

Western Pacific Tropical Research Center 2019 Impact Report



College of Natural & Applied Sciences
University of Guam

Hafa adai,

Readers of this report will notice the ample variety of topics addressed by WPTRC faculty with the invaluable collaboration from numerous field and lab personnel as well as local and regional stakeholders. This is not surprising given the complexity of challenges farmers, growers, and other producers face in Guam and the Western Pacific. Among them, environmental threats continue to impact Guam with intensity and at a rate unparalleled in other parts of the world. WPTRC works to attenuate and remediate the deleterious effects of land degradation and invasive species on precious natural resources while aiming to improve farm productivity and economic conditions of local communities.

We are committed to the continuous improvement of WPTRC facilities. Our research stations do not only provide vital support to research studies but are also valuable resources for instruction and extension activities. During 2019, we acquired new farming equipment, upgraded facilities, and improved personnel working conditions. These efforts will continue in 2020 as we envision an increase in use of the stations in terms of quantity and quality of research efforts, community engagement, and UOG-wide activities such as active visits by international students. This will be coupled with similar improvements in equipment and laboratory facilities at the College of Natural and Applied Sciences. Far are the times when the continuation of some of the WPTRC research stations was under consideration.

Year 2019 was not devoid of challenges such as faculty attrition, delays in approvals because of the relocation of a major federal agency, and unexpected and unannounced budget cuts. All these matters were discussed with WPTRC faculty and other stakeholders who adjusted to move forward with research projects and other activities. One of the definitions of resilience is the capacity to maintain function under stress and shocks. This entails the need to change schedules, redefine priorities, and re-assign personnel without compromising the overall mission of the organization and WPTRC did so.

As always, we express our deep appreciation to American taxpayers for funding research at WPTRC through federal programs and the support from the local community and government. We are open to suggestions to expand our reach and relevance for the benefit of the people of Guam and the Western Pacific. 2019 was a good year, 2020 will be better.



Adrian Ares
Associate Director
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Buenas yan Hafa Adai,

It's been another very productive year for the Western Pacific Tropical Research Center. The selected projects that are highlighted in this year's 2019 Impact Report demonstrate both the diversity and importance of issues that affect our agricultural research and the communities that we serve.

In this year's report we begin by highlighting the new beehives that have been recently established at our three experiment stations and the improvements we have made at these terrestrial farms. We then talk about the possibility of using seaweed as fertilizer that involves undergraduate students and experimental learning. How fungi play an important role in native orchid conservation and how subterranean termites might be the major vector of a bacterial disease on iron wood trees. We have highlighted two specific outreach programs, the Marianas Terrestrial Conservation Conference and an agroforestry workshop. We also turned our attention to promoting forest health and agroforestry in our region and the new partnerships we have created. One of our staff members is currently looking at a new invasive species, the greater banded hornet, and the use of tracking devices to make sure our precious beehives can be protected against this predatory hornet. How funds were spent on a new diagnostic lab for detecting viral pathogens of fresh water shrimp, raised prawns and even the rhino beetle. We partnered for the first time with USDA on brown treesnake research. And we continue to tackle effective teaching methods to reduce obesity in children. I hope each of you will enjoy leaning about Guam and the wider issues we have presented in this year's report.

As the dean of the College of Natural and Applied Sciences and the director of the Western Pacific Tropical Research Center I want to personally acknowledge all faculty, staff, students, and administrators who contributed to this year's 2019 WPTRC Impact Report. This is our 11th Impact Report, and I especially want to thank Ms. Olympia Terral for being my editor all these years and putting together many wonderful articles and photographs that illustrate the wonders of Guam, the research we carry out, and the lives we try to enrich. This is not one person's story it is a contribution of our faculty and staff who work hard each day making a difference for the stakeholders we serve.

Please enjoy this latest publication. After reading these selected articles, we invite you to contact us to let us know your thoughts and concerns!

Have a wonderful 2020.



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Beehives now at experiment stations

Hives for honey bee research and pollination services located at the Inarajan Education and Research Center.

Honey bee hives are now located at all three experiment stations around the island. Research Associate and UOG graduate student, Chris Rosario, is responsible for bringing the bees to the stations. **“All the bees are rescued bees, extracted from the walls of homes and other places they were not wanted,”** said Rosario. **“During extraction, we vacuum the bees into a special box, hoping to get the queen, transfer them to a hive, and support them with food to help them get established in their new home.”**

The advantages of having hives at the research stations are fourfold: to allow CNAS students interested in agriculture or entomology to have bees to study and use for conducting their own research; to educate visitors to the Research and Education Centers about the importance of honey bees; to test the hives for mites as part of the USDA-sponsored Honeybee Health Survey; and to pollinate any crops grown at the stations.

An added bonus of keeping bees at the stations is the prospect of harvesting honey.

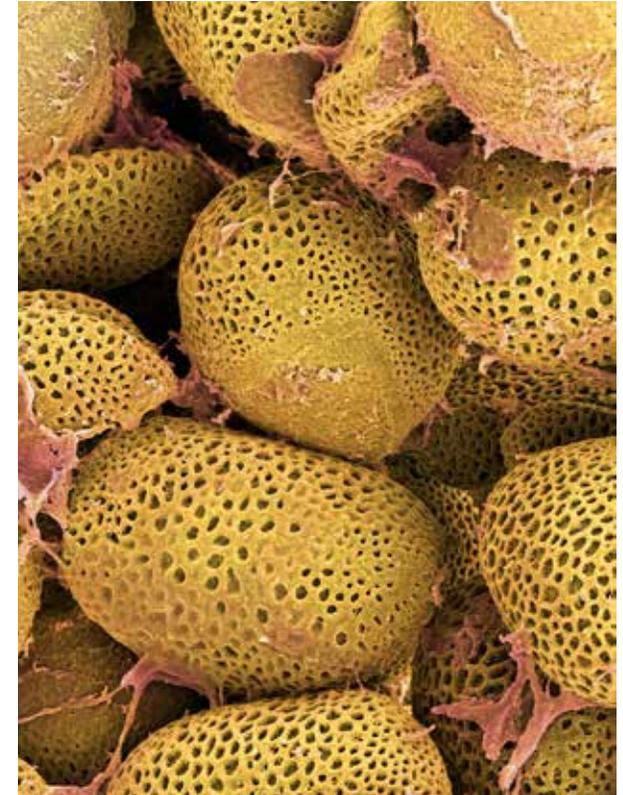
Chris Rosario will be in charge of looking after the hives. This is not the first time bees have been kept at the Yigo station. Rosario had six hives there in the past, but in 2018, the



Honey bees on top of frames inside the hive.

invasive greater banded hornets decimated two hives. He relocated the other four. Since that time, Rosario has destroyed three greater banded hornet nests in the vicinity of the Yigo station. “I will be monitoring the hives and install hornet guards at the hive entrance if there is a problem with hornet attacks again,” stated Rosario.

If people have honey bees in an inconvenient place, please contact Rosario at the number below, so that he may remove them and make a new home for them at one of WPTRC’s research stations. Also, if anyone knows of the locations of greater banded hornet nests, please contact Rosario.



Magnified view of pollen stored by bees in their hive. Pollen is the primary protein source for bees.

Funded by USDA APHIS Program

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Seaweed as fertilizer? →

Students collect data on deposition and decomposition of seaweed washed ashore.

