# 201 IMPACT REPORT

## Western Pacific Tropical Research Center

College of Natural and Applied Sciences

University of Guam

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**Buenas yan Hafa Adai,**

The diversity of the Western Pacific Tropical Research Center is exemplified in our 2010 Impact Report. As you read though the excellent articles presented in this year's report you will find yourself engaged in learning about what makes Guam unique in both terrestrial and aquatic organisms. As a small tropical research institute in the Western Pacific our scientists are known regionally, nationally and internationally. Much of the work presented this year, highlights the collaborative efforts our of faculty in Australia, Asia and in North America. In addition, certain faculty members have demonstrated their long-standing commitment to work along side with our students in both our undergraduate and graduate programs.

From indigenous and endangered tree and bird species to where echinoderms fit into the "Tree of Life" this 2010 report will allow WPTRC to showcase its best research to date. Guam's natural history has wonderful stories to tell. I personally want to thank all that have contributed to this report and I promise you will agree with me that Guam is a very unique place to study.

*Lee S. Yudin*
Dean and Director
CNAS/WPTRC

**Dear Readers,**

The abundance of relatively inexpensive food in the US resulted from a long history of community investment in both infrastructure and research.

In order to conduct modern agricultural and environmental research, WPTRC needs adequate funding. Research funding in typical land-grant universities is a collaborative effort between the state and federal governments with most states matching seven dollars to every federal dollar appropriated by US Congress. WPTRC relies almost exclusively on federal resources.

In these times of significant increases in Guam's population and economic activity, far-reaching progress in production and consumption of healthier food by Guam's residents as well as protection of Guam's natural environment is critical. The community must invest in upgrades to infrastructure as well as environmental and agricultural research. WPTRC researchers have the expertise to make a positive contribution to the ecosystems and food safety of our island. We are here to serve our community and the region.

*Greg Wiecko*
Associate Director
WPTRC

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Ironwood trees (*Casuarina equisetifolia*)
off the southwestern coast of Guam

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# Bioterrorism in the Fields: Of Mites and Men

Many farmers in the region have had their eggplant production stymied by hungry mites, Philippine lady beetles and fruit borers feeding on their crops. Chemical ecologist and entomologist Gadi V. P. Reddy received a $75,000 USDA Natural Resources Conservation Service grant to assist local eggplant farmers in their struggle against invasive insect pests, predominantly mites.

Guam has been a key military, communication, aviation, and shipping hub of Micronesia for many years. The importation of vegetables from Korea and the Philippines has resulted in the arrival of several invasive mite species.

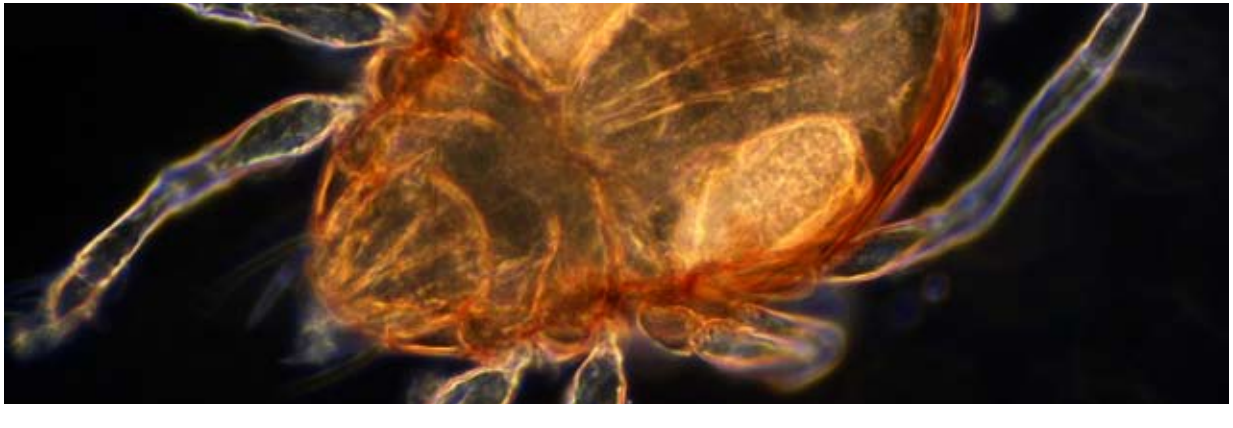
Reddy and his team are developing pest management practices for eggplant farming that will enable growers to transition away from the use of high-risk pesticides including Dicofol and Carbaryl. An Integrated Pest Management system (IPM) is being tested through the introduction of a predatory mite, *Neoseiulus californicus* and the use of petroleum spray oils. The expected results of implementing the IPM will be a measured reduction in the rate of pesticide usage by eggplant farmers in the region.

"This research is the second phase of the eggplant/mite/insect pests study. The first phase was funded by US EPA which allowed us to look at the effects of petroleum sprays on the predatory mite and now we can apply what we learned to developing a successful IPM," says Reddy. The research results will be shared with other Pacific island farmers and places where tropical agriculture is practiced.

