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REPORT ON

WINTER WILDLIFE SURVEYS - STEEPBANK RIVER VALLEY, SHIPYARD LAKE, AND LEASE 25 AND 29 UPLANDS

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ABSTRACT

Three multi-day winter track count surveys were conducted in the Suncor Steepbank River and Lease 29 Study Area in January, February, and March, 1997. A late winter owl survey was conducted within the Lease 25 Study Area. Landscape preference and plant community preference were determined for a variety of ungulates and furbearers. Snowshoe hares preferred upland areas over the escarpment and riparian areas. Hares preferred the low-bush cranberry Aw-Sw (d2) and Labrador tea/horsetail Sw-Sb (h1) community types. Red squirrels preferred escarpment and riparian areas. Red squirrels were found in low-bush cranberry Sw (d3), and avoided lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), Labrador tea/horsetail Sw-Sb (h1), shrubland (shrub) and shallow open water (Wonn). Mice did not show a habitat or landscape preference. Coyotes showed a distinct preference for disturbed areas (CIU). Wolves preferred the upland areas and avoided the escarpment. Marten tracks were frequently observed along the escarpment, red foxes did not show a landscape preference. Also, marten preferred low-bush cranberry Sw (d3), avoiding lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), wooded fen (Ftnn) and wooded bogs (Btnn). Fisher were found in riparian and upland areas. Fisher avoided lichen Pj (a1), Labrador tea/horsetail Sw-Sb (h1), low-bush cranberry Sw (d3) and low-bush cranberry Aw (d1). Weasels also avoided escarpment. Weasels avoided shrubland (shrub) and shallow open water (Wonn). Mink preferred shrubland (shrub). Canada lynx preferred riparian areas and avoided the escarpment and upland areas. Moose were found to prefer the riparian areas in January and February, but had moved to the upland areas in March. Grouse were found in all three landscape features. Grouse preferred wooded fens (Ftnn) and avoided lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), low-bush cranberry Sw (d3), Labrador tea/horsetail Sw-Sb (h1), and wooded bogs (Btnn). Results indicate the importance of the riparian areas for several of the furbearers and ungulates in the study area, including red squirrels, fishers, lynx and moose. Larger mammals probably use the rivers as movement corridors for some of the winter months. The results of the owl survey were poor with only one great gray owl recorded.

Key Words: oil sands, ungulate, furbearer, winter track count survey, owl survey, habitat association, ecosite phases, landscape preference, snow, moose, marten, snowshoe hare, red squirrel, gray wolf, coyote, fisher, weasel, grouse, great gray owl.

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EXECUTIVE SUMMARY

This document reports on the findings of a winter track count survey and a late winter owl survey in the Steepbank River and Lease 29 study areas in support of Environmental Impact Assessment. Objectives of the studies were to: 1) assess wildlife winter movements along and across the Steepbank and Athabasca Rivers; 2) determine the relative abundance and distribution of wildlife species in the study area during the winter; 3) determine ungulate and furbearer habitat use in the study area during the winter; and 4) assess the relative abundance and distribution of owls within the Study Area. Snow thickness and hardness data were also collected as part of the field program to characterize snow conditions.

The Study Area for the winter track counts consisted of the Steepbank River, Lease 29 area and Shipyard Lake. Owl surveys were conducted in the Lease 25 area only. Three multi-day winter track count surveys were conducted in January, February and March of 1997. Surveys were timed so as to occur after significant snowfall.

Tracks of 13 species or species groups were observed. These included tracks of snowshoe hare, red squirrel, mice, coyote, gray wolf, red fox, marten, fisher, weasel (ermine and least weasel were combined), mink, Canada lynx, moose and grouse (grouse and ptarmigan were combined).

Sufficient data were collected during the track count survey to determine vegetation community and landscape preference and avoidance for snowshoe hares, red squirrels, gray wolves, coyotes, marten, fishers, weasels, Canada lynx, moose and grouse. Snowshoe hares preferred upland areas over the escarpment and riparian areas. Snowshoe hares preferred the low-bush cranberry Aw-Sw (d2) and Labrador tea/horsetail Sw-Sb (h1) community types. Red squirrels preferred the escarpment and riparian areas. In addition red squirrel tracks were found more often than expected in the low-bush cranberry Sw (d3) community type, and less often than expected in lichen Pj (a1), low-bush cranberry Aw-Sw (d2), low-bush cranberry Aw (d1), Labrador tea/horsetail Sw-Sb (h1), shrubland (shrub) and shallow open water (Wonn).

Coyotes did not show a landscape preference. As well, no plant community preference was observed during the January surveys. However, coyotes showed a distinct preference for disturbed areas (CIU) in February. Wolves preferred the upland areas and avoided the

escarpment. A plant community preference could not be determined due to the small number of wolf tracks observed. Red foxes did not show a landscape preference, and not enough tracks were observed to determine a plant community type preference.

Marten tracks were frequently observed along the escarpment. Marten also preferred the low-bush cranberry Sw (d3) community type, avoiding lichen Pj (a1) low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), wooded fen (Ftnn), and wooded bog (Btnn). Fishers were found in riparian and upland areas. Fisher avoided lichen Pj (a1), Labrador tea/horsetail Sw-Sb (h1), low-bush cranberry Sw (d3), and low-bush cranberry Aw (d1). Weasels avoided escarpment and avoided shrubland (shrub) and shallow, open water (Wonn). Mink preferred shrubland (shrub).

Canada lynx preferred riparian areas and avoided the escarpment and upland areas. Unfortunately, lynx were not observed during the upland surveys and a plant community preference could not be determined for lynx. Moose were found to prefer the riparian areas in January and February, but had moved to the upland areas in March. In the upland surveys, moose showed no plant community type preference. Grouse were found in all three landscape features. Grouse preferred the wooded fen (Ftnn) community and avoided lichen Pj (a1), low-bush cranberry (d1, d2, d3), wooded bogs (Btnn) and Labrador tea/horsetail Sw-Sb (h1). Qualitative data were obtained for a number of other species.

Results indicate the importance of the riparian areas for several of the furbearers and ungulates in the study area, including red squirrels, fishers, lynx and moose. Larger mammals probably use the rivers as movement corridors for some of the winter months.

The results of the owl survey were poor, perhaps due to less than ideal weather conditions encountered during the survey period. Only one owl, a great gray owl, was recorded during the course of the owl surveys. This owl was heard calling in a wooded swamp (Stnn). During the winter track count surveys, a great gray owl was observed in a lichen Pj stand (a1). No boreal owls nor any other owls were recorded during the owl surveys.

1.0 INTRODUCTION

1.1 Background

Suncor Energy Inc., Oil Sands (Suncor) contracted Golder Associates Ltd. (Golder) to conduct baseline winter wildlife work in the area of the Steepbank Mine in support of the 1996 Environmental Impact Assessment (EIA) (Westworth, Brusnyk and Associates 1996a). The work completed by Westworth Brusnyk and Associates (1996a) was focused along the Athabasca River, within the Steepbank Mine and Project Millennium study area, and west of the Athabasca River (Lease 23). The winter program detailed here focused on the Steepbank River as a potential movement corridor, the pits north of the Steepbank River and Shipyard Lake. The winter work was also designed to provide baseline information on ungulates (e.g., moose and deer) and furbearers (e.g., wolf, marten and mink) for possible future Suncor projects. A list of the species of ungulates and furbearers whose distribution overlaps the Suncor study area is found in Table 1. The winter track count surveys concentrated on most of the wildlife species presented in Table 1.

Ungulates and furbearers play important roles in boreal forest communities. The majority of furbearers are carnivores, thus they can directly or indirectly influence mammalian herbivore and bird populations. Predation may have a direct effect on prey species by limiting population size and distribution. In addition, by decreasing the abundance of one species, predators can ease competition among species and perhaps enable less competitive species to increase in abundance and/or distribution.

Ungulates and furbearers are highly valued by the public for both consumptive and non-consumptive reasons in Alberta. Hunting and trapping provide a significant source of revenue, and First Nation Peoples place high value on these species for subsistence use. Therefore, moose and one or more furbearers (possibly, beaver, fisher and snowshoe hare) will be chosen as Key Indicator Resources (KIRs) for various Suncor projects.

In addition, several of the mammals in the region have been listed nationally or provincially as being threatened or endangered. Of the furbearer and ungulate species found in the region, woodland caribou, wolverines, Canada lynx and fishers have all been classified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (1997) or by Alberta Environmental Protection (AEP) (1996) as being species at risk. Woodland caribou and wolverines have been classified as vulnerable (COSEWIC 1997). Woodland caribou have also been classified as "blue," and Canada lynx and fisher have been classified as "Yellow B" (AEP 1996). Blue-listed species are species that may be at risk. Blue-listed species are

particularly vulnerable because of non-cyclical declines in population or habitat, or reductions in provincial distribution. Yellow B-listed species are not at risk, however they warrant further attention because they are naturally rare, have clumped breeding distributions or they are associated with habitats that are deteriorating (AEP 1996).

Table 1. List of Furbearers and Ungulates Potentially Present in the Steepbank Mine and Project Millennium Study Area

TAXONOMIC ORDER	COMMON NAME	SCIENTIFIC NAME
Rodentia	red squirrel	*Tamiasciurus hudsonicus*
	muskrat	*Onadatra zibethicus*
	beaver	*Castor canadensis*
	porcupine	*Erethizon dorsatum*
Lagomorpha	snowshoe hare	*Lepus americanus*
Carnivora		
• **Canidae**	coyote	*Canis latrans*
	gray wolf	*Canis lupus*
	red fox	*Vulpes vulpes*
• **Ursidae**	American black bear	*Ursus americanus*
• **Mustelidae**	American marten	*Martes americana*
	fisher	*Martes pennanti*
	short-tailed weasel, ermine	*Mustela erminea*
	least weasel	*Mustela nivalis*
	mink	*Mustela vision*
	wolverine	*Gulo gulo*
	river otter	*Lutra canadensis*
• **Felidae**	lynx	*Felis lynx*
Artiodactyla	woodland caribou	*Rangifer tarandus caribou*
	barren-ground caribou	*Rangifer tarandus*
	white-tailed deer	*Odocoileus virginianus*
	mule deer	*Odocoileus hemionus*
	moose	*Alces alces*

Abundance and distribution of mammals is related to factors that influence habitat suitability at the landscape, habitat and microhabitat levels. This study is concentrated on habitat suitability at the landscape and habitat levels. The information collected here will assist in the determination of impacts and mitigation measures in regard to oil sands development. This information may also assist in reclamation planning.

Track count surveys are a cost-effective method to assess relative abundance, distribution and habitat use of mammals. To complement the work of Westworth, Brusnyk and Associates (1996a), this winter program concentrated on wildlife movements along the Steepbank River, in conjunction with movements to and from the Athabasca River; wildlife movements in the Shipyard Lake area; and wildlife movement in the pits north of the Steepbank River. The winter work program also included nocturnal owl surveys conducted in March. The great gray owl was identified as a KIR for the area of the Steepbank Mine (Westworth, Brusnyk and Associates 1996a), and will most likely be used as a KIR for future projects. Both the great gray owl and the boreal owl have been listed by AEP as "Yellow B" (AEP 1996).

1.2 Objectives

The objectives of the winter wildlife program were:

- to assess wildlife winter movements along and across the Steepbank River;
- to assess winter wildlife movements along the Athabasca River in relation to the Steepbank Mine; to contribute to the understanding of ungulate and furbearer habitat use in winter, including the determination of the relative abundance of wildlife species in the study area and distribution of wildlife with respect to habitat types and terrain features; and
- to assess the relative abundance and distribution of owls in the study area.

Winter track count studies were employed to meet these objectives. Track count studies allow the evaluation of wildlife movement corridors and allow the determination of relative abundance and habitat preferences. In addition, an owl survey was designed and implemented to assess the relative abundance and distribution of owls (e.g., great gray owl and boreal owl) in the study area.

2.0 METHODS

2.1 Study Area

The Suncor Winter Wildlife program consisted of three components: winter track count surveys along the Steepbank River, winter track count surveys in the uplands (Lease 29 area) and at Shipyard Lake, and owl surveys conducted at in the Pit 4 area north of the Steepbank River. The study area, including transect locations, is delineated in Figures 1 and 2.

2.2 Winter Track Counts

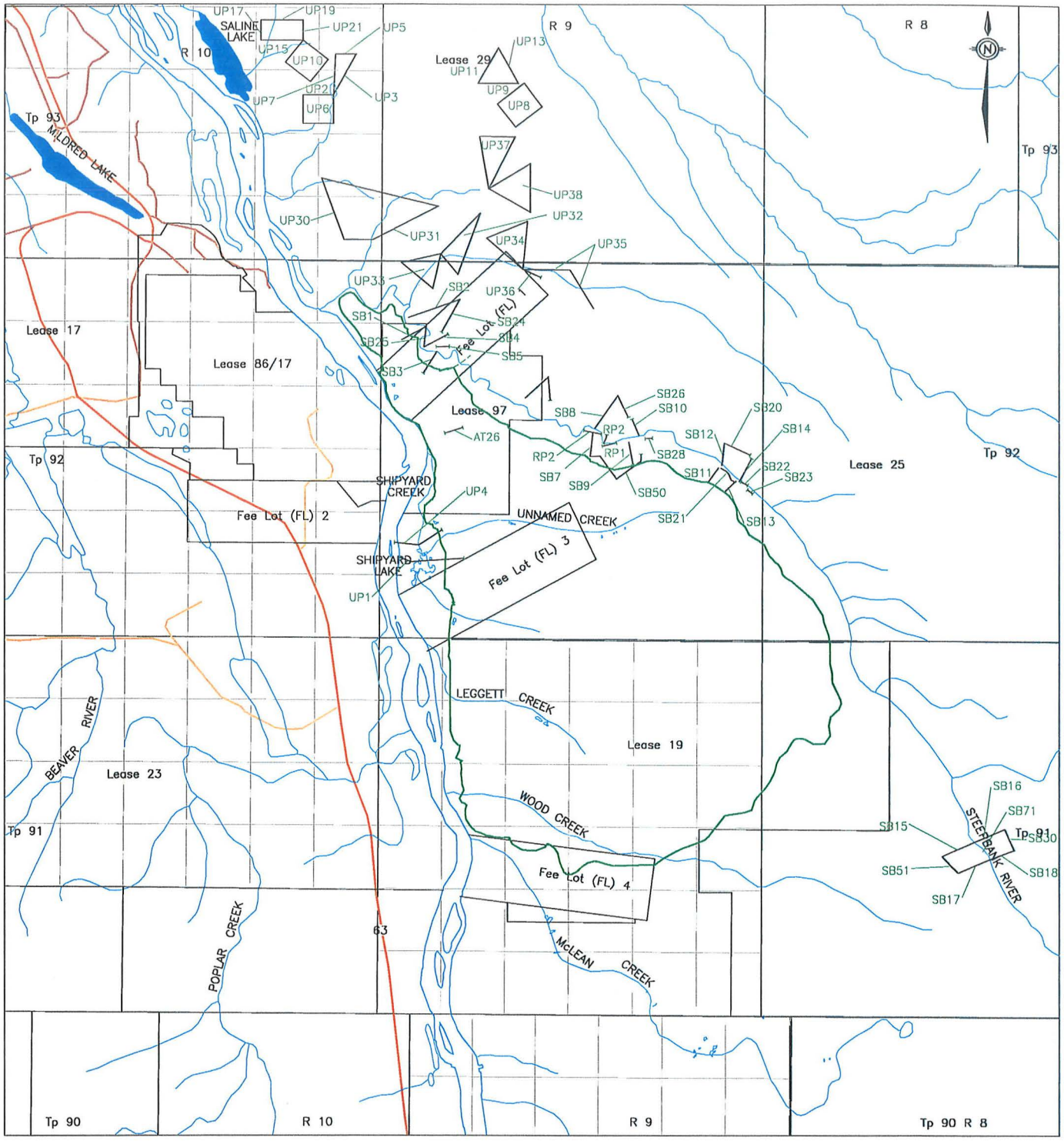
Three multi-day surveys were conducted in mid-winter to assess ungulate and furbearer distribution and habitat use. Surveys were timed to occur after significant snowfall. Track count surveys were conducted January 23 - 27, February 21 - 24 and March 29 - 30, 1997. The January and February surveys included transects along the Steepbank River and in an upland area of Lease 29. Transects were not conducted in the upland area during the March surveys.

Winter track count surveys followed the methods recommended by Raine (1983), Thompson et al. (1989) and Bull et al. (1992). Tracks were identified using methods/information from Rezendes (1992) and Murie (1974). For the Steepbank River surveys, single transects were located perpendicular to the Steepbank River. Each transect extended a minimum of 200 metres (m) into the upland habitat (i.e., 200 m from the edge of the escarpment). Transects were situated approximately 2 kilometres (km) apart, depending on helicopter access and the steepness of the escarpment. Transects were situated using forest inventory maps and 1:50,000 topographic maps. Transects located in the upland area of Lease 29 were initiated 10 m from the cover type boundaries to eliminate "edge" effects.

Track surveys were conducted on snowshoes. All furbearer and ungulate tracks encountered along the linear transects were recorded in 25 m intervals. Information recorded included species, number of animals, time since last snowfall (to the nearest half day), habitat type (overstory and understory as recorded by dominant and subdominant species, to the nearest 10%) and terrain type (riparian, escarpment or upland). Transect distances were measured by hip chain.

A single transect intercept by a single species was recorded as one crossing. Where animals of the same species crossed the transect in a "trail," an attempt was made to determine the number of individuals involved. If the number of individuals could not be determined, the observation was recorded as one "trail."

