

**SNOWMOBILING IN THE ADIRONDACK PARK:**

**Environmental and Social Impacts**

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## Table of Contents

Introduction	
-Summary.....	3
-Background.....	4
-The Problems.....	5
-Stakeholders.....	7
Human Impacts	
-Snowmobile Emissions.....	10
-Effects on Wildlife.....	15
-Effects on Aquatic Communities.....	21
-Effects on Vegetation.....	23
-Social Impacts.....	25
Governmental Jurisdiction.....	26
Solutions.....	27
DEC Draft Snowmobile Plan.....	28
-Public Commentary.....	31
-Feasibility of Draft Plan.....	34
Further Suggestions.....	34
Implementation.....	38
Conclusions.....	40
Appendix.....	42
Map.....	43
Works Cited.....	44

## **Summary**

The Adirondack Park located in northern New York State is a mosaic of public and private land totaling nearly six million acres. All land in the Park is managed with restrictive use to protect the natural integrity of the region. The region attracts many different recreational groups, one such group is snowmobilers. Snowmobilers contribute a great deal to the economy of many towns and businesses within the park, current estimates reach over \$46 million per year (DEC Draft). While this activity has a positive impact on the economy of the Park unfortunately it is having a negative effect on the environment. Negative effects include air, noise and water pollution, wildlife disturbance, soil and vegetation damage, as well as causing conflicts with other recreationalists. In response the DEC has developed a Draft Comprehensive Snowmobile Plan in attempt to manage the impacts of the activity. The findings of this study suggest that this plan is inadequate to address all of the impacts currently inflicted by snowmobiles. In addition to the recommendations of the Draft Snowmobile Plan, snowmobilers must contribute to conservation in the park through an increase of registration fees. Also air and noise pollution must be curtailed through an increase in governmentally imposed emission standards. Due to the lack of information on the impacts of snowmobiling in the Park further studies should be conducted in order to develop appropriate strategies for management.

## **Background**

Snow vehicles were first created in the early 1900s, but it was not until 1923 when the term “snowmobile” was first coined by Virgil White. The design has gone through many adaptations mainly for military transport use but now for recreational use. Snowmobiling became a recreational activity during the late 1960s and early 1970s.

The Adirondack Park was established in 1892 to protect water and timber resources as well as to preserve the natural integrity of the area. The Park has grown over the years and now encompasses 6 million acres. About 43% of the land, or roughly 2.6 million acres is State owned and the rest is privately owned. In the late 1960’s development and land usage in the Park became a concern. In order to better protect the region The Adirondack Park State Land Master Plan was drafted into law in 1971 (APA, 2005). This master plan is essentially a zoning plan for the land within the Park. Land usage ranges from “forever wild” wilderness which requires no lasting man made impacts, to hamlets which allow for the most industrial, commercial and residential use (DEC Draft). During this time the Adirondack Park Agency (APA) was created to administer and oversee the implementation and management of the plan. The master plan restricts usage of both public and private land. The APA is responsible for the overall zoning of the Park. The New York State Department of Environmental Conservation (DEC) is responsible for the management of the public lands within the park and for all of New York state. For the public land within the Park the DEC works closely with the APA. The areas of public land are different within the Park so for each area the DEC must develop a Unit Management Plan (UMP). Each UMP entails inventories of natural, scenic, and cultural resources within the area; recreational use impacts and the carrying capacity; and from

that develops management objectives which may include a need for restoration, restricted use, or protection of endangered species. Simply speaking the UMP is a list of resources and a plan of how and for what purpose those resources should be used. These UMPs are closely tied with the zoning regulations determined by the master plan

### **The Problems**

The economy in the Adirondack region is based on several extractive industries such as mining and logging, but primarily is based on tourism. The tourism industry is centered on the unique natural setting of the Park. Snowmobiling is one of those activities that contributes a great deal to local economies especially in the winter. Unfortunately, there are a great deal of conflicts with snowmobiling which must be addressed to ensure the integrity of the park is maintained and that all stakeholders' needs are met. Snowmobiling currently conflicts with many of the Park's conservation efforts such as the UMPs and Master Plan regulations (Draft DEC). The activity also violates the "forever wild" clause (Article XIV, Section 1) in the state constitution which forbids the creation of roads and the use of motorized vehicles in the forest preserve (See Appendix).

Over all there has been a lack of management and maintenance of the snowmobile trail system. The work that has taken place is done primarily by local clubs and county municipalities. This has lead to a lack of connectivity of the trails and trail conditions. The state must take a lead role in the improvement of the consistency of the trail system in order to benefit the snowmobilers and to demand adherence to environmental regulations.

The lack of management has lead to many negative effects such as environmental impacts, safety, conflicts between other recreational users, and complications with access rights. Environmental impacts such as stress on wildlife during the winter, effect on traditional ranges and changes in deer yards and feeding grounds (DEC Draft). Snowmobile trails and traffic can fragment populations that prefer not to come into contact with the sleds. Wide snowmobile trails through wilderness areas or other core areas create more edge and marginalize those species that prefer core areas. Soil and vegetation are damaged, leading to soil erosion due to trail use with inadequate snow cover. Air quality is reduced and can reach dangerous levels for snowmobilers, other human populations and wildlife. There are also potential effects on water quality from oils and metals leaching out of the snowpack and into the water system which can negatively affect stream ecology and fish.

Lack of management has created issues of safety and conflicts with other recreational users. Snowmobiling is very dangerous and each year there are many snowmobile injuries and deaths (Virkler, 11/12/04). In New York State alone there were 505 accidents and 19 fatalities in the 2004 season which is comparably less than the 665 accidents and 31 deaths of the previous year. Snowmobile trails need strict regulations such as speed limits which need to be actively enforced. In addition, snowmobile trails must be properly maintained and built so that they are wide enough for two-way traffic and major hazards are removed. Trails must be built to connect multiple trail systems together without having snowmobiles rely on lake crossings to get from one trail to another due to the fact that the ice is often thin and unsafe for crossing. In many areas throughout the park snowmobile trails and other trails system such as skiing or

snowshoeing trails merge or bisect one another. These areas lead to conflict between snowmobilers and skiers because each are interested a different recreational experience and the two do not interact well.

Land access rights are also a problem in the Adirondacks due to the mosaic of public and private lands. In order to create trail connectivity, access across private land is needed. Snowmobile clubs often have been the ones paying for and maintaining these trails but the state should also work with land owners so that there is a right of way for snowmobiles to use.

## **Stakeholders**

Snowmobiling has a large constituency base in New York with over 150,000 snowmobiles registered in the state during the 2002 season (DEC Draft). Fifteen percent of the registered snowmobiles are non-residents bringing money into the state mainly from Pennsylvania and New Jersey. Snowmobilers range in age and sex. They participated in the sport for many reasons such as, “to take a risk, to get away from usual demands of life, to be close to nature, to view scenery, to be with friends” (Coupal, et. al. 2001). Studies have shown that snowmobiling is a social activity where 80 percent of trips have party sizes greater than two (Coupal, et. al. 2001). It is an activity in which the whole family can participate in together. The study found that a most of the groups were extended families or a large group of friends riding together (Coupal, et. al. 2001). Snowmobilers in the Adirondacks enjoy long day trips or overnight trips. As a group they would like better connectivity between trail systems so it would be possible to do a large loop in a day or travel around the Park staying at inns over night (DEC Draft).

Safety is one of their largest concerns, they want safe trails which are large enough for two-way traffic, hazards removed from the trails (rocks), and groomed smooth trails which are easier to ride safely on.

Many non-motorized winter recreation participants, such as skiers or snowshoers have similar reasons for participating in their activity. A major difference is noise. Cross-country skiers often find that noise greatly reduces their level of enjoyment in the peaceful winter environment (VittersØ, 2004). In addition to the noise, the gas smell ruins their pristine experience. The speed of snowmobiles can make skiers feel uncomfortable and unsafe and many skiers report that snowmobiles ruin ski trails (DEC Draft). While skiers feel snowmobilers have a negative impact on their experience most snowmobilers are not aware of this impact. When asked, most snowmobilers believe they are improving the skiers experience by improving the trails (Tupper Lake Public meeting, 3/2/2004).

The local community comprised of small business, shops, gas stations, restaurants and hotels have a great stake in the snowmobiling industry because it provides the main income for many communities in the winter. Winter activities such as skiing are focused in certain areas of the Adirondack Park whereas snowmobiling is fairly widely distributed across the park. This means that in some towns snowmobiling is essentially the only winter tourism. As such, it is vital that snowmobiling continues to grow and maintain itself as an industry in order to support small businesses through the winter. Without it many businesses would have to shut down during the winter, meaning less employment and increased economic depression.



