



Weed Biocontrol for Hawaiian Forests

Tracy Johnson

Institute of Pacific Islands Forestry, Pacific Southwest Research Station

USDA Forest Service



Hawaiian rainforest



Strawberry guava invasion

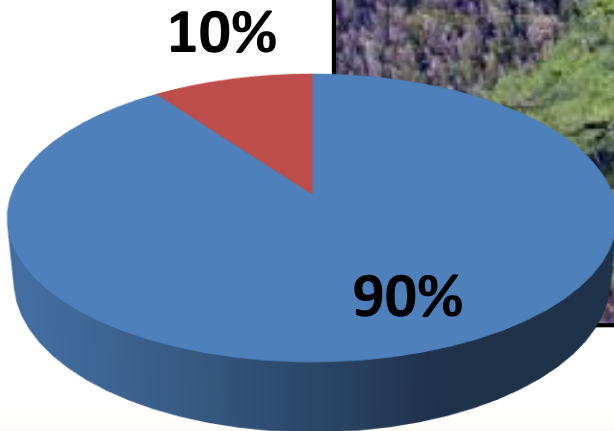
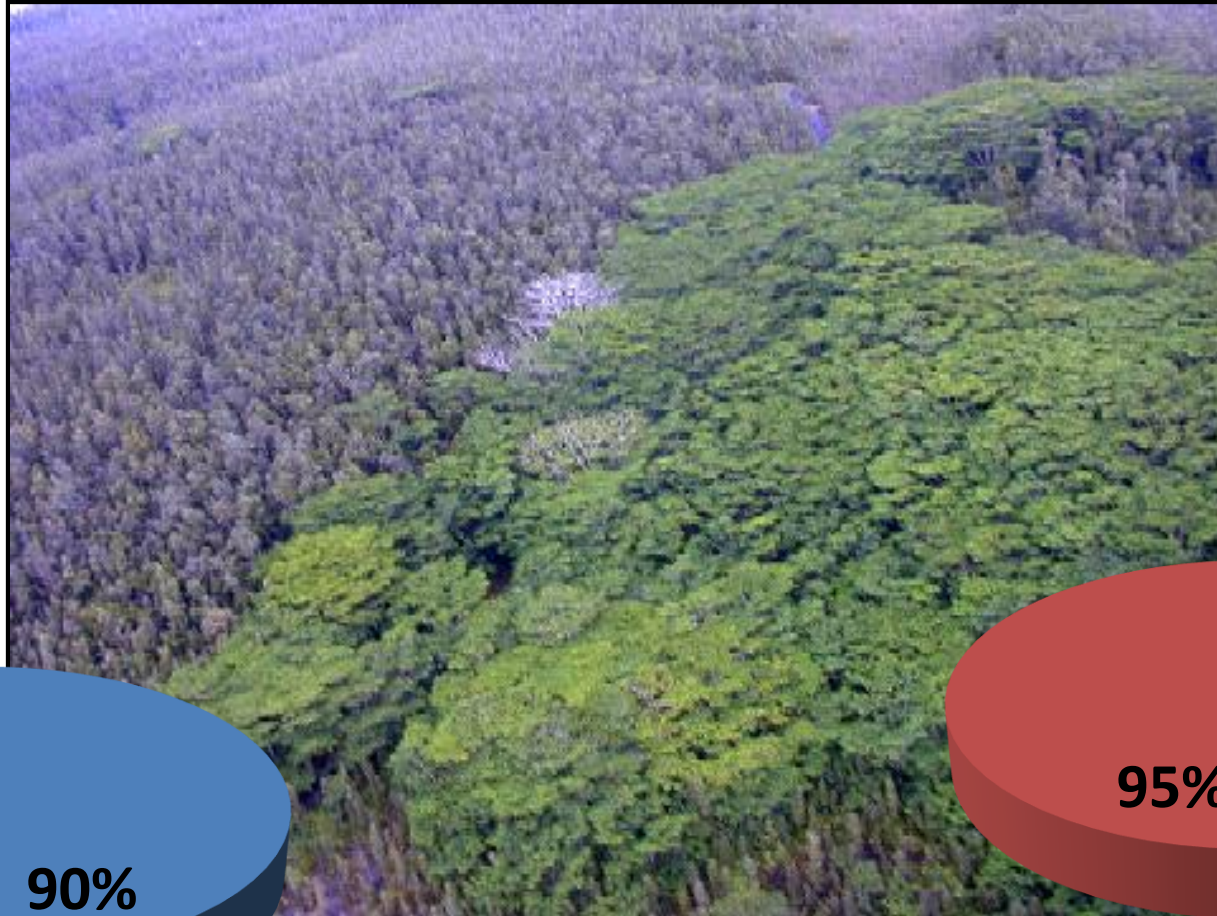
Photos: Jack Jeffrey

