DESCRIPTION OF THE MAIN PHYSIOGRAPHIC UNITS IN THE JAMES BAY REGION

by

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Abstract:

The James Bay region is divided into four main physiographic units: forested uplands, bogs, bay shoreline, and wetland edge of rivers and lakes. Following a general description of these units, their importance to certain species of waterfowl is outlined. The bay shoreline, with its associated tidal marshes and mud flats, is the preferred habitat of migrating birds while the marshy edge of certain rivers and lakes is preferred nesting habitat. The forested uplands are considered of no importance to waterfowl while the importance of the bogs has not as yet been determined. The proposed relationship between waterfowl and available habitat is based on one season's field-work and on extensive literature review. Additional field work must be carried out before a true picture of the land capability for waterfowl can be accurately mapped.

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Translator's note: The table of contents lists graph 7 as being for the Moosonee region and graph 8 for the Mistassini Post region, while the headings in the text give the reverse order.

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ACKNOWLEDGEMENTS

We would like to thank a number of people who helped make this study possible: André Bourget and Germain Tremblay, biologist and technician respectively, of the Canadian Wildlife Service, for allowing us to use the data they collected in their 1972 surveys; and George Arsenault and Austin Reed, officer in charge and research scientist respectively, of the Canadian Wildlife Service's Quebec bureau, for their helpful advice.

CHAPTER 1: INTRODUCTION

The aim of this paper is to describe the main physiographic units in the region located between latitudes 51° and 55° north and longitudes 72° and 80° (Fig. 1).

This region, which is part of the Precambrian Shield, reaches a height of between 1500 and 2000 feet in the hinterland of Quebec, several miles from the coast. The topography is characterized by a great many lakes and marshes, caused by glacial and tectonic activity. The lakes, found mainly in the interior, i.e. about 150 miles from the coast, cover at least ¼ of the total area. The tidal flats and marshes are sometimes several hundred acres in area. The region is drained by six main rivers. These are, from north to south, the La Grande (Fort George), Eastmain, Rupert, Broadback, Nottaway and Harricana Rivers. Most of the territory is located in the taïga zone, except for the most southerly area which is part of the boreal forest.

Because of the extent of the territory to be studied, approximately 80,000 sq. mls., the above-mentioned lakes, rivers and forests cannot be expected to be homogeneous throughout the territory. One can therefore imagine that there are certain climatic, pedologic and hydrographic differences which may have important effects on the distribution of waterfowl in the northern as opposed to the southern areas, and in the coastal as opposed to the inland zones. We shall therefore describe the James Bay region by attempting to find such differences and to determine to what extent they affect the behaviour of the various species of waterfowl.

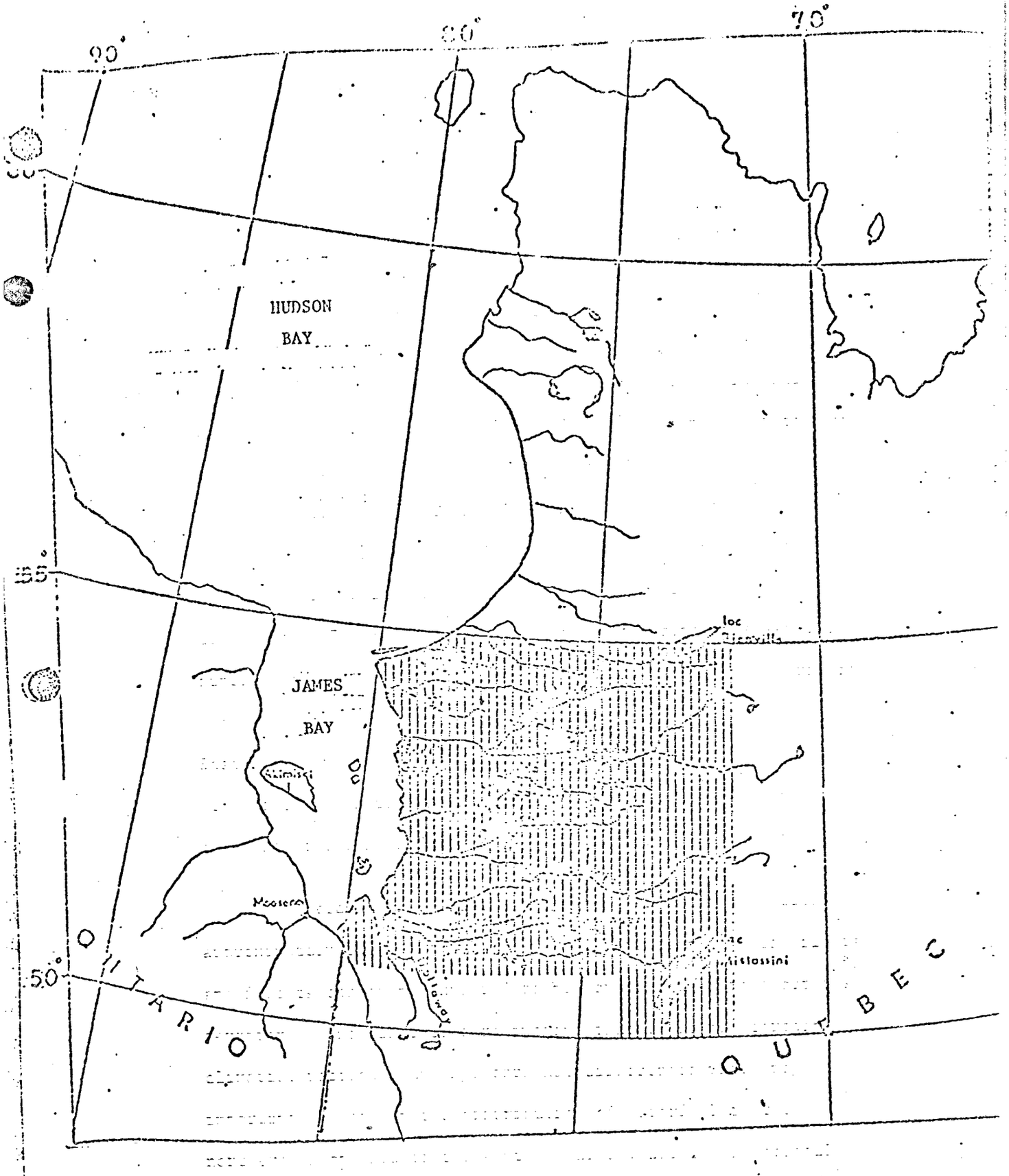


Figure 1. General view of study area.

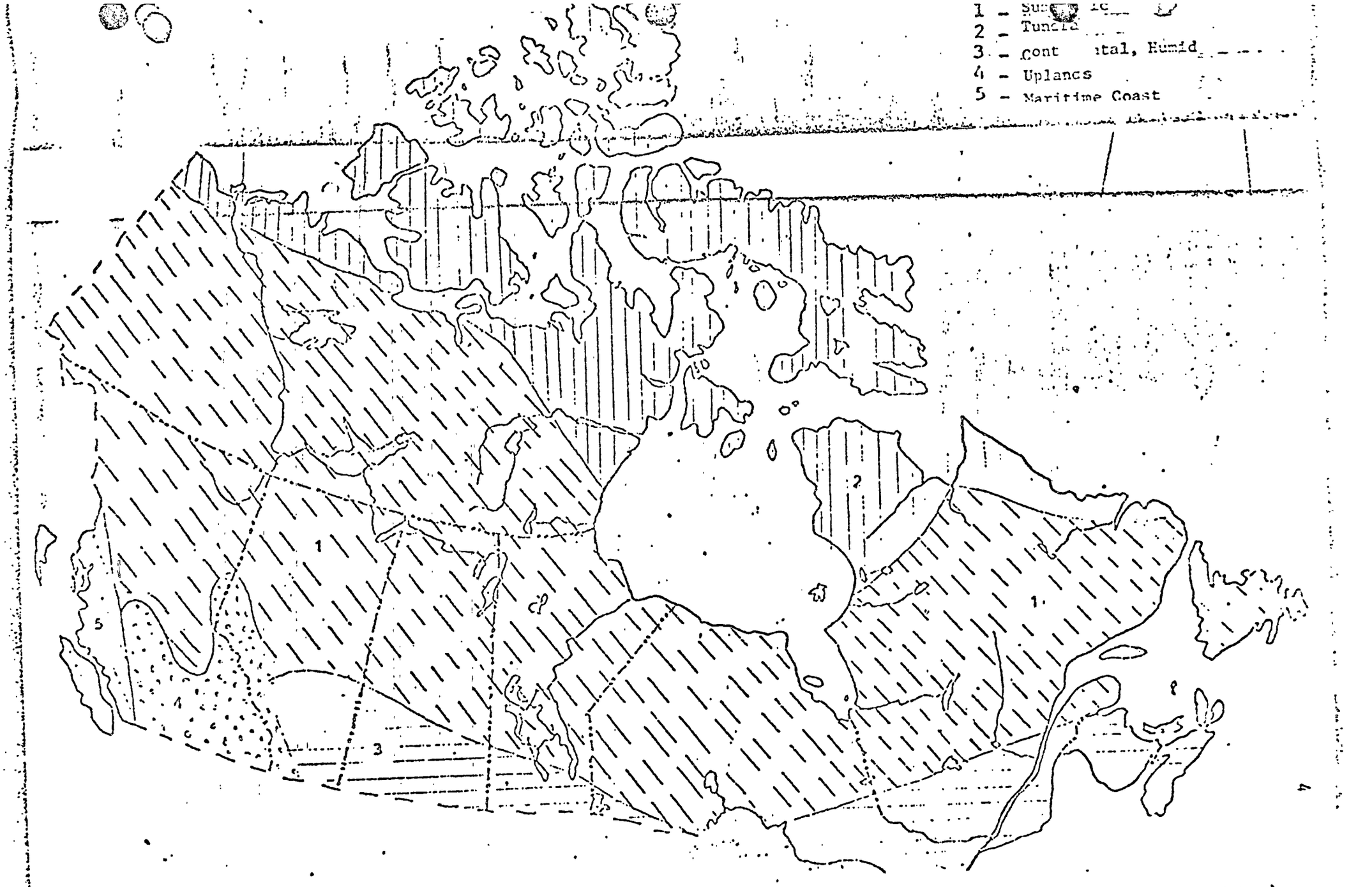
CHAPTER 2: CLIMATE AND TEMPERATURE

The region located between the 50th and 55th parallels north is part of the subarctic climate (Fig. 2)or, in the Koppen-Geiger system, the "DFC" climate (Fig. 3), i.e. one in which the warmest month has an average high above 50°F (10°C) and the coldest an average low below 26.6°F (-3°C).

In the DFC climate there is sufficient precipitation every month and only four months of the year have an average temperature higher than 50°F (10°C), which means that there are less than 50 consecutive days without frost.

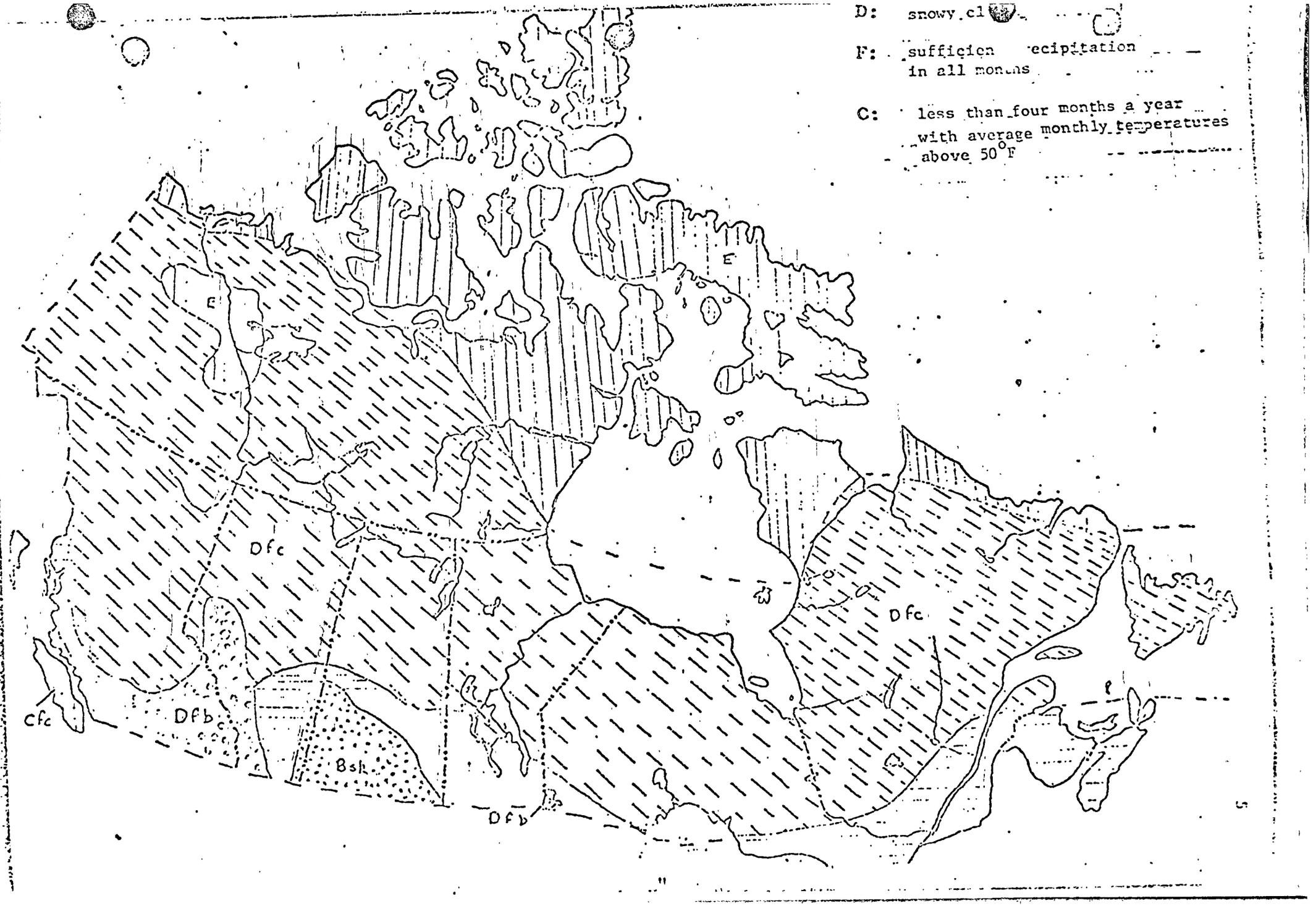
The territory studied is located in the region covered by a polar continental air mass. In winter this mass of very cold air covers the snowy areas. Because of the presence of ice on James Bay and Hudson Bay, the air mass has a very low moisture content and is therefore extremely clear and stable. This clear weather contrasts with the abundance of cloudy days in summer, when the west winds are modified by the water masses of James and Hudson Bays. One must therefore expect to find a climate which shows very wide variations in temperature with excessively severe winters and small total annual precipitations concentrated in the warmest months.

Summer is very short in the subarctic regions. The mean temperature during the warmest month may not be much higher than 50°F (10°C) and frosts may occur at any time during the summer, although the months of June, July and August are usually frost-free. Daily temperatures of 70°F are quite common, however, and at these latitudes the sun remains above the horizon for 16 to 18 hours a day, from May to August.



(Strahler, 1969)

climate distribution


D: snowy cl
F: sufficien ecipitation in all mon
C: less than four months a year with average monthly temperatures above 50°F
E
E
Dfc
Dfc
Cfc
Dfb
Bsk
Dfb

Frost may appear early in the fall. The small lakes and streams generally begin to freeze in mid-October. Because of their size, the larger lakes may not freeze until December.

Winter is the dominant season. Since average monthly temperatures are below freezing for six or seven consecutive months, all the moisture in the soil is completely frozen to depths of several feet. Snow usually comes from fronts to the east and north-east.

Spring usually begins at the end of April and lakes and rivers begin to thaw late in May in the Mistassini Lake region and early in June in the more northerly regions. The ice break-up and the melting snows cause the level of the streams to rise by some six to eight feet. In summer the water level drops gradually, though more slowly in the large lakes, where there is an excess until early July.

In the hinterland of the James Bay region, however, there would not appear to be notable differences between the northern and southern areas or between the bay shoreline and the interior of the plateau. Precipitations, annual mean temperatures, vegetation seasons, the frost-free period and the number of degree-days are almost identical. Table 1 and Figures 4, 5 and 6 give the characterictics of each of the zones.

The only notable differences worth mentioning concern the number of degree-days and the length of the vegetation season. In both cases the south is, of course, at an advantage, with about 500 degree-days and a vegetation season some three weeks longer than that in the northern area (Table 1).

Table 1

Characteristic climatic data for various James Bay zones

zones \ data	Average precipitation (ins.)				No. of days of precip.	Frost-free period (days)	Length of the veg. season	Beginning of the veg. season	End of the veg. season	Degree-days during the veg. season
	April to Sept.	Oct. to March	Annual Minimum	Annual Maximum						
Northern Area	14	10	6	32	180	-	130	20 May	late Sept.	1000
Southern Area	16	12	6	32	180	80	150	15 May	early Oct.	1500
Bay Shore	14 to 16	8 to 12	6	32	180	80	130 to 150	15 to 20 May	late Sept. to early Oct.	1000 to 1500
Interior	14 to 16	12 to 20	6	32	180	80	130 to 150	15 to 20 May	late Sept. to early Oct.	1000 to 1500

(Adapted from the Department of Energy, Mines and Resources)

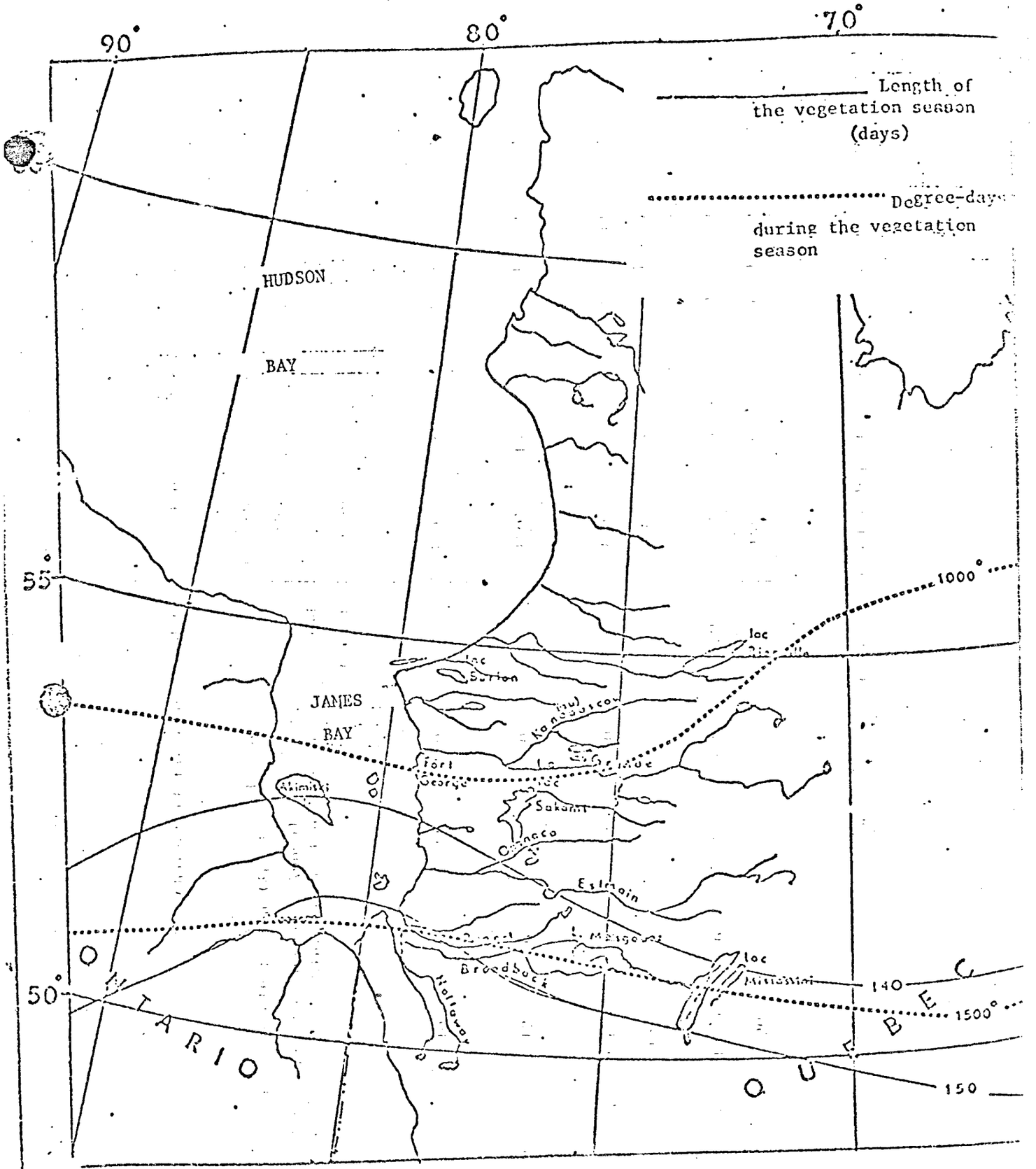


Figure 4. Vegetation season.