J:\1997\2201\7700\TRANSECT.dwg SUNCOR MINE PLAN UPDATED 23 MAR 1998



LEGEND

SB16 TRANSECT LINE AND NUMBER

EAST BANK MINING AREA

REFERENCE

DIGITAL DATA SETS 74D AND 74E RESOURCE DATA DIVISION, ALBERTA ENVIRONMENTAL PROTECTION, 1997.
MINE PLAN SUPPLIED BY SUNCOR ENERGY, MAR 1998.
DATUM IS IN NAD83 UTM

0 1 2 3 4 5km

SCALE 1:150,000

SUNCOR ENERGY

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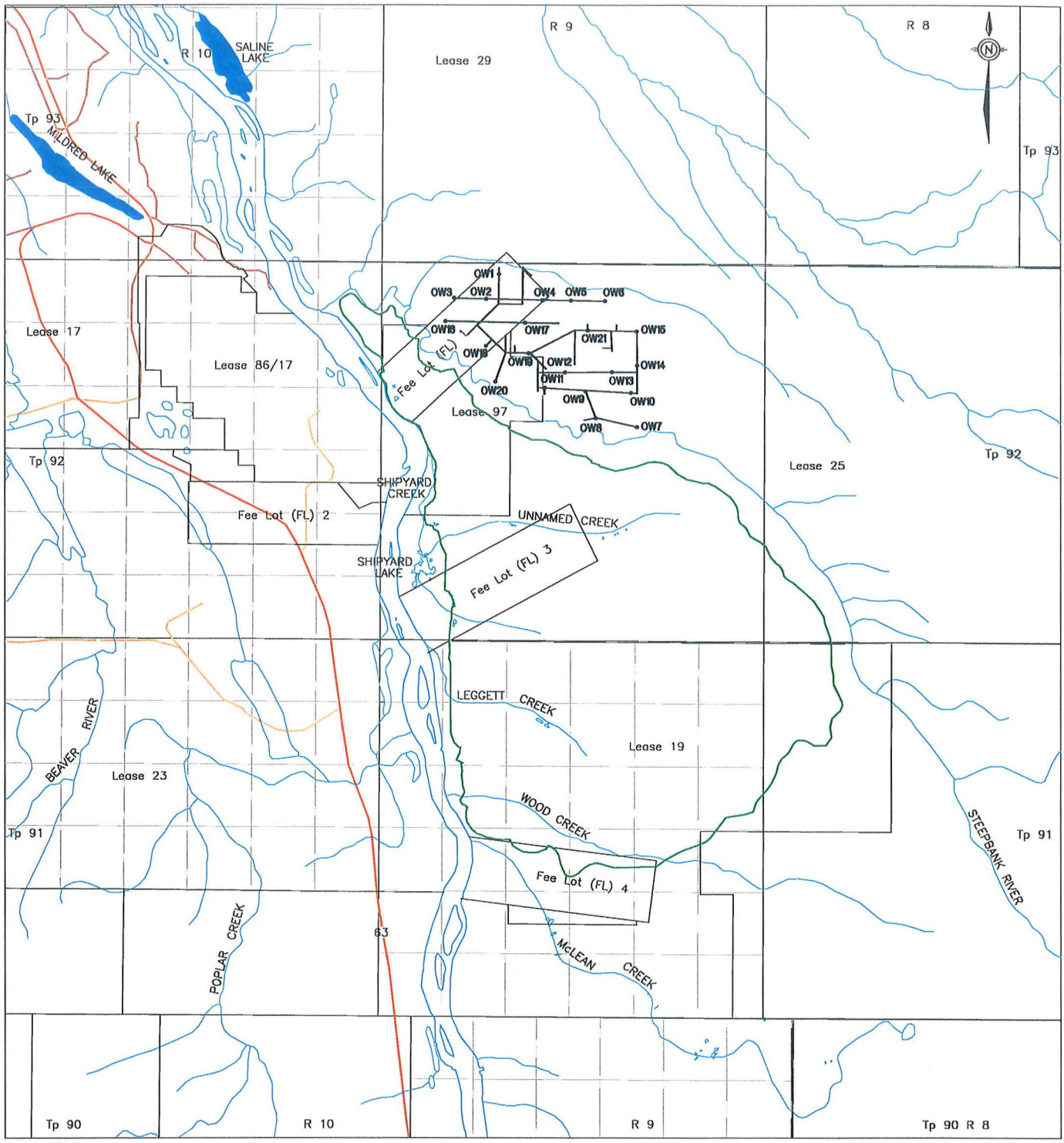
SURVEY LOCATIONS FOR WINTER TRACK COUNTS

Dec. 1997	Figure 1	DRAWN BY: RFM/BGM

J:\1997\2201\7700\OWLS.dwg SUNCOR MINE PLAN UPDATED MAR 23 1998



LEGEND

- TRANSECT LINE
- OW17 OWL PLOT SURVEY NUMBER
- EAST BANK MINING AREA

REFERENCE

DIGITAL DATA SETS 74D AND 74E RESOURCE DATA DIVISION, ALBERTA ENVIRONMENTAL PROTECTION, 1997.
MINE PLAN SUPPLIED BY SUNCOR ENERGY, MAR 1998.
DATUM IS IN NAD83 UTM

0 1 2 3 4 5km
SCALE 1:150,000

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OWL SURVEY PLOT LOCATIONS

Dec. 1997	Figure 2	DRAWN BY: RFM/BGM

If the tracks were separated by a short distance, each track was recorded individually. In some situations, animals criss-crossed the transect many times over a short distance for bedding, feeding or other activities. In this situation, tracks were recorded as a "network" for each metre of transect in which this occurred.

During the Steepbank River winter track count surveys, tracks of larger mammals were "back-tracked" to determine if wildlife were using the river as a movement corridor. The following tracks were back-tracked: coyote, fisher, Canada lynx, marten, moose, red fox and gray wolf. Tracks were generally followed for 100 m or until the tracks were lost. For these surveys, general track direction, number of individuals, distance backtracked and general comments were all recorded.

All wildlife signs within 5 m on either side of the transect was recorded. This included, for example, beds, owl plunge holes and grouse roosting sites. Snow thickness and hardness measurements were recorded in each land form type, as well as for the most common habitat types to determine snow conditions at the time of each survey. Geographic Positioning Systems (GPS) units were used to locate each transect within 15 to 100 m. Differential correction provided further accuracy.

The data were analysed in terms of the number of tracks per species per km-track day, which was represented by dividing the number of tracks observed (for each species, in each habitat type) by the distance traveled times the number of days since the last snowfall. Data were analysed using chi-square tests and Bonferroni Intervals (Byers and Steinhorst 1984). These analyses were used to determine if the abundance of each species differed significantly among habitat types and landscape features. Where chi-square tests were significant, Bonferroni Intervals were used to determine the relationship between a species and individual habitat types (i.e., whether a certain plant community type was significantly preferred or avoided).

2.3 Owl Surveys

Owl surveys were conducted March 27 - 28, 1997. The owl surveys consisted of systematic points along ploughed and unploughed cutlines through the entire Pit 4 area. Smith (1987) suggested that the best way to census owls in extensively wooded areas was to use call playbacks. The owl calls on the playback tape were taken from Peterson Field Guides: Western Bird Songs (1992). Boreal owl and great gray owl calls were played in each survey location. The playback tape included one minute of silence, two minutes of

boreal owl calls, one minute of silence, two minutes of great gray owl calls. The order of calls, from the smaller owl to the larger, was important because large owls will depredate smaller owls. Playing the calls of larger owls will often alert smaller owls to danger, and they will remain silent and/or leave the area (Beck and Beck 1988).

At each survey location, the surveyors moved approximately 30 m away from the parked vehicle. The tape player was then turned on. The first one minute silent interval was used to detect any owls that were already calling. The tape ran continuously through the two minute call intervals of all species. The one minute silent interval between each call interval was used to detect any owls stimulated by the taped calls. While the tape was played, the surveyors remained vigilant to detect any species that approached the tape player.

Plots were separated by at least 1 km to prevent counting an individual owl more than once. At each survey location, number of owls and species type were recorded. Other wildlife observations, time, temperature, wind velocity, precipitation and location were recorded for each survey location. GPS units were used to locate each survey within 15 to 100 m. Differential correction provided further accuracy.

3.0 RESULTS

3.1 Steepbank River Winter Track Counts

Transects were conducted in the following three habitat types: upland, escarpment and riparian. Total distance traveled, the number of km-track days sampled (calculated by multiplying the distance traveled by the time since last snowfall in days) and the number of tracks per km-track day for each species encountered are summarized for each habitat type in Tables 2, 3 and 4. Tracks for 12 species were recorded during the course of the study. River otter, wolverine, deer, caribou, mink, beaver, muskrat and porcupine tracks were not observed during any of the track count surveys, although they have been recorded in the area (Smith 1993).

All chi-square analyses and Bonferroni Intervals are presented in Appendix I. The statistical analysis were used to determine landscape and habitat preferences and avoidances. Common and scientific names of all wildlife mentioned in the text are presented in Appendix II. Snow data are presented in Appendix III.

In all three surveys, snowshoe hares preferred upland habitat and avoided the escarpment and riparian habitat (Appendix I). Red squirrels avoided the escarpment in January, preferred escarpment and avoided upland areas in February, and preferred riparian and escarpment habitat to upland habitat in March. Mice did not show a landscape preference, although sample sizes were small.

Coyote tracks were not observed in February or March, and coyotes did not show a landscape preference in January. Likewise, gray wolf tracks were not observed in February or March. However, wolves showed a preference for upland areas and avoided the escarpment in January. Red foxes did not show a landscape preference. Marten showed a preference for escarpment in January and in March but did not show a landscape preference in February. Fishers showed a preference for riparian areas in January and for upland areas in February. Fishers showed no landscape preference in March. Weasels avoided escarpment areas in January. Weasels showed no preference in February, and no weasel tracks were observed in March. Lynx showed a preference for riparian areas in February. No lynx tracks were observed in January, and lynx did not show a preference in March.

Moose showed a preference for riparian features in January and February but moved to the uplands in March. No deer or caribou tracks were observed. Grouse did not show a landscape preference during any of the surveys.

Table 2. Number of Tracks per km day for Various Wildlife Species in the Steepbank River Area During the January Surveys

Habitat type	Distance (km)	Km Days Sampled	Snowshoe hare	Red squirrel	Mice	Porcupine	Coyote	Gray wolf	Red fox	Wolverine	Marten	Fisher	Weasel	Mink	River otter	Beaver	Muskrat	Lynx	Caribou	Moose	Deer	Grouse
Riparian	1.79	7.14	39.74	11.58	0.00	0.00	0.52	4.52	0.00	0.00	2.61	25.58	11.40	0.00	0.00	0.00	0.00	0.00	0.00	30.61	0.00	0.00
Escarpment	6.76	20.55	218.61	7.52	1.11	0.00	1.11	1.23	1.04	0.00	11.86	0.00	2.97	0.00	0.00	0.00	0.00	0.00	0.00	3.01	0.00	5.42
Upland	4.43	14.29	350.57	18.63	4.44	0.00	4.13	17.06	0.47	0.00	0.00	0.00	16.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36
TOTAL	**12.98**	**41.98**	**608.92**	**37.73**	**5.55**	**0.00**	**5.76**	**22.81**	**1.51**	**0.00**	**14.47**	**25.58**	**30.52**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.62**	**0.0**	**5.78**

Table 3. Number of Tracks per km day for Various Wildlife Species in the Steepbank River Area During the February Surveys

Habitat type	Distance (km)	Km Days Sampled	Snowshoe hare	Red squirrel	Mice	Porcupine	Coyote	Gray wolf	Red fox	Wolverine	Marten	Fisher	Weasel	Mink	River otter	Beaver	Muskrat	Lynx	Caribou	Moose	Deer	Grouse
Riparian	3.74	6.39	116.78	25.34	0.00	0.00	0.00	0.00	0.00	0.00	4.61	0.00	6.04	0.00	0.00	0.00	0.00	2.52	0.00	14.08	0.00	0.00
Escarpment	6.26	15.63	255.86	62.78	0.00	0.00	0.00	0.00	0.00	0.00	3.99	0.56	10.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.79
Upland	9.60	21.20	704.36	35.86	1.39	0.00	0.00	0.00	0.83	0.00	2.46	36.79	12.34	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00	3.03
TOTAL	**19.59**	**43.22**	**1077.00**	**123.98**	**1.39**	**0.00**	**0.00**	**0.00**	**0.83**	**0.0**	**11.06**	**37.35**	**29.02**	**0.00**	**0.00**	**0.00**	**0.00**	**2.52**	**0.00**	**14.81**	**0.00**	**6.82**

Table 4. Number of Tracks per km day for Various Wildlife Species in the Steepbank River Area During the March Surveys

Habitat type	Distance (km)	Km Days Sampled	Snowshoe hare	Red squirrel	Mice	Porcupine	Coyote	Gray wolf	Red fox	Wolverine	Marten	Fisher	Weasel	Mink	River otter	Beaver	Muskrat	Lynx	Caribou	Moose	Deer	Grouse
Riparian	1.72	2.74	0.00	1024.98	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
Escarpment	5.22	6.59	29.24	495.33	0.00	0.00	0.00	0.00	0.00	0.00	12.19	0.00	0.00	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.00
Upland	7.70	11.35	121.17	151.28	0.00	0.00	0.00	0.00	0.00	0.00	6.13	2.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.14	0.00	0.85
TOTAL	**14.64**	**20.68**	**150.41**	**1671.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**18.32**	**2.56**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.27**	**0.00**	**12.14**	**0.00**	**0.85**

3.2 Results From the Backtracking Surveys - Steepbank River Area

Results from the backtracking surveys conducted in conjunction with the Steepbank River surveys are presented in Table 5. The following species were surveyed by following tracks away from the original transect: coyote, fisher, lynx, marten, moose, red fox and wolf. In total, 7 coyote tracks, 6 fisher tracks, 2 lynx tracks, 20 marten tracks, 7 moose tracks, 3 red fox tracks and 13 wolf tracks were backtracked.

Of the wildlife species backtracked, only moose and marten showed a preference for traveling parallel to the Steepbank River. None of the other backtracked species showed a preference for a particular direction of travel (see Appendix I).

3.3 Lease 29 Upland Area Winter Track Counts

Transects were conducted within the following 10 plant community types:

- a1 - lichen jackpine (lichen Pj)
- Btnn - wooded bog
- CIU - disturbed areas
- d1 - low-bush cranberry aspen poplar (low-bush cranberry Aw)
- d2 - low-bush cranberry aspen poplar - white spruce (low-bush cranberry Aw-Sw)
- d3 - low-bush cranberry white spruce (low-bush cranberry Sw)
- Ftnn - wooded fen
- h1 - Labrador tea/horsetail white spruce - black spruce (Labrador tea/horsetail Sw-Sb)
- Shrub - shrubland
- Wonn - shallow, open water

These plant community types are described in detail in Golder (in prep.).

Surveys were not conducted in the upland areas in March. Total distance traveled, the number of km-track days sampled (calculated by multiplying the distance traveled by the time since last snowfall in days) and the number of tracks per km-track day for each species encountered are summarized for each habitat type in Tables 6 and 7. All chi-square analyses and Bonferroni Intervals for the winter track count surveys in the upland areas are in Appendix I. It should be noted that all habitat preferences and avoidances are based on the statistical results presented in Appendix J. Trends were not discussed in this section unless significant.

Table 5. Steepbank River Wildlife Backtrack Information

Transect Number	Number of Individuals	Distance (m) from Start of Transect	Dominant Track Direction	Distance (m) Backtracked	Comments
SB1	1- Coyote	660	North - South	100	Traveling edge of clear-cut. Encountered second tracks in the opposite direction.
SB2	1- Coyote	35	South (upriver)	50	Animal is walking upriver on a packed snowmobile trail and moves a little off of the river to cross our transect. Individual continues upriver through the riparian zone.
SB2	1- Coyote	614	South	N/A	Track was heading southwest, downslope when first encountered. Before the animal was traveling south across the escarpment sideslope. The coyote then headed southwest downhill when it encountered a small gully.
SB3	1- Coyote	284	North	100	Traveling edge of clear-cut and along a road.
SB3	1- Coyote	569	South	100	Individual went up a steep portion of the escarpment. Track possibly came from the river.
SB10	1- Fisher	48, 57 & 82	East / West	150	Track wonders back and forth from west to east then west again.
SB16	1- Fisher	118	Southwest	100	Track travels straight from the northeast. Animal is moving parallel to the river.
SB24	1- Fisher	340	West	50	Track wonders through the upland area searching from tree clump to tree clump.
SB24	1- Fisher	354	Network		Probably same individual as above. Network of fresh tracks centered around a group of burrows in the snow.
SB24	1- Fisher	406	West	50	Track comes from above network. Track parallels transect then crosses to the west. Animal moving without wondering around.
SB8	1- Fisher	659	North	158	Animal hunting and following our snowshoe trail.
SB21	1- Lynx	605	East	50	Individual paralleling the riparian zone hunting where snowshoe hare tracks were abundant.
SB7	1- Lynx	370	East	50	Direct travel.
SB11	1- Marten	68	West to East	60	Foraging along a straight line of travel, tree climbing, burrow investigation.
SB15	1- Marten	15	South	100	No significant changes in vegetation.
SB15	1- Marten	515	Southwest	100	Direct travel.
SB16	1- Marten	48	North	30	Trail lost when animal climbed a tree. Animal was moving randomly in several directions from tree to tree.
SB16	1- Marten	65	South	N/A	Same individual as above.
SB16	1- Marten	152	South	50	Feeding/ searching. Following it's own existing trail. Climbing trees, tunneling under logs and debris.
SB16`	1- Marten	337	Northeast	40	Trail lost under large debris pile. Trail wonders from tree to tree.
SB16`	1- Marten	348	Southeast	N/A	Same individual as above.
SB17	1- Marten	115	North	70	Direct travel.
SB18	1- Marten	401-425	Northeast	N/A	
SB18	1- Marten	451-475	Southeast	N/A	
SB18	1- Marten	136 & 161 & 178	Northeast	100	Same animal at all crossings. Animal is moving northeast up the draw/ ravine. Lost the backtrack when the animal climbed a tree or in fallen snow at the base of the tree.
SB18	1- Marten	660	North	50	Traveling in a straight line from south to north.
SB18	1- Marten	713	South	100	Same individual as above. Animal winds back and searches through a red squirrel network area then moves across the transect.
SB2	1- Marten	362	South	30	Trail lost in a maze of red squirrel tracks. Marten appears to be searching through the area going from tree to tree.
SB2	1- Marten	404	South	N/A	Same individual as above.

