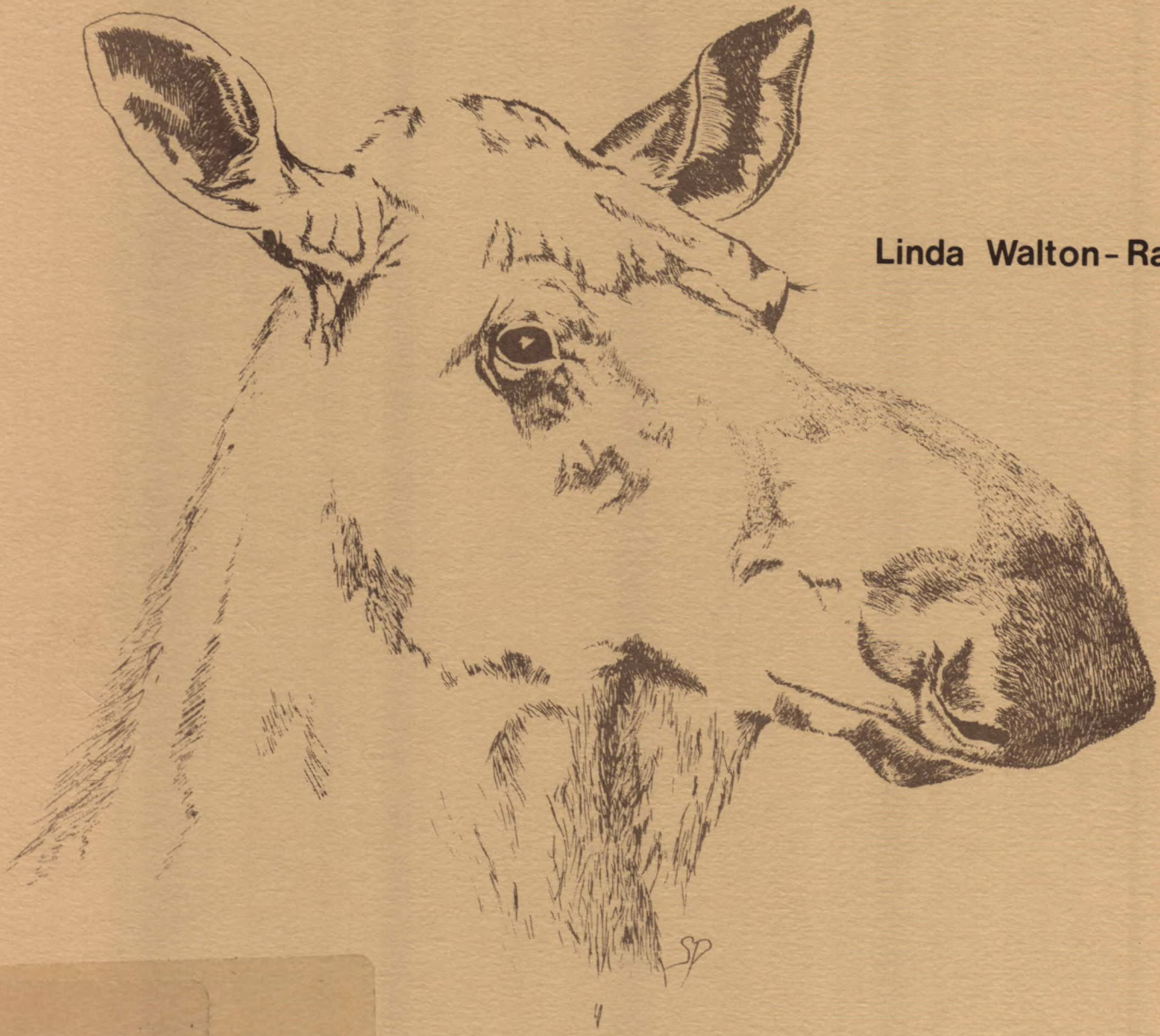
An Inventory of Moose Habitat of the Mackenzie Valley and Northern Yukon

March 1977



by
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Canadian Wildlife Service
Mackenzie Valley Pipeline Investigations

AN INVENTORY OF MOOSE HABITAT OF THE MACKENZIE VALLEY AND NORTHERN YUKON

March 1977

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Prepared by the Canadian Wildlife Service
and funded by the Environmental-Social
Program, Ottawa, Government of Canada

The data for this report were obtained as a result of investigations carried out in 1972-73 under the Environmental-Social Program, Northern Pipelines, of the Task Force on Northern Oil Development, Government of Canada. While the studies and investigations were initiated to provide information necessary for the assessment of pipeline proposals, the knowledge gained is equally useful in planning and assessing other development projects.

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ACKNOWLEDGEMENTS

This study was a Canadian Wildlife Service project funded by the Environmental-Social Committee, Northern Pipelines.

My appreciation goes to Bill Prescott for his invaluable advice and guidance, to my colleagues Gary Erickson, Des Smith and Cliff Larsen for their technical assistance, and to Bryan Kemper for his editorial comments.

I am grateful also to our very competent pilots, Rick Sinotte and Jack Bergeron, and to Linda Harding for her assistance in plotting our survey data.

1. INTRODUCTION

Historical records indicate that moose (*Alces alces*) were widely distributed throughout the Mackenzie River system. However, little specific information was known about preferred habitat types, browse preferences in the area, or movement patterns. Because moose are an economically important species to the native peoples of the area, this information was needed before an assessment of pipeline impact could be made.

During 1972, extensive surveys were done over the entire study area, a region of approximately 391,000 km^2, in an effort to locate areas of preferred habitat. All sightings of moose and moose signs were recorded, and observations on relative population abundance made. It was from this information that the habitat units shown in the Atlas of Moose Habitat Maps (Watson, *et al.* 1973) were delineated. These surveys clearly revealed that the islands of the Mackenzie River were extremely important moose winter range. Because the routes of the Mackenzie Highway and the proposed pipeline are in close proximity to the river in many areas, it was important that more information on moose movements and the winter range characteristics of these islands be acquired.

2. STUDY AREA

The entire area covers a region in the Northwest Territories and northern Yukon of approximately 391,000 km^2. It is a broad corridor extending north from the Alberta-British Columbia border along the Mackenzie River Valley and across the north slope to the Alaska border as shown in Fig. 1.

This region falls in the sub-arctic climatic zone. It is characterized by long winters and short, cool summers having only 3 months with an average temperature over 10°C. Sub-arctic soils are predominant and most of the region has been glaciated. Till moraines occur throughout the area.

It is a boreal forest region with sub-arctic tundra transition in the more northerly portions. The area is dominated by coniferous vegetation, mainly black and white spruce. Birch and poplar occur on many of the better drained sites, including till moraines and river valleys.

Fire plays an important ecological role in creating moose habitat. Numerous large burns have occurred throughout the study area and are in various stages of reforestation. Increased fire control has resulted in fewer burns in the past several years, although small fires still occur regularly throughout the summer months.

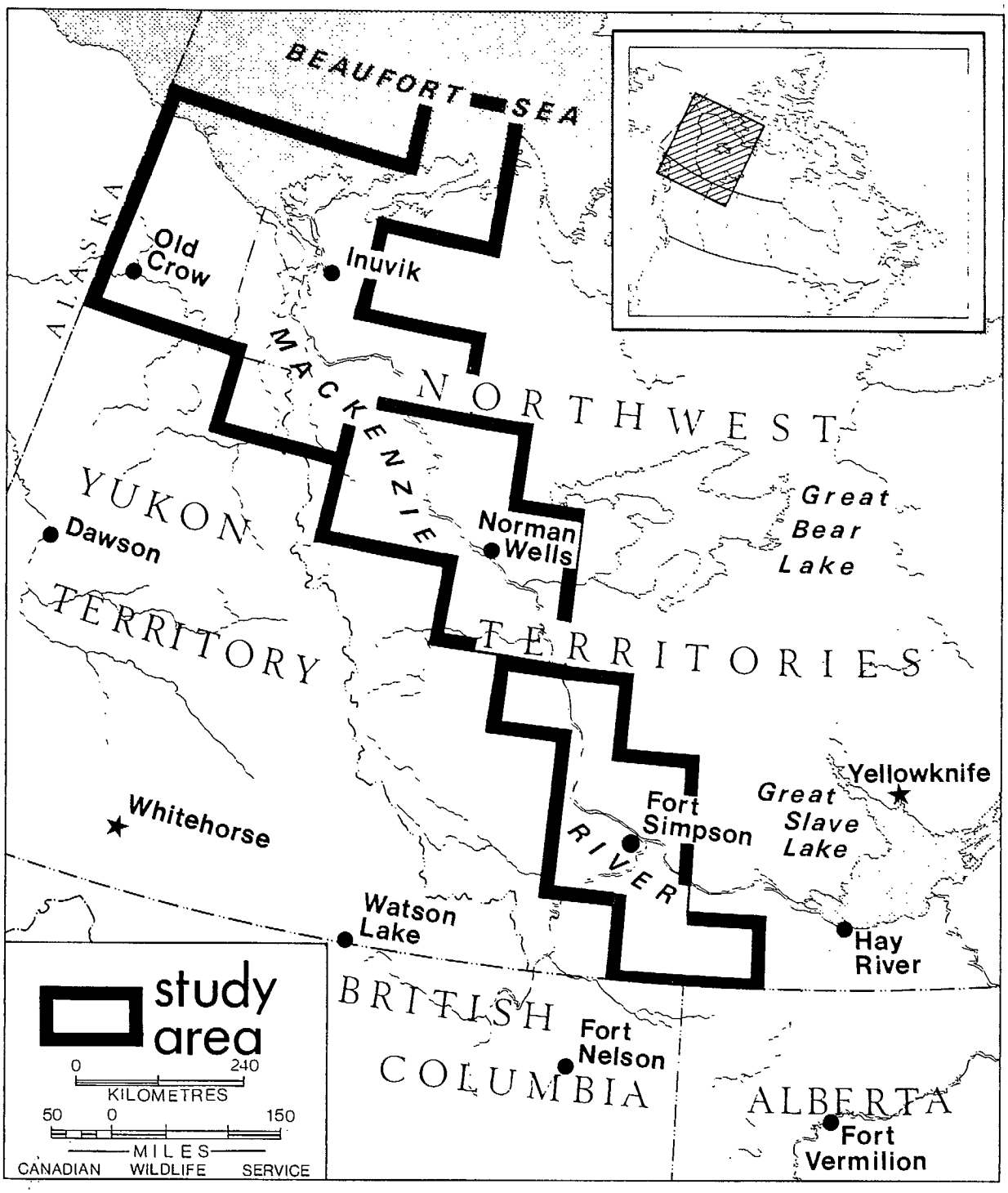


Fig. 1. The Study area.

