CRB BIOLOGY

Know your enemy.

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CNMI CRB Project Teleconference

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US Dept of the Interior
Office of Insular Affairs

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Forest Service

Legislature of Guam

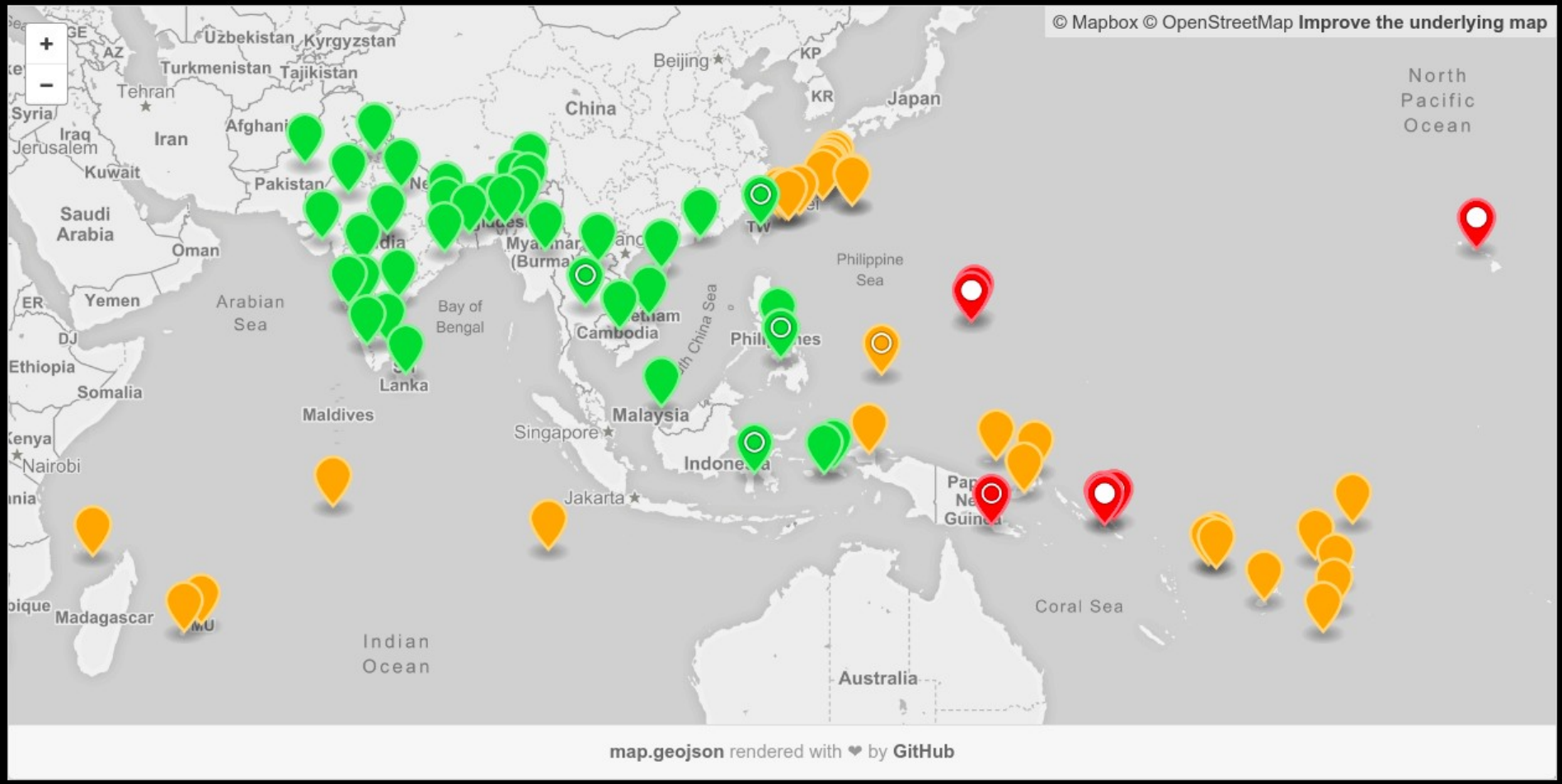
US Dept of Agriculture
Animal Plant Inspection Service

