INTERIM REPORT ON SEMI-AQUATIC MAMMAL STUDIES, 1977-1978

by

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for

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

PROJECT TF 3.1

May 1979

The Hon. J.W. (Jack) Cookson
Minister of the Environment
222 Legislative Building
Edmonton, Alberta

and

The Hon. John Fraser
Minister of the Environment
Environment Canada
Ottawa, Ontario

Sirs:

Enclosed is the report "Interim Report on Semi-Aquatic Mammal Studies, 1977-1978".

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

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Member, Steering Committee, AOSERP
Regional Director-General
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INTERIM REPORT ON SEMI-AQUATIC MAMMAL STUDIES 1977-1978

DESCRIPTIVE SUMMARY

BACKGROUND AND PERSPECTIVE

The objective of this project was to determine the role and significance of semi-aquatic mammal populations in the undisturbed and disturbed boreal forest ecosystem in the AOSERP study area.

Originally the project was expected to proceed for a number of years, but was terminated after one field season.

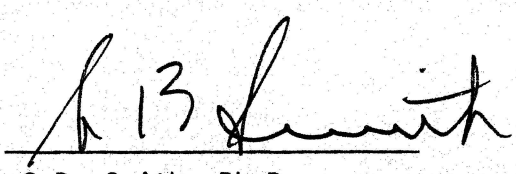
This report was the first to gain information on aquatic mammals in the AOSERP study area. Research has been continued at a later date (incorporated into AOSERP Project LS 23.2).

ASSESSMENT

The report entitled "Interim Report on Semi-Aquatic Mammal Studies, 1977-1978" was prepared by Dr. F.F. Gilbert (University of Guelph, Guelph, Ontario) and has been reviewed by the Alberta Oil Sands Environmental Research Program, members of the Land System Scientific Advisory Committee, and external referees.

The report will received limited distribution. The annotated bibliography to the report (under separate cover) will receive wide distribution, published in view of its high information value to other AOSERP researchers and the public.

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



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ABSTRACT

The semi-aquatic mammals study which was initiated in September 1976 saw its first field season during 1977-78. Research efforts were concentrated in the Muskeg River drainage area and the Dover-Snipe River headwaters area. Live trapping and tagging of the four study species, beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), mink (*Mustela vison*), and otter (*Lutra canadensis*), were conducted while the study areas were intensively reconnoitered.

Analysis of 488 otter scats showed a predominance of fish remains (85.5% contained fish) while 198 mink scats had mammals as the predominant food item (67.7% contained mammalian remains).

Beaver selected *Populus* species ($p < 0.05$) while in descending order of preference was willow (*Salix* sp.), alder (*Alnus* sp.), and white birch (*Betula papyrifera*). Conifer species were only rarely utilized.

Two mink were radio-tracked, one for a period of 5 days and the other for 21 days, during October-November and habitat utilization by the animals was documented.

Beaver surveys (aerial) were conducted for the two study areas as well as the Syncrude area. A muskrat survey was undertaken for the Syncrude area also. Both beaver (+7.5%) and muskrat (+80.0%) populations had increased on the Syncrude site since a 1975-76 survey, probably due to the reduction of trapping and the provision of more habitat for muskrat.

Efforts were made to begin riparian habitat mapping in the absence of such maps from other AOSERP projects. Contacts were made with the trapping community to foster co-operation in the return of tags and information regarding our tagged animals.

An annotated bibliography of selected references of pertinence to the semi-aquatic mammals study was completed and published under separate cover (Gilbert in prep.).

Recommendations for future co-operative research needs and expansion of TF 3.1 into the Richardson Lakes area were itemized.

ACKNOWLEDGEMENTS

I would like to thank the following people who assisted in the data collection for this report. S. McGovern and D. Reid were capable leaders in a field crew which included M. Rothfels, J. Inglis, R. Moses, A. Alexander, and M. Fairbarns. S. Brown and M.E. Stoll worked diligently on the bibliography and G. Nancekivell assisted in some of the scat analysis.

J. McDonnell did an excellent job of detailing a study of the effects of water level changes in the Syncrude lease site as a graduate problem before this project was terminated.

Many people associated with AOSERP support staff at Fort McMurray and Mildred Lake and other research projects were of great assistance, as were biologists of the Alberta Department of Recreation, Parks and Wildlife, Fish and Wildlife Division. Without naming them all I thank them warmly for their help.

Finally, I wish to thank the secretaries in the Department of Zoology at the University of Guelph, particularly D. Alberton who persevered through drafts of this report.

This research project TF 3.1 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 northeastern Alberta.

1. INTRODUCTION

The semi-aquatic mammals study is designed to determine the role and significance of otter, mink, muskrat, and beaver populations in the undisturbed and disturbed boreal forest ecosystem in the Alberta Oil Sands Environmental Research Program (AOSERP) study area (Figure 1). From such data, potential impact of oil sands development will be predicted and reclamation and management strategies to enhance semi-aquatic mammal populations in the post-development period will be recommended.

Aspects of oil sands development likely to affect these four species include air quality changes, land clearing, increased sedimentation rates in certain water bodies, diversion of streams, fluctuations in water levels in holding and tailings ponds, water quality changes, and the concomitant changes in other faunal and floral life system components directly or indirectly related to the above (Anon. 1973). In addition, all four study species are important furbearers and, as such, important elements in the local economy where many families are still, at least partially, dependent on income from fur trapping (Anon. 1973). The beaver has the ability to independently alter the environmental conditions and this attribute may pose conflict with human activities in the AOSERP study area.

The specific objectives of this project are as follows:

1. Conduct a thorough literature review on the following topics. This review will form part of the 1977-78 interim report.
2. Determine population structure (age, sex, density), distribution, and biomass for each species.
3. Determine habitat requirements for each species and develop an annotated list of characteristics that define the habitat of each species and that will be suitable for mapping potential habitats from air photos and ground surveys. Comment on whether the habitat characteristics can be determined from air photos or ground surveys.

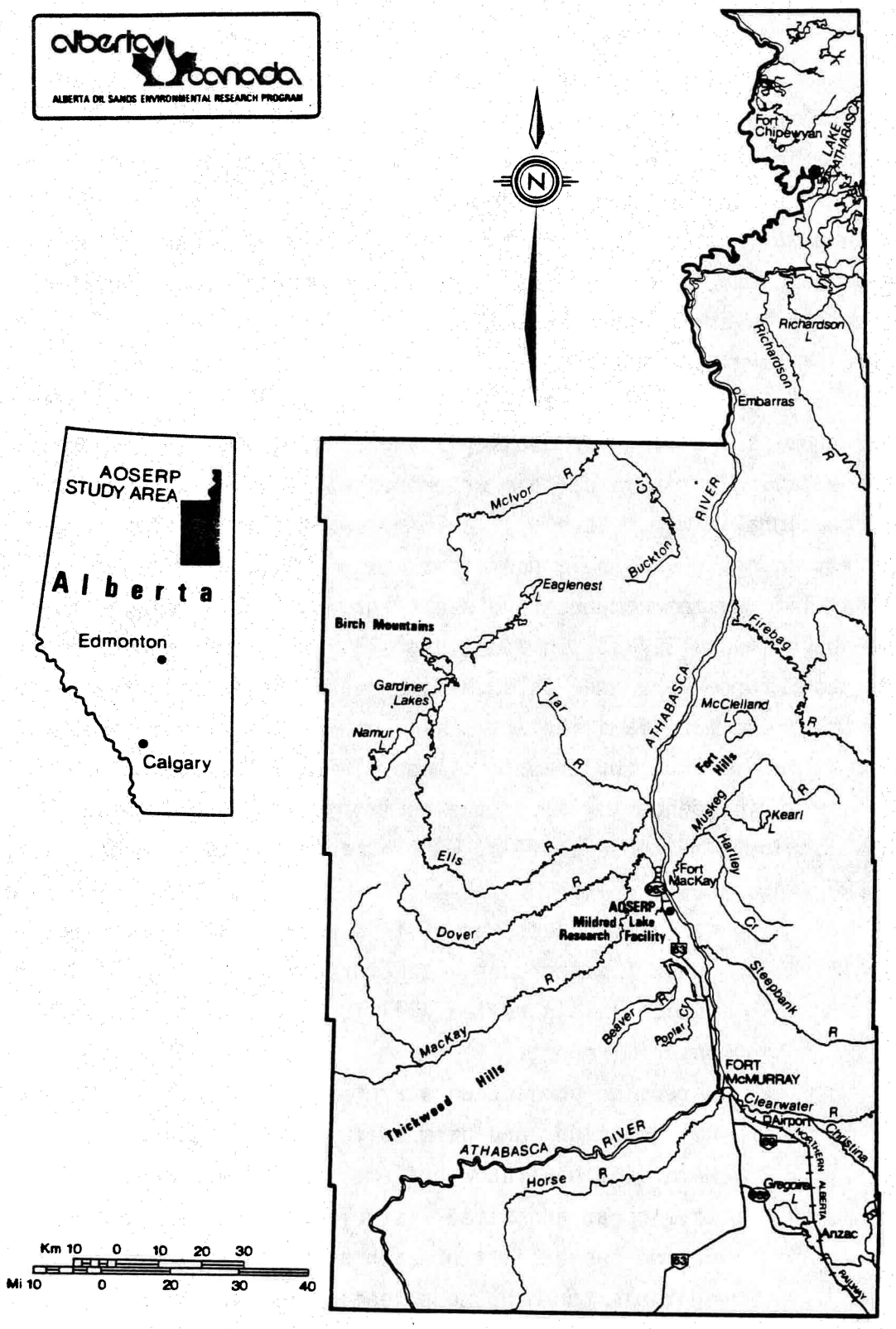

Figure 1. Map of the Alberta Oil Sands Environmental Research Program study area.

4. Work with photo interpreters conducting the vegetation and soils inventory to ensure that interpretation will be compatible with the preliminary habitat mapping of the semi-aquatic mammals. Initially, 1:60,000 color IR photo transparencies will be used, and mapping will be carried out at a scale of 1:50,000. It is anticipated the air photos will be acquired by September 1977. The contractor should comment on the adequacy of these scales for habitat mapping.
5. Describe the relationship of each species to plants and fish.
6. Examine briefly the importance of each species as prey items.
7. Examine hydrological consequences of beaver activity, e.g. on stream flows and sediment flow.
8. Determine impact of industrial developments on semi-aquatic mammals, considering land clearing, stream diversion, sediments, water quality, and water quantity.
9. Examine potential impacts of aquatic contamination, including the potential changes in groundwater quality and quantity, on semi-aquatic mammals.
10. Recommend management alternatives that are required to minimize adverse effects to semi-aquatic mammals during the oil sands development period.
11. Recommend reclamation and management strategies which will enhance the semi-aquatic mammals in the post development period.

The base-line data collected through the semi-aquatic mammals study on the distribution and abundance of these four species in relation to natural and man-influenced environments in the AOSERP study area will allow the development of effective management scenarios by 1981. The first full research year of what was to be a long term study was in 1977-78 and included extensive literature

surveys and the initiation of field work in three different portions of the AOSERP study area. Research included shoreline and stream reconnaisance, live-trapping, radio-tracking, habitat mapping, scat analysis, and the initiation of co-operative activities with the trapping community and personnel of other AOSERP research projects.

2. RESUME OF CURRENT STATE OF KNOWLEDGE

Considerable literature on the beaver, muskrat, mink and otter is available and there have been a few bibliographic efforts to summarize this published information (Shump et al. 1976a, 1976b; Newberry 1973). However, there are few papers of direct relevance to the analysis of the impact of man-induced environmental modification (especially in the boreal forest biome) on these four species (cf. Czapowskyj 1976; Ralston et al. 1977). For the most part the available studies simply attempt to predict impact with no more than rudimentary knowledge of the base populations and their relationship to the local environments and without adequate pre- and post-development assessment of the situation as in the MacKenzie Valley Environmental Assessment (Dennington et al. 1973; Dennington and Johnson 1974). The few cases where detailed evaluation are available are in vegetative and climatic conditions far removed from the AOSERP study area. One must be careful when extrapolating from other studies. For example, studies in the Peace Athabasca Delta (Fuller 1951; Westworth 1973) provided much useful information on muskrat populations but habitat conditions in the Delta are not duplicated in the AOSERP study area. However, the much smaller, localized muskrat populations outside the Delta are possibly very important to the mink and otter populations.

Some useful studies concerning habitat classification have recently been completed (Slough and Sadleir 1977; Whitaker and McCuen 1976) and these will supplement the approach we are taking (Stocker et al. 1977; Stocker and Gilbert 1977).

Although considerable information has been published on North American muskrat and beaver (Gilbert in prep.), few data are available for populations within the AOSERP study area. Generally only affidavits filled out by trappers to report their fur harvest are available and these cannot be used to determine local furbearer abundance (Todd 1976). Studies on these two species within the AOSERP study area have been concentrated

in the Peace-Athabasca Delta (Anon. 1975).

Virtually no comprehensive North American literature exists on otter while Errington's (1943, 1954) mink and muskrat population studies still provide much of the base information on mink biology on this continent. However, some useful studies on mink have been done more recently in Alaska (Burns 1964; Croxton 1960). The fur returns alluded to earlier, and some otter track counts conducted by the Alberta government, are the only information available for mink and otter within the AOSERP study area.

The potential environmental impacts of oil sand development include habitat destruction through aforestation and manipulation of drainage patterns (diversion) and modification of biotic and physical condition of water (Anon. 1973). Changes in pH may well occur in watersheds contaminated by acid fallout and lowered pH means low species diversity (Hargreaves et al. 1975). The resultant faunal and floral changes due to increased acidity are bound to affect the potential of the aquatic system to support mink, muskrat (Arata 1959), beaver (Krenzler 1971), and otter--but to what degree? Furthermore, attempts to predict biological impact (Herricks et al. 1975; Herricks and Shanholtz 1976) generally have not included mammalian vertebrates in the model.

However, even if we assume secondary damage, e.g. increased acidity, to be minimal it is necessary to be in a position to propose rehabilitation criteria which will re-create conditions amenable to the species in question. This must be based on sound ecological study of the relationships of those species to various habitat conditions (e.g. Jenkins 1975; Retzer 1955 for beaver) yet these data are also unavailable for the AOSERP study area. Accordingly, there is a need for ecological studies of the type being undertaken in the semi-aquatic mammals study as the existing literature provides only a few insights into the status of resident AOSERP study area furbearers and the effects that development of the oil sands will have on them.

3. STUDY AREAS

Three areas were under investigation during 1977-78 (Figure 1, see also Figures 14-16). Each possessed physiographic, vegetative and human influence attributes different from the others which will allow extrapolation to much of the entire AOSERP study area.

3.1 MUSKEG RIVER

The Muskeg River drainage basin survey area (approximately 57°10' to 57°20' N and 111°10' to 111°30'W) comprised about 450 km^2 and included most of the drainage below the 355 m contour. Elevation ranged from 275-355 m and the bulk of the riparian habitat bordered on streams. The terrestrial plant communities included Types 1-9 as described by Stringer (1976). This survey area includes parts of oil leases 13, 36, 88 and 89 and registered traplines 1714, 1716 and 2172.

The physiography, surficial geology and soils of the Muskeg River drainage basin have been well described elsewhere (Lindsay et al. 1962; Carrigy and Kramers 1973).

3.2 DOVER-SNIPE HEADWATERS

The Dover and Snipe Rivers have a number of small lakes in their headwaters and these formed the bulk of a second survey area for the semi-aquatic mammals study. Mean elevation ranged from 520-580 m and although Stringer's (1976) vegetative types 1-9 were all represented, in contrast to the Muskeg River survey area, most of the riparian habitat bordered lakes. Parts of oil lease 53 and traplines 21, 771, 772 and 879 were included in this 50 km^2 (approximately 57°10' to 57°20' N and 112°30' to 112°45' W) survey area. While associated with the drainage off the Birch Mountains, the survey area is actually within the high plains area south of the Mountains (Carrigy and Kramer 1973). Few data are available on the soils or surficial geology of this area.

