Release from Natural Enemies Belowground Helps Explains the Invasiveness of *Lygodium microphyllum* in Florida: A Cross-continental Comparison...among other things

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Lygodium microphyllum

Old World Climbing Fern
A Journey to Understand an Alien Plant

1. Reproductive Biology

2. Whole Plant Growth - Under varying light and hydrological conditions

3. Community Ecology

4. Landscape Ecology

5. Lygodium in its native Australia
1. Reproductive Biology

**Spore Collection Sites**

- L. japonicum
- L. microphyllum

Lygodium microphyllum Gametophyte (14 days)
Isolates  Selfing Pairs  Outcrossing

Lygodium microphyllum

Lygodium japonicum

Lott et al. 2003
2. Whole Plant Growth - Under varying light and hydrological conditions

Shade Enclosures

20%  50%  70%
Six month old sporelings
<table>
<thead>
<tr>
<th></th>
<th>DROUGHT</th>
<th>FIELD CAPACITY</th>
<th>FLOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL</td>
<td>LOW</td>
<td>HIGH</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>GA</td>
<td>MEDIUM</td>
<td>HIGHEST</td>
<td>HIGH</td>
</tr>
<tr>
<td>PACLO</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>LOW</td>
</tr>
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Hydrological Treatments

Mean $\Psi$ at watering day
(App. Day 7)

- Flood
- Field Capacity
- Drought
Mass-Based Photosynthesis

Area-Based Photosynthesis

Mass-Based Photosynthesis

TREATMENTS

TREATMENTS
RGR = 19.27\ln(\text{Amass}) + 19.461

R^2 = 0.66

Mass-Based Photosynthesis (n mol g\(^{-1}\) s\(^{-1}\))

RGR (mg g\(^{-1}\) d\(^{-1}\))
3. Community Ecology

Distribution Along Environmental Gradients
Distribution along elevation gradient

Volin et al. 2004
Invasive spread of *Lygodium microphyllum* in southern Florida

Volin et al. 2004
L. microphyllum in a Florida cypress swamp
5. *Lygodium microphyllum* in its native Australia
Queensland Australia
50% Shade Enclosures in Florida Study
Transplanting sporelings for Australia Study
Soil Collection and Sterilization
Day 62

50% Shade Enclosure in Australia
Harvesting Control Study
Growth in Florida versus Australia

The graph compares the growth response of plants grown in Florida versus Australia, under different soil and nutrient conditions. The growth response is measured along the y-axis, while the x-axis categorizes the conditions:

- Control Soil
- Sterilized Soil
- High Nutrient Soil
- Sterilized Soil + High Nutrients

The growth responses are further differentiated by location:

- Florida grown in Florida 26oN
- Florida grown in Australia
- Iron Range 12oS
- Stradbroke Island 26oS
Planting Common Garden Study
CG Studies: AdjRGR by Treatment

Treatment (C=control; N=high nutrients)
Summary

• Lygodium microphyllum poses several life history strategies that makes it a particularly nasty invasive species

- Reproduction - all three mating strategies, year round production of billions of spores at each location, and capable of reproduction in 6-8 months after spore germination;

- Whole-plant growth - capable of growing (the same rate!) in low to high light levels, as a result of its optimal allocation to stem tissues, capable of growing in dry to continuously flooded conditions, as a result of its mass-based photosynthesis;
Summary Con’t

- Release from natural enemies, and likely from key below-ground enemies, facilitates unabated growth in its introduced environment;

- Traits above (i.e., reproduction, continuous growth under varying light and hydrological extremes and release from natural enemies) allow for its long distance spread, establishment and growth far from source populations.
Management/Policy Recommendations

• Flooding is not a viable control technique;

• *L. microphyllum* is a fire-adapted species in its native habitat, and so fire is likely not a viable control technique, and it may do more harm than good;

• Greater emphasis should be placed on identification of potential pathogenic biocontrol agents, especially those that attack below-ground tissues in *L. microphyllum*’s native range, should be prioritized;

• Understory surveys of *L. microphyllum* along its invasion front in Florida should be a priority. In conjunction with this, a survey/sampling optimization model or protocol as well as a coordinated quick herbicide response with land management agencies should be developed.
Research Collaborators

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