As a manager of the public lands within the park, the DEC has a stake in the snowmobiling industry because a great deal of riding happens on state land for which they are responsible for protecting. The Park has particularly strict land use policies which the DEC must enforce to protect the integrity of the natural landscape. The State of New York has legislation protecting the Adirondacks because of its unique character, its tourism producing ability, and because it is a main watershed for most of the state. For these reasons the DEC is entrusted with the responsibility to manage these areas to support tourism while not allowing the land to be degraded.

The other management body, the Adirondack Park Agency (APA) is also involved because they are responsible for all lands in the Park ensuring that the Adirondack State Park Master Plan is not compromised. They are responsible for the overall zoning of the park, both private and public lands. The DEC resources are spread across the state whereas the APA's only focus is the adherence to the Master Plan.

Private landowners are stakeholders because their lands are often needed to connect trail systems on public lands. Often times snowmobile clubs pay for access in addition to creating and maintaining the trails. Private landowners like having snowmobile trails on their property because the clubs keep off ATV's which are much more destructive to the land. Clubs can do this by posting signs and spreading the word by mouth to inform local people that certain areas are prohibited from use of All Terrain Vehicles (ATV's). A concern of private landowners is liability. They do not want to be liable for an accident which happens on their property nor do they want their land to be taken away by the state through eminent domain.

Environmental organizations are concerned with snowmobiling in core wilderness areas and its effect on wildlife. Groups such as the Adirondack Council want to remove snowmobile trails in wilderness areas and want to prevent the creation of new trails (Dedam, 2004). Under New York legislation there is a cap on new roads in the forest preserve and under the stipulations of the law, snowmobile trails are wide enough to be considered a road, therefore no new snowmobile trails can be made. Most environmental groups would like to see no motorized vehicles used of the forest preserve.

Lastly, but most importantly, wildlife has a stake in these issues. The whole principle behind the Park is the preservation of the environment in its natural state including the role wildlife play. Winter can be a tough time of year for wildlife because food can be short and survival through the cold is difficult with out a secure food source. Snowmobiles and other recreational activities must not invade key habitats which animals need to survive through the winter (DEC Draft).

## **Human Impacts**

### **Snowmobile Emissions**

Various studies have looked at snowmobile emissions data. Exposure to benzene, toluene and xylenes are a human health concern because these substances are carcinogenic. Workers at Yellowstone National Park expressed concern over localized air pollution from snowmobile emissions and were able to get the snowmobile rental fleet to use oxygenated fuel to reduce their exposure. Besides exhaust emissions, various studies have looked at snowmobiles' sound and fluid emissions.

The University of Denver was invited by the National Park Service to conduct an emissions survey at Yellowstone National Park due to the health concerns expressed by park employees. The study found that large hydrocarbon (HC) emissions were due to the conventional two-stroke engine design that cannot avoid extensive blowby of the unburned fuel mixture. Blowby refers the exhaust port and the intake port being open at the same time. The combination of higher densities and colder temperatures could also combine to increase the amount of blowby in the engine (Bishop et. al, 1999). The park employees working at the gates where snowmobiles passed through were concerned about the possible negative impacts of being exposed to these carcinogenic substances day in and day out.

The University of Denver was invited back for a second year to look at snowmobile emissions in Yellowstone (Bishop et. al, 2001). Liquid-cooled snowmobiles were found to have HC emissions approximately 10% higher than those of fan-cooled sleds. West Yellowstone's rental fleets switched to use of ethanol (oxygenated fuels) because of the concerns for the workers and the resulting positive publicity. The Yellowstone studies are very important because there is a lack of emission measurements on snowmobiles and absence of realistic comparisons with other mobile source emissions (Bishop et. al, 2001). In the park, HC emissions from snowmobiles can be greater than 500 tons per year and account for nearly 65% of annual HC emissions from mobile sources in the park (EPA, 2002).

In the winter of 2003 a group of public health organizations, including the American Cancer Society and Physicians for Social Responsibility, urged the Park Service to warn every visitor to Yellowstone about the health risks associated with fine

particulate matter in snowmobile exhaust. The park service issued paper masks to rangers working throughout the park to reduce their exposure to the particulate pollution (Natural Trails & Waters Coalition, 2002). Yellowstone began pumping fresh air into the fully enclosed ranger stations at the West entrance, but concern for other park employees, other recreationalists, and the gas station attendants prompted the park to switch the fleet's fuel to oxygenated fuel (Bluewater Network, 2002).

Toluene is primarily used as a solvent and in blending petrol. It is produced during the process of making gasoline and other fuels from crude oil. Mixed xylenes and benzene are also used for blending into petrol. These chemicals can enter into the air during the use of products containing them (ie. Burning fuel in a snowmobile). These chemicals are known as BTEX compounds and may contribute to the formation of ground-level ozone and photochemical smog, which can cause damage to plants and be a health concern for wildlife and humans (European Pollutant Emission Register).

There are a number of negative human health effects associated with snowmobile emissions. Excessive exposure to toluene may impair hearing and cause damage to the brain and unborn child, while benzene causes damage to the brain, eyes, lungs and skin. Excessive exposure to xylene isomers can cause damage to the brain, eyes, lungs, kidney, liver, skin, nose, reproductive system, digestive system, throat and unborn child (European Pollutant Emission Register). Snowmobile riders who are exposed to emissions are exposed to benzene at 2 or 3 times the national average of exposure (EPA, 2002).

Complex chemical reactions of hydrocarbons and NO<sub>x</sub> in the presence of heat and sunlight can cause ground-level ozone. Chronic exposure to this smog can cause

permanent lung damage. Even short-term exposure has caused respiratory ailments in individuals (European Pollutant Emission Register). Exhaust emissions near the ground under low wind conditions may contribute to haze in areas of snowmobile concentration (DEC draft plan). Exposure to elevated carbon monoxide levels can impair visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks. Peak concentrations of CO generally occur during the colder months of the year (European Pollutant Emission Register).

A study conducted in Sweden looked at the exposure to benzene, toluene, xylenes and total hydrocarbons among snowmobile drivers (Erikson et. al, 2003). Even leisure time operation of a snowmobile causes a considerable exposure to benzene. Further, children riding as passengers on a sled may have higher exposure than their parents because the pollutants are emitted from the back of the snowmobile. Exposure to these substances is regulated in occupational settings in Europe, but currently there is no permissible exposure limit set in Sweden regarding exposure to benzene among the general population (Erikson et. al, 2003).

The United States Environmental Protection Agency has adopted emission standards for recreational vehicles including snowmobiles. In 2000, recreational vehicles and engines accounted for 9% of national HC emissions, 4% of carbon monoxide (CO) emissions, 3% of oxides of nitrogen (NO<sub>x</sub>) emissions, and 2% of particulate matter emissions from mobile sources (EPA, 2002). An unregulated 2-stroke snowmobile can emit as much as hydrocarbons, carbon monoxide and nitrogen oxides almost 100 cars (Figure 1). Engine data from the California Air Resources Board shows that seven hours of two-stroke engine use produces more smog-forming pollution than a modern car

creates over 100,000 miles driven. Snowmobiles create up to 1000 times more carbon monoxide pollution than a car (Bluewater Network, 2002).

