Masters Thesis

Prey and Habitat Availability in the Whiskey Jack Forest (Kenora Management Unit, Ontario), to Support a Cougar (*Puma concolor*) Population

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A Masters Thesis submitted in partial fulfillment of the requirements for the degree of Masters in Science, Forestry

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Lakehead University

November 2000

0-612-60846-8

Abstract

Hauck, K. 2000. Prey and Habitat Availability to Support a Cougar (*Puma concolor*) Population in the Whiskey Jack Forest (Kenora Management Unit). M.Sc.F Thesis. Faculty of Forestry, Lakehead University, Thunder Bay, Ontario, Canada. 78 pp. (Advisor: D. Euler, PhD).

Key Words: cougar, mountain lion, habitat analysis, Whiskey Jack Forest, snow tracking, snowshoe hare, prey analysis, transects, *Puma concolor*.

Cougars (*Puma concolor*) are the largest of the cats found in Canada. Abundant now only in British Columbia and Alberta, cougars are possibly making a comeback in their former eastern range. One 'sighting' (scat and tracks), of a cougar was confirmed from the Whiskey Jack Forest during January and February 2000, Herb Lake location. I surveyed 37 kilometres of transects in the Whiskey Jack Forest to determine prey and habitat potential to support a viable cougar population. Eleven transects located in the northern section of Wildlife Management Unit (WMU) 7B, and 10 transects located in the southern section of WMU 6 were surveyed. Combining the Silver Lake and Jones Study Areas, results showed that ecosite 13 had the most abundant animal activity (1.94 animal tracks and trails/10m), followed by ecosites 11 (1.66 animal tracks and trails/10m), rock (1.46 animal tracks and trails/10m), ecosite 19 (1.42 animal tracks and trails/10m), and ecosite 14 (1.21 animal tracks and trails/10m). Snowshoe hare, *Lepus americanus*, was the most abundant prey species identified on all transects. Wolves, *Canis lupus*, a competitor of the cougar, were also abundant on many of the transects, indicating possible competition for habitat and prey resources. Deer (*Odocoileus virginianus*), the primary prey of cougar, were only found on one transect, which could indicate possible problems for permanent cougar residence in this area. Moose, *Alces alces*, however, were quite abundant on many of the transects and have some potential to support the predators.

Whether or not the area can support cougars is unclear. Increasing the amount of time (consecutive winters) allocated to the study and the size of the study area surveyed would strengthen the study.

Dedications

I can honestly say that this adventure has been one of the most difficult to accomplish in my life. But now as I stand back and look at all the paths I have taken, full of excitements and disappointments, I know this journey would not have been the same without the love, support, encouragement and motivation from Kevin. Through computer problems and crashes, late nights, early mornings, tracking animals on snowmobile in minus 20 degrees Celsius weather, and the excitement of possibly finding cougars tracks and finally seeing the light at the end of the tunnel, Kevin has stood by me and supported me through this roller coaster ride. I thank you Kevin from the bottom of my heart for standing by me. I LOVE YOU!!

And to Mira, Marbles, Miineu, Sampson and Frankie for making me take the time to play once and awhile.

"ALL CREATURES GREAT AND SMALL, KATIE LOVES THEM ALL"

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Acknowledgements

I am happy to take this opportunity to thank all of the people who have given me encouragement and support in making this thesis possible. I thank Dr. Euler, my advisor, who maintained my momentum and kept me on course when I thought I reached the end of my trail, and who motivated me to strive higher. I also thank Lakehead University for the financial contribution that made this research possible.

I also want to thank my committee members: Dr. Ken Deacon (Biology Department, Lakehead University), Dr. Tom Potter (Outdoor Recreation Parks and Tourism, Lakehead University), and Neil Dawson (Wildlife Assessment Program Leader, Ontario Ministry of Natural Resources, Thunder Bay). Their constructive criticism, motivation, endless readings, and excellent editing skills have helped me throughout this research project. Thanks also goes out to Martin G. Jalkotzy, the external examiner, for his valuable comments, that enhanced the quality of this research project.

A special thanks goes to Kim Schlosser who came out into the bush with me from the beginning, and hiked endless kilometres in deep snow and cold weather looking for cougars. Sorry we didn't run into any (even with live bait!), but the chili was awesome!! Finally, thanks to my family and friends who supported me throughout this endeavour.

1.0 Introduction

The cougar, *Puma concolor* Linnaeus, also known as: mountain lion, puma, catamount, ghost cat, king cat, or panther, historically had one of the largest distributions of any mammal in the Western Hemisphere; extending from the tip of Chile north to the Yukon, and from the Atlantic to the Pacific oceans (Figure 1) (Busch, 1996; Dixon, 1982; Hummel and Pettigrew, 1991; Lindzey, 1987; Young and Goldman, 1946).

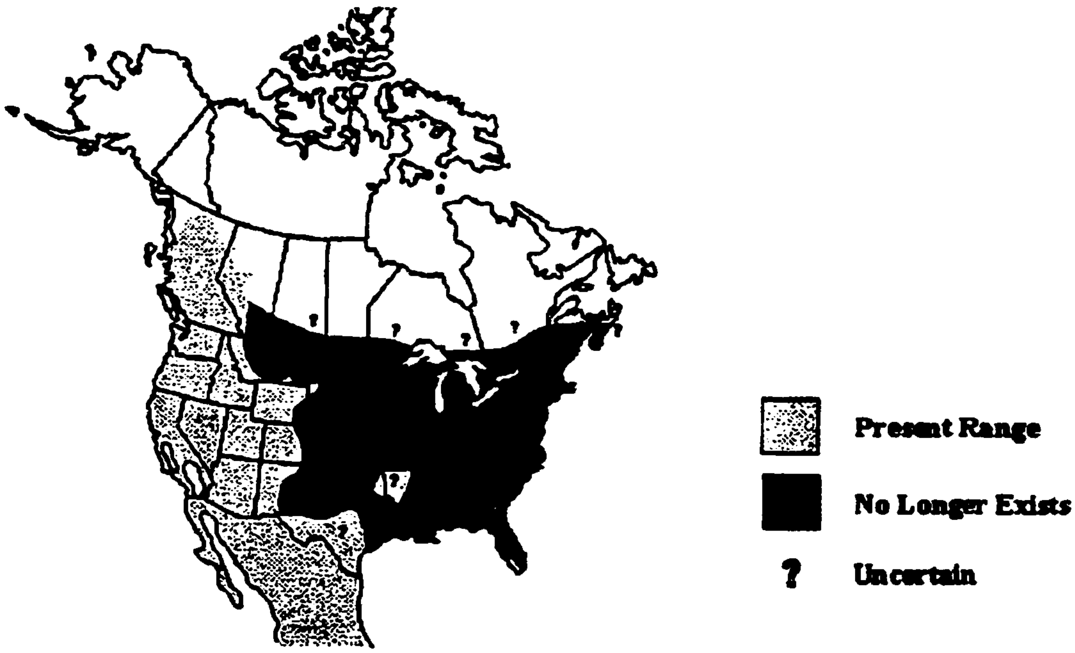

Figure 1. Cougar distribution in North America (Hummel and Pettigrew, 1991, pp.131).

Cougars are one of the many predators that humans attempted to eradicate from their settlements to protect themselves, their livestock, and game populations for their own hunting needs. When settlers began occupying wilderness areas in Canada and the United States during the 1500's, large predators that inhabited the land and competed for prey were targeted for extermination (Busch, 1996; Hummel and Pettigrew, 1991;

Bolgiano, 1995). This program of extermination became very popular, and the practice quickly radiated throughout the United States and Canada (Busch, 1996). With little or no predator management existing prior to the 1960's, the slaughter of many large predators, and specifically the cougar, was an unchecked campaign of extermination that lasted for nearly 400 years (Busch, 1996; Hummel and Pettigrew, 1991).

In British Columbia, bounties for the cougar existed from 1910 to 1957. Between 1930 through to 1955, there were approximately 13,257 cougars slaughtered due to hunting and other human activities (Hummel and Pettigrew, 1991). In 1966, cougars were classified as a game species; therefore, the hunting of cougars became more regulated in 1968 and 1969 (Hummel and Pettigrew, 1991). In 1970, hunting tags for cougars were issued restricting the number of cougars that could be legally killed, followed by a compulsory inspection of all cougars killed, that began in 1976 (Hummel and Pettigrew, 1991). With the compulsory inspection from 1976 through to 1988, there was a decrease in the number of cougars killed; from 190 cougars killed per year to a low in 1981 of 150 cougars killed, but then to a high again of 248 cougars killed in 1986 (Hummel and Pettigrew, 1991). Legal protection for females with kittens started in British Columbia in 1980 and still continues today (Hummel and Pettigrew, 1991). Alberta also had bounties between 1937 and 1964 (Hummel and Pettigrew, 1991). In 1972, Alberta introduced a compulsory cougar registration system similar to that in British Columbia (Hummel and Pettigrew, 1991).

In 1973, a two year old male cougar was killed by a farmer in Manitoba, 92 kilometres from the Ontario border (Nero and Wrigley, 1977). At that time, there were no confirmed sightings of cougars in Ontario but with sightings in Manitoba and

Minnesota, cougars in Ontario were a possibility (Gerson, 1985). In New Brunswick, there were sightings of cougars, as well as a photograph of the skin of a cougar shot in 1932, and a mounted specimen trapped near the Quebec border in 1938 (Wright, 1961 cited in Gerson, 1985). Reported sightings of 'eastern' cougars continued throughout the 1940's and 1950's which increased interest in the cougar (Van Dyke and Brocke, 1987). The eastern cougar subspecies was placed on the endangered species list in the United States in 1973, and in Canada in 1978 (Busch, 1996), and was also listed in Appendix 1 of the Convention on International Trade in Endangered Species (CITES) in 1978 (Busch, 1996).

On 15 May, 1990 in Waasis, New Brunswick, a cougar was captured on video tape by a member of the public. The video tape has not been considered a reliable cougar sighting by many scientists, due to the poor quality of the film (Hummel and Pettigrew, 1991). Certain portions of this video tape show a cougar clearly "walking, standing, sitting and leaping" (Hummel and Pettigrew, 1991 p. 132). In March of 1997, Lillian Anderson, a Fish and Wildlife Technician at the Ministry of Natural Resources in Kenora, Ontario, found fresh tracks and scat that looked like those of a cougar. The scat was sent to the Environmental Protection Services, Fish and Wildlife Division, Forensic Lab in Edmonton, Alberta, for identification. The scat was confirmed to be 'consistent with the cougar and inconsistent with the lynx', which indicated the presence of cougars in the Kenora area (L. Anderson, pers.comm.). A study examining cougar habitat could help to determine if the area is capable of supporting the species.

For a healthy cougar population to exist or to re-establish itself in northwestern Ontario, there first needs to be suitable habitat and an adequate supply of prey to meet the cougar's biological /ecological requirements. Northwestern Ontario has many areas of potential cougar habitat that support a variety of potential prey species. Cougars utilize forests that provide ample cover, and rocky outcrops or vantage points that enable cougars to stalk and catch unsuspecting prey (Banfield, 1974). Long grass, dead falls, leaves, and branches are also utilized to cache captured prey for later consumption (Banfield, 1974). The primary prey species for cougars are white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus)* (Anderson, 1983). Cougars will also consume moose (*Alces alces*), and small game such as snowshoe hare (*Lepus americanus)*, beaver (*Castor canadensis)* and rodents (family *Rodentia*) (Hummel and Pettigrew, 1991; Anderson, 1983). Many of these prey species live in the forests of northwestern Ontario and could provide the cougar with ample food (Banfield, 1974).

1.1 Purpose

The goal of this research project was to evaluate sections of the Whiskey Jack Forest (Kenora Management Unit, Ontario), located 40 kilometres north of Kenora, for their potential to support a cougar. Both habitat and prey availability were examined. The Whiskey Jack Forest was chosen because a cougar, from an unknown origin, had been noted there by Lillian Anderson, Wildlife Technician at the Ministry of Natural Resources, Kenora.

The objectives of the project were:

1. To determine an area of suitable habitat and abundant prey potential to support a viable cougar population within the Whiskey Jack Forest;
2. To identify the presence of a cougar in the study area, (i.e. photographs, video footage, biological samples, etc.).

This project is important in evaluating cougar habitat potential, and prey availability in northwestern Ontario, as a first step to restore a cougar population to its former eastern habitat and range.

2.0 Literature Review

2.1 Historical Distribution of the Cougar

The existence of the cougar in northwestern Ontario has been debated for many years. More than 300 sightings of this elusive cat have been reported in Ontario from 1935 to 1983, (Figure 2.), with supporting evidence from Minnesota and Manitoba (Gerson, 1988); however, no sighting has been successfully documented on film.

