Research Studies Related to Snowmobiling Impacts

VEGETATION AND SOIL/SNOW COMPACTION

Everything we do has some effect on the environment. When a hiker steps on a flower, he or she affects the environment. When land is paved over for a bicycle path, it affects the environment. Many of the foot paths man has used for centuries still exist and are clearly visible throughout the world.

It's a fact however that a snowmobile and rider exert dramatically less pressure on the earth's surface than other recreational activities (i.e., just one-tenth the pressure of a hiker and one-sixteenth the pressure of a horseback rider). Table A2 below shows the average pounds of pressure per square inch exerted on earth's surface by various recreation travel modes (All vehicle weights include an estimated weight of 210 pounds for one person and his/her gear.).

Table 2: Pressure Exerted by Various Recreation Travel Modes

Object	Pounds of Pressure exerted per square inch
Four-Wheel Drive Vehicle	30
Horse	8
Man (hiking)	5
All-Terrain Vehicle	1.5
Snowmobile	0.5

Moreover, the snowmobile's one-half pound of pressure is further reduced by an intervening blanket of snow.

In many States snowmobiles are not classified as off-road vehicles. By both definition and management policies, these States have completely separated snowmobiles from off-road vehicles. Given adequate snowfall and responsible operation, all evidence of snowmobile operation disappears when the season changes and the snow melts.

A U.S. Department of the Interior environmental impact statement concluded: "A major distinction is warranted between snowmobiles and other types of off-road vehicles. Snowmobiles operated on an adequate snow cover have little effect on soils – and hence cause less severe indirect impacts on air and water quality, and on soil-dependent biotic communities, than other ORVs do." It further stated that, "Where snowmobiles are used exclusively over snow on roads and trails, the impact on vegetation is indeed virtually nil."

A University of Wisconsin study found that snowmobile traffic had no effect on grain yield of winter wheat, alfalfa, red clover plots, or grass legume. Species of turf grass showed slightly reduced yields at first harvest, but were not negatively affected in subsequent harvests.

Research undertaken by the University of Maine concluded that "compaction by snowmobiling does not alter the grain weight yields of alfalfa in Maine."

A Utah Water Resource Laboratory study found that snow compaction, caused by snowmobile tracks, does not damage wheat crops. Instead, the compaction increases the yield and eliminates snow mold. Erosion is also reduced.

There is no evidence that snow compaction caused by snowmobiling, ski-touring, or snowshoeing has a significant impact on the population of small burrowing animals. Since these recreations take place over a

minuscule portion of the total land area, the ecosystems of burrowing animals tend to be overwhelmingly affected by natural forces such as wind-induced compaction, early and late snowfalls, temperature fluctuations resulting in thaws and freezes, etc.

Specific studies related to vegetation, soil, and snow compaction include:

General

1. **Effects of Winter Recreation on Vegetation.** (1999) Effects of Winter Recreation on Wildlife of the Greater Yellowstone Area: A Literature Review and Assessment. Olliff, T., Legg, K. & Kaeding, B. Greater Yellowstone Coordinating Committee, Yellowstone National Park. pp. 119-121. http://www.nps.gov/yell/parkmgmt/upload/wildlifewint.pdf

Potential Effects: There is little information available describing the ecological effects of snowmobiling and other winter recreational activities on vegetation. Research cited was completed in the 1970s and focused on assessing the impacts of snowmobile use on vegetation and snow characteristics in Minnesota and Canada. Effects could potentially include impacts on snow compaction, soil temperature, vegetation, and erosion.

Management Guidelines: Adverse effects to vegetation are the result of cumulative factors. The impact of snowmobile activities on the physical environment varies with winter severity, the depth of snow accumulation, the intensity of snowmobile traffic, and the susceptibility of the organism to injury (Wanek 1973). Activities occurring on roadbeds and (most likely) trails are probably having little affect on vegetation as the areas are already compacted or disturbed. Effects of snowmobile activities on off-trail vegetation should be assessed at a landscape level.

