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RELATIONSHIPS BETWEEN HABITATS, FORAGES AND CARRYING CAPACITY OF MOOSE RANGE IN NORTHERN ALBERTA

PART I: MOOSE PREFERENCES FOR HABITAT AND STRATA AND FORAGES

by

R.A. Nowlin
ALBERTA RECREATION, PARKS AND WILDLIFE
FISH AND WILDLIFE DIVISION

for

ALBERTA OIL SANDS ENVIRONMENTAL
RESEARCH PROGRAM

Project TF 1.2

July 1978

The Hon. D.J. Russell
Minister of the Environment
Legislative Building
Edmonton, Alberta

and

The Hon. L. Marchand
Minister of State for the Environment
Fisheries and Environment Canada
Ottawa, Ontario

Sirs:

Enclosed is the report "Relationships Between Habitats, Forages, and Carrying Capacity of Moose Range in Northern Alberta. Part I: Moose Preferences for Habitat Strata and Forages."

This report was prepared for the Alberta Oil Sands Environmental Research Program, through its Terrestrial Fauna Technical Research Committee (now part of the Land System) under the Canada-Alberta Agreement of February 1975 (amended September 1977).

Respectfully,

W. Solodzuk, P.Eng.
Chairman, Steering Committee, AOSERP
Deputy Minister, Alberta Environment

A.H. Macpherson, Ph.D.
Member, Steering Committee, AOSERP
Regional Director-General
Environmental Management Service
Fisheries and Environment Canada

RELATIONSHIPS BETWEEN HABITATS, FORAGES, AND CARRYING CAPACITY OF MOOSE RANGE IN NORTHERN ALBERTA. PART I: MOOSE PREFERENCES FOR HABITAT STRATA AND FORAGES

DESCRIPTIVE SUMMARY

ABSTRACT

Relationships between moose (*Alces alces andersoni*) and the habitat strata and forages available to them in northern Alberta were studied within the Alberta Oil Sands Environmental Research Program (AOSERP) study area during fall (September through November 1976) and winter (December 1976 through March 1977). Radio telemetry was employed to delineate seasonal use, and preference and avoidance of both habitat strata and forages. Specific categories of use of habitats were also identified and evaluated. These included feeding, bedding, non-feeding-bedding, and "presence only". In addition, environmental variables affecting habitat use were variously identified and measured. Both physical and vegetation variables were considered. The habitat use data indictated that upland habitat strata were most heavily utilized and were preferred ($p<0.01$), while lowlands were least utilized and were avoided ($p<0.01$), during both fall and winter, for all categories of habitat use except non-feeding-bedding. Individual upland and lowland habitats were variously important. During the fall, the aspen (*Populus tremuloides*) habitat stratum and aspen mixed with either white spruce (*Picea glauca*) or jack pine (*Pinus banksiana*) were heavily utilized for all categories of use. Only the mixedwood habitats were variously preferred. And, in the "presence only" category of use, black spruce (*Picea mariana*) and black spruce-tamarack (*Larix laricina*) were lightly used and were avoided ($p<0.01$). During the winter, aspen and aspen-white spruce were heavily utilized and were preferred ($p<0.01$) for all categories of use except non-feeding-bedding. Only aspen-white spruce was preferred ($p<0.10$) for this latter category. During

both fall and winter, saskatoon (*Amelanchier alnifolia*) was clearly the most heavily utilized species of browse, and it appeared to be the only species that was preferred. Recommendations relevant to impact assessment and rehabilitiation within the AOSERP study area were made. Both the discussion of results and the recommendations were qualified because of inadequate sample sizes overall, and unusually mild weather conditions during the winter.

BACKGROUND AND PERSPECTIVE

This project was commissioned on behalf of the Alberta Oil Sands Environmental Research Program through the former Terrestrial Fauna Technical Research Committee (now part of the Land System). The study commenced in November 1975 with the general objectives of delineating seasonal food habitats of moose and relating utilization of habitat strata and forage species to their availability. The project is part of a broad investigation of moose ecology intended to gain a thorough understanding of the existing status of the species and of the moose-vegetation-landform interactions in the area. This knowledge will be useful in the assessment of the impact of oil sands development on moose, and in planning reclamation of mined areas.

ASSESSMENT

The Alberta Oil Sands Environmental Research Program has reviewed and accepted the report on "Relationships Between Habitats, Forages, and Carrying Capacity of Moose Range in the AOSERP Study Area" which was prepared by R.A. Nowlin.

The final report contains a large amount of data and has drawn some preliminary conclusions on the relationships of moose to habitat and forages. In association with reports on moose population dynamics from TF 1.1 (LS 21.1) it helps present a picture of the baseline status of moose in the AOSERP study area.

The content of this report does not necessarily reflect the views of Alberta Environment, Fisheries and Environment Canada, or the Oil Sands Environmental Study Group. The mention of trade names for commercial products does not constitute an endorsement or recommendation for use.

R.A. Hursey, Ph.D.
Research Manager
Land System

S.B. Smith, Ph.D.
Director
Alberta Oil Sands Environmental Research Program

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Relationships between moose (*Alces alces andersoni*) and the habitat strata and forages available to them in northern Alberta were studied within the Alberta Oil Sands Environmental Research Program (AOSERP) study area during fall (September through November 1976) and winter (December 1976 through March 1977). Radio telemetry was employed to delineate seasonal use, and preference and avoidance of both habitat strata and forages. Specific categories of use of the habitats were also identified and evaluated. These included feeding, bedding, non-feeding-bedding, and "presence only". In addition, environmental variables affecting habitat use were variously identified and measured. Both physical and vegetative variables were considered. The habitat use data indicated that upland habitat strata were most heavily utilized and were preferred ($p<0.01$), while lowlands were least utilized and were avoided ($p<0.01$), during both fall and winter, for all categories of habitat use except non-feeding-bedding. Individual upland and lowland habitats were variously important. During the fall, the aspen (*Populus tremuloides*) habitat stratum and aspen mixed with either white spruce (*Picea glauca*) or jack pine (*Pinus banksiana*) were heavily utilized for all categories of use. Only the mixedwood habitats were variously preferred. And, in the "presence only" category of use, black spruce (*Picea mariana*) and black spruce-tamarack (*Larix laricina*) were lightly used and were avoided ($p<0.01$). During the winter, aspen and aspen-white spruce were heavily utilized and were preferred ($p<0.01$) for all categories of use except non-feeding-bedding. Only aspen-white spruce was preferred ($p<0.10$) for this latter category. During both fall and winter, saskatoon (*Amelanchier alnifolia*) was clearly the most heavily utilized species of browse, and it appeared to be the only species that was preferred. Recommendations relevant to impact assessment and rehabilitation within the AOSERP study area were made. Both the discussion of results and the recommendations were qualified because of inadequate sample sizes overall, and unusually mild weather conditions during the winter.

ACKNOWLEDGEMENTS

This research project TF 1.2 was funded by the Alberta Oil Sands Environmental Research Program, a joint Alberta-Canada research program established to fund, direct, and co-ordinate environmental research in the Athabasca Oil Sands area of north-eastern Alberta.

I thank Alberta Recreation, Parks and Wildlife, Fish and Wildlife Division, for providing clerical help and supervision for this project. The supervision of Mr. Bill Wishart, Dr. Barrie Gilbert, and Mr. Gerry Lynch was invaluable.

Special thanks go to Mr. Ed Telfer, Canadian Wildlife Service and Dr. Bob Hudson, University of Alberta, who unselfishly gave their time and expertise for improvement of this research.

I also thank Mr. Dirk Hadler and Mrs. Carol Boyle, of the AOSERP field staff, for providing logistical support which was above and beyond the call of duty.

1. INTRODUCTION

The Alberta Oil Sands Environmental Research Program (AOSERP) is committed to determining methods of ensuring an acceptable environment for terrestrial fauna during and after mining of the Athabasca Oil Sands. To satisfy this commitment for moose (*Alces alces andersoni*), detailed, year-round information about the habitat requirements of this ungulate is essential.

Some information is available from Alberta. Allison (1972), Carins (1976), Nowlin (1976), Penner (1971, 1976), and Holsworth (1958) variously considered habitat utilization and/or food habits using radio telemetry, pellet counts, observations, and browse transects. Barrett (1972) described food habits in the Cypress Hills by analysis of rumen samples. However, none of these studies provided the detail required by AOSERP.

Data collected for this project was begun in September 1976. At least two years of field work were planned to achieve the following objectives:

1. Delineate seasonal use of habitat strata;
2. Identify environmental variables affecting habitat use and evaluate the importance of each;
3. Delineate seasonal use of forages; and
4. Relate utilization of habitats and forages to their availability in order to quantify preference and avoidance.

Unfortunately, it was impossible to achieve the objectives because funding was not available to continue this research beyond one year. However, significant progress was made and those results are presented in this report.

2. PROJECT STUDY AREA

The project study area encompassed approximately 220 km^2 within the AOSERP study area (Figures 1 and 2). It was bounded roughly by the Athabasca River on the west, the Muskeg River on the east and south, and the 25th baseline on the north.

Density of moose in the area was low. A helicopter census in 1976 by Jacobson (1978) estimated 0.22 moose per square kilometre.

The study area lies within the mixedwood section of the boreal forest region of Canada (Rowe 1972).

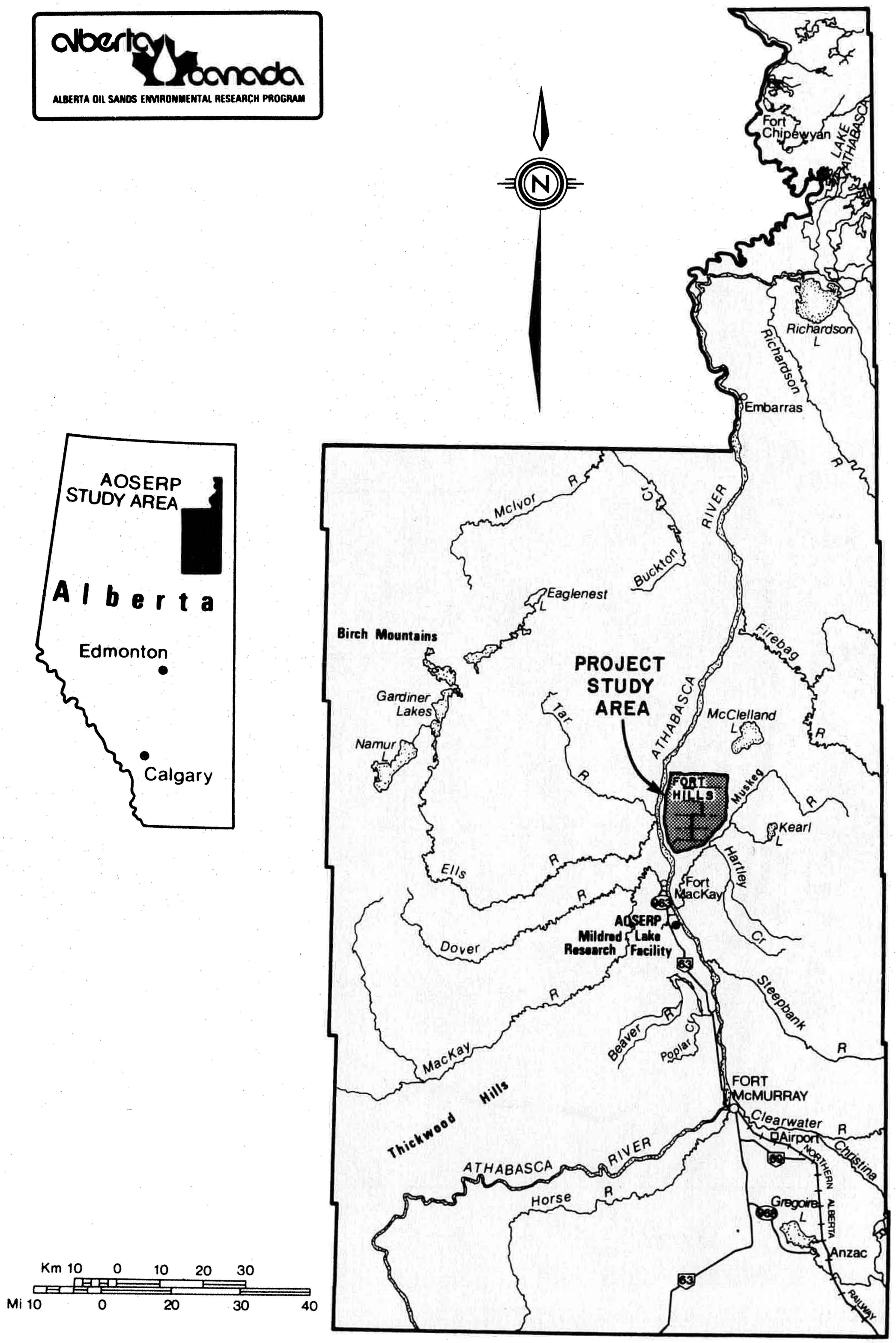


Figure 1. Location of the AOSERP and project study areas.

