

# Guam as a Source of New Insects for Hawaii

## Pacific Entomology Conference

Aubrey Moore

University of Guam  
College of Natural and Applied Sciences  
Cooperative Extension Services / Western Pacific Research Center

February 23, 2012



# Where is Guam?

## Guam as a Source of New Insects for Hawaii

Aubrey Moore

### Introduction

Early Concerns

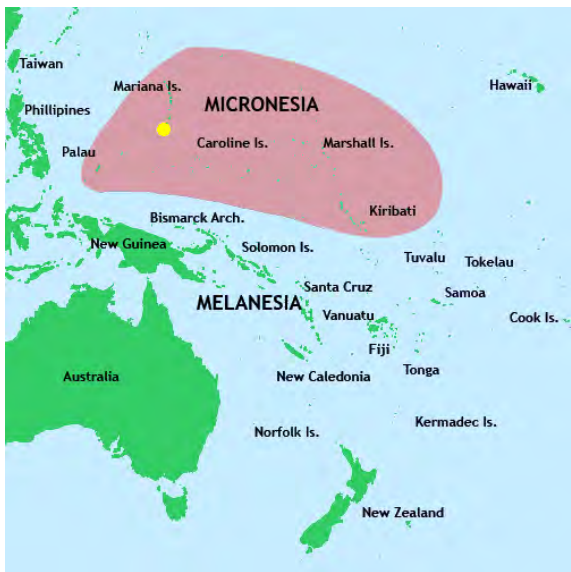
Suspects

Interceptions

Why is Guam Such a Good Source?

Conclusions

References



# Challenges

## Guam as a Source of New Insects for Hawaii

Aubrey Moore

### Introduction

Early Concerns

Suspects

Interceptions

Why is Guam Such a Good Source?

Conclusions

References

- Limited taxonomic expertise
  - only 6 active PhD level entomologists in all of Micronesia (4 on Guam; 2 in Palau)
- High endemism (~45%); many undescribed species
- Very high introduction rate for alien insects

# Origin of New Insects on Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

## New Insects on Guam (1945-89)

Schreiner, I. 1991. New insects in Guam. *Micronesica* Suppl. 3.

Source	1945-54	1955-69	1970-79	1980-89
Asia	7	2	9	8
Micronesia	1	1	4	2
Hawaii	0	2	2	8
Unknown	7	8	6	7
<b>Total</b>	<b>15</b>	<b>13</b>	<b>21</b>	<b>25</b>
<b>No. per Year</b>	<b>1.5</b>	<b>0.9</b>	<b>2.1</b>	<b>2.5</b>

# Origin of New Insects on Guam (1945-1989)

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

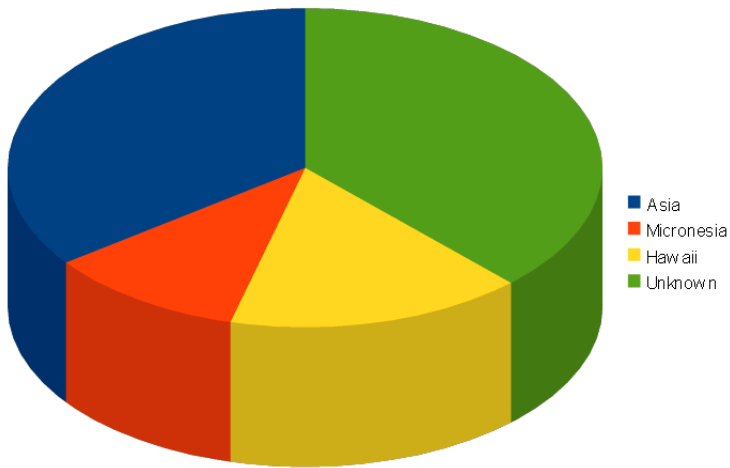
Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



Data source: [Schreiner(1991)]

# Current Invasions

## Guam as a Source of New Insects for Hawaii

Aubrey Moore

### Introduction

Early Concerns

Suspects

Interceptions

Why is Guam Such a Good Source?

