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Golder Associates

REPORT ON

WINTER WILDLIFE SURVEYS CONDUCTED ON SHELL LEASE 13 MARCH 1997

Submitted to:

Shell Canada Limited
400 - 4 Ave. SW
Calgary, AB T2P 2H5

December 1997

972-2221

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January 14, 1998

Proj. No. 972-2221

Dr. Doug Mead
Senior Environmental Scientist
Safety and Environmental Resources
Shell Canada Limited.
400 - 4th Avenue SW
P.O. Box 100, Station M
Calgary, AB T2P 2H5

RE: Lease 13 Winter Work Program - Final Report for Wildlife Surveys

Dear Doug:

Attached is the final report for the Shell Lease 13 Winter Wildlife Surveys Program. This report provides a review of the Winter Wildlife Survey program completed for Shell in 1997. It includes details on: a) areas included in the winter field program; b) methodologies employed; and c) results of track and owl surveys.

The data collected during the winter of 1996-1997 will provide valuable information to allow completion of the wildlife component of the Muskeg River Mine Project Environmental Impact Assessment.

Should you have any questions about this report, please contact me at 299-5640.

Yours very truly,

GOLDER ASSOCIATES LTD.

John R. Gulley
Oil Sands Project Director

attachment

cc. Judy Smith (Shell)
Ian Mackenzie (EIA Project Manager)

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ABSTRACT

A winter track count was conducted in the Shell Canada Limited Lease 13 project area in March 1997 within a 40 km^2 study area bounded by the Muskeg River, Jackpine Creek and the southern boundary of Lease 13. A late winter owl survey was also conducted to determine the relative abundance of great gray owls and boreal owls within Lease 13. Snowshoe hares preferred closed white spruce forests, closed mixedwood forests, closed mixed coniferous, black spruce dominant forests and closed black spruce bogs, and avoided open fens, wetland shrub complexes, and open and closed aspen forests. Red squirrel tracks were found more often than expected in white spruce dominated forests and closed mixedwood white spruce dominant forests, and less often than expected in bogs, fens and aspen forests. Martens and fishers were observed to have no vegetation community preference. Weasels (ermines and least weasels combined) preferred closed mixedwood white spruce dominant forests and avoided aspen and balsam poplar forests. Grouse preferred aspen forests and avoided closed mixedwood, mixed coniferous forests, black spruce bogs and riparian shrub habitats. Riparian and escarpment landforms were preferred by snowshoe hares and red squirrels. Weasels preferred riparian areas only, while grouse, martens and fishers showed no landform preference. Moose showed a slight preference for riparian and escarpment areas, but the small sample sizes precluded definitive conclusions. Taken for all species and species groups, results indicate the importance to wildlife of riparian and escarpment areas along the Muskeg River and Jackpine Creek. The results of the owl survey were poor, in part due to the less than ideal weather conditions encountered during the survey period. Nevertheless, seven boreal owls and one great horned owl were recorded during the owl survey. Non-survey personnel made incidental observations of four great gray owls during the winter program.

Key Words: ungulate, furbearer, owl, survey, winter, snow

ACKNOWLEDGMENTS

Field work for these studies was conducted by Ken Allen, Tony Calverley, Tanis Dirks and Lorne Gould. Initial report production and statistical analyses were conducted by Tony Calverley and John Virgl, respectively.

EXECUTIVE SUMMARY

This document reports on the findings of a winter track count survey and a late winter owl survey in the Shell Canada Limited Lease 13 project area in support of an Environmental Impact Assessment. Objectives of the studies were to: 1) determine the relative ungulate and furbearer abundance by vegetation community type within Lease 13; 2) determine if the Muskeg River and Jackpine Creek valleys are used preferentially by ungulates and furbearers in winter; and 3) determine the relative abundance of great gray owls and boreal owls within Lease 13. Snow thickness and hardness data were also collected as part of the field program to characterize snow conditions.

A winter track count was conducted in March 1997 within a 40 km^2 study area bounded by the Muskeg River, Jackpine Creek and the southern boundary of Lease 13. This study area was selected because it represented the only area within Lease 13 that had not previously been sampled for winter tracks.

Tracks of 10 species or species groups were observed. These included tracks of snowshoe hares, red squirrels, mice, coyotes, martens and fishers, weasels (ermines and least weasels combined), minks, river otters, moose and grouse. While wolf tracks were not observed, tracks of a pack of seven wolves were observed by non-survey personnel in the study area.

Sufficient data were collected during the track count survey to determine vegetation community preference and avoidance for snowshoe hares, red squirrels, weasels and grouse. Snowshoe hares preferred closed white spruce forests, closed mixedwood forests, closed mixed coniferous black spruce dominant forests and closed black spruce bogs, and avoided open fens, wetland shrub complexes, and open and closed aspen forests. Red squirrel tracks were found more often than expected in white spruce dominated forests and closed mixedwood white spruce dominant forests and less often than expected in bogs, fens and aspen forests. Weasels preferred closed mixedwood white spruce dominant forests and avoided aspen and balsam poplar forests. Grouse preferred aspen forests and avoided closed mixedwood, mixed coniferous forests, black spruce bogs and riparian shrub habitats. Qualitative data were obtained for a number of other species.

Snow conditions at the time of the survey were more severe than for similar periods in other winters. Mean snow thicknesses for vegetation communities sampled ranged from 42 to 68 cm.

This contrasts with the mean snow thickness of 19 cm found during 1995 track surveys and the overall late February mean of 38 cm for the Fort McMurray area.

Quantitative data on the use of landforms (riparian, escarpment and upland) by wildlife was also obtained. Riparian and escarpment landforms were preferred by snowshoe hares and red squirrels. Weasels preferred riparian areas only, while grouse and martens and fishers showed no landform preference. Moose showed a slight preference for riparian and escarpment areas, but the small sample sizes precluded definitive conclusions. Overall, the results indicate the importance to wildlife of riparian and escarpment areas along the Muskeg River and Jackpine Creek.

The results of the owl survey were poor, in part due to less than ideal weather conditions encountered during the survey period. Nevertheless, seven boreal owls and one great horned owl were recorded during the owl survey. Non-survey personnel made incidental observations of four great gray owls during the winter program.

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1.0 INTRODUCTION

Shell Canada Limited (Shell) plans to develop Lease 13, which is approximately 75 km north of Fort McMurray and east of the Athabasca River. As part of an Environmental Impact Assessment (EIA) for the project, Shell is required to assess the impacts of the project on wildlife (mammals, birds, amphibians and reptiles). Baseline information about these wildlife groups is required for impact assessment, mitigation planning, closure design and monitoring recommendations.

Some wildlife species are best studied at certain times of the year, because of either their activity patterns or the methods used to study the species. This report describes studies done in late winter 1996-1997: winter track counts for ungulates and furbearers and a winter owl survey.

The most accurate and precise method of estimating the abundance and distribution of furbearers and ungulates is to use mark-recapture and/or radio telemetry techniques (Sutherland 1996). These methods are costly and time consuming, therefore a reasonable surrogate is to count the number of tracks made by different species that intersect a transect line (Sutherland 1996). Track count surveys are cost-effective and provide an index of the relative abundance of furbearers and ungulates in sampled areas.

Previous winter track count work was conducted on most of Lease 13 by Westworth and Associates (1996) in support of the Aurora Mine EIA. The area not previously sampled lies between the Muskeg River, Jackpine Creek and the southern boundary of Lease 13 (Figure 1). This area is semicircular in shape and totals some 40 km^2.