Obtaining the permit to introduce the predatory mite on Guam has taken months, with the USDA certificate received last April. The next step for Reddy's team is to evaluate the viability of the introduced mite in its new environment.

This study will examine economic comparisons for growers using conventional practices and suggested IPM systems. Growers will be educated in the use of IPM practices as a way to assure improved eggplant production resulting in higher income for farmers. "Consumers, farmers, and the environment benefit from the important research Dr. Reddy is conducting," says Greg Wiecko, WPTRC associate director.

Dr. Reddy is co-author of the book *Biological Control of Tropical Weeds using Arthropods,* published by Cambridge University Press.



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# Bioterrorism in the Fields: Trapped Sweet Potato Weevils

The sweet potato weevil, *Cylas formicarius*, is anything but sweet to the plant it feeds upon. Farmers in Micronesia are experiencing high numbers of this weevil in their fields frustrating their efforts to grow this staple island crop. Many growers and backyard farmers spray toxic pesticides to control this pest, but since the grubs bore inside the tubers the chemicals do not affect the immature stages.

Gadi V. P. Reddy has been searching for just the right formula to control this insect without the use of toxic pesticides using Integrated Pest Management techniques (IPM). In his search of the literature, Dr. Reddy did not find any studies that have been carried out on the integration of trapping using pheromones as lures and pathogens for control of the sweet potato weevil. "Combining semiochemicals and microbial pests is an environmentally safe alternative to the use of pesticides in controlling weevil infestations," says Reddy.

Reddy's research team has been conducting trials to determine the best trap size, color and placement. Their findings showed that the weevils in Guam fields prefer gray and yellow traps. Once the most suitable trap is decided upon, the team will develop traps containing Petri dishes with fungal spores (*Beauveria bassiana* and *Metarhizium anisopliae*) for auto-dissemination into the weevil population. "Our evaulation of mass trappings will allow us to determine the efficacy of this approach or how we may need to fine tune things to make sweet potato production a more viable crop for regional farmers," says Reddy.

"Gadi V. P. Reddy has been searching for just the right formula to control this insect without the use of toxic pesticides..."

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# Aphids and their Hosts

Collaborative research at the University of Guam has people asking: "WHAT IS A SPECIES?", and entomologists wondering about the relationship between an insect species and the host plant or plants it feeds on.

Western Pacific Tropical Research Center (WPTRC) entomologist Ross Miller has been studying aphids for years and this work has brought him in contact with entomologists in Canada and the US mainland. Aphid systemetist Robert Foottit, DNA ex-

pert Eric Maw and aphid authority Keith Pike have been working with Miller on the identification of aphids, particularly the dreaded banana aphid, *Pentalonia nigronervosa* for nearly ten years. The banana aphid is of interest to researchers and growers worldwide due to its role in transmitting banana bunchy top virus (BBTV).

Using DNA sequencing, this shared project has discovered genetic differences in aphids that resemble banana aphids, but feed on different plants. In their recently published paper, *Zootaxa 2358: 25-38 (2010),* the authors present data supporting the idea that *Pentalonia caladii* may be a species in its own right instead of a form of *Pentalonia nigronervosa*.

Working with "banana aphids" collected from banana, heliconia and ginger plants gathered throughout Micronesia, Hawaii, Florida, and Australia the researchers discovered, through genetic bar coding, that aphids living on gingers and heliconias are genetically different than those living on banana plants. Their findings are definitive enough to warrant reclassification of *P. caladii*. "This research has important ramifications in the biological control of banana aphids to prevent the spread of BBTV since much of the previous work on banana aphid actually involved *P. caladii* instead of *P. nigronervosa*", says Miller. Researchers may find that aphids living on ginger and heliconia plants may pose no threat to banana plants if they are unable to harbor and transmit the virus.

As is often the case with significant findings, these results call for additional research efforts. It will be interesting to determine which species of aphid is found on other Micronesian islands and whether or not both species are equally capable of transmitting BBTV.

Currently, BBTV is found only on Guam in Micronesia and the Hawaiian islands. Miller and his lab, working with UOG plant pathologist George Wall, have received T-STAR funding to verify the host range of the two aphids and to examine their vectoring capabilities. Julie Duay, a UOG master's candidate in Miller's lab will be working on the new study as part of her thesis. "George, Julie and I look forward to our continued collaboration with Foottit, Maw and Pike to improve local banana farming and increase the understanding of these economically important aphid species", says Miller.

***"Their findings are definitive enough to warrant reclassification of P. caladii."***

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# WPTRC Capitalizes on Rare Opportunity

The WPTRC recently completed a collaborative research project designed to evaluate the use of stem injection as a means of delivering insecticides to protect cycad plants.

"We wanted to use this innovative and environmentally friendly technique to protect Guam's native cycad plant," said Thomas Marler, who was the project leader. Marler teamed up with Jack Fisher from Fairchild Tropical Garden in Florida and Anders Lindström from Nong Nooch Tropical Botanical Garden in Thailand to tackle the problem.

Stem injection has been used to deliver plant nutrients or pesticides to many woody tree species, but a cycad stem is atypical in many regards. The findings of the research, which were published in the journal HortScience, were disappointing and indicated the soft tissue within a cycad stem cannot tolerate the drilling and pressurized injection that is required when the technique is employed.