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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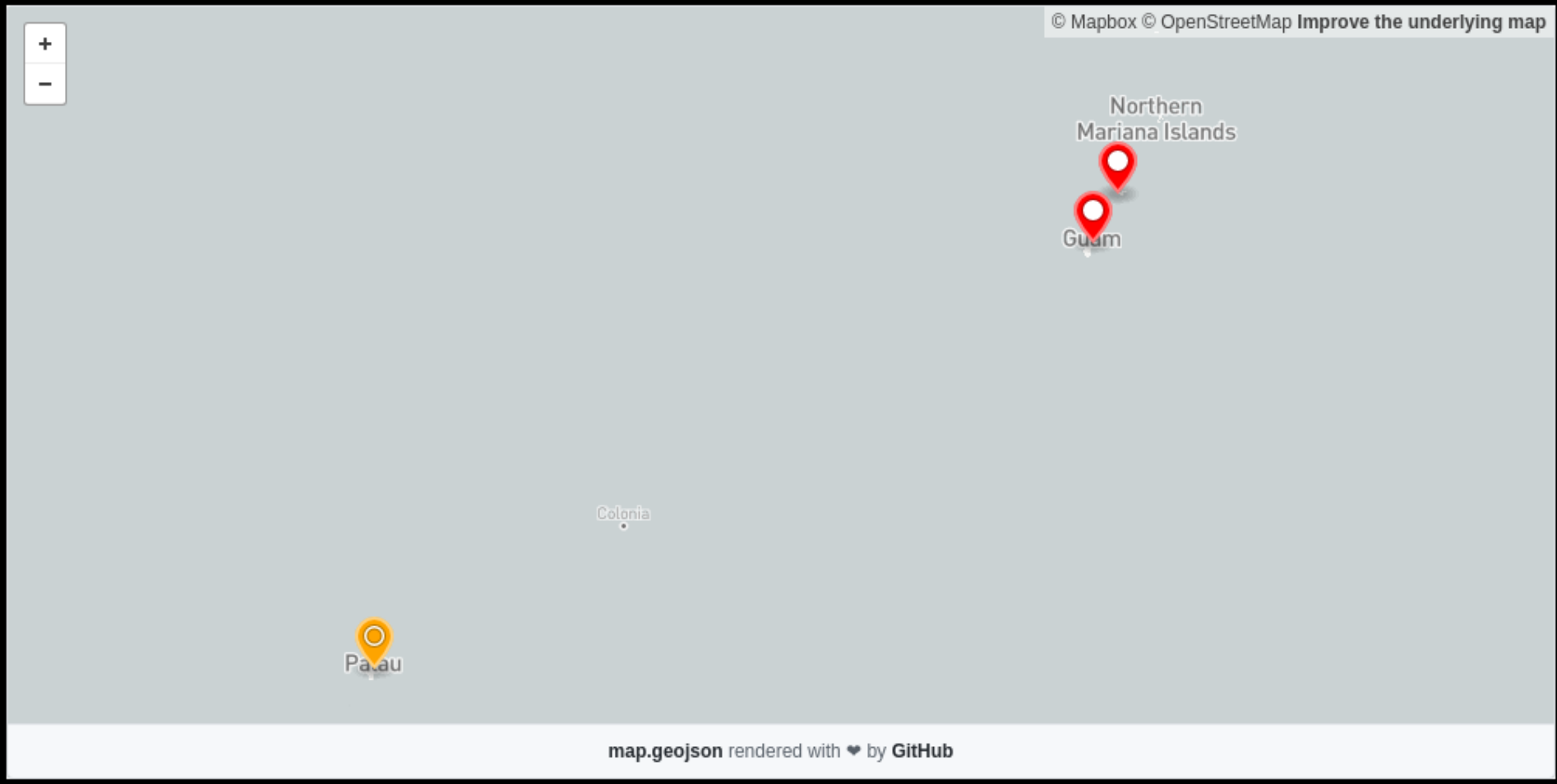

