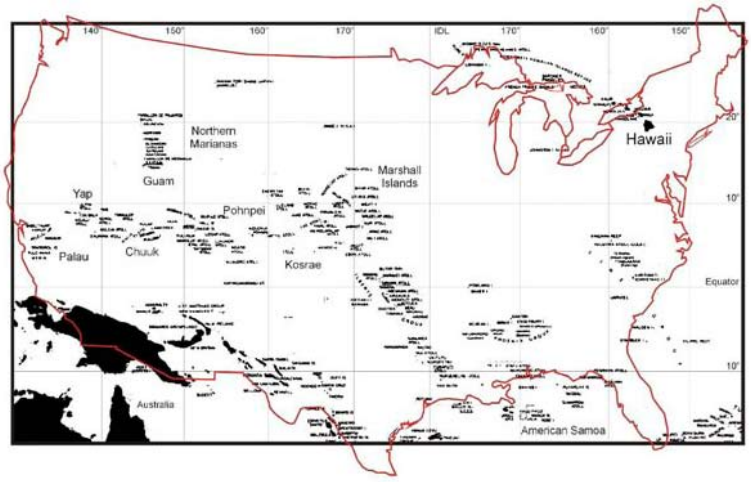
PACIFIC ISLANDS
APRIL 2009

Forest Health *highlights*

Forest Resource Summary

The U.S.-affiliated Islands of the western Pacific cover an area larger than the continental United States, with a total land mass of only 965 square miles (excluding Hawaii). The area includes the Territories of American Samoa and Guam, the states of Chuuk, Kosrae, Pohnpei, and Yap in the Federated States of Micronesia (FSM), the Republics of Palau and the Marshall Islands, and the Commonwealth of the Northern Mariana Islands (CNMI). Approximately 325,000 acres are forested.



Map: Tom Cole, USFS

Forests in the Pacific are locally and globally important. Pacific Islands support a diversity of forest types including coastal strand, mangrove forest, lowland tropical rain forest, and, on the higher islands, montane rain forest and cloud forest. Species diversity is high and many species are endemic to the region or single islands and globally threatened. Forests in the Pacific are host to a variety of pests and pathogens and subject to natural and human-caused disturbances which adversely affect forest health. Agroforests are areas of mixed tree and traditional cropping systems managed to provide food, fiber and medicine, and are common throughout the Pacific. Each Pacific island developed its own complex agroforestry system(s) and these, in turn have been modified by modern ideas and techniques. Integral to island life, these systems fall prey to both forestry and agriculture pests.

Forest health issues vary widely among islands, but due to the prevalence of travel and trade to Island states many pests are widespread throughout the Pacific. Large scale or widespread disturbances can result in undesirable changes in forest structure, composition, and function, including altering of native forest dynamics, facilitating the spread of invasive species, soil erosion, and siltation in streams and on coral reefs. This report highlights forest health issues in the US-affiliated Pacific Islands in 2008 and their effects on island cultures and livelihoods. It is not an exhaustive review of all forest health issues nor an in-depth analysis of any particular issue.

Agroforestry planting, Palau
Photo: Anne Marie LaRosa, USFS

Forest health conditions have been monitored on private, community and government-owned lands throughout the US-affiliated Pacific since 2002. Attention has focused on survey and control of invasive plants, although insect outbreaks are becoming more frequent and problematic and are also monitored. Ground and/or road based surveys are most common. Forest Inventory and Analysis (FIA) plots with forest health indicators have been established on all islands. Monitoring forest health is challenging, expensive and time consuming on remote Pacific islands. Rugged terrain, dense forest cover, poor quality roads, limited access to aircraft, and the sheer distances between widely dispersed islands present substantial logistic hurdles. Varied and complex land ownership patterns present additional challenges.

Changes in Forest Cover Over Time

Forest Health Protection maps basic land cover types using high resolution remotely sensed data in cooperation with the Pacific Northwest Research Station, FIA. These land cover maps provide a baseline of forest cover and, over time, a means for detecting the magnitude of change in overall cover and forest type conversion. Currently, land cover maps have been completed for American Samoa, Guam, Palau, CNMI, Marshall Islands and the Federated States of Micronesia. Vegetation data are available from the Forest Health Protection Web Site at: http://www.fs.fed.us/r5/spf/fhp/fhm/landcover/islands/index.shtml. Trend data are not yet available from FIA plots or vegetation mapping efforts.