Conclusions

References

- Asian cycad scale, *Aulacaspis yasumatsui* - detected 2003; has killed 90% of Guam's endemic cycad which was Guam's most populous tree
- Coconut rhinoceros beetle, *Oryctes rhinoceros* - detected 2007; is killing coconut palms, which was Guam's second most populous tree
- Little fire ant, *Wasmania auropunctata* - detected 2011

# 15 new island records in 2010-2011

## Guam as a Source of New Insects for Hawaii

Aubrey Moore

### Introduction

### Early Concerns

### Suspects

### Interceptions

### Why is Guam Such a Good Source?

### Conclusions

### References

- 4 bark beetles, Scolytidae, from a single CBB trap at a single location
- 2 biting flies: a black fly and an anopheline mosquito
- little fire ant
- 8 other species

# New Island Record for 2012

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

## Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



- *Dinurothrips hookeri* Hood (Thysanoptera: Thripidae)
- Distribution: Caribbean, Florida, Brazil
- Hosts: leaves of banana, tomato, various Asteraceae, sweet potato, eggplant
- For more info, visit <http://guaminsects.myspecies.info/thrips-attacking-young-banana-leaves>



# Early Concerns

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

*Via* PAN AMERICAN

OVER planes and radio waves flight is a direct line to the lands of the West Indies, Central and South America, high above the up-rising waves of the Atlantic. Spanish conquistadores, earth-breaking pioneers, of deeper steps of aerial exploration, and historic figures of long-ago times along the coast of California to the air air-ship that crosses and returns to its western harbors, linking the New World and the old, that span the vast Pacific Ocean, the Philippines and Java.

With a record unexcelled in any other mode of transportation, the schedule commenced in 1919, and eight years ago this month, pioneer air-line flights that have been handled and fine air-line routes, thousands of miles and more have been opened, air-planes that link the Americas, the open oceans, the Pacific and East of Asia, and across the Atlantic to Europe.

Whenever you go to the Pan American, you find in its fleet airplanes of various sizes, the perfect Pan American, you cannot help but see, and you that meet with it, and the air-planes, you, along the air-planes, in, under, and over the seas, the days of your journey.

FOR INFORMATION OR RESERVATIONS CALL

Office of the  
Flying Clipper Ship

WORLD'S STANDARD FOR AIR TRANSPORTATION

# 1936 Entomological Survey of Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Sponsored by the Hawaiian Sugar Planters Association
- Results reported in:
  - Swezey, O. H. 1942. Insects of Guam - 1. Bernice P. Bishop Museum Bulletin 172 1-218. [Swezey and Association(1942)]
  - Swezey, O. H. 1946. Insects of Guam - 1. Bernice P. Bishop Museum Bulletin 172 1-218. [Swezey and Association(1946)]
  - Gressitt, J.L. 1954 - present. Insects of Micronesia series. <http://hbs.bishopmuseum.org/pubs-online/iom.html>

# 1936 Entomological Survey of Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

Justification for the Survey [[Swezey and Association\(1942\)](#)]:

"Guam is the most important station between the Philippines and Honolulu on the route of the Pan-American Airways across the Pacific, and as knowledge of the Guam insect fauna was meager, it was deemed important to acquire as complete a knowledge as possible of this fauna. Unknown insects were already being found in planes arriving at Pearl Harbor, Oahu, and, in spite of the system employed in the fumigation of the planes, an occasional insect was found which had not fully succumbed. There was some concern lest unknown pests might survive and succeed in becoming established, and, perhaps, destructive to sugar cane and other crops grown in Hawaii."