3. METHODS

The field work was divided into two parts, the population surveys, and the browse surveys:

3.1 Population Surveys

In mid-March of 1973, a survey was made along the proposed pipeline route from Fort Simpson to Inuvik. At this time, a census was taken of moose on the islands and sandbars of the Mackenzie River. In addition, to ascertain the winter range value of upland burned areas, four transects each were flown in the Travaillant Lake area, the Martin Hills, and the Redknife Hills. These surveys were repeated in mid-June in an effort to determine seasonal distribution changes. Two more surveys were made of the Mackenzie River Islands, one in mid-November of 1973, and the other in mid-March of 1974, flying the same route as the initial survey of March 1973.

The surveys were done in a Cessna 337 and a Cessna 185. A minimum of two observers and the pilot were on each flight, one observer acting as navigator, and the other recording sightings. Both aircraft proved to be good survey machines. The overhead wing permits good visibility; they are maneuverable and can be slowed down to 145-160 kph.

3.2 Browse Surveys

The browse surveys were carried out in late June and early July of 1972 and late June of 1973 in some of the better wintering areas

along the Mackenzie Corridor. The sites chosen were representative of the various habitats frequented by moose, as determined from the 1972 winter surveys. Most of these were Class I or 2 units (areas of heavy moose utilization) as delineated in the Atlas of Moose Habitat Maps (Prescott, *et al.* 1973). The sites are shown in Fig. 2.

A well known browse survey technique, "the Aldous Method" (Aldous 1944) was used. This method is subjective and may be carried out rapidly. It consists of recording the occurrence of various plant species and the degree to which each has been browsed. The recommended sample area consisted of a circular plot with a radius of 3.6 m, giving an area of .004 ha. Eight to ten plots were spaced along a transect at fixed intervals with the number of transects and their placement dependent upon the physical nature of the unit being sampled.

The occurrence and density of all browse species and the degree of utilization of each species was recorded on a prepared tally sheet. Density was determined by visual estimation of the percentage of ground covered by each browse species under 2 m in height. Removal of any or all of the current year's growth was considered to be browsing. The degree of browsing was an estimate of the current year's growth that had been removed. Since field time was at a premium, subjective estimates were made of density and the degree of utilization of each species. The degrees of density and utilization were each recorded as one of the three categories:

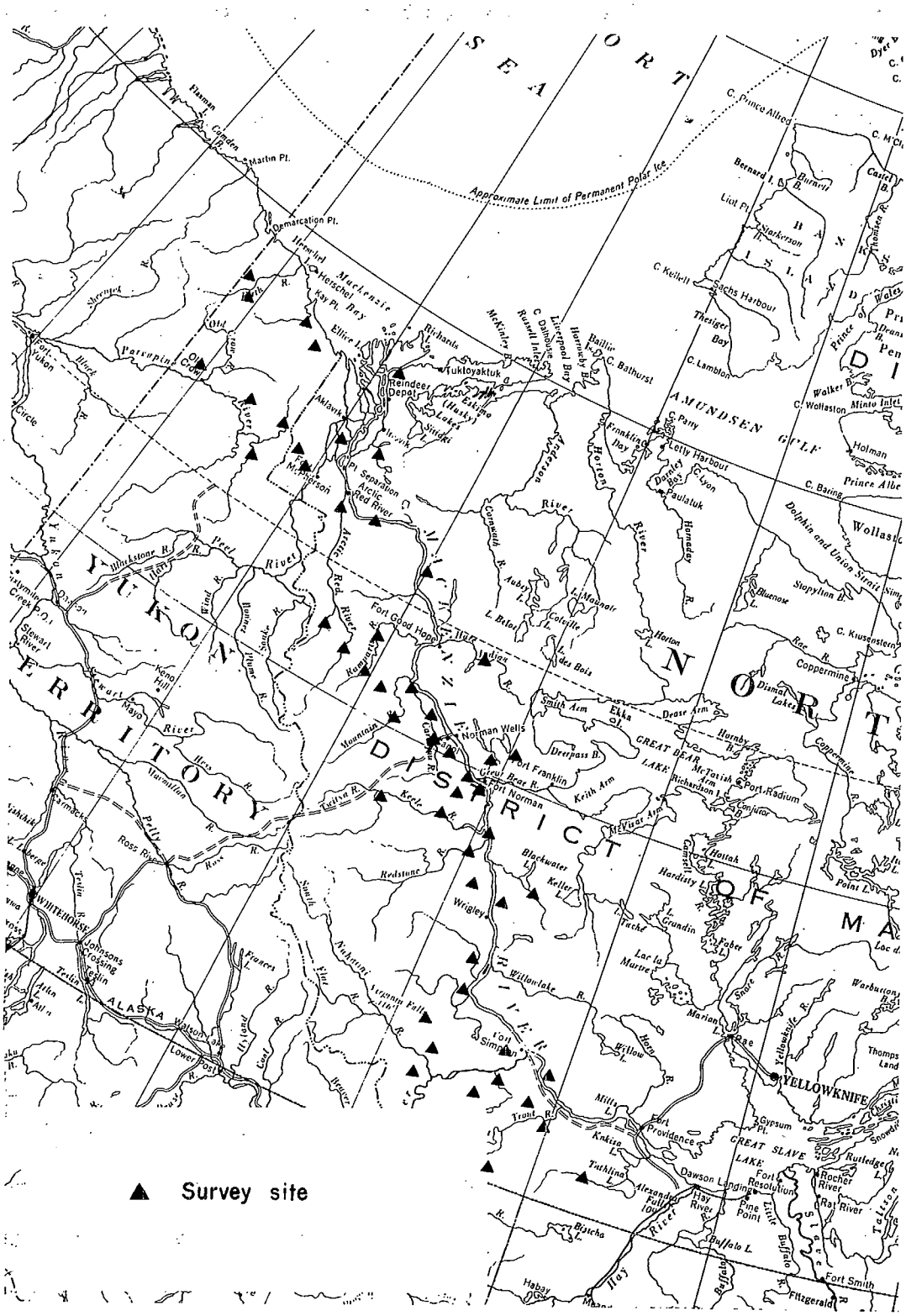


Fig. 2. Location of browse survey sites.

Observed Species Density	Recorded Mean Value	Observed Species Utilization	Recorded Mean Value
trace - 10%	5%	trace - 10%	5%
11% - 50%	30%	11% - 50%	30%
21% -100%	70%	51% -100%	70%

*In calculating species densities and utilization, the mean value was used; e.g., 30% is the mean value between 11% and 50%.

The average density for a species on each site or area being considered was obtained by dividing the sum of the recorded percentage of occurrence by the number of plots. Similarily, the average degree of browsing for a species was calculated by dividing the sum of the recorded percentage of browsing by the number of plots in which the species occurred. The percent of browse available was obtained by dividing the total average density for all species into the average density for each individual species. The percent of the browse eaten was obtained by dividing the product of the average density and the average degree of browsing for each individual species by the total of the products of the average density and the average degree of browsing for all species. The palatability or preference factor was determined by dividing the percent of the browse available into the percent of food eaten for that species. Preferred species were those with palatability factors greater than 1.0.

4. RESULTS

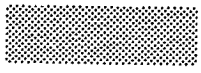
4.1 Population Surveys

Winter surveys along the Mackenzie River indicated heavy moose populations utilize the river islands and sandbars from November to March. On 15 November 1973, Renewable Resources personnel did a survey in the Sans Sault Rapids area; at that time few moose were observed on the islands. The animals were concentrated in the tributary river valleys (David Wooley, personal communication Renewable Resources Consulting Services). One week later, on 22 November, surveys by the Canadian Wildlife Service revealed that the animals had moved out onto the islands of the Mackenzie River.

Winter moose activity was observed along the entire Mackenzie River from Fort Simpson to Arctic Red River. Most of this activity was in willow stands on recent alluvium around the islands, along the river banks, and at the mouths of streams. Populations were most abundant on the islands of the central Mackenzie region from the south of the Redstone River to south of Fort Good Hope.

The distribution of moose associated with the Mackenzie River Islands is depicted in Fig. 3a, b, and c. The heaviest moose concentration, 1.4 moose/km^2, was observed in February 1972 in the Sans Sault Rapids area, and between the mouths of the Keele and Redstone rivers where .8 moose/km^2 were seen

LEGEND FOR DISTRIBUTION FIGS. 3a, 3b, 3c



Sites having very heavy populations of wintering moose.

Sites with moderate to heavy populations of wintering moose.

Sites having good habitat characteristics, but with reduced populations.

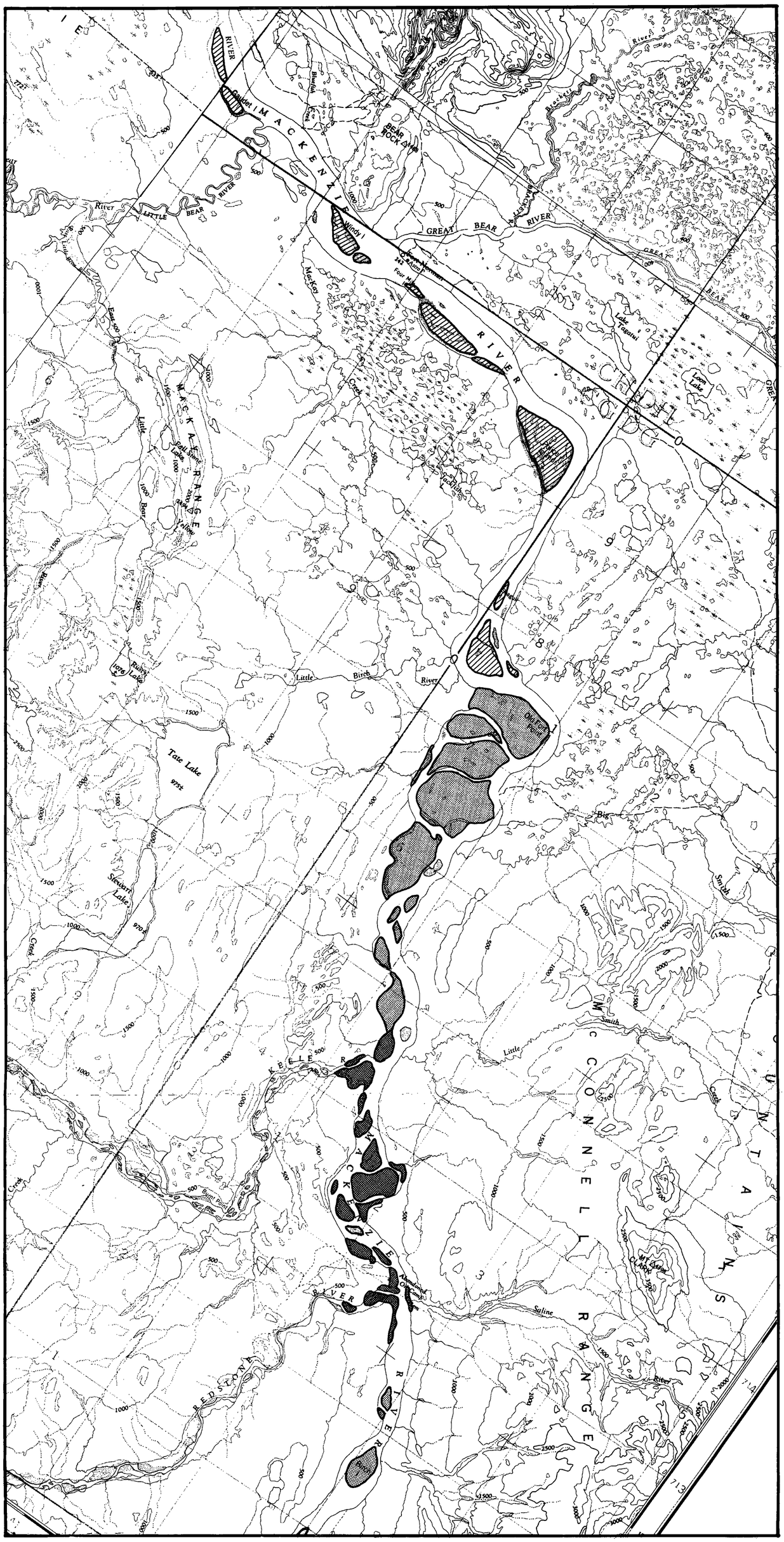


Fig. 3a. Moose concentrations - Ft. Norman region.