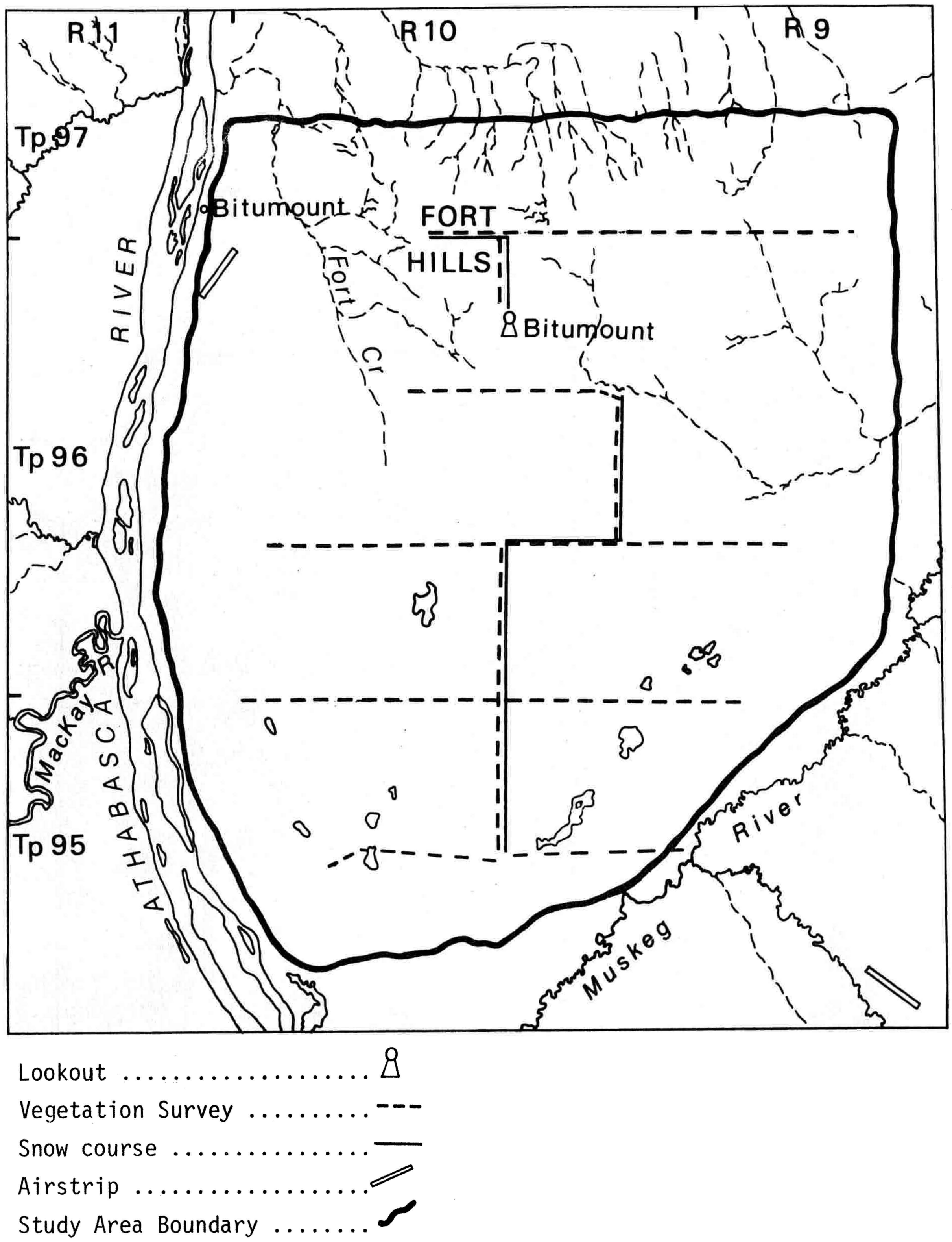


Figure 2. Location of vegetation survey lines and snow course within the project study area.

3. METHODS

3.1 HABITAT STRATIFICATION

Habitat strata were subjectively identified using Stringer's (1976) report as a basis. They were also subjectively grouped into lowland and upland categories based upon relative soil moisture. Uplands were well-drained, and lowlands were poorly-drained.

All forested habitats were classified according to dominant overstory species. In pure stands of one tree species, that species composed at least 90 percent of the overstory. In mixed stands, no single tree species composed more than 89 percent of the overstory, and the stand was identified by the two most dominant species of trees that were present.

A systematic survey was conducted to determine the availability of each habitat (Figure 2). The habitat stratum at 231 sampling points along seismograph lines was identified, and percent occurrence was calculated.

3.2 MOOSE RELOCATIONS

Radiotelemetry was used to relocate the moose. The animals were collared with radio transmitters by the Moose, Caribou, Wolf Ecology (TF 1.1) researchers (Hauge and Keith in prep.). Tracking was begun on 1 September 1976, and continued through 4 March 1977.

Relocations of instrumented animals were determined on an opportunistic basis by ground triangulation of radio signals from known points. Once a relocation was determined, additional fixes were attempted at hourly intervals during daylight for a period of not more than three days.

The geographical position of each relocation was recorded as X-Y co-ordinates read from grids overlaying aerial photos in a manner similar to that described by Phillips et al. (1973). The position was also marked with nylon flagging and/or timber marking paint.

Results were grouped into two time periods, fall (September through November) and winter (December through March).

3.3 HABITAT UTILIZATION

Most observations of use of habitat strata were determined by recording the habitat(s) utilized within a macroplot of approximately 30 m radius, whose centre was defined by the radio relocation of a moose (Figure 3). Use was defined as the presence of fresh tracks within the macroplot.

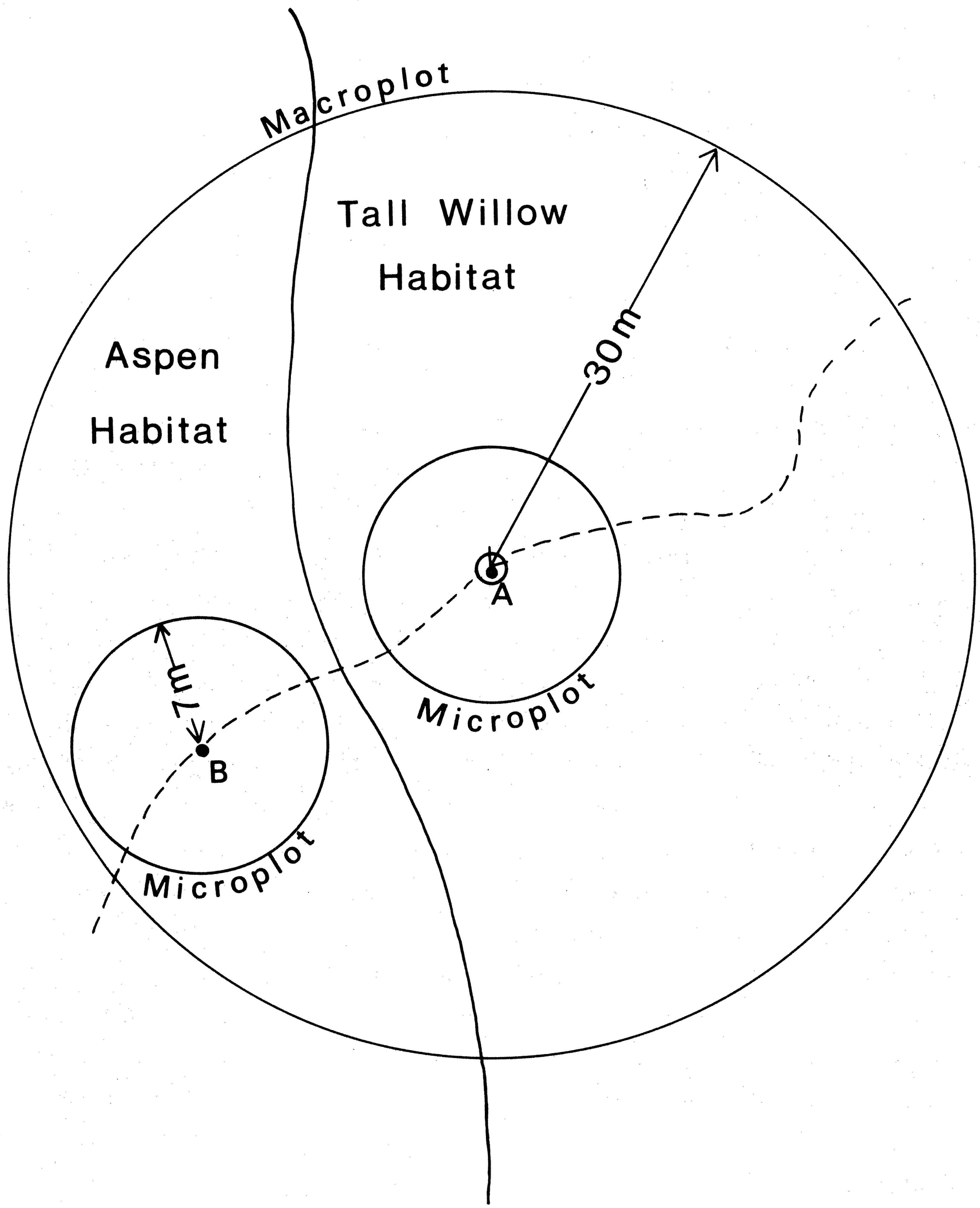
Sometimes, no fresh tracks were found at the radio relocation. In this event, the point closest to the relocation, within a circle of 60 m radius, where fresh tracks were found was used to define the centre of the macroplot. If there was a total absence of tracks, the relocation was discarded.

If more than one habitat was utilized within the macroplot, then two types of observations were recorded (Figure 3). Use of the habitat in which the relocation fell was designated as a primary observation. Use of any other habitat(s) was designated as a secondary observation(s). For present purposes, these two types of observations have been combined.

Radio relocations occurred several times at the same geographical position when the animals did not move from hour to hour. In this case, data collected at the primary observation point were duplicated according to the number of relocations. Data collected at secondary observation points were not duplicated.

Specific categories of use of each habitat were also recorded, depending upon the evidence found within the macroplot. Discernible categories were feeding, bedding, rutting, non-feeding-bedding, and "presence only". The first three categories were not mutually exclusive. Non-feeding-bedding was simply the absence of feeding or bedding. "Presence only" was presence in a given habitat regardless of, and not mutually exclusive of, the other categories.

Some radio relocations were not visited for verification and categorization of habitat use, and, occasionally, moose without collars were sighted. These observations were included in the "presence only" category.



Radio Relocation of a Moose .... ⊙

Primary Observation .... A

Secondary Observation .... B

Fresh Moose Tracks .... - - -

Figure 3. Macroplot and microplot sampling scheme at radio relocations of moose.

3.4 ENVIRONMENTAL VARIABLES

One of the original objectives of this project was to identify environmental variables affecting habitat use and evaluate the importance of each. In order to accomplish this objective, two sets of data were to be developed and compared, statistically. One data set was to consist of variables measured within the macroplots, and the other was to consist of these same variables measured systematically over the entire study area. Both physical and vegetative environmental variables were to be considered.

Measurements of the variables within macroplots was done only during December through February. The measurements were not fully initiated prior to December because manpower was not available. They were terminated in February because of the impending termination of the project.

Environmental measurements within macroplots were completed within circular microplots with a radius of 7 m (Figure 3). The primary and secondary observation(s) of habitat use defined the centres of the microplots.

Measurements of the variables systematically over the study area were not fully initiated. Depth and density of snow were the only ones considered.

Because of the small amount of data collected, only selected results are presented in the body of this report. The bulk of the data is tabularized in the Appendix. The methods of data collection are explained below.

3.4.1 Physical Variables Measured as Microplots

Slope, aspect, position on a slope, minor topographic undulations, and snow depth were the physical variables measured at each microplot.

Slope was measured in percent with a Suunto clinometer (PM-5/360 PC).

Aspect was measured in degrees using a Silva Ranger compass.

Position on a slope was subjectively assessed to be within one of the following categories: top of a ridge, upper one-third of a slope, middle one-third of a slope, lower one-third of a slope, or bottom of a valley.

Minor topographic undulations were subjectively rated according to the amount of relief. The assigned categories were: $\pm$ 0.00 to 0.50 m, $\pm$ 0.51 to 1.50 m, and $\pm$ 1.51 to 3.00 m.

Snow depth was measured (to the nearest centimetre) at the centre of the microplot with a hand-held tape measure.

3.4.2 Vegetation Variables Measured at Microplots

Canopy closure, heights and densities of trees, and browse species were the vegetation variables measured.

Canopy closure was measured as a percent using a spherical densiometer (Lemmon 1957).

Heights of trees and browse were measured to the nearest foot with a Suunto clinometer or tape measure. Final results were converted to metres.

Densities of trees and browse were determined using the corrected-point-distance method of Laycock and Batcheler (1975), with the following modifications for browse.

Density of clumps of browse, regardless of species, was first determined. This was accomplished by measuring two distances at each microplot: from the centre of the microplot to the nearest clump of browse, and from that clump to its nearest neighbour. A clump is defined as one stem growing from one base, or several stems growing from a common base. During the measurements, the number of stems per clump of each species of browse was noted.

Next, densities of clumps of individual species of browse were determined. This was accomplished by multiplying the density of clumps of browse, regardless of species, by the percent occurrence of individual species in the distance measurements.

Finally, densities of stems of individual species were determined by multiplying the densities of clumps of individual species by their mean clump size. Only browse plants greater than

0.61 m high and less than 3.8 cm in diameter at breast height were measured for densities.

3.4.3 Snow Depths Measured Systematically Over the Study Area

A snow course was established systematically over the study area (Figure 2), with 68 measurement points marked at approximately 0.211 km intervals. Habitat strata was recorded at each point.

During January and February 1977, snow depth was measured twice per month, and density was measured once per month. A Mount Rose snow sampler was used.

Results were summarized as means for each habitat stratum for the winter.

3.5 FORAGE UTILIZATION

Feeding sites were examined within the macroplots in order to determine forage use. If feeding was found in more than one habitat type within any one macroplot, then separate feeding sites were examined in each type.

The methods of Cole (1956) and Knowlton (1960) were used to record instances of use of individual plants. An instance of use was each browsed twig, or twig from which leaves had been stripped. Approximately 200 instances of use was the upper limit at each site. Percentage of use for each species was calculated using the average aggregate percent method of Martin et al. (1946).

Willows were identified according to Raup (1959), and other plants according to Moss (1959).

A key to identification of willow twigs during winter was developed. This was accomplished by tagging individuals of each species during the growing season. Following leaf abscission, twig collections were made from the marked individuals and a key was developed, based on vegetative characteristics.

