# 2009 IMPACT REPORT

## Western Pacific Tropical Research Center

College of Natural and Applied Sciences

University of Guam

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WPTRC
Research for Guam's Future

# Table Of Contents






**Lee S. Yudin, Ph.D.**

**Buenas yan Hafa Adai !!**

In mid-November, I attended the 122nd Annual Meeting of the Association of Public and Land-grant Universities (APLU). The new Director of the National Institute of Food and Agriculture (NIFA), Dr. Roger Beachy, spoke during the mass luncheon hosted by the Council of Presidents. In Dr. Beachy's speech, he emphasized the five areas that represent the vision of USDA - to keep American agriculture competitive while ending world hunger, to support our ability to improve nutrition and end child obesity, to support our efforts to radically improve food safety for all Americans, to secure America's energy future, and to help us mitigate and adapt to climate change. Each specific topic is not isolated to US mainland communities but is relevant to the small island populations that we serve as well. As you read through the 2009 Impact Report you will notice that many of our faculty and their students are engaged in these same national priority areas. We have highlighted some very key projects that demonstrate our ability to find grants that are relevant to the communities that we serve. The Western Pacific Tropical Research Center has the capability to be one of the leading showcases in food safety, nutrition, climate changes, and food security issues on Guam and in our region. I again urge our policy makers to allocate more funds for health, food safety and security, and environmental issues that are knocking on our doorsteps.

I personally want to thank all the contributing researchers for a great year. It will be the combination of their efforts and other research scientists throughout our region that will enable us to solve these primary focus areas facing our local communities.

**Biba UoG and Biba WPTRC !!**

**Lee S. Yudin, Ph.D.**
*University of Guam, CNAS*
*Dean/Director*
*Western Pacific Tropical Research Center*

Greg Wiecko, Ph.D.

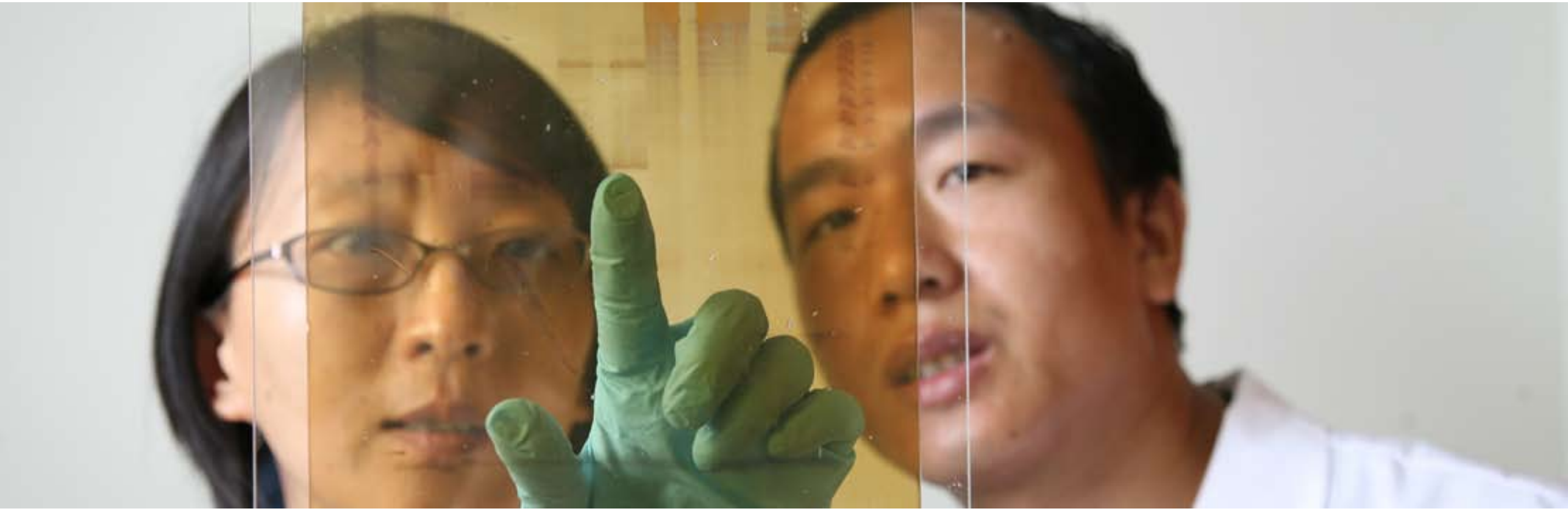
Over the last decade WPTRC researchers have been addressing a broader, increasingly complex, set of questions as focus has shifted from agricultural production to protecting and sustaining the natural environment, nutrition and food safety, and overall healthy development of the community. In the near future Guam and the Western Pacific region will experience tremendous changes in the economy and way of life. Education and dissemination of research conducted at WPTRC will play a key role in guaranteeing a long-term perspective on sustainable development.