"Cycads are quite rare in the international landscape industry, so most research questions are not valuable enough to sacrifice plants in order to generate the answers," said Marler. The stem injection project presented Marler and his cooperators with the extraordinary opportunity to observe the internal stem and root structures of six rare cycad species. And the team exploited this opportunity to document an unexpected observation.

Guam's native cycad is the *fadang*, and it is among the species that seem to be difficult to grow in the urban landscape. The six cycad species selected by the team purposefully included some species that are hardy as landscape specimens and others that are difficult to grow in the landscape. The researchers found that the vessels used to move food and water within the cycad stem were protected by varying amounts of peripheral tissue. And the hardy species that respond well to horticultural operations tended to produce a thick layer of this peripheral tissue, whereas the tender species tended to produce a thin layer.

"We think this thick layer of tissue acts like a buffer zone for protecting the important vascular tissues," said Marler. It points to the need to ensure that no external damage is inflicted on a *fadang* stem whenever a plant is moved in the landscape or nursery. The results will improve the planning of conservation projects in the coming years.

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# Demolition Services a Blessing

Plants and insects engage in intriguing, mutually beneficial relationships. Of the 300+ described species of cycads that have been studied, each has its own insect pollinator. Thomas Marler has been observing cycads, especially Guam's endemic *Cycas micronesica*, for many years and has discovered that the relationship between this cycad plant and a tiny moth currently known to exist only on the islands of Guam & Rota goes deep. The results of this research appeared in the May issue of the *American Journal of Botany*, and the *December issue of Communicative and Integrative Biology.*

Cycads are often called dinosaur plants as their time on earth dates back to the time when *Tyrannosaurus rex* roamed the planet. These ancient plants send out flushes of leaves and at times reproductive cones over their lifespan. The plants need assistance in order to reproduce, on Guam & Rota the tiny Anatrachyntis moth is happy to oblige.

*Cycas micronesica* male and female plants produce reproductive structures that emit chemical attractants to which insects respond. The insects enter loose openings to maneuver throughout the mature male cones and come in contact with the pollen. The female cycad tree then releases chemicals that make her appear to be a male tree, thereby enticing the moths carrying the pollen to stop for a visit. The moths inadvertently deposit their payload and pollination takes place.

The "payment" by the plant for this service is to provide male cones to serve a nursery for the pollinators. The moths lay their eggs in the cones so that their young will have a ready food source. "This service has been portrayed for many cycad species as something the plant sacrifices in the pollination mutualism," says Marler.

The novel findings conveyed in the most recent publications indicate that those male plants providing daycare services, where the insect larvae feed on the cone, produce new cones more rapidly than plants that did not provide this service. In addition to uncovering the nuances of this quid pro quo, the Guam research has also documented that *Cycas micronesica* is the first cycad found to have a moth as a pollinator.

The *Cycas micronesica* research is becoming more difficult as the research subject is under acute threat from several alien insect pests that have entered Guam and Rota in recent years. The declining survival of *Cycas micronesica* puts Marler and other researchers in a race against time to decipher the secrets of this beautiful, ancient plant.

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# Local Teachers Assist Researchers

The Ecology of Bird Loss (EBL) project, a joint initiative between the University of Guam (UOG) and the University of Washington (UW) with funding from the National Science Foundation and United States Department of Agriculture, conducts research on the consequences of the loss of nearly all of Guam's native forest birds. Using parallel experiments in native forests on Guam and Saipan, Tinian and Rota (all three of which have intact bird communities), principle investigators Ross Miller (UOG),

Joshua Tewksbury (UW) and Janneke Hille Ris Lambers (UW) and project director Haldre Rogers (UW) investigate two of the primary ecosystem functions birds provide – seed dispersal and control of insect herbivores.

Although the EBL project has been conducting research in the Marianas since 2005, this year it began a new community outreach initiative in order to spread awareness about the native forests in the Mariana Islands and improve science education in schools on the islands. The EBL project received a Research Experience for Teachers (RET) grant from the National Science Foundation to bring two local teachers onto their field crew for seven weeks to learn about native forests, experience scientific field research first-hand, and develop relevant curriculum to bring the forests back into their classrooms in the fall.

Sabina Perez, a Simon Sanchez High School biology teacher starting her second year in the profession, and Michael Subbert, a Guam High School teacher with 20 years of experience teaching high school biology on Guam, worked long hours in rain and heat crouching over native plant seedlings, hiking up karst-limestone cliffs and digging through leaf litter in order to enhance the biology lessons they teach their students with real-life examples from the forests on Guam. They joined the EBL field crew, which consisted of nine members, ranging from high school volunteers through post-graduate biologists. "I appreciated the balance between academic training and field practice, and the collaborative spirit of the EBL group," said Perez.

Although the whirl-wind seven weeks are over, Perez and Subbert will continue to collaborate with EBL researchers throughout the school year, and are already planning their role as mentors for the teachers selected to participate in the RET program next year. At the end of the summer, Perez reflected: "[The RET experience] has definitely given me the momentum as a beginning biology teacher to emphasize ecology by showcasing EBL's project, bringing the classroom outdoors and the outdoors into the classroom, and providing additional resources to increase student interest in ecology, especially on Guam."

