

Biological Invasion of Guam



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"Invasive species" means an **alien species whose introduction does or is likely to cause economic or environmental **harm** or harm to human health.**

- Executive Order 13112 signed by President William Clinton on February 3, 1999.

“invasive species” = “exotic pests”



Brown tree snake
An invasive species



Rhamphotyphlops braminus
with a penny for scale.

Blind snake
Not an invasive species

Why such a fuss about invasive species?

All animals and plants on Guam have arrived from elsewhere or have evolved from ancestors that arrived from elsewhere.

So, what's the fuss with invasive species?

Why such a fuss about invasive species?

Before man, 1 new species arrived on Guam every few thousand years

Currently, 1 new species arrives on Guam every few months

This is 10,000 times the natural rate!

Tropical island ecosystems are particularly susceptible to biological invasions

Warm climate allows year round population growth

Endemic species are at risk of extinction because they have not evolved defenses against alien predators, parasites, and diseases.

There is often no pre-existing biological control (parasites and predators)

Benefits of Early Detection

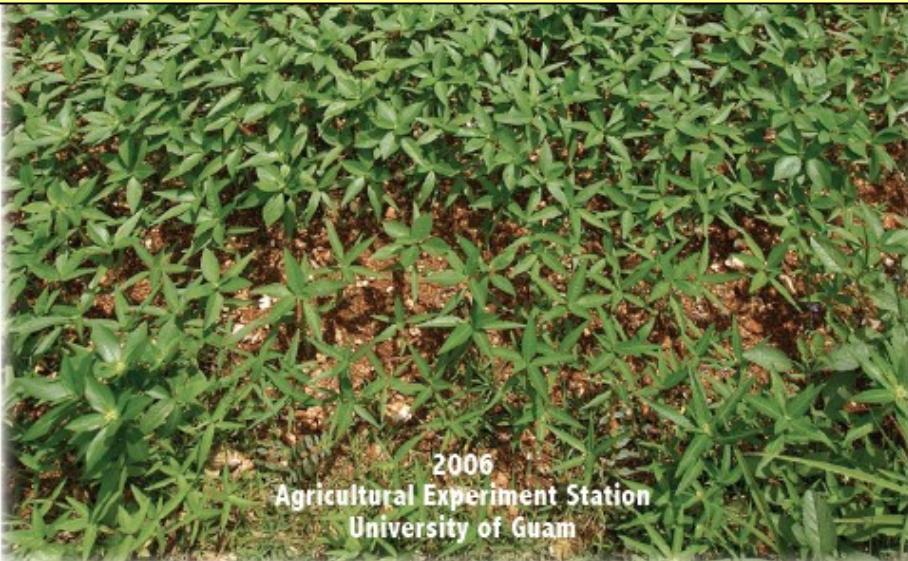
Eradication may be possible if the pest population is localized

Much ecological and environmental damage is done when newly arrived species undergo an initial population explosion. Massive damage may be averted by early application of control tactics

Plants (Weeds)



All of the 54 weeds listed in McConnell & Gutierrez 2006 are invasive species

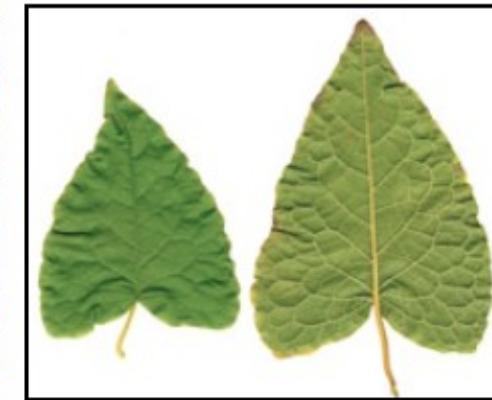


WEEDS OF GUAM

Weed #B1

Antigonon leptopus

Polygonaceae



Leaves with conspicuous veins



Fungi, Bacteria, Viruses

- 6 new plant pathogenic fungi were detected by UOG plant pathologists during 2007
- Most new fungi, bacteria, and viruses are detected only if they cause diseases to man, domesticated animals, or crops

Invasive Species in Guam's Marine Environment



There are now at least 73 species of non-native organisms found on Guam only in Apra Harbor, which implies they arrived via boat traffic.

