From Forest Nursery Notes Winter 2013

60. © Seed germination ecology of three imperiled plants of rock outcrops in the southeastern United States. Albrecht, M. A. and Penagos Z., J. C. Journal of the Torrey Botanical Society 139(1):86-95. 2012.

Journal of the Torrey Botanical Society 139(1), 2012, pp. 86–95

Seed germination ecology of three imperiled plants of rock outcrops in the southeastern United States[1,2]

Matthew A. Albrecht[3] and Juan Carlos Penagos Z.

Center for Conservation and Sustainable Development, Missouri Botanical Garden, PO Box 299, St. Louis, MO 63166

Albrecht, M. A. and J. C. Penagos Z. (Center for Conservation and Sustainable Development, Missouri Botanical Garden, PO Box 299, St. Louis, MO 63166). Seed germination ecology of three imperiled plants of rock outcrops in the southeastern United States. J. Torrey Bot. Soc. 139: 86–95. 2012.—The success of rare plant conservation programs depends upon understanding the ecological factors that regulate seed dormancy and germination. In this study, we characterize the germination niche with respect to temperature and light of three imperiled perennials that are endemic to rock outcrops in the southeastern United States: *Astragalus bibullatus*, *Claytonia ozarkensis*, and *Conradina verticillata*. Our results show that a majority of seeds for each species are unable to germinate at habitat temperatures prevailing after dispersal in early summer. Seeds of the rockface endemic *Claytonia ozarkensis* germinated to high rates in darkness at 5°C, suggesting germination is confined to winter and that seeds are unable to persist beyond one germination season (transient seed bank). For *Conradina verticillata*, 44% of seeds germinated without cold stratification, while the remainder required cold stratification and light to overcome physiological dormancy. Following cold stratification, *Conradina verticillata* seeds germinated in light at cool (15/5 °C) but not at warm (30/15 °C) temperatures, although overall seed viability was low (26%). Seeds of *Astragalus bibullatus* germinated to low rates ($< 10\%$) in seasonal temperature sequences, confirming that this species forms a persistent seed bank. Seeds of *Astragalus bibullatus* lost viability following heat shock for 30 min at 125 °C, but germinated to $> 50\%$ following mechanical scarification and incubation at 30/15 °C. Results from this study can be used to maximize germination for *ex situ* and reintroduction programs, and provide insight into managing wild populations.

Key words: *Astragalus*, *Claytonia*, *Conradina*, *ex situ* conservation, germination niche, rare plants, seed dormancy.

Seed germination is a critical stage in the life cycle of plants and is restricted in space and time to locations that meet a specific set of environmental conditions ('safe sites,' Harper 1977). In temperate habitats, seeds of many species are dormant at maturity and are unable to germinate at prevailing habitat temperatures following dispersal, which are typically unfavorable for seedling establishment (Vleeshouwers et al. 1995). Temperature is the primary factor regulating dormancy break and germination timing, with seeds of temperate herbaceous perennials most frequently germinating in autumn or spring after fulfilling a warm and/or cold temperature requirement for dormancy break (Baskin and Baskin 2001, Walck et al. 2005). Once dormancy is lost, nondormant seeds may require specific temperatures and environmental cues (e.g., light) to germinate (Vleeshouwers et al. 1995, Baskin and Baskin 2001); otherwise seeds can become conditionally dormant and enter the soil seed bank. While members of certain plant families can exhibit similar types of dormancy (e.g., physical dormancy, Fabaceae), species that occupy similar habitats often exhibit different dormancy and germination traits due to variation in seed coat permeability, life history, phylogeny, and response to environmental cues (Grime et al. 1981, Baskin and Baskin 2001, Vandelook et al. 2008).

Understanding factors that regulate seed dormancy and germination in rare plant species is essential for integrated conservation strategies, which combine *in situ* habitat protection and management with safeguarding genetic material in *ex situ* seed banks

[1] Support for this research was provided by grants from the Winslow Foundation and National Park Service and Center for Plant Conservation Cooperative Agreement (H2623032060).

[2] The authors thank the United States Fish and Wildlife Service (USFWS), Tennessee Natural Heritage Program (TNH), and the Big South Fork National River and Recreation (BSFNR) staff for locality data and for assistance in obtaining collection permits. The authors also thank Geoff Call and Maria Kerr for assistance with seed collection of *Conradina verticillata*, Julia Maritz for field and laboratory assistance, and Adam Smith for providing climate data. We also thank Quinn Long and two anonymous reviewers for valuable comments on a previous version of the manuscript.

[3] Author for correspondence. E-mail: matthew.albrecht@mobot.org

Received for publication September 14, 2011, and in revised form December 12, 2011.