

Coconut Rhinoceros Beetle Causes an Ecological Catastrophe on Guam

Aubrey Moore

Extension and Outreach
College of Natural and Applied Sciences
University of Guam

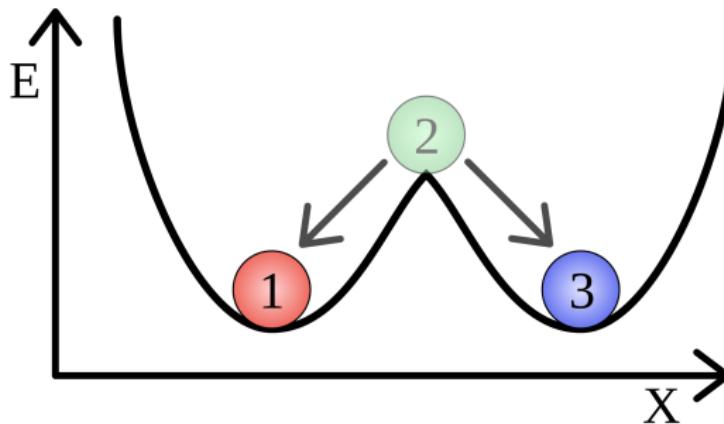
Presentation for UOG Extension Interns
June 21, 2019



Introduction

Definition of Catastrophe

- (colloquial) A large, often sudden, disaster
- (mathematics) A type of bifurcation, where a system shifts between two stable states





