

EFFECTS OF HABITAT, MICROSITE AND SEED DENSITY ON RECRUITMENT

LIMITATION IN

NATIVE SCRUBLAND AND SCRUB UNDERGOING RESTORATION

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Introduction

- In any habitat the availability of seeds for recruitment can be limited due to low seed production, lack of dispersal, or seed predation (Orrock et al. 2006; Ehrlén et al. 2006).
- Understanding the dynamics of seed availability is essential for protecting ecologically important plant populations because seed abundance limits colonization of favorable sites and population persistence.
- Seed availability is particularly pertinent to restoration projects, in which the establishment of native plant populations is a priority. Increasing restoration success furthers conservation objectives by providing more areas where native plant species (including rare and endemic species) can be sustained.
- Seed availability should be considered in managing native plant populations to determine what remedial measures are required.

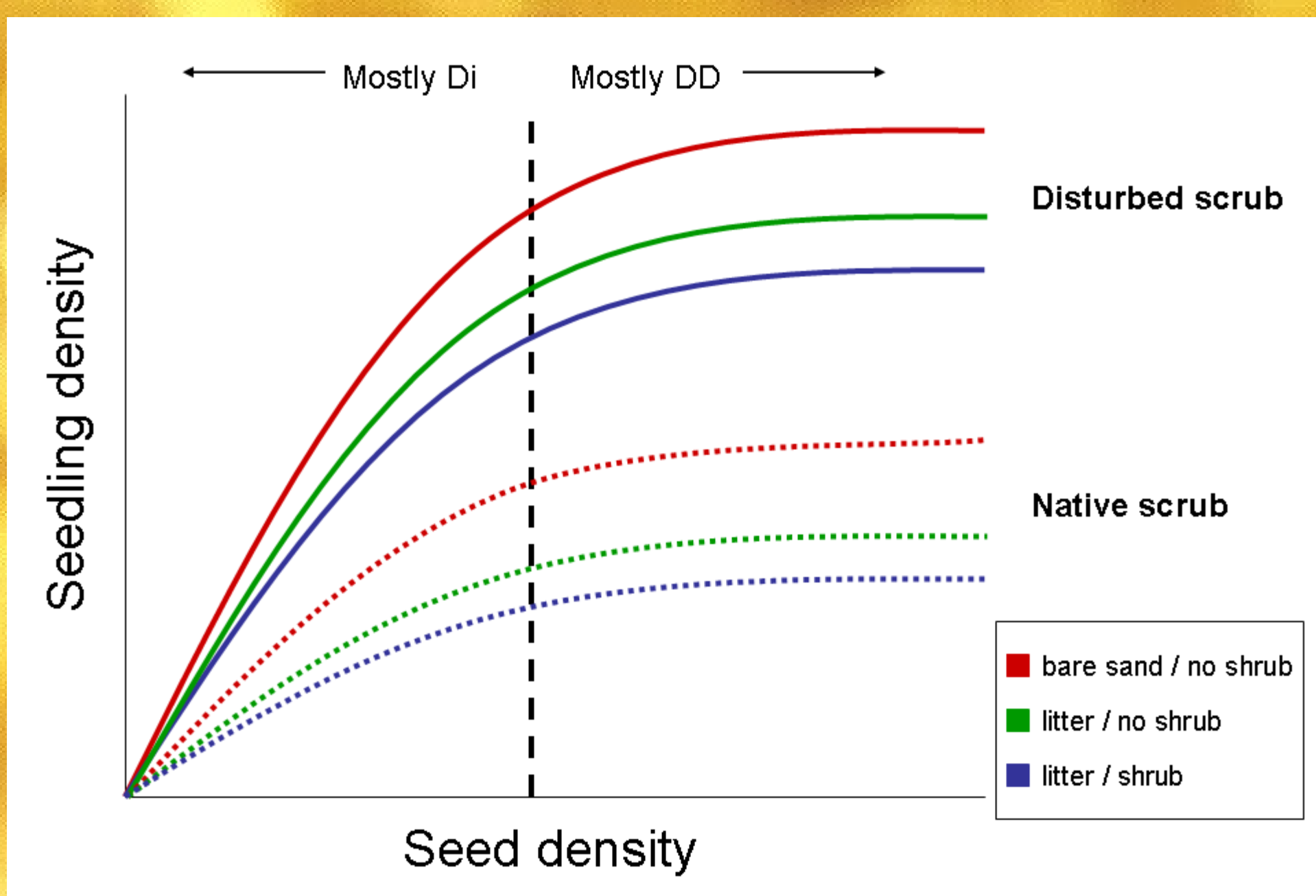


Figure 1. Predictions for seedling densities resulting from initial seed densities in protected native and disturbed scrub (modified from Poulson et al. 2007). Di = influence of density independent factors; DD = influence of density dependent factors.

Study I: Seed Production

Does seed production differ for herb species in native scrub vs. disturbed scrub undergoing restoration?

- B. angustifolia*: 3 disturbed scrub, 4 native scrub sites.
- C. fasciculata*: 3 disturbed scrub, 5 native scrub sites.
- Seed pods or heads of each individual counted within plots.
- Plants harvested just outside each site, seeds counted.
- Seed counts used to estimate total # of seeds in plots.

If a species exhibits significantly lower seed production in one of the habitats, the species' recruitment could be more limited by seed production in that habitat.

