Status of a Major Outbreak of Coconut Rhinoceros Beetle, *Oryctes rhinoceros* Biotype G, on Guam and Attempts at Establishing Biological Control

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US Dept of Agriculture
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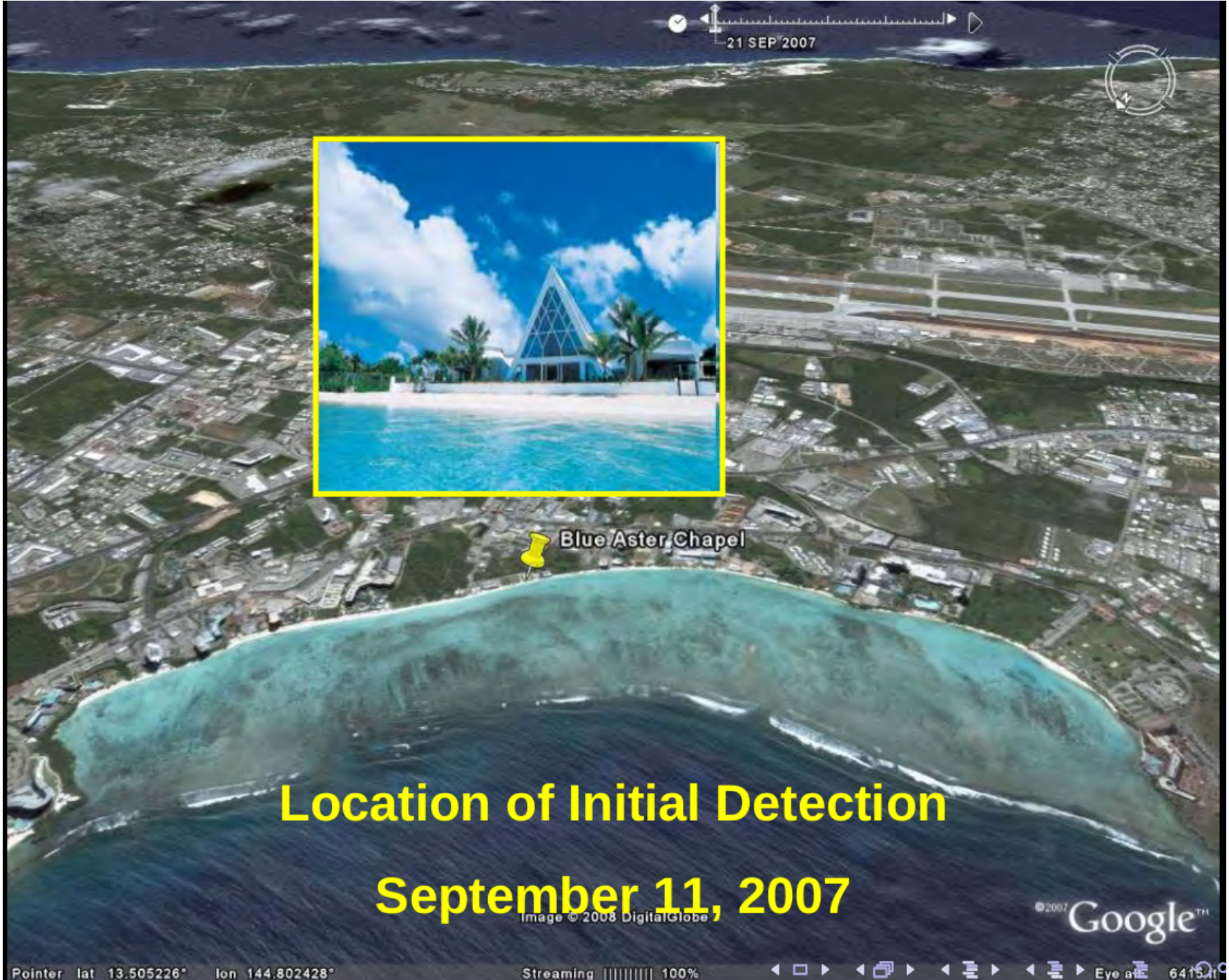
Outline

