

Biocontrol of Glassy-Winged Sharpshooter in French Polynesia: A Major Success for the South Pacific



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Homalodisca vitripennis (Hemiptera: Cicadellidae)

- **GWSS native to SE USA & NE Mexico**
- **Xylem fluid 95-98% water, no defense cmpds**
 - Xylem fluid moves at 1m/sec into GWSS
 - Ingests 100x body wt/day
 - Excretes 99% water and some ammonia
- **Extremely polygphagous >150 plants & highly vagile**
- **Prosperes in highly modified environments**

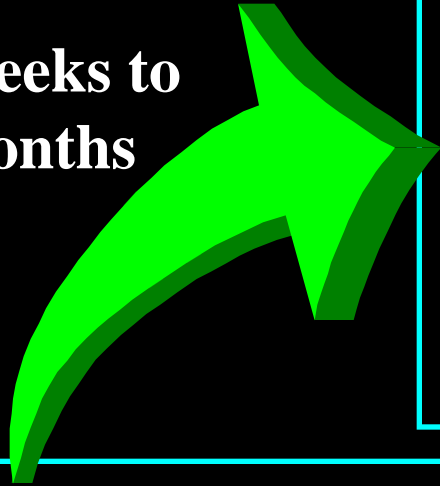


Eggs

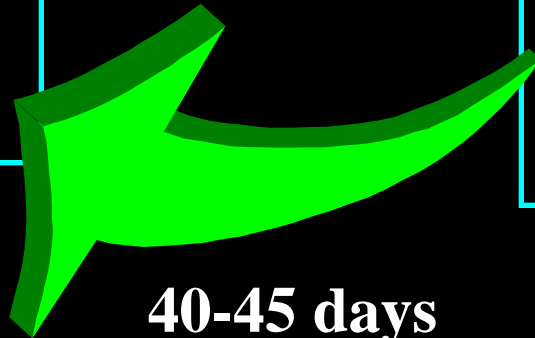


10-12 days

Weeks to months



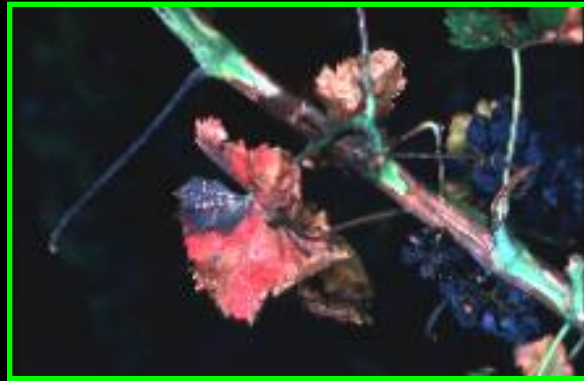
Adult GWSS



40-45 days

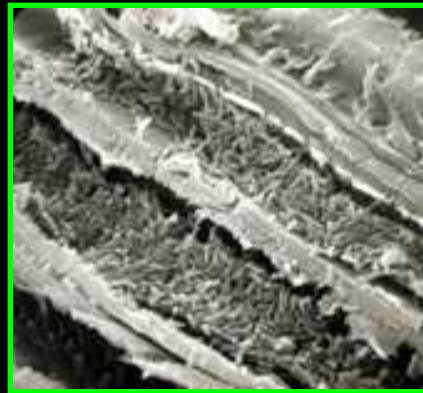


Five Nymphal Instars



***Xylella* is a native xylem inhabiting bacterium**

Bacterial replication blocks xylem & scorching symptoms result



Distribution in the USA is limited to some extent by cold weather

***Xylella* is vectored by sharpshooters**



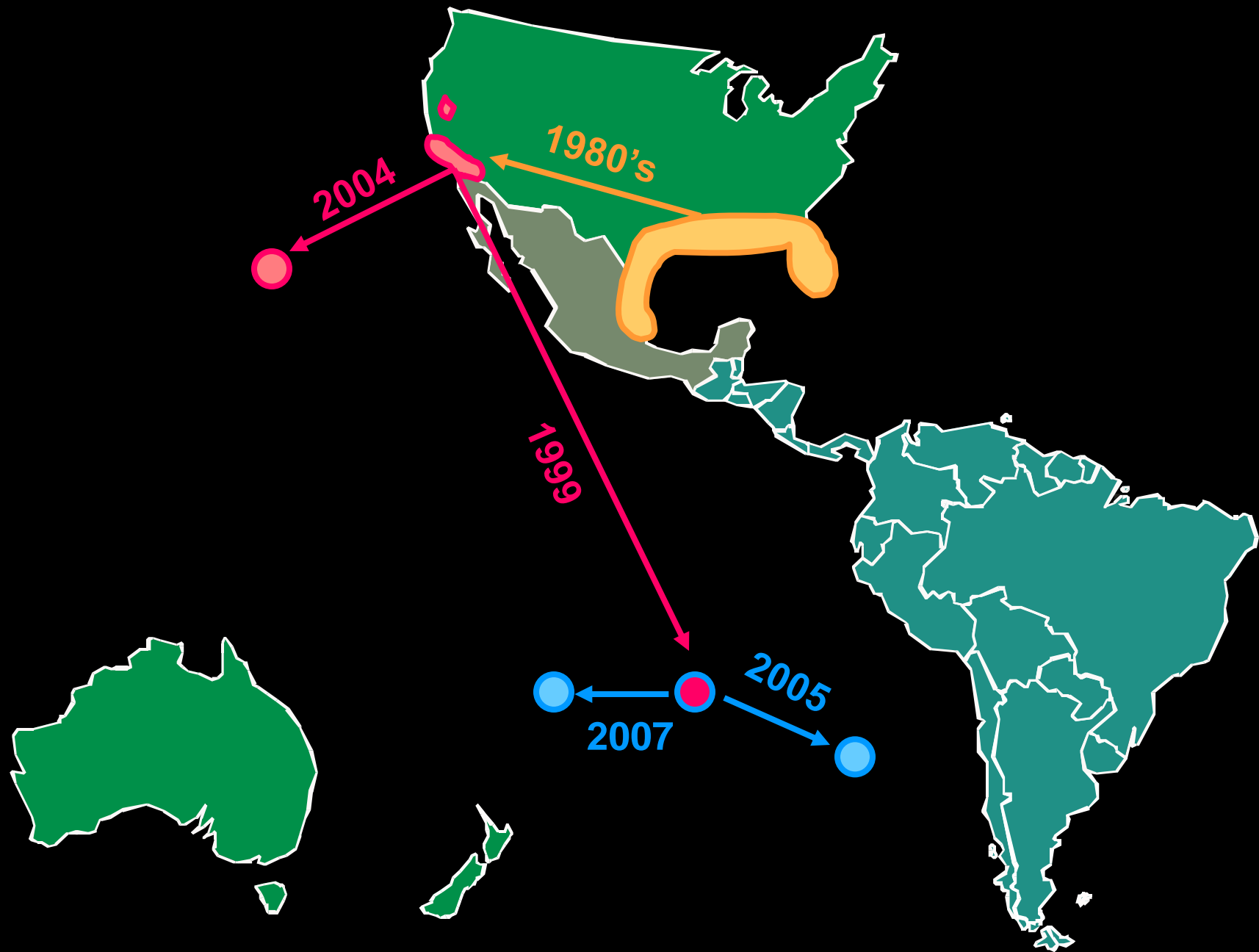


Temecula Valley Wine Industry

-2,500 acres of grapes, mainly Chardonnay

->50% vines with PD

-Industry worth approximately \$30 million per annum



Facts about French Polynesia

- FP 6,000km west of Chile;
5,200km east of Aussie
- Humid, tropical ~12 hr days
 - **Wet season** – hot: Nov.- April