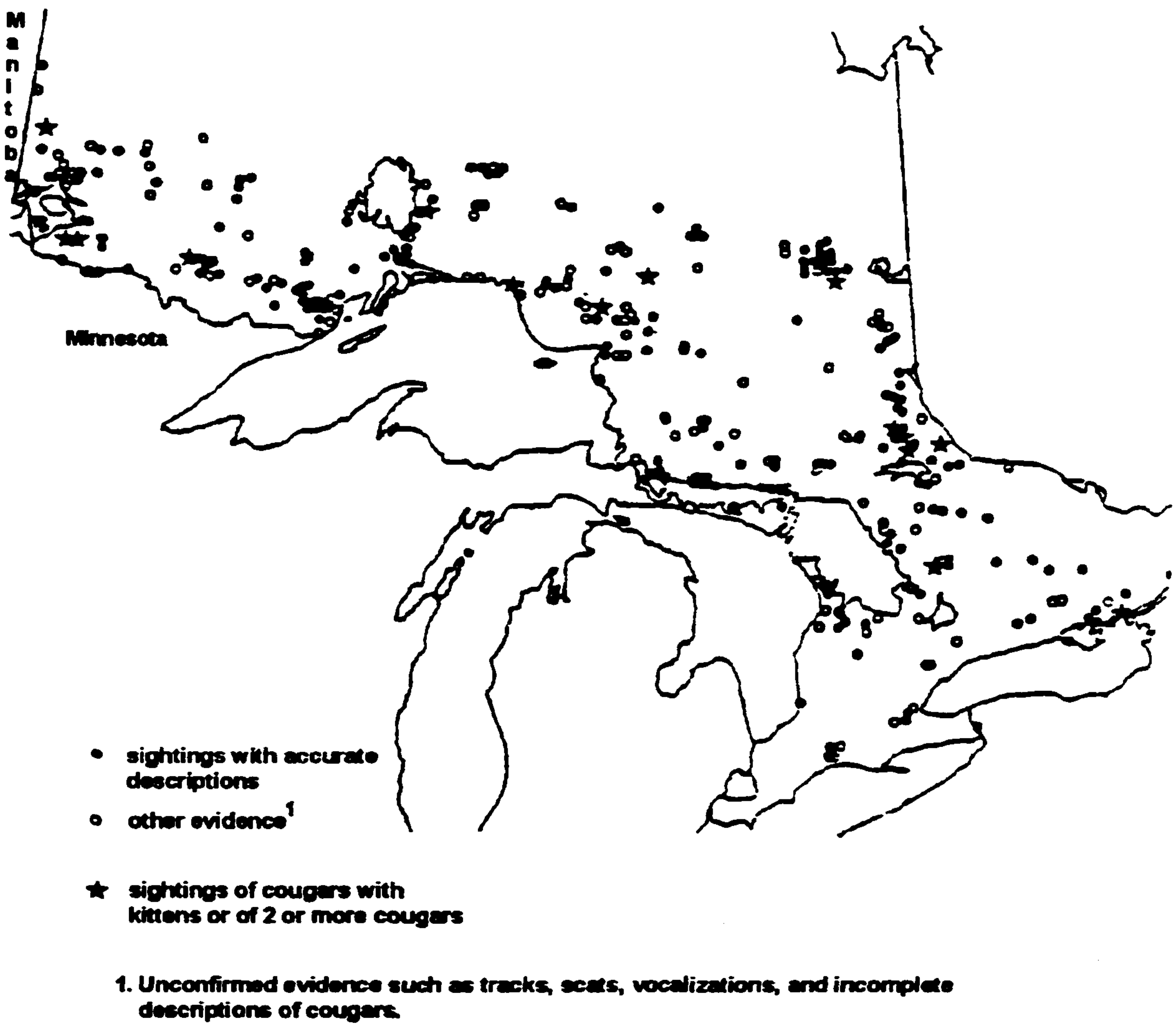

Figure 2. Locations of cougar sightings in Ontario, 1935 - 1983 (Gerson, 1985).

Cougar sightings have increased in Ontario steadily since the 1950's (Table 1.) (Gerson, 1985). The increase in cougar sightings could be related to the greater interest people have in the species; therefore, people are frequently traveling in wilderness and on logging roads that are located in what used to be inaccessible wilderness areas, where the likelihood of seeing a cougar is increased (Gerson, 1985).

Table 1. Number of cougar sightings reported in Ontario from 1930 to 1983 (Gerson, 1986).

Year	Number of Reliable Sightings 1	Number of Incidents of Supporting Evidence 2	Total
1930 - 1939	1	0	1
1950 - 1959	17	11	28
1960 - 1969	25	19	44
1970 - 1979	85	54	139
1980 - 1983	61	42	103
Totals	**189**	**126**	**315**

1. Sightings in which cougars are accurately described.
2. Unconfirmed evidence such as tracks, scat, vocalizations, and incomplete descriptions of cougars.

Cougars once had the largest distribution of any mammal in the Western Hemisphere (Busch, 1996; Dixon, 1982). The historic range of the cougar in Canada and the United States was estimated at 8.9 million square kilometers, compared to the present range which is approximately 3.9 million square kilometers - a reduction of 56% (Hummel and Pettigrew, 1991). Hummel and Pettigrew (1991) suggest that cougars ranged as far east as Quebec and New Brunswick, and north of Lake Superior before the 1800's.

Boardman (1899), and Allen (1894), (cited in Cumberland and Dempsey, 1994), felt that there was sufficient evidence supporting the existence of cougars in eastern Canada. Gesner (1847), and Ganong (1903), however, (cited in Cumberland and Dempsey, 1994), opposed the idea that cougars existed in the east due to the lack of hard evidence. The last known cougar specimen was killed at the Maine, USA/Quebec/New Brunswick border in 1938 (Cumberland and Dempsey, 1994). Cougar numbers have decreased, and in many cases the cougar has been extirpated from its former range in eastern and central Canada (Banfield, 1974). The cougar still inhabits British Columbia and the Rocky Mountains of Alberta in Canada (Gerson, 1985, Young and Goldman, 1946).

Nero and Wrigley (1977), found that from 1941 to 1975, cougar sightings extended northward into the Boreal Forest and eastward to the Great Lakes St. Lawrence Forest in Manitoba. Over the past 22 years, there have been numerous reports of cougars in Northwestern Ontario, including north of Lake Superior (Nero and Wrigley, 1977). Hummel and Pettigrew (1991), however, note that many of these sightings were unconfirmed.

2.2 Historical Uses of Cougar Skins and Other Body Parts

Cougars, like many animals, were preyed upon by humans, for food, skin, fur, and various other body parts. The cougar's skin was considered a tough and durable 'material' that would make good clothing (Young and Goldman, 1946). Western Indians used cougar claws, and occasionally cougar teeth for decorative purposes, while the Plains Indians used the skin for saddles and saddle cloths (Young and Goldman, 1946).

Early trapper-hunters made trousers from cougar skin, and the early settlers from remote parts of North America would utilize entire cougar skins for couch and bed coverings (Young and Goldman, 1946).

2.3 Taxonomic Status

The cougar first appeared in the Pliocene epoch, approximately two million years ago (Busch, 1996). Early American aboriginals knew of the cougar as shown from their rock inscriptions and shrines (Young and Goldman, 1946). In North America, the family *Felidae*, includes cougars, lynx (*Lynx canadensis*) and bobcats (*Lynx rufus*) (Gerson, 1985). Cougars are the largest cat found in North America.

The designations of the various subspecies of cougars are determined by combinations of characteristics such as body size, and cranial and dental characteristics (Gerson, 1985; Young and Goldman, 1946). These characteristics are similar when environmental conditions are homogeneous (Gerson, 1985).

There are 15 subspecies of cougar in North America, and 16 subspecies of cougar in South America (Table 2) (Anderson, 1983). The cougar is now limited to British Columbia, and Alberta as well as to the 12 western-most states in the United States (California, Oregon, Washington, Idaho, Montana, Utah, Nevada, New Mexico, Arizona, Colorado, Texas, Wyoming and Florida) and parts of Central and South America, and Mexico (Busch, 1996).

Table 2. *Puma concolor* subspecies in North and South America with distribution (Anderson, 1983, pp.6-7)

North America | **South America**

Scientific Name	Distribution	Scientific Name	Distribution
P. c. azteca	Chihuahua	*P. c. acrocodia*	Brazil
P. c. browni	Arizona	*P. c. anthonyi*	S. Venezuela
P. c. californica	California	*P. c. araucanus*	Chile
P. c. coryi	Florida	*P. c. bangsi*	Colombia
P. c. costaricensis	Panama	*P. c. borbensis*	Amazonas, Brazil
P. c. couguar	Eastern Canada & U.S	*P. c. cabrerae*	N. Argentina
P. c. hippolestes	Wyoming	*P. c. capricornensis*	Northwest Brazil
P. c. imporcera	Baja California	*P. c. concolor*	Brazil
P. c. kaibabensis	Arizona	*P. c. discolor*	Amazon
P. c. mayensis	Guatemala	*P. c. greeni*	Brazil
P. c. missoulensis	Missoula	*P. c. incarum*	Peru
P. c. oregonensis	Coastal Mountains B.C	*P. c. osgoodi*	Bolivia
P. c. schorgeri	Wisconsin	*P. c. patagonica*	Argentina
P. c. stanleyana	Texas cougar	*P. c. pearsoni*	S. Argentina
P. c. vancouverensis	Vancouver Island	*P. c. puma*	Chile
		P. c. soderstromi	Ecuador

2.4 Physical Description

The cougar is the largest of the North American cats, and has a powerful and well developed muscular structure (Young and Goldman, 1946). The cougar is an animal of great strength, endurance and agility. Large paws, armed with retractable claws, give the cougar terrific ripping power to kill its prey (Young and Goldman, 1946). With the cougar's strength, muscle coordination, cushioned feet, agility and stealth, prey have very little chance of surviving a cougar's attack (Young and Goldman, 1946). Cougar's claws are designed to engage more firmly when the prey tries to break free from the cougar's grasp (Young and Goldman, 1946). Cougars also have impressive jumping abilities. Measurements of the cougar's maximum horizontal leaps have been recorded between 12.2 to 14.3 metres, with maximum vertical leaps of 3.0 to 5.5 metres in height (Anderson, 1983).

An average male cougar stands 76 centimetres at the shoulder with a length ranging from 202 to 231centimetres (including the tail), whereas the female cougar averages between 184 to 202 centimetres in length (including the tail) (Lindzey, 1987). The tail of the cougar which provides balance, is often one-third of the total length of the cougar - approximately 75 centimeters (Busch, 1996; Hansen, 1995; Hummel and Pettigrew, 1991). Male cougars weigh from 53 kilograms to 67 kilograms, whereas female cougars average 34 kg to 48 kg (Hummel and Pettigrew, 1991; Lindzey, 1987). The colour of the cougar ranges between shades of brown, apricot, and rust, with the fur on the underside and throat usually being white (Banfield, 1974; Lindzey, 1987). The cougar has short, coarse fur, but can still survive a severe winter climate (Banfield, 1974; Busch, 1996; Dixon, 1982).

2.5 Reproduction

Sexual maturity for female cougars occurs at approximately 2 to 2.5 years, and for male cougars at approximately 2.5 to 3 years (Busch, 1996; Dixon, 1992; Hummel and Pettigrew, 1991). Busch (1996) suggests that the age difference at which mating occurs is important, as it prevents siblings from mating, which would in turn lead to a weakening of the genetic composition of the population.

Only cougars that have an established home range - called residents - will breed (Lindzey, 1987). Transient cougars, cougars without an established territory, may be sexually mature and ready to mate, but have difficulty breeding (Lindzey, 1987). Unlike many mammals, cougars are not confined to a particular breeding season. A female cougar can breed and have kittens throughout the year (Banfield, 1974; Busch, 1996; Dixon, 1982; Hornocker, 1969a; Hummel and Pettigrew, 1991). Most wild cougars probably give birth at 24 month intervals, yet some female cougars may give birth every 12 to 15 months (Robinette *et al.*, 1961). According to Banfield (1974), two peak birth periods: late winter, and midsummer may exist. Lindzey *et al.* (1994), observed 31 cougar litters between 1979 and 1989 in south-central Utah. Litters were born in every month except for December, January, and March, with peak birthing times during late summer and fall. In southwestern Alberta, Ross and Jalkotzy (1992), documented 30 litters from 18 radio-collared females between 1981 and 1989. The litters were born throughout the year but with a pronounced late summer peak.

When a female is ready to breed, she will travel together with the male, hunting and playing until mating takes place, after which, the pair will stay together for a few days before separating (Busch, 1996). According to Beier *et al.*, (1995), mating periods last between two and five days. During this time, the cougars travel very little, vocalize often, and apparently do not feed (Beier *et al.*, 1995). The gestation period is between 90 and 96 days, with a litter size of two to six kittens (Anderson, 1983; Banfield, 1974; Beier, 1993; Hansen, 1995; Hornocker, 1992). A study conducted in Utah and Nevada, which analysed 258 cougar litters showed that litters of three and two respectively, were most common (Anderson, 1983).

The female chooses a temporary den before the kittens are born. The den can be in a rock overhang, a small cave, or under a fallen tree, providing adequate shelter from snow, rain, or the hot sun (Busch, 1996; Dixon, 1982; Rezendes, 1992). The birth sites are usually located away from other cougars for the safety of the kittens (Anderson, 1983). Cannibalism among cougars has been widely reported (Lindzey, 1987). Male cougars have been known to kill cougar kittens that are not their progeny, possibly as a strategy to increase their "reproductive fitness" (Ross and Jalkotzy, 1992). When a female loses her kittens, she quickly comes into estrus, providing the 'killer' with an earlier breeding opportunity to pass on his genes (Ross and Jalkotzy, 1992). However, Ross and Jalkotzy (1992), point out that this infanticide may be counter-productive to the management of cougars. When resident males are killed by hunters, new males move into the area and kill any progeny there and thus, overall kitten survival is reduced (Ross and Jalkotzy, 1992).

The kittens are born with a woolly, spotted coat which lasts at about six to nine months, a striped tail, and they are fully dependent on their mother for survival. The kittens stay at or near the den for several weeks, while the female provides for their survival. Cougar kittens will begin to eat meat brought to them by their mother at six weeks of age, and by three months the kittens will be fully weaned off their mother's milk (Anderson, 1983; Banfield, 1974, Busch, 1996; Dixon, 1987; Ross, 1994). As the kittens mature and become familiar with their surroundings, they trek further from their den. By approximately 24 months of age, the mother usually separates from her cubs by leaving the denning area (Robinette *et al.*, 1961). The dispersal of 12 cubs in south-central Utah occurred in their second winter or spring at approximately 16 to 19 months of age (Hemker *et al.*, 1984). In Alberta, the average age of independence was 15.2 months (Ross and Jalkotzy, 1992) .

Three cubs from two litters that dispersed, carrying functioning radio collars, were located 6 to 44 kilometres away from their maternal home range in Utah (Hemker *et al.* 1984). Juveniles may stay within the maternal home range when searching for their own territory (Ross and Jalkotzy, 1992). Alternatively, some juvenile cougars may roam up to 640 kilometres to search for available territory (Busch, 1996). Beier (1995), conducted a study in the Santa Ana Mountains of California focusing on the dispersal of juvenile cougars in fragmented habitat. In five of seven cases, the dispersal of juvenile cougars was initiated by the mother. The female cougar left her cub(s), zero to three kilometres from the edge of her home range while she traveled to the opposite boundary of her range, staying there for two to three weeks (Beier, 1995). The dispersal of male and female cubs (n=7) differed. Male cubs (n=6) moved in the direction opposite (150 - 210 degree range) of their mother while the female cub (n=1) traveled 45 degrees from the direction their mother took (Beier, 1995). Siblings in southwestern Alberta were still found together for up to three months after the mother left (Ross and Jalkotzy, 1992).

2.6 Longevity

The life span of a wild cougar is not known. The longevity of three captive male cougars has been documented at 12, 15, and 18 years, and one female cougar reached the age of 10 - 12 years (Anderson, 1983). Beier (1993), found no evidence of wild cougars living past 12 years, however; Young and Goldman's (1946) observations concluded that cougars could reach at least 18 years. Table 3. documents 12 cougars that were held captivity at the National Zoological Park in Washington D.C. One cougar captured on 21 April, 1921 survived 17 years and 8 months in captivity, with the average age at death of the cougars in captivity being 7.4 years (Young and Goldman, 1946, p. 60).