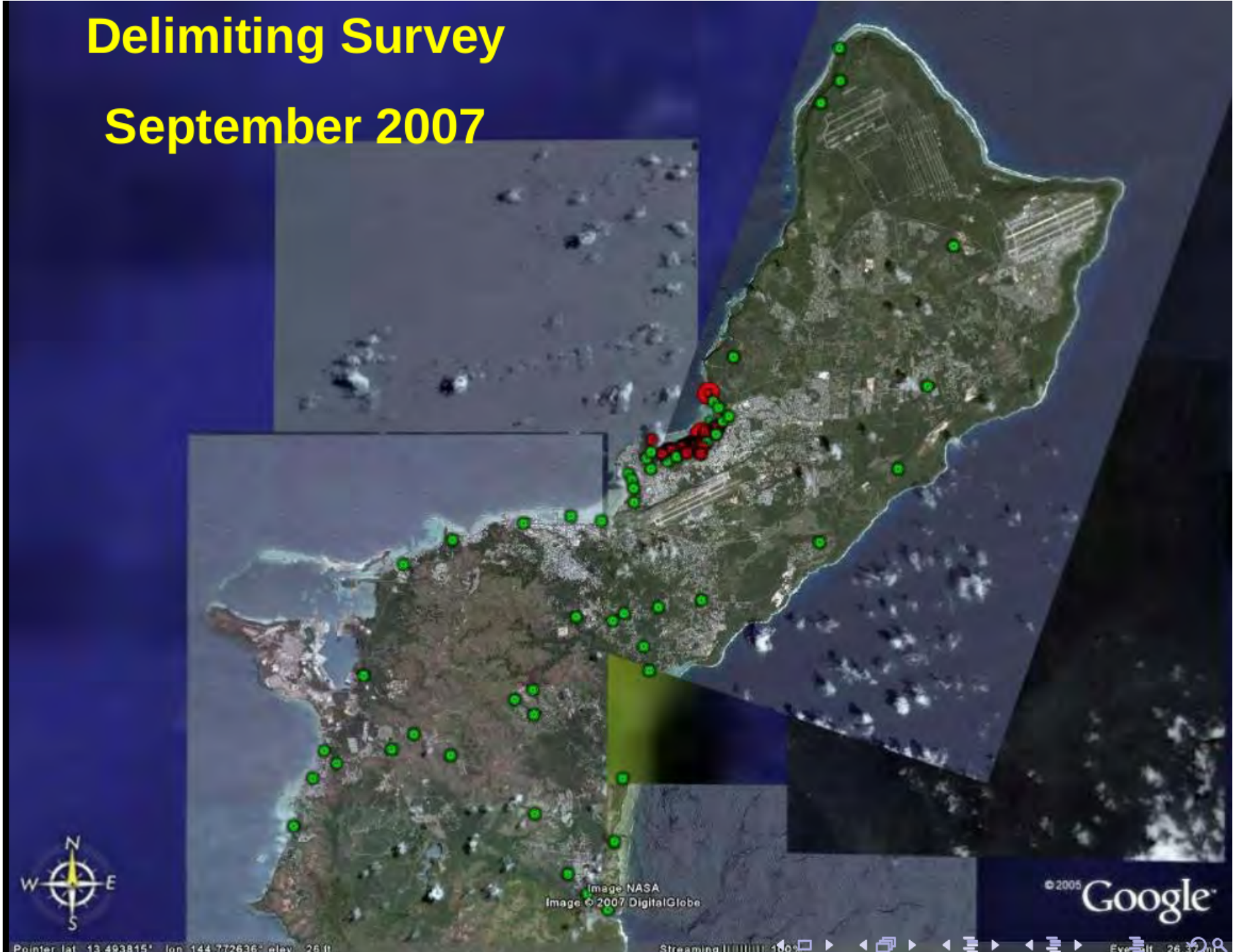
- **Introduction**
- CRB Invasion History
- CRB Population Dynamics
- Recent CRB Activity on Guam
  - Biological Control
  - Damage Survey
  - Online Resources

Guam


21 SEP 2007
Blue Aster Chapel
Location of Initial Detection
September 11, 2007
Image © 2008 DigitalGlobe
©2007 Google™
Pointer lat 13.505226° lon 144.802428°
Streaming 100%
Eye alt 6415 ft

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.

- Note: Only one of many CRB eradication programs has succeeded (Niuatoputapu Is., aka Keppel Is., Tonga; 16 km^2).


