



## ALDO LEOPOLD WILDERNESS RESEARCH INSTITUTE

<http://leopold.wilderness.net/>

### RESTORING RECREATION-IMPACTED SUBALPINE SITES IN THE BITTERROOT MOUNTAINS, MONTANA

**Keywords:** recreation impacts, subalpine, anthropogenic disturbance, seed bank, revegetation, restoration, microbial activity

#### **Background & Management Issues:**

Restoration of recreation-impacted sites in wilderness areas poses a number of challenges. Restoration must be completed relatively quickly to limit reuse, and little information exists concerning successful propagation of many native plant species. Most wilderness areas are in high-elevation, low-productivity habitats, where plant establishment is exceptionally challenging, especially on an impacted site.

#### **Project Objectives:**

- ❖ To understand how recreation impacts may limit plant growth.
- ❖ To identify factors that limit successful revegetation of recreation-impacted sites.

**Project Description:** The study site was a popular lake basin in the northern Bitterroot Mountains of Montana. Site conditions were fairly typical for the subalpine zone of the Northern Rockies, with scattered trees, mostly subalpine fir, and a shrub understory composed of beargrass and huckleberry on fine-grained mineral soils. Soil samples were taken from disturbed and undisturbed sites and analyzed in the laboratory for nutrient levels and microbial activity. Soil collected from the study site was taken to a greenhouse and used to assess seedbank density relative to site disturbance, and the effect of soil amendments on plant growth. At the site itself, five soil treatments and two revegetation treatments were randomly assigned to 25 plots. Plots were monitored for three growing seasons.

#### **Results:**

##### **Recreation Impacts on Site Condition**

Soil conditions were significantly affected by recreational use. Although total numbers of microbes did not differ significantly among sites, functional diversity of the microbial community was 44% less on disturbed sites. Available nitrogen increased in disturbed soils, while potassium and phosphate decreased significantly.

##### **Success of Revegetation Efforts**

###### *Greenhouse Experiment*

Plant growth increased significantly in the greenhouse with the addition of compost. Plant growth on disturbed or undisturbed soils taken from the study site did not differ, however. Seedbank density was closely linked to site disturbance. Soils from highly impacted sites had nearly ten times fewer seeds per m<sup>2</sup> and less than half the plant species than undisturbed sites. An absence of organic matter and an increase in size of a disturbed site both adversely impacted seedbank density.

###### *Field Experiment*

The number of seedlings observed in each plot did not differ among the different soil treatments. Compost was the only soil amendment that had a significant effect on plant growth, but it increased growth only in one species, pearly everlasting.

The revegetation treatment did have a significant affect on seedling numbers, doubling the number of seedlings present. In this treatment native seeds and transplants were planted on the site. The number of seedlings observed on revegetated plots varied widely, however, and even on plots with many seedlings, growth rates were very low.

The variable results from the revegetation treatment and the lack of response to soil amendments suggest that microclimatic conditions greatly limit restoration success. The authors are currently evaluating methods to ameliorate microclimatic conditions.

## **Management Implications:**

- ❖ Disturbed sites with greater soil compaction and less microbial activity have less potential for rapid natural regeneration than less disturbed sites.
- ❖ Microbial activity is heavily affected by recreation. Understanding how changes in microbial activity affect plant growth would assist restoration efforts.
- ❖ A major factor limiting revegetation on heavily disturbed sites is the low quality of the seed bank. Adding organic matter could assist revegetation by trapping seeds from natural seedfall. In the more severe cases, additions of seed or transplants may be necessary for successful restoration.
- ❖ The ineffectiveness of soil amendments in this study does not mean they do not have a place in revegetation efforts. Rather, other factors need to be ameliorated before soil amendments can be helpful.
- ❖ While the addition of seeds and transplants to a disturbed site may dramatically increase the number of seedlings on the site, microclimatic conditions may still prevent successful revegetation.
- ❖ Microclimatic conditions, such as water availability and climate, may be the most important factor limiting seedling establishment and plant growth on disturbed subalpine sites. In order for revegetation to succeed on these sites, adverse microclimatic conditions must be successfully overcome.

## **Publications / Products:**

- ❖ Zabinski, Catherine; Cole, David. 2000. Understanding the factors that limit restoration success on a recreation-impacted subalpine site. In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 5: Wilderness ecosystems, threats, and management; 2000 May 23– 27; Missoula, MT. Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 216-221. **Leopold Publication Number 400.**
- ❖ Zabinski, Catherine A.; Gannon, James E. 1997. Effects of recreational impacts on soil microbial communities. *Environmental Management* 21(2): 233-238. **Leopold Publication Number 305.**
- ❖ Zabinski, Catherine; Wojtowicz, Todd; Cole, David. 2000. The effects of recreation disturbance on subalpine seed banks in the Rocky Mountains of Montana. *Canadian Journal of Botany* 78(5): 577-582. **Leopold Publication Number 377.**
- ❖ Additional products soon will be available on a study of the effects of restoration treatments on soil characteristics in the Eagle Cap Wilderness.

*For additional information...*

**David Cole, Leopold Institute Investigator**  
phone: 406-542-4196  
email: [dcole@fs.fed.us](mailto:dcole@fs.fed.us)

**Catherine Zabinski, Montana State University**  
phone: 406- 994-4227  
email: [cathyz@montana.edu](mailto:cathyz@montana.edu)