Table 3. Longevity records of 12 pumas in captivity at the National Zoological Park in Washington, D.C.

Born	Acquired	Died	Period of confinement Years	Months
Spring 1888	April 18, 1888	June 23, 1894	6	2
Year 1892	November 2, 1893	January 19, 1900	6	3
---------	January 28, 1896	July 5, 1904	8	5
---------	January 28, 1896	March 16, 1901	5	2
Year 1902	October 28, 1902	October 9, 1908	5	11
Year 1903	December 26, 1904	October 11, 1910	5	9
---------	June 19, 1905	August 23, 1909	4	2
About 1906	August 11, 1908	December 7, 1914	6	4
May 23, 1914	November 24, 1914	June 12, 1920	5	7
Year 1916	February 16, 1917	December 2, 1920	3	10
One-third grown	May 12, 1917	December 21, 1930	13	7
About 6 weeks old	April 21, 1921	December 27, 1938	17	8

2.7 Habitat Requirements and Home Range

According to Dixon (1982), the size of a cougar's home range changes, and depends on the sex and age of the cougar, the season, and the pattern and density of the cougar's prey. The home range size for both males and females is influenced by the distribution of deer, and elk, and the presence of growing kittens (Anderson, 1983). Winter-spring, and summer-fall, home ranges of cougars were frequently adjacent to one another (Anderson, 1983).

To ensure that its territory is not trespassed upon by other cougars, a cougar will mark its territory by making scrapes and scratches throughout, and around the perimeter of the home range. Scrapes are depressions, sometimes covered with scat or urine, that are dug into the ground to indicate the territory of a resident cougar (Busch, 1996). Scrapes are usually made by the resident male, in and around his territory, although transient males and females without kittens may also make scrapes (Dixon, 1982). Scratches, an additional territory boundary marker, can be found on trees, stumps or anywhere cougars used their claws (Busch, 1996).

Seidensticker *et al.*, (1973), suggested that the home range size of cougars is, in part dictated by stalking cover. Cougars require a certain minimum stalking distance which includes appropriate forest and shrub cover before attacking their prey (Belden *et al.*, 1988). Logan and Irwin (1985), also suggest that cougars will utilize habitat that will increase their chances of approaching prey within attacking distance. During a winter study, Logan and Irwin (1985), found from snow-tracking information that cougars used cover from vegetation (shrubs, trees), and terrain (cliffs, hills) to approach and attack their prey. Cougars were also observed staying within the same area, until they consumed their prey (Beier *et al.*, 1995). If the carcass was a small mammal, the cougar's movement would be suspended for approximately four to six hours, whereas if a larger mammal is killed the cougar would stay in the area between two and five days (Beier *et al.*, 1995).

Cougar densities may be limited by the social interaction between cougars (Hornocker, 1970). In southwestern British Columbia, winter population densities of cougars were estimated at 3.5 to 3.7 cougars/100 square kilometres (Spreadbury, 1989). Similarly, in southwestern Alberta, the population densities for cougars ranged from 2.7 to 4.7 cougars/100 square kilometres (Ross and Jalkotzy, 1992).

A hunted population of cougars in southwestern Alberta had summer and winter home ranges for individual female cougars which overlapped partially or completely (Ross, 1992). Female cougar density in an area is directly related to the vegetation cover, topography type, and prey availability (Beier, 1993). Male cougars are more likely to compete for access to females, which prevents a male cougar from sharing territory with another male (Beier, 1993). A study in Wyoming illustrated that the average home range size for four female cougars was 67 square kilometres, whereas the average home range size for two male cougars was 320 square kilometres (Logan *et al.*,1986). Resident female cougar home ranges completely overlapped, whereas the two resident male cougar home ranges overlapped only slightly (Logan *et al.*, 1986). Male cougar home ranges often overlapped many of the female cougar home ranges, which increased their chances of breeding (Logan *et.al.*, 1986).

Neal *et al.* (1987), looked at the home range and density of cougars in the Central Sierra Nevada. There were 17 adult cougars radio-tagged within the 557 square kilometre study area. Estimates of the crude density showed one adult cougar per 37.1 square kilometres (Neal *et al.*, 1987). Cougars can cover large distances in a relatively short time period (Lindzey, 1987). A study conducted in southeastern British Columbia by Spreadbury *et al.* (1996), showed that the mean range of resident female cougars was approximately 31 square kilometres +/- 25 in the winter. The male cougars mean annual home range was 55 square kilometres +/- 25.

2.8 Cougar Tracks

The pads on the fore feet of a cougar are larger and wider than the pads on its hind feet (Lindzey, 1987). The heel pads on both the forefeet, and hind feet, have a distinctive three-lobed appearance (Figure 3) (Lindzey, 1987; Young and Goldman, 1946).

Figure 3. Cougar fore and hind tracks with measurements. (Sheldon, 1997, pp. 48)

When walking, there are generally no claw marks, as felids have retractable nails (Dixon, 1982). All cats have five digits on the fore paws and four digits on the hind paws, but only four digits register (Barnes, 1960; Dixon, 1982). A single adult cougar track is approximately 8.9 cm wide by 7.6 cm long, although the size of the track will differ between male and female cougars (Busch, 1996). A female adult cougar pad can be 4.1 cm to 4.7 cm wide, whereas a male adult cougar pad averages between 4.9 cm to 5.7 cm wide (Rezendes, 1992).

The stride of a cougar can differ depending on the speed of its movement. Sheldon (1997, p.15), defines a stride as "the length from the center of one print to the center of the next print." The cougar walks in an alternating pattern, with a stride measuring 50 cm to 81.2 cm in length (Rezendes, 1992). The trail width, or straddle of the cougar measures 20 cm to 27 cm (Rezendes, 1992) (Figure 4.). The straddle, as defined by Sheldon (1997, p.15), is "the total width of the track, all prints considered".

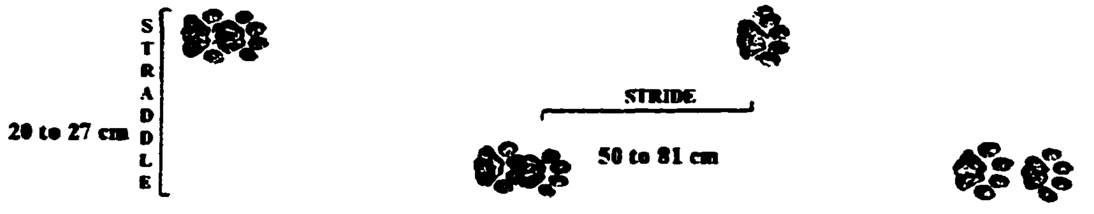

Figure 4. Cougar prints - stride and straddle measurements while walking. (Rezendes, 1992, p. 235)

Sometimes cougar tracks are obscured due to the cougar's tendency to place the hind foot in the track left by the fore foot - known as direct register (Lindzey, 1987). Double register, is when the hind print falls slightly on or beside the fore print and both prints can be seen (Sheldon, 1997). Also if the tail is relaxed, tail drag marks are made in deep snow (Lindzey, 1987).

2.9 Cougar Prey Requirements

The usual prey of cougars are: white-tailed and mule deer, moose, beavers, porcupines (*Erethizon dorsatum*), rabbits, hares (*Leporidae*), ground squirrels (*Spermophilus*), and other rodents (*Rodentia*) (Busch, 1996). The contents of cougars' stomachs and intestines were examined to determine the winter food habits in northeastern Oregon (Maser and Rohweder, 1983). Mule deer were the most-frequently consumed prey, representing 55.3% of the stomach contents, and 42.1% of the colon contents, while North American elk (*Cervus elaphus*), were the second most-frequently consumed prey representing 21.3 % of the stomach contents, and 15.8% of the colon contents (Maser and Rohweder, 1983). Cougars, however, are considered to be opportunistic hunters, catching anything that is available. Maser and Rohweder (1983), found that cougars ate porcupines and also used them for hunting practice by young cougars starting to eat meat. Leopold and Krausman (1986), found that in Big Bend National Park, Texas, when the deer populations declined, cougars altered their diet to include peccaries (*Tayassuidae*), and lagomorphs (rabbits, hares, pikas).

In British Columbia, and the seven American states, large prey, specifically deer, were the most favored prey item (Iriarte *et al.*, 1990). (Table 4).

Table 4. Frequency of occurrence of major prey items in puma diets in British Columbia (BC) (Spalding and Lesowski 1971), Oregon (OR) (Toweill and Meslow 1977), Utah (UT) (Ackerman et al. 1984), Nevada and Utah (NE/UT) (Robinette et al. 1959), California (CA) (Dixon 1925), Arizona (AR) and New Mexico (NM) (Hibben 1937), and Florida (FL) (Maehr et al. 1990)

FOOD ITEMS	BC	OR	UT	NE/UT	CA	AR	NM	FL
TOT LARGE PREY	67.0	83.3	61.6	73.3	87.5	78.3	89.3	72.6
Deer	58.3	83.3	61.3	64.5	85.0	75.4	88.3	28.1
Livestock	8.7	0	0.3	8.8	2.5	2.9	1.0	44.5[a]
TOT MEDIUM PREY	26.2	16.7	20.4	20.7	2.5	20.7	8.2	25.2
Large Rodents	12.6	16.7	3.2	15.5	0	9.3	4.1	0
Carnivores	2.9	0	3.5	0.2	2.5	0	0.5	12.8
Lagomorphs	10.7	0	13.7	5.0	0	11.4	3.6	4.4
Armadillos	0	0	0	0	0	0	0	8.0
TOT SMALL PREY	0	0	10.1	3.8	0	0	0	2.2
Small Rodents	0	0	10.1	3.8	0	0	0	2.2
TOTAL MAMMALS	93.2	100.0	92.1	97.8	90.0	99.0	97.5	100.0
BIRDS	0	0	1.0	0	0	0	0	0
MISCELLANEOUS[b]	6.8	0	6.9	2.2	10.0	1.0	2.5	0
# Vert. Prey	103	18	316	486	40	330	200	75
# Feces	–	–	239	401	–	103	196	75
# Stomachs	103	18	–	277	40	15	–	–
Mean Body Weight	55.6	55.6	57.0	57.0	48.4	43.6	43.6	42.8
MWVP (kg)	47.1	47.8	42.3	41.0	43.0	41.0	39.8	17.1
Diet Breadth	1.6	1.4	2.4	2.2	1.4	1.7	1.3	3.6
B_{sta}[c]	0.15	0.19	0.21	0.20	0.12	0.17	0.06	0.37

[a] Includes wild hogs (*Sus scrofa*)
[b] Mainly carrion
[c] Standardized Diet Breadth

A survival tactic of cougars is food hoarding. According to Holt (1994), food hoarding is the process by which food is handled and preserved for future consumption. Holt (1994), suggested that 'food hoarders' have an advantage over non-food hoarders because they have access to food when other prey is scarce. These food cache sites can be identified by the brush, broken branches, shrubs, and other forest litter that cover the prey for later consumption (Holt, 1994). Ackerman *et al.* (1984), found that cougars normally remained in an area for many days when feeding on a larger animal. A cache of food that lasts for many days provides the cougar with a continuous food source as well as reducing the need to hunt, which consumes energy.

The cougar faces danger each time it hunts. With each hunting pursuit, the cougar is exposed to various risks of serious accidents, and debilitating injuries (Ross *et al.*, 1995). Ross *et al.* (1995), documented three fatal incidents involving cougars and their prey. Based on a necropsy, one cougar died from internal wounds caused by an adult mule deer severely kicking the cougar in the mid-dorsal region (Ross *et al.*, 1995). Additional cougar fatalities were the result of confrontations between the cougar and adult elk, mule deer, and bighorn sheep *(Ovis canadensis)*.

Ross *et al.*, (1995), documented the deaths of 50 of the 87 (57%) cougars in their study in southern Alberta. Thirty-six of the deaths (41%), were human-caused, three were unknown, and 11 of the deaths (12%), were from natural causes. At least three of the 11 naturally - caused deaths (27%), were the result of injuries sustained while pursuing prey (Ross *et al.*, 1995). Being solitary predators, the cougar lacks the support and teamwork that wolves (*Canis lupus)*, employ while hunting large game.

2.10 Competition Between Cougars, Wolves, and Bears

Studies conducted in Glacier and Yellowstone National Parks have shown that bears (*Ursus americanus, U. arctos*), frequently steal kills made by cougars (Murphy *et al.* 1998). One-seventh (14%) of the ungulates killed by cougars were scavenged by bears in Glacier National Park, whereas one-third (33%) of cougar kills were scavenged by bears in Yellowstone National Park (Murphy *et al.*, 1998). In Glacier National Park, there was no displacement of cougar kills by black bears but in 3 out of 55 cases (5.4%), there were displacements of cougars by grizzly bears and 1 in 55 displacements (1.8%), were made by an unknown bear (Murphy *et al.*, 1998). In Yellowstone National Park, black bears displaced cougars from 4 of 58 of the kills (6.9%), grizzly bears displaced cougars 1 of 58 times (1.7%), and 2 in 58 displacements (3.4%), were by unknown bears (Murphy *et al.*, 1998). According to Murphy *et al.* (1998), cougar-bear competitive encounters seem to increase during the spring and in areas where cougars, ungulates, and bears overlap in distribution, and occur at high densities.

Confrontation between cougars and bears causes energy losses which can make it difficult for the cougar to survive (Murphy *et al.*, 1998). Additional energy is expended when the cougar then attempts to kill additional prey, which also increases the risk of injury (Murphy *et al.*, 1998).

Different levels of competition exist between wolves and cougars than between bears and cougars. One difference that exists between cougars and wolves, is the manner in which they hunt. Wolves depend on their speed and endurance to overtake their prey, while cougars rely on short, surprise captures of their prey (Kunkel *et al.*, 1999). In addition to their speed and endurance, wolves hunt in packs, increasing their chances of catching prey. Cougars, however, are solitary hunters that catch their prey over a short distance (Kunkel *et al.*, 1999). The study by Kunkel *et al.*, (1999), in Glacier National Park showed that:

1. Cougars and wolves chose deer as their main prey, and killed deer of similar age, sex, and condition,
2. Cougars and wolves take prey that are most vulnerable in a group, and,
3. The hunting success for wolves was less dependent on habitat features, whereas cougars depend on habitat features for a successful hunt.