Initial Quarantine Area
September 2007
508
509
506
507
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502
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475
476
499
453
497
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486
469
470
465
464
A1
G1
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463
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G3
G2
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Image © 2007 DigitalGlobe
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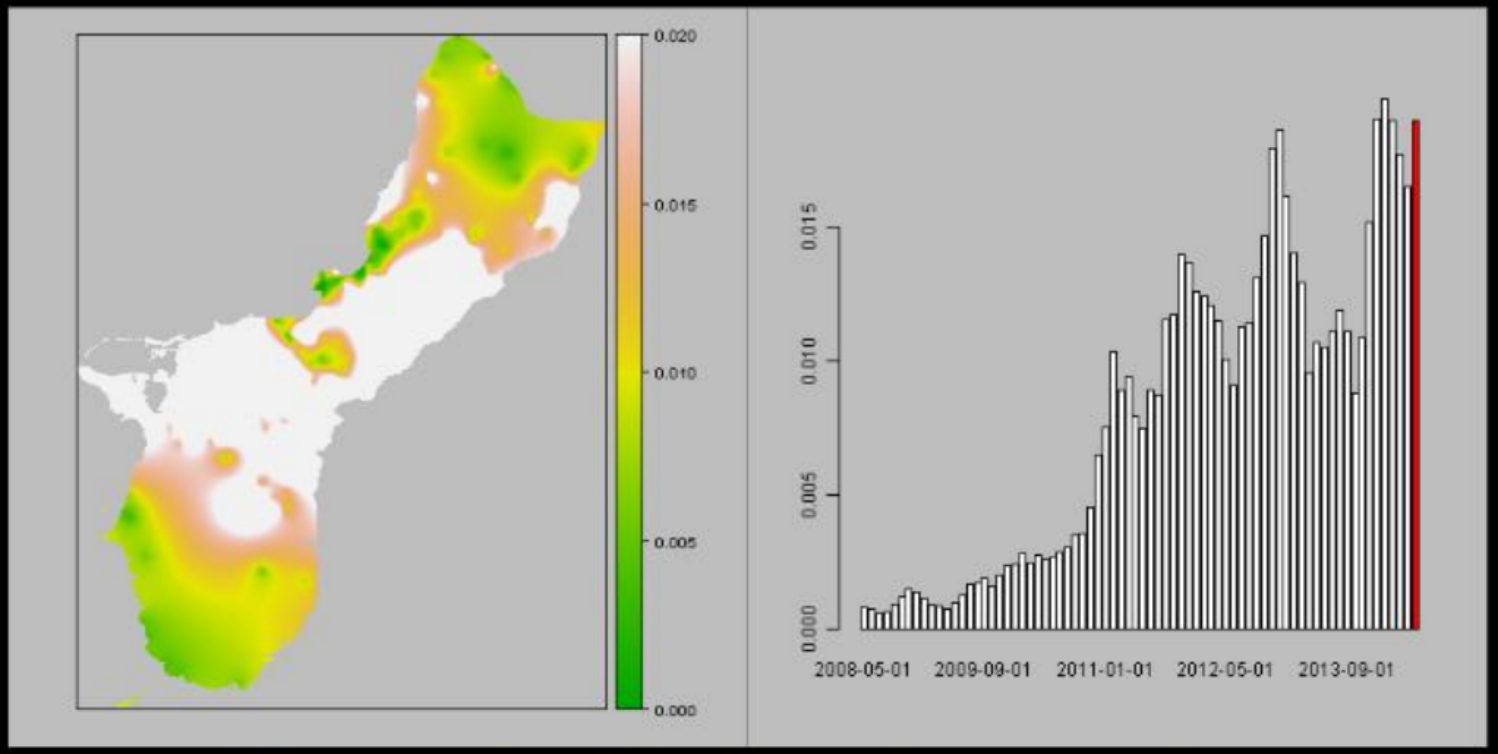
Guam Pheromone Trap Catch Data

