PACIFIC ISLANDS
APRIL 2010

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Forest Health *2009 highlights*

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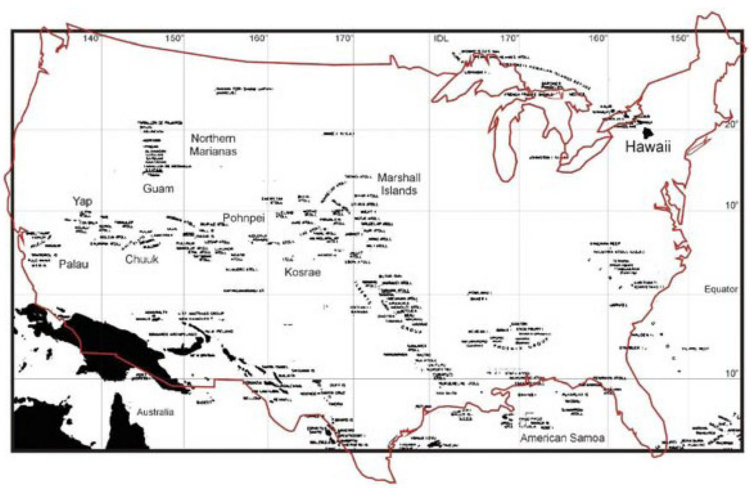
Forest Resource Summary

The US-affiliated Islands of the western Pacific cover an area larger than the continental United States, with a total land mass of 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.

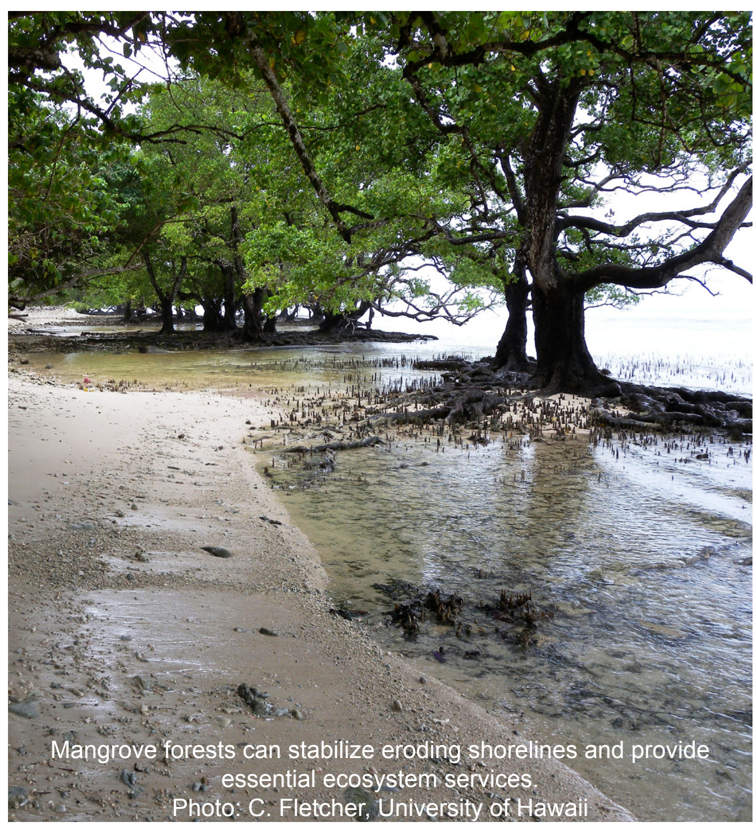


Map: Tom Cole, USFS

Forests in the Pacific are locally and globally important. Pacific Islands support diverse forest types including coastal strand, mangrove forest, lowland tropical rain forest, and, on the higher islands, montane rain forest and cloud forest. 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 through modern ideas and techniques. 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.

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 disturbance can result in undesirable changes in forest structure, composition, and function, including altering 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 2009 and their effects on island cultures and livelihoods. It is neither an exhaustive review of all forest health issues nor an in-depth analysis of any particular issue.

