

**Functional Basis for
Geographical Variation in Growth
Among Invasive Species: the
Case of *Lygodium microphyllum***

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Why a biogeographical approach?

- **Distributions and abundances of exotics in native and introduced ranges are vital**
- **Necessary for rigorous testing of mechanistic hypotheses of exotic plant success**

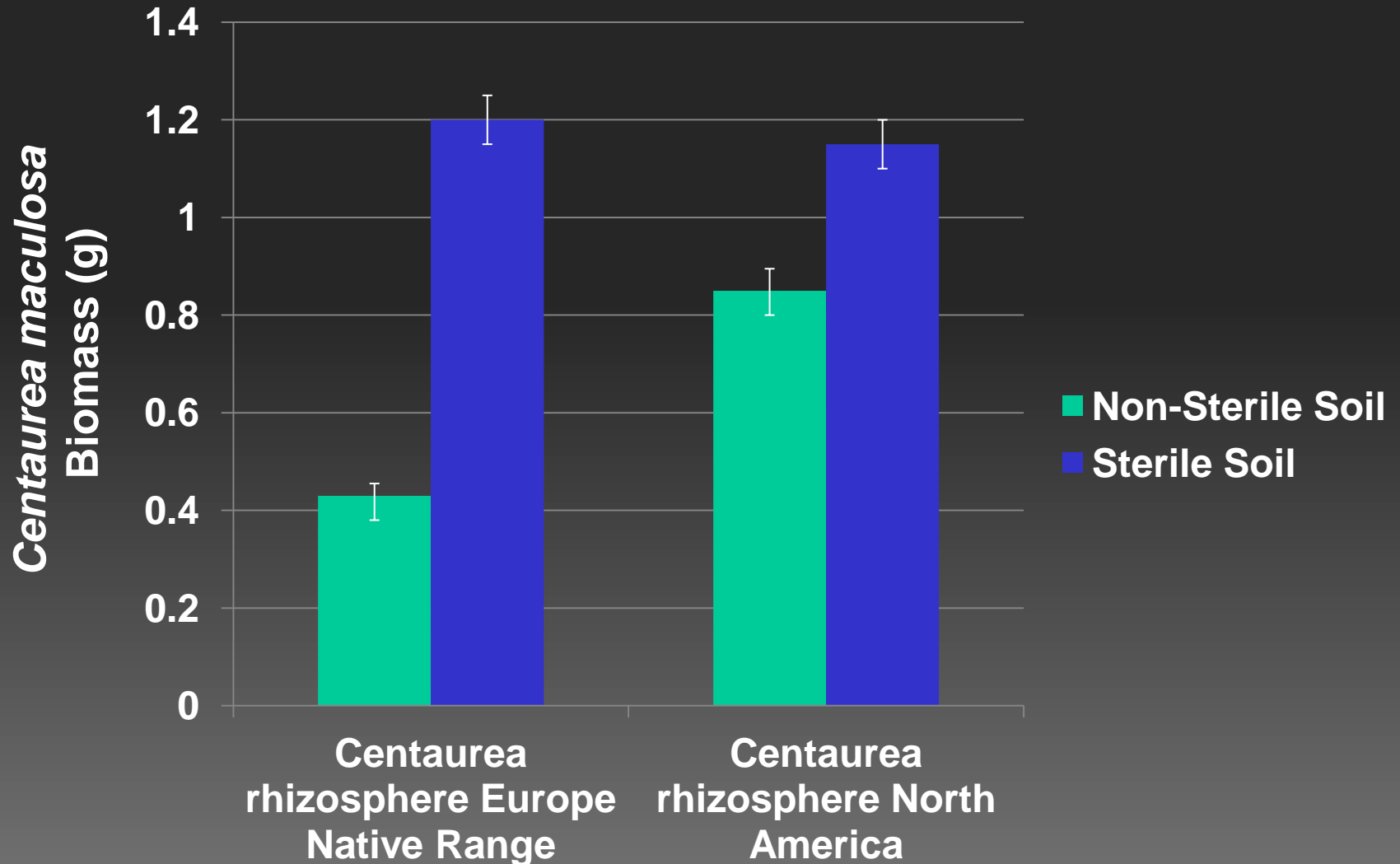
Hypotheses

- **Natural enemies**
- **Evolution of invasiveness**
- **Empty niche**
- **Novel weapons**

Natural Enemies

Upon introduction, the exotic species is liberated from its specialist herbivores and pathogens