3.6 PREFERENCE AND AVOIDANCE OF HABITATS AND FORAGES

The methods of Neu et al. (1974) were employed to determine preference and avoidance of habitat strata. This involved testing the hypothesis that each habitat was utilized in proportion to its availability. If this hypothesis was accepted, the habitat was neither preferred nor avoided. If the hypothesis was rejected, then a habitat used in greater proportion than it was available was preferred, and a habitat used proportionately less than it was available was avoided.

The relatively few feeding sites that were examined and heavy use of only two or three forages precluded an analysis of preference and avoidance of forages. However, some trends were evident upon visual examination of the data.

4. RESULTS

4.1 HABITAT STRATIFICATION

The percent availability of each habitat stratum determined by the systematic survey is presented in Table 1.

4.1.1 Lowland Habitats

Lowland habitats accounted for 49.1 percent of all habitats available. The following individual lowland strata were identified.

4.1.1.1 Fen. Fens were scarce (less than one percent of all habitats available), and were found in very moist or shallow water areas bordering lakes or drainage channels. Sedges (*Carex* spp.) were the dominant plant species.

4.1.1.2 Tall willow. The tall willow habitat was also relatively scarce (5.2%). Found along drainage channels and in other wet areas, this habitat was composed of willows (*Salix* spp.) that were mostly over 3 m tall. The dominant species were pussy willow (*Salix discolor*), *S. maccalliana*, *S. myrtillifolia*, *S. planifolia*, autumn willow (*S. serrissima*), and sandbar willow (*S. interior*).

4.1.1.3 Black spruce. This habitat was common (15.2%), and was characterized by dense stands of black spruce (*Picea mariana*). It developed on thick deposits of sphagnum moss (*Sphagnum* spp.), and the understory was dominated by Labrador tea (*Ledum groenlandicum*).

4.1.1.4 Tamarack. This habitat consisted of lightly forested stands of tamarack (*Larix laricina*) and represented 9.5 percent of the habitats that were available. Dominant shrub in the understory were *S. planifolia*, dwarf birch (*Betula glandulosa*) and Labrador tea.

Table 1. Habitat strata present on the study area and their percent of total habitats available.

Habitat Strata	Percent of Total Habitats Available
Lowland	
Fen	Tr[a]
Tall Willow	5.2
Black Spruce	15.2
Tamarack	9.5
Black Spruce-Tamarack	15.2
Other Mixedwood and Deciduous[b]	4.0
Lowland Total	49.1
Upland	
Aspen	17.6
Jack Pine	9.5
Aspen-White Spruce	10.4
Aspen-Jack Pine	7.4
Upland Shrub	1.3
Other Mixedwood, Deciduous and Coniferous[c]	4.7
Upland Total	50.9

[a]Trace. Less than one percent.

[b]Includes Balsam Poplar (Tr), Aspen-Black Spruce (1.7), and Balsam Poplar-Black Spruce (1.7).

[c]Includes Aspen-Balsam Poplar (Tr), Aspen-Paper Birch (1.3), Paper Birch-Jack Pine (Tr), White Spruce (Tr), and White Spruce-Jack Pine (Tr).

4.1.1.5 Black spruce-tamarack. Semi-open, mixed stands of black spruce and tamarack characterized this common habitat (15.2%). Labrador tea, *S. planifolia*, and swamp birch (*Betula pumila*) were often found in the understory.

4.1.1.6 Other mixedwood and deciduous. Other lowland habitats present in minor amounts were balsam poplar (*Populus balsamifera*), aspen (*Populus tremuloides*)-black spruce and balsam poplar-black spruce. The balsam poplar habitat was most common in the flood plains of major rivers.

4.1.2 Upland Habitats

Upland habitats accounted for 50.9 percent of all habitats. The following individual strata were identified.

4.1.2.1 Aspen. The aspen habitat was common (17.6%), and was characterized by pure stands of aspen. Shrubs commonly present in the understory included beaked willow (*Salix bebbiana*), saskatoon (*Amelanchier alnifolia*), prickly rose (*Rosa acicularis*), wild rose (*Rosa woodsii*), and buffalo-berry (*Shepherdia canadensis*).

4.1.2.2 Jack pine. This habitat was found on the very dry, sandy, uplands and represented 9.5 percent of the total habitats that were available. It was characterized by pure stands of jack pine (*Pinus banksiana*), with blueberry (*Vaccinium myrtilloides*) as the dominant understory.

4.1.2.3 Aspen-white spruce. The aspen-white spruce (*Picea glauca*) habitat was characterized by mixed stands of these species of trees and composed 10.4 percent of the available habitats. Shrubs commonly present included current (*Ribes triste*), prickly rose, low bush cranberry (*Viburnum edule*), and saskatoon.

4.1.2.4 Aspen-jack pine. This habitat, characterized by mixed stands of aspen and jack pine, composed 7.4 percent of all habitats. Common shrubs were river alder (*Alnus tenuifolia*), prickly rose, wild rose, and saskatoon.

4.1.2.5 Upland shrub. The upland shrub habitat was scarce (1.3%) and was found on recently disturbed areas, other than seismograph lines, where the forest overstory had been removed. Saplings in this habitat had a diameter at breast height of less than 3.8 cm. Shrubs commonly present included prickly rose, wild rose, and saskatoon.

4.1.2.6 Other deciduous, mixedwood, and coniferous. Other upland habitats present in minor amounts were aspen-balsam poplar, aspen-paper birch (*Betula papyrifera*), paper birch-jack pine, white spruce, and white spruce-jack pine.

4.2 MOOSE RELOCATIONS

During the fall, six mature moose (four females and two males) were relocated 95 times (Table 2). At these relocations, 117 observations of habitat use were recorded, of which 108 were verified by the presence of fresh tracks, and nine were not verified. Also, three visual observations of uncollared animals were made.

During the winter, 10 mature moose (seven females and three males) were relocated a total of 116 times. At these relocations, 140 observations of habitat use were recorded, four of which were not verified.

4.3 HABITAT UTILIZATION

4.3.1 Habitat Utilization During Fall

Observations of habitat use during the fall are presented in Table 3. The number of observations of feeding, bedding, non-feeding-bedding, and "presence only" were 35, 46, 58, and 120, respectively.

Table 2. Sex, age, and number of relocations of telemetered moose.

Moose			Number of Relocations	
No.	Sex	Age[a]	Fall	Winter
17	M	-[b]	0	12
40	M	-	0	12
47	F	-	0	7
75	M	5.5	11	0
79	F	3.5	0	1
81	F	9.5	0	27
83	M	5.5	0	22
85	F	8.5	12	5
87	F	6.5	26	10
88	F	3.5	0	15
89	M	10.5	14	0
90	F	6.5	11	0
96	F	8.5	21	5
TOTAL			95	116

[a]Supplied by the Ungulate Ecology project of AOSERP (TF 1.1).

[b]Not presently available.

Table 3. Percent habitat utilization according to categories of use during fall and winter.

Habitat Stratum	Category of Use: Feeding		Bedding		Non-Feeding-Bedding		Presence Only	
	Fall	Winter	Fall	Winter	Fall	Winter	Fall	Winter
Lowland								
Fen	-	-	-	-	6.9	-	4.2	-
Tall willow	2.9	6.0	-	2.3	-	2.2	Tr[a]	4.3
Black spruce	2.9	3.6	-	2.3	6.9	17.4	5.8	9.3
Tamarack	-	-	10.9	-	12.1	-	8.3	-
Black spruce-tamarack	2.9	10.7	-	9.3	3.4	21.2	2.5	15.0
Balsam poplar	-	-	-	-	-	2.2	-	Tr
Aspen-black spruce	-	-	-	-	-	8.7	-	2.9
Paper birch-black spruce	-	-	-	-	-	2.2	-	Tr
Lowland Total	8.7	20.3	10.9	13.9	29.3	53.9	20.8	31.5
Upland								
Aspen	31.4	46.4	32.6	25.5	20.7	8.7	24.2	30.7
Jack pine	-	-	2.2	-	15.5	-	9.2	-
Aspen-balsam poplar	-	4.8	-	13.9	-	-	-	3.6
Aspen-paper birch	-	-	-	-	-	-	Tr	-
Aspen-white spruce	28.6	26.2	28.3	46.5	12.1	27.6	16.7	27.1
Aspen-jack pine	22.9	2.4	22.7	-	20.7	2.2	23.3	2.1
Paper birch-jack pine	5.7	-	-	-	3.4	-	2.5	-
White spruce-jack pine	-	-	-	-	-	8.7	-	2.9
Upland shrub	2.9	-	4.3	-	-	-	1.7	Tr
Upland Total	91.5	79.8	90.1	85.9	72.4	47.2	77.6	66.4
Sample Size	35	84	46	43	58	47	120	140

[a]Trace; less than one percent.

Uplands were much more heavily utilized for all categories of habitat use than were lowlands. This difference was greatest for the feeding and bedding categories.

For feeding, uplands accounted for 91.5 percent of the observations, while lowlands accounted for 8.7 percent. For bedding, use of uplands was 90.1 percent, with lowlands being 10.9 percent. For non-feeding-bedding, uplands were 72.4 percent, while lowlands were 29.3 percent. When use was categorized as "presence only", uplands were 77.6 percent and lowlands were 20.8 percent.

Utilization of individual habitat strata was variable.

The aspen habitat was most heavily used for feeding, accounting for 31.4 percent of the observations. It was followed by aspen-white spruce (28.6%) and aspen-jack pine (22.9%). Also lightly used were the paper birch-jack pine habitat with 5.7 percent, and tall willow, black spruce, black spruce-tamarack, and upland shrub habitats with 2.9 percent each.

Aspen was also most heavily utilized for bedding, with 32.6 percent of the observations. Aspen-white spruce and aspen-jack pine were next with 28.3 and 22.7 percent, respectively. They were followed by tamarack (10.9%), upland shrub (4.3%), and jack pine (2.2%).

For non-feeding-bedding, the aspen and aspen-jack pine were most important, both with 20.7 percent of the observations. Also used were jack pine (15.5%), tamarack (12.1%), aspen-white spruce (12.1%), black spruce (6.9%), fen (6.9%), and paper birch-jack pine (3.4%).

When utilization was defined as "presence only", aspen was most important, with 24.2 percent. It was closely followed by aspen-jack pine, 23.3 percent. Also used were aspen-white spruce (16.7%), jack pine (9.2%), tamarack (8.3%), black spruce (5.8%), fen (4.2%), black spruce-tamarack (2.5%), paper birch-jack pine (2.5%), upland shrub (1.7%), tall willow (<1%), and aspen-paper birch (<1%).

Observations of rutting behavior are not presented in Table 3 because only 11 observations were recorded. Of these, nine were in aspen, and one each were in black spruce and aspen-jack pine.

4.3.2 Habitat Utilization During Winter

The number of observations of habitat use during the winter for feeding, bedding, non-feeding-bedding, and "presence only" were 84, 43, 47, and 140, respectively (Table 3).

Uplands were more heavily utilized than lowlands for all categories of use except non-feeding-bedding. In this category lowlands were used slightly more than uplands.

For feeding, uplands accounted for 79.8 percent of the observations, while lowlands accounted for 20.3 percent. For bedding, use of uplands was 85.9 percent, with lowlands being 13.9 percent. For non-feeding-bedding, uplands were 47.2 percent, while lowlands were 53.9 percent. For "presence only", uplands were 66.4 percent and lowlands were 31.5 percent.

Observations of use of individual habitats were variable.

Aspen was the most important habitat for feeding with 46.4 percent. It was followed by aspen-white spruce (26.2%), black spruce-tamarack (10.7%), tall willow (6.0%), aspen-balsam poplar (4.8%), black spruce (3.6%), and aspen-jack pine (2.4%).

Aspen-white spruce was most heavily utilized for bedding, accounting for 46.5 percent of the observations. Aspen, with 25.5 percent, was second, and was followed by aspen-balsam poplar (13.9%), black spruce-tamarack (9.3%), tall willow (2.3%), and black spruce (2.3%).

For non-feeding-bedding, aspen-white spruce was most important, with 27.6 percent. It was followed by black spruce-tamarack (21.2%), and black spruce (17.4%). Next were aspen-black spruce, aspen, and white spruce-jack pine, all with 8.7 percent. Least important were tall willow, balsam poplar, paper birch-black spruce, and aspen-jack pine, all with 2.2 percent.

For the "presence only" category of use, aspen with 30.7 percent, was the most important habitat. Aspen-white spruce (27.1%) was a close second. These were followed by black-spruce tamarack (15.0%), black spruce (9.3%), tall willow (4.3%), aspen-balsam poplar (3.6%), white spruce-jack pine (2.9%), aspen-black spruce (2.9%), and aspen-jack pine (2.1%). Least important were balsam poplar, paper birch-black spruce, and upland shrub, all used less than one percent.

4.4 ENVIRONMENTAL VARIABLES

Results of snow depth measurements are presented in Table 4. Only those habitats in which at least five measurements were taken are listed.

Examination of microplot data reveals very little difference between habitats. Snow depth was greatest in the tall willow habitat (23 cm) and least in the aspen-white spruce (17 cm).

The snow course measurements that were taken over the entire study area also exhibit little difference between habitats, for either depth or density (Table 4). Depth was greatest in the tamarack (25 cm) and least in the aspen-black spruce habitat (15 cm). Density was greatest in the tall willow (0.21) and least in the jack pine habitat (0.15).

Comparisons between snow depths at microplots and at sampling points on the snow course for individual habitats also reveals little difference.

No detailed analysis was done on snow measurements because of the small differences noted above, and because it is very doubtful that the shallow depths could influence moose movements. Coady (1974) reviewed the influence of snow on behavior of moose and concluded that movements of moose were not hindered until depths reached 40 to 70 cm. However, even at these depths, movement was only slightly restricted.