-Brent Tibbatts, Guam DOA/DAWR,
personal communication





This dry dock arrived from Pearl Harbor in 1999 with 42 new species including snails, sponges, bivalves, ascidians, polychaetes, barnacles, bryozoans, and hydrozoans.
-Brent Tibbatts, Guam DOA/DAWR, personal communication

Mammals

- Man
- Ungulates
- Rodents

Ungulates





Before deer and pig fence
erected March 2004 (NW Field
AAFB)

22 months after deer and pigs
excluded January 2006

Loss of native forest
Few young trees survive
intensive browsing



Amphibians (Frogs & Toads)

- 13 invasive species (1 eradicated)
- Cane toad, *Bufo marinus*, introduced intentionally in 1937
- 8 new species of frogs detected on Guam between May 2003 and December 2005

Source: **Christy et al. 2007.** Recent records of alien anurans on the Pacific Island of Guam. Pacific Science 61(4) 469-483.



Reptiles (snakes, lizards, turtles)

19 invasive species



Insects

- **263 species of insects on Guam are listed as agricultural pests
>95% of these are invasive species**
- **Including non-agricultural pests such as ants, termites, mosquitoes, and household pests invasive insect species on Guam probably exceeds 400**

New Insect Pests Detected on Guam Since Jan. 2002

<i>Paracoccus marginatus</i>	papaya mealybug	2002
<i>Aulacaspis yasumatsui</i>	Asian cycad scale	2003
<i>Myllocerus sp.</i>	calamansi weevil	2004
<i>Pseudaulacaspis cockerelli</i>	false oleander scale	2004
<i>Metaleurodes cardini</i>	Cardin's whitefly	2004
<i>Nipaecoccus nipae</i>	coconut mealybug	2004
<i>Orthezia insignis</i>	greenhouse ensign coccid	2004
<i>Aleurotrachelus trachoides</i>	neotropical solanum whitefly	2004
<i>Chilades pandava</i>	cycad blue butterfly	2005
<i>Daphnis nerii</i>	oleander hawk moth	2005
<i>Quadrastichus erythrinae</i>	Erythrina gall wasp	2006
<i>Lepisiota frauenfeldi</i>	ant	2006
<i>Diaphorina citri</i>	Asian citrus psyllid	2007
<i>Tetraleurodes acaciae</i>	acacia whitefly	2007
<i>Henosepilachna sp.</i>	cucurbit lady beetle	2007
<i>Oryctes rhinoceros</i>	coconut rhinoceros beetle	2007

Nipaecoccus nipae, Coconut mealybug 2004







Why are Hemipterans so invasive?

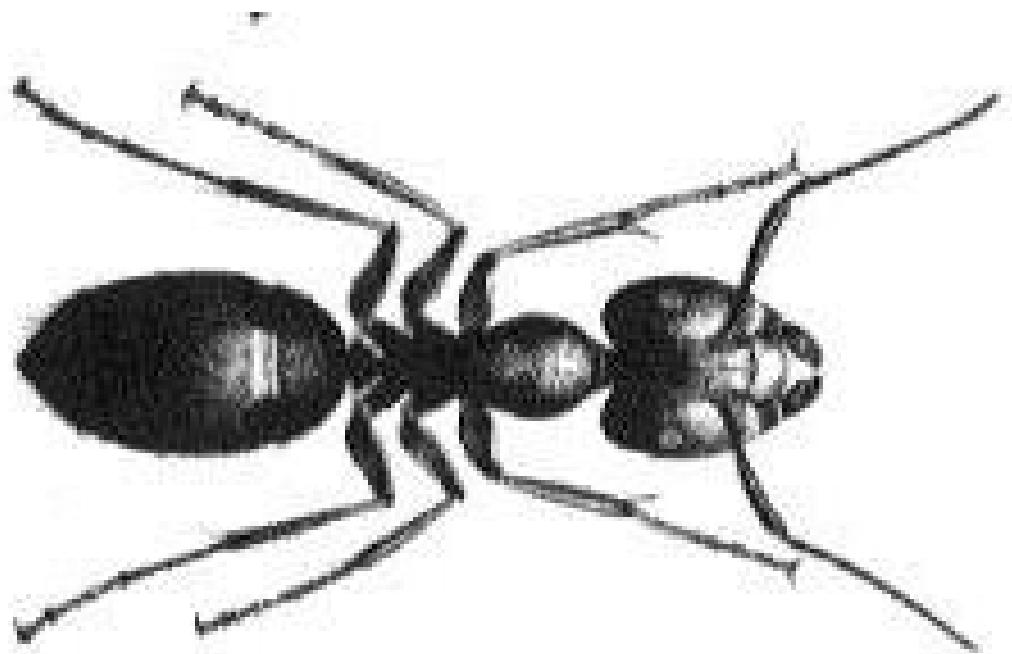
(The order Hemiptera include scales, mealybugs, whiteflies, aphids, psyllids, leafhoppers)