Competition with wolves for prey also increases during severe winters (Kunkel *et al.*, 1999). Deer will congregate in winter areas, where there is less snow and they stay warmer. These areas of high deer concentrations may encourage cougars and wolves to overlap in their territories, thus creating a greater chance for a confrontation (Kunkel *et* *al.*, 1999). The study by Kunkel *et al.*, (1999), two of 40 radio-tagged cougars were killed by wolves. According to (Kunkel *et al.*, 1999), cougars usually escape wolves by climbing trees. Boyd and Neale (1992), in Glacier National Park, Montana, found that confrontations between wolves and cougars were due to competition for food and habitat. One encounter ended in death when wolves trapped a cougar in a dead, branchless tree, forcing the cougar to come to the ground. The cougar was killed and dragged 15 metres away from the attack site, abandoned, and left unconsumed (Boyd and Neale, 1992).

Starvation is another concern that the cougar faces. Six of 40 radio-collared cougars were found dead from starvation in Glacier National Park (Kunkel *et al.*, 1999). These deaths could be the result of exploitation, competition, or an overall prey population decline (Kunkel *et al.*, 1999).

Cougar competition with bears and wolves is an important consideration when examining population dynamics. Competition between predators could have a significant impact on population numbers of both predators and prey.

3.0 Methods and Materials

3.1 The Study Area

The study area was located in the Whiskey Jack Forest (Figure 5), beginning approximately 30 kilometers northeast of Kenora, Ontario, and extending twenty kilometers to the northwest, past the hamlet of Jones, Ontario.

The Whiskey Jack Forest is 1,158,502 hectares in size, with a total forested landscape of 848,007 hectares - the productive forest accounting for 748,150 hectares, or 88% of the forested landscape [1]. Within the Whiskey Jack Forest, two distinct forest types can be found. The southern area of the Whiskey Jack Forest encompasses the transition zone between the Great Lakes - St. Lawrence forest, and the Boreal forest. In the Great Lakes - St. Lawrence region, conifer species such as red pine (*Pinus resinosa*), white pine (*Pinus strobus*), and cedar (*Thuja occidentalis*), are the dominant species. The remainder of the Whiskey Jack Forest is dominated by Boreal forest conditions - black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), and aspen (*Populus tremuloides*). This boreal forest has been greatly influenced by natural disturbances, such as fire, and blowdowns.

The Whiskey Jack Forest is licensed to Abitibi Consolidated Inc., under a Sustainable Forest Licence - # 54223. The Abitibi Consolidated Inc., Whiskey Jack Forest Management Plan, was prepared in February 1999, for a 20-year period from April 1999 to March 31, 2019, with five-year increments for revisions, under the

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[1]This information is located in the Ontario Ministry of Natural Resources and Abitibi Consolidated Inc. 1999. The Forest Management Plan for the Whiskey Jack Forest Kenora District, Northwestern Region.

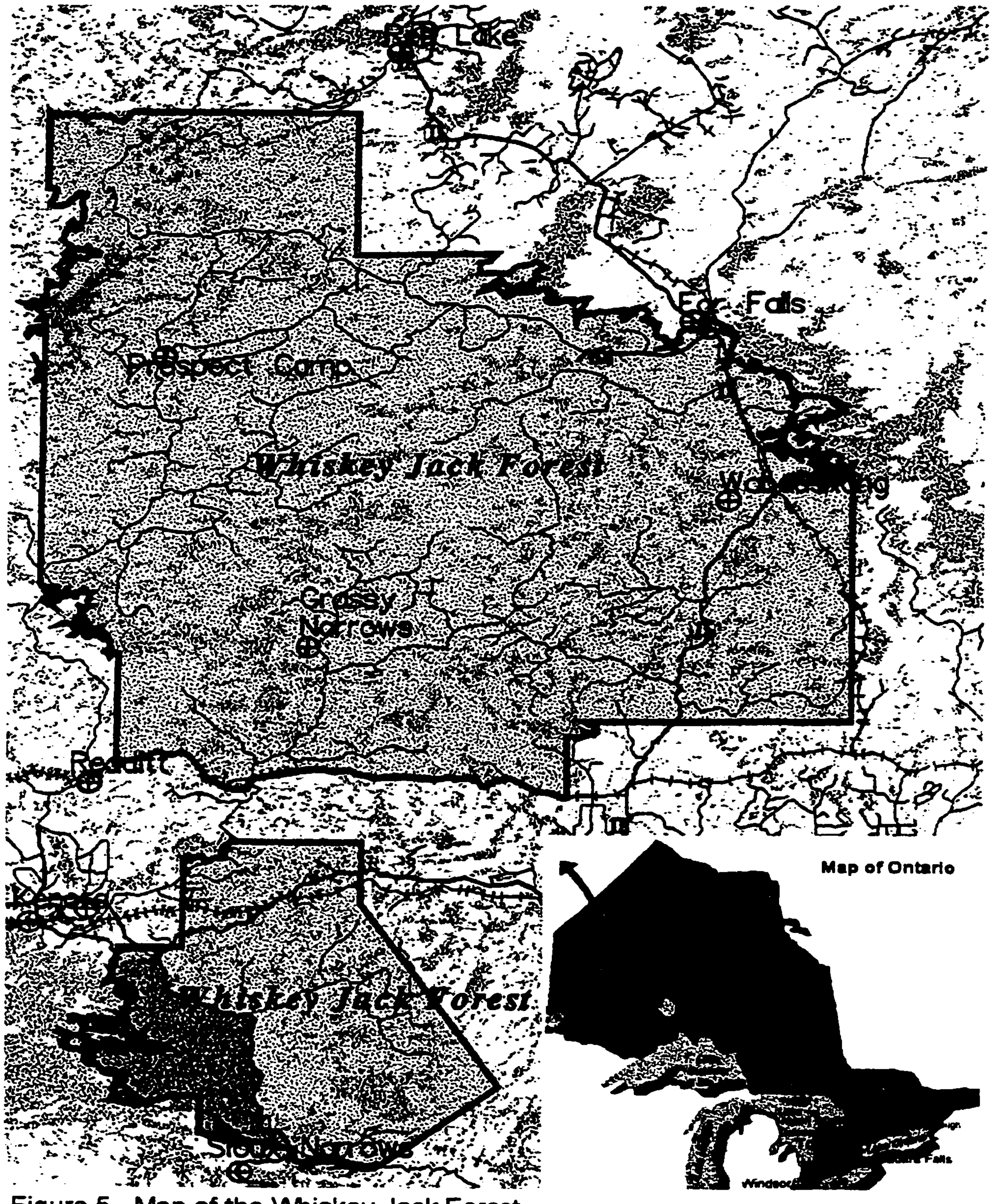


Figure 5. Map of the Whiskey Jack Forest

authority of the Crown Forest Sustainability Act (1995).

3.1.1 Jones Study Area

Jones is a small hamlet located approximately 40 kilometres northeast of Kenora. The CN Railway runs parallel to many of the 10 transects that were surveyed (Appendix I). The terrain consists of open and treed muskeg, brush and alder, as well as, many small lakes. There are also many rocky cliffs and hills that surround many of the transects. The dominant tree species are jack pine, white birch (*Betula papyeifera*), poplar, and black spruce.

In the Jones Study Area, 10 transects that contained 17 different ecosites were surveyed. Table 5 lists all of the ecosites, ecosite splits (when a transect runs along the border of two different ecosites), and the accumulated length in metres for each ecosite that occurred in the Jones Study Area. Appendix II, indicates the length of each ecosite per transect, as well as the ecosite identified in each interval. Of the 17 different ecosites in the Jones Study Area, eight were ecosite splits. In addition, there are also large areas of rock in each of the study areas, identified as 'Rk' (rock), on the Forest Resource Inventory Base Map (F.R.I.). Rock is not classified as an ecosite (according to the M.N.R. F.R.I. Base Maps for the study areas), and has no classification as such. However, the areas classified as rock/bedrock, are not completely bare. Trees, shrubs, mosses, and lichens grow on and around the rock, providing habitat for a variety of species.

Table 5. Total accumulated trail length, in metres, by ecosite, in the Jones Study Area.

Ecosite	Length (m)
11	2850
13	1520
14	980
19	2900
20	890
26	160
28	360
31	310
Rock	870
Rock/11	332
Rock/13	350
Rock/19	200
Rock/20	90
ES 11/20	120
ES 11/26	90
ES 19/13	40
ES 19/20	230

3.1.2 Silver Lake Study Area

The 11 transects (Appendix III), in this study area consist of brush, alder, and open and treed muskeg. Silver Lake is the largest lake in the area. Herb Lake, a cold water lake, is located approximately 3 kilometres east of Silver lake, and is surrounded by many medium sized lakes scattered throughout the area.

Jack pine, black spruce, poplar and cedar are the dominant tree species found in the area, with trees ranging in age from 15 to 150 years old. Many areas, however, do not have tree age and height specifications documented. In the Silver Lake Study Area, 11 transects were surveyed, containing 18 different ecosites. Table 6., lists the ecosites, ecosite splits, and the accumulated trail length in metres for each ecosite, that occurred in Silver Lake Study Area.

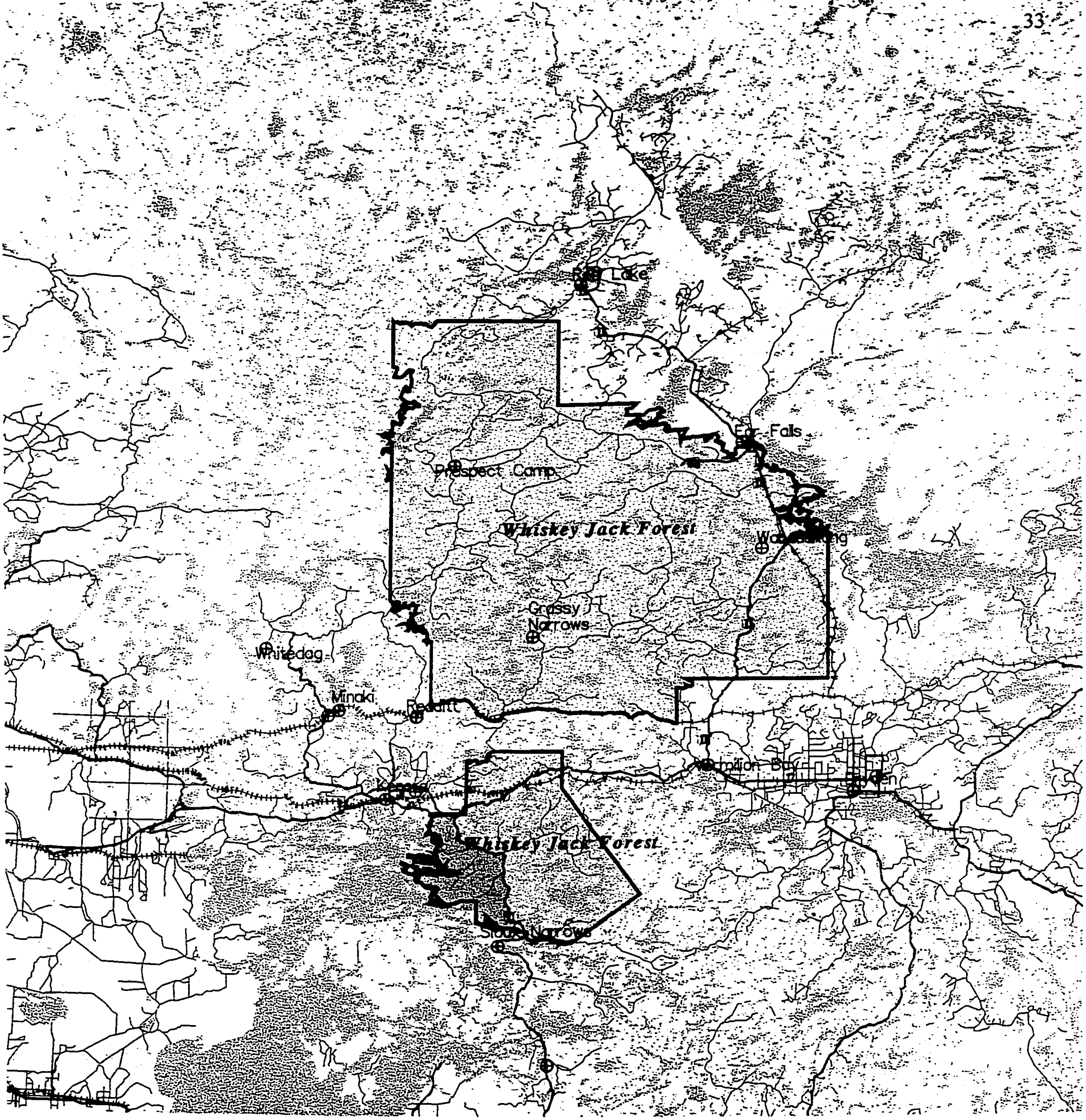
Of the 18 different ecosites identified in the Silver Lake Study Area, nine ecosites were splits. Appendix IV, lists the ecosites found in each interval, in each transect . As in the Jones Study Area, there are also large areas of rock, identified as 'Rk' on the Forest Resource Inventory Base Map (F.R.I.).

Table 6. Total accumulated trail length, in metres, by ecosite, in the Silver Lake Study Area.

Ecosite	**Length (m)**
11	6140
12	1540
13	5160
14	3890
19	1760
20	390
22	1400
23	1840
Rock	1270
Rock/11	530
Rock/19	70
ES 11/13	160
ES 11/19	200
ES 14/13	60
ES 14/22	210
ES 14/23	90
ES 14/25	150
ES 23/13	50

One particular area of interest in the Whiskey Jack Forest Management Plan, that is related to my study, is the section concerning the habitat of selected wildlife species. Habitat for selected wildlife species is used as an indicator to measure the sustainability of a forest. The various management zones for moose, deer, and caribou in the Kenora area, highlights the areas that support various ungulate populations (Figure 6). The Whiskey Jack Forest is also managed to enhance habitat for American marten (*Martes americana*), to maintain or to enhance moose habitat, to maintain or enhance deer winter concentration areas where the deer are the featured species, and to enhance osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), spruce grouse (*Dendragapus canadensis*), great grey owl (*Strix nebulosa*), pileated woodpecker (*Dryocopus pileatus*), woodland caribou, and snowshoe hare.

Figure. 6 Ungulate Management Areas of the Whiskey Jack Forest for Caribou, Deer, and Moose (See Footnote 1).



Ungulate Management Areas Key Map.

