2018 CRB Damage Assessments and Distribution In Palau

Melemalt E. Benedict

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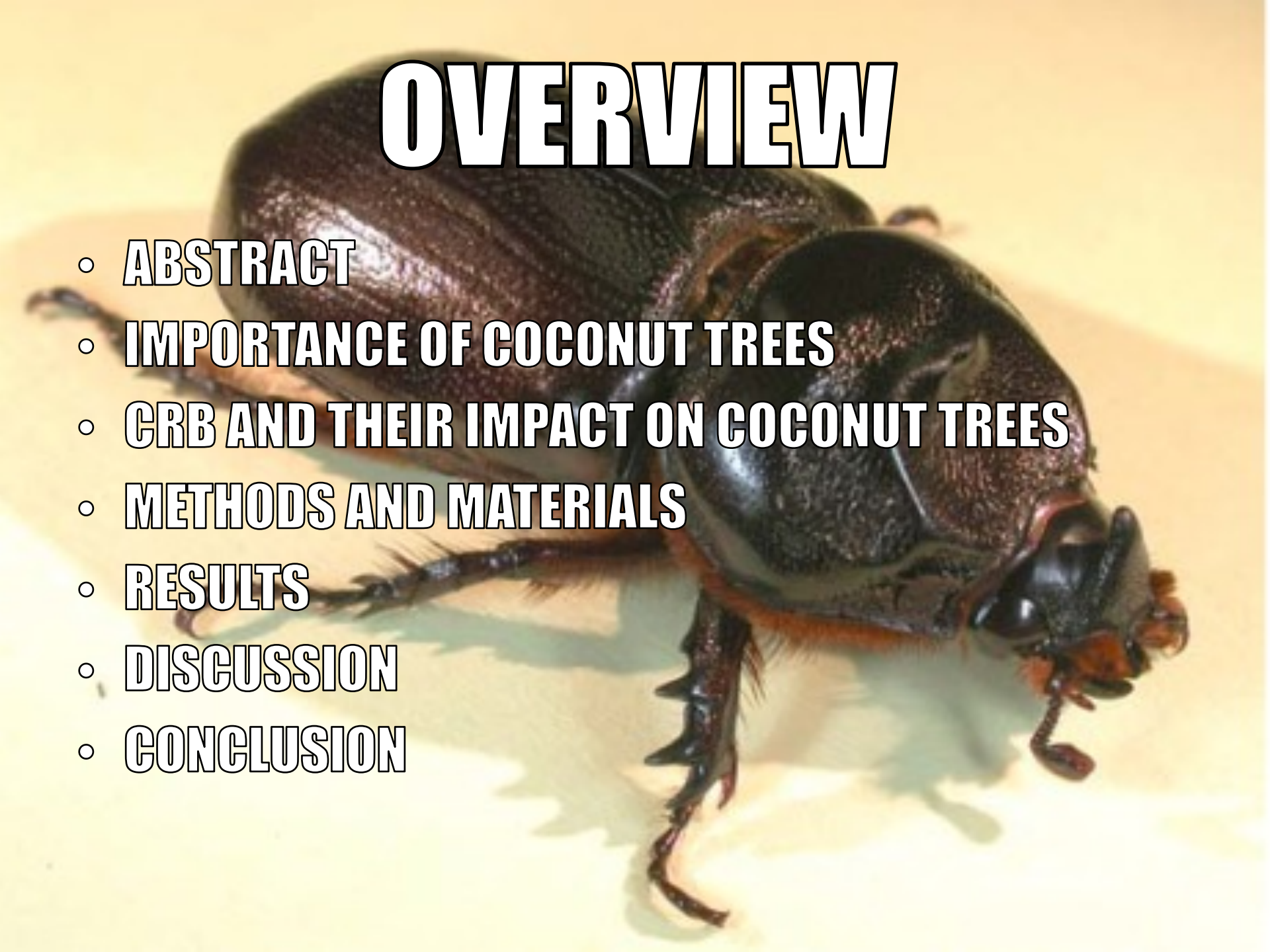
Joel Miles PhD, & Christopher Kitalong PhD


Japan
3215.5km
Palau
870 km
Philippines
Palau
900 km
Papua
Google earth

OVERVIEW



- ABSTRACT
- IMPORTANCE OF COCONUT TREES
- CRB AND THEIR IMPACT ON COCONUT TREES
- METHODS AND MATERIALS
- RESULTS
- DISCUSSION
- CONCLUSION