Table 4. Mean depth of snow at microplots, and mean depth and density of snow at sampling points on the snow course for each habitat stratum.

Habitat Stratum	Microplot Depth (cm)		Snow Course Depth (cm)		Snow Course Density	
	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N
Lowland						
Tall willow	3	5	4	20	0.21	10
Black spruce	19	11	19	29	0.20	13
Tamarack	-[a]	-	25	20	0.17	10
Black spruce-tamarack	21	20	21	20	0.19	10
Aspen-black spruce	-	-	15	14	0.17	6
Upland						
Aspen	9	37	20	55	0.20	25
Jack pine	-	-	18	26	0.15	13
White spruce	-	-	17	20	0.17	10
Aspen-white spruce	17	37	18	26	0.20	13
Aspen-jack pine	-	-	21	23	0.18	11
Upland Shrub	-	-	21	6	-	-

[a]Insufficient data.

Additional environmental information was obtained from Environment Canada, Atmospheric Environment Service, at the Fort McMurray airport (Table 5).

These data reveal that the winter of 1976-77 was extremely mild compared to long term conditions. Temperatures were well above normal for January, February, and March; snow depths were considerably below normal for December through March.

4.5 FORAGE UTILIZATION

During the fall season, 31 feeding sites were examined and 3,321 instances of browse use were recorded (Table 6).

Saskatoon was the most heavily utilized browse species, accounting for 46 percent of the observations. Second in importance was beaked willow with 20 percent. All other species were utilized less than 8 percent each.

During the winter, 46 feeding sites were examined and 5,734 instances of use recorded (Table 6).

Saskatoon was again the most heavily utilized species, with 57 percent of the observations. It was followed by small leaf willow, with 15 percent, and beaked willow with 10 percent. All other species were utilized less than 3 percent each.

4.6 PREFERENCE AND AVOIDANCE OF HABITAT STRATA

Results of the statistical analysis to determine preference and avoidance of habitat strata are presented in Tables 7, 8, and 9.

For the analysis of individual habitat strata, it was sometimes necessary to group certain strata together in order to achieve adequate sample sizes for each. This was required only when the strata were used in small amounts (usually less than 6 percent). Two approaches were employed: lightly used strata were combined with heavily used strata, if similar; or, lightly used strata were combined into an "other" classification, if all were dissimilar.

Table 5. Long-term and 1976-77 meteorological summaries from the Fort McMurray airport for December through March (provided by Environment Canada, Atmospheric Environment Service).

	Dec.	Jan.	Feb.	Mar.
1944-70				
Mean Temp. (°C)	-16.9	-21.5	-16.6	- 9.3
Mean Max. Temp. (°C)	-12.1	-16.0	-10.3	- 2.4
Mean Min. Temp. (°C)	-21.8	-27.0	-23.0	-16.5
1976-77				
Mean Temp. (°C)	-16.8	-18.7	- 3.3	- 5.1
Mean Max. Temp. (°C)	-12.7	-13.2	3.6	1.3
Mean Min. Temp. (°C)	-21.4	-24.1	-10.2	-11.5
1946-72				
Mean Snow Depth (cm)[a]	28	36	38	28
Max. Snow Depth (cm)[a]	58	66	64	53
1977				
Snow Depth (cm)[a]	3	18	12	20

[a]Measured in centimetres on the last day of each month.

Table 6. Utilization of browse species during fall and winter, and availability of browse during winter.

Species	Percent of Available Browse[a]	Percent of Diet[b] Fall	Percent of Diet[b] Winter
Alnus crispa	ND	Tr	2
Amelanchier alnifolia	9	46	57
Betula papyrifera	*	6	0
Betula spp.[c]	10	0	3
Cornus stolonifera	Tr	Tr	0
Corylus cornuta	*	3	1
Populus balsamifera	Tr	0	1
Populus tremuloides	2	7	2
Prunus pensylvanica	*	7	0
Prunus virginiana	*	0	Tr
Rosa woodsii	2	Tr	0
Rubus spp.	ND	2	Tr
Salix bebbiana	19	20	10
Salix discolor	*	3	1
Salix planifolia	30	3	15
Salix maccalliana	Tr	0	1
Salix mackenzieana	*	2	0
Salix myrtillifolia	*	0	3
Salix serissima	Tr	Tr	0
Salix spp.	ND	0	Tr
Shepherdia canadensis	21	0	1
Viburnum edule	3	Tr	3
Number of feeding sites examined		31	46
Total instances of use		3,321	5,734

[a] Symbols: Tr = trace; ND = no data (not measured); * = not encountered.

[b] Average aggregate percent (Martin et al. 1946).

[c] Includes *Betula glandulosa* and *B. pumila*.

Table 7. Preference and avoidance of upland and lowland habitats for different categories of habitat use during fall and winter.

Category	Habitat Stratum[c]	Proportion of total habitat (pi_o)	Number of observations	Expected number of observations[a]	Proportions observed in each habitat ($\overline{pi}$)	Confidence interval on proportions observed (pi)[b]
Feeding						
Fall						
	Lowland	0.491	3	17	0.087	-[d]
	Upland	0.509	32	18	0.915	-
			N=35			
Winter						
	Lowland	0.491	17	41	0.203	$0.080 \le p_1 \le 0.326$
	Upland	0.509	67	43	0.798	$0.675 \le p_2 \le 0.921$
			N=84			
Bedding						
Fall						
	Lowland	0.491	5	23	0.109	$0.000 \le p_1 \le 0.238$
	Upland	0.509	42	23	0.901	$0.777 \le p_2 \le 1.000$
			N=47			
Winter						
	Lowland	0.491	6	21	0.139	$0.000 \le p_1 \le 0.287$
	Upland	0.509	37	22	0.859	$0.710 \le p_2 \le 1.000$
			N=43			
Non-Feeding-Bedding						
Fall						
	Lowland	0.491	17	28	0.293	$0.125 \le p_1 \le 0.461$
	Upland	0.509	41	30	0.724	$0.559 \le p_2 \le 0.890$
			N=58			
"Presence Only"						
Fall						
	Lowland	0.491	26	59	0.208	$0.104 \le p_1 \le 0.312$
	Upland	0.509	94	61	0.776	$0.669 \le p_2 \le 0.883$
			N=120			
Winter						
	Lowland	0.491	46	69	0.315	$0.229 \le p_1 \le 0.401$
	Upland	0.509	94	71	0.664	$0.552 \le p_2 \le 0.776$
			N=140			

[a]Calculated by: $pi_o \times N$.

[b]Compared to corresponding pi_o to determine if hypothesis of proportional use is accepted or rejected (99% family confidence coefficient).

[c]All hypothesis of proportional use were rejected at the one percent level, except for feeding during the fall.

[d]Sample sizes were inadequate for test of hypothesis.

Table 8. Preference and avoidance of habitat strata for different categories of habitat use during fall.

Category	Habitat Stratum	Proportion of total habitat (pi_o)	Number of Observations	Expected[a] number of observations	Proportions observed in each habitat (pi)	Confidence interval on proportions observed (pi)[b]
Feeding	Aspen	0.176	11	6	0.314	$0.138 \le p_1 \le 0.490$[c]
	Aspen-white spruce[f]	0.104	10	4	0.286	$0.115 \le p_2 \le 0.457$
	Aspen-jack pine	0.074	8	2	0.229	$0.070 \le p_3 \le 0.388$
	Other[g,f]	0.646	6	23	0.173	$0.000 \le p_4 \le 0.365$[e]
			N=35			
Bedding	Aspen	0.176	15	8	0.326	$0.171 \le p_1 \le 0.481$
	Aspen-white spruce[f]	0.104	13	5	0.283	$0.117 \le p_2 \le 0.449$[d]
	Aspen-jack pine[f]	0.074	10	3	0.227	$0.089 \le p_3 \le 0.365$
	Other[f]	0.646	8	30	0.174	$0.006 \le p_4 \le 0.342$[e]
			N=46			
Non-Feeding-Bedding	Tamarack	0.095	7	5	0.121	$0.016 \le p_1 \le 0.226$
	Black spruce-tamarack	0.152	6	9	0.103[h]	$0.005 \le p_2 \le 0.201$
	Aspen	0.176	12	10	0.207	$0.077 \le p_3 \le 0.337$
	Jack pine	0.095	9	5	0.155	$0.038 \le p_4 \le 0.271$
	Aspen-white spruce	0.104	7	6	0.121	$0.016 \le p_5 \le 0.226$
	Aspen-jack pine[f]	0.074	12	4	0.207	$0.077 \le p_6 \le 0.337$
	Other	0.304	5	18	0.086	$0.032 \le p_7 \le 0.204$[e]
			N=58			
"Presence Only"	Black spruce[f]	0.152	7	18	0.058	$0.000 \le p_1 \le 0.127$[e]
	Tamarack	0.095	10	11	0.083[h]	$0.020 \le p_2 \le 0.146$
	Black spruce-tamarack[f]	0.152	8	18	0.067	$0.000 \le p_3 \le 0.141$[e]
	Aspen	0.176	29	21	0.242	$0.144 \le p_4 \le 0.340$
	Jack pine	0.094	11	11	0.092	$0.026 \le p_5 \le 0.158$
	Aspen-white spruce	0.104	20	12	0.167	$0.091 \le p_6 \le 0.243$
	Aspen-jack pine[f]	0.074	28	9	0.233	$0.108 \le p_7 \le 0.358$[e]
	Other[f]	0.153	7	18	0.058	$0.011 \le p_8 \le 0.127$[e]
			N=120			

[a] Calculated by: $pi_o \times N$.
[b] Compared to corresponding pi_o to determine if hypothesis of proportional use is accepted or rejected.
[c] 90% family confidence coefficient, unless otherwise indicated.
[d] 95% family confidence coefficient.
[e] 99% family confidence coefficient.
[f] Hypothesis of proportional use rejected at the confidence level indicated.
[g] Observations of use of individual habitats are listed in Table 3.
[h] Includes observations of use of fens.

Table 9. Preference and avoidance of habitat strata for different categories of habitat use during winter.

Category	Habitat Stratum	Proportion of total habitat (pi_o)	Number of Observations	Expected[a] number of observations	Proportions observed in each habitat ($\bar{p}i$)	Confidence interval on proportions observed (pi)[b]
Feeding	Tall Willow	0.052	5	4	0.060	$0.000 \le p_1 \le 0.120$[c]
	Black Spruce-Tamarack	0.152	9	13	0.107	$0.028 \le p_2 \le 0.185$
	Aspen[f,h]	0.176	43	15	0.512	$0.343 \le p_3 \le 0.681$[e]
	Aspen-White Spruce[h]	0.104	22	9	0.262	$0.113 \le p_4 \le 0.412$[e]
	Other[g,h]	0.516	5	24	0.059	$0.000 \le p_5 \le 0.139$[e]
			N=84			
Bedding	Black Spruce-Tamarack	0.152	4	6	0.093	$0.000 \le p_1 \le 0.192$
	Aspen[f,h]	0.176	17	8	0.395	$0.209 \le p_2 \le 0.581$[e]
	Aspen-White Spruce[h]	0.104	20	5	0.465	$0.237 \le p_3 \le 0.693$[e]
	Other	0.568	2	24	0.047	$0.000 \le p_4 \le 0.144$[e]
			N=43			
Non-Feeding-Bedding	Black Spruce	0.152	8	7	0.174	$0.053 \le p_1 \le 0.295$
	Black Spruce-Tamarack	0.152	10	7	0.212	$0.069 \le p_2 \le 0.355$
	Aspen[f]	0.176	5	8	0.106	$0.000 \le p_3 \le 0.214$
	Aspen-White Spruce[h]	0.104	13	5	0.276	$0.119 \le p_4 \le 0.432$
	Aspen-Black Spruce	0.017	5	1	0.106	$0.000 \le p_5 \le 0.214$
	Other[h]	0.399	6	19	0.127	$0.000 \le p_6 \le 0.280$[e]
			N=47			
"Presence Only"	Tall Willow	0.052	6	7	0.043	$0.002 \le p_1 \le 0.084$
	Black Spruce	0.152	13	21	0.093	$0.034 \le p_2 \le 0.152$
	Black Spruce-Tamarack	0.152	21	21	0.150	$0.078 \le p_3 \le 0.222$
	Aspen[f,h]	0.176	44	25	0.314	$0.191 \le p_4 \le 0.437$[e]
	Aspen-White Spruce[h]	0.104	38	15	0.271	$0.153 \le p_5 \le 0.389$[e]
	Other[h]	0.364	13	51	0.093	$0.016 \le p_6 \le 0.170$[e]
			N=140			

[a]Calculated by: $pi_o \times N$.
[b]Compared to corresponding pi_o to determine if hypothesis of proportional use is accepted or rejected.
[c]90% family confidence coefficient, unless otherwise indicated.
[d]95% family confidence coefficient.
[e]99% family confidence coefficient.
[f]Includes observations of use of Aspen-Balsam Poplar and Balsam Poplar.
[g]Observations of use of individual habitats are listed in Table 3.
[h]Hypothesis of proportional use rejected at the confidence level indicated.

All habitats grouped into the "other" classification of habitat strata were avoided (P<0.01) during both fall and winter for all categories of habitat use. However, this means little because it is impossible to assess the importance of individual habitats grouped within the "other" classification. Therefore, this avoidance will not be further discussed.

In the following results, preference or avoidance of habitats was significant at the one percent level unless otherwise specified.

4.6.1 Preference and Avoidance During Fall

During the fall, uplands were preferred and lowlands were avoided for all categories of habitat use, except feeding (Table 7). The test for the feeding category was not conducted because of inadequate sample sizes. However, by examination, it appears probable that uplands were preferred and lowlands avoided.

Preference and avoidance of individual habitat strata were variable.