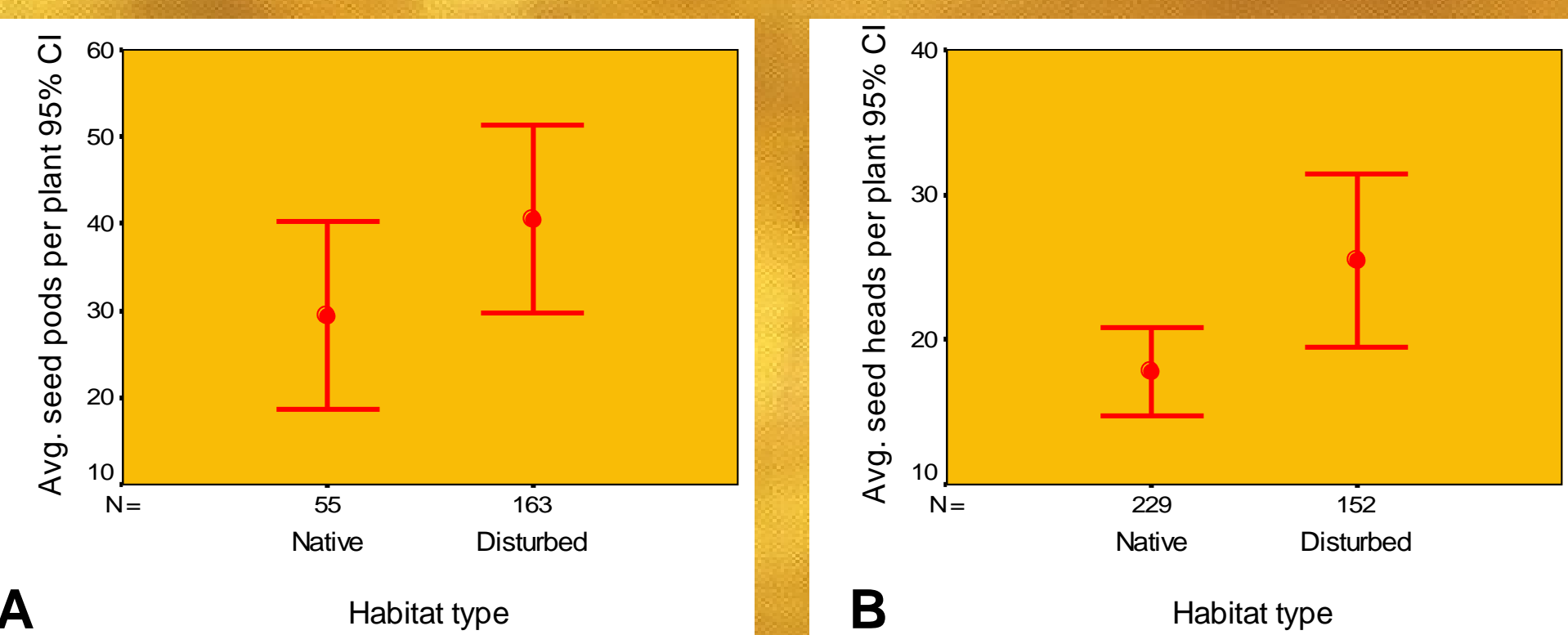
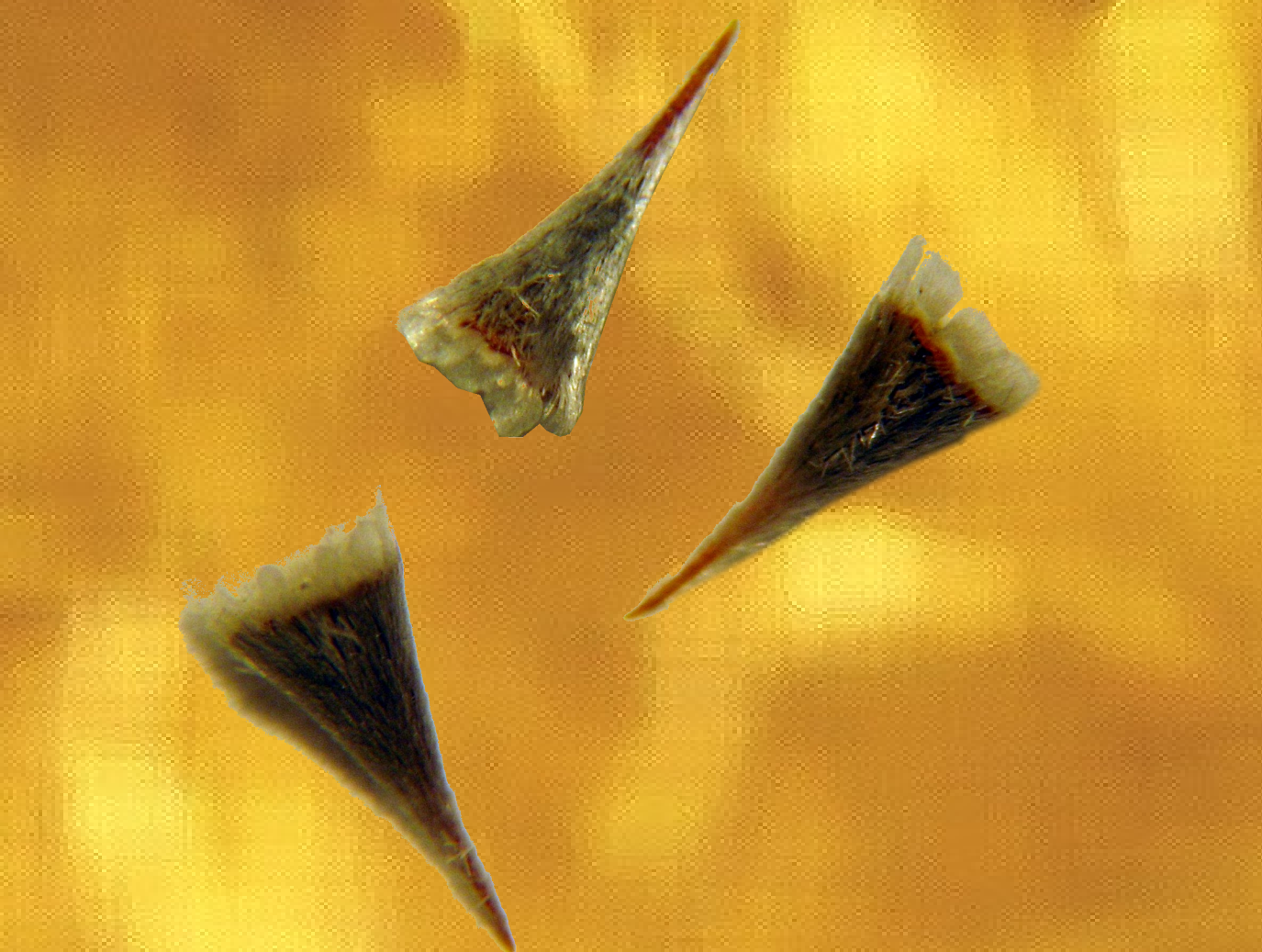


Figure 3. Average seed production per plant for study species in native and disturbed scrub. A.) *C. fasciculata* (Sep. 2008 – Nov. 2008), B.) *B. angustifolia* (Nov. 2008 – Dec. 2008). As expected, seed production was significantly higher in the disturbed than in native scrub for *B. angustifolia* ($p = 0.003$). Counter to expectations, seed production was not significantly different between habitat types for *C. fasciculata*.



