



A comparison of plant communities and substrates of avalanche and non-avalanche areas in  
South-Central Montana  
by Sharon Thornberry Eversman

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of  
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**Abstract:**

A study was conducted in the Bridger Bowl area in the Bridger Range in south-central Montana, U.S.A., to determine vegetation and soil features of an avalanche area and compare avalanche tracks with areas where no avalanches occurred, 2x5 dm plots and quarter methods were employed in obtaining quantitative data of plant communities. Surface soil analyses were made. Increment cores were obtained to determine ages of trees, and some trees were cut to determine patterns of tree ring growth, *Abies lasiocoma* is the dominant tree taxon in all timbered areas above 7000 feet. *Pseudotsuga menziesii* occurs where there is no snow movement and is dominant on forested slopes below 7000 feet. Perennial forbs and grasses occur on all open slopes in communities that have no correlation with snow movement. Exposure, substrate, available moisture, and altitude affect local variations of the herbaceous communities, The topographic features, long-existing snow movement, and the present vegetation patterns have developed concomitantly.

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SHARON THORBERRY EVERSMAN

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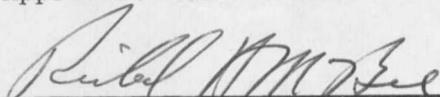
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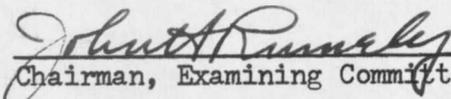
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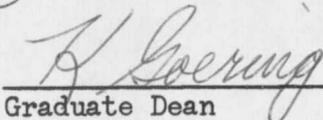
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ABSTRACT

A study was conducted in the Bridger Bowl area in the Bridger Range in south-central Montana, U.S.A., to determine vegetation and soil features of an avalanche area and compare avalanche tracks with areas where no avalanches occurred. 2x5 dm plots and quarter methods were employed in obtaining quantitative data of plant communities. Surface soil analyses were made. Increment cores were obtained to determine ages of trees, and some trees were cut to determine patterns of tree ring growth.

Abies lasiocarpa is the dominant tree taxon in all timbered areas above 7000 feet. Pseudotsuga menziesii occurs where there is no snow movement and is dominant on forested slopes below 7000 feet. Perennial forbs and grasses occur on all open slopes in communities that have no correlation with snow movement. Exposure, substrate, available moisture, and altitude affect local variations of the herbaceous communities. The topographic features, long-existing snow movement, and the present vegetation patterns have developed concomitantly.

## INTRODUCTION

The Bridger Bowl Ski Area and adjacent region in the Bridger Range in south-central Montana, U.S.A., is the site of extensive snow research by the Earth Science Department at Montana State University at Bozeman. Some studies concentrate on snow metamorphosis and strength of the snow pack (Bradley, 1966, 1967). These studies determine conditions leading to collapse of unstable snow layers that contribute to slab avalanches. Other work deals with avalanche forecast, control, and prevention, including installation of devices to inhibit cornice formation at the top of the ridge under which the ski area is located (Montagne, et al., 1967).

Observations indicate that avalanches and other snow movements occur consistently in the same paths on the same slopes. It has been speculated that ecological features might contribute to the susceptibility and maintenance of specific areas as snow movement paths. (The present study was undertaken to attempt to ascertain whether plants and soil of avalanche tracks vary significantly from adjacent or similar slopes where snow movement does not occur.

Abundant information is available on snow physics (Davos Symposium, 1965; International Conference on Low Temperature Science, 1966; Forest Service, 1961). This literature concentrates on snow types and metamorphosis, weather and other conditions affecting avalanche release, slope characteristics, and avalanche control and rescue. Slope vegetation, if mentioned, is given in very general terms.

European ecological studies in the Alps focus on deforested slopes

that subsequently became dangerous avalanche paths. The avalanches start either above timberline and slide through the deforested area, or they are able to start in a formerly timbered area. Wind control for reforestation projects is discussed by LaChapelle (1966) and Hopf and Bernard (1963). In the Austrian Alps, wind deflection structures are being placed where they will affect snow distribution as natural forests do. These devices prevent extremely deep snow accumulations in localized areas, and inhibit wind scouring of trees and exposed sites. Controlled grazing and timber cutting are also being practised.

This kind of information is not directly applicable to the Bridger Bowl area, since timberline extends to the top of the ridge wherever there is a suitable substrate. Very little, if any, tree cutting has been done in the avalanche zones. There is no evidence that the present avalanche paths have ever been forested.

## DESCRIPTION OF THE AREA

The Bridger Range extends for about 30 miles along a north-northwest to south-southeast axis in Gallatin County in south-central Montana. The Bridger Bowl Ski Area is situated on the east side of an 8500-foot ridge in the Bridger Range (Appendix A).

An aerial photograph (Figure 1) illustrates the topography and vegetation patterns of the Bridger Bowl region. Forested slopes are darkest in color and are usually convex slopes, ridges or mounds of soil. Meadow vegetation, primarily herbaceous perennials and grasses, appears light gray and occurs on convex and concave slopes. Loose rock and outcrops appear white. The specific sites studied are numbered in Figure 2; their more detailed descriptions appear in Table I.

Bridger Bowl slopes face nearly due east; northeast and southeast exposures are formed only on the sides of the ridges that alternate with gullies and wide circular depressions (bowls). The average slope is about  $27^{\circ}$ , with generally steeper slopes above 7000 feet, and gentler slopes below 7000 feet.

The streams draining the area are intermittent above 6500 feet, being filled with water only while the snow is melting. They are usually dry by mid-July. Occasional springs contribute a small amount of water.

Man's activities have altered the vegetation patterns in the avalanche zone very little. Some tree cutting has been done during continuous development of the area for skiing, but most of this is well below the avalanche zone. Extensive logging has been done on the slopes below the ski area.

Grazing pressure on the meadows is slight. Flocks of domestic sheep use some of the land below 7000 feet about once in four years. Some mule deer and blue grouse inhabit the area, and elk and mountain lions are occasionally seen.

Weather records have been kept since 1951 at the Forsythe Ranch, altitude 6000 feet. The average annual temperature is about 38.6° F. July is the warmest month and January is the coldest (Table II).

Average annual precipitation is 33.88 inches. July is the driest month and June is the wettest. Most of the precipitation from September to May is snow. Maximum snow depth is usually 95 to 100 inches in the Bridger Bowl area, with local depths ranging from 50 to 100 inches, depending on topography and altitude. Bridger Bowl is on the lee side of the Bridger Range. On the windward, or west, side of the ridge, maximum snow depth is about 60 inches.







































