Natural Enemies



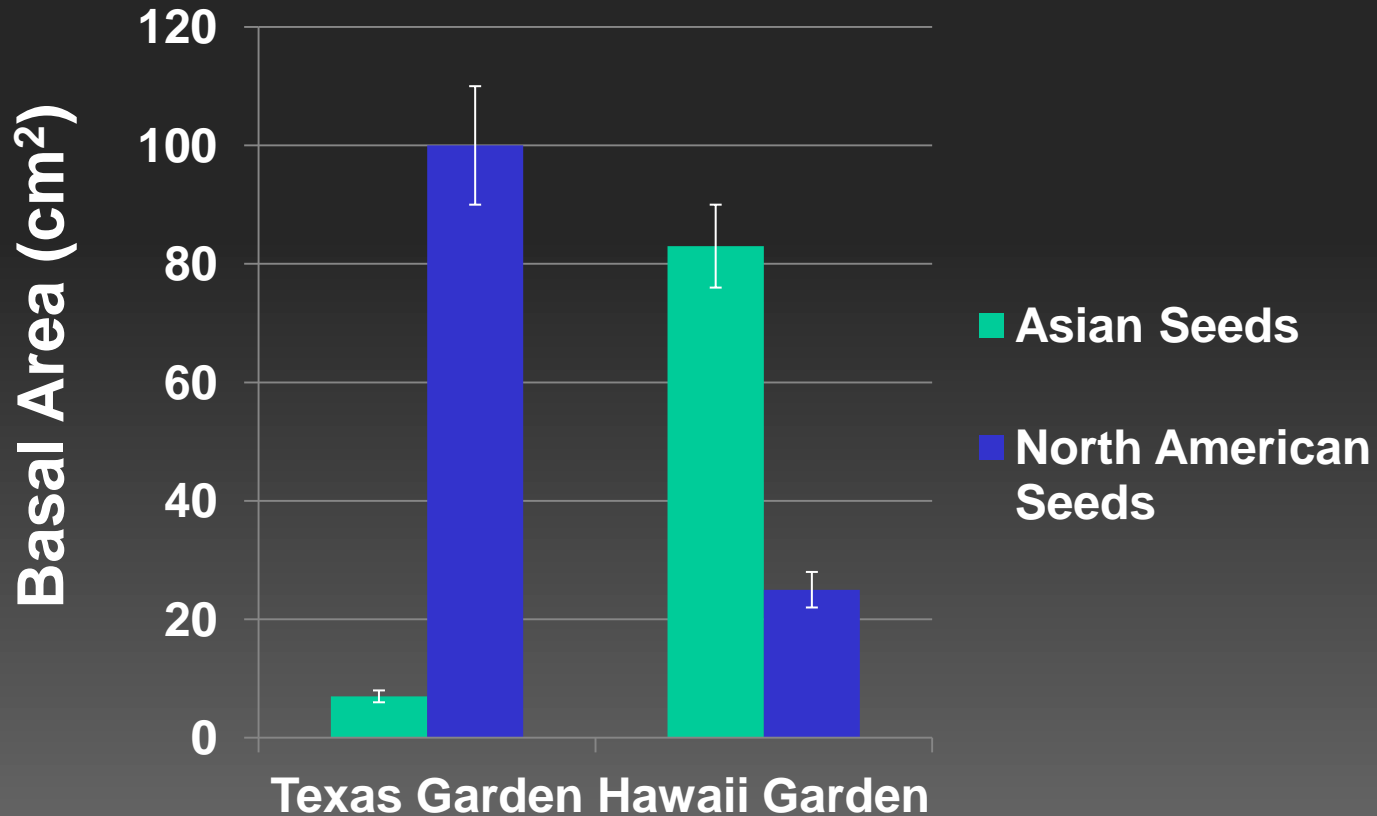
Adapted from Callaway *et al.* 2004, *Nature*

Evolution of Invasiveness

Exotics attain dominance in introduced range because they experience rapid genetic changes

Evolution of Invasiveness

Sapium sebiferum



Adapted from Siemann and Rogers 2003, *Ecological Applications*

Empty Niche Hypothesis

Exotics are successful because they have access to resources in the introduced community that no local species utilize

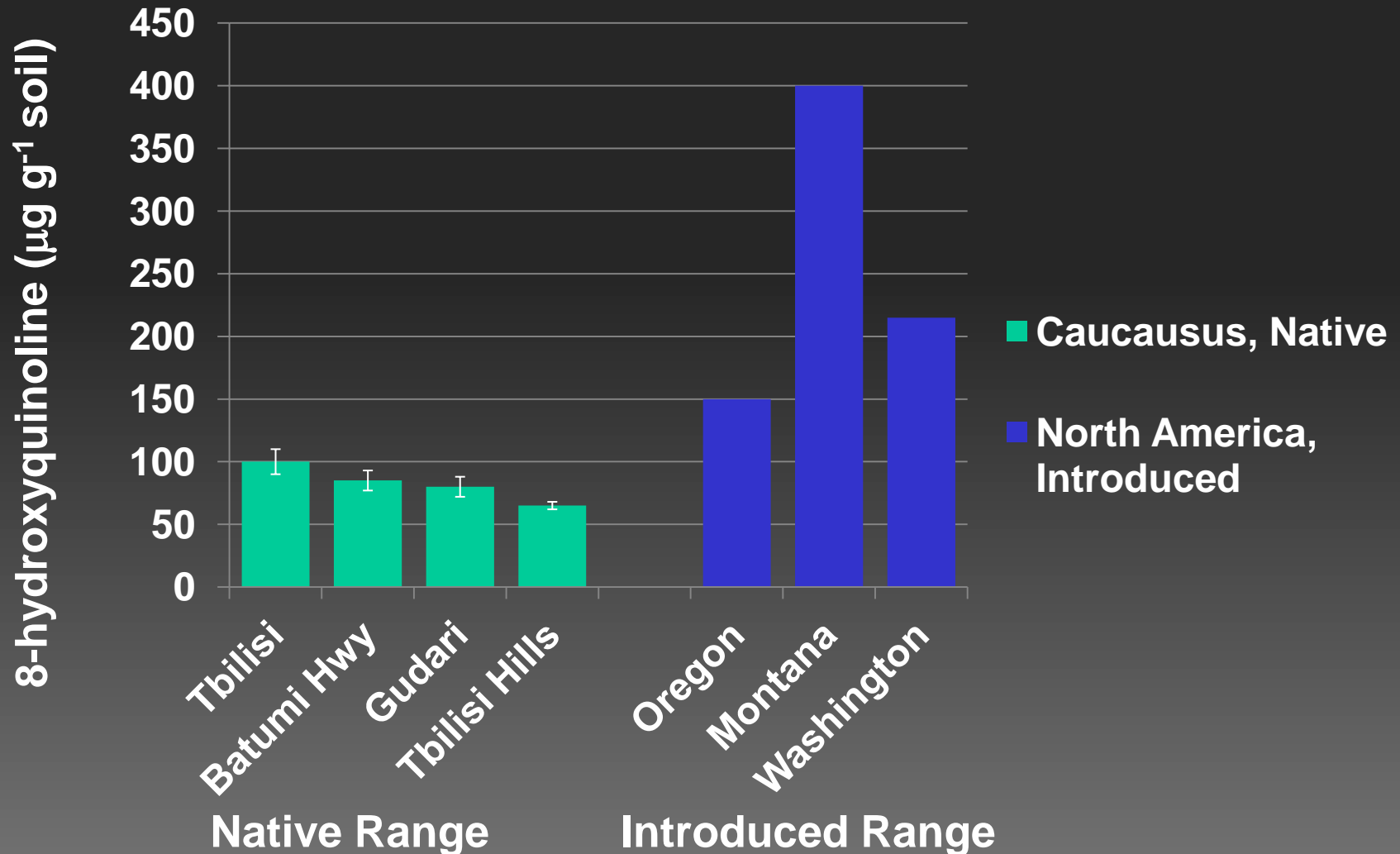
No parallel studies in both the native and introduced range to test this hypothesis have been conducted

