

A collage of nature images including a cougar, a person with a bow, a dog, and a bird.

# Biological Control of *Melaleuca*: From rags to species richness

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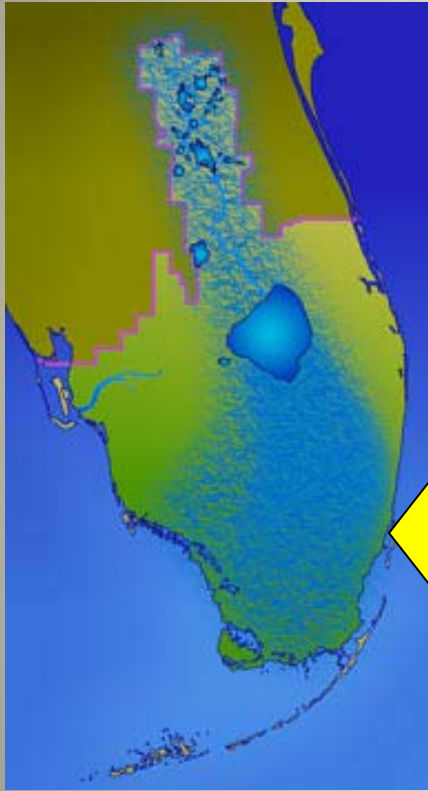


# Invasive Plant Research Lab

**Mission statement:** To develop sustainable methods based primarily on biological and integrated control technologies to manage invasive plant species



# The Everglades





# Broad-leaved paperbark tree *Melaleuca quinquenervia*





*Melaleuca quinquenervia* - "melaleuca"

# *Melaleuca quinquenervia*



- Native to eastern Australia (New Caledonia)
- introduced in late 1800s
  - Ornamental
  - Forestry
  - Soil stabilization
  - “dry up the Everglades”

# *Melaleuca quinquenervia*

- *Melaleuca*:
  - black and white
- *quinquenervia*:
  - five veins





# *Melaleuca quinquenervia*

- Related to "tea tree oil" species, *M. alternifolia*
- Large tree up to 100' tall
- Large tap root
- Coppices readily
- Evergreen
  - 4 yr leaf life span
- White papery bark
- Paper bark tree, white bottle brush tree, punk tree, melaleuca



# *Melaleuca quinquenervia*

- Can flower within 1 yr
- Flowers winter and summer
- White bottle brush flowers
- Capsular fruit
  - Arranged in clusters
  - Open when damaged
- Seeds
  - 200-300 seeds
  - 56 million seeds on adults
  - Most land 500' from parent
  - Hurricane: 11 miles





# Species displacement



Increased fire intensity





# Melaleuca Management Plan

## Strategy

```
graph TD; Strategy --> Eliminate_stands[Eliminate stands]; Strategy --> Prevent_Regrowth[Prevent Regrowth & Recruitment]; Eliminate_stands --> Herbicidal_Control[Herbicidal Control & Mechanical Removal]; Prevent_Regrowth --> Biological_Control[Biological Control];
```

Eliminate stands

Herbicidal Control  
&  
Mechanical Removal

Prevent Regrowth  
& Recruitment

Biological  
Control

# Biological Control Agents



Melaleuca snout weevil  
(*Oxyops vitiosa*)

Released 1997



Melaleuca psyllid  
(*Boreioglycaspis melaleucae*)

Released 2002



# Biological Control Agents



Melaleuca gall fly  
(*Fergusonina turneri*)

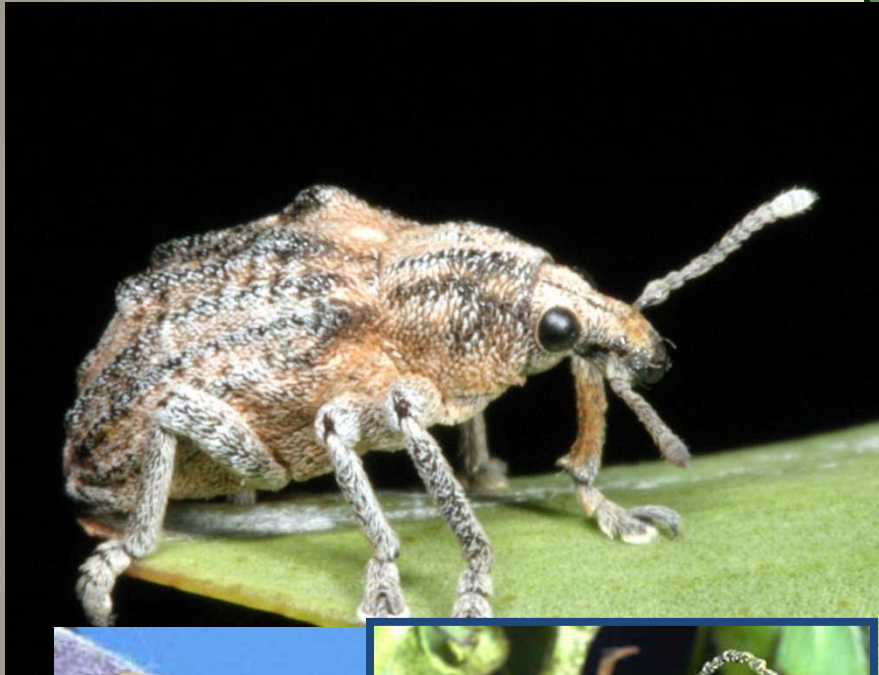
Released 2005



Melaleuca midge  
(*Lophodiplosis trifida*)