- Most are small and cryptic
- Many are not easily identified as insects
- Many reproduce without mating
- These sucking insects are often sedentary and are easily transported on host plants.

Ants

All ants on Guam are invasive species.

30 species



Aphids

All aphids on Guam are invasive species.

18 species



Mosquitoes

Most mosquitoes on Guam are invasive species.

14 invasive species



Daphnis nerii, Oleander hawk moth 2005



First Coconut Rhinoceros Beetle
Collected on Guam 11-Sep-2007

Tumon Bay





FELCO 2
SWISS MADE







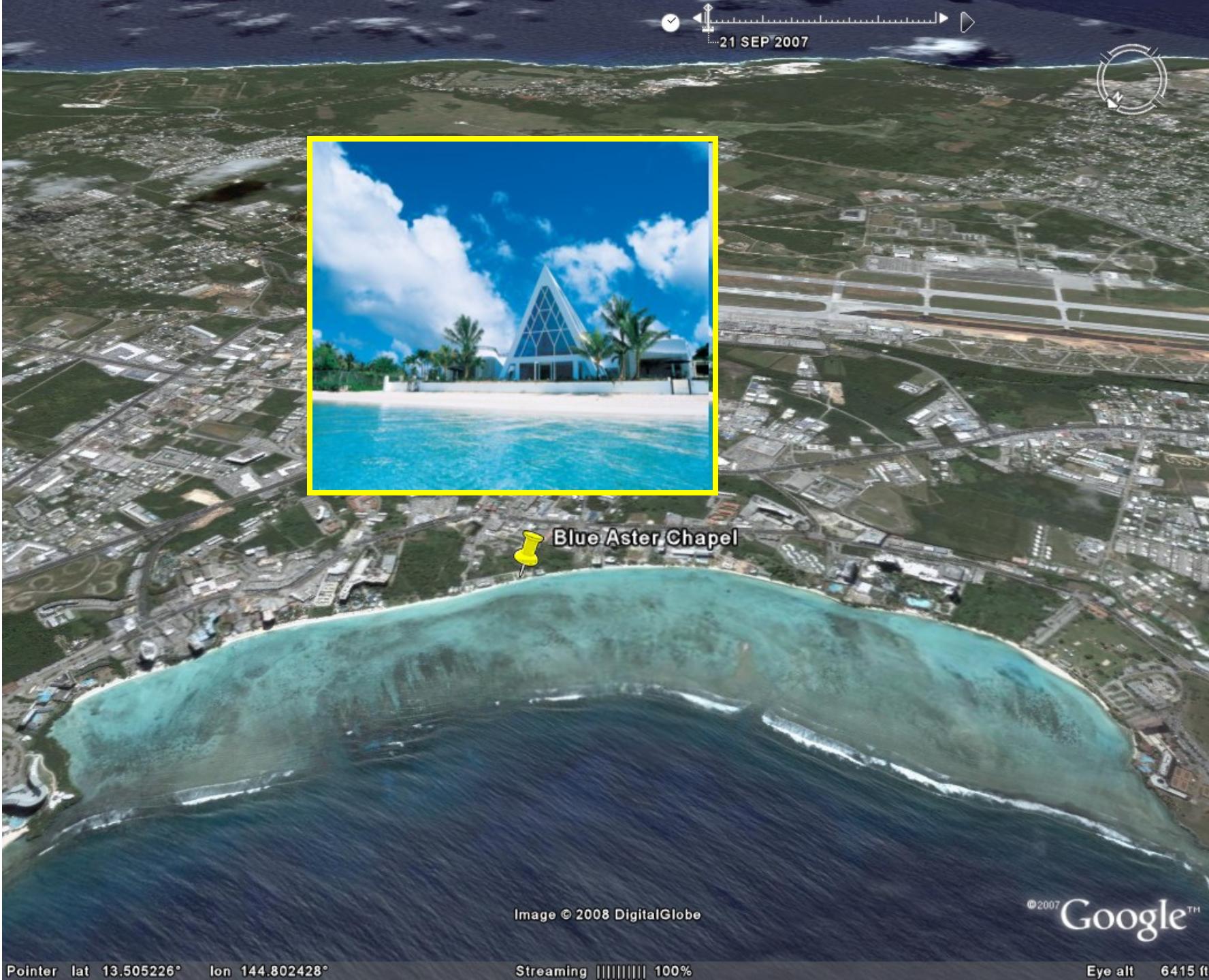


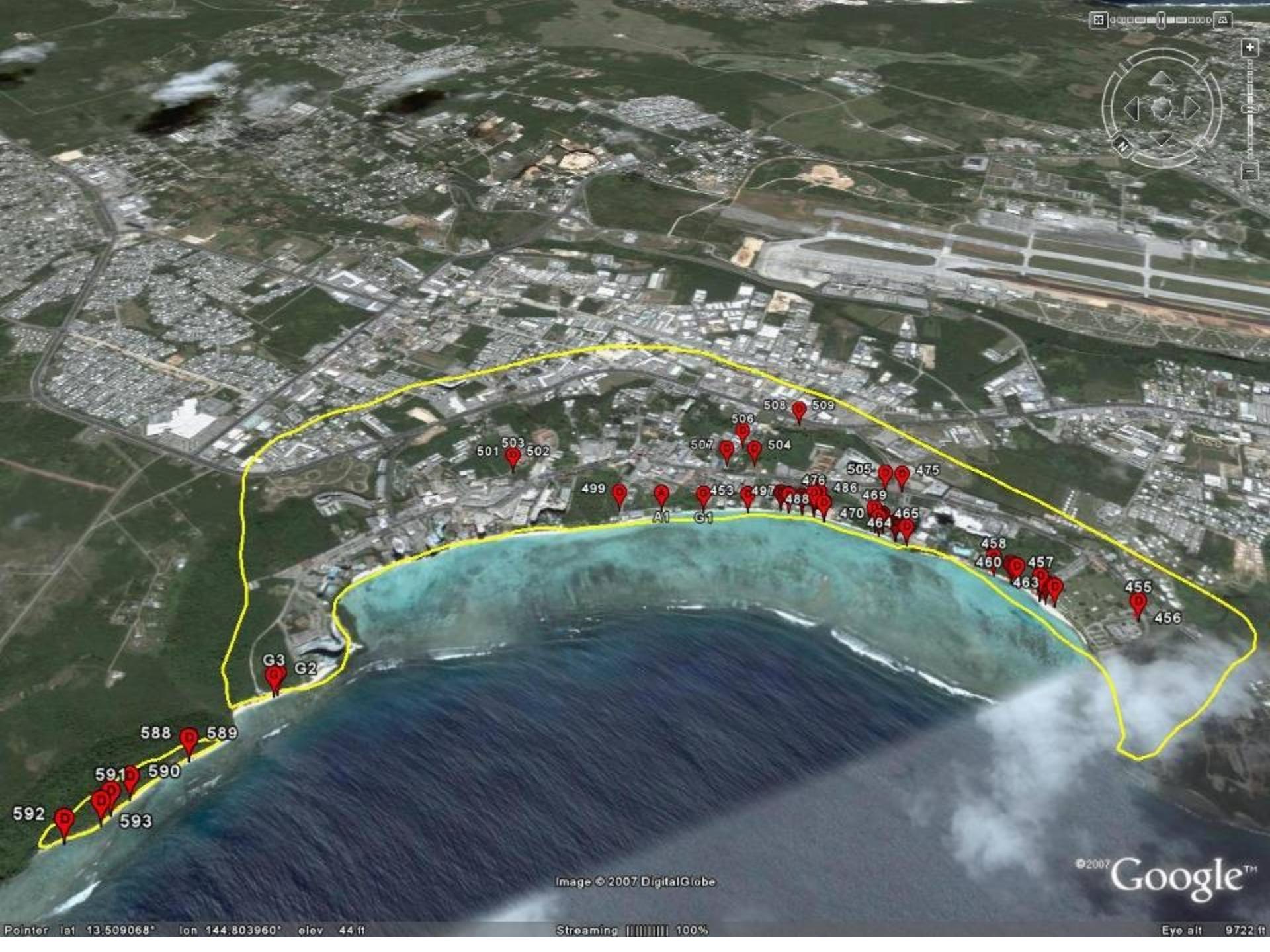
Image © 2008 DigitalGlobe

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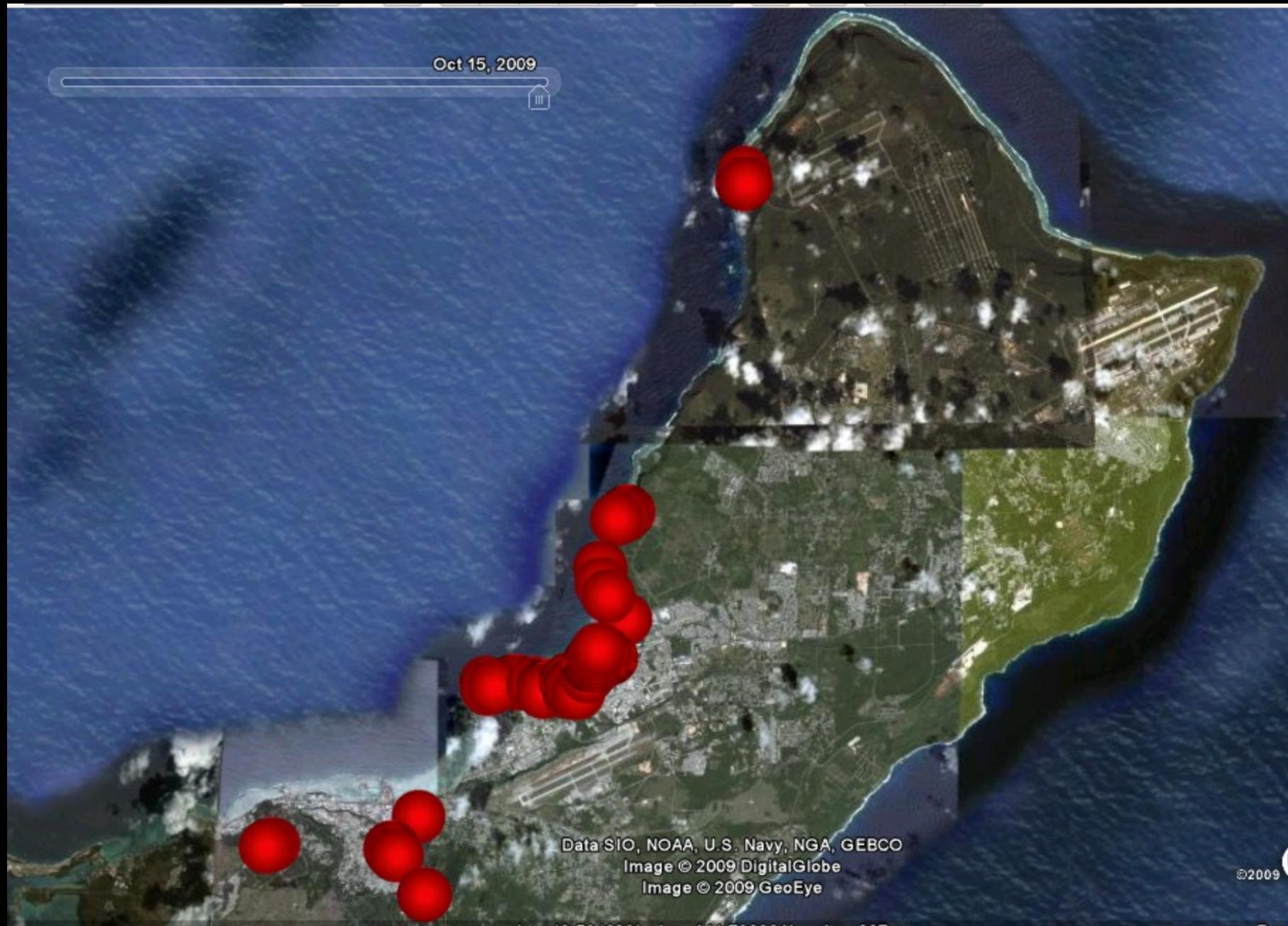
Pointer lat 13.505226° Lon 144.802428°