No previous owl studies have been done on Lease 13.

This is a data report for the winter surveys and does not include a detailed discussion of the results. The report will be used as a component of the Environmental Baseline for the Lease 13 EIA. A full discussion and interpretation of the results will be presented in that document.

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Lease 18

ATHABASCA RIVER

TAR RIVER

Lease 5

FORT CREEK

STANLEY CREEK

Lease 10

SYNCRUDE
Aurora Mine North

Lease 34

Lease 12

Mobil

Lease 36

KEARL LAKE

MUSKEG CREEK

MUSKEG RIVER

SHELLEY CREEK

SYNCRUDE
Aurora Mine South

IYINIMIN CREEK

WESUKEMINA CREEK

JOSLYN CREEK

Shell
Lease 13

JACKPINE CREEK

KHAHAGO CREEK

ELLS RIVER

Lease 7

Lease 24

MACKAY RIVER

FORT MCKAY

Lease 6

Lease 90

Shell

Lease 30

Lease 31

BLACKFLY CREEK

Lease 49

0 1000 2000 3000 4000 5000(metres)

SCALE 1:100,000

REFERENCE

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

LEGEND

STUDY AREA

Golder Associates

SHELL CANADA LIMITED

**WINTER TRACK SURVEY STUDY AREA
WITHIN SHELL LEASE 13**

15 JAN 98	FIG. No. 1	JOB No. 972-2221

2.0 OBJECTIVES

This report presents the results of a winter track count study designed to assess the relative abundance and distribution of ungulates and furbearers within the area not sampled during the Syncrude Canada Ltd. Aurora Mine (Aurora) EIA. A secondary objective was to assess wildlife use of the Muskeg River and Jackpine Creek valleys. The report also presents the results of a great gray owl (key wildlife species for the EIA) and boreal owl survey designed to assess the relative abundance and distribution of owls within Lease 13. Specific objectives of these surveys were to:

- determine relative abundance of, and vegetation community type use by, ungulates and furbearers within areas of Lease 13 not previously surveyed;
- determine use of the Muskeg River and Jackpine Creek valleys by ungulates and furbearers;
- determine snow conditions within the snow track study area; and
- determine relative abundance and distribution of great gray owls and boreal owls within Lease 13.

3.0 METHODS

3.1 Track Surveys

Paired transects, a minimum of 500 m apart, were established perpendicular to the Muskeg River and Jackpine Creek, running a minimum of 500 m into upland vegetation communities on either side of each watercourse. (Because of the shape of the study area, the Jackpine Creek transects extended only west of the creek.) Paired transects were connected on one side, within the upland landform type. In addition, rectangular "box-shaped" transects were placed evenly along the road that cut through the centre of the study area. Overall, eight transects were established to sample the 40 km^2 study area over two days (Figure 2).

Track surveys were initiated five days after a significant snowfall. Transect routes were travelled by snowshoe and all furbearer, ungulate, grouse and other tracks that intercepted the transects were recorded. Information recorded included species, number of animals, time since last snowfall (to the nearest half day), vegetation community type (overstory and understory - recorded by dominant and subdominant species, to the nearest 10%), and landform type (riparian, escarpment or upland). Transect distances were measured by hip chain. The distance travelled within each vegetation community type was also recorded.

A vegetation community description was derived for the project based on dominant tree species in the canopy because vegetation mapping for the study area was not available at the time of this study and because the ecosystem mapping system of Beckingham and Archibald (1996) requires a description of the herb and bryophyte layers in the forest (unavailable during the winter). The vegetation communities delineated in this study will be correlated at a later date to the vegetation units that will be mapped in the study area during summer 1997.

A single transect intercept was recorded as one crossing. If animals of one species crossed the transect in a trail, the number of individuals was recorded if that number could be determined. If the number of individuals could not be determined, the observation was recorded as one "trail." One trail was considered equivalent to three individual intercepts. If the tracks were separated by even a short distance, each track was recorded individually. In some situations, animals

J:\1997\2221\7700\TRANSSEC.DWG

Lease 18

TAR RIVER

ATHABASCA RIVER

Solv-Ex
Lease 5

FORT CREEK

STANLEY CREEK

Lease 10

SYNCRUDE
Aurora North Mine
Lease 34

Lease 12

Mobil

Lease 36

KEARL LAKE

MUSKEG CREEK

MUSKEG RIVER

SHELLEY CREEK

JOSLYN CREEK

Shell
Lease 13

JACKPINE CREEK

KHAHAGO CREEK

SYNCRUDE
Aurora
South
Mine

IYNIMIN CREEK

WESUKEMINA CREEK

ELLS RIVER

Lease 7

Lease 24

MACKAY RIVER

FORT MCKAY

Lease 6

Lease 90

Shell

Lease 30

Lease 31

BLACKFLY CREEK

Lease 49

N

0 1000 2000 3000 4000 5000(metres)

SCALE 1:100,000

REFERENCE

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

LEGEND

TRACKING SURVEY TRANSECTS

Golder Associates

SHELL CANADA LIMITED

TRACK SURVEY TRANSECTS CONDUCTED WITHIN SHELL LEASE 13, MARCH 13-14, 1997

15 JAN 98	FIG. No. 2	JOB No. 972-2221

crisscrossed the transect many times over a short distance for bedding, feeding or other activities. In such a case, tracks were recorded for each 1 m of transect that this occurred, as one "network." One network was considered equivalent to five individual intercepts.

In addition, all wildlife sign in the snow within 5 m on either side of the transect was recorded (beds, owl plunge holes, grouse roosting sites). Snow thickness and hardness measurements were also taken for the most common vegetation community types to determine snow conditions at the time of the survey, as snow conditions can often influence wildlife movements. GPS units were used to ensure the geographic location of each transect was accurate.

The data were analysed in terms of the number of tracks per species per km-day, which was represented by dividing the number of tracks observed (for each species, in each vegetation community type or landform type, depending on the analysis) by the distance travelled times the number of days since the last snowfall.

Statistical analyses included lumping of vegetation community types where sample sizes were low, application of Yate's Correction Factor (Sokal and Rohlf 1969) where sample sizes were less than five, and chi-square analysis. Where chi-square analysis indicated statistically significant ($P < 0.05$) differences between observed and expected values, preference for and/or avoidance of each vegetation community type was determined through the Bonferroni Z-test (Byers et al. 1984).

3.2 Owl Surveys

The optimal time to survey great gray owls according to Beck and Beck (1988) is the period from the last week of March to the end of the first week of April. This period is also appropriate for surveying boreal owls as breeding season begins in early April (Beck and Beck 1988).

A playback tape for boreal owls and great gray owls was used for the owl surveys. The playback tape consisted of one minute of silence, two minutes of boreal owl calls, one minute of silence, two minutes of great gray owl calls. At each census point the surveyors moved approximately 30 m from the vehicle so that noise from the parked vehicle did not interfere with detection of owls. The tape player was then turned on. The first one-minute silent interval was used to detect owls that were already calling. The tape ran continuously through the two-minute call intervals of both species. The one-minute silent interval between each call interval was used to detect any owls

stimulated by the taped calls. The surveyors remained vigilant while the tape was played to allow detection of any species that approached the tape player.

The number of owls of each species at each census point was recorded. Other species of wildlife, time, temperature, wind velocity, precipitation, vegetation community type and location were recorded for each census point. Owls and other species encountered away from survey plots were also recorded. GPS units were used to ensure the geographic location of each point was accurate.

