

Old World Climbing Fern (*Lygodium microphyllum*)
Invasion in Hurricane Caused Treefalls



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Project Background

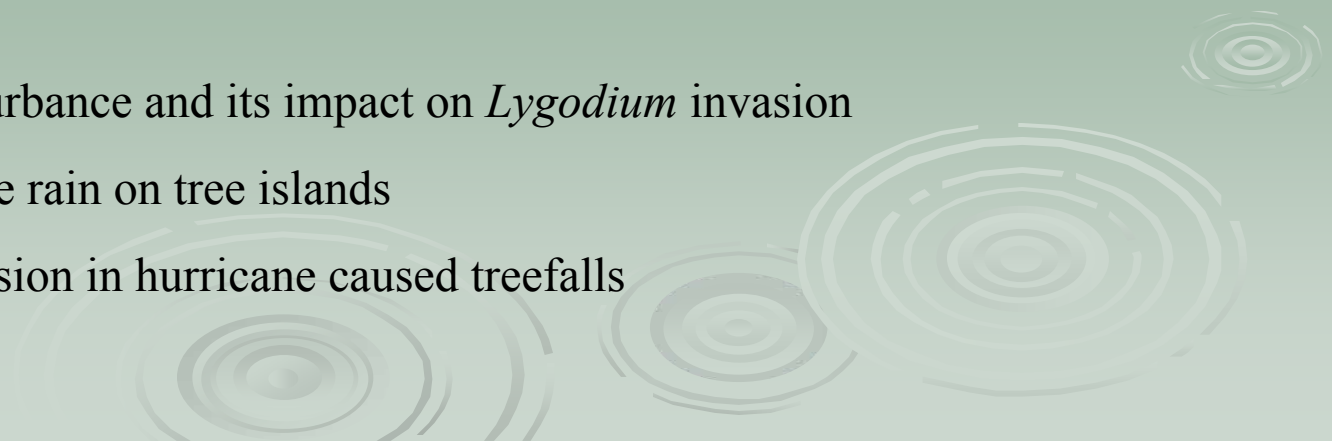
Objective:

To assess hurricane impacts to tree