Released 2008

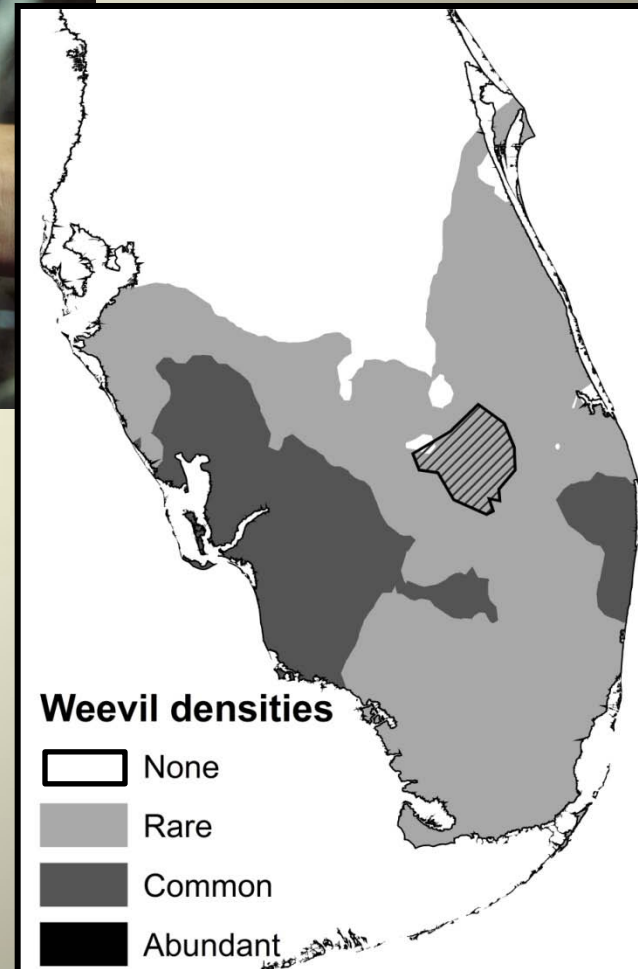
# The *Melaleuca* weevil



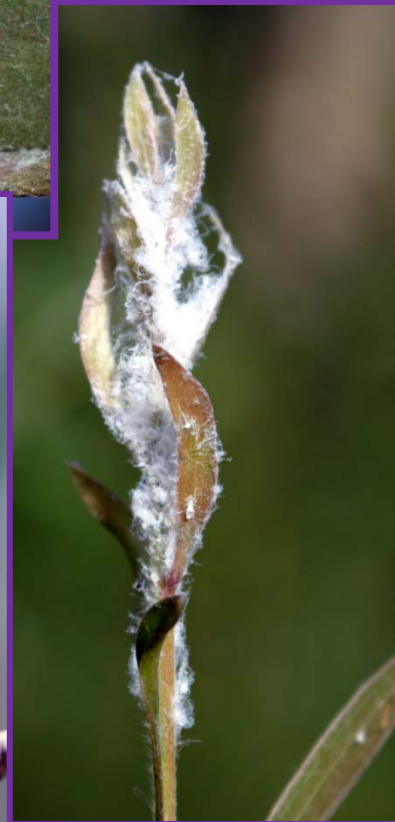
# The *Melaleuca* weevil



- Spreading at 1 km/yr
- > 500K individuals released
- At >150 sites



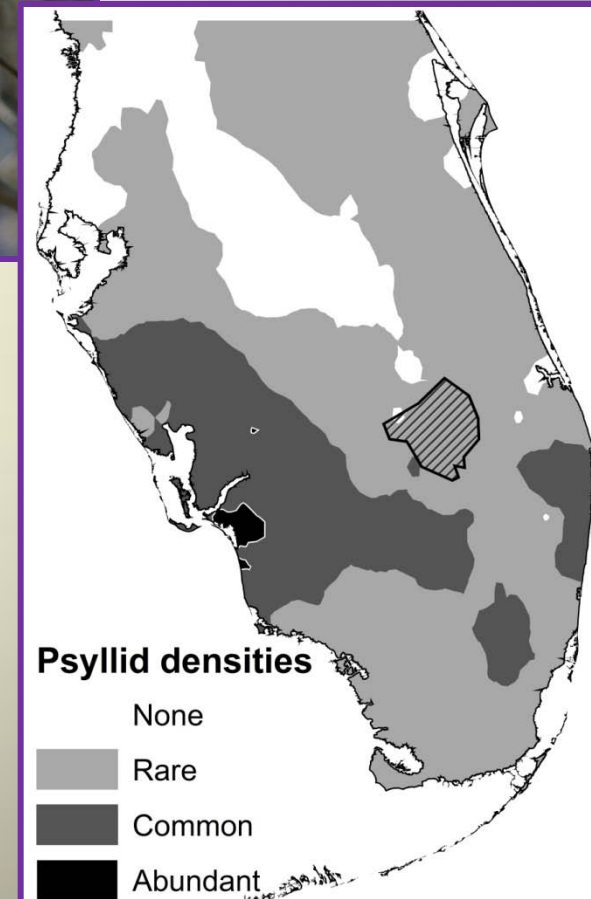
# The *Melaleuca* Psyllid



# The Melaleuca Psyllid



- Spreading at a rate of 7 km/yr
- > 3.3 million redistributed
- Now released at >95 sites

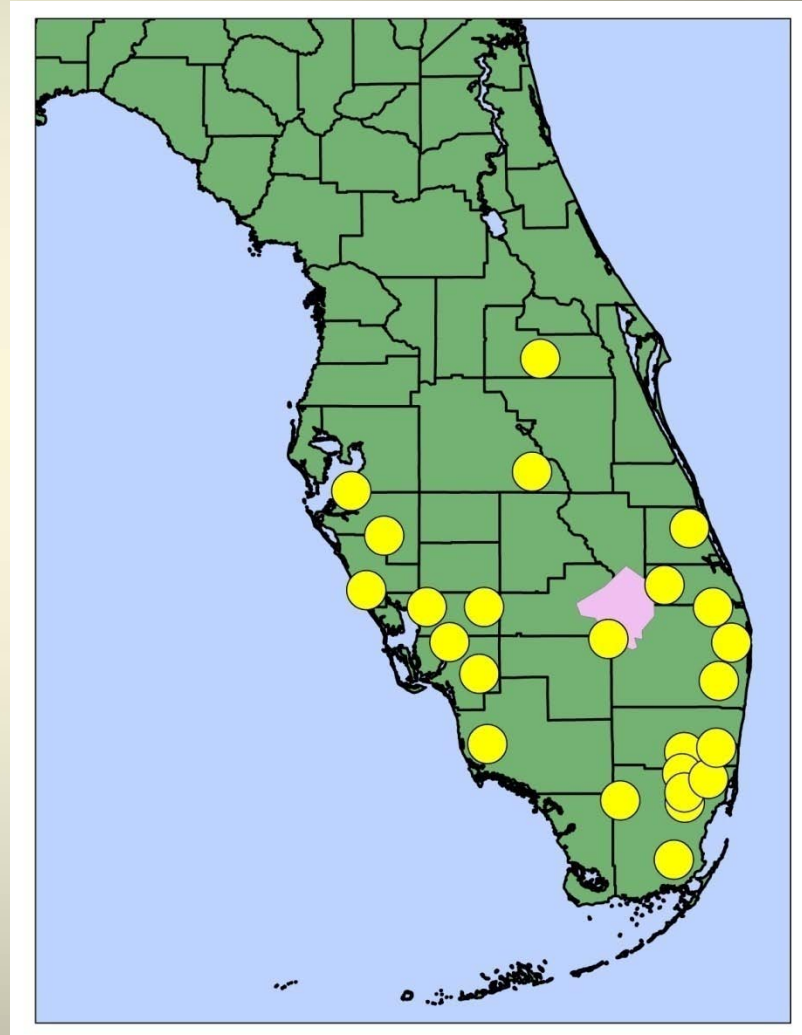


# The *Melaleuca* Midge



# The *Melaleuca* Midge

- Released at 24 sites
  - Variable founding pop. size
  - Variable stand size
- Uniform establishment initially
- Dispersing at 20 Km/yr



