

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

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College of Natural and Applied Sciences  
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Entomological Society of America Annual Meeting, Vancouver  
November 13, 2018



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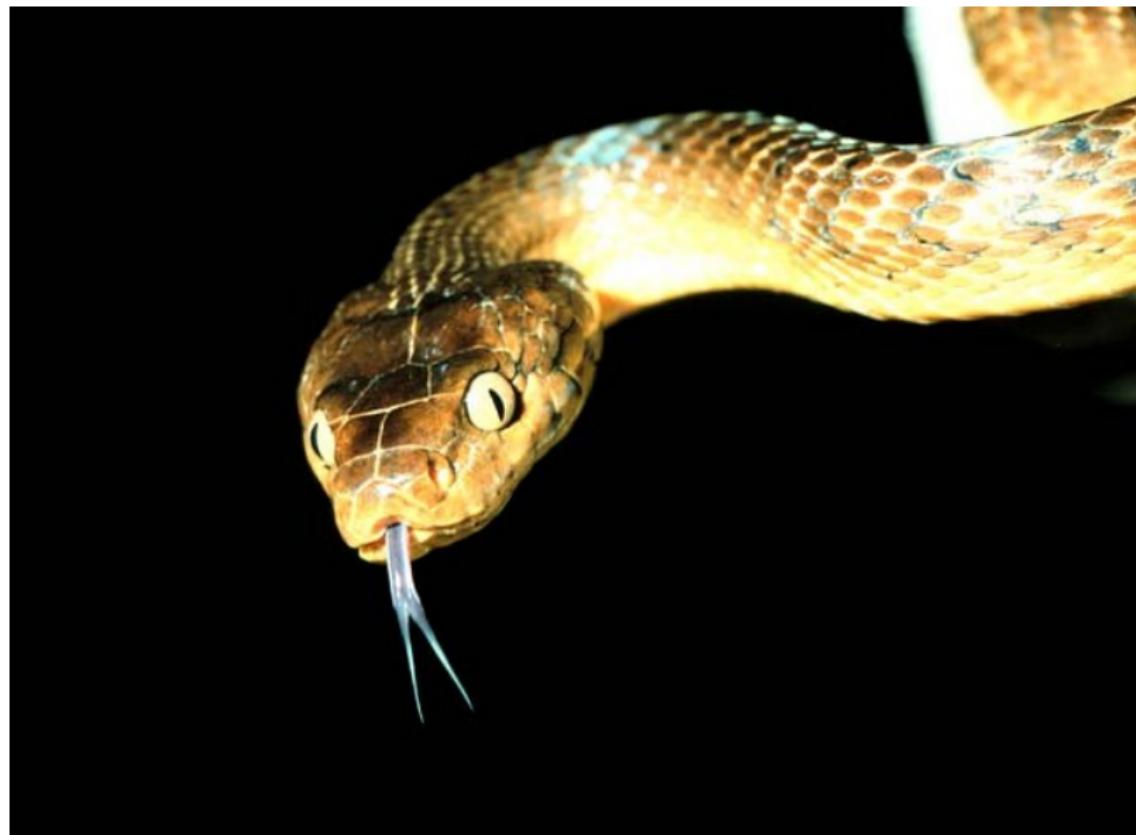


# Introduction

# Guam



# Brown treesnake



Courtesy of USGS

Aubrey Moore (University of Guam)

IPM Failures on Guam

# Forest Birds before BTS



# Forest Birds after BTS



# Loss of Ecosystem Services Provided by Birds



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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 <sup>1</sup>	% 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](http://www.fs.fed.us/pnw/pubs/pnw_rb243.pdf)

<sup>1</sup>Estimated number of trees with DBH greater than 5 inches.



