Measuring the Effect of Decreasing Water Potential on Seed Germination, Seedling Development, and Population Growth in Endangered Wildflower Northern Wild Senna (*Senna hebecarpa*)

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Background and Objectives

Northern Wild Senna (*Senna hebecarpa*) is an endangered native wildflower with a limited range within the New England states. Extant populations in the region are in decline, with a number of states listing the species as historic (Clark 2001). Possible reasons for the decline include natural ecological succession, habitat loss, and, of greatest interest for this study, changes in soil hydrology. *Senna* thrives in moist soils and is typically found along stream banks or other alluvial sites such as fields or roadsides. Decreases in springtime soil water potential (Ψ) due to hydrological changes from dam construction, ditching, or other means may adversely affect germination rates, contributing to further population decline. The objectives of this study were to:

1. Examine the effect of Ψ on seed germination and seedling growth
2. Model the effect of reduced germination under low Ψ conditions on population growth

Methods

• Simulated water potentials from 0Ψ (pure water) to -1Ψ using a colloidal suspension of Polyethylene Glycol (PEG) 8000 and water (Norsworthy and Oliveira 2005, Burlyn 1982)
• Scarified 432 seeds with 70% H_2SO_4 for 3m, planted seeds in petri dishes on moist filter paper and grew for 14 days (Figure 2)
• Recorded germination rate (% emergence), radicle length, and hypocotyl length on days 7, 10, and 14
• Incorporated germination results into transition matrix model parameterized with field data and conducted eigenanalysis to calculate finite rate of increase (λ) and elasticity values

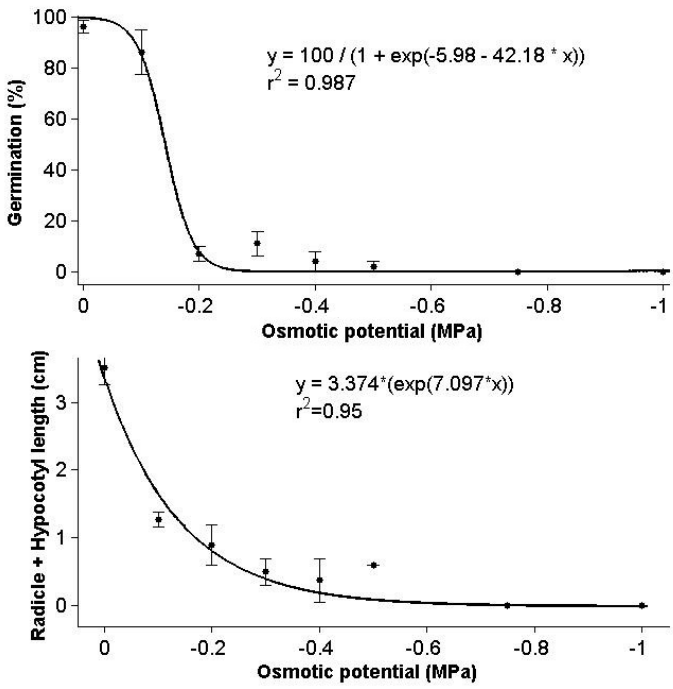


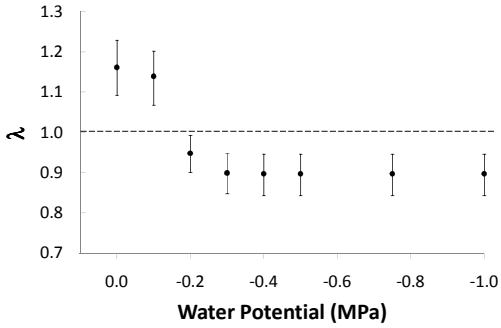
Figure 1. Impact of osmotic potential on *S. hebecarpa* germination (top) and seedling growth (bottom). Bars represent standard error of the mean (n = 9 dishes / treatment).

Figure 2. Germination set-up (left) and flowering adult (right). All treatments were grown under 15h / d fluorescent lights at 25°C.

Results and Conclusions

• Seeds germinated well under conditions between 0 and -0.1Ψ, but germination rates and seedling growth drop to near zero less than -0.2Ψ (Figure 1)
• Population models revealed significant reductions to λ under declining Ψ conditions (Figure 3); results consistent with elasticities showing λ's sensitivity to germination rates (Figure 4)
• Our results reinforce concern over hydrological changes that alter flooding regimes within the species primary habitat

Figure 3. Effect of water potential on λ. Reported are mean values and 95% confidence intervals from bootstrap analysis (n = 1000 iterations)



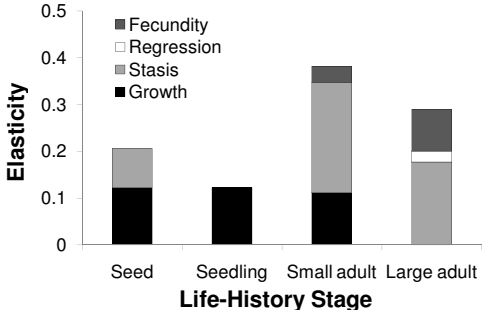


Figure 4. Composite elasticities for each stage, shaded to show the relative contribution of each life-history parameter.

References

• Jason K. Norsworthy, Marcos J. Oliveira (*2005*) Coffee senna (*Cassia occidentalis*) germination and emergence is affected by environmental factors and seeding depth. Weed Science: Vol. 53, No. 5, pp. 657-662.
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Acknowledgments

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