(Department of Energy, Mines and Resources)

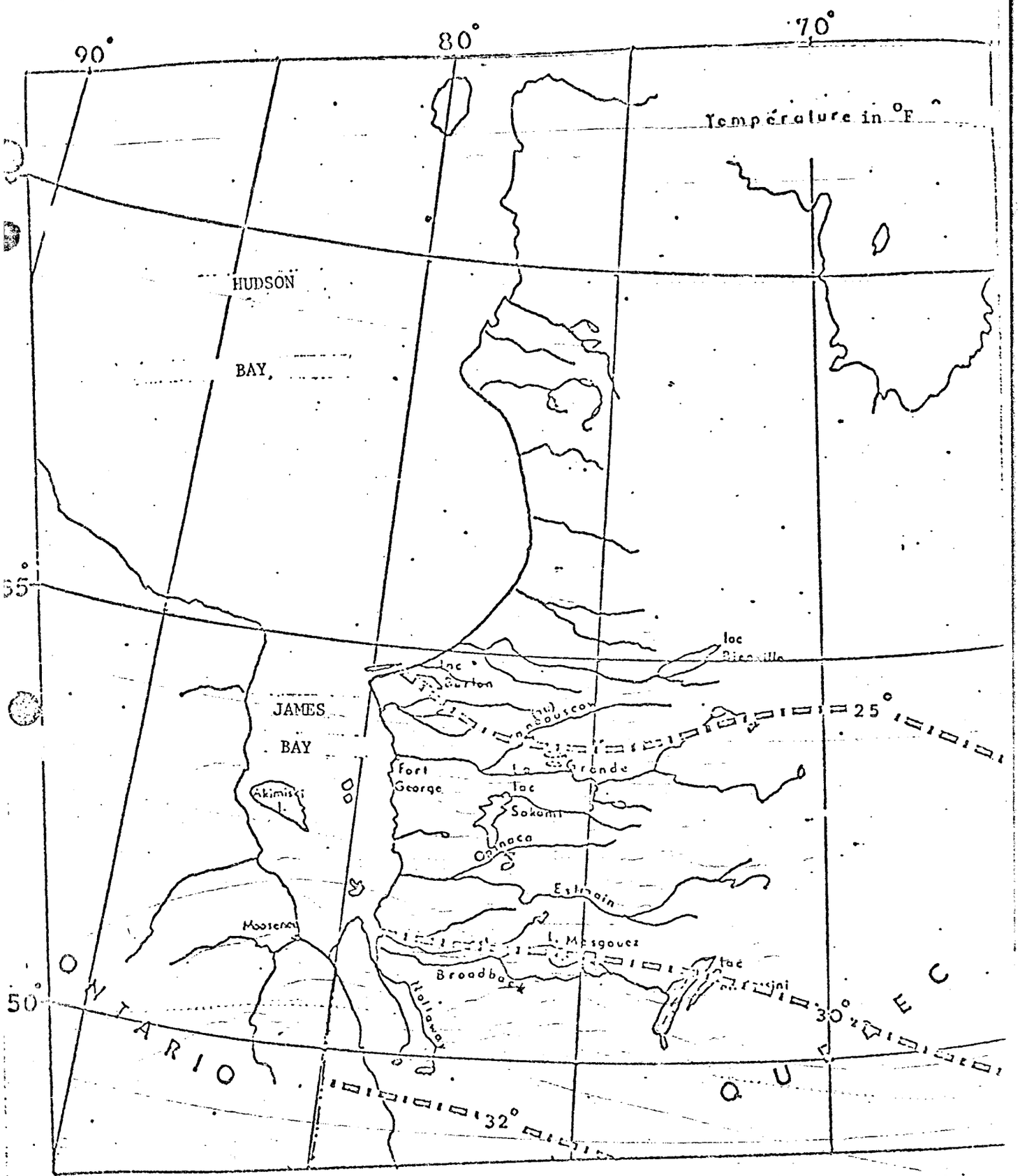


Figure 5. Annual mean temperature

(Marsan, 1971)

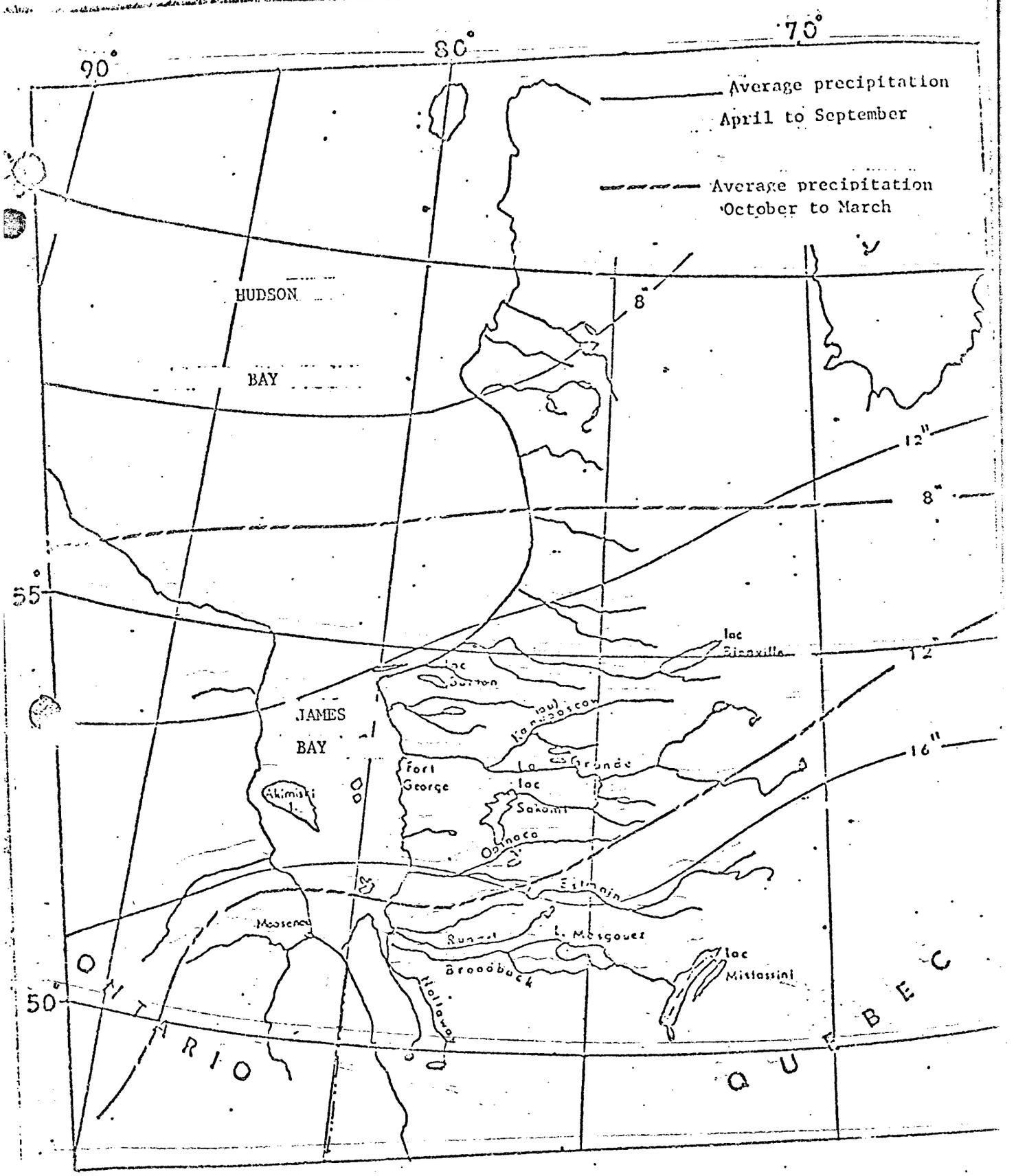


Figure 6. Precipitation

(Department of Energy, Mines and Resources)

It is quite difficult to imagine that such climatic differences could in any way affect the distribution of waterfowl within the region. The two important factors which might affect distribution are the length of the vegetation season and the thaw on certain inland lakes.

Though the vegetation season is slightly shorter in the north than in the south, it still gives the birds enough time to breed. Even assuming that the birds do not begin nesting until the lakes are completely thawed, there is nothing to prevent their doing so in the more northerly regions. If we take as an example the Black Duck (*Anas rubripes*), one of the most common ducks in the region, we find that it requires about 92 days to complete its breeding cycle. To this we must add about fifteen days for the territorial selection and acquisition period, giving us a total of around 107 days. The lakes are ice-free for approximately 125 days, which is quite sufficient for the species to breed.

The same calculations can be made for the Canada Goose (*Branta canadensis*); its breeding cycle takes 109 days, including the territorial selection and acquisition period, which once again does not exceed the limits mentioned above.

One point which we must stress further concerns the weekly mean temperatures during the months most critical for nesting, i.e. April and May. According to Reed (1970), the Black Duck begins nesting, or at least is most likely to do so,

when the mean weekly temperature in the region is about 38°F. On the basis of data collected by the meteorological service of the Department of Natural Resources, it is possible to draw a graph showing both average daily and weekly temperatures at different locations on James Bay. This then enables us to estimate the date when the Black Duck begins nesting in these locations (Graph 1): May 18 at Fort George, May 10 at Moosonee and May 9 at Mistassini.

One notes that this species begins nesting slightly later as one moves north or away from the upland zones, in this case, the Mistassini area. It is true that on the dates mentioned the lakes are still frozen but the Black Duck is known to be a very mobile and enterprising bird, and may easily leave the lake shores to feed on the rivers or any other streams which may already have thawed.

If we assume that the same phenomenon occurs with other species it is then possible to extrapolate the nesting dates of these species by obtaining from the literature available the temperature at which these species usually nest. These results are given in Table 2.

We have taken the liberty of including in this table the Blue-winged Teal (*Anas discors*), a species whose distribution, according to Godfrey (1966), is further south than the region with which we are concerned. One thus notes that the question of temperature may be one of the factors limiting the dispersion of

Graph 1: Approximate date of the start of the nesting season of the Black Duck at various locations on James Bay

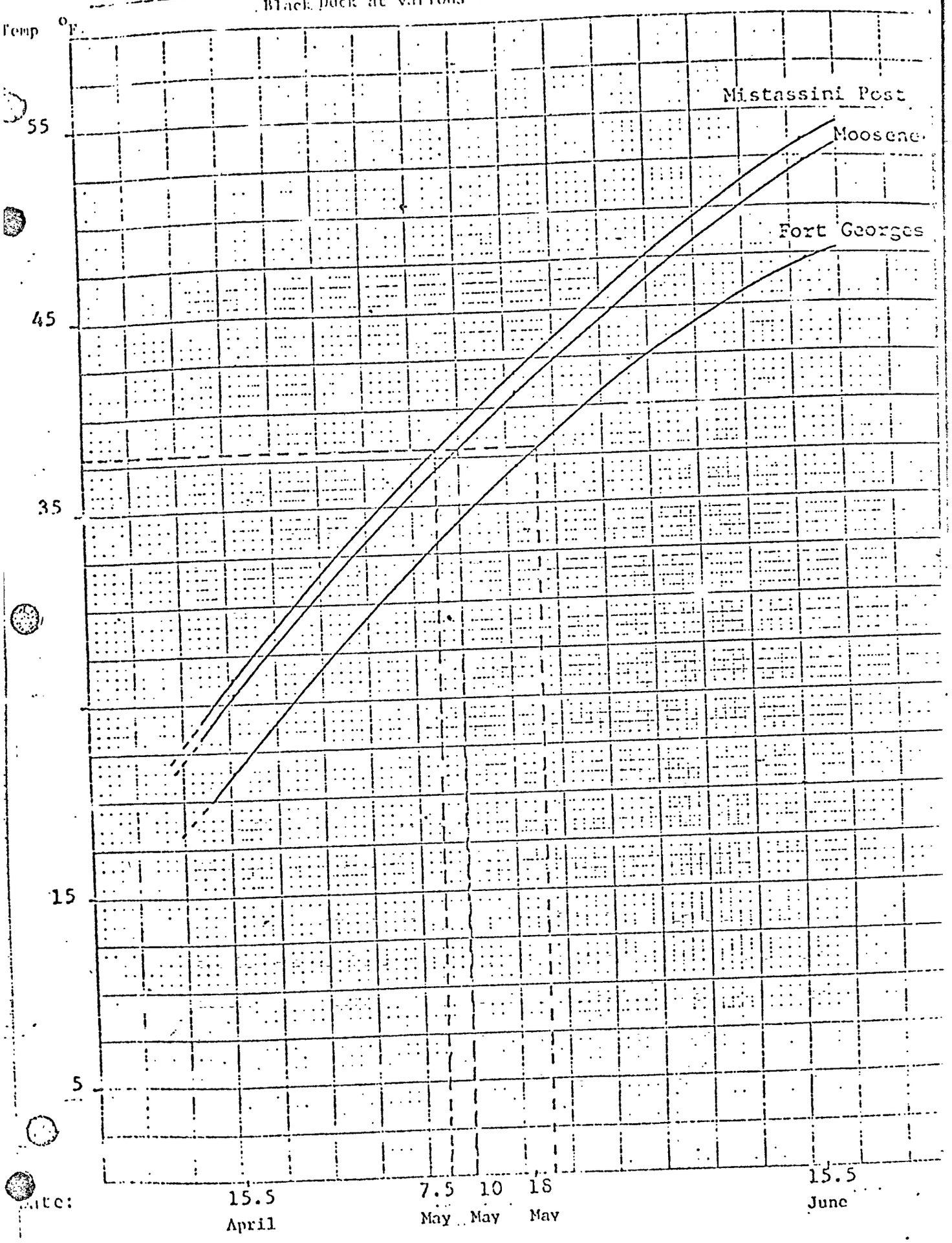


Table 2. Approximate date of the start of the nesting season for several species of waterfowl at various locations on James Bay.

Species	Fort George	Moosonee	Mistassini Post
Canada Goose	June 22	June 6	June 3
Mallard	June 4	May 23	May 20
Blue-winged Teal	July 10	June 18	June 14
Pintail	June 7	May 27	May 23
Common Merganser	May 17	May 9	May 6
Red-breasted Merganser	July 24	June 26	June 22

this species, since the temperature required for nesting would only be reached by about July 10 at Fort George. By this date not enough of the vegetation season would be left for it to breed.

With regard to the other species appearing in the table, the Red-breasted Merganser (*Mergus serrator*) would also seem to be restricted by temperature. Godfrey (1966), however, stipulates that the duck nests throughout the James Bay region. We must

therefore assume either that our data are incorrect, which would force us to make a more complete survey of the literature, or that the idea that ducks can nest (only ?) when the temperature reaches a certain level cannot be applied in this case.

CHAPTER 3: RELIEF

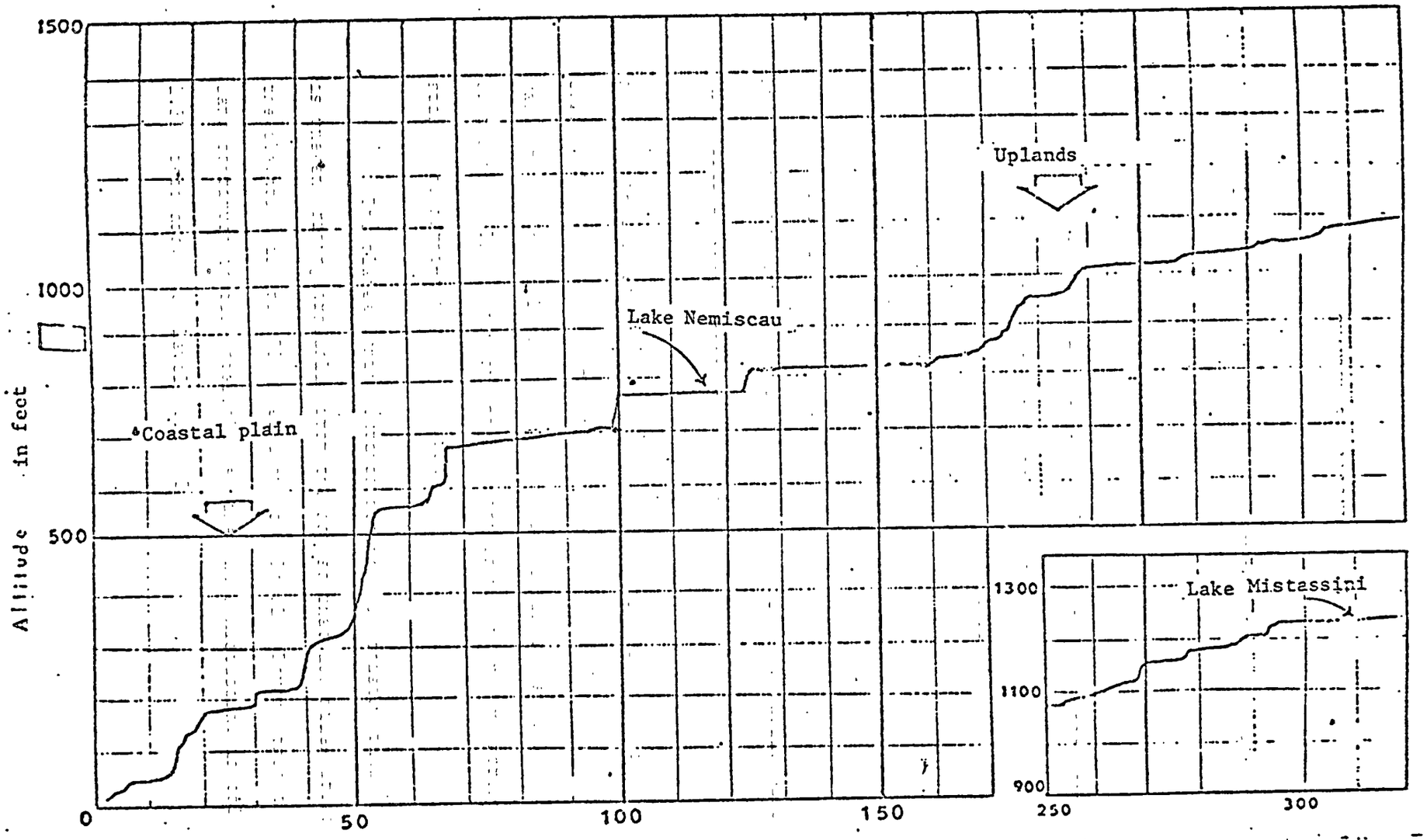
The James Bay region may be divided into two quite distinct zones: the coastal plain and the upland region (Graph 2- Photos 1 and 2).

The coastal plain is formed by a fifty-mile wide strip of poorly drained low-lying land adjacent to the bay. The plain is irregular, becoming narrower to the north till it disappears at Cape Jones, and giving way to uplands that may reach heights of 300 to 400 feet at the very edge of the bay.

This is the only zone not covered by lakes. The area in question was covered by a thick layer of clay and marine sand which filled surface irregularities and prevented the formation of lakes. Nevertheless the zone is covered by a network of small- and medium-sized streams with deep beds cut into the stratified drift. This is also the preferred area for bogs. The bogs are vast and may cover large areas, particularly in the southern part of the bay. In zones where no bogs are found, there are forest stands and burnt-out woodland areas.

The plateau which extends behind this coastal plain is uneven, rising gradually from the bay so that 100 miles inland the elevation is only 700 feet above sea level. Beyond that the land continues to rise gradually so that Lake Mistassini is only 1,300 feet above sea level (Graph 2).

at Rupert



(Adapted from the Department of Natural Resources, 1965)

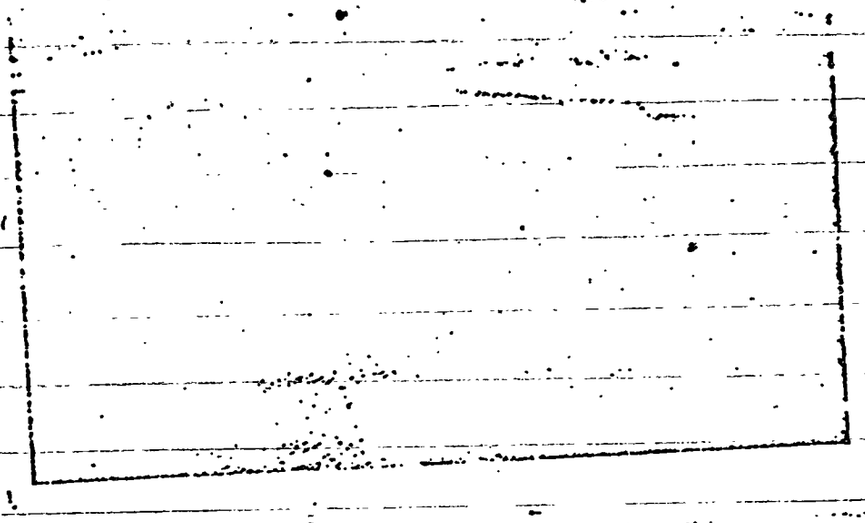


Photo 1. The coastal plain, 60 miles east of Fort George with its forest stands, lakes and bogs.

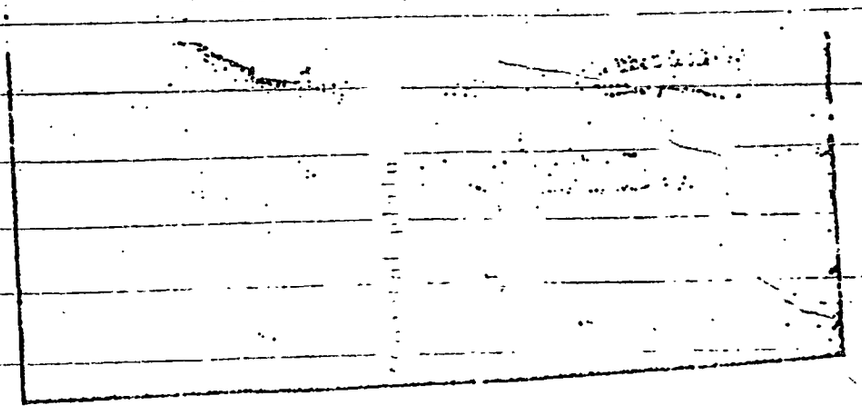


Photo 2. Hinterland region, 60 miles north-west of Lake Mistassini

This entire zone was glaciated during the Pleistocene era and the present countryside reflects this to some extent. Several hills and peaks were denuded during glaciation, exposing the parent rock (matrix).

The plateau is also remarkable because of the presence of glacial deposits such as eskers and drumlins. Eskers are steep-sloped embankments of sand and gravel, and are generally between .. and 100 feet higher than the surrounding land. They are often rectilinear, covering large areas, some of them being over a hundred miles long. Drumlins, on the other hand, are glacial forms resembling small oval hills and composed of glacial till. On the plateau surface one also finds a proliferation of rock outcroppings ranging in height from 50 to 200 feet. These outcroppings are partly covered by sand and pebbles.

To the aerial observer the most striking feature is the great number of lakes throughout the region; these are separated in some areas by small hills while some are connected to each other by rapids. It is quite difficult to determine their depth but they seem to be shallow, and a great many of them contain islets. The proportion of water to land is also difficult to estimate but one can safely say that it varies between 10 and 30 per cent, depending on the region.

While the lakes in the upland region are much more numerous than on the coastal plain, there are fewer bogs. These are dispersed throughout the interior and are never extensive in area except along the bay shore line. Forest stands and burnt-out woodland areas are also common in this zone.

The James Bay region does not have continuous permafrost (Fig. 7). In this case we speak of discontinuous permafrost. Brown (1968) states that these discontinuous permafrost areas are found where peatlands are common and permafrost distribution is determined mainly by the thermal properties of the peat.

Such a description of the James Bay region might perhaps give the impression that the hinterland region with its abundant lakes provides more suitable nesting-places for waterfowl. In the chapters which follow, therefore, we shall try to describe in greater detail the types of lakes and bogs found in each area, not forgetting the fact that the coastal plain borders the bay and that its vast marshes and sandbanks are an ideal habitat for migrating birds.