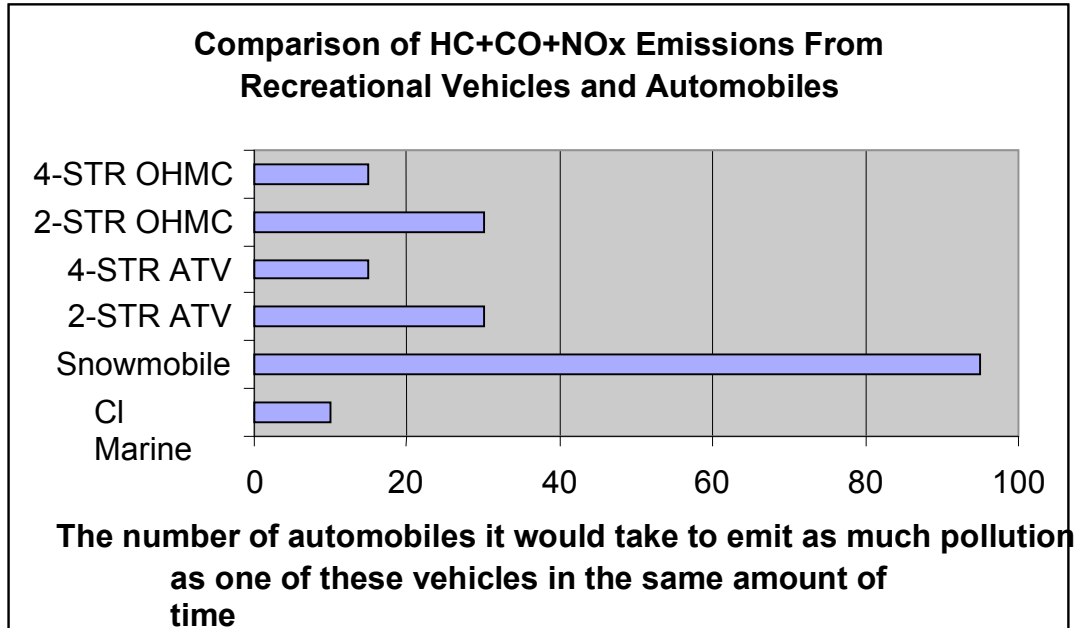


Figure 1. Comparison of Hydrocarbon, Carbon Monoxide and Nitrogen Oxide Emissions From Recreational Vehicles (Off-highway Motorcycles, All Terrain Vehicles, Snowmobiles, Marine engines) and Automobiles. Source: (EPA, 2002).

In one study area, even though snowmobiles numbered on average 16 times fewer than cars, snowmobile emissions sometimes equaled or exceeded total annual emissions from other mobile sources (DEC Draft).

Concentrations of ammonium and sulfate in snowmobile trail pack have been positively correlated with snowmobile use. Contamination from snowmobile emissions is localized and appears to be limited to within 50 meters of the trail (DEC Draft).

Snowmobiles equipped with four-stroke engines with a catalyst help to reduce emissions, but currently two-stroke engines are still on the market. According to local snowmobile dealers sales are still high in both types of engines. Another way to reduce

emissions exposure would be to lengthen the tail pipe. Furthermore, the content of benzene in the fuel could be minimized (Eriksson et. al, 2003).

As far as fluid emissions go, snowmobiles do not emit nearly as much as automobiles do. Snowmobile designs have not used wet-sump lubrication systems since the first models were introduced years ago and thus do not leak oil onto the ground like cars can. Because the fuel system is fully closed when the cap is on the gas tank, snowmobiles do not leak gasoline (DEC Draft). Other studies have shown, however, that snowmobiles discharge up to one-third of their unburned fuel through the tail-pipe (Bluewater Network, 2002).

Laws in New York State require than an adequate muffler system be in place on all snowmobile models that specifies 73 decibels as the maximum sound output for sleds manufactured after June 1980. There are still problems with excessive sound, however, when people modify their exhaust system or replace it with a racing system. These modifications are illegal for trail use in New York State. Suggestions for minimizing the noise impacts of snowmobiles include creating natural sound barriers to trails, careful trail planning and reduced speed limits (DEC Draft). However, speed limits can be difficult to enforce. In a study conducted by the National Park Service, researchers found that noise generated by snowmobiles could be heard over 2 miles away in open areas and over 1 mile away in dense forests (Biodiversity Conservation Alliance, 2002). Four stroke engine snowmobiles are noticeably quieter than two stroke snowmobiles.

### **Effects on wildlife**

A number of studies have been conducted around the world that look at the ways in which wildlife are negatively effected by snowmobiling. Effects on wildlife include

elevated heart rates, elevated glucocorticoid stress levels, increased flight distance, pollution impacts, habitat fragmentation as well as community and population disturbance. There are still observable as well as unobservable responses in wildlife to snowmobiling. Studies have been conducted with white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), coyotes (*Canis latrans*) and wolves (*Canis lupus*). Even though not all of these animals are present in the Adirondack Park it is still important to include information about these studies to show that there is a significant negative impact on a number of different species. While most animals are well adapted to surviving winter conditions, the season creates added stress to wildlife due to harsher climate and more limited foraging opportunities (Reinhart, 1999).

An interesting effect that snowmobiling has on wildlife is how species use the trails the machines create when driving over and compacting the snow. A study conducted by the Cooperative Wildlife Research Unit and the Department of Inland Fisheries and Wildlife of Orono, Maine found that deer use snowmobile trails for short distances (rarely exceeding 0.2 km of their daily movements). Deer tend to follow the trails slightly longer in early and late winter than in mid-winter, coinciding with the general pattern of activity observed in deer through the long winter months. It is suspected, however, that deer follow snowmobile trails through habit and not need. Deer show a tendency to run when approached by a snowmobile in the open and an increased tendency to stay when approached in softwood stands. It seems like a deer's response to snowmobiles depends on its apparent security (Richens et. al, 1978). In one study,



researchers found that large ungulates such as caribou are disturbed by snowmobiles from distances over 1250 feet (Bluewater Network, 2002).

Snowmobiles cutting trails through winter habitats can be in a way increasing edge effects in the habitats. Trails and roads that dissect the forest can create edge environments around the perimeter of the disturbance that is substantially different from the forest interior (Biodiversity Conservation Alliance, 2002). Edge effects refers to the negative influence of the edge of a habitat on the interior conditions of a habitat. Various edge effects can include changes in the climate and other physical factors; changes in biota due to increases in aggressive edge-adapted species (ie. Coyotes); increased human activities; and increased rates of invasion by noxious weeds (Biodiversity Conservation Alliance, 2002). The term also refers to the effect of adjoining habitat types on the populations in the edge ecotone. The result is usually more species in the edge than in either habitat alone. Many species are attracted to the edge habitat created by the snowmobile trails, which function as a sort of “ecological trap” (Meffe, 1997). For game species such as deer and elk, edge created by snowmobile trails may not be as much of an issue as it would be for smaller species. In an area where a deer might cross a snowmobile trail to adjacent habitat, a smaller mammal might use the edge as a boundary, thus constricting its home range. Wind speed, air and soil temperatures, and isolation are significantly higher for edges when compared to the interiors of forests. Soil and air moisture are substantially lower in edge environments. Generalist species can flourish in edge habitats, but interior forest species are usually found away from road edges (Biodiversity Conservation Alliance, 2002).

The Department of Ecology at Montana State University conducted a study to measure the glucocorticoid stress responses in wolves and elk to snowmobiles. Immunoassays of fecal glucocorticoid (GC) levels is a non-invasive way to measure the physiological stress responses of wildlife to disturbances. Through measuring the GC levels in the feces of various species the study found that GC levels were significantly higher in elk during snowmobile season in Yellowstone than during the wheeled vehicle season. Elevated GC levels can suppress some immune function in wildlife and disrupt activity of the hypothalamic-pituitary-gonadal axis. An interesting finding from this study was the observation of wolves using snowmobile trails in much the same way that the white-tailed deer were observed following trails in Maine (Creel et. al, 2002). The continuous packed surface and excellent supportability for large animals make them desirable places for these animals to travel. Traveling on snowmobile trails greatly reduces the energy expenditure of deer and wolves, but greatly increases their risk of getting hit (Richens et. al, 1978).

A study conducted in Northern Wisconsin found that deer use snowmobile trails when convenient, but do not prefer them over their own trails. Therefore, trails should be routed away from forest types where deer tend to congregate. During severe weather deer concentrate in Northern White Cedar, Eastern Hemlock and swamp conifer areas (Eckstein et. al, 1979).

Another negative impact snowmobiles have on wildlife is increased heart rates. In a study conducted on captive white-tailed deer, snowmobiles increased the animals' heart rates on average 2.5 times the pre-stimulus rates when the snowmobile moved tangentially to the deer and on average 2.9 times when it circled the deer. These deer did

not show habituation to the snowmobiles after days of experimentation (Moen et. al, 1982).

Mule deer in north-central Colorado displayed responses to snowmobiles that ranged from benign to panic. Some of the less overt responses include increased metabolism, lowered body weight, reduced fetus size and a withdrawal from habitat that is suitable for the species. When compared to responses deer have to people approaching on foot, snowmobiles elicit less of a response. When directly approached on foot, deer ran longer, more frequently and expended more energy. The factors that influence the flight distance are the species, the intensity of sport-hunting (are the deer associating humans with hunting?), the types of vegetation, and the season (Freddy et. al, 1986). A study conducted at St. Croix State Park in east-central Minnesota found that home range size, movement and distance from radio-collared deer to the nearest trail increased with snowmobile activity (Dorrance et. al, 1975). Deer are already quite stressed in the middle of winter, so snowmobiles only increase their stress.