Caribou Management Area

Moose Management Area

Deer Management Area

Scale = 1 : 1352611

3.2 Data Collection

Observing animal tracks and trails in the snow is a good technique to use when studying mammal distributions, including rare and wide-ranging species (Beauvais and Buskirk, 1999). The animal's tracks and trails are readily identifiable, and the snow assists in preserving a relatively continuous record of animal movements which occur between snowfalls (Beauvais and Buskirk, 1999). Snow-trail surveys can help to create indices of relative occurrence which can then be compared across species and habitat types (Thompson *et al.*, 1988 cited in Beauvais and Buskirk, 1999).

Within the study areas, four-metre-wide transects that ranged in length from approximately 440 metres to 4400 metres, were chosen as representative sites, to determine the habitat and prey availability. Each transect was divided into 10 metre intervals. This method allows the data to be accumulated by ecosite, facilitates an analysis of data from different ecosites, and allows for correlation studies of ecosites with prey abundance.

Within each 10 metre interval, animal tracks that crossed the transect, or that were within the four metre width of the transect were counted. Appendix V shows an example of the tracking sheet which was used to record tracks and trails identified in each transect interval.

The transects to be studied were chosen after analysing Ministry of Natural Resources 1: 20 000 map sheets 20 15 4100 55200, 20 15 4200 55200, 20 15 4200 55300, and 20 15 4100 5530. All of the transects were on old logging roads established several years prior to the study. The specific transects chosen were marked in the field with flagging tape to aid in the location of the study sites during the winter months.

To ensure accurate data collection in the snow, certain requirements must be met. Thompson *et al.*, (1988), suggests that transects should be surveyed 12 - 96 hours after a snowfall. Additional requirements for accurate snow tracking and track identification are:

1. The snow must be of a sufficient depth for the prints to register clearly,
2. The snow must be soft enough, or of the correct density for the registered prints to express details and specific characteristics to make them identifiable as belonging to a particular species,
3. There must be a sufficient amount of new snow to cover all old tracks, and
4. Tracks must not have degraded, or distorted from exposure to direct sunlight and warm conditions (Zielinski and Kucera, 1996).

3.3 Cataloging Animal Tracks

To assist with the identification of animal tracks, three animal tracking books were used. They were: (1) The Field Guide to Tracking Animals in the Snow, (Forrest, 1988); (2) Animal Tracks of Washington and Oregon, (Sheldon, 1997); and (3) Tracking and the Art of Seeing, (Rezendes, 1992). Each of these references assisted with identifying individual animal tracks, trails, gaits, and any other track identification that was required.

For the purpose of this study, animals tracks are defined as either a single print made by a particular species, or a single continuous line of prints (a track) belonging to a single animal of a particular species. A continuous animal track that crossed the transect more than once, but stayed within the maximum four metre width was counted once. However, if the animal track extended outside of the maximum four metre width (where visibility was obscured) on either side of the transect, and traveled into the bush beyond the line of sight and then returned and crossed the transect again further ahead, but still in the same interval, the returning animal track was counted a second time. This method of counting takes into consideration that there was no way of knowing whether the same animal was responsible for making all of the tracks that crossed in and out of an interval.

If a single animal track from a particular species ran down the centre of the transect, and continued throughout the entire interval, and then continued in this same manner throughout many of the following intervals, this single animal track was considered to be one animal track of that particular species, and was counted as such in every interval in which this continuous animal track occurred, in that transect.

3.3.1 Cataloging Animal Trails

Animal trails are defined as multiple animal tracks (multiple, continuous lines of prints) that belong to a particular species. These animal trails are generally concentrated in a particular area, and form paths that are well-used. These animal trails may have crossed the transect, or ran the length of the transect. It was, however, very difficult to distinguish whether an animal trail was made by several animals of a particular species, or by a single animal that may have traversed the same path many times. As well, the animal trail could have had bi-directional traffic versus uni-directional traffic - some of the snowshoe hare trails were double, and even triple width. An animal trails were counted in the same manner that animal tracks were counted.

The numbers of tracks and trails collected in Jones, and Silver Lake Study Areas may represent a single animal walking up a transect and therefore, it may have been counted each time it entered a 10 metre interval. If one wolf, for example, walked through 176 intervals (1760 metres) then the completed information states that 176 wolf tracks have been identified in the transect. One hundred and seventy six wolf tracks made by one wolf are not a indication of density, just an indication of relative abundance.

3.4 Ecosite Descriptions

The Whiskey Jack forest is composed of 28 ecosites. Table 7 illustrates the different ecosites and the area, in hectares, each ecosite covers.

Table 7. Ecosite Type Summary on the Whiskey Jack Forest (O.M.N.R., 1999, p.75). (See footnote)

Ecosite	Area (Ha)	Ecosite	Area (Ha)
11	40586.42	25	10029.22
12	39032.68	26	39517.57
13	168274.68	27	8155.46
14	75789.36	28	62970.47
15	2200.37	29	12167.7
16	13050.53	30	1332.41
17	3060.55	31	13691.17
18	850.01	32	538.69
19	85130.81	33	1185.61
20	105909.01	34	5531.25
21	11736.75	35	8486.49
22	18264.22	36	2595.41
23	15098.43	37	422.74
24	1029	38	528.89

There were 18 ecosites identified within and surrounding the study areas (Table 8.), using F.R.I. base maps 41553, 42553, 41552, and 42552. Six dominant ecosites covered a large portion of the transects within the study area. They were: ecosites 11, 13, 20, 12, 14, and 19 respectively by area.

Table 8. Ecosites, with the total number of hectares per ecosite.

Ecosite	**Number of Hectares**	**Percentage of Study Area**
11	2775	27.4
12	768	7.6
13	2661	26.3
14	753	7.4
15	18	0.17
16	322	3.1
19	690	6.8
20	958	9.4
21	71	0.7
22	306	3.0
23	246	2.4
25	19	0.1
26	173	1.7
28	182	1.8
31	101	0.9
34	9	0.08
35	44	0.4
37	14	0.1
18 ECOSITES	**10,110 Hectares**	**100%**

The following are general descriptions of the six dominant ecosites provided in the Ministry of Natural Resources (1997): Silvicultural Guide to Managing for Black Spruce, Jack Pine, and Aspen on Boreal Forest Ecosites in Ontario: Book 2: Ecological and Management Interpretations for Northwest Ecosites.

Ecosite 11

Conifer dominant stands with red, white, and jack pine. Aspen, large-toothed aspen, white birch and white spruce occur occasionally. White cedar may be locally abundant. Shrub and herb-poor.
Soils very shallow (less than 20 cm) with bedrock outcrops. Ground cover consists of bedrock, needle litter, feathermoss and lichen.

Ecosite 13

Jack pine dominated, often consisting of even-aged stands. Black spruce sparse to abundant, white birch and trembling aspen may be present. Feathermoss abundant under closed canopy; replaced by lichens under open canopy. Soils dry to moderately fresh, rapidly to well drained, coarse to fine sandy. Predominately on glacial-fluvial or lacustrine parent materials. Ground cover consists of feathermoss, lichen and conifer litter.

Ecosite 20

Overstory dominated by black spruce and jack pine. Scattered occurrences of trembling aspen, white birch, and fir. Usually shrub- and herb- poor, but may be locally rich where silt content is higher. Soils dry to fresh, rapidly to well drained, fine to coarse sandy and coarse loamy. Primarily on morainal and glaciofluvial parent material. Ground cover consists of feathermoss and conifer litter.

Ecosite 12

Overstory open and patchy to close-crowned. Dominated by black spruce and jack pine. Balsam fir and trembling aspen in patches. Shrub- and herb-poor. Soils very shallow (<20 cm) with bedrock outcrops. Bedrock frequently covered only by shallow litter layer. Ground cover consists of bedrock, needle litter, lichen and feathermoss.

Ecosite 14

Overstory dominated by jack pine and black spruce with mixtures pf white birch and aspen. Understory variable but usually abundant herbs and shrubs. On deeper sites, soils moderately dry to moderately fresh, rapidly to well drained, coarse to fine sandy. On shallow to moderately deep sites, soils predominantly morainal. Ground cover consists of feathermoss, conifer and broadleaf litter.

Escosite 19

Dominated by trembling aspen, white birch and balsam fir, with occasional occurrences of white and black spruce. Deciduous tree component exceeds 50% of the canopy. Understory composition variable; shrub- and herb- rich. Soils are fresh, well drained, coarse loamy to fine sandy. Parent materials are commonly glaciofluvial on deep soil sites and morainal on shallow sites. Ground cover consists of broadleaf litter, conifer litter, wood and feathermoss

3.5 Snow Tracking Quality

Snow tracking quality (STQ) is defined by Zielinski and Kucera (1996 p. 129), as " the ability of the snow to preserve an identifiable foot print and trail". Snow tracking can be difficult when there are extreme changes in temperature. During periods of melting and freezing, tracks can be distorted making it hard to identify the species that left the track. Snow tracks can change in shape and size due to changes in weather, or due to an abundance of varying tracks, making it difficult to identify and measure individual tracks. If melting and freezing occurs, it is necessary to identify tracks early in the morning before distortion is too great (Zielinski and Kucera, 1996).

STQ values were calculated for each transect that was surveyed. A rating from zero to four (zero being unidentifiable, and four being the best quality track possible) was used to rate the quality of the prints left by the animals, while taking into consideration snow conditions, temperature, exposure to sunlight, and other factors that affect the quality of tracks in the snow (Table 9). Decimal ratings (3.7 for example) were used to indicate intermediate conditions (Zielinski and Kucera, 1996). Any track that registered as a 0 or 1 on the STQ scale was not included in data analysis because it was unidentifiable.

Table 9. Snow tracking quality ratings (Zielinski and Kucera, 1998, pp.129).

Rating	Description
0	Unacceptable; target species does not leave enough prints to identify gait patterns left on trail.
1	Poor, many prints do not register. Track details lacking. Identification is essentially by gait patterns, and may be possible only in microtopographic sites.
2	Acceptable; some prints fail to register, and footprint details, if present, are visible only by microtopographic sites. Identification based primarily on gait patterns.
3	Good; every print registers but details are weak. Perhaps obscured by snow falling in print. Print details usually visible in microtopographic sites e.g. tree wells and shadows. Identification is based in track details, but gait patterns offer needed support.
4	Best; every footprint registers, and detail within prints is very clear. Species identification is essentially absolute based on track details.

4.0 Results

Field observations took place between January 14th, and February 6th, 2000. According to Thompson *et al.* (1988), when conducting transect studies, it is best to conduct them in the early winter (before mid December), to " reduce variance from over-winter mortality...". However, there was no snow cover during the month of December. Snow did not accumulate until early January, 2000.

I was not able to collect definitive evidence such as scat, photos, or video footage of a cougar in the study areas. The area around Herb Lake, where there had been a positive identification of a cougar in 1998 was surveyed, but did not contribute any additional evidence to identify the presence of a cougar. There were, however, many tracks from a cat in the Herb Lake area, specifically on transect 7. Some of these tracks matched the patterns of gait, stride length, stride width, and print size that fall within the established ranges for cougar. Without a photograph of a cougar or a scat sample, however, it cannot be assumed that the tracks were made by cougar. Thus, the identification of those tracks were recorded as lynx, as lynx and cougar tracks can be similar, and fall within similar stride and straddle ranges.

4.1 Jones Study Area

The Jones Study Area, had eight different species of wildlife identified in the area (Table 10). Appendix VI, lists each transect, and the number of animal tracks and trails identified in each transect, for all wildlife species found in the Jones Study Area.

Table 11, lists by ecosite, the abundance of animal tracks and trails per 10 metres within the Jones Study Area. In addition, Appendix VII, lists the total number of animal tracks and trails per 10 metres.

The five ecosites with the greatest abundance of animal tracks or trails, per 10 metres, in the Jones Study Area, were ecosites 19/13 (1.25/10m), 28 (1.12/10m), 31 (.96/10m), 11/20 (.58/10m), and rock/13 (.57/10m) (Appendix VII). Wolf tracks were the most abundant animal tracks in the Jones Study Area. In ecosite split 19/13, 1.25 wolf trails/10m, were recorded, followed by ecosite 28 with 1.06 wolf trails per 10 metre interval (Appendix VII).There were no deer or moose, tracks or trails found in the Jones Study Area.

Table 10. Jones Study Area - number of transects with tracks, trails, and tracks and trails combined (expressed as a percentage of the total number of transects). Transects (N = 10).

Species	Tracks	Trails	Either Tracks/Trails
snowshoe hare	8 (80%)	5 (50%)	9 (90%)
wolf	4 (40%)	2 (20%)	5 (50%)
fox	8 (80%)	1 (10%)	9 (90%)
weasel	4 (40%)	0	4 (40%)
rodent	10 (100%)	0	10 (100%)
bird	3 (30%)	0	3 (30%)
moose	0	0	0
lynx	1 (10%)	0	1 (10%)
marten	1 (10%)	0	1 (10%)
beaver	0	0	0
porcupine	0	0	0
deer	0	0	0
coyote	0	0	0

Total species detected in all study areas = 13
Total species detected in Jones study area = 8 (72.7% of Total)

Table 11. Abundance of animal tracks and trails, per 10 metres, per ecosite, in the Jones Study Area.

Ecosite	Tracks and Trails/10m
11	0.25
13	0.56
14	0.22
19	0.12
20	0.33
26	0.5
28	1.12
31	0.96
Rock	0.54
[1]Rock/11	0.12
Rock/13	0.57
Rock/19	0
Rock/20	0
ES 11/20	0.58
ES 11/26	0.22
ES 19/13	1.25
ES 19/20	0.08

1. Ecosite Split

4.2 Silver Lake Study Area

There were 13 different species of wildlife identified in the Silver Lake Study Area. Table 12, lists each of the 13 species identified in the study area, and the percentage of occurrences of animal tracks, trails, and tracks and trails combined, in all of the transects in the Silver Lake Study Area. Appendix VIII, lists each transect and the number of animal tracks and trails identified in each transect, for the 13 different wildlife species found in the Silver Lake Study Area. Appendix IX, lists the total number of animal tracks and trails per 10 metres, found in each transect.

Table 12. Silver Lake Study Area - number of transects with tracks, trails, and tracks and trails combined (expressed as a percentage of the total number of transects). Transects (N = 11).

