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Preliminary Wildlife Survey of the Mackenzie Delta with Special Reference to the Muskrat.

In the months of June, July and August, 1947, the writer assisted by W. E. Stevens, undertook a preliminary study of the biota of the Mackenzie River Delta.

Arrival at Aklavik was by air on June 7, and the next three days were taken up with establishing our headquarters, interviewing various men believed to have information pertinent to our study, and making the necessary arrangements for the field work.

On June 11 we set up a camp on the trapping area of Mr. Albert Boxer, nine miles north of Aklavik, and began the field studies of the muskrat and other members of the vertebrate fauna of the Mackenzie Delta. The remainder of the month was spent here and on a four-day trip to the tundra region bordering the Richardson Mountains about forty miles northwest of Aklavik.

The early part of July was spent in a reconnaissance of the western part of the Delta south of Aklavik in search of areas suitable for more intensive study. This was followed by a period at Reindeer Depot on the east channel of the Delta, July 9 to 17 inclusive. A week in mid-July was given to further work on the Boxer area and the last week of July was spent at Kidluit Bay on Richards Island, for the purpose of taking part in the reindeer roundup.

During the first two weeks of August, we set up a field station at the trading post of Knud Lang, thirty miles south of Aklavik on Peel Channel.

Between periods of field work opportunity was made to interview many persons in the Delta whose special knowledge and interest had put them in possession of data pertinent to the study.

Three areas were chosen for the detailed population studies and the life history studies of the muskrat that were deemed to be essential to the attainment of a proper understanding of the biological situation surrounding this most important mammal.

Area 1 consists of the trapping area of Albert Boxer situated on the west side of the Delta about nine miles north of Aklavik. This is one of the smaller trapping areas on the Delta, with an area of approximately thirteen square miles; it is, however, a productive trapline yielding a large annual crop of muskrats as well as smaller numbers of mink, coloured fox and weasel.

The ecological situation on this area is particularly good for study purposes and for certain experiments in management. The majority of the lakes are steep-sided with a minimum of emergent vegetation, and not subject to violent flooding with river water

during the spring run-off. There are, however, several lakes with direct channel communication with silt and display the successive floral stages that accompany such filling. In general, the emergent vegetation on these lakes is abundant. Two of the lakes are drained only by a narrow channel with high banks and are thus most suitable for experimental flooding through dam construction.

Area 2 is in the vicinity of Reindeer Depot. Here the field studies were largely confined to a series of flooding lakes directly west of the depot and extending from the west bank of East Channel in a westwardly-directed series toward Middle Channel. Here again the conditions represent various stages in lake filling with certain of the lakes now shallow, with gently shelving shoreline, and others somewhat deeper and steep-sided.

Area 3 is the trapping area of Knud Lang situated in the vicinity of 135° west longitude and 68° north latitude. This again is a small but highly productive area, of almost the same size as Area 1. The ecological situation here, however, differs in several respects from that in either of the other areas. There are several smaller lakes and large ponds that have reached the bog stage in their evolution and in general there are more extensive series of interconnected lakes and ponds. Some of these are long, relatively deep, and subject to violent wind action, while others are smaller, more compact of shape, shallow and well protected from wind action both by surrounding forest and by the emergent and floating vegetation that they support.

It is to be noted that all of these areas are in the forested part of the Delta. Our two short excursions into the tundra areas of the Delta were not productive of suitable study areas in this floral region. However, there is some suggestion that the tundra habitat, being marginal for muskrats, gives earlier evidence of approaching population declines than does any part of the upper Delta. In consequence, it seems highly desirable that at least one study area be established in the tundra region. Mr. Stevens plans to undertake this during 1948.

The Mackenzie River Delta

For the purpose of this study the Mackenzie River Delta is taken to be the Delta proper, and does not include the much broader area eastward as far as the Anderson River considered as part of the Delta by Porsild (1935, 1943 and 1945) in his earlier papers on the fauna of the region.

From Point Separation, in latitude 67° 35' at the head of the Delta, to the Arctic coast, the region is approximately one hundred miles in length, while at the coastal end, from Shingle Point on the west to Tuktoyaktuk on the east, it has an extreme width of about one hundred and ten miles. The Delta proper is bounded on the west by the Richardson Mountains and on the east by the Caribou Hills. Porsild (1935) has estimated the area of the alluvial part of the Delta to be about four thousand square miles.

Lynch (1940) has given an admirable summary of the general features of the fresh water habitats of the hydrosere as represented in the Mackenzie Delta. The entire Delta is a maze of waterways; ponds, lakes, sloughs and channels are the dominant feature of the landscape as viewed from the air. One is left with the conviction that over the greater part of the Delta, water area exceeds that of land.

