Restoring native forest plant diversity through partial defoliation of an invasive tree with an introduced fungal pathogen

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Biological control as a restoration tool?

- When and why biocontrol?
- What beneficial effects?
- A case study - and successful story! - : 15 years of biocontrol of *Miconia calvescens* in the island of Tahiti (South Pacific)
A dominant plant invader in tropical rainforests

Miconia calvescens DC (Melastomataceae)

Cyanophyllum magnificum (Rev. Hort 1859)
Jardin botanique Harrison Smith Papeari, Tahiti (1963)
(Meyer 1996. Pacific Science 50)
Direct impacts on endemic plant diversity

Miconia dense monospecific forest

Miconia invaded forest understory

Indirect impacts on forest ecosystem services

- Soil erosion & landslides
- Watersheds
Manual and chemical control methods

miconia 2003
Raiatea
Biocontrol with a fungal pathogen

- *Cgm = Colletotrichum gloeosporioides forma specialis miconiae* (Melanconiales, Coelomycetes, Deuteromycetinae)
- Discovered in Brazil in 1997, cultivated and tested in Hawaii for plant host-specificity
- Released in Tahiti in 2000
- Causes leaf anthracnose and necrosis leading to plant death
  
  (Killgore et al. 1999. *Plant Disease* 83)
Cgm impacts on Miconia seedlings

- 100% plant and leaf infection
- 75% mortality (one month old seedlings) in the lab
- 30% mortality (< 50 cm tall) in situ

(Meyer, Taputuarai & Killgore 2008, Proc. XII Int. Symposium on Biological Control of Weeds)
Cgm impacts on Miconia canopy leaves

- Partial defoliation of *M. calvescens* trees: between 5-35%, increasing with elevation (and lower temperatures)

Study of the recovery of rare and endemic plants

Ophiorrhiza subumbellata (Rubiaceae)

Myrsine longifolia (Myrsinaceae)


(Meyer & Fourdrigniez 2011, *Biological Conservation* 144)
Long-term study of forest dynamics

- **Miconia**
  - Stem density & DBH (> 1.30m)
  - Basal area

- **Understorey plants (≤ 1.30m)**
  - % cover of all (native vs alien) species in quadrats
  - Taxonomic status (flowering plants vs ferns)
  - Light preference (light demanding vs semi-shade vs shade-tolerant species)
Significant increase of native plant diversity and abundance with time

(Meyer, Fourdrigniez & Taputuarai 2012, *BioControl* 57)
Monitoring of seedling recruitment

Ten 100 m² permanent plots along an elevation gradient (600-1300 m)

- 64 subplots (1m²)
- 20 quadrats 1x1 m per plot
- Number and size of all woody plant seedlings (native & alien species)
**COMMON NATIVES**

- *Rhus tabitensis* (Anacardiaceae)
- *Wikstroemia coriacea* (Thymelaeaceae)

**ALIEN INVADERS**

- *Spathodea campanulata* (Bignoniaceae)

**RARE ENDEMICs**

- *Pittosporum tabitense* (Pittosporaceae)
- *Liparis chypeolum* (Orchidaceae)
- *Rubus rosifolius* (Rosaceae)

(Meyer, Jordan & Taputuarai, *in prep.*)
Conclusions & lessons learned

- **Direct negative impacts of** \textit{Cgm} **on Miconia**
  - with elevation (effect of rainfall and temperature)

- **Indirect positive effects on rare endemic plant species**
  - Fertility
  - Density

- **Native forest regeneration**
  - Species number
  - Cover
  - Seedling recruitment of native and endemic species

- **Partial restoration**
  - Change in species composition (« novel ecosystem » ?)
  - Possible reinvasion by other alien species?
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