Strawberry guava invasion in Hawaiian rainforest

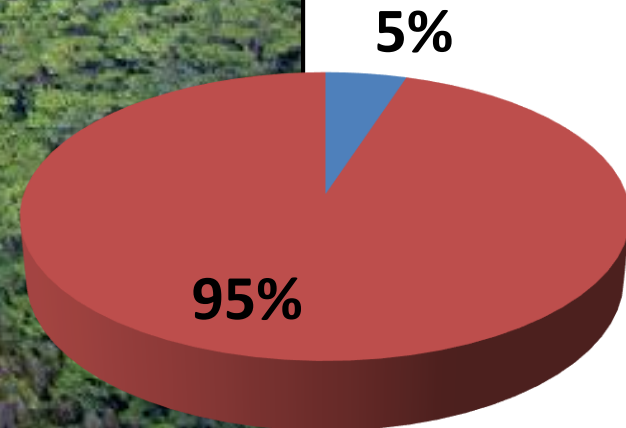
photo: Carnegie Airborne Observatory



Loss of Native Trees when Albizia invades (Hughes et al)



Native Ohia Forest



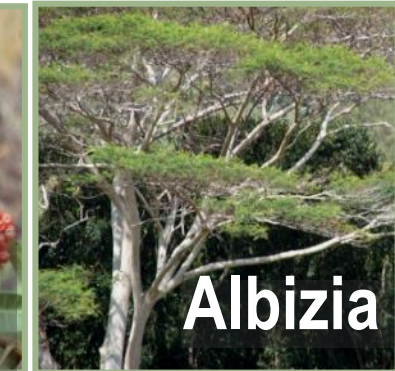
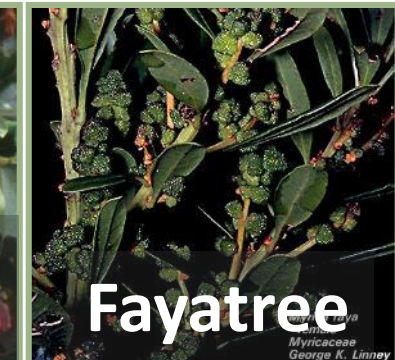
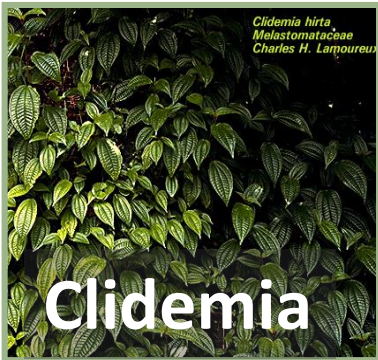
Albizia-invaded

■ Dominant Native Tree - Live

■ Dominant Native Tree - Dead

Managers need new tools in Hawaii:

Abundant invasive species, vulnerable forest ecosystems



Forest weed biocontrol partners: US Forest Service, National Park Service, Univ. Hawaii, Hawaii Dept. Agric., Hawaii Dept. Land & Natural Resources, USGS, US Fish & Wildlife Service, Hawaii Invasive Species Council, Watershed Partnerships, The Nature Conservancy



Mongoose?