## Asian Cycad Scale

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



# Scale Morphology & Life History

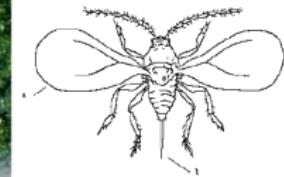


Eggs

Male  
cocoon

Female

Crawlers



Adult male

# 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 lophantheae* (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)



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Contents lists available at ScienceDirect

## Journal of Invertebrate Pathology

journal homepage: [www.elsevier.com/locate/jip](http://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

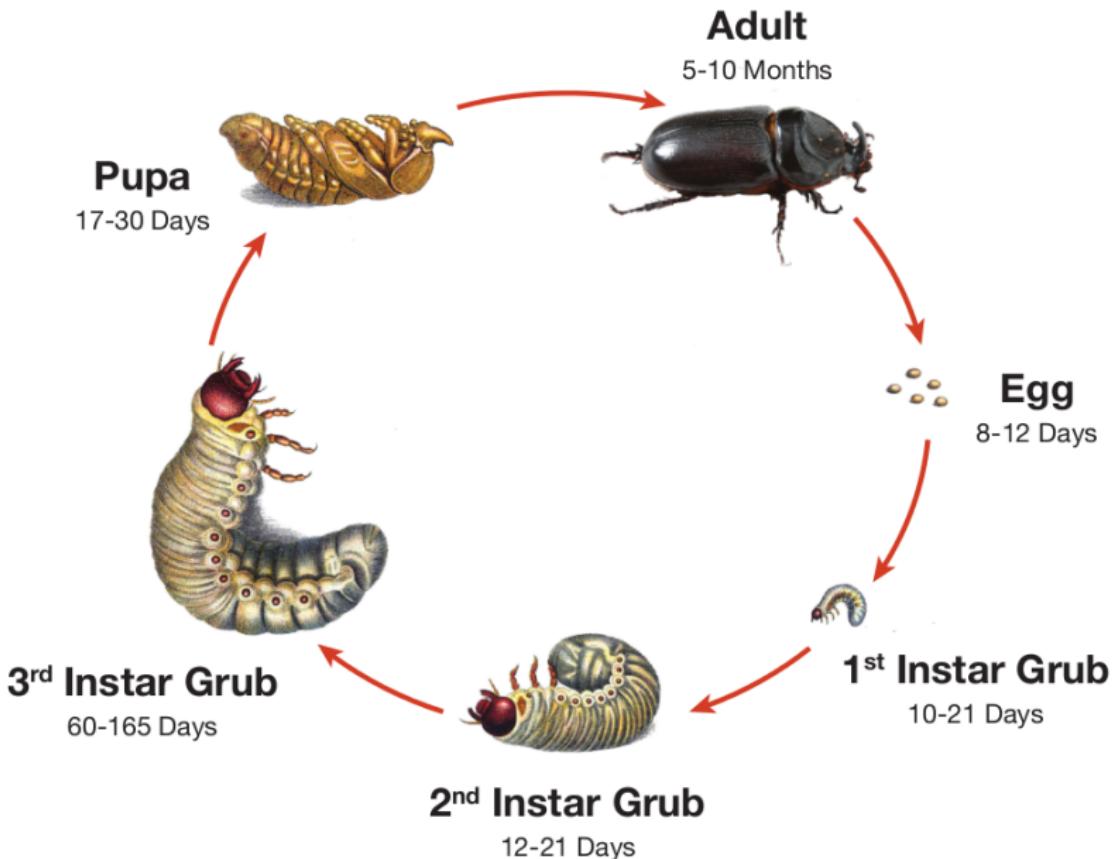


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# CRB Damage 1



## CRB Damage 2



# CRB Breeding Sites



# Coconut rhincoceros beetle

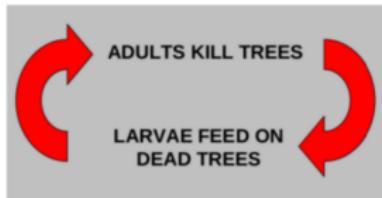


Figure : Coconut palms killed by *Oryctes rhinoceros* in Fiji (photo by Bedford)

# Coconut rhincoceros 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

# Conclusion

- 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.**