Lands end, where the land meets the sea, holds iconic meaning for many people. The beginning of adventures to new shores, or a homecoming, or for Michael Orr's ecophysiology laboratory, a possibly fertile place where seaweed is deposited and decomposes to feed coastal forests.

Having worked on studies of salmon returning to the rivers of Canada, where the well-known story of how reproducing salmon eaten by bears can fertilize the surrounding vegetation, Orr thought to apply the same methodology in his new home of Guam. Does the tropical ocean supply any nutrients to terrestrial landscapes, and if so, to what degree? With grant funding, he and his students began their research to test this hypothesis.

His research team of four students, including two high school students who were winners of the Island Wide Science Fair held annually at UOG, began beach combing to answer the questions: how much seaweed ends up on Guam beaches, what species are present, what happens to the nutrients once seaweed reaches the shore? Mapping out transects, they began to collect data. Using standard ecological techniques such as transects, quadrats and herbivore exclusion cages, the team monitored deposition and decomposition of seaweeds on Guam beaches. They determined that deposition rates depend on the tidal cycle and the type of seaweed being washed ashore. Species like *Turbinaria* sp., are very buoyant and

wash ashore frequently during the highest tides. *Pedina* sp., comes ashore in abundance and degrades very rapidly. *Halimeda* sp. is algae with a calcium carbonate skeleton which when degrades contributes the white sandy beaches of Guam. *Halimeda* also has a degradation time of weeks to months because of the extra carbonate skeleton.

The onshore deposition of seaweed might provide significant nutrient sustenance directly into coastal forest herbivores and decomposer communities as well as indirectly into coastal forest vegetation, soil, and terrestrial communities.

As seaweed absorbs nutrients from their aquatic environment, they develop an isotopic signature or isotopic fingerprint of what has been consumed. Once these seaweed signatures have been determined, the next phase of the project involves taking core sample from trees in the area to see whether the trees exhibit this isotopic signature, which would indicate they have been utilizing the nutrients from the decaying seaweed in their vicinity.

“My students and I have a great deal of enthusiasm knowing we are contributing to an area of tropical ecology that has not been previously explored on the island,” said Orr.

If seaweed indeed is found to be a potent fertilizer for coastal trees, perhaps the piles of



seaweed that get washed ashore periodically could also be used as an organic fertilizer for local crops.

Funded by USDA McIntire-Stennis Program

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Fungi important in conservation practices for native orchids



Research conducted on *Taeniophyllum mariannense*, an orchid native to Guam, confirmed the presence of mycorrhizae in wild native orchids.

The Guam Plant Extinction Prevention Program (GPEPP) has been actively cultivating endangered and rare native plants, including orchids, in their nursery located on the University of Guam campus. Mario Martinez, a GPEPP research associate, has clocked many hours in the field surveying and documenting native plants. He is the first Master of Science graduate of the Sustainable Agriculture, Food, & Natural Resources degree program, and centered his graduate thesis on the interactions of mycorrhizae and native orchids.

Mycorrhizae are the fungi that assist plants, including epiphytic orchids, in their uptake of nutrients and water. Applications of mycorrhizal fungi are used in agricultural and horticultural production as they augment the surface area of roots, which promotes plant vitality.

Martinez set out to explore the beneficial relationship between native orchids and the fungi that live symbiotically with them. Orchid mycorrhizae are important during particular periods of the plant's growth. There are a great number of species of these symbiotic fungi, therefore, it is important to know which species of fungi is beneficial to which species of orchid, especially for conservation purposes.

Orchid mycorrhizae have not previously been identified for native Guam orchids. The orchid used in this study was *Taeniophyllum*

mariannense, a tiny but significant leafless orchid considered to have one of the world's smallest orchid flowers. This plant, endemic to Micronesia, contains chloroplasts in its roots, which allow for photosynthesis. Using proven methods for visual and genetic identification of mycorrhizal fungi in orchids, Martinez chose two different habitats for orchid collection, limestone forests in northern Guam and ravine forests in the southern Guam.

Focusing on fungi inside the root cortex to eliminate contamination from fungi on the root surface, Martinez removed the outer coating of the root before taking small segments for analysis. Examining specimens under a microscope, he looked for the yellow-colored cells that indicate colonization by orchid mycorrhizae, noting the particular area of the root hosting a mycorrhizal colony. Using DNA extracted from the roots and following polymerase chain reaction (PCR) protocols, the amplified DNA was sent to a commercial sequencing service. The results were then compared to known sequences of mycorrhizal fungi at the National Center for Biotechnology Information to confirm the species.

This study is the first of its kind to contribute to the understanding of biological symbiosis in the native orchids of Guam. Martinez was successful in confirming the presence of mycorrhizae in a wild orchid population on Guam. These findings



can be used as a foundation for future research in orchid conservation in the Mariana Islands.

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Marianas Terrestrial Conservation Conference



Jerilyn Calaor, a UOG graduate, presents her research on the role of spiders in arthropod communities in the absence of birds, via online connection from Iowa.

The 3rd Marianas Terrestrial Conservation Conference & Workshop (MTCC) was held for the first time in Saipan November 19-20. The conference attracted over 100 attendees with 28 presentations on the first day and nine scientific posters on the second day. Free and open to the public,

the MTCC is the only conference held in the region that brings researchers together around conservation issues facing the islands that make up the Mariana archipelago. Talks included research on recovery of fanihi (Mariana fruit bat), sãli (Micronesian starling) åga (Mariana crow), native skinks, and snails.

Several University of Guam (UOG) students and graduates presented at the conference including Maria Lynn Cruz, Jerilyn Calaor, and Ann Marie Gawel. Calaor and Gawel are currently working toward their PhD degrees with Haldre Rogers at Iowa State University.

Moneka de Oro, research technician at the Ecology of Bird Loss Project on Guam attended the conference and believes it is important to have a venue to showcase terrestrial research in the region. **“It is vital for people to know about the research being conducted on native flora and fauna in order to understand where we are now and our relationship to the land,”** said de Oro.

The Western Pacific Tropical Research Center was a major sponsor for the conference. “I was very impressed with the caliber of the research and presentations at the conference, as well as the diversity of topics,” said WPTRC Associate Director Adrian Ares.

Researcher Michael Lanzone from Cape May, New Jersey, presented on an upcoming project tracking sãli (Micronesian starling) on Guam at Anderson Air Force Base. “I believe this conference is critically important for

understanding the conservation of island ecosystems. It brings people together to learn from each other and allows conservation players a chance to get on the same page,” said Lanzone.

Emma Hollowell, a recipient of the John A. Knauss Marine Policy Fellowship that allows participants to gain hands-on experience at host government offices in Washington, D.C., transferring science to policy and management, attended the conference. She came because she personally cares about the issues around invasive species management and conservation and wanted to see firsthand what is happening in the Marianas. Working in D.C. with the office of the Deputy Assistant Secretary of the Navy (Environment), she hears a great deal about environmental issues in the region.

The second day of the conference, scientists along with representatives from local and federal agencies, focused on brown tree snake research in the region. A panel discussion on conservation efforts in the islands brought together the issues of reintroducing birds on the island of Guam and brown tree snake eradication efforts.