ABSTRACT

Assessment of Coconut Rhinoceros Beetle Damage and Resistance in the Palau Archipelago

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ABSTRACT

The Coconut Rhinoceros Beetle (CRB), a.k.a. *Oryctes rhinoceros*, is an invasive insect that kills coconut trees and other palm species by feeding on the plant's crown. There is a confirmed presence of at least two biotypes of the CRB in Palau, Nudivirus (OrNV) resistant CRB-G versus all other CRB types. The resistant CRB-G has caused the devastation of palm trees throughout Southeastern Asia and Pacific. Multiple institutions across the globe have been working to help control and eradicate CRB.

In Palau, Damage Assessment Surveys were conducted on coconut trees at representative locations throughout all states in 2016, 2017, and 2018. Specialized traps were used along with manual searches through debris to collect samples as well. DNA analysis was used to determine distribution of CRB-G as well as incidence of Nudivirus infection in each sample.

The results of the Damage Assessment Surveys show slow recovery/reduced damage in coconut tree fronds. Furthermore, analysis of biotype and viral detection show a very high rate of infection of all CRB with the Nudivirus (CRB: 92%; CRB-G: 83%).

These findings lead to the preliminary conclusion that the OrNV in Palau's CRB is virulent. This is one of the largest collections and assessment in the region and the first sites where the resistant strain was found infected by the Nudivirus. Further assessment is necessary but immediate focus of all parties should be made to identify and test virulence of OrNV in Palau in order to control CRB for the region.

WHY COCONUT TREES ARE IMPORTANT...

- TOURIST ATTRACTION
- SIGNIFICANT PART OF PALAUAN CULTURE
- USED IN PRODUCING OIL, BASKETS, & BROOMS
- IMPORTANT SOURCE OF FOOD & DRINK

CRB (COCONUT RHINOCEROS BEETLE)

- INVASIVE SPECIES FROM SOUTHEAST ASIA
- FIRST APPEARED IN PALAU IN THE 1950S
- ADULT MALES LIVE FOR ~5 MONTHS FEMALES ~9 MONTHS

CRB LARVAE

CRB Adult

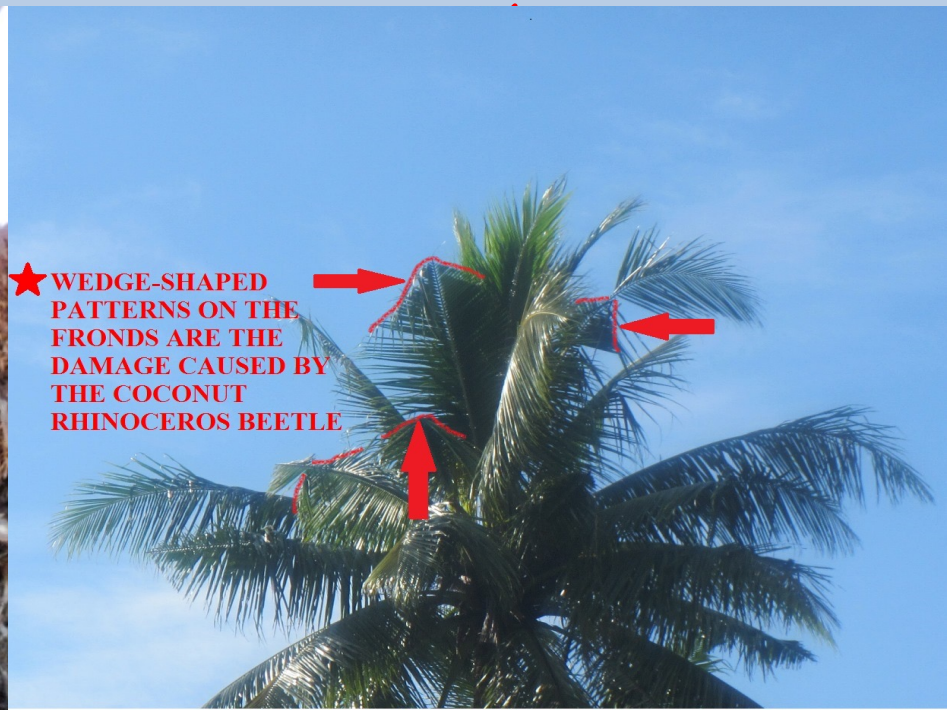
https://dlnr.hawaii.gov/hisc/info/invasive-species-profiles/coconut-rhinoceros-beetle/