Novel Weapons Hypothesis

Some exotics succeed because they exude allelochemicals that are relatively ineffective against well-adapted neighbors in native range, but highly inhibitory to plants in introduced range.

Novel Weapons Hypothesis

Centuarea diffusa



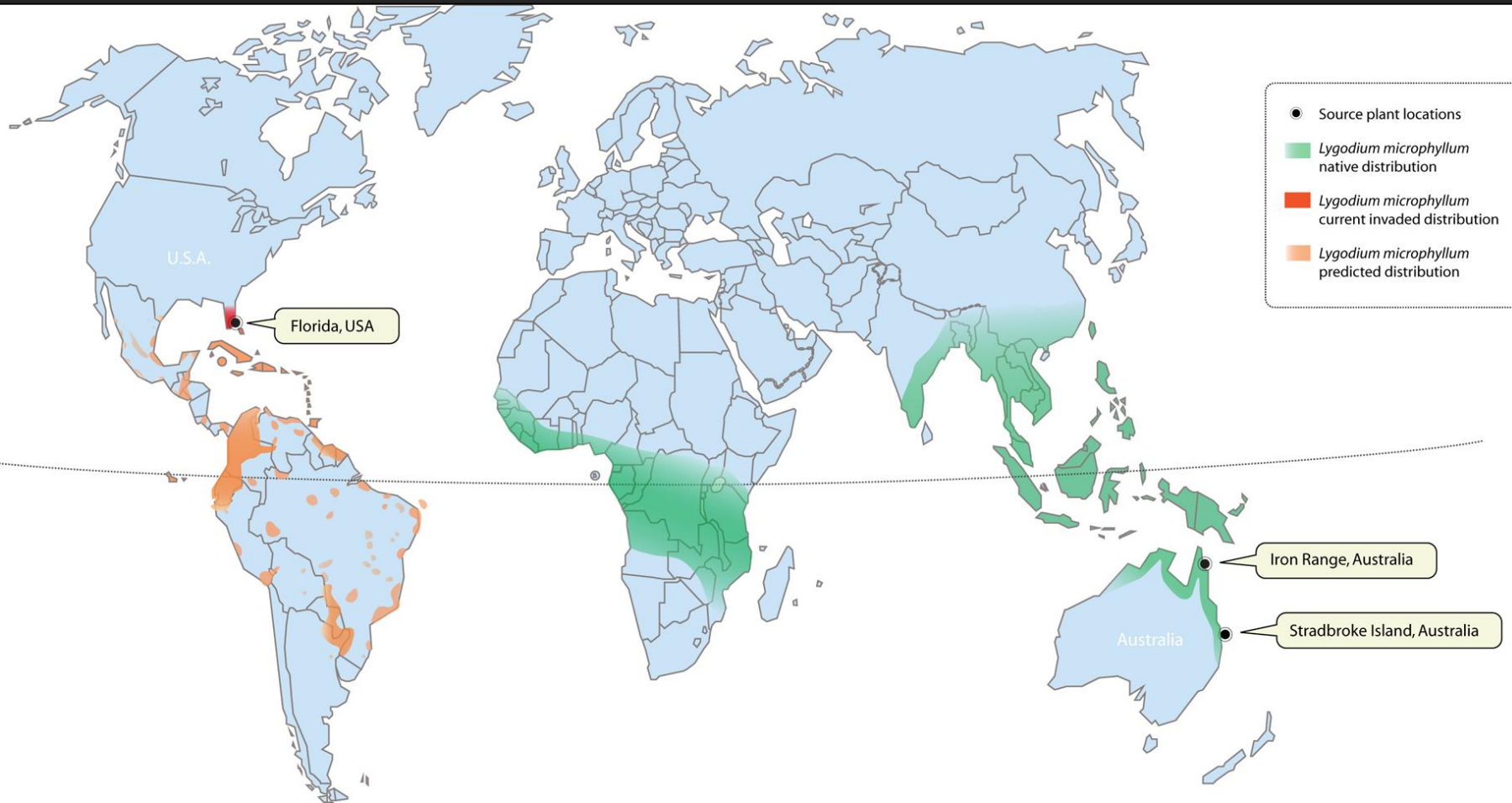
Adapted from Vivanco *et al.* 2004, *Ecology Letters*