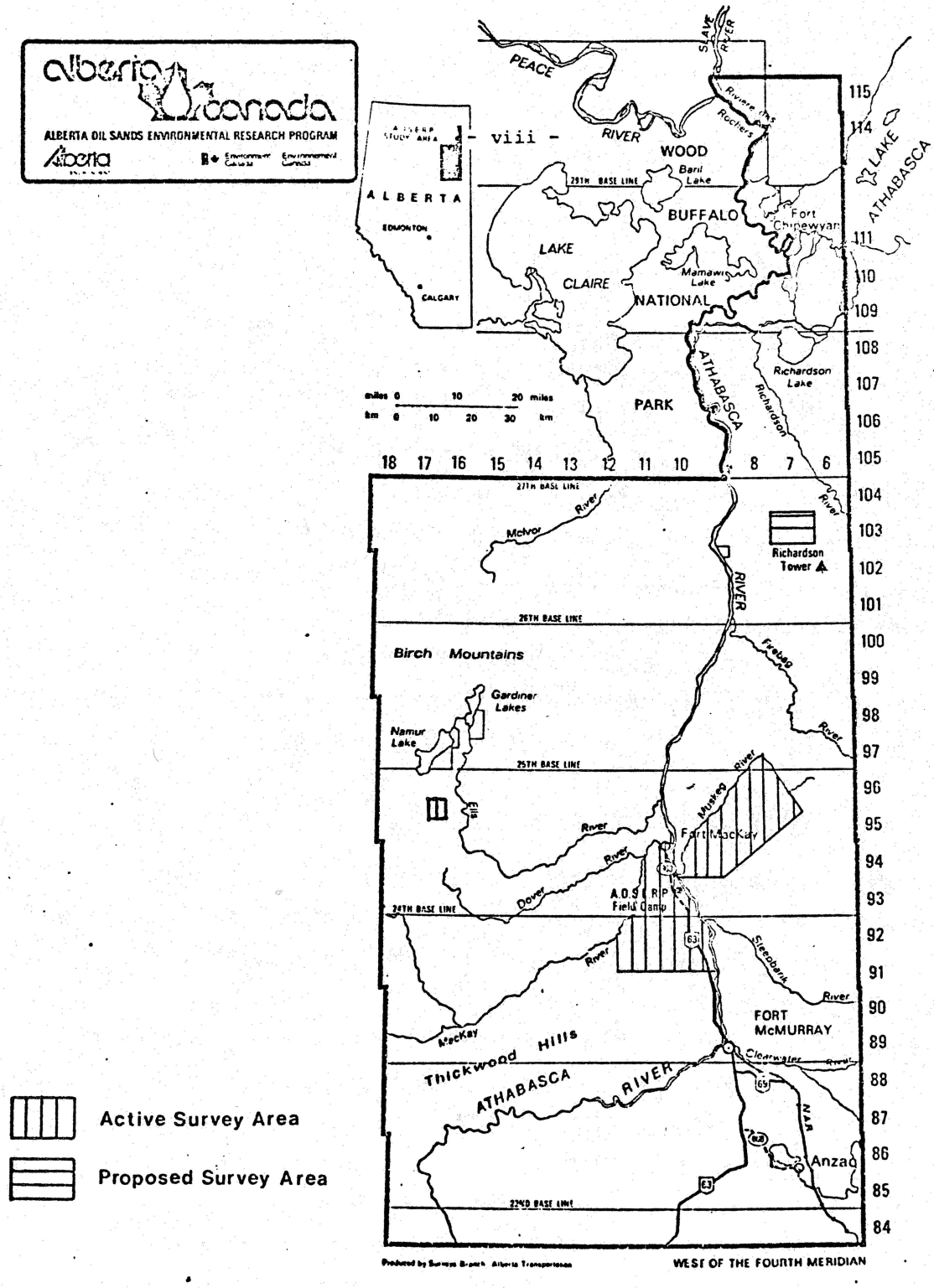

Figure 2. Semi-aquatic mammal survey areas 1977-78 and proposed 1978-79.

3.3 SYNCRUDE LEASES

The Syncrude survey area incorporated leases 17 and parts of 22 and 23. It was almost 400 km^2 (approximately 57°00' to 57°10' N and 111°35' to 111°45' W) in size and elevation ranged from 275 to 400 m.

There are no active trap-lines in the area and Syncrude controls trapping activity (Aleksiuk, Head, Aquatic Environment Section, Syncrude; discussions June-Aug. /77, letters 28 Nov./77, 25 Jan./78). The physiography, soils and vegetation of this general area are described by Penner (1976). This survey area offered the opportunity to evaluate semi-aquatic mammal populations in an environment currently similar to the other two survey areas but where major modifications would take place in 1978 due to the initiation of production at the Syncrude plant. This survey area also offered the advantage of reduced direct human intervention in the form of trapping on semi-aquatic mammal populations in recent years.

3.4 RICHARDSON LAKES

It is proposed that a fourth survey area, the Richardson Lakes, will be incorporated in the 1977-78 otter survey and the 1978-79 field work. This survey area would provide the opportunity to study semi-aquatic mammals in riparian habitats dominated by jack-pine (*Pinus banksiana*), Stringer's (1976) Type 10, which is not presented in either the Muskeg River or Dover-Snipe Headwaters survey areas.

4. MATERIALS AND METHODS

4.1 RECONNOITERING

Both the Muskeg River drainage and the Dover-Snipe headwaters survey areas were reconnoitred intensively on foot during the period May-August to pinpoint centres of activity for the four study species. This information was needed to allow correlation of distribution with habitat types.

4.1.1 Beaver Cuttings

The riparian habitats were examined to determine beaver cutting locations (old and fresh).

These areas of concentrated beaver cutting activity were sampled using two 10 m x 10 m plots. The plot boundaries were 20 m apart and fronted on the water-land interface. All trees within the plot were identified to species and classified as cut or uncut; diameter at breast height (dbh) was either measured or estimated when only a stump was available. The data from the two plots in each cutting area were combined to represent one sampling area. The data from all sampling areas were then analyzed to determine if beaver were selecting certain species to cut. Each tree species was represented by a regression line where Y axis = trees selected (represented by newly cut stumps) and X axis = trees available (represented by trees cut this year plus trees still standing). Only the current year's cut trees were considered in the regression analysis as older stumps would have to be aged accurately to exact year of cut to determine the variation in the number of trees available to the beaver during the past cutting seasons. The slopes of the regression lines for each species were compared by analysis of covariance to determine if significant differences existed indicating a preference for one species over another. If the slopes were significantly different ($P < 0.05$) the analysis of covariance was continued by employing multiple comparisons among the slopes to illustrate which were different

from which others (Zar 1974).

Other data collected at the cutting sites included the maximum distance of cutting activity from the water's edge, and slope conditions from shore-line to furthest point of cutting activity along randomly selected transects (Section 11.1).

4.1.2 Other Semi-aquatic Mammal Sign

Beaver lodge and dam locations were reported on sketch maps of the area being reconnoitred. Other pertinent information recorded included the locations of mink dens, muskrat houses, otter latrines, and otter trails. These data were transferred to permanent reference maps at appropriate scales for reference when habitat mapping was complete and for selection of live-trapping sites.

4.1.3 Scat Collection

All otter and mink scats found during reconnoitering or other research activities were collected in plastic bags, labelled as to date of collection and location, and stored for future analysis. Some scats from old otter latrines and mink den sites, where separation of individual scats was impossible, were pooled.

Wolf scats were also collected and handled as above but analysis was carried out by personnel of the large mammals project.

4.2 LIVE TRAPPING AND TAGGING

A live trapping and tagging program was necessary to provide information on population, sex and age composition, population density, and species movement patterns.

4.2.1 Beaver

Beaver were live-trapped using Hancock (Hancock Trap

Co., Hot Springs, S.D.) traps. Traps were placed in channels to feeding sites as blind sets or were set on land baited with trembling aspen. Captured animals, excepting young of the year, were anaesthetized with ketamine hydrochloride (Ketaset, Rogar Chemical Co., London, Ont.) at a dosage rate of approximately 10 mg/kg. Beaver were tagged in each ear with a size No. 1 monel tag and in the tail with a size No. 681 monel tag (National Band and Tag Co., Newport, N.Y.). Data collected included sex (determined by external or internal palpation), age (kit, yearling, or adult), weight (to nearest 0.5 kg), zygomatic breadth (by caliper measurement), and trap location (Section 11.1).

4.2.2 Muskrat

Muskrat were live-trapped using wire box traps (12.7 cm x 12.7 cm x 40.6 cm, National Life Trap Co., Tomahawk, Wisc.; 20.3 cm x 21.0 cm x 59.4 cm, Tender-Trap, Victor/Woodstream, Niagara Falls, Ont.). Carrots were used as bait in these traps. Submarine traps (Canadian Trading Post, Burlington, Ont.) were also used. Captured animals were anaesthetized with Ketaset (approximately 8 mg/kg) and then ear-tagged with No. 1 monel tags, sexed, aged (juvenile or adult), weighed (to nearest 10 mg), and released. Trap site location was recorded (Section 11.1).

4.2.3 Mink

Mink were live-trapped using the same types of traps used for muskrat trapping. Baits included Hawbaker's Lures (Canadian Trading Post, Burlington, Ont.), sardines, muskrat flesh, and vegetation scented by the presence of muskrat. Captured mink were ear-tagged with No. 1 monel tags while anaesthetized with Ketaset (approximately 10 mg/kg). Sex, age (juvenile or adult), weight, and location of capture were recorded (Section 11.1). Radio-collars (AVM Instrument Co., Champaign, Ill.) operating in the 164 mHz range were placed about the neck of captured mink.

4.2.4 Otter

Otter were to be treated in a fashion similar to mink once captured (No. 3 monel ear tags and radio-collars from AVM Instruments Co.). Hancock traps were set under water near beaver dams, at latrine locations, and at the end of otter trails. No. 2 Blake-Lamb (Hawkins Co., South Britain, Conn.) leg hold traps were set on land at trail and latrine locations.

4.3 RADIO-TRACKING

Attempts were made to re-locate radio-collared animals each day a field crew was operating within the survey area where the animal was captured. The animal's location was determined by triangulation using hand-held yagi antennae and receivers (Model LA12, AVM Instruments Co., Champaign, Ill.). Streams were walked or attempts to pick up signals were made where access trails crossed the streams.

When an animal was located its position was plotted on a sketch map and habitat conditions and any signs of the animal's activity patterns at the site were recorded. A rough estimate of home range was determined by measuring the maximum length of stream or shore-line utilized by the animal.

4.4 SCAT ANALYSIS

Mink and otter scats which had been collected in the field were brought to the Mildred Lake laboratory where they were air dried, total volume was determined, and the scat contents separated into fish, mammalian, avian, other vertebrate, invertebrate, vegetation, and debris categories (Section 11.1). Fish remains were identified to species using a reference scale, otolith collection, and Lagler's (1947) key to scale identification. Mammalian remains were identified by skeletal material and hair impressions (Stains 1959; Adjorjan and Kolenosky 1969). Avian and other vertebrate remains were identified by feathers and skeletal parts while invertebrates

were identified by exoskeleton, wing, and remains of other hard structures (consultation with experts A. Middleton, Ornithology; D. Pengelley, Entomology, University of Guelph). Based on these identifications prey species lists were compiled for various regions of the Muskeg River and Dover-Snipe Headwaters survey areas where scats had been collected.

Volumetric measurements were also made of each scat component category.

4.5 AERIAL CENSUSES

Aerial censuses were conducted to determine the numbers of active beaver and muskrat domiciles. Area population estimates require knowledge of both active domicile locations and average numbers of individuals per domicile. The latter was to be provided by the reconnoitering and live-trapping results.

4.5.1 Muskeg River Drainage Beaver Census

The entire Muskeg River survey area was flown with a Cessna 180 aircraft during the first week of October. All water courses were followed and the location of all active beaver areas plotted on 1:50,000 maps. An active beaver area was determined by the presence of a freshly mudded lodge plus fresh food pile (cache), or in the absence of a visible lodge, solely on the presence of a fresh food cache. Altitude and speed were variable as much circling was involved to accurately observe all water areas but average height was about 200 m and average speed 150 km/hr. Two observers were used.

4.5.2 Dover-Snipe Headwaters Beaver Census

The Dover-Snipe Headwaters survey area was also flown during the first week of October to ascertain the location of all active beaver sites. Aerial survey techniques were identical to the Muskeg River drainage survey except that three observers were present.

4.5.3 Syncrude Beaver and Muskrat Census

The Syncrude survey area was flown during the first week of October using a Hughes 500 helicopter. The entire area was flown on a systematic basis which included parallel overlapping transects to the west of the road to Fort MacKay. Beaver impoundments and lakes were flown at a height of about 15 m above the water surface to locate active muskrat houses (defined as those with recent cuttings and mudding present). Beaver activity was classified as active or old based on the presence or absence of a fresh food cache with the lodge. This area was surveyed with the author as sole observer.

4.6 TRAPPER CO-OPERATION

Rewards were offered for the return of tags and radio-collars found on semi-aquatic mammals taken during the fur trapping season and information on the place of harvest. Posters advertising this were displayed in Fort MacKay and Fort McMurray (Section 11.1). In addition, discussions were held with the band chief in Fort MacKay to publicize the study and the need for trapper co-operation. Personal contacts with Indians and Métis trapping the Muskeg River and Dover-Snipe Headwaters survey areas were made. This included discussions with Indians from the Chipewayan Lake settlement who trapped in the Dover-Snipe Headwaters survey area.

4.7 HABITAT MAPPING

Riparian habitats in the Muskeg River survey areas were typed using aerial photograph interpretation (Figure 3). Photographs used were 1:12,500 colour prints taken in 1976 and 1:21,120 black and white prints that were taken in 1972. The habitats were classified by dominant tree species; white birch (*Betula papyrifera*), willow/alder (*Salix* sp./*Alnus* sp.), white spruce (*Picea glauca*), black spruce (*Picea mariana*),

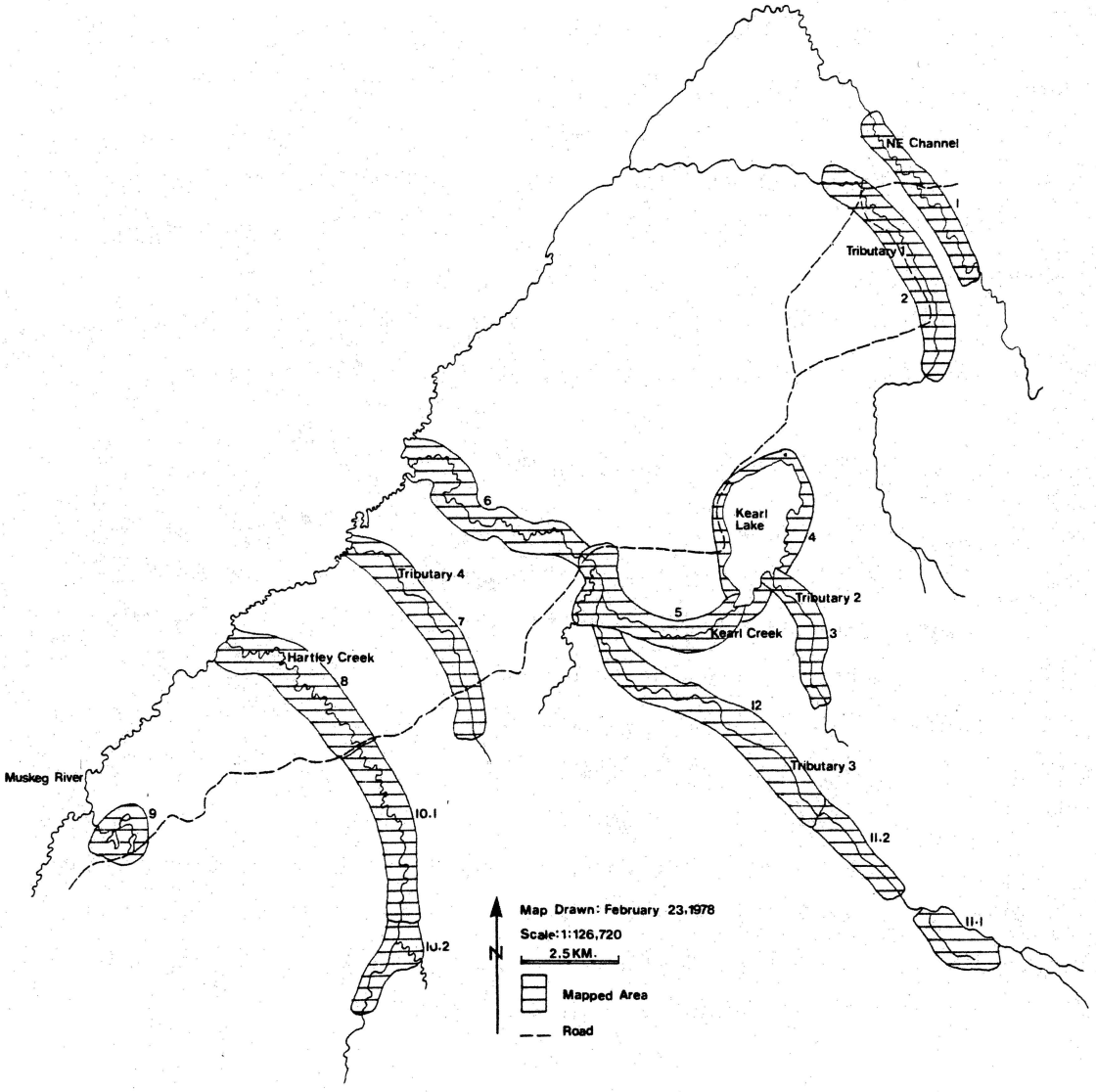

Figure 3. Portions of Muskeg River drainage mapped for riparian habitat typing.

aspen or poplar (*Populus* sp.), or by other vegetation (shrubs, bog/marsh). Tree composition and percent crown cover were given as <25%, 25-50%, 50-75%, >75%, or 100%. Height was measured as <20 ft (6.1 m), 20-40 ft (6.1 - 12.2 m), and >40 ft (12.2 m) by use of a parallax wedge. Each habitat type was delineated on an acetate overlay and the areal extent of each unit determined by a dot grid.