The conference organizers included interesting field trips making the two-day conference overwhelmingly enjoyable. Thrilling pre-conference proa rides by Saipan-based nonprofit 500 Sails, Inc. and a hike to visit a Mariana swiftlet cave gave conference goers an introduction to Saipan. Multiple



Mariana kingfisher, as captured by Michael Lanzone during a conference field trip.

morning field trips included an early morning birding trip, tree planting for typhoon Yutu recovery efforts, and a native limestone forest hike.

MTCC’s 2020 conference will be held in mid-November in Guam. For more information contact Haldre Rogers.

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Agroforestry workshop at Humatak farm



The second day of the workshop was held at Marilyn Salas' farm in southern Guam where she applies agroforestry techniques.

“Until a few years ago, the ancient culture of agroforestry was not on the radar for most growers. Today, an increasing number of people throughout the Pacific are eager to plant food forests again to increase profitability, regenerate soils, and reduce risks associated with weather extremes, but they are not sure how to proceed,” said Craig Elevitch, PhD, who began his career as an agroforestry planner in 1991 on the island of Hawai’i.

The Guam workshop was co-presented by the Western Pacific Tropical Research Center and The Pacific Farmers Together Cooperative with support from the Western Sustainable Agriculture Research and Education Program and the Pacific Islands SBDC Network. The workshop entitled, “Designing and growing an agroforest: Creating regenerative and profitable landscapes” was part of a series presented by Permanent Agriculture Resources in Guam, Saipan, Pohnpei, Marshall Islands, and two Hawaiian islands.

Presenters at the Guam workshop included Craig Elevitch, Neil Logan, Aunty Shirley Kauhahao, Marilyn Salas, and Ansito Walter, who shared their unique set of skills and knowledge in traditional agroforestry, ethnobotany, systems engineering, organic agriculture, and economic analysis acquired over decades of study and field experience.

In addressing the urgent need to strengthen our local food system, author, educator, and community organizer Marilyn Salas noted,



Craig Elevitch assists workshop participants in planning the design for their own food forest.

“We can learn by observing how Mother Nature places plants in relation to other plants in the natural landscape. Agroforestry is a way of farming that mirrors Mother Nature. In my observations, agroforestry allows plants to co-exist, to protect, to produce an abundance of good fruits and vegetables, to withstand natural disasters such as typhoons, floods, and dry spells, and thereby satisfying our social, spiritual and economic needs.”

Craig Elevitch and his team of educators guided workshop participants in the steps needed to design an agroforest to optimize

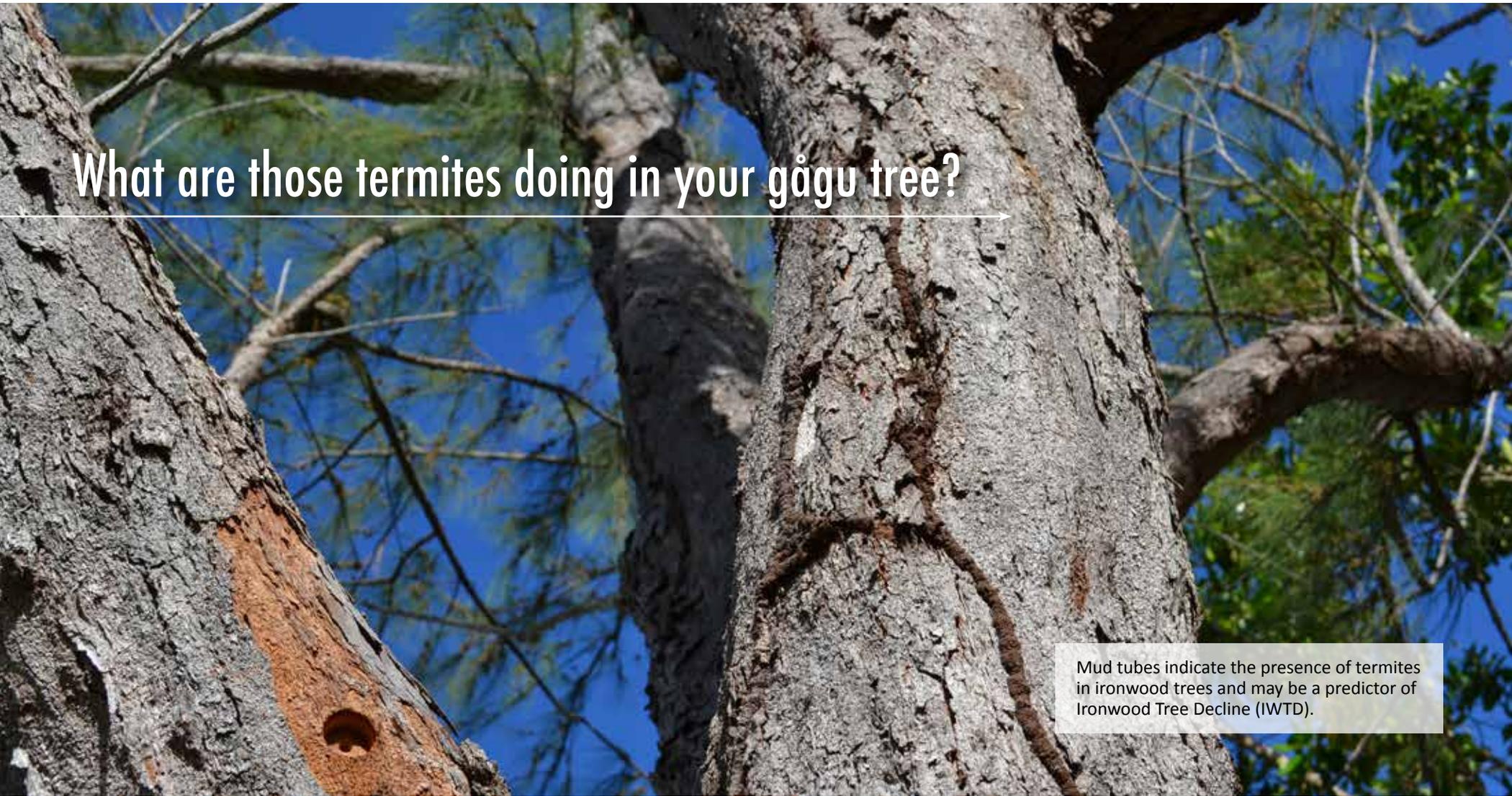
production, marketability, soil building, and resilience. These are steps toward food security for the islands.

Funded by Western SARE

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What are those termites doing in your gāgu tree?



Mud tubes indicate the presence of termites in ironwood trees and may be a predictor of Ironwood Tree Decline (IWTD).

Today many of Guam's *Casuarina equisetifolia*, locally known as gāgu in CHamoru and in English as ironwood, are commonly infested with termites. The current high level of infestation is linked to tree death that began in 2002. In 2008, the condition was coined ironwood tree decline (IWTD).

In 2010, as part of Karl Schlub's master thesis from Louisiana State University (LSU), it was statistically determined that IWTD is linked to the presence of termites, which could be used to predict the future health of a tree.

The presence of termite 'mud tubes' on the trunks of ironwood trees meant that there are subterranean termites foraging up and down the tree. Subterranean termites are amongst the most destructive insect pests of both residential and commercial structures in Guam and the neighboring islands. Of the various subterranean termites, species of *Coptotermes* were Guam's most destructive; however, we did not know if they were in our ironwood trees.