Balduina angustifolia
Asteraceae

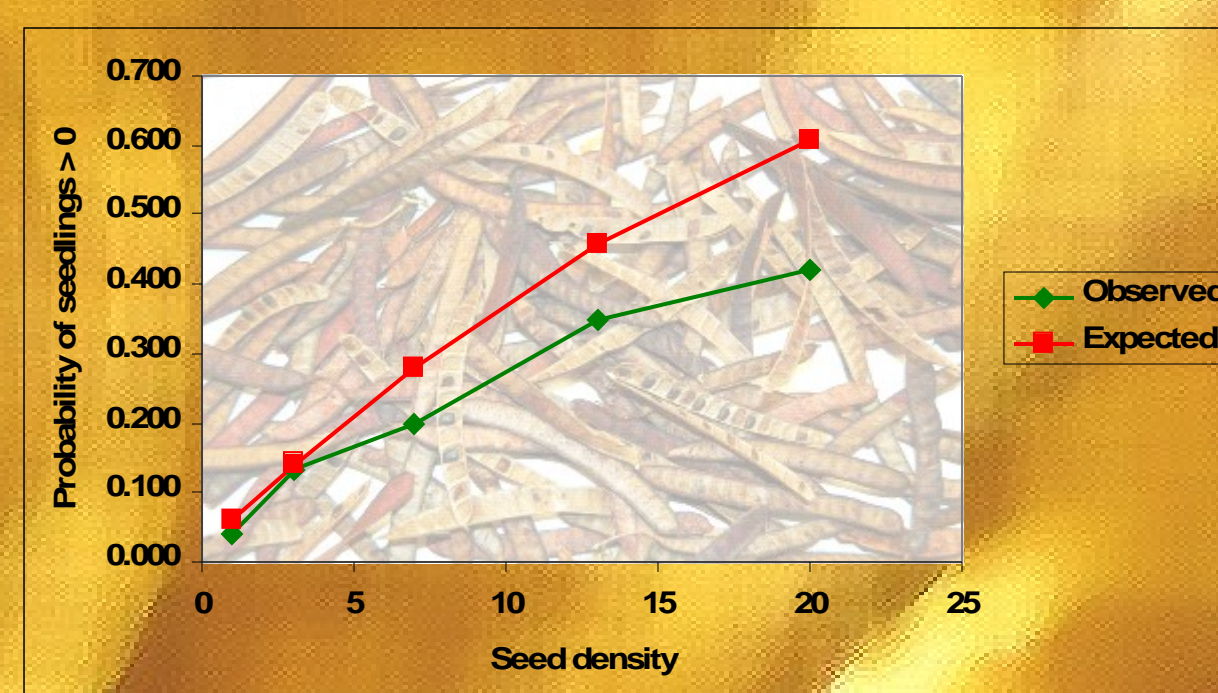


Figure 4. Observed and expected probabilities of seedlings (for >0 seedlings) per deposited seed density in preliminary *C. fasciculata* study. For a given seed density, observed values were calculated by dividing the number of observed seedlings by the total number of seeds planted at that density. Expected values were calculated with the assumption that germination of individual seeds were independent events.

Hypothesis and Predictions

A study of factors limiting seed availability and establishment for two herbs in native Florida scrub (Archbold) and scrub undergoing restoration (Reserve)

I propose that production and survival of seeds, and establishment of seedlings of Florida scrub species are differentially affected by environmental conditions in native scrub and disturbed scrub undergoing restoration (Figure 1).