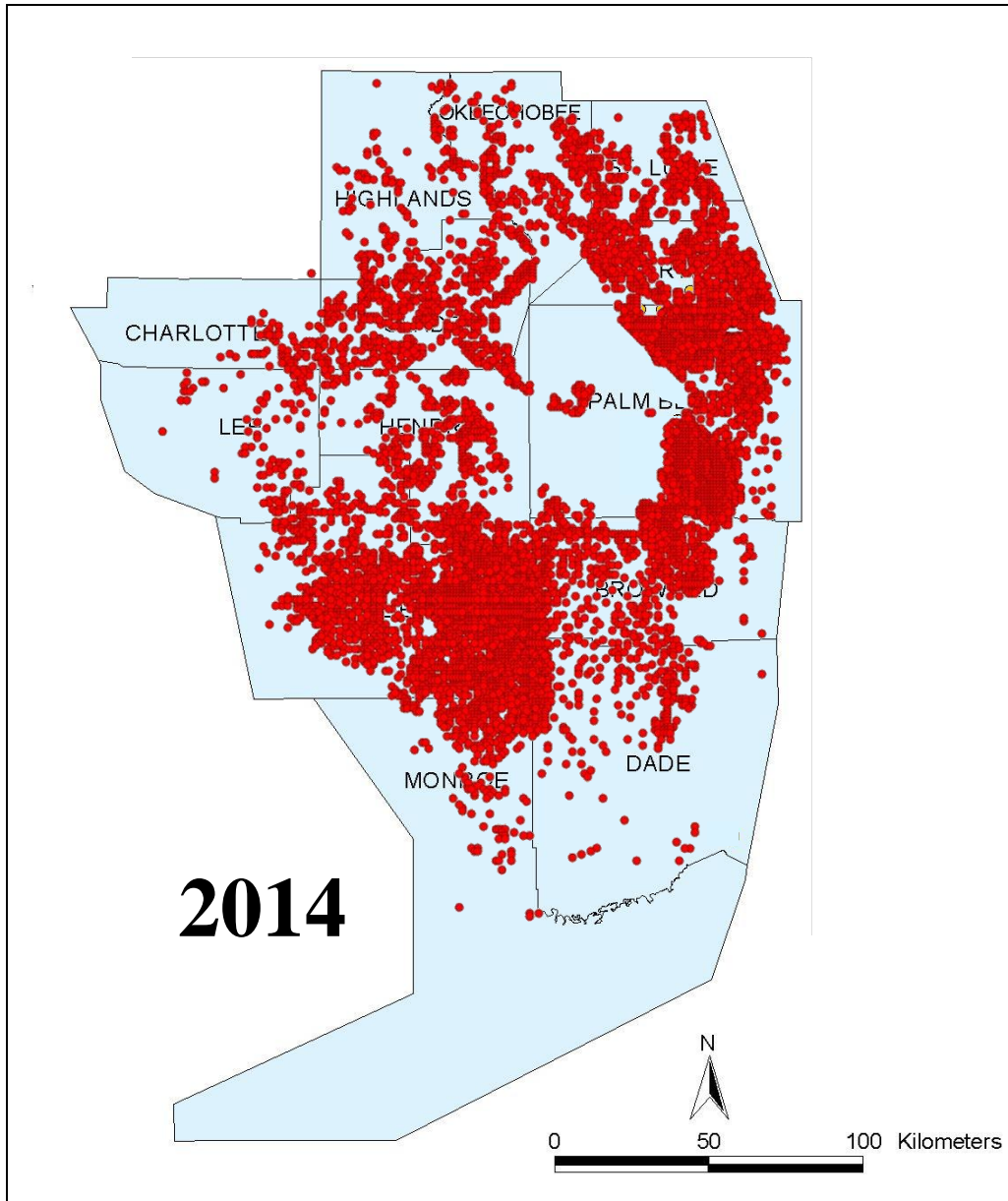
*Lygodium
microphyllum*



**Old World
Climbing Fern**

Lygodium microphyllum native, introduced and potential distribution





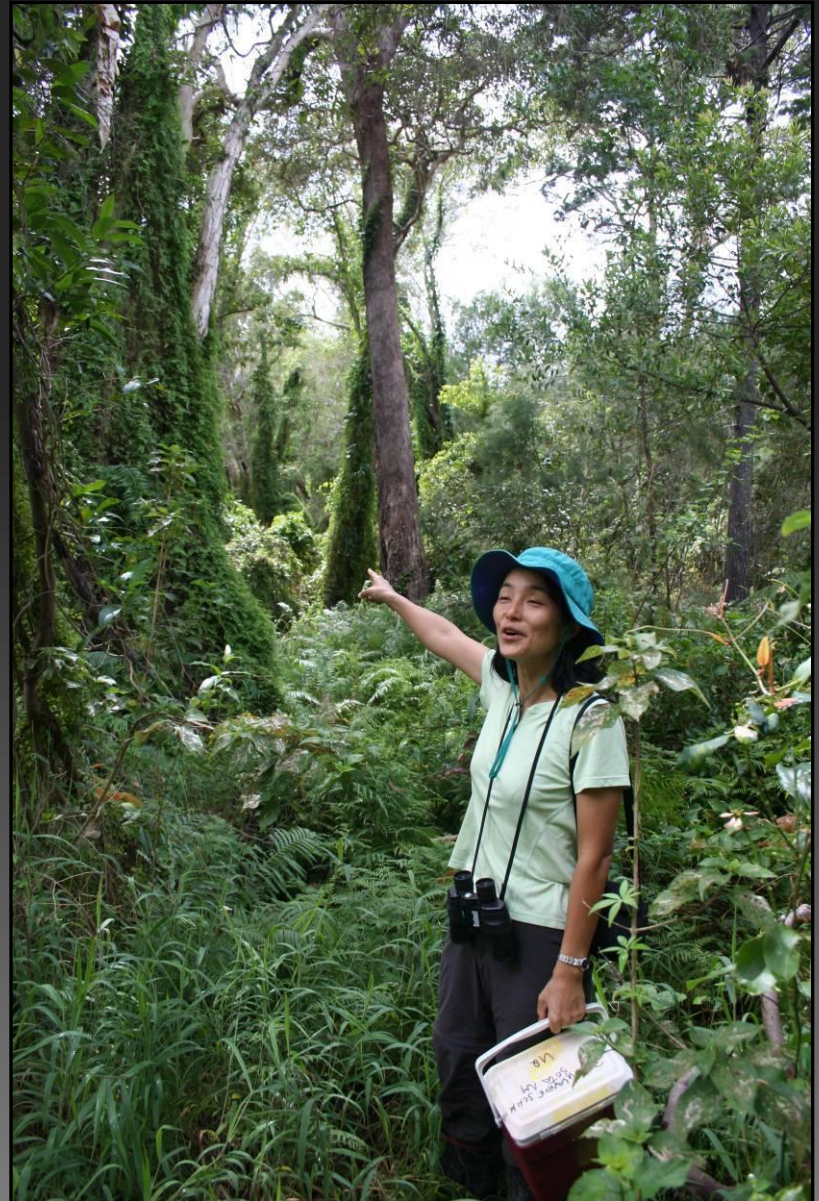
Invasive spread of *Lygodium microphyllum* in southern Florida

Volin *et al.* 2004

Lygodium microphyllum in Australia



Lygodium microphyllum in Queensland Australia



Comparing Growth of *L. microphyllum* in Florida vs. Australia