 - **Dry Season** – cool: May - Oct
- 188 islands, only 6 > 100km²; 76 are inhabited
- Islands highly degraded by invasive species; native flora & fauna impoverished
- ~250,000 people, Five major archipelagos
 - **Society islands** (86% Pop.)
 - **Windward** (Tahiti & Moorea)
 - **Leeward** (Huahine, Taha'a, Bora Bora, & Maupiti)
 - **Tuamotus** (7%), **Marquesas** (4%), **Australs** (2%), and **Gambiers** (<1%)







GWSS

Video

Magnitude of Problem - ENORMOUS



WSS p
ality of
business
biting, irritating **“BUZZ**



ds declin
threat to
to native
naïve ge







Vulnerability of Generalist Predators

- **Predation activity of native spiders against GWSS assessed**
 - **Crab spiders (*Misumenops melloleitao*)**
 - 30 given GWSS 17 died within 45 mins of consumption
 - Survivors that attacked a 3rd GWSS only 3 survived
- **Communal web spinners (*Cyrtophora moluccensis*)**
 - 7 out of 10 died after feeding on GWSS
 - Moribund GWSS fell into webs below – 3 predation attempts and all 3 spiders died



*Cyrtophora
moluccensis*

*Misumenops
melloleitao*



Gonatocerus ashmeadi (Hymenoptera: Mymaridae)

- Egg parasitoid attacking *Proconinii* sharpshooters
- Native to SE USA, self-introduced into CA
- Omnipresent in CA and dominant GWSS egg parasitoid
- Natural enemy of choice for potential use in FP – **Imported Sept. 2004**



