RESEARCH ABSTRACT

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Study Title: Long-term succession in subalpine habitats

Key Words: terrestrial plant succession recovery uplands subalpine survival lahars dispersal seedling herbs grasses long-term studies

Abstract: A long-term study of recovery and primary plant succession in higher elevations was initiated in 1980. The objectives included to document recovery and invasion in several distinct habitats (e.g. lahars, pumice, blasted ridges, tephra) and to determine the mechanisms of invasion and establishment. In addition, large grids of contiguous 100 m^2 quadrats have been established since 1986 in several habitats. Recovery patterns vary with the size and intensity of the initial impacts. Tephra impacted sites were completely recovered by 1983 and subsequent vegetation change has not been directional. In contrast, intensively impacted sites have recovered much more slowly. Recovery rates differ primarily with the degree of isolation, but the intensity of the impact also governs the recovery rate. For example, lahars surrounded by intact vegetation have acquired as many species as intact vegetation, but community structure remains very different. Total cover after 11 growing seasons remains less than 10% of intact vegetation. Nutrients limit the development of biomass and cover, but most species in the immediate vicinity have established on lahars.

On the Plains of Abraham, an isolated site with low fertility and little soil development, cover is barely measurable and composition is strongly dominated by wind-dispersed species such as pearly everlasting and fireweed. Here, as in other locations, initial invaders are confined to "safe-sites", e.g. emerging from underneath small rocks or growing along the edges of erosion features. Very few of the locally available species have migrated more than 50 m from pockets of surviving herbs. Spatial analyses of this grid imply that most new plants are derived from outside the plot, that some portions of the grid are more likely to be invaded than others, and that microtopography is the single most important proximate factor in determining invasion success.

Experiments have demonstrated that most sites must first be modified by physical processes such as erosion, frost-fracturing, or nutrient input from dust, pollen, seeds, dead insects, etc. We have determined that the immediate cause of seedling death is, in most cases, associated with drought, but susceptibility to drought is conditioned by initial growth rates, which is nutrient dependent. Once physical amelioration occurs, it is possible for wind dispersed species, which have a limited ability to establish in unaltered substrates, can establish in a few sites. Once established, the rate of succession appears to accelerate.

One species, Lyall's lupine (Lupinus lepidus), is locally important in producing biotic facilitation effects. Individuals of this species contribute nitrogen and carbon to the soil and accumulate fine soil material. However, seedlings of other species generally do not grow under the influence of lupines since living lupines also compete strongly for water. After a lupine dies, invading species strongly prefer the mound created by it, a phenomenon called "delayed nursing".

Most of the devastated habitats on Mount St. Helens remain sparse, but the number of species and individuals is increasing rapidly. As more plants become established and produce seeds, we expect the rate of development to increase, biotic facilitation to become more important, and competitive interactions to intensify.

See Research Abstract from David Wood for relevant study information.

Type of Measurement(s):
1. Permanent plots: species composition and percent cover
2. Grids: species presence in 10 x 10 m plots and cover by a scale.
3. Seed traps: number of seeds per year.
4. Manipulation plots: seedling recruitment and survival.

Frequency of Measurement(s): Annually beginning in 1980.

Data Storage: Data are stored permanently on field data forms, on print-outs of each stand, and in data files on disk. Many summary data for grids, such as species richness per plot, are also on data files and in graphical arrays. Data for permanent plots and for grids are stored in standard Cornell Condensed format compatible with many programs, including programs that will expand the data to full format for statistical purposes (ASCII). Software includes turbo-pascal data summary routines, COENOSE for rapid clustering, or such Fortran programs as DCA, TWINSPAN, etc.

Long-term plans: Data available for collaborative efforts: Baseline data are available to bona-fide investigators. Long-term plans are to continue monitoring permanent plots and permanent grids through 1994, then shifting to a rotating sampling regime.