islands and recovery of tree islands with special emphasis on the establishment of the exotic species *Lygodium microphyllum* (*Lygodium*) in the Arthur R. Marshall Loxahatchee National Wildlife Refuge

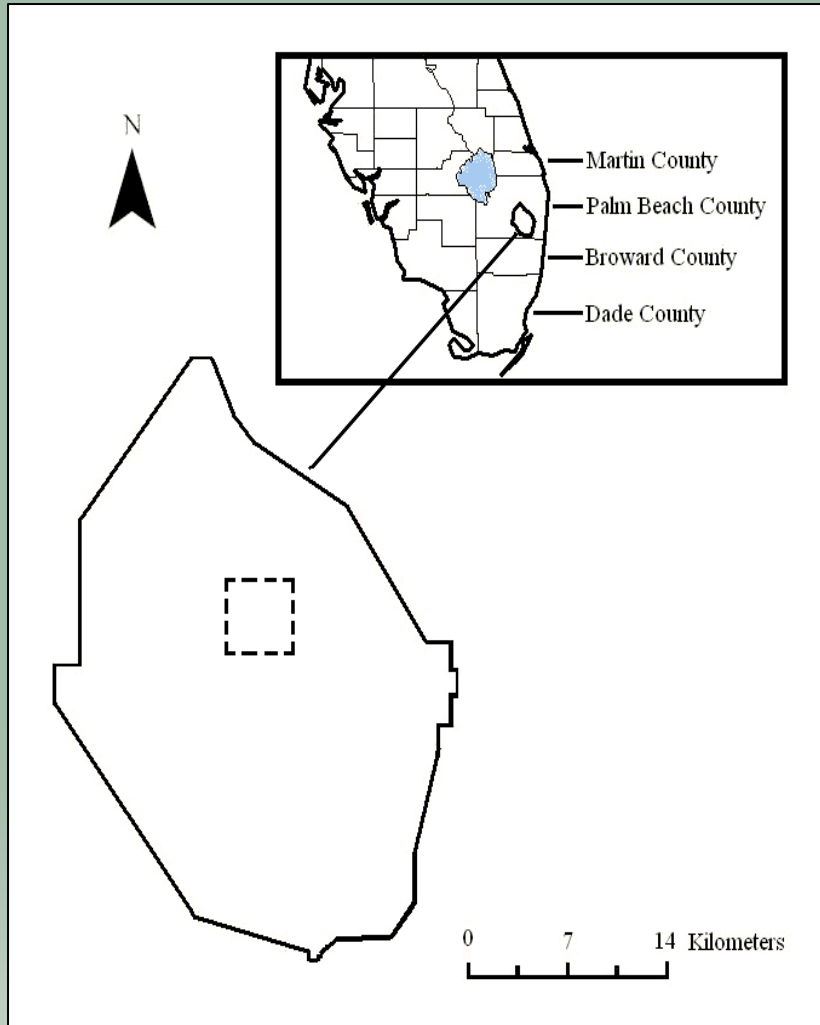
Two core projects:

- (1) Effect of hurricane-caused canopy gaps on *Lygodium* invasion
- (2) Hurricane impacts on the establishment and spread of *Lygodium* patches

Three sub-projects:

- (1) Hurricane disturbance and its impact on *Lygodium* invasion
 - (2) *Lygodium* spore rain on tree islands
 - (3) *Lygodium* invasion in hurricane caused treefalls
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Study Site



- Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge)
- Palm Beach County
- Refuge covers 59,646 ha
- Characterized by thousands of tree islands

Hurricane history

- In 2004 and 2005 three major hurricanes impacted South Florida
 - Frances (Category 2 storm)
 - Jeanne (Category 3 storm)
 - Wilma (Category 2 storm)
- All three hurricanes passed through Palm Beach County impacting the A.R.M Loxahatchee N.W.R. ecosystem



Frances



Jeanne



Wilma

Hurricane Impacts to Tree Islands



- Snapped trunks



- Loss of foliage

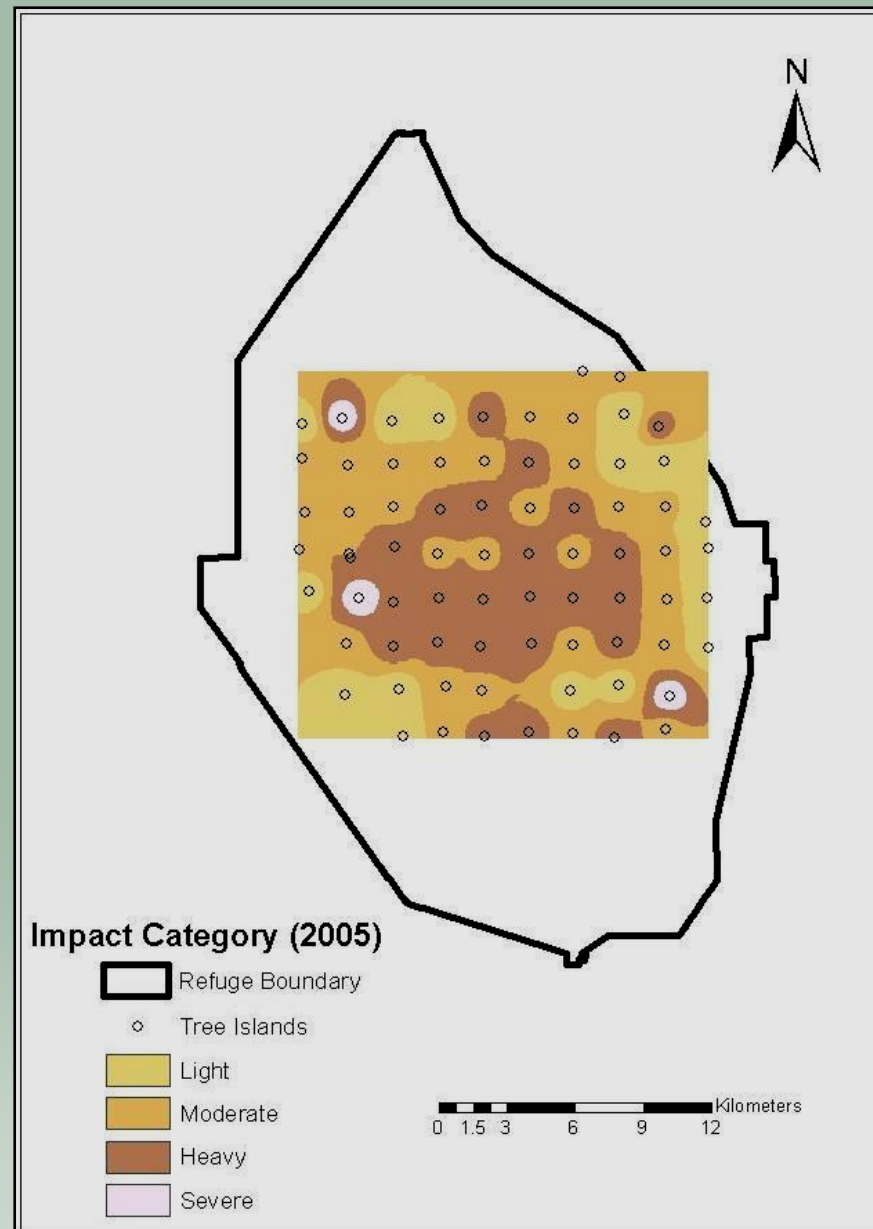


- Broken branches



- Treefalls

Hurricane Impacts across LNWR



Lygodium

- Native to the old world tropics (Africa, Australia, Asia)
- First observed in Florida in the 1960's
- Presently the fern is found across South Florida
- Considered a Category 1 exotic species by the Florida Exotic Pest Plant Council
 - Altering native communities
 - Changes ecological structure