# 1936 Entomological Survey of Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- The 1936 survey identified 50 agricultural pests on Guam which were not present in Hawaii at the time.
- "No doubt there are many among them which would become serious crop pests if they should reach Hawaii and become established." [Swezey and Association(1942)]

# Insects Suspected of being Introduced from Guam or Other Mariana Islands to Hawaii

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Island Hoppers
  - Oriental fruit fly
  - Banana leaf roller
  - Southern green stink bug
  - Grass bagworm
  - Oriental flower beetle
  
- Endemics
  - Hibiscus whitefly
  - Ochrosia fruit fly
  - Biting bug

# Oriental fruit fly, *Bactrocera dorsalis*

"As much troop and other military movement occurred about this time between Hawaii and Saipan, where the fly occurred, this new pest could have come from the latter island."  
[Pemberton(1964)]



Photo by Scott Bauer

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

# Banana leaf roller, *Erionata thrax*

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Oahu (Hickam AFB) Davis and Kawamura 1975
  - PHES 22(1): 21.



Photo by Forrest and Kim Starr

# Southern green stink bug, *Nezara viridula*

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

“As this insect is known in Guam and Samoa but not in California, it possibly came from one of those islands.”  
[Pemberton(1964)]



Photo by Russ Ottens, University of Georgia, Bugwood.org



# Grass bagworm

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



*Brachycyttarus griseus*

1976: first detected  
on Guam

1984: first detected  
on Oahu at Kaneohe  
Marine Base

# Oriental flower beetle

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

**Suspects**

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



*Prottaetia orientalis*

~1970: first detected  
on Guam

2002: first detected  
on Oahu at Hickam  
AFB golf course

# Endemics

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Ochrosia fruit fly, *Bactrocera ochrosiae* (Malloch) 1942 (Diptera: Tephritidae)
  - Molokai 1972 Kjargaard, PHEs 32: 5.
- *Botocudo marianensis* (Usinger) 1946 (Hemiptera: Lygaeidae)
  - Oahu 1974, Beardsley, PHEs 22:160-161
  - Maui 1972, Gagne, PHEs 22:167
  - Hawaii 1977, Beardsley, PHEs 22: 410
  - Kauai 1977, Nakahara, PHEs 23(2): 158

## Armed Forces Pest Management Board Technical Guide No. 31

---

### RETROGRADE WASHDOWNS:

#### Cleaning and Inspection Procedures

Published and Distributed by the  
DEFENSE PEST MANAGEMENT INFORMATION ANALYSIS CENTER  
Forest Glen Section  
Walter Reed Army Medical Center  
Washington, DC 20307-5001  
March 2008

<http://www.afpmb.org/sites/default/files/pubs/techguides/tg31.pdf>

## Appendix J - USDA APHIS History of Interceptions

<http://www.afpmb.org/sites/default/files/pubs/techguides/tg31/appendix-j.xls>

# APHIS Interceptions on USAF Aircraft Arriving in Honolulu from Guam I

Guam as a Source of New Insects for Hawaii

Aubrey Moore

Introduction

Early Concerns

Suspects

Interceptions

Why is Guam Such a Good Source?

Conclusions

References

## ■ COLEOPTERA

### ■ Curculionidae

- *Myllocerus* sp. (10/27/1987; 6/10/1986)

### ■ Elateridae

- *Conoderus* sp. (6/11/1989)

### ■ Chrysomelidae

- *Altica* sp. (10/11/1984)
- *Rhyparida* sp. (10/18/1984)

### ■ Scarabeidae

- *Adoretus sinicus* (8/28/1987; 4/1/1990; 7/29/1990)
- *Anomola* sp. (11/27/1986; 8/20/1987; 6/14/1985; 5/16/1990; 5/12/1989; 6/8/1992; 6/11/1990; 5/25/1991)
- *Popillia lewisi* (7/22/1991; 8/2/1991; 6/8/1990)

# APHIS Interceptions on USAF Aircraft Arriving in Honolulu from Guam II

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- *Protaetia orientalis* (11/22/1984; 5/10/1993)