Screen capture from http://aubreymoore.github.io/crbdist/mymap.html 2021-02-20

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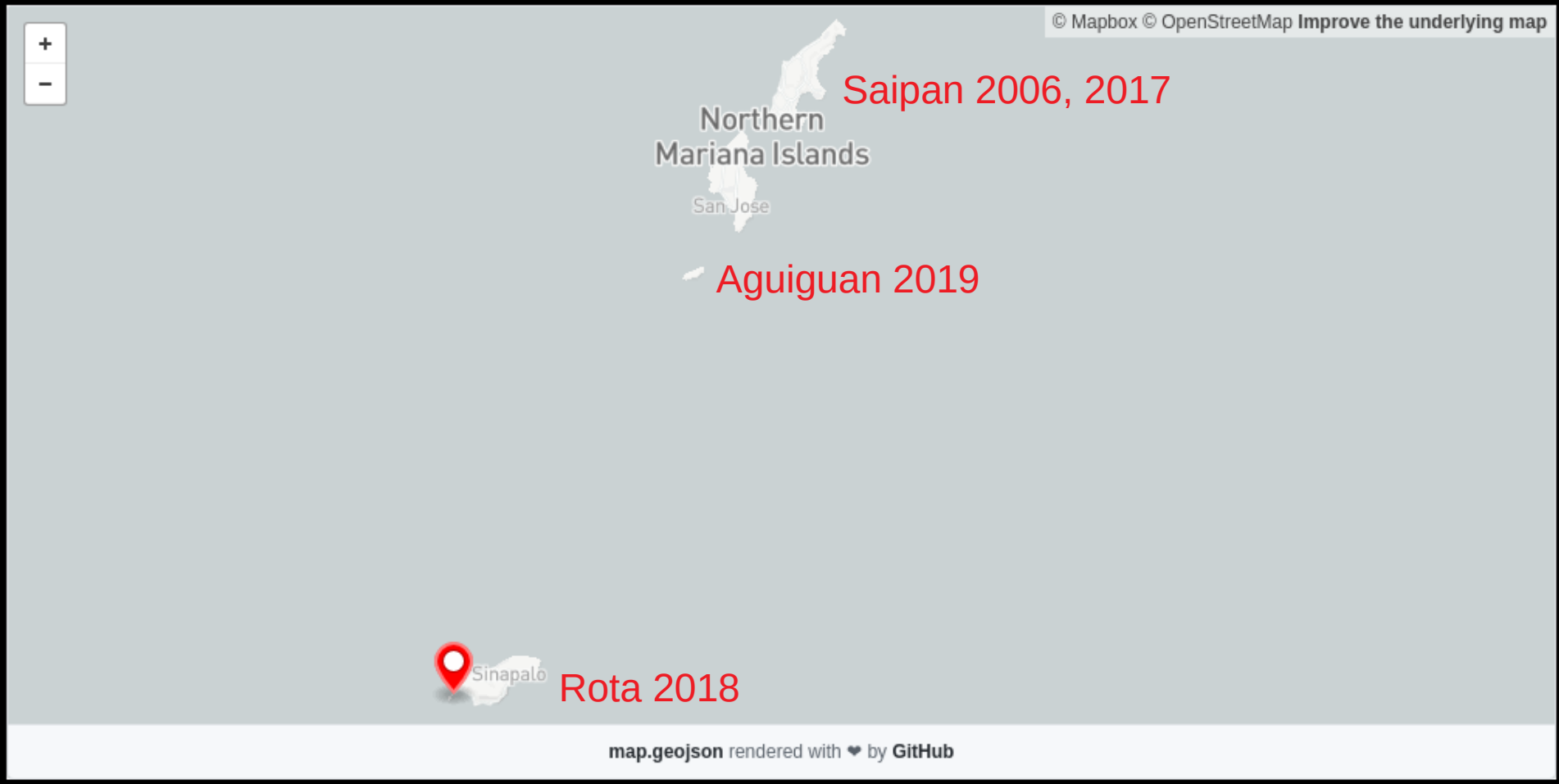


Screen capture from http://aubreymoore.github.io/crbdist/mymap.html 2021-02-20

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.