As a result of research conducted in 2019 by Plant Pathologist Robert Schlub and Research Associate Joe Afaisen from UOG and Entomologists Jong-Soek Park and Claudia Husseneder from LSU, we have determined the threat these ironwood termites pose to Guam's homeowners. It was found that 93% of Guam's ironwood trees were infested with *Nasutitermes takasagoensis*. In 2002, Extension Entomologist Lee Yudin, identified *Nasutitermes* as one of the four groups of termites on Guam that are predominately found on living trees not in homes, therefore the threat posed by *N. takasagoensis* is very low. However, two percent of Guam ironwood trees were infested with *Coptotermes gestrori*. This subterranean termite is a voracious feeder of wood products on Guam;



Nasutitermes takasagoensis (Nawa), is the termite commonly found in Guam's ironwood trees: (a) Dorsal view of soldier, (b) Ventrolateral view of soldier, (c & d) Dorsal and lateral view of worker, (e) Dorsal view of imago.

therefore, a tree infested with *C. gestrori* does pose a threat to nearby structures with wood.

The next phase of research into the role of termites and IWTD began this fall when Schlub was awarded a three-year WSARE Research and Education grant to examine the bacterial population of ironwood trees and associated termites. This grant will explore the possibility that termites may play a role in spreading IWTD by their feeding on healthy and diseased trees.

Through the application of macrobiotics, Mohammad Arif, plant bacteriologist at the University of Hawaii, will profile the bacteria associated with healthy and diseased ironwood trees. Meanwhile, Claudia Husseneder at LSU will identify the bacterial

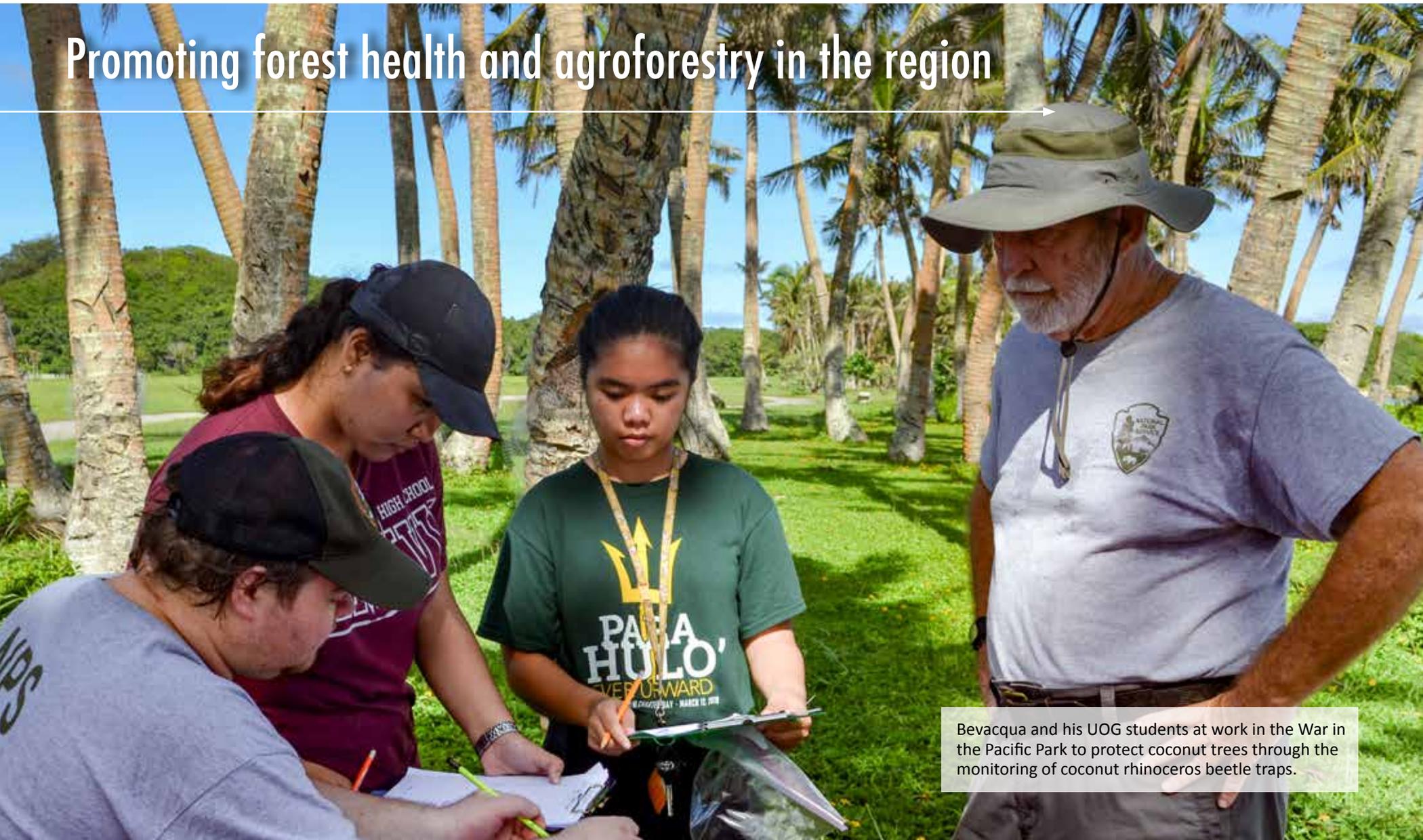
gut content of termites from these same trees. Combined, this information will be used to determine if, in fact, termites have the potential to spread the bacteria responsible for IWTD.

Funded by USDA McIntire-Stennis Program

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Promoting forest health and agroforestry in the region



Bevacqua and his UOG students at work in the War in the Pacific Park to protect coconut trees through the monitoring of coconut rhinoceros beetle traps.

Two years of collaboration between Ross Miller, WPTRC researcher, and the US Forest Service (USFS) have come to fruition with the recent hiring of a forest health/ agroforestry specialist. Robert Bevacqua, adjunct professor with UOG, signed on for a two-year contract to coordinate the protection and restoration of tropical forest ecosystems in the region. The span of the program includes three independent countries, a commonwealth, and a territory of the US. “I look forward to the challenge and opportunity to apply previous experiences in agriculture, forestry, and invasive species,” said Bevacqua. “Many of my former students come from Micronesia and to be working with them in this new capacity is exciting.”

Bevacqua will begin this endeavor by establishing a network of professionals in forestry for the Western Pacific region to include at least one person from Guam, Saipan, Palau, Yap, Chuuk, Pohnpei, Kosrae, and Majuro. With this network of professionals, he will develop and implement workshops on invasive species with emphasis on little fire ant (LFA) and coconut rhinoceros beetle, which pose a threat to trees and agriculture for all the islands.

“This is really a very important and timely decision to hire an agroforestry professional to coordinate all the players in the region. We are appreciative of the understanding and willingness of the US Forest Service to fund this unique program,” said Miller.



Robert Bevacqua collaborates with participants in an agroforestry workshop held at UOG and partially sponsored by the Western Pacific Tropical Research Center.

Miller has been in the forefront of working to control the invasive little fire ant, *Wasmannia auropunctata*, on Guam. LFA was first detected on Guam in 2011. “Once an invasive insect arrives on Guam, it is only a matter of time before it hitches a ride to other islands in the region,” warned Miller. LFA has been detected on Yap, where officials are looking for help in controlling the tiny but terrible ant.