Snowmobile use can result in mortality, habitat loss, and harassment of wildlife. White-tailed deer show signs of displacement and increased movement (Boyle and Samson, 1985). Studies have shown that shorter flight distance and a higher tolerance for vehicles and humans is a result of habituation. Habituation, however can lead to an increased attraction to human-use areas and thus and increased stress response from the animal as well as human-caused mortality (Reinhart, 1999).

Generally speaking, within the Adirondack Park public lands provide pretty poor habitat for white-tailed deer when compared to the managed forests. Deer wintering areas may provide protection from the elements, but they are extremely deficient in

available and/or nutritious foods that deer need to survive the winter. Severity of weather, availability of good deer habitat and hunting may be more influential factors affecting deer mortality in the winter in the Adirondacks (DEC Draft), but snowmobiling certainly adds to the stress these animals endure during these harsh months.

Coyotes aggressively compete with or prey upon a number of different vertebrate species that are adapted and limited to deep snow. Snowmobile trails give coyotes access to bobcat and lynx habitats that they never had before, and if prey is in short supply the coyote always wins (Biodiversity Conservation Alliance, 2002).

Some small species depend on the space between the frozen ground and the snow to live. When snow compaction from snowmobiles occurs the subnivean (below snow) space temperatures decrease, which can lead to increased metabolic rates in these small mammal species. If the subnivean air space is cooled by as little as 3 degrees Celsius, the metabolic demands of small mammals living in the space would increase by about 25 calories per hour. These small mammals must work harder to find food (Neumann and Merriam, 1972). Compaction can restrict these small mammals' movement to the point of causing asphyxiation (Smith), as oxygen flow is restricted and deadly levels of carbon dioxide build up (Canadian Wildlife Federation 1998). When the snow is compacted, barriers are created that restrict movement of these small species that travel through tunnels in the subnivean space. As the subnivean trails are cut off these small mammals are forced up to the surface where hungry predators are waiting to attack (Canadian Wildlife Federation 1998).

## **Effects on Aquatic Communities**

Aquatic communities can be impacted both directly and indirectly by snowmobile use. Direct impacts include disturbance caused by snowmobiles riding over river and lake ice. Indirect impacts of snowmobiling are potential degradation of water quality due to runoff of snowmelt contaminated by snowmobile emissions.

Two-stroke snowmobile engines produce high levels of pollutants from incomplete fuel combustion. This type of combustion results in deposition of unburned fuel and various combustion products (as discussed earlier). Water bodies that receive runoff from high-traffic trails in snowmobile areas may affect water quality in fish habitat (National Park Service, 2003). One study used captive brook trout to determine effects of exhaust on fish. The exhaust components taken up by the fish correlated with the levels present in the environment due to snowmobile use. The uptake of hydrocarbons occurs through the gills during respiration. Hydrocarbons initially rest on the surface of the water, but eventually sink, potentially impacting invertebrate and fish species, also accumulating in sediments. Hydrocarbons are incorporated into fatty tissues in a similar way to chlorinated hydrocarbon pesticides. (Ruzycki and Lutch, 1999). These pollutants are concentrated in aquatic ecosystems during the snowmelt in spring. Pollutants from snowmobile emissions get trapped in the snowpack, magnifying the toxic effects during the first few days of spring. The elevated acidity levels in the surrounding waterways can kill aquatic insects and amphibians. Fluctuations in acidity can disable watersheds' ability to regulate its pH level, and can trigger system-wide problems (Bluewater Network, 2002). Even at extremely low levels of hydrocarbon pollution fish may experience chromosome damage, retarded growth, disruption of normal biological

functions, and death (Ruzycki and Lutch, 1999). Stamina (measured by the ability to swim against the current), was significantly less in trout exposed to snowmobile exhaust than in control fish (Trochta, 1999).

Fish can be directly impacted by snowmobile traffic across ice. Snowmobiles riding on top of ice can disturb fish concentrations in over-wintering areas. These disturbances place high energy demands on fish, and could be quite serious in oxygen-depleted water (National Park Service, 2003).

Sometimes snowmobile enthusiasts test their machines by attempting to cross open water. This type of activity can be harmful to aquatic species, riparian dependent wildlife and can affect water quality. Areas that people tend to engage in this activity are shallow ponds or shallow streams with a gradual sloping bank where the machine can exit or be retrieved (Trochta, 1999). This is an extremely environmentally damaging activity and should be stopped.

In addition to protecting aquatic ecosystems, riparian areas should also be protected. These areas are the terrestrial communities that are found along streams, lakes, and wetlands, and encompass the entire floodplain of a given body of water. These areas are hotspots for biodiversity. Riparian areas are reservoirs of open-adapted plant species and can be sources for plant recolonization of surrounding areas after disturbances. These areas are also important for connecting fragmented forest environments (Biodiversity Conservation Alliance, 2002).

Minimizing use of two-stroke snowmobiles as well as restricting access near streams, lakes and wetlands would minimize the negative impacts to aquatic communities (Ruzycki and Lutch, 1999). Buffer zones should be put in place around all riparian

vegetation. A 300 foot buffer around riparian areas, development limits, as well as limited access on the slopes surrounding the riparian buffer zone (Biodiversity Conservation Alliance, 2002) would provide one way of protecting these ecologically important areas.

### **Effects on Vegetation**

Vegetation is severely impacted by snowmobile use. Impacts on soil and vegetation include retarded growth, erosion, and physical damage.

When snowmobiles are riding over the snow abrasion and breakage of seedlings, shrubs and other exposed vegetation is quite common (Stangl, 1999). Snowmobiles can cause considerable erosion on steeper slopes and in areas where snow levels are low. This erosion can lead to increased soil runoff resulting in sedimentation and turbidity in the immediate area and throughout the watershed (Smith). If steep slopes are intensively used, underlying soil can be exposed and made prone to more damage from continued use (Stangl, 1999).

As the snow is compacted the soil temperature below can be significantly reduced. Besides the impacts this decrease in temperature has on subnivean mammal species, soil microbial activity and the germination of seeds can be severely slowed. These impacts can be exacerbated by compaction of the underlying soil layers that result from increased use of trails (Smith). The thermal conductivity of compacted snow is greater than undisturbed snow, and can reduce the buffering effect against temperature extremes and fluctuation (DEC Draft). The timing of snowmelt determines the distribution of plant communities in subalpine zones, so delays in spring growth caused by snowmobiles could cause drastic changes in subalpine plant communities

(Biodiversity Conservation Alliance, 2002). In addition, the packed snowmobile trails can also dilute important sunlight “cues” that filter down to subnivean plants and stimulate them to grow or reproduce (Canadian Wildlife Federation, 1998).

Soil in areas where snowmobiles compacted the snow thawed later than areas that were not driven across. When this happens the ground deep freezes and could affect the survival of many types of vegetation (Stangl, 1999). Soil bacteria that play a critical role in the plant food cycle were reduced 100-fold beneath a snowmobile trail (Stangl, 1999). A natural, un-compacted snow thickness that is greater than 45 cm will prevent frost from penetrating the soil (DEC Draft).

Researchers found that after being run over by snowmobiles, 78% of saplings in the area were damaged, with 27% of these damaged severely enough to cause a high probability of mortality (Natural Trails & Waters Coalition, 2002). Young conifers are extremely susceptible to damage from snowmobiles. Depth of snow is the greatest factor that determines the severity of damage. In general, the deeper the snow, the better protected are some age classes and species of young trees. Vegetation in bog habitats is also highly susceptible to damage from snowmobiles (Stangl, 1999).

Snowmobile areas should be managed and restrictions should be held in place. When designing a plan of where snowmobiles should have access, fragile or unique vegetative communities need to be taken into consideration. In order to preserve these habitats, snowmobiles should not have unregulated access to riparian and wetland habitats and areas with sensitive plant species (Stangl, 1999). There should be seasonal closures at times and places when the snow is not deep enough to prevent damage to the underlying vegetation when it is compacted (Biodiversity Conservation Alliance, 2002).



## **Social Impacts**

Although snowmobiling is a social activity it has many negative social impacts. As mentioned above, snowmobiling interferes with other recreational activities. A combination of the noise, smell and the speed ruin the tranquility of the natural setting other groups seek for their experience. Self propelled activity participants (skier, hikers) enjoy the peacefulness of their activity which does not interact well with motorized sports. These conflicts usually happen in areas of concentrated use such as where trails intersect one another or different recreational participants use the same trail for a section. Areas of high confrontation need to be strictly managed and avoided as much as possible so that each recreationalist can enjoy their experience to the fullest.