Transect Number	Number of Individuals	Distance (m) from Start of Transect	Dominant Track Direction	Distance (m) Backtracked	Comments
SB2	1- Marten	377	Southeast	30	Searching/feeding. Wanders through the riparian area, climbing trees. Trail lost when animal climbed a large tree.
SB26	1- Marten	534	West	50	Track wonders through the upland but marten does not climb any trees.
SB8	1- Marten	670	East	50	Track comes to the transect from the east in a straight line.
SB9	1- Marten	457	North	30	Traveling along the transect.
SB15	1- Moose	5	Southeast	70	There was no significant change in vegetation. Shrubs in the area had been browsed.
SB15	1- Moose	1000	North	100	Bed located 35 m south. Primarily direct travel.
SB51	1- Moose	21	Southeast	100	Meandering
SB9	2- Moose	680	West	100	Traveling along the river, foraging. Two bedding areas observed.
SB9	2- Moose	N/A	North then West	< 1000	Walking and feeding on bent over alder along the river for 350 m. Then went north up the north bank. Moose followed a seismic line in the upland, crossed the escarpment and riparian to the river and followed the river west.
SB24	1- Red Fox	933	Northwest	100	Track follows a straight line course. Animal is traveling without stopping or wondering.
SB8	1- Red Fox	196	Southeast	100	Traveling a sideslope, paralleling river valley along middle of escarpment.
AT26	1- Wolf	201-225	South	N/A	Direct travel along the escarpment.
SB1	1- Wolf	716	North	100	Traveling in a clear-cut.
SB10	1- Wolf	594	East (upriver)	100	Track leads back to the river where a total of 4 wolf tracks were observed. The other 3 wolf tracks remain on the river moving upriver along snowmobile trails. The fourth wolf wonders from the river, up the south bank, back down to the river and across to the north bank. The track then turns east to cross the transect and continues upriver through the riparian zone.
SB11	1- Wolf	320	South	80	Direct travel.
SB12	1- Wolf	328	Southeast (upriver)	100	Following ridge at the top of the escarpment.
SB12	1- Wolf	368	Southeast (upriver)	100	Traveling with above individual, except following a cutline.
SB3	1- Wolf	248	North	100	Traveling along clear-cut and along a road.
SB4	1- Wolf	270	North (downriver)	100	Wolf was following the west side of the escarpment north, then turned into the uplands slightly to cross the transect. Wolf is roughly paralleling the river valley, moving downstream.
SB14	2- Wolves	234	Southeast	100	Paralleling river valley near top of escarpment. Probably one of the same wolves as transect SB12.
SB2	2- Wolves	414	South	N/A	Two wolves traveling together through the riparian zone back from the north.
SB3	2- Coyotes, 1- Red Fox, 1- Wolf	115	North - South	100	Moving along edge of clear-cut and along a cutline.

Table 6. Number of Tracks per km-Track day for Various Wildlife Species in Lease 29 (Upland Area) During the January Surveys

Habitat type (a)	Distance (km)	Km Days Sampled	Snowshoe hare	Red squirrel	Mice	Porcupine	Coyote	Gray wolf	Red fox	Wolverine	Marten	Fisher	Weasel	Mink	River otter	Beaver	Muskrat	Lynx	Caribou	Moose	Deer	Grouse
a1	0.92	3.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
d3	0.63	1.33	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d1	0.62	0.94	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d2	2.34	7.53	7.05	0.78	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
h1	0.93	3.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00
Ftnn	6.52	23.40	1.52	0.19	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.00	3.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79
Btnn	8.61	29.53	5.25	0.68	1.35	0.00	1.32	0.00	0.00	0.00	4.10	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
Shrub	1.15	1.72	4.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.47	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
Wonn	0.12	0.43	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**21.86**	**71.57**	**18.81**	**2.83**	**1.61**	**0.00**	**1.32**	**0.00**	**0.00**	**0.00**	**5.68**	**0.00**	**6.63**	**10.47**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.35**	**0.00**	**2.65**

(a) a1 = lichen Pj
d3 = low-bush cranberry Sw
d1 = low-bush cranberry Aw
d2 = low-bush cranberry Aw-Sw
h1 = Labrador Tea/horsetail Sw-Sb
Ftnn = wooded fen
Btnn = wooded bog
Shrub = shrubland
Wonn = shallow, open water

Table 7. Number of Tracks per km day for Various Wildlife Species in Lease 29 (Upland Area) During the February Surveys

Habitat type (a)	Distance (km)	Km Days Sampled	Snowshoe hare	Red squirrel	Mice	Porcupine	Coyote	Gray wolf	Red fox	Wolverine	Marten	Fisher	Weasel	Mink	River otter	Beaver	Muskrat	Lynx	Caribou	Moose	Deer	Grouse
a1	0.35	1.21	21.83	3.64	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
d3	1.25	0.78	3.45	10.05	0.00	0.00	0.00	0.00	0.00	0.00	100.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d1	1.00	1.07	2.51	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
d2	1.50	2.68	84.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	5.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
h1	1.19	3.04	114.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Ftnn	12.42	30.32	203.72	10.04	0.93	0.00	1.56	0.00	0.00	0.00	36.59	11.76	34.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.06
Btnn	9.16	21.82	224.82	5.32	0.30	0.00	0.00	0.00	0.00	0.00	35.84	4.92	26.97	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	1.82
Shrub	0.10	0.20	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
CIU	0.14	0.25	0.00	0.00	0.00	0.00	4.31	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
TOTAL	**27.10**	**61.37**	**655.19**	**29.05**	**1.23**	**0.00**	**5.87**	**0.00**	**0.00**	**0.00**	**181.07**	**22.17**	**61.63**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**45.88**

(a)
a1 = lichen Pj
d3 = low-bush cranberry Sw
d1 = low-bush cranberry Aw
d2 = low-bush cranberry Aw-Sw
h1 = Labrador tea/horsetail Sw-Sb
Ftnn = wooded fen
Btnn = wooded bog
Shrub = shrubland
CIU = disturbed area

3.3.1 Snowshoe Hare

Snowshoe hares were the most common herbivore in the study area with a combined habitat type total of 18.81 tracks/km-track day in January and 655.19 tracks/km-track day in February. Snowshoe hares avoided the lichen Pj (a1), low-bush cranberry Aw (d1), Labrador tea/horsetail Sw-Sb (h1), low-bush cranberry Sw (d3), wooded fen (Ftnn) and shallow open water (Wonn) community types in January (Appendix I). In February, snowshoe hares preferred the low-bush cranberry Sw Aw (d2), Labrador tea/horsetail Sw-Sb (h1) community types. Hares avoided the low-bush cranberry Aw (d1) and wooded fen (Ftnn) community types.

3.3.2 Red Squirrel

Red squirrels were less common than snowshoe hare with track densities of 2.83 and 29.05 tracks/km-track day in January and February, respectively. During the January surveys, red squirrels avoided the lichen Pj (a1), Labrador tea/horsetail Sw-Sb (h1), shrubland (shrub) and shallow open water (Wonn) community types (Appendix I). In February, red squirrels showed a preference for the low-bush cranberry Sw (d3) community type. Squirrels avoided the low-bush cranberry Aw (d1), low-bush cranberry Sw-Aw (d2) and Labrador tea/horsetail Sw-Sb (h1) community types.

3.3.3 Mice

Mouse tracks were not common in either of the surveys. Mice showed track densities of 1.61 and 1.23 tracks/km-track day in January and February, respectively. Mice did not show a habitat preference during either survey.

3.3.4 Porcupine

No porcupine tracks were encountered during the winter track surveys.

3.3.5 Coyote

Coyote tracks were not common in the study area. Coyotes showed track densities of 1.32 and 5.87 tracks/km-track day in January and February, respectively. Coyotes did not show a habitat preference in January (Appendix I). During the February surveys, coyotes showed a preference for disturbed areas (CIU). Coyotes avoided the lichen Pj (a1), low-bush cranberry (d1, d2, d3), Labrador tea/horsetail Sw-Sb (h1) and wooded bog (Btnn).

3.3.6 Gray Wolf

No wolf tracks were encountered along the track survey transects in the upland areas during the winter track survey.

3.3.7 Red Fox

No red fox tracks were encountered during the winter track surveys in the upland areas.

3.3.8 Wolverine

No wolverine tracks were encountered during the winter track surveys in the upland areas.

3.3.9 Marten

Marten tracks were common during the winter track count surveys in the upland areas. Marten showed track densities of 5.68 and 181.07 tracks/km-track day in the January and February surveys, respectively. Marten showed no habitat preference in January. In February, marten showed a preference for the low-bush cranberry Sw (d3) community type. Marten avoided the lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), wooded fen (Ftnn) and wooded bog (Btnn) community types (Appendix I).

3.3.10 Fisher

Fisher tracks were not observed during the upland January surveys. In February, fisher showed a track density of 22.17 tracks/km-track day. In February, fisher avoided the lichen Pj (a1), low-bush cranberry Sw (d3), low-bush cranberry Aw (d1) and Labrador tea/horsetail Sw-Sb (h1) (Appendix I).

3.3.11 Weasel

Two species of weasel are found in the study area, the ermine and the least weasel (Smith 1993). For the purpose of this study, the tracks of both species were combined. Weasels showed track densities of 6.63 and 61.63 tracks/km-track day in January and February, respectively. Weasels did not show a habitat preference in January, but weasels avoided shrubland (shrub) and shallow open water (Wonn). Weasels did not show a habitat preference or avoidance in February.

3.3.12 Beaver

No beaver tracks were encountered during the winter track count surveys in the Lease 29 upland study area.

3.3.13 Muskrat

No muskrat tracks were encountered during the winter track counts in the Lease 29 upland study area.

3.3.14 Mink

Mink track density was 10.47 tracks/km-track day in January. No mink tracks were observed in February. Mink showed a distinct preference for the wetland shrub (shrub) community type in January. Mink avoided lichen Pj (a1), low-bush cranberry (d1, d2, d3), Labrador tea/horsetail Sw-Sb (h1), wooded fen (Ftnn), wooded bog (Btnn) and shallow open water (Wonn) (Appendix I).

3.3.15 River Otter

No river otter tracks were encountered during the winter track count surveys in the Lease 29 upland study area.

3.3.16 Canada Lynx

No lynx tracks were encountered during the winter track surveys in the Lease 29 upland study area.

3.3.17 Caribou

No caribou tracks were encountered during the winter track surveys in the Lease 29 upland study area.

3.3.18 Deer

Two species of deer, mule deer and white-tailed deer, are native to the Fort McMurray area. It is difficult to distinguish tracks between the two species, so for the purposes of this study, all deer tracks were combined. No deer tracks were encountered during the winter track surveys.

3.3.19 Moose

Moose track density was 0.35 tracks/km-track day in January. Moose tracks were not observed in February. Moose showed no habitat preference during the January upland surveys.

3.3.20 Grouse

Three species of grouse are native to the oil sands area, spruce grouse, ruffed grouse and sharp-tailed grouse (Semenchuk 1992). Willow ptarmigan are found in the region, as well (J. Gulley, pers. com.). For the purpose of these surveys, the tracks of all these species were combined as a single grouse track. Grouse showed track densities of 2.65 and 45.88 tracks/km-track day in January and February, respectively. Grouse showed no habitat preference in January. In February, grouse showed a preference for wooded fen (Ftnn) community type. Grouse avoided the lichen Pj (a1), low-bush cranberry (d1, d2, d3), Labrador tea/horsetail Sw-Sb (h1) and wooded bog (Btnn) community types (Appendix I).

3.4 Shipyard Lake Results

Shipyard Lake was only surveyed in January. Along Transect Up1, the survey crew mainly recorded snowshoe hare tracks, weasel tracks, and mouse tracks. Two old moose beds were recorded as well as some old wolf tracks. Along Transect Up4, the survey crew recorded moose tracks, old moose tracks, deer tracks, weasel tracks, squirrel tracks and several mink tracks.

3.5 Owl Surveys

The owl surveys consisted of 21 systematic points. This consisted of nine census points sampled on March 27 and 12 census points sampled on March 28, 1997. Owl surveys were conducted in 8 habitat types, as follows:

- Btnn wooded bog
- d2 low-bush cranberry aspen poplar - white spruce (low-bush cranberry Aw-Sw)
- Ftnn wooded fen
- g1 Labrador tea-subhygric black spruce - jack pine (Labrador tea-subhygric Sb-Pj)
- h1 Labrador tea/horsetail white spruce - black spruce (Labrador tea/horsetail Sw-Sb)
- Sb/Lt black spruce/tamarack forest
- Stnn wooded swamp

The owl surveys were conducted from 2100 hours (March 27) to 0030 hours (March 28). The plant community types sampled are shown in Table 8. Weather conditions were overcast skies, winds light from the northeast and a temperature of -6 to -10°C. Before accessing the Pit 4 Study Area, a single great gray owl was heard calling in the riparian area along the Steepbank River and the confluence with the Athabasca River. Only one other call was heard during the survey. This occurred at plot number WO3, in a wooded swamp (Stnn). No other owls were heard for the balance of the survey.

Owl surveys were conducted on March 28 from 1915 to 2300 hours. Weather conditions were overcast skies, light to moderately heavy snowfall, winds were light in the early evening, with increases to gusts of 25 km/h from the southeast and a temperature of -2 to -4°C. During this survey, noise from the Suncor fixed plant facility, and background wind gusts may have affected the perception of auditory calls. No owls were heard during this survey.

3.6 Incidental Wildlife Sightings

Incidental wildlife sightings for all surveys are presented in Tables 9 and 10. The most noteworthy sightings included a female moose in a riparian area, east of Transect SB1 and a great gray owl in two transects in a lichen Pj (a1) stand.

3.7 Summary

A summary of the habitat and landscape preferences for the various species recorded during the winter field programs is presented in Table 11.

Table 8. Owl Census Sample Plots and Related Plant Community Types

Owl Census Sample Plot Number	Plant Community Type	
WO1	h1	Labrador tea/horsetail Sw-Sb
WO2	Sb/Lt	black spruce/tamarack forest
WO3	Stnn	wooded swamp
WO4	g1	Labrador tea - subhygric Sb-Pj
WO5	Stnn	wooded swamp
WO6	Btnn	wooded bog
WO7	d2	low-bush cranberry Aw-Sw
WO8	Ftnn	wooded fen
WO9	Btnn	wooded bog
WO10	h1	Labrador tea/horsetail Sw-Sb
WO11	Ftnn	wooded fen
WO12	Btnn	wooded bog
WO13	Ftnn	wooded fen
WO14	Btnn	wooded bog
WO15	Ftnn	wooded fen
WO16	Ftnn	wooded fen
WO17	h1	Labrador tea/horsetail Sw-Sb
WO18	Ftnn	wooded fen
WO19	g1	Labrador tea - Subhygric Sb-Pj
WO20	Sb/Lt	black spruce/tamarack forest
WO21	Stnn	wooded swamp

Table 9. Incidental Wildlife Observations - Steepbank River Winter Track Counts

Wildlife Observation	Transect Number	Landform Type
Black-capped chickadee	SB2, SB22, SB28, RP2	Riparian
Black-capped chickadee	SB8, SB14, SB16, SB18	Escarpment
Black-capped chickadee	SB7, SB8, SB10	Upland
Boreal chickadee	SB15, SB16	Riparian
Boreal chickadee	SB10, SB12, SB13, SB14, SB21	Escarpment
Boreal chickadee	SB8, SB10, SB11, SB20, SB26, SB30, SB50	Upland
Common raven	SB3, SB8, SB13, SB16	Escarpment
Common raven	SB1, SB2, SB22, SB23, SB28	Riparian
Common raven	SB1, SB2, SB4, SB16, SB24, SB50	Upland
Downy woodpecker	RP1, SB5	Riparian
Gray jay	SB1, SB13	Escarpment
Gray jay	SB3, SB4, SB8, SB13, SB20, SB24, SB30	Riparian
Moose (cow)	East of Transect SB1	Riparian
Pine siskin	SB16	Escarpment
Red squirrel	SB8, SB13, SB16, SB18	Escarpment
Red squirrel	SB10, SB16, SB21, SB71	Riparian
Red squirrel	SB2, SB8	Upland
Red-breasted nuthatch	SB14, SB18	Escarpment
Ruffed grouse	SB8	Escarpment
Ruffed grouse	SB11, SB12, SB15	Upland
Snowshoe hare	SB17	Escarpment
Snowshoe hare	SB4	Upland
Three-toed woodpecker	SB16	Escarpment
Unknown chickadee	SB51	Upland
Unknown finch	SB14	Escarpment
Unknown woodpecker	SB13	Escarpment
White-winged crossbill	SB13, SB16, SB18	Escarpment
White-winged crossbill	SB15, SB16	Riparian
White-winged crossbill	SB9	Upland

Table 10. Incidental Wildlife Observations - Lease 29 Upland Area Winter Track Counts

Wildlife Observation	Transect Number	Habitat Type
Black-capped chickadee	UP11	a1
Black-capped chickadee	UP32	Ftnn
Black-capped chickadee	UP33	h1
Boreal chickadee	UP32	Ftnn
Common raven	UP31	Btnn
Common raven	UP32	a1
Common raven	UP32, UP 33, UP 34	Ftnn
Common raven	UP33	Btnn
Downy woodpecker	UP1	d1
Gray jay	UP1, UP 9, UP 33	Btnn
Gray jay	UP11, UP 31	a1
Gray jay	UP31, UP 32, UP 34, UP 38	Ftnn
Gray jay	UP32	Ftnn
Gray jay	UP33	h1
Gray jay	UP33	d2
Gray jay	UP35, UP 37	Btnn
Great gray owl	UP9, UP 11	a1
Northern hawk owl	UP1	Btnn
Red squirrel	UP1	Btnn
Red squirrel	UP9	a1
Spruce grouse	UP4, UP 13	Btnn
Unknown chickadee	UP6	Btnn
Unknown woodpecker	UP6	Btnn
White-winged crossbill	UP32	Ftnn

Table 11. Summary of Landscape and Habitat Preferences for Wildlife Species Recorded During the 1997 Winter Field Program