Miller has worked with Haldre Rodgers of Iowa State University in the delivery of the Tropical Forest Ecology course intensive, funded by the USFS, that has been offered in Guam and Saipan in the past. Several participants in the 2018 Guam course asked for that same course to be taught in Pohnpei. With Bevacqua’s assistance, Miller and Rodgers will bring the course to Pohnpei in

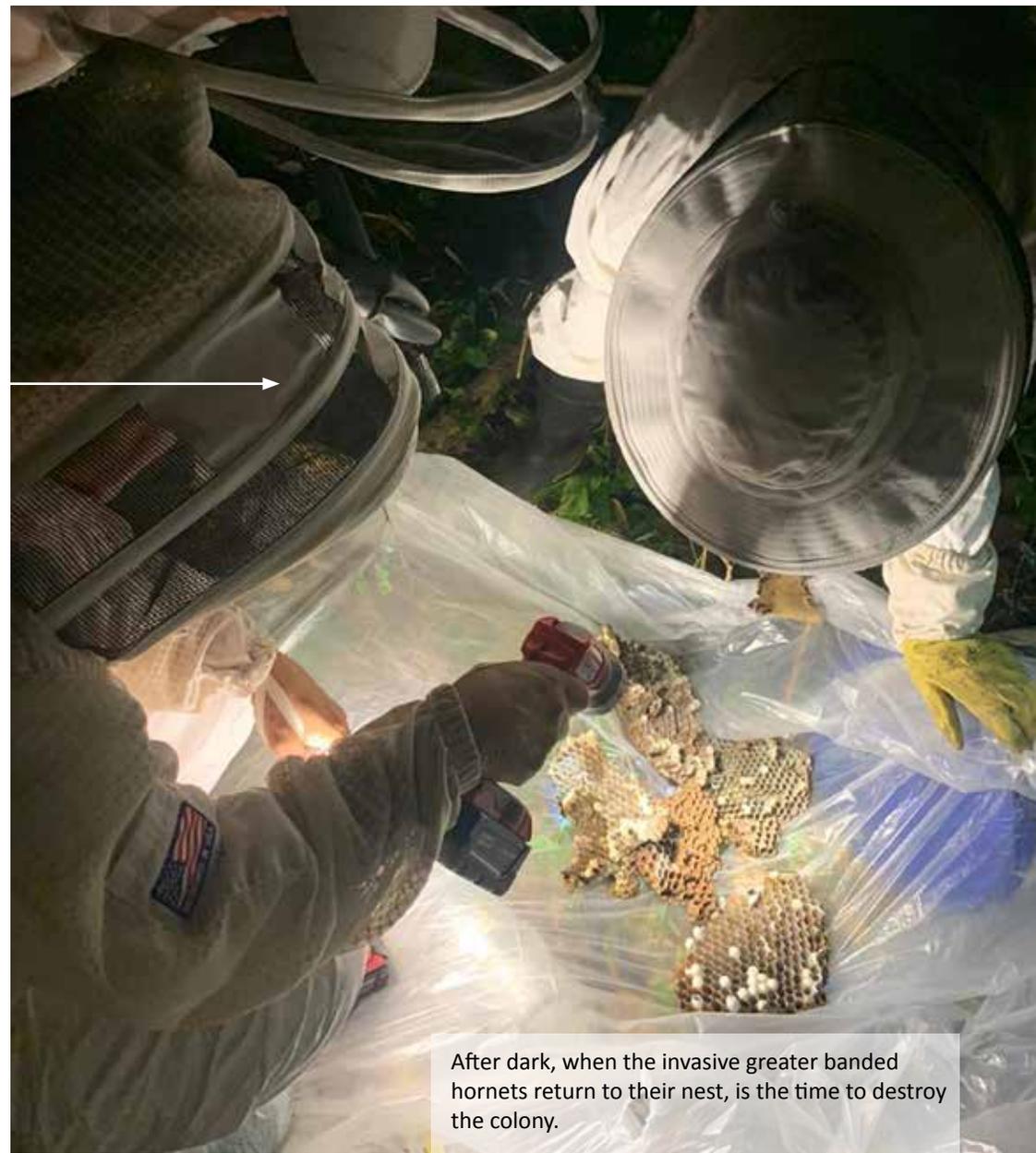
May of 2020. The three-week course will greatly benefit forestry, agroforestry, and agriculture professionals in the region.

Funded by USDA Forest Service

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Tracking greater banded hornets to find their nests



After dark, when the invasive greater banded hornets return to their nest, is the time to destroy the colony.

Chris Rosario, WPTRC research associate and environmental science graduate student, is experimenting with tracking devices to understand the range of the very invasive greater banded hornets (GBH), *Vespa tropica*. Hopefully, the tracking devices will serve as a way to locate their cryptic GBH nest sites.

Radio telemetry techniques have been successfully employed in Europe to study another invasive hornet, *Vespa velutina*. This hornet attacks beehives in the search for protein to feed their young. Beekeepers in France found that predation by the hornets decimated their beehives. Using radio tags, researchers were able to capture, tag, and release raiding hornets following them back to their individual nests high in the treetops. Researchers returned to kill the hornets with insecticide and then removed the nests.

Although it is a different hornet species preying on Guam honey bees, the problems faced by beekeepers are the same. Beekeepers have been forced to relocate hives, or watch as greater banded hornets attack and destroy their bee colonies.

Rosario is collecting preliminary data using Avian Glue-on series A2415 as the tracking device for the GBH. The process entails capturing a hornet, attaching the device, and then using a Yagi antenna, a shortwave radio receiver, to follow the insect back to its nest.



Chris Rosario works at attaching tracking devices to captured greater banded hornets in order to find cryptic nests for removal.



Stunned greater banded hornet will awaken with a tracking device attached to its abdomen.

“I encountered difficulties in my first attempts to attach transmitters to the hornets, but once I had a successful attachment, I was able to track the hornet and follow it back to its individual nest,” said Rosario. He returned in the evening, when the hornets would be in the nest for the night, and destroyed the colony. Unfortunately, the hornet with the tracking device was not found, which resulted in the loss of an expensive tracking device.