The aspen-white spruce habitat appeared to be preferred for feeding, while aspen and aspen-jack pine were probably used in proportion to their availability (Table 8).

The results presented above for feeding were qualified because a portion of the constraints for sample size was not met for the statistical tests.

For bedding, both aspen-white spruce (P<0.05) and aspen-jack pine (P<0.10) were preferred. Aspen was used in proportion to its availability.

Aspen-jack pine (P<0.10) was preferred for non-feeding-bedding. Tamarack, black spruce-tamarack, aspen, jack pine, and aspen-white spruce were all used in proportion to their availability.

When habitat use was categorized according to "presence only", aspen-jack pine was the only stratum that was preferred. Tamarack, aspen, jack pine, and aspen-white spruce were used in proportion to their availability while black spruce and black spruce-tamarack were avoided.

4.6.2 Preference and Avoidance During Winter

During the winter upland habitats were preferred, and lowlands were avoided for feeding, bedding, and "presence only" classifications.

Preference and avoidance of individual habitats was again variable.

Both the aspen and the aspen-white spruce habitats were preferred for feeding (Table 9). Tall willow and black spruce-tamarack were used in proportion to their availability.

For bedding, aspen and aspen-white spruce were probably preferred while black spruce-tamarack appeared to be used in proportion to its availability.

The results presented above for bedding were qualified because constraints for sample sizes were not entirely satisfied.

Aspen-white spruce ($P<0.10$) was the only habitat preferred for non-feeding-bedding. Black spruce, black spruce-tamarack, aspen, and aspen-black spruce were used in proportion to their availability.

When use was defined as "presence only", aspen and aspen-white spruce were preferred. Tall willow, black spruce, and black spruce-tamarack were used in proportion to their availability.

4.7 PREFERENCE AND AVOIDANCE OF FORAGES

Saskatoon was probably preferred during both fall and winter. It was the most heavily utilized of all the forage species and was scarce (Table 6). Beaked willow was used in proportion to its availability during the fall as it was abundant and heavily utilized. During the winter, both beaked willow and *S. planifolia* were probably avoided. They received relatively heavy utilization, but they were also present in proportionately greater amounts than they were utilized.

5. DISCUSSION

The data obtained allow only preliminary conclusions because constraints on sample sizes were not satisfied for all statistical tests and overall sample sizes were relatively small.

The majority of studies reporting use of habitats by moose are based upon "presence only" in a particular habitat, as are all the studies cited in the following discussion.

The upland habitats were most heavily used and were preferred during both fall and winter for all categories of habitat use except non-feeding-bedding. For the same period and categories of use, the lowlands were utilized least and were avoided.

In the non-feeding-bedding category, uplands were most heavily used and were preferred during the fall. Lowlands were least utilized and avoided. During the winter, both lowlands and uplands were used in proportion to their availability. This was the only major shift in use of uplands versus lowlands between fall and winter.

Hauge and Keith (in prep.) also found use of uplands to be greater than use of lowlands in the AOSERP study area in the fall. This was also the case for the winter months, with the exception of December, during which most observations were in lowlands.

Contrary results for the fall season were found by Keith and Frojker (in prep.). They reported that 50 percent of observations of radio-collared moose at Rochester, Alberta were in lowland muskegs during October and November. However, they also reported that 86 percent of their observations were in uplands during December through March.

Within the upland habitat strata, the aspen and aspen mixed with either white spruce or jack pine were heavily utilized for all categories of use during the fall. However, only the mixed-wood stands were variously preferred. This trend is most noticeable in the feeding and bedding categories.

In the "presence only" category of habitat use, the black spruce and black spruce-tamarack habitats were used in small amounts and were also avoided.

Hauge and Keith (in prep.) reported a similar magnitude of use of aspen, aspen-white spruce, and aspen-jack pine, during the fall. However, their observations of use of the black spruce and black spruce-tamarack habitats were two to three times greater.

Contrary results were reported by Allison (1972) for the Peace-Athabasca Delta. She found that moose were primarily sighted in tall willow and tall willow-meadow habitats during the fall.

During the winter, aspen and aspen-white spruce were heavily utilized and preferred for all categories of use except non-feeding-bedding. For this category, aspen-white spruce was most heavily utilized and was preferred. Black spruce and black spruce-tamarack were also heavily utilized for this category, but they were not preferred.

Hauge and Keith (in prep.) reported the same pattern of use during February and March. However, during December they found less use of aspen and aspen-white spruce, and greater use of black spruce and willow.

Other Alberta studies of habitat use during the winter have reported heavy use of deciduous habitats, primarily aspen and balsam poplar, with little or no use of coniferous or mixed deciduous-coniferous habitats (Nowlin in prep.; Penner 1971). However, conifers were very scarce in the areas where these studies were conducted.

The most heavily used browse species during both fall and winter was saskatoon. In the fall, beaked willow was second in importance, while in winter *S. planifolia* was second and beaked willow was third. All other species were utilized in minor amounts during both fall and winter.

Comparison of browse utilization with availability suggests that, of the three important species, only saskatoon was preferred.

The heavy use of saskatoon during winter appears to be an Alberta anomaly. Barrett (1972) also documented unusually high use of this species in southern Alberta. He found that it composed 56 percent of the total diet, and he believed it to be preferred. Moreover, Peek (1974), after reviewing food habits of moose in North America, stated that Barrett's level of utilization of saskatoon was the highest that had been reported.

Other studies in Alberta have discovered similar patterns of forage utilization during winter, with some additions. Nowlin (in prep.), working in central Alberta, also reported heavy use of saskatoon and believed it was preferred. Other important species were pussy willow, beaked hazelnut, and red osier dogwood. Allison (1972) reported that moose in the Peace-Athabasca Delta fed primarily on willow, red osier dogwood, paper birch, and balsam poplar. Saskatoon was uncommon on her study area, but heavily utilized where it occurred.

Food habits studies from outside of Alberta have reported some dissimilar results. In Minnesota, Peek et al. (1976) found that willows were the most important species throughout the year. However, they were most heavily used in September through December. Of the willows, pussy and beaked willow were preferred. During both fall and winter, red osier dogwood and beaked hazlenut were also heavily used. Peek (1974), in his review of food habits, also reported that balsam fir, trembling aspen, and paper birch were important for Canadian moose.

It appears that habitat use and selection during both fall and winter could be correlated to preference for saskatoon. The most important habitats were also the only habitats in which the preferred browse species was commonly found. Relationships between habitat utilization, or selection, and forage supplies have also been variously reported by Bassard et al. (1974), Kearney and Gilbert (1976), Peek et al. (1976), and Telfer (1967).

It is necessary to emphasize that this discussion of habitats and forages has been based upon data collected during a very mild winter. A winter with deeper snow and lower temperatures might influence habitat utilization and selection by forcing moose to seek shelter in dense habitats often dominated by conifers. This has been documented in other areas by Coady (1974), Krefting (1974), Peek et al. (1976), and Van Ballenberghe and Peek (1971). Moreover, the latter two papers also reported a shift in food habits corresponding to the change in habitat use.

6. RECOMMENDATIONS

The following recommendations are preliminary because of the problems with the data base that were pointed out in the discussion.

In terms of fall and winter habitat, it appears that the greatest potential impact on moose populations in the Athabasca Oil Sands would result from destruction or alteration of upland habitat strata. Moreover, within the uplands, aspen, aspen-white spruce, and aspen-jack pine are most critical during the fall, while aspen and aspen-white spruce are most important during the winter. Disturbance of these habitats would adversely affect both the supply of essential browse and the availability of suitable sites for bedding and non-feeding-bedding.

Rehabilitation of fall and winter habitat after mining should be planned to produce habitat strata which are as similar as possible to the the three mentioned above. Moreover, use of the browse species listed in Table 6 which occur in these habitats should be given priority, particularly saskatoon and beaked willow.

7. LITERATURE CITED

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8. APPENDIX

This appendix includes Tables 10 to 15 which present the field data collected for this project.

Table 10. Numerical codes for interpretation of Table 2 for habitat strata, categories of habitat use, position on slope, and topographic undulations.

Category	Numerical code
Habitat Stratum	
Fen	1
Tall Willow	2
Black Spruce	3
Black Spruce-Tamarack	4
Tamarack	5
Balsam Poplar	6
Aspen	7
Balsam Poplar-Aspen	8
White Spruce	9
Aspen-White Spruce	10
Jack Pine	11
Aspen-Jack Pine	12
Upland Shrub	13
Aspen-Paper Birch	14
Paper Birch-Jack Pine	15
White Spruce-Jack Pine	16
Aspen-Black Spruce	17
Paper Birch-Black Spruce	18
Category of Habitat Use	
Feeding	1
Bedding	2
Presence Only	3
Rutting	5
Position on Slope	
Top of Ridge	1
Upper 1/3 of slope	2
Middle 1/3 of slope	3
Lower 1/3 of slope	4
Bottom of Valley	5
Topographic Undulations (m)	
$\pm$ 0.00 to 0.50	6
$\pm$ 0.51 to 1.50	7
$\pm$ 1.51 to 3.00	8

Table 11. Animal number, date, time, location, habitat stratum utilized, verification, location type, category of habitat use, canopy closure, and physical factors for each microplot.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c] Photo[e] Ln.[d]	Aerial Photo[c] Photo[e] No.	Aerial Photo[c] Grid No.[f] X	Aerial Photo[c] Grid No.[f] Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography Slp.[l]	Topography Asp.[m]	Topography Pos.[n]	Topography Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
85	9	1	1220	24	224	55.50,	58.75	5	1	1	3	-	0	0	0	-[q]	-		1
85	9	1	1400	24	224	54.50,	60.00	5	1	1	3	70	0	0	0	-	-		2
85	9	1	1500	24	224	54.50,	60.00	5	1	1	3	70	0	0	0	-	-		3
85	9	1	1625	24	224	54.50,	60.00	5	1	1	3	70	0	0	0	-	-		4
85	9	1	1720	24	224	54.50,	60.00	5	1	1	3	70	0	0	0	-	-		5
96	9	12	1235	23	189	46.50,	61.50	12	1	1	3	-	0	0	0	-	-		6
96	9	12	1300	23	189	46.50,	61.50	12	1	1	3	-	-	-	-	-	-		7
96	9	12	1525	23	189	46.50,	61.50	12	1	1	3	-	-	-	-	-	-		8
96	9	12	1650	23	189	46.50,	61.50	12	1	1	3	-	-	-	-	-	-		9
96	9	13	0830	23	189	69.00,	61.00	12	1	1	1,2,3	-	-	-	-	-	-		10
85	9	14	1145	24	223	75.75,	67.00	13	1	1	2,3	-	-	-	-	-	-		11
85	9	14	1530	24	223	75.00,	81.00	10	1	1	2,3	14	0	0	0	-	-	2 beds	12
85	9	14	1615	24	223	75.00,	78.50	10	1	1	3	34	0	0	0	-	-		13
85	9	14	1715	24	223	76.00,	79.00	10	1	1	3	5	0	0	0	-	-		14
85	9	15	0950	24	225	64.75,	60.25	11	1	1	3	9	0	0	0	-	-		15
85	9	15	1045	24	225	64.75,	60.25	11	1	1	3	9	0	0	0	-	-		16
87	9	24	0850	24	219	42.00,	73.50	3	1	1	3	25	0	0	0	-	-		17
87	9	24	1335	24	219	50.00,	75.50	7	1	1	1,3	78	0	0	0	-	-		18
87	9	24	1500	24	219	51.00,	74.00	7	1	1	3	90	0	0	0	-	-		19
87	9	24	1620	24	219	49.00,	76.00	7	1	1	1,2,3	87	0	0	0	-	-		20
87	9	24	1620	24	219	49.75,	77,00	11	1	2	2,3	77	0	0	0	-	-		21
87	9	24	1620	24	219	49.00,	77.25	12	1	2	3	88	0	0	0	-	-		22
87	9	24	1712	24	219	49.50,	73.25	7	1	1	2,3	85	0	0	0	-	-		23
87	9	25	0710	24	219	41.50,	75.75	3	2	1	-	-	-	-	-	-	-		24
87	9	25	0750	24	219	49.00,	76.00	7	1	1	1,2,3	87	0	0	0	-	-		25
87	9	25	0950	24	219	47.25,	75.25	7	1	1	3,5	90	0	0	0	-	-		26
87	9	25	1100	24	219	45.75,	76.00	7	1	1	1,3	84	0	0	0	-	-		27
87	9	25	1155	24	219	46.00,	76.76	12	1	1	2,3	18	0	0	0	-	-	4 beds	28
87	9	21	1200	24	219	57.00,	48.00	5	1	1	3	0	0	0	0	-	-		29
90	9	22	1450	23	189	15.00,	49.50	11	1	1	3	30	0	0	0	-	-		30

continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c]: Photo[e] Ln.[d]	Aerial Photo[c]: Photo[e] No.	Aerial Photo[c]: Grid No.[f] X	Aerial Photo[c]: Grid No.[f] Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography: Slp.[l]	Topography: Asp.[m]	Topography: Pos.[n]	Topography: Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
90	9	22	1700	23	189	11.00,	44.00	11	1	1	3	39	0	0	0	-	-		31
90	9	23	0850	23	189	15.75,	36.75	12	1	1	3	43	-	-	-	-	-		32
90	9	23	0850	23	189	14.25,	36.75	11	1	2	3	84	-	-	-	-	-		33
90	9	23	0850	23	189	14.25,	36.75	11	1	2	3	46	-	-	-	-	-		34
89	9	23	0850	23	189	17.00,	40.50	12	2	1	-	-	-	-	-	-	-		35
89	9	21	1000	25	261	22.25,	47.00	3	1	1	1,3	22	0	0	0	-	-		36
89	9	21	1000	25	261	22.25,	47.25	5	1	2	3	0	0	0	0	-	-		37
90	9	21	1300	23	188	38.00,	57.00	11	1	1	3	-	0	0	0	-	-		38
89	9	27	1133	22	153	42.00,	36.25	7	1	1	2,3,5	32	0	0	0	-	-	2 beds	39
89	9	27	1350	22	153	42.00,	36.25	7	1	1	2,3,5	32	0	0	0	-	-	2 beds	40
89	9	27	1440	22	153	42.00,	36.25	7	1	1	2,3,5	32	0	0	0	-	-	2 beds	41
89	9	27	1550	22	153	42.00,	36.25	7	1	1	2,3,5	32	0	0	0	-	-	2 beds	42
89	9	27	1650	22	153	42.00,	36.25	7	1	1	2,3,5	32	0	0	0	-	-	2 beds	43
89	9	27	1750	22	153	44.25,	37.25	7	1	1	3	51	0	0	0	-	-	2 beds	44
90	9	27	1540	22	153	33.00,	30.50	4	1	1	3	24	0	0	0	-	-		45
89	9	28	0950	22	152	68.00,	38.25	5	1	1	2,3	1	0	0	0	-	-		46
89	9	28	1125	22	152	68.00,	38.25	5	1	1	2,3	1	0	0	0	-	-	2 beds	47
89	9	28	1335	22	152	68.00,	35.24	4	1	1	3	49	0	0	0	-	-		48
89	9	28	1500	22	152	69.75,	37.75	10	1	1	2,3	74	0	0	0	-	-		49
89	9	28	1705	22	152	69.75,	37.75	10	1	1	2,3	74	0	0	0	-	-		50
Obs.[r]	9	28	1350	22	152	70.00,	43.75	7	1	1	3	91	0	0	0	-	-		51
89	9	28	1815	22	152	68.00,	38.25	5	1	1	2,3	1	0	0	0	-	-	2 beds	52
90	9	28	0950	22	152	69.75,	37.75	10	1	1	2,3	74	0	0	0	-	-		53
90	9	28	1125	22	152	76.25,	34.25	7	1	1	3	92	0	0	0	-	-		54
90	9	28	1345	22	152	79.50,	35.50	7	1	1	3	91	0	0	0	-	-		55
90	9	28	1540	22	152	80.25,	38.75	7	1	1	3	21	0	0	0	-	-		56
90	9	28	1705	22	152	80.25,	38.75	7	1	1	3	21	0	0	0	-	-		57
89	9	28	1705	22	152	69.25,	37.25	3	1	2	3,5	-	0	0	0	-	-		58
89	9	28	1705	22	152	69.25,	37.75	3	1	2	3	30	0	0	0	-	-		59
obs.[s]	9	28	-	22	152	71.50,	43.75	7	1	1	3,5	46	0	0	0	-	-	2 rut. wal.	60

continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c]: Photo[e] Ln.[d]	Photo[e] No.	Grid No.[f] X	Grid No.[f] Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography: Slp.[l]	Asp.[m]	Pos.[n]	Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
96	10	10	1030	23	188	70.75,	61.75	11	2	1	-	-	-	-	-	-	-		61
96	10	10	1340	23	188	65.50,	63.75	12	1	1	1,3	83	0	0	0	-	-		62
96	10	10	1535	23	188	66.50,	66.50	12	1	1	3	87	0	0	0	-	-		63
96	10	10	1625	23	188	66.50,	66.50	12	1	1	1,3	87	0	0	0	-	-		64
96	10	10	1625	23	188	66.75,	66.50	7	1	2	1,3	86	0	0	0	-	-		65
75	10	10	1340	23	189	28.75,	61.75	12	1	1	1,3,5	20	0	0	0	-	-		66
75	10	10	1535	23	189	29.00,	63.50	12	1	1	1,2,3	84	0	0	0	-	-		67
75	10	10	1625	23	189	29.00,	63.50	12	1	1	1,2,3	84	0	0	0	-	-		68
75	10	10	1340	23	189	28.50,	62.25	7	1	2	1,3,5	13	0	0	0	-	-		69
75	10	20	1035	23	188	73.00,	69.00	11	1	1	3	71	0	0	0	-	-		70
75	10	20	1330	23	188	81.00,	74.75	4	1	1	1,3	0	0	0	0	-	-		71
75	10	20	1440	23	188	83.00,	77.75	1	1	1	3	0	0	0	0	-	-		72
75	10	20	1540	23	188	83.00,	77.75	1	1	1	3	0	0	0	0	-	-		73
75	10	20	1635	23	188	83.00,	77.75	1	1	1	3	0	0	0	0	-	-		74
75	10	20	1700	23	188	82.00,	74.75	2	1	1	1,3	31	0	0	0	7	-		75
75	10	20	1700	23	188	82.00,	75.50	1	1	2	3	0	0	0	0	0	-		76
75	10	20	1330	23	188	80.75,	74.50	3	1	2	3	30	0	0	0	0	-		77
75	10	20	1330	23	188	80.75,	74.25	14	1	2	3	75	0	0	0	7	-		78
75	10	20	1330	23	188	81.00,	75.00	1	1	2	3	0	0	0	0	0	-		79
96	10	24	0945	23	188	84.00,	50.00	12	2	1	-	-	-	-	-	-	-		80
96	10	24	1220	23	188	79.75,	53.75	12	1	1	1,3	90	0	0	0	0	-		81
96	10	24	1220	23	188	80.00,	54.00	12	1	2	1,3	56	85	16	0	0	-		82
96	10	24	1445	23	188	84.75,	53.50	12	1	1	1,2,3	21	0	0	0	0	-		83
96	10	24	1530	23	188	82.00,	52.00	12	1	1	1,3	76	0	0	0	0	-		84
75	10	24	1025	23	188	81.00,	48.75	12	2	1	-	-	-	-	-	-	-		85
75	10	24	1220	23	188	81.00,	48.75	12	2	1	-	-	-	-	-	-	-		86
Obs.	10	24	1615	23	188	80.00,	50.00	12	1	1	2,3	85	-	-	-	-	-	2 beds	87
87	10	27	1025	24	218	78.00,	36.50	3	2	1	-	-	-	-	-	-	-		88
87	10	27	1300	24	218	79.00,	38.50	7	1	1	3	90	0	0	0	0	-		89
87	10	27	1350	24	218	79.00,	38.50	7	1	1	3	90	0	0	0	0	-		90

continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c] Photo[e] Ln.[d]	Photo No.	Grid No.[f] X	Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography Slp.[l]	Asp.[m]	Pos.[n]	Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
87	10	28	0850	24	218	56.50,	18.75	10	1	1	1,3	77	0	0	0	0	-		91
87	10	28	0930	24	218	56.50,	18.75	10	1	1	1,3	77	0	0	0	0	-		92
87	10	28	0850	24	218	56.50,	18.50	7	1	2	1,3	82	0	0	0	0	-		93
87	10	28	1020	24	218	55.50,	19.50	10	1	1	1,3	82	0	0	0	0	-		94
87	10	28	1125	24	218	55.50,	19.50	10	1	1	1,3	82	0	0	0	0	-		95
96	11	21	1330	23	188	80.50,	42.25	15	1	1	1,3	76	0	0	0	0	-		96
96	11	21	1330	23	188	79.50,	42.50	12	1	2	1,3	73	0	0	0	0	-		97
96	11	21	1435	23	188	81.50,	42.75	15	1	1	1,3	87	0	0	0	6	-		98
96	11	21	1515	23	188	81.50,	42.75	15	1	1	1,3	87	0	0	0	6	-		99
96	11	22	1007	23	190	21.25,	44.50	12	1	1	3	38	0	0	0	0	-		100
96	11	22	1007	23	190	21.75,	44.25	7	1	2	1,3	24	0	0	0	0	-		101
96	11	22	1145	23	190	21.25,	44.50	12	1	1	4	38	0	0	0	0	-		102
96	11	22	1315	23	190	22.75,	44.25	12	1	1	1,3	54	0	0	0	0	-		103
96	11	22	1315	23	190	22.50,	45.00	7	1	2	1,3	11	0	0	0	0	-		104
96	11	22	1430	23	190	23.75,	45.00	7	1	1	1,2,4	67	0	0	1	0	-		105
96	11	22	1530	23	190	23.75,	45.00	7	1	1	1,2,3	67	0	0	1	0	-		106
96	11	22	1530	23	190	23.50,	45.00	13	1	2	1,2,3	0	0	0	0	0	-		107
90	11	4	1205	24	221	27.75,	45.75	7	1	1	1,3	-	0	0	1	0	-		108
85	11	19	1630	24	224	65.25,	59.25	12	1	1	3	81	0	0	0	6	-		109
85	11	19	1630	24	224	65.25,	69.00	11	1	2	3	84	0	0	0	6	-		110
87	11	24	1300	24	218	59.50,	38.00	10	1	1	1,2,3	73	0	0	0	0	-	3 beds	111
87	11	24	1330	24	218	55.25,	36.00	10	1	1	1,3	80	20	255	4	0	-		112
87	11	24	1350	24	218	55.25,	36.00	10	1	1	1,3	80	20	255	4	0	-		113
87	11	24	1350	24	218	54.75,	36.00	10	1	2	3	69	0	0	0	0	-		114
87	11	25	1040	24	219	29.00,	40.00	10	1	1	1,2,3	75	0	0	0	0	-	3 beds	115
87	11	25	1040	24	219	28.25,	40.00	10	1	2	3	80	0	0	5	0	-		116
87	11	25	1120	24	219	29.00,	41.75	10	1	1	1,2,3	85	20	287	0	0	-	2 beds	117
87	11	25	1315	24	219	27.75,	40.25	10	1	1	1,3	87	30	240	0	0	-		118
87	11	25	1415	24	219	27.75,	40.25	10	1	1	1,3	87	30	240	0	0	-		119
87	11	25	1510	24	219	27.75,	40.25	10	1	1	1,3	87	30	240	0	0	-		120

Continued . . .

Table 11. Continued.

				Aerial Photo[c]									Topography						
				Photo[e]		Grid No.[f]													
An.[a] No.	Mon.	Day	Time[b]	Ln.[d]	No.	X	Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Slp.[l]	Asp.[m]	Pos.[n]	Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
87	11	25	1510	24	219	28.25,	40.00	10	1	2	3	80	0	0	5	0	-		121
85	12	15	1215	22	154	46.25,	53.00	3	2	1	-	-	-	-	-	-	-		122
85	12	15	1355	22	154	44.00,	57.00	4	2	1	-	-	-	-	-	-	-		123
85	12	15	1535	22	154	41.00,	57.00	3	2	1	-	-	-	-	-	-	-		124
85	12	16	1220	22	154	28.00,	59.50	13	2	1	-	-	-	-	-	-	-		125
85	12	16	1500	22	154	36.00,	52.00	10	1	1	1,3	54	0	0	0	0	20		126
79	12	11	1245	24	218	20.25,	29.50	2	1	1	1,3	27	0	0	0	0	-		127
79	12	11	1245	24	218	19.50,	19.00	3	1	2	3	24	0	0	0	0	-		128
79	12	11	1245	24	218	20.75,	29.75	1	1	2	3	-	0	0	0	0	-		129
96	12	18	1155	22	155	42.00,	45.50	10	1	1	1,2,3	84	0	0	0	6	19		130
96	12	18	1330	22	155	42.00,	45.50	10	1	1	1,2,3	84	0	0	0	6	19		131
96	12	18	1510	22	155	43.00,	45.50	10	1	1	1,2,3	64	0	0	0	6	18		132
96	12	18	1545	22	155	43.00,	45.50	10	1	1	1,2,3	64	0	0	0	6	18		133
96	12	18	1630	22	155	43.00,	47.00	10	1	1	1,2,3	53	0	0	0	6	21	2 beds	134
81	1	13	1430	20	91	31.00,	54.75	7	1	1	1,3	77	0	0	0	0	18		135
81	1	13	1510	20	91	31.00,	53.75	7	1	1	1,3	77	0	0	0	0	19		136
81	1	13	1610	20	91	31.00,	53.75	7	1	1	1,3	77	0	0	0	0	19		137
81	1	14	1350	20	91	51.00,	64.00	7	1	1	1,2,3	84	0	0	0	0	18		138
81	1	14	1440	20	91	50.00,	64.75	7	1	1	1,2,3	33	0	0	0	8	20		139
81	1	14	1400	20	91	50.00,	64.75	7	1	1	1,2,3	86	0	0	0	0	18		140
81	1	14	1510	20	91	51.00,	64.00	4	1	1	1,2,3	7	0	0	0	0	26		141
81	1	14	1440	20	91	50.75,	64.75	4	1	2	1,3	9	0	0	0	0	21		142
83	1	19	1500	22	153	42.50,	33.00	7	1	1	1,3	90	10	190	3	0	18		143
83	1	19	1605	22	153	33.50,	44.75	10	1	1	2,3	84	0	0	0	7	21	2 beds	144
83	1	19	1200	22	153	33.50,	44.75	10	1	1	2,3	84	0	0	0	7	21	2 beds	145
83	1	19	1500	22	153	33.75,	44.50	16	1	2	3	79	0	0	0	0	17		146
83	1	20	1335	22	153	29.50,	67.25	7	1	1	1,3	-	0	0	0	7	-		147
83	1	20	1435	22	153	29.50,	67.25	7	1	1	1,3	-	0	0	0	7	-		148
83	1	20	1530	22	153	29.50,	67.25	7	1	1	1,3	-	0	0	0	7	-		149
83	1	20	1610	22	153	29.50,	67.25	7	1	1	1,3	-	0	0	0	7	-		150

Continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c] Photo[e] Ln.[d]	Aerial Photo[c] Photo[e] No.	Aerial Photo[c] Grid No.[f] X	Aerial Photo[c] Grid No.[f] Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography Slp.[l]	Topography Asp.[m]	Topography Pos.[n]	Topography Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
17	1	18	1645	24	222	35.25,	54.50	8	1	1	1,2,3	90	0	0	0	6	17	3 beds	151
17	1	20	1310	24	222	28.25,	59.25	10	1	1	3	83	0	0	0	0	17		152
17	1	20	1430	24	222	28.25,	59.25	10	1	1	3	83	0	0	0	0	17		153
17	1	20	1610	24	222	28.25,	59.25	10	1	1	3	83	0	0	0	0	17		154
17	1	20	1700	24	222	28.25,	59.25	10	1	1	3	83	0	0	0	0	17		155
17	1	21	1040	24	222	34.50,	58.00	7	1	1	1,2,3	91	0	0	0	7	15		156
17	1	21	1040	24	222	34.00,	57.50	18	1	2	3	91	0	0	0	0	15		157
17	1	21	1150	24	222	32.25,	59.50	10	1	1	1,2,3	22	0	0	0	6	18		158
17	1	22	1030	24	222	27.50,	58.50	10	1	1	3	89	0	0	0	0	13		159
17	1	22	1200	24	222	27.50,	58.50	10	1	1	3	89	0	0	0	0	13		160
17	1	22	1245	24	222	27.50,	58.50	10	1	1	3	89	0	0	0	0	13		161
17	1	22	1420	24	222	27.50,	58.50	10	1	1	3	89	0	0	0	0	13		162
17	1	22	1520	24	222	27.50,	58.50	10	1	1	3	89	0	0	0	0	13		163
87	1	24	1245	21	122	32.75,	77.00	17	1	1	3	85	0	0	0	0	24		164
87	1	24	1525	21	122	35.75,	33.25	4	1	1	3	23	0	0	0	0	20		165
87	1	24	1615	21	122	35.75,	33.25	4	1	1	3	23	0	0	0	0	20		166
87	1	24	1650	21	122	38.00,	33.00	3	1	1	3	7	0	0	0	0	27		167
87	1	25	1055	21	122	35.75,	33.25	4	1	1	3	23	0	0	0	0	20		168
87	1	25	1200	21	122	35.75,	33.25	4	1	1	3	23	0	0	0	0	20		169
87	1	25	1305	21	122	35.75,	33.25	4	1	1	3	23	0	0	0	0	20		170
87	1	25	1350	21	122	36.50,	31.00	4	1	1	3	0	0	0	0	0	22		171
87	1	25	1515	21	122	36.50,	31.00	4	1	1	3	0	0	0	0	0	22		172
87	1	25	1625	21	122	36.50,	31.00	4	1	1	3	0	0	0	0	0	22		173
83	1	25	1345	22	153	56.75,	67.50	16	1	1	3	36	0	0	0	0	19		174
83	1	25	1500	22	153	56.75,	67.50	16	1	1	3	36	0	0	0	0	19		175
83	1	25	1640	22	153	56.75,	67.50	16	1	1	3	36	0	0	0	0	19		176
83	1	25	1640	22	153	57.50,	67.25	12	1	1	3	10	0	0	0	0	23		177
47	2	11	1300	21	120	54.00,	60.00	7	1	1	1,3	-	0	0	0	0	-		178
47	2	11	1420	21	120	52.75,	61.00	10	1	1	1,3	81	0	0	0	0	20		179
47	2	11	1420	21	120	53.25,	60.00	7	1	1	1,2,3	68	0	0	0	0	21		180

Continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c] Photo[e] Ln.[d]	No.	Grid No.[f] X	Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography Slp.[l]	Asp.[m]	Pos.[n]	Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
47	2	11	1520	21	120	51.00,	59.50	8	1	1	1,2,3	73	0	0	0	0	22		181
47	2	11	1520	21	120	51.00,	58.75	10	1	2	1,2,3	83	0	0	0	0	21		182
47	2	11	1625	21	120	52.50,	58.75	8	1	1	1,3	69	0	0	0	0	20		183
88	2	13	1010	20	90	82.50,	18.75	7	1	1	1,3	87	0	0	0	0	20		184
88	2	13	1130	20	90	82.50,	18.75	7	1	1	1,3	87	0	0	0	0	20		185
88	2	13	1315	20	90	82.50,	18.75	7	1	1	1,3	87	0	0	0	0	20		186
88	2	12	1215	20	90	74.25,	18.75	7	1	1	1,3	83	0	0	0	6	21		187
88	2	12	1340	20	90	74.25,	18.75	7	1	1	1,3	83	0	0	0	6	21		188
88	2	12	1600	20	90	74.25,	18.75	7	1	1	1,3	83	0	0	0	6	21		189
81	2	15	1040	20	92	42.75,	65.00	7	1	1	1,3	90	0	0	0	7	15		190
81	2	15	1200	20	92	42.75,	65.00	7	1	1	1,3	90	0	0	0	7	15		191
81	2	15	1315	20	92	42.75,	65.00	7	1	1	1,3	90	0	0	0	7	15		192
81	2	15	1440	20	92	42.75,	65.00	7	1	1	1,3	90	0	0	0	7	15		193
81	2	15	1605	20	92	42.75,	65.00	7	1	1	1,3	90	0	0	0	7	15		194
81	2	15	1040	20	92	43.25,	65.00	17	1	2	3	89	0	0	0	6	18		195
81	2	15	1040	20	92	43.50,	65.00	3	1	2	3	49	0	0	0	0	18		196
81	2	16	0945	20	92	43.50,	70.50	10	1	1	3	85	0	0	0	7	19		197
81	2	16	1130	20	92	43.50,	70.70	10	1	1	3	85	0	0	0	7	19		198
81	2	16	1130	20	92	42.75,	70.25	3	1	1	3	53	0	0	0	0	18		199
81	2	16	1245	20	92	42.00,	69.75	3	1	1	3	22	0	0	0	0	14		200
81	2	20	1015	20	92	45.75,	85.75	2	1	1	1,3	0	0	0	0	0	22		201
81	2	20	1115	20	92	45.50,	83.50	4	1	1	3	0	0	0	0	0	20		202
40	2	20	1105	20	92	46.00,	86.25	2	1	1	1,3	0	0	0	0	0	23		203
40	2	20	1115	20	92	46.00,	82.00	2	1	1	3	0	0	0	0	0	26		204
88	2	22	1330	19	56	51.00,	48.75	10	1	1	1,3	8	0	0	0	6	22		205
88	2	22	1330	19	56	51.50,	48.75	17	1	2	3	72	0	0	0	0	22		206
88	2	22	1430	19	56	52.50,	48.75	4	1	1	1,2,3	2	0	0	0	0	25		207
88	2	22	1640	19	56	52.25,	51.25	4	1	1	1,3	36	0	0	0	0	26		208
88	2	22	1715	19	56	52.25,	51.25	4	1	1	1,3	36	0	0	0	0	26		209
88	2	23	1015	19	56	57.25,	53.25	7	1	1	1,2,3	18	0	0	0	8	25		210

Continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c] Photo[e] Ln.[d]	No.	Grid No.[f] X, Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography Slp.[l]	Asp.[m]	Pos.[n]	Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
88	2	23	1015	19	56	56.75, 52.75	3	1	2	1,2,3	29	0	0	0	0	23		211
88	2	23	1055	19	56	58.75, 55.25	2	1	1	1,2,3	0	0	0	0	0	25		212
88	2	23	1055	19	56	59.00, 54.75	3	1	2	1,3	64	0	0	0	0	23		213
88	2	23	1255	19	56	58.50, 53.50	7	1	1	3	81	0	0	0	7	20		214
88	2	23	1340	19	56	58.50, 53.50	7	1	1	3	81	0	0	0	7	20		215
88	2	23	1340	19	56	58.25, 54.00	3	1	2	3	17	0	0	0	0	17		216
81	2	22	0950	20	93	30.75, 78.00	7	1	1	3	57	0	0	0	7	21		217
81	2	22	0950	20	93	31.25, 78.00	3	1	2	3	26	0	0	0	0	23		218
81	2	22	1045	20	93	27.00, 75.75	17	1	2	3	80	0	0	0	6	17		219
81	2	22	1045	20	93	27.00, 76.00	4	1	1	1,3	0	0	0	0	0	12		220
81	2	22	1045	20	93	27.25, 75.75	12	1	2	1,3	74	0	0	1	0	23		221
81	2	23	0955	20	93	22.50, 82.00	6	1	1	3	73	0	0	0	0	22		222
81	2	23	0955	20	93	22.00, 82.00	10	1	2	3	85	0	0	0	0	10		223
81	2	23	0955	20	93	21.75, 82.00	7	1	2	3	84	0	0	0	7	21		224
81	2	23	1200	20	93	24.25, 82.25	8	1	1	1,2,3	64	0	0	0	0	22		225
81	2	23	1200	20	93	23.75, 82.00	2	1	2	1,3	51	0	0	0	0	19		226
81	2	25	1015	20	93	22.50, 77.25	4	1	1	1,2,3	12	0	0	0	0	21		227
81	2	25	1100	20	93	22.50, 77.25	4	1	1	1,2,3	12	0	0	0	0	21		228
81	2	26	0955	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		229
81	2	26	1115	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		230
81	2	26	1210	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		231
81	2	26	1310	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		232
40	2	22	0950	20	93	30.25, 76.50	3	1	1	1,3	4	0	0	0	0	21		233
40	2	22	1106	20	93	27.50, 77.50	7	1	1	1,3	22	0	0	0	7	16		234
40	2	22	1106	20	93	27.25, 77.00	8	1	1	2,3	14	0	0	0	0	21		235
40	2	23	0955	20	93	21.00, 86.50	4	1	1	3	20	0	0	0	0	26		236
40	2	23	0955	20	93	21.25, 86.50	3	1	2	3	75	0	0	0	0	8		237
40	2	23	1150	20	93	24.25, 87.75	3	1	1	3	26	0	0	0	0	21		238
40	2	23	1150	20	93	24.50, 87.75	10	1	2	3	73	0	0	0	0	21		239
40	2	25	1015	20	93	24.00, 77.50	7	1	1	1,2,3	66	0	0	0	7	15		240

Continued . . .

Table 11. Continued.

An.[a] No.	Mon.	Day	Time[b]	Aerial Photo[c]: Photo[e] Ln.[d]	Aerial Photo[c]: Photo[e] No.	Aerial Photo[c]: Grid No.[f] X, Y	Hab.[g] Str.	Ver.[h]	Loc.[i] Ty.	Hab.[j] Use	Can.[k] Cl.	Topography: Slp.[l]	Topography: Asp.[m]	Topography: Pos.[n]	Topography: Und.[o]	Sn.[p] Dep.	Comm.	ID.[t] No.
40	2	25	1100	20	93	24.00, 77.50	7	1	1	1,2,3	66	0	0	0	7	15		241
40	2	26	0955	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		242
40	2	26	1115	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		243
40	2	26	1210	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		244
40	2	26	1310	20	93	33.25, 84.50	7	1	1	1,3	71	0	0	1	0	20		245
83	3	1	1135	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		246
83	3	1	1300	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		247
83	3	1	1405	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		248
83	3	2	1205	22	152	59.50, 73.73	10	1	1	1,2,3	82	15	270	2	0	17		249
83	3	4	1445	22	152	62.25, 71.00	7	1	1	1,2,3	15	10	265	4	0	20		250
83	3	4	1015	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		251
83	3	4	1145	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		252
83	3	4	1220	22	152	61.00, 72.75	10	1	1	1,3	84	0	0	1	0	13		253
83	3	4	1340	22	152	59.50, 73.75	10	1	1	1,2,3	82	15	270	2	0	17		254
83	3	4	1415	22	152	59.50, 73.75	10	1	1	1,2,3	82	15	270	2	0	17		255
83	3	4	1535	22	152	59.50, 73.75	10	1	1	1,2,3	82	15	270	2	0	17		256
47	3	2	1100	22	152	74.25, 58.25	7	1	1	1,3	78	0	0	0	7	20		257
47	3	2	1100	22	152	73.75, 58.50	12	1	2	1,3	74	0	0	0	0	15		258
47	3	4	1210	22	152	69.00, 54.00	10	1	1	1,2,3	78	0	0	0	7	21	2 beds	259
47	3	4	1000	22	152	67.50, 55.25	10	1	1	1,2,3	78	0	0	0	7	21		260

[a]Animal number.
[b]Mountain standard time.
[c]Geographical location on aerial photo (photos used were black and white and were taken on 22 August 1972, with a scale of 1:21,120).

continued ......

Table 11. Concluded.

d Aerial photo flight line number.
e Aerial photo number.
f X,Y coordinates read from grids overlaying aerial photos for each microplot.
g Habitat stratum utilized (see Table 10 for numerical codes).
h Whether or not the radio relocation was verified: 1=yes, 2=no.
i Location type: 1=primary observation, 2=secondary observation.
j Category of habitat use (see Table 10 for numerical codes).
k Canopy closure in percent.
l Slope in percent.
m Aspect in compass degrees.
n Position on slope (see Table 10 for numerical codes).
o Rating of topographic undulations (see Table 10 for numerical codes).
p Snow depth in centimetres.
q Not obtained.
r Observation of an uncollared bull (probably two years old).
s Observation of an uncollared bull.
t Identification number for each microplot.

Table 12. Abbreviations for browse species.

Browse Species	Abbreviation
Alnus crispa	ALCR
Amelanchier alnifolia	AMAL
Betula papyrifera	BEPA
Betula spp.[a]	BE spp
Cornus stolonifera	COST
Populus balsamifera	POBA
Populus tremuloides	POTR
Prunus pensylvanica	PRPE
Prunus virginiana	PRVI
Rosa woodsii	ROWO
Rubus spp.	RUspp.
Salix bebbiana	SABE
Salix discolor	SADI
Salix planifolia	SAPL
Salix Maccalliana	SAMA
Salix mackenzieana	SAMC
Salix myrtillifolia	SAMY
Salix serrissima	SASE
Salix spp.	SAspp.
Shepherdia canadensis	SHCA
Viburnum edule	VIED

[a]Includes *Betula glandulosa* and *B. pumila*.

