

Failed Attempts to Establish IPM for Asian Cycad Scale and Coconut Rhinoceros Beetle on Guam

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Entomological Society of America Annual Meeting, Vancouver
November 13, 2018



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Introduction

Guam



Brown treesnake



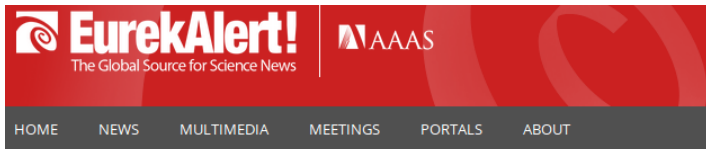
Courtesy of USGS

Forest Birds before BTS



Forest Birds after BTS





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Birds eat 400 to 500 million tonnes of insects annually

Along with spiders, insectivorous birds play a vital role in consuming insects that would otherwise destroy forests or crops

"Birds are an endangered class of animals ... we must fear that the vital ecosystem services that birds provide - such as the suppression of insect pests - will be lost." says Nyffeler.

Ecological Disasters on Guam

- Brown treesnake (arrived around 1945)
 - Killed most of Guam's birds and small mammals.
 - Caused 7 bird extinctions.
- Asian Cycad Scale (detected 2003)
 - Threatens survival of Guam's endemic cycad.
- Coconut Rhinoceros Beetle (detected 2007).
 - Threatens Guam's coconuts and other palms.
- Little Fire Ant (detected 2011)
 - Threatens most animals remaining in Guam's forests.

Dominant Trees in Guam's Forests are Threatened by Asian Cycad Scale (ACS) and Coconut Rhinoceros Beetle (CRB)

Threat	Species	Status	Tree count ¹	% of total tree count
ACS	<i>Cycas micronesica</i>	endemic	1,571,556	16%
CRB	<i>Cocos nucifera</i>	native	1,162,494	12%
CRB	<i>Heterospathe elata</i>	introduced	1,075,552	11%
	<i>Vitex parviflora</i>	introduced	902,990	9%
	<i>Leucaena leucocephala</i>	introduced	890,217	9%

Tree census data source: J. A. Donnegon et al. 2004. Guam's Forest Resources, 2002. Available from:

http://www.fs.fed.us/pnw/pubs/pnw_rb243.pdf

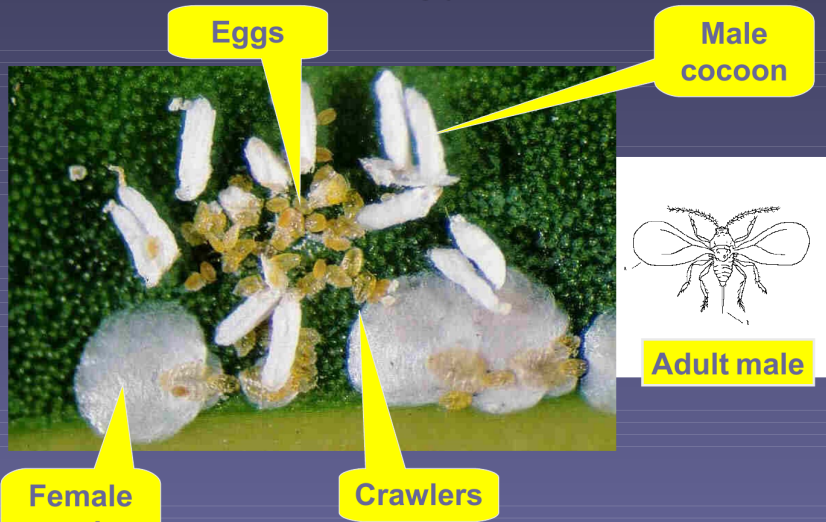
¹Estimated number of trees with DBH greater than 5 inches.

Asian Cycad Scale

Asian Cycad Scale (ACS), *Aulacaspis yasumatsui* (Hemiptera: Diaspididae)



Scale Morphology & Life History



Invasion History

- Origin: Southeast Asia
- Florida 1996
- Hawaii 1998
- Guam 2003
- Rota 2005
- Palau 2005

Damage to *Cycas revoluta*



Damage to *Cycas micronesica*



IPM Tactics for Asian Cycad Scale

Insecticides can be used to protect ornamentals

Biocontrol is the only feasible tactic for island-wide protection of *Cycas micronesica*. A beetle predator has been introduced but attempts at introducing parasitoids have failed.