Most land on tropical Pacific high islands without distinct dry seasons or specialized soil types was almost certainly forested prior to human settlement. Clearing land for agriculture and other uses, followed by abandonment and later reforestation, has gone on for for several thousand years. Current levels of forest cover vary widely. Islands with steep rugged terrain or drought prone areas that are less desirable for agriculture have seen less historical forest loss. Guam, the largest island in Micronesia, with a population of about 175,000 and a land area of 541 km^2, is highly developed and has lost more than 50% of its native forest to development and past land use. Forest conversion is likely to continue as the population of Guam is expected to increase substantially over the next 10 years with the scheduled buildup of U.S. forces and facilities on Guam.

The island of Pohnpei State in the Federated States of Micronesia, has a population of 35,000 and a land area of 128 square miles (about 1/10 the size of our smallest state, Rhode Island). Increasing pressure to plant high value crops like sakau, or kava,(*Piper methysticum*) has resulted in extensive forest clearing in critical watershed areas. In American Samoa, population pressure and changing land use is resulting in the conversion of native forests to agroforests and from agroforests to residential use. Natural disturbance also may significantly affect forest cover and composition on Pacific islands. Typhoons are a regular feature throughout most of the Pacific. No sizable typhoons struck the US-affiliated Pacific islands this year.

Clearing native forest to plant sakau - Pohnpei, FSM.
Photo: Rich MacKenzie, USFS

Invasive Species

Increasingly, invasive species are affecting the culture and livelihood of people living in the US affiliated islands of the Pacific. Most of the forest health concerns on Pacific Islands are due to introduced species. In the age of globalization, with the movement of people and goods throughout the world, the Pacific Islands sit in a vulnerable position between the economies of Asia and North America. Guam sits at the center of this trade pathway in the northern Pacific and serves as a stepping off point for the remainder of Micronesia. Many pests are first detected on Guam and later appear elsewhere in Micronesia. Guam has suffered greatly from the accidental introduction of the brown tree snake in the late 1940's, via off-island cargo. This single introduction is credited with the permanent loss of nine of Guam's original 11 native bird species. The cost to Guam of lost productivity and direct damages is estimated at one to four million dollars annually. Guam and other Pacific islands spend over a million dollars each year to control the snake and prevent its movement between islands.

While the Pacific Islands have traditionally received pests from North America via Guam, now the potential for the spread of invasive species from Asia to Guam, and then to the rest of Micronesia and Hawaii, is significant with increasing global trade and the sizeable increase in military and civilian cargo associated with military expansion on Guam. From Hawaii, spread of certain pests to the U.S. mainland and American Samoa is likely to occur in the future. The considerable influx of new species of plants, insects, and pathogens that may be expected with this increased movement of people and goods will likely have a significant effect on the culture and livelihood of Pacific peoples. The magnitude will depend, in part, upon the availability of adequate prevention, quarantine, and early detection programs in the region.

Invasive plants remain one of the most serious threats to forest health throughout the Pacific. The Pacific islands list more than 300 naturalized plant species that may be causing harm. Invasive weeds follow closely in openings created through natural and

human–caused forest disturbance. A much smaller number of plants are able to spread into and through intact forests. Pacific islanders have recognized the serious threat and the need for action by organizing into island, national and regional invasive species groups, most of which have strategic plans in place. Priority species are controlled through mechanical, chemical, and biological methods. Weeds of widespread importance in the western Pacific that are currently under control actions include cogon grass (*Imperata cylindrica*), mile-a-minute vine (*Mikania micrantha*), Siam weed (*Chromolaena odorata*), Koster's curse (*Clidemia hirta*), giant sensitive plant (*Mimosa invisa*), root beer plant (*Piper auritum*) and Molucca albizia (*Falcataria moluccana*).

Early detection and eradication of weeds includes such target species as African tulip (*Spathodea campanulata*) in Palau and Panama rubber tree (*Castilla elastica*) in American Samoa. For certain plants, biological control agents have been introduced and are spreading. These include the release of natural enemies to control ivy gourd, giant sensitive plant, and Siam weed on Guam and Saipan and the latter two on Palau.

