a scale called *Aulacaspis yasumatsui*, as compared to a healthy *Cycas micronesica* tree, left, found in Yap. In a 15-year study, published in the May 2020 issue of Diversity journal, researchers studied the rate and influences of mortality in Guam cycads affected by invasive species.

*Photos courtesy of University of Guam*