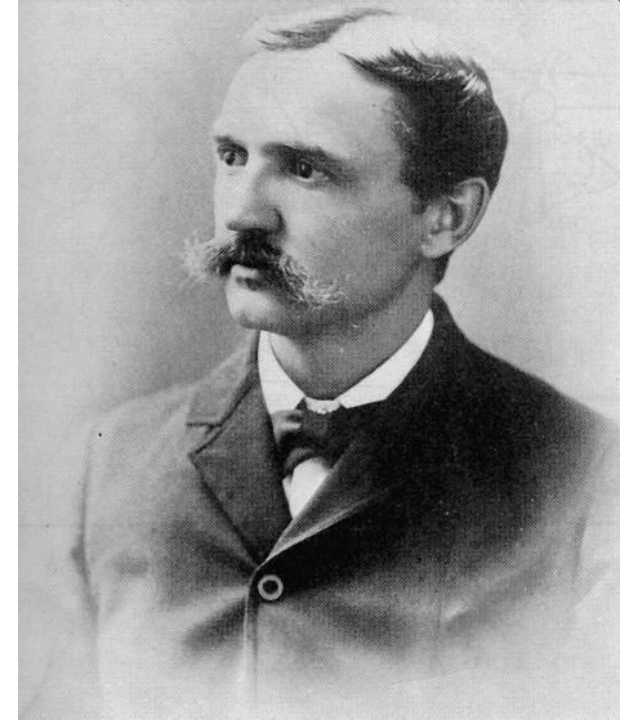
To the public: Best known example of unwise intentional introduction for control

- **Introduced 1883**
- **No science, no review, no regulation**

NOT representative of biological control!