Ground truthing was conducted during July and August, using randomly selected plots within accessible areas, representative of the different overstory types. Ground cover was visually estimated while understory and overstory were quantified by the point quarter method (Greig-Smith 1964).

Consultations were held with Intera Environmental Consultants Ltd. (Calgary, Alta.) with respect to the habitat characteristics we would like to see included in the phase I habitat mapping of the AOSERP study area.

4.8 ANNOTATED BIBLIOGRAPHY

An annotated bibliography of selected references of pertinence to the semi-aquatic mammal study was compiled. Literature of no relevance to the AOSERP study was not included. In addition to perusal of abstracts (e.g. Bioabstracts, Zoological Review, Wildlife Review) and journals (e.g. J. Wildl. Manage., Can. J. Zool., J. Mammal.) held in the University of Guelph's McLaughlin Library, references were acquired through the Biological Information Service, the Fish and Wildlife Reference Service, and the Journal of Mammalogy's citation retrieval system for the four species. Categories utilized in compilation for each species were: life history, mortality factors, physiology, environmental quality, and management. In addition, a few references not directly on the species in question but of relevance were listed under "Pertinent Ancillary Studies".

This bibliography has been published under separate cover as AOSERP Report 59, Semi-Aquatic Mammals: Annotated Bibliography (Gilbert in prep.).

5. RESULTS

5.1 RECONNAISSANCE

Thirty-two active beaver lodges, 70 active dam sites, 3 active mink dens, and 16 active otter latrines were located in the Muskeg River drainage area (Figures 4-10). This compared with 15 active beaver lodges, 14 active dam sites, 21 active mink dens, and 18 active otter latrines found in the Dover-Snipe Headwaters area (Figures 11-12). Muskrat activity was limited to Kearl Lake, the outflow area of Pelican Lake, and a few of the marshes on Dover Lake. However, only Pelican, Dover, and Clearwater lakes were reconnoitred for muskrat sign in the Dover-Snipe Headwaters survey area.

Otter and mink were seen several times in the Dover-Snipe Headwaters survey area and heavily used otter trails were found linking the water routes between the lakes in this survey area. There was much evidence of heavy trapping pressure in the Muskeg River drainage with an active trapper's cabin on Kearl Lake. Trappers in the Dover-Snipe Headwaters area maintained snowmobile trails into Snipe, Pelican, and Dover Lakes but there were no permanent dwellings being utilized.

5.2 BEAVER CUTTINGS

The data from a total of 30 sample areas were analyzed to derive the following regression lines for the tree species:

trembling aspen	(*Populus tremuloides*)	Y = 0.818 X -0.98
balsam poplar	(*Populus balsamifera*)	Y = 0.797 X -0.47
willow	(*Salix*)	Y = 0.400 X +0.10
alder	(*Alnus*)	Y = 0.161 X +0.59
white birch	(*Betula papyrifera*)	Y = 0.104 X +0.62
white spruce	(*Picea glauca*)	Y = 0.71 (X=0)
jack pine	(*Pinus banksiana*)	Y = 0.71 (X=0)

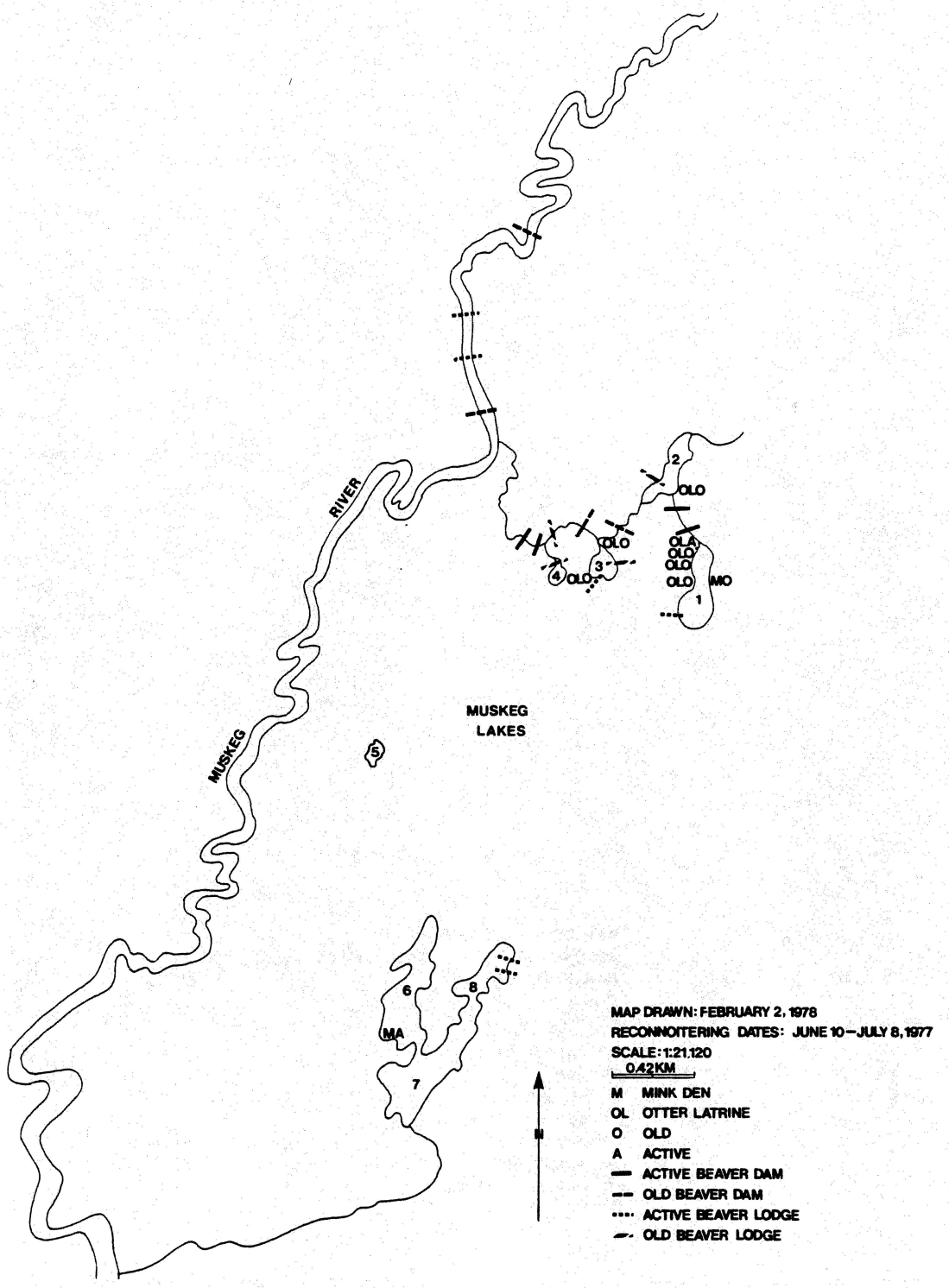

Figure 4. Muskeg River drainage survey area 1977 reconnaissance (western sector including Muskeg Lakes).

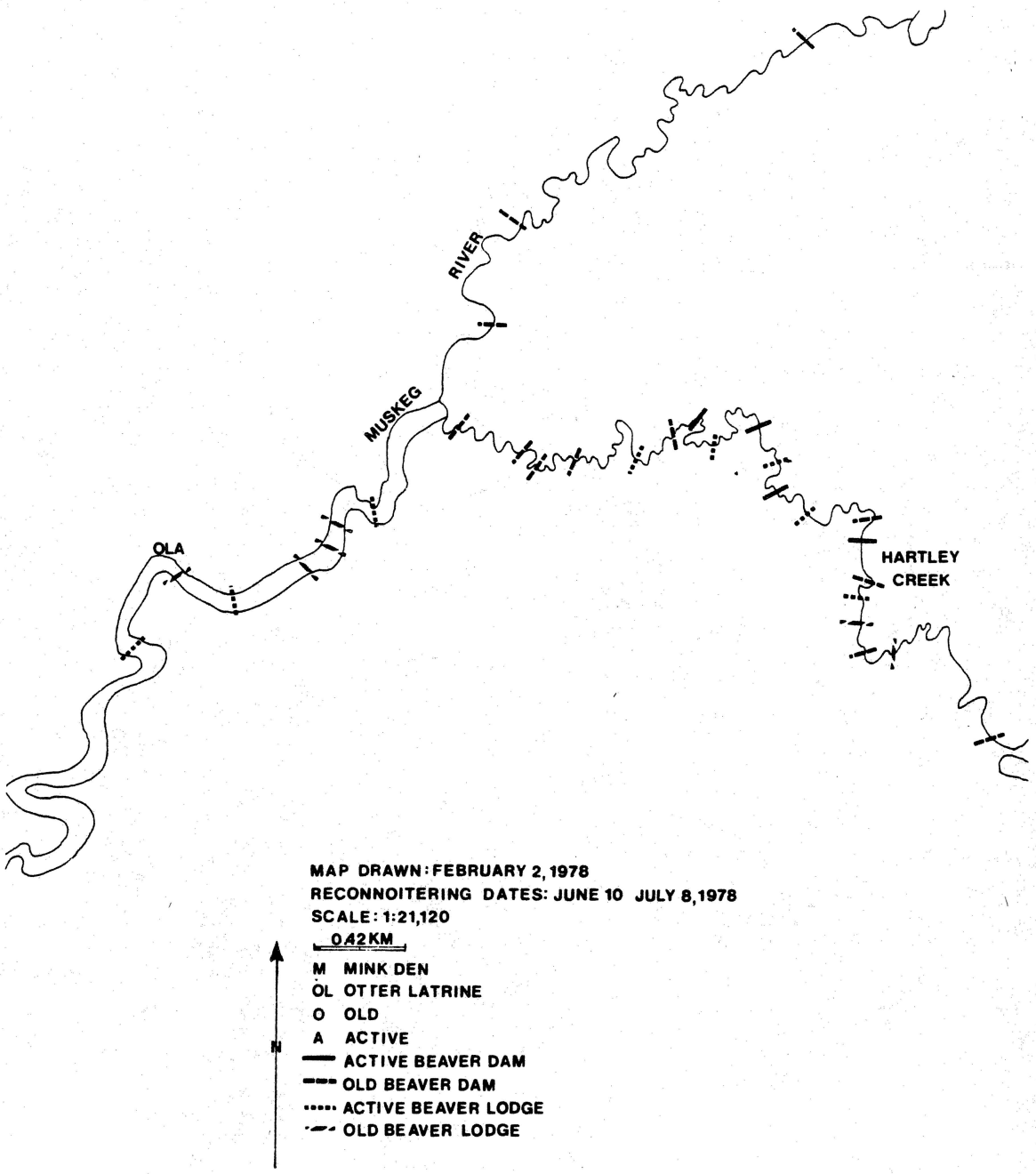

Figure 5. Muskeg River drainage survey area 1977 reconnaissance (western sector including lower Hartley Creek).

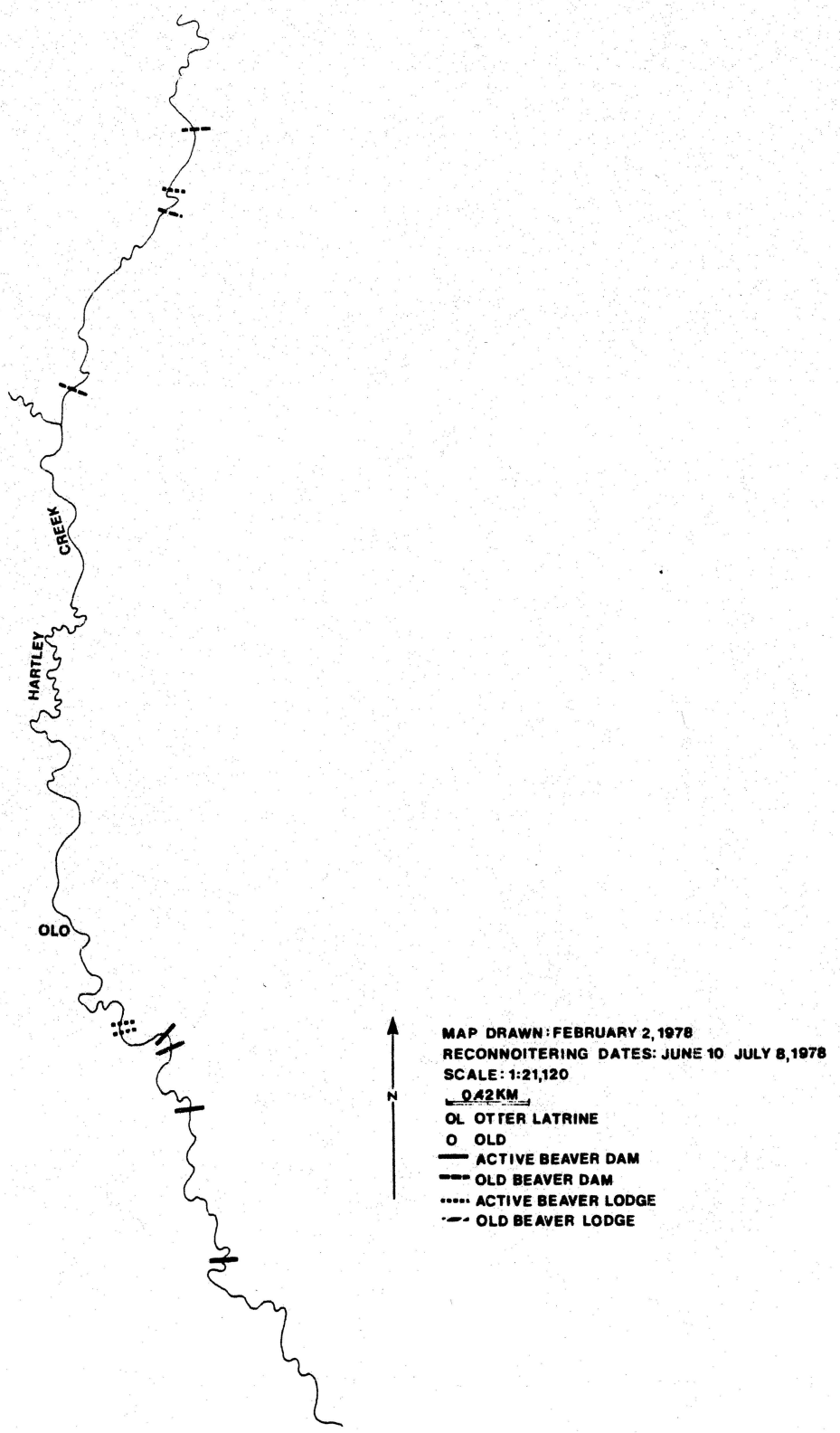

Figure 6. Muskeg River drainage survey area 1977 reconnaissance (upper Hartley Creek).