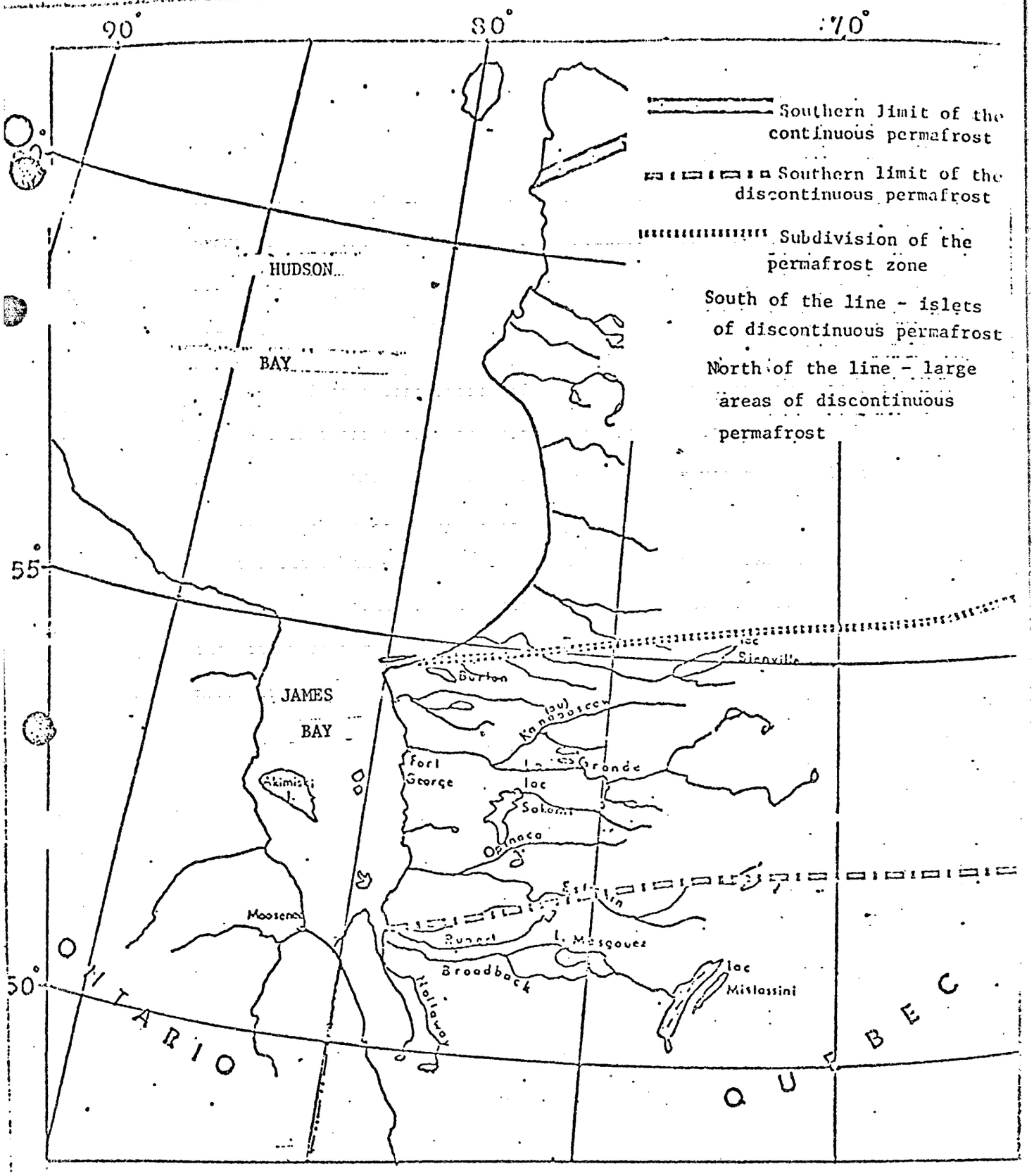


Figure 7. Permafrost distribution.

(Brown, 1963)

CHAPTER 4: FORESTS

Hare (1950) states that the arborescent flora of the region is made up of nine specied of trees:

Betula papyrifera	*Pinus Banksiana*	*Abies balsamea*
Populus tremuloides	*Picea alba*	*Larix laricina*
Populus balsamifera	*Picea pigra*	*Thuja occidentalis*

The northern limit of each of these species is given in Figures 8 and 9.

Since the type of soil which is closely associated with the subarctic climate is of low fertility, lacking in elements important to plants, the only species which thrives in abundance in the region is the Black Spruce *(Picea mariana)*.

Two important types of spruce stands are found, namely the cladonia and the moss spruce stand. The moss spruce stand is found in well-drained regions. The soil vegetation consists of moss with a little *Cornus canadensis* and *Oxalis montana*.

The cladonia spruce stand consists of trees with a heavy layer of lichens. Black Spruce, White Spruce *(Picea glauca)*, Larch *(Latrix laricina)* and Grey Pine *(Pinus divaricata)* are found in such environments, spruce being the dominant species. The trees

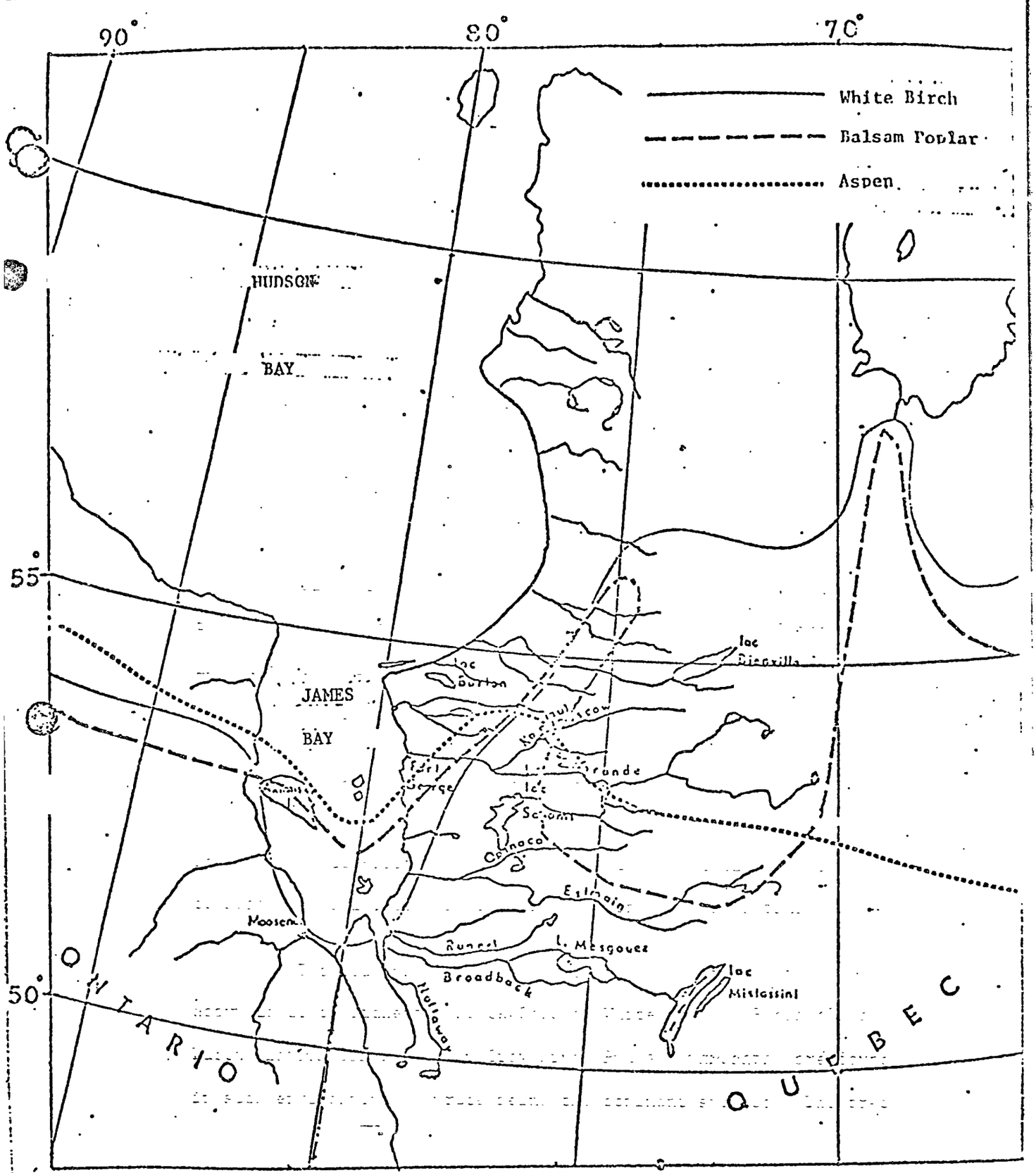


Figure 8. Northern limit of deciduous species.

(Hare, 1950)

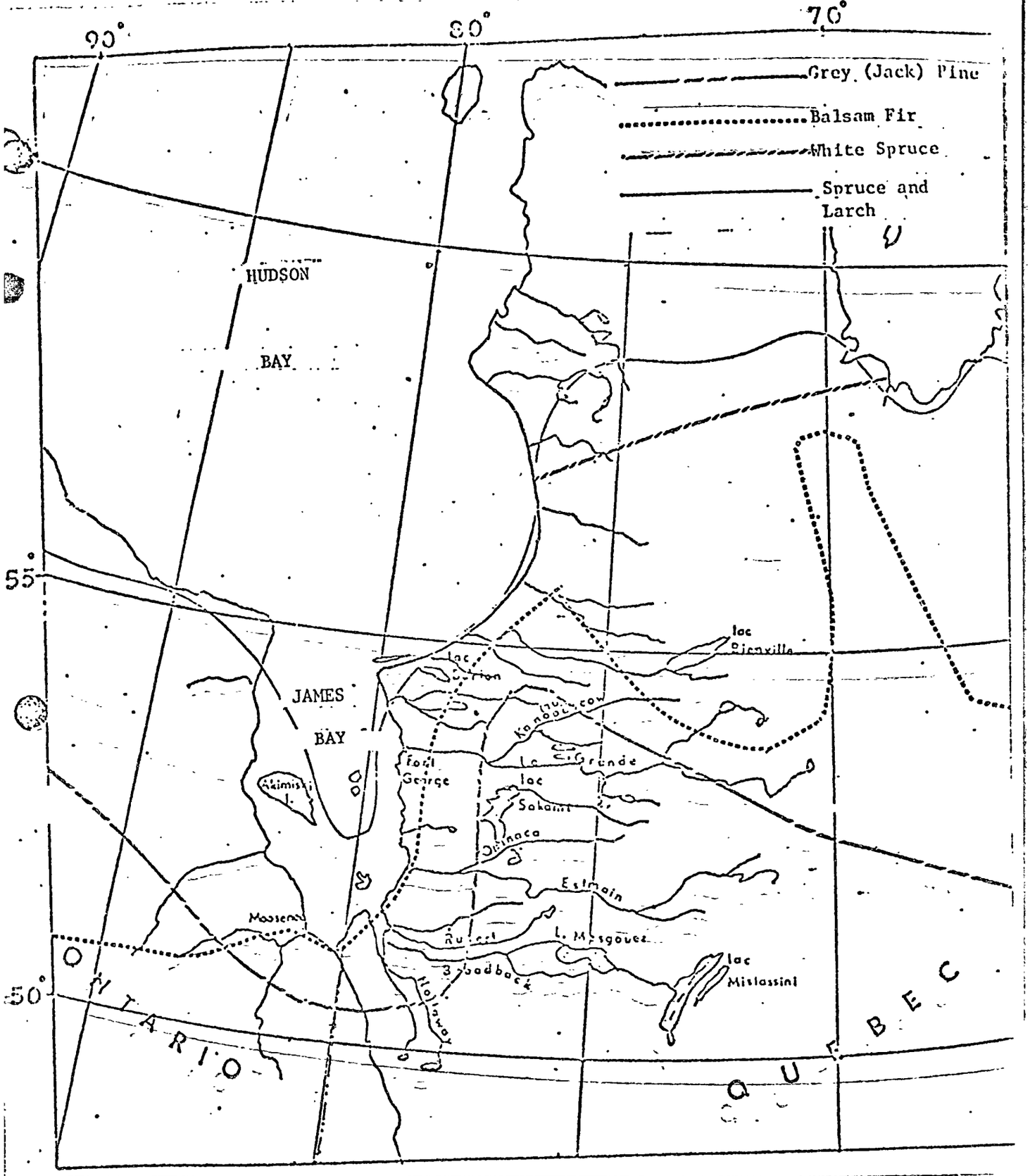


Figure 9. Northern limit of conifers.

(Hare, 1950)

are quite far apart and this type of spruce stand may cover 50 to 60 per cent of the Labrador plateau.[1]

One finds associated with conifers a small group of deciduous trees such as poplars and birches, but none of these trees has reached the climax stage.

Birches and aspens abound in the regions recently devastated by fire. Poplars are distributed throughout the region, but in localized areas, almost exclusively around rivers and lakes.

It is clear that this type of environment has little attraction for waterfowl. However, such a description gives an idea of the extent of the forested and burnt-over areas (Fig. 10 - Photos 3 and 4).

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[1] Hare (1950) explains why the trees are so far apart. The ground is still frozen in July, the season of growth, and the trees are therefore able to draw moisture only from the upper zones of the soil; in order to do so they have developed a horizontal root system. The ensuing competition keeps the trees farther apart.

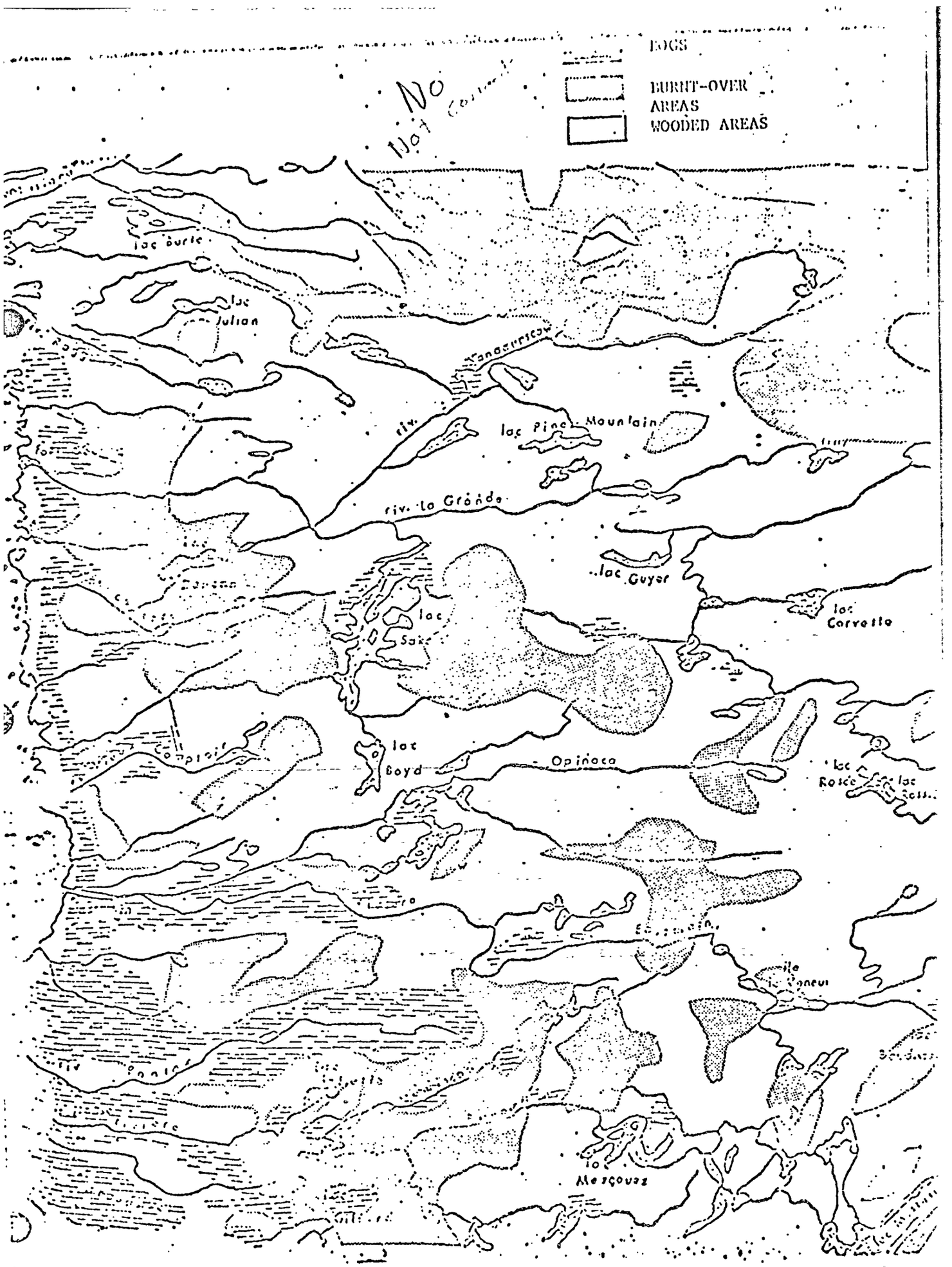


Figure 10. Relative importance of wooded areas, burnt-over areas and bogs.

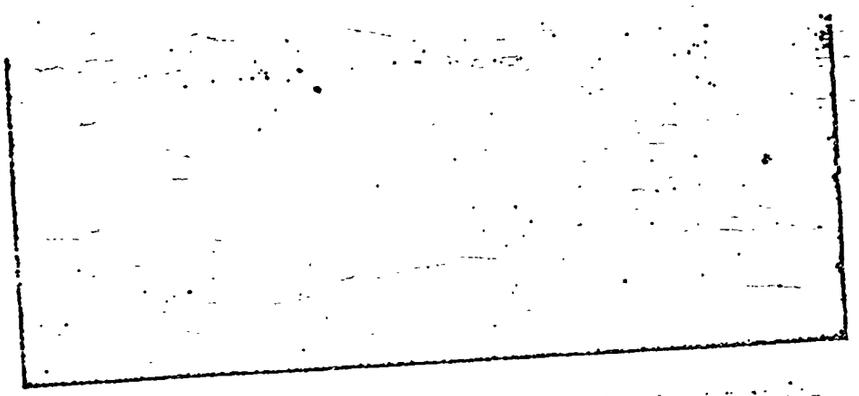


Photo 3. Two types of spruce stand characteristic of James Bay.

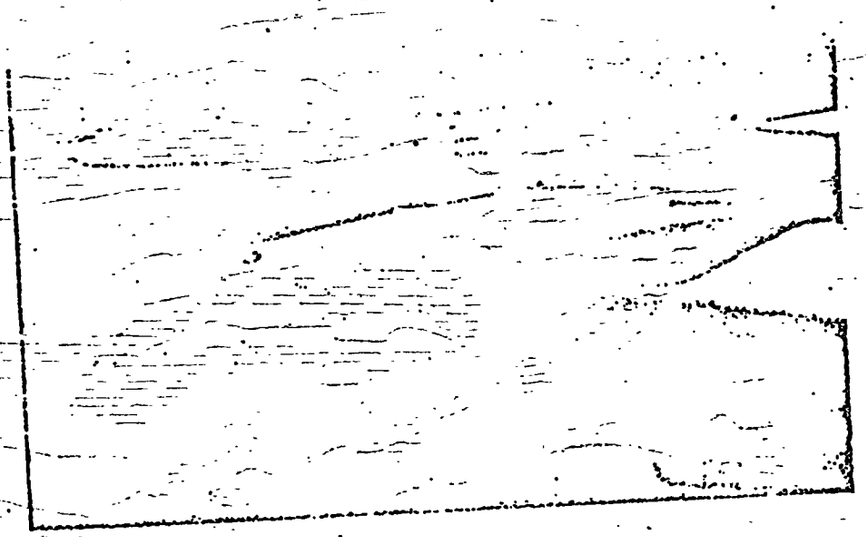


Photo 4. Burnt-over areas girdling lakes a few miles east of Old Factory Lake.

CHAPTER 5: BOGS

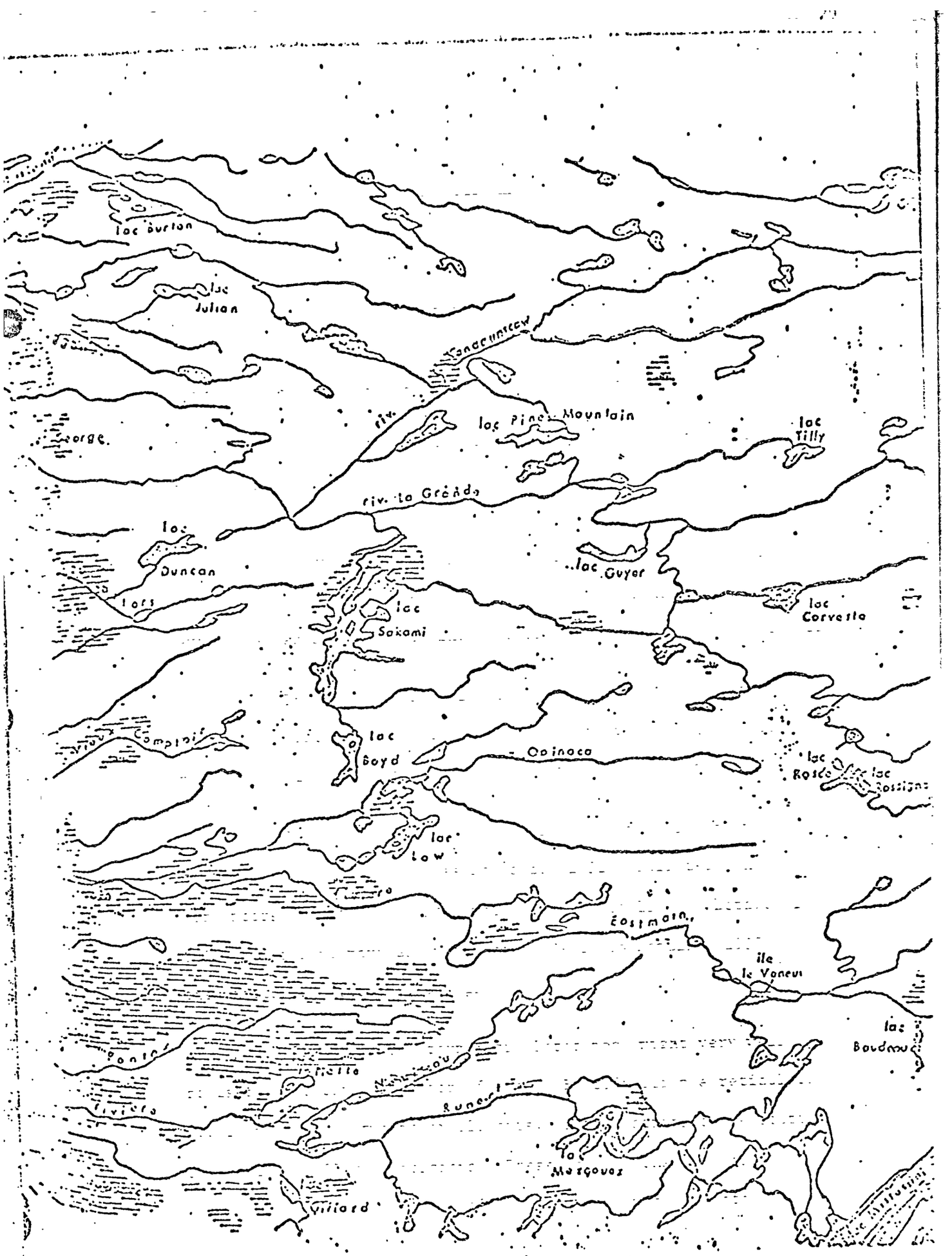
Bogs are not distributed uniformly throughout the James Bay hinterland; they vary depending on whether they are located on the coastal plain or in the uplands.