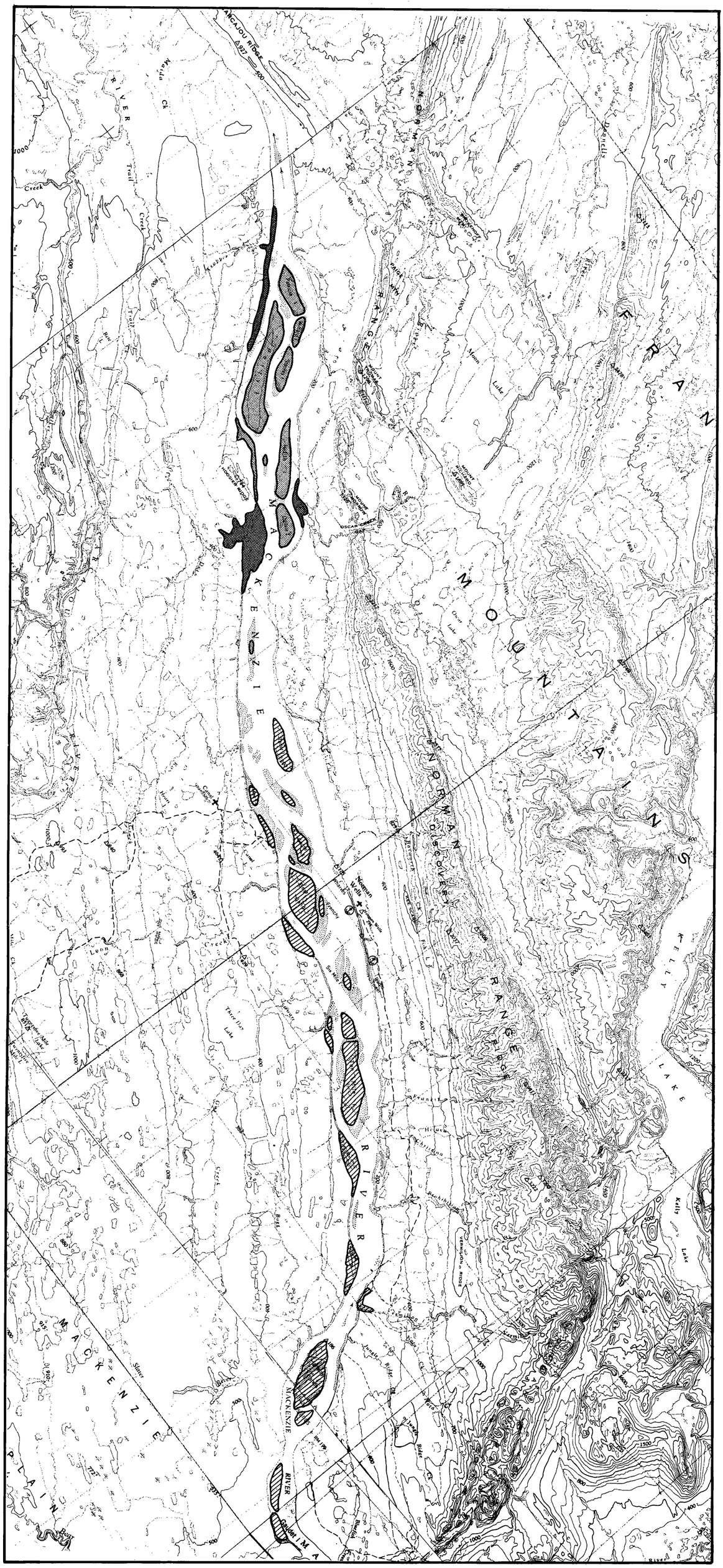


Fig. 3b. Moose concentrations - Norman Wells region.

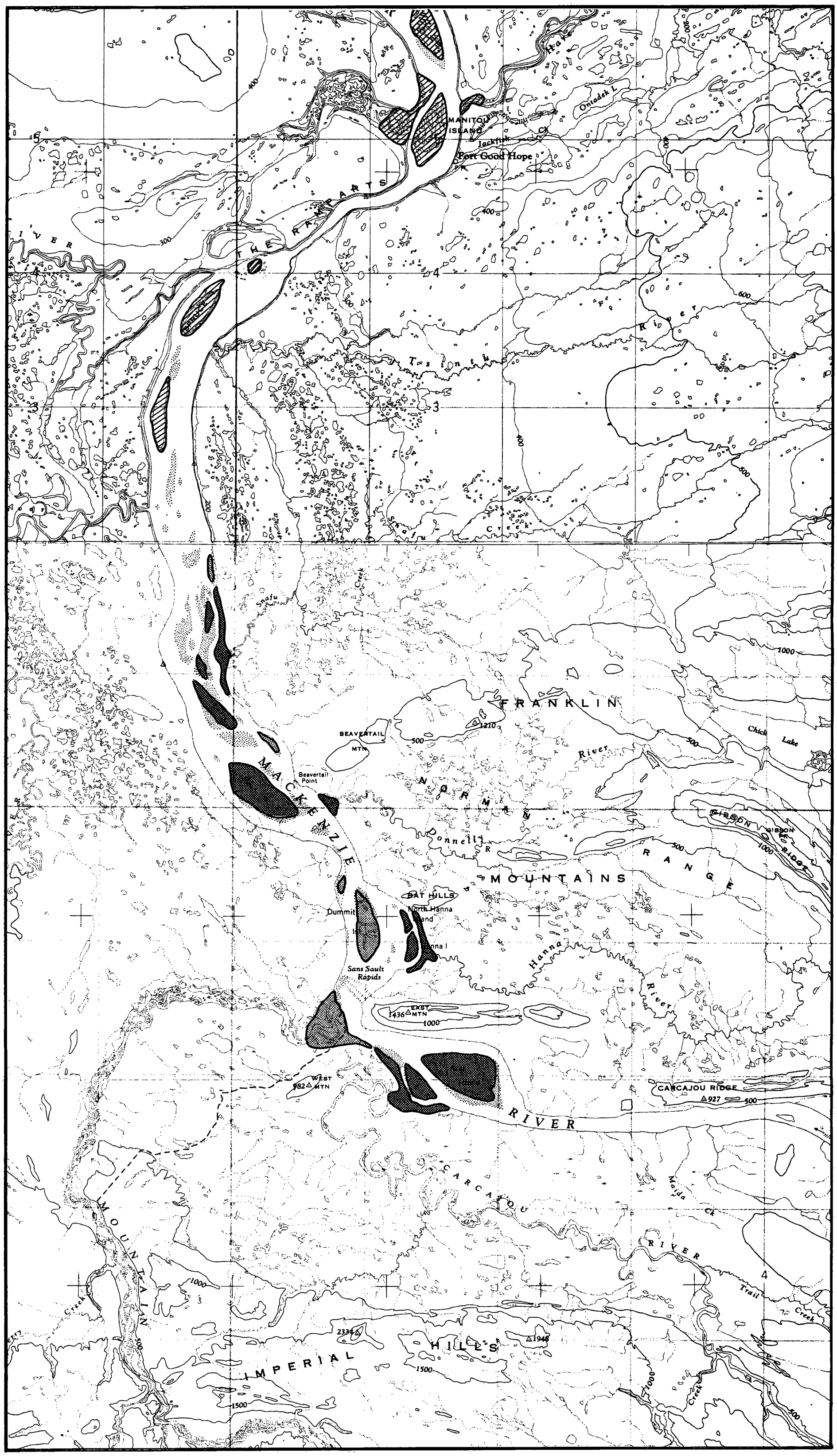


Fig. 3c. Moose concentrations - Sans Sault Rapids region.

in March 1973. The appeal of these islands may be related to their proximity to the Carcajou and Mountain rivers and Oscar Creek, and the Keele and Redstone rivers, respectively. Moose were frequently observed in these tributary river valleys and it is believed that they use them as movement corridors between the Mackenzie Valley and the uplands.

4.2 Browse Surveys

The browse surveys were carried out in late June and early July. Table 1 gives the distribution of the plots in various habitat types and Class 1, 2, 3 units. Fifty-two sites were sampled and 357 plots measured. Fig. 2 illustrates the browse site locations and the summarized results of this survey are presented in Table 2. The results varied with habitat type and with region as summarized in Tables 3 -- 5 and 6 -- 8, respectively.

On the 52 sites, 22 species were encountered, of which 14 showed significant degrees of utilization. Four species, Labrador tea, larch, cinquefoil, and a *Ribes* species showed no evidence of browsing. Willow, alder, balsam poplar and red osier dogwood composed 65.1% of the browse available, yet they provided 90.6% of the food eaten. Willow was the most important species, providing over half (52.1%) of the total diet. Of the less abundant species, aspen poplar, saskatoon and twining honeysuckle appeared highly preferred.

Table 1. Distribution of browse plants according to landform and class (Prescott *et al.* 1973).