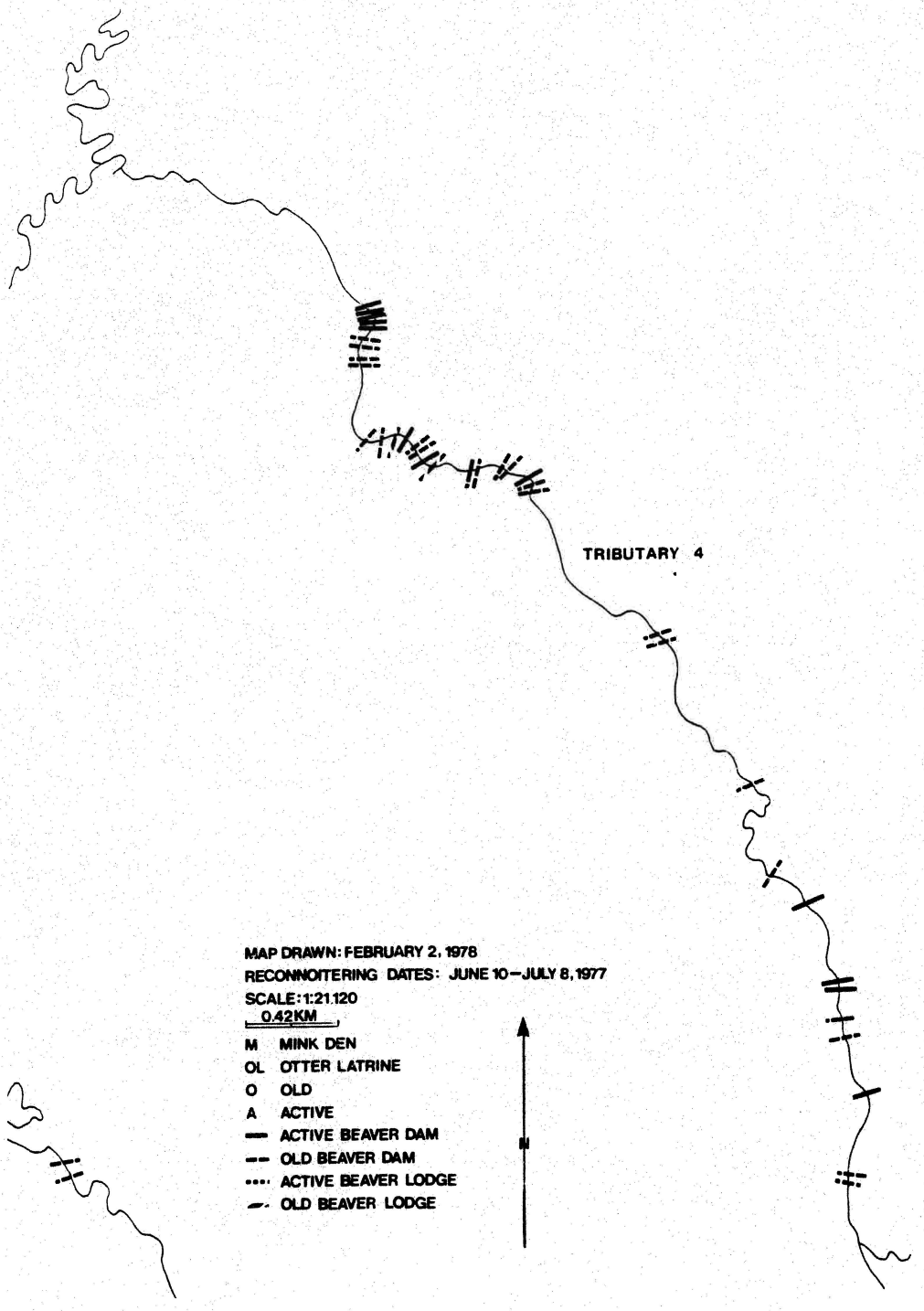

Figure 7. Muskeg River drainage survey area 1977 reconnaissance (Tributary 4).

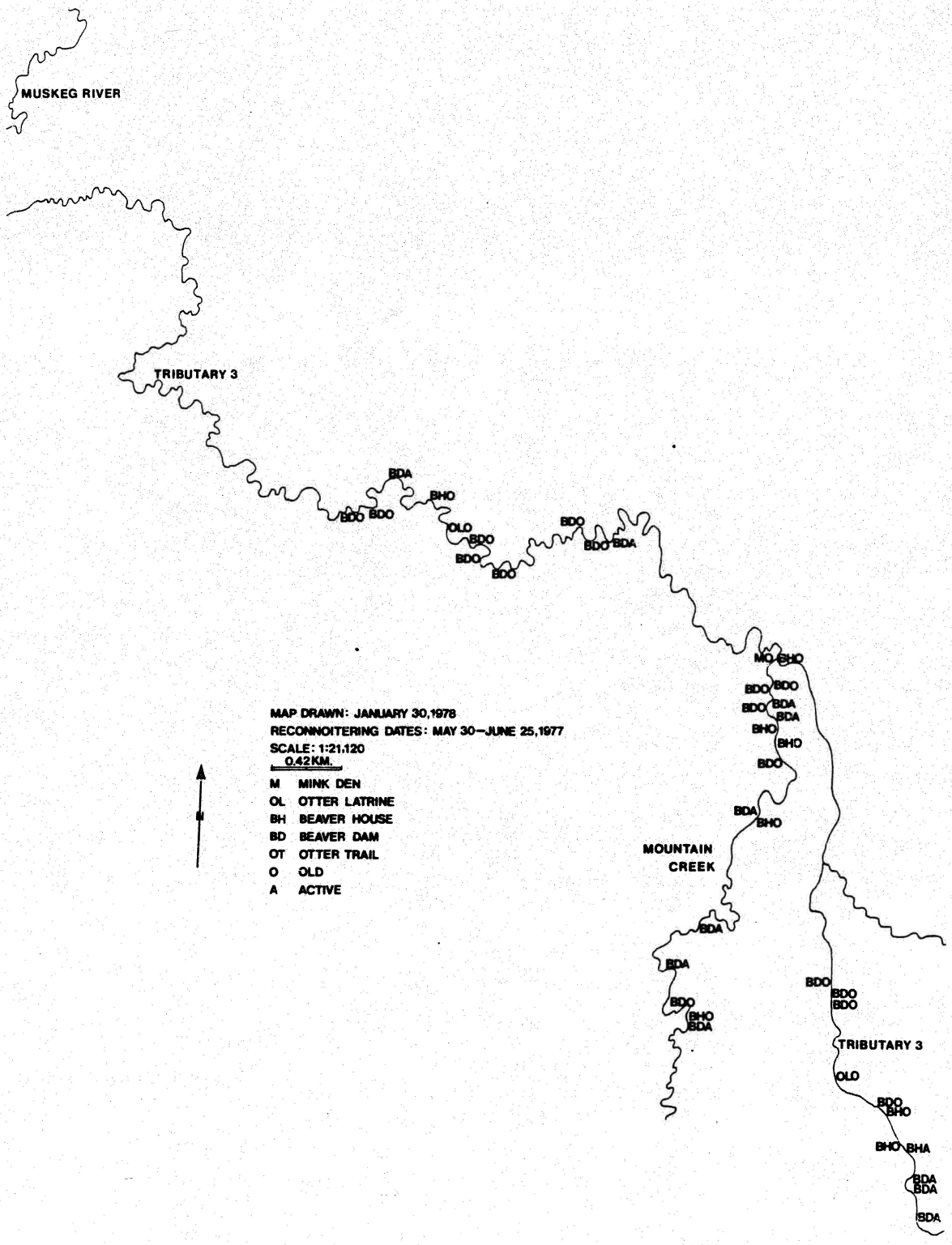

Figure 8. Muskeg River drainage survey area 1977 reconnaissance (Tributary 3 and Mountain Creek).

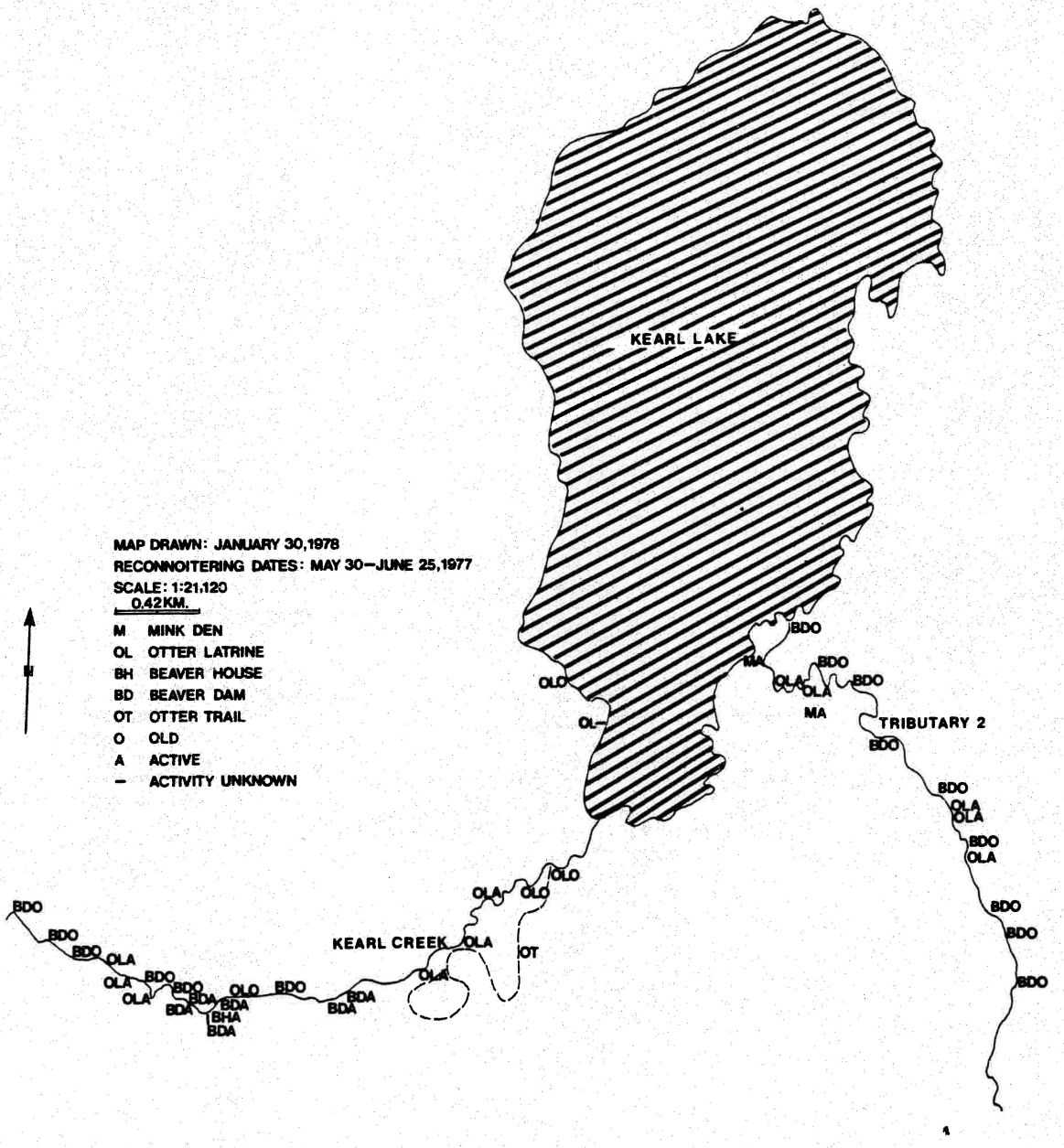

Figure 9. Muskeg River drainage survey area 1977 reconnaissance (Kearl Lake area).

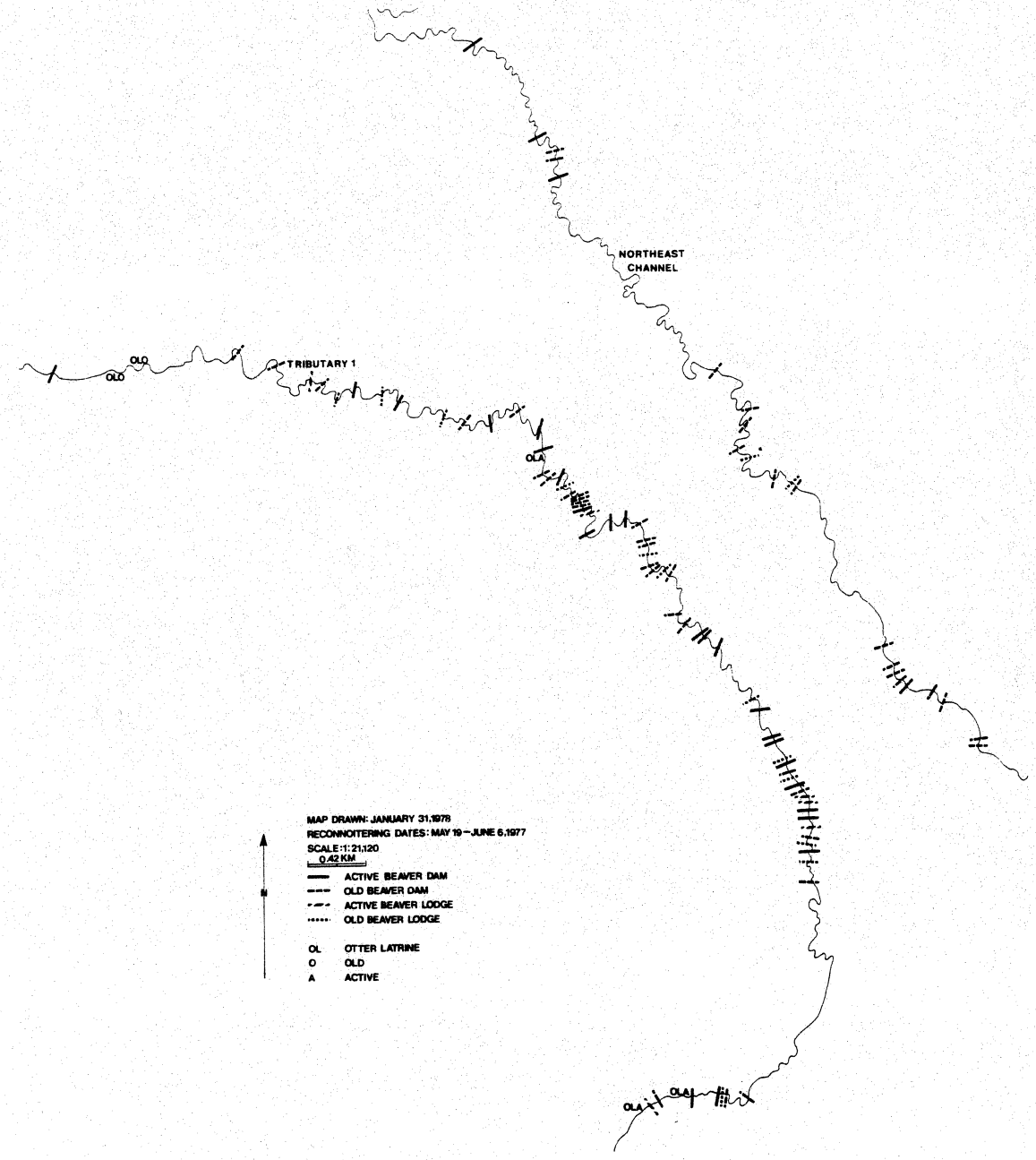

Figure 10. Muskeg River drainage survey area 1977 reconnaissance (eastern sector including Tributary 1).

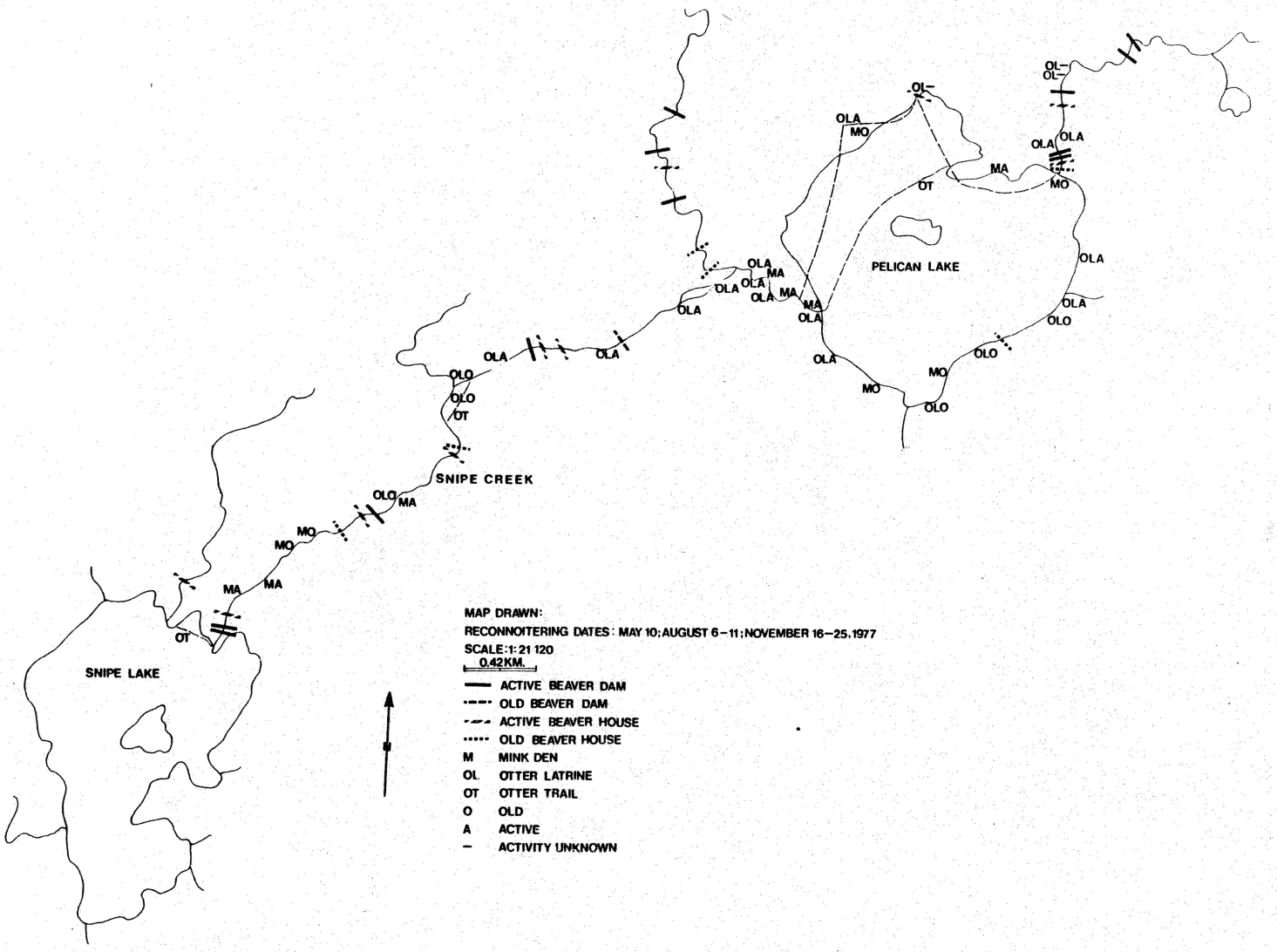

Figure 11. Dover-Snipe Headwaters semi-aquatic mammals survey area, 1977 reconnaissance (Pelican Lake and Snipe Lake).

