



Ecological Restoration Institute



*Fact Sheet: Long-term Responses of *Penstemon clutei* (Sunset Crater beardtongue) to Root Trenching and Prescribed Fire: Clues for Population Persistence*

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Penstemon Clutei (Sunset Crater beardtongue). Photo by Judith Springer, ERI

INTRODUCTION

Penstemon clutei (Sunset Crater beardtongue) is a rare plant species that grows on volcanic soils northeast of Flagstaff in northern Arizona. It is primarily restricted to tephra deposits from the Sunset Crater eruption at an elevation of approximately 7,000 feet and is typically found in open ponderosa pine forests and pinyon-juniper woodlands in areas containing a sparse understory. Its conservation status is ranked “imperiled” (G2) by NatureServe, a non-profit conservation organization, and it is on the U.S. Forest Service sensitive species list for Region 3 (Southwestern Region). Observations in the field suggest a positive link between disturbances (events that disrupt the ecosystem such as fire, logging, tornadoes, and death of trees by bark beetles) and reproduction and colonization. Published information on the ecology of this species is limited to about a half-dozen studies.

PREVIOUS RESEARCH

We initiated a study in 1992 to test the hypothesis that restoration of historic ecosystem conditions may enhance the sustainability of this species. We initiated a prescribed burning component in 1994 to test the hypothesis that prescribed fire would increase *P. clutei* density by removing litter and competing vegetation. After evaluating results from the prescribed burning experiment, we investigated the possibility that vigorous responses following fires were a result of mortality of overstory trees and removal of root competition. We then initiated a study in 1998 to test the hypothesis that cutting root competition through trenching (digging trenches in the soil approximately 1 yard deep and lining it with heavy plastic) would increase *P. clutei* density. In 1999, one year following the trenching, there was a significant difference in density between trenched and control plots, mostly in the form of *P. clutei* seedlings. Two preliminary conclusions were drawn from the trenching study: 1) trenching had a positive effect on *P. clutei* reproduction, and this trend was still evident a year later, and 2) increases in *P. clutei* were likely due to reduced root competition with overstory trees. In an effort to gain additional information on long-term dynamics, we revisited the study area 10 years after root trenching, and 13–14 years following prescribed burning. Our objectives were to assess the long-term effects of the prescribed burning and trenching treatments and to evaluate the importance of a persistent seed bank in population dynamics.

The Ecological Restoration Institute is dedicated to the restoration of fire-adapted forests and woodlands. ERI provides services that support the social and economic vitality of communities that depend on forests and the natural resources and ecosystem services they provide. Our efforts focus on science-based research of ecological and socio-economic issues related to restoration as well as support for on-the-ground treatments, outreach and education.

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RESEARCH FINDINGS

- In 2008, 13 and 14 years after spring and fall burning, respectively, there was no significant difference in *P. clutei* density between burned and unburned plots.
- Over the course of this study, there has been a general decline in *P. clutei* in both burned and control plots.
- However, there was still a significant difference in mean density between trenched and control plots 10 years after the first re-measurement. Mean density in trenched plots was significantly higher.
- Nearly all of the seedlings that emerged from the soil seed bank came from the samples taken in control (unburned) plots.

MANAGEMENT IMPLICATIONS

Our results indicate that prescribed burning alone may kill reproductively mature individuals, leading to potential decreases in available seeds for future recruitment. However, patchy tree mortality does appear to benefit *P. clutei* through increased reproduction, possibly facilitated by reduced root competition and/or other factors. Determining the long-term population dynamics of this species is integral to future conservation management planning and points out the direct need for long-term monitoring, particularly in the face of potential climate change and unmanaged off-highway vehicle (OHV) activity. Other potential threats include hybridization with other penstemon species, herbivory, and urban expansion. Teasing out whether *P. clutei* population declines occur from disturbance (fire, logging, tornadoes, etc.), absence of disturbance, senescence (biological aging), competition, drought, climate change, interactive effects, or other as-yet-undetermined factors will be critical for understanding future conservation and management needs.



Determining the long-term population dynamics of *P. clutei* is integral to future conservation management planning and points out the direct need for long-term monitoring. Photo by Judith Springer, ERI

This Fact Sheet summarizes information from the following publication:

Springer, J.D., P.Z. Fulé, and D.W. Huffman. 2012. Long-term responses of *Penstemon clutei* (Sunset Crater beardtongue) to root trenching and prescribed fire: Clues for population persistence. *Calochortiana*, 1:164-171. <http://library.eri.nau.edu/gsd/collect/erilibra/index/assoc/HASH0174/9a708f30.dir/doc.pdf>

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