

Evaluating the Potential Invasiveness of *Eucalyptus* in Florida

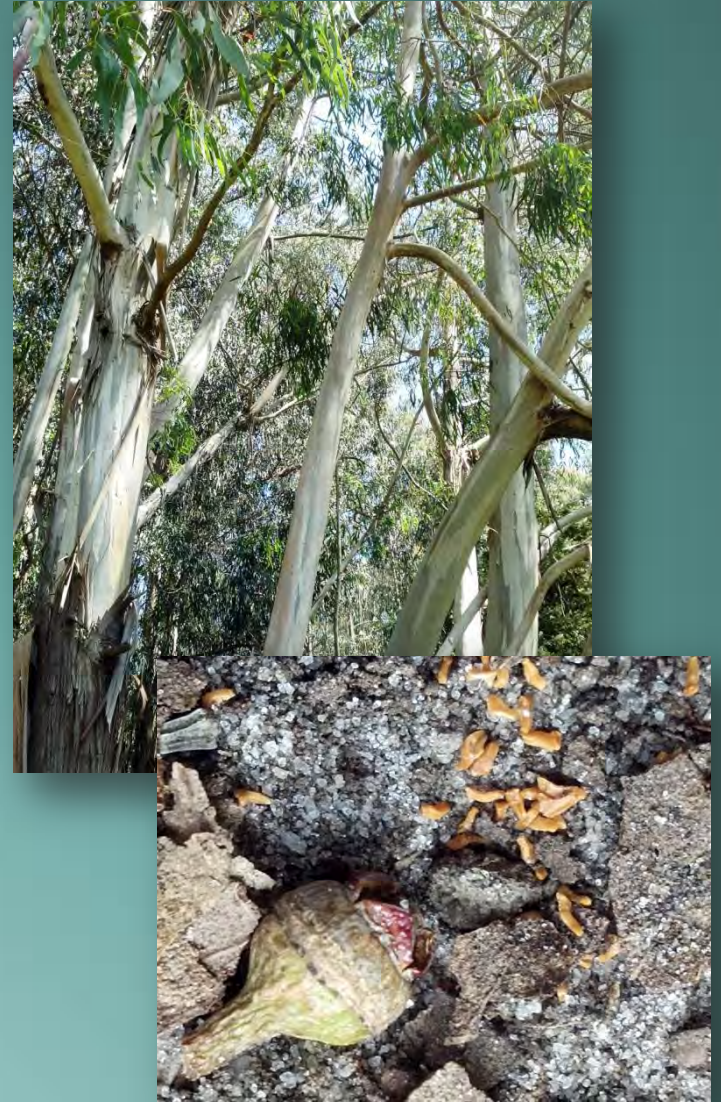
Kim Lorentz and Pat Minogue

May 22, 2013



Eucalyptus Biology

- 700+ species
- Grown for pulp, mulch, windbreaks, and bioenergy
- Rapid growth
- Grow in infertile soil
- Disease and pest resistant
- Drought resistant
- Many small seeds (1 to 3 mm; 4,000 seeds per m²) in a gum nut
- Variable germination (11 to 98%)
- Require intensive culture for plantation establishment



Eucalyptus Invasiveness

- Invasive in South Africa, Hawaii, coastal California
- Undesirable Impacts:
 - Increased fire intensity
 - Reduced river flows
 - Altered faunal composition and density

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Eucalyptus beyond
Its Native Range:
Environmental Issues in
Exotic Bioenergy Plantations