The success of *L. microphyllum* in establishing and outcompeting native Florida species can be partly explained by a release from natural enemies belowground

Soil treatments:

- sand
- soil (from a *Lygodium* site)
- sterilized soil

Nutrient treatments:

- amended vs. unamended

Growth and its determinants:

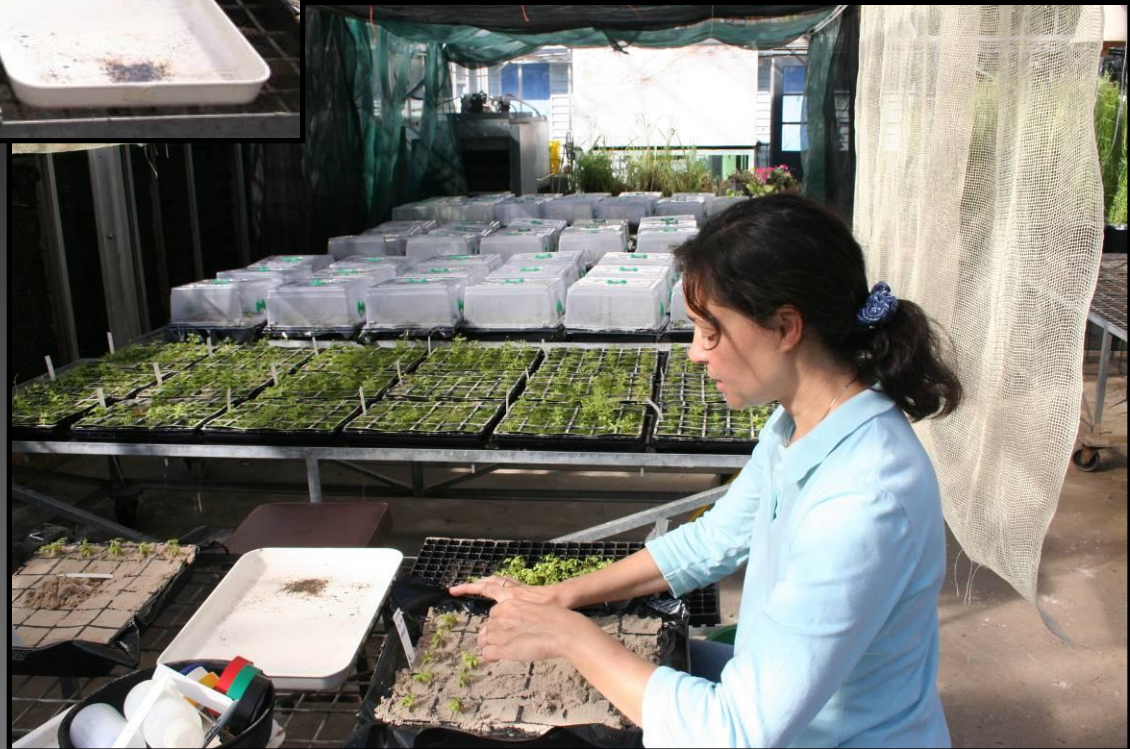
- physiological
- allocational
- morphological