Geographic Distribution of Coconut Rhinoceros Beetle

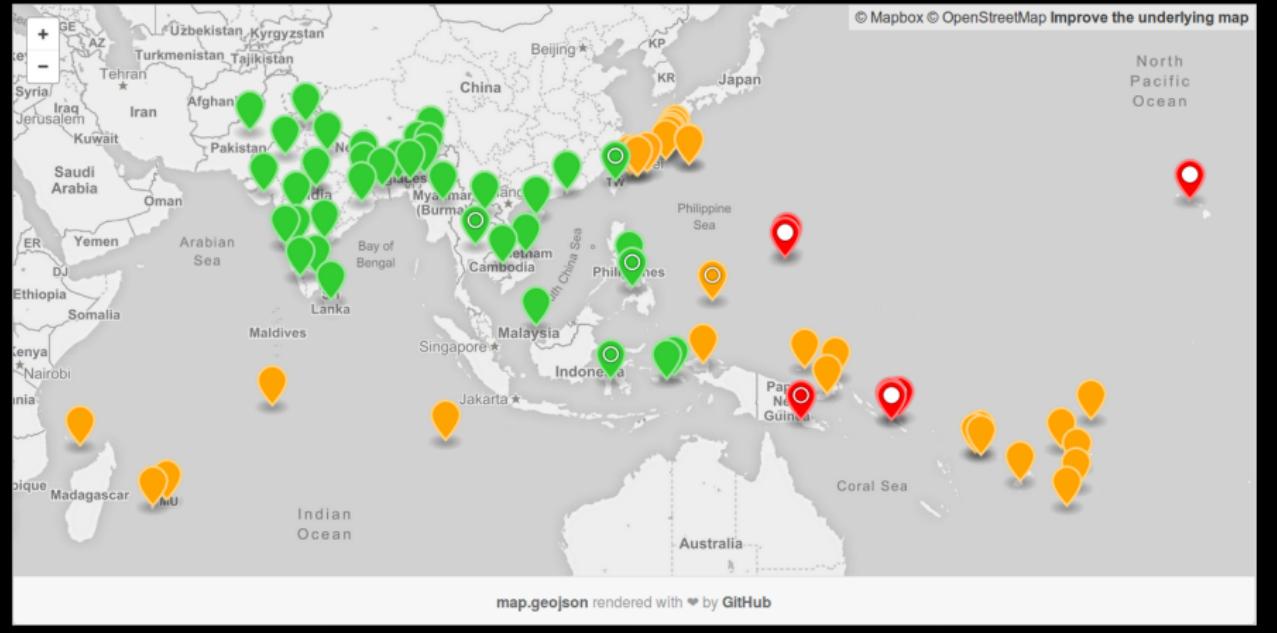
native range

first detected in the 20th century

first detected in the 21st century

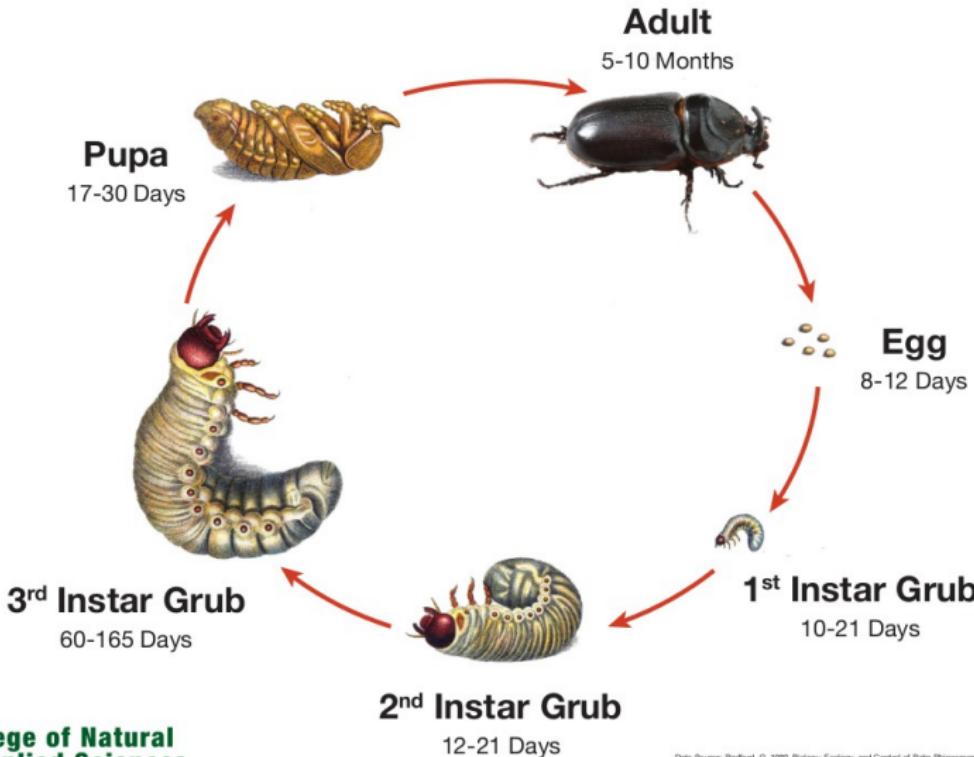
open circle: population includes CRB-G biotype

filled circle: population is exclusively CRB-G biotype



LIFE CYCLE OF THE COCONUT RHINOCEROS BEETLE

Oryctes rhinoceros



**College of Natural
& Applied Sciences**
University of Guam | Unibetsedåt Guåhan

University of Guam | Unibetsedåt Guåhan

Data Source: Bedford, G. R. 1980. Biology, Ecology, and Control of Pathogenic Beetles. *Annual Review of Entomology* 25: 309-332.

Publication: The Society of Natural History, Cornell University, Ithaca, NY 14853, USA. © 1980 by the U.S. Department of Agriculture, contract No. 14-76-3000. Reproduction or use of material in whole or in part without written permission is illegal except where specific written permission is granted under the copyright laws.

Social Data: USDA Station, Mongolian People's Socialist Republic, 1980. Contract No. 14-76-3000. The University of Illinois at Urbana has opportunity to inspect information preceding, programs and services in this paper at the time of publication.