The Interaction Between Disturbance and Invasive Plants in Tropical Forests

Over 75% of Palau's 188 square miles (42,000 ha) is still forested, but development associated with a growing economy and population and the construction of a circum-island road on Babeldaob are encroaching onto forested lands. The new Compact Road has opened up secondary tropical forest land on the largest island, Babeldaob. Disturbance from construction associated with the Compact Road has facilitated the spread and encroachment of *Merremia peltata*, or kebeas, a native large-leaved vine, into adjacent forest. The construction and use of the road has also facilitated the spread of other introduced weeds. Using Forest Health Protection and Urban and Community Forestry funding, Palau is working with communities on Babeldaob, using regular volunteer cleanups along with limited government assistance, to control this plant along roadsides. Merremia is also a serious pest on American Samoa and several other Pacific Islands.

Merremia overtopping trees compact road Palau.
Photo: Anne Marie LaRosa, USFS

Panama Rubber Tree *(Castilla elastica).*
Photo: Tavita Togia, NPAS

Panama Rubber Tree (*Castilla elastica*)

- Native to southern Mexico and Central America to Colombia and perhaps southward.
- One of several sources of latex, it was used to make a ball for Aztec ceremonial games and is currently used in cricket balls.
- Seeds spread by birds.
- The National Park of American Samoa estimates 1030 acres of native forest infested in American Samoa, where it is a target for control and possible eradication.

Mile-a-minute Weed (*Mikania micrantha*)

- Native to South and Central America; invasive throughout the Western Pacific.
- Smothering vine spreads easily by seed or vegetatively.
- Used as cattle feed and cover crop in some areas.
- Palau has started a national mapping effort to determine the extent of Mikania and will refine their existing strategy with this new information.
- Yap and Palau have changed from an eradication to a control strategy.

Strawberry Guava (*Psidium cattleianum*)

- Native from southern Mexico to northern South America.
- Detected in American Samoa in 2005. Covers less than 10 acres.
- Seeds are probably spread by birds and bats.
- Has formed dense, monospecific stands over large areas in Hawaii.
- Targeted for eradication in American Samoa. Known populations have been treated but the species suckers profusely and re-sprouting is occurring.

Psidium cattleianum

INVENTORY AND MONTORING: PIER Survey of Invasive Plants in Palau

In March of 2008, the US Forest Service, National Tropical Botanical Garden, the Palau Bureau of Agriculture and the Belau National Museum conducted a comprehensive survey of the weed flora of the islands of Palau, with an emphasis on invasive plant species of environmental concern. Palau was concerned with what new species may have come in with the development of the Compact Road, increased travel and tourism, and with the passage of time since the previous survey in 2002. The survey focused on probable high detection areas: roads, beach landing sites, and gardens. The report highlighted species observed in the survey as spreading or potentially invasive, including rattan palm (*Calamus* sp.), coral bean (*Adanathera pavonina*), prickly solanum (*Solanum torvum*), paperbark (*Melaleuca quinquenervia*), liberal (*Timonius timon*), albizia (*Falcataria moluccana*), prickly sesban (*Sesbania cannabina*), and giant reed (*Arundo donax*) among others. Several resorts surveyed had large numbers of ornamental or landscape species not found elsewhere, although not all of these are likely to be invasive.

Liberale (*Timonius timon*)
Photo: Anne Marie LaRosa, USFS

Liberal, *Timonius timon*

- Native to Timor, Moluccas, northern Australia, New Guinea, and Solomon Islands.
- Naturalized in Palau on Angaur and Peleliu; spreading, with individual trees and small stands on several of the Rock Islands.
- Recent survey (2008) found that it has spread from Peleliu island to gardens in Babeldaub by people nostalgic for their home island and its plants.
- Significant risk that *T. timon* may hybridize with endemic Timonius species growing nearby.

Rattan palm, *Calamus sp.*

- Rattans are native to southern India and Sri Lanka.
- Present in limited areas in Palau; mapping effort in progress; evaluating for possible eradication.
- Current plants probably the remnants of an old rattan plantation in Aimeliik State, Babeldaob.
- Rattan's spine-armed stems and pairs of hooked flagellae on leaves make travel where it is present difficult and painful.
- Eradication efforts are ongoing in Samoa.