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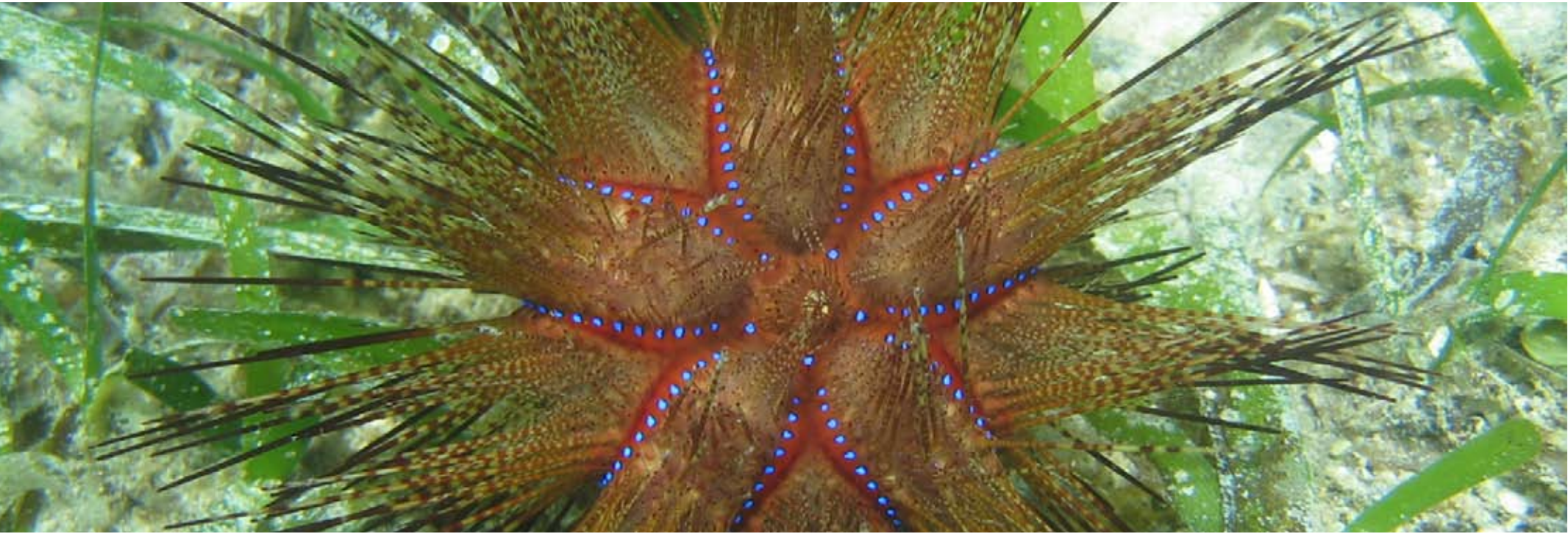
# Echinoderms and the Tree of Life Project



The echinoderms - starfish, sea urchins and their kin - are the next major group of organisms to be documented in the U.S. National Science Foundation's Assembling the Tree of Life project. Marine Lab scientist, Alexander M Kerr, will join an international team from ten institutions in using genetic information from modern species, as well as data from fossils dating back more than 500 million years to figure out precisely where echinoderms fit into the history of all life. The $3 million initiative begins in January 2011.

Echinoderms include five living classes of animals whose common names are starfish, brittle stars, sea urchins, crinoids and sea

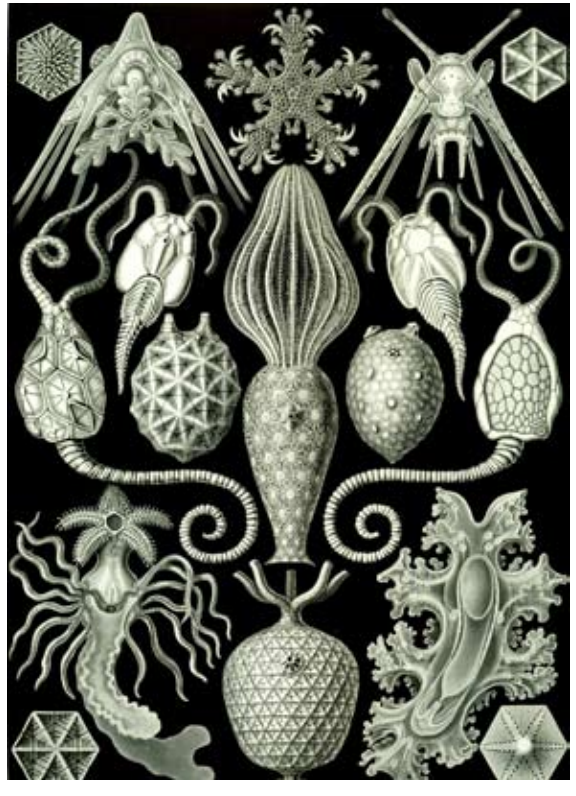
cucumbers. But those five living classes don't tell the entire echinoderm story. Up to 16 other classes are extinct and known to have existed since at least the Cambrian Period, 540 million years ago. Fossil echinoderms are common throughout Earth's history, but a comprehensive effort to reconstruct the group's entire history has yet to be attempted.