Guest John A. Stanturf, Eric D. Vance, Thomas R. Fox,
and Matias Kirst

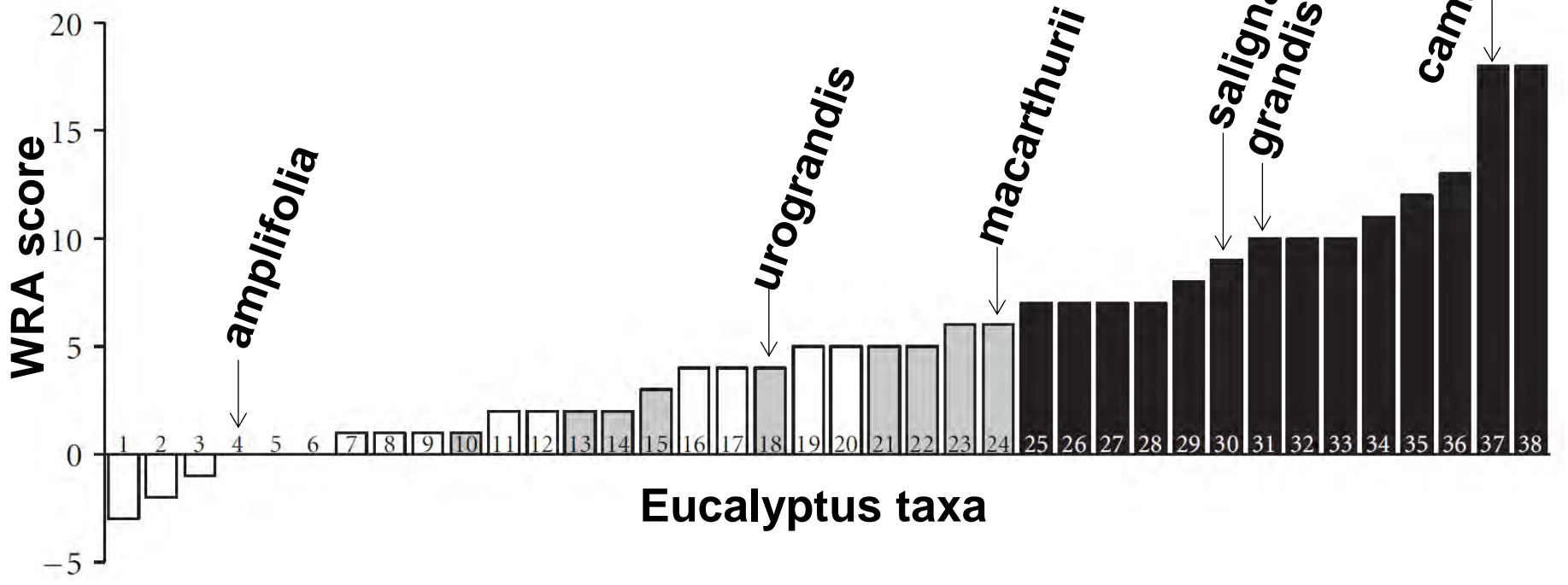


Prevention

Avoidance through appropriate risk assessments and quarantine enforcement (McCormick and Howard 2013), is often considered the most cost effective approach in dealing with biological invasions (Leung et al. 2002).

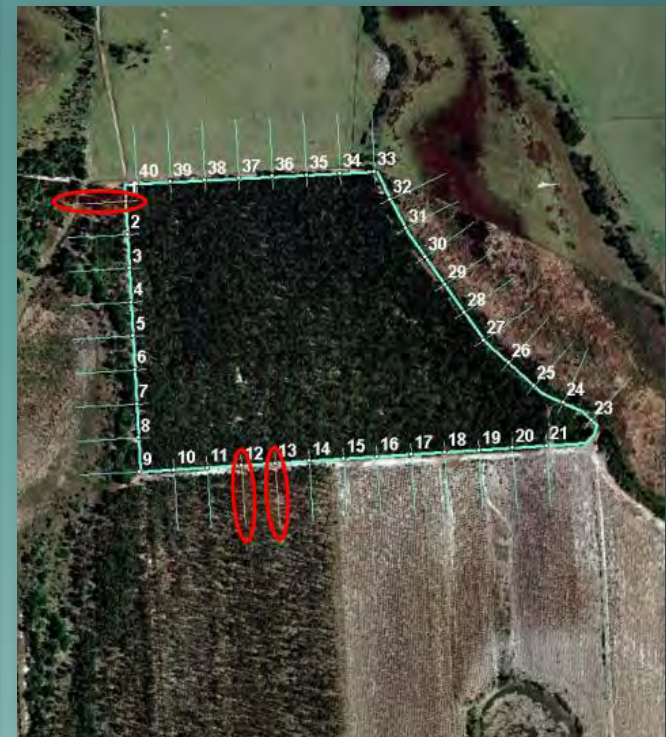
Eucalyptus Species Weed Risk Assessment, US