# Do these introductions satisfy the goals of the *Melaleuca* Management Plan?

– Reduce regrowth and recruitment



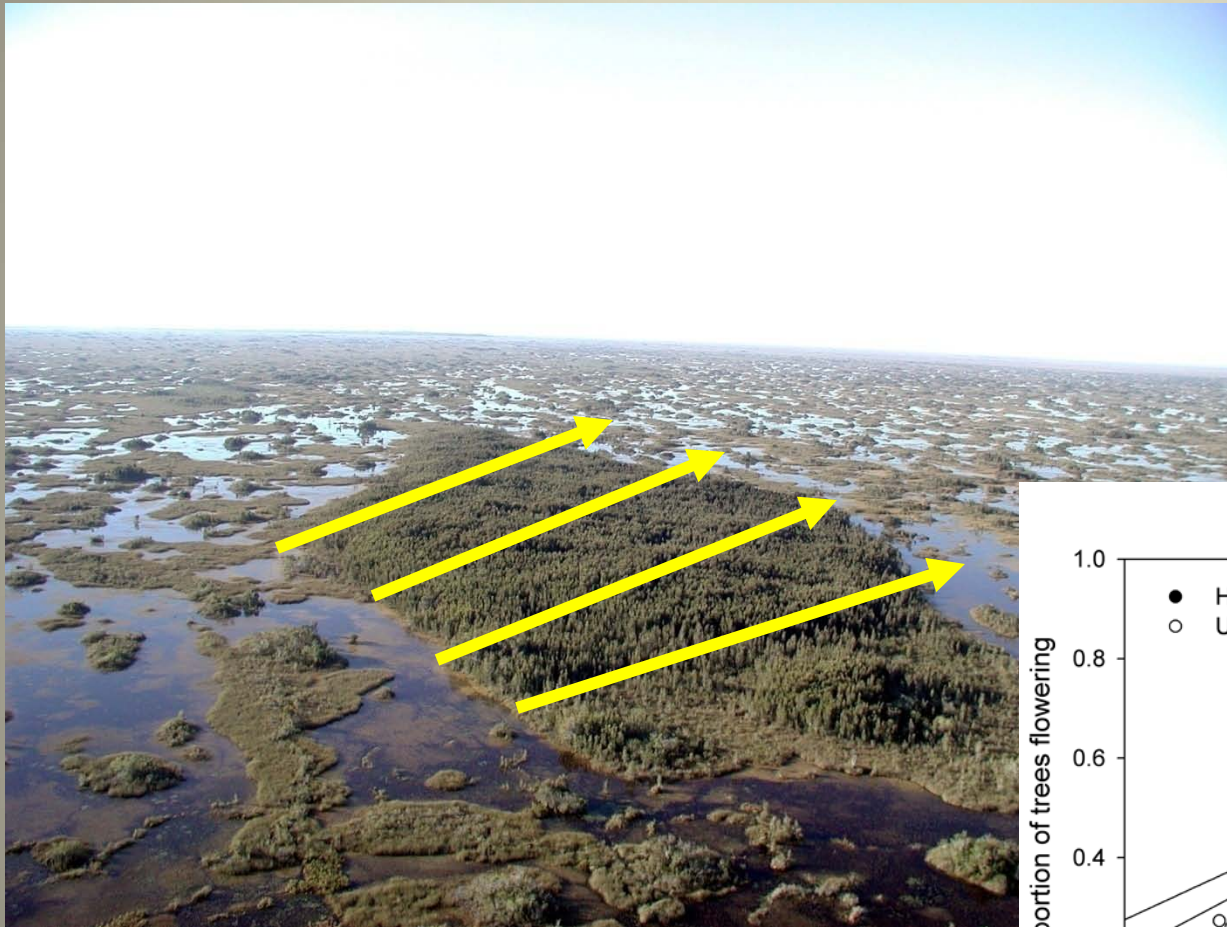


# Herbivory reduces stump regrowth:

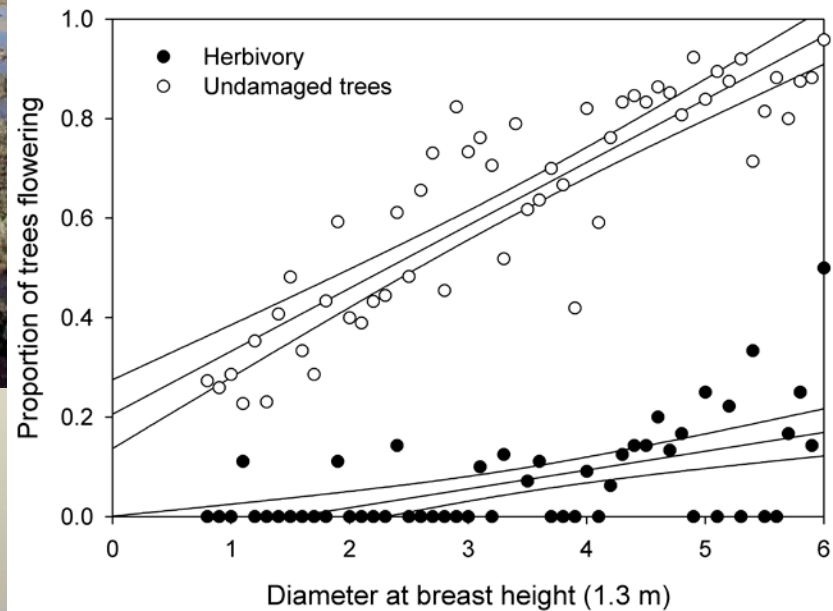
- Replicated insect exclusion studies:
  - 76% reduction in regrowth
  - 80% mortality of cut stumps