This project is rare within the NSF Tree of Life initiative for its mix of coral-reef biologists, paleontologists, geneticists and computational biologists. "We all complement one another – the idea is to pool and digitize as much information as possible and come up with a consensus about how evolutionary history unfolded in echinoderms," said Bill Ausich, a team leader and paleontologist at Ohio State University.

Meanwhile, other scientists will be able to collect genetic and anatomical data on living echinoderms. "The University of Guam Marine Laboratory will form an important link in this project by providing researchers unrivalled access to a rich and poorly studied set of living species of echinoderms in our region." Kerr said.

That broad combination of research techniques, however, will also pose an information-technology challenge. To address this, computational biologists will link computers together to analyze massive amounts of data. The computer array will explore the similarities and differences between the modern samples containing both genetic and anatomical information, and the fossils containing only anatomical information to construct what is called a phylogenetic tree for the entire echinoderm group. Phylogenetics is the study of the evolutionary relationships among various biological species believed to have a common ancestor. "The Tree of Life is, in fact, one massive phylogenetic structure involving all organisms, from bacteria to fungi as well as plants and animals," notes Dan Janies, team organizer and computational biologist at Ohio State University Medical School.

Collaborating institutions for this project are the universities of Guam, Michigan, and Tennessee; Abilene Christian, Duke, West Virginia, Louisiana State and Nova Southeastern universities; and the University of California, San Diego's Scripps Institution of Oceanography.



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# Guam's Dying Gago Gain World Attention

For the last 8 years, the University of Guam has been struggling to unravel the mysterious deaths of hundreds of Guam's Gago or Ironwood trees (*Casuarina equisetifolia*) and to bring the problem to the attention of the world. In the past year major accomplishments on both fronts were realized in large part by analysis of data collected over the past 2 years by Drs. Zelalem Mersha and Robert Schlub and presentation of these findings in 2010 at three international conferences on three continents: Asia, North America, and Europe. There are currently 11 individuals directly participating in Dr. Schlub's Ironwood Tree Decline (IWTD) project, which began in 2009 when six off-island experts were brought to Guam to exam the island's ironwood trees.

In 2009, the general consensus of the experts was that a complex of biotic and abiotic factors were responsible for the decline and advanced the theory that an opportunistic conk-producing fungus in association with wounding could explain the majority of Guam's declining trees. Subsequent research efforts focused on identifying these factors and determining their role in IWTD. Among the abiotic factors studies were wounding, tree site density, and management practices. Biotic factors considered were termites, a newly discovered eulophid wasp, and conk-forming fungi. In 2010, Karl Schlub and Dr. Brian Marx of Louisiana State University applied various modeling techniques to a set of IWTD predictors and concluded that the presence of conks, termites, and improper tree care were significant explanatory variables for the decline. "The analysis of the 2009 survey data, which consisted of 1427 trees, 44 sites, and 15 variables, proved to be quite complex and lead to my son, Karl earning a Master of Science in Applied Statistics from Louisiana State University for his efforts," says Schlub.

There are several implications that can be drawn from this study. First, decline may be reduced or eliminated with measures that preclude favorable conditions for termites and wood rotting fungi. Second, the biotic component of decline is not highly virulent; therefore, decline on Guam could be reduced substantially by the introduction of new cultivars of *Casuarina equisetifolia*. Third, Guam's current management and cultural practices need to be revised to avoid promoting decline by creating wounds from improper use of grass trimmers and lawnmowers or by spreading infectious agents on pruning tools.

Future research is being planned to enhance the current statistical model used to predict IWTD through the use of GIS map generated data; to develop chemical, cultural, and varietal selection methods for controlling IWTD; and to develop an ironwood decline assessment guide to evaluate the health of *Casuarina equisetifolia* trees grown in the Pacific Basin.

This research was funded by UOG and WPTRC as well as various United States Department of Agriculture programs including: WSARE, EIPM, RREA, WIPM, and WPDN.