90 day trapping period ending on 01 Jun 2014

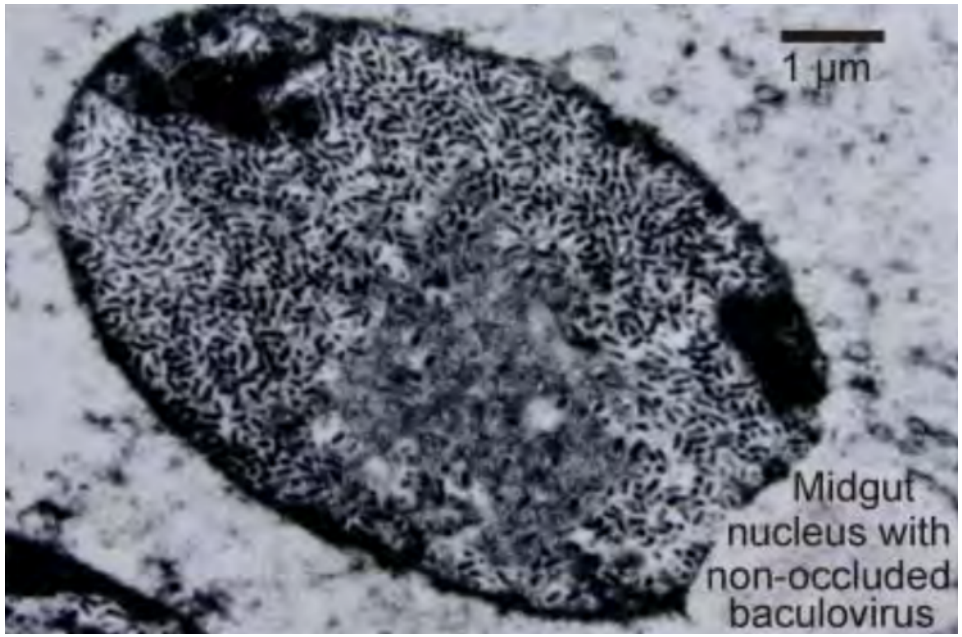


Mean number of beetles caught per trap-day

Screen capture from https://www.youtube.com/watch?v=DtBkEOsdGRE

Biocontrol

Oryctes rhinoceros nudivirus (OrNV)



Green muscardine fungus (GMF) *Metarhizium majus*

Discovery of the CRB-G Biotype

Marshall, S. D. G., Moore, A., Vaqalo, M., Noble, A., & Jackson, T. A. (2017).

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

Journal of Invertebrate Pathology, 149, 127–134.
https://doi.org/10.1016/j.jip.2017.07.006

Characteristics of CRB-G

- genetically distinct
- resistant to all available isolates of OrNV
- behavioral differences ???
  - not highly attracted to oryctalure
  - higher per-capita damage