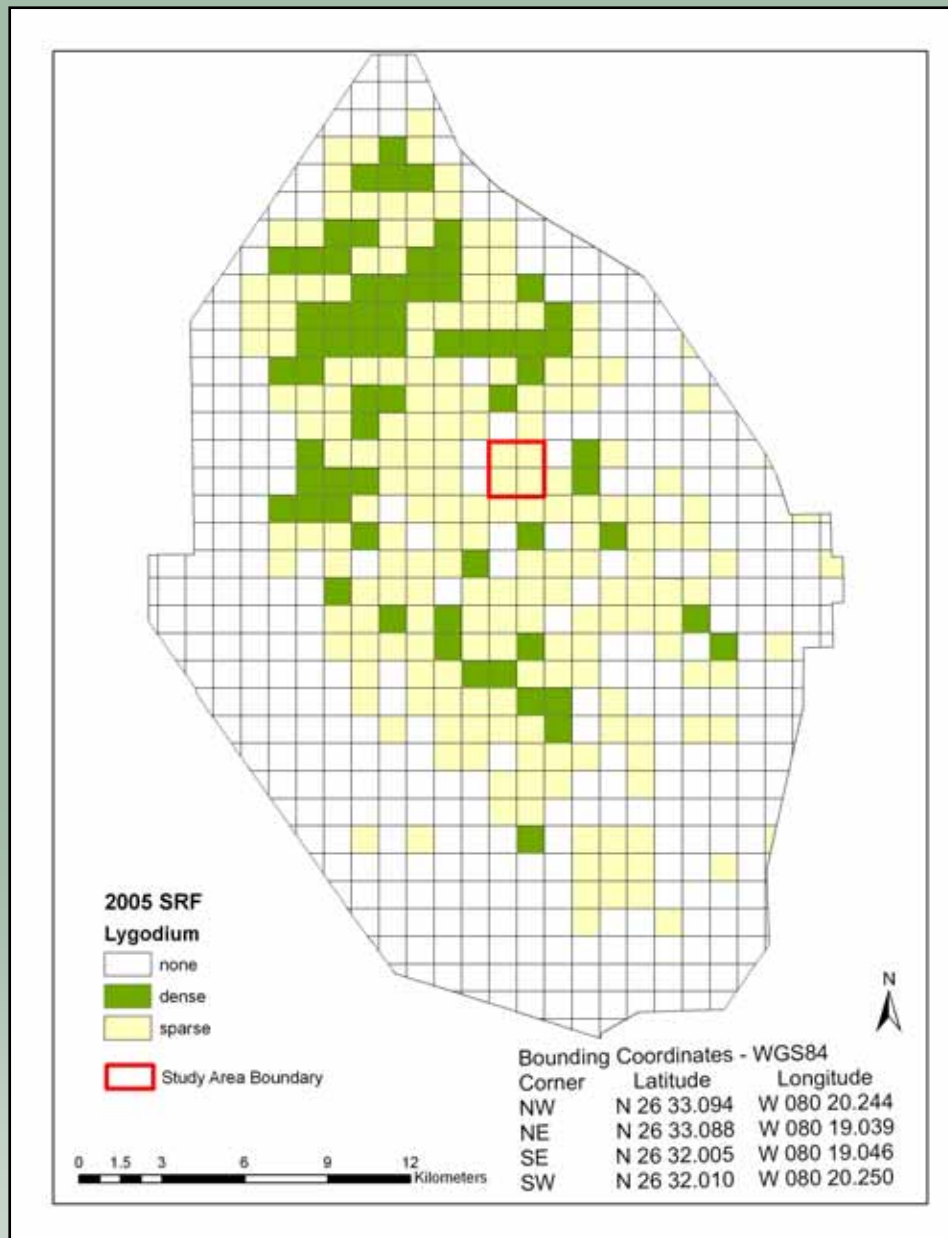


Characteristics that make *Lygodium* a major threat:

- Ability to grow in a variety of substrates
- Produces large number of spores
- Spores are dispersed long distances by wind



Lygodium in A.R.M. Loxahatchee N.W.R.