In recent years, WPTRC's budget represented nearly $2 million in research funding. This past year, more than $1 million of that funding came from grants and contracts generated by our research scientists themselves. WPTRC scientists are experts in tropical agriculture, forestry, ecology, entomology and aquaculture collaborating with numerous universities and research institutes in Asia, Australia, both Americas, and Europe. We are convinced that WPTRC expertise and research results will stimulate decision makers and will be broadly utilized in policy making.

It is an exciting time to be involved in both basic and applied research endeavors and WPTRC continues to make important contributions to the quality of life on Guam.

**Greg Wiecko, Ph.D.**
*University of Guam, CNAS*
*Associate Director*
*Western Pacific Tropical Research Center*

# Catching up with the Cutting Edge



WPTRC scientists are upgrading their research capabilities by setting up an advanced molecular biology laboratory on campus. This lab will be equipped with real-time PCR capabilities for diagnostics and genotyping.

PCR stands for polymerase chain reaction, and this technology allows detection of DNA or RNA that may be specific for certain microorganisms, pathogens, genes, or gene products and is commonly used for disease diagnostics. In real-time PCR, the

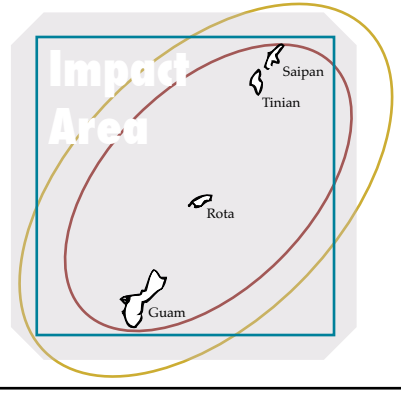
accumulation of PCR product is detected as it happens. Therefore, this technique is highly sensitive and can quantify small numbers of nucleotide copies. Real-time PCR technology is also used to determine how the genetic expression of a particular gene changes over time in response to changes in dietary or environmental conditions.

WPTRC scientists will be using the new PCR lab for DNA extractions in their work on molecular genetics, plant pathology, insect surveys and population biology. It will allow researchers to answer questions as to whether they are working with a single or multiple species. With real time PCR capabilities researchers can quickly and accurately diagnose plant and animal diseases.

In setting up the new molecular biology laboratory, Hui Gong and her research team will make use of this technology in their work on shrimp genetic studies at the Guam Aquaculture Development and Training Center (GADTC). “Real-time PCR is a big asset for our program. It allows us to immediately detect and diagnose shrimp or fish viruses as well as permits us to conduct gene expression studies,” says Gong.

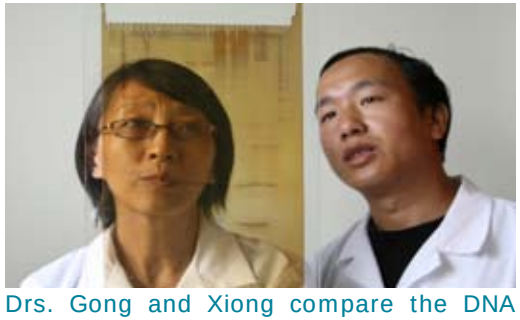
This molecular facility gives Gong and her research team a platform from which to develop microsatellite markers. DNA samples from shrimp families are collected then run through the PCR process for acquiring targeted fragments. Using the newly obtained automatic genetic analyzer system, different genotypes can be distinguished among the selected shrimp families. Dr. Gong is expecting to develop a panel of useful microsatellite markers, in order to maintain the genetic diversity of the shrimp stocks at GADTC. These genetic markers will also help researchers identify pedigrees without the need for individual tagging and will facilitate marker assisted selection, which links genetic markers to desirable phenotypic traits.

Aquaculture research at WPTRC will reach new heights with the synergetic combination of dedicated scientists and the capacities of this new laboratory.




Dr. Hui Gong (left) and her colleague Dr. Jian-Hua Xiong use real-time PCR technology for their shrimp genetic studies.

Young shrimp are tagged with color-coded markers near their tails to identify their familial background.



Drs. Gong and Xiong compare the DNA bands from different shrimp samples on the vertical gel in order to screen useful microsatellite markers.

# Visiting Scholars Develop Super Shrimp

Fascinated by the shrimp she studies, Hui Gong works at finding sound methods for improving their health and welfare. Her connections with her native China have resulted in an official collaboration between the Guang Xi Institute of Fisheries and UOG. This partnership benefits UOG research activities by allowing two post-doctorial researchers from the institute to come to Guam and work with Dr. Gong at the Guam Aquaculture Development and Training Center (GADTC),

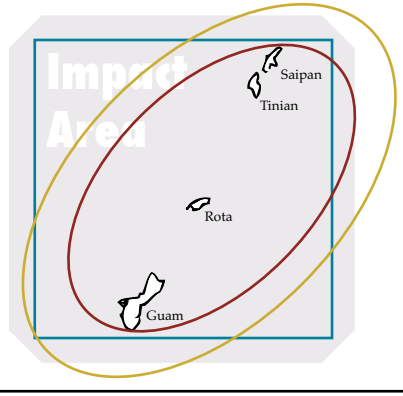
also known as the Fadian Hatchery of UOG, the largest and oldest aquaculture center in the Western Pacific.