Forest health conditions have been monitored on private, community and government-owned lands throughout the US-affiliated Pacific since 2002. Invasive plants remain one



Mangrove forests can stabilize eroding shorelines and provide essential ecosystem services.
Photo: C. Fletcher, University of Hawaii

of the greatest forest health issues in the islands and all islands have active survey and control programs. 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

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 several thousand years. 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. An updated vegetation map for American Samoa is near completion and will be posted when available.

Land use changes and their effects on Forest Cover

Trend data are not yet available from FIA plots or island wide vegetation mapping efforts from which to directly measure changes in forest cover. In Palau, however, several comparison studies on the largest island, Babeldoab, strongly indicate a reversion from non-forest or savanna to more closed forest types in the latter half of the 20th century. A detailed study of changes in land cover in the Ngeremedu Bay Drainage Area, an 84 km^2 area located along the west central coast of Babeldaob by Endress & Chinea (2001)[1], showed a 10.9% increase in forest between 1947 and 1992. A majority of this conversion from grassland to forest (41.6%) occurred between 1947 and 1976, but the conversion slowed substantially after 1976 when only 3.6% of the grassland areas reverted to forest. Forests expansion was significantly associated with the location of abandoned agricultural communities, most of which occur on Babeldaob. Over 92% of forest expansion occurred within 100 m of established forests suggesting that nearby forests facilitate recovery following human disturbance.

In contrast, the smaller islands of Palau, including Peleliu, Koror and Angaur were losing forest land to urban and non-forest land uses. With the development of the circle-island Compact Road, the new capitol, and associated residential development on Babeldaob there may be a reverse of this trend in the next several decades. Palau is beginning a Sustainable Land Use Planning process and this will likely be addressed.

Natural disturbances also 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 but a major tidal wave struck American Samoa resulting in damage to coastal vegetation, including mangrove forests and the coastal strand.

On September 29, 2009 an 8.3 magnitude earthquake located 120 miles southwest of Samoa generated a deadly tsunami. Two to four waves, with heights up to of 8 meters (Pago Pago Harbor) reached up to 700 meters inland from the shore in several areas of American Samoa. Runup (the elevation at the farthest distance that the tsunami travels inland) was 10 meters above mean sea level. Complex wave patterns resulted in areas on the north and west sides of Tutuila Island being hardest hit while other areas, including the Manua Islands, received little to no damage. Thirty two people lost their lives and thousands were homeless after the event.

Damage surveys after the tsunami revealed multiple effects on coastal vegetation, including vegetation killed by saltwater inundation and erosion along coastlines and in stream corridors. Additional erosion is anticipated with future rainfall in areas now devoid of vegetation.

Healthy coastal forests and coastal strand vegetation plays an important role in helping to mitigate tsunami impacts. New Zealand scientists from the National Institute of Water and Atmospheric Research surveyed damage in Samoa after the tsunami and concluded that the extent and condition of existing coastal vegetation, especially mangroves, reduced flow speeds and inundation depths over land, leading to greater human survival and less damage to infrastructure and that "…removing beach vegetation would increase the potential for tsunami damage".

Damage to Coastal Vegetation from September 2009 Tsunami, American Samoa. Photo: Anne Marie LaRosa, USFS

El Niño/Southern Oscillation (ENSO)

Micronesia is beginning to feel the effects of a changing climate and facing issues of sea level inundation, drought, and food and water security. Climate and sea level in Micronesia are strongly influenced by the El Niño/Southern Oscillation (ENSO). During El Nino events, Micronesia experiences drier than normal conditions while during La Nina events, rainfall increases. In 2009, the pattern switched from La Nina early in the year to El Nino conditions. A moderate El Nino, centered in the central and eastern Pacific, intensified in the latter half of 2009, and dry weather, with rainfall at about 50% of normal, are predicted to extend into the spring of 2010. These conditions are contributing to an increase in the number of wildfires on Palau and Yap. With dry conditions, fires move from flammable grasslands into the margins of intact forest.