Rattan Palm, *Calamus sp*. Photo: Anne Marie LaRosa, USFS

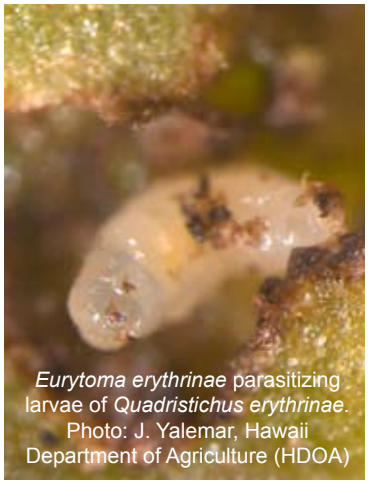
Paperbark, *Melaleuca quinquenervia*

- Native to eastern Australia, New Guinea and New Caledonia.
- Introduced to Palau, Yap, Pohnpei, Hawaii, Fiji, Tahiti and New Caledonia.
- Weed risk assessment of 15, "high risk".
- Produces large quantities of wind-dispersed seeds and reproduces profusely after fire or other disturbance.
- The tree has been planted on Babeldaub in Palau and is reproducing; more prolific reproduction can be expected if a fire occurs.

Paperbark, *Melaleuca quinquenervia*
Photo: Anne Marie LaRosa, USFS

Erythrina Gall Wasp –Threats to native forests, birds and fruit bats

The Erythrina gall wasp (EGW), *Quadristichus erythrinae*, is currently found in the Pacific in American Samoa and its neighbor Samoa, Guam, and the Commonwealth of the Northern Mariana Islands, where populations continue to affect *Erythrina* species (coral trees). A major source of spread has likely been by accidental movement in major transportation systems between islands; wasps have been documented first near major ports and airports on several of the Hawaiian Islands. In American Samoa, infested trees were observed early on near ports and transport of infested leaves by boat travel may be responsible, in part, for the spread of this pest throughout the islands. In the Northern Mariana Island chain, the wasp has reached Guam, Saipan and Tinian but has not been found on Rota, which is located between Guam and Tinian. Air and boat travel is relatively infrequent between Rota and the other islands which may explain the current distribution pattern.



Eurytoma erythrinae parasitizing larvae of *Quadristichus erythrinae*.
Photo: J. Yalemar, Hawaii Department of Agriculture (HDOA)

While significant infestations of the wasp have been observed and *Erythrina* trees continue to be weakened by the repeated deformation of all new growth, little mortality has been reported outside of Hawaii. The popular cultivar *Erythrina variegata* cv. 'Tropic Coral', propagated only from cuttings and used widely as a living fence and windbreak, is the most susceptible species. Mortality of this cultivar has been high in Hawaii, where significant die-off of Tropic Coral has occurred. This tree is less affected elsewhere in the Pacific.

In American Samoa, where monitoring of the EGW is ongoing, the introduced ornamental *Erythrina variegata* var. *variegata*, an attractive variety with variegated leaves, generally shows less damage. Only minor damage has been noted to the introduced agroforestry species, *E. subumbrans*. Oviposition and initial gall formation, but no adult emergence, have been observed on *E. fusca*, a native wetland species of limited distribution in American Samoa. In the Marianas islands, including Guam, where there are no native *Erythrina*, injury by EGW to introduced

trees has been similar. Ornamental coral trees are also host to the larval stage of the fruit piercing moth (*Eudocima fullonia*), a highly destructive agricultural pest, so the infestation has been beneficial to farmers.

Control of EGW currently rests with a previously undescribed parasitic wasp from Africa, *Eurytoma erythrinae*. The Hawaii Department of Agriculture released this agent in 2008 and preliminary releases in Hawaii are promising. It is hoped that this biocontrol agent will soon be available to other Pacific Islands

Asian Cycad Scale: recent interception on Palau

In July 2008, the Asian cycad scale was intercepted in Palau on an ornamental cycad in an urban area on the island of Koror. An intial survey found three infested plants and chemical and mechanical control was initiated on these plants. A subsequent survey of the island of Koror was completed in December of 2008. The survey found CAS on 24 plants in 11 locations. All of the infested plants to date are (introduced) ornamental cycads. Additional surveys of other islands are planned for 2009, as is the introduction of the biological control agent, *Rhyzobius lophanthae*, from Guam.