	Class 1	Class 2	Class 3
River valleys	15	14	9
Lake complexes	1	2	5
Upland sites	0	2	4

Table 2. Results of Browse Surveys - Grand total for Mackenzie Corridor. Total sample sites-52; total plots - 357.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palata-bility*
Willow (*Salix* spp.)	307	86.0	52.1	29.4	1.8
Alder (*Alnus* spp.)	230	64.4	20.4	22.2	0.9
Spruce (*Picea* spp.)	159	44.5	1.7	9.0	0.2
Balsam Poplar (*Populus balsamifera*)	139	38.9	7.0	8.0	0.9
Rose (*Rosa* spp.)	126	35.3	1.2	6.2	0.2
Red Osier Dogwood (*Cornus stolonifera*)	86	24.1	11.1	5.5	2.0
Birch (*Betula* spp.)	68	19.0	2.0	3.4	0.6
Labrador Tea (*Ledum* spp.)	53	14.8	0	3.6	-
Buffalo Berry (*Shepherdia canadensis*)	53	14.8	0.1	2.0	0.1
Aspen Poplar (*Populus tremuloides*)	47	13.2	1.2	1.1	1.1
Cinquefoil (*Potentilla* spp.)	40	11.2	0	1.1	0
Bog Birch (*Betula glandulosa*)	27	7.6	0.3	1.8	0.2
Cranberry (*Viburnum edule*)	25	7.0	0.1	1.9	0.1
Vaccinium spp.	23	6.4	0.1	1.7	0.1
Ribes spp.	15	4.2	0	0.2	-
Silverberry (*Elaeagnus commutata*)	14	3.9	0.1	0.2	0.5
Saskatoon (*Amelanchier alnifolia*)	13	3.6	1.5	0.7	2.1
Juniper (*Juniperus* spp.)	11	3.1	0.2	0.2	1.0
Snowberry (*Symphoricarpus* spp.)	9	2.5	0.1	0.4	0.3
Rubus spp.	9	2.5	0	0.3	-
Larch (*Larix laricina*)	5	1.4	0	0.1	-
Twining Honeysuckle (*Lonicera involucrata*)	1	0.3	0	0	-

* Palatability factor - $\frac{\%\text{ browse eaten}}{\%\text{ browse available}}$

Table 3. Results of browse surveys - Fort Simpson region. Total sample sites - 17; total plots - 121.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palata-bility
Willow (*Salix* spp.)	102	84.3	38.3	23.7	1.6
Alder (*Alnus* spp.)	69	57.0	16.2	18.0	0.9
Spruce (*Picea* spp.)	59	48.8	5.3	10.8	0.5
Red Osier Dogwood(*Cornus stolonifera*)	58	47.9	16.9	10.8	1.6
Rose (*Rosa* spp.)	58	47.9	3.9	11.4	0.3
Balsam Poplar (*Populus balsamifera*)	42	34.7	2.9	4.2	0.7
Aspen Poplar (*Populus tremuloides*)	27	22.3	3.8	2.1	1.8
Birch (*Betula* spp.)	22	18.2	3.3	2.8	1.2
Cranberry (*Viburnum edule*)	21	17.4	0.5	4.4	0.1
Buffalo Berry (*Shepherdia canadensis*)	19	15.7	0.2	1.9	0.1
Cinquefoil (*Potentilla* spp.)	18	14.9	0	1.7	-
Bog Birch (*Butla glandulosa*)	14	11.6	0.6	2.6	0.2
Saskatoon (*Amelanchier alnifolia*)	13	10.7	5.2	1.9	2.7
Ribes spp.	9	7.4	0	0.4	-
Rubus spp.	8	6.6	0	0.9	-
Snowberry (*Symphoricarpus* spp.)	7	5.8	0.4	1.2	0.3
Labrador Tea (*Ledum* spp.)	3	2.5	0	0.1	-
Larch (*Larix laricina*)	2	1.7	0	0.1	-
Silverberry (*Elaeagnus commutata*)	1	0.8	2.0	0.4	5.0
Juniper (*Juniperus* spp.)	1	0.8	0.3	0.1	3.0
Twining Honeysuckle (*Lonicera involucrata*)	1	0.8	0.1	0.1	1.0

Table 4. Results of browse surveys - Norman Wells region. Total sample sites - 21; total plots - 156.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palatability
Willow (*Salix* spp.)	140	89.8	45.9	22.3	2.1
Alder (*Alnus* spp.)	121	77.6	17.8	23.7	0.8
Spruce (*Picea* spp.)	90	57.7	0.3	10.8	0
Balsam Poplar (*Populus balsamifera*)	78	50.0	14.8	11.4	1.3
Rose (*Rosa* spp.)	64	41.0	0.4	4.6	0.1
Labrador Tea (*Ledum* spp.)	50	32.1	0	8.2	-
Birch (*Betula* spp.)	41	26.3	2.7	4.9	0.6
Red Osier Dogwood (*Cornus stolonifera*)	28	18.0	16.1	3.5	4.6
Cinquefoil (*Potentilla* spp.)	22	14.1	0	1.1	-
Vaccinium spp.	22	14.1	0.5	3.6	0.1
Buffalo Berry (*Shepherdia canadensis*)	20	12.8	0.1	1.1	0.1
Aspen Poplar (*Populus tremuloides*)	20	12.8	0.3	0.8	0.4
Bog Birch (*Betula glandulosa*)	13	8.3	0.3	2.1	0.1
Silverberry (*Elaeagnus commutata*)	13	8.3	0.3	0.7	0.4
Juniper (*Juniperus* spp.)	10	6.4	0.4	0.6	0.7
Ribes spp.	6	3.8	0	0.1	-
Larch (*Larix laricina*)	3	1.9	0	0.1	-
Snowberry (*Symphoricarpus* spp.)	2	1.3	0	0.1	-
Rubus spp.	1	0.6	0	0	-
Cranberry (*Viburnum edule*)	1	0.6	0	0.1	-

Table 5. Results of browse surveys - Inuvik region. Total sample points - 15; total plots - 80

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palatability
Willow (*Salix* spp.)	65	81.3	70.8	54.7	1.3
Alder (*Alnus* spp.)	40	50.0	26.9	25.6	1.1
Balsam Poplar (*Populus balsamifera*)	19	23.8	1.4	7.4	0.2
Buffalo Berry (*Shepherdia canadensis*)	14	17.5	0.2	4.5	0
Spruce (*Picea* spp.)	10	12.5	0	1.4	-
Birch (*Betula* spp.)	5	6.3	0.2	1.3	0.2
Rose (*Rosa* spp.)	4	5.0	0	0.4	-
Cranberry (*Vibrunum edule*)	3	3.8	0	1.4	-
Vaccinium spp.	1	1.3	0	0.7	-

Table 6. Results of browse surveys carried out in locations classed as river valleys. Total sample points - 42; total plots - 286.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palata-bility
Willow (*Salix* spp.)	238	83.2	18.3	8.1	2.3
Alder (*Alnus* spp.)	186	65.0	7.1	8.1	0.9
Balsam Poplar (*Populus balsamifera*)	124	43.4	5.2	5.4	1.0
Spruce (*Picea* spp.)	103	36.0	0.8	4.1	0.2
Rose (*Rosa* spp.)	88	30.8	1.5	4.9	0.3
Red Osier Dogwood (*Cornus stolonifera*)	86	30.1	13.1	6.1	2.1
Buffalo Berry (*Shepherdia canadensis*)	42	14.7	0.4	2.4	0.2
Aspen Poplar (*Populus tremuloides*)	30	10.5	3.6	2.4	1.5
Cinquefoil (*Potentilla* spp.)	26	9.1	0	2.5	-
Bog birch (*Betula glandulosa*)	20	7.0	0.5	3.9	0.1
Birch (*Betula* spp.)	19	6.6	5.1	4.7	1.1
Cranberry (*Viburnum edule*)	16	5.6	1.1	7.6	0.1
Silverberry (*Elaeagnus commutata*)	14	4.9	2.6	3.1	0.8
Saskatoon (*Amelanchier alnifolia*)	13	4.5	11.8	5.8	2.0
Labrador Tea (*Ledum* spp.)	13	4.5	0	3.1	-
Juniper (*Juniperus* spp.)	11	3.8	3.1	2.6	1.2
Snowberry (*Symphoricarpus* spp.)	7	2.4	3.3	8.2	0.4
Ribes spp.	4	1.4	0	1.4	-
Rubus spp.	4	1.4	0.1	1.3	0.1
Vaccinium spp.	2	0.7	17.3	7.8	2.2
Larch (*Larix laricina*)	1	0.3	0	3.6	-
Twining Honeysuckle (*Lonicera involucrata*)	1	0.3	4.3	1.8	2.3

Table 7. Results of browse surveys carried out in locations classed as upland sites. Total sample sites = 5; total plots = 35.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palatability
Willow (*Salix* spp.)	33	94.3	60.6	17.0	3.6
Spruce (*Picea* spp.)	29	82.9	0	19.4	-
Labrador Tea (*Ledum* spp.)	27	77.1	0	18.5	-
White Birch (*Betula* spp.)	25	71.4	20.0	9.3	2.2
Bog Bilberry (*Vaccinium uliginosium*)	21	60.0	0	9.3	-
Rose (*Rosa* spp.)	17	48.6	0	3.3	-
Alder (*Alnus* spp.)	16	45.7	14.7	9.3	1.6
Aspen Poplar (*Populus tremuloides*)	12	34.3	2.0	1.5	1.3
Shrubby Cinquefoil (*Potentilla fruticosa*)	11	31.4	0	2.0	-
Bog Birch (*Betula glandulosa*)	10	28.6	1.5	5.6	0.3
Balsam Poplar(*Populus balsamifera*)	9	25.7	1.2	2.3	0.5
Buffalo Berry (*Shepherdia canadensis*)	8	22.9	0	2.3	-
Larch (*Larix laricina*)	2	5.7	0	0.3	-
Ribes spp.	1	2.9	0	0.1	-

Table 8. Results of browse surveys carried out on sites classed as wetland complexes. Total sample sites - 5; total plots - 35.

Browse Species	Frequency	%Freq.	%Browse Eaten	%Browse Available	Palatability
Willow (*Salix* spp.)	33	94.3	56.1	20.5	2.7
Alder (*Alnus* spp.)	23	65.7	28.1	15.3	1.8
Birch (*Betula* spp.)	19	54.3	11.1	11.4	1.0
Spruce (*Picea* spp.)	22	62.9	2.6	4.9	0.5
Rose (*Rosa* spp.)	17	48.6	1.9	7.5	0.3
Labrador Tea (*Ledum* spp.)	11	31.4	0	10.3	-
Ribes spp.	7	20.0	0	3.4	-
Rubus spp.	5	14.3	0	11.7	-
Cranberry (*Viburnum edule*)	4	11.4	0	7.7	-
Snowberry (*Symphoricarpus* spp.)	2	5.7	0	3.4	-
Larch (*Larix laricina*)	1	2.9	0	3.4	-

Fig. 4. Vegetation zonation - Mackenzie River islands.

Fig. 5. Browsing on red osier dogwood - Rabbitskin River.

Fig. 6. Use of aspen - Rabbitskin River.

Fig. 7. Blow River browse plot. In this region, willow is found only in the river valleys, the surrounding tundra providing no browse whatever. The resultant heavy use of the available browse may be observed in Fig. 8.