Predictions

- Seed production will be higher in the disturbed scrub than in the native scrub.
- Frequency of seed removal will be higher in the native scrub than in the disturbed scrub.
- Seedling establishment will be greater in the disturbed scrub than in the native scrub.
- Higher seed densities will result in more frequent seed removal and higher seedling densities.
- Microsites with shrubs and litter will have a higher frequency of seed removal and microsites without shrubs or litter (bare sand) will have more seed removal.

Study II: Seed Predation

What is the role of seed predation in the seed availability of herb species in native scrub vs. disturbed scrub undergoing restoration?

- Animal enclosures used to evaluate seed removal (Table 2).
- Seed removal approximates seed predation (no fruit/eliasomes on seeds; wind/water displacement reduced).
- 6 sites from seed production study.
- Petri dishes of seeds placed in each; remaining seeds counted after 48 hours (based on preliminary trials).

Does seed density affect seed predation? Do microsites within each habitat affect seed removal?

- Different initial densities (1, 4, 8, 24) used in the above study.
- Treatment/density combinations replicated in each of 3 microsites. (bare sand/no nearby shrub; litter/adjacent shrub; litter/no nearby shrub)

If a species experiences significantly greater seed predation in a particular habitat, microsite in a habitat, or for a particular seed density, this suggests seed predation is a limiting factor for recruitment for the species under those conditions.

Table 2. Treatment descriptions for seed predation experiment. PVC collars to reduce wind/water displacement of seeds.

Treatment	Enclosure	Animal access	PVC collar
No access control	Wire mesh cage with lid, clear plastic covering on sides, tanglefoot on rim	None	Yes
Limited access	Wire mesh cage with lid only	Invertebrates	Yes
All access	None	Vertebrates & invertebrates	Yes
Unmanipulated	None	Vertebrates & invertebrates	No

Germinants	B	S.E.	Wald	df	Sig.	Exp(B)
HABITAT(1)	.176	.402	.192	1	.661	1.193
DENSITY	.111	.026	17.664	1	.000	1.118
CAGE_PVC			4.354	2	.113	
CAGE_PVC(1)	-.802	.489	2.689	1	.101	.448
CAGE_PVC(2)	-.857	.470	3.323	1	.068	.425
Constant	-2.542	.474	28.783	1	.000	.079

Figure 5. Output from logistic regression analyses for preliminary *C. fasciculata* study (Jun. 2008 – Jan. 2009). Seed density was also found to be the only significant factor for establishment.