Drs. Jian-Hua Xiong and Yong-Zhen Zhao arrived on Guam in January. Jian-Hua Xiong is a molecular biologist working on identifying shrimp genotypes from different families and looking at their genetic relationships. His experiments involve extracting DNA from shrimp then using electrophoresis systems to find their genotype. Yong-Zhen Zhao specializes in shrimp breeding and genetics. He is working on a mating model for shrimp, selecting males and females from different families in order to produce a line of super shrimp. “These super shrimp would be highly disease resistant, fast growers and taste delicious,” says Zhao.

Their expertise compliments the work Dr. Gong has been doing at the hatchery. The main draw for these two scientists to come to Guam is Gong’s work. “Her reputation for professionalism and the research she is conducting made us really want to come. We know we will learn so much and we are grateful for the opportunity to work with her,” says Xiong.

Aquaculture farmers in the region will benefit from their research in the long run. Last year, Dr. Gong produced 20 families at the hatchery and now this team will select 10 families based on their performance under various conditions. Using statistical analysis they will select the families with the most desirable characteristics and begin breeding the next generation. Once the best combination of families has been found, requiring several years of work in genetic selection, the seedstock can be made available to regional farmers, and possibly for export.

The team is devoted to research aimed at producing healthier shrimp for sustainable aquaculture by maintaining stock at the highest health standard of specific pathogen free (SPF). Guam has ideal conditions for the development of SPF broodstock: clean ocean water, warm temperatures year round and geographical proximity to large broodstock markets in Asia. These attributes, as well as this talented and committed research team, will allow the University of Guam to play a major role in shaping the aquaculture industry in the region.




These healthy specimens of *Penaeus vannamei* are important to aquaculture production and WPTRC research.

Dr. Gong demonstrates the proper technique for obtaining a blood sample, minimizing stress for the shrimp, to her colleagues Dr. Xiong (left) and Dr. Zhao.

Dr. Gong proudly cradles her favorite research subject in her hands.

# Researcher Helps Local Farmers and Protects the Environment

With a $75,000 Pacific Islanders Conservation Innovation Grant from the USDA Natural Resources Conservation Service Gadi V.P. Reddy has been spending time in the cabbage patch in order to help farmers in Guam and the CNMI. Using an integrated pest management (IPM) system for managing insect pests on cabbage and other cruciferous crops, Dr. Reddy conducted trials to find the best means to eliminate the application of toxic insecticides and increase crop yields.

Targeting two important pests of cabbage, the cabbage looper *Chrysodiexis chalcitens* and cutworm *Spodoptera litura*, Dr. Reddy and his research team used Aza-Direct®, an insecticide developed from a chemical extracted from the neem tree. In addition to being environmentally friendly, the neem-based insecticide is relatively non-toxic to beneficial insects as well as insect pollinators and is listed by OMRI (Organic Material Review Institute).

Included in the IPM was the use of DIPEL® a biological insecticide based on a well-known microbial pest control agent, *Bacillus thuringienis* subsp. *kurstaki*. DIPEL® is also certified by OMRI for use on organic crops.

Different treatments of Aza-Direct®, DIPEL®, carbaryl, and malathion, were applied to cabbage fields at the UOG Agricultural Experiment Stations in Inarajan and Yigo. A control field, which had no treatment, was also planted.

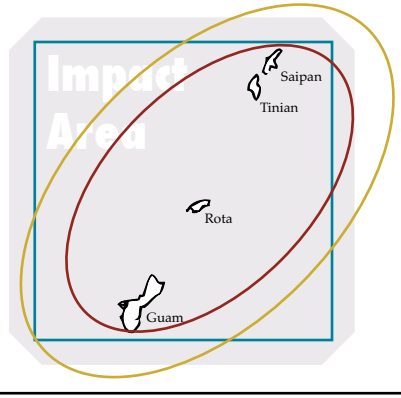
The results of these comparative experiments revealed that of the eight random plants selected from each treatment for damage assessment, larval damage (holes) caused by cabbage looper and cutworm was found to be most serious among control (no spray) plants, averaging more than 180 holes per plant. The occurrence of larval holes was lowest in the Aza-Direct®/DIPEL® treated plants.