Hawaii has a long history of biocontrol introductions

First release of weed enemies
against lantana in 1902

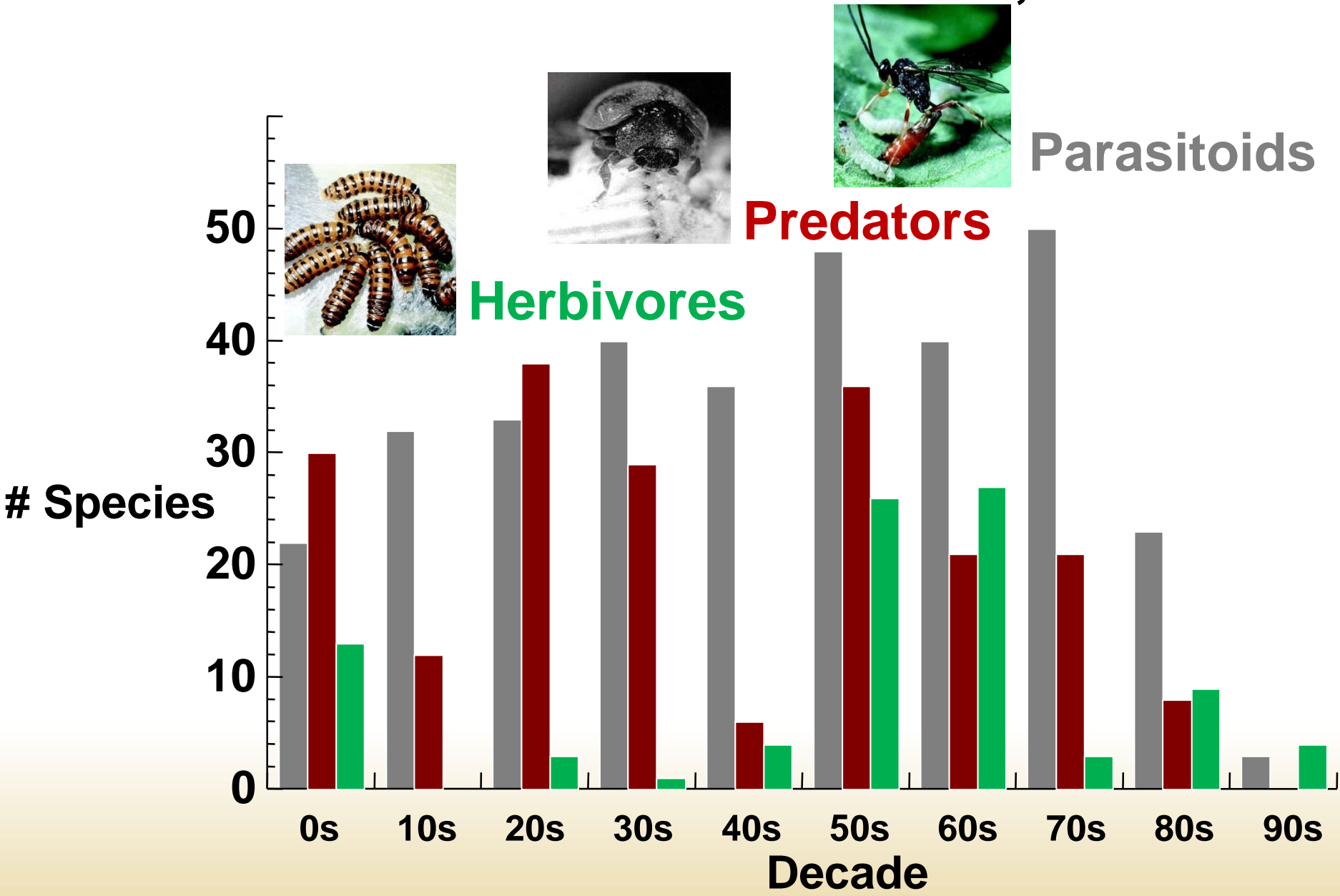


Albert Koebele
1853 - 1924



**Vidalia beetle for
cottony cushion scale**

Biocontrol introductions in Hawaii, 1900-1995



Non-target effects of biocontrol in Hawaii

“The importation of parasites to control various moths of economic importance, together with the accidental importation of other parasites, has resulted in the wholesale slaughter and near to complete extermination of countless species. It is now impossible to see the Hawaiian Lepidoptera in the natural proliferation of species and individuals of Perkin’s day.”

Zimmerman 1958

**Howarth 1983. Classical biocontrol: Panacea or Pandora's box?
Proc. Hawaii. Entomol. Soc. 24:239-44**

History of non-target issues (Reimer 2002)

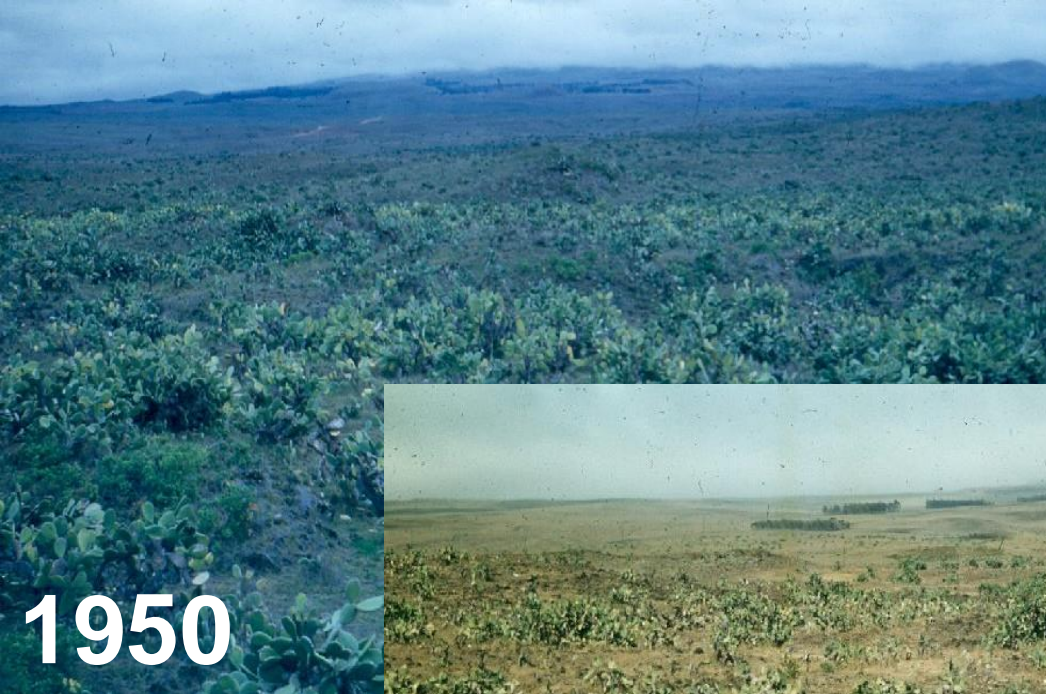
Frequency of host-specific biocontrol introductions

Before 1944: 54.7%

1944-1975: 77.4%

Since 1975: 100% (over 50 introductions)

Prickly Pear Cactus (Panini) in Hawaii: Biocontrols released 1949-1951



1950



1954



1958











photos: Hawaii Dept of Agric

Impacts

- Usually gradual
- Plants and biocontrols remain interacting

Invasive Plants targeted for biocontrol in Hawaii

Biocontrols introduced

		Lantana	1902-1974
		Purple nutsedge	1925
		Prickly Pear cactus	1949-1951
		Gorse	1949-1995 ...
		Clidemia	1953-1995 ...
		Christmas berry	1954 ...
		Hamakua pamakani	1955-1974
		Emex	1957-1962
		Melastoma	1958-1964
		Puncturevine	1963
		Florida blackberry	1963-1966
		Klamath weed (St. Johnswort)	1965-1966
		Fayatree	1991 ...
		Banana poka	1991-1996
		Ivy gourd	1996-1998
		Miconia	1997 ...
		Strawberry guava	2012 ...
		Fireweed	2013 ...