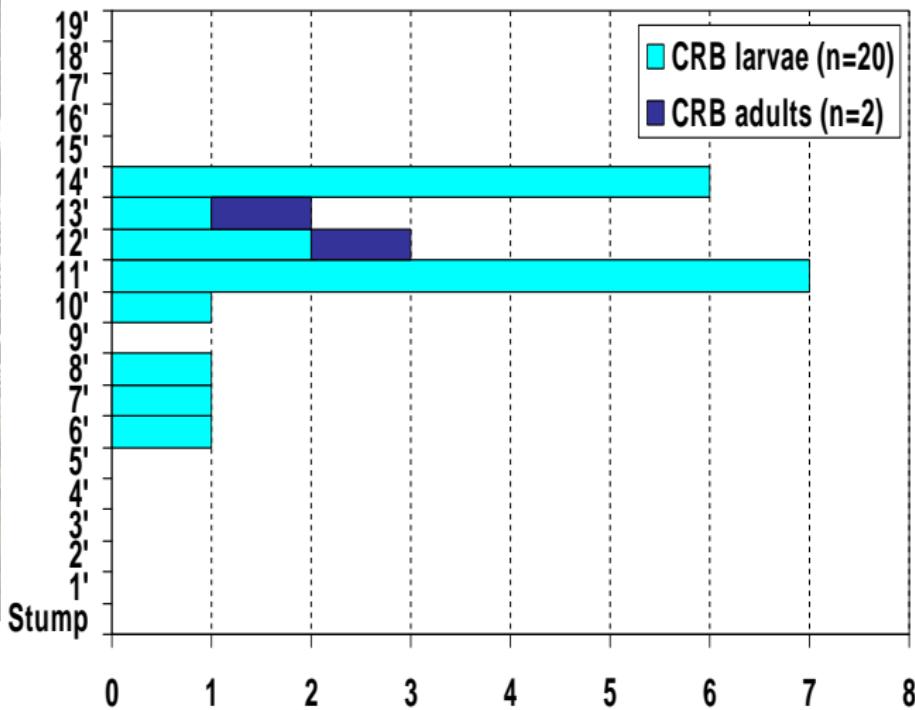








Vertical Distribution of CRB Larvae & Adults in Standing Dead Coconut Trankilidat, Guam; 25 Oct 2007







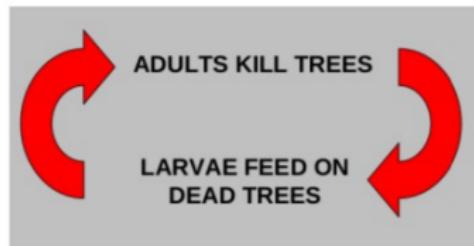


Figure : Coconut palms killed by *Oryctes rhinoceros* in Fiji (photo by Bedford)