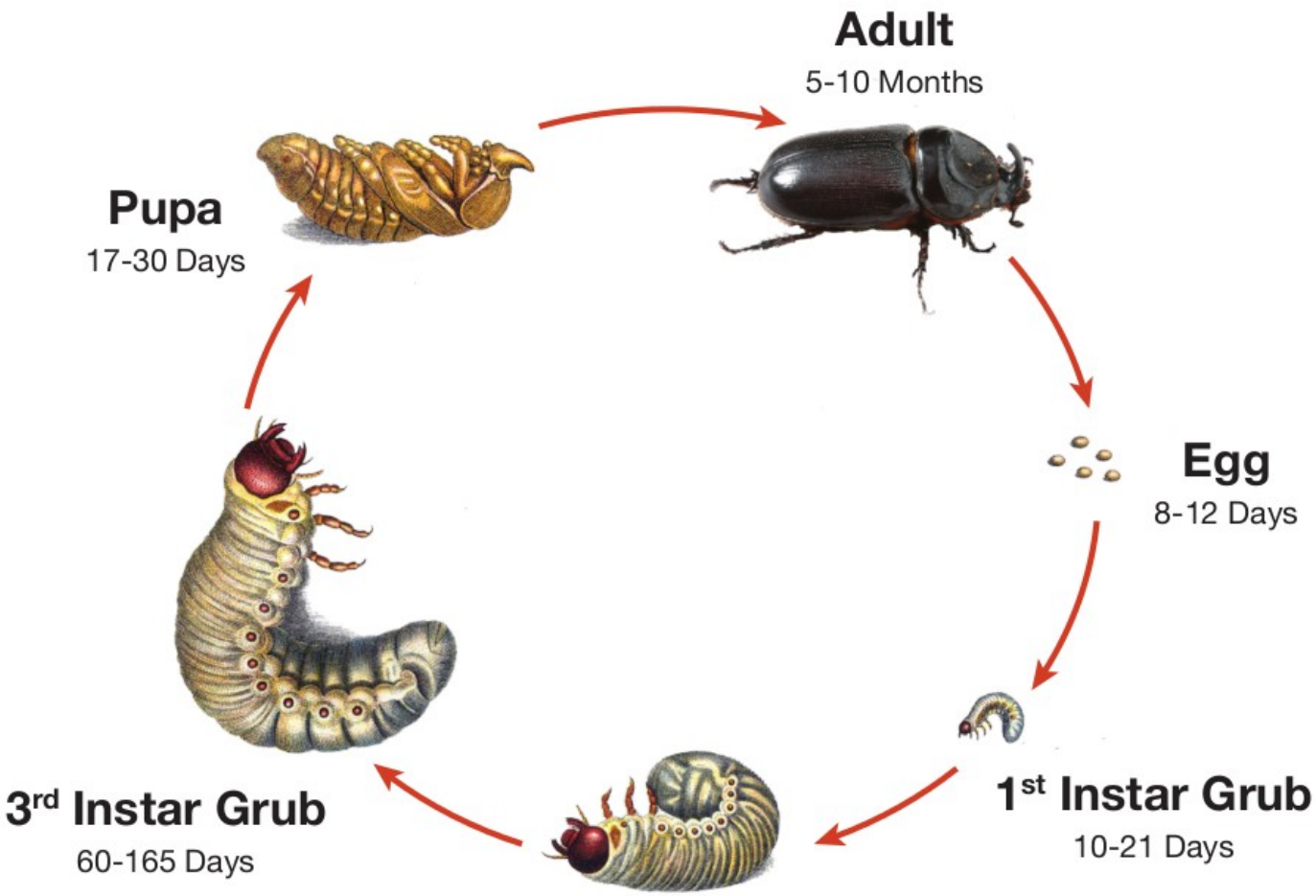
Journal of Invertebrate Pathology, 149, 127–134.
https://doi.org/10.1016/j.jip.2017.07.006

Characteristics of CRB-G

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

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.

Potential Population Growth

- Each female lays 60 eggs
- No mortality
- Sex ratio is 1:1

Generation	CRB Population
1	60
2	1,800
3	54,000
4	1,620,000
5	48,600,000
6	1,458,000,000
7	43,740,000,000
8	1,312,200,000,000


FELCO 2

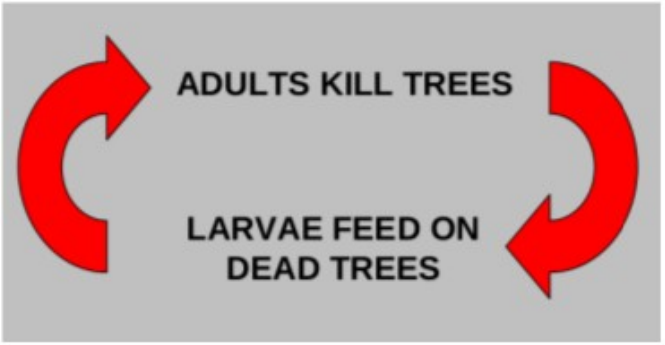


Figure : Coconut palms killed by *Oryctes rhinoceros* in Fiji (photo by Bedford)

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

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

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)