The bogs on the coastal plain are usually numerous and sometimes cover vast areas. Moreover, they are distributed on a sort of gradient which rises from north to south. Those in the more northerly areas are sometimes limited to the edges of the shore while further south, for example at Rupert, they extend as far as 100 miles inland from the bay shoreline. (Fig. 11).

The upland region is quite different in appearance from this point of view; bogs are more scattered (sporadic) and never cover large areas as do those on the coastal plain (Photo 5).

The names given to these bogs vary greatly depending on the author. Some, such as Rousseau (1952), call them *parcs secs* (dry moors) or *parcs humides* (wet moors). Dutilly and Lepage (1958) call them inland marshes, while others such as Hamelin (1957) the expression reticulated bogs.

Of course the term reticulated bogs might very well be used to describe a number of them. By definition a reticulated bog is made up of two major elements: narrow strips of vegetation and small, shallow depressions. These depressions, or more accurately, basins, are generally filled with water (Photo 6).



ure 11. Distribution of bogs.

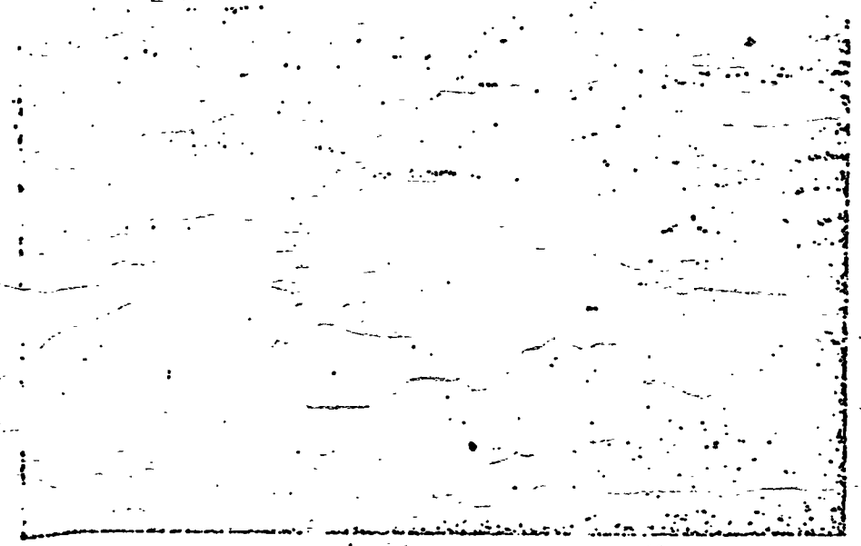


Photo 5: Some of the bogs found scattered over the Precambrian Shield.

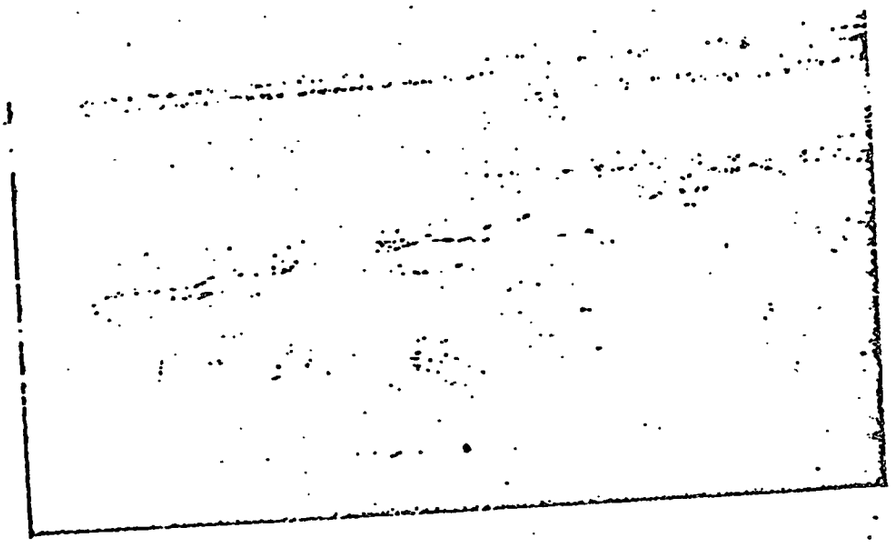


Photo 6: The reticulated bog with characteristic basins and strips of vegetation.

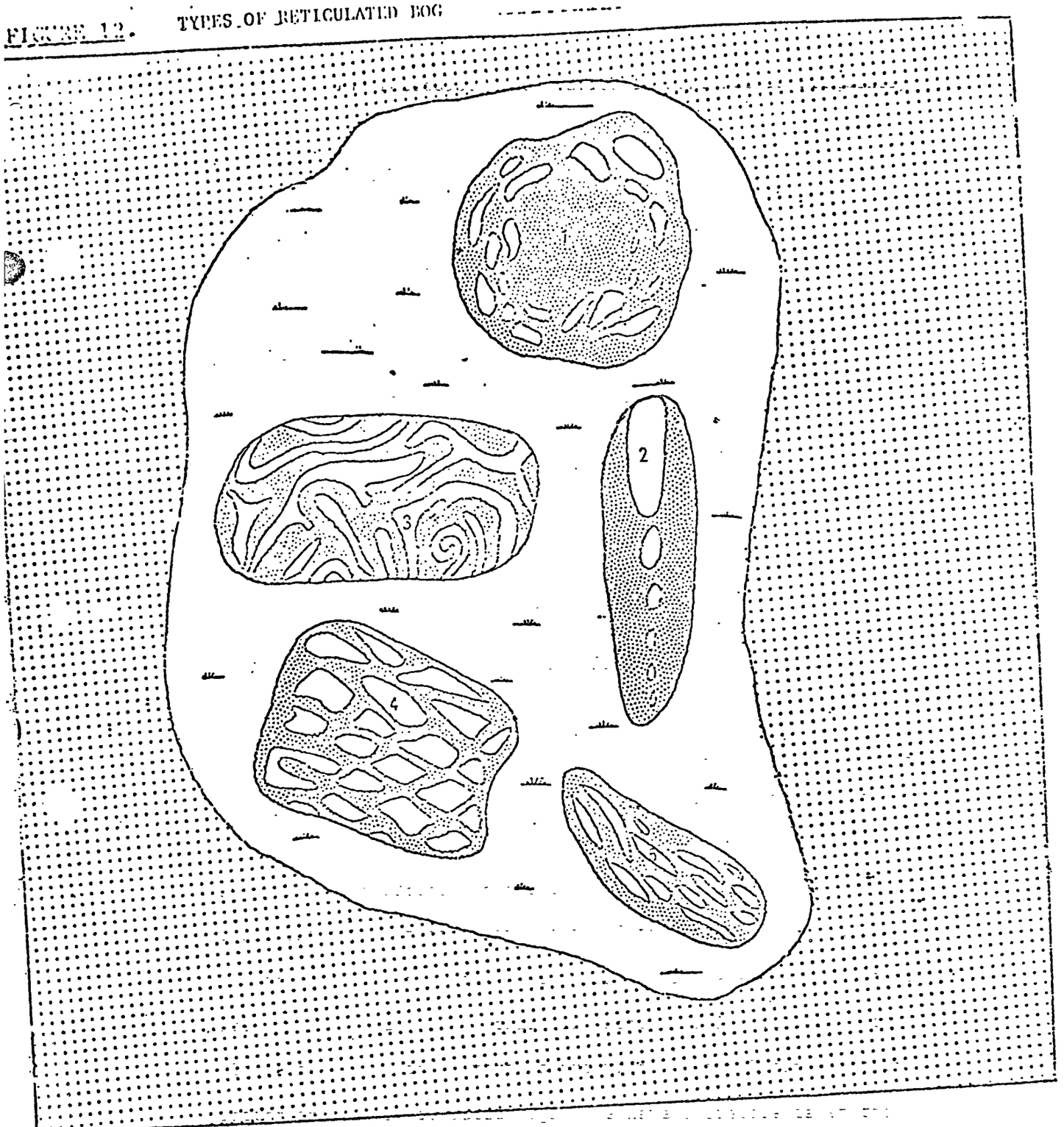
The reticulated bog varies in size but is frequently about a mile in diameter. The general shape varies, depending on the disposition of the basins relative to one another. The different layouts thus give rise to several types of reticulated bog: rectilinear, in which the basins are parallel to each other; concentric, in which the basins are dispersed in the arc of a circle around a central point; vermiculated and anastomosed (braided) bogs and those with basins in a line (Fig. 12). The first two seem to be the most important kinds in the study region.

Plant life is of a special kind. It consists of peat mosses, ericaceae including *Ledum groenlandicum*, *Carex*, Dwarf Birches and occasional *Picea mariana*.

These types of bog are found both on the coastal plain and in the uplands. In other locations it is possible to find bogs which do not have the characteristics of reticulated bogs, in that they do not have basins. Rousseau (1952) defines them as subarctic dry parks (moors?) (Photo 7). This absence of basins may depend on a number of factors, among them various drainage conditions, the thickness of the peat or the depth of the underground water. Rousseau (1952) lists for us the plants which are characteristic of such areas (Table 3). Dutilly and Lepage (1958) also list the plants suited to tidal marshes but without stipulating whether the latter include reticulated bogs. We have therefore taken the liberty of including this list in Table 4.

At the present time it is quite difficult to give any clear idea of the importance of bogs to waterfowl in general. The vegetation within the actual basins which characterize

FIGURE 12. TYPES OF RETICULATED BOG



Spruce stand

1 Concentric

2 In a line

3 Vermiculated

4 Anastomosed (Braided)

5 Rectilinear

Adapted from (Hamelin, 1957)

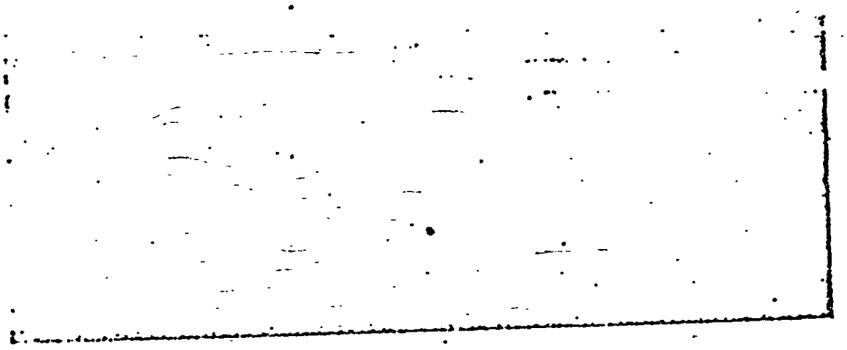


Photo 7. The subarctic dry park (moor?) as described by Rousseau (1952).

Table 3. List of plants characteristic of the subarctic dry park (moor?)

Stratum	Species	Family
Lichen	*Cladonia sp.*	--
Moss	*Polytrichum sp.*	--
Arborescent shrubs	*Ledum groenlandicum*	Ericaceae
	Chiogenes hispidula	Ericaceae
	Vaccinium sp.	Ericaceae
	Betula glandulosa	Betulaceae
	Empetrum nigrum	Empetraceae
	Ribes glandulosum	Saxifragaceae
	Salix discolor	Salicaceae
Herbaceae	*Deschampsia flexuosa*	Graminaceae
	Carex sp. (several)	Cyperaceae
	Solidago macrophylla	Compositae
	Cornus canadensis	Cornaceae
	Linnaea borealis	Caprifoliaceae
	Lycopodium annotinum	Lycopodiaceae

Rousseau (1952)

Table 4. List of plants characteristic of inland marshes

Stratum	Species	Family
Arborescent shrubs	*Andromeda glaucophylla*	Ericaceae
	Chamaedaphne calyculata	Ericaceae
	Betula Michauchauxii	Betulaceae
	Betula pumila var. *glandulifera*	Betulaceae
	Empetrum nigrium	Empetraceae
	Juniperus horizontalis	Cupressaceae
Herbaceae	*Carex exilis*	Cyperaceae
	Carex limosa	Cyperaceae
	Carex livida var. *Grayana*	Cyperaceae
	Carex oligosperma	Cyperaceae
	Rhynchospera alba	Cyperaceae
	Scirpus hudsonianus	Cyperaceae
	Aster radula	Compositae
	Aster nemoralis	Compositae
	Solidago Purshii	Compositae
	Juncus stygius var. *americ.*	Juncaceae
	Juncus balticus var. *litt.*	Juncaceae
	Triglochin maritima	Juncaginaceae
	Utricularia sp.	Lentibuliaceae
	Menyanthes trifoliata	Gentianaceae
	Sarracenia purpurea	Sarraceniaceae

Dutilly and Lepage (1958)

reticulated bogs is often quite dense, providing cover for the ducks and making aerial inventories inaccurate. Nevertheless, the few specimens observed there may allow us to assume that they meet the needs of some species. These species, or at least the number of individuals, should not be very numerous, in spite of the fact that there is a great deal of shrub cover and herbaceous vegetation in the area.

Abundance is not always an ideal criterion for judging a habitat's value to waterfowl for breeding purposes; quality must also be considered. Shrub cover, particularly plants such as *Kalmia* and *Ledum*, seems to be preferred by the Black Duck for nesting. On the other hand, mosses and grasses do not seem to be the type of vegetation on which ducks usually feed. Some cyperaceae is found in the region, but little or no graminaceae or naiadaceae, according to the observations of Dutilly and Lepage (1958), and assuming that this list is fairly representative of what can also be found in reticulated bogs.

According to the literature these last two families include the basic plant species on which ducks feed (Table 5). However, it must be noted that the literature gives us mainly the plant species eaten by the ducks during the winter season. It is therefore possible that the summer and winter foods, may not be quite the same since the species of plant may change as the waterfowl move to a different environment and since animal food may play a greater role, at least in the feeding of the young.

able 5. General food preferences of six species of surface-feeding duck and four species of diving duck *

ant food	Black Duck	Mallard	Blue-winged Teal	Green-winged Teal	Pintail	American Widgeon	Greater Scaup	Lesser Scaup	Ring-necked Duck	Common Golden-eye	Mean Total
	3%	25%	13%	12%	28%	43%	20%	18%	35%	11%	20.8%
ACEAE											
dweed											
ia											
s											
era											
RACEAE	38%	1%	19%	39%	22%	10%	5%	5%	4%	4%	14.7%
pus											
ex											
ocharis											
MINACEAE		40%	18%	11%	15%	14%	3%	7%	5%		14.1%
ania sp.											
zia sp.											
inochloa											
aria sp.											
ARGANIACEAE	28%	1%	3%	5%					10%		9.4%
argania											
OLYGONACEAE	7%	10%	8%	5%	10%	4%		1%	5%	1%	5.7%
lygonum											
DROCHARITACEAED	10%				3%	6%	3%	5%	4%		5.2%
lisneria											
E			3%	5%		8%	3%	3%			4.4%
AGINACEAE	1%			5%	3%						3.0%
rglochin											

able 5.
ont.)

	Black Duck	Mallard	Blue-winged Teal	Green-winged Teal	Pintail	American Widgeon	Greater Scaup	Lesser Scaup	Ring-necked Duck	Common Golden-eye	Mean Total
							4%	2%			3.0%
RATOPHYLLACEAE											
ratophyllum											
ALORAGACEAE	2%		3%	5%			5%	1%			3.2%
riophyllum											
ppuris											
NYMPHAEACEAE		1%	1%		3%	2%	3%	2%	11%	2%	3.1%
ymphea								1%			1.7%
LISMATACEAE		1%	3%								
agittaria											2.0%
LEMNACEAE		1%		2%		3%					
pmn											2.0%
CORNACEAE	2%										
Cornus											
MISCELLANEOUS	9%			2%	3%	3%	1%	12%	14%	5%	
Animal Food											
Molluscs	4%	3%	17%	4%	6%	6%	40%	30%	6%	10%	12.6
Insects	4%	5%	10%	5%	3%	1%	7%	12%	10%	28%	8.9
Crustaceans		2%	2%		4%		6%	1%		32%	7.3
Fish										3%	

* Adapted from Mendall, 1949; Martin, 1939

Even taking these various factors into consideration, one can still question the value of bogs for breeding except perhaps in the case of the Black Duck and the Green-winged Teal. It is hard to imagine that waterfowl can change their feeding habits so drastically, so that if the summer habitat differs too greatly from the winter habitat it might be avoided.

There is practically no information in the literature on the animal food available in peatlands. Hanson (1949) states that insects, amphipoda and isopoda are rare in the relatively sterile and acid waters of the plateau's peat moss swamps, but these data are too vague to be dependable. If this were the case, however, one could assume that the peat-bogs would be of little use to the waterfowl for raising their young. The latter eat a great deal of this type of food in the first few days after hatching perhaps partly because the seeds of plants are not yet very abundant in the marsh. If there is little animal food and little plant food the marshes would be of little use for breeding, at least in the early summer. Is it possible that they are useful during the migration period? Future studies may give us the answer.

CHAPTER 6: THE COAST AND THE SHORELINE

The James Bay region was glaciated for quite a long period between 70,000 and 4,000 years B.C. Under the glacier's weight the coast subsided for several hundred feet (approximately 1,200') and only after the melting of the glacial mass did it begin to emerge.

Several authors agree that the uplift movement, which has enabled the coast to recover about 700' of the 1,200' it had lost, is still going on. Gutenberg (1941) claims that the raising of the shoreline at this location occurs at the rate of more than 1 m/century. Assuming that this is applicable to the zone which interests us, it would take another 1,500 years before the last 500 feet still missing were recovered.

The shoreline, estimated to be about 400 miles long, is typical of a region in the process of emergence. It is very jagged with numerous islets some distance off-shore.

The coast is somewhat different from that on the Ontario side, since geological deposits have not been the same over the centuries. In Ontario one finds Devonian limestone, which give the region its flat, monotonous appearance, while the dominant forms on the Quebec side are outcroppings of gneiss, granite and schist.

The tidal flats and marshes are not all of equal importance. To the south two bays deserve mention. They are

Cabbage Willows and Boatswain Bays. The former has an area of 7,000 acres and its average width ranges between ½ mile and 1 mile. There are three important zones: one of *Hippuris tetraphyla* near the water, the *Scirpus paludosus* zone near the centre and finally the *Carex paleacea* zone, the highest in the marshes (taken from the inventories made by Chapdelaine, Tremblay and Repentigny in summer 1972).

Within these major zones there are sub-zones containing plants such as: *Eleocharis Smallii, Scirpus americanus, Festuca rubra, Triglochin palustris, Senecio congestus, Pucinellia sp., Calamagrostis neglecta, Suaeda maritima, Salicornia europaea, Juncus balticus.* In areas where shallow basins of water remain at low tide one finds *Menyanthes trifoliata.* Smith (1946) states that there are few such basins in this bay and that these are concentrated only in certain locations.

Boatswain Bay, which is about 10 miles long, covers an area of 4,000 acres (Photo 8). The marsh is narrower in the southern section but it gradually widens to the north. No survey has been made of the marsh plants, but one may assume that they are very much the same as in Cabbage Willows. Between these two major bays there are usually very few important if any marshy zones.

As one goes further north the coast becomes rockier and more cut up and the marshy zones are often limited to small bays (Photo 9). The size of these bays may vary greatly, from a few hundred feet to several miles in length. On this part of the coast one even finds granite hills rising to an altitude of about 50 feet.

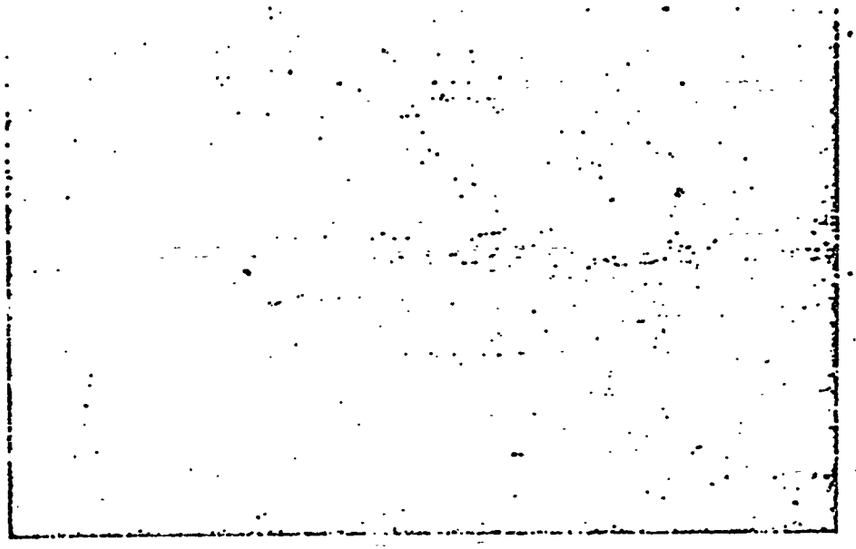


Photo 8: Boatswain Bay, one of the most important stops for migrating geese in spring and autumn.

