RESEARCH ABSTRACT

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Study Title: Physiological and population ecology of lupines colonizing early successional habitats on Mount St. Helens

Key Words: terrestrial, plant, upland, lupines, herbs, survival, physiology, temperature, reproduction, recolonization, pyroclastic flows, archives

Abstract: Lupinus lepidus and Lupinus latifolius were prominent survivors and among the first colonizers of early succession habitats following the 1980 eruption of Mount St. Helens. Several physiological and morphological properties of seedlings and adults were found to govern the response of these species to the harsh environmental conditions of these habitats.

Morphological, phenological, and demographic studies revealed that L. lepidus was a short-lived wintergreen species (3-5 year lifespan) with low, spreading shoots and small, hairy, solar-tracking leaves. Within the early successional habitats of Mount St. Helens, L. lepidus had a high population growth rate, early reproductive maturity and high reproductive allocation. In contrast, L. latifolius was a longer-lived species (estimated 12-16 year lifespan), with an erect and densely-branched growth form. L. latifolius had a much lower population growth rate, delayed reproductive maturation and low reproductive allocation.

Comparative analyses of plant water relations showed that seasonal and diurnal trends of plant water balance were remarkably similar between species and between age classes within a species. Stomatal conductance and leaf water potential were correlated with soil and atmospheric water deficits. Minimal levels of seasonal and diurnal osmotic adjustment were observed in both species. Collectively, these and other traits were indicative of mesophytic species with leaf tissues that are sensitive to water deficits.

Comparative analyses of photosynthetic responses to temperature and light revealed significant differences between species. The photosynthetic capacity of L. lepidus was higher over a wider range of environmental conditions than L. latifolius. In particular, juvenile and mature plants of L. lepidus were able to acclimate to higher temperatures than L. latifolius.

By limiting seedling establishment, growth and the reproductive activity of L. lepidus and L. latifolius, high temperatures and periodic water deficits are the primary environmental factors controlling their influence upon the pattern and process of plant succession at Mount St. Helens. Additional studies have shown that high temperatures and periodic water deficits are also important in determining the differential survival of other species at Mount St. Helens.

Type of Measurement(s): Sampling within 3 permanent plots -- 1, 5 x 20 m, 2 10 x 10 m -- with 100 0.5 x 0.5 m subplots.
Air and soil temperature (^{o}C); leaf water potential (megapascals,Mpa); soil water potential (MPa); stomatal conductance (mmol $H_2O/M^2/s$); photosynthesis (mmol $CO_2/M^2/s$); percent seedling mortality; PAR and total shortwave radiation (nm); precipitation (ml); soil color, texture, pH, organic matter, nutrient concentrations, and cation exchange capacity; percent cover for all vascular plant species; biomass and nutrient analyses of lupines.

Frequency of Measurement(s): Measurements throughout growing season, 1983-1988.

Data Storage: Field notebooks, floppy disks in Macintosh Microsoft in personal possession.

Long-term plans: Data available for collaborative efforts: These projects have been completed, and manuscripts are in the process of publication. Future plans may include studying physiological factors governing species colonization on the pumice plain. Baseline data are not available for future studies.