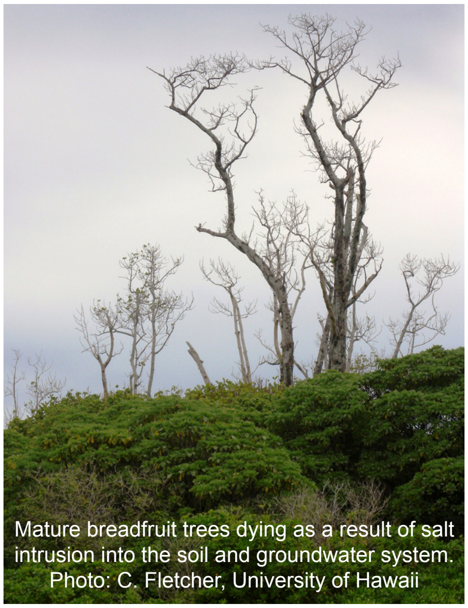
Fire in savanna encroaches into forest, Yap, FSM. Photo: Anne Marie LaRosa, USFS

Also associated with ENSO is marine inundation related to high sea levels. An event of this type occurred in late 2008. Between December 7 and 12, 2008, the Federated States of Micronesia experienced a tidal surge that inundated inhabited islands and atolls and caused damage to crops and coastal areas throughout the country. The tidal surge event was caused by an atmospheric low pressure system across the northern and western Pacific that coincided with very high tides during which some areas were inundated as much as forty feet inland. A state of emergency was declared due to extensive damage including property flooding and damage to and destruction of houses, businesses, infrastructure and crops. A dry spell between October 2007 and April 2008 exacerbated the loss of food crops.

Taro, breadfruit, bananas, sweet potatoes and tapioca are all important food sources and elements in traditional subsistence agroforests. A USAID-FEMA Damage Assessment Team noted that damage to breadfruit and taro, the two principal subsistence crops, was largely due to salt water inundation and upwelling from below the soil while coconut loss was mainly from root exposure by sea waves. Damage included direct salt water damage and crop losses from inundation and lower fruiting and yields from extended exposure to salt water. In some areas salt water toxicity remains.

High and low islands were differentially affected and the severity of the damage varied among islands from negligible to areas where crops were destroyed. On Nukuoro Atoll in Pohnpei State, the loss of taro for the islands was moderate (60% loss) while the loss of breadfruit, both young and old trees, was very high (80%). These losses represent a significant threat to long term food security for these islands.

High islands fared much better. For example the island state of Kosrae suffered minor damage to taro patches in the tidal zone (< 20%). The loss of strand vegetation along the coast resulted in an increase in salt spray and subsequent dieback in a few breadfruit trees along the coast but on the whole these trees were not affected and food security was not threatened.



Mature breadfruit trees dying as a result of salt intrusion into the soil and groundwater system. Photo: C. Fletcher, University of Hawaii

Invasive Plants

Increasingly, invasive species are affecting the culture and livelihood of people living in the US affiliated islands of the Pacific. 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.

The Pacific Islands have traditionally received pests from North America via Guam. With the planned military expansion on Guam and its associated increase in military and civilian cargo the potential for the spread of invasive species from Asia through Guam to the rest of Micronesia, Hawaii and the continental US will significantly increase. The magnitude of the effects on culture and livelihoods in the Pacific region will depend, in part, upon the availability of adequate prevention, early detection, and quarantine programs in the region. A Biosecurity Plan for the region will be implemented to address the increased risk.

Mikania micrantha infesting forest margins.
Photo: Michael Day, Biosecurity Queensland

Effective girdling technique developed by National Park of American Samoa. Photo: Tavita Togia, NPS

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 disturbances. 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.

Many invasive plants that threaten forests in the western Pacific and are widely distributed throughout the region are currently being controlled. These 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*). Some weeds have limited distribution and are candidates for early detection and eradication programs such as African tulip (*Spathodea campanulata*) in Palau, Yap and Chuuk and Panama rubber tree (*Castilla elastica*) in American Samoa.