Species	Tracks	Trails	Either Tracks/Trails
snowshoe hare	11 (100%)	11 (100%)	11 (100%)
wolf	3 (27.3%)	2 (18.2%)	3 (27.3%)
fox	5 (45.4%)	0	5 (45.4%)
weasel	9 (81.8%)	2 (18.2%)	9 (81.8%)
rodent	10 (90.9%)	2 (18.2%)	10 (90.9%)
bird	6 (54.5%)	0	6 (54.5%)
moose	7 (63.6%)	4 (36.4%)	8 (72.7%)
lynx	7 (63.6%)	3 (27.3%)	7 (63.6%)
marten	3 (27.3%)	0	3 (27.3%)
beaver	1 (9.1%)	0	1 (9.1%)
porcupine	1 (9.1%)	0	1 (9.1%)
deer	1 (9.1%)	1 (9.1%)	1 (9.1%)
coyote	1 (9.1%)	0	1 (9.1%)

Total species detected in all study areas = 13
Total species detected in Silver Lake study area = 13 (100 % of Total)

Snowshoe hare was the most abundant animal species found in the Silver Lake study area. See Table 13, for a breakdown of snowshoe hare numbers. Ecosite split 19/rock had the highest number of snowshoe hare tracks per 10 metre interval (1.86 snowshoe hare tracks/10m). Lynx, rodent, moose, and weasel (*Mustelidae*) tracks were also abundant throughout the Silver Lake Study Area.

Table 13. Snowshoe hare track abundance, per ecosite, per 10 metres, in the Silver Lake Study Area.

Ecosite	Total Distance (m)	Tracks	Tracks per 10m
22	1400	36	0.26
13	5160	545	1.06
11	6140	581	0.95
19	1760	205	1.17
14	3890	166	0.43
20	390	8	0.21
rock	1270	134	1.06
23	1840	20	0.11
12	1540	117	0.76
[1]Es 14/25	150	14	0.93
Es 14/13	60	0	-
Es 14/22	210	1	0.05
Es 11/13	160	2	0.13
Es 14/23	90	0	-
Es 23/13	50	0	-
Es 19/11	200	0	-
Es 19/rock	70	13	1.86
Es rock/11	530	37	0.7

1. Ecosite Split

Table 14, shows by ecosite, the abundance of animal tracks and trails per 10 metre interval within the study area. The five ecosites that have the highest abundance of animal tracks and trails per 10 metres, per ecosite, in the Silver Lake Study Area, were ecosites: 19/rock (3.57/10m), 19 (3.15/10m), 13 (2.33/10m), 11 (2.30/10m), and 12 (2.14/10m) (Appendix IX). Deer tracks and trails were found only in ecosite 11; deer tracks were .001/10m and deer trails were .011/10m.

Table 14. Abundance of animal tracks and trails, per 10 metres, per ecosite, in the the Silver Lake Study Area.

Ecosite	Tracks and Trails/10m
11	2.3
12	2.14
13	2.33
14	1.46
19	3.15
20	0.82
22	0.53
23	1.19
Rock	2.06
[1]Rock/11	2.13
Rock/19	3.57
ES 11/13	0.69
ES 14/13	1.17
ES 14/22	0.19
ES 14/23	0.22
ES 14/25	1.67
ES 19/11	1.95
ES 23/13	0.01

1. Ecosite Split

4.3 Abundance of Animal Tracks and Trails by Ecosite

There are eight ecosites that are identified as being common to both of these study areas (Table 15).

Table 15. Combined totals of transect lengths within an ecosite, for the Silver Lake and Jones Study Areas, expressed as a percentage of the total transect length, for the eight common ecosites, found in the Silver Lake and Jones Study Areas.

Ecosite	Length (m)	Percentage
Ecosite 11	8990 metres	30.2
Ecosite 13	6680 metres	22.5
Ecosite 14	4870 metres	16.4
Ecosite 19	4660 metres	15.7
Ecosite 20	1280 metres	4.3
Rock	2140 metres	7.2
Rock/11	862 metres	2.9
Rock/ 19	270 metres	0.9
Total	**29,752**	**100**

The total length of the combined ecosites is 29,752 metres (Table 15). Ecosite 11 is the largest ecosite, at 8990 metres in length, followed by ecosite 13, at 6680 metres in length. The ecosite that had the highest abundance of animal tracks and trails within the eight common ecosites, in the study areas, was ecosite 13, with 1.94 animal tracks and trails per 10 metres (Table 16). Appendix X, lists the total number of animal tracks and trails found in the eight common ecosites in the study areas. Appendix XI, shows the total amount animal tracks and trails, per 10 metres from the ecosites that the Jones and Silver Lake study area share.

Table 16. The eight common ecosites in the entire study areas, with total animal track and trail abundance, per 10 metres.

Ecosite	Total Animal Track and Trail Abundance
13	1.94
11	1.65
Rock	1.46
19	1.42
14	1.21
Rock/11	1.05
Rock/19	.92
20	.46

5.0 Discussion and Conclusions

Based on the data in Table 16, I am unable to find a clear relationship between ecosites, and animal activity in the winter time. Based on knowledge of wildlife habitat, ecosite 19 seems to provide the best habitat for various mammals in the forest. This ecosite is a diverse mixture of hardwood, fir, spruce mixed wood with fresh, sandy-coarse loamy soil. Ecosite 13, however, - a jack pine, conifer, area with dry-moderately fresh, sandy soil - had the highest animal abundance (1.94/10m). This was surprising because ecosite 13 had a relatively low diversity of vegetation compared to ecosite 19 that had a more diverse ecosystem.

Factors influencing the animals to choose one ecosite over another during the winter may not necessarily be related to ecosite characteristics, but may be due to influence by predators or the weather. It would be difficult to understand why animals are not utilizing the ecosites that the *Ecological and Management Interpretations for Northwest Ecosites* (1997), guide book would indicate as being the optimum ecosite. Various environmental factors may be influencing the movement of mammals throughout the forest, thus different ecosites will have an abundance of wildlife while other ecosites will have very little wildlife presence.

Cougars are more inclined to reside in areas that provide adequate stalking cover, including rocky cliffs and outcrops that give the vertical advantage that cougars use for hunting. Even though ecosite 13 may not be the optimum ecosite for the mammals that I identified, it was ecosite 13, that had more rocky cliffs as well as hills and valleys that could provide optimum hunting habitat for the cougar. In addition there is also substantial tree-shrub cover in ecosite 13, to provide food, habitat, and protection for other species.

My opinion, is that the Jones Study area has less animal activity because: train tracks run through the area which could cause disturbance; and the area has many wide open spaces where timber-harvesting has occurred, leaving large areas with no tree cover or protective habitat. The Silver Lake study area has more tree cover, shrubs, cliffs and many small rivers and swamps that could be used as water sources. There is less disturbance in the Silver Lake transects except for occasional snowmobilers using the trails and lakes. Most of the wolf tracks and trails identified in the Jones transects were found on the packed snowmobile trails we made, and then diverged into the forest. Some wolf tracks ran parallel to the packed trail but it seemed using the trail was easier for travel.

During the first week of September 2000, a report was made to Lillian Anderson, of a cougar sighting located in the study area. The sighting has not been listed as a 'positive identification' because the tracks were not studied, nor was a picture taken. The individuals who reported the sighting have ample bush experience and were able to determine that the cat was neither a lynx or a bobcat. The individuals were able to view the cat from 150 feet (at the closest point) where the golden colored, short haired ,and long tailed cat was then recognized as a cougar (L. Anderson, pers. comm, 2000).

Snowshoe hare tracks and trails, lynx tracks, rodent tracks, and wolf tracks were the most abundant animal activity found in the Silver Lake Study Area. In the Jones Study Area, wolf trails, snowshoe hare tracks, rodent tracks, and fox tracks were the most abundant animal activity.

5.1 Snowshoe Hare

Snowshoe hare are not the primary prey of the cougar. However, cougars may rely on snowshoe hare to sustain themselves during short periods when larger prey, such as deer and moose are scarce and hare populations are high. In British Columbia, during years of high snowshoe hare densities, the cougar's diet contained 27% snowshoe hare, which indicates that cougars took advantage of the abundant snowshoe hare population (Spalding and Lesowski, 1971). The cycles of snowshoe hare may mean they are not a reliable source of food for large predators.

The cyclic nature of snowshoe hare populations has been studied for many years (Mowat *et al.*, 1996; Keith *et al.*, 1993). One recent study in the Yukon illustrated widespread changes in snowshoe hare abundance from approximately 1 to 400 hares on a 60-hectare trapping grid during a 10-year population cycle (Boulanger and Krebs, 1996). Snowshoe hares typically have relatively high birth rates with corresponding high death rates (Haydon *et al.*, 1999). During the summer period, female snowshoe hares can have three to four litters, of three to eight young each resulting in as many as 20 offspring in one breeding season (Haydon *et al.*, 1999).

In the Yukon, hare densities had a peak and decline point that fluctuated throughout the study (Mowat *et al.*, 1996). The mean densities of snowshoe hare were calculated at 5.7 hares per hectare during 1989-90, which then increased to 7.4 hares per hectare in 1990-91, but then decreased to 4.7 hares per hectare in 1991-92, and to 1.3 hares per hectare in 1992-93 (Mowat *et al.*, 1996).

According to Haydon *et al.*, (1999), the snowshoe hare has a maximum rate of increase of tenfold per year, provided that there exists an even sex ratio. During a 10-

year population cycle, there has been an increase from 0.2 to 4.0 hare per hectare per year with equally high change in both the birth and death rates over the cycle (Haydon *et al.*, 1999).

The Whiskey Jack Forest has not been surveyed to determine the cycles of certain small mammals, such as snowshoe hares, although 10-year cycles are expected here, as elsewhere. High snowshoe hare track and trail numbers identified in the study area could indicate that the snowshoe hare population is approaching a peak in its cycle.

Cougars would have a chance of surviving on snowshoe hare during a peak but would suffer when there was a decline, and face competition for snowshoe hare with lynx and other hare predators. Peak snowshoe hare numbers based on studies noted above range from 5.0 to 7.0 per hectare. This density in northwestern Ontario may keep a cougar population supported for a short time when deer numbers are low, but probably could not support cougars without other prey for an extended period.

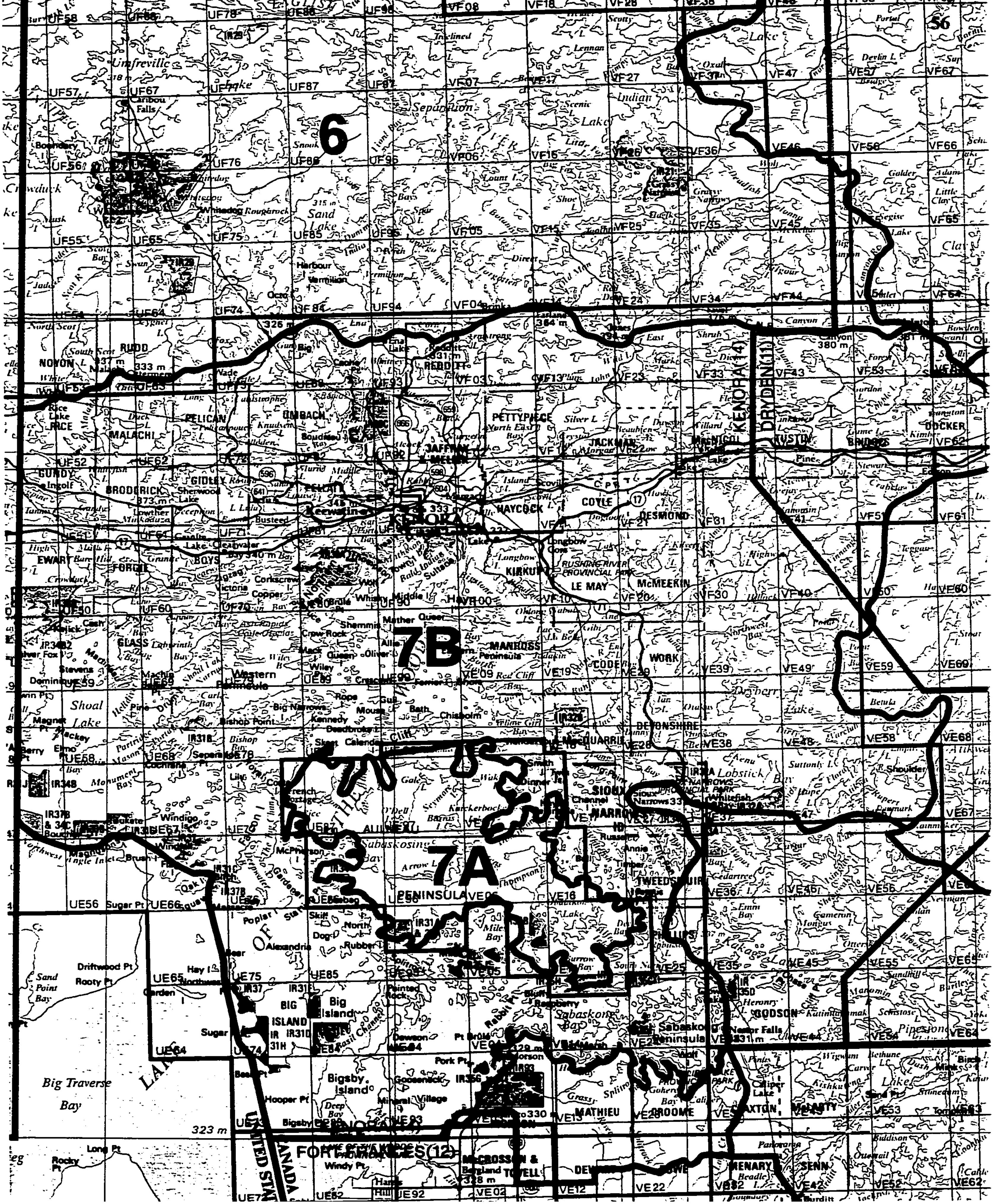
5.2 Ungulate Distribution

5.2.1 Deer

Lillian Anderson, the local Wildlife Technician in Kenora (L. Anderson, pers. comm. 2000), has indicated that deer inhabit areas north of Kenora, although the use of the forest varies from year to year. During some winters the deer occupy land further south of the train tracks in Wildlife Management Unit (WMU) 7B and sometimes north of the train tracks in WMU 6 (Figure 7).

During the winter months, both WMU 7B, and 6 usually have less than one deer per square kilometre. In the summer months, there may be a maximum of five deer per square kilometre, but it is more likely that there will be one to three deer per square kilometre (L. Anderson, pers. comm, 2000). The wintering area for deer is approximately 20 - 25 kilometres away from the study area, and may have 10 to 15 deer per square kilometre (Anderson, personal communication, 2000). The total estimated population of deer in 7B is 15,000 to 25,000 post-fawning (L. Anderson, pers. comm, 2000). During the post-fawning season, cougars would have enough deer to support them. However, during the winter with the deer numbers being so low, cougars may have to travel further to find food, or follow the deer to the wintering areas. Cougars could also prey upon alternative resources such as snowshoe hare or moose until the deer became more available.