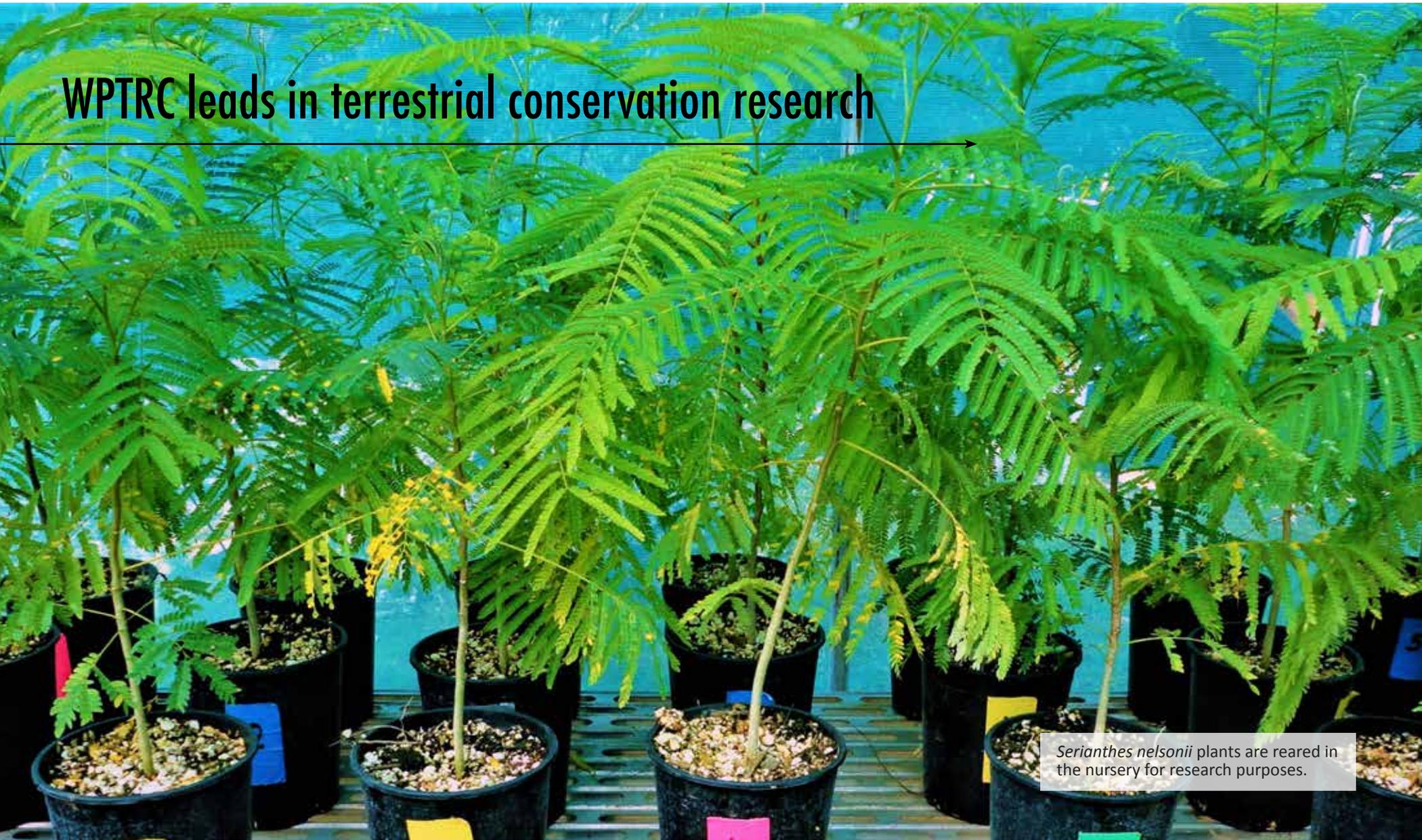
Invasive species continue to warrant the attention of WPTRC researchers and the allocation of funding dollars.

Funded by USDA Hatch Program

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WPTRC leads in terrestrial conservation research



Serianthes nelsonii plants are reared in the nursery for research purposes.

The expansion of knowledge is a crucial role of any research institute, and the WPTRC is ideally positioned in a part of the world where research needs are myriad. Information required to make informed conservation decisions is particularly lacking, leaving the door wide open for WPTRC scientists to rise to the challenge of improving adaptive management conservation knowledge.

The recovery plan for conservation of Guam's endangered *Serianthes nelsonii* was published in 1994, and explicitly called for expanded research to improve decision-making during the recovery efforts. Two decades of conservation actions and funded projects ensued with no progress on this urgent agenda. Then the plant physiology laboratory at WPTRC entered the picture, and jump-started the long-ignored agenda. The six *Serianthes* publications listed at the bottom of this page add to the seven *Serianthes* 2019 publications listed at the end of this Impact Report.

Propagation and nursery management studies have revealed the species is easily grown if appropriate horticultural protocols are employed, indicating historical claims that the species is difficult to grow were invalid. A healthy 5-6 foot tall nursery plant can be produced in about one year, provided the nursery workers possess an understanding of plant water relations and organ functional equilibrium. Protection from rainfall,



Healthy 13-month-old *Serianthes nelsonii* plants in the nursery.

infrequent watering, repetitive stem pruning, and mechanical stimulation of the stem are components of the best nursery management practices.

The native tree is plagued by a profusion of non-native insect herbivores, but all are easily controlled in a managed setting. Mealy bugs, whiteflies, and other piercing-sucking insects are adequately controlled with uninterrupted applications of a systemic insecticide. The damaging butterfly species can be thwarted by removal of the easily seen egg batches if a trained horticulturist embraces the discipline of daily scouting. Mites and leaf-feeding beetles tend to exploit ephemeral post-typhoon conditions to attack the plants, so a nursery manager can mitigate this damage by

being more vigilant in scouting for damage during the 2-3 weeks after each typhoon.

When conservation projects are managed within a research institute and those projects fail to contribute to the scientific literature, the outcome is a distraction from the institute's ability to reach expected collective research performance. Generating research results is of little lasting value until the new knowledge is embedded into the living body of scientific literature. The WPTRC has met this challenge with a burgeoning number of articles on *Serianthes nelsonii*.

Funded by USDA Hatch Program

Further reading:

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Improvements for Ija, Inarajan, & Yigo research stations



Crops used for research experiments planted at the Ija Research and Education Center in southern Guam.

Three research stations located across Guam are valuable assets for the Western Pacific Tropical Research Center (WPTRC) contributing to generating new knowledge and addressing challenges in agriculture, natural resource management, and human nutrition. The stations are currently being improved not only for research purposes but also to host additional teaching and extension activities. In 2019, new farm equipment was purchased and safety gear for the station personnel was upgraded. Data from three recently installed state-of-the-art weather stations are being transmitted to the University of Guam (UOG) campus.

Visitors to the Yigo station, which comprises 46 acres on shallow limestone soil in northern Guam, can see well-tended research experiments, a working farm, and collections of *Cycas micronesica*, tropical fruit tree species, and taro varieties. The five-acre Triton Farm is an excellent example of an integrated farming system known among locals for free-range chicken eggs, delicious aquaponic lettuce, calamansi fruits, and other produce.

The Inarajan station includes 11 acres near the ocean with soils somewhat similar to those at the Yigo Station. There are experiments on papaya variety selection, intercropping, peanut, and mung beans. Bees in hives close to the entrance are thriving under the shade of native trees. Windbreaks

with native tree species are an excellent alternative to protect fields and conserve these species. A planting of native binålo trees (*Thespesia populnea*) will be established at the Inarajan station as a windbreak for crops.

The Ija station is the least developed of WPTRC'S field facilities, but provides opportunities to conduct relatively large experiments on deep and highly-weathered soils derived from volcanic parent materials. Within a landscape of rolling hills and pleasant ocean views, long, rectangular plots serve to test practices to control soil erosion, a rampant problem in several areas in Guam. In 2019, three new experiments were set to test the resistance of ironwood varieties to *Ralstonia*, a pathogenic bacteria. Collections of *Cycas* and mango varieties also speckle the landscape. A recent study examined the presence and abundance of vesicular-arbuscular mycorrhizae across transects on grassland, badland, and agriculture soils within the station.