Location of Initial Detection

September 11, 2007
Image © 2008 DigitalGlobe

Pointer lat 13.505226° lon 144.802428°

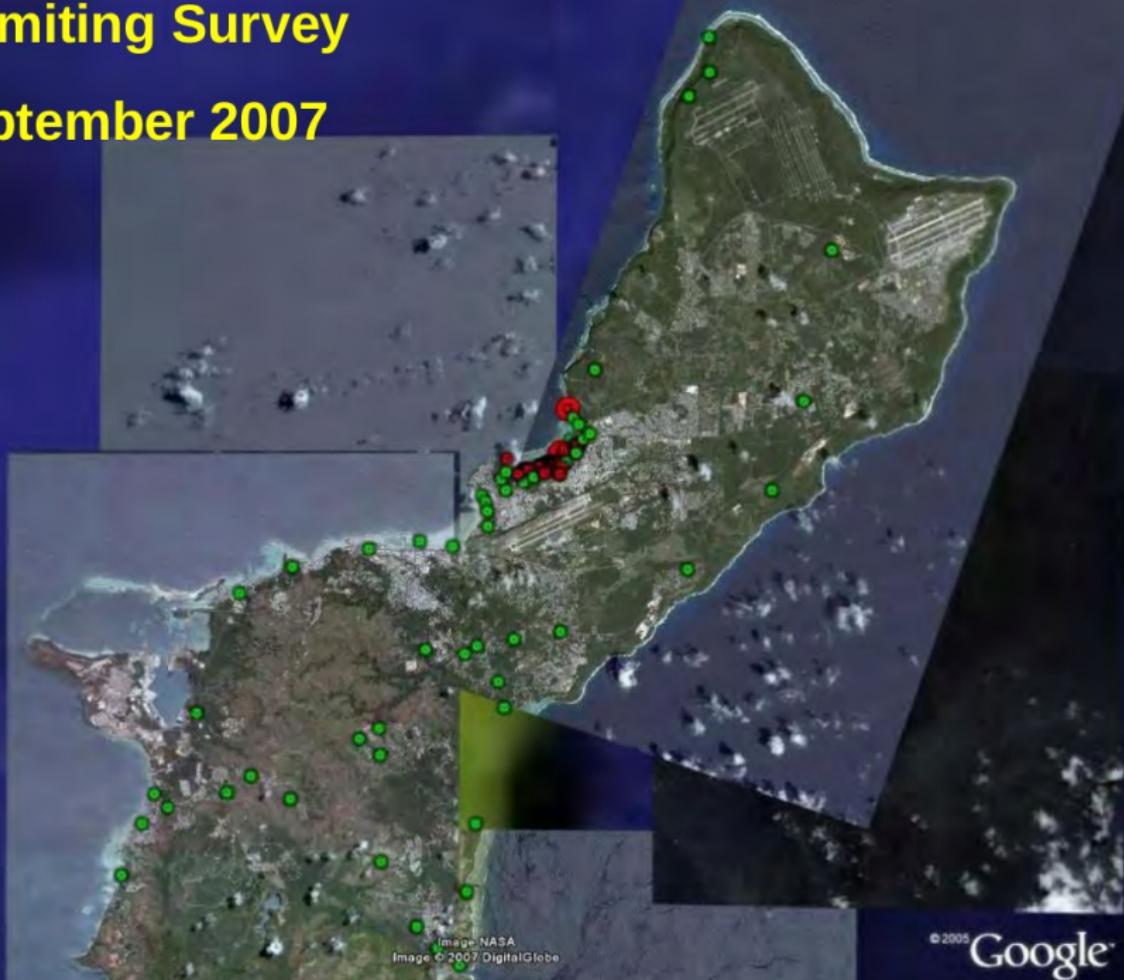
Streaming 100%



©2007 Google™

Delimiting Survey

September 2007



How to Eradicate CRB

- **Sanitation:** Locate and destroy all active and potential breeding sites.
- **Quarantine:** Close pathways to prevent re-introduction and accidental transport to uninfested areas.



Initial Quarantine Area

September 2007



Additional CRB Control Tactics

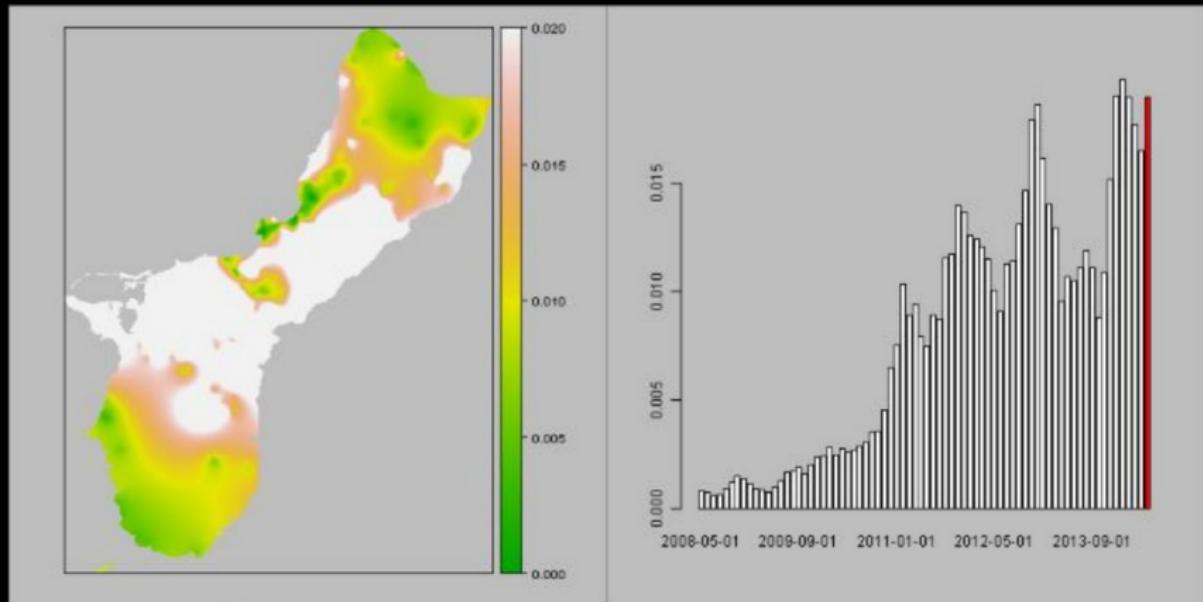
- Sanitation
- Quarantine
- Trapping
- Chemical control
- Biological control

Trapping



- › Pheromone traps baited with oryctalure proved useless for population suppression
- › Pheromone traps are useful for detection and monitoring