- Low risk (15 species)
- ▒ Further evaluation (9 species)
- High risk (14 species)



Surveys for Natural Recruitment

Land cover type	Proportion of plots in land cover type with seedlings
Disturbed soil	0
Roadside	0
Agricultural	0
Citrus orchard	0
Bamboo	0
Lawn/mown	0
Field/pasture	0.0079
<i>Eucalyptus</i> plantation, managed [†]	0.0602
“Failed” <i>Eucalyptus</i> plantation [‡]	0.1429
Young pine plantation	0
Pine plantation	0.0027
Suburban wooded	0
Partially wooded	0.0263
Forest, unmanaged	0
Wetland	0.025

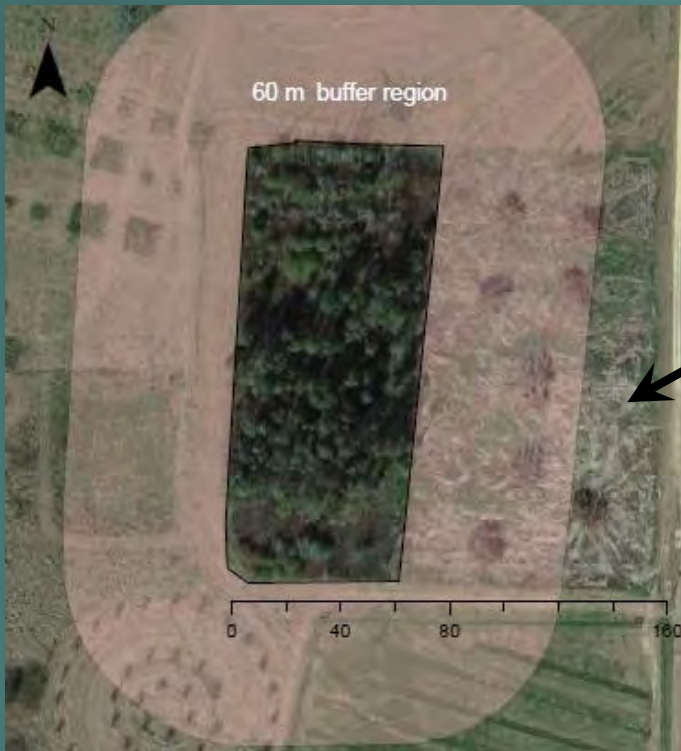


Our Study: Surveys and experiment to test *Eucalyptus* Invasiveness in Native and Managed Florida Plant Communities

- **Site surveys**- *Eucalyptus* recruitment in proximity to mature stands in native and managed plant community types
- **Seed addition studies**- determine emergence and survival of *E. amplifolia*, *E. camaldulensis*, and *E. grandis* relative to
 - Seeding density (Propagule pressure)
 - Disturbance
 - Proximate plant community type

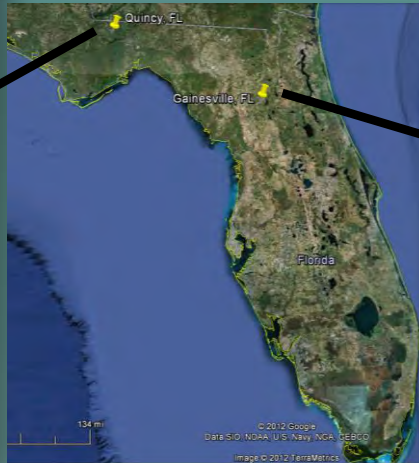
Study Locations

Quincy



E. amplifolia progeny test
planted 1999, 0.9 ha

- Non-grazed pasture
- Intensively site-prepared forest land



Gainesville



E. amplifolia seed orchard
planted 1992-1997, 0.7 ha

- Forest road
- Upland mixed pine-hardwood

Site Survey Methods

- Line transect sampling, May 2012
- 1 m² sampling frame
- Every 10 m on transect lines 20 m apart
- Extending 60 m out
- Sample plots: 72 Gainesville, 238 Quincy
- 60 m is twice the *Eucalyptus* canopy height at both locations.
- **Eucalyptus seeds disperse by wind to twice the canopy height (Cremer 1977).**



Site Survey Results

No seedlings in 310 plots!