CRB BREEDING SITES

- ROTTEN COCONUT LOGS
- COMPOST PILES
- MULCH
- OLD PILES OF LEAVES OR FRONDS

CRB DAMAGE TO COCONUT TREES

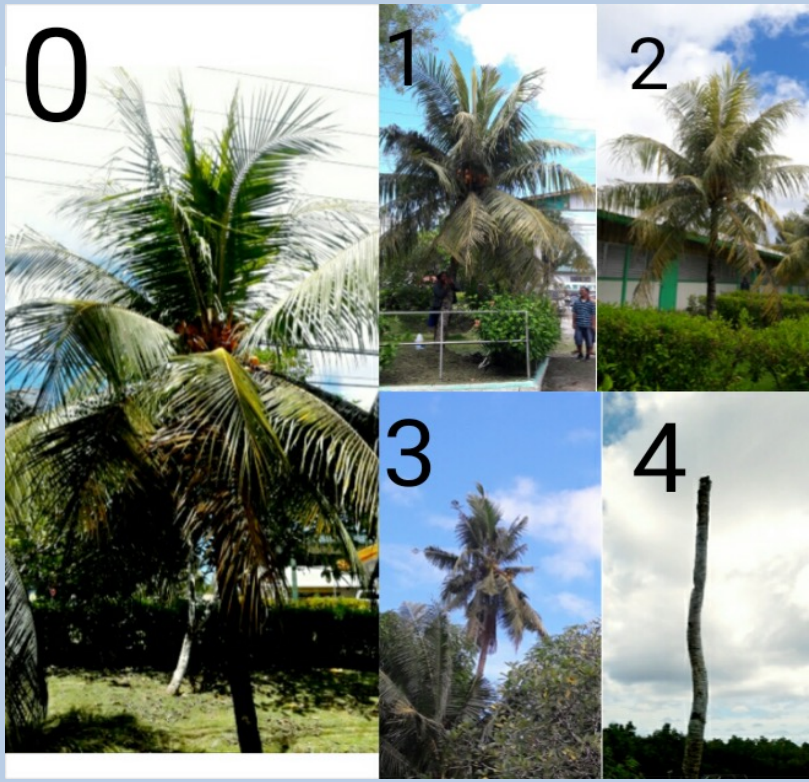
The CRB drills holes into the coconut when the coconut tree is still young and makes its way to the crown or "heart" of the tree where it feeds on the inside. Damage to the leaves is later indicated by wedge shapes on the fronds.



TREE DAMAGE

CRB DAMAGE ASSESSMENTS, A scale of 0-4, developed by SPC (Secretariat of the Pacific Community), is being used to rate the amount of damage on coconut trees in numerous sites around Palau.

- 0 = No damage (0% of leaves are removed)
- 1 = Light Damage (1% - 29% of leaves are removed)
- 2 = Moderate Damage (30% - 49% of leaves are removed)
- 3 = Severe Damage (>50% of leaves are removed)
- 4 = Dead Tree (100% of leaves are removed)



METHODS AND MATERIALS

- LOCATING SURVEY SITES AND RECORDED THEIR GPS COORDINATES
- RECORDING DAMAGE ASSESSMENT DATA
- ANALYZED ASSESSMENT DATA IN R VERSION 3.5.1 VIA ANOVA.

RGui (32-bit)