Leaf from seedling of *Cycas micronesica* heavily infested with Asian cycad scale.
Photo: Dr. Thomas Marler, University of Guam

Asian Cycad Scale on Guam and Rota:

Continued threats from the Asian cycad scale and the Cycad Blue Butterfly on fading, a keystone understory forest species

Asian cycad scale (*Aulacaspis yasumatsui*), now occurs throughout Guam and continues to be a serious problem for the health of Guam's native forests. First detected in 2003 on the ornamental king sago (*Cycas revoluta*) in Tumon Bay, it is a pest of both native and ornamental cycads. *Cycas micronesica*, or fading, is a dominant mid-to-upper-canopy forest component in the island's native limestone forests and riparian ravine habitats. If the current rate of cycad mortality continues, native cycads could be threatened with extirpation within a decade, according to researchers in Guam. *C. micronesica* was placed on the IUCN Red List of Threatened species in 2006. Fadang is also an important plant in Chamorro culture. The unprocessed seeds of fadang are considered poisonous, but the starchy pith can be made into flour, and historically was a part of the Chamorro diet and on occasion used as a famine food.

Initial mortality from the scale was very high. In 2004 a coccinellid beetle (*Rhyzobius lophanthae*) was introduced and has established on cycads. Although initial dispersal of the biocontrol agent was poor, it has improved. Where beetles are abundant, relatively good control of the scale has subsequently been achieved on taller, mature cycads. High seedling mortality rates continue to occur as beetles apparently do not feed near the ground or do not infest small, immature plants.

Chilades pandava

Ecosystem level interactions are complex and the introduction of new pests to native ecosystems frequently has unknown and cascading consequences. Continued defoliation by the larvae of the cycad blue butterfly (*Chilades pandava*), first detected on Guam in July of 2005, greatly reduces leaf area and the cycads' ability to recover from defoliation caused by the Asian cycad scale. Very limited parasitism (about 1%) is occurring on the eggs of the cycad blue butterfly by a native wasp (*Trichogrammatoidia guamensis*). *C. pandava* larvae are attended by at least five non-native species of ants. The ants prevent attacks from predators and parasites in exchange for a reward of a sweet liquid produced by special glands on the caterpillars' backs. The Asian cycad scale and the caterpillar (*C. pandava*) are joined by a number of other pests of cycads, both native and introduced. Secondary insect pests, including a native cerambycid stem borer (*Dihammis marianarum*) and a bark beetle, are heavily impacting stressed cycads, and herbivory by introduced ungulates is also occurring. Feral pigs, which normally feed on the starchy stems of fallen cycads are now pushing over cycads to get at the beetles within the stems.

Spread of the scale has been slower on Rota (Commonwealth of the Northern Mariana Islands), where it was first detected on *Cycas micronesica* in March of 2007. The infestation is still limited to an area of about one acre. This is likely due, in part, to the lower number of cycads on Rota and the rapid release of the *R. lophanthae* beetles from Guam by Alejandro Badilles, Northern Marianas College in May of 2007. A subsequent survey in July of 2007 by Dr. Joaquin Tenorio revealed that the beetle had established and was providing some control of the scale, although limited cycad mortality was occurring. Scales are apparently confined to within about 100 feet radius from the heaviest focal point of the infestation. Monitoring continues. The cycad blue butterfly was first detected on Rota in 2006. The scale remains a threat to Saipan and Yap.

Recent taxonomic work on Pacific cycads suggests that native cycads on Palau and Yap may not be *Cycas micronesia* making a solution to the problem on Guam even more critical. The combined effects of these pests are taking a heavy toll on Guam's cycads. In the last four years, monitoring of cycad population densities has shown a 10-fold reduction of cycads from their original average of 7400 plants per acre (3000/ha) and many of the remaining live trees are in poor health. The current strategy on Guam includes selection and maintenance of genetic stock on uninfested islands, maintenance of genetic

stock in-situ in selected areas through periodic chemical control of the scale, and continued release of biological control agents. Additional biological agents are needed, particularly to control scales on cycad seedlings. If the cycad is to continue be a major understory component of Guam's forests and an important part of Chamorro culture, a better understanding is needed of the complex interactions of the suite of pests currently impacting cycads.