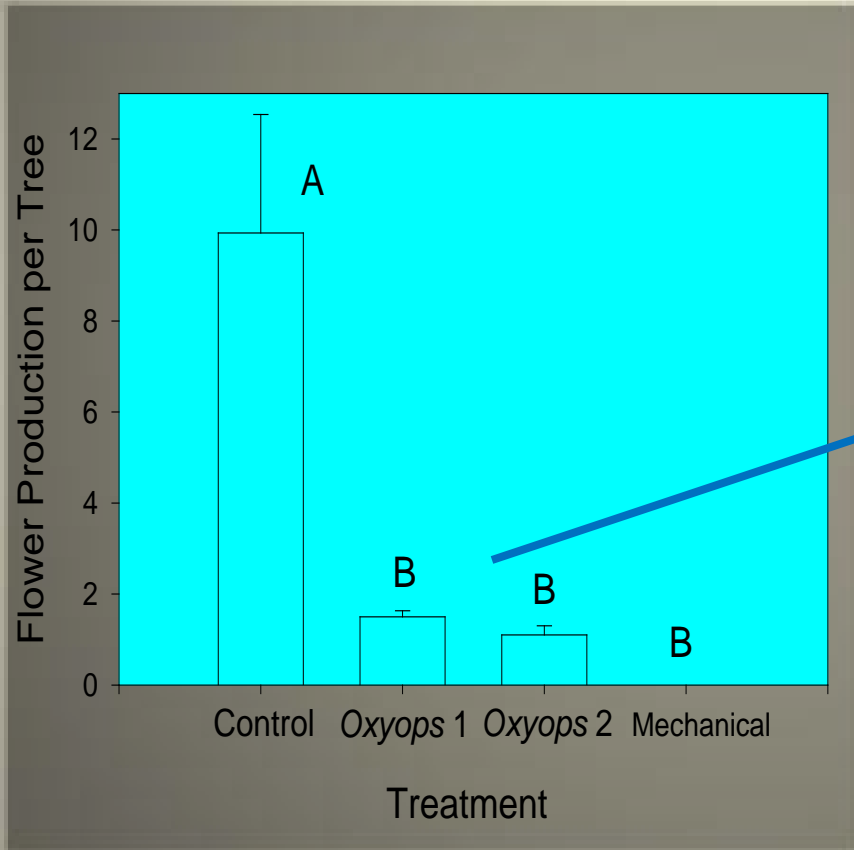
# Herbivory decreases reproduction



Pratt et al. 2005. *Ecol. Entomol.* 30: 316-326

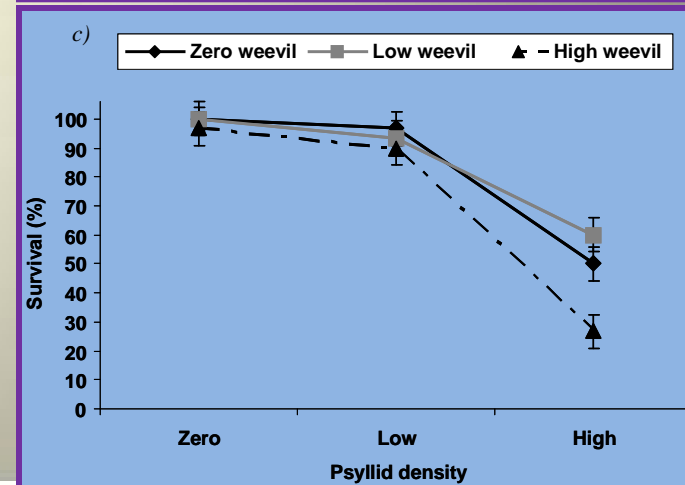
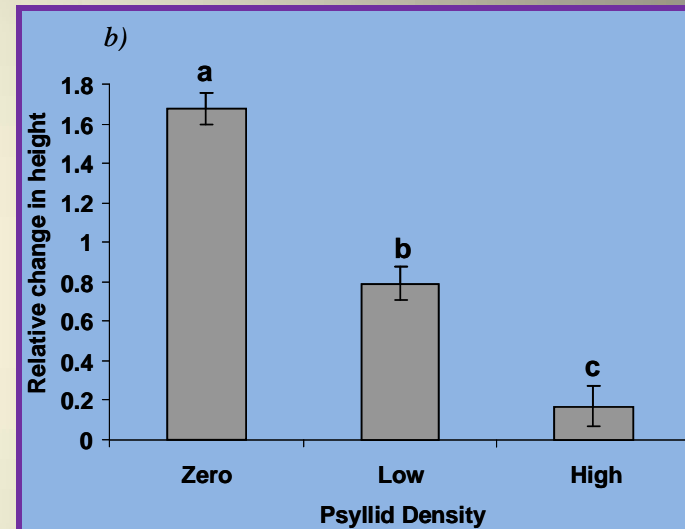


# Herbivory decreases reproduction



# Herbivory decreases recruitment

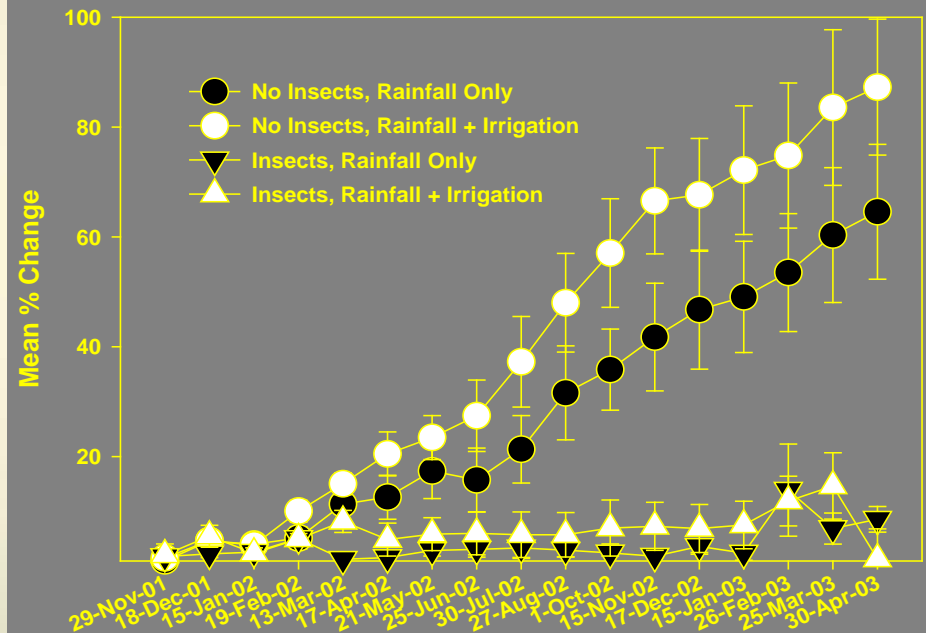
- Insect exclusion studies of seedling survival:
- Density dependent
  - Growth: shrinking!
  - mortality: 40 to 80%