Nine people work to maintain experiments and facilities. Frankie Matanane, who is busy maintaining valuable plant collections in the Yigo and Ija stations, as well as at the UOG campus expressed, **“It is a big responsibility to take care of these plant collections and help keep them healthy. I report any plant that looks diseased or any unusual sighting of insects to the researchers working with the specimens.”**



Weather station at the Yigo Research & Education Center with the multipurpose education facility in the background.

The research stations are a work in progress. Plans include having full internet connectivity at the Yigo station, to developing a GIS web page with all relevant thematic layers, and expand extension and training activities to benefit multiple stakeholders including more international students.

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“Food Friends & Mighty Moves” effective in addressing obesity in children



SNAP-ED professionals present preschool students with healthy snacks to encourage healthy eating habits.

Collaborative efforts across disciplines have been wildly successful for introducing, implementing and evaluating curriculum designed to prevent obesity for children on Guam. The beginnings of this effort came out of the Children’s Healthy Living (CHL) program. When the CHL program ended, Tanisha Aflague continued the work on a subsequent grant that evolved into partnerships with SNAP-Ed, Guam Head Start, GDOE’s Pre-K and Pre-GATE programs, and UOG Press.

The over arching goal was to examine the efficacy of the *Food Friends and Mighty Moves* curriculum designed by faculty at Colorado State University targeting childhood obesity prevention in Guam preschool classrooms. The fifth year of the grant is coming to a close, and data indicates the curriculum was successful in encouraging students to try new, healthy foods and healthy moves for increasing the development of gross motor skills.

“Over the last two years we have been able to collect data from 23 preschool classrooms. Preliminary analysis shows the curriculum was well received by teachers and was effective for learners,” said Tanisha Aflague, principal investigator on the grant.

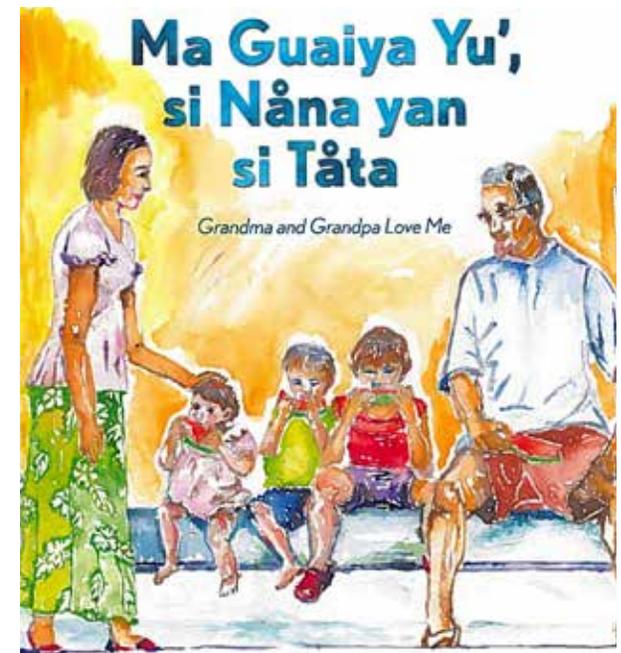
The 23 preschool classrooms were a part of the Guam Head Start and Guam Department of Education’s Pre-K and Pre-GATE programs. Among the classrooms that received the

curriculum, 352 preschool children, 3-5 years (54% male), participated in the research activities. Majority of participants were Native Hawaiian or Other Pacific Islander (61%), followed by children that identified as two or more races (20%), Asian (15%), and Caucasian (3%). Among Pacific Islanders, the majority were CHamoru (72%) or Chuukese (19%).

The collaboration with the Guam Head Start and GDOE preschool programs was central for getting the number of classrooms for a valid study. SNAP-Ed allowed for qualified extension personnel to train teachers in the curriculum materials they provided - over \$3,000 for each classroom – for the *Food Friends and Mighty Moves* curriculum. SNAP-Ed personnel were also key in developing culturally relevant teaching aids for Guam including food cards and posters depicting local fruits and vegetables.

Although the curriculum was well received by teachers, implementing teachers reported locally relevant adaptations are needed to support the continuation of the curriculum in Guam. UOG Press was instrumental in this effort by providing culturally relevant books in the CHamoru language for all participating students and classrooms in the pilot program. This was an important partnership to strengthen the implementation of *Food Friends and Mighty Moves* in Guam.

There will be 26 classrooms implementing *Food Friends and Mighty Moves* with the culturally relevant teaching aids in the next



Cover from one of the culturally relevant CHamoru language children’s books published by UOG Press used in the *Food Friends and Mighty Moves* classrooms.

school year, reaching over 400 preschool children in Guam. Collaboration is the key to delivering effective means to keep Guam students healthy and ready to learn.

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New WPTRC diagnostic lab for shrimp, prawns, & rhino beetles

A gel image commonly used in a PCR laboratory to read the results of PCR assays.

With aquaculture currently the fastest growing animal production sector worldwide, it is vitally important to take all precautions to insure the animals stay disease free. Disease outbreaks remain the major constraint for shrimp aquaculture development. The pathogens to watch for are from viruses (either of DNA or RNA origin), bacteria, protozoa, and fungi.

The industry has seen viral pandemics in the mid 1990s, a bacterial pandemic from 2009-2015, and most recently, a microsporidian (fungi-related parasite) pandemic. These outbreaks underscore the need for an onsite diagnostic lab to monitor the specific pathogen free (SPF) shrimp families that Hui Gong Jiang and her team have been researching over the last ten years at WPTRC.

Effective pathogen surveillance and disease prevention methods with consistent and reliable diagnostic capabilities are essential for the development, maintenance, and use of SPF stocks as well as live shrimp movement (import of export). The establishment of a PCR-based shrimp and prawn disease diagnostic lab at UOG, equipped with the most updated research efforts and findings is underway to fill in the gap for meeting both Guam’s and the region’s needs.

“The results from the first test runs completed at the new lab on samples from the hatchery with the plasmid positive controls came back all negative

for 15 viral types. This indicates the animals remain disease free from all 15 pathogens and that the lab is functioning optimally,” said Jiang.

The detection methods that will be available include the following:

DNA extractions and single-step and/or nested PCR for

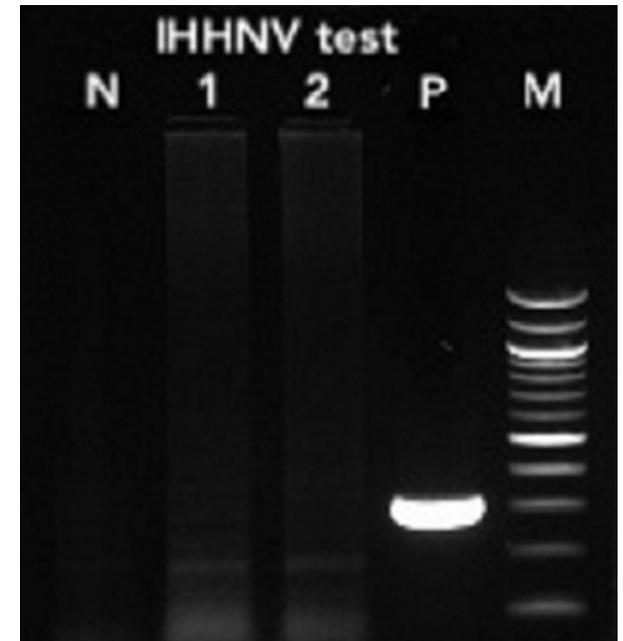
- bacterial infections (NHP, AHPND)
- parasitic infections (EHP)
- DNA virus infections (WSSV, IHHNV, HPV, MBV, BP)

RNA extractions and RT-PCR for

- RNA virus infections (YHV, IMNV, TSV, MrNV, LSNV, PvNV)

The new laboratory will also benefit other UOG scientists. Jim Grasela will be using the lab for coconut rhinoceros beetle research into finding the virus that can be used as a biological control for the beetles. The present PCR capabilities allow him to detect if there is a virus present in dead beetles he uses in his research. He extracts DNA from the midgut of the dead beetles. The DNA is copied by PCR and placed on a gel that can separate the DNA into observable bands for detection. This enables him to detect the possible presence of a virus, but this will not be definitive evidence as to the cause of death of the beetle.