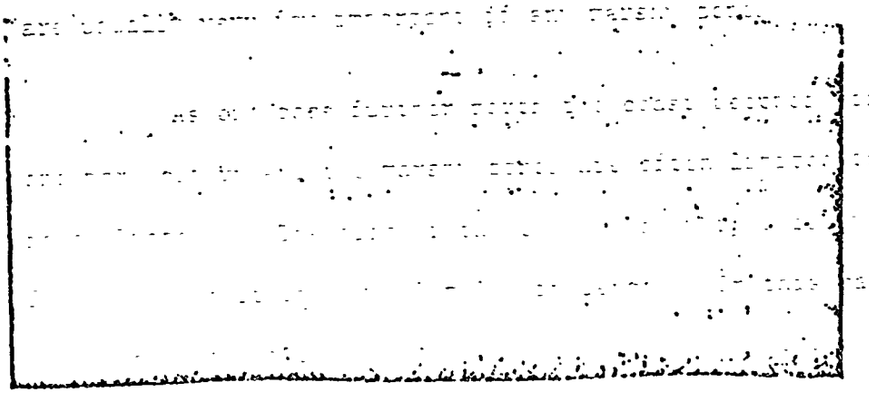


Photo 9: Paul Bay typical, small bay north of Fort George.

The bay itself is shallow for it is continually being silted up with sand and mud brought down by the large rivers. Low (1889) considers the bay to be a slightly submerged plain whose depth varies from 2-3'/mile. Kindle (1925) gives some further figures for various latitudes: 12-40 fathoms between 54° and 55°, 12-37 fathoms between 53° and 54°, 4 to 49 fathoms between 52° and 53° and 3 to 18 fathoms south of 52°.

The water in the bay is saline except at the mouths of the rivers where it becomes more or less brackish, depending on the quantity of water flowing into the bay. The action of the waves above the muddy zone tends to keep the water perpetually turbid and the spring run-off from the rivers further increases this turbidity.

The tide is generally quite uniform throughout the bay though tending to be slightly higher as one goes further south. The average high and low tides are: 5.9' and 2.2' at Cape Jones, 6.1' and 2.5' at Stag Island. Under unusual conditions, that is when high tides coincide with appropriate strong winds, the tides may reach 10-12'. During low tides vast, muddy zones (tidal flats) are exposed for distances of five miles.

The central part of the bay as far as the shores is occupied by floating ice. According to the Ice Forecasting Central of the Canadian Department of the Environment, the thaw and break-up of the ice in the southern part of James Bay begin during the second week of June and by the end of the month most of the ice south of Akimiski Island has melted. There may be an ice displacement flow because of violent winds in May or early June,

but these channels may disappear again when the wind changes. In July the southern boundary of the ice reaches latitude 53°N and it takes almost two weeks for the ice in the north-western sector to melt. Several strips of ice may remain during the first three weeks of August but the rest of the summer is ice-free.

Ice would seem to begin forming in mid-November, spreading rapidly over the entire surface of the bay by the end of the month. The ice is very unstable at this time and breaks up readily in strong winds. This phenomenon occurs less frequently in early December and a firm cover probably forms by the middle of the month. The shallowness is one of the factors which contribute to the rapid freezing (Figure 13).

Little data is available on the rivers adjacent to the bay. The only information available is for Moose River on the Ontario side. The average date on which this river freezes over completely is November 26, and the first permanent ice usually forms on November 12. The first thawing begins around April 25 and the river is completely free of ice about May 8, which is considerably earlier than the bay.

The tidal marshes are undoubtedly important to waterfowl. Nevertheless, this importance varies, depending on:

- the size and the location of the marshes;
- the period during which they are used by waterfowl;
- the waterfowl species which use them.

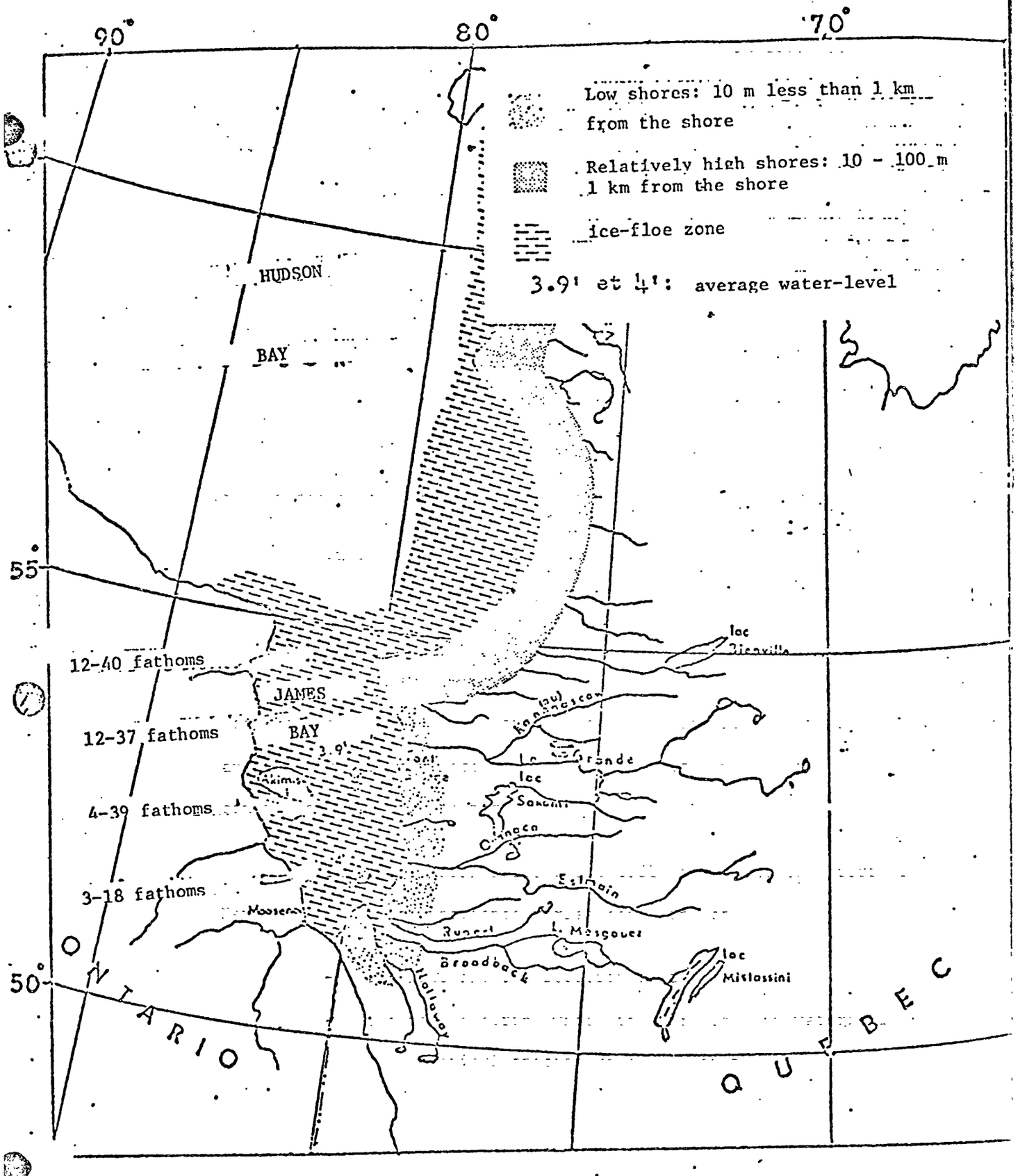


Figure 13. Shores and coastal waters

(Adapted from Brochu, 1965)

The southern tidal marshes, that is between Point Mesaconane and Boatswain Bay, are much more extensive and flatter than those further north. Smith (1946) gives their sizes as 7,000 acres and 4,000 acres for Cabbage Willow and Boatswain Bays respectively, compared to 9,000 acres for all the rest of the coast. These marshes are therefore likely to attract a greater number of birds than the bays further north, which are often small and muddy.

In addition to the size of the marsh, the season may have a major effect on the distribution and concentration of waterfowl. In the fall the marshes to the south of the bay are the areas preferred by geese and even ducks. The spring surveys made by Bourget and Tremblay have shown us that the geese arrive during the last week of April, with a maximum concentration during the second and third weeks of May. There are also a great many ducks, particularly Black Duck, Mallard and Pintail *(Anas acuta)*. The largest concentration of Black Duck and Mallard in Rupert Bay occurs during the last days of April and the first week of May. The Pintail arrives somewhat later, appearing only in the first week in May.

This large spring concentration is easily understood if one is aware that when the geese and ducks arrive from the south the only zones which have begun to thaw are, as a matter of fact, the tidal marshes on Rupert Bay. Further north a great deal of ice still remains.

This phenomenon occurs again in the fall when the waterfowl return from their nesting areas. Stirret (1954) and Lumsden (1971) state that the number of geese increases gradually between mid-September and mid-October, reaching its peak about October 18. The number of Snow Geese *(Chen hyperborea)* and Blue Geese *(Chen caerulescens)* in Cabbage Willows Bay was estimated to be 60,000 by Lumsden in 1971. May we note that this figure does not give the total goose population of James Bay but only the maximum number of geese observed at one location on a given date.

Nevertheless the value of the small, marshy bays further north should not be underestimated. Though these bays seem to have less to offer the Snow Goose and the Blue Goose, in spite of the fact that some of these birds are found there, they might nevertheless be more attractive to the Canada Goose and some species of duck. It should not be forgotten that some of the latter nest in the lands adjacent to James Bay and could therefore gather all along the coast before beginning the search for nesting sites. In autumn the opposite phenomenon would occur, that is the waterfowl which had nested in the interior might return to James Bay along the rivers and thus be distributed along the coast.

During the summer the importance of the tidal marshes for nesting is dubious, simply because they are likely to be flooded. Under exceptional circumstances, as mentioned above, tides of 10' to 12' are possible which would of course result in the destruction of the nests. This is especially true of the northerly bays, which are often small in area.

The tidal marshes would thus serve only as feeding areas for moulting ducks or for broods which have easy access to the bay. This hypothesis is quite plausible, especially if one compares the plants available in the marsh with those usually eaten by the ducks found there. A survey of the literature reveals that species such as Black Duck, Mallard and Teal forage for plants such as cyperaceae, graminaceae or naiadaceae which are present in the marshes.

It is quite difficult to determine whether the tidal marshes between Point Mesaconane and Cabbage Willows are more intensively used than those to the north. However, we have no reason to believe that the number of birds per acre of marsh is not the same in both cases.

Finally, the importance of the tidal marshes seems to vary according to the species of waterfowl. The marshes between Point Mesaconane and Boatswain Bay are certainly much more important to the Snow Goose and the Blue Goose than any other location along the coast. It seems that the same thing occurs for other species, such as the Canada Goose, the Mallard, the Pintail, and the Green-winged Teal *(Anas carolinensis)*. On the other hand, the Black Duck, the American Widgeon and the saltwater ducks would seem to prefer the more northerly marshes (Table 6). This applies to the summer season. In the fall the results change somewhat since the Canada Goose is more common in the more northerly bays.

Table 6. Distribution of species of waterfowl in the south (between Hannah Bay and Black Bear Pt.) and the north-east of James Bay.

	Summer - 1st week of July, 1972				Fall, October 9, 1972			
	Southern area		Northern area		Southern area		Northern area	
	No.	%	No.	%	No.	%	No.	%
Canada Goose	404	38	50	7	1135	33	18680	88
Black Duck	192	18	247	48	1768	52	2502	11.8
Mallard	171	16	24	3	22	1	--	--
Pintail	171	16	1	--	57	2	2	--
Green-winged Teal	103	10	20	3	400	12	--	--
American Widgeon	10	1	167	23	--	--	--	--
Saltwater Ducks	--	--	27	4	--	--	2	--
Scaup	--	--	--	--	30	1	--	--
Goldeneye	--	--	--	--	--	--	14	--

Taken from the data collected by André Bourget and Germain Tremblay (1972)

One might assume that the feeding habits may influence the distribution pattern of some of these species such as the Scoter (*Melanitta* sp.) and the Eider (*Somateria* sp.). These are saltwater ducks which feed mainly on crustaceans and molluscs and sometimes even on fish. Thus the shallow and often turbid waters of the southern part of the bay do not suit them. It will be noted that these ducks are never very numerous close to shore; they remain some distance off-shore, where the water is much clearer and deeper. However, the depth of the water is perhaps not as essential as its clarity, since the Scoter normally obtains its food at a depth barely exceeding 15 to 20 feet.

CHAPTER 7: THE AQUATIC ENVIRONMENT

Rivers

Many rivers flow into James Bay, but not all are of equal importance. Some of them have their sources far inland while others are only a few miles long. Yet others, particularly in the region north of the La Grande (Fort George) meander so widely that they give the impression of a number of lakes linked together.

All the large rivers which flow into the bay have the same features. A detailed description of each one is not necessary for the purposes of this study. It suffices to know that the James Bay region forms a plateau several miles from the shores and that it is precisely the formation of this plateau which determines the appearance so characteristic of these rivers.

Upstream the rivers flow through a generally uniform region where they sometimes widen into long stretches resembling lakes (Photo 10). In these locations the current is slow (Fig. 14). As soon as they reach the plateau edge the current becomes somewhat faster as they descend into the valleys through quite sizable falls and rapids (Photo 11). Here the waterways become no more than an uninterrupted series of rapids extending to the plain. The cross-sections taken on the Rupert, Eastmain and La Grande rivers give a good idea of this (Graphs 3-4-5).

Interpretation of aerial photographs and an aerial survey of the region revealed marshy zones on some sections of the rivers which flow on the plateau surface (Graphs 3-4-5 and Photo 10). In

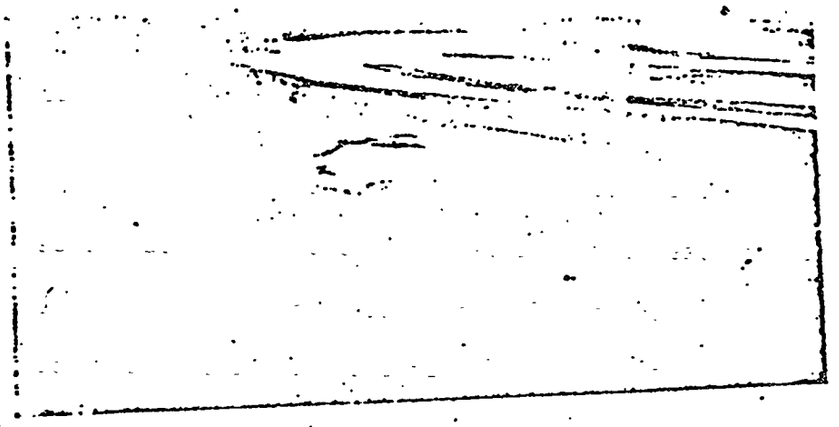


Photo 10: Marshy zone on the Rupert River, 110 miles east of James Bay. The Canada Goose and the Black Duck are often seen in such zones.

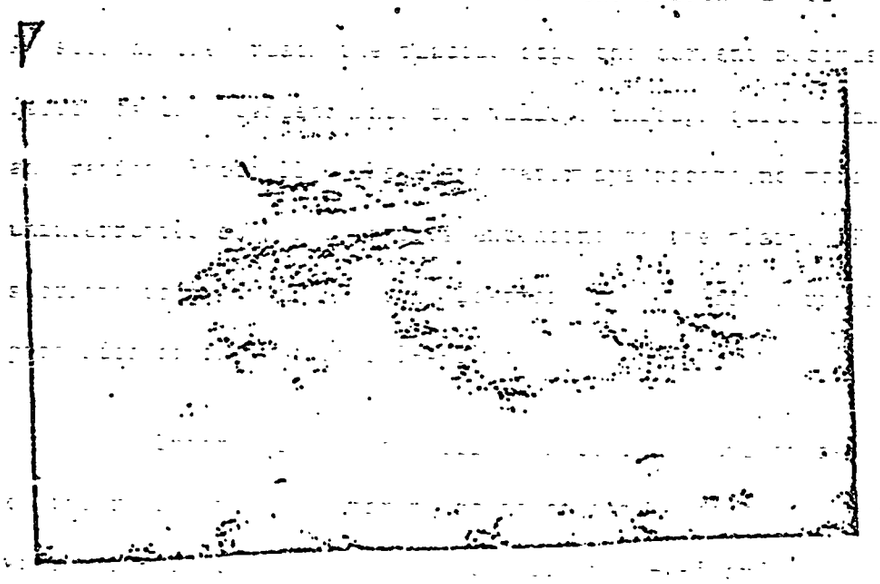


Photo 11: Zone of rapids on the downstream portion of the Rupert River.

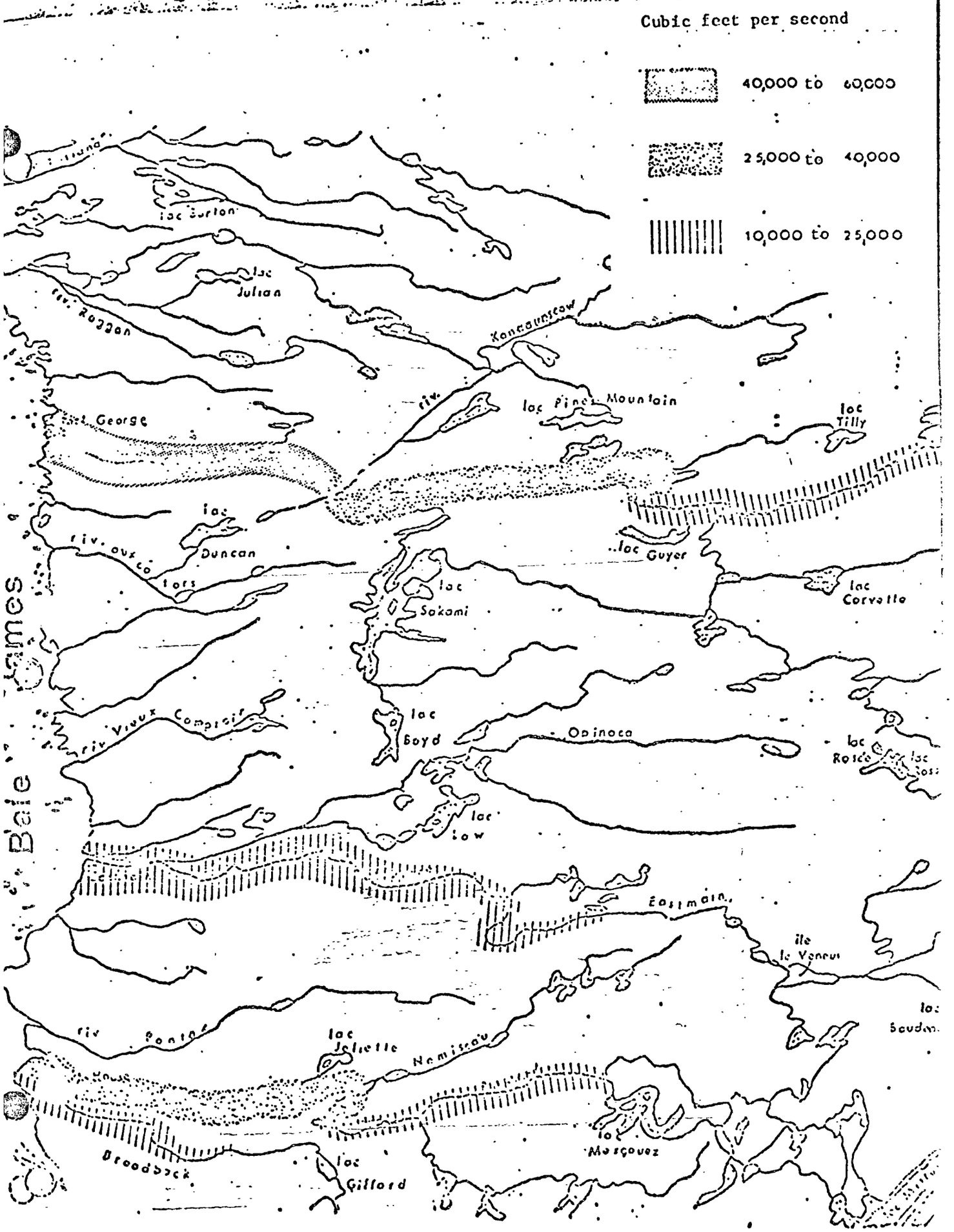
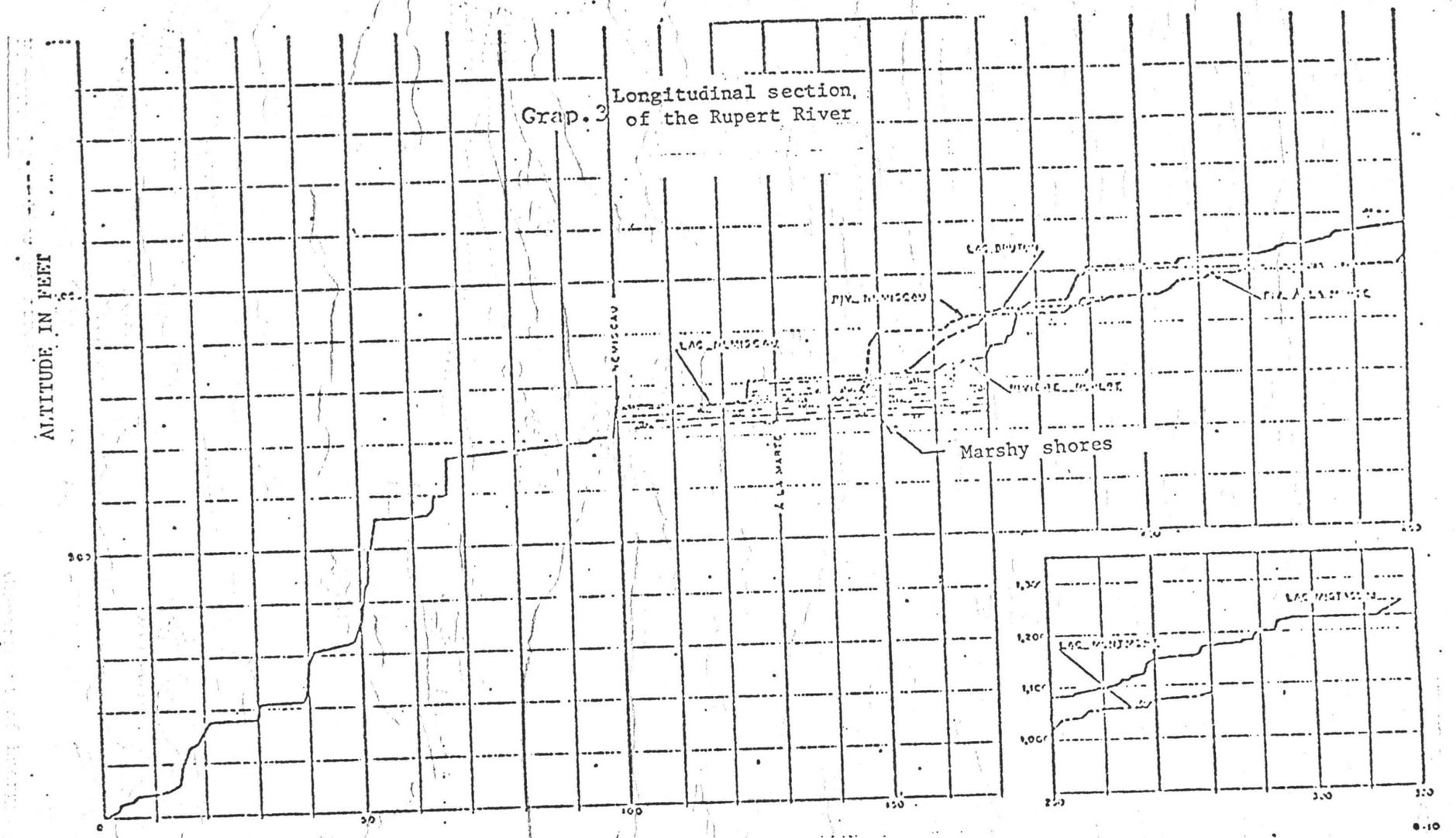


Figure 14. Flow of streams.