Fig. 8. Heavy browsing on willow - Blow River plot.

Fig. 9. Aspen Creek plot - note presence of willow and poplar.

The number of browse species available to moose decreased in the more northerly regions. Of the 22 species encountered during samplings, only *Vaccinium* spp. were not available in the Fort Simpson region; saskatoon and twining honeysuckle were absent in the Norman Wells region. Only nine species were available in the Inuvik region, although it is significant to note that two of these were preferred species, willow and alder. No red osier dogwood was found north of Fort Good Hope.

Most of the areas selected for surveying were within Class 1 and 2 units located in valleys. In these areas, willow, red osier dogwood, saskatoon and blueberry were the preferred species. They comprised only 27.8% of the browse available, but provided 60.5% of the food eaten. Birch, aspen poplar, juniper, and twining honeysuckle were also preferred species in these areas, but did not occur regularly. White birch and alder were more important on the upland sites and alder on the wetland sites.

Willow was the most important browse species in all habitat types in all regions. It made up only 29.4% of the browse available, while providing 52.1% of that eaten.

5. DISCUSSION

The combined surveys revealed a relationship between the occurrence of willow and the location of moose winter ranges in the Mackenzie Valley corridor. Because willow most frequently occurs in disturbed areas such as regularly flooded river valleys, or as regeneration after a burn, moose are frequently associated with these habitat types and their physiographic units.

There is suggestion, however, that degree of utilization varied among the willow species present, some being preferred more than others. Local variations in moose distribution and more specifically, abundance, may be due in part to their variable preferences among willow species. This theory has been extensively studied in Alaska where it was illustrated that *Salix interior*, *Salix alaxensis*, *Salix arbusculoides*, and *Salix pulchra* were preferred over other willow species in that area (Milke 1969). Renewable Resources, (David Wooley, personal communication) did work on browse preferences in the Chick Lake area north of Norman Wells. They found five different willow species present, some showing more evidence of browsing than others.

In the Fort Simpson region, the river islands are situated well above the flood stage of the river and have characteristically steep, unvegetated banks. Most are not flooded during spring high water levels. Vegetation on these islands is mature spruce and

poplar stands, with little willow present. Hence the islands of this region are not expected to have large moose populations.

In the Norman Wells region, the islands do not rise as sharply above the river level; thus, their perimeters are regularly flooded each spring. This maintains a constant state of regeneration, hence willow growth in the peripheral vegetation. The centres of these islands do remain above water level, thus permitting growth of mature poplar stands. This combination of poplar stands for cover and abundant willow stands for browse provides an ideal situation for wintering moose.

The islands in the Inuvik region do not rise more than a few meters above the river flood stage and are completely flooded in the spring. They also receive a significant amount of ice damage, both to their physical and vegetational attributes. The complete flooding prevents the growth of mature spruce and poplar stands so there is little cover available for moose in this region. The ice damage results in dense broken vegetation which makes passage difficult for humans. It is uncertain what effect this has on moose movements.

Native hunting also plays a role in moose distribution as evidenced by "moose vacuums" around the major settlements (Watson, *et al.*, 1973). The survey data illustrate that in regions of concentrated human activity moose numbers are lower than would be expected.

With the accelerated development of the Mackenzie Valley, increased pressure on the existing moose population is inevitable. The construction of roads into what were formerly isolated areas, and the growing population of the entire area will result in greater hunting pressure.

The Mackenzie Islands have been proposed as a source of borrow material for highway and pipeline construction. Because the process of revegetating a borrow area would take a considerable length of time, the use of islands for this purpose would probably result in the complete loss of portions of these areas as ungulate winter range. Submerged gravel bars lacking vegetation would be a more suitable source from a wildlife point of view.

Disturbances, natural or otherwise, could have some positive effects however. As has been discussed, willow and other browse species commonly occur in regeneration on recently disturbed sites. Regeneration of preferred species in a cleared area, such as right of ways and seismic lines, could provide increased browse and result in an increase in habitat.

6. SUMMARY

The proposed routes of the Mackenzie Valley Gas Pipeline and Highway are close to the Mackenzie River in many areas. It was observed that more information on moose movements to the river islands was required. In an effort to determine preferred species, a study of browse was initiated.

Surveys were flown in mid-March 1973 and 1974, and mid-June and November 1973. The browse surveys were carried out in late June and early July of 1972, and late June of 1973 in some of the more heavily used wintering areas.

Winter surveys along the Mackenzie River indicated that heavy moose populations utilize the willow flats along the river islands and sandbars from November to March. Heaviest moose concentrations occurred in the Sans Sault Rapids area and on the islands between the mouths of the Keele and Redstone rivers.

Twenty-two browse species were encountered, 14 of which showed significant degrees of utilization. Willow, alder, aspen and balsam poplar, and red osier dogwood composed 65.1% of the browse available, yet provided 90.6% of the food eaten. Willow was the most important species, providing over half (52.1%) of the total diet.

As human activity increases along the Mackenzie Valley the factors most seriously affecting moose will be increased hunting pressure as a result of improved access and a redistribution of

human settlement. Destruction of habitat by borrow sites or other developments may be important locally, but will not be of great significance over the total area.

7. IMPLICATIONS AND RECOMMENDATIONS

Without specific information on the schedule for construction and project procedures, it is difficult to make specific recommendations. Generally, however, moose are an adaptable species, and there should be fewer conflicts judging by experience in the south.

1. Consideration should be given to sites of known importance and development limited with regard to access or use of borrow areas.
2. Increased hunting pressures could be a problem, and this should be carefully controlled by any agency involved in game management programs. Extensive moose hunting by employees engaged in pipeline surveying, construction, and maintenance could significantly alter moose populations in key wintering areas in the Mackenzie Valley. While the current effects of hunting are localized, widespread hunting pressure could be exerted by the highly mobile work force which will be in the valley when construction is implemented. The advent of snowmobiles causes greater pressure to be exerted upon the wintering moose population than ever before. Since winter construction activities have been proposed for permafrost areas, the overlap of moose winter ranges and the pipeline right-of-way may tempt a well equipped and mobile work force to harvest an

apparently abundant moose population. An increased hunting pressure exerted throughout the valley in consecutive years could have serious effects on the moose distribution and numbers for many years in the future.

3. There is a clearly demonstrated need for increased monitoring of the moose harvest in the Mackenzie River Valley. Hunting is the most significant factor which will affect moose in this area. Before a final assessment of the full impact of development in the north can be made, a thorough study of hunting practices, number of animals taken each year, and hunter distribution should be made. This information would be required before a sound management program could be established. If any portion of the work force employed on the gas pipeline are permitted to hunt, a close check should be kept on the number and location of the kills. It is anticipated that winter range survey and kill figures reviewed on an annual basis would assist managers to minimize the impact of the increased hunting pressure on the moose population.

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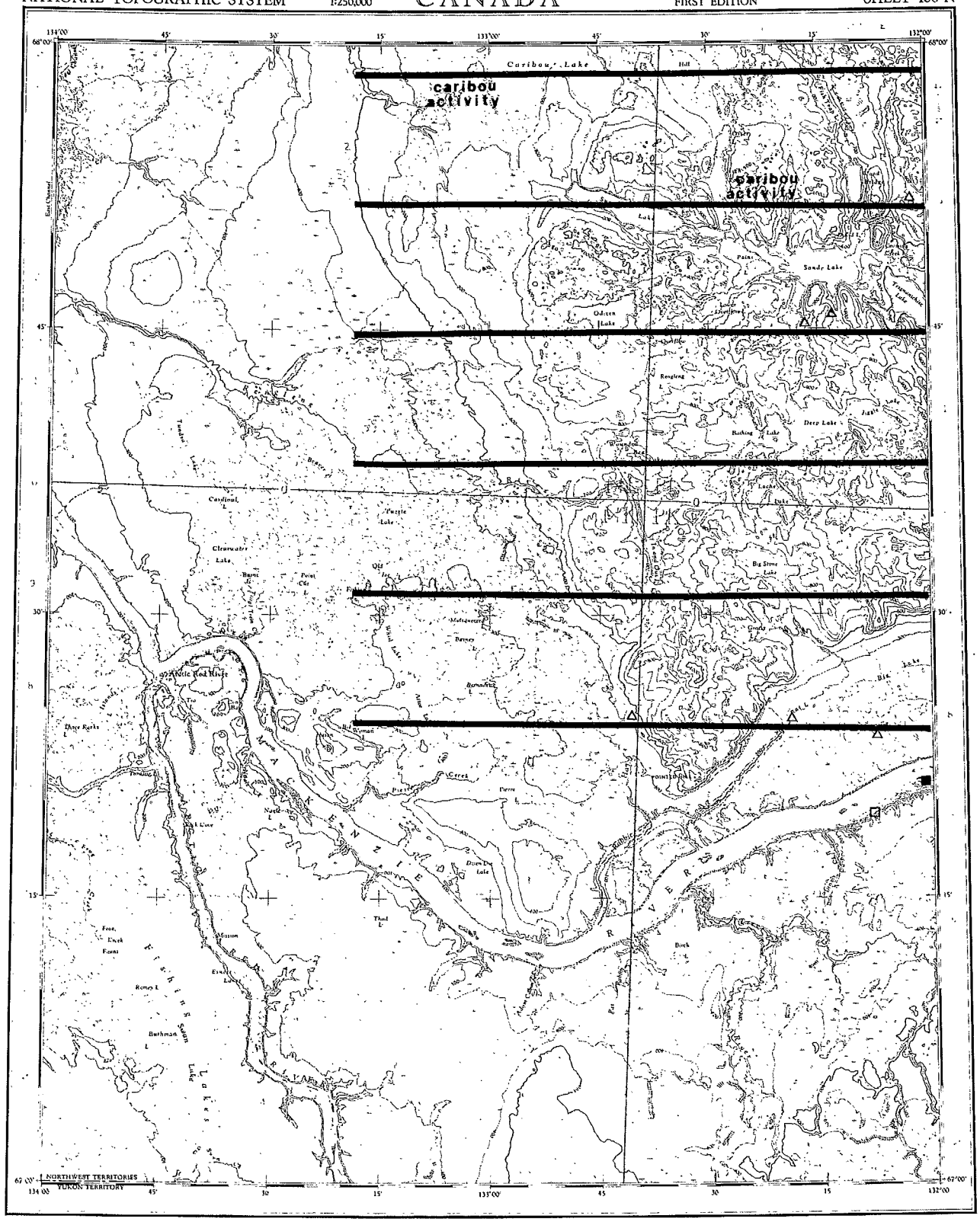
9. APPENDIX A: MOOSE SURVEYS

LEGEND

March survey, 1973	▲	Moose sightings
	△	Moose tracks
November survey, 1973	●	Moose sightings
	○	Moose tracks
March survey, 1974	■	Moose sightings
	□	Moose tracks