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C:\Users\User\Desktop\STEP-UP Research\REORGANIZED CRB DATA\DATA ANALYSIS.R - R Editor

```
summary(allstates.2016$TOP.4.FRONDS)
summary(allstates.2017$TOP.4.FRONDS)
summary(allstates.LATE2017$TOP.4.FRONDS)
summary(allstates.MID2018$TOP.4.FRONDS)

aov.allstates.overall.sites<-aov(all.states$OVERALL~all.states$SITE)
aov.allstates.overall.year<-aov(all.states$OVERALL~all.states$YEAR)
aov.allstates.TOP.4.FRONDS.sites<-aov(all.states$TOP.4.FRONDS~all.states$SITE)
aov.allstates.TOP.4.FRONDS.year<-aov(all.states$TOP.4.FRONDS~all.states$YEAR)
summary(aov.allstates.overall.sites)
summary(aov.allstates.overall.year)
summary(aov.allstates.TOP.4.FRONDS.sites)
summary(aov.allstates.TOP.4.FRONDS.year)
TukeyHSD(aov.allstates.overall.year)
TukeyHSD(aov.allstates.overall.sites)
TukeyHSD(aov.allstates.TOP.4.FRONDS.sites)
TukeyHSD(aov.allstates.TOP.4.FRONDS.year)

summary(all.states)

#COMARISON OF STATES BY ODP
aov.AIRAI<-aov(AIRAI$OVERALL~as.factor(AIRAI$YEAR))
TukeyHSD(aov.AIRAI)

aov.KAYANGEL<-aov(KAYANGEL$OVERALL~as.factor(KAYANGEL$YEAR))
TukeyHSD(aov.KAYANGEL)

aov.NGARCHELONG<-aov(NGARCHELONG$OVERALL~as.factor(NGARCHELONG$YEAR))
TukeyHSD(aov.NGARCHELONG)

aov.NGARRARD<-aov(NGARRARD$OVERALL~as.factor(NGARRARD$YEAR))
TukeyHSD(aov.NGARRARD)

aov.NGIWAL<-aov(NGIWAL$OVERALL~as.factor(NGIWAL$YEAR))
```