Snowmobiling can negatively impacts private landowners whose land is used to gain access to other trail systems. Even though snowmobile clubs broker deals with land owners to use their land, trespassing is still a problem in some areas. Most private land owners are open and willing to have snowmobiles crossing their land, as long as their lands are not being negatively affecting. In some cases snowmobilers travel across people's yards and driveways and disturb land owners while they are in their house. This trespassing and unwanted disturbance must be prevented to ensure a good relationship between snowmobilers and landowners.

Individuals who violate snowmobiling ethics are a problem which affects all stakeholders. Some snowmobilers do not adhere to the laws and rules by trespassing on non-snowmobile trails where collisions with skiers are possible. This is dangerous and

creates a bad reputation for all snowmobilers most of whom abide by the rules and act responsibly. Speeding is another dangerous violation which puts everyone at serious risk. Snowmobiles are being built increasingly faster, allowing drivers to reach higher speeds in less time. This can lead to disasters on the trails where there could be another sled or a deer coming in the other direction. More law enforcement is needed to protect humans and other animals from renegade riders and those who may be driving under the influence.

### **Governmental Jurisdiction**

Since the Adirondacks are a State Park there are strict regulations on land use and development. With multiple regulating bodies who are responsible for the land. There are twelve counties in the Park and over one hundred towns each with their own zoning boards and planning committees that participate in the regulation of the Park. Local governments have the first say in their town and county planning, but before any policies are passed they must be reviewed by the Adirondack Park Agency APA and DEC to ensure that the Master Plan or the environment are not being compromised. The DEC has a great deal of importance in the management of the Park but as it is a state wide agency and the park is only a part of its jurisdiction. The one agency with the overall say about development or change in the park is the APA. This agency is in charge of the Adirondack State Park Master Plan which was signed into law in 1972 to protect and maintain the park in its natural state (APA, 2005). The DEC will be responsible for developing and carrying out the snowmobile plan but the APA will review the document and give the final go ahead. The major change in the snowmobile plan will be to make

the DEC responsible for maintaining snowmobile trails instead of the town and county municipalities. Towns and snowmobile clubs will still maintain their trails but the DEC will manage the major arteries connecting the different regions of the park and those trails in the forest preserve. The APA will oversee these happenings and issue permits to allow the development of new trail to take place.

### **Solutions**

It is clear that the state will need to play a larger role in managing the snowmobile industry in the Park due to the growing conflicts and the need for an interconnecting trail system. Currently there are many different agencies, town governments, and organizations responsible for the trail system. The state must take on an administrative role outlining a set of rules, regulations and standards for the trail system and provide funds for those processes to happen. In response to this need the DEC and the New York State Office of Parks, Recreation and Historical Preservation (OPRHP) developed the Draft Comprehensive Snowmobile Plan for the Adirondacks Park/Draft Generic Environmental Impact Statement. The document was published for public review in December of 2003 and remained open for comments for one year. Currently the plan is under revision taking into consideration the public comments and the need for additional research, which is currently underway (Messenger, 2005). A revised version is expected by the end of 2005.

## **DEC Draft Snowmobile Plan**

Understanding the needs of the snowmobile industry, those of the environment and other stakeholders, the DEC made several recommendations to alleviate some of the conflicts. These recommendations call for an amendment to the Adirondack Park State Land Master Plan to allow for the creation of a new Class III snowmobile trail designation. These trails will have a similar width to that of a road and on these trails mechanized groomers would be permitted to maintain the trail surface.

Recommendations also call for revisions of DEC policy in regards to Snowmobile Trails within the Forest Preserve. Revisions include “creation of a new trail classification system, replacement of the current mileage limit regarding snowmobile trails in the Adirondack Forest Preserve, revision of standards for design, construction and maintenance of snowmobile trails on Forest Preserve lands, inclusion of enhanced tree cutting guidelines” (DEC Draft). Amendments to these two documents (DEC policy and the Master Plan) will take place after the final draft of the snowmobile plan is reviewed and accepted. The need to make amendments to the law shows the invasiveness of the creation of new trails but the DEC feels that while initially there will be a great deal of impact to the environment, in the long run impacts will be reduced.

The development of the draft was a difficult and lengthy task. A great deal of data has been and continues to be collected to quantify the impacts of snowmobiling in the Park. The research has involved a literature review from studies on snowmobiling in the Northeast and other snowmobile destinations, studying accidents, quantifying economic impacts, studying effects on wildlife and ecosystem, and mapping the current snowmobile trail system. The result showed that new trails would be needed to connect

gaps in the trail system, a new trail classification would be needed to widen and groom trails for safety, and trails in wilderness areas should be moved to the “periphery” to avoid core habitat areas and adhere to the “forever wild” clause.

In order to implement the Draft Plan, trees would have to be cut down on the forest preserve to allow for the new trails and trail widening and the cap of snowmobile trail in the forest preserve would have to be lifted. New trails are needed to close trails that currently run through core areas of wilderness. By moving the trails from the interior to more developed areas or closer to roads the DEC would be maintaining the wilderness characteristic of the forest, reducing user conflicts between motorized and non-motorized forms of recreation, and decreasing impact on wildlife (DEC Draft, 147). In areas where a new trail is being created roughly 1.5 acres per mile of trees and other vegetation will be cleared. In addition to moving trails to the “periphery,” a new trail classification is needed to better maintain and manage the trail system. The new system has four classifications of trails and they range in intensity of use to give a variety of recreational experiences. Class I and II-a are eight foot wide trails and are groomed by light grooms such as drags pulled by utility snowmobiles. These trails are meant for light to moderate traffic. The II-b class is meant for low intensity use and would not be groomed, where as class III would be a twelve foot trail, groomed by heavy duty snow cats with hydraulic drags. Class III trails are meant to connect communities around the park and are expected to have heavy traffic.

In addition to tree cutting, a great deal of other trail maintenance would be required such as removing rocks and other hazards. However no, invasive grading to trail surfaces will be allowed. Rocks would be removed from trails only if they are greater

then six inches off the ground. The thought behind this is that it will be a good indicator of snow depth. One foot of snow is predicted to pack down into six inches. This will be the minimal snow depth for riding to prevent soil or vegetation damage. In a typical year the season will last from December to March. The trail will be designed to avoid any steep slopes because snowmobiles tend to slip and dig in on steep slopes and may damage the soil. Culverts and bridges will be needed to avoid erosion and drainage problems. Wetlands will be avoided “to the greatest extent possible.” If trails are forced to cross wet lands, impacts will be minimized by requiring the APA to develop a site impact statement and solutions to minimize impacts.

Securing access through private land is another important issue in connecting the park through snowmobile trails. The state proposes to identify and recruit private land owners in key areas of the park to allow trails on their property to connect the snowmobile system (DEC Draft). The state is willing to work with private landowners to create a long-term relationship to allow access. Those who do not want to participate in the public trail system can refuse freely and the state will take measures to prevent snowmobilers from using their property.

Strict and well defined regulations are believed to be necessary so that all trails will have the same character. These regulations will leave no room for interpretation so that the trail system will be consistent and uphold the strictest environmental standards. Since the Park is designed for human recreational use, the DEC is attempting to provide the best experience for snowmobiling without sacrificing the natural integrity of the land. The Park is not managed as a biodiversity area so wildlife is protected but that is not the soul mission of managers. Before these changes can happen the plan will have to be

approved and DEC policy for snowmobile trails and the Master Plan will have to be amended. The DEC and the New York State Office of Parks, Recreation and Historical Preservation (OPRHP) both agree that despite building new trails and cutting down trees on the forest preserve, in the long run the changes will benefit the environmental integrity of the Park (DEC Draft). Trails with the appearance of roads detract from the wilderness setting so it is vital to remove large human impacts from these areas in order to maintain its wilderness characteristics. These changes are the best solutions to improvement of wildlife habitat by removing human traffic from the core areas where animals can escape the pressure of humans while benefiting the snowmobile industry and improving both the snowmobilers and non-motorized recreationalist experiences (DEC Draft).

### **Public Commentary**

As mentioned above the public commentary lasted just over one year and brought out a great deal of controversy. The DEC faced criticism from both the snowmobile community and environmentalists. A great deal of the criticism was over the lack of data that the draft was based on (DEC Draft). During the time of the creation of the draft plan little data of both the negative and positive impacts was known which makes criticism easy from the public. Often managers have to make decisions without knowing all of the facts due to lack of funding, time and manpower (Monz, 2004). A management strategy for snowmobiling in the Park was needed and the DEC took the information that they had and made the best decision they could knowing that in the future as new information surfaced they could make changes.