# Herbivory reduces plant stature

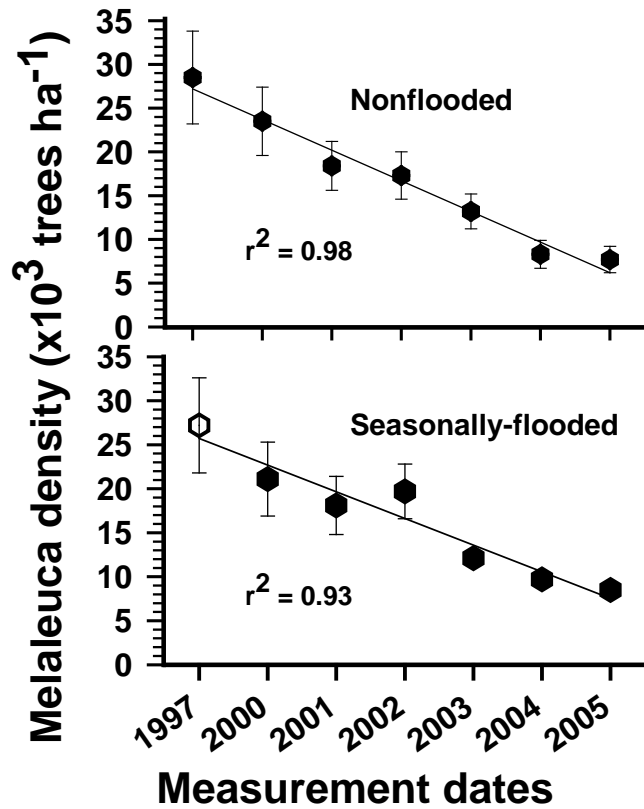


Impact of *O. vitiosa* on *M. quinquenervia*  
Tree Height

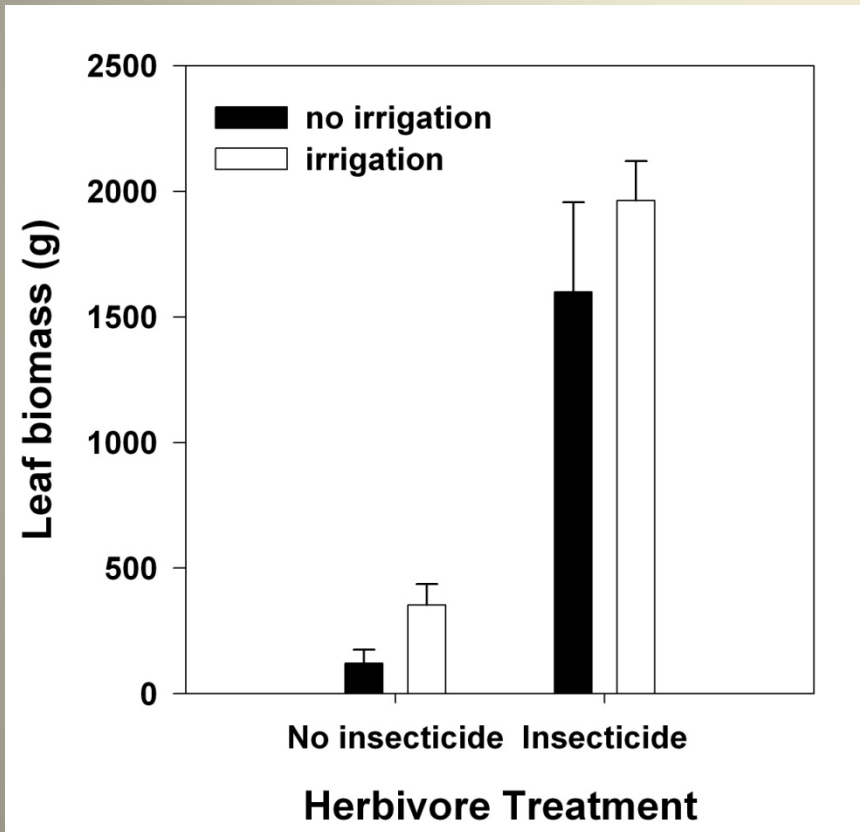


Tipping et al. 2008. Biol. Contr. 44: 235-241.