Successes

Non-target issues

Developing biological control for Pacific Island forest weeds

Target Selection



Foreign Exploration



Quarantine Testing



Release & Monitor



Biocontrol of strawberry guava

Biocontrol is a lengthy process involving much collaboration!



**Native range of
strawberry guava
Psidium cattleianum
(araçazeiro)**

**Foreign
exploration for
biocontrol
agents began
in 1988**

***Tectococcus* survives only on small subset of *Psidium* spp.**

Brazil

Common guava

Strawberry guava





Leaf-galling scale insect *Tectococcus ovatus* tested and approved as a potentially effective natural enemy

Strawberry guava biocontrol release and establishment 2012



Insect forms leaf galls



Methods for release of strawberry guava biocontrol



Selecting biocontrols for invasive Melastomataceae (all melastomes in Hawaii are alien)



Syphraea uberabensis



Tibouchina & Melastoma



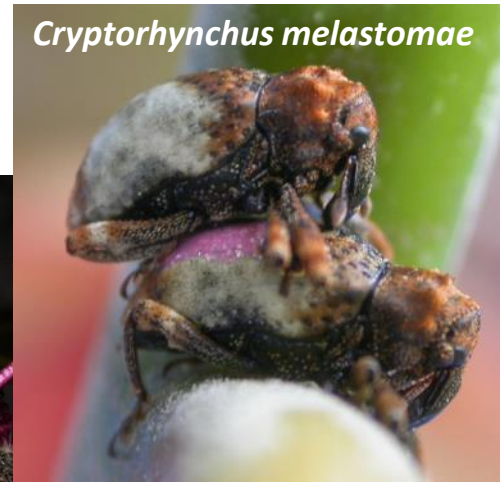
Nematode galls

Miconia



Euselasia chrysippe

Cryptorhynchus melastomae



Clidemia

***Tibouchina herbacea*, Waihee Ridge, Maui**

Photo: Forest & Kim Starr



Brazilian leaf beetle *Syphraea uberabensis* host specificity



Order Myrtales
Melastomataceae

- Cibotium glaucum*
- Myoporum sandwicense*
- Fragaria vesca*
- Rubus hawaiiensis*
- Rubus ellipticus*
- Sophora chrysophylla*
- Acacia koa*
- Wikstroemia sandwicensis*
- Dodonaea viscosa*
- Terminalia catappa*
- Oenothera laciniata*
- Epilobium ciliatum*
- Fuchsia magellanica*
- Cuphea hyssopifolia*
- Cuphea ignea*
- Cuphea carthagenensis*
- Lythrum maritimum*
- Eugenia uniflora*
- Psidium cattleianum*
- Syzygium jambos*
- Syzygium malaccense*
- Syzygium cumini*
- Metrosideros polymorpha P*
- Metrosideros polymorpha G*
- Tetrazygia bicolor*
- Miconia calvescens*
- Clidemia hirta*
- Medinilla cummingii*
- Arthrostemma ciliatum*
- tis rotundifolia*
- ptemnervium*
- plinervium*
- glomerata*
- urvilleana*
- longifolia*
- herbacea*