50% shade enclosures in the Florida study





Transplanting sporelings for the Australia study



Soil collection and sterilization



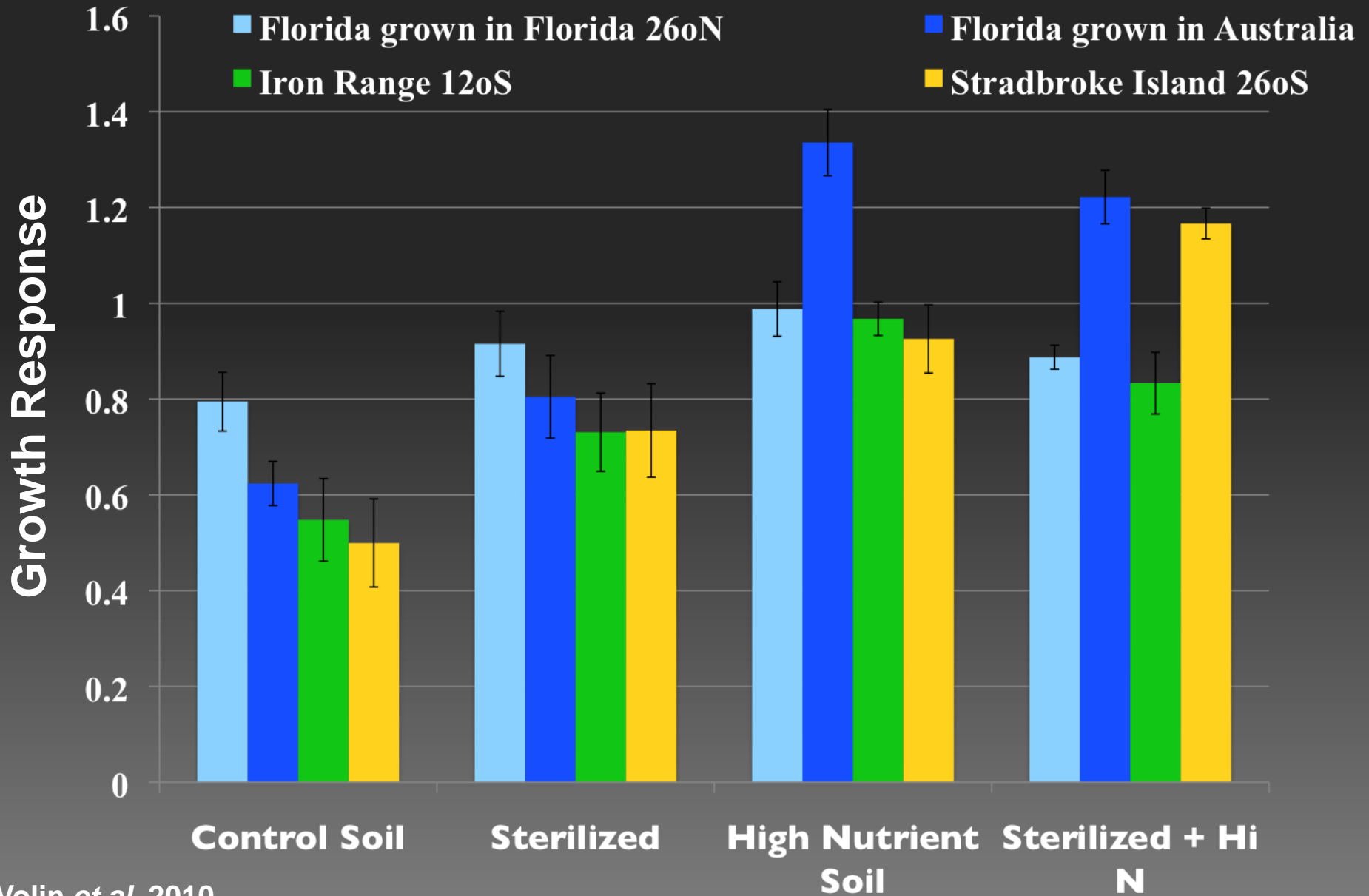
50% shade enclosure in the Australia study