NATIONAL TOPOGRAPHIC SYSTEM 1:250,000 CANADA FIRST EDITION SHEET 106 N



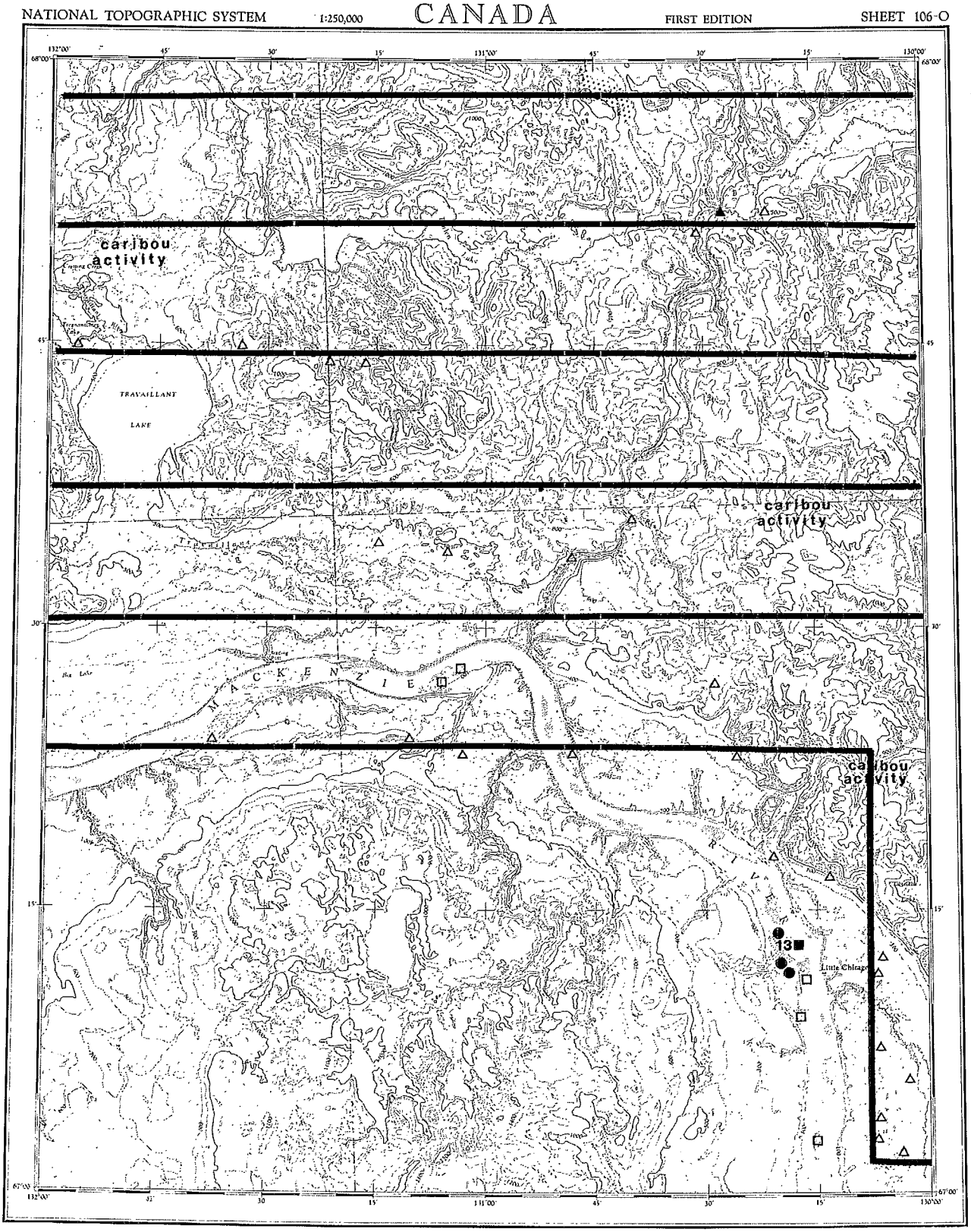
ARCTIC RED RIVER

DISTRICT OF MACKENZIE
NORTHWEST TERRITORIES

CARIBOU TRANSECTS

MARCH 20 - 22, 1973

Flight lines for these surveys were confined to the river and the proposed pipeline route (except as indicated).

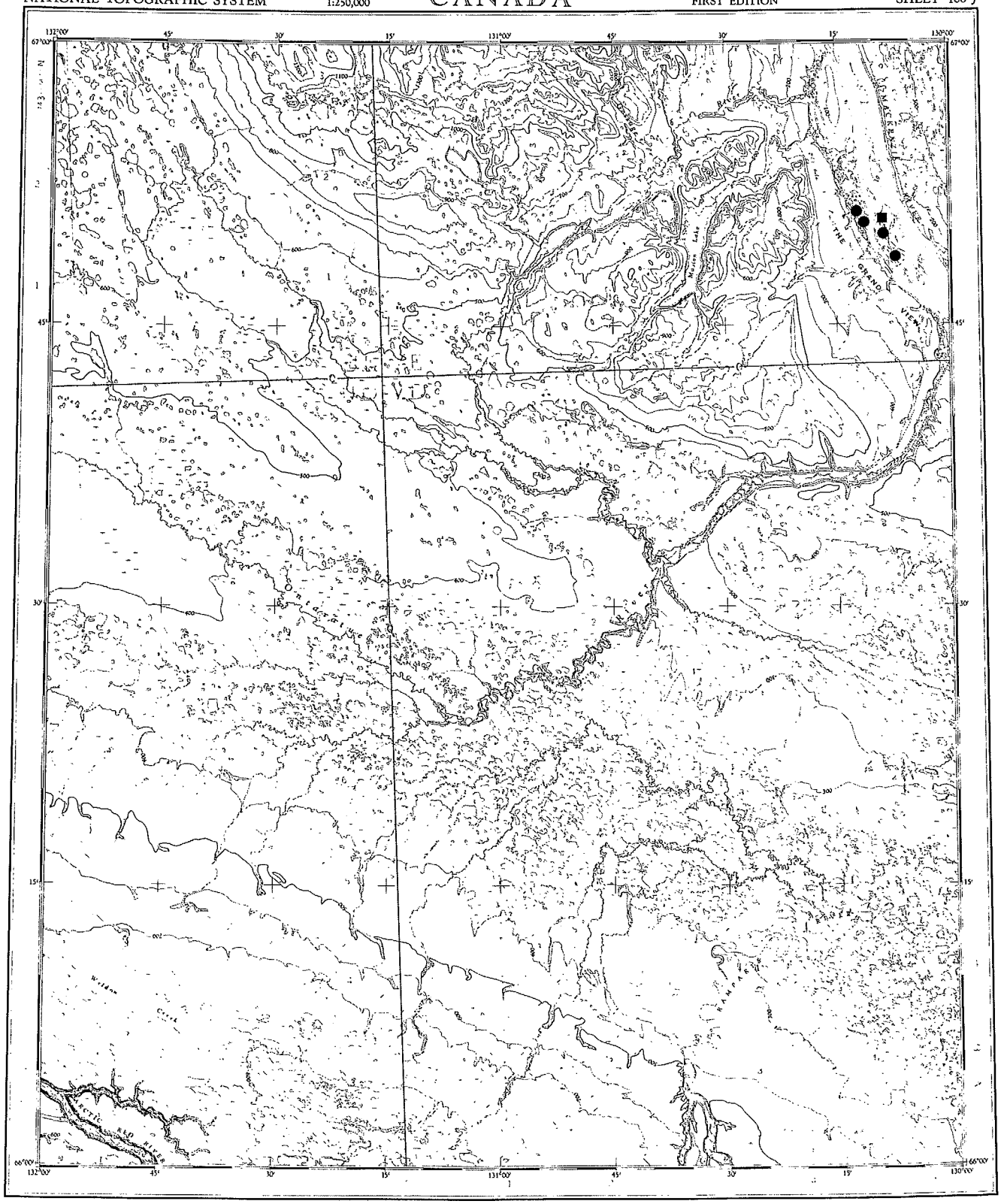


TRAVAILLANT LAKE
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE

CARIBOU TRANSECTS
MARCH 20 - 22, 1973

Flight lines for these surveys were confined to the river and the proposed pipeline route (except as indicated).

NATIONAL TOPOGRAPHIC SYSTEM 1:250,000 CANADA FIRST EDITION SHEET 106 J



ONTARATUE RIVER

NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE

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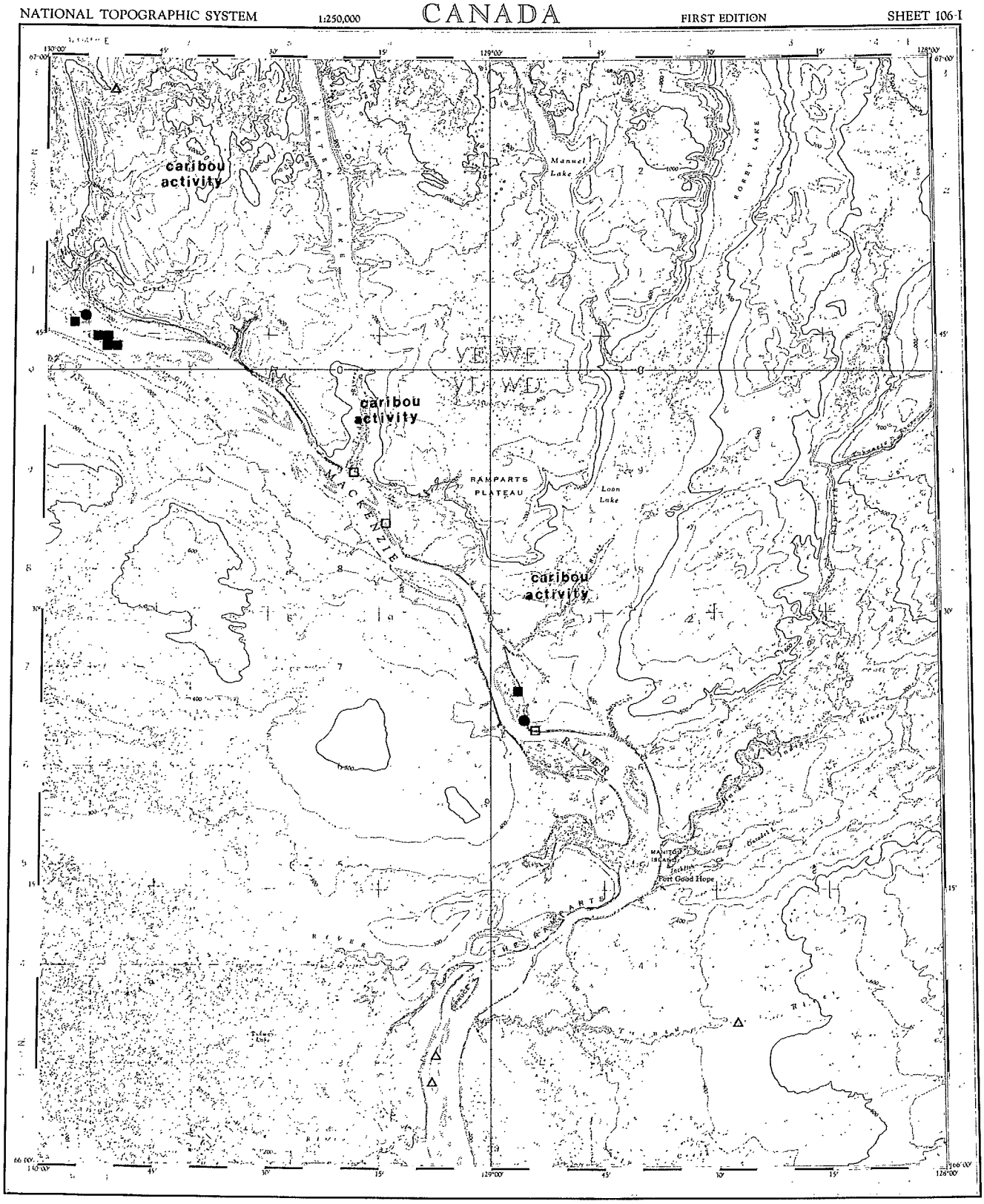