Cabbage plants were harvested one week after the last application of the various treatment sprays. The Aza-Direct®/DIPEL® treated plants had the greatest yield weighing in at 48 kg/plot. The malathion treated plants placed second at 46 kg/plot.

Field experiments will continue with the evaluation of IPM versus locally adapted insecticidal treatments to be repeated at the Yigo location. With the additional data, cost benefit analysis of the IPM plots and other treatments will be calculated.

The results of Dr. Reddy's research will be shared with farmers in the Micronesia/Pacific region and practical IPM training will be given to local farmers on demonstration plots at the Agricultural Experiment Station in Yigo.

Keeping farmers prosperous and the ecosystems in the region healthy are two important aspects of the work of WPTRC scientists like Dr. Reddy and his team.




This cabbage, grown in a control field without treatment, shows signs of cutworm larvae damage.

WPTRC Research Assistant Zerlene Cruz and Research Technician Frankie Matanane plant cabbage seedlings for the trials.

Thomas Marler prepares a female fadang tree for installation of an insect trap on Rota.

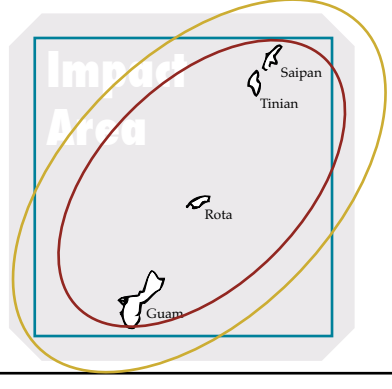
# Pollination: Scent of a Cycad

Respected botanist Benjamin C. Stone reported in 1970 that virtually no research had been accomplished on the ecology and physiology of Guam's native plants. Forty years have lapsed and the paucity of research on this subject remains. The WPTRC is actively addressing this void by studying Guam's only gymnosperm, *Cycas micronesica*. The unique features of this plant are numerous and diverse, and it is a fitting recipient of the research focus.

WPTRC professor Thomas Marler and Adjunct Faculty Irene Terry have been examining the chemistry and pollination biology of the *fadang*, as it is called on Guam. Their work was initially funded by the National Science Foundation, and the results were recently published in the journal *Micronesica*. "The first step toward building an understanding of how a plant species interrelates with insect pollination is to determine the insects that visit the plant's reproductive structures," said Marler. The team used a variety of trapping methods and endless hours of direct observations to generate a list of more than a dozen types of insects that were attracted to *fadang* reproductive structures.

"We then looked more closely at several factors to generate predictions about which insects likely play a direct role in pollination," said Terry. "A characteristic of *fadang* that helps is that each plant is either male or female." This plant trait allowed the researchers to look at the insect species that were highly attracted to both male and female plants. When these data were combined with the actual number of trapped insects sorted by species, an inconspicuous moth emerged as the most likely pollinator. Direct scrutiny of these tiny moth insects trapped on female *fadang* plants revealed *fadang* pollen grains adhering to the insect bodies.

Marler and Terry have recently received a United States Department of Agriculture grant to further study how the insect and plant behaviors interplay. "We are excited to learn more about this pollination system, as we are the first to implicate a moth species as a pollinator of any cycad worldwide," said Terry.




Dr. Irene Terry (left) and WPTRC Research Technician Frankie Matanane prepare a trap for studying insect pollination of a female *fadang* tree.

Dr. Terry collects aromatic chemicals emitted from a male fadang tree to determine how the plant attracts insect pollinators.

# The Coconut Rhinoceros Beetle Update

The coconut rhinoceros beetle (CRB) invasion, first detected in 2007, has been checked by the determined efforts of UOG scientists, Guam Department of Agriculture and the United States Department of Agriculture. “We’ve stopped the expected population explosion,” says UOG entomologist Aubrey Moore, “due to the rapid response of the government of Guam and the federal government. The infestation has been contained to the northwest coast of the island, but we have yet to see a decrease in the population.”

“Research has shown the bucket traps baited with pheromone lures are not as effective as we had hoped in curtailing the beetles,” says Roland Quituqua, director of the Guam Coconut Rhinoceros Beetle Eradication Project. As head rhino hunter he is in the field

daily with his eradication team.

New tactics are being employed to drive the population to zero. Canine skills are being utilized to sniff out rhino breeding sites. Four dogs were recruited from Georgia and Guam Customs and Quarantine officers were dispatched to bring the dogs to Guam. Handlers were hired and training for both the dogs and their handlers began in July. The dogs were deployed in November and they are helping the eradication team to detect breeding sites so that they can be destroyed.