- Tenebrionidae

- *Caedius* sp. (7/2/1990; 6/9/1990; 6/9/1990)

- *Gonocephalum* sp. (4/8/1990; 6/15/1990; 6/15/1990)

- LEPIDOPTERA

- Noctuidae

- unidentified sp. (9/18/1987; 11/30/1984; 9/17/1989; 9/17/1989)

- *Chrysodeixis chalcites* (11/11/1984) NKFG

- *Helicoverpa armigera* (4/6/1986)

- *Leucania* sp. (8/30/1987; 12/14/1985)

- *Mocis frugalis* (9/18/1987; 7/6/1990)

- *Platysenta* sp. (10/23/1986; 8/16/1987; 8/31/1987; 12/11/1984; 11/7/1984) NKFG

- *Pseudaletia* sp. (9/4/1987; 3/31/1990)

# APHIS Interceptions on USAF Aircraft Arriving in Honolulu from Guam III

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- *Spodoptera* sp. (4/21/1987; 9/20/1987; 5/9/1987; 8/17/1987; 7/10/1987; 12/14/1985; 8/28/1993; 6/29/1989; 6/30/1990)
- *Spodoptera litura* (1/29/1985; 11/30/1984; 10/6/1984; 8/5/1986)
- *Spodoptera mauritia* (8/24/1987; 3/5/1986)
  
- Pyralidae
  - Unidentified sp. (9/2/1987; 9/14/1987)
  - *Cnaphalocrocis medinalis* (5/17/1987; 9/20/1985; 9/15/1984; 10/6/1984; 10/23/1984) NKFG
  - *Herpetogramma licarsisalis* (8/22/1984)
  - *Ostrinia furnacalis* (9/15/1984)
  - *Sameodes cancellalis* (11/27/1984) NKFG
  
- Lyonetiidae
  - Unidentified sp. (7/30/1985) NKFG
  
- Sphingidae

# APHIS Interceptions on USAF Aircraft Arriving in Honolulu from Guam IV

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

**Interceptions**

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Unidentified species (11/24/1987)

## ■ HEMIPTERA

### ■ Cydnidae

- *Aethus indicus* (7/13/1990) NKFG

### ■ Pentatomidae

- *Plautia* sp. (7/2/1985) NKFG

### ■ Cicadellidae

- Unidentified sp. (6/6/1987; 6/16/1990)

## ■ ISOPTERA

### ■ Rhinotermitidae

- *Coptotermes* sp. (5/24/1990)

## ■ ORTHOPTERA

### ■ Tettigoniidae



# APHIS Interceptions on USAF Aircraft Arriving in Honolulu from Guam V

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- *Euconocephalus* sp.(11/22/1987; 11/30/1987; 10/30/1987; 9/11/1987; 10/16/1987; 12/15/1984; 1/15/1986)
- Gryllidae
  - *Metioche vittaticollis* (8/3/1986) (listed in MAD as *Trigonidium vittaticolis*)
  - *Phyllopalpus* sp. (8/30/1987) NKFG
- HYMENOPTERA
  - Torymidae
    - *Megastigmus pistaciae* (1/14/1985) NKFG

# Interceptions of Insects on USAF Aircraft Arriving on Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

**Interceptions**

Why is Guam  
Such a Good  
Source?

Conclusions

References

NO RECORDS AVAILABLE



# Why is Guam Such a Good Source?

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Guam's biosecurity is weak
- Guam is hypersusceptable to pest invasions and outbreaks
- Agricultural pests may remain hidden on Guam
- Active military pathway for movement of invasive species between Guam and Hawaii

# Why is Guam Such a Good Source?

Guam's biosecurity is Weak

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- 2003 - USDA APHIS establishes the Guam Plant Inspection Station
  - 0 APHIS inspectors; 0 identifiers
- 2003 - GovGuam PPQ inspectors moved from Agriculture to Customs
- Intercepted insects are usually identified only to taxonomic level of order or family
- Double standard for treatment
  - Infested plant material from US or trans-shipped through the US is “reconditioned” (washed with soapy water)
  - Infested plant material from elsewhere is destroyed

# Why is Guam Such a Good Source?

Guam is hypersusceptible to pest invasions and outbreaks

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



All tropical islands are susceptible to biological invasions and outbreaks.