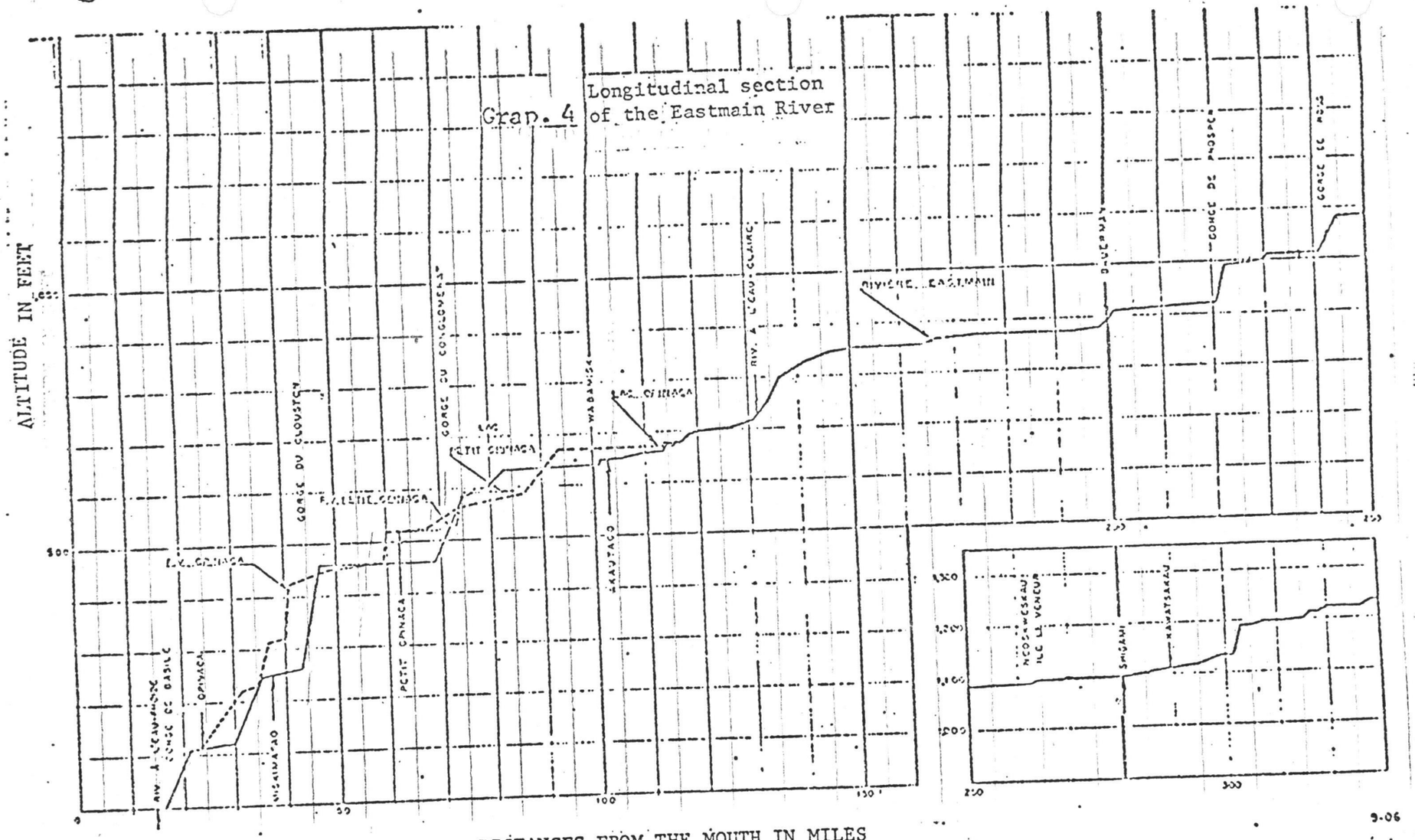
(Department of Energy, Mines and Resources)

Grap. 3 Longitudinal section of the Rupert River



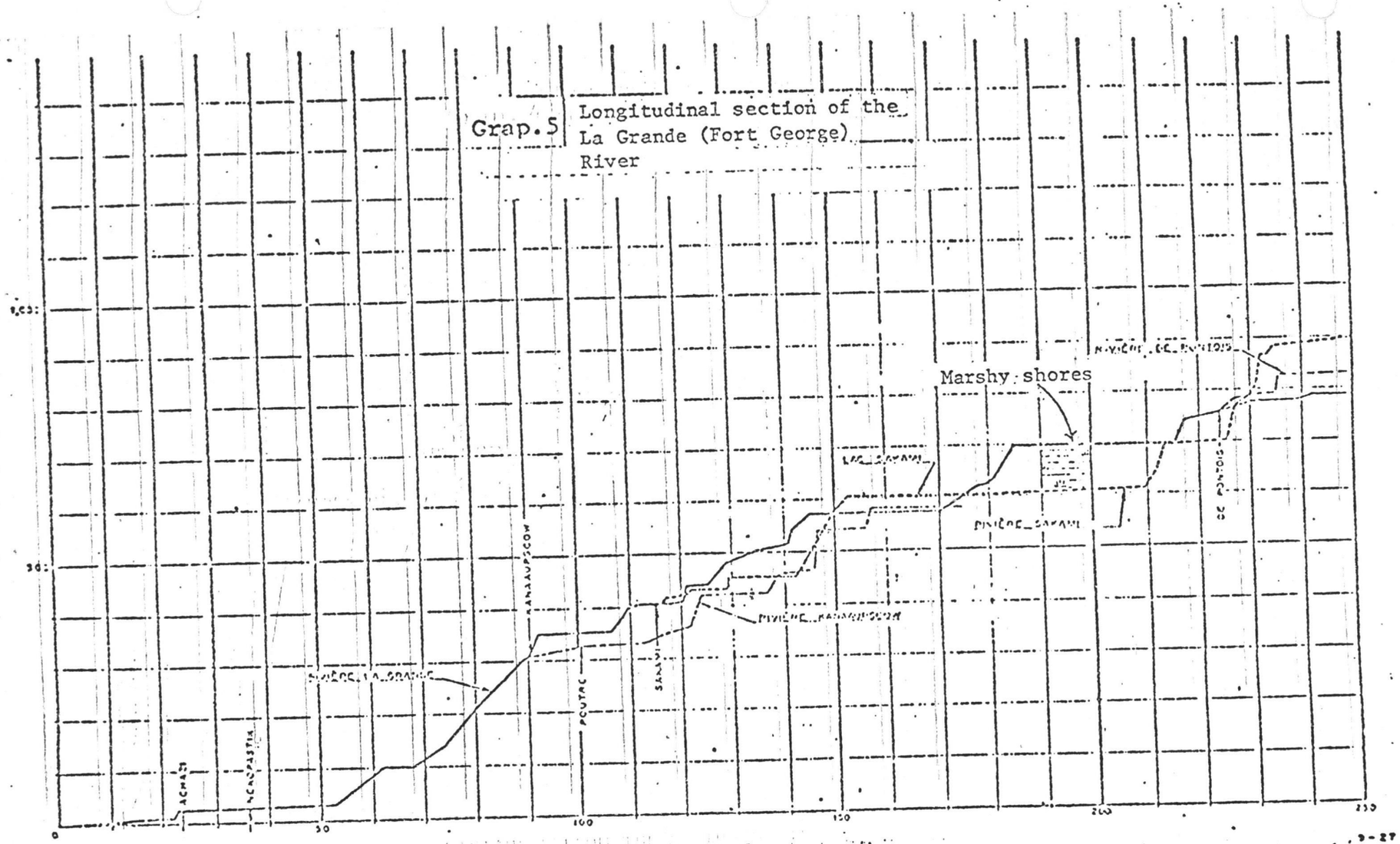
(Dept. of Natural Resources, 1965)

Grap. 4 Longitudinal section of the Eastmain River



(Dept. of Natural Resources, 1969)

Grap. 5 Longitudinal section of the La Grande (Fort George) River



DISTANCES FROM THE MOUTH IN MILES

(Dept. of Natural Resources, 1965)

such places the banks are usually low and there are numerous bays and islets. Elsewhere the banks are usually higher and sometimes, as in the case of the La Grande, they are actually cliff-like.

It is possible to find such marshes on the lower reaches of the rivers, where the effects of the tide may be felt for several miles upstream, indeed as much as 17 miles in the case of the Eastmain River. The Roggan River is another example since the last 20 miles separating it from the coast is an area with low shores and many marshy islets (Photo 12). This may also be true within the spruce stand zones which often border streams. Indeed, when the river banks are not too steep or rocky there is usually a line of spruce stand running along the bank (Photo 13); within this strip of vegetation it is not unusual to find reticulated bogs.[1] These rivers are not very deep, ranging between two and 25 feet depending on the region.

Fewer rivers are found far inland, that is about 200 miles from the coast, than on the coastal plain. There are of course the upper reaches of the waterways already mentioned, such as the Rupert, the Eastmain and the La Grande, since their sources are located in very distant regions. The Rupert flows out of Lake Mistassini; the Eastmain's source is a number of lakes located near Lake Nichicien, 400 miles inland. Finally, the La Grande rises in the mountain range to the south and east of the Eastmain's source and near the sources of the Peribonka, Manicouagan and Aux Outardes rivers.

[1] Auer (1930) explains the phenomenon by saying that the sediment brought down by the rivers sometimes forms embankments along the waterway. When these slopes have become high enough to prevent the stream from overflowing, the bog can then form. The formation of the bog may also result from the filling of the stream with plant matter.

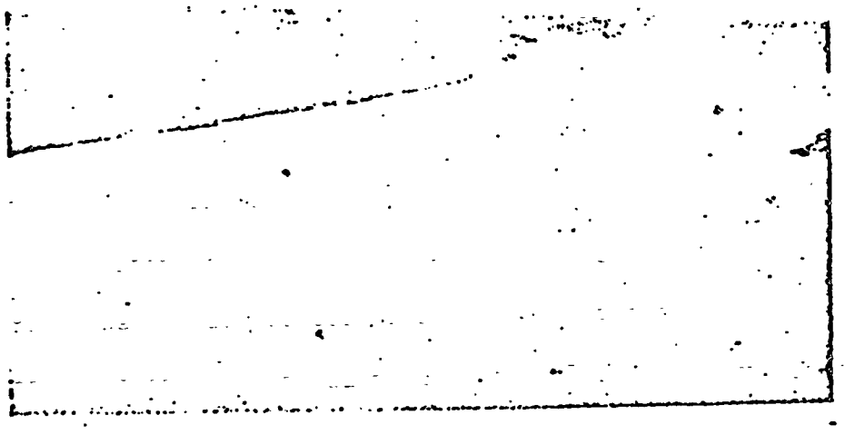


Photo 12: Downstream portion of Roggan River, several miles from the bay.

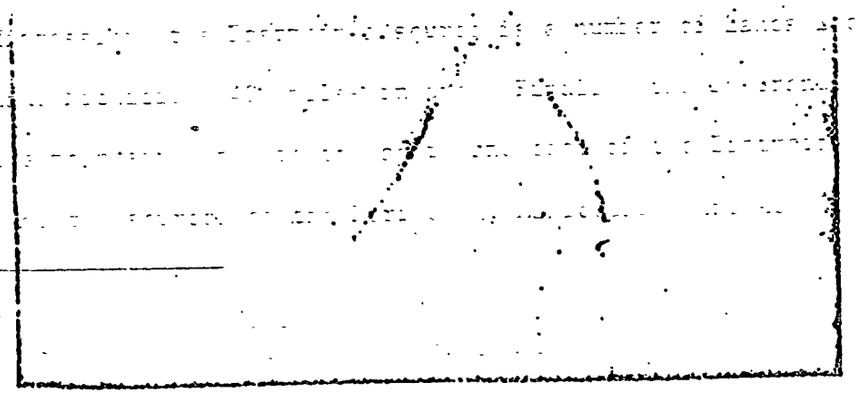


Photo 13: The Pontax River with a strip of spruce stand along its banks. Mergansers were observed in this location.

There are few other important rivers, except for the Sakami, Temiscami and Kanaaupscow. With a few exceptions, the others are not true rivers but rather, as was the case in the region north of Fort George, narrow streams connecting two or more lakes near one another.

The rivers found in this region far from the plateau are not quite the same in appearance as those found on the coastal plain. The La Grande River, for example, flows through a denuded zone full of rocky outcroppings; there are few marshes and the river itself is slow and shallow, so that in some places one can easily see sand banks on the river bed. The only river which still seems to have marshy banks and islets is the Sakami, at least in the area near Lake Corvette.

The concentration of waterfowl in this type of habitat is not usually very high, or about 1.40 individuals/mile (Table 7). The rivers all have approximately the same support capability, except perhaps the Roggan and the Nottaway: the Roggan is exceptionally good, with 5.23 inds/mile, while the Nottaway is apparently of little value to waterfowl, with 0.12 inds./mile. The species found are quite numerous: Canada Goose, Black Duck, Merganser, Goldeneye, (*Bucephala* sp.) and occasionally Scoter, Mallard and Scaup (*Aythia* sp.). The first two species are unquestionably the most common. What distinguishes a good river from a bad one, as far as value to waterfowl is concerned, seems to depend largely on the abundance of the marshy banks and islets likely to be found. In these marshy zones described earlier the number of individuals/mile is much higher than elsewhere, i.e. on rocky or wooded shores. This is

Table 7. Distribution of waterfowl on the rivers.

Rivers	Date	Number of individuals per species							Number of inds/mile surveyed	
		Canada Goose	Black Duck	Merg-anser	Golden-eye	Mallard	Scoter	Unident-ified		
Nottaway	11/07/72	--	--	3	--	3	--	--	0.12	
Broadback	04/07/72	18	--	15	16	--	--	8	0.64	1.00
	02/08/72	26	32	--	--	--	--	--	3.62	
Rupert	04/07/72	--	8 + 1 brood	6	1	--	--	7	0.31	1.88
	02/08/72	97	25	7	--	--	--	--	12.9	
Pontax	07/07/72	--	--	--	--	--	--	--	0	0.38
	02/08/72	16	11	6	--	1	--	1	2.33	
Eastmain	08/07/72	103 + 3 broods	26 + 3 broods	7	--	2	--	--	2.7	1.68
	01/08/72	35	5	--	--	--	--	--	0.72	
Conn	09/07/72	9	--	--	--	--	--	--	0.22	
Little Opinaca	08/07/72	--	13 + 1 brood	1	--	--	--	--	0.9	
Vieux Comptoir	09/07/72	35	27	8	--	--	--	20	2.2	
La Grande (Fort George)	05/07/72	--	--	--	--	--	5	--	0.16	0.81
	24/08/72	91	32	2	--	--	--	--	2.4	
Roggan	10/07/72	175	68	6	7	--	--	--	25.6	5.23
	27/08/72	25	6	1	--	--	--	--	0.71	
Sakami	24/08/72	50	15	--	--	--	--	--	2.6	
Temiscami	03/09/72	16	29	8	--	--	--	--	1.51	
		696	297	70	24	6	5	36	1.48	

easily understood when one is aware that these zones are found where the current is slow and the water calm. Table 8 shows this clearly; one notes that the marshy zones support about 15 times as many birds as the other areas. This therefore explains the value of the Roggan River compared, for example, to the Nottaway: the former is very marshy, while the latter has no marshes at all, at least for its first 50 miles.

The distribution of the various species seems to follow the same pattern, very noticeably for the Black Duck and the Canada Goose and to a lesser degree for the Goldeneye and the Merganser (Table 9). Moreover it is quite surprising to note that species of diving ducks can be found in such zones, if one assumes that these locations are shallow and would therefore not exactly suit the needs of the last two species.

Little has been said so far about the smaller streams that flow into the bay; this is simply because there is insufficient data available on them. Indeed, it is extremely difficult to follow their course from the air since they are very narrow and winding. Although they are usually bordered by spruce stands they inevitably flow through marshy zones and it is precisely in these marshy zones that one is justified in wondering whether there may not be some waterfowl. Moreover, Hanson (1949) states that the Black Duck's favourite nesting places are along these small rivers.

This applies also to the rivers located not on the plateau edge or the coastal plain, but in the regions further inland, for example around Lake Mistassini. The places along the rivers where most waterfowl were observed were usually either shallow or marshy.

Table 8. Distribution of waterfowl in the marshy and non-marshy zones of the rivers.

River	Date	No. of inds. in marshy zone	No. of inds./mile	No. of inds. in non-marshy zone	No. of inds./mile
Nottaway	11/07/72	No marshy zone surveyed aerially	--	6	0.12
Broadback	04/07/72	No marshy zone surveyed aerially	--	49	0.64
Rupert	04/07/72	No marshy zone surveyed aerially	--	22	0.31
	02/08/72	129	12.9	No non-marshy zone surveyed aerially	--
Pontax	07/07/72	No marshy zone surveyed aerially	--	0	0
	02/08/72	29	4.8	6	1.0
Eastmain	01/08/72	40	2	0	0
Conn	09/07/72	No marshy zone surveyed aerially	--	9	1.22
La Grande (Fort George)	05/07/72	No marshy zone surveyed aerially	--	5	
	24/08/72	95	2.4	30	
Roggan	10/07/72	256	25.6 } 8	No non-marshy zone surveyed aerially	0.4
	27/08/72	24	0.9 }		
Sakami	24/08/72	65	0.6	No non-marshy zone surveyed aerially	--
		638	4.56	129	0.27

Table 9. Distribution of species of waterfowl in the marshy and non-marshy zones of the rivers mentioned in Table 8.

Species	No. of inds. in marshy zone	No. of inds./mile	No. of inds. in non-marshy zone	No. of inds./mile
Merganser	13	.09	33	.07
Goldeneye	7	.05	17	.04
Black Duck	132	.93	13	.03
Canada Goose	362	2.8	57	.12
TOTAL	514	3.67	120	.26

Finally, during the migration period one can assume that the geese and ducks arriving via James Bay to nest inland follow these natural paths and concentrate in the places most suitable, which are the marshy zones. Some birds might remain there while the majority would spread out to the nearby lakes or even to more distant lakes. The opposite phenomenon would occur during the fall migrating season.

The value of the rivers located deep within the upland region is undoubtedly less than that of the rivers on the coastal plain. On the one hand, migrating species in this region are undoubtedly more attracted by the great number of lakes, among them Lake Mistassini, while on the other hand, there are fewer and less marshy rivers in the uplands. These hypotheses should, however, be examined in future surveys.

Lakes

Lakes are not evenly distributed throughout the James Bay region. Generally speaking there can be said to be two distinct areas: first the coastal plain, where the frequency increases as one goes from south to north, and second, the area extending inland from the bay shoreline, the frequency increasing as one moves from west to east. In the interior of the Labrador Peninsula there are so many lakes that in some regions they cover no less than one quarter of the total area.

The size of these lakes varies from small ponds to lakes tens of square miles in area. Most, however, are less than 5 miles long and compared with the total number there are few very big lakes. Some of the largest are Lakes Sakami, Burton, Mistassini and Albanel.

The lakes are as varied in shape as they are in size. Though it is difficult to generalize, most can be described as elongated. It is also quite common for them to contain wooded islets.

According to Low (1896) the lakes in shallow valleys are usually dammed by drift and are therefore not very deep, seldom exceeding 50 feet, while many are less than 20 feet deep. The data collected by the hydrometric service of the Department of Natural Resources in the Nottaway, Broadback and Rupert river basins show this to be true. Of eleven lakes studied at two stations on each lake, four had depths of 40 to 55 feet, two of 20 to 40 feet, and the remainder less than 20 feet. Lake Mistassini, which occupies an ancient basin, is one exception, being more than 100 feet deep.

While the inland lakes, that is in the region of Lake Mistassini and the area north of it, are practically identical in shape and size with those found on the coastal plain, the vegetation surrounding, or found in them, differs greatly. Though the inland lakes are very numerous, on the whole they are not at all marshy. Most of them have rocky shores or are surrounded by arborescent and (or) shrub cover, consisting of Black Spruce, alders, willows and ericaceae. From the air there appears to be little aquatic vegetation and what little there is is limited to some small bays on the lakes.

On the other hand, the lakes close to the coast may be marshy or wooded (Photos 14 and 15) and of course with every possible combination in between, i.e. half wooded, half marshy, etc. As a general rule, however, there are seldom any completely marshy lakes;

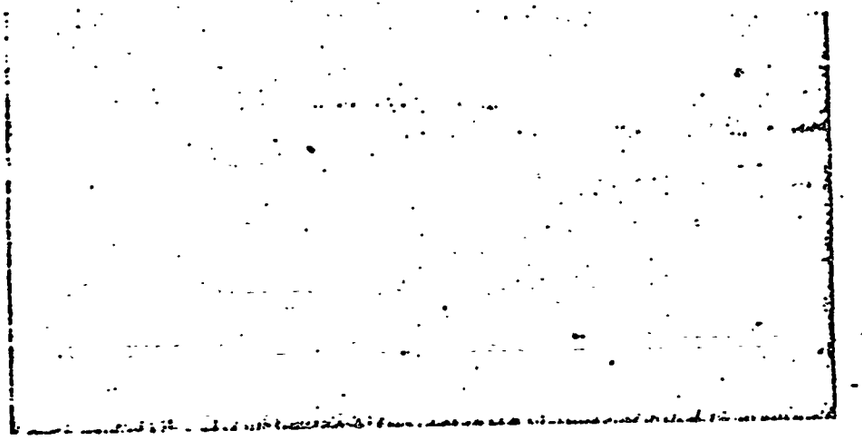


Photo 14: Lake with marshy shores, 30 miles north of Fort George.