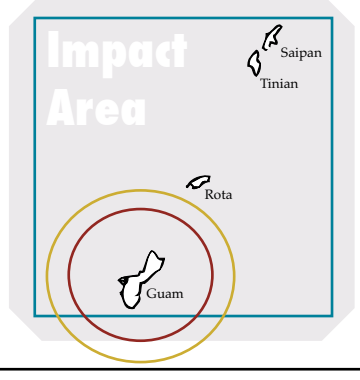
A new wood chipper, especially designed for fibrous wood like that of coconut trees, has arrived on island and will be used for grinding up old coconut logs and debris that are the preferred breeding places for the beetles. This addition may result in the development of large scale composting of green waste on Guam.

With $25,000 grant from USDA APHIS, a New Zealand scientist, Trevor Jackson, was contacted to obtain and release a bio-control organism into the rhino beetle, *Oryctes rhinoceros*, population. Produced in a New Zealand laboratory, this naturally occurring bio-control virus, orycto virus, is very host-specific, targeting only rhino beetles. It is dispersed using autodissemination: adult beetles are fed a solution of the virus, become infected, and then they are released to infect the resident population. 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.

Sadanand Lal, formerly an entomologist with the Secretariat of the Pacific Community in Fiji, was on Guam in October for the initial release of the virus, which will have an adverse effect on the stomach walls of the beetles, resulting in death.

This latest tactic in the CRB saga is true international collaboration at its best. The virus is naturally occurring and was originally discovered in Malaysia, cultured in New Zealand laboratories and released on Guam.

WPTRC scientists in collaboration with government entities and colleagues worldwide are making a difference for Guam and the region.




Entomologist Dr. Aubrey Moore admires the design of a male rhinoceros beetle as it sits on his finger.

Dr. Moore administers a bio-control virus to a rhino beetle.

The beetles will be released to infect other CRB with this host-specific virus.

Local farmer Bernard Watson (left) and Dr. Mersha collaborate on finding clues to unravel the mystery of ironwood tree decline.

# Scientists Network to Save the Gago

University of Guam scientists are networking with scientists from around the world to identify the cause or causes of the mysterious deaths of hundreds of ironwood trees, known in Chamorro as *Gago*, on the island. Indigenous to the region and traditionally pest and disease free, the ironwood tree, *Casuarina equisetifolia* ssp. *equisetifolia* is one of the dominant forest and agroforest species in the Pacific. The tree plays an important role in island life including providing firewood for barbeques and windbreaks for crops. Due to its ability to withstand salt spray and poor soil, it is ideal for reducing soil erosion on hills and beaches, providing protection from the trade winds and typhoons, land reclamation, and island beautification.

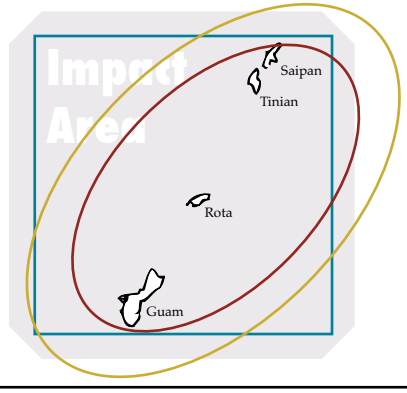
Local farmer Bernard Watson first brought this perplexing problem to the attention of UOG scientists in 2003. He observed many of his young ironwood trees, planted as windbreaks for his crops, dying. Since that time, the condition, labeled by Plant Pathologist Robert Schlub as ironwood tree decline, has been responsible for the death of hundreds of ironwood trees throughout Guam's parks, golf courses, farms, and residential areas.

Funding from a Western Region Sustainable Agriculture Research and Education grant, and a Western Regional Integrated Pest Management Center Special Issues grant was used to bring 6 off-island scientists to Guam for an Ironwood Tree Decline Conference: Dr. Khongsak Pinyopusarerk (Australia), Dr. Pauline Spaine (Georgia), Dr. Jason Smith (Florida), Dr. Dillip Nandwani (Saipan), Mr. Alejandro Badilles (Rota) and Dr. Scot Nelson (Hawaii).

As a result of the Conference and subsequent research efforts by Drs. Robert Schlub and Zelalem Mersha, it is believed that Guam's decline of ironwood trees is most likely due to complex biotic and abiotic factors. Possible biotic candidates include fungi of the genera *Ganoderma*, *Pestalotia,* *Botryosphaeria* and *Fusarium* and several yet unidentified fungi and bacteria. Insects that may play a role in the decline are termites and a newly discovered Eulophid wasp, which forms galls in branchlet tips.

Among the contributing abiotic factors are the two major typhoons in 2002 and the intervening severe drought, as well as proximity to urban development. "Decline prevalence is highest on plantations such as wind breaks, beaches, parks, and golf courses as compared to natural forest stands," says Mersha.

Through partnerships with local farmers and collaboration with colleagues around the world, WPTRC scientists are in search of solutions to this ecological mystery.





Ironwood trees on UOG campus show symptoms of ironwood tree decline.


At his farm in Yigo, Bernard Watson discusses the decline of his trees with attendees of the Ironwood Tree Decline Conference.