- Guam is hypersusceptible because:
  - the brown treesnake has exterminated birds and other vertebrate insectivores
    - large day-flying insects are extremely abundant
- Guam does not have a large guild of previously imported biocontrol agents, as does Hawaii

# Why is Guam Such a Good Source?

Agricultural pests may remain hidden on Guam

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- Guam has no large-scale commercial farming and limited variety of crops. Agricultural pests may be overlooked because their hosts are not grown as crops on Guam.
- Examples:
  - coffee berry borer, *Hypothenemus hampei* (Coleoptera: Scolytidae)
    - Saipan 1944 Dybas; Pohnpei 1953 Gressitt; Pohnpei 1950 Adams [[Wood\(1960\)](#)]
  - sugarcane leafmining buprestid, *Aphanisticus cochinchinae seminulum* Obenberger (Coleoptera: Buprestidae)
    - Guam 2007 [[Zack et al.\(2009\)](#) [Zack, Moore, and Miller](#)]

# Why is Guam Such a Good Source?

Active military pathway for movement of invasive species between Guam and Hawaii

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References

- There is ample historical evidence that several pest insects have moved from Guam to Hawaii in association with movements of military personnel and equipment.
- It is expected that traffic of invasion species on this “military pathway” will increase as the Guam military buildup gets underway.

# Conclusions

## Guam as a Source of New Insects for Hawaii

Aubrey Moore

Introduction

Early Concerns

Suspects

Interceptions

Why is Guam Such a Good Source?

**Conclusions**

References

- Evidence indicates that Guam has been and continues to be a high risk source of insects invading Hawaii.



# References I

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



C. E. Pemberton.

Highlights in the history of entomology in Hawaii  
1778-1963.

*Pacific Insects*, 6(4):689–729, 1964.

URL [http:](http://hbs.bishopmuseum.org/pi/pdf/6%284%29-689.pdf)

[//hbs.bishopmuseum.org/pi/pdf/6%284%29-689.pdf](http://hbs.bishopmuseum.org/pi/pdf/6%284%29-689.pdf).



Ilse Schreiner.

Sources of new insects established on Guam in the post  
World War II period.

*Micronesica*, Suppl. 3(2):5–13, 1991.

# References II

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



O.H. Swezey and Hawaiian Sugar Planters' Association.  
*Insects of Guam I.*

Number no. 172 in Bernice P. Bishop Museum bulletin.  
Bernice P. Bishop Museum, 1942.

URL

<http://books.google.com/books?id=ftcrAAAAMAAJ>.



O.H. Swezey and Hawaiian Sugar Planters' Association.  
*Insects of Guam II.*

Number no. 189 in Bernice P. Bishop Museum bulletin.  
Bernice P. Bishop Museum, 1946.

URL

<http://books.google.com/books?id=o-wrAAAAMAAJ>.

# References III

Guam as a  
Source of  
New Insects  
for Hawaii

Aubrey  
Moore

Introduction

Early  
Concerns

Suspects

Interceptions

Why is Guam  
Such a Good  
Source?

Conclusions

References



Stephen L. Wood.

Platypodidae and Scolytidae.

*Insects of Micronesica*, 18(1):74, 1960.

URL <http://hbs.bishopmuseum.org/pubs-online/pdf/iom18-1.pdf>.



R. S. Zack, A. Moore, and R. H. Miller.

First record of *Aphanisticus cochinchinae seminulum*

Obenberger (Coleoptera: Buprestidae) from Micronesia.

*Coleopterists Bulletin*, 63:4, 2009.