4.0 RESULTS

4.1 Track Surveys

Track counts were conducted 13-14 March 1997. A total 14.7 km of transects were followed, resulting in 78 km-days of data collected (Figure 2, Table 1). A brief description of the vegetation community types is provided in the following section, followed by the results of the track counts.

4.1.1 Vegetation Community Types Sampled

No vegetation community mapping had been conducted in the 40 km^2 study area before this study. Therefore, detailed canopy descriptions were recorded so track count data could be correlated to the eventual vegetation community types mapped during the summer 1997 vegetation mapping program.

Sixteen vegetation community types (Table 2) were sampled during the study. Vegetation communities included three types of deciduous forest (closed balsam poplar, open and closed aspen), six types of coniferous forest (jack pine, white spruce, black spruce, black spruce tamarack fen, open and closed black spruce bog, and open tamarack fen), two types of mixedwood (closed and white spruce dominant), two types of mixed coniferous (black spruce and balsam fir), two types of shrub communities (wetland and riparian) and a disturbed grass/forb type. Each is described briefly in the following section.

Table 1 Wildlife Track Intercepts (tracks per km-day) Summarized by Vegetation Community Types

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Snowshoe Hare	Red Squirrel	Mice	Coyote	Marten/ Fisher	Weasel	Mink	River Otter	Moose	Grouse
closed jackpine	732	4.03	182.08	41.90	1.82	0.00	14.96	7.88	0.00	0.00	0.00	3.37
closed white spruce	675	3.44	421.60	210.31	0.00	3.13	5.87	6.43	0.00	0.00	2.35	3.75
closed balsam poplar	250	1.20	101.73	12.05	0.00	8.70	18.50	2.24	0.00	0.00	0.00	6.54
closed mixedwood	1506	7.84	248.84	36.33	3.35	0.00	3.77	30.51	0.00	0.00	6.99	2.66
closed mixed coniferous,black spruce dominant	690	3.72	340.76	21.17	7.86	1.19	16.32	0.84	0.00	0.00	0.00	1.19
black spruce/tamarack fen	99	0.50	12.12	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
closed mixedwood, white spruce dominant	392	1.93	237.08	218.71	0.00	1.23	6.66	45.57	0.00	0.00	5.95	0.00
peatland: closed black spruce bog	956	4.92	312.04	3.89	4.66	0.00	4.72	7.41	0.00	0.00	0.00	1.08
peatland: open tamarack fen	382	1.94	41.81	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
peatland: open black spruce bog	2622	14.16	108.36	42.56	11.78	0.00	14.12	13.08	0.00	0.00	0.00	24.32
wetland shrub complex	727	3.63	10.59	2.45	5.50	0.00	5.22	9.07	0.00	0.00	0.00	43.90
disturbed	74	0.44	11.26	0.00	2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
riparian shrub dominant	1781	9.19	92.49	126.01	4.65	4.54	7.42	9.63	0.58	4.26	1.01	1.55
open aspen	1260	7.13	26.07	5.45	13.85	0.38	1.75	0.84	0.00	0.00	1.68	17.35
closed aspen	2544	13.80	70.23	8.62	11.70	0.25	9.38	2.15	0.00	0.00	1.98	27.79
mixed coniferous, balsam fir dominant	29	0.14	20.00	58.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**14719**	**77.99**	**2237.07**	**790.57**	**67.44**	**19.41**	**108.70**	**135.65**	**0.58**	**4.26**	**19.95**	**133.48**

Table 2 Vegetation Community Types Within Shell Lease 13

VEGETATION COMMUNITY TYPE	DESCRIPTION
Closed jack pine	Upland areas where well-drained sandy knolls are present, support small patches of jack pine forest.
Closed white spruce	Present in the upland areas. Often support mixes of black spruce and jack pine. Canopy cover is typically very high.
Closed balsam poplar	Upland areas usually dominated by trembling aspen and balsam poplar, which offer high canopy cover.
Closed mixedwood	Mixedwood forest usually dominated by trembling aspen in association with various coniferous species.
Closed mixed coniferous, black spruce dominant	Black spruce stands that often support a low to moderate jack pine component.
Black spruce / tamarack fen	Present in the upland areas, this ecosite supports both black spruce and tamarack in various covers.
Closed mixedwood, white spruce dominant	Drier upland sites predominantly dominated by white spruce and decadent aspen.
Closed black spruce bog	Upland communities, dominated by black spruce in areas with an annual high standing water condition.
Open tamarack fen	Fens dominated by low to tall tamarack strata, often scattered with black spruce in low cover.
Open black spruce bog	Open upland bog areas, where low stature black spruce is the predominant vegetation type.
Wetland shrub complex	Closed upland shrub communities, usually found as narrow communities along drainages.
Disturbed / herb and grass dominant	Associated with disturbed areas, dominated by a combination of low shrubs and forbs.
Riparian shrub dominant	Closed riparian shrub community types, usually found as narrow communities along creeks and rivers.
Open trembling aspen	Open communities where canopy cover consists of the occasional trembling aspen.
Closed trembling aspen	Closed canopy trembling aspen forest, which provides good canopy cover.
Mixed coniferous, balsam fir dominant	Present in moist upland areas where the closed mixed coniferous forest is dominated by balsam fir.

Closed Jack Pine

Forest cover types in which jack pine was the dominant species (Plate 1) were not common in the study area. Trembling aspen was usually present, especially around the periphery of jack pine stands. The understory was usually dominated by green alder. This type most closely resembles the jack pine/alder/lichen type (a1.3) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 4.03 km-track days of effort, based on 732 m of transect and 5.5 days since the last snowfall.

Closed White Spruce

Forest cover types in which mature white spruce was the dominant species (Plate 2) were not common within the study area sampled. Although not always present, trembling aspen was commonly associated with this forest cover type. The dominant understory was usually several strata of younger shade-tolerant white spruce and balsam fir, as well as green alder and willow. This type most closely resembles the white spruce/balsam fir/fern (e3.3) and white spruce/alder/fern (e3.2) types of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 3.44 km-track days of effort. Total distance covered in this vegetation community type was 675 m.

Closed Balsam Poplar

This vegetation community type was dominated by balsam poplar and trembling aspen in the overstory canopy, and often had a sparse cover of white spruce in the lower canopy. The understory canopy layer was usually dominated by willow, white spruce and sometimes balsam fir. This type most closely resembles the balsam poplar type series (e1.1 - e1.3) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 1.20 km-track days of effort. Total distance covered in this vegetation community type was 250 m.

Closed Mixedwood

This community type represents closed mixedwood forest cover types in which trembling aspen or balsam poplar were co-dominant with conifer species (Plate 3). Shrub species included green alder and willow. This type most closely resembles the aspen/white spruce types (b3.1, b3.2, b3.3, d2.1 -

d2.9) and balsam poplar/white spruce types (e2.1 - e2.5) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 7.84 km-track days of effort. Total distance covered in this vegetation community type was 1506 m.

Closed Mixed Coniferous, Black Spruce Dominant

These sites were successional to black spruce, white spruce or jack pine in the shrub strata. This type most closely resembles the black spruce/jack pine/Labrador tea/feathermoss (g1.1) and the black spruce/jack pine/feathermoss (g1.2) types of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 3.72 km-track days of effort. Total distance covered in this vegetation community type was 690 m.

Black Spruce/Tamarack Fen

This community type supported both black spruce and tamarack trees. The understory vegetation supported both black spruce and tamarack in various successional stages. This type most closely resembles the black spruce/tamarack types (j1.1 - j2.1) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved only 0.50 km-track days of effort. Total distance covered in this vegetation community type was only 99 m.