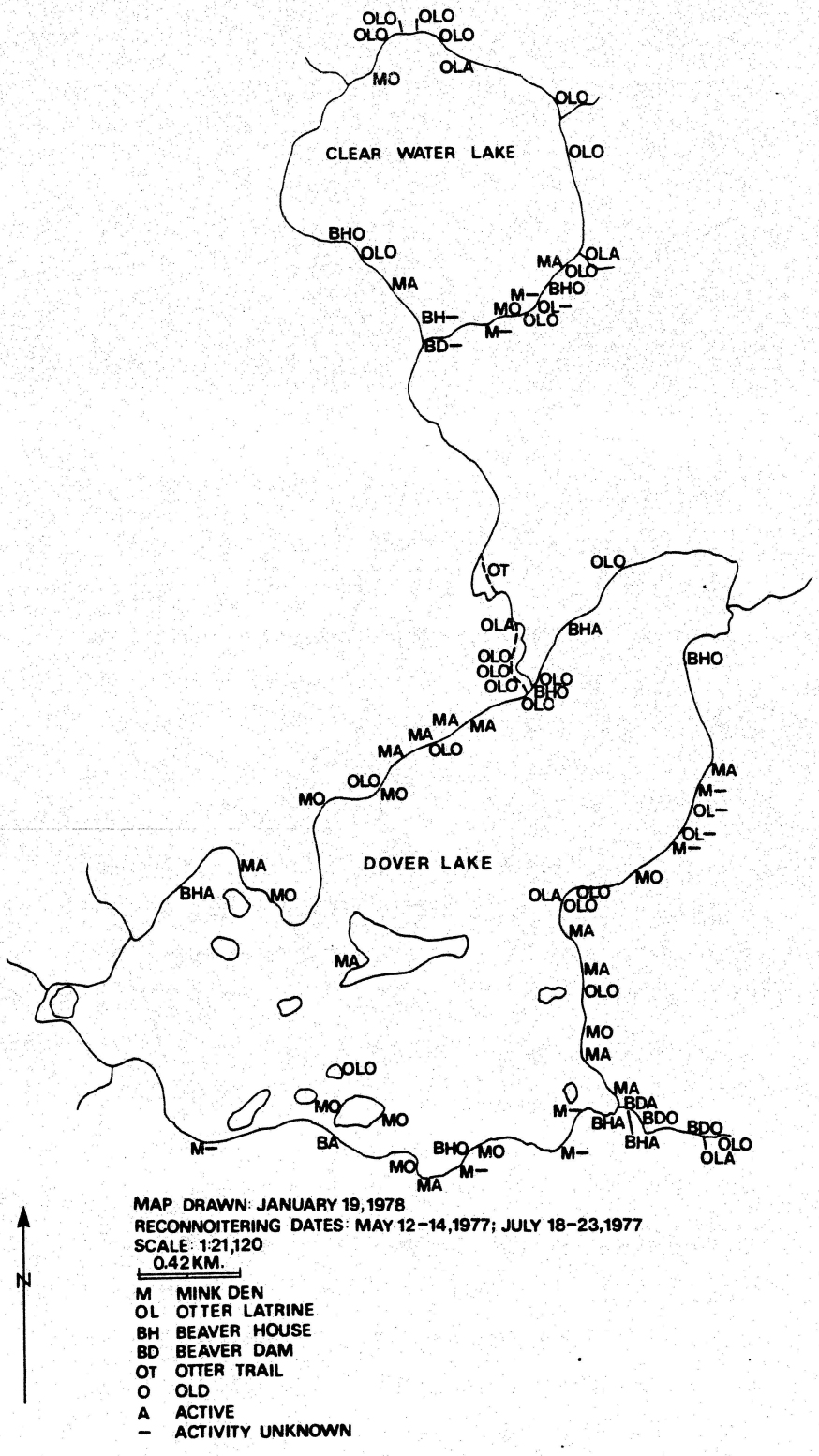

Figure 12. Dover-Snope Headwaters semi-aquatic mammals survey area, 1977 reconnaissance (Clearwater Lake and Dover Lake).

The analysis showed significant differences of slopes indicating beaver were selecting for particular species. Neither conifer species was utilized though readily available on the plots and thus were being avoided by beaver. The regression lines for balsam, poplar, and trembling aspen were significantly parallel at the p = 0.05 level (Table 1). However, balsam poplar differed significantly from willow with the probability of the computed F value of 5.943 = 0.981. Willow and alder were significantly parallel as were willow and white birch. As suspected, white birch departed significantly from parallelism when compared to white spruce.

In terms of tree selection vs. tree availability, *Populus* sp. were preferable to the other tree species present. Willow, alder, and white birch all departed from parallelism with white spruce and jack pine indicating preference for these species over the conifers.

The average distance from water's edge to furthest cutting was 29.1 m (31.1 m Dover-Snipe Headwaters; 24.9 m Muskeg River drainage). No further analysis of the data was made.

The average slope for 30 transects in the Dover-Snipe Headwaters survey area was 0.129 and in the Muskeg River survey area 0.216 for 46 transects. The slopes associated with streams (average = 0.204) were greater than those associated with lakes (average = 0.170).

5.3 LIVE-TRAPPING

The 1,781 trap nights for beaver produced 201 captures (0.11 beaver/trap night) (Table 2). There were 7 mortalities; 5 due to drowning, 1 killed by the trap closing on its neck, and 1 due to unknown causes. In the Muskeg River drainage 104 different animals were tagged while in the Dover-Snipe Headwaters areas 48 beaver were individually marked. The overall sex ratio was not statistically different from 1:1 (Table 3).

Table 1. Multiple comparisons among slopes of regression lines for tree species at beaver cutting sites to determine selectivity (analysis of co-variance).

Regression Line Comparisons			Probability of Occurrence of Bartlett's Statistic	α	Parallelism Hypothesis $Ho\text{-}B_1 = B_2$	Computed F - value	Probability of Computed F - value
aspen	vs.	balsam poplar	0.9718	0.05	accepted	0.01	0.116
balsam poplar	vs.	willow	0.9871	0.05	rejected	5.943	0.981
willow	vs.	alder	0.9847	0.05	accepted	2.18	0.853
alder	vs.	white birch	0.8036	0.05	accepted	0.367	0.439
white birch	vs.	white spruce	1.0	0.05	rejected	5.773	0.978
aspen	vs.	willow	1.0	0.05	rejected	4.873	0.970
aspen	vs.	white birch	1.0	0.05	rejected	10.581	0.997
aspen	vs.	white spruce	1.0	0.05	rejected	26.882	1.000
willow	vs.	white birch	0.9999	0.05	accepted	3.438	0.930
willow	vs.	white birch	1.0	0.05	rejected	11.775	0.999

Table 2. Beaver live-trapping results for Dover-Snipe Headwaters and Muskeg River survey areas, 1977.

Area	Trap Nights	Captures	(Recaptures)	#Tagged	Mortalities	Beaver/Trap Night
Clearwater Lake	71	10	(0)	10	0	0.14
Dover Lake	251	34	(7)	24	2	0.14
Pelican Lake	54	17	(3)	14	1	0.31
Muskeg River	207	17	(6)	11	2	0.08
Tributary 1	322	32	(6)	26	0	0.10
Tributary 2	10	1	(1)	0	0	0.10
Tributary 3	89	16	(4)	12	0	0.18
Tributary 4	104	5	(0)	5	0	0.05
Hartley Creek	298	29	(5)	21	2	0.10
Kearl Creek	72	21	(5)	16	0	0.29
Kearl Lake	29	4	(2)	2	0	0.14
Muskeg Lake 2	82	6	(2)	4	0	0.07
Muskeg Lake 3	40	4	(0)	4	0	0.10
Muskeg Lake 4	132	1	(0)	1	0	0.0.
Muskeg Lakes Outflow	20	4	(2)	2	0	0.20
Totals	1,781	201	(43)	152	7	0.11

Table 3. Sex and age data for tagged beaver in Dover-Snipe Headwaters and Muskeg River survey areas, 1977.

Area	Adults			Juveniles		Kits		
	♂	♀	?	♂	♀	♂	♀	?
Clearwater Lake	1	3	-	4	2	-	-	-
Dover Lake	12	3	-	-	-	5	4	-
Pelican Lake	2	3	-	2	1	4	2	-
Muskeg River	7	1	-	3	-	-	-	-
Tributary 1	7	6	-	4	6	1	1	-
Tributary 3	2	5	-	-	1	3	1	-
Tributary 4	1	2	-	1	-	-	-	-
Hartley Creek	11	4	1	-	3	2	-	1
Kearl Creek	3	5	-	2	5	1	1	-
Kearl Lake	-	1	-	1	-	-	-	1
Muskeg Lake 2	1	1	-	-	1	1	-	-
Muskeg Lake 3	2	1	-	-	-	1	-	-
Muskeg Lake 4	1	-	-	-	-	-	-	-
Muskeg Lakes Outflow	-	-	-	-	-	2	-	-
Totals	40	35	1	17	19	20	9	2

Eight muskrats were tagged on Kearl Lake and five on Pelican Lake (Table 4). Submarine traps were abandoned for muskrat trapping when three animals (one a re-capture) were found dead of exposure. Three mink were captured in the Muskeg River drainage survey area and two in the Dover-Snipe Headwaters survey area (Table 5). Radio-collars were placed on the male and female caught at Muskeg River Tributary 3 and on a male caught at the Pelican Lake outflow marsh. No otter were caught despite 218 trap nights of effort.

5.4 RADIO-TRACKING

Two mink, an adult male and an adult female, captured near the confluence of Kearl Creek, Mountain Creek, and Tributary 3 were radio-collared. Although the transmitter on the collar placed on the female was operating when she was released, the animal was never re-located and radio failure is suspected. The male was radio-tracked from 21 October to 10 November. The animal was located on 10 different days within the three week period. Four denning sites were located all associated with spruce (3 white, 1 black) habitat types (Figure 13). The animal appeared to move between hunting den locations about every four days. Evidence of a bird kill was found. Known length of stream utilized by this male was about 6.5 km (Figure 13).

The adult male mink captured in the outflow area of Pelican Lake was radio-tracked from 7 October to 11 October. It was successfully re-located twice. Total stream length known to be utilized was about 1.0 km (Figure 14) but this animal also must have worked the northern shore of Pelican Lake. It was caught by trappers on 23 November and the collar was retrieved. Because the battery ends had worn through, the radio was not transmitting at the time of capture. There was some sign of abrasion from the collar.

Table 4. Muskrat live-trapping results in AOSERP study area, 1977.

Area	Trap Nights	Captures	(Recaptures)	Tagged	Mortalities	Muskrat/Trap Night
Dover Lake	68	0	-	-	-	0.00
Pelican Lake	94	8	(1)	5	3	0.09
Kearl Creek	86	0	-	-	-	0.00
Kearl Lake	150	16	(8)	8	1	0.11
Totals	398	24	(9)	13	4	0.06

Table 5. Mink live-trapping results in AOSERP study area, 1977.

Area	Trap Nights	Captures	Tagged	Mink/Trap Night
Dover Lake	13	0	-	0.00
Pelican Lake	223	2	1	0.01
Tributary 3	110	2	2	0.02
Tributary 4	86	0	-	0.00
Kearl Lake	168	1	-	0.01
Kearl Creek	30	0	-	0.00
Mountain Creek	86	0	-	0.00
Totals	716	5	3	0.01

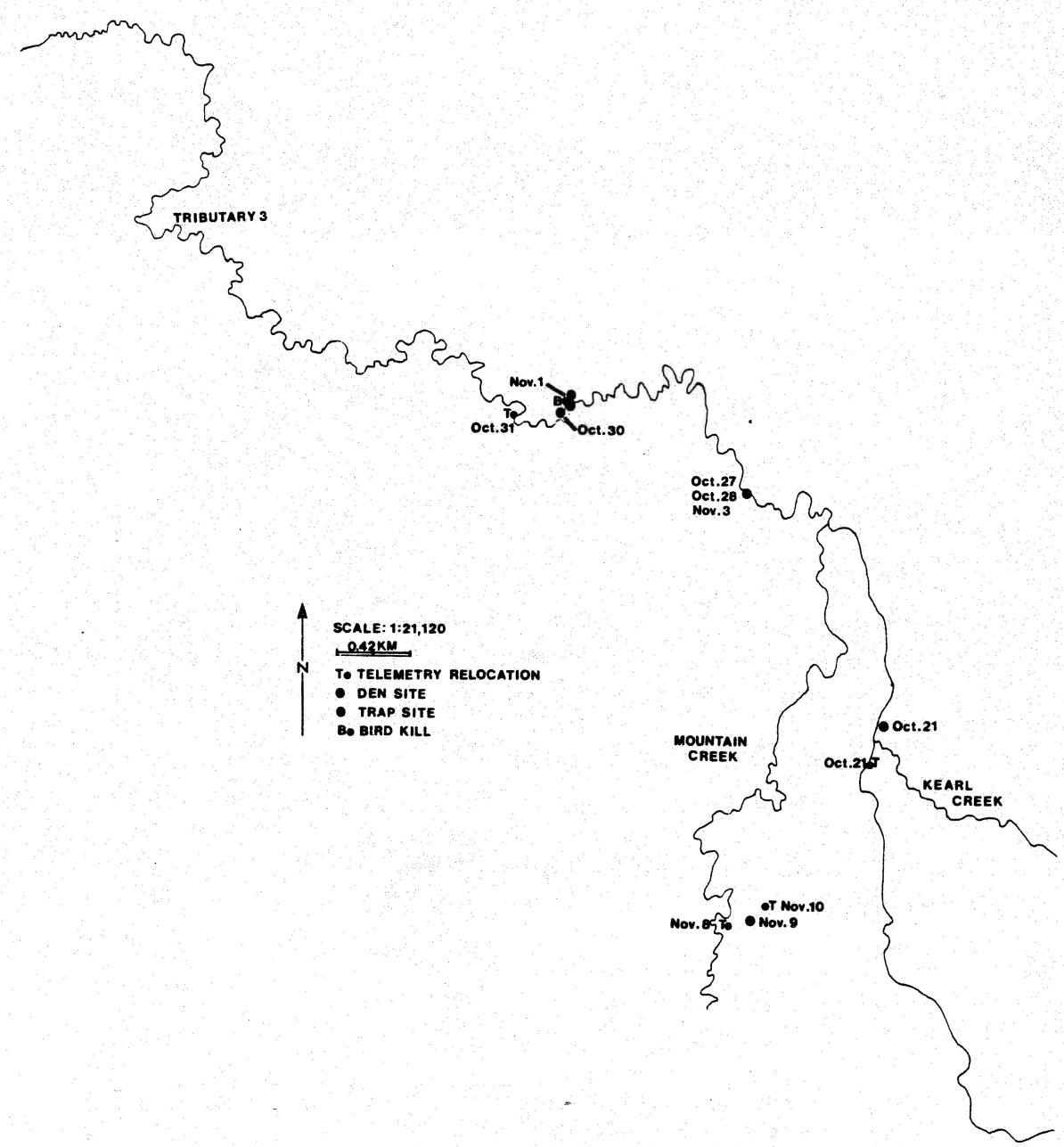

Figure 13. Trap and radio locations for male mink captured in Muskeg River survey area 21 October 1977.