Rhyzobius lophanthae (Coleoptera: Coccinellidae)



Rhyzobius lophanthae (Coleoptera: Coccinellidae)



Arrhenophagus chionaspidus (Hymenoptera: Encyrtidae)
Fortuitous introduction 2013-02-10



Asian Cycad Scale - Current Status on Guam

- 90% of Guam's endemic cycads have been killed by the scale and other invasive species
- *Cycas micronesica* placed on the US National Endangered Species List in 2015. (Was the most abundant tree on Guam in 2002.)
- Mature plants are protected by the biocontrol beetle, but **no natural reproduction is occurring**

Coconut Rhinoceros Beetle

Coconut Rhinoceros Beetle Biotype-G (CRB) (Coleoptera: Scarabaeidae)





Contents lists available at [ScienceDirect](#)

Journal of Invertebrate Pathology

journal homepage: www.elsevier.com/locate/jip



A new haplotype of the coconut rhinoceros beetle, *Oryctes rhinoceros*, has escaped biological control by *Oryctes rhinoceros* nudivirus and is invading Pacific Islands

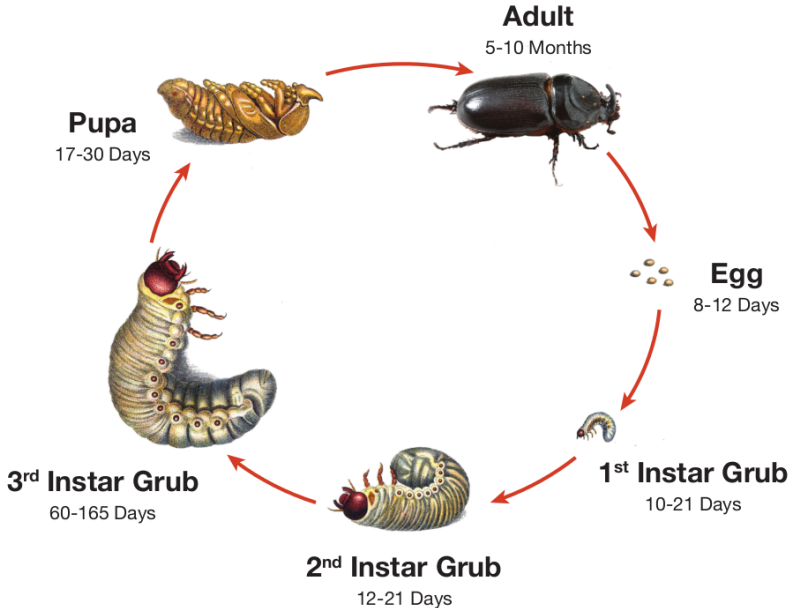


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CRB Damage 1



CRB Damage 2



CRB Breeding Sites



Coconut rhinoceros beetle

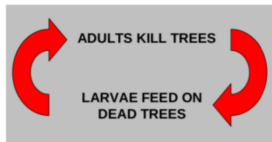
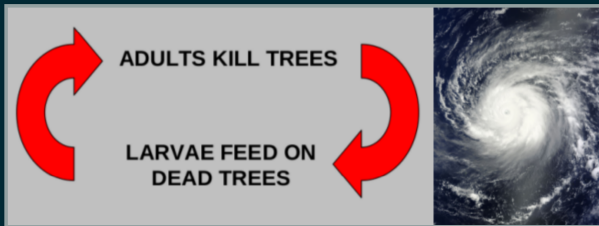


Figure : Coconut palms killed by *Oryctes rhinoceros* in Fiji (photo by Bedford)

Coconut rhinoceros beetle



- A typhoon leaves large numbers of potential CRB breeding sites
- Large numbers of CRB adults emerge from these sites and kill many coconut palms
- Dead standing coconut palms generate even more CRB adults which kill even more palms.

Invasion History: Coconut Rhinoceros Beetle Biotype G

- Origin: Southeast Asia (Taiwan, Thailand, Philippines, Indonesia)
- Guam 2007
- Palau 2010
- Hawaii 2013
- Papua New Guinea 2015
- Solomon Islands 2015
- Rota 2017

Eradication Attempt based on sanitation and mass trapping failed when CRB-G spread throughout Guam

Sanitation May be effective when practiced by a village community, but ineffective island-wide.

Pheromone traps Ineffective for population suppression:
mark-release-recapture indicates **oryctalure** traps have a capture rate of about 1% of available adults

Insecticide application **cypermethrin** can be used to protect palms

Biological control is the only feasible tactic for island-wide control

***Metarhizium majus* (GMF)** Successfully introduced from Philippines; survey indicates about 20% from fungal infection

***Oryctes rhinoceros nudivirus* (OrNV)** CRB-G is resistant to all available isolates

Coconut Rhinoceros Beetle - Current Status on Guam

- Mature coconuts and other palms are rapidly being killed by an uncontrolled outbreak of CRB-G which was triggered by Typhoon Dolphin in 2016
- Damage estimates are not available. History suggests that we will lose 50% or more of our palms if the outbreak is not controlled.
- A search for an effective biological control agent, most likely a new isolate of *Oryctes rhinoceros* nudivirus is under way.
- If current outbreaks of CRB-G cannot be controlled, CRB-G will spread to other islands and possibly the Americas.

Conclusion

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- Development of IPM for invasive species which become wide-spread forest pests is difficult.
- Classical biocontrol may be the only feasible, stand-alone tactic.

**Invasive species aren't all bad.
They provide job security for biologists.**