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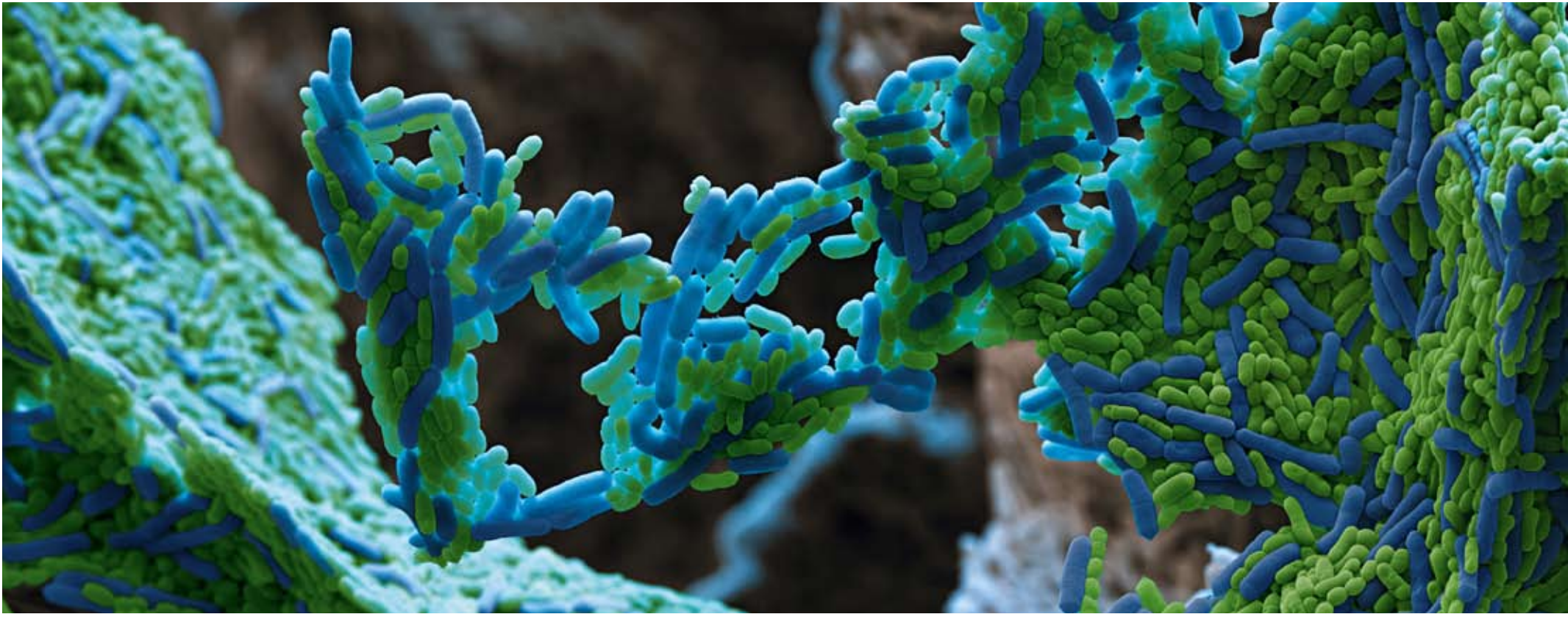
# Novel Value-added Product "Probiotic Soursop Drink"



Probiotics are live microorganisms that bring health benefits to people when consumed in adequate amounts. Some of these benefits include relieving gastrointestinal infections, improving lactose metabolism, fighting carcinogens, reducing serum cholesterol, and stimulating the immune system. Consuming dairy products such as yogurt and cheese is one of the most common ways to ingest probiotics. However, dairy products may contribute to allergens and high serum cholesterol. Non-dairy products, such as fruit juices, cereals, and nutritional bars, are recently used as carriers to deliver probiotics, but these products may not support viable cells or sensory quality. For example, the acidity of fruit juice (pH 3.5) may reduce the number of viable probiotic cells during storage; adding probiotics may also result in undesirable flavors.

Soursop is a unique tropical fruit. Its distinct aroma and sour-sweet taste are highly appealing to both tourists and island residents. Soursop fruit juice has a pH of 3.6 and may be a delicious and novel carrier for probiotics.

To investigate the potential of soursop probiotic juice, Dr. Jian Yang and his food science research team tested the survival of probiotic lactobacilli *L. acidophilus* and *L. paracasei* in soursop nectar. The nectar was made of soursop pulp (200 g), sugar (100 g), and water (600 mL) with an adjusted pH of 3.0-4.0 using lemon juice and sodium hydroxide. In the preliminary study, they inoculated *L. acidophilus* or *L. paracasei* in pasteurized soursop nectar and observed both strains survived in soursop nectar at 4°C. Also *L. acidophilus* and *L. paracasei* exhibited a 0.5-1 logarithmic increase after storage at 4°C for 7 days. The acidic environment (pH 3.0-4.0) of soursop nectar did not negatively affect the survival of *L. acidophilus* and *L. paracasei*, indicating its potential as a carrier for probiotics.

Soursop is a seasonal tropical fruit. The development of a probiotic soursop drink not only advances the consumption of fresh soursop fruit, but also provides additional health benefits for consumers. Research on the production of this novel value-added drink may promote the development of soursop plantations and encourage entrepreneurial activities in Pacific island communities. This research was supported by a seed grant from the College of Natural and Applied Sciences, University of Guam.

