Impact of Light Environment on Seed Germination and Seedling Growth of Endangered Northern Wild Senna (*Senna hebecarpa*)

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Introduction

Northern Wild Senna (*Senna hebecarpa*) is an endangered native wildflower whose range is restricted to only 7 extant populations in New England (Clark 2001), including our field site at the Amherst Country Club in Amherst, NH. The decline of *S. hebecarpa* is due primarily to changes in habitat by human development and changes in hydrology from ditching and dams that have changed the flooding regimes along stream banks and wet meadows that are the species prime habitat (Weatherbee 1996). Much of this habitat has been further changed via natural secondary succession whereby trees have gradually replaced herbaceous species as the dominant vegetation. Evidence from related *S. marilandica* indicates that Senna may not be well adapted to such shaded conditions (Baskin *et al*. 1999), raising questions about the role of succession in contributing to the species decline. Our study addressed this question by examining the impact of light intensity on:

1. seed germination
2. seedling growth and development

Methods

- 10 October 2009: 144 seeds planted / treatment. Seeds were scarified (sand paper), surface sterilized (1:8 bleach), and planted at a depth of 2 cm using Fafards super-fine germinating mix.
- 10 October - 14 November: seeds and seedlings grown in Saint Anselm College Greenhouse under three light conditions (Figure 1).
- 10 October - 24 October: seeds monitored daily for emergence
- 14 November: seedling growth parameters measured
- Mean difference between treatments for all parameters except seedling emergence (used X^2 test) were analyzed using a One-Way ANOVA with a Tukey's post-hoc test.

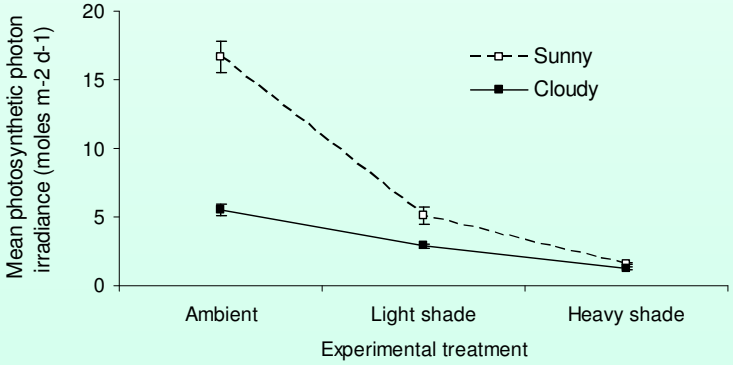

Figure 1. Mean daily light intensity at plant level in Goulet Greenhouse under ambient conditions and two shade treatments. Data were collected Oct - Nov 2008. ANOVA confirmed significant differences between the treatments on both sunny (F=111.2, P< 0.005) and cloudy (F=76.0, P<0.005) days.

References

Baskin, J.M., Nan, X., and Baskin, C.C. 1999. A comparative study of the seedling-juvenile and flowering stages of the life cycle in an annual and a perennial species of Senn (Leguminosae; Caesalpinioideae). American Midlands Naturalist 141:381-390.

Clark, F. H. 2001. *Senna hebecarpa* (Northern Wild Senna) Conservation and Research Plan. New England Plant Conservation Program, Framingham, Massachusetts, USA (http://www.newfs.org)

Weatherbee, P. 1996. *Flora of Berkshire County, Massachusetts*. Berkshire Museum, Pittsfield, Massachusetts, USA.

Results

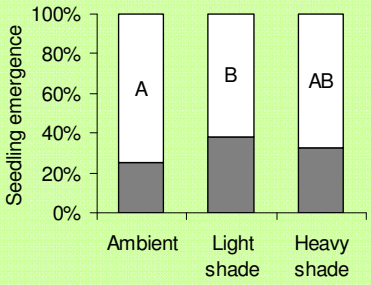

Figure 2. Proportion of *S. hebecarpa* seedlings emerging within 14 days of seed planting under three light intensities. Different letters indicate statistically significant differences (ά = 0.017).

Table 1. Comparisons of leaf size and structure for plants grown under three light intensities. Different letters indicate statistically significant differences within rows.

Parameter (units)	Ambient Light Mean ± SE	Light Shade Mean ± SE	Heavy Shade Mean ± SE	ANOVA *F*	ANOVA *P*
Stomatal density (number / mm²)	183 ± 15a	163 ± 15ab	123 ± 12b	4.841	0.012
Dry mass (g)	0.076 ± 0.006a	0.048 ± 0.004b	0.017 ± 0.001c	48.762	<0.005
Water content (% fresh mass)	81.3 ± 0.2a	82.7 ± 0.3b	82.8 ± 0.4b	6.954	0.002
Leaf area (cm²)	10.33 ± 0.72a	9.24 ± 0.40a	5.45 ± 0.29b	25.844	<0.005
Specific leaf area (mm area / g dry mass)	143 ± 7a	210 ± 17b	324 ± 16c	42.633	<0.005

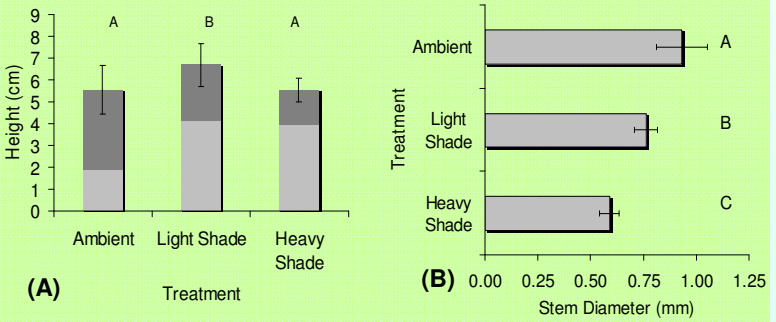

Figure 3. **(A)** Seedling height after week 3 (lt. gray) and week 5 (dk. gray). Different letters indicate statistically significant differences (F=11.498, P<0.005). **(B)** Stem diameter after week 5. Different letters indicate statistically significant differences (F=71.89, P<0.005).

Conclusions

- Shade-grown seeds germinated at a higher percentage, but seedlings showed signs of etiolation: (1) ↑ stem elongation (2) ↓ stem diameter (3) ↓ leaf area
- Shade-grown seedlings exhibited traits that correspond with reduced photosynthetic capacity: (1) ↑ specific leaf area (2) ↓ stomatal density

These results indicate that *S. hebecarpa* is not well adapted to shade and will suffer reduced growth and reproduction in environments where trees have closed the canopy and greatly reduced photosynthetic photon irradiance.

Acknowledgments

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