R Console

```
RIS006-MER003  9.006780e-01  1.032252e-01  1.6981307543 0.0049048
KOR001-MER003  4.361905e-01 -6.359390e-01  1.5083199473 1.0000000
KOR002-MER003  1.349474e+00  5.353193e-01  2.1636281064 0.0000000
KOR003-MER003  9.885714e-01  1.446719e-01  1.8324709652 0.0020933
KOR004-MER003  1.310000e+00  4.477825e-01  2.1722075142 0.0000004
KOR005-MER003  [illegible]  [illegible]  [illegible] 0.0000025
KOR006-MER003  [illegible]  [illegible]  [illegible] 1.0000000
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KOR010-MER003  5.564912e-01 -3.123641e-01  1.4253465470 0.9770670
KOR011-MER003  8.488889e-01  8.079438e-03  1.6896983399 0.0428249
KOR012-MER003  1.137215e+00  3.060620e-01  1.9683684061 0.0000226
KOR013-MER003  3.855319e-01 -5.110610e-01  1.2821247934 1.0000000
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KAY004-MER003  1.266667e+00  4.302025e-01  2.1031308201 0.0000005
KAY005-MER003  1.413333e+00  5.768692e-01  2.2497974868 0.0000000
KAY006-MER003  1.533333e+00  6.968692e-01  2.3697974868 0.0000000
NGC001-MER003  6.100000e-01 -3.134314e-01  1.5334314220 0.9582570
NGC002-MER003  3.600000e-01 -5.272042e-01  1.2472042127 1.0000000