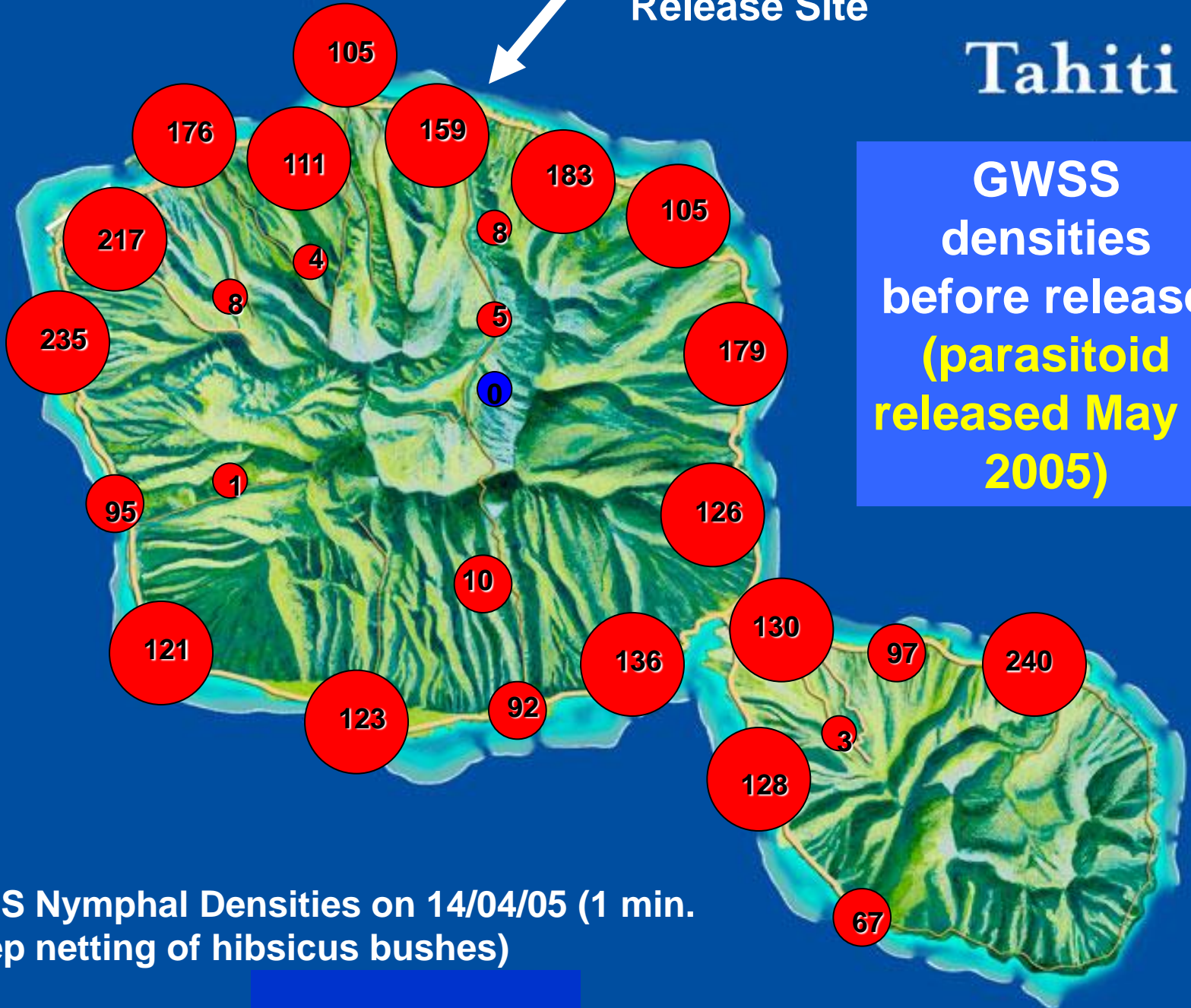




Release Site

Tahiti

GWSS densities before release (parasitoid released May 2 2005)