Seed Addition Studies



Seed Addition Studies Germination Testing

- Weight-specific germination was determined for each species because of small seed.
- Germination rates of *E. amplifolia*, *E. camaldulensis*, and *E. grandis*
- Growth chamber set to North-Central FL June conditions
 - average min temp (night, 20.1 C)
 - and max temp (day, 32.5 C)
 - 14 hours of light daily
- 14 d test duration (Boland 1986)



Growth Chamber Seed Germination Results

Eucalyptus species	Germination rate	500 Germinating seeds m⁻²	1000 Germinating seeds m⁻²
	seeds g ⁻¹	g	g
<i>E. grandis</i>	655	0.048	0.095
<i>E. amplifolia</i>	92	0.339	0.678
<i>E. camaldulensis</i>	388	0.081	0.161

Seed Addition Plots and Experimental Design

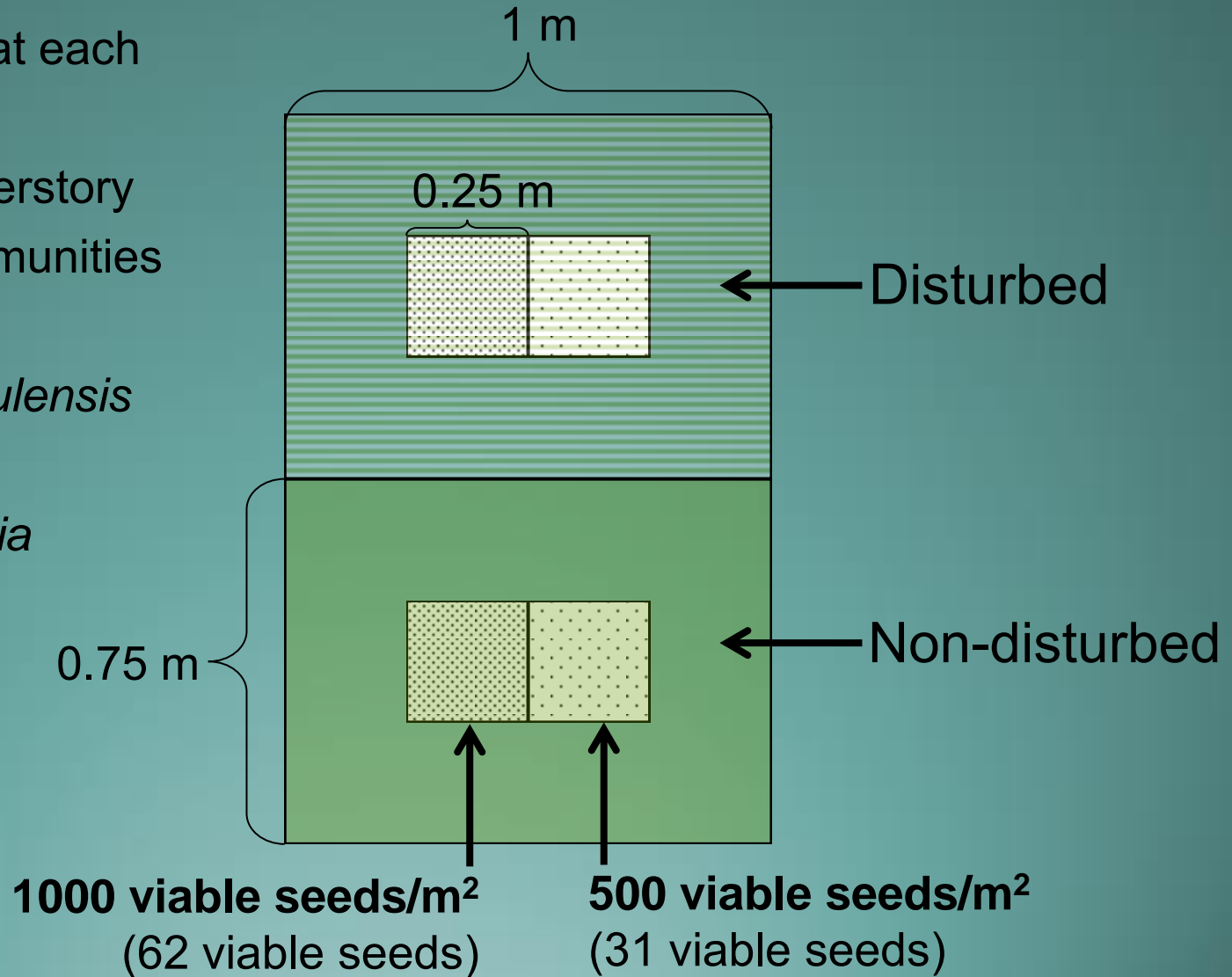
63 addition plots at each study location:

- Eucalyptus understory
- 2 adjacent communities

5 reps *E. camaldulensis*

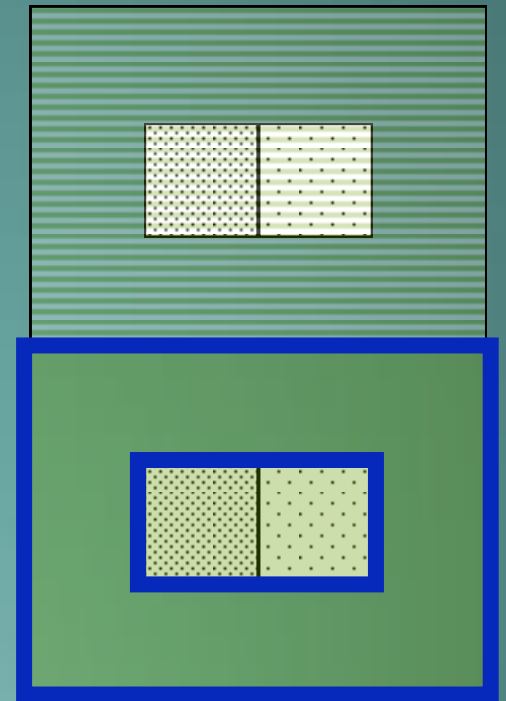
8 reps *E. grandis*

8 reps *E. amplifolia*



Measurements and Analyses

- Seedlings counted and marked every 3 weeks for 25 weeks.
- Used model to determine treatment effects on the proportion of observed/expected seedlings
- The effect of disturbance on recruitment from the existing stand could be modeled
- Time of survival (<1, 1–2, >2 months) compared by species, community, disturbance



Seed Addition Studies: Raw Seedling Counts

Location	Community	Disturbance	Total # of seedlings
Gainesville	Eucalyptus stand	Disturbed	42
Gainesville	Eucalyptus stand	Non-disturbed	9
Quincy	Eucalyptus stand	Disturbed	7
Quincy	Eucalyptus stand	Non-disturbed	0
Gainesville	Forest road	Disturbed	4
Gainesville	Forest road	Non-disturbed	0

No seedlings were found in mixed upland forest, intensively site prepared forestland, or fallow pasture.

Treatment Effects and Proportion of Observed/Expected Seedlings

- Disturbance, species, community not significant
- Could not test effect of seeding density (propagule pressure)
- Proportion emergence 0.0 to 0.0032 depending on treatment combination.
- For example:

Location	Vegetation community	Eucalyptus species	Proportion seedling emergence
Gainesville	<i>Eucalyptus</i> stand	<i>E. amplifolia</i>	3.02×10^{-11}
		<i>E. camaldulensis</i>	3.24×10^{-03}
		<i>E. grandis</i>	1.27×10^{-03}