Species	Month	Landscape Preference	Landscape Avoidance	Habitat Preference[a]	Habitat Avoidance[a]
Snowshoe hare	Jan.	• Upland	• Riparian • Escarpment	• No preference	• a1 • d3 • d1 • h1 • Ftnn • Wonn
Snowshoe hare	Feb.	• Upland	• Riparian • Escarpment	• d2 • h1	• d1 • Ftnn
Snowshoe hare	March	• Upland	• Riparian • Escarpment	• ---	• ---
Red squirrel	Jan.	• No preference	• Escarpment	• No preference	• a1 • h1 • Shrub • Wonn
Red squirrel	Feb.	• Escarpment	• Upland	• d3	• d1 • d2 • h1
Red squirrel	March	• Riparian • Escarpment	• Upland	• ---	• ---
Mice	Jan.	• No preference	• No avoidance	• No preference	• No avoidance
Mice	Feb.	• No preference	• No avoidance	• No preference	• No avoidance
Mice	March	• Not observed	• Not observed	• ---	• ---
Coyote	Jan.	• No preference	• No avoidance	• No preference	• No avoidance
Coyote	Feb.	• Not observed	• Not observed	• CIU	• a1 • d3 • d1 • d2 • h1 • Btnn
Coyote	March	• Not observed	• Not observed	• ---	• ---
Gray wolf	Jan.	• Upland	• Escarpment	• Not observed	• Not observed
Gray wolf	Feb.	• Not observed	• Not observed	• Not observed	• Not observed
Gray wolf	March	• Not observed	• Not observed	• ---	• ---
Red fox	Jan.	• No preference	• No avoidance	• Not observed	• Not observed
Red fox	Feb.	• No preference	• No avoidance	• Not observed	• Not observed
Red fox	March	• Not observed	• Not observed	• ---	• ---
Marten	Jan.	• Escarpment	• Upland	• No preference	• No avoidance
Marten	Feb.	• No preference	• No avoidance	• d3	• a1 • d1 • d2 • Ftnn • Btnn
Marten	March	• Escarpment	• Riparian	• ---	• ---
Fisher	Jan.	• Riparian	• Escarpment • Upland	• Not observed	• Not observed
Fisher	Feb.	• Upland	• Riparian • Escarpment	• No preference	• a1 • d3 • d1 • h1
Fisher	March	• No preference	• No avoidance	• ---	• ---
Weasel	Jan.	• No preference	• Escarpment	• No preference	• Shrub • Wonn
Weasel	Feb.	• No preference	• No avoidance	• No preference	• No avoidance
Weasel	March	• Not observed	• Not observed	• ---	• ---

Species	Month	Landscape Preference	Landscape Avoidance	Habitat Preference[a]	Habitat Avoidance[a]
Mink	Jan.	• Not observed	• Not observed	• Shrub	• a1 • d3 • d1 • d2 • h1 • Ftnn • Btnn • Wonn
Mink	Feb.	• Not observed	• Not observed	• Not observed	• Not observed
Mink	March	• Not observed	• Not observed	• ---	• ---
Canada lynx	Jan.	• Not observed	• Not observed	• Not observed	• Not observed
Canada lynx	Feb.	• Riparian	• Escarpment • Upland	• Not observed	• Not observed
Canada lynx	March	• No preference	• No avoidance	• ---	• ---
Moose	Jan.	• Riparian	• Escarpment • Upland	• No preference	• No avoidance
Moose	Feb.	• Riparian	• Escarpment • Upland	• Not observed	• Not observed
Moose	March	• Upland	• Riparian • Escarpment	• ---	• ---
Grouse	Jan.	• No preference	• No avoidance	• No preference	• No avoidance
Grouse	Feb.	• No preference	• No avoidance	• Ftnn	• a1 • d3 • d2 • d1 • h1 • Btnn
Grouse	March	• No preference	• No avoidance	• ---	• ---
Owl		• One owl heard calling in the riparian area along the Steepbank River and the confluence with the Athabasca River	• ----	• One owl recorded in wooded swamp (stnn)	• One owl recorded in a lichen Pj (a1) stand as an incidental sighting

(a) Information obtained from statistical analysis presented in Appendix I.

4.0 DISCUSSION

Winter track count surveys can provide a reasonable index of the relative abundance and distribution of furbearers in a general area (Thompson et al. 1989). Indices of animal abundance are, however, susceptible to environmental and behavioural variation that can significantly bias estimates of abundance (Sutherland 1996). For example, poor snow conditions or inclement weather can make some species difficult to detect, and/or individuals may be so over dispersed that the sampling regime may underestimate abundance. In this study, an attempt was made to conduct surveys under optimal snow conditions (i.e., a minimum of one day after fresh snowfall), and as much of the study area as possible was surveyed to detect more widespread species. In addition, three surveys were conducted along the same transects in the Steepbank River Study Area. Not only did this compensate for the potential for poor snow conditions or bad weather during the course of the surveys, it potentially allowed determination of seasonal wildlife habitat or landscape preferences and use.

For the purpose of the discussion, the species-specific habitat and landscape preferences from the Steepbank River surveys and the Lease 29 upland area surveys have been combined. This should facilitate the discussion on each wildlife species, their landscape preferences and habitat preferences. A summary of wildlife use of the Steepbank River and the upland areas of Lease 29 is presented first.

4.1 Steepbank River

The results of the winter track count surveys along the Steepbank River indicate that the landscape features associated with the Steepbank River are important to most species of wildlife surveyed. Of the 12 species for which adequate data exist, four were clearly associated with the riparian corridor for at least part of the study. These were red squirrels, fishers, Canada lynx and moose. Fishers, lynx and moose have large home ranges (Table 12), and these species may use the river as a movement corridor to travel great distances. By March, moose tracks were found more often in the uplands, indicating that their habitat preference had switched as winter progressed, although sample sizes were small. Mice, coyotes, red foxes, weasels and grouse either showed no landscape preference or their tracks were not observed. Snowshoe hares showed a preference for upland habitat. Wolves showed a preference for the upland in January and were not observed in February or March, while marten showed a preference for the escarpment. The escarpment was avoided by most species during most of the surveys.

Table 12. List of Wildlife Species, Associated Habitats, and Home Range Size (From Golder 1997b)

COMMON NAME	GOLDER 1997	OTHER SOURCES[a]	HOME RANGE
American black bear	Not determined	Mixedwood as well forest openings	20,200 ha
American marten	Closed white spruce Closed mixedwood-white spruce dominant	Mature, old growth coniferous forests with fallen logs and a well established understory	Male 1,000 - 2,000 ha Female 300 - 600 ha
Beaver	Not determined	Occupy ponds or streams and lake margins with aspen trees within area	200 - 300 ha
Canada lynx	Not determined	Early successional stands where hare are plentiful	Male 1,730 - 5,100 ha Female 830 - 1,820 ha
Coyote	Disturbed areas	Generalist	Male 4,192 ha Female 1,008 ha
Fisher	Not determined	Prefer mature to late coniferous forests with multi-layered structure	Male 4,000 ha Female 1,500 ha
Weasel	Black spruce tamarack fens	Open forests, meadows, forested riparian areas	Male 0.6 - 26.2 ha Female 0.2 - 7.0 ha
Mink	Wetland shrub complex Closed white spruce	Stream banks, lakeshores, forest edges and large swamps	Males up to 777 ha Females 7.7 - 20.3 ha
Muskrat	Not determined	Occupy most aquatic habitats including creeks, lakes, marshes and ponds	Within 1 ha of their primary dwelling
Red fox	Not determined	Semi open forests and natural clearings, and agricultural areas	363 - 813 ha
Red squirrel	Closed white spruce	Late successional coniferous forests	1.11 - 2.44 ha
River otter	Not determined	Occur on the shores of deep lakes, rivers and large marshes	
Snowshoe hare	Closed mixedwood	Mixedwood and coniferous forests, swamps and riparian areas, early regenerating stands	Males 7.29 ha Females 2.84 ha
Wolf	Harvested stands, late stage trembling aspen	Forest mosaic with adequate ungulate prey base	25,900 - 67,300 ha
Wolverine	Not determined	Undisturbed coniferous forests	Male 42,200 ha Female 38,800 ha
Moose[b]	Not determined	Young mixed-wood forests, muskeg lowlands and well-drained valley bottoms	0.5 - 1.5/km^2
Deer[b]	Not determined	Riparian forests	0.2 - 1.0 animals/km^2
Caribou[b]	Not determined	Climax coniferous forest and muskeg habitats	0.01 - 0.05/km^2

(a) Banfield 1974; Skinner and Westworth 1981, Stelfox 1993, Westworth et al. 1996 a,b, Westworth and Brusnyk 1982.

(b) These animals typically do not have individual spatial ranges. Instead the typical abundance per km^2 is reported.

4.2 Back-track Surveys Along the Steepbank River

As indicated by the back tracking surveys, only moose and marten showed a distinct preference for traveling along the Steepbank River. Most of the predators (i.e., coyote, wolf, red fox, fisher and lynx) showed no preference for direction of travel. Predators may not show a preference because they may be searching for a variety of prey in a variety of habitat types.

Mammalian prey, including squirrels and hares, dominate the winter diet of martens (Ruggiero et al. 1994). Since these species typically prefer coniferous and mixedwood forests (Smith 1993), it is somewhat surprising that marten traveled parallel to the river. However, most marten tracks led from tree to tree, as the marten were probably searching for squirrels.

It was not surprising that moose were noted to travel along the river corridor. Most other studies in the Fort McMurray region have indicated that riparian habitat types are preferred during the winter (Penner 1971, Thompson et al. 1989, Skinner and Westworth 1981, Westworth and Brusnyk 1982). Moose probably prefer the riparian areas because of the high availability of browse species in these areas.

4.3 Lease 29 Upland Areas

In general, lichen Pj (a1), low-bush cranberry Aw-Sw (d2), low-bush cranberry Aw (d1), Labrador tea/horsetail Sw-Sb (h1), low-bush cranberry Sw (d3), wooded fen (Ftnn), shrubland (shrub) and shallow open water (Wonn) were all avoided to some extent. Snowshoe hares preferred low-bush cranberry Aw-Sw (d2) and Labrador tea/horsetail Sw-Sb (h1). Low-bush cranberry Sw (d3) was preferred by marten and red squirrel. Disturbed areas were preferred by coyotes. Riparian shrubland (shrub) was preferred by mink, while wooded fens (Ftnn) were preferred by grouse.

4.4 Species Specific Accounts and Habitat Associations

Like all animal species, suitable habitat for furbearers and ungulates depends on many environmental factors. Environmental factors that limit the abundance and distribution of wildlife include the quality and quantity of den and resting sites, food resources and cover. The spatial scale at which environmental factors may limit life history traits is important. For example, a weasel may be able to find suitable shelter and food resources in a wooded fen (Ftnn), but a fisher may have to travel through several forest stands to

obtain enough food. Home range and dispersal distances are two biological parameters that can be used to address the spatial scale of habitat requirements for a given species. Mammal species, their associated habitats and home range sizes are shown in Table 12. From this table, it is clear that certain species, including lynx, wolf, wolverine and moose, have larger home range sizes than other species.

Habitat suitability not only involves environmental conditions within and among stands, but also includes factors at the landscape level. The importance of landscape features (i.e., riparian, escarpment and upland areas) to particular wildlife species was determined in the Steepbank River portion of the study.

4.4.1 Small Herbivores

Snowshoe Hare

During the three winter track count surveys in the Steepbank River Study Area, snowshoe hare were associated with upland areas but they avoided the riparian and escarpment areas. Westworth, Brusnyk and Associates (1996a) found similar results in their Athabasca River study. The distribution of snowshoe hare in upland areas is most likely related to the distribution of mixedwood and coniferous forests within this landscape feature, since snowshoe hares prefer the lowland forests in this landscape.

Snowshoe hare were quite common throughout the upland study area, with 19 tracks/km-track day in January and 655.19 tracks/km-track day in February. These numbers are high compared to Westworth, Brusnyk and Associates (1996a) survey of the Athabasca River, but comparable to Skinner and Westworth (1981) and Westworth and Brusnyk (1982). Alsands Project Group (1978) reported that snowshoe hare were abundant on Lease 17, with a track count of 2.94 tracks/km-track day. Snowshoe hare populations are cyclical in nature, with populations undergoing fluctuations approximately every 10 years (Keith and Windberg 1978, Keith et al. 1984). Thus, numbers could have been low last year but on the increase this year.

In the upland study, snowshoe hares preferred the low-bush cranberry Aw-Sw (d2) and Labrador tea/horsetail Sw-Sb (h1) community types. This is similar to the habitat associations reported in Westworth, Brusnyk and Associates (1996a); however in that study, hare also preferred closed jack pine stands. Comparable with this study, Skinner and Westworth (1981) found that hare avoided jack pine, showing a preference for mixedwood, black spruce and white spruce forests instead. Likewise, Golder

(1997a) found that snowshoe hares prefer low-bush cranberry Sw (d3), Labrador tea/horsetail Sw-Sb (h1), wooded bog (Btnn), low-bush cranberry Sw-Aw (d2) and lichen Pj (a1) community types in a study on the Shell Canada Limited Lease 13 area. The Alsands Project Group (1978) reported that snowshoe hares preferred aspen, willow, dense black spruce and tall shrubs, while they avoided cleared areas and moderately used roads. Pietz and Tester (1983) reported that snowshoe hares avoided open habitat of all plant community types.

Red Squirrel

In the Steepbank River surveys, red squirrels avoided the escarpment in January, but were found primarily in the escarpment and riparian areas in February and March. Upland areas were avoided in February and March. Westworth, Brusnyk and Associates (1996a) found that squirrels preferred the escarpment over the riparian and upland areas. Upland areas may be avoided due to the prevalence of lowland coniferous forests consisting mainly of black spruce and tamarack. Red squirrels are known to prefer climax coniferous forest (Banfield 1974).

The highest track frequency for red squirrels in the upland study was 29.05 tracks/km-track day, recorded during the February surveys. This is much higher than the 2.78 tracks/km-track day observed by Westworth, Brusnyk and Associates (1996a). Skinner and Westworth (1981) and Westworth and Brusnyk (1982) also reported lower track frequencies for red squirrels. As well, the Alsands Project Group (1978) recorded a red squirrel winter track index of 2.33 tracks/km-track day. In the upland study, red squirrels showed a preference for the low-bush cranberry Sw (d3) community type while avoiding lichen Pj (a1), low-bush cranberry Aw-Sw (d2), low-bush cranberry Aw (d1), Labrador tea/horsetail Sw-Sb (h1), shrubland (shrub) and shallow open water (Wonn). Westworth and Brusnyk (1982) and the Alsands Project Group (1978) also reported that red squirrels preferred white spruce forest. On the other hand, Westworth, Brusnyk and Associates (1996a) found that red squirrels preferred closed jack pine and mixed coniferous forest.

Mice

Mice showed no landscape or habitat preference in either January or February, however sample sizes were small. Mouse tracks were not observed in March. Westworth, Brusynk and Associates (1996a) did not collect data on mice.

The highest mouse track frequency in the upland study was seen in January with 1.61 tracks per km-track day. Mice were also quite common in the Shell Lease 13 winter track count (Golder 1997a). In the upland study, mice showed no preference for any particular plant community type. However, Golder (1997b) reported that the greatest mouse track frequencies were recorded in open aspen forest, open black spruce bog and the closed aspen forest.

Porcupine

No porcupine tracks were observed during the course of the surveys. Although porcupine have been recorded throughout the province in most mixed forest cover types (Smith 1993), porcupine are most likely rare in the Fort McMurray area (S. Tuttle and J. Gulley pers. com.). Porcupine tracks were not recorded during the upland surveys, thus, track frequency and habitat preferences could not be determined.

4.4.2 Terrestrial Carnivores

Coyote

In the Steepbank River survey, coyotes showed no landscape feature preference in January, and coyote tracks were not recorded in February or March. This is similar to the findings of Westworth, Brusnyk and Associates (1996a). In their study, coyote did show a preference for riparian areas in December. Kansas (1984) reported that coyotes were abundant along river systems in winter.

The highest frequency of coyote tracks in the upland study was seen in February, with 5.87 tracks/km-track day. These numbers are high compared to an overall frequency of 0.45 tracks/km-track day reported by Westworth, Brusynk and Associates (1996a), Skinner and Westworth (1981), and Westworth and Brusnyk (1982). Penner (1976) reported a track frequency of 0.29 tracks/km-track day.

In the upland study, coyotes did not show a plant community type preference in January. In February, coyote showed a preference for disturbed areas (CIU) and avoided low-bush cranberry (d1, d2, d3), lichen Pj (a1), Labrador tea/horsetail Sw-Sb (h1) and wooded bog (Btnn). Disturbed areas may be preferred by coyotes since winter travel is often easier in these areas. Westworth, Brusnyk and Associates (1996a) reported that coyotes preferred closed deciduous forest while closed black spruce and shorelines were avoided. Penner (1976) found that coyotes preferred cleared areas, garbage dumps and areas of reduced cover. In general, aspen, aspen-willow and black spruce willow habitats were avoided. Other studies (Keith et al. 1984, Todd et al. 1981) have indicated a relationship between coyotes habitat use and snowshoe hare abundance. Thus, coyotes should have been found in some of the mixedwood and closed black spruce bogs.

Gray Wolf

Gray wolf tracks were not observed during the February or March surveys in the Steepbank River Study Area. During the January surveys, wolves showed a preference for the upland areas and avoided the escarpment. Westworth, Brusnyk and Associates (1996a) reported that wolves preferred the escarpment. This is not surprising in that differences in the distribution of wolf tracks may be related to the habitat use of their prey (Mech 1970). Thus, wolves may be following deer movements. Unfortunately, deer, which are quite susceptible to predation by wolves, were not observed during any of the surveys, and a correlation could not be determined.

Wolf tracks were not recorded during the upland surveys, thus, track frequency and specific habitat preferences could not be determined. Penner (1976) found that wolves avoided dense coniferous cover and used areas of cleared or disturbed cover. Travel occurred primarily in areas where snow depth was minimal (i.e., roads, cutlines, lakeshores and snowmobile trails). This is similar to the results seen for coyotes.

Fuller and Keith (1978) conducted a comprehensive radio-tracking study of wolves along the Muskeg River drainage. They followed 9-10 animals in the Muskeg River Pack, and determined the home territory size to be over 1500 km^2. On average, the wolves killed and consumed one moose every 4.6 days in the winter. Eighty-one percent of the kills occurred in lowland habitat.