Figure 7. Wildlife Management Unit - Illustrating Units 6 and 7B (MNR, 1992). Map Scale is 1:600,000.


6
7B
7A
56
KENORA
KENORA (4)
DRYDEN (11)
FORT FRANCES (12)
Umfreville
Caribou Falls
Separation Lake
Indian Lake
Sand Lake
Whitedog
RUDD
NOVON
RICE
MALACHI
PELICAN
UMBACH
REDDITT
PETTYPIECE
JAFFRAY & MELICK
JACKMAN
GUNDY
BRODERICK
GIDLEY
HAYCOCK
COYLE
DESMOND
EWART
FORGIE
BOYS
KIRKUP
LE MAY
McMEEKIN
GLASS
MANROSS
WORK
CODE
DEVONSHIRE
McQUARRIE
SIOUX NARROWS ID
TWEEDSMUIR
PHILLIPS
GODSON
MATHIEU
BROOME
PAXTON
McCROSSON & TOVELL
DEVLIN
MENARY
SENN
RUSHING RIVER PROVINCIAL PARK
SIOUX NARROWS PROVINCIAL PARK
Shoal Lake
Western Peninsula
Sabaskong Bay
Big Traverse Bay
Big Island
Bigsby Island
UNITED STATES
CANADA
Lobstick Bay
Kakagi Lake
Dryberry Lake
Keewatin

5.2.2 Moose

A possible explanation for the abundance of moose tracks, is that during the data collection process in the Silver Lake Study area, a moose survey was being conducted by the MNR, using helicopters. This may have increased moose movement.

The moose density in WMU 6 is approximately .75 moose per square kilometre (approximately 2600 moose per unit), and in the WMU 7B, there is an estimate of .4 moose per square kilometre (approximately 1700 per unit). These moose number estimates are midwinter - January populations (L. Anderson, pers. comm. 2000).

In the Sheep River area of southwestern Alberta, 4.4% of the prey killed by female cougars were moose. However, moose only constituted 12% of the prey biomass consumed in winter by females (Ross and Jalkotzy, 1996). For male cougars, moose made up 69% of the prey killed, although, moose accounted for 92% of the prey biomass they consumed during the winter season (Ross and Jalkotzy, 1996). In the Sheep River, 50 moose were killed by cougars; 44 were calves (88%), and the remaining 6 were yearlings (12%), aged 13 - 20 months (Ross and Jalkotzy, 1996). Ross and Jalkotzy (1996) suggested that cougars avoided adult moose and concentrated more on hunting calves and yearlings. In their study area, Ross and Jalkotzy (1996), found that eight radio-collared male cougars killed 25 different animals - 18 were moose (64%), with 16 of the moose being calves and 2 being yearlings. Adult moose however, are not the ideal prey for the cougar to pursue. Unlike pack hunting techniques employed by wolves, cougars are solitary hunters, and face greater danger when hunting large adult moose (Kunkel *et al.*, 1999 .

5.3 Wolves

Wolves compete with cougars, and have even been known to kill cougars. Direct interactions, however, between cougars and wolves are an uncommon occurrence, with fatal encounters being quite rare (Boyd and Neale, 1992). Deer are the preferred prey for cougars and for wolves; therefore, it is important to determine if there would be competition for resources and habitat between wolves and cougars. Both wolves and cougars greatly influence the communities they inhabit (Kunkel *et al.*, 1999). The density of wolves and cougars in Glacier National park was approximately 10 wolves/1000 square kilometres and 70 cougars/1000 square kilometres. A wolf study conducted near Glacier National Park in the North Fork Basin from 1992 to 1996 found that wolves killed a greater proportion of less healthy prey, including fawns and calves than in the population as a whole. The prey that were killed were in poorer nutritional condition, and were larger prey species (Kunkel *et al.*, 1999). Due to the cougar's hunting technique (stalking, with little chase), they are more inclined to kill stronger, healthier prey; which increases the chances of injury to the cougar (Kunkel *et al.*, 1999). The implications of wolf activity in the study area for cougars is that there may be more competition for prey and habitat, and that there may be a possible increase in confrontations between wolves and cougars, which could have negative impacts on cougars.

5.4 Conclusions

Overall, with the information that was collected and analysed, I suspect that a population of cougars could not survive in the selected study areas.

The objectives of this research project were to evaluate sections of the Whiskey Jack Forest in northwestern Ontario, for its potential to support a viable cougar population. The Jones and Silver Lake Study Areas had a variety of forest conditions that could very well provide a cougar with required habitat for survival. There are ample rocky outcrops and high vantage points that a cougar could utilize for hunting and denning. The physical characteristics of the study areas seem to be consistent with the cougar habitat requirements. However, a more in-depth, long-term study that focuses on consecutive winters exploring and surveying the entire Whiskey Jack Forest is required for a better analysis.

The potential of prey to support cougars in the study areas was inconclusive. Deer do not winter in the same area that the research took place, although this was the area where a cougar was positively identified two years ago. The deer were concentrated further south and west from the study sites, although the weather conditions could have made the deer travel further south from the study area. There were abundant snowshoe hare in the study area, that might provide a cougar with a source of food until deer become more available. Moose were also fairly abundant in the study area, and might support a cougar population for a limited period, when other prey are scarce.

The Whiskey Jack Forest is relatively large with a variety of habitats that support different wildlife. However, with the information collected from this study, the potential of the prey base to support a cougar population is uncertain. One interpretation of the results is that overall, prey necessary to support a viable cougar population was not found in the surveyed area; therefore, the study areas surveyed could not support a cougar population. A second interpretation of the results is that not enough area was surveyed, and not enough time was spent studying the areas that were surveyed. If there was a chance to survey for two or more consecutive winters over a larger area, then there may have been a greater possibility of locating the presence of a cougar in the area.

Additional research possibilities that could be used in the study, are to conduct surveys in the deer wintering areas where finding evidence of a cougar could be increased; bringing in trained cougar dogs for tracking any cougars in the area; and selecting a specific area to disperse urine collected from a cougar from another area, hopefully to entice a resident cougar to visit the selected area for identification.

6.0 Recommendations

Based on my study, I would recommend the following:

1) *Increase the amount of time the study is conducted.*

Many cougar studies are conducted over many years (e.g. Hornocker, 1970; Ross and Jalkotzy, 1992), with consecutive winter seasons. My study was completed in one month during one winter. This time frame limits the amount of information collected. If cougars are only occasional, possibly seasonal, inhabitants of the area, several complete winters of snow tracking may be required to document their presence.

2) *Increase the size of the study area.*

Many cougar studies had larger study areas, often many hundreds to thousands of square kilometres (e.g. Murphy et al., 1998; Ross and Jalkotzy, 1992). My study area encompassed approximately 40 square kilometres. With such a small study area, the information collected was restricted, and may not reflect actual animal populations within a larger landscape.

3) *Increase the number of people involved in data collecting.*

Increasing the size of the study area would increase the need for more people to survey the forests to document prey populations. Gathering more information, would strengthen our abilities to determine if the Whiskey Jack Forest supports a cougar population.

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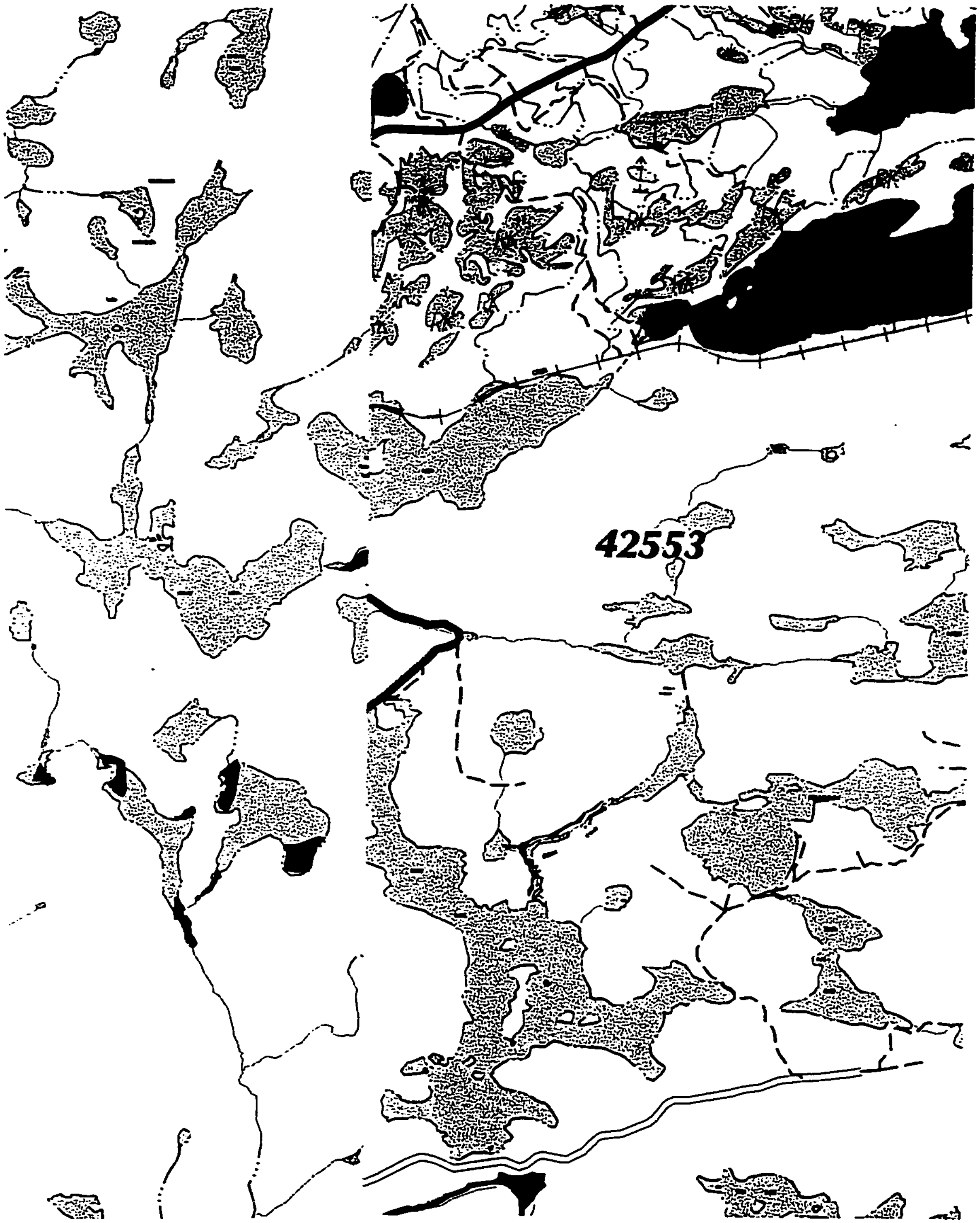
Appendices

Appendix I: Map of Jones study area transects.



Appendix II. Jones Study Area - ecosite lengths per transect.

Transect 1

		Interval		
es 13	350m	0-24	580/860 =	0.67
rock	150m	25-34		
es 13	360m	35-58		

Transect 2

rock/13	250m	0-20	1270/1590=	0.8
rock/11	152m	21-32		
es 11	60m	33-37		
rock	70m	38-42		
rock/11	180m	43-57		
es 11	750m	58-117		
rock	130m	118-127		

Transect 3

rock	220m	0-17	1110/1460	0.76
es 11	320m	18-41		
es 20	80m	42-47		
es 11/20	40m	48-50		
es 20	210m	51-66		
es 11	170m	67-79		
es 20/11	80m	80-85		
es 11	70m	86-90		
es 14	200m	91-106		
es 20	70m	107-111		

Transect 4

rock	20m	0-2	920/1190 =	0.77
es 11	530m	3.-42		
rock	40m	43-46		
es 11	310m	47-70		
es 19	50m	71-73		
rock/19	60m	74-78		
es 19	180m	79-92		

Transect 5

es 19	430m	0-32	1380/1880=	0.73
es 20	60m	33-36		
rock/20	90m	37-42		
rock	120m	43-50		
rock/19	140m	51-61		
es 19	370m	62-88		
es 19/20	150m	89-99		
es 19	390m	100-128		
es 13	130m	129-138		

Transect 6

		Interval		
es 19	300m	0-22	530/710 =	
es 31	310m	23-46		0.75
es 19	100m	47-53		

Transect 7

es 13	40m	0-4	1630x = 1790	
es 19	200m	5.-26		1.1
es 19/13	40m	27-31		
rock/13	100m	32-42		
es 13	460m	43-92		
es 19	200m	93-114		
rock	80m	115-123		
es 20	150m	124-139		
es 28	360m	140-179		

Transect 8

es 13	180m	0-18
es 19	150m	19-33
19/20	80m	34-41
es 20	320m	42-73
es 14	620m	74-135
es 11	190m	136-154
es 26	60m	155-160

Transect 9

es 14	160m	0-16
es 26	50m	17-21
es 11	140m	22-35
es 11/26	90m	36-44
es 11	310m	45-75
es 26	50m	76-80

Transect 10

rock	40m	0-4
es 19	530m	5.-57

70

Appendix III. Map of the Silver Lake study area transects.

Appendix III. Map of the Silver Lake study area transects.

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Appendix IV. Silver Lake Study Area - ecosite lengths per transect.