Closed Mixedwood, White Spruce Dominant

These closed mixedwood forest cover types were dominated by white spruce in the overstory canopy. Other overstory tree species were jack pine, black spruce and trembling aspen. The shrub canopy supported a variety of communities, and included willow, Canada buffaloberry and green alder. Track counts in this vegetation community type involved 1.43 km-track days of effort. Total distance covered in this vegetation community type was 292 m.

Closed Black Spruce Bog

Closed black spruce bog forest cover types were dominated by black spruce in both the over- and understory. This resulted in stands of high structural, but low species diversity. This type most closely resembles the black spruce/Labrador tea/cloudberry/peat moss type (i1.1) of Beckingham

and Archibald (1996). Track counts in this vegetation community type involved 4.92 km-track days of effort. Total distance covered in this vegetation community type was 956 m.

Open Tamarack Fen

Tamarack fens were dominated by low to tall tamarack shrub strata. Black spruce was often scattered in low cover areas. Shrub species included bog birch and willow. This type most closely resembles the larch/dwarf birch/sedge/golden moss type (k1.1) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 1.94 km-track days of effort. Total distance covered in this vegetation community type was 382 m.

Open Black Spruce Bog

Open black spruce bog was the predominant vegetation type in the study area sampled (Plate 4). This vegetation type was similar to the closed black spruce bog, but considerately more open with very little overstory canopy. The black spruce was typically low in stature, usually less than 5 m. Shrub species included sparse bog birch and willow. This type most closely resembles the black spruce/Labrador tea/cloudberry/peat moss type (i2.1) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 14.16 km-track days of effort. Total distance covered in this vegetation community type was 2622 m.

Wetland Shrub Complex

Wetland shrub community types were associated with upland drainages and wetland meadows. Shrubs in this community usually consisted of various willow species and green alder. This type most closely resembles the willow/sedge/golden moss type (k2.2) of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 3.63 km-track days of effort. Total distance covered in this vegetation community type was 727 m.

Disturbed/Herb and Grass Dominant

Disturbed/herb and grass communities were largely a result of clearing and subsequent early seral regeneration. Regenerating sites are dominated by a mix of herbs, forbs and low shrubs. Track

counts in this vegetation community type involved only 0.44 km-track days of effort. Total distance covered in this vegetation community type was only 74 m.

Riparian Shrub Dominant

Riparian shrub community types were present as narrow communities along creeks and rivers (Plate 5). Shrub species were predominantly river alder and willow. While this type most closely resembles the willow/sedge/golden moss type (k2.2), no real equivalent to this vegetation community was recorded by Beckingham and Archibald (1996). Track counts in this vegetation community type involved 9.19 km-track days of effort. Total distance covered in this vegetation community type was 1781 m.

Open Trembling Aspen

Open trembling aspen forest was dominated by trembling aspen, but was considerably more open than other cover types and offered sparse overstory canopy cover. The shrub layer consisted of regenerating trembling aspen and often willow. This type most closely resembles the aspen/buffaloberry (d1.1) type of Beckingham and Archibald (1996). Track counts in this vegetation community type involved 7.13 km-track days of effort. Total distance covered in this vegetation community type was 1260 m.

Closed Trembling Aspen

Closed trembling aspen forest cover types were dominated by trembling aspen that provided a closed canopy cover (Plate 6). Often, a few scattered white spruce were also present in the overstory canopy. Understory shrubs were usually dominated by green alder and white spruce. This type most closely resembles the aspen/alder type (d1.4). Track counts in this vegetation community type involved 13.81 km-track days of effort. Total distance covered in this vegetation community type was 2544 m.

Mixed Coniferous, Balsam Fir Dominant

This type was represented by a mixed coniferous forest cover type in which balsam fir was the dominant conifer species. Regenerating balsam fir was also present in the understory. Understory

shrubs were usually dominated by green alder and willow. This type is not described by Beckingham and Archibald (1996), but is likely a variation of their white spruce/balsam fir/fern (e3.3) type. Track counts in this vegetation community type involved only 0.14 km-track days of effort. Total distance covered in this vegetation community type was only 29 m.

4.1.2 Snow Conditions

Snow thicknesses averaged from 42-68 cm in the various vegetation community types sampled (Table 3). Closed coniferous upland forest communities (e.g., closed white spruce, jack pine) had lower average thicknesses (42-52 cm) than did bogs and fens (59-68 cm). The snowpack was soft and fluffy in all vegetation communities sampled. Westworth and Associates (1996) recorded unusually low snow thicknesses (overall mean of 19 cm; maximum thickness of 28 cm) in their study area in January-February 1995. Hauge and Keith (1978) stated that the long-term (1944-1972) average snow thickness for the Fort McMurray area was 28 cm at the end of December and 38 cm at the end of February. Thus it appears that snow conditions in the winter of 1996/1997 were unusually thick.

Table 3 Snow Thicknesses Recorded in Different Vegetation Communities in the Study Area

Vegetation Community	Mean	95% C.L.	Count	Minimum	Maximum
Closed white spruce	42.4	7.2	9	26	55
Closed jack pine	52.2	5.6	6	45	65
Closed mixedwood	50.7	4.7	13	32	61
Riparian shrub	54.9	6.1	11	30	69
Closed aspen	55.8	2.7	19	47	67
Closed black spruce bog	59.3	14.8	3	47	73
Open black spruce bog/fen	67.7	3.0	12	60	78

4.1.3 Selection of Vegetation Community Types by Wildlife

Ten species or species groups were recorded during the track surveys (Table 1):

- snowshoe hare;
- red squirrel;
- mice (not differentiated to species);
- coyote;
- marten and fisher (combined due to potential overlap in track sizes);
- weasel (includes ermines and least weasels);
- mink;
- river otter;
- moose; and
- grouse (not differentiated to species).

Each of the above, in addition to species expected to be present but not encountered, is discussed below.

Snowshoe Hare

Snowshoe hares were the most common herbivore in the study area with a combined vegetation community type total of 22.36 tracks/km-track day (Table 1, Plate 7). Results of the chi-square analysis were significant, (1455; 15 degrees of freedom; $P < 0.01$ (Table 4), which means that tracks were found more often than expected in certain vegetation communities than could be expected by chance alone. The greatest snowshoe hare track frequency was recorded in the closed white spruce forest cover type with 94.82 tracks/km-track day. Other closed vegetation community types that were moderately high in rank of preference were closed mixed coniferous-black spruce dominant forest (39.80), closed black spruce bog (37.37) and closed mixedwood (44.92). All these community types had a greater number of observed track intercepts than expected (Table 4). Vegetation communities that were avoided by hares included the open tamarack fen (7.24), wetland shrub complex (1.93), riparian shrub (11.97), and the open and closed aspen forest (8.69 and 5.58, respectively) types.

Red Squirrel

Red squirrels were the second most common mammal in the study area with a combined vegetation community type total of 5.65 tracks/km-track day (Plate 8). Results of the chi-square analysis were significant: (1547; 12 degrees of freedom; $P < 0.01$ (Table 5). Vegetation communities preferred by red squirrels included the closed mixedwood, white spruce dominant (55.57) and the closed white spruce (35.78 tracks/km-track day) communities. Communities that were avoided by red squirrels included the open and closed fen/wetland shrub (0.83), closed black spruce bog (0.81), open aspen (1.54) and closed aspen (0.65) types (Table 5).