Management or restriction of snowmobile activities should be considered in areas where forest regeneration is being encouraged as deformation patterns was observed in conifers where leaders had been removed by snowmobile activities (Neumann and Merriman 1972). Management or restrictions should also be considered in fragile or unique communities, such as riparian and wetland habitats, thermal areas, sensitive plant species habitat, and areas of important wildlife habitat, in order to preserve these habitats.

2. **Snowmobile Impact on Old Field and Marsh Vegetation in Nova Scotia, Canada: An Experimental Study**. Keddy, P.A., Spavold, A.J., & Keddy, C.J. Department of Biology – Dalhousie University, Halifax, Nova Scotia. (1979) Environmental Management, Vol. 3, No. 5, 409-415.

Abstract: A study was carried out in Nova Scotia, Canada, to experimentally assess the effect of snowmobiles on old field and marsh vegetation. Snowmobile treatments ranging from a single pass to 25 passes (five passes on five separate days) were administered. The first pass by a snowmobile caused the greatest increase in snow compaction – roughly 75% of that observed after five sequential passes. Snowmobile treatment resulted in highly significant increases in snow retention in spring. Frequency was more important than intensity in this regard.

Standing crop and species composition were measured the following summer. Standing crop in the field showed a significant reduction with increasing snowmobile use; frequency of treatment ($p < 0.01$) was more important than intensity ($p = 0.125$). *Stellaria graminea, Aster corifolius, Ranunculus repens,* and *Equisetum arvense* all showed significant ($p < 0.05$) differences in percent cover resulting from the treatment. Marginally significant changes were observed in *Agrostis tenius* and *Phleum pretense*. Marsh vegetation showed no significant effects of snowmobile treatment. This may have been because of solid ice cover during the winter.

Grasses

1. **Effects of snowmobile traffic on bluegrass.** Foresman, C.L., Ryerson, D.K., Walejko, R.N., Pendleton, J.W., & Paulson,W.H. (1976). Journal of Environmental Quality 5(2): 129-130. http://nohvcclibrary.forestry.uga.edu/SCANNED%20FILES/W-0002-effect%20of%20snowmobile%20bluegrass.pdf

Abstract: Result of staged snowmobile passes, compared with undisturbed plots. Early growth was slower but late summer yields were the same. No soil compaction was detected in the treated plots. The researchers concluded that snowmobiling would adversely affect only the plots intended for early harvest. Report includes a brief bibliography.

2. **Effects of Snowmobile Traffic on Non-Forest Vegetation and Grasses.** (1974) Proceedings of the 1973 snowmobile and Off the Road Vehicle Research Symposium., Michigan State University. East Lansing, MI

Abstract: The main objective of this study was to determine the effect of varying degrees of snowmobile traffic on non-forest vegetation and grasses found in open field areas and farms throughout the Snow Belt states. The results revealed that: where snow cover exceeded 3 inches in depth there were no detrimental effects on grass or vegetation stands, their vigor, or yield; high-grade grasses recover naturally from heavy snowmobile traffic; and snowmobile traffic caused no stand reductions, but did cause a slower recovery in early spring.

3. **Snowmobile Impact on Three Alpine Tundra Plant Communities.** Greller, A.M., Goldstein, M., & Marcus, L. (1974) Environmental Conservation, Volume 1, No. 2, 101-110.

Summary: The study observed snowmobile travel on a route located on Niwot Ridge in the Front Range of the Colorado Rocky Mountains, between two weather stations operated by the Institute of Arctic and Alpine Research – University of Colorado, from November 1968 to May 1969 and from November 1969 to May 1970. General conclusions included: 1) In communities that are snow-free in winter, damage by snowmobiles was severe to lichens, *Selaginella*, and to relatively prominent, rigid cushion-plants. Part of the damage to these communities in the present study may have been due to the manual removal of rocks, necessary for the operation of snowmobiles in snow-free areas. 2) *Kobresia*, present in isolated tussocks in a cushion-plant community, absorbed the major portion of snowmobile impact. As *Kobresia* is thought to form the climatic climax community in this ecosystem, differential damage to it should seriously retard succession. 3) Snowmobile travel in uniform, closed *Kobresia* meadows inflicted much less damage to most plants, including *Kobresia* itself, than did similar travel on a sparsely vegetated community. 4) Plants best able to survive the heaviest snowmobile impact were those with small stature and little woodiness, or with buds well-protected at or below the soil surface. 5) Snowmobile traffic should be carefully restricted to snow-covered areas. Whenever this is not feasible, the least destructive and easiest alternative is travel on mature, well-vegetated *Kobresia* meadows or similar well-drained plant communities.