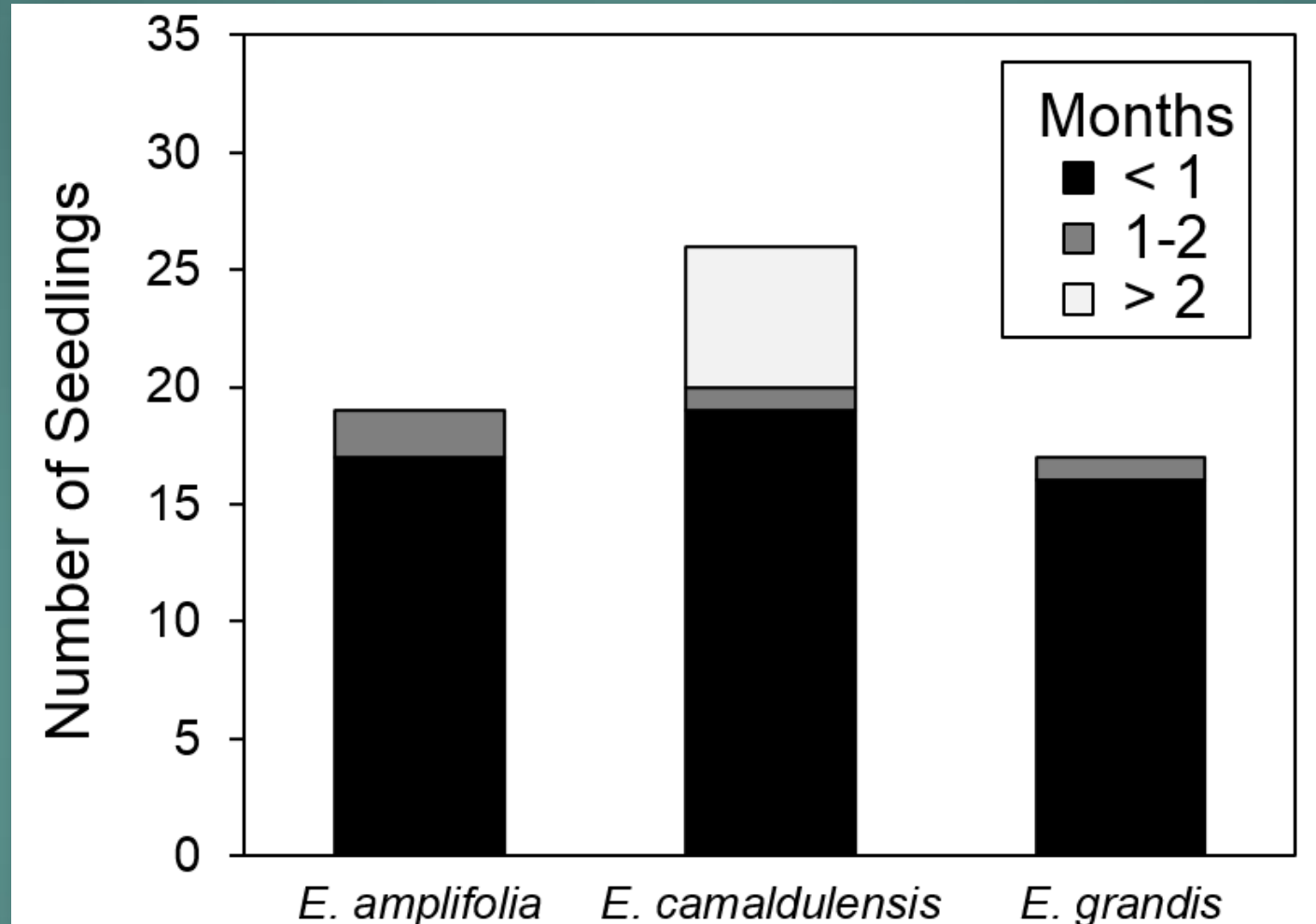
Disturbance Effect on Natural Recruitment



- Disturbance significant in Gainesville stand ($P = 0.0005$), not in Quincy
- Model Predicts:
 - Disturbed, $1.84 \text{ seedlings m}^{-2} = 18,004 \text{ seedlings ha}^{-1}$
 - Non-disturbed, $0.33 \text{ seedlings m}^{-2} = 3,317 \text{ seedlings ha}^{-1}$