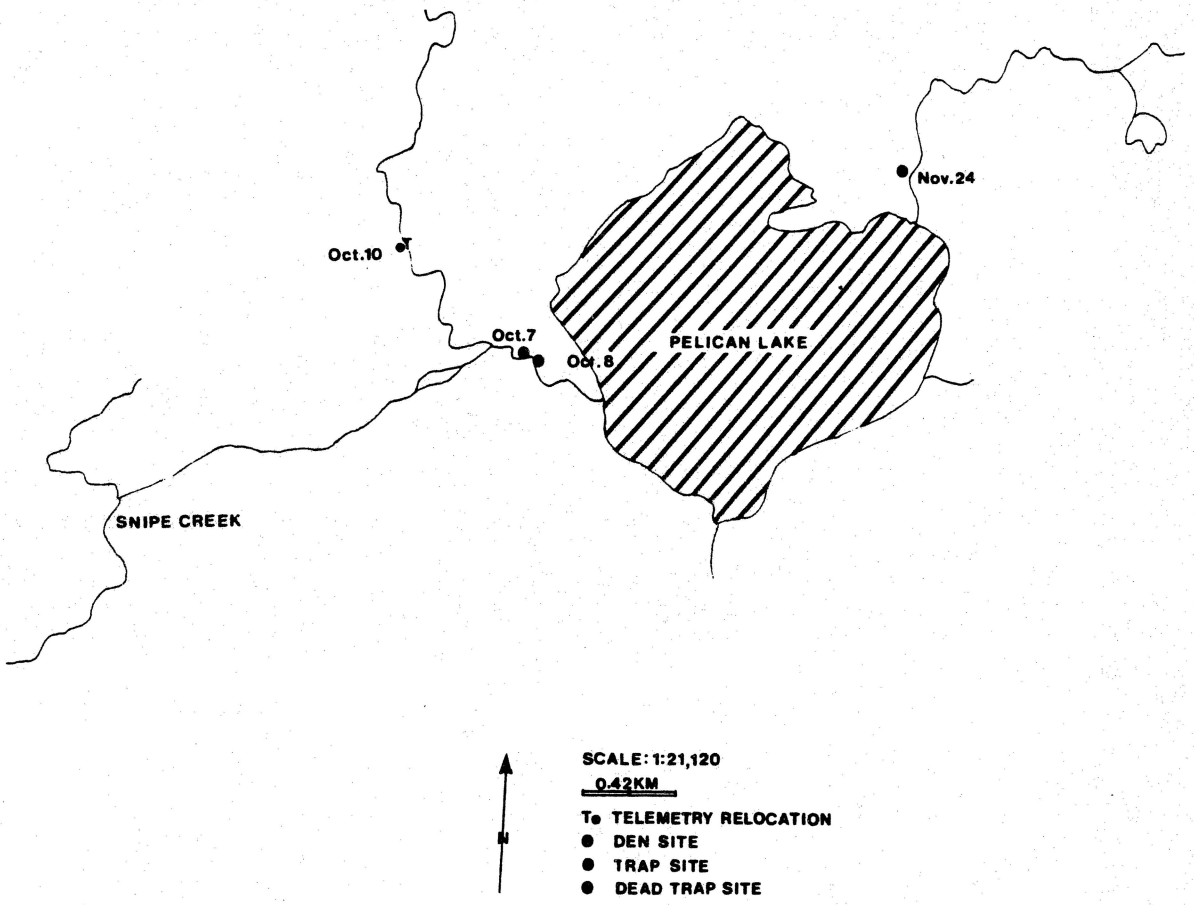

Figure 14. Trap and radio locations for male mink captured in Dover-Snipe Headwaters survey area, 7 October 1977.

5.5 SCAT ANALYSIS

A total of 686 scat samples (488 otter and 198 mink) were analysed. The otter scats had average percent occurrences of 85.5 for fish, 51.2 for invertebrate, 37.3 for vegetation, 15.2 for bird, and 11.3 for mammal remains (Table 6). Comparative values for the mink scats were 21.7%, 26.3%, 34.3%, 32.3%, and 67.7% for fish, invertebrates, vegetation, birds, and mammals, respectively (Table 7). As of the date of this report volumetric measurements of scat components had not been completed.

Northern pike (*Esox lucius*), white sucker (*Catostomus commersoni*), brook stickleback (*Eucalia inconstans*), and arctic grayling (*Thymallus arcticus*) were the predominant fish species, based on both volume and frequency occurrence, found in the scats (Table 8).

Mammalian remains identified to date in mink and otter scats include voles (*Microtus* sp.), northern bog lemming (*Synaptomys borealis*), red-backed vole (*Clethrionomys gapperi*), shrews (*Sorex* sp.), varying hare (*Lepus americanus*), and muskrat. Ear tags from a muskrat tagged at Pelican Lake were recovered in an otter scat collected at Pelican Lake.

5.6 AERIAL SURVEYS

The beaver survey of the Muskeg River drainage area resulted in identification of 69 active beaver lodges and 8 fresh food piles (lodge not seen). The food piles sighted, without lodges, were all on the mainstem of the Muskeg River where willow growth obscured visibility (Figure 15).

The beaver survey of the Dover-Snipe Headwaters area revealed 31 active beaver lodges (Figure 16).

The Syncrude site survey (which did not include the MacKay River) resulted in the locating of 111 active beaver lodges, 45 abandoned beaver lodges, and 81 active muskrat houses (Figure 17).

Table 6. Frequency occurrence of different food items in otter scats collected during 1977.

Area	Total No. of Scats	Fish		Mammals		Birds		Vegetation		Inverts[a]		Debris		Unidentified	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pelican Lake	87	75	86.2	5	5.7	9	10.3	46	52.9	53	60.9	16	18.4	1	1.1
Clearwater Lake	80	79	98.8	17	21.3	17	21.3	75	93.8	32	40.0	11	13.8	4	5.0
Snipe Creek	15	8	53.5	1	6.7	7	46.7	1	6.7	3	20.0	10	66.7	0	0.0
Dover Lake	23	22	95.7	6	26.1	13	56.5	2	8.7	17	73.9	17	73.9	2	8.7
Slough Lake	27	15	55.6	2	7.4	11	40.7	3	11.1	15	55.6	14	51.9	0	0.0
Muskeg River	17	10	58.8	3	17.6	5	29.4	3	17.6	6	35.3	7	41.2	1	5.9
Tributary 1	31	30	96.8	1	3.2	1	3.2	7	22.6	13	41.9	14	45.2	2	6.5
Tributary 2	35	31	88.6	1	2.9	0	0.0	9	25.7	22	62.9	21	60.0	1	2.9
Tributary 3	11	10	90.9	1	9.1	0	0.0	1	9.1	5	45.5	10	90.9	0	0.0
Tributary 4	2	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Muskeg Lake 1	33	25	75.8	5	15.2	2	6.1	9	27.3	23	69.7	13	39.4	2	6.1
Muskeg Lake 2	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Muskeg Lake 3	2	1	50.0	0	0.0	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0
Muskeg Lake 7	4	0	0.0	4	100.0	0	0.0	0	0.0	4	100.0	2	50.0	0	0.0
Muskeg Lake 8	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hartley Creek	5	4	80.0	1	20.0	0	0.0	0	0.0	3	60.0	4	80.0	0	0.0
Kearl Creek	80	78	97.5	1	1.3	4	5.0	16	20.0	29	36.3	47	58.8	2	2.5
Kearl Lake	36	29	80.6	5	13.9	4	11.1	10	27.8	25	69.4	22	61.1	1	2.8
Mountain Creek	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	488	417	85.5	55	11.3	74	15.2	182	37.3	250	51.2	209	42.8	16	3.3

[a] Invertebrates

Table 7. Frequency occurrence of different food items in mink scats collected during 1977.

Area	Total No. of Scats	Fish		Mammals		Birds		Vegetation		Inverts[a]		Debris		Unidentified	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pelican Lake	38	8	21.1	31	81.6	11	28.9	17	44.7	10	26.3	5	13.2	2	5.3
Clearwater Lake	41	23	56.1	19	46.3	8	19.5	32	78.0	12	29.3	4	9.8	1	2.4
Snipe Creek	8	0	0.0	5	62.5	4	50.0	1	12.5	0	0.0	3	37.5	0	0.0
Dover Lake	28	1	3.6	14	50.0	23	82.1	6	21.4	14	50.0	15	53.6	1	3.6
Slough Lake	18	5	27.8	11	61.1	6	33.3	1	5.6	5	27.8	4	22.2	1	5.6
Muskeg River	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tributary 1	4	3	75.0	1	25.0	1	25.0	2	50.0	1	25.0	1	25.0	0	0.0
Tributary 2	1	0	0.0	1	0.0	0	0.0	1	100.0	0	0.0	1	100.0	0	0.0
Tributary 3	27	1	3.7	25	11.1	3	11.1	3	11.1	2	7.4	10	37.0	3	11.1
Tributary 4	7	1	14.3	5	14.3	1	14.3	1	14.3	1	14.3	1	14.3	0	0.0
Muskeg Lake 1	4	0	0.0	3	25.0	1	25.0	0	0.0	2	50.0	4	100.0	0	0.0
Muskeg Lake 2	1	0	0.0	1	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
Muskeg Lake 3	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Muskeg Lake 7	2	0	0.0	2	100.0	2	100.0	1	50.0	1	50.0	1	50.0	0	0.0
Muskeg Lake 8	6	0	0.0	6	100.0	1	16.7	0	0.0	2	33.3	1	16.7	0	0.0
Hartley Creek	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Kearl Creek	1	0	0.0	0	0.0	1	100.0	1	100.0	1	100.0	0	0.0	0	0.0
Kearl Lake	11	1	9.1	9	81.8	2	18.2	2	18.2	1	9.1	3	27.3	0	0.0
Mountain Creek	1	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
Total	198	43	21.7	134	67.7	64	32.3	68	34.3	52	26.3	55	27.3	8	4.0

[a] Invertebrates

Table 8. Fish species found in mink and otter scats from locations in the Muskeg River and Dover-Snipe Headwaters survey areas (1977).

Scat Collection Area	Northern Pike	White Sucker	Brook Stickleback	Arctic Grayling	Lake Whitefish (*Coregonus clupeaformis*)	Redbelly Dace (*Chrosomus eos*)	Cisco (*Leuchichthys artedii*)
Pelican Lake	✓	✓	✓	✓	✓	-	-
Clearwater Lake	✓	✓	✓	-	-	-	-
Snipe Creek	✓	✓	✓	✓	-	-	?
Dover Lake	✓	✓	✓	-	-	-	-
Slough Lake	-	-	✓	-	-	-	-
Muskeg River	✓	✓	-	✓	-	-	-
Tributary 1	-	✓	✓	-	-	-	-
Tributary 2	-	✓	✓	-	-	-	-
Tributary 3	✓	?	✓	✓	-	-	-
Tributary 4	-	-	-	✓	-	-	-
Muskeg Lake 1	✓	✓	✓	-	-	-	-
Muskeg Lake 3	-	✓	-	-	-	-	-
Hartley Creek	-	✓	✓	✓	-	-	-
Kearl Creek	✓	✓	✓	✓	-	-	-
Kearl Lake	✓	✓	✓	-	-	✓	-

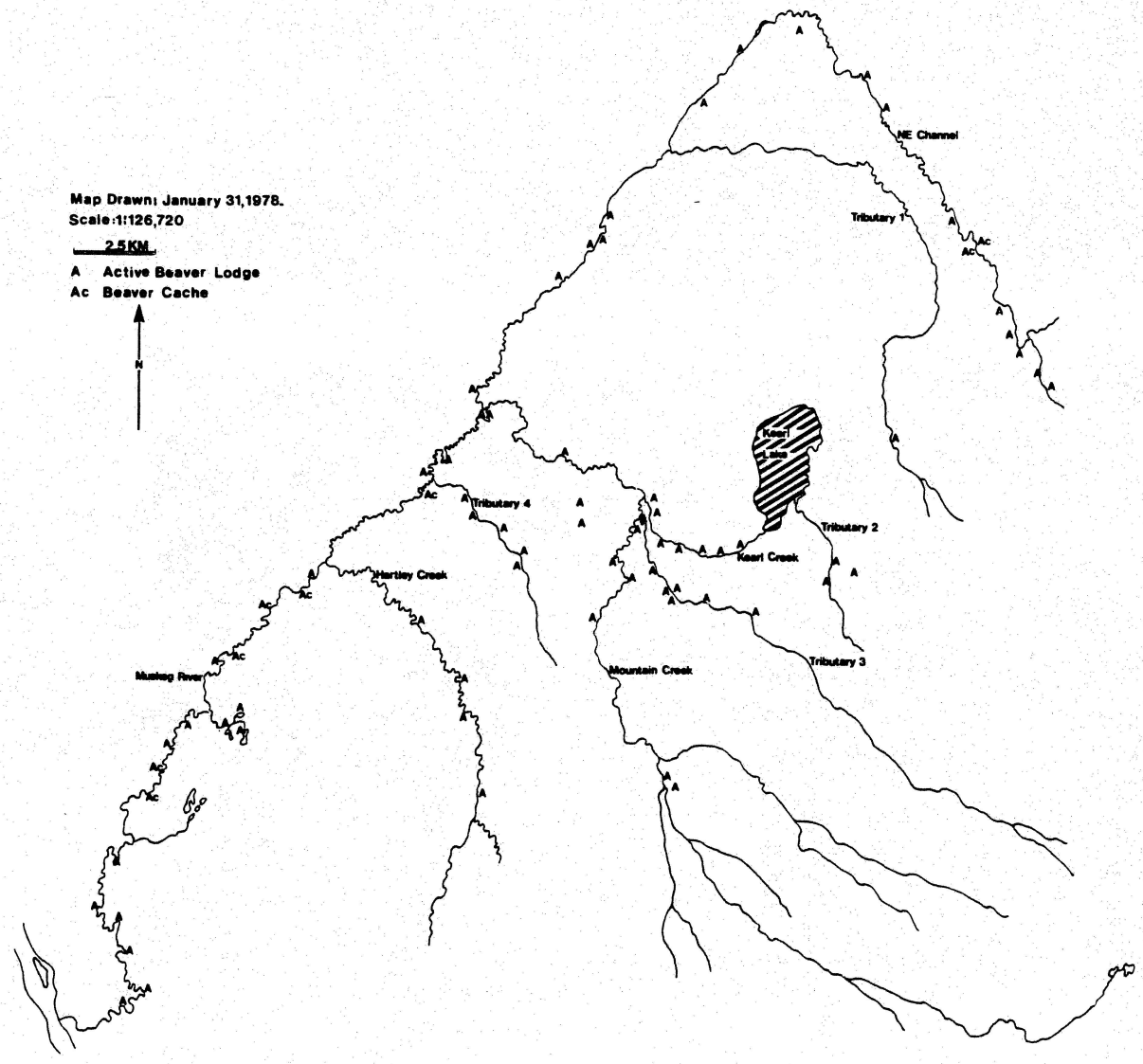

Figure 15. Locations of active beaver lodges and food caches in Muskeg River drainage survey area, October 1977.

Figure 16. Locations of active beaver lodges in Dover-Snipe Headwaters survey area, October 1977.

