

THE EFFECTS OF SNOW COMPACTION ON WATER RELEASE AND SEDIMENT YIELD

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Ski area development is taking place at a rapid rate in the western U.S. Coincident with this expansion is the increased use of over snow vehicles for trail maintenance and grooming. The use and maintenance of ski trails leads to the compaction of snow. In light of the increased ski area development, an understanding of the effects of snow compaction on runoff and sediment production is imperative.

This field study utilizes a paired watershed approach to analyze the effects of snow compaction. In this study, one watershed underwent snow compaction while the other did not. Basin comparability is established using geology, area, aspect, relief, soils, mean basin elevation, mean basin slope, tree cover type and amount and the proximity of the two basins to each other. Snow monitoring was done using snowpits, Ram penetrometer profiles, and Federal Snow Sampler measurements. Compaction impacts on runoff were monitored by recording surface water discharges and suspended sediment amounts. Compaction effects were also evaluated through the use of two slope runoff collectors.

Compacted snow releases water later than uncompacted snow. The basin in which snow compaction took place had a "flashier" hydrograph, characterized by steeper rising and receding limbs, and a higher peak discharge value. Snow compaction over approximately thirty percent of the basin area resulted in a lag time of between seven and thirty days. For the basins compared in this study, snow compaction had little effect on sediment production.

Compaction affects the snowpack in a two-fold manner. First, compacted snow has less permeability than does the uncompacted snow. This results from both the snow densification and a vertical permeability anisotropy due to the greater number of ice lenses in the compacted snow cover. This reduced permeability retards the movement of water within the snowpack. Secondly, since heat transfer is expedited by the presence and the amount of liquid water within the ice matrix this retarded water flow impedes the development of wet snow grains. The development of wet snow grains is a necessary precursor to water release. Therefore, the measured lag times are due to retarded wet snow grain development as well as retarded water movement.