Red Fox

Red foxes did not show a landscape preference in either January or February. No red fox tracks were observed in March. Likewise, Westworth, Brusnyk and Associates (1996a) did not find a landscape preference for red foxes. Red fox tracks were not recorded during the upland surveys, thus, track frequency and specific habitat preferences could not be determined. The track frequency of red foxes was also low in other studies (Skinner and Westworth 1984, Westworth and Brusnyk 1982).

Marten

Marten showed a landscape preference for escarpment. In January, they avoided the upland areas, and in March, they avoided the riparian areas. Westworth, Brusnyk and Associates (1996a) reported that marten preferred escarpment and riparian areas over the upland areas.

Marten showed no plant community type preference in the upland surveys in January. In February, marten preferred low-bush cranberry Sw (d3). Marten avoided lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), wooded fen (Ftnn) and wooded bog (Btnn). Westworth, Brusnyk and Associates (1996a) reported that marten were associated primarily with closed white spruce forest and mixed coniferous forest. Penner (1976) reported that marten preferred pure white and black spruce stands in Lease 17. This is consistent with other studies that indicate marten have specific habitat preferences (Ruggiero et al. 1994). Other studies have reported that marten are most likely found in late successional or climax coniferous or mixedwood forests (Hargis and McCullough 1984, Bateman 1986, Slough 1989, Ruggiero et al. 1994).

The highest marten track frequency in the upland surveys was 181.07 tracks/km-track day, recorded during the February surveys. This is comparable to work on Lease 13, which recorded 100.50 tracks/km-track day (Golder 1997a). These numbers are much higher than the 0.10 tracks/km-track day and 0.04 tracks/km-track day recorded by Westworth, Brusnyk and Associates (1996a).

Fisher

In the Steepbank Surveys, fishers showed a preference for riparian areas in January and upland areas in February. Fishers did not show a landscape preference in March. Westworth, Brusnyk and Associates

(1996a) reported that fisher were more common in riparian areas, areas considered important habitat for fisher in other studies (Ruggiero et al. 1994).

The highest fisher track frequency in the upland surveys was 22.17 tracks/km-track day. Golder (1997a) recorded 14 tracks/km-track day in a similar study on Lease 13. This was much higher than that recorded by Westworth, Brusnyk and Associates (1996a), with 0.04 tracks/km-track day. Penner (1976) reported a track density of 0.6 tracks/km-track day.

Fisher were not observed in January in the Lease 29 upland area surveys. Fisher avoided lichen Pj (a1), low-bush cranberry Aw (d1), low-bush cranberry Sw (d3) and Labrador tea/horsetail Sw-Sb (h1) in February. Golder (1997a) found the highest percentage of tracks in the aspen stands. Westworth, Brusnyk and Associates (1996a) found that fisher preferred black spruce-tamarack forest, while Penner (1976) reported that fisher preferred pure white and black spruce habitats. The literature on habitat preference of fisher is scant. Kohn et al. (1993) reported that fisher preferred lowland mixedwood forest and avoided lowland coniferous forest. Other studies have reported that fisher use most forest types within the northern coniferous forests (Raine 1983, Ruggiero et al. 1994). Fisher are known to prefer climax coniferous forests in the vicinity of watercourses and may have home ranges extending up to 16 km in diameter (Banfield 1974). The habitat preference of this species is probably mainly related to prey availability. Common prey include snowshoe hares, squirrels, mice, shrews and porcupines (Ruggiero et al. 1994).

Weasel

In the Steepbank River surveys, weasels avoided escarpment in January, showed no landscape preference in February, and were not observed in March. Westworth, Brusnyk and Associates (1996a) reported that weasels preferred upland habitat over escarpment and riparian areas. This was probably due to the prevalence of black spruce and tamarack in the upland areas.

Weasels were prevalent in the Lease 29 upland study area with track densities of up to 61.63 tracks/km-track day. Weasel showed no preference for plant community types during the January upland surveys but weasels avoided riparian shrubland (shrub) and shallow open water (Wonn). In February, a habitat preference or avoidance was not determined. This is comparable to results reported by Westworth, Brusnyk and Associates (1996a) and Skinner and Westworth (1981). Penner (1976) reported that weasels preferred

aspen-willow, low density black spruce and tall shrub habitats, and avoided black spruce-willow, cleared areas and areas of disturbed cover.

Wolverine

Wolverine tracks were not recorded during the surveys, nor during the Westworth, Brusnyk and Associates (1996a) survey. Thus, specific landscape and habitat preferences could not be determined. Penner (1976) reported a track density of 0.1 tracks/km-track day. In that study, wolverine avoided construction and disturbed habitats (Penner 1976). Typically, wolverines are restricted to boreal forests, tundra and western mountains (Ruggiero et al. 1994). Wolverine habitat use is most likely related to prey abundance and distribution. Home ranges of adult wolverines may range from less than 100 km^2 to over 900 km^2, based on the abundance and distribution of prey (Ruggiero et al. 1994).

Canada Lynx

Canada lynx were not observed during the January survey in the Steepbank River Study Area. Lynx preferred riparian areas in February and avoided the escarpment and upland areas. Lynx did not show a landscape preference in March. Westworth, Brusnyk and Associates (1996a) reported low lynx populations and were unable to determine a landscape preference. As well, Golder (1997a) did not record any lynx tracks in a similar study on Lease 13. Lynx may be uncommon in the area due to the tendency for population fluctuations every 9 to 12 years (Koonz 1976).

Lynx tracks were not recorded during the upland surveys, thus track frequency and specific habitat preferences could not be determined. Westworth, Brusnyk and Associates (1996a) reported lynx tracks in closed deciduous forest, mixed coniferous forest, black spruce-tamarack and disturbed habitats. However, Westworth, Brusnyk and Associates (1996a) were not able to determine a habitat preference. Penner (1976) observed only two sets of lynx tracks in black spruce habitats of Lease 17, resulting in a track density of 0.002 tracks/km-track day.

Lynx rely on snowshoe hare as their principal prey species (Koonz 1976, Parker 1981), and the distribution and abundance of lynx is related to that of the snowshoe hare (Kansas 1984, Ruggiero et al. 1994). Thus, lynx population cycles may lag behind snowshoe hare cycles by a year or two (Brand and Keith 1979). Since snowshoe hare are often found in dense coniferous thickets, lynx may also be found in this plant

community type (Alsands Project Group 1978, Ruggiero et al. 1994). Since snowshoe hare populations appeared to be low in 1996 but up in 1997, lynx populations may soon increase.

4.4.3 Semi-Aquatic Carnivores

Beaver

Beaver tracks were not recorded during the Steepbank River surveys; thus, specific landscape preferences could not be determined. Beavers are usually associated with slow-flowing streams, lakes, rivers, and marshes (Banfield 1974).

Muskrat

Muskrat tracks were not recorded during the Steepbank River surveys; thus, specific landscape preferences could not be determined. Muskrats are usually found near lakes, rivers, ponds, sloughs, and marshes (Banfield 1974).

Mink

Mink tracks were not recorded during the Steepbank River surveys, thus, specific landscape preferences could not be determined. Penner (1976) recorded mink at a rate of 0.1 tracks/km-track day on Lease 17 within riparian aspen/willow habitats along the McKay and Athabasca rivers. Mink are usually aquatic and are often associated with stream banks, lakeshores, forest edges and large swamps (Banfield 1974).

Mink were only observed during the January upland surveys. Mink track density was recorded at 10.47 tracks/km-track day. At this time, mink showed a preference for the wetland shrubland (shrub), community type and avoided lichen Pj (a1), low-bush cranberry (d1, d2, d3), Labrador tea/horsetail Sw-Sb (h1), wooded fen (Ftnn) and wooded bog (Btnn) community types.

River Otter

Otter tracks were not recorded during the surveys, thus, specific landscape and habitat preferences could not be determined. Golder (1997a) only recorded one set of river otter tracks along the Muskeg River in a similar study. Penner (1976) observed one otter along the Athabasca River near Lease 17 for a low track density of 0.07×10^{-2} tracks/km-track day. Otters are generally amphibious and prefer the shores of deep, clear rivers, lakes and large marshes (Alsands Project Group 1978).

4.4.4 Ungulates

Moose

During the Steepbank River surveys, moose preferred riparian areas in January and February. Moose appeared to move to the upland areas in March. They avoided the escarpment in all three months. Westworth, Brusnyk and Associates (1996a) reported that moose preferred escarpment in December and the upland areas in February.

Moose showed no habitat preference during the January surveys in the Lease 29 upland areas. Moose tracks were not observed during the February surveys. According to the Steepbank River surveys, moose were more likely to be found in the riparian areas at this time. This has been reported in other studies in the regional area (Penner 1976, Thompson et al. 1989, Westworth and Brusnyk 1982). Westworth, Brusnyk and Associates (1996a) also reported that moose were concentrated in closed jack pine stands in December and open tamarack fens in February.

In the upland surveys, moose track density was reported at 0.35 tracks/km-track day in January. Westworth, Brusnyk and Associates (1996a) reported a track frequency of 0.36 tracks/km-track day in the upland areas. This is consistent with other studies in the region (Alsands Project Group 1978).

Deer

White-tailed and mule deer populations are believed to be low in the Fort McMurray to Fort McKay area (Penner 1976). This is supported by this study where deer tracks were only recorded at Shipyard Lake (see

Section 4.5). As well, Golder (1997a) encountered no deer tracks in a similar study. Thus, specific landscape preferences could not be determined.

Caribou

Woodland caribou once ranged throughout forested Alberta, south to Sundre (Soper 1964). Distribution has been reduced to localized regions between the Birch Mountains, the Caribou Mountains and Wood Buffalo National Park. During winter, caribou migrate to lower elevations north and east of these mountainous areas. Also, barren-ground caribou have been reported as far south as Fort McMurray (Alsands Project Group 1978). Smith (1993) has reported the distribution of caribou as far south as Winefred Lake and in the Lesser Slave Lake area. The significance of the study area to caribou has not been determined definitively, however the study area appears to be on the edge of caribou range (Westworth, Brusnyk and Associates 1996a). However, no caribou were recorded within the study area throughout the course of the winter track count surveys or those conducted on Lease 13 (Golder 1997a). In addition, caribou were not recorded by Westworth, Brusnyk and Associates (1996a).

4.4.5 Other

Grouse

Grouse tracks were recorded in all three landscape features, and grouse showed no preference for any particular feature during the Steepbank River Surveys.

Grouse track densities were 2.70 and 45.88 tracks/km-track day in the January and February upland surveys, respectively. In the January upland surveys, grouse showed no preference for any of the plant community types. In February, grouse showed a preference for wooded fens (Ftnn). Grouse avoided lichen Pj (a1), low-bush cranberry (d1, d2, d3), Labrador tea/horsetail Sw-Sb (h1) and wooded bog (Btnn). Ruffed grouse typically prefer aspen dominated and mixedwood forests (Semenchuk 1992). Sharp-tailed grouse use openings made by fire and man, muskegs and bogs, while spruce grouse prefer coniferous and mixedwood forests with muskegs and small openings.

4.5 Shipyard Lake

Shipyard Lake appears to be a very important area for moose. Several moose tracks were sighted, as well as some old moose bedding areas. The only deer tracks observed during the surveys were observed at Shipyard Lake. As well, Shipyard Lake is very important for mink. Other species observed at Shipyard Lake included weasels, wolves, hares, squirrels and mice.

4.6 Owls

A single great gray owl was recorded during the owl surveys. The great gray owl was heard calling in a wooded swamp (Stnn). In addition, during the winter track count surveys, a great gray owl was observed in a lichen Pj (a1) stand. In Alberta, great gray owls generally prefer coniferous, deciduous and mixed woodlands, usually near water sources such as muskegs, marshes and wet meadows in undisturbed boreal forest (Semenchuk 1992).

No boreal owls nor any other owls, besides the previously mentioned great gray owl, were heard during the course of the owl surveys. Boreal owls typically prefer coniferous and mixedwood forests (Semenchuk 1992).

5.0 SUMMARY

The riparian area appears to the most important landscape feature for many of the furbearers and ungulates in the study area. The riparian area was preferred by red squirrels, fisher, lynx and moose. The larger mammals (i.e., fisher, lynx and moose) probably use the Steepbank River as a movement corridor, although in this study, only moose and marten preferred travel along the river. Red squirrels and marten preferred the escarpment for at least part of the winter. Snowshoe hares, wolves, fisher and moose also used the upland areas for at least part of the winter. Coyotes, red foxes, and weasels either showed no landscape preference or their tracks were not observed.

Low-bush cranberry Sw (d3) was preferred by marten and red squirrels. Disturbed areas (CIU) were preferred by coyotes. Low-bush cranberry Aw-Sw (d2), and Labrador tea/horsetail Sw-Sb (h1) were preferred by snowshoe hares. Wooded fens (Ftnn) were preferred by grouse and weasel. Wetland shrub complexes (Shrub) were preferred by mink. Habitat preferences could not be determined for moose, lynx, wolves, fishers, red foxes and various other species.

6.0 CLOSURE

We trust that this report presents the information that you require. Should any portion of the report require clarification, please contact the undersigned.

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APPENDIX I

CHI-SQUARE ANALYSES AND BONFERRONI INTERVALS

Chi-Square Analyses and Bonferroni Intervals for Winter Track Count Surveys

Table 1. Numbers of Snowshoe Hares Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	39.74	0.06	$0.04 \le P_i \le 0.08$ *
Escarpment	20.55	0.49	218.61	0.36	$0.31 \le P_i \le 0.41$ *
Upland	14.29	0.34	350.57	0.58	$0.53 \le P_i \le 0.63$ *
$\chi^2 = 160.14$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	116.8	0.11	$0.09 \le P_i \le 0.13$ *
Escarpment	15.63	0.36	255.9	0.24	$0.21 \le P_i \le 0.27$ *
Upland	21.20	0.49	704.4	0.65	$0.62 \le P_i \le 0.68$ *
$\chi^2 = 116.37$	d.f. = 2	$P < 0.05$			
March:					
Riparian	2.74	0.13	0.0	0.0	$0.00 \le P_i \le 0.00$ *
Escarpment	6.59	0.32	29.24	0.19	$0.11 \le P_i \le 0.27$
Upland	11.35	0.55	121.17	0.81	$0.73 \le P_i \le 0.89$ *
$\chi^2 = 44.82$	d.f. = 2	$P < 0.05$			

Table 2. Numbers of Red Squirrels Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	11.58	0.31	$0.13 \le P_i \le 0.49$
Escarpment	20.55	0.49	7.53	0.20	$0.04 \le P_i \le 0.36$ *
Upland	14.29	0.34	18.63	0.49	$0.30 \le P_i \le 0.68$
$\chi^2 = 13.27$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	25.34	0.20	$0.11 \le P_i \le 0.29$
Escarpment	15.63	0.36	62.78	0.51	$0.40 \le P_i \le 0.62$ *
Upland	21.20	0.49	35.86	0.29	$0.19 \le P_i \le 0.39$ *
$\chi^2 = 20.02$	d.f. = 2	$P < 0.05$			
March:					
Riparian	2.74	0.13	495.33	0.30	$0.27 \le P_i \le 0.33$ *
Escarpment	6.59	0.32	1024.98	0.61	$0.58 \le P_i \le 0.64$ *
Upland	11.35	0.55	151.28	0.09	$0.07 \le P_i \le 0.11$ *
$\chi^2 = 1446.39$	d.f. = 2	$P < 0.05$			

Table 3. Numbers of Mice Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* P < 0.05)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	0.0	0.0	
Escarpment	20.55	0.49	1.11	0.20	
Upland	14.29	0.34	4.44	0.80	
$\chi^2 = 5.33$	d.f. = 2	P = ns			
February:					
Riparian	6.39	0.15	0.0	0.0	
Escarpment	15.63	0.36	0.0	0.0	
Upland	21.20	0.49	1.39	1.00	
$\chi^2 = 1.45$	d.f. = 2	P = ns			
March:					
No mice tracks were observed.					

Table 4. Numbers of Coyotes Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* P < 0.05)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	0.52	0.09	
Escarpment	20.55	0.49	1.11	0.19	
Upland	14.29	0.34	4.14	0.72	
$\chi^2 = 3.68$	d.f. = 2	P = ns			
February:					
No coyote tracks were observed.					
March:					
No coyote tracks were observed.					

Table 5. Numbers of Gray Wolves Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	4.52	0.20	$0.00 \leq P_i \leq 0.40$
Escarpment	20.55	0.49	1.23	0.05	$0.00 \leq P_i \leq 0.16$ *
Upland	14.29	0.34	17.06	0.75	$0.53 \leq P_i \leq 0.97$ *
$\chi^2 = 16.72$	d.f. = 2	$P < 0.05$			
February:					
No wolf tracks were observed.					
March:					
No wolf tracks were observed.					

Table 6. Numbers of Red Fox Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	0.0	0.0	
Escarpment	20.55	0.49	1.04	0.69	
Upland	14.29	0.34	0.47	0.31	
$\chi^2 = 3.83$	d.f. = 2	P = ns			
February:					
Riparian	6.39	0.15	0.0	0.0	
Escarpment	15.63	0.36	0.0	0.0	
Upland	21.20	0.49	0.83	1.00	
$\chi^2 = 0.85$	d.f. = 2	P = ns			
March:					
No red fox tracks were observed.					