Table 13. Measurements taken at microplots to determine densities of browse species.

ID.[a]	Nearest Clump[b]			Nearest Neighbor[c]		
No.	Species	Dist.[e]	No. of Stems[d]	Species	Dist.	No. of Stems
132	POTR[f]	15	1	AMAL	87	1
133	POTR	15	1	AMAL	87	1
130	AMAL	19	1	AMAL	30	1
131	AMAL	19	1	AMAL	30	1
134	POTR	87	1	AMAL	82	1
136	ROWO	28	1	AMAL	16	1
137	ROWO	28	1	AMAL	16	1
139	ROWO	25	1	ROWO	40	1
140	ROWO	25	1	ROWO	40	1
142	SASE	65	1	SASE	65	1
138	SAPL	70	1	SAPL	60	22
141	SAPL	70	1	SAPL	60	22
143	AMAL	8	1	AMAL	50	1
144	AMAL	21	1	AMAL	22	1
145	AMAL	21	1	AMAL	22	1
146	SABE	220	1	SABE	100	1
159	VIED	35	1	ROWO	55	1
160	VIED	35	1	ROWO	55	1
161	VIED	35	1	ROWO	55	1
162	VIED	35	1	ROWO	55	1
163	VIED	35	1	ROWO	55	1
152	VIED	120	1	COCO	40	1
153	VIED	120	1	COCO	40	1
154	VIED	120	1	COCO	40	1
155	VIED	120	1	COCO	40	1
151	COCO	22	1	VIED	8	1
156	VIED	45	1	VIED	28	1
157	SABE	25	1	SABE	200	1
158	ROWO	334	1	POTR	150	1
164	SHCA	42	6	SHCA	60	2
172	SAPL	250	24	SAPL	80	4
173	SAPL	250	24	SAPL	80	4
165	SAPL	25	1	SAPL	155	5
166	SAPL	25	1	SAPL	155	5
168	SAPL	25	1	SAPL	155	5

Continued ...

Table 13. Continued.

	Nearest Clump[b]			Nearest Neighbor[c]		
ID.[a] No.	Species	Dist.[e]	No. of Stems[d]	Species	Dist.	No. of Stems
169	SAPL	25	1	SAPL	155	5
170	SAPL	25	1	SAPL	155	5
167	SABE	142	27	SAPL	150	23
174	SHCA	275	10	SHCA	300	10
175	SHCA	275	10	SHCA	300	10
176	SHCA	275	10	SHCA	300	10
177	POTR	40	1	POTR	250	1
178	AMAL	35	3	AMAL	10	1
179	ROWO	37	1	AMAL	60	1
180	AMAL	20	1	AMAL	76	1
181	POTR	15	1	SABE	45	8
182	AMAL	20	1	AMAL	20	1
183	AMAL	34	1	AMAL	14	1
184	AMAL	70	1	AMAL	22	1
185	AMAL	70	1	AMAL	22	1
186	AMAL	70	1	AMAL	22	1
187	AMAL	43	1	AMAL	10	1
188	AMAL	43	1	AMAL	10	1
189	AMAL	43	1	AMAL	10	1
190	VIED	20	1	VIED	15	1
191	VIED	20	1	VIED	15	1
192	VIED	20	1	VIED	15	1
193	VIED	20	1	VIED	15	1
194	VIED	20	1	VIED	15	1
195	SHCA	25	1	SHCA	25	1
196	SHCA	25	1	SHCA	25	1
197	ROWO	48	1	ROWO	106	1
198	ROWO	48	1	ROWO	106	1
199	-[g]	-	-	-	-	-
200	-	-	-	-	-	-
201	BEspp.	30	1	BEspp.	60	7
202	BEspp.	13	1	BEspp.	13	1
203	BEspp.	45	1	BEspp.	20	1
204	BEspp.	20	1	BEspp.	15	1
205	POTR	43	1	POTR	5	1

Continued . . .

Table 13. Continued.

ID.[a] No.	Nearest Clump[b] Species	Dist.[e]	No. of Stems[d]	Nearest Neighbor[c] Species	Dist.	No. of Stems
206	SABE	50	3	SABE	60	4
207	SAPL	33	1	SAPL	35	1
208	SAPL	11	1	SAPL	10	1
209	SAPL	11	1	SAPL	10	1
210	POTR	43	1	SHCA	80	1
211	BEspp.	30	1	BEspp.	15	1
212	SASE	55	2	SASE	40	2
213	SAMA	37	9	SAMA	35	1
214	VIED	110	1	SHCA	90	3
215	VIED	110	1	SHCA	90	3
216	POTR	100	1	BEspp.	89	14
217	POTR	25	1	POTR	110	1
218	POBA	90	1	BEspp.	89	1
219	SABE	20	1	SABE	25	1
220	BEspp.	10	1	BEspp.	8	1
221	SHCA	15	2	SHCA	45	3
222	BEspp.	30	3	BEspp.	25	1
223	SABE	22	4	SABE	20	1
224	VIED	10	1	AMAL	19	1
225	ROWO	45	1	ROWO	35	1
226	SAPL	50	6	SAPL	40	7
227	SAPL	25	10	SAPL	45	18
228	SAPL	25	10	SAPL	45	18
229	SABE	65	10	SHCA	55	6
230	SABE	65	10	SHCA	55	6
231	SABE	65	10	SHCA	55	6
232	SABE	65	10	SHCA	55	6
233	SHCA	105	9	SHCA	75	15
234	SHCA	42	5	SHCA	25	1
235	POBA	42	1	POBA	21	1
236	BEspp.	45	19	BEspp.	130	9
237	SABE	270	1	-	-	-
238	BEspp.	70	7	BEspp.	130	20
239	SABE	43	3	SABE	47	3
240	AMAL	24	1	AMAL	41	3

Continued . . .

Table 13. Concluded.

ID.[a]	Nearest Clump[b]			Nearest Neighbor[c]		
No.	Species	Dist.[e]	No. of Stems[d]	Species	Dist.	No. of Stems
241	AMAL	24	1	AMAL	41	3
242	SABE	65	10	SHCA	55	6
243	SABE	65	10	SHCA	55	6
244	SABE	65	10	SHCA	55	6
245	SABE	65	10	SHCA	55	6
246	AMAL	20	1	AMAL	25	1
247	AMAL	20	1	AMAL	25	1
248	AMAL	20	1	AMAL	25	1
250	AMAL	20	1	AMAL	25	1
251	AMAL	20	1	AMAL	25	1
252	AMAL	20	1	AMAL	25	1
253	AMAL	20	1	AMAL	25	1
254	AMAL	28	1	AMAL	22	1
255	AMAL	28	1	AMAL	22	1
256	AMAL	28	1	AMAL	22	1
257	AMAL	25	1	SHCA	5	1
258	POTR	113	1	AMAL	35	1
259	AMAL	12	1	AMAL	11	1
260	SABE	47	5	SABE	48	4

[a] Identification number of microplot where measurements were taken (see Table 11).
[b] Nearest clump to microplot centre.
[c] Nearest neighboring clump to nearest clump.
[d] Number of stems in each clump.
[e] Distance in centimetres.
[f] Abbreviation for browse species (see Table 12).
[g] No clump of browse encountered.

Table 14. Instances of use of each browse species within macroplots.

ID.[a] No.	Species	Use[b]	Species	Use	Species	Use	Species	Use	Species	Use
10	PRPE[c]	69	POTR	12						
18	SABE	40								
20	SABE	77	AMAL	158						
27	AMAL	30	SABE	16	COST	5	ROWO	2		
66	AMAL	16	RVspp	28						
69	SABE	33	POTR	4						
67	SABE	66								
65	PRPE	15	AMAL	4						
63	AMAL	3								
62	SABE	46	AMAL	29						
75	SADI	50	SASE	2	SAMC	57	SABE	6		
71	SAMC	7	SASE	10	SADI	8	SAPL	112		
81	AMAL	13	POTR	4	PRPE	3				
82	SABE	63	SADI	4						
83	SABE	66	AMAL	3	PRPE	5	SADI	42		
84	AMAL	5								
91	AMAL	196	ROWO	13	SABE	9				
93	AMAL	136	SABE	18						
94	AMAL	94	ROWO	4						
108	AMAL	231	PRPE	12						
96	BEPA	12								
97	AMAL	9	POTR	6						
98	BEPA	34	POTR	52						
104	AMAL	10	POTR	42						
101	AMAL	73	POTR	6	COCO	141	PRPE	1		

Continued . . .

Table 14. Continued.

ID.[a] No.	Species	Use[b]	Species	Use	Species	Use	Species	Use	Species	Use
105	AMAL	159	PRPE	2	ALCR	6	POTR	5	COCO	49
107	AMAL	164	ALCR	20	POTR	10	PRPE	35		
117	AMAL	128	ROWO	8	SABE	17	VIED	3		
118	AMAL	246	VIED	6						
111	AMAL	223	SABE	12						
112	AMAL	7	VIED	1	SABE	8	BEPA	9		
127	BEspp.	49	SADI	17	SASE	4				
126	AMAL	35								
132	AMAL	110	SABE	6						
130	AMAL	105	SABE	62	SHCA	3	POTR	2	VIED	3
134	AMAL	43	SABE	43	VIED	1	POTR	1		
138	AMAL	177	ROWO	6	POTR	1				
139	AMAL	7								
140	SAPL	69	SASE	17	SAspp.	2				
141	SAPL	142	SAMA	4	SASE	27	SAspp.	2		
145	AMAL	160	POTR	4						
143	AMAL	118	SABE	5	PRVI	3				
151	VIED	115	COCO	111	AMAL	24	ROWO	1		
156	SABE	38	VIED	24	BEPA	17				
184	AMAL	156								
187	AMAL	150								
179	AMAL	95	SABE	49	ROWO	1				
180	AMAL	88	SABE	25						
178	AMAL	167	SABE	5						
181	AMAL	23	SABE	2	POTR	8				

Continued . . .

Table 14. Continued.

ID.[a] No.	Species	Use[b]	Species	Use	Species	Use	Species	Use	Species	Use
183	AMAL	149	SABE	21						
182	AMAL	118	SABE	4	POTR	1				
190	AMAL	82	VIED	10						
201	SAMY	53	SASE	28	BEspp.	33				
205	ALCR	37	SABE	9	POTR	6				
207	SABE	13	SAPL	31	SASE	26				
208	SAPL	163	SASE	10	SAMA	3				
210	AMAL	178	ALCR	21	POTR	2				
211	SAPL	50	SAMY	80						
212	SAPL	93								
213	SAMA	3	SAPL	19	SABE	11				
229	AMAL	120								
225	VIED	30	AMAL	18	SABE	13				
226	POBA	7	SAPL	19						
227	BEspp.	36	SAPL	41	SASE	27	SAMY	54	SAMA	9
240	AMAL	106	SABE	32	VIED	1	SADI	18	POTR	36
221	AMAL	72	POTR	4						
220	SAPL	43								
234	AMAL	140	SABE	19	POTR	6	POBA	3	SADI	3
233	SABE	84	SAMA	5						
250	AMAL	132	POTR	14						
246	AMAL	203								
249	AMAL	141	POTR	4						
257	AMAL	151	POTR	2						
258	AMAL	130	POTR	22						

Continued . . .

Table 14. Concluded.

ID.[a] No.	Species	Use[b]	Species	Use	Species	Use	Species	Use	Species	Use
259	AMAL	201	POTR	6						
260	AMAL	194	SABE	5						

[a]Identification number of microplot at feeding site (see Table 11).
[b]Number of instances of use of each browse species.
[c]Abbreviations for browse species (see Table 12).

Table 15. Depth and density of snow measured at sampling points on the snow course during January and February.

	Depth (in)[a]				Density	
Habitat Stratum	Jan. 8	Jan. 23	Feb. 10	Feb. 27	Jan. 8	Feb. 10
Tall Willow	16.00	7.00	9.50	8.00	0.13	0.32
	7.75	8.00	9.00	6.50	0.26	0.22
	11.50	8.50	11.00	8.75	0.17	0.23
	11.50	7.00	11.00	6.50	0.19	0.18
	10.00	7.50	10.00	13.00	0.18	0.20
Black Spruce	9.25	7.00	10.00	9.00	0.16	0.20
	8.25	6.50	10.00	7.50	0.18	0.25
	7.50	8.00	11.00	7.50	0.13	0.27
	9.00	6.00	7.50	7.00	0.17	0.13
	3.50	5.50	6.50	4.00	0.29	0.23
		14.00	11.50	9.50		0.32
		3.50	3.50	2.50		0.14
		7.50	11.00	8.00		0.18
Tamarack	11.00	8.25	9.00	9.00	0.18	0.22
	7.50	10.00	13.00	7.00	0.13	0.23
	16.50	9.50	11.50	7.00	0.11	0.22
	11.00	8.50	10.00	9.50	0.14	0.15
	11.00	8.00	12.00	9.00	0.18	0.17
Black Spruce-Tamarack	10.00	8.00	8.50	8.50	0.13	0.18
	8.75	6.25	9.00	9.00	0.23	0.22
	10.50	8.00	9.50	9.00	0.17	0.21
	5.50	7.25	7.50	6.50	0.18	0.13
	10.00	7.00	11.00	8.50	0.23	0.23
Apsen-Black Spruce	9.00	7.00	10.00	9.00	0.17	0.20
	2.50	4.50	7.00	4.50	0.20	0.14
		6.50	8.50	5.50		0.18
		3.00	7.00	5.00		0.14

continued ...

9. AOSERP RESEARCH REPORTS

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21.		AOSERP Second Annual Report, 1976-77
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28.	VE 2.1	Interim Report on a Soils Inventory in the Athabasca Oil Sands Area
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