90 day trapping period ending on 01 Jun 2014

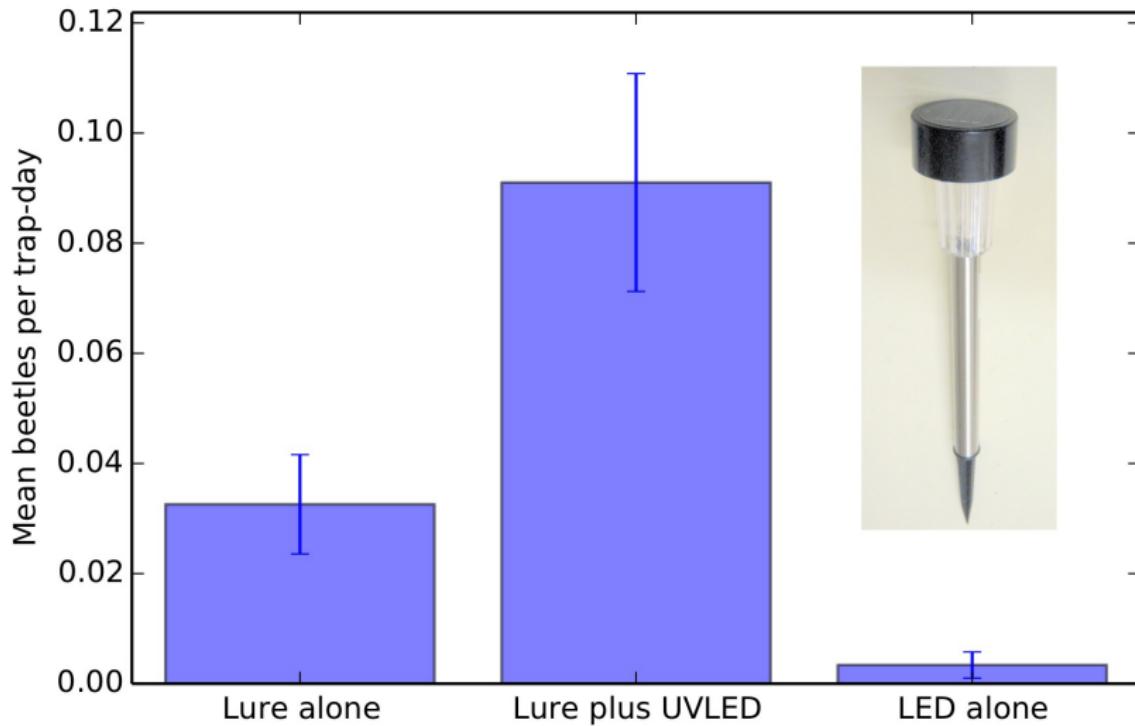


Mean number of beetles caught per trap-day

Pheromone Trap Development



UV LED increases Trap Catch



Tekken Trap



Tekken Trap



DeFence Trap



DeFence Trap



**DeFence Trap
Instruction Manual**

For capturing
Coconut Rhino Beetles



G College of Natural & Applied Sciences
University of Guam | Unibetsedåt Guahan