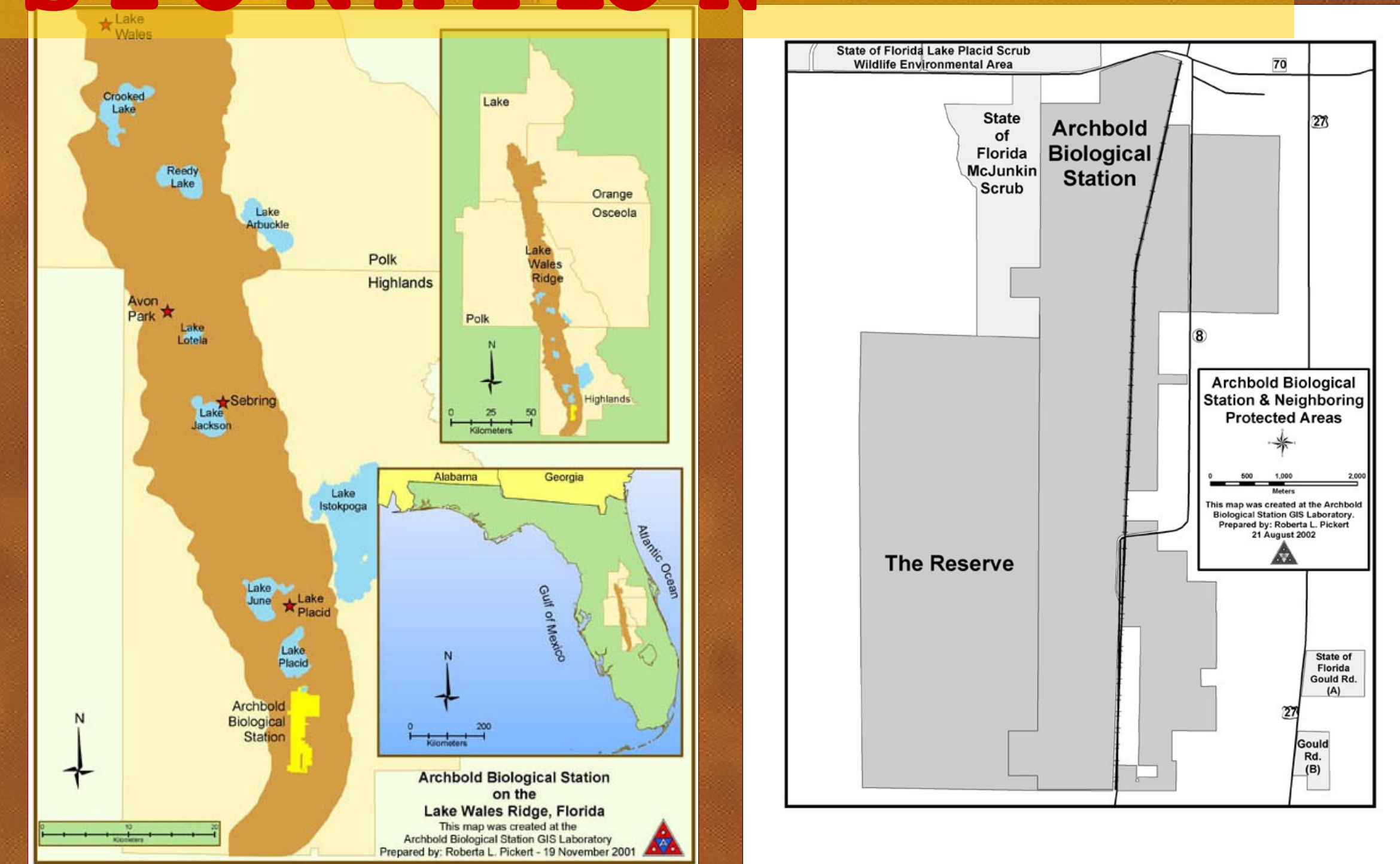


Figure 2. Study sites. Reference native scrub sites were selected from Archbold Biological Station, and disturbed scrub sites were selected from the Archbold Reserve (undergoing restoration). All sites share soil and topography characteristics.

Table 1. Characteristics of study species. Seed descriptions relative to other Florida scrub herbs.

	<i>Balduina angustifolia</i>	<i>Chamaecrista fasciculata</i>
Growth rate	fast	fast
Seed predation	ants, birds	birds, deer
Reproductive season	fall	fall-early winter
Seeds	sizeable, abundant	sizeable, abundant
Occurrence	widespread gap specialist	generalist

Study III: Seedling Establishment

How is seedling establishment affected by native scrub vs. disturbed scrub undergoing restoration?

- Seedling establishment will be assessed from deposited seeds.
- 6 sites previously mentioned.
- Seedling germination/establishment monitored 1x per week for a month, then 1x per month for a year.

Does seed density affect seedling establishment? Do microsites within each habitat affect seedling establishment?

- Different initial densities (0, 1, 4, 8, 24) used in the above study.
- Non-zero densities weighted against the 0 density (control for seed arrival from extant adult plants).
- Seedlings otherwise parsimoniously assumed to be from nearest point of seed release (manual deposition).

I will examine the affect of different microsites on seedling establishment in the above seedling establishment study.

- Each seed density replicated in 3 microsites from seed predation study.

If a species exhibits significantly less seedling establishment in a particular habitat, microsite in a habitat, or for a particular seed density, this suggests seedling establishment is a limiting factor for recruitment for the species under those conditions.

Application

These efforts will help to explain the success of individual species in a community, and how seed availability ultimately contributes to population dynamics and community structure. Understanding gained from this research will inform conservation planners about the potential effect of seed/establishment limitation on the success of restoration efforts. Results will directly contribute to the restoration of the Reserve scrub, which will further the preservation of federally listed rare and endemic plants.

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