Mice

Mice were the fifth most common mammal/mammal group in the study area with a combined vegetation community type total of 1.13 tracks/km-track day (Table 1). Insufficient track intercepts were recorded to warrant statistical analysis. The greatest mouse track frequency was recorded in the open aspen forest cover type with 3.22 tracks/km-track day, disturbed areas (2.25) and closed aspen forest (2.17).

Porcupine

No porcupine tracks were encountered during the winter track survey, even though the porcupine is distributed throughout the province (Smith 1993). It is most commonly found in mixed forest cover types.

Table 4 Observed Versus Expected Track Intercepts for Snowshoe Hares

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Tracks		Proportion		lower 95%	upper 95%	Preference
			Obs.	Exp.	Obs.	Exp.			
closed jackpine	732	4.03	182	115	0.08	0.05	0.06	0.10	p
closed white spruce	675	3.44	422	99	0.19	0.04	0.16	0.21	p
closed balsam poplar	250	1.20	102	34	0.05	0.02	0.03	0.06	p
closed mixedwood	1506	7.84	249	225	0.11	0.10			n
closed mixed coniferous,black spruce dominant	690	3.72	341	107	0.15	0.05	0.13	0.18	p
black spruce/tamarack fen	99	0.50	12	14	0.01	0.01			n
closed mixedwood, white spruce dominant	392	1.93	237	55	0.11	0.02	0.09	0.13	p
peatland: closed black spruce bog	956	4.92	312	141	0.14	0.06	0.12	0.16	p
peatland: open tamarack fen	382	1.94	42	56	0.02	0.02			n
peatland: open black spruce bog	2622	14.16	108	406	0.05	0.18	0.03	0.06	a
wetland shrub complex	727	3.63	11	104	0.00	0.05	0.00	0.01	a
disturbed	74	0.44	11	13	0.01	0.01			n
riparian shrub dominant	1781	9.19	92	264	0.04	0.12	0.03	0.05	a
open aspen	1260	7.13	26	205	0.01	0.09	0.00	0.02	a
closed aspen	2544	13.80	70	396	0.03	0.18	0.02	0.04	a
mixed coniferous, balsam fir dominant	29	0.14	20	4	0.01	0.00			*
Total	**14719**	**77.99**	**2237**	**2237**	**1**	**1**			

a= avoided
n = neutral
p = preferred
* = not applicable

chi square =	3437.16
df =	15
P	< 0.01

Table 5 Observed Versus Expected Track Intercepts for Red Squirrels

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Tracks Obs.	Tracks Exp.	Proportion Obs.	Proportion Exp.	lower 95%	upper 95%	Preference
closed jackpine	732	4.03	42	41	0.05	0.05			n
closed white spruce	675	3.44	210	35	0.27	0.04	0.22	0.31	p
closed balsam poplar	250	1.20	12	12	0.02	0.02			n
closed mixedwood	1506	7.84	36	79	0.05	0.10	0.02	0.07	a
closed mixed coniferous,black spruce dominant	690	3.72	21	38	0.03	0.05	0.01	0.04	a
open and closed fen; wetland shrub	1208	6.07	5	62	0.01	0.08	0.00	0.01	a
closed mixedwood, white spruce dominant	392	1.93	219	20	0.28	0.02	0.23	0.32	p
open and closed black spruce bog	3578	19.08	47	194	0.06	0.24	0.03	0.08	a
disturbed	74	0.44	0	5	0.00	0.01			n
riparian shrub dominant	1781	9.19	126	93	0.16	0.12	0.12	0.20	n
open aspen	1260	7.13	5	72	0.01	0.09	0.00	0.02	a
closed aspen	2544	13.80	9	140	0.01	0.18	0.00	0.02	a
mixed coniferous, balsam fir dominant	29	0.14	58	1	0.07	0.00			*
Total	**14719**	**78.00**	**791**	**791**	**1**	**1**			

a= avoided
n = neutral
p = preferred
* = not applicable

chi square =	5619.61
df =	12
P	< 0.01

Coyote

Coyote tracks were not commonly found in the study area, considering that the coyote was the most abundant large carnivore during the wildlife inventory of Oil Sands Leases 12, 13 and 34, prepared for Syncrude Canada Limited (Westworth and Associates 1996). The vegetation community type with the greatest coyote track frequency was the closed balsam poplar forest, with 0.84 tracks /km-track day. The closed mixedwood, white spruce dominant community also had a relatively high incidence of track intercepts (0.52 tracks/km-track day) as did the closed white spruce type (0.29 tracks/km-track day). In contrast, coyote tracks were not recorded in black spruce bogs or tamarack fens.

Gray Wolf

No wolf tracks were encountered along the track survey transects during the winter track survey. However, during the owl survey, two gray wolves were observed crossing the road 50 m east of Muskeg Creek in a closed mixedwood forest cover type in which white spruce was the dominant vegetation species. From closer inspection of the tracks, the group size was determined to be seven. Wolf group sizes vary widely, but most groups include seven or fewer wolves that hunt and live as packs (Rezendes 1992). Fuller and Keith (1980) estimated the density of wolves in the AOSERP (Alberta Oil Sands Environmental Research Program) study area at 1 wolf/151 km^2.

Red Fox

No red fox tracks were encountered during the winter track survey. The red fox is uncommon in northern Alberta; however, indications are that the population is increasing (Smith 1993). Westworth and Associates (1996) also considered the red fox uncommon in the Syncrude area in their wildlife inventory of Oil Sands Leases 12, 13 and 34.

Marten and Fisher

Martens and fishers were the fourth most common mammals in the study area with a combined vegetation community type total of 1.26 tracks/km-track day (Table 1). Chi-square analysis of the distribution of marten and fisher tracks (Table 6) indicated there were no significant differences in

observed versus expected track intercepts at the 0.01 probability level (18; 11 degrees of freedom; P = 0.03).

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 both species tracks were combined as one. Weasel tracks were common in the study area with the sixth highest overall track frequency. The combined vegetation community type total was 1.12 tracks/km-track day (Table 1). The highest frequency recorded were in the closed mixedwood-white spruce dominant community type with 7.79 tracks/km-track day. This community was found to have more tracks observed than expected by chance alone (Table 7). Most other vegetation community types had sparse or no use by these species. Vegetation communities avoided by weasels included closed balsam poplar and open and closed aspen forests.

Mink

Mink tracks were uncommon in the study area. The two sets of mink tracks recorded were along the Muskeg River. The track frequency recorded was in the riparian shrub dominant vegetation community type with 0.22 tracks/km-track day (Table 1).

River Otter

River otter tracks were likewise uncommon in the study area. The only river otter tracks recorded were along the Muskeg River in the riparian shrub dominant vegetation community type (Plate 9). The track frequency recorded was 0.11 tracks/km-track day.