The dominant vegetative cover on the delta consists of a dense riparian association of willow and alder. On the drier ground white spruce, some black spruce, and some balsam poplar, occur north, on the west side of the Delta, almost twenty miles beyond Reindeer Depot. North of these points the willows and alders persist in gradually lessening density to the Arctic coast where tundra becomes the dominant vegetative type.

There appear to be two climax vegetative types in the Delta region, spruce forest, and tundra. All the plant formations, then, are progressing toward one or the other of these two.

As is so frequently the case the climaxes are relatively barren of wildlife and it is the early stages in the floral succession that support the heavy populations of fur-bearing animals and wildfowl.

The primary reason for the great productivity of the Delta in marsh wildlife is that its water courses are continually subject to change. River floods, storm tides, and river-borne or wind-driven ice produce an unceasing movement of the alluvial materials of which the Delta is largely composed.

As pointed out by Lynch (op.cit.) the upper and middle portions of the Delta exhibit channel braiding to a marked degree. The Mackenzie is unique, however, in that the innumerable secondary channels which characterize its Delta for the most part remain active. Thus river influence continues to be felt over the entire Delta where it is constantly renovating the aquatic habits.

All the active river channels are winding and along them the downstream banks, beset by current thrust, and cut and torn by floating ice, are continually eroding. At the same time their materials are being deposited as upstream mud bars that may form extensive mud flats or build up, in the course of a single flood season, into high river banks.

As the bars build up by successive deposits of alluvium their vegetation passes quite rapidly from the pioneer community dominated by Equisetum variegatum and E. arvense in association with Arctophila fulva and Carex aquatilis into a community dominated by willows (Salix alascensis and S. walpolei) which, in turn, is succeeded by alder (Alnus crispa) and finally by spruce (Picea glauca).

Many of the smaller lakes and ponds of the Delta have arisen following the damming off of smaller river channels, others are left behind as depressions between successively developed new upstream river banks. The channel lakes frequently retain a drainage effluent through which they are flooded each spring by the rising waters that accompany the break-up of the ice. Periodically through the summer they may be reflooded, for an onshore wind at the river mouth can completely reverse the river flow for a distance of at least one hundred miles upstream.

The larger lakes, and many of the smaller ones also, represent the natural depressions of deltaic islands. Many of these are rimmed by high banks and are not subject to spring flooding with the silt-laden river water, while others have drainage channels and flood regularly.

Where river influence is dominant, and each year sees a new deposit of mineral soil on the lake bottom, a distinctly alluvial type of plant succession takes place. In the deeper waters the pondweeds (Potomageton richardsoni and P. gramineus) are dominant over large areas or are present as codominants with Myriophyllum exalbescens. These forms were found in water depths of from three to twelve feet. In the shoal waters other species of pondweed (Potomageton filiformis, P. vaginatus and P. friesii) along with bur reed (Sparganium angustifolium and S. hyperboreum) are abundant and along many gently sloping shores dense beds of goose grass (Equisetum fluviatile) occupy some areas while on others the water oats (Arctophila fulva) is dominant. These dense stands of emergent vegetation reduce wave action and hasten the accretion of new soils that at the appropriate state are invaded by willows, still later by other shrubs and trees, and finally by spruce.

The steep-shored lakes and lakelets also support an abundant bottom flora of the type already described. Such lakes however have a much longer life, as they are not carpeted annually with several inches of alluvium. In general their immediate shores are sparsely vegetated, except in the occasional shallow spots and protected bays. Here the sedge Carex aquatillis is dominant. The accumulation of organic soil, rather than mineral soil, fosters the development of a bog flora. In lakes of this type on our Area 3 the submerged vegetation was sparse and consisted of milfoil (Myriophyllum exalbescens) and marestail (Hippuris vulgaris). These ponds were some of them bordered by dense floating mats of buckbean (Menyanthes trifolium) while others were bordered with marsh calla (Calla palustris)with here and there beds of the sedge (Carex aquatilis) and cotton grass (Eriophorum angustifolium).

Soundings were taken in ten lakes during the summer and all were found to be shallow. The greatest depth recorded in July and August was fourteen feet and the majority of the lakes sounded had extreme depths at mid-summer of nine to twelve feet.

Population:-

The trapping population of the Delta consisted of ninety-seven Eskimos, seventy Indians, twenty-two half-breed Indians, eight half-breed Eskimos and thirty whites. These numbers refer to males of trapping age, supporting themselves or their families in whole or in part by trapping and, in a few instances, to widows or spinsters occupying an equivalent position. The figures include Fort McPherson, Aklavik and the Delta proper but not Arctic Red River or the villages along the river south of there, nor do they include the population of Tuktoyaktuk.