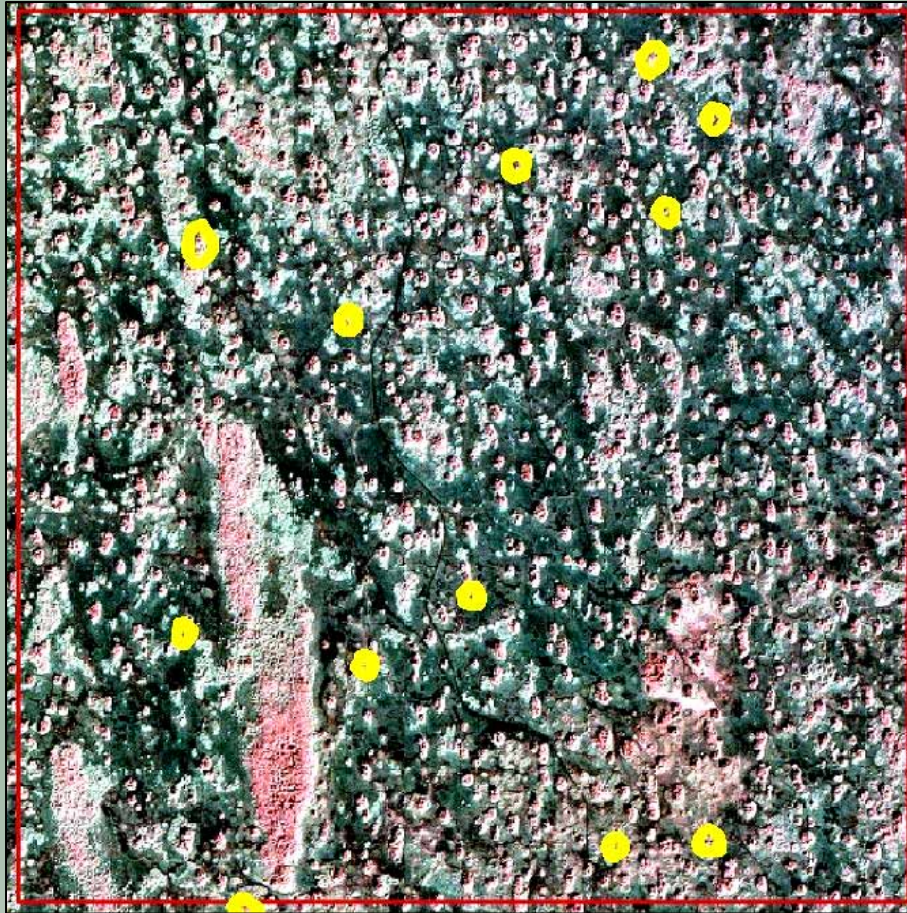
Map from Woodmansee et al. 2005

Questions

1. Does *Lygodium* invade disturbed areas caused by treefalls more commonly than non-disturbed locations on tree islands?
2. Are there specific environmental conditions within disturbed areas that are correlated with *Lygodium* invasion?



Study islands



2 km

2 km

- 12 tree islands
- 2 km x 2 km area
- All islands had moderate hurricane impacts
 1. Few snapped trunks/ treefalls
 2. Large broken branches
 3. Leaning trees
 4. 25-50% open canopy
- Average island area ranged from 400 to 2200 square meters
- Within an area of detected *Lygodium*

Refuge Islands



- **Major tree species on tree islands include:**

- *Persea palustris*
(swamp bay)
- *Myrica cerifera*
(wax myrtle)
- *Ilex cassine*
(dahoon holly)

- **Common understory species:**

- *Chrysobalanus icaco* (coco plum)
- *Cephalanthus occidentalis* (button bush)

- **Fern species:**

- *Blechnum serrulatum*, *Woodwardia virginica*, *Osmunda regalis*

Methods

- The 12 tree islands were surveyed for treefalls in January 2007 using north-south transects
- For each treefall encountered a rectangular plot measured along the longest axes representing the length (m) and width (m) of the disturbed area was surveyed



Treefall plots

- Information recorded for each treefall encountered included:
 1. Tree species
 2. Presence of water (y/ n)
 3. Canopy cover percentage

- Information collected on *Lygodium* :
 1. Presence (y/n)
 2. Number of stems (density)
 3. Size class (<10 cm, 10-50 cm, 50-100 cm, and >100 cm)



Non-disturbed plots

- For each treefall plot surveyed on an island a randomly selected non-disturbed plot of equal size was surveyed for:
 - Presence of water (y/n)
 - Percent canopy cover
 - Presence of *Lygodium* (y/n)
 - Number of *Lygodium* stems