Table 6 Observed Versus Expected Track Intercepts for Martens and Fishers

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Tracks		Proportion		lower 95%	upper 95%	Preference
			Obs.	Exp.	Obs.	Exp.			
closed jackpine	732	4.03	15	6	0.14	0.05	0.04	0.23	n
closed white spruce	675	3.44	6	5	0.05	0.04			n
closed balsam poplar	250	1.20	18	2	0.17	0.02	0.07	0.28	p
closed mixedwood	1506	7.84	4	11	0.03	0.10	-0.02	0.09	a
closed mixed coniferous	719	3.86	16	5	0.15	0.05	0.05	0.25	n
open and closed fen	481	2.44	0	3	0.00	0.03			*
closed mixedwood, white spruce dominant	392	1.93	7	3	0.06	0.02			n
open and closed black spruce bog	3578	19.08	19	27	0.17	0.24	0.07	0.28	n
wetland shrub complex	727	3.63	5	5	0.05	0.05			n
disturbed	74	0.44	0	1	0.00	0.01			*
riparian shrub dominant	1781	9.19	7	13	0.07	0.12	0.00	0.14	n
open and closed aspen	3804	20.93	11	29	0.10	0.27	0.02	0.19	a
Total	**14719**	**78.00**	**109**	**109**	**1**	**1**			

a= avoided
n = neutral
p = preferred
* = not applicable

chi square = 219.74
df = 11
P < 0.01

Table 7 Observed Versus Expected Track Intercepts for Weasels

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Tracks		Proportion		lower 95%	upper 95%	Preference
			Obs.	Exp.	Obs.	Exp.			
closed jackpine	732	4.03	8	7	0.06	0.05			n
closed white spruce	675	3.44	6	6	0.05	0.04			n
closed balsam poplar, open and closed aspen	4054	22.13	5	38	0.04	0.28	-0.01	0.08	a
closed mixedwood	1506	7.84	31	14	0.23	0.10	0.12	0.33	p
closed mixed coniferous	719	3.86	1	7	0.01	0.05	-0.01	0.03	a
open and closed fen	481	2.44	0	4	0.00	0.03			*
closed mixedwood, white spruce dominant	392	1.93	46	3	0.34	0.02	0.22	0.45	p
open and closed black spruce bog	3578	19.08	20	33	0.15	0.24	0.06	0.24	n
wetland shrub complex	727	3.63	9	6	0.07	0.05	0.01	0.13	n
disturbed	74	0.44	0	1	0.00	0.01			*
riparian shrub dominant	1781	9.19	10	16	0.07	0.12	0.01	0.13	n
Total	**14719**	**78.00**	**135**	**135**	**1**	**1**			

a= avoided
n = neutral
p = preferred
* = not applicable

chi square =	586.37
df =	10
P	< 0.01

Canada Lynx

No lynx tracks were encountered during the winter track survey. The population of this species is known to fluctuate greatly over a 9 to 12 year cycle (e.g., Koonz 1976), thus the population may have been at a cyclic low during the survey.

Deer

Two species of deer, mule and white-tailed, are native to the Fort McMurray area. However, no deer tracks were encountered during the winter track survey.

Moose

Moose tracks were relatively uncommon in the study area, with a combined vegetation community type total of 0.26 tracks/km-track day. The greatest moose track frequencies were recorded in the closed mixedwood white spruce dominant forest cover type with 1.04 tracks/km-track day. Other vegetation community types where moose tracks were encountered included closed white spruce, closed mixedwood, riparian shrub dominant, and open and closed aspen forest cover types (Plate 10). Insufficient moose track intercepts were recorded to warrant statistical analysis.

Grouse

Three species of grouse are native to the oil sands area: the spruce grouse, ruffed grouse and sharp-tailed grouse (Semenchuk 1992). Tracks of the three species were combined since tracks could not be differentiated by species. A total of 1.71 tracks/km-day were recorded for all community types (Table 1). Grouse tracks were found more often than expected (chi-square = 160; 11 degrees of freedom; $P < 0.01$: Table 8) in closed aspen (6.17) and open aspen (3.77) forests. Types avoided by grouse included the closed mixedwood (0.38), closed mixed coniferous (0.27) and riparian shrub (0.11) communities. Plates 11 and 12 show grouse and grouse tracks.

Table 8 Observed Versus Expected Track Intercepts for Grouse

Vegetation Community Type	Distance (m) Sampled	Km-days Sampled	Tracks		Proportion		Confidence Limits		Preference
			Obs.	Exp.	Obs.	Exp.	lower 95%	upper 95%	
closed jackpine	732	4.03	3	7	0.03	0.05			n
closed white spruce	675	3.44	4	6	0.03	0.04			n
closed balsam poplar	250	1.20	7	2	0.05	0.02	0.00	0.10	n
closed mixedwood	1898	9.77	3	17	0.02	0.13	-0.01	0.05	a
closed mixed coniferous	719	3.86	1	7	0.01	0.05	-0.01	0.03	a
open and closed fen	481	2.44	0	4	0.00	0.03			*
open and closed black spruce bog	3578	19.08	25	33	0.19	0.24	0.09	0.28	n
wetland shrub complex	727	3.63	44	6	0.33	0.05	0.21	0.45	p
disturbed	74	0.44	0	1	0.00	0.01			*
riparian shrub dominant	1781	9.19	2	16	0.01	0.12	-0.01	0.04	a
open aspen	1260	7.13	17	12	0.13	0.09	0.05	0.21	n
closed aspen	2544	13.80	28	24	0.21	0.18			n
Total	**14719**	**78.01**	**133**	**133**	**1**	**1**			

a= avoided
n = neutral
p = preferred
* = not applicable

chi square =	266.73
df =	11
P	<0.01

4.1.4 Selection of Landform Types by Wildlife

The three terrain types within the Study Area (riparian, escarpment and upland) were sampled 12.67, 3.08 and 62.99 km, respectively (Table 9). The short distance sampled in the escarpment type was because the Muskeg River did not have a discernible escarpment, and that the escarpment for Jackpine Creek was relatively small.

Riparian and escarpment landforms were preferred by snowshoe hares and red squirrels (Table 10). Both species tended to avoid upland landforms relative to riparian and escarpment ones.

Weasels were found to prefer riparian areas but avoid uplands, while martens and fishers were found to avoid upland types.

Fewer moose tracks than expected were encountered in upland areas. Moose tracks were observed more often than expected in riparian and escarpment landforms, but these differences were not significant.

Grouse were found to have no landform preference.

Overall results indicate the importance of riparian and escarpment areas along the Muskeg River and Jackpine Creek to snowshoe hares and red squirrels.

4.2 Owl Surveys

Owl surveys were conducted during the evenings of 31 March-3 April 1997. Thirty-four census stations were visited (Figure 3). Although the surveys were conducted within the suggested period for such work, spring weather conditions at the time of the survey were not ideal. Spring snowstorms with snow, blowing snow and high winds were common during the survey period.

Table 9 Wildlife Track Intercepts (tracks per km-day) Summarized by Landform Type

Landform	Km Days Sampled	Snowshoe Hare	Red Squirrel	Mice	Coyote	Marten/ Fisher	Weasel	Mink	Otter	Moose	Grouse
Riparian	12.670	238.07	171.92	1.41	0.99	10.09	27.03	0.41	0.21	3.49	4.84
Escarpment	3.082	50.17	50.83	1.74	0.00	2.21	1.26	0.00	0.00	3.79	3.79
Upland	62.990	231.92	24.79	10.12	0.47	11.75	6.11	0.00	0.00	1.76	24.64