An estimate of the total native population of the Delta supplied to me by Mission authorities at Aklavik was about six hundred Leaucheaux Indians and something over five hundred Eskimos.

The white population of the Delta consists of about 170 people, the majority of them government or mission employees, the remainder engaged in trading, trapping and other activities.

It was not found possible to determine the lengths of residence of the various trappers of the Delta, but it was widely stated that the population of the region had shown a sharp increase during the war years, in large part to the high prices of fur, and to the ease with which a large muskrat harvest could be taken.

The Eskimos are almost all of them of Alaskan origin. They have moved into the Delta over a period of twenty years because of the comparative ease of living there compared with the rigors of the Arctic coast of Alaska. I heard no expressions of a desire to return to the native way of life upon the coast.

The way of life of the trappers enters importantly into consideration of conservation measures best suited to the region.

The basic business of living under Arctic conditions is most time-consuming and, although maintaining native standards, of comfort, nutrition, and sanitation is much simpler than trying to live the life to which most Canadians south of the Arctic Circle are accustomed, there are, nonetheless, many duties that cannot be escaped.

Winter travel necessitates the use of dogs. Most teams in the western Arctic consist of six or seven large dogs in constant need of food and water. Fish is the standard summer diet for the dogs, as it is also for the native human population, so the tending of fish nets is one inescapable task.

Winter dog food has to be either bought, or provided for during the summer. Here again fish is the staple item and it is prepared for winter use either by splitting and drying or by freezing. Drying is very satisfactory but it is hazardous during wet summers, such as that of 1947, and in consequence the provision of winter dog food is usually left until the onset of cooler weather in September when a period of intensive fishing is counted upon to fill fish pits against the winter's requirements.

The cutting of wood for fuel is another general task. It, like the last, is usually left until the late summer, but for the reason that the colder weather then largely eliminates the hordes of mosquitoes that earlier make outdoor activity almost unbearable.

A small number of people supplement their income by cutting wood for the missions, hospitals, and other places in Aklavik that burn wood, or by fishing for winter dog food for the various government and private agencies that need this service.

In general the Indian trappers and their families, during the summer months, confined their activities to the unavoidable routine of living and reduced this to an absolute minimum. Numbers of them congregated at Aklavik where they lived in makeshift dwellings in depressing squalor.

The Eskimos of the Delta live a vastly different life than do those of the Arctic coast. Apparently the Eskimos living to the east of the Delta still maintain many of the primitive behaviour patterns that have been so ably and graphically detailed by many students of Arctic anthropology.

They still live throughout the year in small groups of families, go trapping in small parties and subscribe to a patriarchal type of social organization that admits little private ownership.

The Delta Eskimos, on the other hand, have taken on many of the ways of white men. We found that the majority of Eskimo trappers have been, for varying periods of time, trapping upon areas that they regard as their own. On these areas they have built cabins and done some development work. In a few places two or three families have built their cabins close together and established a small community from which the trappers work their respective areas.

At the end of the 1947 trapping season the Eskimos from all parts of the Delta converged upon Aklavik for a week or two of community life and festivity, disposal of their furs, and purchase of new supplies and equipment. Upon receipt of word of open water in the river estuary, they all departed to summer camps on the coast east and west of the river. Here they fished, caught white whales for dry meat and oil, and remained until the late summer before returning to their winter quarters to put up fish for dog food and to cut some of the winter's fuel supply.

Several of the white trappers undertook the same summer migration to the coast to take advantage of the superior fishing there and the reduced number of biting flies.

Many of the Eskimos own motor-powered schooners, all of them have canoes, most of them one or more outboard motors, radios and other white-man apurtenances, and are now part of an economy based upon sale and purchase of goods with the interchange of currency. A large part of their diet and clothing is now purchased, not obtained from their environment. Most of them are Christians and send their children to the Mission schools.

Although the native trappers of the Mackenzie Delta have forsaken the primitive way of life, the animal inhabitants of the area still provide for the natives, and for the majority of the white inhabitants of the Delta, the means of maintaining life.

In the primitive Eskimo community the animals produced food, clothing, fuel and to a certain extent, shelter. To the primitive Indian the fauna was at least food and clothing. Although shelter, fuel and to a large extent clothing, are now supplied from other sources, the fauna retains its most important function - the provision of food.

A map of the distribution of the native population of Northwest Territories is at the same time a map showing the localities at which fish, birds and mammals are available in quantities sufficient to maintain human life.

The animal forms that serve this primary function are, peculiarly, an entirely different group than the fur bearers that constitute, to the native, the source of all wealth, the means of providing a varied diet, adequate clothing, means of travel, the means to hunt and fish, and the ability to obtain the few luxuries they possess.