Transect 1

es 22	630 m	0 - 58	1970/2120 =	0.93
es 13	850 m	59 -138		
es 11	220 m	139- 158		
rock/11	420 m	159 - 197		

Transect 2

es 19	1000 m	0 - 95	2400/2520 =	0.95
es 19/rock	70 m	96 - 102		
es 19	180 m	103 - 119		
es 19/11	200 m	120 - 138		
11/rock	70 m	139 - 145		
es 11	610 m	146 - 203		
es 14	390 m	204 - 240		

Transect 3

es 14	590 m	0 - 59

Transect 4

es 14	750 m	0 -75

Transect 5

es 11	370 m	0 - 37
rock	60 m	38 - 43
es 11	820 m	44 - 125
rock	60 m	126 - 131
es 11	300 m	132 - 161

Transect 6

es 22	370 m	0 - 35	3270/3430 =	0.95
es 14/22	90 m	36 - 44		
es 13	80 m	45 - 51		
es 11	600 m	52 - 109		
es 20	240 m	110 - 132		
es 13	360 m	133 - 166		
es 11	90 m	167 - 174		
es 11/13	110 m	175 - 185		
es 13	1310 m	186 - 310		
es 11	80 m	311 - 317		
es 11/rock	40 m	318 - 321		
es 11	60 m	322 - 327		

Transect 7

es 11	1190 m	0 - 119
rock	580 m	120 - 177
es 13	2560 m	178 - 433

Transect 8

es 11	440 m	0 - 40

Transect 9

es 23	50 m	0 - 4
es 12	40 m	5. - 7
rock	200 m	8. - 21
es 12	140 m	22 - 32
rock	80 m	33 - 38
es 12	60 m	39 - 42
rock	290 m	43 - 64
es 12	1300 m	65 - 160

1600/2160 = .740740741

Transect 10

es 14	780 m	0 - 78
es 14/25	150 m	79 - 93
es 14	70 m	94 - 100
es 11	600 m	101 - 160
es 19	580 m	161 - 218
es 11	330 m	219 - 251
es 14/13	60 m	252 - 257
es 14	270 m	258 - 284

Transect 11

es 14	440 m	0 -47
es 22	230 m	48 - 72
es 14/22	120 m	73 - 84
es 14	600 m	85 - 148
es 14/23	90 m	149 - 158
es 23	650 m	159 - 227
es 20	150 m	228 - 243
es 23	780 m	244 - 327
es 23/13	50 m	328 - 332
es 11/13	50 m	333 - 337
es 11	430 m	338 - 383
es 22	170 m	384 - 402
es 23	360 m	403 - 412

4120x = 4400

1.07

Tracking Sheet

Transect #: ______________ **Trail Name/#:** ______________ **Date/Time:** ______________

Weather: ______________ **Last snowfall:** ______________ **Temp:** ______________

Interval #	Tracks Trails		Tracks Trails

Appendix VI. Animal tracks and trails located on the Jones Study Area Transect 1 - 10.

Intervals	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks
Transect 1													
Total	25	5	3	0	0	5	0	0	1	0	1	0	0
Average	0.29	0.06	0.03	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.01	0.00	0.00
Transect 2													
Total	30	8	7	0	6	0	0	0	4	0	0	0	0
Average	0.19	0.05	0.04	0.00	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Transect 3													
Total	32	15	0	0	2	0	0	0	5	0	0	0	0
Average	0.22	0.10	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Transect 4													
Total	17	2	0	0	4	0	0	0	5	0	1	0	0
Average	0.14	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00
Transect 5													
Total	0	1	0	0	4	0	0	0	2	0	0	0	0
Average	0	0.003	0	0.00	0.011	0	0	0.00	0.006	0	0	0	0
Transect 6													
Total	1	0	0	53	0	0	1	0	15	0	1	0	0
Average	0.01	0.00	0.00	0.75	0.00	0.00	0.01	0.00	0.21	0.00	0.01	0.00	0.00
Transect 7													
Total	2	0	2	176	4	0	1	0	2	0	0	0	0
Average	0.01	0.00	0.01	1.08	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Transect 8													
Total	5	0	0	0	11	0	3	0	6	0	0	0	0
Average	0.031	0.000	0.000	0.000	0.069	0.000	0.019	0.000	0.038	0.000	0.000	0.000	0.000
Transect 9													
Total	2	0	0	0	1	0	1	0	3	0	0	0	0
Average	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00
Transect 10													
Total	0	0	1	0	5	0	0	0	1	0	0	0	0
Average	0	0	0.02	0	0.09	0	0	0	0.02	0	0	0	0

Intervals	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails
Transect 1													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 2													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 3													
Total	0	5	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 4													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 5													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0	0	0	0
Transect 6													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 7													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 8													
Total	0	0	0	1	0	0	0	0	0	0	0	0	0
Average	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 9													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transect 10													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix VII. Jones study area ecosites, and total amount of animal tracks and trails per 10 metres.

Jones Study Area	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails	TOTAL
Ecosite 13 (13 = 1520 m)	0.13	0.01	0.02	0.35	0.00	0.03	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
Ecosite 11 (11 = 2850 m)	0.14	0.03	0.00	0.00	0.05	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Ecosite 20 (20 = 890 m)	0.11	0.01	0.00	0.18	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
Ecosite 14 (14 = 980 m)	0.11	0.02	0.00	0.00	0.01	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
Ecosite 19 (19 = 2900m)	0.01	0.00	0.01	0.00	0.03	0.00	0.01	0.00	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Rock (R = 870 m)	0.21	0.14	0.00	0.10	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Ecosite 26 (26 = 160 m)	0.00	0.00	0.00	0.00	0.13	0.00	0.13	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Ecosite 28 (28 = 360 m)	0.00	0.00	0.00	1.06	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12
Ecosite 31 (31 = 310 m)	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Ecosite Splits																											
Rock/13 (R/13 = 350m)	0.14	0.03	0.00	0.31	0.06	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
Rock/11 (R/11 = 332 m)	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Rock/19 (R/19 = 200m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rock/20 (R/20=90m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
es11/20 (11/20=120m)	0.25	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58
es19/20 (19/20=230m)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
es19/13 (19/13=40m)	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.25
es11/26 (11/26=90m)	0.11	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22

Appendix VIII. Silver Lake Study Area - Totals, Averages and Standard Deviation - Transects 1 - 11.

Intervals	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails
Transect 1																										
Total	84	16	0	0	1	0	18	0	13	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.284	0.076	0.000	0.000	0.008	0.000	0.071	0.000	0.062	0.000	0.000	0.000	0.000	0.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 2																										
Total	364	190	242	13	0	0	12	0	1	0	0	0	134	6	0	0	0	0	0	0	0	0	1	7	0	0
Average	1.444	0.784	0.960	0.082	0.000	0.000	0.048	0.000	0.004	0.000	0.000	0.000	0.832	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.028	0.000	0.000
Transect 3																										
Total	21	14	3	89	0	0	0	0	3	0	1	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
Average	0.386	0.237	0.081	1.000	0.000	0.000	0.000	0.000	0.081	0.000	0.017	0.000	0.000	0.000	0.119	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 4																										
Total	40	34	0	0	2	0	1	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0	0	0	0
Average	0.833	0.483	0.000	0.000	0.027	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 5																										
Total	80	34	0	0	0	0	12	0	8	0	2	0	18	0	109	0	0	0	0	0	0	0	0	0	0	0
Average	0.497	0.211	0.000	0.000	0.000	0.000	0.078	0.000	0.080	0.000	0.012	0.000	0.112	0.000	0.677	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 6																										
Total	208	112	0	0	1	0	31	0	60	1	2	0	9	0	23	0	2	0	0	0	0	0	0	0	8	0
Average	0.606	0.327	0.000	0.000	0.003	0.000	0.091	0.000	0.178	0.003	0.006	0.000	0.026	0.000	0.067	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.000
Transect 7																										
Total	696	408	0	0	0	0	38	0	55	2	1	0	12	1	322	35	0	0	1	0	1	0	0	0	0	0
Average	1.607	0.938	0.000	0.000	0.000	0.000	0.088	0.000	0.127	0.008	0.002	0.000	0.028	0.002	0.744	0.081	0.000	0.000	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Transect 8																										
Total	35	27	0	0	0	0	0	0	1	0	0	0	0	0	14	0	1	0	0	0	0	0	0	0	0	0
Average	0.795	0.614	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.318	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 9																										
Total	181	121	0	0	0	0	48	1	81	0	4	0	3	0	31	1	2	0	0	0	0	0	0	0	0	0
Average	0.699	0.840	0.000	0.000	0.000	0.000	0.208	0.008	0.236	0.000	0.019	0.000	0.014	0.000	0.144	0.008	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 10																										
Total	137	97	0	0	89	0	30	2	66	0	18	0	18	2	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.482	0.342	0.000	0.000	0.208	0.000	0.106	0.007	0.232	0.000	0.083	0.000	0.083	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Transect 11																										
Total	93	8	235	0	11	0	68	0	11	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.226	0.019	0.870	0.000	0.027	0.000	0.168	0.000	0.027	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix IX. Silver Lake study area ecosites, and total amount of animal tracks and trails per 10 metres.

Silver Lake Study Area	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails	TOTAL
Ecosite 22 (22 = 1400 m)	0.26	0.02	0.14	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	**0.53**
Ecosite 13 (13 = 6160 m)	1.06	0.64	0.00	0.00	0.00	0.00	0.05	0.00	0.13	0.00	0.00	0.00	0.02	0.00	0.40	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.33**
Ecosite 11 (11 = 6140 m)	0.95	0.43	0.18	0.01	0.00	0.00	0.11	0.00	0.11	0.00	0.01	0.00	0.05	0.00	0.41	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**2.30**
Ecosite 19 (19 = 1760 m)	1.17	0.69	0.55	0.00	0.00	0.00	0.07	0.00	0.07	0.00	0.00	0.00	0.58	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**3.15**
Ecosite 14 (14 = 3890 m)	0.43	0.34	0.14	0.17	0.16	0.00	0.06	0.00	0.10	0.00	0.02	0.00	0.01	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.46**
Ecosite 20 (20 = 390 m)	0.21	0.05	0.41	0.00	0.08	0.00	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	**0.82**
Rock (R = 1270 m)	1.06	0.63	0.00	0.00	0.00	0.00	0.10	0.00	0.11	0.00	0.00	0.00	0.10	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.06**
Ecosite 23 (23 = 1840 m)	0.11	0.01	0.80	0.00	0.04	0.00	0.22	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.19**
Ecosite 12 (12 = 1840 m)	0.76	0.71	0.00	0.00	0.00	0.00	0.19	0.01	0.23	0.00	0.03	0.00	0.00	0.00	0.20	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.14**
Ecosite Splits																											
ES 14/25 (14/25=150m)	0.93	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.67**
ES 14/13 (14/13=60 m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.67	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.17**
ES 14/22 (14/22=210m)	0.05	0.00	0.00	0.00	0.05	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.19**
ES 11/13 (11/13=160m)	0.13	0.06	0.31	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.69**
ES 14/23 (14/23 = 90m)	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.22**
ES 23/13 (23/13=50m)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**
ES 19/11 (19/11=200m)	0.00	0.00	0.95	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.95**
ES 19/R (19/R= 70m)	1.86	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**3.57**
ES R/11 (R/11=530m)	0.70	0.15	0.13	0.00	0.00	0.00	0.11	0.00	0.60	0.00	0.00	0.00	0.09	0.26	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.13**

Appendix X. Total number of animal tracks and trails observed on ecosites found in both Jones and Silver Lake Study Areas.

	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails	TOTAL
ECOSITE 13																											
JONES	20	2	3	53	0	5	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	545	332	0	0	1	0	24	0	67	0	1	0	9	0	208	17	2	0	0	0	1	0	0	0	0	0	
TOTAL	565	334	3	53	1	5	24	0	69	0	2	0	9	0	208	17	2	0	0	0	1	0	0	0	0	0	1293
ECOSITE 11																											
JONES	40	8	0	0	13	0	0	0	9	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	
SL	581	265	109	4	0	0	66	2	70	3	9	0	30	1	250	18	1	0	1	0	0	0	1	7	0	0	
TOTAL	621	273	109	4	13	0	66	2	79	3	9	0	30	1	252	18	1	0	1	0	0	0	1	7	0	0	1490
ECOSITE 19																											
JONES	3	1	3	73	10	0	2	0	13	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	205	121	97	0	0	0	12	0	12	0	0	0	102	6	0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	208	122	100	73	10	0	14	0	25	0	2	0	102	6	0	0	0	0	0	0	0	0	0	0	0	0	662
ECOSITE 14																											
JONES	11	2	0	0	1	0	1	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	
SL	166	131	53	68	61	0	25	0	38	0	9	0	2	0	14	2	0	0	0	0	0	0	0	0	0	0	
TOTAL	177	133	53	68	62	0	26	0	42	0	9	0	2	0	17	2	0	0	0	0	0	0	0	0	0	0	591
ECOSITE 20																											
JONES	10	1	0	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	8	2	16	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
TOTAL	18	3	16	16	5	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	61
ROCK																											
JONES	18	12	0	9	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	134	80	0	0	0	0	13	0	18	0	0	0	13	1	6	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	152	92	0	9	4	0	13	0	22	0	0	0	13	1	6	0	0	0	0	0	0	0	0	0	0	0	312
ROCK/11																											
JONES	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	37	8	7	0	0	0	6	0	6	0	0	0	5	14	4	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	40	8	7	0	0	0	6	0	7	0	0	0	5	14	4	0	0	0	0	0	0	0	0	0	0	0	91
ROCK/19																											
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SL	13	0	2	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	13	0	2	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	25

Appendix XI. Total amount of animal tracks and trails, per 10 metres, from the ecosites that Jones and Silver Lake study area shared.

	Snowshoe Hare Tracks	Snowshoe Hare Trails	Wolf Tracks	Wolf Trails	Fox Tracks	Fox Trails	Weasel Tracks	Weasel Trails	Rodent Tracks	Rodent Trails	Bird Tracks	Bird Trails	Moose Tracks	Moose Trails	Lynx Tracks	Lynx Trails	Marten Tracks	Marten Trails	Beaver Tracks	Beaver Trails	Porcupine Tracks	Porcupine Trails	Deer Tracks	Deer Trails	Coyote Tracks	Coyote Trails	TOTAL
ECOSITE 13 (13 = 6680 m)	0.85	0.50	0.00	0.08	0.00	0.01	0.04	0.00	0.10	0.00	0.00	0.01	0.01	0.00	0.31	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.94
ECOSITE 11 (11 = 8990 m)	0.69	0.30	0.12	0.00	0.01	0.00	0.07	0.00	0.09	0.00	0.01	0.00	0.03	0.00	0.28	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.65
ECOSITE 19 (19 = 4660 m)	0.44	0.26	0.22	0.16	0.02	0.00	0.03	0.00	0.05	0.00	0.00	0.00	0.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42
ECOSITE 14 (14 = 4870 m)	0.36	0.27	0.11	0.14	0.13	0.00	0.06	0.00	0.09	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.21
ECOSITE 20 (20 = 1280 m)	0.14	0.02	0.12	0.12	0.04	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.46
ROCK (R = 2140 m)	0.71	0.43	0.00	0.04	0.02	0.00	0.06	0.00	0.10	0.00	0.00	0.00	0.06	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46
ROCK/11 (R/11 = 862 m)	0.46	0.09	0.08	0.00	0.00	0.00	0.07	0.00	0.08	0.00	0.00	0.00	0.06	0.16	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05
ROCK/19 (R/19 = 270 m)	0.48	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92