Casuarina equisetifolia (gago or ironwood), showing extensive dieback to crown. Photo: Zelalem Mersha, University of Guam

Casuarina Dieback on Guam

Casuarina equisetifolia (gago or ironwood) is a hardy, pioneer, salt-resistant tree that occurs on both limestone and volcanic soils. Its ability to fix free nitrogen allows it to thrive on coastal sands where few other plants can survive. Native to the Marianas, including Guam, ironwood is widely used and propagated for windbreaks, reforestation and erosion protection programs on southern Guam's volcanic soils. Although normally a hardy species, widespread dieback of ironwood is occurring on Guam. The health and survival rate of ironwood trees on Guam have been declining since a series of severe typhoons during 2002. Chata'an (July, 2002) and Pongsona (December, 2002) caused widespread limb breakage and defoliation. The USFS FIA program estimated that Guam had 116,000 ironwood trees 5 inches in diameter and greater, during a 2002 forest inventory and that trees were generally healthy. Today, tens of thousands of these trees are dying on Guam.

At the international Ironwood Tree Decline Conference held in Guam in January 2009, an international team of scientists concluded that the dieback was most likely due to a complex of biotic and abiotic factors. According to conference participants, possible biotic factors include: fungi of the genera Ganoderma, Pestalotia, Botryosphaeria, and Fusarium and several yet unidentified fungi and bacteria; insects, including termites and a newly discovered gall-forming eulophid wasp. Specimens of the wasp, tentatively identified by John LaSalle of Australia as belonging to the genus Selitrichodes (Eulophidae: Tetrastichinae), were collected at Ritidian Point in January, 2009. Although any causal connection between wasp damage and Casuarina decline is currently undetermined, infested trees have also been found elsewhere on Guam. In some trees almost 100% of branchlet tips show feeding damage and exit holes. In addition to typhoons, abiotic factors include severe drought and proximity to urban development. Many of the dead trees are from plantings in urban areas and parks. The healthiest ironwood trees are located in native stands of the trees on Cocos Island, 1.6 miles off the southern tip of Guam, and at Ritidian Point, a National Wildlife Refuge located on the northern tip of Guam. The wasp and the corresponding damage on Casuarina have recently been found in Palau and on Rota, CNMI.

Galls on Casuarina branchlet tips collected at Polaris Point, Guam in January, 2009. These galls were formed by a recently discovered eulophid wasp. Note exit holes. Photo by Aubrey Moore, University of Guam Cooperative Extension Service.

Undescribed wasp: (genus Selitrichodes, Eulophidae: Tetrastichinae) Photo: A. Moore, University of Guam, Extension

The decline appears to be distributed randomly across island and is also reported from Rota but not Saipan or the Federated States of Micronesia, where it is native, nor Hawaii where it has been introduced and widely planted.

Coconut Rhinoceros Beetle

The coconut rhinoceros beetle (CRB) (*Oryctes rhinoceros* L.) was detected at Tumon Bay on September, 12, 2007. An initial delimiting survey showed that the beetle was present in Tumon Bay (960 ac) and Faifai (15 ac), and indicated that it probably arrived on Guam one to two years previously, possibly as a stowaway in cargo. The beetle is native to much of southeast Asia, including the Philippines, and has been introduced to Palau, American Samoa and Fiji. Past outbreaks of CRB elsewhere in the Pacific have caused widespread damage: nearly 50% of palms in Palau were killed soon after its introduction there in 1942. Although the infestation on Palau has been under control following the introduction of a virus which attacks the beetle, there is currently an increase in the amount of damage noted, particularly on isolated Sonsorol Island, suggesting that the beetle may have developed some resistance to the virus.