One model invasive plant control program for *Falcataria moluccana*, an exotic nitrogen-fixing tree that has invaded native forests throughout the Pacific, can be seen in American Samoa. This introduced tree has been shown to create profound and persistent changes in forest composition, structure, and function in Hawaii and American Samoa.
Approximately 35% of Tutuila Island was invaded by *Falcataria moluccana*, (*tamaligi*) prior to control efforts. Since 2001, Tavita Togia, a terrestrial ecologist at the National Park of American Samoa (NPAS), and his staff have killed almost 6,000 mature *tamaligi* trees and reclaimed nearly 2,000 acres of forest throughout the island of Tutuila. NPAS developed a novel, effective non-chemical control technique which involves girdling the base of the tree down to the exposed roots. Early efforts were limited to areas within the National Park and all accessible trees within the Park were killed by 2006. Using a highly successful partnership funded by Seacology and the US Fish and Wildlife Service, Park staff then worked with locally hired and trained crews to control *tamaligi* in areas outside the Park. This partnership provided employment and training for over 60 local residents. A similar AMERICORPS project has killed over 500 additional trees outside the Park. The forestry staff from the American Samoa Community College are also looking to include the use of effective herbicide techniques they employ on other invasive trees to control *tamaligi*.

Scientists Flint Hughes and Amanda Uowolo of the USFS's Pacific Southwest Research Station's Institute of Pacific Island Forestry are also leading research with NPAS colleagues to document impacts of *tamaligi* on native Samoan forests, as well as the consequences of its removal on the structure and function of forests. This collaboration produced vital data demonstrating the success of land management actions taken by the NPAS to control *tamaligi* and the potential for recovery of native vegetation.

Following *tamaligi* control, multiple pathways of forest recovery are possible. In both forests where the *tamaligi* had invaded and those invaded stands that had been controlled, most of dominant native Samoan trees were present, albeit in lower numbers. This should allow for a quick recovery once *tamaligi* are killed. Surrounding native species also may move in and capture the sites. Rapid recovery of Samoan trees following *tamiligi* control keeps forest floor light levels low and severely limits *tamaligi* seedling recruitment. *Tamaligi* did not affect overall carbon – total biomass of *tamaligi* dominated and native dominated forest was the same, but in a *tamaligi* forest, a majority of the biomass was from *tamaligi* and only 30% of the biomass was from native Samoan forest species.

Control efforts appear to restore the soil characteristics as well. Available soil nitrogen (N) is naturally low in intact native forests and *tamaligi* invasion increases soil N availability, changing the way Samoan forests function and potentially facilitating the invasion of other non-native species. With control, *tamaligi* inputs of N are eliminated, returning soil N levels to those of intact forests. Similar effects may be anticipated for areas in Micronesia where *Falcateria* has been introduced. Research will begin in the Republic of Palau in 2010 to look at its impacts there.

Biological Control of Invasive Plants

Biological agents have long been released for the control of widespread invasive plants in Micronesia; many of the recent introductions with the help of scientists at the University of Guam. Current target plants include: *Chromolaena odorata* in Palau, CNMI, Guam and the FSM; *Coccinia grandis* and *Lantana camara* in CNMI and Guam; and *Mimosa diplotricha* in CNMI, Guam, and FSM. Over the years, these introductions have had varying degrees of success.

Recently, biological agents for control of widespread and damaging invasive plants in the Pacific got a boost at a regional biological control workshop in November of 2009 in Auckland, New Zealand. The goals of the meeting were to increase collaboration and begin to develop a strategic plan and priority target species in the region. Forty seven delegates, from 17 countries and territories and organizations representing the Pacific region participated in the workshop. Proceedings from the meeting will be on-line at the Secretariat of the Pacific Community's (SPC) website in 2010.

Examples of on-going biocontrol projects confirmed that biocontrol is a highly successful and relatively inexpensive tool for controlling pests and diseases in the Pacific region. Meeting outcomes included an agreement to more widely share the many well-known, highly effective biocontrol agents currently available in the Pacific, identification of several key regional projects for funding, and development of an advisory group to review biocontrol agent release applications and provide independent advice for the region. Several proposals to regional funding organizations are in preparation, including one to introduce the rust, *Puccinia spegazzinii*, a successful biocontrol agent for the vine *Mikania micrantha* in Fiji, into areas in Micronesia where it is a serious problem in forest margins and taro patches.