The animal food sources of the western Arctic are the barren ground caribou, fish, seals, white whales, snowshoe and Arctic hares, ptarmigan and waterfowl. In certain localities beaver and muskrat add variety to the diet during the short period that their capture is legal.

It will be readily understood, then, that the conservation of these food-producing animals must constitute a primary objective in any wildlife management program even though the economic incentive for this conservation may be much less than that involved in the conservation of the fur bearers.

The primary purpose of the field work upon which this report is based was the study of the fur resources of the Mackenzie River Delta with particular reference to the muskrat, but because of the vital importance of certain of the other animal forms, and of a personal interest in all forms of wildlife, advantage was taken of every opportunity of making observations upon these.

The study fell into two phases. In the first instance, the work of the summer was merely the beginning of a more extensive study, thus much thought was given to the long-term program of field research upon Arctic wildlife. In the second instance, it was realized that administrative moves towards putting the fur resources on a more satisfactory basis could not well await the completion of the long-term study; that some of the more obvious improvements in policy should be instituted at the earliest possible moment. To this end, considerable time and thought was given to

ascertaining the existing situation with regard to the population of fur bearing mammals, the methods of harvesting these, and the sociological implications of the fur industry in the Delta.

Final conclusions on these must await the gathering of additional information but some preliminary observations can be placed on record and recommendations made for the alleviation of certain of the more obvious disharmonies in the present situation.

Wildlife Conservation on the Mackenzie Delta.

A record of furs exported from the Northwest Territories has been maintained since 1931 but it is impossible to excerpt from these records those pertinent to the Delta exclusively. This is because much fur taken outside the Delta is traded at Aklavik.

The export records of coloured fox, mink, muskrat and lynx from Aklavik and Fort McPherson have been combined on Table 1 to give an approximation of the take with respect to these animals in the Delta region.

From this table it will be seen that the muskrat catch far exceeds the combined total of all other species. The mean number of muskrats taken during this sixteen-year period is roughly one hundred and fifty thousand, while the corresponding figures for coloured fox, mink and lynx have been only twelve hundred and ninety-three, twelve hundred and twenty-eight and one hundred and thirty-one respectively.

Despite this tremendous preponderance in numbers of muskrat the fine fur animals contribute an important part of the monetary returns for fur harvested in the Delta region. It is difficult to strike representative value figures for a commodity so subject to price fluctuation as fur but it is estimated that under average price conditions, the trappers would receive $225,000 for the muskrat crop and about $60,000 for the fine fur crop exclusive of beaver, marten and white fox, that are not now produced in any numbers on the Delta.

Thus under existing circumstances the staple fine furs of the Delta are probably contributing about one-fifth of the value of the fur harvest. Success with the beaver conservation program would certainly increase this figure to one-quarter, possibly to one-third. It is important, therefore, not to lose sight of the overall picture and to neglect the fox, mink and beaver by concentration upon muskrat.

Table 1

Fur Returns, Aklavik and Fort McPherson

1930-1946.

Year	Fox	Mink	Muskrat	Lynx
1930-31	395	581	92,963	193
1931-32	957	1,745	132,616	257
1932-33	905	3,928	142,577	394
1933-34	1,145	4,381	60,680	249
1934-35	1,125	1,016	37,839	115
1935-36	716	224	41,208	29
1936-37	1,345	146	48,521	186
1937-38	1,244	70	105,680	33
1938-39	1,602	165	155,146	11
1939-40	1,149	734	198,419	19
1940-41	1,829	1,101	232,919	34
1941-42	2,541	1,716	208,062	23
1942-43	1,739	935	287,804	58
1943-44	2,367	492	152,073	70
1944-45	621	744	202,379	113
1945-46	1,018	1,734	285,969	313
	20,698	19,649	2,384,835	2,097
Mean	1,293	1,228	149,053	131

Table 1 also reveals that all four animals have undergone violent fluctuations in numbers during the sixteen years. The lynx had a peak in 1932-33 followed by a depression in 1938-39 and a steady rise to a new high in 1945-46. Indications in the field were that this animal is still increasing its numbers. The records cover so short a period that they offer insecure ground for interpretation, however, the indications are that present intensity of trapping may have had a retarding effect upon the increase, but has not been sufficient to break the cycle.

The data for coloured fox do not show a cyclic type of fluctuation, rather the population behaviour has been irregular. The sharp decline in 1944-45 is highly significant. Almost every trapper consulted told of the epidemic disease that swept through the coloured fox population that year and left dead animals strewn about the country. Virtually every trapper, had seen one or more dead animals and some had even watched foxes die in the wild.