Table 10 Observed Versus Expected Track Intercepts for Landform Type

		Riparian	Escarp.	Upland	Chi Square	P
Km days sampled		12.67	3.08	62.99		
Snowshoe Hare	Observed	238	50	232		
	Expected	84	20	416		
	Chi Square	283	42	81	406.23	<0.01
	Prop(obs)	0.46	0.10	0.45		
	Prop(exp)	0.16	0.04	0.80		
	Lower CI	0.40	0.06	0.39		
	Upper CI	0.52	0.13	0.50		
	Preference	p	p	a		
Red Squirrel	Observed	172	51	25		
	Expected	40	10	198		
	Chi Square	435	171	151	756.01	<0.01
	Prop(obs)	0.69	0.21	0.10		
	Prop(exp)	0.16	0.04	0.80		
	Lower CI	0.62	0.14	0.05		
	Upper CI	0.77	0.27	0.15		
	Preference	p	p	a		
Marten/Fisher	Observed	10	2	12		
	Expected	4	1	19		
	Chi Square	8	1	3	11.62	<0.01
	Prop(obs)	0.42	0.09	0.49		
	Prop(exp)	0.16	0.04	0.80		
	Lower CI	0.15	-0.06	0.22		
	Upper CI	0.69	0.25	0.76		
	Preference	n	n	a		
Weasel	Observed	27	1	6		
	Expected	6	1	28		
	Chi Square	80	0	16	95.64	<0.01
	Prop(obs)	0.79	0.04	0.18		
	Prop(exp)	0.16	0.04	0.80		
	Lower CI	0.60	-0.05	0.01		
	Upper CI	0.97	0.12	0.35		
	Preference	p	n	a		
Moose	Observed	3	4	2		
	Expected	1	0	7		
	Chi Square	2	24	3	29.40	<0.01
	Prop(obs)	0.39	0.42	0.19		
	Prop(exp)	0.16	0.04	0.80		
	Lower CI	-0.04	-0.01	-0.15		
	Upper CI	0.81	0.85	0.54		
	Preference	n	n	a		
Grouse	Observed	5	4	25		
	Expected	5	1	27		
	Chi Square	0.00	3.03	0.08	3.11	>0.10
	Prop(obs)	0.15	0.11	0.74		
	Prop(exp)	0.16	0.04	0.80		
	Preference	n	n	n		

a = avoided
n = neutral
p= preferred
* = not applicable

J:\1997\2221\7100\points2.DWG

Lease 18

Lease 5

Lease 10

Lease 12

Lease 34

Aurora Mine North

Mobil

Lease 36

Lease 7

Lease 24

Lease 13

Lease 6

Lease 90

Lease 30

Lease 31

Lease 49

Aurora Mine South

ATHABASCA RIVER

TAR RIVER

FORT CREEK

STANLEY CREEK

MUSKEG CREEK

MUSKEG RIVER

SHELLEY CREEK

JACKPINE CREEK

KHAHAGO CREEK

JOSLYN CREEK

ELLS RIVER

MACKAY RIVER

FORT McKAY

KEARL LAKE

IYNIMIN CREEK

WESUKAMINA CREEK

BLACKFLY CREEK

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

0 1000 2000 3000 4000 5000(metres)

SCALE 1:100,000

REFERENCE

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

Golder Associates

OWL SURVEY LOCATIONS CONDUCTED WITHIN SHELL LEASE 13 MARCH 31 to APRIL 3, 1997

15 JAN 98	FIG. No. 3	JOB No. 972-2221

5.0 DISCUSSION

Winter track count surveys can provide a reasonable index of the relative abundance and distribution of furbearers (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 can make some species difficult to detect, and/or individuals may be so overdispersed (extremely patchy) that the sampling regime may strongly underestimate abundance. In this study, an attempt was made to carry out surveys under peak snow conditions and sample as much of the study area as logistically possible. However, interpretation of the results must still be weighted with the inherent bias in the abundance index. The unusually thick snow conditions encountered during the track count program may have particularly influenced mammal movements.

Like all animal species, suitable habitat for furbearers and ungulates depends on the environmental factors that influence reproductive and mortality rates. Environmental factors that can limit the abundance and distribution of these animals include quality and quantity of den and resting sites, food resources and cover from predators. However, when discussing the habitat requirements of a particular species, it is important to address the level (i.e., spatial scale) at which environmental factors may limit life history traits. For example, although a weasel may find suitable shelter and food resources within a softwood stand, a fisher may have to travel through several forest stands to obtain enough food. Home range and dispersal distance are two biological parameters that can be used to address the spatial scale of habitat requirements for a given species.

Results of the winter wildlife program indicate that 10 species and/or species groups of furbearers and ungulates frequent the 40 km^2 study area not previously sampled by others. Relative densities and vegetation community use by species was similar to those found by Westworth and Associates (1996).

Results of the analysis of track intercepts by landform type indicate that the riparian and escarpment areas of the Muskeg River and Jackpine Creek are important to ungulates and furbearers. Such areas likely serve as wildlife corridors and are worthy of protection from development to the extent that this is possible. Conservation of these landform types during project development will not only help maintain the ecological integrity of the landbase, but will aid in the colonization of the reclaimed landscape by wildlife following closure.

These conditions limit the range of the song playback tapes for calling owls and hinder the ability to hear or see the responding owls (Smith 1987).

Over the course of the sampling period, seven boreal owls responded to the song playback tapes. Six owls were heard from stations situated in closed mixedwood stands and one from a station in a closed trembling aspen stand. However, the owls that responded were generally from 200-500 m from the census stations. Therefore, the actual vegetation community type of the owls could not be ascertained with certainty.

One great horned owl vocalization was also recorded. The census station for this observation was a mixed coniferous, black spruce dominant and jack pine and trembling aspen co-dominant stand.

Daytime field surveys for owls active during daylight hours produced no results.

No great gray owls were seen or heard during the owl survey period. However, during work in the area two weeks before the owl survey, four great gray owls were observed (Plates 13, 14). Great gray owls are primarily nocturnal, but they hunt in the daylight during the nesting period and during the winter months (Bull and Duncan 1993). Two of the owls were observed in the study area, one near Shelly Creek, and one in the vicinity of Jackpine Creek. The other two great gray owls were observed adjacent to Lease 13. Male owls are known to hunt up to 3.2 km from their nests during the breeding season (Bull and Duncan 1993). In addition, the home range for adult owls may be up to 67.3 km^2 (Bull et al. 1988). These results will be discussed further in the baseline for the EIA.

See Plates 13 and 14 for photos of the recorded great gray owls.

6.0 REFERENCES

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7.0 CLOSURE

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

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APPENDIX I

COMMON AND SCIENTIFIC NAMES OF WILDLIFE RECORDED WITHIN SHELL LEASE 13 STUDY AREA

Table 1 Common and Scientific Names of Wildlife Within the Shell Lease 13 Study Area

Common Name	Scientific Name
Snowshoe hare	*Lepus americanus*
Red squirrel	*Tamiasciurus hudsonicus*
Porcupine	*Erethizon dorsatum*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Marten	*Martes americana*
Fisher	*Martes pennanti*
Ermine	*Mustela erminea*
Least weasel	*Mustela nivalis*
Mink	*Mustela vison*
River otter	*Lutra canadensis*
Canada lynx	*Lynx canadensis*
Black bear	*Ursus americanus*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*Odocoileus virginianus*
Moose	*Alces alces*
Ruffed grouse	*Bonasa umbellus*
Spruce grouse	*Canachites canadensis*
Sharp-tailed grouse	*Pedioecetes phasianellus*
Great gray owl	*Strix nebulosa*
Boreal owl	*Aegolius funereus*
Great horned owl	*Bubo virginianus*