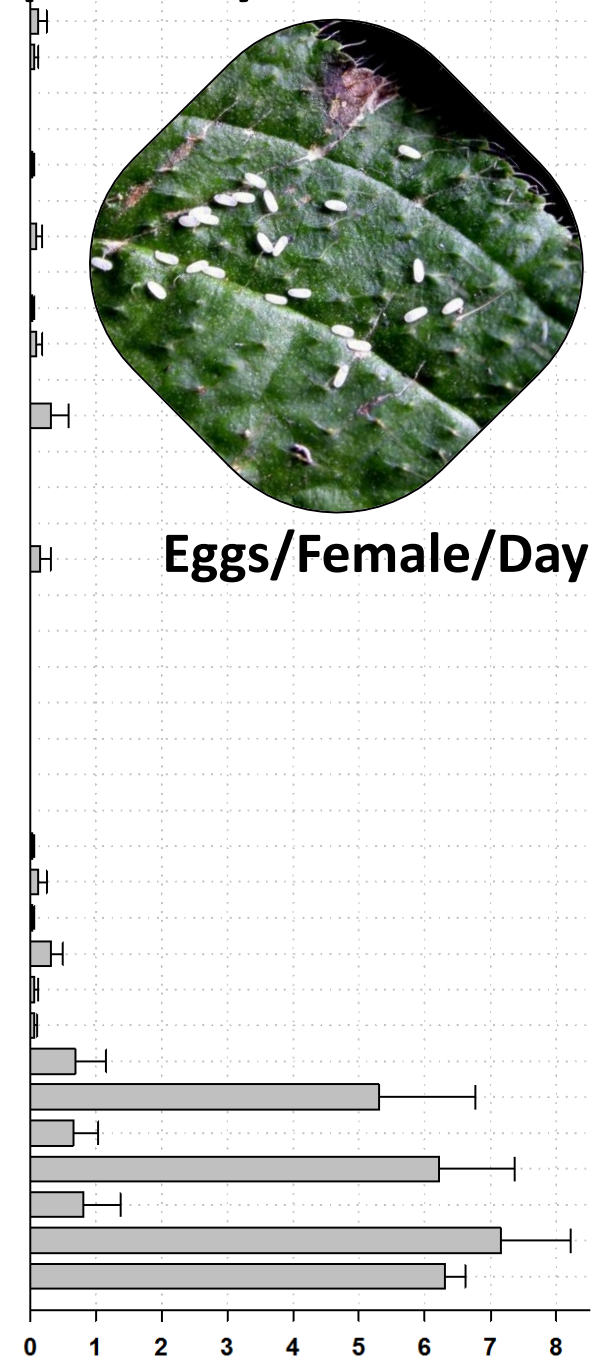
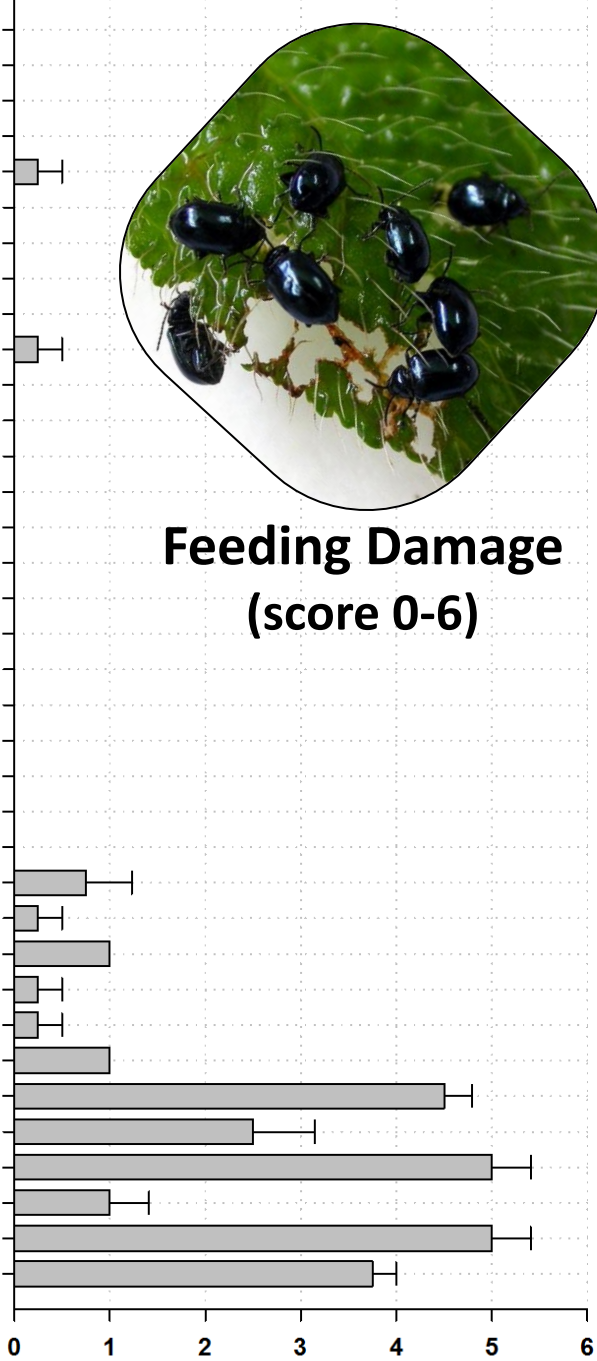
Melastoma