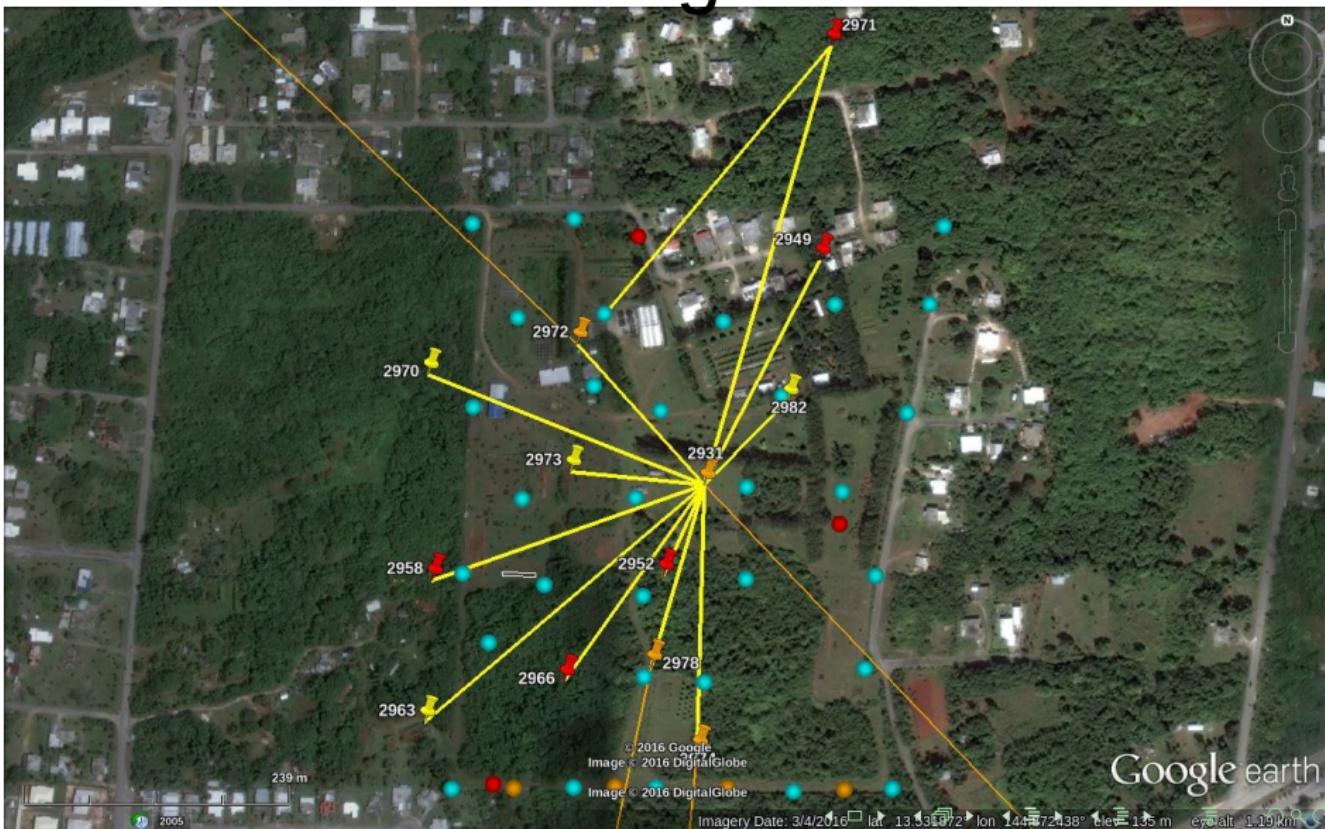
Detector Dogs for Locating Breeding Sites



Detector Beetles for Locating Breeding Sites



Detector Beetles for Locating Breeding Sites



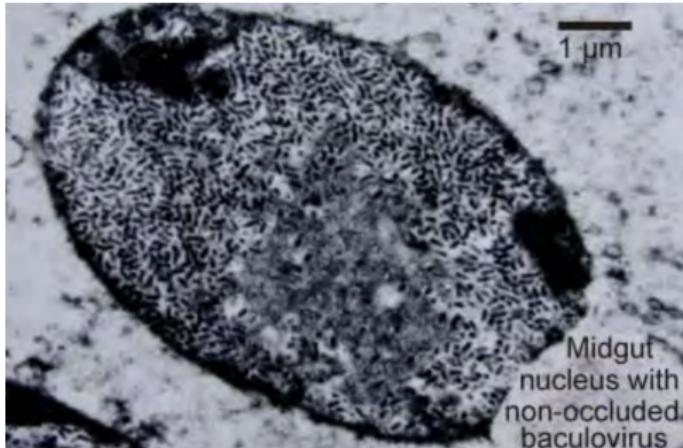
Chemical Control

Spraying Crowns with DEMON MAX (Cypermethrin)

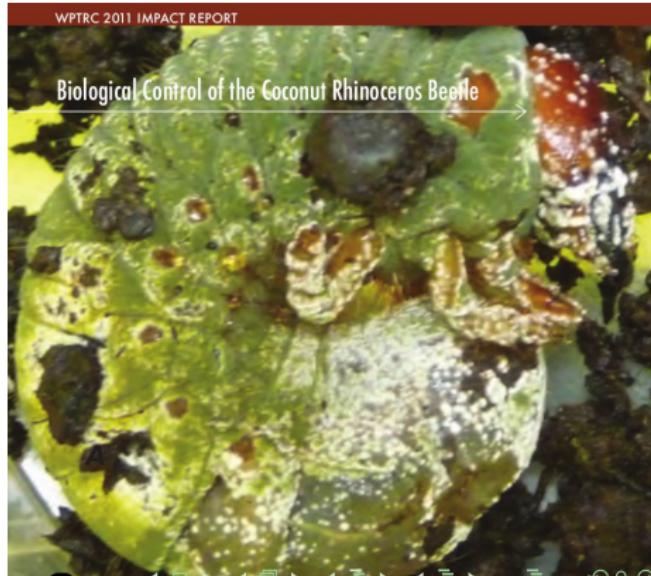


Biocontrol

Oryctes rhinoceros nudivirus
(OrNV)