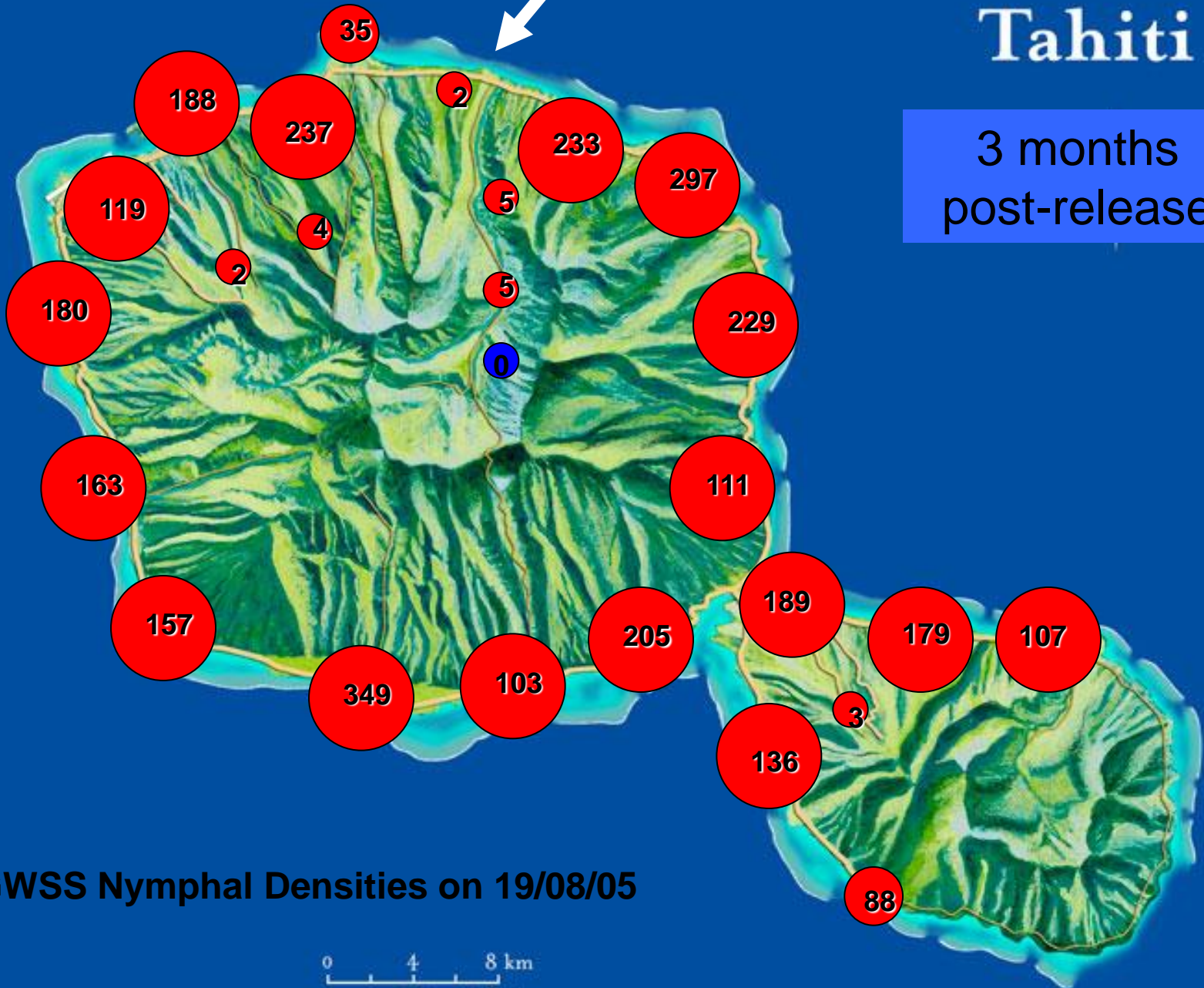


GWSS Nymphal Densities on 14/04/05 (1 min. sweep netting of hibiscus bushes)