# Herbivory reduces plant density



# Herbivory reduces foliar biomass

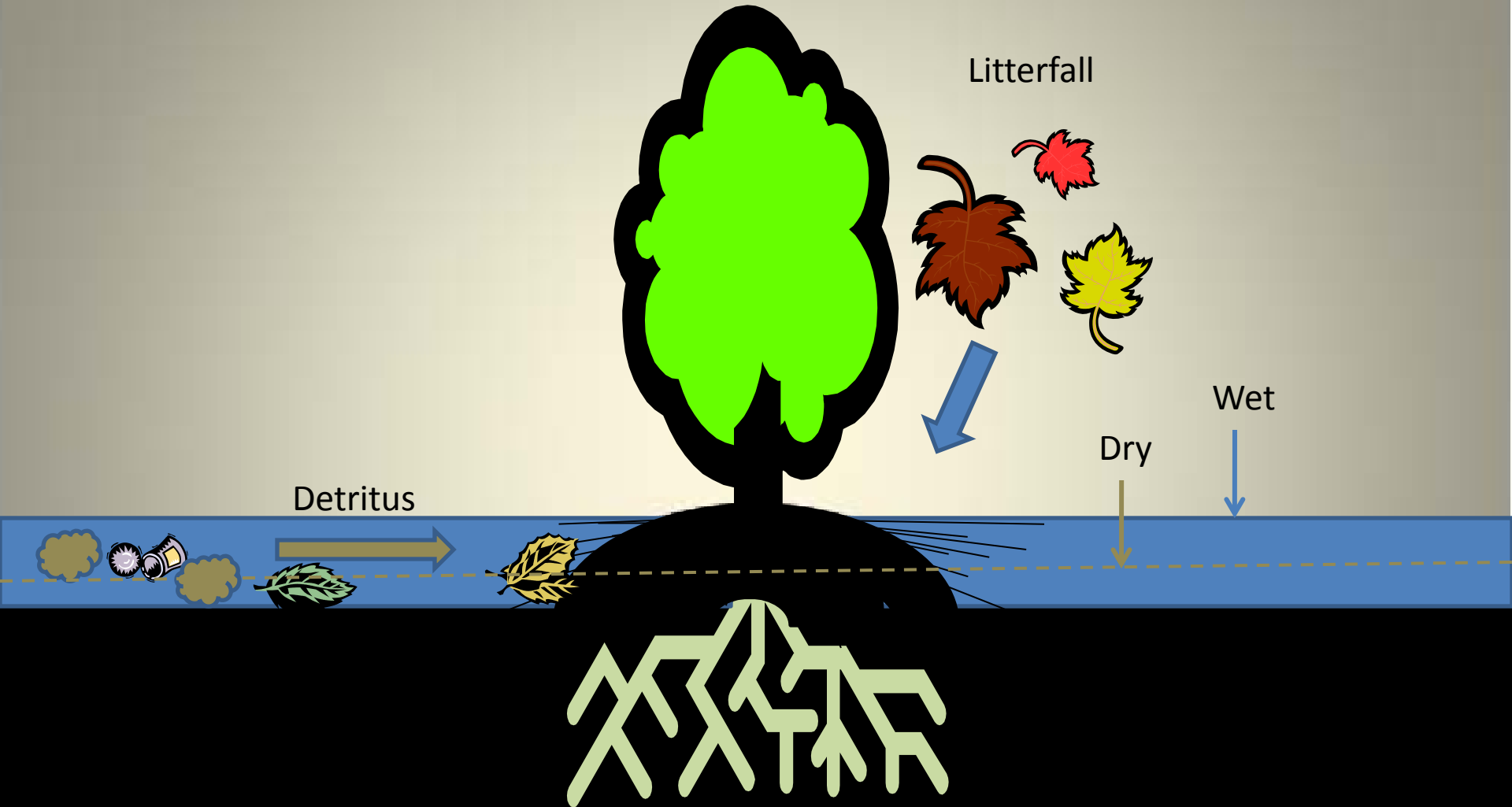


# Soil accretion



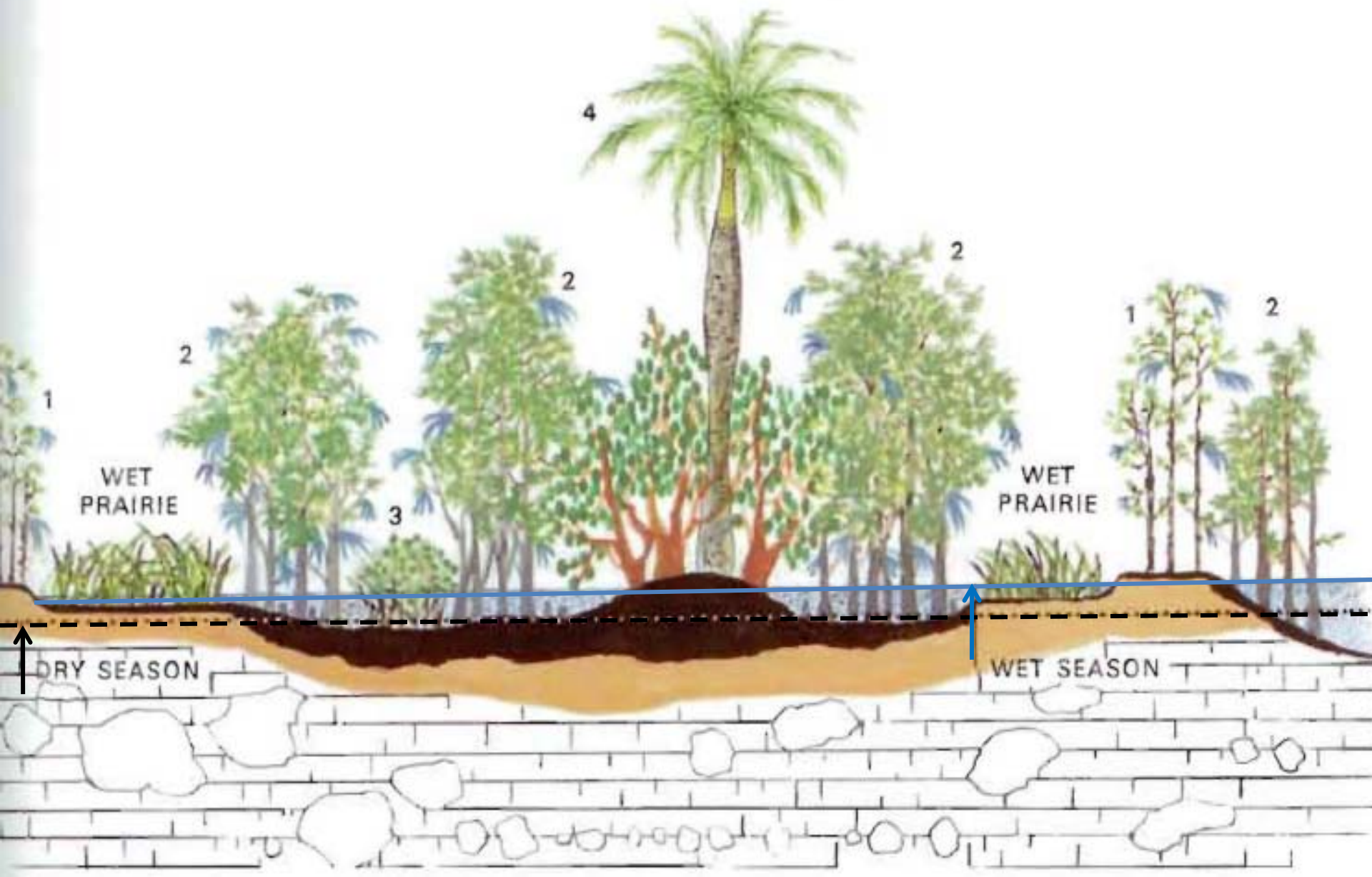


# Legacy Effect: Soil Accretion



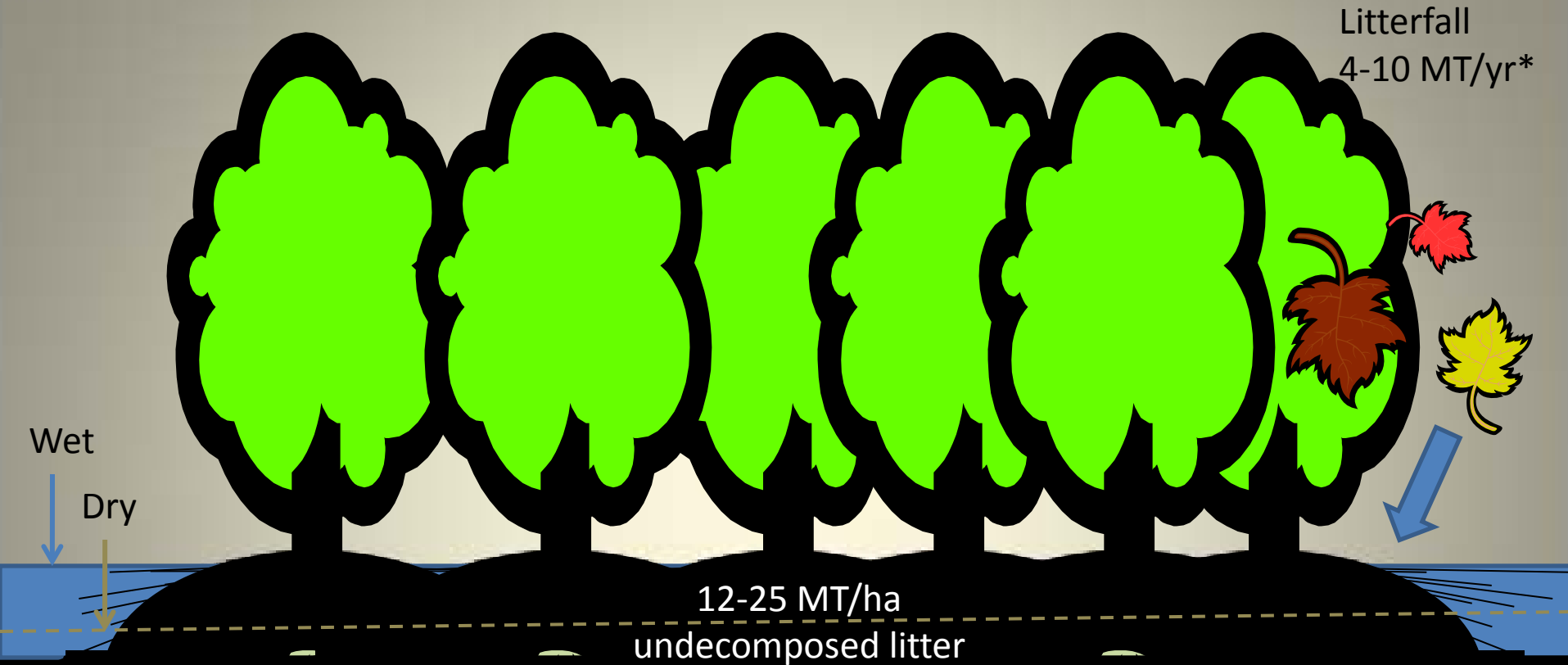
CYPRESS STRAND

TROPICAL HARDWOOD HAMMOCK