The symptoms described suggest an encephalitis. Afflicted animals indulged in erratic movements, bounding into the air or somersaulting, seemed to lose their vision and frequently collided with bushes and other objects. It was quite usual to find a fox dead up against a willow thicket through which it had been trying to blunder in an erratic fashion when it collapsed. Three men reported seeing attacks by foxes on men and dogs.

Foxes are still dying in small numbers from what may be the same disease but fox sign was abundant in the summer of 1947 throughout the timbered parts of the Delta and the indications are that the numbers are increasing again.

Much of the same can be said of mink as of fox. There is no indication of a ten-year cycle nor indeed of any regular cyclic phase in the available data. There was a peak in 1932-34, a low peak in 1941-42 and another in 1945-46. A marked depression culminated in 1937-38.

Catch statistics for the Delta reveal a peak in the muskrat harvest in the years 1931-33 followed by a depression from 1934 through 1937; since 1935, however, there has been an almost steady increase in the number of muskrats taken until 1942-43 and again in 1945-46 over two hundred and eighty thousand pelts were marketed.

It is impossible to assess the possible influence of general world economic conditions on the fur harvested and the trapping pressure on the Mackenzie Delta and we can but assume the catch records to be a reasonable indication of the state of the animal population.

In 1946, a freeze-out is reported to have seriously reduced the number of muskrats. It would have been expected to show up in the catch records of that year, but did not and the 1946-47 records have not yet been made available. However, whether from freezing, disease or overtrapping, the population of muskrats has recently taken a sharp decline.

This decline, coupled with the sudden drop in the value of muskrat pelts, from a high of nearly $3.00 to a 1946-47 price of about $1.00, have produced much hardship among the natives. Many of them had gone so heavily into debt on the strength of several good harvests that they were this year unable to settle their debts and found themselves without funds to purchase the bare necessities of life. At the same time the fishing season of 1947 was poor and finally the caribou avoided the Delta during their autumn movement. The result has been widespread hardship, particularly among the Indian part of the population that lives in a land of much lower food potential than does the Eskimo.

The population of breeding muskrats in 1947 was not large in comparison with other areas the writer has studied. On the other hand conditions may normally be different from those in more southerly areas and the general situation is thus rendered difficult to assess. There was apparently a good crop of young in 1947 and given satisfactory winter conditions and a reasonably early break-up the 1948 harvest should be better than that of 1947. There has also been some recovery in the price of muskrat pelts and this too should contribute to the betterment of the trappers' lot in 1948.

It is difficult to assess the overall picture as regards fur animal conservation on the Mackenzie Delta. The muskrat take during the recent peak years has been twice that of the highest take during the 1932-33 peak. This may reflect a greatly increased density in the population, on the other hand it may be in part at least the result of a wider distribution and greater intensity of effort as a result of an increase in the number of trappers.

Muskrats are known to suffer heavy natural losses where under-trapping and over-population exist. Thus heavy trapping, is, up to a point, beneficial in increasing the long-time harvest of muskrats from an area and this factor too may have contributed to the heavy crop. However in general it is the writer's opinion that the catch statistics available show signs of overtrapping of mink, and lynx, but no certain indications of over-use of the muskrat.

On the other hand, there has been a steady influx of trappers into the Delta area where the rich fur harvest could be taken so easily and in so short a time. Few of the trappers have made much real effort to secure fine fur, but merely put out a few traps in a desultory sort of way and awaited the opening of the muskrat season in early March. With the opening of this season, trapping began in earnest. Skill is required, and effort demanded of the successful muskrat trapper, but the returns are good and the high men have made as much as $3000 in a season on this phase of the work alone.

The break-up of ice and the onset of the spring floods in late May introduced the shooting season. It has been the custom on the Delta to, at this time, forsake the winter trapping areas and to roam at large in small canoes shooting rats wherever opportunity offered. It was not unusual for a man to take 200 muskrats in a day, and two or three thousand for a family take during the two or three weeks of shooting has occurred on several occasions.

The majority of pelts taken during the shooting season have sold at a price 25% below those taken by trapping earlier in the winter.

The increasing population of trappers, the present intensive use, and the unsatisfactory condition of the beaver population all point to the need of introducing a system of trapping administration that puts the individual trapping area or trapline under closer control and places the onus of, and incentive for, practical conservation upon the individual trapper, at the same time protecting him from periodically losing portions of his line or area to new arrivals or more aggressive neighbors.

It is the considered opinion of the writer that the most effective way of promoting the conservation of the fur resources of the Mackenzie Delta would be to institute a system of registered traplines.

Acting on instructions to explore the possibility of instituting such a system, Forest and Wildlife Officer Lee Post of Aklavik has made notable progress with the trappers. As a result of his efforts it will be possible to undertake a preliminary registration with a minimum of conflict and disturbance.