APPENDIX II

SNOW DEPTH MEASUREMENTS

Table 1 Snow Depth Measurements and Snow Hardness in Vegetation Community Types

Habitat Type	Snow Depth (cm)	Snow Hardness
Closed mixedwood	39	Loose/Compacted
Closed mixedwood, white spruce dominant	32	Compacted
Open black spruce bog	78	Loose/Compacted
Close mixedwood	55	Crusted
Closed white spruce	26	Crusted
Closed white spruce	50	Loose/Compacted
Mixed coniferous, balsam fir dominant	28	Crusted
Closed aspen	48	Compacted
Closed aspen	52	Compacted
Closed aspen	53	Compacted
Closed aspen	55	Compacted
Closed white spruce	28	Compacted
Closed white spruce	41	Compacted
Closed white spruce	50	Compacted
Closed aspen	50	Compacted
Riparian shrub dominant	51	Compacted
Riparian shrub dominant	54	Compacted
Riparian shrub dominant	69	Compacted
Riparian shrub dominant	57	Compacted
Closed white spruce	48	Loose
Riparian shrub dominant	65	Loose
Riparian shrub dominant	62	Loose
Closed mixedwood	50	Compacted
Closed white spruce	55	Loose/Compacted
Riparian shrub dominant	53	Loose/Compacted
Closed aspen	47	Loose/Compacted
Open black spruce bog	66	Loose/Compacted
Closed black spruce bog	73	Loose
Closed black spruce bog	58	Loose/Compacted
Closed mixedwood	41	Compacted
Closed mixedwood	51	Compacted
Closed mixedwood	50	Compacted
Closed aspen	62	Compacted
Riparian shrub dominant	56	Compacted
Riparian shrub dominant	30	Compacted
Riparian shrub dominant	48	Compacted

Habitat Type	Snow Depth (cm)	Snow Hardness
Riparian shrub dominant	59	Compacted
Closed mixedwood	61	Compacted
Closed mixedwood	57	Compacted
Open tamarack fen	68	Compacted
Open tamarack fen	64	Compacted
Closed mixedwood, white spruce dominant	51	Compacted
Open aspen	67	Compacted
Open aspen	67	Compacted
Closed black spruce bog	58	Compacted
Closed jack pine	48	Loose
Closed jack pine	49	Loose
Closed jack pine	53	Compacted
Closed jack pine	65	Compacted
Closed deciduous	61	Loose
Closed white spruce	55	Compacted
Open aspen	57	Compacted
Open black spruce bog	70	Compacted
Open black spruce bog	70	Compacted
Open black spruce bog	66	Compacted
Open black spruce bog	65	Compacted
Open black spruce bog	64	Compacted
Open black spruce bog	77	Compacted
Open black spruce bog	64	Compacted
Open tamarack fen	60	Compacted
Closed mixedwood	59	Compacted
Closed white spruce	32	Compacted
Closed white spruce	52	Compacted
Closed aspen	58	Compacted
Closed jack pine	53	Compacted
Closed jack pine	45	Compacted
Closed aspen	61	Compacted
Closed aspen	57	Compacted
Closed aspen	59	Compacted
Open aspen	59	Compacted
Closed aspen	48	Compacted
Closed aspen	53	Compacted
Closed aspen	49	Compacted
Closed aspen	57	Compacted
Open aspen	63	Loose/Compacted
Closed aspen	58	Loose

Habitat Type	Snow Depth (cm)	Snow Hardness
Closed black spruce bog	47	Compacted
Closed mixed coniferous, black spruce dominant	70	Loose
Closed mixedwood	58	Crusted
Closed mixed coniferous, black spruce dominant	77	Crusted
Closed mixedwood	55	Compacted

APPENDIX III

PLATES

Photographs

Plate 1 Closed Jack Pine Forest Cover Type

Plate 2 Closed White Spruce Forest Cover Type

Photographs

Plate 3 Closed Mixedwood Forest Cover Type

Plate 4 Open Black Spruce Bog Forest Cover Type

Photographs

Plate 5 Riparian Shrub Dominant Cover Type

Plate 6 Closed Trembling Aspen Forest Cover Type

Plate 7 Snowshoe hare tracks in a riparian shrub dominant habitat type

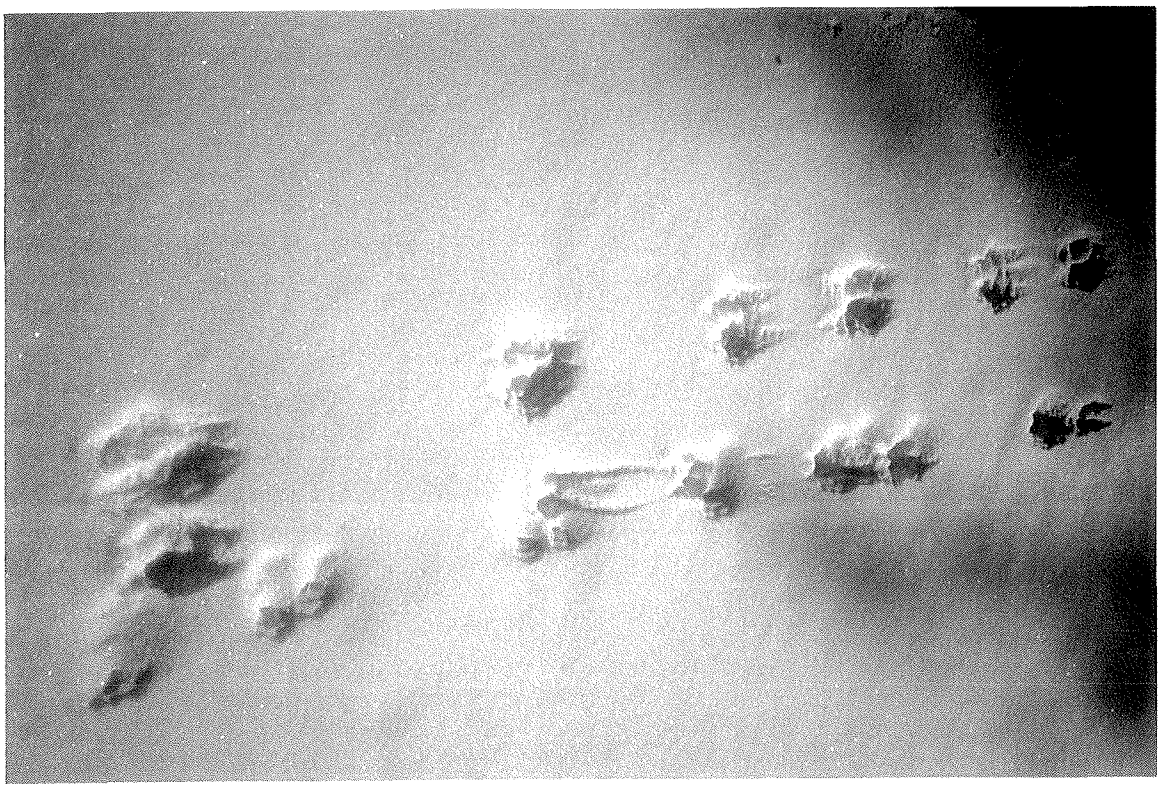

Plate 8 Two red squirrel tracks within a mixedwood forest cover type

Plate 9 River otter tracks along the Muskeg River (riparian shrub dominant habitat type)

Plate 10 Moose tracks and pellets within the riparian shrub dominant habitat (Muskeg River)

Photographs

Plate 11 Spruce grouse perched in a jack pine tree within a mixedwood forest cover type

Plate 12 Several grouse tracks crisscross each other within an open trembling aspen forest cover type

Plate 13 · Great Gray Owl perched in a closed trembling aspen forest cover type near Shelly Creek

Plate 14 Great Gray Owl hunting along the road side of Hwy 63 adjacent to Lease 13