40' Sud

Tahiti

3 months
post-release



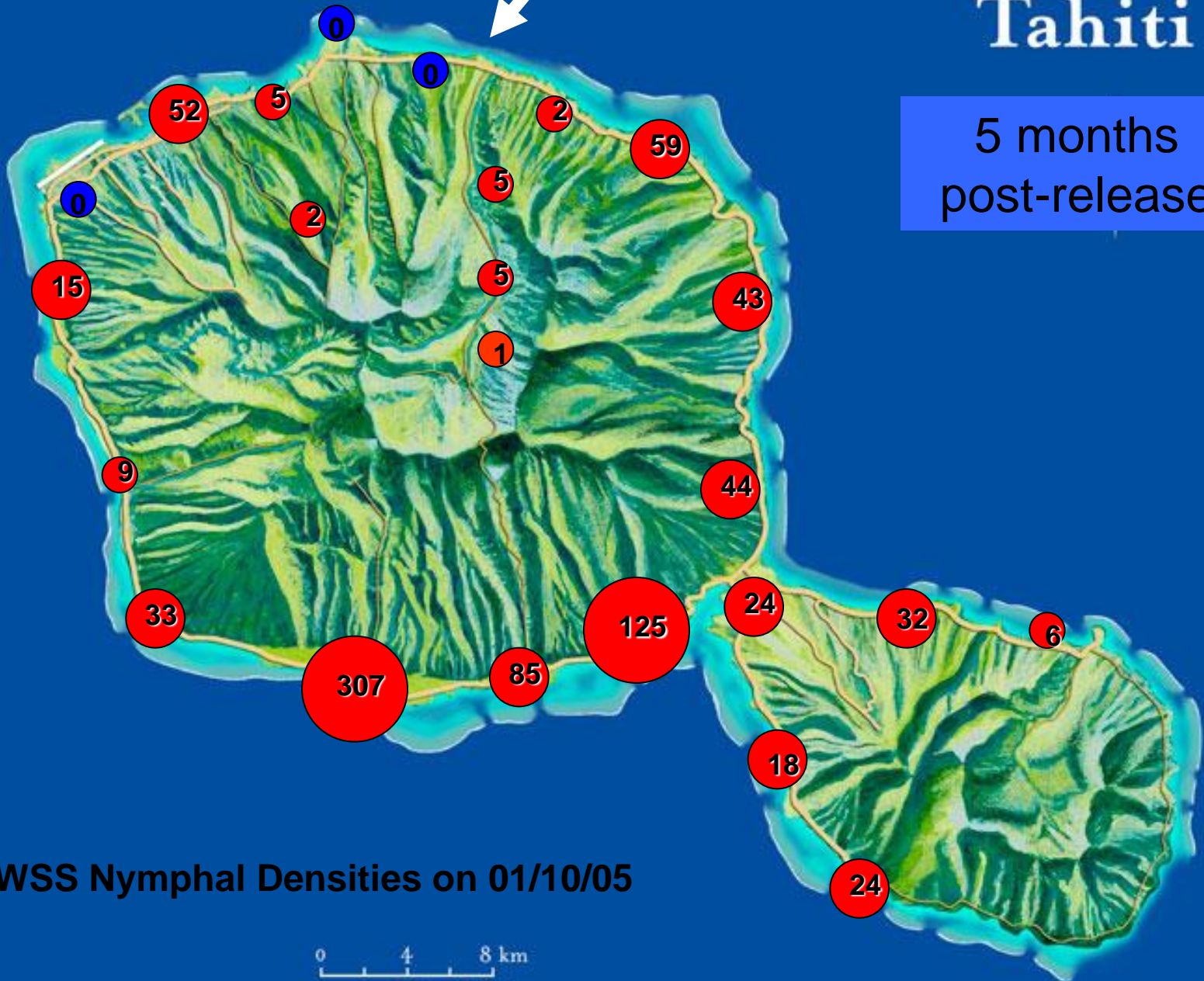
17°40' Sud

GWSS Nymphal Densities on 19/08/05



Tahiti

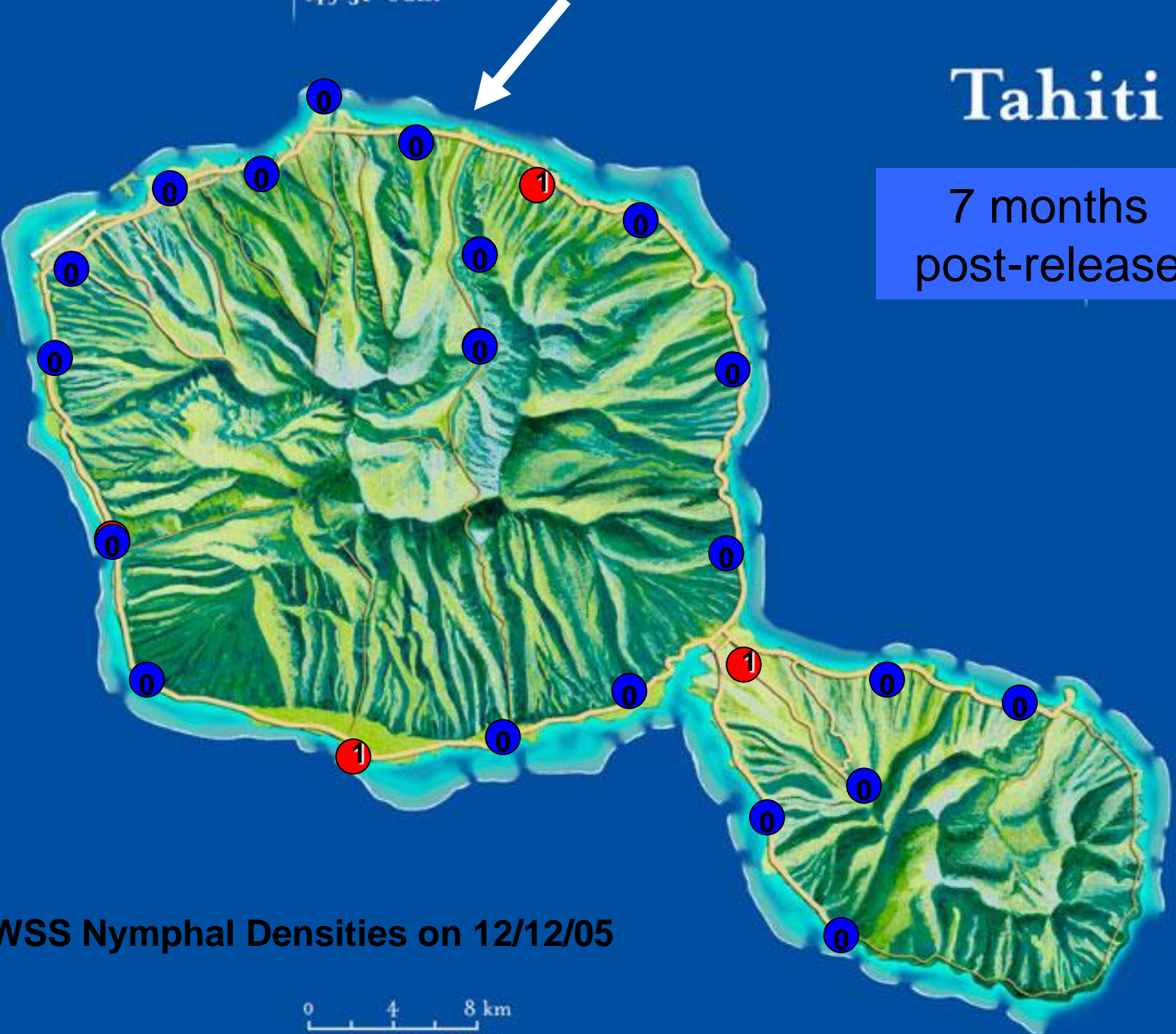
5 months
post-release



GWSS Nymphal Densities on 01/10/05

Tahiti

7 months
post-release



GWSS Nymphal Densities on 12/12/05

© Pacific-image - D'ap. ill. Saquet



2 YEARS AFTER RELEASE

Tahiti



17°40' Sud

4-Apr-2007

0 4 8 km
0 2,4 4,8 miles

Conclusions – BioControl Project

- **May 2 2005, parasitoids released from quarantine after ~12 months of non-target impact assessment work**
- **13,786 parasitoids released between May & Oct. 2005**
- **GWSS populations rapidly decreased by >98% at monitored sites ~ 7 months**
- **Population structure of GWSS radically altered due to reduced nymph recruitment from eggs**

What Did We Learn About the Invasion Biology of GWSS & Ash?