Results

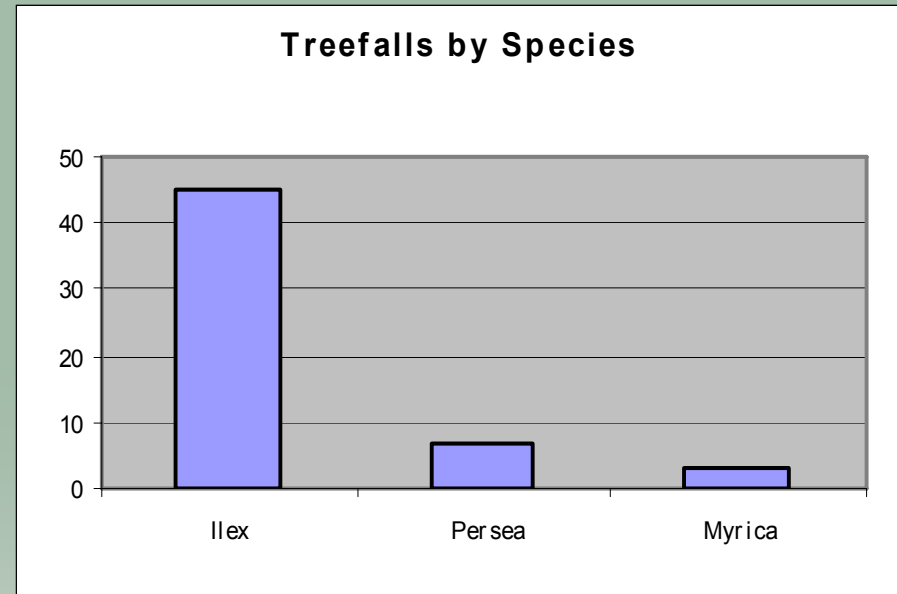
- 55 treefalls and 55 non-disturbed plots were surveyed from the 12 tree islands
- Number of treefalls per island ranged from 1 – 13; average 4.6 per island

- Treefall species:

Ilex cassine - 45 (82%)

Persea palustris - 7 (13%)

Myrica cerifera - 3 (5%)



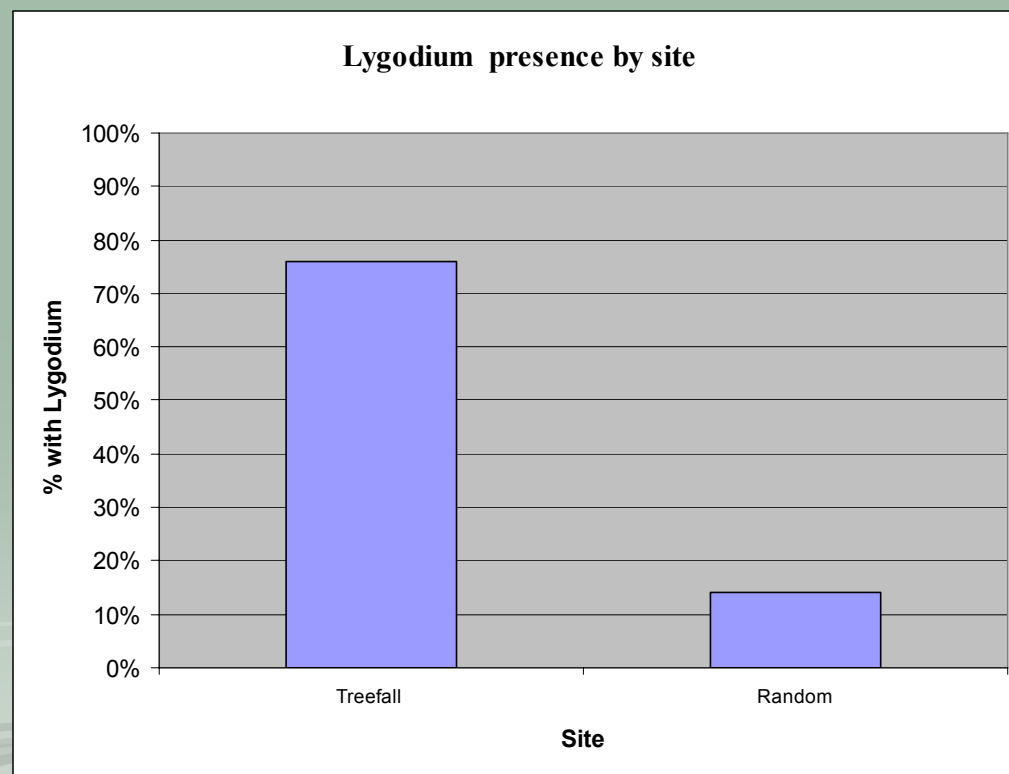
- Disturbed area created by treefalls ranged in size from 0.3 – 7.3 m², with an average area of 2.5 m²

Lygodium Results

Presence

- Treefall sites had a significantly greater occurrence of *Lygodium* than random non-disturbed sites
($\chi^2 = 39.9$, $df = 1$, $P < 0.001$).