During the course of this summer interviews were held with most of the trappers in the Delta, native and white. As a result of these interviews Mr. Post has a map upon which are outlined

the trapping areas claimed by each man. An admirable degree of co-operation was shown on the part of many trappers when it came to finding areas for younger men of the native community and for older men who, for one reason or another, had no established claim to an area.

There are difficulties in the way of designing a successful registration policy. Some of these will only be solved over a period of several years; for this reason it is deemed advisable to make the initial registration a tentative one.

One of the most important difficulties is that the Delta is overcrowded with trappers and in consequence some of the trapping areas are going to be too small to provide an adequate income during the times of depressed fur prices.

A random selection of fifty of the presently claimed areas was made and the area of each determined. They ranged in size from 84 square miles to 5.4 square miles with a mean of 23.2 square miles. Table 11 gives the details of the fifty areas included in this random sample. They have been segregated as to race of the trapper and the average size of trapping area computed for each racial group.

Fourteen white trappers in the sample have areas averaging 23.79 square miles; nineteen Eskimos have areas averaging 24.35 square miles in extent, and the trapping areas of sixteen Indians average 21.3 square miles.

It is believed that a number of the areas claimed by the native trappers are too small to support the men and their families during periods of poor trapping or low fur prices. The time to experiment with size and productivity of individual areas and to attempt adjustments is when animal populations and fur prices are high, and it is the writer's opinion that no time should be lost. Of course area alone cannot be taken as the basis for deciding upon the size of trapping area necessary to provide a family with a living. Areas vary greatly in productivity. For example, two of the most productive trapping areas in the upper Delta are comparatively small, being only 21 and 12.6 square miles in extent. In general the overall productivity per unit area decreases toward the coast.

However there is at present no basis for determining the existing or potential productivity of individual trapping areas. Only experience and further investigation will provide the answers.

Trapline Records - Fifty Lines Selected
at Random from all Parts of the Delta

Area No.	Race	Name	Area Sq. Mis.	Location	Remarks
34	White	Hans Hansen	31.5	(135° 68°45'	
17	White	E. Lacombe	14.4	(134°22' 68°00'	
163	White	F. Carmichael	23.4	(135°10' 68°5'	
111	White	H. Harrison	21.	(135° 68°	2 half-breed spinster daughters trap also
33	White	G. Kane	12.6	(135°30' 68°20'	
36	White	B. Boxer	12.6	(135° 68°15'	
29	White	Geo. White	12.6		
84	White	D. McLeod	36.0	(134°30' 68°15'	3 sons, 2 other trappers also.
	White	A. Norris	84.6	(134°10' 68°	
42	White	J. Peffer	9.9	(134°45' 68°15'	
25	White	N. Hoadim	25.2	(135°30' 68°30'	
85	White	W. Jamieson	16.2	(135° 68°20'	
21	White	Knud Lang	12.6	(135° 68°	
112	White	C. Betz	19.8	(135° 67°45'	
	AVERAGE AREA		23.79		
82	Eskimo	Big Jim	23.4	(134°40' 68°30'	
95	Eskimo	B. Wingakick	11.7	(134°30' 68°30'	
194	Eskimo	Hibert Allan	27.9	(135° 68°45'	
45	Eskimo	Isaac Simon	16.2	(134°30' 68°30'	
49a	Eskimo	Josie Timniak	29.7	(135° 68 30'	
105	Eskimo	Owen Allen	12.6	(134°30' 68°30'	
73A	Eskimo	Colin Harry	28.8	(135°30' 68°30'	
170	Eskimo	Dan Sidney	12.6	(135°30' 68°	
78	Eskimo	Ed. Dick	16.2	(135° 68°15'	