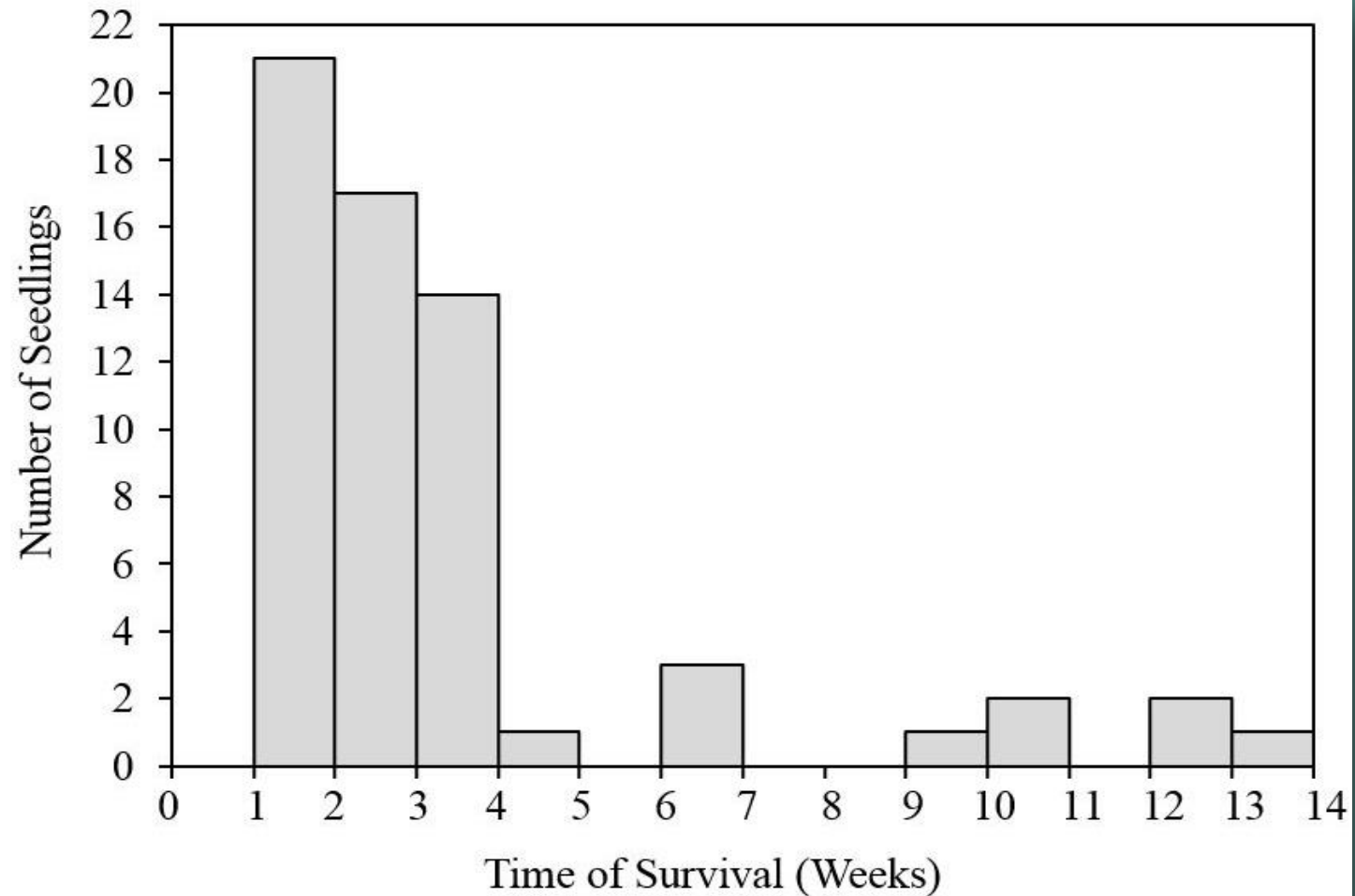
Survival

Species had a significant effect on survival ($P=0.04$)



Survival

No seedlings survived more than 13 weeks



Study Summary

- No seedlings in surveys
- Low emergence of added seed
- Survival time low
- *E. camaldulensis* had greater survival time
- Emergence greater within *Eucalyptus* stands
- Disturbance increased emergence



Implications for Management & Future Research

- Rethink disturbed buffer zones
- Risk mgmt. practices for *E. camaldulensis*
- Future research in south FL needed
- Experiments with other species