NGC003-MER003  8.800000e-01 -1.444552e-01  1.9044551820 0.3259669
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NGR004-MER003  6.647619e-01 -1.412751e-01  1.4707989316 0.4508874
NGI001-MER003  7.345098e-01 -7.380353e-02  1.5428231330 0.1846633
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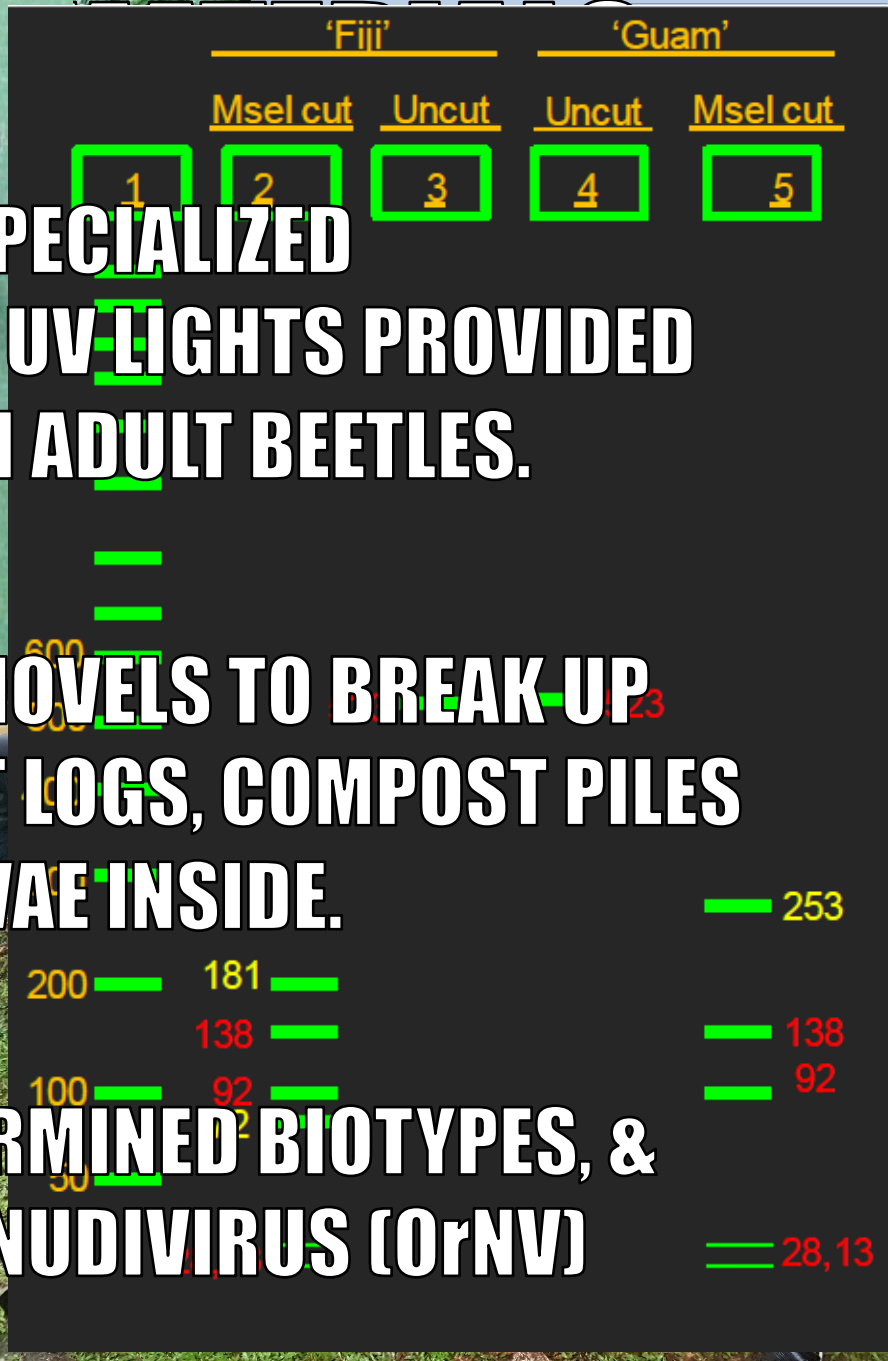
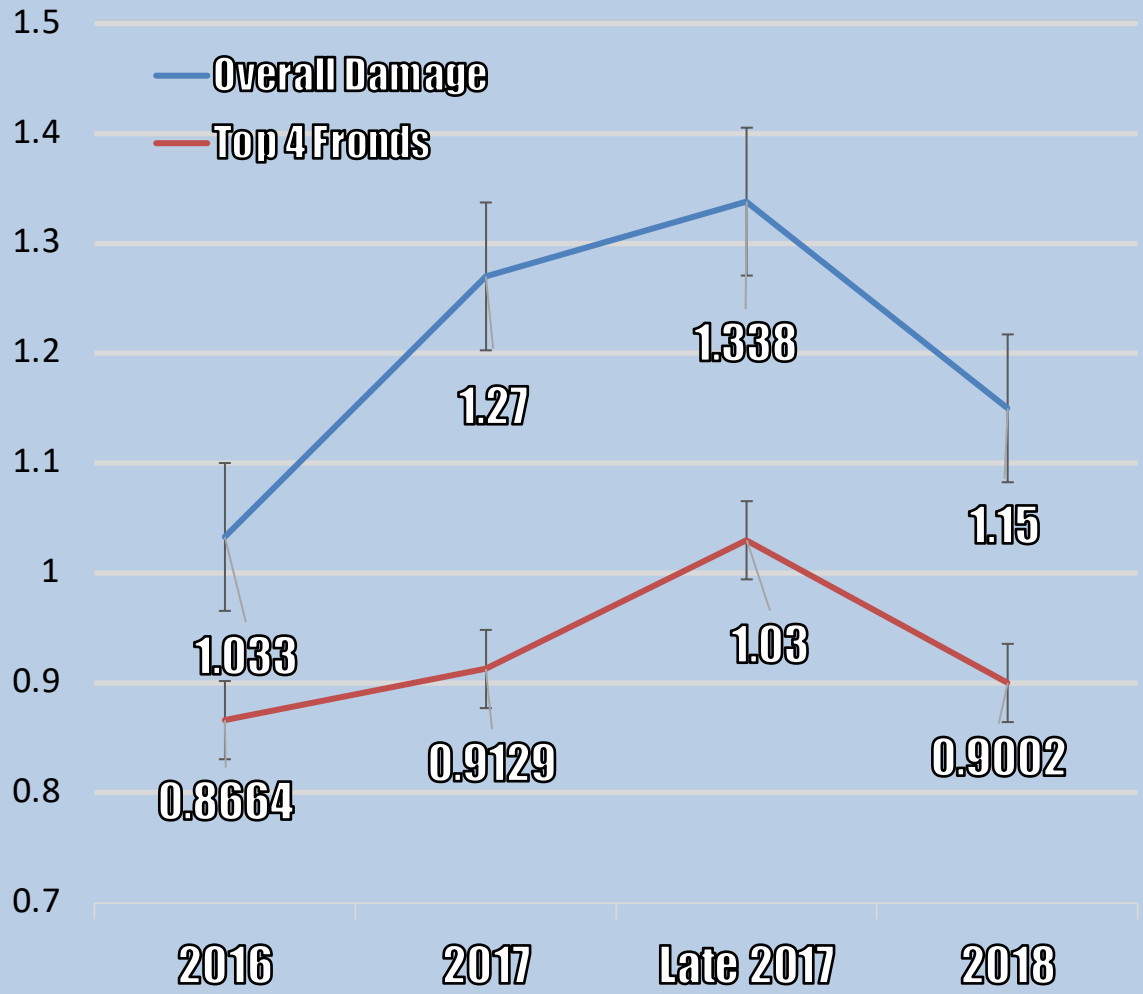


- COLLECTING ADULT CRB SPECIALIZED PHEROMONE TRAPS WITH UV LIGHTS PROVIDED BY UH ARE USED TO CATCH ADULT BEETLES.

- USED GLOVES, PICKS, & SHOVELS TO BREAK UP MULCH, ROTTEN COCONUT LOGS, COMPOST PILES TO COLLECT THE CRB LARVAE INSIDE.

- DISECTED SAMPLES, DETERMINED BIOTYPES, & DETECTED THE PRESENCE NUDIVIRUS (OrNV)

Mean Damage Over 3 Years



Collected 2015-2017

		CRB-G		CRB-P	
	State	n	% Infected	n	% Infected
1	Aimeliik	12	92	22	100
2	Airai	6	100	10	91
3	Angaur	1	100	0	0
4	Kayangel	0	0	7	100
5	Koror	60	75	30	86
6	Melekeok	3	100	0	0
7	Ngaraard	5	100	1	100
8	Ngarchelong	6	100	10	91
9	Ngardmau	34	100	14	88
10	Ngatpang	3	100	0	0
11	Ngchesar	9	100	1	100
12	Ngeremlengui	12	92	2	50
13	Ngiwal	12	92	2	100
14	Peleliu	3	100	8	89
15	Rock Islands	8	75	7	58
16	Sonsorol	0	0	19	73
	Total	**174**	**83**	**133**	**70**

