PRODUCTION, LOSSES, AND GERMINATION OF *CEANOTHUS FENDLERI* SEEDS IN AN ARIZONA PONDEROSA PINE FOREST

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Quantified seed production and ovule losses for *Ceanothus fendleri* Gray (Fendler ceanothus) plants protected from large ungulate herbivores in a ponderosa pine (Pinus ponderosa [Laws]) forest of northern Arizona. I also tested seed germination responses to cold stratification and heat treatments in the laboratory. Fruit production on fecund stems ranged From 7.I to 38.2 fruits per stem, which equated to 22.2-118.2 potential seeds based on 3 ovules per fruit. Stems that produced fruit were signifiicantly large relative to their expected sizes. Predispersal ovule losses ranged from 70.7%, to 91.4% across the 2 years studied. A seed parasite (*Eurytoma squamos* Bugbee) consumed 19-28% of the total number of seeds produced. Postdispersal seed predation varied from 0% to 24% and was significantly affected by forest floor substrate in I study year. Cumulative ovule losses were estimated to be 71%-92%. Cold stratification did not significantly affect seed germination and exposure to 90ºC resulted its the highest germination percentage. Both dormant and nondormant seeds suggested a bet-hedging life history strategy. This study provides basic ecological information important for management of ponderosa pine forest and nursery production of *C.fendleri*.

Key words: Fendler ceanothus, seed ecology, ovule losses, seed predation, heat scarification, bet-hedging.

For many forest plant species, basic data on the ecology of seed populations are incomplete. However, these data may have many important applications. For example, information about seed production and inputs to sod seed banks can assist land stewards as they formulate plans for vegetation management activities such as site rehabilitation, ecological restoration, or weed control. Data on seed parasitism and predation can help scientists to model food web interactions or long-term plant population growth. Finally, horticulturists need information regarding germination of desirable species and factors that affect seed viability.

Ceanothus fendleri Gray (Fendler ceanothus) is a small shrub common ill ponderosa pine *(Pinus ponderosa)* forests of the southwestern United States and Rocky Mountains (Epple 1995). Like its congeners, C. fendleri is a nitrogen-fixer (Story 1971, Collard et al. 1985) and provides important functional and structural qualities in understory communities. It is particularly valuable as wildlife browse, although intensive herbivory by native ungulates such as mule deer (*Odocoileus Hemionus*) and Rocky Mountain elk *(Cercus elaphus)* can reduce stem length, leaf area, and flower production (Huffman and Moore 2003). Clusters of white flowers appear in early spring and provide an important resource for invertebrates. Constraints on flower production resulting from intensive herbivory indirectly affect abundance and richness of invertebrate assemblages (Huffman unpublished data). In the absence of herbivory, flower production call be prolific, and this lends an ornamental quality desirable for urban landscaping.

C. fendleri fruits are 3-celled capsules that ripen August–September (Kearney and Peebles 1964). Seeds are dark brown and about 2 mm in diameter. Limited data suggest that Fendler ceanothas seeds have some level of innate dormancy (Story 1974, Krishnan 1989). Observations of seedling emergence after prescribed fire suggest that dormant seeds remain viable in soil seed pools until scarified by heat or