FORT GOOD HOPE

NORTHWEST TERRITORIES

DISTRICT OF MACKENZIE

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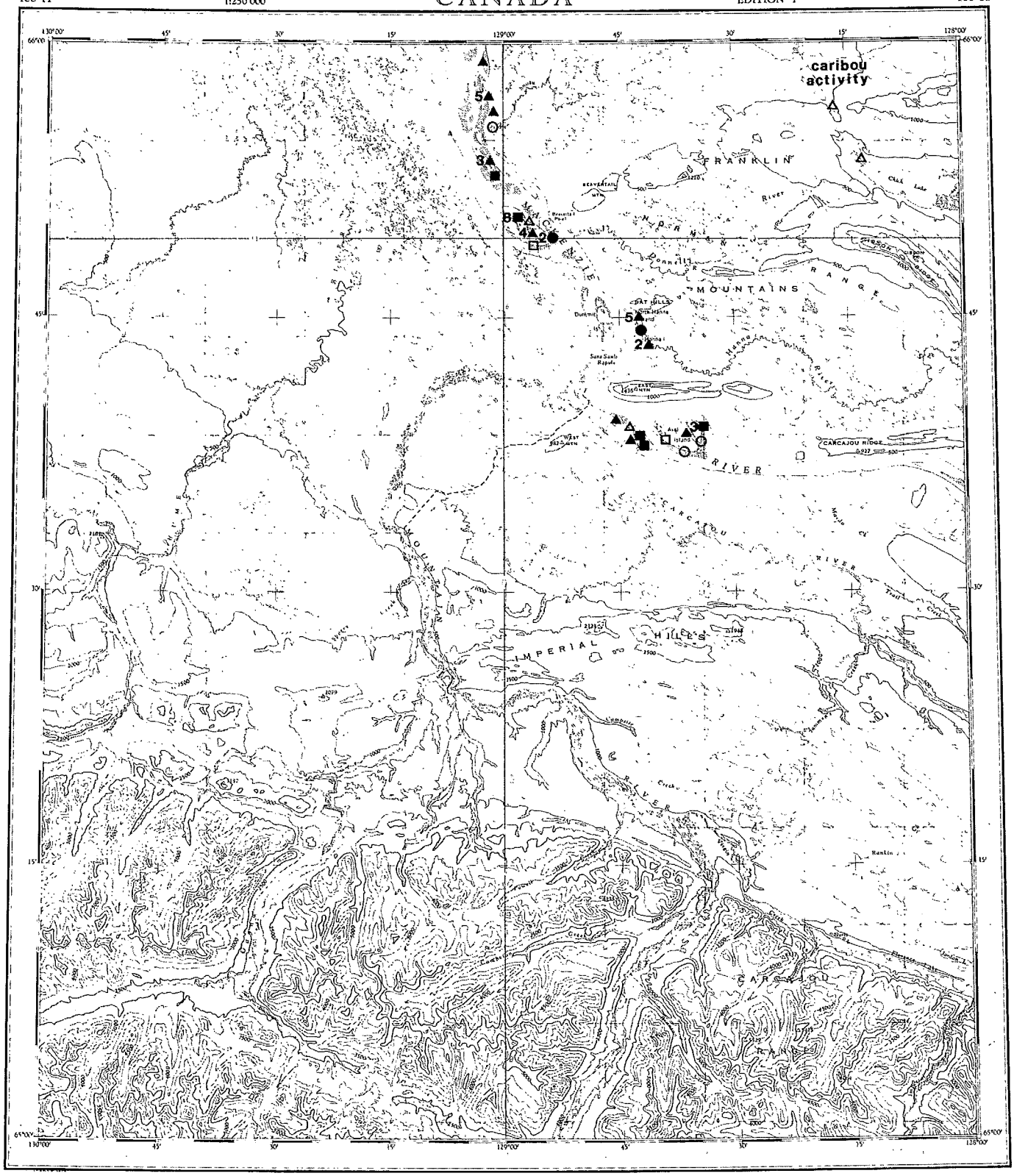
106 H 1:250 000 CANADA EDITION 1 106 H



SANS SAULT RAPIDS

NORTHWEST TERRITORIES

DISTRICT OF MACKENZIE

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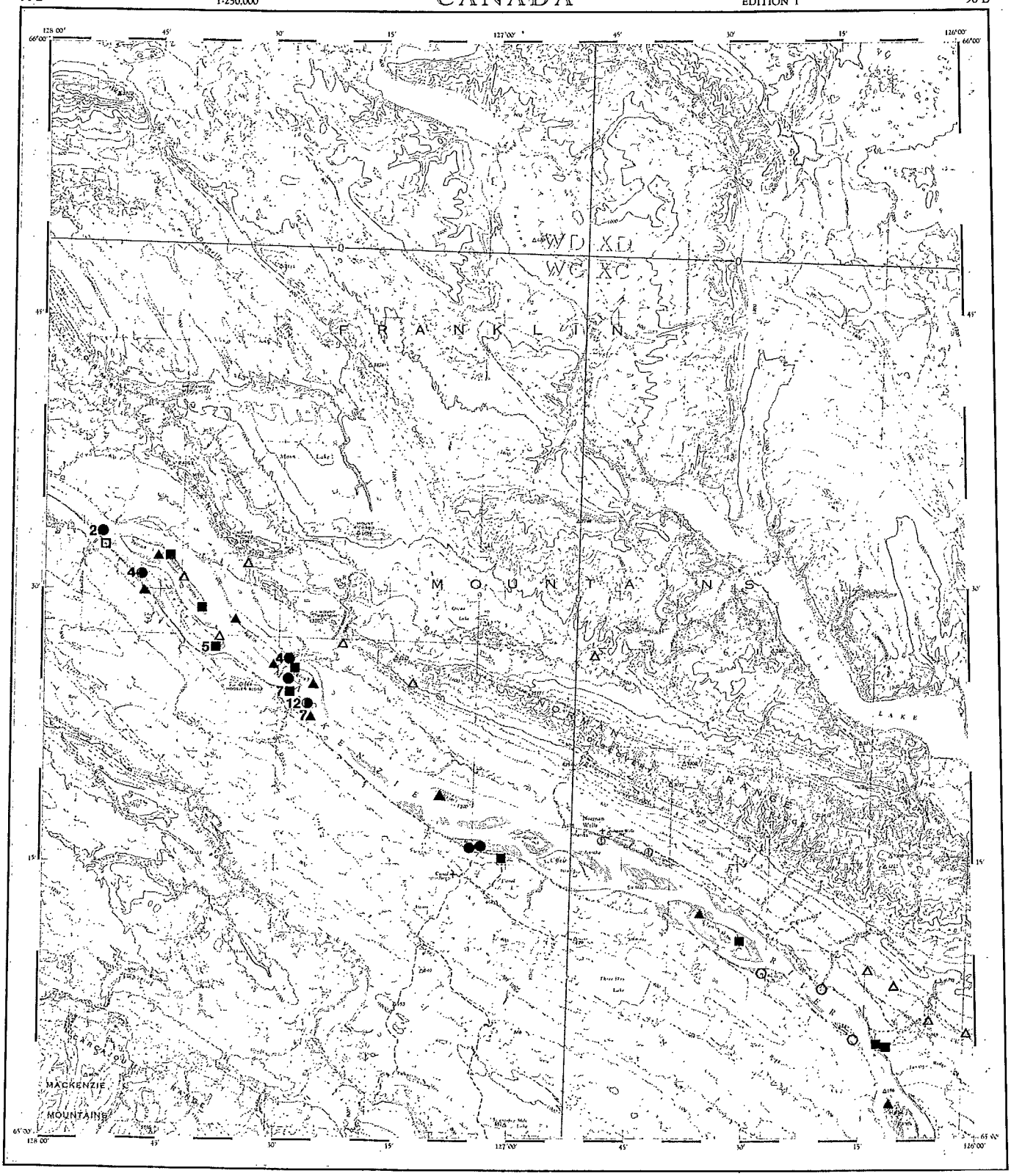
96 E 1:250,000 CANADA EDITION 1 96 E



NORMAN WELLS

NORTHWEST TERRITORIES

DISTRICT OF MACKENZIE

Flight lines for these surveys were confined to the river and the proposed pipeline route.