Green muscardine fungus (GMF)
Metarhizium majus



Discovery of the CRB-G Biotype

Marshall, Sean, Maclean Vaqalo, Aubrey Moore, Roland Quitugua, and Trevor Jackson (2015). **A new invasive biotype of the coconut rhinoceros beetle (*Oryctes rhinoceros*) has escaped from biological control by *Oryctes rhinoceros nudivirus*.**

Presented at the International Congress on Invertebrate Pathology and Microbial Control and the 48th Annual Meeting of the Society for Invertebrate Pathology, Vancouver, BC, August 2015.

Characteristics of CRB-G

- genetically distinct
- resistant to all available isolates of OrNV
- more invasive (all 4 recent invasions involve CRB-G)
- behavioral differences ???
 - not highly attracted to oryzalure
 - higher per-capita damage



Current CRB Situation on Guam

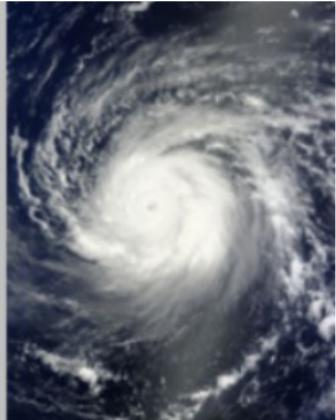
An uncontrolled CRB outbreak is killing large numbers of coconut palms.



ADULTS KILL TREES



LARVAE FEED ON
DEAD TREES



The current outbreak was triggered by Typhoon Dolphin which visited Guam in May 2015. Adult CRB emerging from abundant breeding sites where numerous to start killing mature coconut palms.

Dead standing coconuts are now generating further generations of CRB which are killing even more palms.

Current Prognosis for Guam

Current tactics of sanitation, trapping, application of *Metarhizium* may reduce local damage, but will do little to protect palms on an island-wide basis because most breeding sites are inaccessible (in jungle and/or on military bases).

Based on historical data from Palau and elsewhere, it is likely that Guam will lose 50% or more of its coconut palms.

Risk of accidental export of CRB to other islands is high.

What Can Be Done?

Effective biocontrol is probably our best chance of saving Guam's coconut palms on an island wide basis.

There is an urgent need to find an effective biocontrol agent for CRB-G. This will probably be an isolate of OrNV from an endemic CRB-G population in Asia.

CRB-G is a Regional Problem

Jackson, Trevor (2015).

Need for emergency response for a new variant of rhinoceros beetle (Guam biotype).

International Association for the Plant Protection Sciences Newsletter (XI). November, 2015.

Available on-line at

<https://www.plantprotection.org/portals/0/documents/newsletters/2015/iapps%2011-2015.pdf>

Vaqalo, Maclean, Sean Marshall, Trevor Jackson, Aubrey Moore (2015).

An Emerging Biotype of the Coconut Rhinoceros Beetle Discovered in the Pacific.

Secretariat of the Pacific Community, Land Resources Division.

Available on-line at

http://www.spc.int/lrd/plant-health-publications/doc_download/2374-ph-agalertno51



Link to Climate Change





Conclusion

CRB is Causing a Catastrophe in the Colloquial Sense

Guam's forests are rapidly being destroyed by invasive species. Loss of palms is part of a larger catastrophe:

- Brown treesnake killed most forest birds
- Cycad scale has killed 90 percent of Guam's endemic cycad
- Little fire ant is killing many other species

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.



CRB is Causing a Catastrophe in the Mathematical Sense

- Typhoons initiated a catastrophic switch in the state of CRB population dynamics on Guam.
- Prior to typhoons, CRB population levels were regulated by availability of an extrinsically generated larval food supply.
- After typhoons, the CRB population generates its own larval food supply by killing palms.