- *Lygodium* was present in:
 - 76% of treefall sites
 - 14% of random sites



Lygodium Results

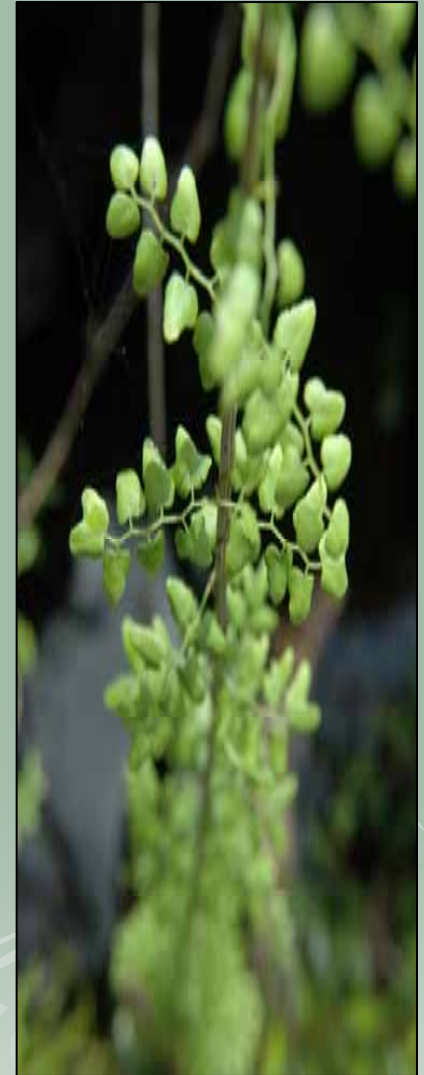
Density

- There were significantly more stems per m² of *Lygodium* in treefall sites compared to random sites ($t = 4.3$, $df = 11$, $P = 0.001$).
 - Treefall sites: mean 6.0 stems per m²
 - Random sites: mean 0.5 stems per m²
- Larger disturbed areas resulted in higher densities of *Lygodium*

Size

- Size of *Lygodium* stems encountered in all sites

68%	< 10cm
20%	10-50cm
9%	50-100cm
3%	> 100cm



Results continued

- Environmental conditions and *Lygodium* occurrence by plot type

	N	% with Water	% with Canopy Cover <50%	% with <i>Lygodium</i>
Treefall Plots	55	89 %	60 %	76 %
Random Plots	55	26 %	11 %	14 %

- *Lygodium* presence in treefall sites was significantly related to presence of water ($P < 0.001$) and percent canopy cover ($P < 0.001$)

Conclusions

- The increased presence and density of *Lygodium* in treefall plots suggests that hurricane-caused treefalls can play a significant role in the recruitment and invasion of tree islands by *Lygodium*.
- Hurricane impacts to tree islands such as treefalls likely promote recruitment and invasion by exotic species in numerous ways:
 1. Opening up large areas available for potential invasion
 2. Decreasing surrounding competition
 3. Increasing soil disturbance



Conclusions

- The environmental conditions (water & open canopy) that were found to be correlated to the presence of *Lygodium* are most commonly encountered on the edge of tree islands and in the disturbed area created by treefalls
- It is likely that treefalls speed up the colonization and expansion of *Lygodium* from the edge of tree islands into tree island interiors

Management Implications:

- If severe disturbance to tree islands following hurricanes is in fact an accurate predictor of *Lygodium* invasion, then information on the extent and type of damage to tree islands can assist managers to develop early detection and rapid response strategies to newly invaded sites

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