# Ecology of Bird Loss

The immediate effects of the introduction of the brown tree snake to Guam have been well documented- the greatest direct ecological impact was the decimation of Guam's native forest bird community. But the indirect effects of this snake are much less well studied. How has the loss of birds affected the island's forests and agriculture? What changes can we expect to see in the future?

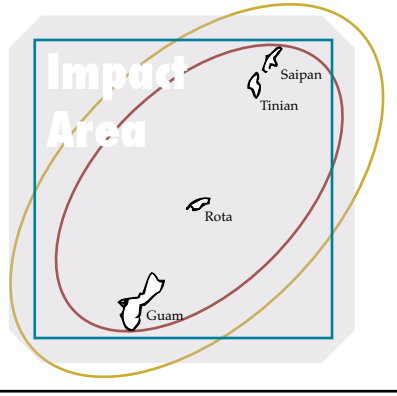
The Ecology of Bird Loss (EBL) research team is working to find out. EBL is a collaboration between University of Guam and University of Washington. The project, now in its second year of funding from the National Science Foundation and the US Department of Agriculture, is headed by Haldre Rogers, a doctoral student and former US Geological Society Brown Treesnake Project employee, under the direction of Ross Miller from the University of Guam, and Josh Tewksbury and Janneke Hille Ris Lambers from the University of Washington. EBL is conducting

research in the native limestone forests and on agricultural land to compare plant and insect communities on Guam to those on Rota, Saipan and Tinian, which still have intact native bird populations. "The unfortunate situation on Guam provides a rare opportunity to determine the extent to which birds influence the structure of tropical forests worldwide," says Rogers.

Results from EBL's seed dispersal experiments conducted from 2008-2009 have shown that all fleshy-fruited seeds from three native forest tree species on Guam fall directly underneath the parent tree since there are no birds to eat the seeds and move them through the forest. On Saipan, Tinian and Rota, however, seeds from the same species are moved many meters away from the parent trees by birds. These results suggest that birds such as the Marianas Fruit Dove and the White-throated Ground Dove are very important for seed dispersal in these forests.

Changes in seed dispersal are just one of the possible effects of bird loss on Guam. The EBL team is preparing a new suite of field experiments for the coming year to examine other effects of bird loss. In one project, they will examine the impact of the loss of insectivorous birds like the Rufous Fantail (*Naabak*) and the Bridled White Eye (*Nosa'*) on the food web in the limestone forests. EBL will also expand its research to the agricultural aspects of bird loss in a project led by Rogers and UOG graduate, Maia Raymundo. By collaborating with local farmers on Guam and the Northern Marianas, Rogers and Raymundo will assess the role that native birds play controlling insect pests on locally grown crops. These studies will offer insight on the economic impacts of bird loss to local agriculture.

As the research expands, so does the team. Three former and two current field technicians are recent biology graduates from the University of Guam. "It's important to me to be able to expand on my scientific career while giving back to the community where I was raised," says technician Julie Anne Duay. University of Guam graduate student and Guam native, Ann Marie Gawel is also collaborating with the EBL project. Ann's research focuses on the role of ungulates in native forests on Guam. Her work adds an important component to understanding the big picture of forest community structure in the Marianas. The EBL project is truly a collaborative effort invested in understanding the long term ecological and economic effects of the introduction of the brown tree snake on Guam.





The voracious brown tree snake found a banquet on Guam.


An *Ifit* seedling sprouts on the forest floor.


Rota, Tinian and Saipan still have intact bird populations unlike Guam's silent forests.

# PCR Testing of Plants for Diseases

One of the most sensitive techniques known for detecting diseases in plants and animals is called PCR, which stands for polymerase chain reaction. Before plants are propagated in a large scale for distribution to the public, they should be tested to make sure they are disease-free. Otherwise, buyers may be getting plants that are already sick with one or several diseases.

At UOG's Plant Pathology Lab, a PCR technique has been developed to test coconut plants for a disease known as Tinangaja. This technique is based on molecular methods, extracting nucleic acids from coconut leaf samples and then using these extracts in a PCR reaction. If the sample came from a diseased tree, the results of the test would be positive, even in the case of an early infection in which symptoms are not yet visible.

Tinangaja is a very destructive disease of coconuts, found only on the island of Guam. It is spread by contact, that is, if you use a cutting tool like a machete on an infected tree and then use the same tool on a healthy tree, you may spread the disease. The disease may also spread by pollen; flowers from infected trees may produce infected pollen, which in turn may infect other coconut trees.