- Natural island system allowed investigation of:

For GWSS

- Relationship between urbanization & GWSS invasion success
- Allee effects on GWSS founding populations
- Determination of dispersal dynamics

For *G. ashmeadi*

- Spread within Tahiti
- Spread to other islands & archipelagos
- Use of Ash as a “biomarker” allowed assessment of quarantine effectiveness



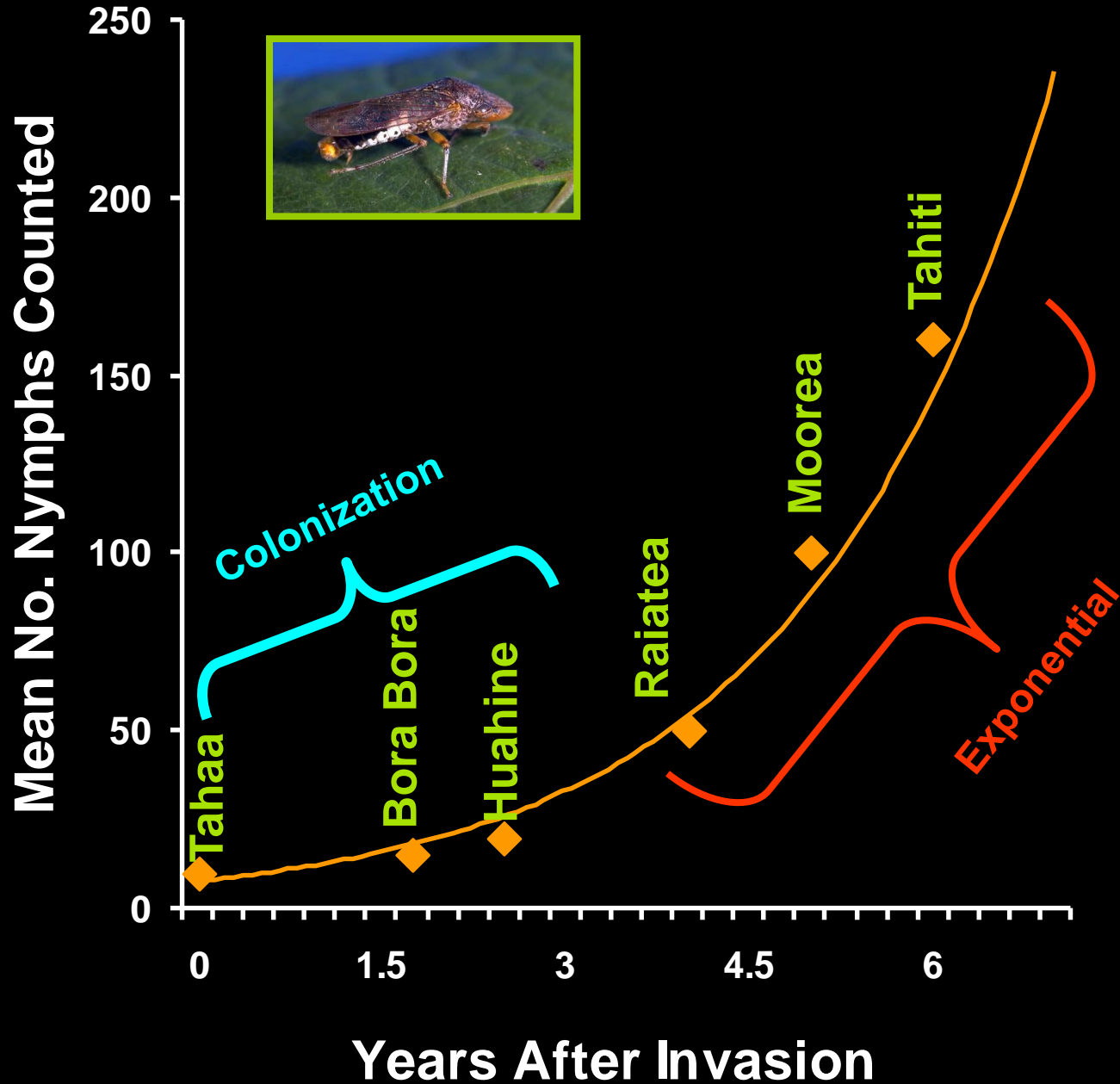
Regular Surveys Within and Across Islands for GWSS & Ash