Puccinia spegazzinii rust pustules on *Mikania micrantha.*
Photo: Michael Day, Biosecurity Queensland

Inventory and Monitoring: Erythrina Gall Wasp

A continuing threat to forests and trees - help on the way to control EGW

The Erythrina gall wasp (EGW), *Quadristichus erythrinae*, has spread widely throughout the Pacific region. These tiny insects form galls on all photosynthetic tissue (leaves, buds, stems, flowers) of native and ornamental *Erythrina*, often killing the trees in the process. Although the mode of spread around the Pacific is unknown, recent work on the genetics of the invading *Q. erythrinae* populations show a lack of detectable genetic variation (Rubinoff et. al., 2010)[2]. This suggests that infestations began from an introduction to a single location and subsequent invasions in other countries arose from the original source invasion (Rubinoff et. al., 2010).

Significant infestations of the wasp have been observed and *Erythrina* trees continue to be weakened by the repeated deformation of all new growth. EGW has resulted in the complete loss of the popular cultivar *Erythrina variegata* cv. 'Tropic Coral', used widely as a living fence and windbreak, from Hawaii's urban forests. In American Samoa, both native *E. variegata variegana* and *E. variegate orientalis* have been hit hard in the past year with little to no damage to the introduced agroforestry species, *E. subumbrans* and the native wetland species *E. fusca*. 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 and many countries without native *Erythrina* species have little concern about the infestation.

A parasitic wasp from Africa, *Eurytoma erythrinae*, was recently released in Hawaii by the Hawaii Department of Agriculture to control EGW. Early monitoring of *Eurytoma* and its host shows much promise as a control for EGW. This agent may soon be available for other Pacific island countries, if needed.

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

Cycad Aulacaspis Scale (CAS) in Micronesia:

Guam's native cycad, fadang (*Cycas micronesica*), continues to decline from the infestation of the cycad aulacaspis scale (*Aulacaspis yasumatsui*) and other native and introduced pests. The cycad scale is now also found on Rota (Northern Marianas Islands) and Palau, where cycad populations are smaller, scale infestations fewer and effects are less dramatic

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

Guam

CAS invaded Guam in 2003 and spread throughout the island during 2004 and 2005. Guam's native cycad, *Cycas micronesica* was the most abundant arborescent species at the time, so the ubiquitous availability of native trees in the forest and prevalence of the ornamental cycad, *Cycas revoluta*, in the urban landscape facilitated the population explosion and rapid spread of the scale. The cycad blue butterfly, *Chilades pandava*, was discovered on Guam in early 2005, and the combined assault of these two cycad-specific arthropod pests generated epidemic mortality throughout the island's forests and urban landscape. Initial mortality from the scale was very high and in 2004 a coccinellid beetle (*Rhyzobius lophanthae*) was introduced and has established on cycads in Guam, Rota and Palau.

Permanent monitoring plots were established in May of 2004 to quantify *C. micronesica* population responses to the scale (Marler and Lawrence, UOG). One plot was invaded by *A. yasumatsui* in February of 2005. Initial plant mortality was skewed toward seedling and juvenile plants. As of January 2010, 100% of the plants that were 100-cm or less in height during the 2004 census are dead. Mature cycads are also showing significant decline. Raw data from one representative transect for 2007-2010 (Fig. 1) indicates the cycads may disappear from the wild by summer 2019, provided no change in mortality rates occur. General health of the remaining plants has declined in recent years due to cumulative pressures of several arthropods, so it is likely that the rate of mortality will increase in the coming years. Lower tree health has also led to a decline in seed production and infestation of seeds by CAS reduces the germination percentage of mature seeds. As a result, no new seedlings have been observed in 2008 and 2009.