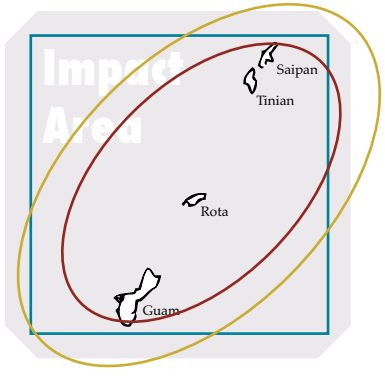
Another PCR technique developed at the Plant Pathology Lab is aimed at a disease of taro, caused by the Taro Bacilliform Virus (TaBV). Taro diseases are easily spread because taro is propagated by corms; taking corms or suckers from an infected taro plant will spread the disease. Mealybugs can also carry this virus around, and it also spreads by pollen and seed, although taro rarely forms seed in our climate. Now our taro can be screened for TaBV.

# Two Orchid Viruses Found in Imported and Local Plants

Virus tests carried out during 2008 at UOG's Plant Pathology Lab revealed that imported orchids from Thailand, the Philippines and Taiwan were often infected with either Cymbidium Mosaic Virus, known as CyMV, or Odontoglossum Ringspot Virus, also called ORSV. This led to the rejection of various orchid shipments by quarantine officials until a survey of local nurseries and orchid collections showed that the same two viruses, CyMV and ORSV, are already present on our island.

Virus infections may cause orchid plants to grow much more slowly than healthy ones, and infected plants also produce flowers much less frequently. In addition, flowers may be abnormal in appearance or color; they may be stained, discolored or even deformed. Leaves of orchids may also develop unsightly symptoms when infected by either of these viruses, or both of them at the same time. Once an orchid plant is infected, all plant parts contain the virus and it should not be propagated.

Many orchid collectors spend considerable amounts of money purchasing their plants, and they expect them to be healthy. However, the survey showed that there is no such guarantee, since some plants being imported for sale by nurseries showed no visible symptoms of disease and yet tested positive for either CyMV or ORSV. If you want virus-free orchids, the only way to be sure is to test them. Testing for CyMV and ORSV involves a rather quick procedure and costs about $10 per plant. Interested persons can call the Plant Pathology Lab at UOG for further assistance; the number is 735-2140.




Because orchids grow so slowly, they can be infected with a virus for some time without any visible symptoms.

Once an orchid plant is infected by a virus, it cannot be cured. It should be destroyed immediately to avoid contagion.

Infected plants are also susceptible to other diseases caused by bacteria and fungus.

# Lemon Plus: Kelaguen Safety Project

*Kelaguen* is a popular Chamorro delicacy. Food Scientist Dr. Jian Yang's research on this dish shows that many people on island eat *kelaguen* regularly. Unfortunately, according to reports from the Guam Department of Public Health and Social Services, about 13% of foodborne illness outbreaks are associated with *kelaguen*. A high percentage of these illnesses are the result of eating *kelaguen* prepared at home. In a self-administrated survey (n = 200), 14% of the participants admitted to experiencing diarrhea, vomiting and/or abdominal pain after consuming *kelaguen*. The estimated number of cases of foodborne illness associated with *kelaguen* on Guam exceeds 1,000 cases per year.

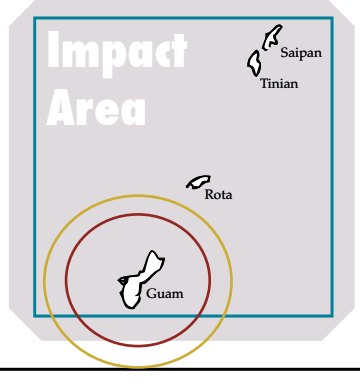
*Kelaguen* is prepared by mixing meat with lemon, onions, hot peppers, and grated coconut. Improper food handling practices, such

as using raw or partially cooked meat and time/temperature abuse, raise the risk of foodborne illness. According to the *kelaguen* survey, many participants believe that lemon juice can eliminate or kill harmful bacteria in *kelaguen*. To avoid time/temperature abuse at parties and fiestas, *kelaguen* can be acidified with lemon to a pH of 4.2, alleviating the need for temperature and time control for safety (non-TCS food). However, verification of pathogen survival in beef marinated with lemon and pathogen growth in non-TCS *kelaguen* is needed.

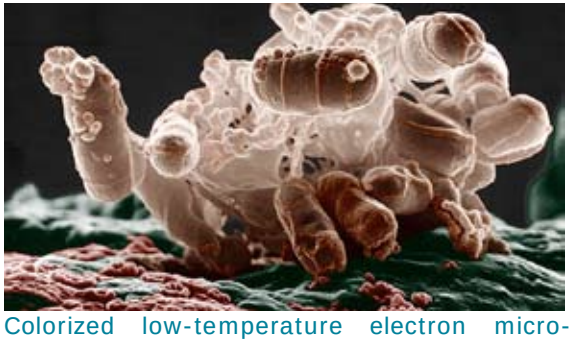
The traditional practice of marinating beef —with lemon juice (15%) at 24°C for 10 hours—only achieved 1-2 log-reductions of *E. coli* O157:H7, *S. enteritidis* and *L. monocytogenes*. To achieve 5 log-reductions of selected pathogens for safety, the minimum lemon concentration required is 6 times greater than the usual practice. Therefore, marinating beef with the amount of lemon juice traditionally used does not effectively kill foodborne pathogens. To reduce the risk of foodborne illness when preparing *kelaguen* the meat should be cooked.