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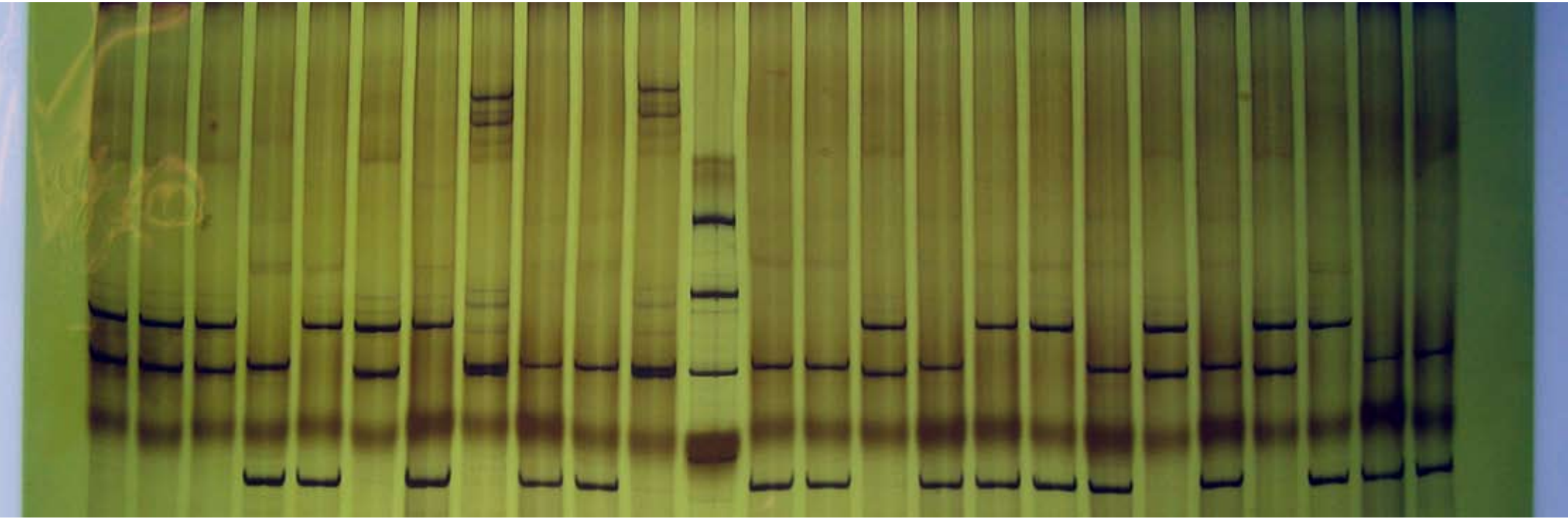
# Researchers Find Correlation between Genetics and Nutrition in Shrimp



**A**quaculture has been practiced in China for centuries, and the earliest literature, *Classics of Fish Culture* was written around 500BC. Much later, the Chinese introduced fish culture to Japan and possibly Southeast Asia. With an eye on developing sustainable aquaculture, it is fitting that Dr. Hui Gong and her team of post-doctorial researchers is breaking new ground in genetic and nutritional studies on Pacific white shrimp, *Penaeus vannamei*, at the Guam Aquaculture Development and Training Center (GADTC).

In a recent experiment using 6 specific-pathogen-free founder populations, the team produced 18 families and implanted each

juvenile shrimp with visible elastomer implants at the 5th abdominal segment of the tail muscle. The implants allowed the researchers to track the families, each with their own distinct genetic background to study the genetic variations of the utilization efficiency of plant proteins.

This project was a collaborative effort between GADTC and the Shrimp Mariculture Project at Texas A&M University who were responsible for dietary formulation and processing.

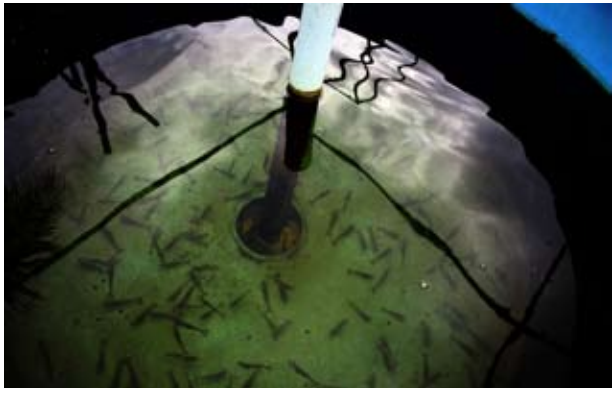
Using 5 dietary treatments representing different protein levels and percentages of marine and plant proteins, the shrimp families were evenly distributed over 20 two-ton tanks with 4 tanks for each dietary treatment. Diets 1 and 2 were commercial diets and diets 3-5 were semi-purified diets. Crude protein (CP) for diets 1 and 2 was 40% and 35% respectively with 5% squid meal only in diet 1. For the semi-purified diets, diet 3 had 35% CP originating mostly from marine proteins. Diet 4 also had 35% CP with less coming from marine sources. Diet 5 had a significantly reduced protein level (20%CP) but the same level of marine derived proteins as diet 4.

At the end of the experiment the weight, tag code and sex of each individual shrimp was recorded. The average daily weight gain (ADG), coefficient of variation (CV%) of ADG, and survival rate of each family in each tank were submitted for statistical analysis.

Statistical analysis showed the interaction between genetics and diets highly significant for average daily weight gain but not for survival rates, but a large variation was observed among combinations of families and diets for both growth rate and survivability.