Populations of the predatory beetle *Rhyzobius lophanthae* and its host, the cycad aluacaspis scale, are cyclical. The beetle very rapidly established and began to control CAS. Many *C. micronesica* plants were relatively free of CAS infestations during

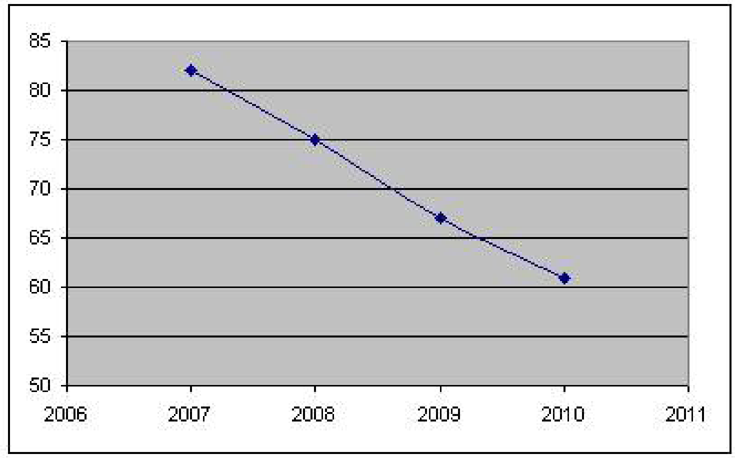


Figure 1. Total number of live *Cycas micronesica* trees on one representative transect in Ritidian, Guam as a function of time.

2007 and early 2008. A decline in *R. lophanthae* occurred in late 2008 and an explosion of scale led to heavily infested plants during early 2009. As of January 2010, the CAS population has been brought under control in Guam for a second time and few plants show signs of heavy infestation.

Interactions with other arthropods reveal highly unpredictable relationships. Damage to *C. micronesica* plants by the endemic stem borer *Dihammus marianarum* increased to epidemic levels in 2007-2008 and may be responsible for more direct mortality than the scale *A. yasumatsui*. Members of this longhorn beetle family are known to exploit stressed host plants, and the increase in borer activity was likely a direct result of the compromised plant health that followed the *A. yasumatsui* invasion. Direct signs of *D. marianarum* infestation have declined in the past year, and the characteristic stem dieback that signifies recent stem borer damage has increase in the past year.

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. The strategy on Guam continues to be 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. If the cycad is to continue be a major

Stem borer damage on mature cycads, stem borer larvae.
Photo: Dr. Thomas Marler, University of Guam

Cycad aulacaspis scale damage on *Cycas revoluta* in Palau. Photo: Joel Miles

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.

Rota

Rhyzobius lophantae beetles have also successfully established on Rota in 2009, preventing rapid spread of the scale beyond the initial core infestation area (one-acre). But there have been several new sightings in the northern part of Rota at Pali'e and at the Taga Stone Quarry in As Nieves. CAS remains a threat to the small populations of native cycads in the southern and central parts of the island. No scales have been found on Saipan or Tinian.

Palau

In July 2008 an infestation of CAS was discovered on ornamental cycads (*C. revoluta*) on the island of Koror in the Republic of Palau. A survey of infested areas in November 2008 found CAS on 24 plants in 11 locations. The infestation was treated with insecticides. Subsequently, the scale was also been found on ornamental cycads on Babeldaob island, to the north of Koror, but no infested native cycads, *Cycas micronesica*, have been found. Both *C. micronesica*, common in the limestone forests of Palau's famous Rock Islands, as well as elsewhere throughout the country, and the ornamental *C. revoluta,* are clearly at risk in Palau.

In March and April of 2009, *R. lophanthae* beetles were released at eight sites. Monitoring is ongoing and initial results indicate that the beetles are successfully established and controlling CAS.

Casuarina Dieback on Guam

Casuarina equisetifolia (gago or ironwood) is a hardy, pioneer, salt-resistant tree that occurs on both limestone and volcanic soils. It's 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

Galls from undescribed eulophyid wasp on *Casuarina* branchlet tips at Polaris Point, Guam, suspected to contribute to the decline of *Casuarina*. The wasp and the corresponding damage on *Casuarina* trees have also been found in Palau and on Rota, CNMI. Photo by Aubrey Moore, University of Guam Cooperative Extension Service.

been declining since a series of severe typhoons in 2002 caused widespread limb breakage and defoliation. Thousands of gago or ironwood trees, *Casuarina equisetifolia*, continue to decline on Guam. A complex of yet unresolved biotic and abiotic factors are thought to contribute. Steady progress is being made in characterizing the decline and bringing international awareness to the problem. In 2009, several indicators of decline emerged from on-going research and international collaborations. These include: the percentage of bare branches, loss of fresh weight of branchlet per branch section and percentage of internal discoloration of truck and primary branches.