Continued upgrades to WPTRC facilities give scientists the tools they need to make informed decisions regarding the problems



A gel image of PCR tests for IHHNV (DNA virus) from two pooled *Penaeus vannamei* postlarval samples (1 and 2), positive control (P), negative control (N), and Molecular marker (M).

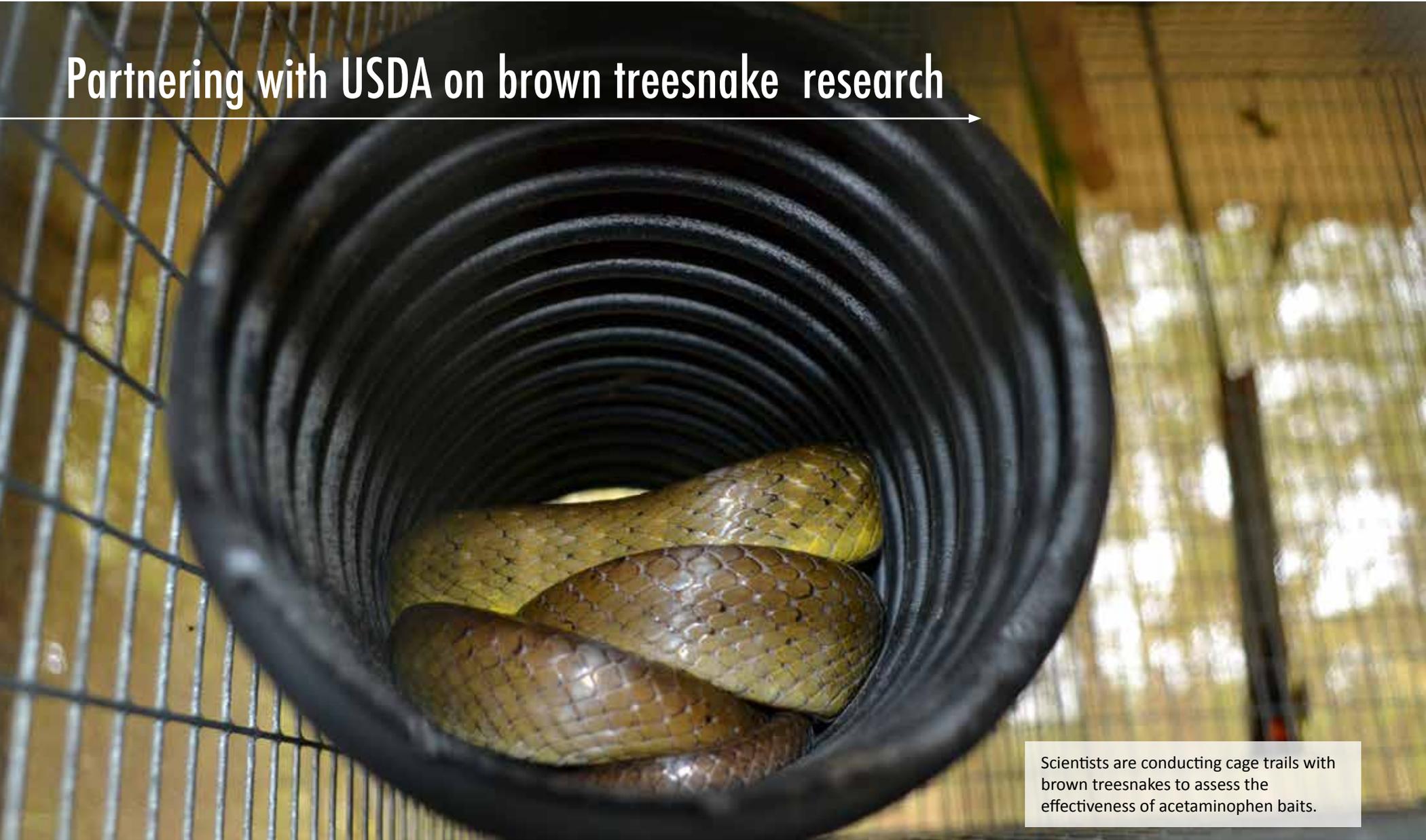
facing farmers and the natural environment on the island and in the region.

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Partnering with USDA on brown treesnake research



Scientists are conducting cage trails with brown treesnakes to assess the effectiveness of acetaminophen baits.

The brown treesnake is Guam’s most notorious invasive predator. As the snakes spread across the island, so did collapses in native forest bird populations and increases in power outages and other negative impacts of unnaturally abundant snakes in this formerly snake-free paradise.

Since the 1990s, the U.S. Department of Agriculture’s (USDA) Wildlife Services program has effectively established a “quarantine” to prevent the spread of brown treesnakes to the Commonwealth of the Northern Mariana Islands (CNMI) and Hawaii, preventing further catastrophic invasions. Since that time, the WS National Wildlife Research Center has also developed and tested tools to control brown treesnake numbers in priority areas – including the discovery of acetaminophen (common pain medication) as a safe and effective toxicant for use with brown treesnakes.

The most significant recent advancement has been the development and testing of a helicopter-mounted system for delivering acetaminophen baits to the forest canopy where brown treesnakes feed. No longer satisfied with just preventing the spread of brown treesnakes, USDA and its partners are now able to reduce brown treesnake numbers on a landscape scale, fueling hopes for ecological restoration on Guam.

USDA is collaborating with WPTRC to evaluate and improve this delivery system, and predict

the benefits of reducing brown treesnake predation. In 2019, USDA began utilizing the UOG Yigo Research & Education Center for cage trials to assess the effectiveness of acetaminophen baits on the largest of brown treesnakes and to test new camera systems for brown treesnake monitoring in forest plots.

In 2020, USDA is establishing cooperative agreements with UOG to enlist their faculty, staff, and students in several research studies:

- improving and testing the automated baiting system for experimental eradication of brown treesnakes in a fenced forest plot;
- evaluating the effectiveness of experimental control of brown treesnakes in urban and residential areas;
- estimating the level of brown treesnake control required for survival of reintroduced native birds; and
- determining if acetaminophen baits could be used to eliminate a new snake population if one was discovered in the CNMI.

This partnership between USDA and WPTRC ushers in a new era of collaboration, provides opportunities for education and employment, and contributes to setting the stage for recovery of Guam’s ecological heritage.

Funded by US Department of the Interior and Department of Defense



Biodegradable bait cartridges tangle in the canopy, exposing the dead mouse and acetaminophen tablet for consumption by feeding treesnakes.

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