Surveys for GWSS Revealed

- **GWSS abundance significantly higher in urban areas, intermediate in semi-urbanized areas, low in natural areas**
- **Successive invasion events on islands had varying infestation times**
 - Yr 0-3 of an island invasion establishment phase
 - 4+ yrs exponential growth exhibited
- **Initial pest populations detected most often in urban areas close to airports/sea ports**
 - **Human movement of plants responsible, removes stochastic events that typically wipe out incipient populations**

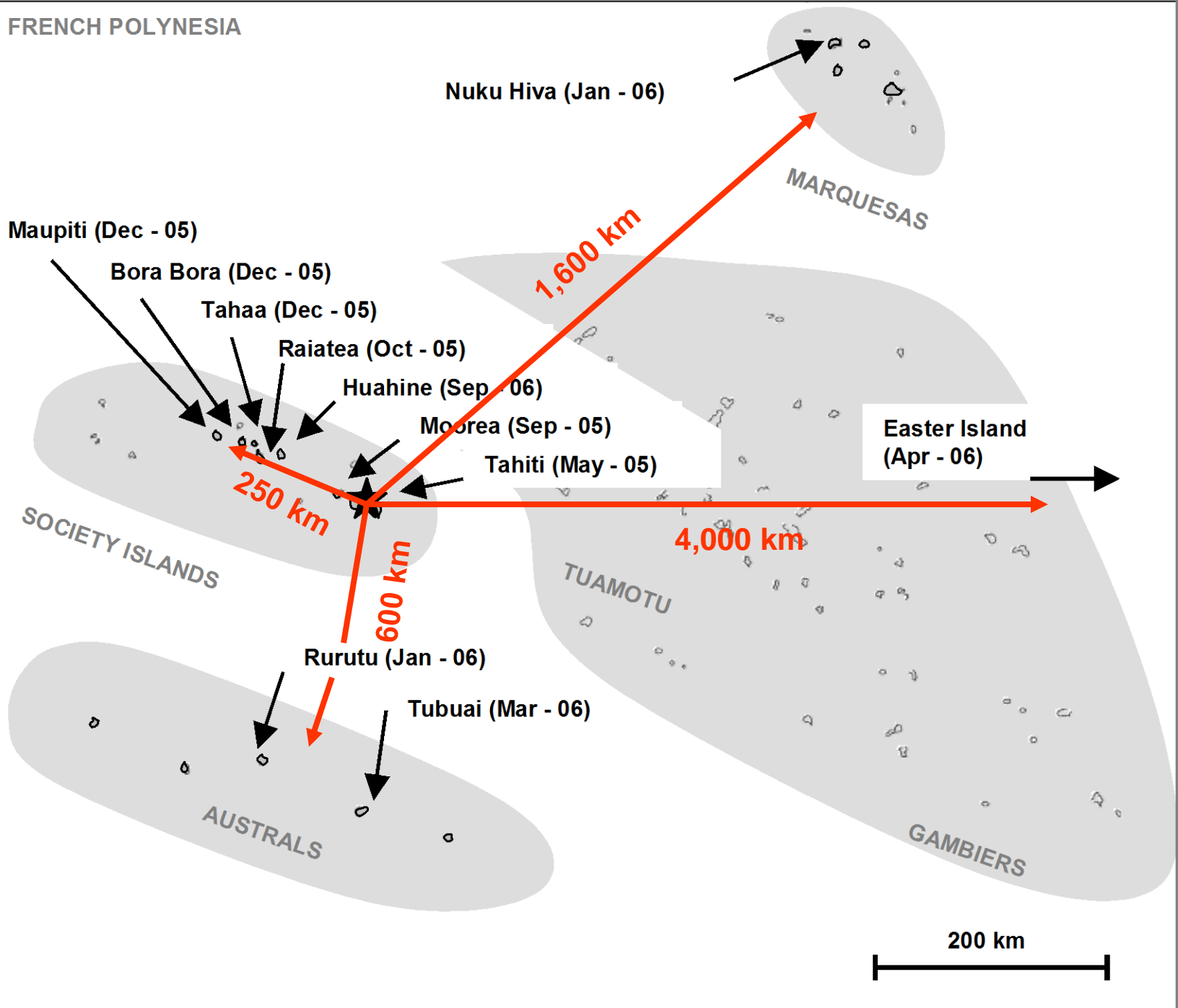
Population Dynamics of GWSS in FP



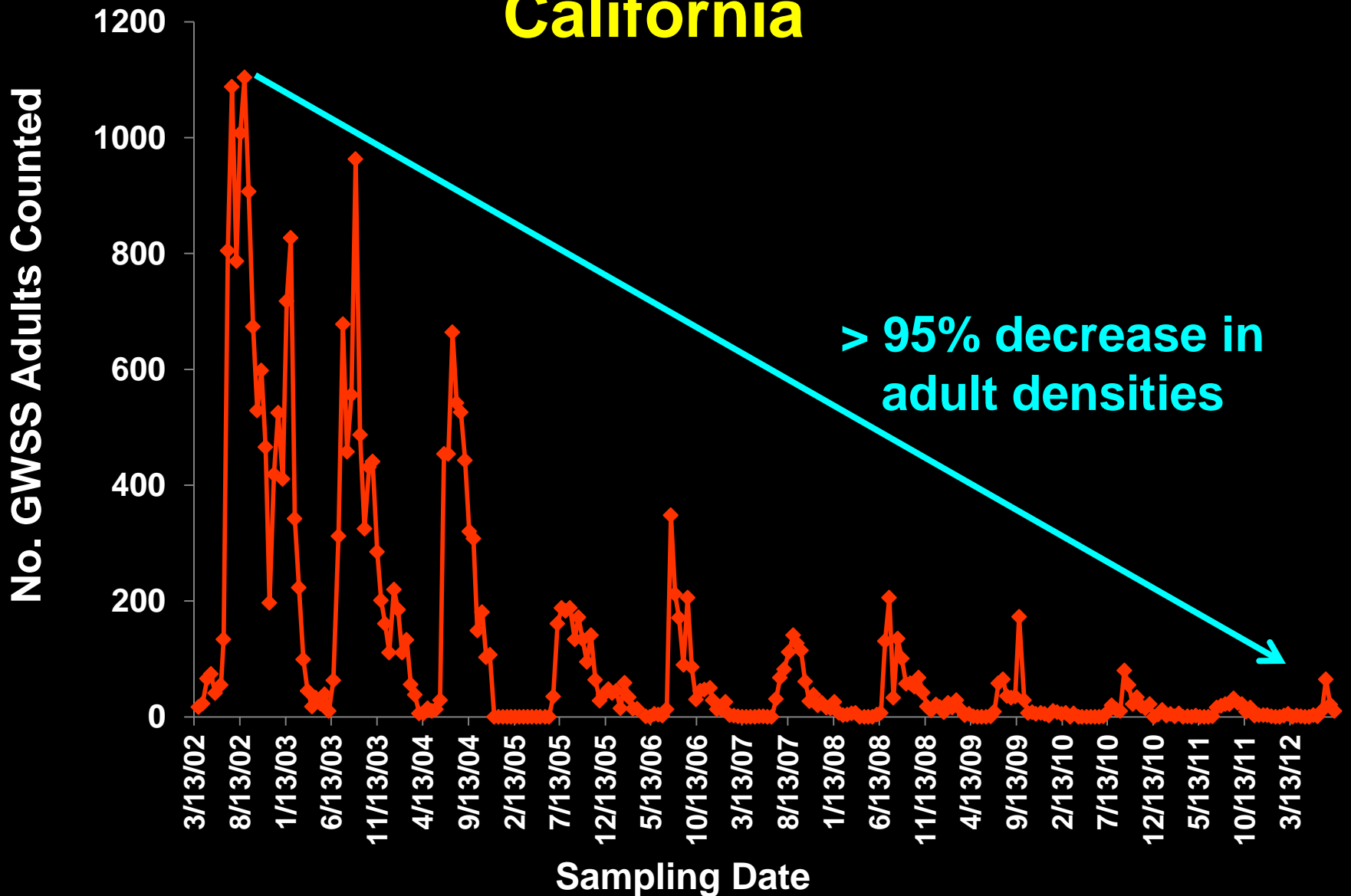
Long Distance Dispersal of Ash

- **Ash released on one island – Tahiti – May 2 2005 ~ 13,500 Ash released**
 - 4-10 months post release, Ash had colonized every archipelago with GWSS (~ 6 yrs needed for GWSS to achieve this!)
 - Sweep netting revealed 5-7 GWSS/min needed for accidentally introduced Ash to establish on islands
 - Rapid long distance movement almost certainly due to humans moving plants with parasitized GWSS eggs
 - Ash – a biomarker clearly demonstrated continued failure of quarantine & poor enforcement of no plant movement laws
 - **Facilitated amazing success of Ash against GWSS**
 - **Non-target impacts could have occurred**

FRENCH POLYNESIA



Total No. GWSS Adults Counted in California



Implications for NZ & Australia

- **GWSS biocontrol in Sth Pacific benefited NZ & Australia**
- **Why was this important?**
 - NZ & Aus have significant grape industries
 - Recent work by Rathe et al. & Groenteman et al demonstrated that:
 - Native NZ & Aussie plants can support GWSS feeding & devpt, but also Ash parasitism
 - Native plants can incubate *Xylella* – lethality uncertain
 - GWSS adults can survive simulated air travel and lay eggs on host plants

Conclusions

- **Biocontrol of GWSS in F.P.**
 - Safety major concern of this program
 - Total control achieved in ~ 7 months
 - High GWSS densities few Ash needed for establishment; low GWSS densities (2-5) many Ash needed to overcome establishment barriers; 5-7 GWSS Ash can self-establish
- **GWSS invasion biology**
 - ~6 yrs post-colonization before exponential growth observed
 - Closely associated with humans and highly disturbed habitats with high plant diversity
- **Ash invasion biology**
 - Rapid spread, not influenced by wind direction
 - Rapid accidental relocation across islands by humans moving parasitized GWSS eggs on illegally moved plants
- **Other Pacific nations benefited from reduced invasion risk**

Acknowledgments