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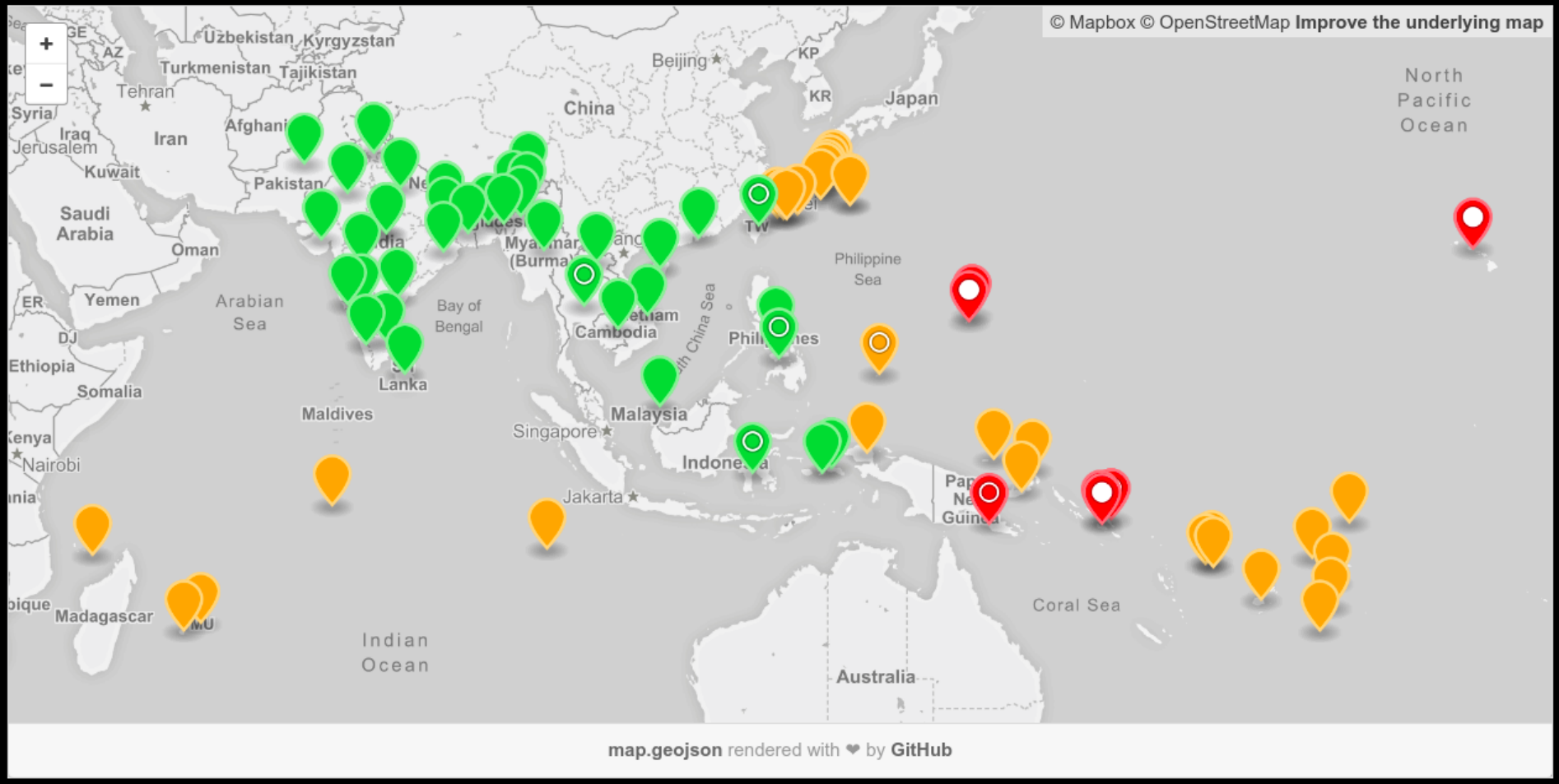
Coconut rhinoceros beetle invasion history