CANADA
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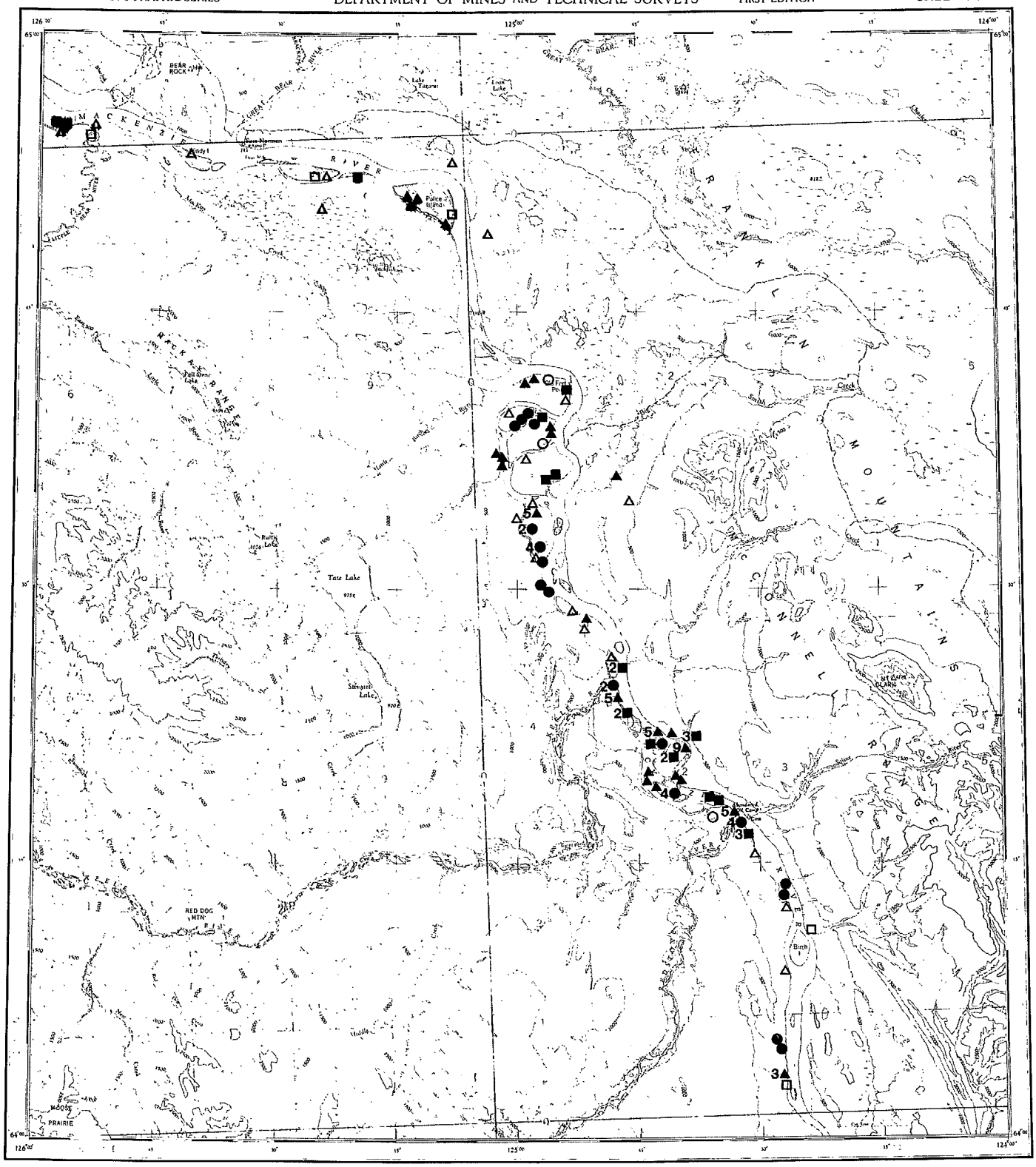

FORT NORMAN

DISTRICT OF MACKENZIE
NORTHWEST TERRITORIES

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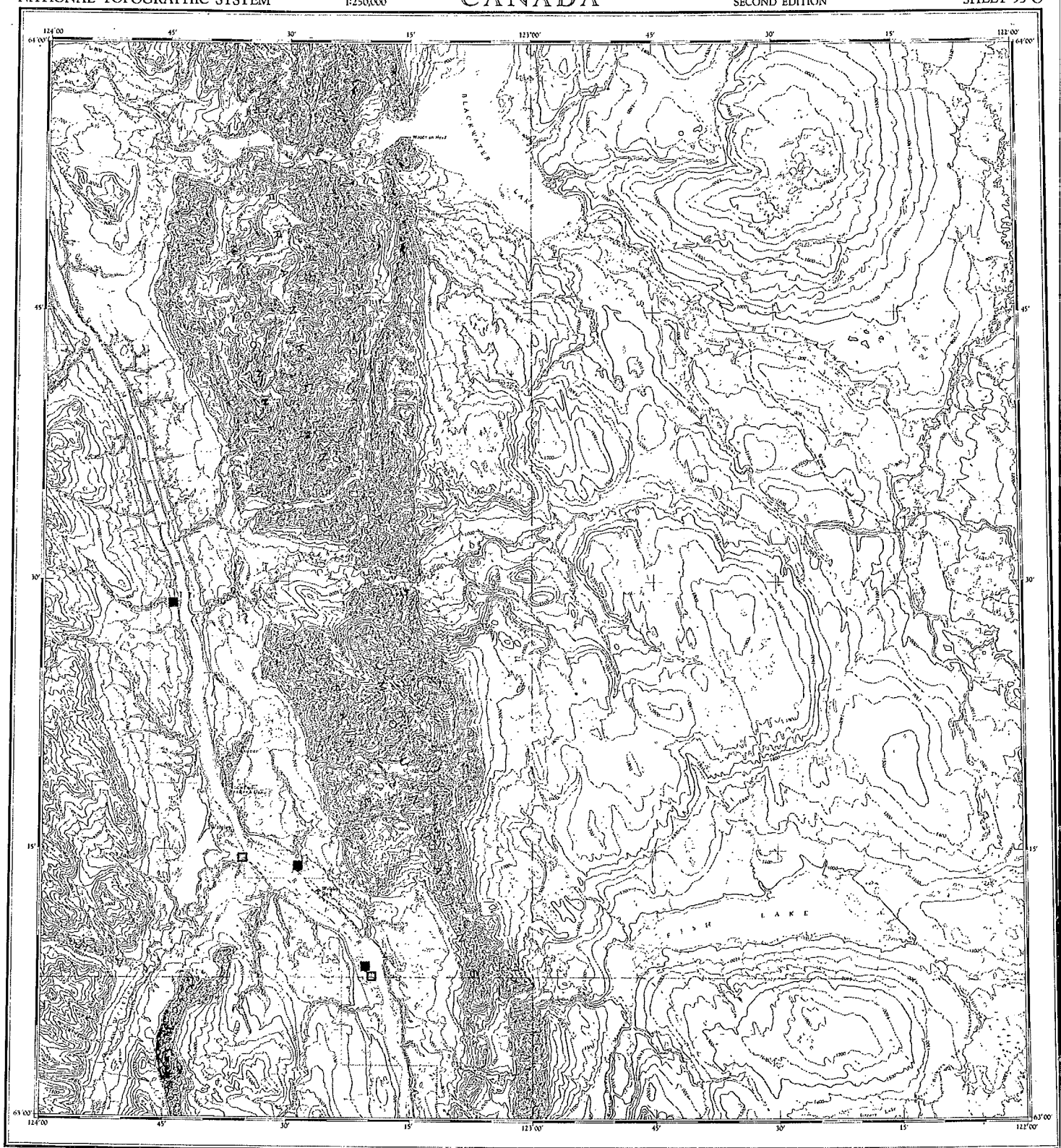
NATIONAL TOPOGRAPHIC SYSTEM 1:250,000 CANADA SECOND EDITION SHEET 95-O



WRIGLEY

NORTHWEST TERRITORIES

DISTRICT OF MACKENZIE

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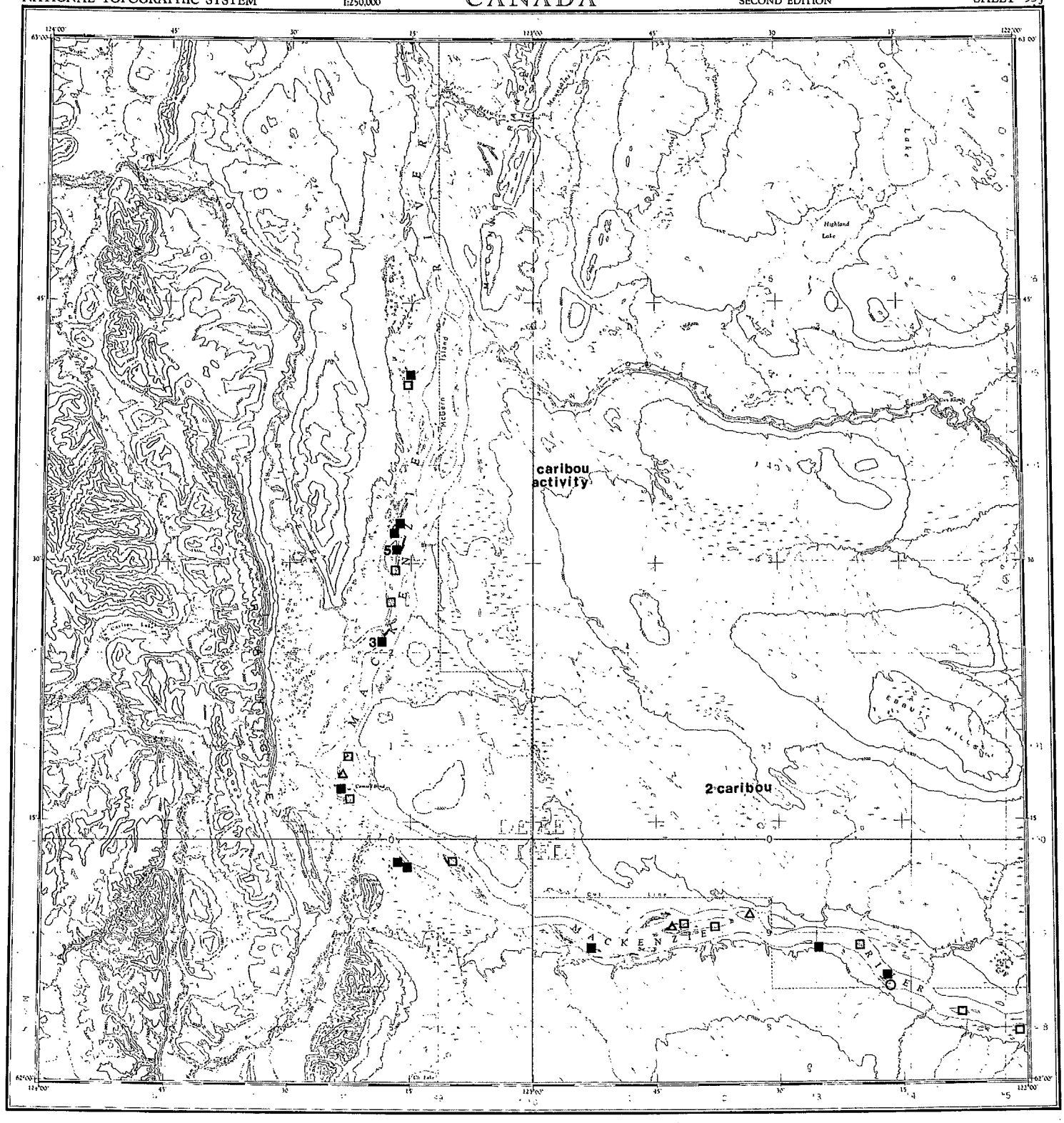
NATIONAL TOPOGRAPHIC SYSTEM 1:250,000 CANADA SECOND EDITION SHEET 95J



CAMSELL BEND

NORTHWEST TERRITORIES

DISTRICT OF MACKENZIE

Flight lines for these surveys were confined to the river and the proposed pipeline route.