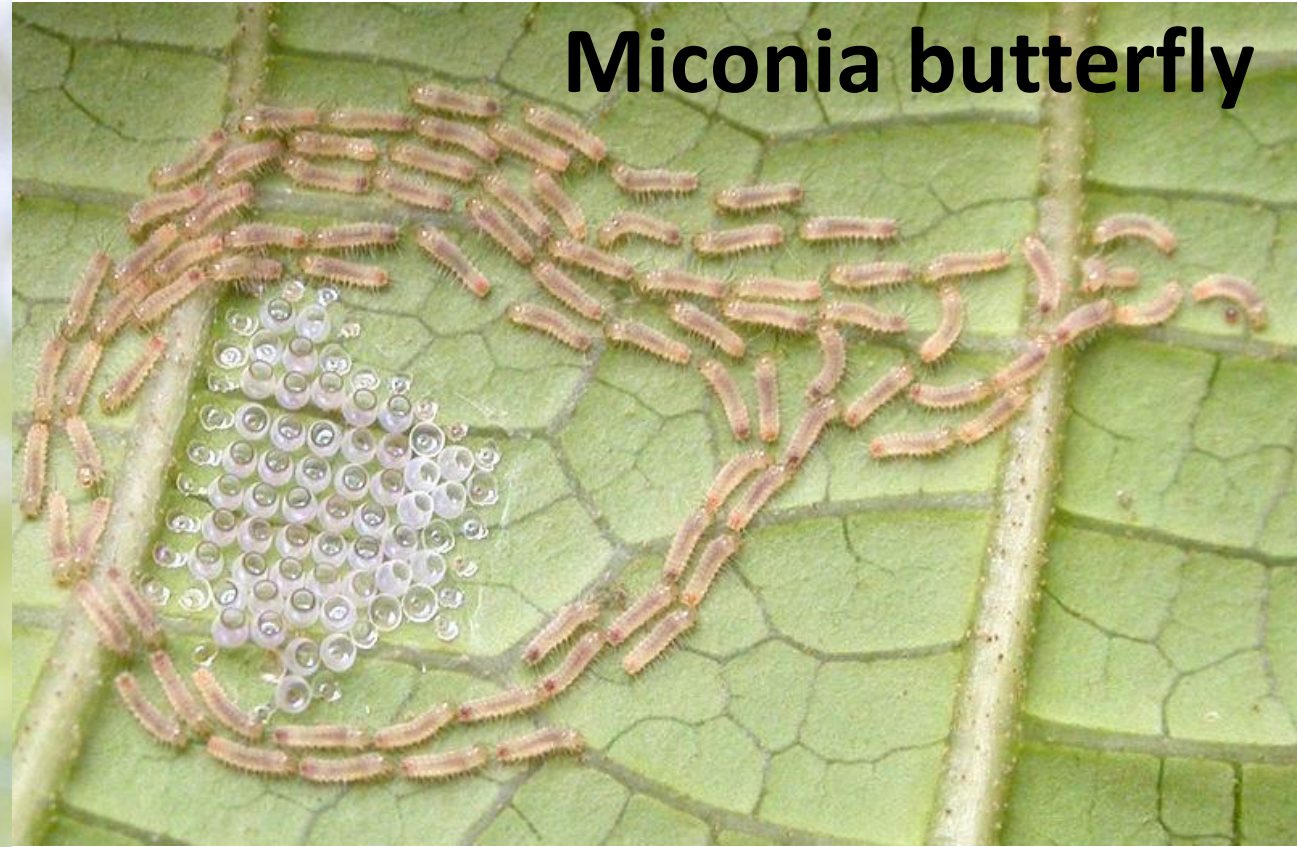
Pterolepis

Tibouchina

Feeding Damage
(score 0-6)

Eggs/Female/Day





Miconia butterfly



Clidemia with nematode galls (*Ditylenchus*)



Allorhogas gall wasp on *Clidemia hirta* in quarantine



Albizia biocontrol: 2015 initiated collaborations in Indonesia and Papua New Guinea



Mahalo!

To the many partners that share our vision for
conservation in Pacific Islands !



J. Jeffrey