At a temperature of 29°C, with a pH of 4.2, it took 48 hours for *E. coli* O157:H7 and *L. monocytogenes* to start to grow in *kelaguen*. However, *S. enteritidis* showed growth in *kelaguen* with a pH of 4.2 after 10 hours. At 4°C, with a pH of 6.0, *E. coli* O157:H7 and *L. monocytogenes* exhibited growth after 48 hours. Results suggest the maximum storage time for non-TCS *kelaguen* at tropical ambient temperature at parties or fiestas is 10 hours. "The best way to reduce the risk of foodborne illness from *kelaguen* is to control for pH and time or temperature," says Dr. Yang.

The *kelaguen* safety project was supported by the USDA, National Integrated Food Safety Initiative (NIFSI) program. The research results and extension workshops, video and brochures about safe *kelaguen* preparation have been delivered to consumers in the community to help reduce the risk of *kelaguen* foodborne illness.




Contamination of kelaguen from unclean cutting boards is one cause of foodborne illness.



Colorized low-temperature electron micrograph of a cluster of *E. coli* bacteria courtesy of USDA.

Food science experts recommend using cooked meat or fish when preparing kelaguen.

A close-up of *Bidens alba* yellow disc florets, a ubiquitous plant found at all survey sites around the island.

# Guam's Top 20 Invasive Plants

With a grant from USDA Cooperative Lands Forest Health Management – Invasive Plants, Dr. G.V. P. Reddy and his research team conducted a survey of invasive plants on the island. They identified twenty of the most serious invasive plants in Guam, estimating the total areas of infestation and projecting the rate and direction of spread.

For the survey, Dr. Reddy chose twenty locations representing the cardinal directions with varying habitats such as forested areas, residential areas, roadsides, vacant lots and agricultural areas within selected villages. Using a line intercept transect method, commonly used in the field for ecology work, Reddy and his team traveled the length and breadth of Guam placing a 1 meter square grid on the ground then identifying and counting the total number of invasive plants that fell within the transect.

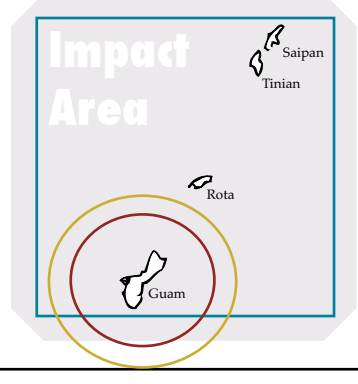
Of the top twenty, *Bidens alba* was the most prolific found at all of the survey sites, occurring in large numbers in agricultural areas, vacant lots and residential areas. According to *Color Atlas of Common Weeds of Guam*, a UOG publication, this plant is native to tropical America and was first recorded in the Pacific Islands of Hawaii in 1958. Based on percent occurrence, *Bidens alba* covers an estimated 49,837 acres.

The second most widespread weed, *Panicum maximum* was found predominantly along roadsides. A native of Africa, the common name is Guinea grass, estimated coverage of this plant on Guam is approximately 14,000 acres.

"Besides producing a list of the twenty most invasive plants, we are putting the finishing touches on a poster depicting the top 20 plants with a description of best control or eradication methods," says Dr. Reddy.

Dr. Reddy is the co-editor and co-author of the first book particularly dealing with biological control and sustainability of tropical weeds, *Biological Control of Tropical Weeds using Arthropods,* published in March 2009 by the Cambridge University Press.

*Color Atlas of Common Weeds of Guam* is available on compact disk through the College of Natural & Applied Sciences. To purchase a copy contact Doris Camacho at 735-2100.




Three of Guam's top 20 invasive weeds: *Bidens alba* (white) *Stachytarpheta jamaicensis* (purple), *Passiflora foetida* (yellow).

*Paspalum paniculatum* is a clumping grass with tiny purple to pink flowers.

Highly invasive *Chromolaena odorata* has fragrant flowers.

# WPTRC 2009 Impact Report

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Excellence in research in support of the land grant mission of discovery, learning and engagement. We excel in the areas of tropical agriculture, environmental and life sciences.

WPTRC Mission Statement

The most beautiful and deepest experience a man can have is the sense of the mysterious. It is the underlying principle of religion as well as all serious endeavors in art and science.

- Albert Einstein, The World As I See It (1949)


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*Special thanks to Herman Crisostomo for making shrimp, dogs and rhino beetles look so beautiful.*



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