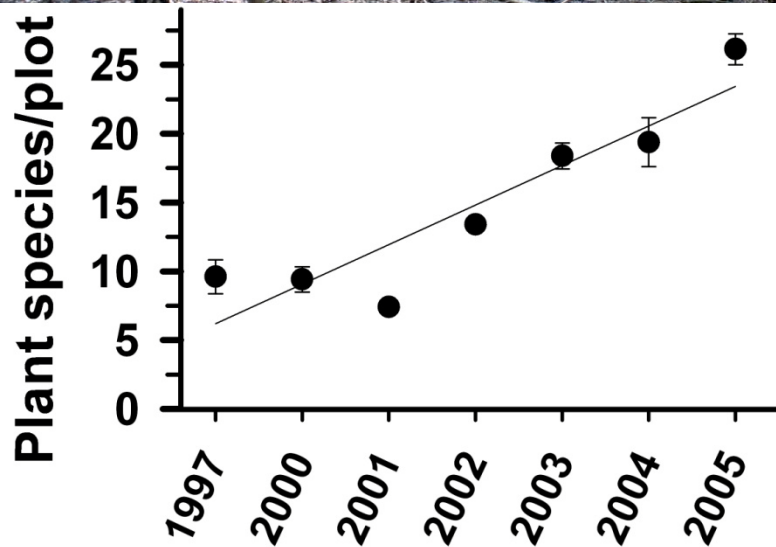
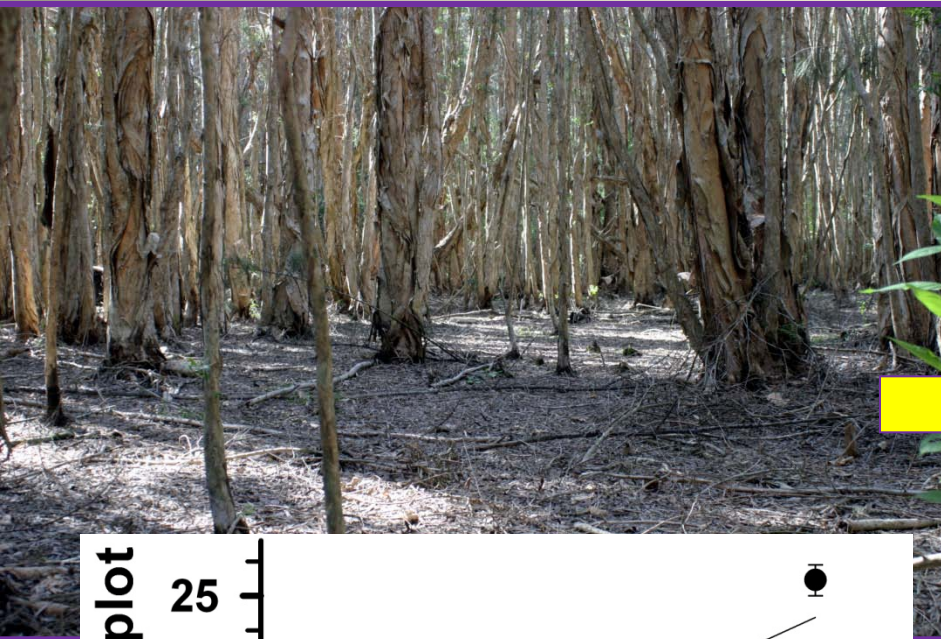
# Legacy effect



\*Rayamajhi et al., 2006

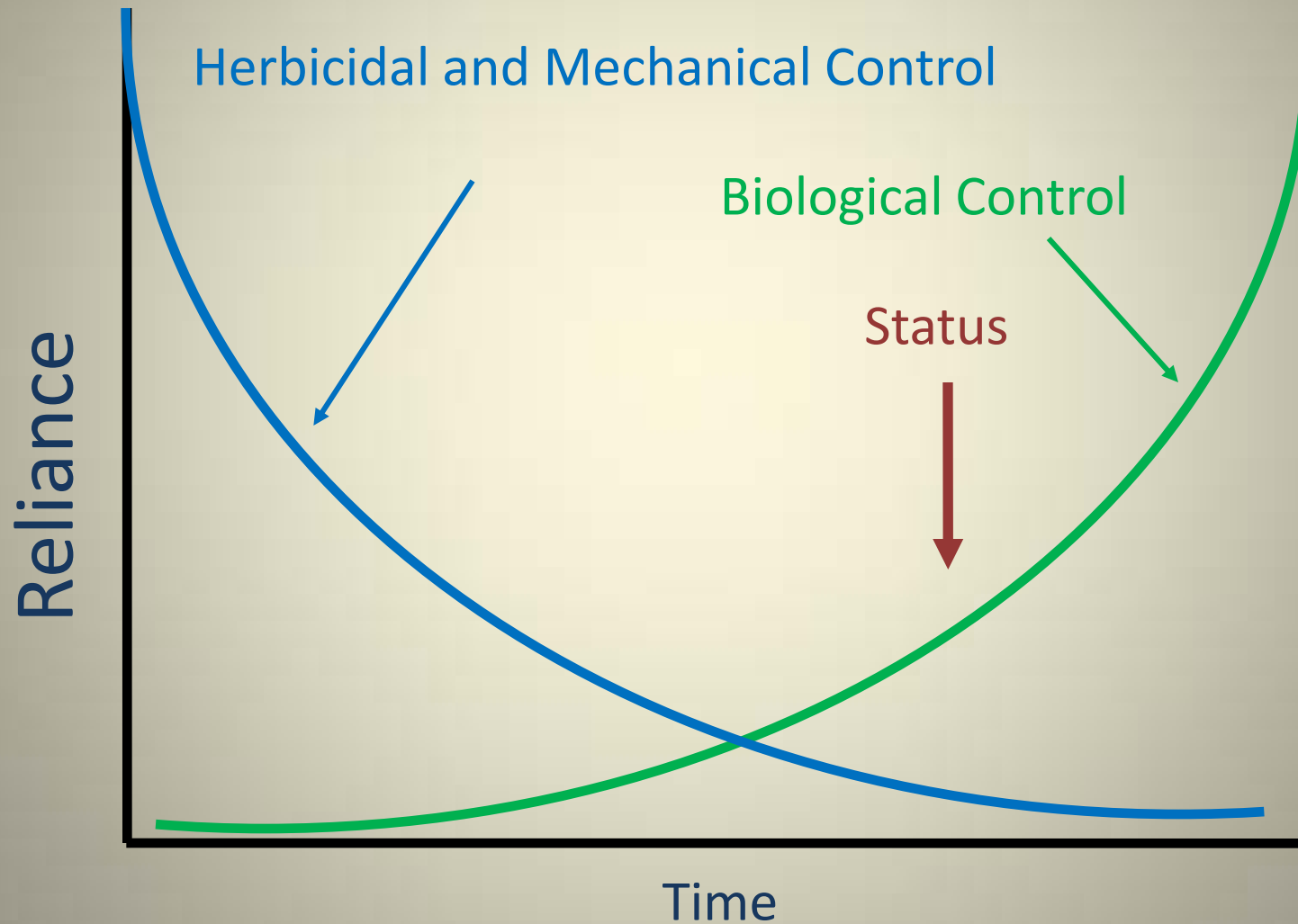
Increased elevation, reduced hydroperiod

# Is one exotic replacing another? NO!!



Rayamajhi et al. 2009. *Wetlands Ecol. & Manage.* 17: 455-467.