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



Data available at https://github.com/aubreymoore/crbdist

Screen capture from http://aubreymoore.github.io/crbdist/mymap.html 2018-08-05

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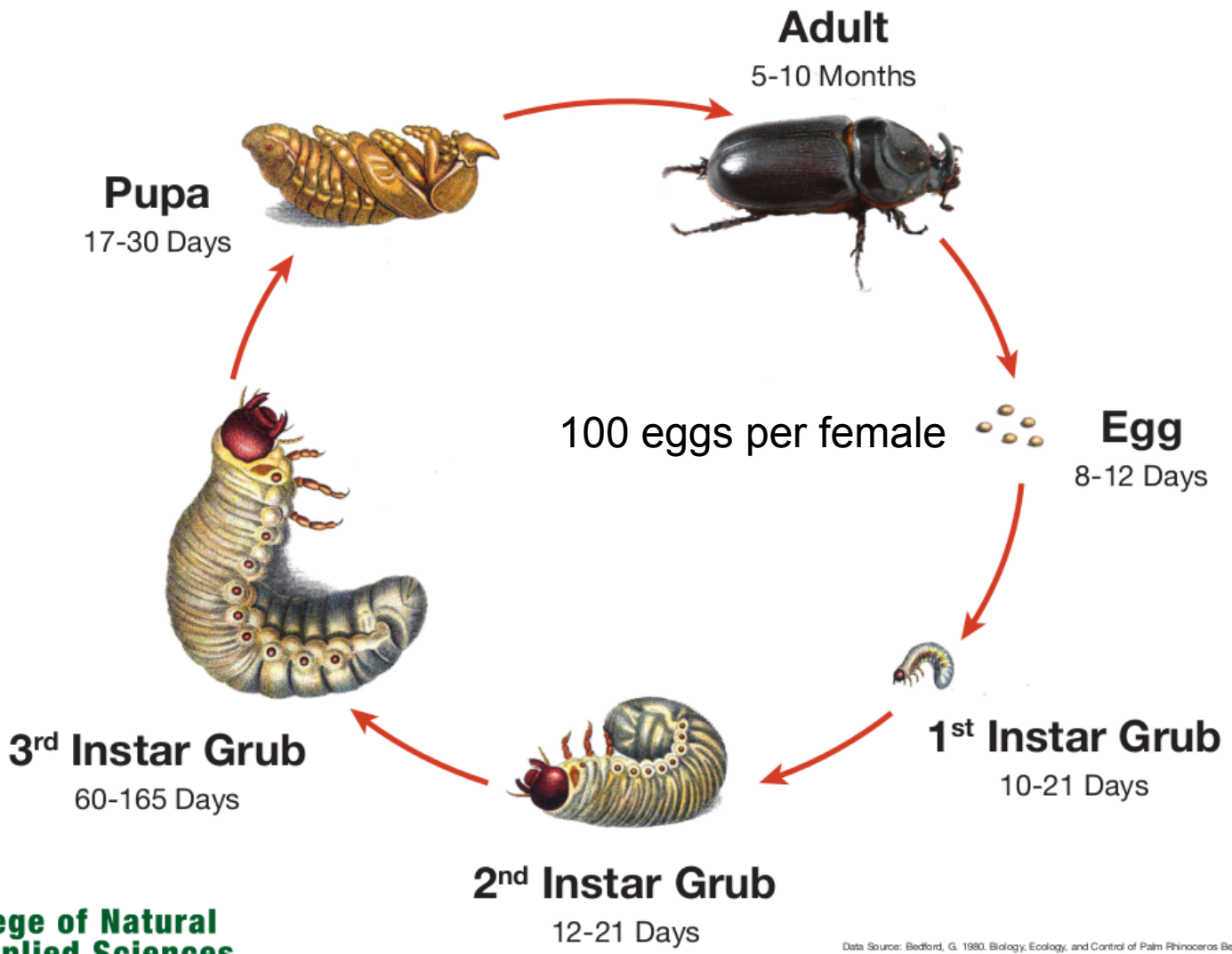
LIFE CYCLE OF THE COCONUT RHINOCEROS BEETLE

Oryctes rhinoceros



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Data Source: Bedford, G. 1980. Biology, Ecology, and Control of Palm Rhinoceros Beetles. *Annual Review of Entomology* 25: 309-339.

CRB Population Growth May Be Explosive

Generation	Number of Beetles
0	2
1	100
2	5,000
3	250,000
4	12,500,000
5	625,000,000
6	31,250,000,000
7	1,562,500,000,000
8	78,125,000,000,000

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

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.

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Recent OrNV / CRB-G Bioassay Results

Table 1: *Oryctes rhinoceros* nudivirus (OrNV) bioassay results summary.

OrNV isolate	bioassay	method[1]	beetles	replicates	virus mortality (p)[2]	inactivated virus mortality (p)[3]
DUG42	DUG42[1]	injection	30	2	40% (0.65)	40% (0.65)
MALB	MALB[2]	injection	30	2	50% (0.37)	0% (1.00)
	MALBperOS[3]	per os	13	1	-60% (1.00)	20% (1.00)
PNG	PNG[4]	injection	81	4	90% (0.00)	5% (1.00)
	PNGperOS[5]	per os	21	1	0% (1.00)	0% (1.00)
V23B	V23B[6]	injection	66	4	88% (0.00)	0% (1.00)
	V23BperOS[8]	per os	32	2	80% (0.07)	20% (0.69)
	V23-large_bioassay[7]	per os	53	1	42% (0.00)	-
	V23_perOSIN[9]	per os	16	1	60% (0.06)	-

[1] Adult beetles were dosed either by direct injection of virus suspension into the haemocoel or by applying a droplet containing virus to mouthparts.

[2] Percent mortality in beetles treated with virus, adjusted for untreated control mortality; number in parentheses is the p-value resulting from a Fisher's exact test of significant difference between mortality of treated and untreated beetles.

[3] Percent mortality in beetles treated with heat inactivated virus, adjusted for untreated control mortality; number in parentheses is the p-value resulting from a Fisher's exact test of significant difference between mortality of treated and untreated beetles.