Research Priorities

- Establishment of effective self-sustaining biological control
- Development of automated detecting and monitoring of CRB damage
- Precision pesticide application using drones
- Improved methods for detecting CRB breeding sites

Establishment of self-sustaining biological control

Reduction in CRB damage after introduction of Oryctes nudivirus in Fiji (Bedford 1985)

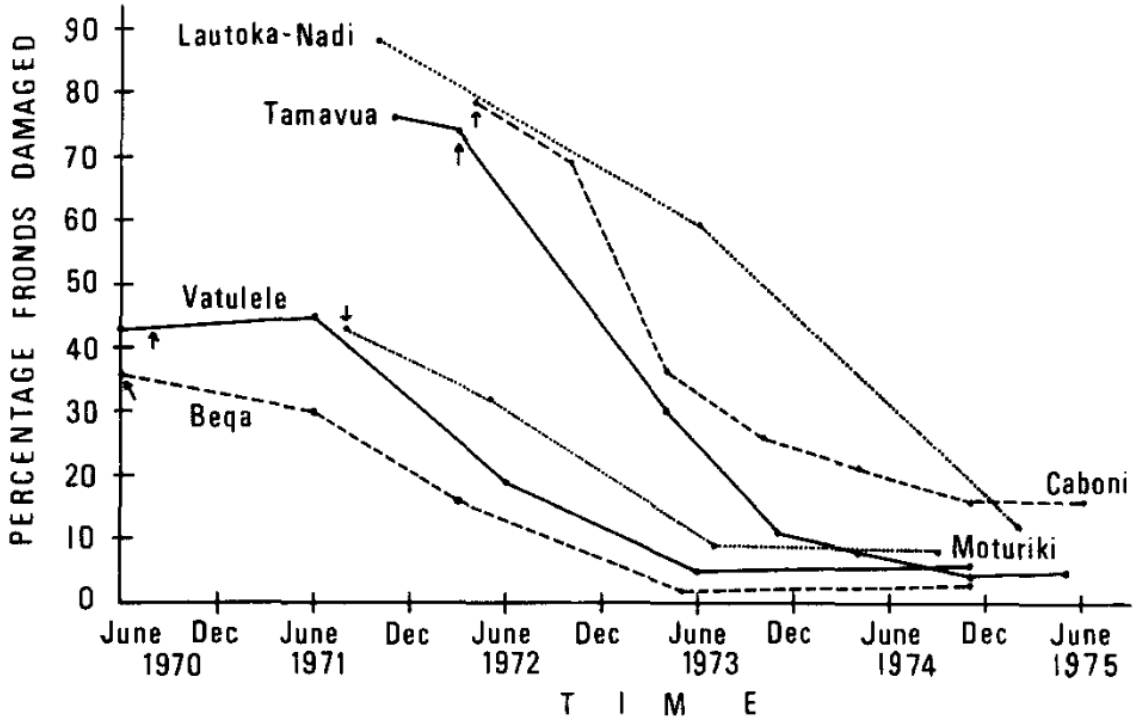
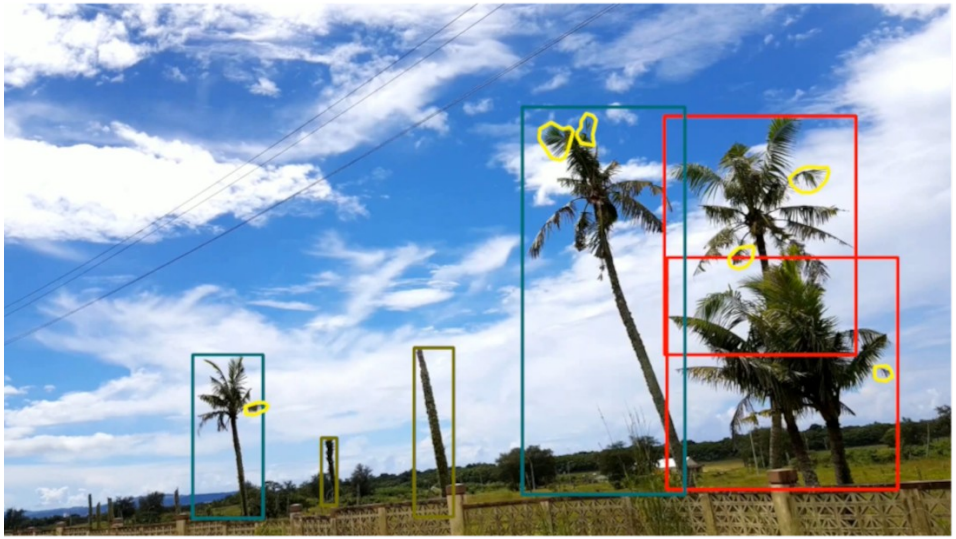
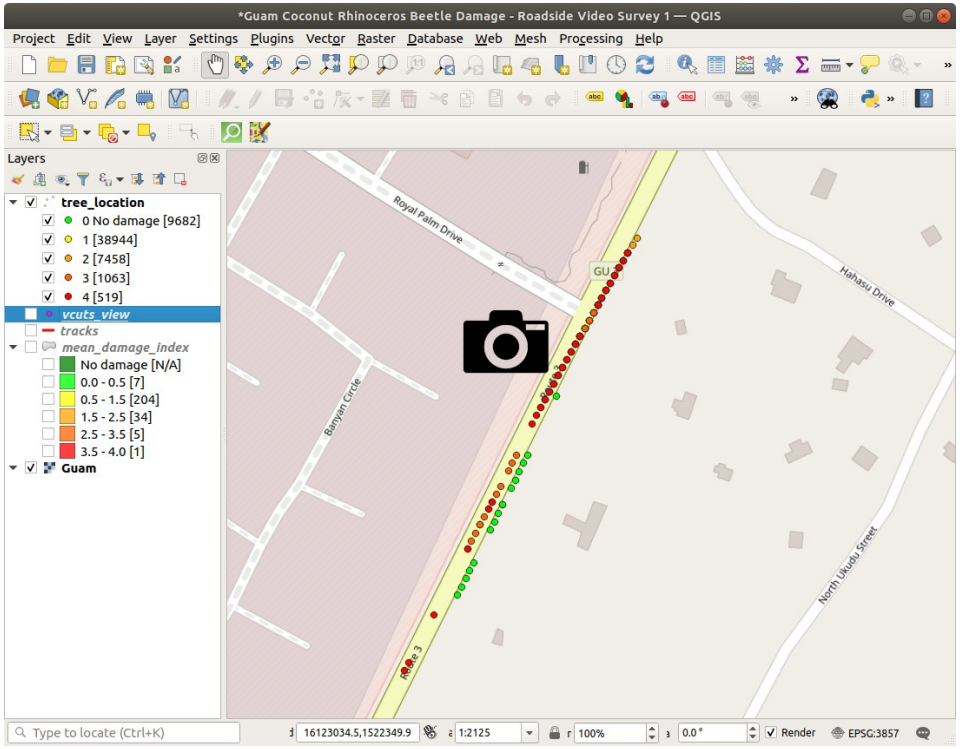