More specific comments from environmentalists included disapproval with the increase in the mileage cap for snowmobiles and the cutting of trees on the forest preserve. Environmentalists believe new trails and cutting of trees violate the State's constitution and should not be allowed to happen (Action Alert, 2005). They also do not think there should be motorized access into wilderness areas or wild forest. Unfortunately it is not possible to integrate the snowmobile trail system and not create new trails. Moving trails to the periphery of the forest preserve does not seem to be adequate compensation for many environmentalists. They were largely unhappy with the draft plan, but willing to work with it.

The snowmobile community and members of local businesses who depend on the industry were not happy either. There was a great deal of hostility towards the DEC plan and towards Rob Messenger, DEC Bureau of Forest Preserve Management in charge of the draft plan. The hostility towards the DEC and Messenger as an individual shows an overall disapproval of the management of the park. Many shared the concern that the DEC was attempting to take away their livelihoods by changing restrictions on snowmobiling. Comments were made such as "People will die..." and "What kind of man is Messenger? ..." (Tupper Lake Public meeting, 3/2/2004). Overall there seems to be a deep seeded disapproval of the DEC, APA and management of the park. This hostility seemed to blind people from the fact that the DEC was attempting to make a compromise between improving the snowmobile industry and reducing negative environmental and social impacts. The impact will be less because the new trail system will be carefully constructed and properly managed where as older trails are not designed very well or maintained.



Other concerns from snowmobilers had to do with safety of the trail system. One of the largest problems was trail width. Modern sleds are forty eight inches wide which makes it very difficult for two-way traffic to pass on an eight foot trail. All trails, they would argue, should be over eight feet (9-10 feet wide) to allow for comfort room when two sleds are passing. Another problem is hazards in the trail such as rocks. A six inch rock is too high and may cause accidents and injury. All dangerous rocks should be removed from the trail so as to provide a safe ride.

Carol Young is a member of the Moonlighter club located in Long Lake (per. comm., 3/25/05). The club has 295 members and Carol runs a small business catering to the snowmobilers. She is willing to compromise on the change in snowmobile trails just as long as trails are made safe. Her business at Long Lake is “land locked” meaning there are no trails which reach her business, unless snowmobilers travel along the road or cross the lake which is very dangerous because the lake does not often freeze completely. For safety she wants trails made so people do not have to cross lakes or travel on roads. If sharp turns are made wider so they can be maneuvered easily, snowmobilers will be happy with the trail modifications. Trails should allow two-way traffic, and rocks that are dangerous and could injure a rider should be removed from the trail even if they are less then six inches above the ground (DEC Draft).

The DEC has taken note of all of these concerns and is considering what changes to the draft plan are acceptable to satisfy the needs of the stakeholders. For any issue a few people will take extreme sides and are not willing to compromise. The majority though, such as Carol Young, are willing and want to make compromise. Despite the

disagreement it is widely felt that there is plenty of land in the Park to satisfy everyone's needs, snowmobilers, skiers and wildlife.

### **Feasibility of Draft plan**

The Draft plan is feasible although fairly invasive. The state will be forced to invest an untold amount of revenue into the creation of miles of new snowmobile trails avoiding the interior of the wilderness areas. Despite this fact, in the long run, it is the best alternative plan to deal with the growing snowmobile industry. The plan has some issues brought up by the two sides in the public commentary which will need to be worked out before it will be ready for its final review. In general it is a good compromise between the conservation of wildlife, protection of the Park's integrity and the needs of the snowmobile industry. Conservation and snowmobiling can happen along side one another in the park as long as all stakeholders remain willing to work together and compromise.

### **Further suggestions**

The DEC draft plan addressed some of the negative impacts from snowmobiling but it does not address them all. By re-routing, widening, and improving trails, some safety issues are addressed and conflicts with non-motorized winter recreationalists as well as wildlife are reduced but the larger problems with snowmobiles are not dealt with. Some of these problems are air pollution, noise, and rule enforcement.

Snowmobiles have much higher levels of pollution than cars partly because of poor design but also because there is not post emission controls such as a catalytic

converter. The EPA has imposed emissions standards for new models but it is not enough because older models have no emission standards and are highly polluting. Two-stroke engine snowmobiles should be restricted in the Park. Despite the EPA's attempts, the new regulations are not strict enough and if stricter standards are not imposed at the national level, they will have to be at the state level.

Fred Stone from Clarkson University believes that currently there is no need for catalytic converters on snowmobiles because manufacture can easily adhere to national emission standards through simple engine modifications and design improvements (Stone, 2005). Improving engine design is a much more cost effective way for manufactures to keep up with the emission standards. Stone is the advisor of the Clean Snowmobile Challenge at Clarkson, where multiple schools compete to design the best performing and most environmentally friendly snowmobile. The schools do this by adding a catalytic converter and muffling the exhaust system among many other things. The team estimates that it would cost approximately \$288 per sled for manufactures to make the same modifications to sleds as the Clarkson team has. This seems like a worthwhile investment but there is no pressure on the manufacturers to make such modifications. New York State must take the initiative and push manufactures to make real improvement in emissions, an additional cost of \$300 to a snowmobile is an affordable investment considering that new basic model sleds cost three to four thousand and up. The EPA should force manufacturers to use all affordable technology to reduce HC emissions from leaky tanks and tubing, and to reduce post combustion emissions. These small engines should be held to the same standards as cars and over the course of 5 to 10 years the industry should attempt to reach this goal.

Another problem with the draft is that it does not properly address law enforcement. The only suggestion made in addressing this problem is the education of riders, which is important, but is not enough to ensure that individuals are not compromising the safety of other riders. Trail rules and laws must be enforced by police officials (which in many areas is already happening), and be continuous throughout the park. In Lewis County the Sheriff's department patrols 8,085 miles of the 504 miles of groomed trail in the county (Virkler, 11/12/04). The patrolling was made in coordination with other law enforcement agencies such as the State police, DEC police, and State park police. As a result 490 tickets were issued for snowmobiling offences, such as riding while intoxicated, no insurance, and inadequate muffler. These patrols should continue and increase as traffic on the trails increases. In addition, maintaining safety patrols can ensure that environmental regulations are being adhered to by making sure riders stay on the trails that are open and that the new emission regulations are being met.

Another policy which could be adopted by the state is an increase in the registration fee by a few dollars to be put towards conservation efforts for wildlife. Current registration fees are \$45, so a small increase would not effect the number of registrations. This could be another way to help reduce the conflicts between environmentalists who disapprove of the sport in the park and snowmobilers. The money could be put towards studying and maintaining healthy populations of wildlife and possibly towards the protection of corridors in and out of the area to maintain metapopulations. An example of this is the reintroduction of species who are native to the Park but no longer inhabit the area. Carol Young, the snowmobile club member from Long Lake, feels that snowmobilers would definitely be interested in contributing

towards conservation in the park as long as they were getting something in return (Young, 2005). What snowmobilers want are safe trails connecting different regions around the park. Snowmobilers are reasonable and will cooperate with other groups so that everyone's best interest can be met.

Snowmobile trails should be kept away from aquatic communities and riparian areas. To minimize the impact on white-tailed deer in the park trails should not bisect their over-wintering areas. To minimize the impact of erosion, minimum snow depths should be strictly adhered to, allowing for closing of trails that do not have adequate snow depth.

With respect to the use of private land for state snowmobile trails, the state does offer liability protection but it may be necessary to create more incentives to allow snowmobile trails on private land (DEC Draft). Incentives such as tax reductions and easements in addition to the preexisting incentives such as snowmobile clubs clearing and maintaining trails that in other seasons the land owner can use. The idea of a snowmobile easement is being studied. The easement would be seasonal and would encompass 20-30 feet along the trails (Tenny, 04/25/99). This would allow snowmobilers access in the winter while not requiring land owners to put a traditional easement on their property which would put certain restrictions on the property. More incentives for private landowners would open up more access for trails on private land and reduce the need for trails on state land.