Table 7. Numbers of Marten Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	2.61	0.18	$0.0 \le P_i \le 0.42$
Escarpment	20.55	0.49	11.87	0.82	$0.58 \le P_i \le 1.00$ *
Upland	14.29	0.34	0.0	0.0	$0.0 \le P_i \le 0.0$ *
$\chi^2 = 8.15$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	4.61	0.42	
Escarpment	15.63	0.36	3.99	0.36	
Upland	21.20	0.49	2.46	0.22	
$\chi^2 = 6.86$	d.f. = 2	P = ns			
March:					
Riparian	2.74	0.13	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Escarpment	6.59	0.32	12.19	0.67	$0.41 \le P_i \le 0.93$ *
Upland	11.35	0.55	6.13	0.33	$0.07 \le P_i \le 0.59$
$\chi^2 = 10.76$	d.f. = 2	$P < 0.05$			

Table 8. Numbers of Fisher Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	25.58	1.00	$1.0 \le P_i \le 1.0$ *
Escarpment	20.55	0.49	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Upland	14.29	0.34	0.0	0.0	$0.0 \le P_i \le 0.0$ *
$\chi^2 = 124.84$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Escarpment	15.63	0.36	0.56	0.01	$0.0 \le P_i \le 0.05$ *
Upland	21.20	0.49	36.79	0.99	$0.95 \le P_i \le 1.0$ *
$\chi^2 = 69.26$	d.f. = 2	$P < 0.05$			
March:					
Riparian	2.74	0.13	0.0	0.0	
Escarpment	6.59	0.32	0.0	0.0	
Upland	11.35	0.55	2.56	1.0	
$\chi^2 = 2.09$	d.f. = 2	P = ns			

Table 9. Numbers of Weasels Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	11.40	0.37	$0.16 \leq P_i \leq 0.58$
Escarpment	20.55	0.49	2.97	0.10	$0.0 \leq P_i \leq 0.23$ *
Upland	14.29	0.34	16.15	0.37	$0.31 \leq P_i \leq 0.75$
$\chi^2 = 20.24$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	6.04	0.21	
Escarpment	15.63	0.36	10.64	0.37	
Upland	21.20	0.49	12.34	0.42	
$\chi^2 = 0.91$	d.f. = 2	P = ns			
March:					
No weasel tracks were observed.					

Table 10. Numbers of Lynx Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
No lynx tracks were observed.					
February:					
Riparian	6.39	0.15	2.52	1.0	$1.0 \leq P_i \leq 1.0$ *
Escarpment	15.63	0.36	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Upland	21.20	0.49	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
$\chi^2 = 14.19$	d.f. = 2	$P < 0.05$			
March:					
Riparian	2.74	0.13	0.0	0.0	
Escarpment	6.59	0.32	1.27	1.0	
Upland	11.35	0.55	0.0	0.0	
$\chi^2 = 2.66$	d.f. = 2	P = ns			

Table 11. Numbers of Moose Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	30.61	0.91	$0.71 \leq P_i \leq 1.0$ *
Escarpment	20.55	0.49	218.63.011	0.09	$0.0 \leq P_i \leq 0.21$ *
Upland	14.29	0.34	350.570.0	0.0	$0.0 \leq P_i \leq 0.0$ *
$\chi^2 = 130.74$	d.f. = 2	$P < 0.05$			
February:					
Riparian	6.39	0.15	14.08	0.95	$0.81 \leq P_i \leq 1.0$ *
Escarpment	15.63	0.36	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Upland	21.20	0.49	0.73	0.05	$0.0 \leq P_i \leq 0.19$ *
$\chi^2 = 74.56$	d.f. = 2	$P < 0.05$			
March:					
Riparian	2.74	0.13	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Escarpment	6.59	0.32	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Upland	11.35	0.55	12.14	1.00	$1.0 \leq P_i \leq 1.0$ *
$\chi^2 = 9.92$	d.f. = 2	$P < 0.05$			

Table 12. Numbers of Grouse Seen (in Tracks per km-Track day), and Numbers Expected, Within the Steepbank River Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
Riparian	7.14	0.17	0.0	0.0	
Escarpment	20.55	0.49	5.42	0.80	
Upland	14.29	0.34	1.36	0.20	
$\chi^2 = 2.87$	d.f. = 2	P = ns			
February:					
Riparian	6.39	0.15	0.0	0.0	
Escarpment	15.63	0.36	3.79	0.55	
Upland	21.20	0.49	3.03	0.45	
$\chi^2 = 1.77$	d.f. = 2	P = ns			
March:					
Riparian	2.74	0.13	0.0	0.0	
Escarpment	6.59	0.32	0.0	0.0	
Upland	11.35	0.55	0.85	1.0	
$\chi^2 = 0.69$	d.f. = 2	P = ns			

Chi-Square Analyses and Bonferroni Intervals for Back Tracking Surveys

Table 13. Numbers of Coyotes Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	2	3.5
Perpendicular	5	3.5
$\chi^2 = 1.28$	d.f. = 1	P = ns

Table 14. Numbers of Fisher Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	2	2.5
Perpendicular	3	2.5
$\chi^2 = 0.2$	d.f. = 1	P = ns

Table 15. Numbers of Lynx Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	2	1
Perpendicular	0	1
$\chi^2 = 2.0$	d.f. = 1	P = ns

Table 16. Numbers of Marten Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	15	10
Perpendicular	10	10
$\chi^2 = 5.0$	d.f. = 1	P < 0.05

Table 17. Numbers of Moose Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	7	3.5
Perpendicular	0	3.5
$\chi^2 = 7.0$	d.f. = 1	P < 0.05

Table 18. Numbers of Red Fox Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	1	1.5
Perpendicular	2	1.5
$\chi^2 = 0.34$	d.f. = 1	P = ns

Table 19. Numbers of Gray Wolf Seen and Numbers Expected, Running Parallel and Perpendicular to the Steepbank River Area (* P < 0.05)

Predominant Direction:	Observed	Expected
Parallel	7	5.5
Perpendicular	4	5.5
$\chi^2 = 0.82$	d.f. = 1	P = ns

Chi-Square Analyses and Bonferroni Intervals for Winter Track Count Surveys

Table 20. Numbers of Snowshoe Hare Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d3	1.33	0.02	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d1	0.94	0.01	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d2	7.53	0.11	7.05	0.38	$0.07 \le P_i \le 0.69$
h1	3.38	0.05	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Ftnn	23.40	0.32	1.52	0.08	$0.0 \le P_i \le 0.25$ *
Btnn	29.53	0.41	5.25	0.28	$0.0 \le P_i \le 0.57$
Shrub	1.72	0.02	4.99	0.27	$0.0 \le P_i \le 0.56$
Wonn	0.43	0.01	0.0	0.0	$0.0 \le P_i \le 0.0$ *
$\chi^2 = 17.09$	d.f. = 8	$P < 0.05$			
February:					
a1	1.21	0.02	21.83	0.03	$0.01 \le P_i \le 0.05$
d3	0.78	0.01	3.45	0.01	$0.0 \le P_i \le 0.02$
d1	1.07	0.02	2.51	0.0	$0.0 \le P_i \le 0.0$ *
d2	2.68	0.04	84.08	0.13	$0.09 \le P_i \le 0.17$ *
h1	3.04	0.05	114.78	0.18	$0.14 \le P_i \le 0.22$ *
Ftnn	30.32	0.49	203.72	0.31	$0.26 \le P_i \le 0.36$ *
Btnn	21.82	0.36	224.82	0.34	$0.29 \le P_i \le 0.39$
Shrub	0.20	0.00	0.0	0.0	$0.00 \le P_i \le 0.00$
CIU	0.25	0.0	0.0	0.0	$0.0 \le P_i \le 0.0$
$\chi^2 = 442.38$	d.f. = 8	$P < 0.05$			

Table 21. Numbers of Red Squirrels Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d3	1.33	0.02	0.48	0.17	$0.0 \leq P_i \leq 0.79$
d1	0.94	0.01	0.70	0.25	$0.0 \leq P_i \leq 0.97$
d2	7.53	0.11	0.78	0.28	$0.00 \leq P_i \leq 1.00$
h1	3.38	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Ftnn	23.40	0.32	0.19	0.07	$0.0 \leq P_i \leq 0.49$
Btnn	29.53	0.41	0.68	0.24	$0.0 \leq P_i \leq 0.50$
Shrub	1.72	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Wonn	0.43	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
$\chi^2 = 19.75$	d.f. = 8	$P < 0.05$			
February:					
a1	1.21	0.02	3.64	0.12	$0.01 \leq P_i \leq 0.29$
d3	0.78	0.01	10.05	0.35	$0.10 \leq P_i \leq 0.60$ *
d1	1.07	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d2	2.68	0.04	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
h1	3.04	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Ftnn	30.32	0.49	10.04	0.35	$0.10 \leq P_i \leq 0.60$
Btnn	21.82	0.36	5.32	0.18	$0.0 \leq P_i \leq 0.38$
Shrub	0.20	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.00$
CIU	0.25	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
$\chi^2 = 351.56$	d.f. = 8	$P < 0.05$			

Table 22. Numbers of Mice Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	
d3	1.33	0.02	0.0	0.0	
d1	0.94	0.01	0.0	0.0	
d2	7.53	0.11	0.26	0.16	
h1	3.38	0.05	0.0	0.0	
Ftnn	23.40	0.32	0.0	0.0	
Btnn	29.53	0.41	1.35	0.84	
Shrub	1.72	0.02	0.0	0.0	
Wonn	0.43	0.01	0.0	0.0	
$\chi^2 = 1.54$	d.f. = 8	P= ns			
February:					
a1	1.21	0.02	0.0	0.0	
d3	0.78	0.01	0.0	0.0	
d1	1.07	0.02	0.0	0.0	
d2	2.68	0.04	0.0	0.0	
h1	3.04	0.05	0.0	0.0	
Ftnn	30.32	0.49	0.93	0.76	
Btnn	21.82	0.36	0.30	0.24	
Shrub	0.20	0.0	0.0	0.0	
CIU	0.25	0.0	0.0	0.0	
$\chi^2 = 0.38$	d.f. = 8	P= ns			

Table 23. Numbers of Coyotes Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	
d3	1.33	0.02	0.0	0.0	
d1	0.94	0.01	0.0	0.0	
d2	7.53	0.11	0.0	0.0	
h1	3.38	0.05	0.0	0.0	
Ftnn	23.40	0.32	0.0	0.0	
Btnn	29.53	0.41	1.32	1.00	
Shrub	1.72	0.02	0.0	0.0	
Wonn	0.43	0.01	0.0	0.0	
$\chi^2 = 1.92$	d.f. = 8	P = ns			
February:					
a1	1.21	0.02	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d3	0.78	0.01	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d1	1.07	0.02	0.0	0.0	$0.0 \le P_i \le 0.0$ *
d2	2.68	0.04	0.0	0.0	$0.0 \le P_i \le 0.0$ *
h1	3.04	0.05	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Ftnn	30.32	0.49	1.56	0.27	$0.0 \le P_i \le 0.78$
Btnn	21.82	0.36	0.0	0.0	$0.0 \le P_i \le 0.0$ *
Shrub	0.20	0.0	0.0	0.0	$0.0 \le P_i \le 0.0$
CIU	0.25	0.0	4.31	0.73	$0.22 \le P_i \le 1.00$ *
$\chi^2 = 922.42$	d.f. = 8	P < 0.05			

Table 24. Numbers of Marten Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.16	0.03	
d3	1.33	0.02	0.0	0.0	
d1	0.94	0.01	0.0	0.0	
d2	7.53	0.11	0.0	0.0	
h1	3.38	0.05	0.27	0.05	
Ftnn	23.40	0.32	1.15	0.20	
Btnn	29.53	0.41	4.10	0.72	
Shrub	1.72	0.02	0.0	0.0	
Wonn	0.43	0.01	0.0	0.0	
$\chi^2 = 2.60$	d.f. = 8	P = ns			
February:					
a1	1.21	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d3	0.78	0.01	100.7	0.56	$0.46 \leq P_i \leq 0.66$ *
d1	1.07	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d2	2.68	0.04	2.23	0.01	$0.0 \leq P_i \leq 0.03$ *
h1	3.04	0.05	5.71	0.03	$0.0 \leq P_i \leq 0.07$
Ftnn	30.32	0.49	36.59	0.20	$0.12 \leq P_i \leq 0.28$ *
Btnn	21.82	0.36	35.84	0.20	$0.12 \leq P_i \leq 0.28$ *
Shrub	0.20	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
CIU	0.25	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
$\chi^2 = 5458.68$	d.f. = 8	P < 0.05			

Table 25. Numbers of Fishers Seen (in Tracks per km-Track day), and Numbers Expected, Within the Lease 29 Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
No fisher tracks were recorded					
February:					
a1	1.21	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d3	0.78	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d1	1.07	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d2	2.68	0.04	5.49	0.25	$0.0 \leq P_i \leq 0.51$
h1	3.04	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Ftnn	30.32	0.49	11.76	0.53	$0.24 \leq P_i \leq 0.82$
Btnn	21.82	0.36	4.92	0.22	$0.0 \leq P_i \leq 0.46$
Shrub	0.20	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
CIU	0.25	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
$\chi^2 = 27.21$	d.f. = 8	$P < 0.05$			

Table 26. Numbers of Weasels Seen (in Tracks per km-Track day), and Numbers Expected, Within the Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.22	0.03	$0.0 \leq P_i \leq 0.21$
d3	1.33	0.02	0.08	0.01	$0.0 \leq P_i \leq 0.12$
d1	0.94	0.01	1.05	0.16	$0.0 \leq P_i \leq 0.55$
d2	7.53	0.11	0.76	0.11	$0.0 \leq P_i \leq 0.45$
h1	3.38	0.05	0.09	0.01	$0.0 \leq P_i \leq 0.12$
Ftnn	23.40	0.32	3.26	0.49	$0.0 \leq P_i \leq 1.00$
Btnn	29.53	0.41	1.17	0.18	$0.0 \leq P_i \leq 0.59$
Shrub	1.72	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Wonn	0.43	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
$\chi^2 = 15.64$	d.f. = 8	PL = 0.05			
February:					
a1	1.21	0.02	0.0	0.0	
d3	0.78	0.01	0.0	0.0	
d1	1.07	0.02	0.0	0.0	
d2	2.68	0.04	0.0	0.0	
h1	3.04	0.05	0.0	0.0	
Ftnn	30.32	0.49	34.66	0.56	
Btnn	21.82	0.36	26.97	0.44	
Shrub	0.20	0.0	0.0	0.0	
CIU	0.25	0.0	0.0	0.0	
$\chi^2 = 10.32$	d.f. = 8	P = ns			

Table 27. Numbers of Mink Seen (in Tracks per km-Track day), and Numbers Expected, Within the Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d3	1.33	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d1	0.94	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d2	7.53	0.11	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
h1	3.38	0.05	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Ftnn	23.40	0.32	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Btnn	29.53	0.41	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
Shrub	1.72	0.02	10.47	1.00	$1.0 \leq P_i \leq 1.0$ *
Wonn	0.43	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
$\chi^2 = 511.51$	d.f. = 8	$P < 0.05$			
February:					
no mink tracks were recorded.					

Table 28. Numbers of Moose Seen (in Tracks per km-Track day), and Numbers Expected, Within the Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.0	0.0	
d3	1.33	0.02	0.0	0.0	
d1	0.94	0.01	0.0	0.0	
d2	7.53	0.11	0.0	0.0	
h1	3.38	0.05	0.0	0.0	
Ftnn	23.40	0.32	0.0	0.0	
Btnn	29.53	0.41	0.0	0.0	
Shrub	1.72	0.02	0.35	1.00	
Wonn	0.43	0.01	0.0	0.0	
$\chi^2 = 11.9$	d.f. = 8	P = ns			
February:					
No moose tracks were observed.					

Table 29. Numbers of Grouse Seen (in Tracks per km-Track day), and Numbers Expected, Within the Upland Area (* $P < 0.05$)

Habitat Type	Km-track days Sampled	Proportion	Tracks/Km-track day	Proportion of Sightings	Bonferroni Intervals
January:					
a1	3.31	0.05	0.33	0.12	
d3	1.33	0.02	0.0	0.0	
d1	0.94	0.01	0.0	0.0	
d2	7.53	0.11	0.13	0.05	
h1	3.38	0.05	0.0	0.0	
Ftnn	23.40	0.32	1.79	0.68	
Btnn	29.53	0.41	0.40	0.15	
Shrub	1.72	0.02	0.0	0.0	
Wonn	0.43	0.01	0.0	0.0	
$\chi^2 = 2.17$	d.f. = 8	P = ns			
February:					
a1	1.21	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d3	0.78	0.01	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d1	1.07	0.02	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
d2	2.68	0.04	0.0	0.0	$0.0 \leq P_i \leq 0.0$ *
h1	3.04	0.05	4.0	0.09	$0.0 \leq P_i \leq 0.21$
Ftnn	30.32	0.49	40.06	0.87	$0.73 \leq P_i \leq 1.00$ *
Btnn	21.82	0.36	1.82	0.04	$0.0 \leq P_i \leq 0.12$ *
Shrub	0.20	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
CIU	0.25	0.0	0.0	0.0	$0.0 \leq P_i \leq 0.0$
$\chi^2 = 57.26$	d.f. = 11	$P < 0.05$			

APPENDIX II

COMMON AND SCIENTIFIC NAMES OF WILDLIFE IN THE STUDY AREA

Table 1. Common and Scientific Names of Wildlife in the Study Area

Common Name	Scientific Name
Black bear	*Ursus americanus*
Black-capped chickadee	*Parus atricapillus*
Boreal owl	*Aegolius funereus*
Canada lynx	*Lynx canadensis*
Common raven	*Corvus corax*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Ermine	*Mustela erminea*
Fisher	*Martes pennanti*
Gray jay	*Perisoreus canadensis*
Gray wolf	*Canis lupus*
Great gray owl	*Strix nebulosa*
Great horned owl	*Bubo virginianus*
Least weasel	*Mustela nivalis*
Marten	*Martes americana*
Meadow jumping mouse	*Zapus hudsonicus*
Mink	*Mustela vison*
Moose	*Alces alces*
Mule deer	*Odocoileus hemionus*
Porcupine	*Erethizon dorsatum*
Red fox	*Vulpes vulpes*
Red squirrel	*Tamiasciurus hudsonicus*
River otter	*Lutra canadensis*
Ruffed grouse	*Bonasa umbellus*
Sharp-tailed grouse	*Pedioecetes phasianellus*
Snowshoe hare	*Lepus americanus*
Spruce grouse	*Canachites canadensis*
White-tailed deer	*Ocodoileus virginianus*
White-winged crossbill	*Loxia leucoptera*