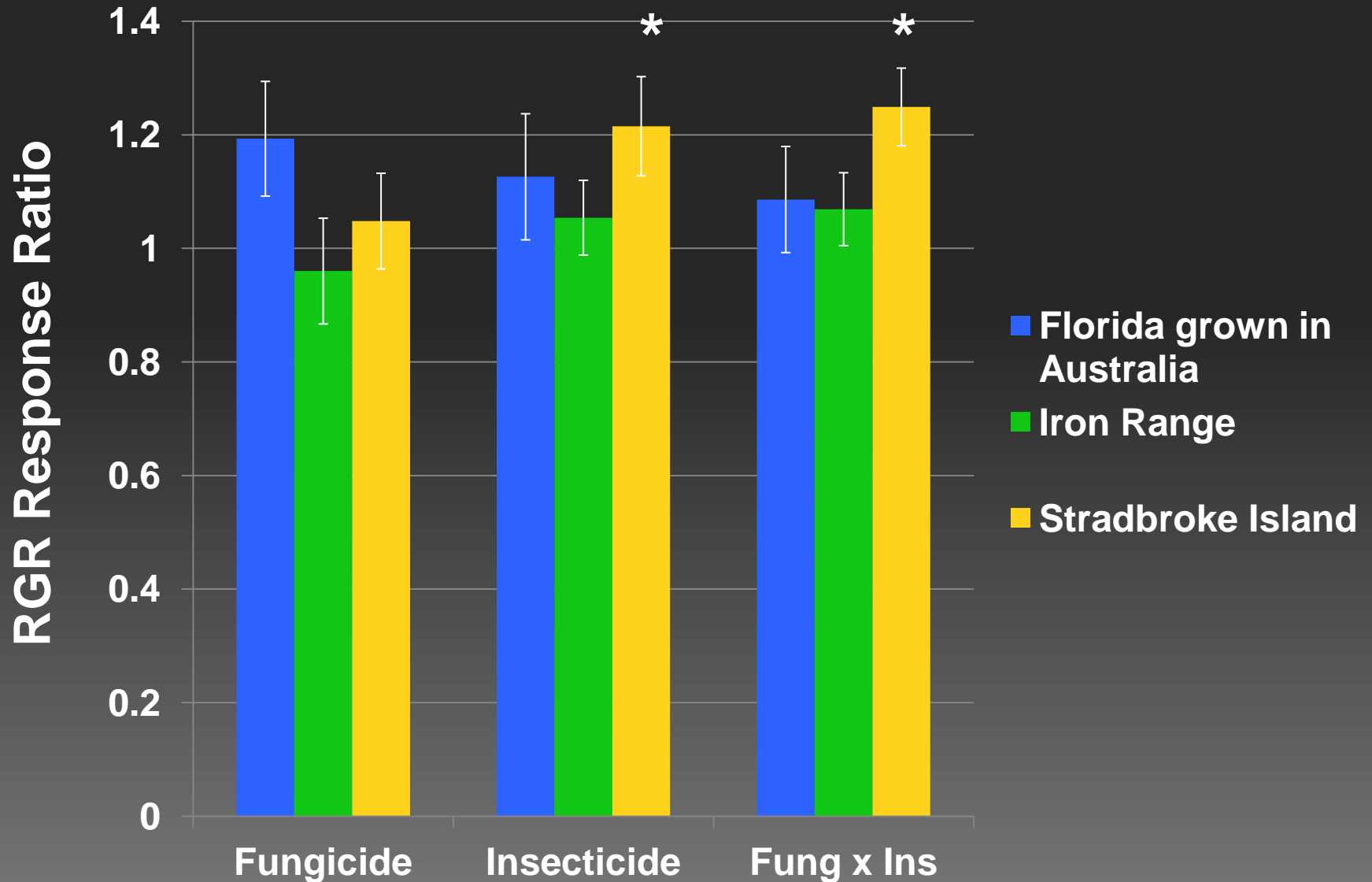
Harvesting the control study



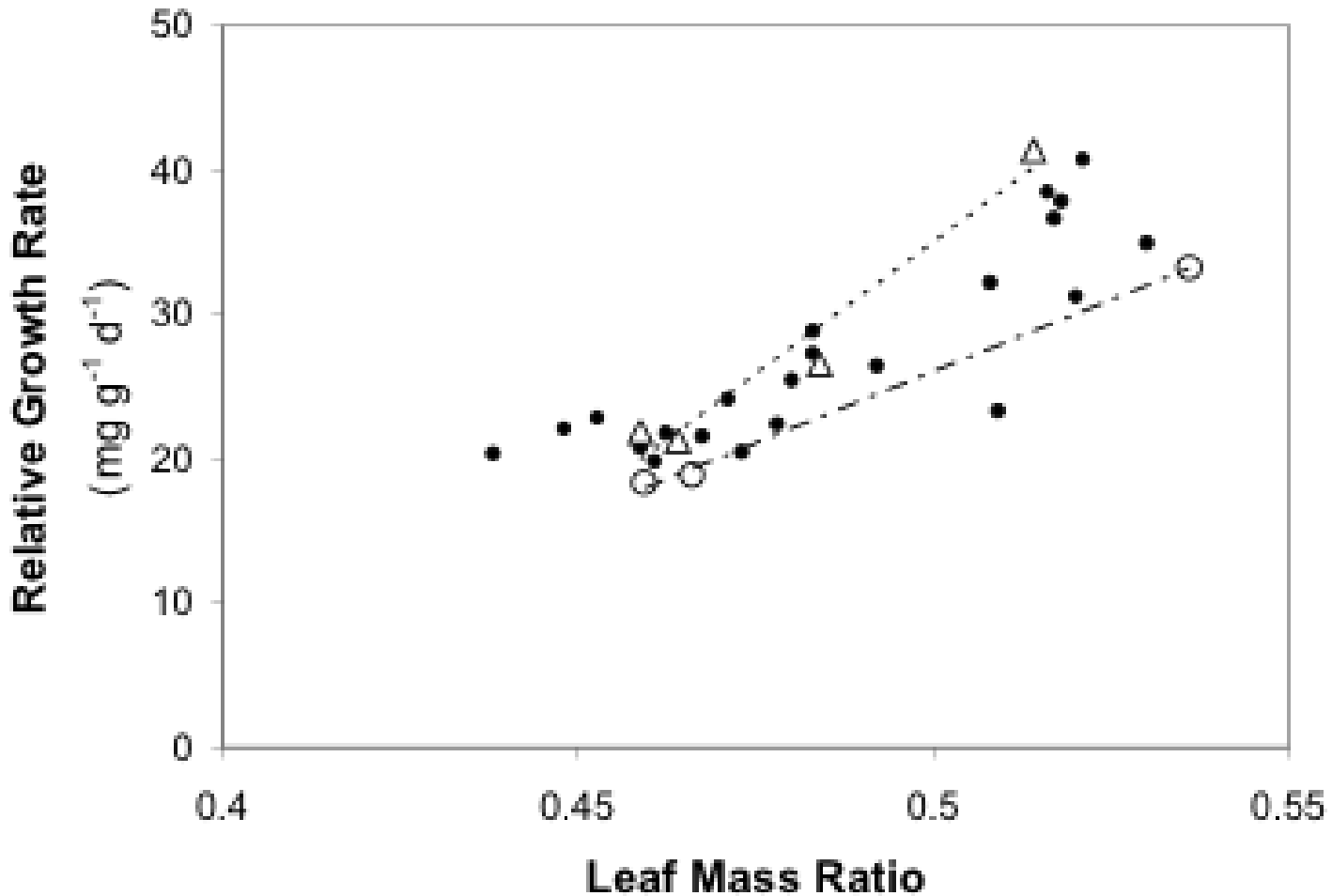
Growth in Florida versus Australia



Growth Response for the Three Source Populations Growing in Australia at 26 °S Latitude



* Denotes significantly different from unity at $P < 0.05$ within a source population



$RGR = 213 * LMR - 76$, $R^2 = 0.75$, $P < 0.0001$, $n = 29$
from Volin et al. 2010, *Plant Ecology*



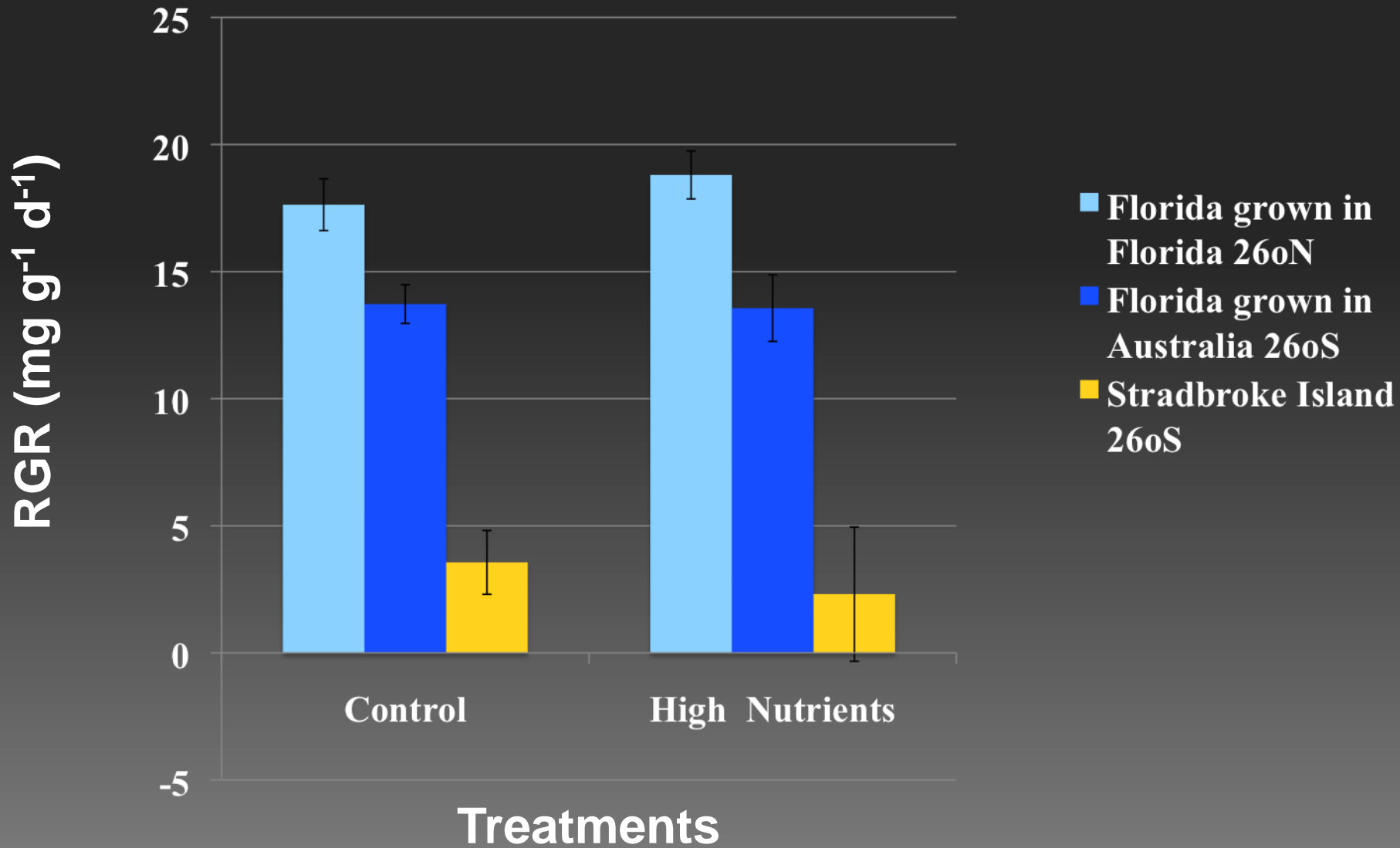
Planting Common Garden Study



Planting Common Garden Study



Relative Growth Rate in the Common Garden Study



Summary

- Invasiveness of *Lygodium microphyllum* is not a simple phenotypic difference in growth rate as predicted by the evolution of increased competitive ability.
- Invasiveness of *Lygodium microphyllum* appears to be mediated in part by release from soil-borne enemies that vary in their effectiveness even within the native geographical range of the fern.

Research Collaborators



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