## **Implementation**

Upon completion, the revised and final Snowmobile Plan will be published and submitted to the involved agencies and the public for a 10 day commentary (DEC Draft). After this period the plan will be submitted for approval. Once accepted, the DEC will have to revise its policies and make changes to the way State land is managed. Changes for non-state land will go directly to the APA. For the snowmobile plan, the DEC will have allow for the creation of a new trail classification system, replace the 848.88 mile cap on snowmobile trails in the park, make wider trails, allow tree cutting in the forest preserve, remove rocks from trails, create of drainage systems, and create some trails near or on wetlands (DEC Draft). These policy revisions will be open for public commentary and further revision for a period of 30 days before they are finalized. Further DEC policy revisions will have to be approved by the APA. Such policy revisions are development of new trails classification and amendments to the Master Plan (DEC Draft). This approval process consists of discussions between involved State agencies, final public hears, APA approval and then is signed into law by the Governor.

As the plan is still in its draft form, the implementation of the plan is still a long way off. Currently the DEC has only outlined the process of getting the plan approved and not the actual implementation. Since it is not known how long it will take to be approved it is not possible to create a time table for the construction and completion of the recommendations to the trail system. Nor is there any indication of how much these improvements might cost the state or where the money will come from. The DEC must develop a time table, a budget, and delegate construction programs to the different

regional offices in the park. Otherwise they will not be prepared to implement the plan in a timely fashion when it is approved.

Legislation for higher emission standards should be pursued at both the national and state level. Research conducted by Clarkson University students (among others), demonstrates that snowmobiles can be designed to run much cleaner at a marginal cost. Manufacturers should utilize all available technology to produce cleaner sleds and pass on the increased cost to consumers. Higher standards may slightly reduce sales but currently the true costs of snowmobile are being externalized in the form of air pollution. Those who enjoy the sport must accept the cost and participate willingly.

To provide better trail safety and adherence to the law, law enforcement agencies simply need more funding to put more officers on the trails. The multiple agencies should coordinate which regions they will patrol so that the high traffic areas are being covered. The officers should be equipped with radar technology to issue speeding tickets and emission testing units to ensure that sleds are adhering to the new standards.

The couple dollar increase in registration fee should be put into a state fund where it can collect interest. State agencies or non profit organizations such as the Nature Conservancy, Adirondack Mountain Club or snowmobile clubs can use the funds for the promotion of conservation. These funds should be used strictly for conservation and not for the maintenance and creation of trails or other projects relating to snowmobiling because such projects receive their own specific funds. The conservation fund will be directed towards projects benefiting wildlife and the ecology of the park. Projects could be studies of populations to better conserve them, the creation of corridors to maintain the

parks metapopulations, the removal and prevention of invasive species, and the reintroduction of native species.

The DEC should also include legislation in the plan which will provide more incentives to private land owners to open up their land to the use of snowmobiles. This can include snowmobile easements, as described earlier, or other tax incentives. The DEC should simply recruit willing land owners and create long term contracts so that snowmobile trails can be moved off of state land and onto the periphery of private land.

## **Conclusion**

The DEC has defined a plan that will allow for the growth of the snowmobile industry in the Park while reducing many of the negative impacts. The plan however, does need revision as discussed in the public commentary section and further suggestions offered by this case study. Trails need to be moved to avoid important wildlife habitat and other recreational use areas. The trails also must be made the appropriate width and have all hazards removed. In addition, and perhaps most importantly, snowmobile manufactures must be pressured into using the best technology to build sleds that pollute less. With the many suggestions offered in this case study included into the management of snowmobile industry, wildlife, motorized and non-motorized recreationalist can all utilize the park to the best extent.

The overall problem with the conservation of wildlife in the Park is that the park is not designed or managed for biological conservation. It is managed to protect certain resources for human use. The park was created and is managed to protect the watershed, the timber industry and recreational activities and tourism. Wildlife conservation is



important to the management of the Park because it is part of the reason why visitors come to the area to visit, not because of non-anthropocentric reasons. The best way to improve wildlife habitat is to manage some land for strictly this purpose and not human recreation.

**APPENDIX:**

LIST OF ABBREVIATIONS USED

- APA = Adirondack Park Agency
- ATV = All-terrain vehicle
- DEC = Department of Environmental Conservation
- GC = glucocorticoid
- HC = hydrocarbon
- NOx = nitrogen oxides
- NYSCG = New York Snowmobile Coordinating Group
- OPRHP = New York State Office of Parks, Recreation and Historical Preservation

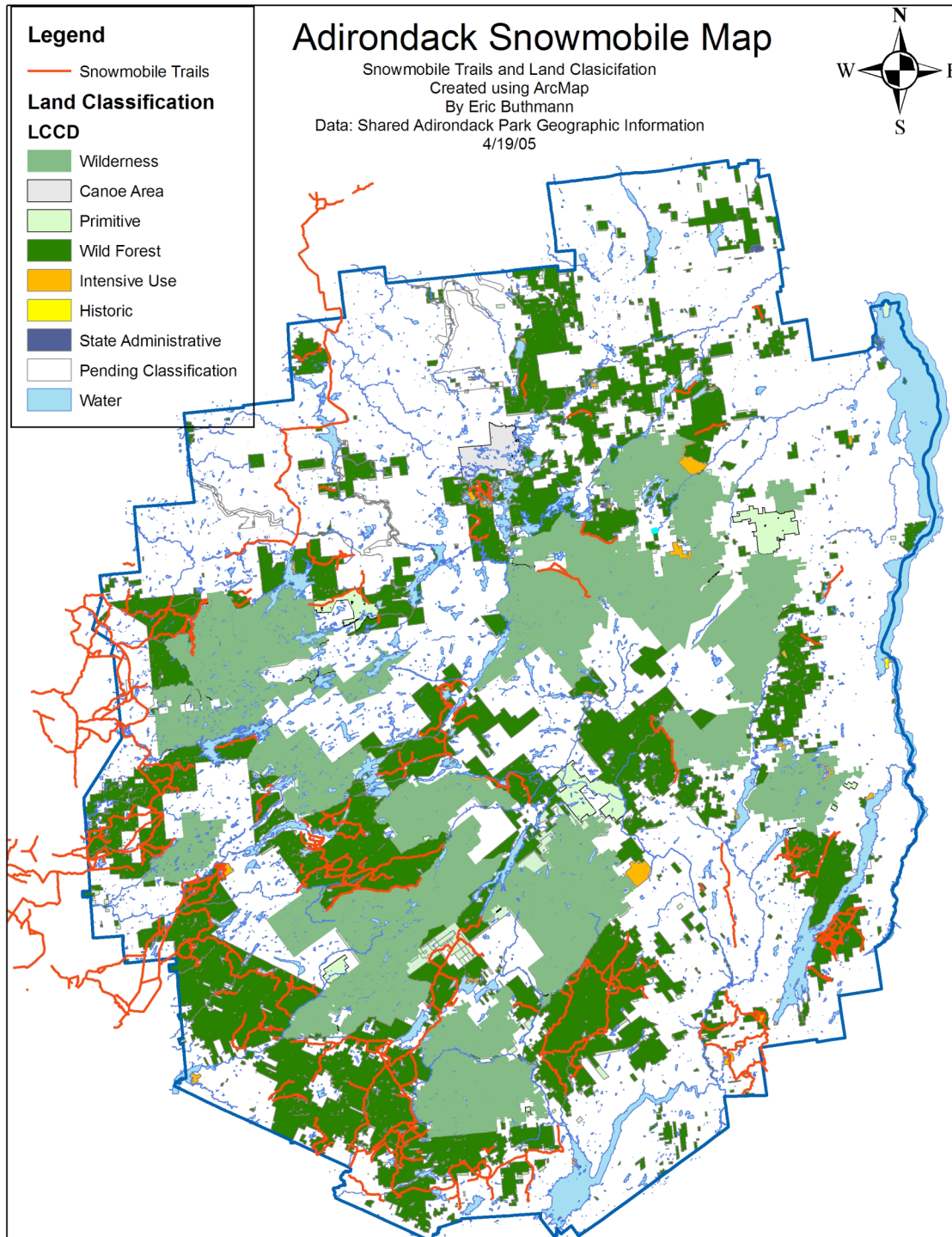
Table 1. Approximate Mileage of Snowmobile Routes in the Adirondack Forest Preserve.  
Source: (DEC Draft).

<b>Approximate Mileage of Snowmobile Routes in the Adirondack Forest Preserve</b> (based on initial data, to be verified through the UMP process)	
Trails	741
Public Roads	259
DEC Administrative Roads	142
Railroads	49
Utility Lines	4

New York State Constitution: ARTICLE XIV Section 1.