Fig. 1. Effect of baculovirus on palm damage by *Oryctes rhinoceros* at localities in the Fiji Islands. Arrows indicate time of virus introduction. Virus had spread naturally into the Lautoka-Nadi area by mid-1973.

Automated detection and monitoring of CRB damage





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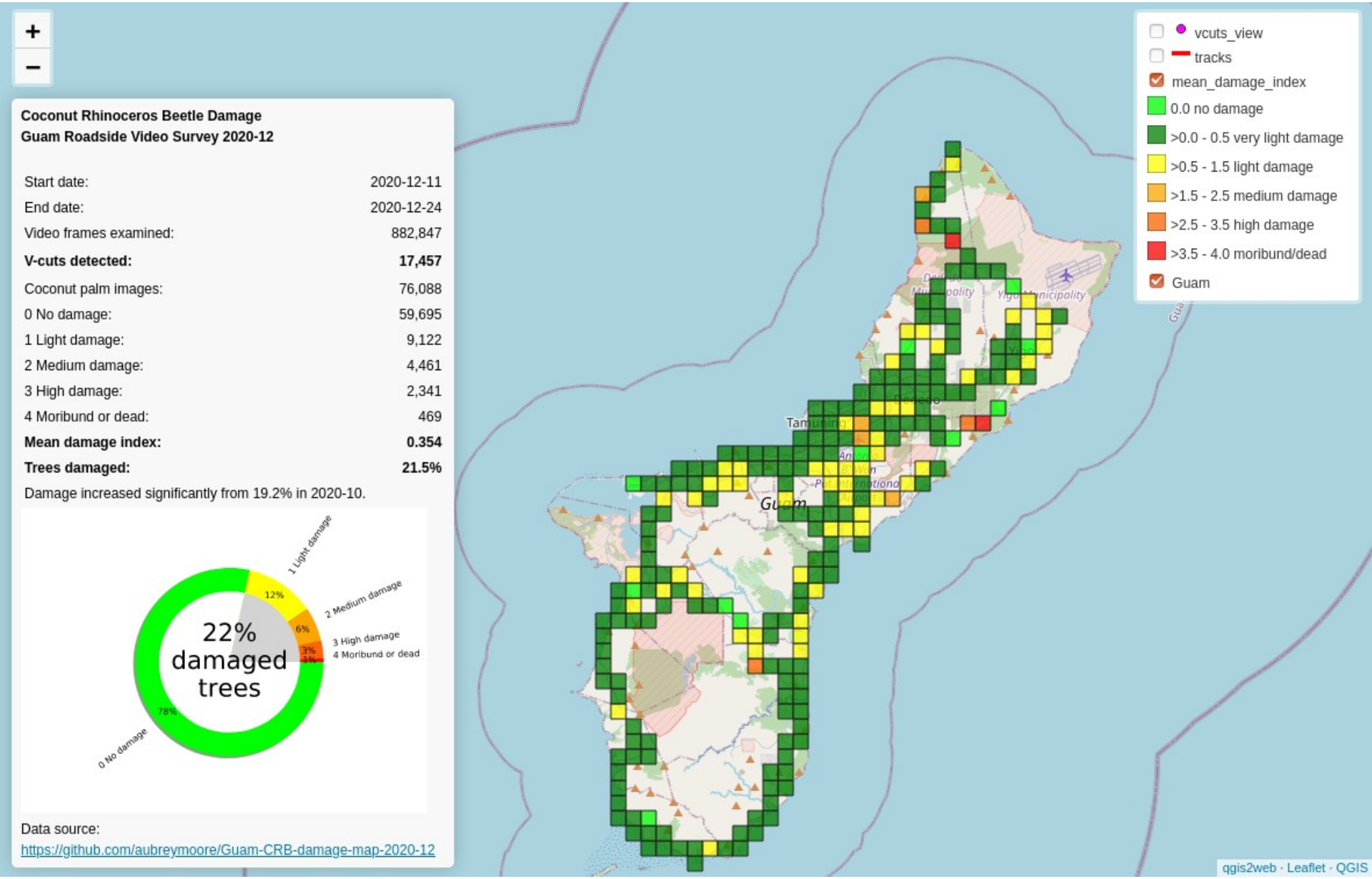
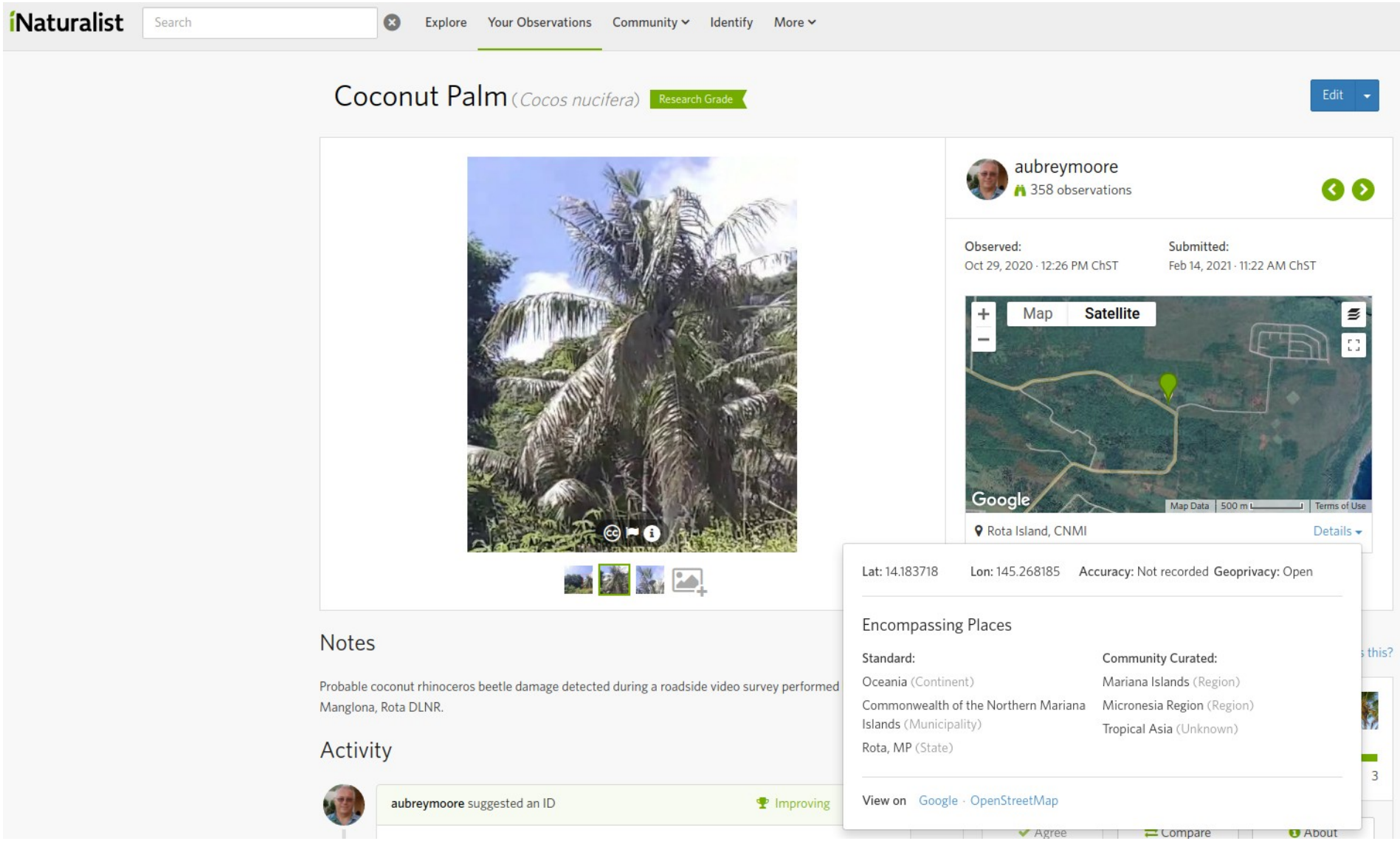