The high number of palms in urban settings and significant stands of coconut and beetle nut palms found in Guam's forests are currently threatened by CRB. Habitat for this large scarab beetle is plentiful; larvae live in litter and debris, of which there is an abundance due to the presence of high levels of dead and dying coconut palms left in the wake of recent storms. Adult beetles bore into the crowns of palms to feed on sap, injuring emerging leaves and resulting in a characteristic v-shaped deformation of the fronds. Injury to the growing tip of the palm can result


Coconut rhinoceros beetle feeding injury.
Photo: Ben Quicocho

in death. Moreover, potential vertebrate predators of beetles, including native birds, have been largely eliminated on Guam by the brown tree snake.

An interagency incident command team has been in place since the initial stages of the infestation on Guam with a cooperative eradication program between the USDA (APHIS and the USFS), the Guam Department of Agriculture, and the University of Guam. The initial quarantine area was 5000 acres. Early eradication efforts met with limited success and by October of 2008, the quarantine area had been expanded to over 28,000 acres. Early strategies included sanitation and removal of breeding sites, trapping adults, and prophylactic tree treatments. Pesticide treatments were ineffective in causing significant mortality in adult CRB at field application rates. Sanitation is not effective without a means to detect breeding sites and adult CRB in live trees. Acoustic methods for detection of adult CRB in live trees were also studied but considered beneficial only toward the latter stage of eradication. Traps and lures tested were largely ineffective and were discontinued for eradication purposes. Treatment and disposal of infested or potentially infested material also proved problematic.


Coconut rhinoceros beetle larvae.
Photo: Aubrey Moore

According to a critical needs assessment by project scientists,eradication is still possible if CRB infestations remain in open beach areas and CRB inhabit only primary host (coconut) feeding and breeding material and the number of infestation sites remains limited. The recent discovery of CRB on secondary hosts (fan palms) calls this in to question. In many countries, two diseases are used to kill coconut rhinoceros beetles, one fungal (*Metarhizium anisopliae*) and one viral (*Oryctes sp.*), and these may prove to be an important component in the IPM strategy on Guam. If eradication efforts fail and biocontrol agents are not introduced or are not effective, Guam may expect consequences similar to Palau; mortality of coconut palms on Guam could be as high as 50%. Loss of economically important palm trees in resort areas of Tumon could result in upwards of two and a half million dollars in replacement costs. Additionally, the CRB infestation in Guam poses a significant risk to Hawaii through various pathways, particularly if the population explodes.

The Cuban slug, *Veronicella cubensis*

Cuban slugs are a recent introduction to Rota. Populations have multiplied rapidly and are currently the highest known for this species anywhere in the world. From their initial introduction, likely as a hitchhiker on agricultural or horticultural commodities, the slugs have spread widely throughout the island from urban settings to native forest. Cuban slugs continue to be a major pest on Rota, where agricultural losses have been substantial, and the costs for appropriate corrective measures prohibitive. Many farmers and landowners have already abandoned their fields because of the prevalence of slugs. The increasing presence of slugs will continue to threaten Rota's Agricultural industries and the myriad ecosystem services provided by native forests, including their economic value for ecotourism.

One method currently being examined to slow the spread of slugs is to employ ducks as predators for the slugs. The ducks serve multiple purposes: clearing weeds, fertilizing the ground, providing farmers with eggs, and eating slugs and other pests that they encounter. Ducks do little damage to crops, and have been used in the Far East for centuries to clear slugs and snails from rice and vegetable fields.


Cuban slugs.
Photo: David Robinson

Data Sources

The data sources used for this report include data gathered by island Invasive Species Committees, the Territorial Foresters of the US–affiliated islands (funded in part by Forest Service's Forest Health Programs), the US Forest Service's,Forest Inventory and Analysis (FIA) Program, the US Fish and Wildlife Service, the National Park of American Samoa, Secretariat of the Pacific Community, American Samoa Community College. Special thanks go to Dr. Thomas Marler, Aubrey Moore, and Robert Schlub from the University of Guam. The USDA Forest Service's Forest Health Aerial Survey Program is not currently active in the Islands.

For more information visit:

USDA Forest Service, Institute of Pacific Islands Forestry - http://www.fs.fed.us/psw/ipif/
Hawaiian Ecosystems at Risk project (HEAR) - http://www.hear.org/
USDA Forest Service, Pacific Southwest Region - http://www.fs.fed.us/r5/spf/fhp/

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USDA United States Department of Agriculture