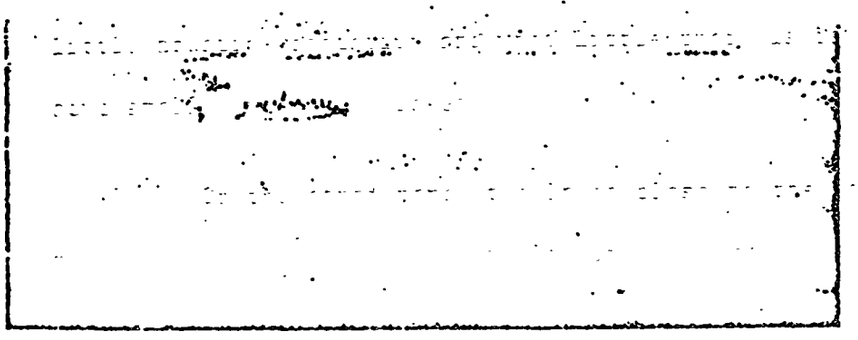


Photo 15: Lake with islets and wooded shores, 30 miles north of Fort George.

the wooded portions usually being larger than the marshy sections, which are often restricted to the heads and outlets of lakes. In addition to the presence of marshy shores, the lakes on the coastal plain usually have more aquatic vegetation than do the inland lakes.

The presence of such vegetation, Auer (1930) tells us,

> may result in various types of supra-aquatic or infra-aquatic filling up.[1]

The plants found in these lakes adapt themselves in different ways. Some species are attached to the bottom and the stems of some extend, following variations in the water level. Some float on or beneath the surface. Variations depend on the quantity of salt, carbonates, pH and depth.

There have been few opportunities to land on the surface of lakes with this type of aquatic vegetation. The only two such lakes which we were able to visit were Lac à l'Eau Froide, a small lake south of the Eastmain River and another 10 miles west of Lake Alder, from which we collected the following plants:

- From the lake bed or floating on the surface:
  Carex aquatilis, Callitriche palustris, Equisetum palustri, Nuphar rubrodiscum, Najas sp., *Potamogeton Spirillus.*
- From the shore:
  Carex aquatilis, Carex vesicaria, Iris versicolor, Scirpus atrovirens, Potentilla palustris, Myrica Gale, Salix sp.

---

[1] Infra-aquatic filling up occurs when the plants on the banks begin to advance and grow out over the water.

Supra-aquatic filling up occurs when a plant covering grows over the water surface. This covering consists of submerged moss over which grow Carex, menyanthes and even shrubs.

The banks of non-marshy lakes are usually covered with spruce, alder, willow and ericaceae, as was the case with some inland lakes.

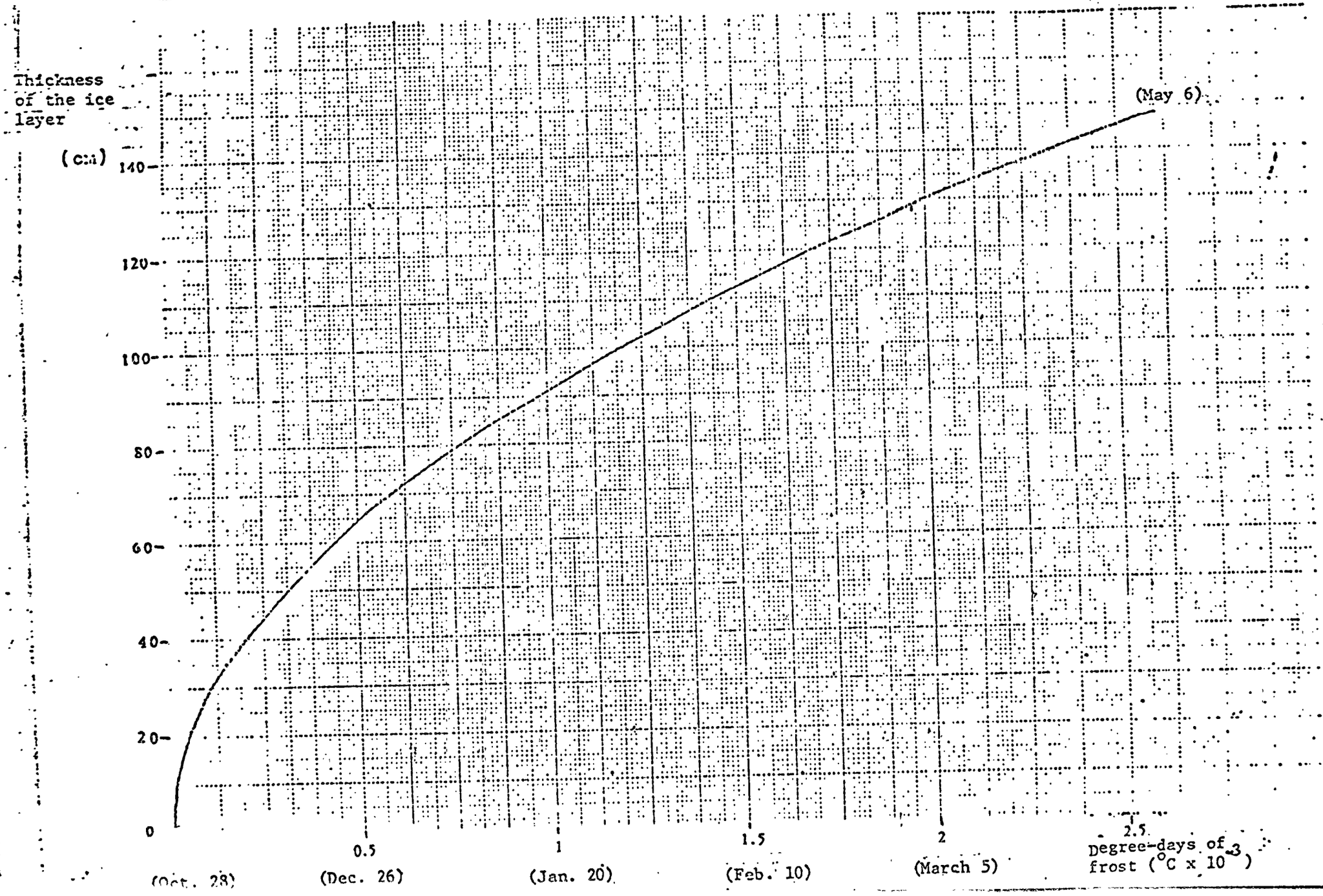
Of course these various types of lakes are not all of equal value to waterfowl, for each species of duck has its own food and nesting habitat requirements.

Since the inland lakes are not very marshy, often having rocky or shrubby and (or) arborescent shores and also being quite deep, they cannot attract large numbers of ducks or geese. The only species which might be satisfied with such a habitat are the diving ducks, such as the Merganser and the Goldeneye. In our surveys in early September we saw only Merganser and no Goldeneye, but this does not mean that the latter species cannot thrive here.

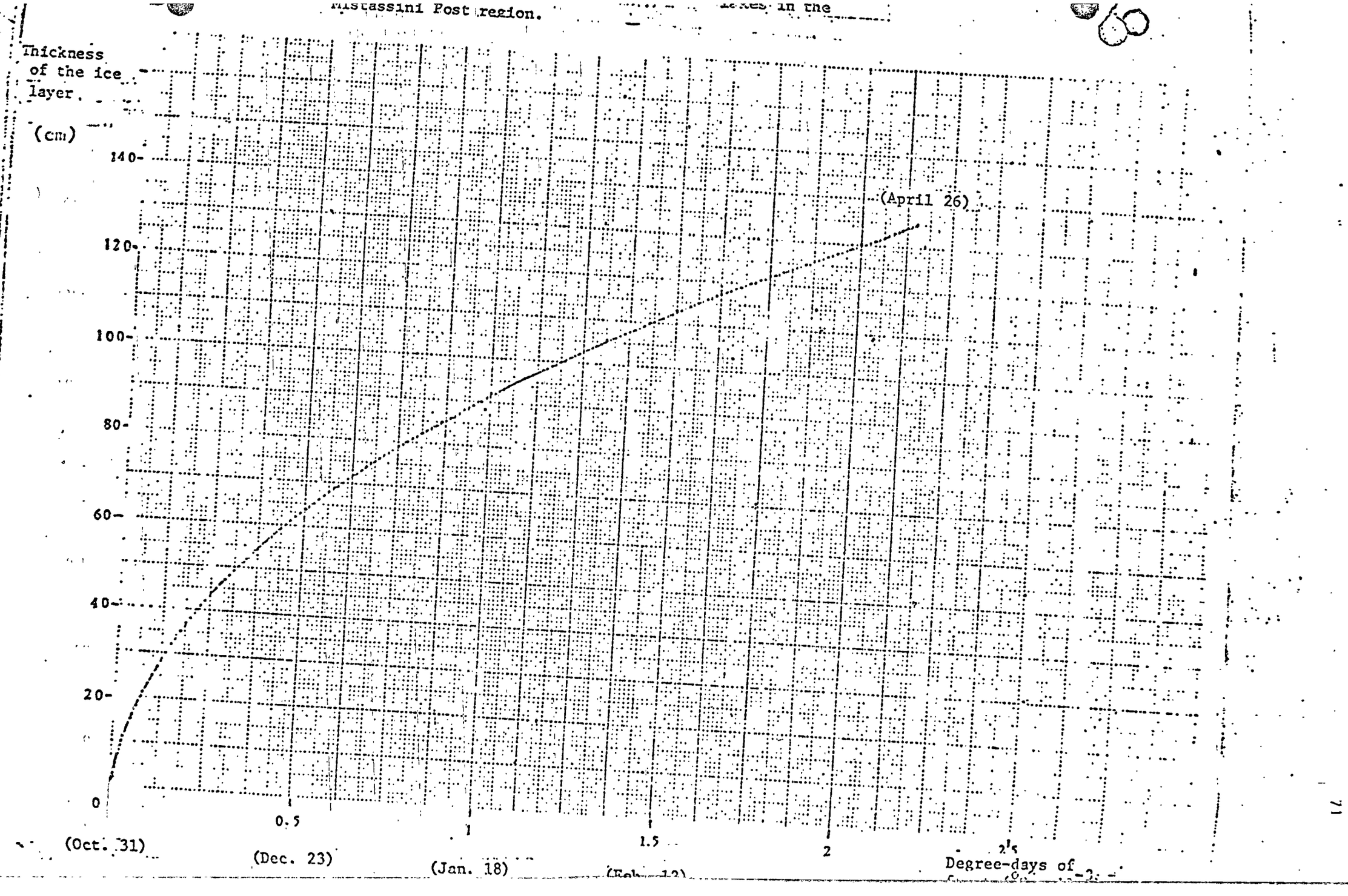
The lakes in the uplands are not all very deep, some being less than twenty feet deep, as has already been mentioned; they are therefore likely to freeze in winter, killing any fish in them. Since fish are an important source of food for the Merganser, this is yet another factor limiting the proliferation of this species and any other species whose basic food is fish.

It is possible to obtain quite accurate measurements of the maximum thickness of the ice on the lakes, by using certain formulae; the results obtained appear in Graphs 6, 7 and 8, that is 4.86 ft. (148 cm) at Fort George, 4.60 ft. (140 cm) at Moosonee and 4.42 ft. (134 cm) at Mistassini Post. According to this data, any lake less than five feet deep would be able to support few or no fish, and therefore few or no Merganser.

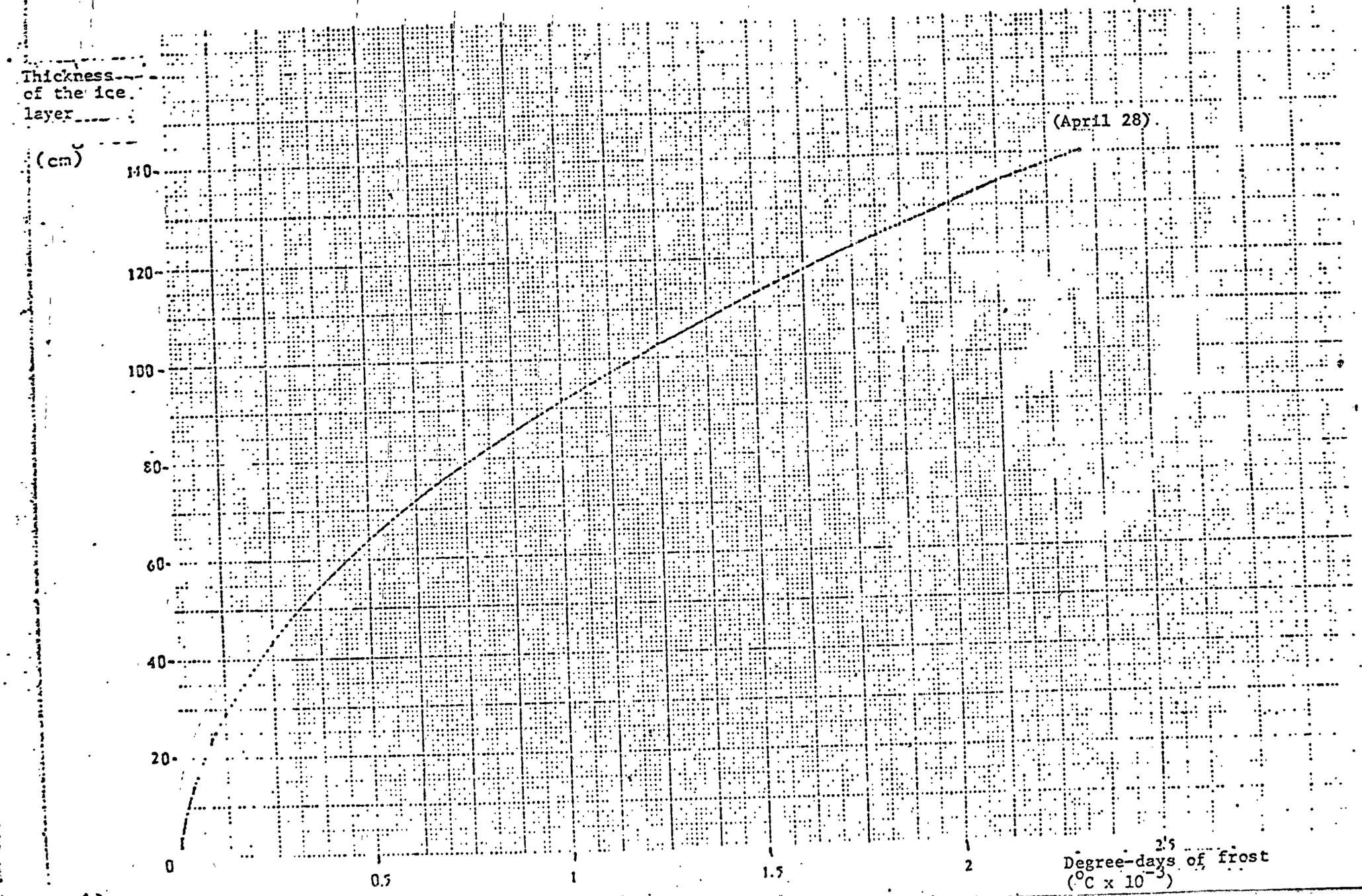
Estimated thickness of the ice layer on the lakes in the Fort George region.



Mistassini Post region.



Graph 8. Estimated thickness of the ice layer on the lakes in the Moosonee region.



Since we now have little data it is still quite difficult to generalize on the upland habitat of the Merganser. Nevertheless, it would appear that this species mainly seeks large lakes, i.e. larger than 10 miles, with rocky or wooded shores. The choice seems logical when one realizes that there are almost no marshy lakes, and that the largest lakes are possibly deeper and therefore support larger numbers of fish. It should also be mentioned that the Merganser may also be found on smaller lakes, in which case one must assume that these are fairly deep, or at least more than five feet deep.

There are fewer lakes nearer the bay, but they do offer more varied habitats, such as marshy shores and shallow waters well suited to some species of goose and duck, for example the Black Duck, the Canada Goose and even the Scaup, or deeper lakes with arborescent or shrub vegetation better suited to the needs of the Goldeneye and the Merganser.

It quite frequently happens that this ideal classification is not respected, particularly in the case of the coastal plain; Table 10 shows this quite clearly, though it applies to the entire James Bay region. For example, one notes that in terms of numbers of individuals/lake, there are more Black Duck and Canada Geese on lakes with wooded shores than on those with marshy shores. What is the explanation for this and for such astronomical figures as 65, 54 and 49 inds./lake for the Canada Goose, the Black Duck and the Scaup respectively?

Table 10. Relative importance of the lakes in the James Bay region for various species of waterfowl and waterfowl in general.

SPECIES	TYPE OF LAKES								TOTAL	
	< 1 mile		1 to 5 miles		5 to 10 miles		> 10 miles		< 1 m. to > 10 m.	
	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy
	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake	Inds./ lake
GOLDENEYE	2	--	5	--	1	7	7	--	3.7	7
MERGANSER	4.5	--	8	6.5	5.8	2.5	15.2	5.8	8.5	5.3
SCAUP	--	10	9.4	49	24	11	10.3	13	15	32.8
BLACK DUCK	16.5	8.1	18.5	21.2	54.3	13.6	16.5	16.2	22.1	13.0
CANADA GOOSE	20	3.6	9.1	10.	65	8.1	2	6.1	15.7	6.1
TOTAL	13	5.9	13.6	25.8	43.7	10.4	23.7	17.8	19.5	16.5

Most of the lakes on which this phenomenon was observed were north of Fort George, that is in the coastal plain zone. The idea one generally has of a lake with wooded shores, that is quite a deep lake with no aquatic vegetation, may not apply in this case. Indeed, it is possible that the lakes on the coastal plain are shallow in relation to those in the inland zone. It may also be possible that although there are no marshy shores aquatic vegetation may exist in lagoons and bays on the lake that are not visible from aircraft. Moreover, many plants do not necessarily surface and their vegetative parts are therefore underwater. Examples are: *Potamogeton* sp. and *Najas* sp. In *Flore Laurentienne*, Marie Victorian says on the subject of *Najas flexiles:* (Translation) "The *Najas flexiles* adjoins the *Chara* and the *Nitella* to quite a considerable depth." If this were true it would partially explain the problem of the large concentration of surface-feeding ducks on lakes with wooded shores.

With regard to the impressive number of surface-feeding or diving ducks which we were able to observe on several lakes on the coastal plain, especially north of Fort George, it is certain that these birds do not belong to groups of breeding or migrating ducks. The reason is very simple: some of the groups observed in July were composed only of adult birds. It is therefore possible that these ducks were quite simply moulting. The ducks which would gather to moult in this region would mostly be males, along with a few females unable to nest inland. These lakes seems to be ideal for moulting: they are numerous and varied enough to meet the food requirements of several species and they are also close to the bay, a main migration route.

Finally, with regard to the relative importance of waterfowl species, one notes (Table 11) that the Black Duck is almost always more numerous than the other species, regardless of the type of lake. It is followed by the Scaup, the Merganser and the Canada Goose. The relative importance of these three species does vary with the type of lake. The large lakes have more Merganser than Scaup and Canada Geese; medium-sized lakes (1-5 miles) have more Scaup; while the smaller lakes have more Canada Geese.

Table 11. Relative importance of the various species of waterfowl on the lakes in the James Bay region.

SPECIES	TYPE OF LAKE							
	< 1 mile		1 to 5 miles		5 to 10 miles		> 10 miles	
	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy	Wooded	Wooded + Marshy
GOLDENEYE	2%	--	1.2%	--	0.3%	7.4%	5%	--
SCAUP	--	13.2%	11.5%	42.3%	15.7%	11.8%	28%	11.4%
MERGANSER	9.8%	--	23.8%	10%	9.5%	10.6%	42.6%	25.4%
BLACK DUCK	68%	64.5%	50%	36.7%	53.3%	43.6%	23%	46.5%
CANADA GOOSE	21%	22.3%	13.4%	11%	21.2%	26.6%	1.4%	16.7%
TOTAL OF DUCKS AND GEESE OBSERVED	97	76	408	462	306	94	143	114

CHAPTER 8: DISTRIBUTION OF WATERFOWL IN THE JAMES BAY REGION

Figure 15 gives us a general view of the territory covered by our summer 1972 surveys. In these surveys the coastal plain region was, of course, given more intensive coverage than the uplands, because of its importance to waterfowl. Two zones were left untouched, the area west of Lake Rosée and that north of Lake Tilly; these two zones will be the subject of future surveys.

Not too many species of waterfowl were observed in the uplands, eight to be exact, and not all are of equal importance, since the Canada Goose and the Black Duck far outnumber the other species (Table 12). Their respective distribution varies somewhat but as a general rule greater use is made of the coastal plain than of the uplands. Four species deserve special attention -- the Canada Goose, the Black Duck, the Merganser and the Scaup.

The Canada Goose is found throughout the study area (Fig. 16) but in smaller numbers as one moves further inland on the plateau. In the interior it is found only on shallow and (or) marshy rivers, or on lakes with marshy shores. Since these last two types of habitat are rare, there are few Canada Geese in the region.

On the coastal plain the Canada Goose is found on both lakes and rivers, though it seems to be more numerous on the rivers later in the season (Table 13). The purpose of this concentration would seem to be the feeding of the young birds, or perhaps moulting, or simply the start of migration to the bay.