Area No.	Race	Name	Area Sq. mis.	Location	Remarks
103A &B	Eskimo	Peter and Fred Laughing Joe	14.4	134°15' 68°30'	
94	Eskimo	Charlie Smith	29.7	134° 68°30'	
79	Eskimo	Archie Ugakloak	42.3	135°30' 68°30'	
100	Eskimo	Lucas Mumatana	27.0	134°30' 69°	
55	Eskimo	Foster Allen	10.8	134°45' 68°30'	
6	Eskimo	John Kevak	21.6	Reindeer Station	
107	Eskimo	Elijah H. Kotuk	40.6	135° 68°45'	
59	Eskimo	Laughing Neepok	32.4	135° 68°30'	
99	Eskimo	Bob Cockney & 3 sons	36.0	Reindeer Station	
89	Eskimo	Garret	28.8	134° 68°15'	
	AVERAGE AREA		24.35		
43	Indian	Albert and Tom Ross	55.8	134°15' 68°15'	
32	Indian	L. Sittichinli	21.6	Husky and Aklavik	
63	½ Indian	Tom Philips	11.7	134°40' 68°	
101	½ Indian	Joe Adams	18.0	134° 68°15'	
51	Indian	J. J. Stewart	56.7	134°30' 68°	3 other licensed trappers
113	Indian	Victor Stewart	12.6	135°30' 68°	
158	Indian	Jerome Bernard	18.9	134°30' 68°	Fine fur line elsewhere
153	Indian	Charlie Stewart	9.9	135° 68°	
2	½ Indian	Jim Firth	36.0	134°40' 68°10'	4 others to share, 2 part time only
67	Indian	Moise Mitchell	32.4	134° 68°25'	
62	Indian	J. E. Sittichinli	5.4	Aklavik	Full time mission work
	Indian	Andrew Stewart	20.7	134°30' 68°15'	
11	½ Indian	Noel Firth	5.4	Aklavik and part of #2	
104	Indian	L. Greenland	7.2	135° 68°	Fine fur line on Peel Channel
15	Indian	Joe Gully	14.4	134° 68°30'	
		School Area	9.0	Aklavik	
	AVERAGE AREA		21.3		

Another troublesome factor is to be found in the natural increase of the Eskimo population of the Delta. Vital statistics examined revealed an excess of births over deaths for the past four years at least. With better sanitary conditions and increased facilities for the control of tuberculosis the rate of population increase may well be raised.

It should be understood that despite the natural human desire of the trapping population to share in the easy harvest of the Delta, there is not now, nor is there any likelihood in the foreseeable future, of there being room for more than the present two hundred and twenty-seven trappers. It would be most desirable indeed if that number could be reduced to not more than two hundred. The necessity will arise, therefore, of finding additional trapping areas for the Eskimo population.

The combined Indian populations of Fort Good Hope, Arctic Red River, Fort MacPherson and Aklavik have shown a steady decline during recent years. There is thus little likelihood of increased demand for Indian trapping areas due to natural increase. Registration of areas will tend to curb population increase by migration.

The Muskrat of the Mackenzie Delta.

It should be understood that the study of the biology of the muskrat is still in its very early phase and that many of the most pertinent facts concerning the life history and limiting factors of the muskrat in this Arctic environment are merely suggested by the data already assembled or have not as yet been the subject of study.

Despite the inconclusive nature of the present information, it is often most valuable to take stock of the status quo and thus to throw into relief the major needs of further studies.

It is for this reason that the information here presented has been assembled.

The muskrat of the Mackenzie River Delta is Ondatra zibethica spatulata, a race with a very wide range extending from the Arctic coast south into northern British Columbia and from the eastern limits of the Mackenzie drainage basin west to the mouth of the Yukon River. It is a pallid race of muskrat in comparison with the population of central and southern British Columbia, O.z. osoyoosensis. The fur is dense and of fine texture though somewhat shorter than that of the more southerly race.

Size--Weight:-

The selected group of 22 adult muskrats taken for examination between June and mid-August 1947 consisted of 13 females and 9 males. The proportion of the sexes is not significant as we found it possible to distinguish sex, in many instances, under field conditions and took females in preference to males.

In both sex groups the weights seem to fall into two classes. In the series of females five individuals weighed between 780 and 853 grams whereas the other eight ranged from 1000 to 1133 grams. Similarly among the nine males there were three between 799 and 967 grams and the remaining six from 1010 to 1582. On the basis of this data, then, it seems probable that the two age groups represented in the early summer population are separable on a basis of gross weight. The lighter group we assume to be yearling animals, the heavier group those of more than one year in age.

The information obtained so far suggests that yearling females weigh less than 900 grams, yearling males less than 1000 grams whereas animals two years old or older weigh in excess of 1000 grams in each sex.

The mean weight of the eight females judged to be two years old or older was 1070 grams, that of males of the same age 1189 grams, of yearling females 832 grams and of yearling males 894 grams. It will thus be seen that the sexes differ in weight, with males heavier on the average than females of similar age.

Size--Measurements:-

The measurements of the females judged to be over two years of age were: total length 540 mm. (487-556); tail 242 mm. (218-270); hind foot 75 mm. (74-78). Yearling females measured total length 512 mm. (500-526); tail 226 mm. (214-240); hind foot 72 mm. (71-74). Males two years old and older, total length 559 mm. (525-640); tail 235 mm. (205-252); hind foot 75 mm. (72-76) Yearling males total length 513 mm. (493-530); tail 231 mm. (207-245); hind foot 74 mm. (73-75).