Based on Karl Schlub's on-going work several measurable variables have been shown to correlate with decline: presence of termites, presence of basidiocarps (conks and woody pustules), levels of management, storm damage, and tree density. A species of wasp reared from branchlet tip galls was identified as belonging to the genus *Selitrichodes* (Eulophidae: Tetrastichinae) by John LaSalle, CSIRO, Australia, and is correlated with decline severity in restricted locations on the island; however, future studies are needed to confirm whether the wasp is responsible for any significant impact on health of ironwood trees on Guam. The decline appears to be distributed randomly across the island and is also reported from Rota but not Saipan or the Federated States of Micronesia, where Casuarina is native, nor Hawaii, where it has been introduced and widely planted.

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

Coconut Rhinoceros Beetle

The coconut rhinoceros beetle (CRB) (*Oryctes rhinoceros* L.) was initially detected at Tumon Bay, Guam, on September, 12, 2007. Control efforts began immediately but Guam's urban forests and ornamental palms remain at risk. The current infestation on Guam is widespread and centered in the northwest quadrant of the island. The eradication zone increased from the initial

Coconut rhinoceros beetle feeding injury. Photo: Ben Quicocho

discovery area of about 1,000 acres to 3,335 acres in 2009. Nearly 600 distinct locations were observed with almost 100 breeding sites. The beetle is native to much of Southeast Asia, including the Philippines, and has previously been introduced to Palau, American Samoa, and Fiji. Past outbreaks of CRB elsewhere in the Pacific have caused widespread damage, but biological controls have generally kept populations of the beetle from reaching catastrophic levels.

Two years of rigorous, cooperative efforts between the Guam Department of Agriculture, the University of Guam and USDA (APHIS and the USFS) have slowed the growth and limited the spread of CRB populations on Guam. Efforts have centered around two principal tactics: sanitation of breeding sites (including fumigation) and trapping of adult beetles. The inability to sanitize sufficient breeding sites due to access and other factors and the low trap efficiency have hindered efforts and eradication appears unattainable with the current tactics. Prophylactic tree treatments with systemic insecticides to protect high value coconut trees have also proven ineffective to date. Two additional tactics are planned for 2010: detector dogs to assist in finding breeding sites and the introduction of the *Oryctes baculovirus*, which is carried by adult beetles to breeding sites.

Dogs and handlers hard at work - a new approach to detecting Coconut Rhinoceros Beetle, Guam. Photo: Herman Crisostomo

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 Forest Service's Pacific Southwest Research Station's Institute of Pacific Island Forestry; USDA-APHIS, USDA-NRCS; US-AID; Guam Department of Agriculture, the National Park of American Samoa, New Zealand National Institute of Water and Atmospheric Research, American Samoa Community College.

Special thanks go to Ann Kitalong, the Environment, Inc. Palau and Thomas Marler, Aubrey Moore and GVB Reddy, scientists from the University of Guam's College of Natural and Applied Sciences and their Cooperative Extension Service. The USDA Forest Service's Forest Health Aerial Survey Program is not currently active in the Islands.

[1]Endress, B. A. and J. D. Chinea. 2001. Landscape patterns of tropical forest recovery in the Republic of Palau. Biotropica 33:555–565

[2]Rubinoff D., B.S. Holland, A. Shibata, R.H. Messing, and M. G. Wright. Rapid Invasion Despite Lack of Genetic Variation in the Erythrina Gall Wasp (*Quadrastichus erythrinae* Kim) Pacific Science 64(1):23-31. 2010

For more information visit:

USDA Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry - http://www.fs.fed.us/psw/ipif/

USDA Forest Service, Pacific Southwest Region - http://www.fs.fed.us/r5/spf/fhp/

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USDA United States Department of Agriculture