The response of different families to the assorted dietary protein levels and protein sources also varied considerably. Between-family variation of ADG suggested that expression of shrimp growth potential was influenced by dietary nutrition. The reduction of marine protein in diets 3 and 5 resulted in an average ADG decrease of only 2.7% across all families, but for individual families, the reduction resulted in values between a 10.8% decrease to a 4.1% increase of ADG. "Such large variability suggests that genetic selection should play an important role in improving plant protein utilization by shrimp, which could consequentially facilitate a reduction in need for fishmeal by the shrimp industry," says Gong.

Funded by the National Oceanic and Atmospheric Administration (NOAA), this study addressed NOAA research priorities involving "alternative protein based diets" and "protecting and managing the use of coastal and ocean resources".



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# Bioengineering with Vetiver Grass

Guam's coral reefs are vital natural resources that deserve protection. One of the major health hazards facing Guam's reefs is soil erosion and run-off that result in sedimentation and suffocation of the complex organisms that make up a reef system.

Soil scientist Mohammad Golabi has put his years of research on the incredible attributes of vetiver grass to practical use in shielding the reefs in Pago Bay from harmful effects of construction-induced run-off.

The scientific name for vetiver is *Vetivaria zizaniodes* with 12 known species, but there are many other cultivars that have distinctive varietal differences that may be exploited depending on need. The thick, stiff-stemmed cultivars that can withstand high water velocities are used for controlling soil erosion. Researchers around the world have evaluated the application of vetiver grass and found it to be very effective when bioengineering technology is needed to stabilize soil. "Vetiver's ability to tolerate high stress situations, adapt to a variety of conditions, develop a dense vertical root system, and powerful soil binding characteristics make it an ideal candidate for controlling soil erosion," says Golabi.

The plant's spongy root system binds the soil beneath the plant to a depth of up to 3 meters forming a dense underground curtain that prevents gullying and tunneling. Once the hedge has been established, it can live up to 50 years and does not require further maintenance other than periodic trimming. Under certain circumstances thick hedges can be formed in one year, it generally takes two to three growing seasons to establish a hedge dense enough to withstand torrential rains and/or heavy storm events, and protect the shoreline from sedimentation.

In this pilot project, Golabi and his team planted vetiver grass along a Pago Bay beach area adjacent to a tract of land that had been cleared for a large development project. Fully developed vetiver seedlings were planted in contour rows along the beach without disturbing the aesthetics of the area. The plants established in a few months, forming a thick hedge that prevents sediment from water-borne erosion from flowing into the ocean.

"It is also expected that these vetiver hedges may even be able to protect the beach area against tidal surge once their root systems are well established. These hedgerows clearly demonstrate that the vetiver grass system is a unique, economical and effective bioengineering technology for protecting coral reefs from further degradation in the Pago Bay area and may be applied to other sites around the island," says Golabi.

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# Unusual Rhino Beetle Behavior Discovered

The coconut rhinoceros beetle continues to munch its way through the crowns of coconut trees on the northwest coast of Guam. Rhino hunters are ready to get tough with bio-control measures that will decrease the rhino beetle population.

Russ Campbell, Guam's territorial entomologist and Aubrey Moore, UOG extension entomologist, welcomed New Zealand scientist, Trevor Jackson to Guam in early June. Jackson was invited to assist in the release of a virus into the rhino beetle (*Oryctes rhinoceros*) population. This virus only infects rhino beetles and it has been successful in controlling populations of the pest on other Pacific islands.

The virus is naturally occurring in Malaysia and is produced in a New Zealand laboratory. It is dispersed using auto-dissemination: adult beetles are fed a solution of the virus, become infected, and then they are released to infect the resident population. This method of bio-control has been successfully used in Samoa, Fiji, Tonga, Palau and other Pacific islands where the rhino beetle was accidentally introduced. It will take several months to see the results. "The bio-control agent will not completely eradicate the CRB, but it will help to keep it under control," says Moore.

Aubrey Moore and his assistant Bob Bourgeois have been rearing rhino beetles in a converted shipping container at the Guam Plant Inspection Station. About 2,000 beetles are housed individually in Mason jars, waiting to be infested with the virus. Hungry beetles are fed the virus, and then strategically released into island rhino populations. Once the beetles are infected, the virus damages their stomach walls causing them to stop eating.

During Jackson's visit the team discovered unusual rhino beetle behavior. Immature beetles, or grubs, do not feed on live plants and are usually only found in dead standing coconut palms, and decaying logs or compost piles on the ground. However, on Guam it appears that significant numbers of beetles are developing from egg to adult in the crowns of live trees. In cutting down 121 large coconut palms they found a complete ecosystem in the crowns including brown tree snakes, crabs, and, unfortunately, all life stages of rhinoceros beetles, from eggs to larva to young adults, a total of 510 rhino beetles. This new discovery makes the release of the bio-control virus even more vital. Moore thinks this arboreal breeding behavior, seen only on Guam, may be due to the fact that the brown tree snake has wiped out most of Guam's rats. Elsewhere, rats love to live in coconut crowns, and they love to eat rhino beetle grubs.

This never-before-seen rhino beetle behavior of breeding in the crowns of coconut trees underscores an important point regarding invasive species on small islands. Their impact is often severe because there are no natural enemies, such as predators, parasites, or diseases, to control their population growth.

To report any sightings of rhino beetles or rhino beetle damage please call 475-1426.

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