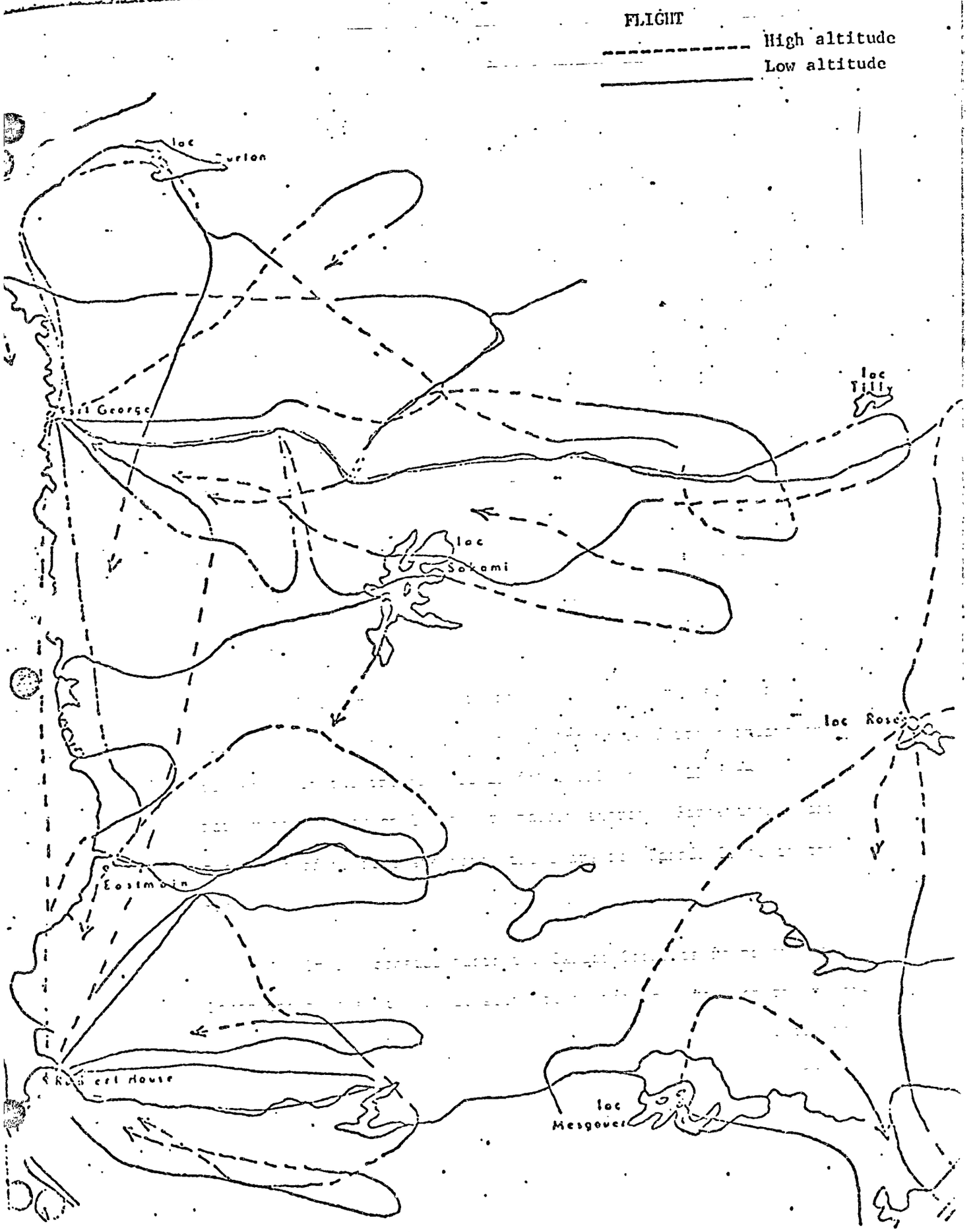


Figure 15: Territory covered by the summer '72 surveys.

Table 12. Relative importance of waterfowl species in the James Bay region, summer 1972

SPECIES	JULY			AUGUST-SEPT.			TOTAL		
	No.	%	Inds./ 100 miles	No.	%	Inds./ 100 miles	No.	%	Inds./ 100 miles
CANADA GOOSE	602	42.5	30.5	764	35.3	42.4	1366	38.2	36.2
BLACK DUCK	510	36.0	25.8	630	29.2	35.0	1140	31.8	30.2
MERGANSER	95	6.7	4.4	306	14.2	17.0	401	11.2	10.4
SCAUP	91	6.4	4.0	303	13.9	16.6	394	11.0	10.0
GOLDENEYE	69	4.9	3.5	--	--	--	69	1.9	1.8
SCOTER	7	0.6	--	30	1.4	1.6	37	1.0	1.0
MALLARD	8	0.7	0.6	4	0.2	0.2	12	0.3	0.30
WIDGEON	9	0.8	0.6	--	--	--	9	0.2	0.19
UNIDENTIFIED	27	1.9	1.3	127	5.9	7.0	154	4.3	4.0
TOTAL	1418	100	70.7	2164	100	119.9	3582	100	94.2

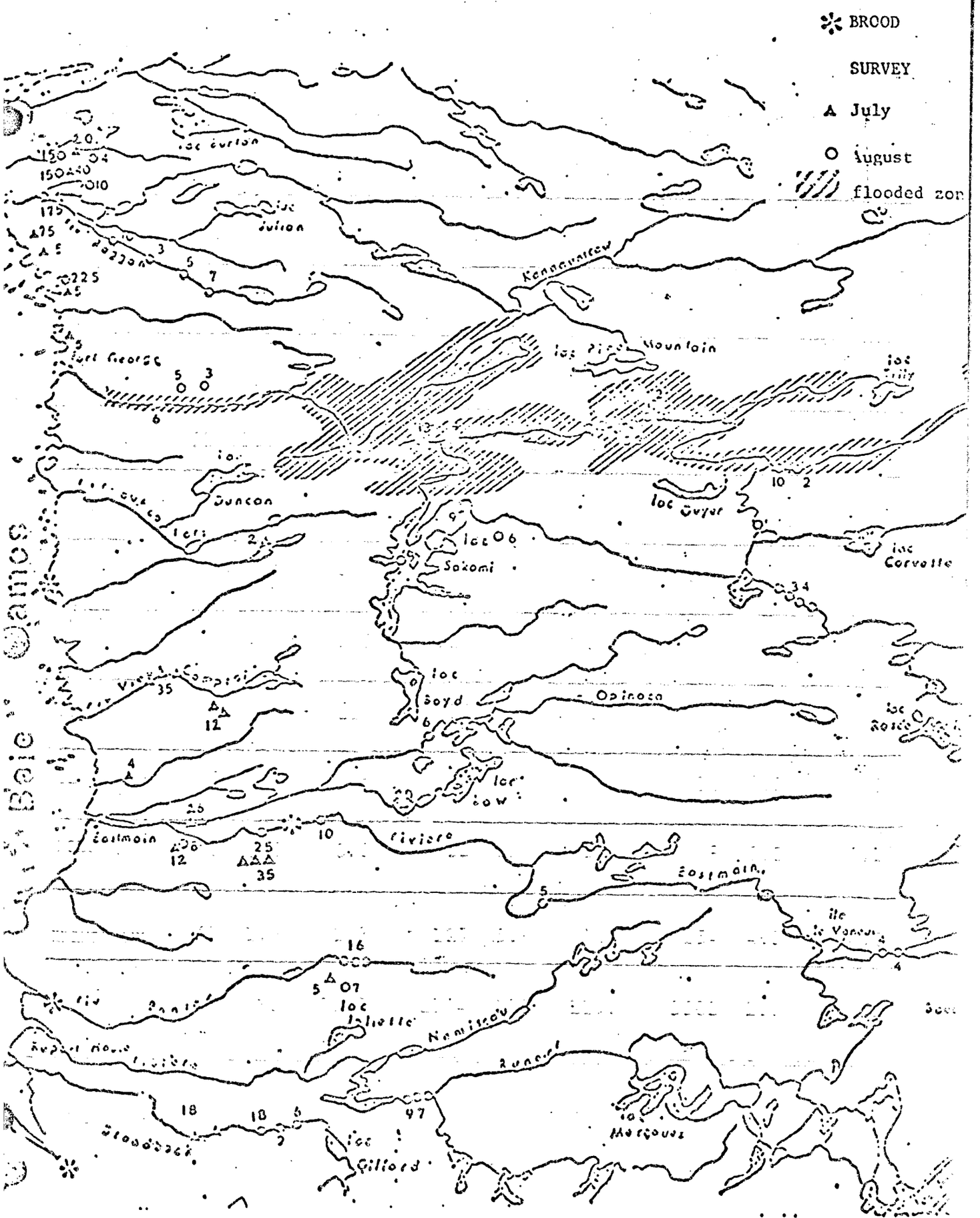


Figure 16: Distribution of Canada Goose.

Table 13. Relative importance of lakes and rivers for the various species of waterfowl in the James Bay region, summer 1972.

SPECIES	No. of individuals on the lakes			No. of individuals on the rivers		
	July	August - Sept.	Total	July	August - Sept.	Total
CANADA GOOSE	254	88	342	340	418	758
BLACK DUCK	348	417	765	162	172	334
MERGANSER	45	244	289	50	62	112
SCAUP	83	302	385	8	--	8
GOLDENEYE	44	--	44	30	--	30
WIDGEON	9	--	9	7	--	7
MALLARD	3	3	6	5	1	6
SCOTER	--	--	--	--	--	--
TOTAL	786	1054	1840	602	653	1255

Canada Geese may sometimes be found on lakes with wooded shores, but most of these lakes are situated adjacent to the bay or north of the La Grande River.

The number of birds which will possibly be directly involved in the flooding caused by the dams on the La Grande River does not seem to be very great and should in no case endanger the species. If one assumes, as Table 13 would seem to indicate, that the Canada Goose is concentrated on the rivers at the end of summer, then the surveys made on the La Grande in August might be quite indicative of the population to be found in the immediate vicinity of the river or at least concentrated on the lakes connected to the river. The population here would number approximately 125, but this figure will have to be checked.

The Black Duck is distributed in much the same way as the Canada Goose (Fig. 17), that is it makes more intensive use of the coastal plain than of the uplands. However, it makes greater use than the Canada Goose, throughout the whole summer, of the lakes on the coastal plain (Table 13). There does not seem to be any great concentration on the rivers at the end of August as there is in the case of the preceding species.

Strictly speaking there are no high density zones for the Black Duck except the Piagochioui River and the Pointe Louis XIV area, which is perhaps used for moulting.

There are few Black Duck on the La Grande River in August and the total number of birds observed was only about six per cent of the total count for that month.

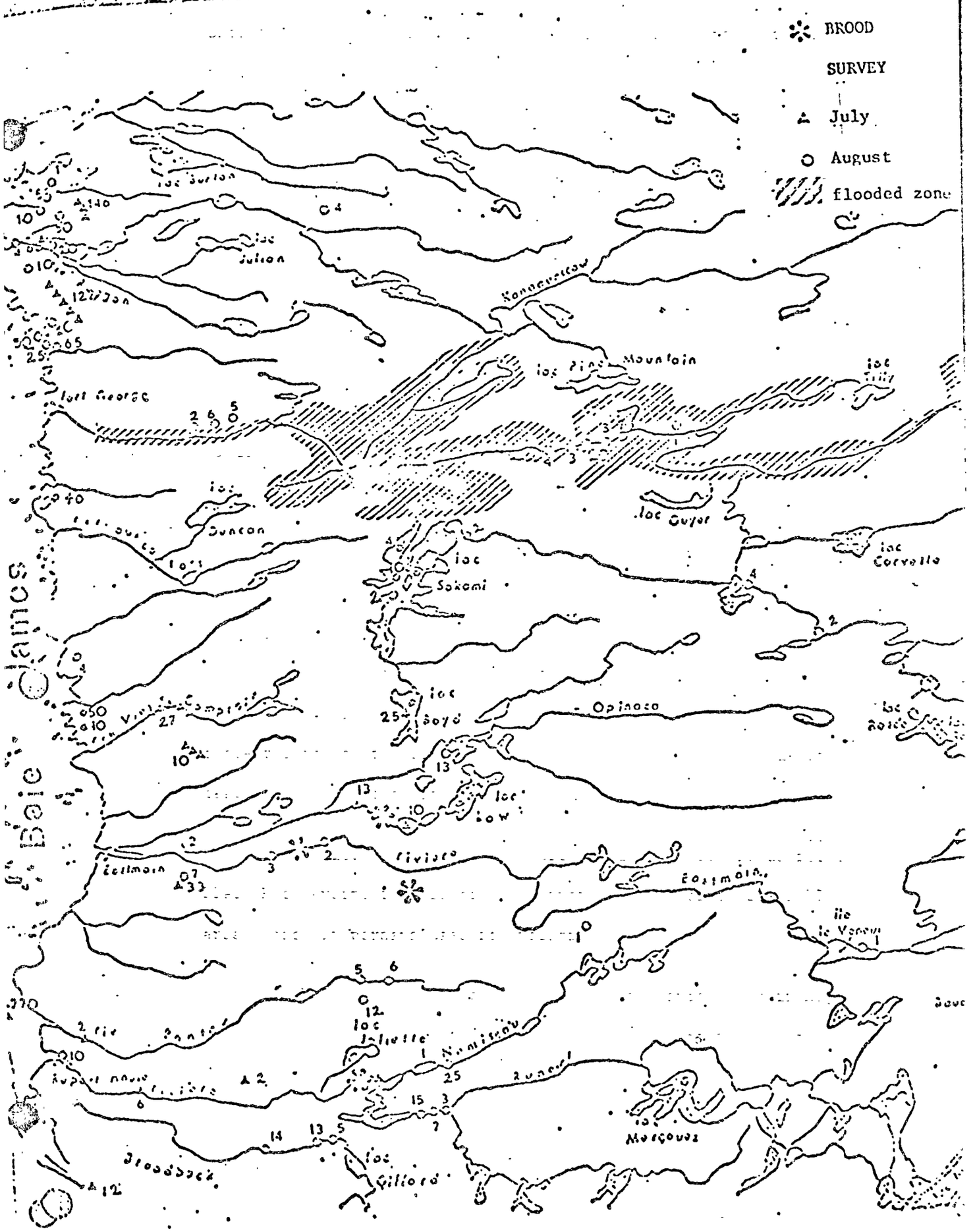


Figure 17: Distribution of Black Duck.

The Merganser is probably the species which makes the most rational use of the James Bay territory, since it is found very far into the uplands as well as on the coastal plain (Fig. 18). Though more common on the lakes, Merganser can nevertheless adapt quite well to rivers which support some fish (Table 13). However, there were few Merganser on the La Grande, the total number being eight. It is therefore possible that the rise in water level caused by the dams might favour this species, if, of course, the existing spawning grounds are not destroyed.

Unlike the preceding species, the Scaup seems to be restricted almost exclusively to the coastal plain and even on the plain it is found only in two or three definite locations, around Lake Duncan, north of the Roggan River and on the Broadback River (Fig. 19).

The fact that the Scaup is found on rivers is, however, unusual, for in almost all cases it was concentrated on lakes with both wooded and marshy shores. The plans for the La Grande river will have no effect on this species. Note that the zone north of the Roggan River might perhaps be an area for moulting, as was the case for the Black Duck and the Canada Goose.

Finally, Figure 20 gives us a view of the zones in which waterfowl in general are concentrated. The extent of the territory to be studied prevented us from covering it in its entirety; this figure is therefore far from complete and does not give a fully representative picture of the area.

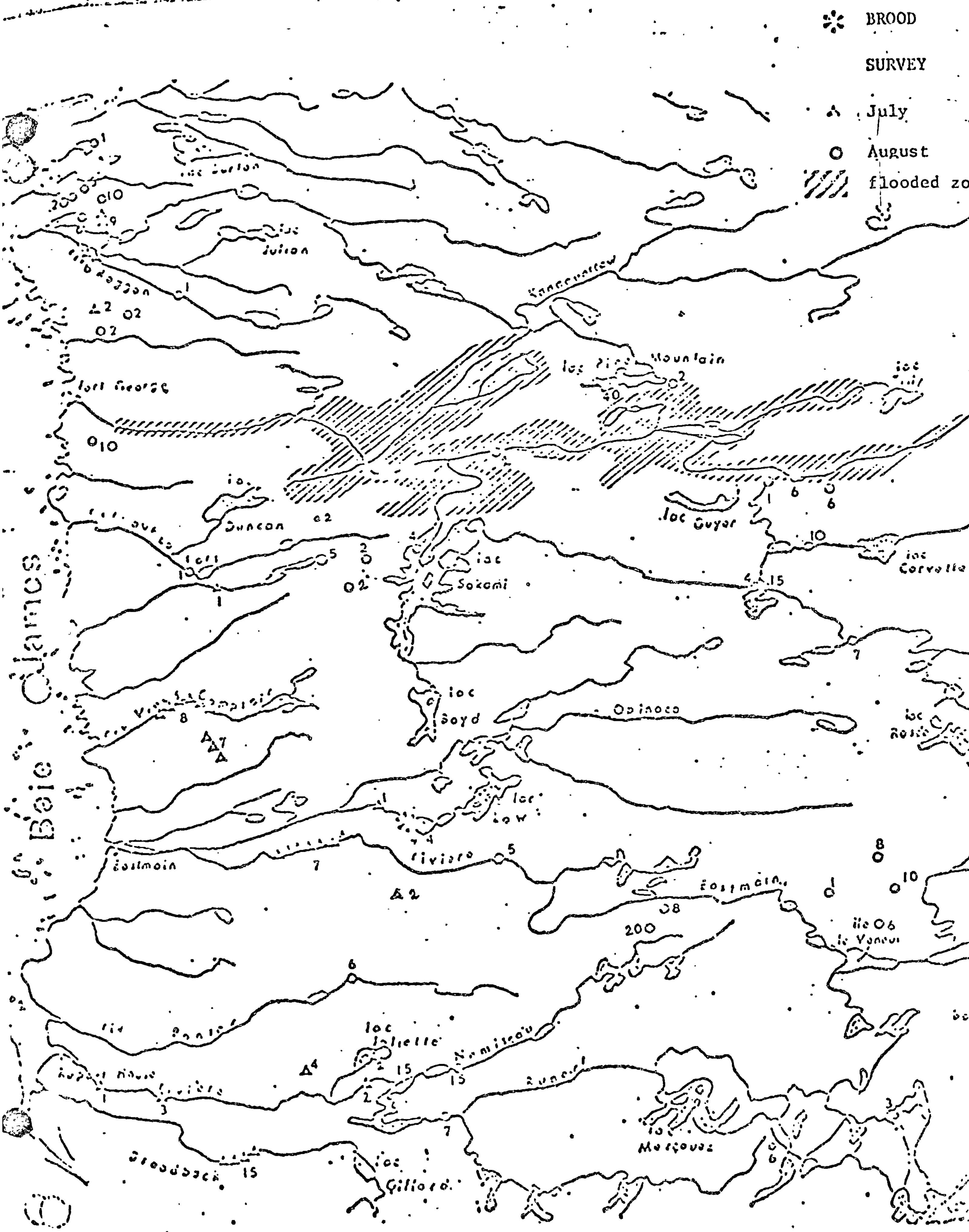
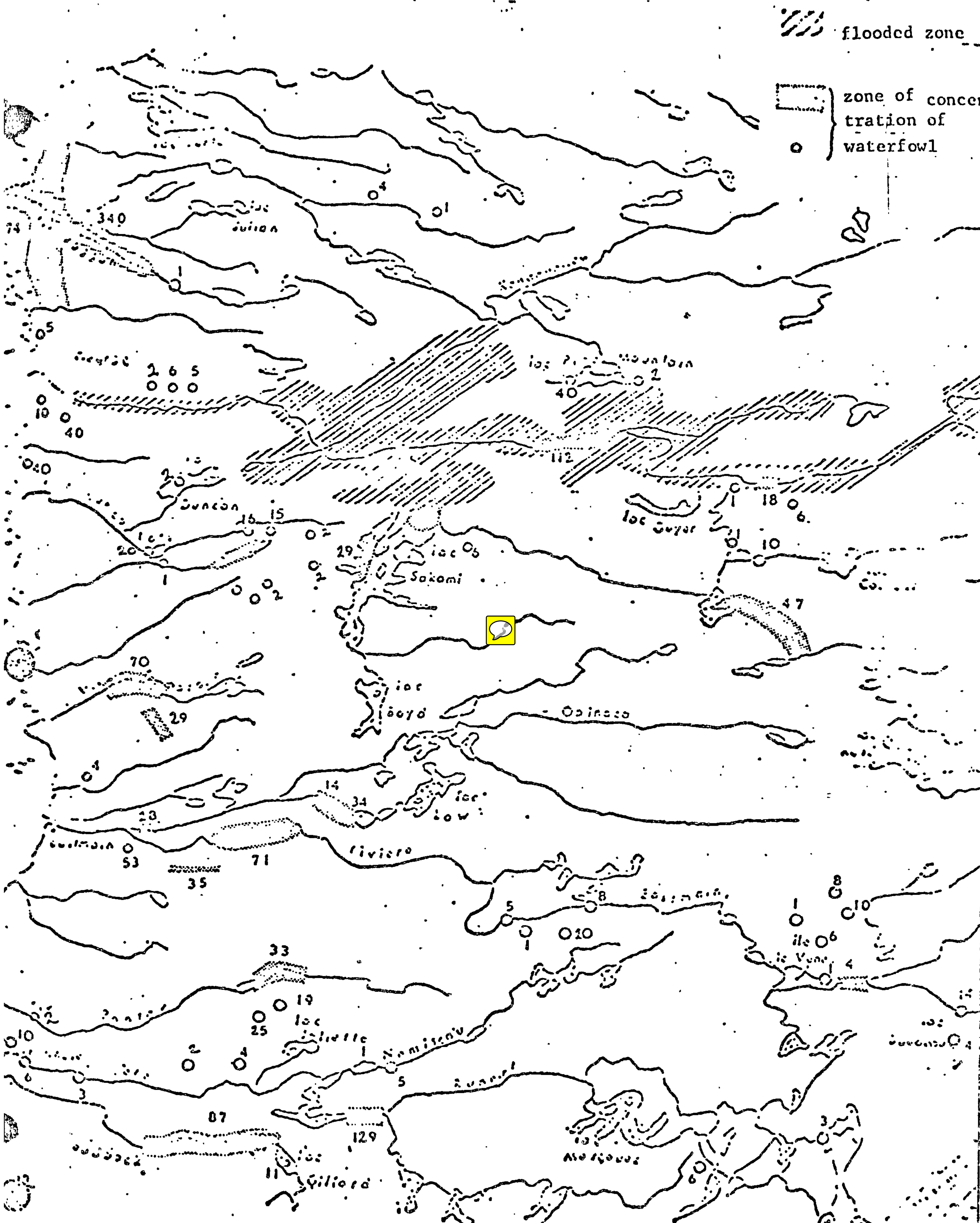


Figure 18: Distribution of Merganser.



igure 20: Distribution of waterfowl.

CHAPTER 9: CONCLUSION

The information gained from our surveys last summer is already giving us an idea of the possibilities of the James Bay territory. For example, it is certain that the marshy river zones are better than the other zones, be they wooded or rocky, that the inland lakes support a smaller number of birds and species than do those on the coastal plain and that lakes with wooded or marshy shores attract both surface-feeding and diving ducks.

Nevertheless, the definitive classification of the maps 1:125,000, in relation to their importance for waterfowl, can only be completed when a number of points have been cleared up.

Are bogs as unimportant to waterfowl as we have claimed? If not, what species are found there, do they nest there, and do they gather there in larger numbers during the migrating season?

Do the lakes with wooded and (or) shrubby shores have aquatic vegetation which would attract surface-feeding ducks, either for nesting or moulting?

What is the importance of the lakes bordering the bay during the moulting period?

Can the inland lakes, particularly the Mistassini, be an important halting place for species migrating overland?

Those are some of the questions which we must try to answer in the next few months. The answers will perhaps give us a clearer idea of the value of the James Bay territory.

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