It should be noted that the snowmobile damage to vegetation on Niwot Ridge was probably of greater severity than would be expected from undirected recreational travel. Recreational drivers would be expected to avoid snow-free areas whenever possible, thus reducing, considerably, the impact on vegetation. Also, it is unlikely that large numbers of stones would be removed by random travel on those snow-free areas.

Soil and Snow

1. **Effect of snow compaction on frost penetration and soil temperature under natural conditions in central Maine.** Wentworth, D. S. (1972).

Abstract: The effect of snow compaction in relation to frost penetration and soil temperatures was studied on eight sample plots. Multiple linear regression analysis was used to develop regressions of three environmental variables, as well as time, upon soil temperature. Compaction of the snow cover had little effect on average soil temperature under the different treatment areas.

Winter Wheat

1. **Effects of snowmobile traffic on several forage species and winter wheat**. Ryerson, D. K., Schlough, D. A., Foresman, C. L., Tenpas, G. H., & Pendelton, J. W. (1977). Agronomy, 69 (Sept.-Oct.), 769-772. http://nohvcclibrary.forestry.uga.edu/SCANNED%20FILES/W-0031.pdf

Abstract: Attempted to identify conditions under which OSV use would cause plant damage; this was not accomplished because each winter had unique and unpredictable characteristics. Six common species were studied for 3 years. 4 species showed no detrimental effects; winter wheat yields were not reduced below the check (control) areas; 1 species was significantly reduced during one year but unaffected during the next year Concluded that trail use (rather than open uncontrolled use) would be most appropriate in crop vegetation environs. Paper includes a bibliography.

Woody Plants

1. **A continuing study of the ecological impact of snowmobiling in Northern Minnesota.** Wanek, W., & Schumacher, L. H. (1975) The Center for Environmental Studies, Bemidji State University, Bemidji, MN.

Abstract: Five years of research have shown conclusively that snowmobiles have an impact on the physical environment and plant communities of northern Minnesota. The impact may vary from year to year due to differing temperature extremes and snowfall. The extent of plant injury often depends on the intensity of snowmobile traffic and the susceptibility of each species to physical or cold temperature damage. The environment beneath the snow compacted by snowmobiles is substantially colder than that under natural snow cover. This can cause damage to herbs and perennials. Many woody plants are particularly vulnerable to physical damage by snowmobiles.

The damage to plant communities reported during this study should not be considered maximal. In all cases snowmobile traffic began after six inches of snow had accumulated – a condition which is usually not met during normal snowmobiling activity.

2. **The ecological impact of snowmobiling in Northern Minnesota.** Wanek, W. (1973) The Center for environmental studies-Bemidji State College Bemidji, Minnesota.

Abstract: Snowmobiles have an impact on the physical environment and biota of northern Minnesota. The impact varies with the severity of the winter, the depth of snow accumulation, the intensity of snowmobile traffic, and the susceptibility of the organism to injury, caused by cold temperatures or physical contact. Temperatures beneath the snow compacted by snowmobiles are considerably colder than those under undisturbed snow cover. The growth of early spring flowers is retarded, and reproductive success is reduced where snowmobiles travel. Many herbs with massive underground storage organs (alfalfa included) are winterkilled in the modified environment under snowmobile tracks. Woody plants are particularly vulnerable to physical damage by snowmobiles. Snowmobile traffic can be beneficial by reducing the stature of woody vegetation in area where it needs to be controlled. However, traffic is unwise in places where forest regeneration is being encouraged, or where the esthetic or economic value of fragile communities necessitates their preservation.