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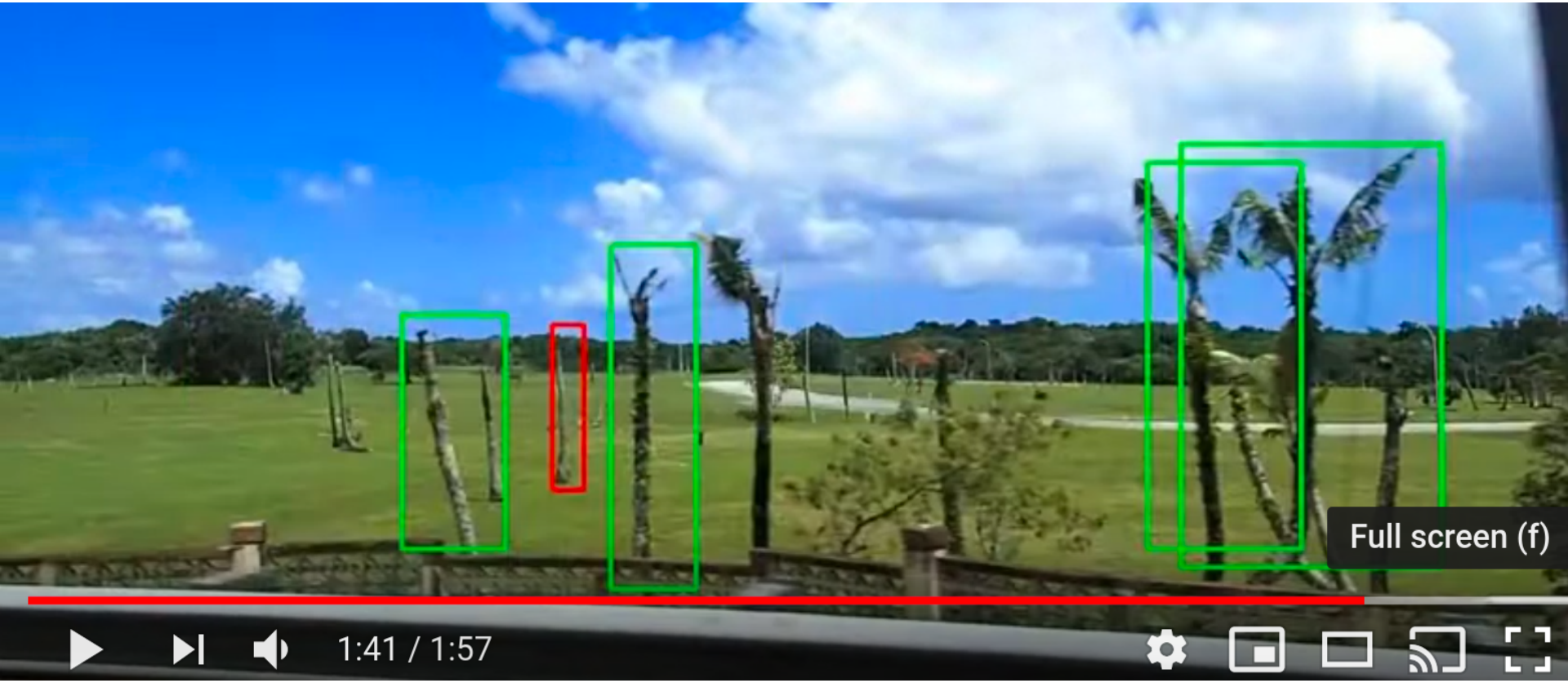
Automated Mapping of CRB Damage from Roadside Video Surveys



Screen capture from https://www.youtube.com/watch?v=zzSorqcmt9U 2019-11-04

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Online Resources

- CRB Bibliography
  https://github.com/aubreymoore/CRB-Bibliography
- Interactive CRB Invasion History Map
  http://aubreymoore.github.io/crbdist/mymap.html
- CRB Wiki Site
  http://guaminsects.net/CRBG/index.phptitle=CRB-G_Wiki
- CRB-G Facebook Site
  https://www.facebook.com/groups/crbg07/


FRUIT
Shredded Coconut
SHELL
Coconut Water
HUSK
Coconut Cream
Scraper
Fish Hook
Coconut Meat
Kindling
Musical Instument
Posts
LEAF
Lashing
Basket
TRUNK
Mat
Drum
MIDRIB
Kukui Nut
Torch
Skewer
SPATHE
Container
Fish Trap
Mat
LEAF
BUD SHEATH