# Melaleuca on the ropes:



Brown is beautiful!



# The Return of the Native(s)





# Acknowledgements

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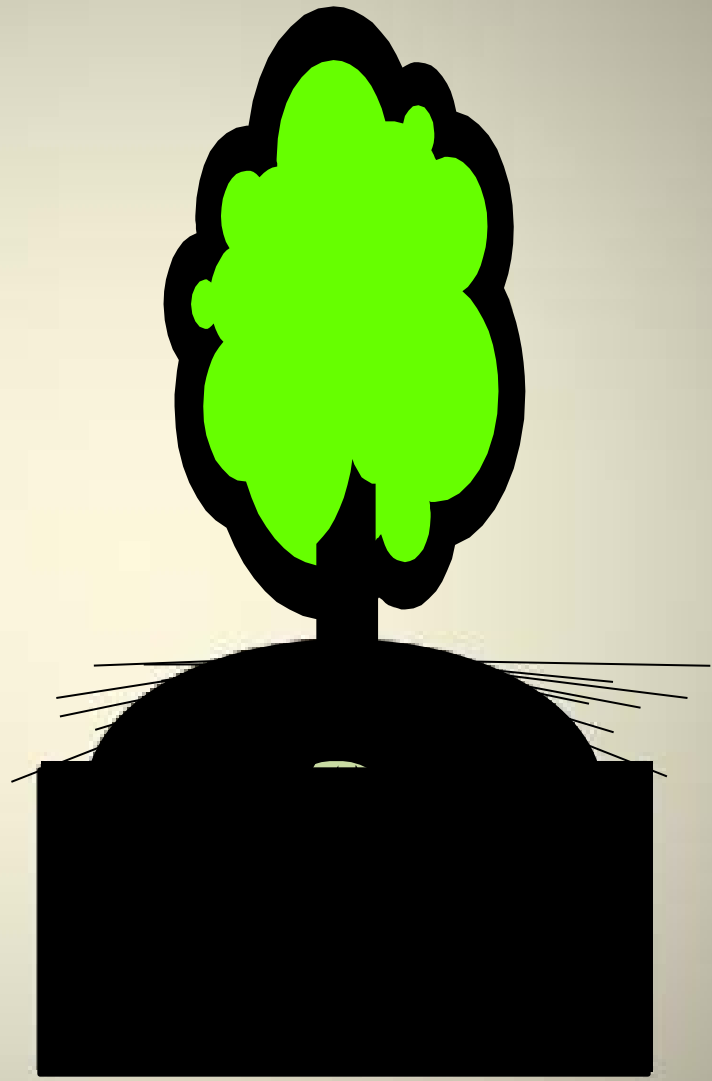
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- Bradley Brown
- Joe Balciunas
- John Goolsby

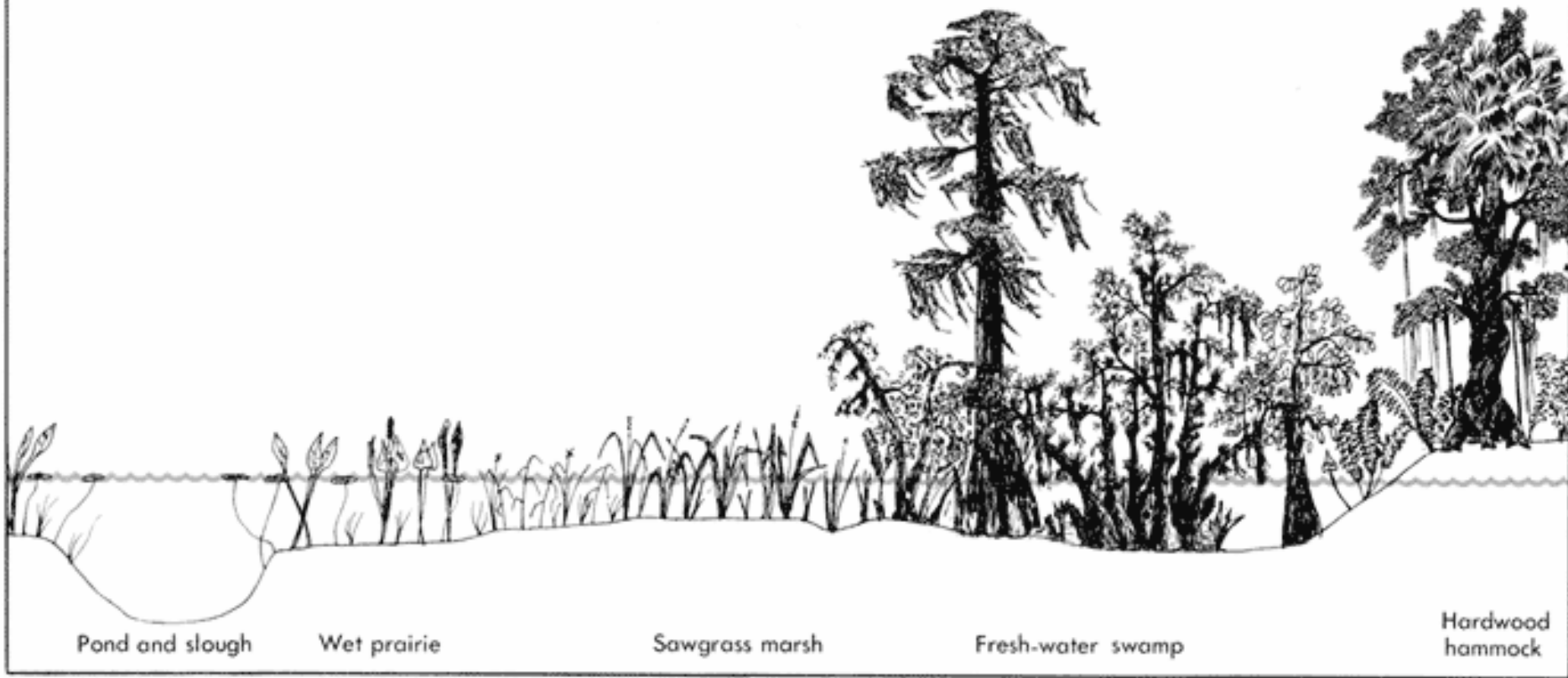
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- Lucero Sevillano
- Scott Wiggers
- Shannon Morath
- Karen Balentine





Wet Prairie  
(marl)

Sawgrass Marsh  
sparse      dense

Wet Prairie  
(peat)

Slough

Alligator  
Hole

Tree Is.