P-Values for Overall
2017-2016=0.0000000
2017-Late 2017=0.0926417
Late 2017-2018=0.0000000

P-Values for Top 4 Fronds
2017-2016=0.0121349
2017-Late 2017=0.0018246
Late 2017-2018=0.0000000

174 CRB-G
133 CRB-P
83% of CRB-G tested positive for OrNV

DISCUSSION

- Based on the survey we did these past three years, the coconut trees showed slight increase in damage.

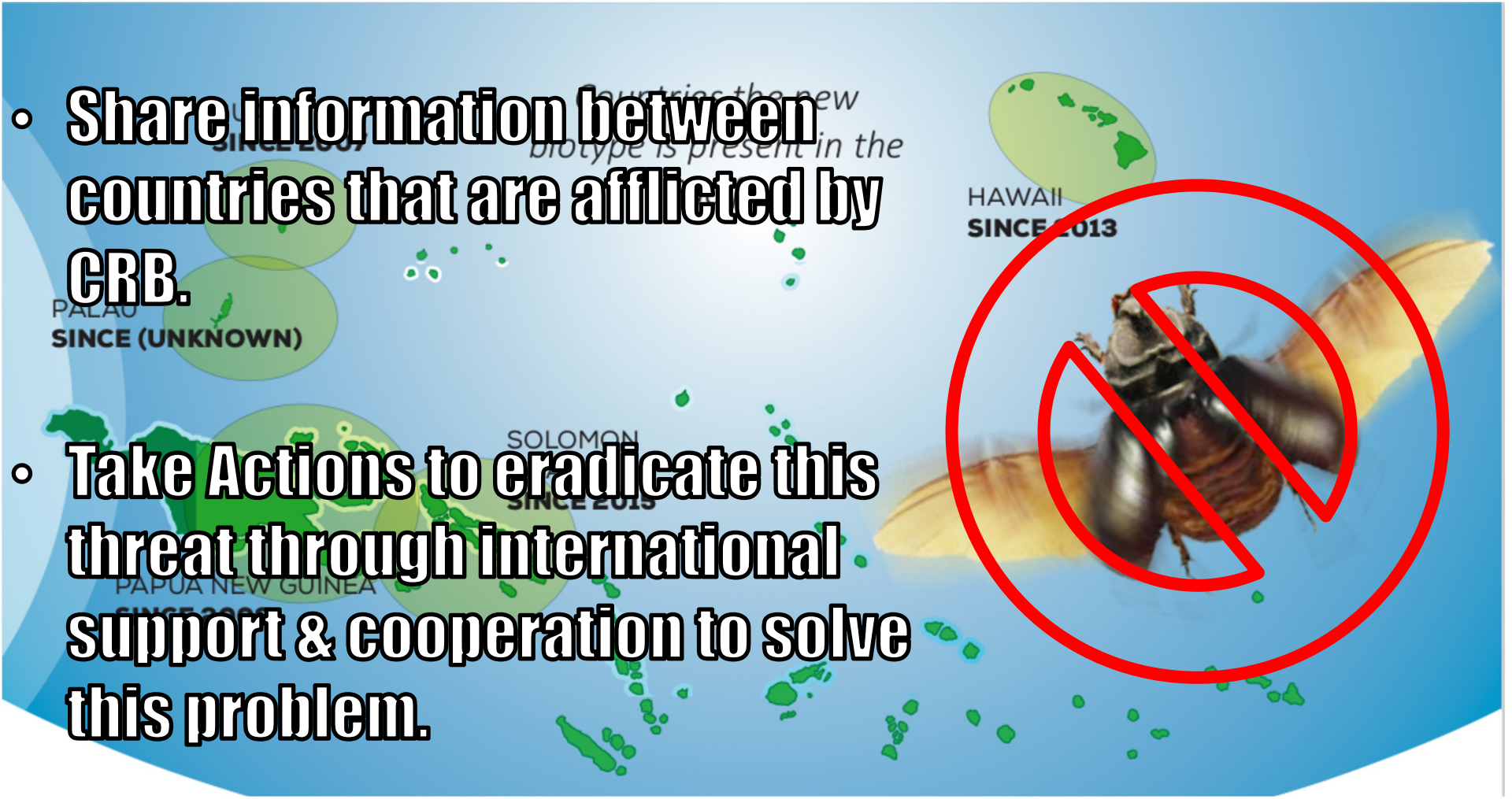
- The rate of increase of damage to the trees is much lower in Palau compared to other affected countries.

CONCLUSION

- These trends in addition to other evidence have led us to believe that cross-breeding between the two bio-types in Palau has made the resistant strain susceptible to the Nudivirus thereby killing them and sparing the coconut trees.

WHAT'S NEXT?

- We will raise awareness of CRB.
- Share information between countries that are afflicted by CRB.
- Take Actions to eradicate this threat through international support & cooperation to solve this problem.



Acknowledgments

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- Jose, Yaya, Marinca, Jason, & Jesse “PAIR CAMP TEAM”
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