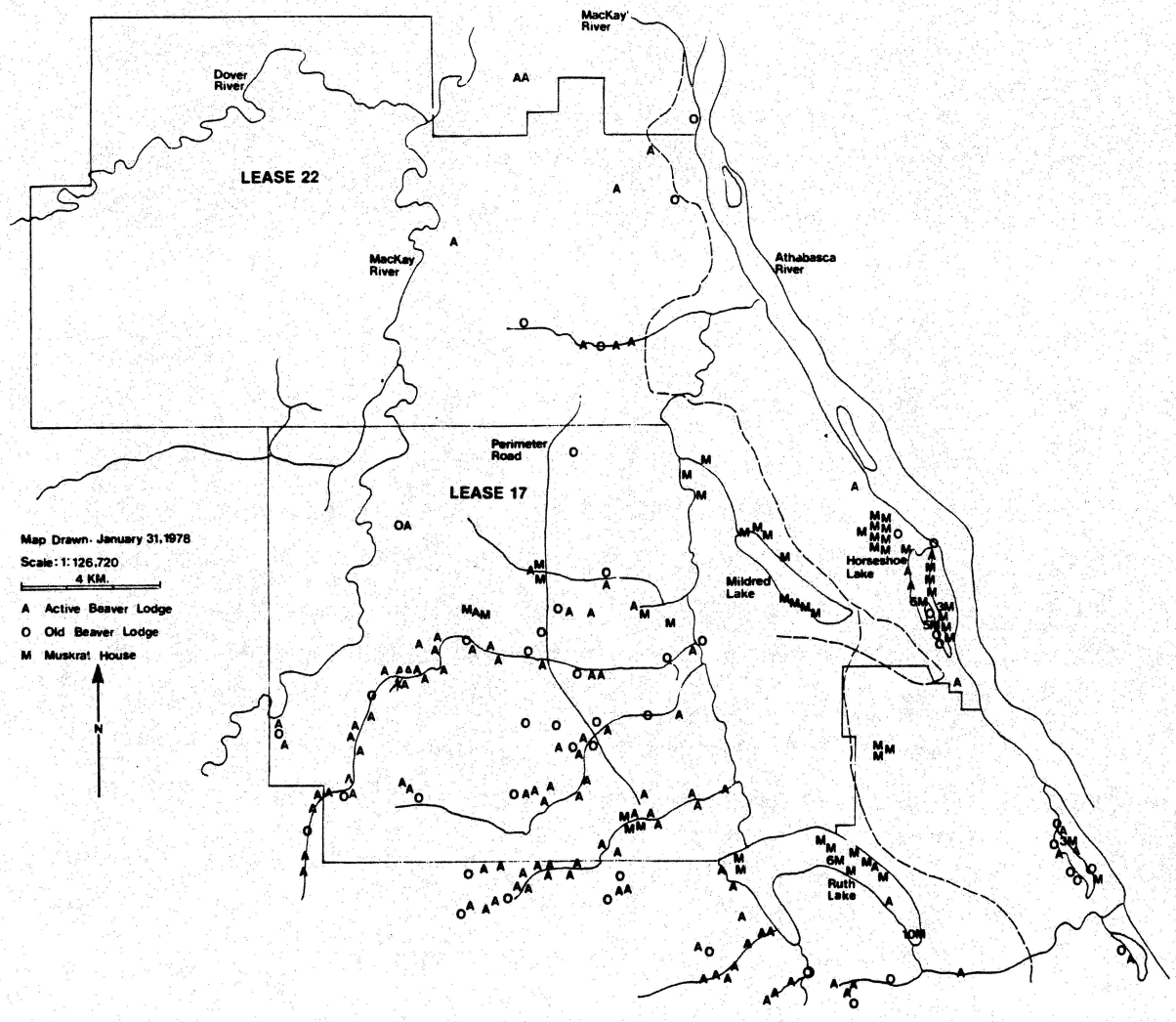

Figure 17. Locations of active and abandoned beaver lodges and active muskrat houses in Syncrude survey area, October 1977.

Comparative active beaver lodge densities for the three survey areas were 0.16, 1.15, and 0.20 /km^2 for the Muskeg River drainage, Dover-Snipe Headwaters, and Syncrude site, respectively.

5.7 TRAPPER CO-OPERATION

As of the date of this report only one trapper had provided information on tagged animals taken during the fur harvest period. This was an Indian from Fort MacKay who was trapping at Pelican Lake and returned the radio-collar and tags from the male mink originally captured at the Pelican Lake outflow.

5.8 HABITAT MAPPING

Maps of the riparian habitat in the Muskeg River drainage study area were completed. Aerial photo interpretation proved to be sufficiently accurate for the level of habitat classification attempted as the ground truthing substantiated the initial categorization. As an example of habitat detail, the map for the Kearl Lake shoreline is shown in Figure 18.

We identified the need to delineate the following terrestrial vegetative types in the Phase I habitat mapping:

1) pure stands (by 3 m height classes or 5-10 year age classes)
   - white birch
   - balsam poplar
   - trembling aspen
   - black spruce
   - white spruce
   - jack pine
   - alder
   - willow
   - tamarack (*Larix laricina*)
   - cherry (if any) (*Prunus* sp.)
   - sedge
   - muskeg
   - bog

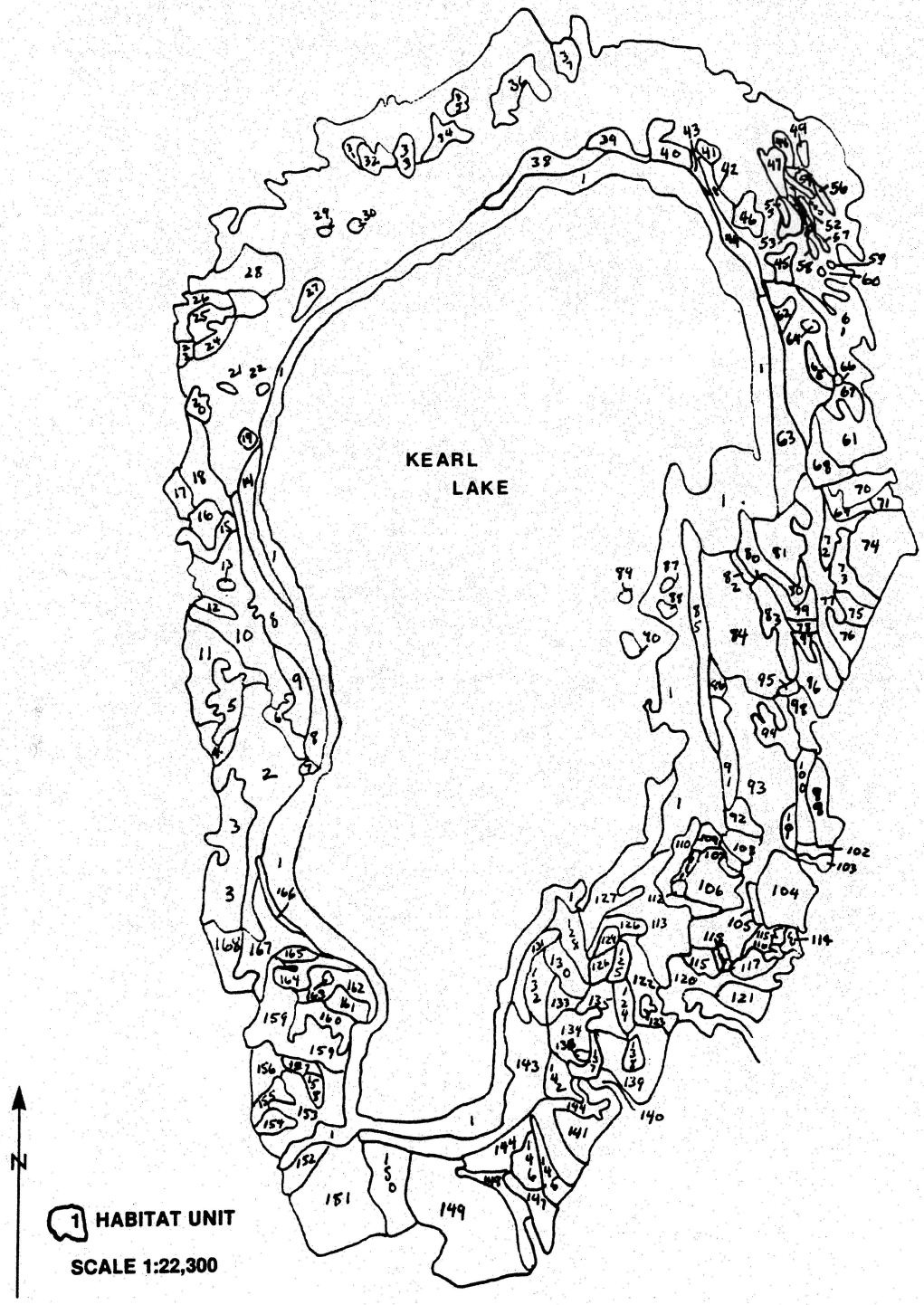

Figure 18. Riparian habitat map of Kearl Lake re-produced from aerial photographs for semi-aquatic mammals study, 1977.

2) mixed stands (delineated by % composition of various components not simply lumped together)
   - poplar (balsam poplar and trembling aspen - differentiated where possible)
   - white birch-poplar
   - white spruce-poplar
   - white spruce-white birch
   - white spruce-black spruce
   - jackpine-poplar
   - jackpine-cherry
   - willow-alder
   - white spruce-poplar-white birch
   - cherry-poplar-white brich
   - alder-poplar (white birch)

We wanted particular emphasis put on riparian habitats (250m from water interface) and also indicated the need for aquatic vegetation (emergent) mapping for the entire AOSERP area.

5.9 ANNOTATED BIBLIOGRAPHY

The completed bibliography contains about 700 references considered to be of value to the semi-aquatic mammals study (Gilbert in prep.). Only minor updating will be required in the future.

It must be noted that the contract for this study was terminated at the end of March 1978. Therefore, data analysis for the 1977-78 season could not be completed and much information remains in its raw form. The incompleteness of the Results and Discussion sections of this report reflect the untimely termination of the study rather than a lack of data or of a long-term program designed to fulfill the objectives of this study as it was originally conceived.

6. DISCUSSION

6.1 BEAVER

6.1.1 Population Size

There was a considerable change in number of active lodge sites between the time of the ground reconnaissance and the fall aerial survey. The increase noted in October usually resulted from re-activation of old lodges by dispersing two year olds although we had evidence of older beaver (based on weight data) re-locating as well. Much of this movement occurred during July-August although fresh work on dams indicated some dispersal and establishment as early as May-June.

Based on active lodge densities, one would expect to find, if trapping pressure was equivalent, higher returns from traplines in the Dover-Snipe Headwaters survey area than the Muskeg River drainage. However, fur trapping returns are acknowledged to be inaccurate reflections of either trapping effort or furbearer populations on individual traplines (Todd 1976). Furthermore, trapping pressure has apparently been heaviest in the Muskeg River area. The presence of an active trapper's cabin at Kearl Lake, and the excellent access into the Muskeg River drainage area, generally corroborate discussions project personnel had with trappers in both survey areas which supported our conclusion of differential trapping pressure. The highest beaver return per year (1971-75) for either survey area was on trapline 2172 in the Muskeg River drainage (Anon. 1976).

Average colony size was quite variable. For example, a lodge at Clearwater Lake contained about 12-14 beaver. There was no evidence of recent human activity at this lake. No trails were marked into it and our live-trapping effort was the first disturbance for apparently at least two years. This finding of such a large colony is supportive of Novakowski's (1965) work in Wood Buffalo National Park which suggested that in non-disrupted colonies the two-year olds do not leave their home

lodge until the spring or early summer. Trapping pressure appears to disrupt the colony causing early dispersal and smaller colony size. Probably at least 50 percent of the beaver populations in the two study areas were tagged during 1977. This conclusion is based on population extrapolation from the aerial census assuming an average of 3-4 beaver per active colony. For intensively trapped segments of the study areas the value is closer to 90 percent (based on the above and recapture data). There was considerable variability in colony size, as already noted, with the majority of active lodges in the Muskeg River drainage having only two animals unless there was a pregnant female who had survived the trapping season and then her litter contributed to the colony size. There was evidence in both areas of single adult males being the only remnants of formerly active colonies. This complication of a wide range in colony size will necessitate establishment of different correction factors for population estimates based on colony density in areas of different trapping pressure. Further live-trapping and a personalized trapper survey in 1978 will provide a means of generating accurate mean colony size which will be reflective of trapper activity in the AOSERP study area. Dispersal and colony relocation data will be obtained when recaptures of 1977 tagged animals are made.

Preliminary analysis of the 1978 data suggest that lake-dwelling beaver may have distinct advantages over stream-dwelling beaver in avoiding natural predation. Slopes were greater at streams, and in many cases in the Muskeg River drainage particularly, beaver were travelling some distance from the water to obtain *Populus* sp. In addition, wolf sign (scats and active trails) was most abundant along streams as opposed to lake shores. However, this proclivity to natural predation along streams is probably partially offset by a higher vulnerability to trapping for lake-dwelling beaver. Those sections of the Muskeg River with high beaver densities were generally the most

inaccessible to trappers. As a result, locations such as Kearl Lake which had an abundant supply of food (both aquatic and terrestrial vegetation) but was readily accessible to trappers had few beaver (population estimated at 3 animals). It would appear that the more inaccessible willow swamp areas therefore function as "seed stock refuges" (Beer 1955) for the heavily trapped surrounding areas.

6.1.2 Habitat Utilization

Most studies have shown that beaver will select species and diameter classes of the trees available (Brenner 1962; Crawford et al. 1976; Hall 1960; Jenkins 1975; O'Brien 1938; Shadle and Austin 1939; Solov'er 1964) although Cottle (1951) reported that aspen was utilized without respect to size. The current study confirmed the importance of *Populus* sp. in the beaver's diet. Further data analysis is necessary before the importance of slope, diameter class, and other riparian habitat factors are known with respect to food selection by beaver in the AOSERP area.

6.1.3 Impoundment Effects

It is still necessary to determine the influence of beaver impoundments on the biomass (species and abundance) of shoreland (e.g. mink), aquatic fauna (fish), and water quality Numerous studies have shown that faunal changes can be expected (Bates 1973; Gard 1958; Hodkinson 1975a, 1975b; Keiper 1966) but no data are available for AOSERP waters. We hope that personnel undertaking aquatic fauna studies will be able to sample natural and beaver-created pools on streams in the Muskeg River survey area so that determinations of invertebrate, algal, etc. differences and hence fish production and water quality differences can be made.

6.2 MUSTELIDS

6.2.1 Population size

Preliminary observations suggest higher mink and otter populations occur in the Dover-Snipe Headwaters survey area than the Muskeg River drainage survey area. Although this difference may be habitat related, i.e. a function of the predominance of lakes in the Dover-Snipe survey area as opposed to streams in the Muskeg River survey area, final conclusions must be based on the availability of prey species and their total biomass. Only with such biomass data can the potential energy transfer to the next trophic level be extrapolated and the exact role current trapping has on population density of mink and otter be accurately ascertained.

6.2.2 Habitat Utilization

Both mink and otter have been termed opportunistic feeders (Erlinge 1967, 1969; Gerell 1967; Waller 1962; Greer 1953). Thus they primarily select prey on the basis of vulnerability. The wide range of species occurring in analysed scats of these animals from the AOSERP study area would seem to confirm this. In fact, the presence of certain fish species in some lakes was only confirmed after otter scat analysis suggested they occurred, e.g. a Kearl Lake fish survey failed to show that northern pike were present (Malcolm Orr, Senior Fisheries Technician, Freshwater Institute, Environment Canada, personal communication). Both otter food habits and a local trapper confirmed the presence of pike in Kearl Lake.

Preliminary lake surveys in the Dover-Snipe Headwaters survey area (Malcolm Orr, correspondence 19 Jan. 1978) confirmed that white suckers, northern pike, and brook stickleback were to be found. Otter scat analysis suggests that arctic grayling utilize at least Pelican Lake in this area. Scat analysis alone is insufficient to allow determination of the degree of selectivity which might be occurring. Both the otter and mink studies require more

accurate prey species availability data. Both the aquatic and riparian habitats in the two major survey areas need to be characterized in terms of fish and small mammal species occurrence and population densities. This will necessitate co-operative efforts between the semi-aquatic mammals project and other AOSERP projects. With such data, however, it will be possible to characterize the most productive habitat conditions for these two mustelid species.

Although only limited data were collected in 1977 on radio-collared mink, we have overcome all the difficulties associated with capturing this species and anticipate a very productive 1978 season as minor modifications have been made in collar design which will prevent abrasion. However, we still have technical problems to overcome with the otter component of the semi-aquatic mammals study. We will be testing a new trapping system for otter in 1978 as it will be impossible to define the habitat requirements of this species without knowing the circuits of individual animals and location of their den sites. Consultations with Lloyd Cook (President, Ontario Trapper's Association) have resulted in a new trap design which should prove more successful than the Hancock and leg-hold sets used in 1977.

6.3 REACTIONS TO OIL SANDS DEVELOPMENT

Beaver and muskrat populations on the Syncrude survey area continued to increase in 1977 and this is thought to be due primarily to reduced trapper activity. Part of the site (Horseshoe Lake area) had not been surveyed in 1976 (Gilbert 1977) but in 1977 we excluded the MacKay River from the survey so the large increase in muskrat, and the smaller increase in beaver, activity must result from an expanded population. Rapid invasion of the Ruth Lake area by muskrats has taken place and the species is even using portions of the old Beaver Creek drainage channel within the cleared portion of Lease 17. Beaver activity occurs up to the edge of the cleared land adjacent to the plant, initial extraction area

and proposed settling pond site and it is apparent that both beaver and muskrat are readily adaptive to the type of human impact currently taking place on the Syncrude lease because their habitat requirements are still being met. Similar behavioural attributes have been reported for these species in other studies (Panov 1974; Westworth 1977).