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/23/97	UP2	38	Loose compacted	h1
1/23/97	UP2	50	Loose compacted	h1
1/23/97	AT26	45	Loose	d2
1/23/97	AT26	50	Loose	d2
1/23/97	AT26	72	Loose	Ftnn
1/23/97	AT26	61	Loose	Ftnn
1/23/97	AT26	69	Loose	Ftnn
1/23/97	AT26	61	Loose	Ftnn
1/24/97	SB15	51	Loose	Shrub
1/24/97	SB15	53	Loose	Shrub
1/24/97	SB15	55	Loose	Shrub
1/24/97	SB15	54	Loose	Shrub
1/24/97	SB15	58	Loose	Ftnn
1/24/97	SB15	71	Loose	Ftnn
1/24/97	SB15	71	Loose	d3
1/24/97	SB15	65	Loose	d3
1/24/97	SB15	43	Loose	d3
1/24/97	SB15	53	Loose	d3
1/24/97	SB15	49	Loose	d2
1/24/97	SB15	50	Loose	d2
1/24/97	SB15	43	Loose	d2
1/24/97	SB15	56	Loose	d2
1/24/97	SB17	52	Loose	d2
1/24/97	SB17	53	Loose	d2
1/24/97	SB17	44	Loose	d2
1/24/97	SB17	54	Loose	d2
1/24/97	SB17	47	Loose	d1
1/24/97	SB17	50	Loose	d2
1/24/97	SB17	48	Loose	d2
1/24/97	SB17	61	Loose	d2
1/24/97	SB17	58	Loose	d3
1/24/97	SB17	25	Loose	h1
1/24/97	SB17	53	Loose	d3
1/24/97	SB17	38	Loose	d3
1/24/97	SB17	49	Loose	d3
1/24/97	UP1	41	Crusted	d1
1/24/97	UP1	38	Loose compacted	h1
1/24/97	UP1	44	Loose compacted	shrub
1/24/97	UP1	43	Loose compacted	Ftnn
1/24/97	UP1	44	Loose compacted	d2
1/24/97	UP1	50	Loose compacted	d2
1/24/97	UP1	38	Loose compacted	Shrub
1/24/97	UP1	40	Loose compacted	Shrub
1/24/97	UP1	38	Loose compacted	Shrub
1/24/97	UP1	34	Loose compacted	d2
1/24/97	SB16	44	Loose	d3
1/24/97	SB16	56	Loose	d3
1/24/97	SB16	36	Loose	d1
1/24/97	SB16	50	Loose	d1
1/24/97	SB16	54	Loose	Btnn

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/24/97	SB16	65	Loose	Btnn
1/24/97	SB18	44	Loose	d3
1/24/97	SB18	45	Loose	d3
1/24/97	SB18	40	Loose	d2
1/24/97	SB18	45	Loose	d2
1/24/97	SB18	40	Loose	d3
1/24/97	SB18	57	Loose	Btnn
1/24/97	UP4	45	Loose	Shrub
1/24/97	UP4	40	Loose	d3
1/24/97	UP4	32	Loose	Shrub
1/24/97	UP4	48	Loose	d1
1/24/97	UP4	47	Loose	d1
1/24/97	UP4	46	Loose	d1
1/24/97	UP4	38	Crusted	d1
1/24/97	UP4	40	Loose	d1
1/24/97	UP4	48	Loose	d1
1/24/97	UP4	50	Loose	Btnn
1/24/97	UP4	50	Loose	Btnn
1/25/97	UP6	44	Loose	Btnn
1/25/97	UP6	74	Loose	Btnn
1/25/97	UP6	60	Loose	Btnn
1/25/97	UP6	70	Loose	Btnn
1/25/97	UP6	60	Loose	Btnn
1/25/97	UP6	50	Loose	Btnn
1/25/97	UP6	90	Loose	Btnn
1/25/97	UP6	53	Loose	Ftnn
1/25/97	UP6	56	Loose	Btnn
1/25/97	SB14	45	Loose	d3
1/25/97	SB14	52	Loose	d3
1/25/97	SB14	43	Loose	d3
1/25/97	SB14	42	Loose	d3
1/25/97	SB14	48	Loose	d3
1/25/97	SB14	34	Loose	d3
1/25/97	SB14	27	Loose	d3
1/25/97	SB14	50	Loose	d3
1/25/97	SB14	67	Loose	Btnn
1/25/97	SB14	53	Loose	d3
1/25/97	SB14	41	Loose	d3
1/25/97	SB14	48	Loose	d3
1/25/97	SB12	38	Loose	d2
1/25/97	SB12	33	Loose	d2
1/25/97	SB12	24	Loose	d2
1/25/97	SB12	45	Loose	d2
1/25/97	SB12	48	Loose	d1
1/25/97	SB12	48	Loose	d1
1/25/97	SB12	45	Loose	d1
1/25/97	SB12	48	Loose	d1
1/25/97	SB12	48	Loose	d2
1/25/97	SB12	43	Loose	d2
1/25/97	SB12	57	Loose	d2

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/25/97	SB12	46	Loose	d2
1/25/97	SB13	51	Loose	Shrub
1/25/97	SB13	49	Loose	Shrub
1/25/97	SB13	55	Loose	Shrub
1/25/97	SB13	48	Loose	Shrub
1/25/97	SB13	37	Loose	d3
1/25/97	SB13	30	Loose	d3
1/25/97	SB13	47	Loose	d3
1/25/97	SB13	66	Loose	d3
1/25/97	SB13	50	Loose	d3
1/25/97	SB13	44	Loose	d3
1/25/97	SB13	40	Loose	d3
1/25/97	SB13	40	Loose	d3
1/25/97	SB11	45	Loose	Shrub
1/25/97	SB11	51	Loose	Shrub
1/25/97	SB11	45	Loose	Shrub
1/25/97	SB11	44	Loose	Shrub
1/25/97	SB11	37	Loose	d1
1/25/97	SB11	45	Loose	d1
1/25/97	SB11	28	Loose	d3
1/25/97	SB11	44	Loose	d2
1/25/97	SB11	52	Loose	d2
1/25/97	SB11	44	Loose	d2
1/25/97	SB11	48	Loose	d2
1/25/97	SB11	61	Loose	d2
1/25/97	SB11	56	Loose	ClU
1/25/97	UP3	51	Loose	Ftnn
1/25/97	UP3	60	Loose	Ftnn
1/25/97	UP3	62	Loose	Ftnn
1/25/97	UP3	55	Loose	Ftnn
1/25/97	UP3	59	Loose	Ftnn
1/25/97	UP3	71	Loose	Ftnn
1/25/97	UP3	57	Loose	Ftnn
1/25/97	UP3	60	Loose	Ftnn
1/25/97	UP3	60	Loose	Ftnn
1/25/97	UP3	65	Loose	a1
1/25/97	UP3	54	Loose	Ftnn
1/25/97	UP3	58	Loose	Ftnn
1/26/97	UP8	64	Loose	Ftnn
1/26/97	UP8	68	Loose	Btnn
1/26/97	UP8	70	Loose	Btnn
1/26/97	UP8	60	Crusted	Ftnn
1/26/97	UP8	54	Loose compacted	Ftnn
1/26/97	UP8	58	Loose	Btnn
1/26/97	UP8	58	Loose	Btnn
1/26/97	UP8	64	Loose compacted	Ftnn
1/26/97	UP8	40	Loose compacted	Wonn
1/26/97	SB7	38	Loose	Shrub
1/26/97	SB7	42	Loose	Shrub
1/26/97	SB7	38	Loose	Shrub

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/26/97	SB7	37	Loose	Shrub
1/26/97	SB7	43	Loose	d1
1/26/97	SB7	45	Loose	d1
1/26/97	SB7	63	Loose	d1
1/26/97	SB7	52	Loose	d1
1/26/97	SB7	43	Loose	d1
1/26/97	SB7	47	Loose	d1
1/26/97	SB7	40	Loose	d2
1/26/97	SB7	49	Loose	d2
1/26/97	SB9	48	Loose	Shrub
1/26/97	SB9	44	Loose	Shrub
1/26/97	SB9	50	Loose	Shrub
1/26/97	SB9	53	Loose	Shrub
1/26/97	SB9	51	Loose	d2
1/26/97	SB9	64	Loose	d2
1/26/97	SB9	48	Loose	d2
1/26/97	SB9	58	Loose	d2
1/26/97	SB9	71	Loose	Ftnn
1/26/97	SB9	57	Loose	Ftnn
1/26/97	SB9	24	Loose	d2
1/26/97	SB9	51	Loose	d2
1/26/97	RP1	51	Loose	Shrub
1/26/97	RP1	48	Loose	Shrub
1/26/97	RP1	40	Loose	Shrub
1/26/97	RP1	55	Loose	d1
1/26/97	SB8	45	Loose	d1
1/26/97	SB8	45	Loose	d1
1/26/97	SB8	58	Loose	d1
1/26/97	SB8	46	Loose	d1
1/26/97	SB8	54	Loose	d1
1/26/97	SB8	40	Loose	d1
1/26/97	SB8	45	Loose	d1
1/26/97	SB8	49	Loose	d1
1/26/97	SB8	45	Loose	d
1/26/97	SB8	47	Loose	d1
1/26/97	SB8	72	Loose	d1
1/26/97	SB8	68	Loose	Ftnn
1/26/97	SB10	28	Loose	d2
1/26/97	SB10	40	Loose	d2
1/26/97	SB10	51	Loose	d2
1/26/97	SB10	38	Loose	d2
1/26/97	SB10	40	Loose	d1
1/26/97	SB10	48	Loose	d1
1/26/97	SB10	32	Loose	d1
1/26/97	SB10	44	Loose	d1
1/26/97	SB10	56	Loose	d1
1/26/97	SB10	54	Loose	d1
1/26/97	SB10	62	Loose	d1
1/26/97	SB10	34	Loose	d2
1/26/97	UP9	58	Loose	Ftnn

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/26/97	UP9	75	Loose	Btnn
1/26/97	UP9	52	Loose	Btnn
1/26/97	UP9	54	Loose	Btnn
1/26/97	UP9	72	Loose	a1
1/26/97	UP11	48	Loose	d2
1/26/97	UP11	42	Loose	a1
1/26/97	UP11	62	Loose	a1
1/26/97	UP11	72	Loose	Btnn
1/26/97	UP11	52	Loose	d2
1/26/97	UP13	70	Loose	Btnn
1/26/97	UP13	44	Loose	a1
1/26/97	UP13	53	Loose	Btnn
1/26/97	UP13	59	Loose	Btnn
1/26/97	UP13	71	Loose	Btnn
1/26/97	UP13	50	Loose	d2
1/27/97	UP10	63	Loose	Btnn
1/27/97	UP10	60	Loose	Btnn
1/27/97	UP10	63	Loose	Btnn
1/27/97	UP10	50	Loose	Btnn
1/27/97	UP10	60	Loose	Btnn
1/27/97	SB4	44	Loose	d3
1/27/97	SB4	53	Loose	d3
1/27/97	SB4	37	Loose	d2
1/27/97	SB4	51	Loose	d2
1/27/97	SB4	45	Loose	d1
1/27/97	SB4	47	Loose	d1
1/27/97	SB4	44	Loose	d1
1/27/97	SB4	43	Loose	d1
1/27/97	SB4	66	Loose	Btnn
1/27/97	SB4	30	Loose	Btnn
1/27/97	SB4	50	Loose	Btnn
1/27/97	SB4	44	Loose	d2
1/27/97	SB2	48	Loose	d3
1/27/97	SB2	45	Loose	d3
1/27/97	SB2	50	Loose	d3
1/27/97	SB2	45	Loose	d3
1/27/97	SB2	67	Loose	d2
1/27/97	SB2	57	Loose	d2
1/27/97	SB2	47	Loose	d2
1/27/97	SB2	42	Loose	d2
1/27/97	SB2	48	Loose	d2
1/27/97	SB2	67	Loose	Ftnn
1/27/97	SB2	62	Loose	Ftnn
1/27/97	SB2	56	Loose	Ftnn
1/27/97	SB5	47	Loose	Shrub
1/27/97	SB5	51	Loose	d1
1/27/97	SB5	56	Loose	d1
1/27/97	SB5	34	Loose	d1
1/27/97	SB3	57	Loose	Shrub
1/27/97	SB3	60	Loose	Shrub

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
1/27/97	SB3	48	Loose	Shrub
1/27/97	SB3	35	Loose	Shrub
1/27/97	SB3	49	Loose	d1
1/27/97	SB3	53	Loose	d1
1/27/97	SB3	51	Loose	d1
1/27/97	SB3	50	Loose	d1
1/27/97	SB3	30	Loose	Shrub
1/27/97	SB3	48	Loose	Shrub
1/27/97	SB3	63	Loose	d3
1/27/97	SB3	59	Loose	d3
1/27/97	SB1	46	Loose	Shrub
1/27/97	SB1	42	Loose	Shrub
1/27/97	SB1	38	Loose	Shrub
1/27/97	SB1	29	Loose	Shrub
1/27/97	SB1	34	Loose	d3
1/27/97	SB1	47	Loose	d2
1/27/97	SB1	58	Loose	d1
1/27/97	SB1	34	Loose	d2
1/27/97	SB1	57	Loose	d2
1/27/97	UP15	54	Crusted	Ftnn
1/27/97	UP15	49	Crusted	d1
1/27/97	UP15	54	Crusted	Ftnn
1/27/97	UP15	48	Crusted	Btnn
1/27/97	UP17	67	Crusted	Btnn
1/27/97	UP17	67	Crusted	Btnn
1/27/97	UP19	60	Crusted	Ftnn
1/27/97	UP19	63	Crusted	Ftnn
1/27/97	UP19	57	Crusted	Ftnn
1/27/97	UP19	56	Crusted	Ftnn
1/27/97	UP21	52	Crusted	Btnn
1/27/97	UP21	63	Crusted	Btnn
1/27/97	UP21	54	Crusted	Ftnn
2/21/97	SB11	68	Loose	Shrub
2/21/97	SB11	55	Loose	Shrub
2/21/97	SB11	68	Loose	d2
2/21/97	SB11	56	Loose	d2
2/21/97	SB11	56	Loose	d2
2/21/97	SB11	71	Loose	d1
2/21/97	SB11	63	Loose	d1
2/21/97	SB12	52	Loose	d1
2/21/97	SB12	46	Loose	d1
2/21/97	SB12	58	Loose	d1
2/21/97	SB12	68	Loose	d1
2/21/97	SB12	61	Loose	d1
2/21/97	SB12	56	Loose	d1
2/21/97	SB12	58	Loose	d1
2/21/97	SB12	65	Loose	d1
2/21/97	SB12	56	Loose	d2
2/21/97	SB12	61	Loose	d2
2/21/97	SB12	66	Loose	d2

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/21/97	SB12	65	Loose	d2
2/21/97	SB13	73	Loose	Shrub
2/21/97	SB13	68	Loose	Shrub
2/21/97	SB13	49	Loose	d2
2/21/97	SB13	65	Loose	d1
2/21/97	SB14	42	Loose	Shrub
2/21/97	SB14	51	Loose	Shrub
2/21/97	SB14	57	Loose	Shrub
2/21/97	SB14	63	Loose	Shrub
2/21/97	SB14	29	Loose	d2
2/21/97	SB14	66	Loose	d2
2/21/97	SB14	36	Loose	d2
2/21/97	SB14	27	Loose	d2
2/21/97	SB14	65	Loose	d2
2/21/97	SB14	42	Loose	d2
2/21/97	SB14	51	Loose	Btnn
2/21/97	SB14	35	Loose	d2
2/21/97	SB20	49	Loose	d2
2/21/97	SB20	65	Loose	d2
2/21/97	SB20	66	Loose	d3
2/21/97	SB20	69	Loose	d3
2/21/97	SB20	57	Loose	Btnn
2/21/97	SB20	62	Loose	Btnn
2/21/97	SB20	57	Loose	Btnn
2/21/97	SB20	57	Loose	Btnn
2/21/97	SB20	68	Loose	Btnn
2/21/97	SB20	62	Loose	Btnn
2/21/97	SB20	45	Loose	Btnn
2/21/97	SB20	50	Loose	Btnn
2/21/97	SB21	60	Loose	Shrub
2/21/97	SB21	71	Loose	d1
2/21/97	SB21	73	Loose	CIU
2/21/97	SB21	68	Loose	Shrub
2/21/97	SB22	53	Loose	d3
2/21/97	SB22	60	Loose	d3
2/21/97	SB22	39	Loose	d3
2/21/97	SB22	47	Loose	d3
2/21/97	SB22	56	Loose	d3
2/21/97	SB23	63	Loose	Shrub
2/21/97	SB23	46	Loose	d2
2/21/97	SB23	37	Loose	d2
2/21/97	SB23	47	Loose	d2
2/21/97	UP30	67	Loose	Btnn
2/21/97	UP30	71	Loose	d2
2/21/97	UP30	40	Loose	d2
2/21/97	UP30	55	Loose	d3
2/21/97	UP30	60	Loose	d2
2/21/97	UP30	61	Loose	d1
2/21/97	UP30	65	Loose	d1
2/21/97	UP30	60	Loose	d2

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/21/97	UP30	90	Loose	Btnn
2/21/97	UP31	62	Loose	Ftnn
2/21/97	UP31	85	Loose	Ftnn
2/21/97	UP31	87	Loose	Ftnn
2/21/97	UP31	71	Loose	Ftnn
2/21/97	UP31	100	Loose	Btnn
2/22/97	SB1	49	Loose	d2
2/22/97	SB1	60	Loose	d1
2/22/97	SB1	43	Loose	d3
2/22/97	SB1	56	Loose	Shrub
2/22/97	SB1	62	Loose	d2
2/22/97	SB1	36	Loose	d1
2/22/97	SB1	57	Loose	d1
2/22/97	SB1	55	Loose	d1
2/22/97	SB1	41	Loose	d3
2/22/97	SB2	51	Loose	d2
2/22/97	SB2	61	Loose	d2
2/22/97	SB2	42	Loose	d2
2/22/97	SB2	63	Loose	Btnn
2/22/97	SB2	41	Loose	d2
2/22/97	SB2	36	Loose	d2
2/22/97	SB2	67	Loose	d2
2/22/97	SB2	45	Loose	d2
2/22/97	SB2	55	Loose	Ftnn
2/22/97	SB2	67	Loose	Ftnn
2/22/97	SB2	66	Loose	Ftnn
2/22/97	SB2	65	Loose	Ftnn
2/22/97	SB3	72	Loose	d3
2/22/97	SB3	64	Loose	d2
2/22/97	SB3	69	Loose	d3
2/22/97	SB3	52	Loose	d3
2/22/97	SB3	55	Loose	d3
2/22/97	SB3	56	Loose	d1
2/22/97	SB3	52	Loose	d1
2/22/97	SB3	62	Loose	d1
2/22/97	SB3	67	Loose	d3
2/22/97	SB4	59	Loose	d2
2/22/97	SB4	53	Loose	d2
2/22/97	SB4	56	Loose	d2
2/22/97	SB4	54	Loose	d2
2/22/97	SB4	61	Loose	d1
2/22/97	SB4	57	Loose	d1
2/22/97	SB4	60	Loose	d1
2/22/97	SB4	44	Loose	d1
2/22/97	SB4	48	Loose	Btnn
2/22/97	SB4	72	Loose	Btnn
2/22/97	SB4	63	Loose	Btnn
2/22/97	SB4	43	Loose	d3
2/22/97	SB24	58	Loose	Ftnn
2/22/97	SB24	67	Loose	Ftnn