*“The lands of the state, now owned or hereafter acquired, constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed”.*

# GIS Map of Snowmobile Trail and Land Classification



## Works Cited

- Adirondack Park Agency. Accessed 4/2005. Available: <http://www.apa.state.ny.us/>
- Action Alert. Adirondack Snowmobile Plan Fails Human Health, Sound Planning and “Forever Wild” Tests. The Association for the Protection of the Adirondacks. Viewed 3/2005. Available: <http://www.protectadks.org/>
- Biodiversity Conservation Alliance. 2002. Keep the Medicine Bow *WILD* : An Ecosystem Management Alternative for the Medicine Bow National Forest Plan Revision. Available: [www.biodiversityassociates.org/mbnf/pubs/mb\\_cit\\_alt.pdf](http://www.biodiversityassociates.org/mbnf/pubs/mb_cit_alt.pdf)
- Bishop, Gary A., Donald H. Stedman, Mary Hektner and John D. Ray. 1999. An In-Use Snowmobile Emission Survey in Yellowstone National Park. *Environmental Science & Technology* 33 (21): 3924-3926.
- Bishop, Gary A., Jerome A. Morris and Donald H. Stedman. 2001. Snowmobile Contributions to Mobile Source Emissions in Yellowstone National Park. *Environmental Science & Technology* 35 (14): 2874-2881.
- Bluewater Network. 2002. Snowmobile Position Paper. [www.bluewaternetwork.org/reports/rep\\_pl\\_snow\\_snowposition.pdf](http://www.bluewaternetwork.org/reports/rep_pl_snow_snowposition.pdf)
- Boyle, Stephen A. and Fred B. Samson. 1985. Effects Of Nonconsumptive Recreation On Wildlife: A Review. *Wildlife Society Bulletin* 13: 110-116.
- Canadian Wildlife Federation. 1998. Below Zero Activities: Snowmobile Savvy. *Wild Education: Wild Programs* [www.wildeducation.org](http://www.wildeducation.org)
- Coupal, R. H., Bastian, C., May, J., Taylor, D. T. 2001. The Economic Benefits of Snowmobiling to Wyoming Residents: A Travel Cost Approach with Market Segmentation. *Journal of Leisure Research*. 33(4):492-510.
- Creel, Scott, Jennifer E. Fox, Amanda Hardy, Jennifer Sands, Bob Garrot and Rolf O. Peterson. 2002. Snowmobile Activity and Glucocorticoid Stress Responses in Wolves and Elk. *Conservation Biology* 16 (3): 809-814.
- Dedam, Kim. S. (03/03/2004). DEC Spells out Adirondack snowmobile plan. *Press Republican.com*. Available:<http://www.pressrepublican.com>.
- Dorrance, Michael J., Patrick J. Savage and Dan E. Huff. 1975. Effects Of Snowmobiles

- On White-Tailed Deer. *Journal of Wildlife Management* 39 (3): 563-569.
- Eckstein, Ronald G., Thomas F. O'Brien, Orrin J. Rongstad and John G. Bollinger. 1979. Snowmobile Effects on Movements of White-tailed Deer: A Case-study. *Environmental Conservation* 6 (1): 45-51.
- Erikson, Kare, Dan Tjarner, Inger Marqvardsen and Bengt Jarvholm. 2003. Exposure to benzene, toluene, xylenes and total hydrocarbons among snowmobile drivers in Sweden. *Chemosphere* 50 (10): 1343-1347.
- European Pollutant Emission Register. 2000. Pollution Database : Benzene, toluene, ethylbenzene, xylenes (as BTEX) <http://pollution.unibuc.ro/?substance=43>
- Freddy, David J., Whitcomb M. Bronaugh and Martin C. Fowler. 1986. Responses Of Mule Deer To Disturbance By Persons Afoot And Snowmobiles. *Wildlife Society Bulletin* 14: 63-68.
- Fredman, Peter., Heberlein, Thomas. A. 2003. Changes in Skiing and Snowmobiling in Swedish Mountains. *Annals of Tourism Research*. 30(2):485-488.
- Heberlein, Thomas. A., Fredman, Peter., Vuorio, Tuomas. 2002. Current Tourism Patterns in the Swedish Mountain Region. *Mountain Research and Development* 22(2):142-149.
- Meffe, Gary K. and C. Ronald Carroll. 1997. *Principles of Conservation Biology*. Sinaur Associates Inc.: Sunderland, Massachusetts.
- Messenger, Rob. DEC Bureau of Forest Preserve Management. Personal Communication: 3/25/2005.
- Moen, Aaron N., Susan Whittemore and Bonnie Buxton. 1982. Effects Of Disturbance By Snowmobiles On Heart Rate of Captive White-Tailed Deer. *New York Fish and Game Journal* 29 (2): 176-183.
- Monz, Chris. Professor of Environmental Studies St. Lawrence University. Personal Communication. 3/2/2004.
- National Park Service. 2003. Draft Backcountry Management Plan: Denali National Park and Preserve, Alaska. Chapter 4: Environmental Consequences.
- Natural Trails & Waters Coalition. 2002. Field Guide to Off-Road Vehicles. Available: [www.naturaltrails.org/issues/fieldguide2vehicles.html](http://www.naturaltrails.org/issues/fieldguide2vehicles.html)
- Neumann, P.W., and H. G. Merriam. 1972. Ecological effects of snowmobiles. *The Canadian Field Naturalist*. 86:207-212.

- New York State Department of Environmental Conservation, Office of Parks, Recreation, and Historical Preservation. 2003. Draft Comprehensive Snowmobile Plan for the Adirondack State Park/Draft Generic Environmental Impact Statement. Available: <http://www.dec.state.ny.us/website/dlf/publands/snow/index.html>.
- Rapp, Jason. 2004. Snowmobiling and National Park Management: To Conserve for Future Generations or Provide for Public Enjoyment? *Tulane Environmental Law Journal* 17:301.
- Reich, Leonard. S. 1999. Ski-Dogs, Pol-Cats, and the Mechanization of Winter: The Development of Recreational Snowmobiling in North America. *Technology and Culture* 40(3):484-516.
- Reinhart, Dan. 1999. Effects of Winter Recreation on Habituated Wildlife. *National Park Service: Effects of Winter Recreation on Wildlife*: 151-153. Available: [www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf](http://www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf)
- Richens, Voit B. and Gerald R. Lavigne. 1978. Response of White-tailed Deer to Snowmobiles and Snowmobile Trails in Maine. *The Canadian Field Naturalist* 92: 334-344.
- Ruzycki, Jim and Jeff Lutch. 1999. Impacts of Two-Stroke Engines on Aquatic Resources. *National Park Service: Effects of Winter Recreation on Wildlife*: 145-147. Available: [www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf](http://www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf)
- Smith, Jacob. Snowmobiles Stress Wildlife in Winter. Biodiversity Legal Foundation, The Road-RIPorter 1.4
- Stangl, J.T. 1999. Effects of Winter Recreation on Vegetation. *National Park Service: Effects of Winter Recreation on Wildlife*:119-121. Available: [www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf](http://www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf)
- Trochta, Dan. 1999. Effects of Snowmobiling Across Open Water on Fish and Wildlife. *National Park Service: Effects of Winter Recreation on Wildlife*: 161-162. Available: [www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf](http://www.nps.gov/yell/publications/pdfs/wildlifewinter/issuesimpacts.pdf)
- Stone, Fred. Clarkson University. Advisor of the Clean Snowmobile Challenge. Personal Communication: 3/25/2005.
- Tenny, Author. 04/25/1999. Easements Suggested as Snowmobile Trail “Rewards”. *Watertown Daily Times (NY)*. Page B1.
- United States Environmental Protection Agency. 2002. Environmental Impacts of Newly Regulated Nonroad Engines: Frequently Asked Questions. Office of Transportation and Air Quality.

- Vail, David., Heldt, Tobias. 2004. Governing snowmobilers in multiple-use landscapes: Swedish and Maine (USA) cases. *Ecological Economics* 48:469-483.
- Virkler, Steve. 11/12/2004. Snowmobile Accidents in Lewis County Drop – Tickets, Complaints and Usage Also Decrease. *Watertown Daily Times (NY)*. Page D6.
- Vitterso, J., Chipeniuk, R., Skar, M., Vistad, Odd Inge. 2004. Recreational Conflict Is Affective: The Case of Cross-Country Skiers and Snowmobiles. *Leisure Sciences*. 26:227-243.
- Withgott, Jay. 2002. Signs of Stress Seen in Snowmobile Season. *Science* 296 (5574): 1784.
- Young, Carol. Moonlighters Club member and small business owner Long Lake NY. Personal Communication: 3/25/2005.