

Conserving Our Nation's Only Native Cycad Species

NAVFAC Marianas Partners to Create Living Gene Bank

ISLAND LIFE IS difficult, just ask Guam's native cycad (*Cycas micronesica*) and the animals that rely on it. "This unique native tree spent eons as a mainstay of the islands' ecosystem" said Dr. Anne Brooke, Conservation Program Manager for Naval Facilities Engineering Command (NAVFAC) Marianas. "It was the most abundant tree in the forest then almost overnight it was decimated by a new invasive insect pest."

In 2003, the arrival of a new scale insect, the diaspidid scale, felled these trees until only seven percent remained by 2011. This valuable biological and cultural resource, known as fadang in the native Chamorro language, is now being considered for listing under the U.S. Endangered Species Act.

Cycads are an ancient lineage of plants, with fossil records indicating they were prevalent when dinosaurs roamed the earth. They were once found virtually worldwide, from as far north as Alaska and Greenland to as far south as Antarctica. Today, these plants are confined in nature to certain tropical and subtropical regions. Though cycads retain many primitive features, they were able to adapt to the global changes that rendered countless of their former co-inhabiting species extinct. The fadang was also able to adapt to Guam's particular climate challenges, including drought and typhoons.

Plants and animals that evolved on this remote island had few herbivores and predators until they were introduced by modern people. The fadang evolved without chemical defenses to keep pests away so when an alien pest arrives, the plants are crippled by the lack of natural resistance to herbivory. Scale insects are particularly invasive



Healthy fadang in the forest before scale insects arrived on Guam.

Thomas Marler



Reproductive female fadang with young exposed seeds.
Anne Brooke

as the young attach to the host plant and gain sustenance from the plant's juices. Additionally, Guam has no native scale predators, so the cycad trees fell quickly to the onslaught of tiny insects.

In the years since World War II Guam has hosted a catastrophe of invasive pests from around the world that have eaten the native flora and fauna. The most notorious example is the brown tree snake, which caused the loss of ten native forest bird species. Only small numbers of fruit bats, native lizards, and other native bird species remain on the island.

Brooke works with Dr. Thomas Marler of the University of Guam on a unique project that is giving fadang trees a chance at survival by conserving them in a living gene bank. Once the danger of the scale invasion on Guam's fadang became evident, NAVFAC Marianas acted rapidly to collect seeds that truly represented the pre-invasion population. This quick move was invaluable, as only seven percent of the cycad population remained only eight years after the devastating pest arrived. Had the seed scouting and harvesting not proceeded with such speed, it would have been too late because much of the Guam gene pool would have been lost.

In 2005, more than 3,000 cycad seeds were collected throughout Guam's varied habitats. The seeds were



Fadang infested with scale insect
(Inset shows scale on leaves.)
Anne Brooke, Thomas Marler



Dr. Thomas Marler (left) discusses cycad biology with Sam Palacios. Palacios was representing the Tinian government in the inter-agency cooperative project.

Thomas Marler

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cleaned of all scale-insects then transported to Department of Defense (DoD) lands on the island of Tinian because the island is free of the scale insects. A nursery was set up to start the slow process of growing the plants. Known as a germplasm repository or living gene bank, the 1,000-seedling nursery was planted in 2008 in native limestone forest.

Dr. Marler's extensive knowledge and experience has extended the conservation efforts beyond the borders of military installations of the Mariana Islands and into established international cycad conservation efforts. Human activity is devastating the

health of forests throughout the tropics, and the Marianas stand out as an ideal location for DoD to showcase an organized response to these anthropogenic effects. The lush, tropical islands have been under the protection of DoD for 70 years under territorial or commonwealth status. This conservation project illuminates just how successful DoD can be in the pursuit of these goals.

The project has not only safeguarded the gene pool of the Guam cycad population, it has also generated critical data that will aid in understanding the ecosystem supported by the nation's only native cycad species. As

cycad plants were killed in various DoD habitats in Guam by the invasive pests, numerous biotic and abiotic habitat traits were quantified. Changes to nitrogen cycling in the forest are being monitored because cycads are the only native plant that have an association with nitrogen-fixing cyanobacteria.

The conservation team has enacted a mirror approach within the Tinian germplasm collection. Starting with a native limestone forest devoid of cycad plants, the adaptive management protocols are quantifying the ecosystem changes that accrue as the cycad plants mature. "We expect to

DoD Contributes to Global Initiatives

IN 1988, **ALARMED** by the accelerating rate of species extinctions, the United Nations convened a panel of experts to address ways of preserving biological diversity around the world. From this working group, the Convention on Biological Diversity (CBD) was formed. In 2002, CBD adopted a Global Strategy for Plant Conservation.

Updated in 2010, the Global Strategy contains a multitude of goals or targets aimed at the understanding, conserving, and sustainable use of flora. Guidance for natural resource managers has been included in the new strategy.

The DoD's Mariana Islands cycad conservation efforts fit ideally into the goals for conservation and protection of threatened species by having cycads protected both in the country of origin and in collections that are outside of the plants natural habitat.

Read more about the Global Strategy for Plant Conservation and find resources for sustainable management at www.cbd.int/gspc.



see ecosystem contributions by the cycad plants such that the biogeochemistry of the habitat will advance toward the characteristics that defined Guam's cycad habitats prior to the alien invasions," said Brooke. "This dual approach will allow us to understand how cycads as a nitrogen producer changes the forest ecosystem. This approach also helps

us understand how the loss of those nitrogen producers can be restored via future restoration projects."

The cycad species is also represented in two other off-site germplasm repositories: the Nong Nooch Tropical Botanical Garden in Thailand, and the Montgomery Botanical Center in Florida. However, according to the

United Nations' Global Strategy for Plant Conservation, there is a strong preference to establish ex situ conservation efforts in the country of origin wherever possible. (See our sidebar entitled "DoD Contributes to Global Initiatives.") Of the three cycad repositories, only the DoD's Tinian germplasm is being maintained in native forests that are analogous to the forests of the natural areas of occupancy in Guam and Rota. This is a perfect example of how DoD is exhibiting stewardship that is in conformity with an international conservation agenda. ↴



Thomas Marler (University of Guam) and Anne Brooke (NAVFAC Marianas) inspect healthy cycad leaves of robust cycad plants five years after planting in the DoD's Tinian germplasm collection.

Thomas Marler

CONTACTS

Anne Brooke
Naval Facilities Engineering Command
Marianas
671-349-1104
DSN: 349-1104
Anne.Brooke@fe.navy.mil

Bill Austin
Naval Facilities Engineering Command
Marianas
671-349-4053
DSN: 349-4053
William.Austin@fe.navy.mil