6.4 TRAPPER CO-OPERATION

Personal communication with individual trappers appeared to be more successful than "broadcast" efforts at co-operation. Although the posters received the attention of many trappers, the only tag returns were a result of personal contact. The cultivation of closer ties with individuals therefore would appear necessary if greater returns of tags from harvested animals are to be obtained.

6.5 HABITAT MAPPING

Progress was made in 1977, at least in the Muskeg River survey area, to provide riparian habitat maps. In addition, consultations with Marc Wride (Senior Ecologist, Intera Environmental Consultants Ltd.; telephone conversations and mail correspondence) indicated that most of the terrestrial and aquatic vegetation and typing we required could be done at the map scale of 1:50,000. The major deficiencies of the 1:50,000 mapping were the lack of delineation of pure white birch stands by height class and of the percent composition of willow-alder associations in mixed stands (Wride, letter 13 March 1978). It would appear that all of the necessary riparian and aquatic habitat delineations for the semi-aquatic mammals study probably could be provided at a scale of 1:21,120. However, as of the writing of this report none of the Phase I habitat maps have been seen by the author.

Accurate mapping of the riparian zone should prove useful to studies other than the semi-aquatic mammals project (Meehan et al. 1977).

6.6 ANNOTATED BIBLIOGRAPHY

It is our opinion that the bibliography presented in Gilbert (in prep.) is a comprehensive summary of the pertinent literature on semi-aquatic mammals currently available. However, there will be need to up-date it at the end of each year.

7. CONCLUSIONS

1. Differential trapping pressure has been experienced in the 1977 survey areas and has contributed to differences in semi-aquatic mammal distribution, density, and population structure. Trapping can be expected to influence semi-aquatic mammal populations to varying degrees throughout the AOSERP study area and it will be necessary to have more accurate trapping records for at least the survey areas if the influence of this factor is to be accurately determined.
2. Both mink and otter consume a wide variety of food items in the AOSERP survey areas. Available prey biomass must be determined before the degree of food selectivity by these predators can be quantified. Preliminary observations suggest that lake habitats may be more productive than stream habitats for these two mustelids.
3. Beaver appear to be more vulnerable to natural predation when occupying stream locations but more vulnerable to trapping when occupying lake sites. As a consequence, in the heavily trapped areas, the more inaccessible stream locations (willow swamps) apparently serve as centres of repopulation for the depleted more accessible (to both trappers and wolves) stream and lake locations.
4. Beaver selected *Populus* sp. when available and preferred it to all other species. Willow was selected over alder and white birch, while conifer species were avoided almost completely.
5. The continuing increase of muskrat and beaver populations on the Syncrude site, reflects both expansion into new habitats (e.g. Ruth Lake) and re-occupation of old habitats which may have previously been

depleted by trapping. It also reflects a tolerance of human activities as long as adequate habitat conditions exist.

6. The field techniques tested during the current year will be adequate to produce sufficient data to meet the continuing objectives of the semi-aquatic mammals study providing we can develop an adequate method for live-trapping otter.
7. Most riparian and aquatic habitat types can be delineated at a scale of 1:50,000 but a more suitable scale for detailed habitat typing and subsequent correlation to otter, mink, muskrat, and beaver habitat requirements would be 1:21,120.

8. IMPLICATIONS AND RECOMMENDATIONS

As the semi-aquatic mammals study has only completed one full field season it would be premature to make any specific recommendations regarding matters relating to oil sands development.

The annotated bibliography has been published as a separate AOSERP document with co-authorship by Gilbert, Brown, and Stoll. We have already had a number of requests from other researchers for such a publication.

It is vital that the co-operative studies with Aquatic Fauna (stream flora and fauna, lake fish populations), Hydrology (stream flow characteristics), and other projects (small mammals, wolves) be implemented and/or continued, as the case may be. Predictive modelling will only be possible when all habitat elements are adequately quantified.

Preliminary indications from the semi-aquatic mammals study are that identifiable habitat elements exist which should be protected, or re-created, if populations of mink, otter, muskrat, and mink are to thrive during the development and post-development phases. Once habitat mapping is complete the 1977 reconnoitering survey, live-trapping, and radio-telemetry data should be correlated to vegetative types.

Aquatic vegetation needs to be typed for the AOSERP study area. Riparian habitat typing alone is insufficient to allow definition of the specific requirements for semi-aquatic mammals.

Better data on the distribution and intensity of trapping pressure within the AOSERP study area are necessary. Trapline returns are not adequate as often animals listed for a particular trapline were never caught there. Accurate location data for animals trapped in the semi-aquatic mammal survey areas must also be obtained. Effective maintenance of semi-aquatic mammal populations in undisturbed (from oil sands development) locations will ultimately hinge on more effective management of trappers.

9. NEED FOR FURTHER STUDY

We recommend that the semi-aquatic mammals study continue with its existing terms of reference as the ground work has been accomplished which will allow realization of some of the objectives at the conclusion of the 1978-79 field season and all of the objectives by the expected termination in 1980.

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11. APPENDIX

11.1 DATA FORMS

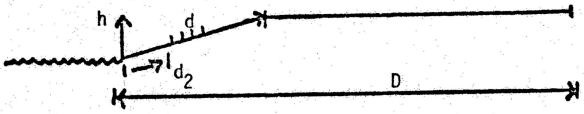
The forms used to collect data during the semi aquatic mammals study are presented in the following pages.

Beaver Sampling Page:____

Area:____

Plot:____ Total Length of Cut:_____

Transect Information:



Transect	1	2	3
D			
d_1			
h			
d_2			

D - distance from water to furthest cutting
d - slope distance
h - height of slope
d_2 - distance from water's edge to 1st cutting sign

Aspen/Balsam Poplar Stump Count (dbh) 5 groups of 5 sampled at random

Groups	1	2	3	4	5
1.					
2.					
3.					
4.					
5.					

N.B. - specify balsam stumps wherever possible.

Cut vs. Standing (two plots within cut area)

Cut Trees		With Shrubbery				Standing Trees									
		Willow		Alder		Aspen		Balsam		Wh Birch		Wh Spruce		Other	
Aspen (dbh)	Balsam Pop.	No. clumps	% chewed	No. clumps	% cut	dbh	ht	dbt	ht	dbh	ht	dbh	ht	dbh	ht

Beaver Trapping Records

Trapper(s) _____

Field Camp Location: _____ Water System: _____

Date	Trap Site	Trap No.	Tail Tag	Rt. Ear	L. Ear	Kg. Weight	Sex	Age	Tail L&W	Zygo-matic breadth	Notes

Muskrat Trapping Records

Trapper(s) _____

Field Camp Location: _____ Water System: _____

Date	Trap Site	Trap No.	Rt. Ear	L. Ear	Kg. Weight	Sex	Age	Tail L&W	Notes

Mink Trapping Records

Trapper(s) _____

Field Camp Location: _____ Water System: _____

Date	Trap Site	Trap No.	Rt. Ear	L. Ear	Kg. Weight	Sex	Age	Tail L&W	Notes

SCAT ANALYSIS DATA SHEET

Date examined _____

Examiner _____

(Volume & Species)

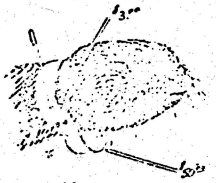
Scat #	Data Collected	Area Collected from	Species	Total Volume	Fish	Mammals	Birds	Vege-tation	Inverts	Other	Unident-ified	Comments & Notes

TRAPPERS

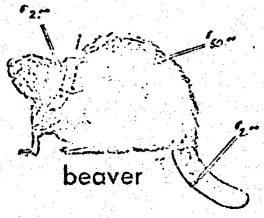
WE NEED YOUR HELP!!

IF YOU FIND ANY OF THE FOLLOWING,
PLEASE REPORT OR SEND A LETTER TO:

A.O.S.E.R.P. OFFICE
8316 FRASER AVENUE
FORT McMURRAY (743-7181)
AND COLLECT A REWARD

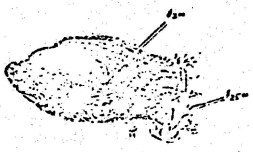


otter



beaver

muskrat



mink

WE NEED TO KNOW THE LOCATION WHERE YOU CAUGHT THE ANIMAL. PLEASE PROVIDE THIS INFORMATION WHEN RADIO COLLARS OR TAGS ARE RETURNED.

SEMI-AQUATIC MAMMALS STUDY
UNIVERSITY OF GUELPH

Trap Site Characterization

Trap No.: _____

Trap Set by: _____ Date Set: _____

Set for which species: Beaver _____ Type of Set: Blind _____

Mink _____ Land _____

Otter _____ Water _____

Muskrat _____ Baited _____

Semi-submerged _____

Other _____

Water System: _____

Trap Opened: _____

Trap Closed: _____

Total No. Trapping Nights: _____

No. successes: _____ No. times empty: _____

No. times tripped: _____

Habitat Characteristics: (sketch map of trap location relative to nearest water systems)

Trap Number Code

K - Kearl Study Area
R - Richardson Study Area
P - Birch Mountain Area
B - Beaver Set
M - Mink Set
O - Otter Set
Mu - Muskrat Set

e.g. KB10 = Beaver set #10 in Kearl Area
e.g. RO15 = Otter set #15 in Richardson Area

Beaver Telemetry Record

Person Reporting: _____ Date: _____

Study Area: _____ Observation No.: _____

Water System: _____ Inflow: _____

Outflow: _____

Collar Number: _____ Channel: _____

Detection Method: _____ Distance from
(homing, triangulation) last reception: _____

Evidence of Recent Cuttings: Yes ____ Approx. No.
of stems: _____

No ____

Scent Mounds: Major species cut:

Present: _____ Approx. No. _____ _____

Absent : _____ _____

Habitat

	% Cover	Predominant Species (%)	Height
Overstory			
Understory			
Ground Cover			

Water/Land Interface:

Slope -

Vegetation -

Streamflow -

Water depth -

Comments -

Relocation Record

Species: _____

Person Reporting: _____ Date: _____

Study Area: _____ Observation No.: _____

Water System: _____ Code Name: _____

Collar Number: _____ Channel: _____

Detection Method: _____
(homing, triangulation)

Scats Present in Vicinity? Yes: _____ How many? _____

No : _____

Habitat Description

	% Cover	Predominant Species	Height
Overstory			
Understory			
Ground Cover			

Water/Land Interface:

Slope -

Vegetation -

Streamflow -

Water depth -

Comments -

Trap Site Record

Trap No.	Date	Open	Closed	Tripped (no animal)	Tripped (Animal) (sex, species, age, tag #)

12. AOSERP RESEARCH REPORTS

1.		AOSERP First Annual Report, 1975
2.	AF 4.1.1	Walleye and Goldeye Fisheries Investigations in the Peace-Athabasca Delta--1975
3.	HE 1.1.1	Structure of a Traditional Baseline Data System
4.	VE 2.2	A Preliminary Vegetation Survey of the Alberta Oil Sands Environmental Research Program Study Area
5.	HY 3.1	The Evaluation of Wastewaters from an Oil Sand Extraction Plant
6.		Housing for the North--The Stackwall System
7.	AF 3.1.1	A Synopsis of the Physical and Biological Limnology and Fisheries Programs within the Alberta Oil Sands Area
8.	AF 1.2.1	The Impact of Saline Waters upon Freshwater Biota (A Literature Review and Bibliography)
9.	ME 3.3	Preliminary Investigations into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area
10.	HE 2.1	Development of a Research Design Related to Archaeological Studies in the Athabasca Oil Sands Area
11.	AF 2.2.1	Life Cycles of Some Common Aquatic Insects of the Athabasca River, Alberta
12.	ME 1.7	Very High Resolution Meteorological Satellite Study of Oil Sands Weather: "a Feasibility Study"
13.	ME 2.3.1	Plume Dispersion Measurements from an Oil Sands Extraction Plant, March 1976
15.	ME 3.4	A Climatology of Low Level Air Trajectories in the Alberta Oil Sands Area
16.	ME 1.6	The Feasibility of a Weather Radar near Fort McMurray, Alberta
17.	AF 2.1.1	A Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area
18.	HY 1.1	Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program
19.	ME 4.1	Calculations of Annual Averaged Sulphur Dioxide Concentrations at Ground Level in the AOSERP Study Area
20.	HY 3.1.1	Characterization of Organic Constituents in Waters and Wastewaters of the Athabasca Oil Sands Mining Area

21.		AOSERP Second Annual Report, 1976-77
22.	HE 2.3	Maximization of Technical Training and Involvement of Area Manpower
23.	AF 1.1.2	Acute Lethality of Mine Depressurization Water on Trout Perch and Rainbow Trout
24.	ME 4.2.1	Air System Winter Field Study in the AOSERP Study Area, February 1977.
25.	ME 3.5.1	Review of Pollutant Transformation Processes Relevant to the Alberta Oil Sands Area
26.	AF 4.5.1	Interim Report on an Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta
27.	ME 1.5.1	Meteorology and Air Quality Winter Field Study in the AOSERP Study Area, March 1976
28.	VE 2.1	Interim Report on a Soils Inventory in the Athabasca Oil Sands Area
29.	ME 2.2	An Inventory System for Atmospheric Emissions in the AOSERP Study Area
30.	ME 2.1	Ambient Air Quality in the AOSERP Study Area, 1977
31.	VE 2.3	Ecological Habitat Mapping of the AOSERP Study Area: Phase I
32.		AOSERP Third Annual Report, 1977-78
33.	TF 1.2	Relationships Between Habitats, Forages, and Carrying Capacity of Moose Range in northern Alberta. Part I: Moose Preferences for Habitat Strata and Forages.
34.	HY 2.4	Heavy Metals in Bottom Sediments of the Mainstem Athabasca River System in the AOSERP Study Area
35.	AF 4.9.1	The Effects of Sedimentation on the Aquatic Biota
36.	AF 4.8.1	Fall Fisheries Investigations in the Athabasca and Clearwater Rivers Upstream of Fort McMurray: Volume I
37.	HE 2.2.2	Community Studies: Fort McMurray, Anzac, Fort MacKay
38.	VE 7.1.1	Techniques for the Control of Small Mammals: A Review
39.	ME 1.0	The Climatology of the Alberta Oil Sands Environmental Research Program Study Area
40.	VE 7.1	Interim Report on Reclamation for Afforestation by Suitable Native and Introduced Tree and Shrub Species
41.	AF 3.5.1	Acute and Chronic Toxicity of Vanadium to Fish
42.	TF 1.1.4	Analysis of Fish Production Records for Registered Traplines in the AOSERP Study Area, 1970-75
43.	TF 6.1	A Socioeconomic Evaluation of the Recreational Fish and Wildlife Resources in Alberta, with Particular Reference to the AOSERP Study Area. Volume I: Summary and Conclusions
44.	VE 3.1	Interim Report on Symptomology and Threshold Levels of Air Pollutant Injury to Vegetation, 1975 to 1978
45.	VE 3.3	Interim Report on Physiology and Mechanisms of Air-Borne Pollutant Injury to Vegetation, 1975 to 1978

46.	VE 3.4	Interim Report on Ecological Benchmarking and Biomonitoring for Detection of Air-Borne Pollutant
47.	TF 1.1.1	A Visibility Bias Model for Aerial Surveys of Moose on the AOSERP Study Area
48.	HG 1.1	Interim Report on a Hydrogeological Investigation of the Muskeg River Basin, Alberta
49.	WS 1.3.3	The Ecology of Macrobenthic Invertebrate Communities in Hartley Creek, Northeastern Alberta
50.	ME 3.6	Literature Review on Pollution Deposition Processes
51.	HY 1.3	Interim Compilation of 1976 Suspended Sediment Data in the AOSERP Study Area
52.	ME 2.3.2	Plume Dispersion Measurements from an Oil Sands Extraction Plant, June 1977
53.	HY 3.1.2	Baseline States of Organic Constituents in the Athabasca River System Upstream of Fort McMurray
54.	WS 2.3	A Preliminary Study of Chemical and Microbial Characteristics of the Athabasca River in the Athabasca Oil Sands Area of Northeastern Alberta.
55.	HY 2.6	Microbial Populations in the Athabasca River
56.	AF 3.2.1	The Acute Toxicity of Saline Groundwater and of Vanadium to Fish and Aquatic Invertebrates
57.	LS 2.3.1	Ecological Habitat Mapping of the AOSERP Study Area (Supplement): Phase I

These reports are not available upon request. For further information about availability and location of depositories, please contact:

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