Streaming ||||||| 100%

Eye alt 6415 ft



CRB Breeding Sites





A close-up photograph of a cycad leaf, showing its characteristic pinnate venation. The leaf is a vibrant green color, with many fine, parallel veins running from the base to the tip. The background is slightly blurred, creating a sense of depth.

Asian Cycad Scale
Aulacaspis yasumatsui Tagaki 1972
DIASPIDIDAE

Asian Cycad Scale Chronology

- **1996** – Scale detected in Florida on cycads growing in a botanical garden
- **1998** – Scale detected in Hawaii
- **2003** – Scale detected on cycads used for landscaping in Tumon hotel district on Guam
- **2004** – Scale spreads to *Cycas revoluta* and *C. micronesica* throughout Guam
- **2006** – Scale infests *C. micronesica* on Rota
- **2007** – Scale infests cycads in Palau





Scale Morphology & Life History



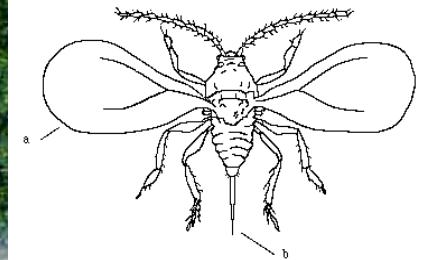
Eggs

Male cocoon

Female scale

Crawlers

Adult male



























Fadang plants flush at start of rainy season





New cycad growth defoliated by *Chilades pandava* larvae



Defoliation by *Chilades pandava*



Chilades pandava larva on *Cycas micronesica* with attendant ant,
Aplopopolepis gracilipes



Current Status of *Cycas micronesica*

- Most ornamental cycads have been killed and between 60% and 90% of the endemic *Cycas micronesica* have died from attacks by ACS and other recently arrived invasive insects.
- *C. micronesica*, which was Guam's most populous tree in 2002, is now on the IUCN Red List of Threatened Species.
- Seedlings are not surviving – no recovery by reproduction

**Invasive species aren't all bad.
They provide job security for biologists.**





State of Hawaii
DEPARTMENT OF AGRICULTURE

New Pest Advisory

Updated July 2004 No. 04-02



Glassy-winged Sharpshooter

Homalodisca coagulata (Say)

(Homoptera: Cicadellidae)

Ronald. A. Heu, Bernarr R. Kumashiro,
Troy H. Suh and Renato C. Bautista



State of Hawaii
DEPARTMENT OF AGRICULTURE

New Pest Advisory

No. 01-03 Updated September 2008



R. Heu and W. Nagamine

Nettle Caterpillar

***Darna pallivitta* Moore**

(Lepidoptera: Limacodidae)

Patrick Conant, Arnold H. Hara*,
Walter T. Nagamine, Chris M. Kishimoto and
Ronald A. Heu



State of Hawaii
DEPARTMENT OF AGRICULTURE

New Pest Advisory
No. 99-02 Updated February 2007



Little Fire Ant

Wasmannia auropunctata
(Roger)

(Hymenoptera: Formicidae)

Patrick Conant, Ronald A. Heu
Larry Nakahara, Bernarr Kumashiro and
Neil Reimer