Screenshot of https://aubreymoore.github.io/Guam-CRB-damage-map-2020-12/webmap/v1

Automated detection and monitoring of CRB damage



Screenshot of https://www.inaturalist.org/observations/69534809

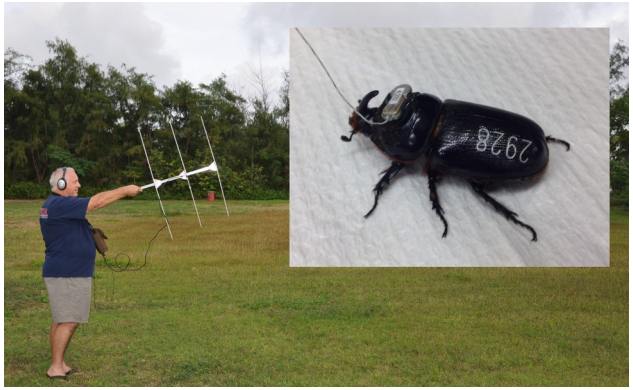
Precision pesticide application using drones

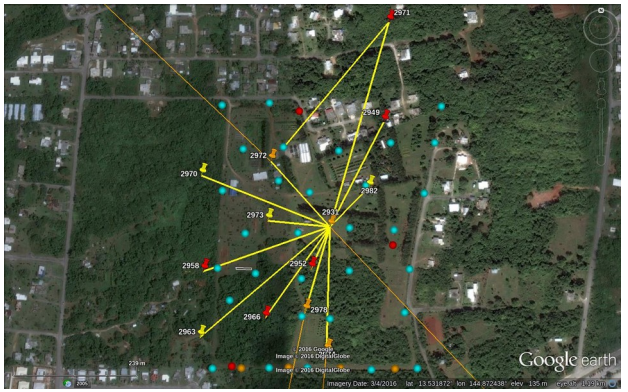
- Get precise location of coconut palms with v-shaped cuts using drone imagery and AI
- Program an applicator drone to apply pesticide to crowns of damaged palms

Improved methods for detecting CRB breeding sites

Detector dogs

Detector Beetles
(radio-tracking)





Detector Beetles
(harmonic radar)


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