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/22/97	SB24	66	Loose	Ftnn
2/22/97	SB24	63	Loose	Ftnn
2/22/97	SB24	66	Loose	Ftnn
2/22/97	SB24	51	Loose	Ftnn
2/22/97	SB24	66	Loose	d3
2/22/97	SB24	67	Loose	d3
2/22/97	SB25	62	Loose	d3
2/22/97	SB25	56	Loose	d3
2/22/97	UP32	54	Loose	Ftnn
2/22/97	UP32	92	Loose	Ftnn
2/22/97	UP32	80	Loose	Ftnn
2/22/97	UP32	71	Loose	a1
2/22/97	UP32	73	Loose	Btnn
2/22/97	UP32	67	Loose	Btnn
2/22/97	UP32	71	Loose	Btnn
2/22/97	UP32	79	Loose	Btnn
2/22/97	UP33	105	Loose	Ftnn
2/22/97	UP33	76	Loose	Ftnn
2/22/97	UP33	60	Loose	d2
2/22/97	UP33	40	Loose	d2
2/22/97	UP33	58	Loose	d1
2/22/97	UP33	70	Loose	Btnn
2/23/97	SB7	49	Loose	d2
2/23/97	SB7	59	Loose	d3
2/23/97	SB7	60	Loose	d1
2/23/97	SB7	59	Loose	d1
2/23/97	SB7	59	Loose	d1
2/23/97	SB7	59	Loose	d1
2/23/97	SB7	58	Loose	d3
2/23/97	SB7	57	Loose	d1
2/23/97	SB8	61	Loose	d1
2/23/97	SB8	65	Loose	d1
2/23/97	SB8	76	Loose	d1
2/23/97	SB8	70	Loose	d1
2/23/97	SB8	62	Loose	d1
2/23/97	SB8	51	Loose	d1
2/23/97	SB8	51	Loose	d1
2/23/97	SB8	54	Loose	d1
2/23/97	SB8	58	Loose	d1
2/23/97	SB8	67	Loose	Btnn
2/23/97	SB8	75	Loose	Btnn
2/23/97	SB8	66	Loose	Btnn
2/23/97	SB9	63	Loose	d1
2/23/97	SB9	70	Loose	d1
2/23/97	SB9	56	Loose	d2
2/23/97	SB9	60	Loose	d2
2/23/97	SB9	58	Loose	d1
2/23/97	SB9	73	Loose	Btnn
2/23/97	SB9	67	Loose	Btnn
2/23/97	SB9	56	Loose	d2

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/23/97	SB10	59	Loose	d3
2/23/97	SB10	50	Loose	d3
2/23/97	SB10	65	Loose	d3
2/23/97	SB10	62	Loose	d3
2/23/97	SB10	57	Loose	d1
2/23/97	SB10	40	Loose	d1
2/23/97	SB10	53	Loose	d1
2/23/97	SB10	59	Loose	d1
2/23/97	SB10	75	Loose	Ftnn
2/23/97	SB10	36	Loose	d3
2/23/97	SB10	65	Loose	d3
2/23/97	SB10	27	Loose	Ftnn
2/23/97	RP1-RP2	63	Loose	Shrub
2/23/97	RP1-RP2	59	Loose	Shrub
2/23/97	RP1-RP2	52	Loose	d1
2/23/97	SB50	62	Loose	d1
2/23/97	SB50	57	Loose	d1
2/23/97	SB50	60	Loose	d1
2/23/97	SB50	64	Loose	d2
2/23/97	SB26	67	Loose	d2
2/23/97	SB26	65	Loose	Btnn
2/23/97	SB26	60	Loose	d2
2/23/97	SB26	62	Loose	d2
2/23/97	SB26	47	Loose	Btnn
2/23/97	SB26	52	Loose	Btnn
2/23/97	SB28	66	Loose	d3
2/23/97	SB28	66	Loose	d3
2/23/97	SB28	55	Loose	d3
2/23/97	SB28	61	Loose	d3
2/23/97	UP34	61	Loose	Btnn
2/23/97	UP34	67	Loose	Btnn
2/23/97	UP34	69	Loose	Btnn
2/23/97	UP34	70	Loose	Btnn
2/23/97	UP34	71	Loose compacted	Btnn
2/23/97	UP34	68	Loose compacted	Ftnn
2/23/97	UP34	51	Loose compacted	Ftnn
2/23/97	UP34	71	Loose compacted	Ftnn
2/23/97	UP35	81	Loose	Ftnn
2/23/97	UP35	84	Loose	Ftnn
2/23/97	UP35	87	Loose	Btnn
2/23/97	UP35	81	Loose	Btnn
2/23/97	UP35	84	Loose	Btnn
2/23/97	UP36	64	Loose compacted	Btnn
2/23/97	UP36	67	Compacted	Btnn
2/23/97	UP36	59	Compacted	Btnn
2/23/97	UP36	54	Compacted	Btnn
2/23/97	UP36	60	Compacted	Btnn
2/24/97	SB16	53	Compacted	d1
2/24/97	SB16	54	Compacted	d1
2/24/97	SB16	53	Compacted	d1

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/24/97	SB16	54	Compacted	d1
2/24/97	SB16	32	Compacted	d3
2/24/97	SB16	51	Compacted	d3
2/24/97	SB16	71	Compacted	d3
2/24/97	SB16	65	Compacted	d3
2/24/97	SB16	51	Compacted	d3
2/24/97	SB16	68	Compacted	d3
2/24/97	SB16	67	Compacted	Btnn
2/24/97	SB16	67	Compacted	Btnn
2/24/97	SB18	22	Compacted	Shrub
2/24/97	SB18	28	Compacted	Shrub
2/24/97	SB18	31	Compacted	Shrub
2/24/97	SB18	35	Compacted	Shrub
2/24/97	SB18	59	Compacted	d3
2/24/97	SB18	41	Compacted	d3
2/24/97	SB18	60	Compacted	d3
2/24/97	SB18	33	Compacted	d3
2/24/97	SB18	46	Compacted	Btnn
2/24/97	SB18	38	Compacted	Btnn
2/24/97	SB18	46	Compacted	Btnn
2/24/97	SB18	29	Compacted	Btnn
2/24/97	SB30	62	Compacted	Btnn
2/24/97	SB30	61	Compacted	Btnn
2/24/97	SB30	72	Compacted	Btnn
2/24/97	SB30	95	Compacted	Btnn
2/24/97	SB30	48	Compacted	Btnn
2/24/97	SB30	60	Compacted	d3
2/24/97	SB30	50	Compacted	d3
2/24/97	SB30	64	Compacted	d3
2/24/97	SB30	48	Compacted	d3
2/24/97	SB30	45	Compacted	Btnn
2/24/97	SB30	50	Compacted	Btnn
2/24/97	UP37	47	Compacted	Ftnn
2/24/97	UP37	61	Compacted	Ftnn
2/24/97	UP37	50	Compacted	Ftnn
2/24/97	UP37	57	Compacted	Ftnn
2/24/97	UP37	62	Compacted	Btnn
2/24/97	UP37	75	Compacted	Btnn
2/24/97	UP37	75	Loose compacted	Ftnn
2/24/97	UP37	67	Loose compacted	Btnn
2/24/97	UP37	68	Compacted	Ftnn
2/24/97	UP37	58	Compacted	Btnn
2/24/97	UP37	72	Compacted	Ftnn
2/24/97	UP38	67	Loose compacted	Ftnn
2/24/97	UP38	70	Loose compacted	Ftnn
2/24/97	UP38	90	Loose compacted	Ftnn
2/24/97	UP38	90	Loose compacted	Ftnn
2/24/97	UP38	90	Loose compacted	Ftnn
2/24/97	UP38	69	Compacted	Ftnn
2/24/97	UP38	76	Compacted	Ftnn

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
2/24/97	SB51	50	Loose compacted	d3
2/24/97	SB51	53	Loose compacted	d2
2/24/97	SB51	45	Loose compacted	d3
2/24/97	SB51	52	Loose compacted	d3
2/24/97	SB17	57	Loose compacted	Shrub
2/24/97	SB17	53	Loose compacted	d2
2/24/97	SB17	66	Loose compacted	d2
2/24/97	SB17	60	Loose compacted	d2
2/24/97	SB17	58	Loose compacted	d1
2/24/97	SB17	51	Loose compacted	d2
2/24/97	SB17	54	Loose compacted	Shrub
2/24/97	SB17	56	Loose compacted	d1
2/24/97	SB17	60	Loose compacted	d1
2/24/97	SB17	62	Loose compacted	d2
2/24/97	SB15	60	Loose	Shrub
2/24/97	SB15	55	Loose	Ftnn
2/24/97	SB15	73	Loose	Ftnn
2/24/97	SB15	80	Loose	Ftnn
2/24/97	SB15	67	Loose	Shrub
2/24/97	SB15	43	Loose	d3
2/24/97	SB15	48	Loose	d3
2/24/97	SB15	60	Loose	Btnn
2/24/97	SB15	62	Loose	Btnn
2/24/97	SB15	50	Loose compacted	d2
2/24/97	SB15	57	Loose compacted	d2
3/29/97	SB16	32	Heavy crusted	Shrub
3/29/97	SB16	40	Heavy crusted	d3
3/29/97	SB16	24	Heavy crusted	d3
3/29/97	SB16	45	Heavy crusted	d3
3/29/97	SB16	54	Heavy crusted	Btnn
3/29/97	SB16	65	Heavy crusted	Btnn
3/29/97	SB16	78	Heavy crusted	Btnn
3/29/97	SB16	58	Heavy crusted	Btnn
3/29/97	SB30	58	Heavy crusted	Btnn
3/29/97	SB30	53	Heavy crusted	Btnn
3/29/97	SB30	48	Heavy crusted	Btnn
3/29/97	SB30	56	Heavy crusted	Btnn
3/29/97	SB18	37	Heavy crusted	d3
3/29/97	SB18	17	Heavy crusted	d3
3/29/97	SB18	28	Heavy crusted	d3
3/29/97	SB18	48	Heavy crusted	Btnn
3/29/97	SB18	50	Heavy crusted	d1
3/29/97	SB71	58	Compacted	d3
3/29/97	SB71	38	Compacted	Shrub
3/29/97	SB71	50	Compacted	d3
3/29/97	SB71	51	Compacted	d3
3/29/97	SB51	60	Crusted	d1
3/29/97	SB51	42	Crusted	d3
3/29/97	SB51	33	Crusted	d3
3/29/97	SB51	50	Crusted	d3

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
3/29/97	SB17	29	Crusted	Shrub
3/29/97	SB17	46	Crusted	Shrub
3/29/97	SB17	64	Crusted	Shrub
3/29/97	SB17	38	Crusted	Shrub
3/29/97	SB17	51	Crusted	d2
3/29/97	SB17	43	Crusted	d3
3/29/97	SB17	50	Crusted	d3
3/29/97	SB17	57	Crusted	d3
3/29/97	SB17	45	Crusted	d3
3/29/97	SB17	42	Crusted	d2
3/29/97	SB17	51	Crusted	d2
3/29/97	SB17	51	Crusted	d1
3/29/97	SB15	63	Crusted	Shrub
3/29/97	SB15	53	Crusted	Shrub
3/29/97	SB15	50	Crusted	Shrub
3/29/97	SB15	64	Crusted	Shrub
3/29/97	SB15	58	Crusted	d3
3/29/97	SB15	46	Crusted	d3
3/29/97	SB15	45	Crusted	d3
3/29/97	SB15	40	Crusted	d3
3/29/97	SB15	56	Crusted	d3
3/29/97	SB15	69	Crusted	d3
3/29/97	SB15	51	Crusted	d1
3/29/97	SB15	53	Crusted	d1
3/30/97	SB8	25	Heavy crusted	d1
3/30/97	SB8	29	Heavy crusted	d1
3/30/97	SB8	43	Heavy crusted	d1
3/30/97	SB8	49	Heavy crusted	d1
3/30/97	SB8	33	Heavy crusted	d1
3/30/97	SB8	35	Heavy crusted	d1
3/30/97	SB8	32	Heavy crusted	CIU
3/30/97	SB8	38	Heavy crusted	CIU
3/30/97	SB8	30	Heavy crusted	d1
3/30/97	SB8	54	Heavy crusted	Btnn
3/30/97	SB8	58	Compacted	Btnn
3/30/97	SB8	46	Compacted	Btnn
3/30/97	SB26	44	Compacted	d2
3/30/97	SB26	51	Compacted	Btnn
3/30/97	SB26	51	Compacted	Btnn
3/30/97	SB26	45	Compacted	Btnn
3/30/97	SB10	45	Compacted	d2
3/30/97	SB10	46	Compacted	d2
3/30/97	SB10	25	Compacted	d2
3/30/97	SB10	36	Compacted	d2
3/30/97	SB10	40	Compacted	d1
3/30/97	SB10	22	Compacted	d1
3/30/97	SB10	32	Compacted	d1
3/30/97	SB10	39	Compacted	d1
3/30/97	SB10	47	Compacted	Ftnn
3/30/97	SB10	44	Compacted	Ftnn

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
3/30/97	SB10	34	Compacted	Ftnn
3/30/97	SB10	34	Compacted	d3
3/30/97	SB12	16	Compacted	d1
3/30/97	SB12	26	Compacted	d1
3/30/97	SB12	34	Compacted	d1
3/30/97	SB12	40	Compacted	d1
3/30/97	SB12	24	Compacted	d1
3/30/97	SB12	30	Compacted	d1
3/30/97	SB12	37	Compacted	d1
3/30/97	SB12	35	Compacted	d1
3/30/97	SB12	34	Compacted	d2
3/30/97	SB12	53	Compacted	d2
3/30/97	SB12	43	Compacted	d2
3/30/97	SB12	37	Compacted	d2
3/30/97	SB20	37	Compacted	d2
3/30/97	SB20	33	Compacted	d2
3/30/97	SB20	67	Compacted	d3
3/30/97	SB20	50	Compacted	Btnn
3/30/97	SB14	36	Compacted	d2
3/30/97	SB14	37	Compacted	d2
3/30/97	SB14	42	Compacted	d2
3/30/97	SB14	35	Compacted	d2
3/30/97	SB14	19	Compacted	d2
3/30/97	SB14	18	Compacted	d2
3/30/97	SB14	23	Compacted	d2
3/30/97	SB14	33	Compacted	d2
3/30/97	SB14	39	Compacted	Btnn
3/30/97	SB14	64	Compacted	d2
3/30/97	SB14	40	Compacted	d2
3/30/97	SB14	34	Heavy crusted	d2
3/30/97	SB50	45	Crusted	Btnn
3/30/97	SB50	53	Crusted	d2
3/30/97	SB50	37	Crusted	d1
3/30/97	SB50	47	Crusted	d1
3/30/97	SB50	31	Crusted	d2
3/30/97	SB50	45	Crusted	Btnn
3/30/97	SB21	56	Crusted	Shrub
3/30/97	SB21	51	Crusted	Shrub
3/30/97	SB21	46	Crusted	d2
3/30/97	SB21	44	Crusted	Shrub
3/30/97	SB13	59	Crusted	Shrub
3/30/97	SB13	51	Crusted	Shrub
3/30/97	SB13	50	Crusted	Shrub
3/30/97	SB13	55	Crusted	Shrub
3/30/97	SB13	54	Crusted	Shrub
3/30/97	SB13	57	Crusted	Btnn
3/30/97	SB13	43	Crusted	Btnn
3/30/97	SB13	46	Crusted	d2
3/30/97	SB13	42	Crusted	d3
3/30/97	SB13	49	Crusted	d1

Date	Transect	Snow	Hardness	Habitat
m/d/yr	Number	Depth (cm)		Type
3/30/97	SB13	40	Crusted	d1
3/30/97	SB13	45	Crusted	d1
3/30/97	SB11	44	Crusted	Shrub
3/30/97	SB11	35	Crusted	Shrub
3/30/97	SB11	26	Crusted	Shrub
3/30/97	SB11	29	Crusted	d1
3/30/97	SB11	58	Crusted	d1
3/30/97	SB11	32	Crusted	d1
3/30/97	SB11	70	Crusted	d3
3/30/97	SB11	32	Crusted	d3
3/30/97	SB11	49	Crusted	d1
3/30/97	SB11	50	Crusted	d1
3/30/97	SB11	58	Crusted	d1
3/30/97	SB11	40	Crusted	d1
3/30/97	SB9	46	Crusted	d1
3/30/97	SB9	49	Crusted	d1
3/30/97	SB9	43	Crusted	d1
3/30/97	SB9	45	Crusted	d1
3/30/97	SB9	79	Crusted	d1
3/30/97	SB9	40	Crusted	d2
3/30/97	SB9	38	Crusted	d2
3/30/97	SB9	47	Crusted	d1
3/30/97	SB9	46	Crusted	Btnn
3/30/97	SB9	53	Crusted	Btnn
3/30/97	SB9	28	Crusted	d2
3/30/97	SB9	43	Crusted	d2
3/30/97	SB7	39	Crusted	Shrub
3/30/97	SB7	37	Crusted	Shrub
3/30/97	SB7	46	Crusted	Shrub
3/30/97	SB7	47	Crusted	Shrub
3/30/97	SB7	52	Crusted	d2
3/30/97	SB7	47	Crusted	d1
3/30/97	SB7	44	Crusted	d1
3/30/97	SB7	48	Crusted	d1
3/30/97	SB7	44	Crusted	d1
3/30/97	SB7	48	Crusted	d3
3/30/97	SB7	43	Crusted	d1
3/30/97	SB7	49	Crusted	d2