These measurements are not as consistent as the weights and are more variable and consequently less reliable. In general males appear to have a greater body length and shorter tail but have hind feet of the same length as the females. The inadequate series of yearlings examined so far shows no size differences attributable to sex.

Another secondary sex character noted was the greater height and circumference of the tails of males.

Environment:-

The muskrat of the Mackenzie Delta has its centre of abundance in the sub-Arctic part of the Delta and was, in 1947, much less abundant in the tundra regions. It was present on Richards Island to its northermost extremity, where two skulls were picked up in the burrow of an Arctic fox. Signs of its former presence on the tundra plateau surmounting the Caribou Hills were scarce, but burrow systems, occupied not more than two seasons previously, were examined. We saw no occupied burrows in the tundra lakes this year but were not able to examine the tundra regions usually most productive.

As has already been stated the lakes of the Delta vary from small ponds to lakes three miles or more in length. They are also variable as to water depth, shoreline contour, seasonal rise and fall and exposure to wind action, all of them factors influencing the muskrat population.

Depth of water and bottom contour are probably the most important features from the standpoint of the muskrat population.

Several people had measured ice thickness under different snow conditions and were in agreement that with normal snowfalls and eighteen to twenty-four inches of snow on the ground, the lakes froze to a depth of from four to five feet. However, on years when snowfall was light, as for instance in the winter of 1945-46, ice formed to a depth of seven feet or more.

The lakes of the Delta are shallow. Of ten lakes sounded, the deepest was fourteen feet and the majority had a maximum depth of ten to twelve feet.

If a lake has a gently sloping bottom and only a small area of deep water it will be understood that the area available to muskrats during the winter months will be quite restricted and that the addition of another foot or two of ice depth will seriously interfere with the carrying capacity of the environment. This matter will be discussed in a later section of this report.

We found no muskrats denning in the banks of the river channels, and few with dens in the banks of streams effluent from lakes. In general the muskrat population of the Delta breeds and winters on the lakes. This is probably due in large part to the scarcity of aquatic vegetation in and along the river channels.

The lakes were separable into two types. Those with gently shelving shores supported a dense marginal growth of emergent vegetation dominated by Equisetum or by Carex aquatilis, over large areas, and by Arctophila fulva over other large areas. In water more than

a foot in depth the pondweeds, primarily Potomageton richardsonii and Potomageton sp. became dominant and the former, in company with Myriophyllum exalbescens extended into water ten or more feet in depth.

These lakes supported the heaviest breeding populations of muskrats encountered by us. However, as a product of their shallowness and gentle slope, these lakes certainly suffer the greatest contraction in available winter habitat. Certain highly productive lakes of this type examined by us had virtually no areas that would not freeze to the bottom in a normal winter. It follows that many of these highly productive lakes are untenable in the winter and their muskrat population must move before the freeze-up or perish long before the legal trapping season. We are informed that many of the tundra lakes suffered from the same adverse depth conditions and usually lost their muskrat populations early in the winter.

The other type of lake is steep-sided with banks four or five feet in height above high water level around much of their circumference and plunging almost vertically to a depth of three or four feet below low water level. The majority of lakes of this type flooded to a limited extent, or not at all, with river water. Such lakes usually had some shoreline of a sloping or marshy nature and this was usually dominated by the sedge Carex aquatilis. Equisetum was a rarity as it appeared to prefer lakes subject to annual flooding with its attendant silt deposition.

The bottoms of the steep-sided lakes were heavily vegetated with pondweeds (Potomageton richardsonii, P. gramineus and Potomageton sp.) as well as with Myriophyllum and other plants in lesser abundance.

Many of these lakes supported an abundant muskrat population along the sheltered sides but a very sparse population where wind action was constant.

Burrows:-

We saw no muskrat houses although we were told of certain tundra areas in the lower Delta where the muskrats built houses for summer use.

All the muskrats studied by us were inhabiting burrows excavated into the banks of the lakes and ponds. In steep-sided lakes subjected to a great seasonal rise and fall in the water level the burrows sometimes had several entrances at different levels. Characteristically only submerged entrances were in use at any time and

entrances exposed by falling water levels were plugged with mud and food debris.

In the shallow lakes and marshy areas the burrows often passed many feet, at a depth of two inches to a foot beneath the soil surface, before reaching the elevated part of the bank where the nest chamber was located.

Three burrow systems were excavated to the nest and this was in each case situated well above water level and in two instances was beneath the roots of a clump of willows.

Upon our arrival in the Delta on June 7, 1947, the river was in spate, about eight feet above its late August level, and had backed up into many of the lakes. From the air the flooded lakes were distinguishable from those that had not received river water because the former were largely ice-free while the others were still ice-bound. Later, after the ice was gone from all lakes, those subject to flooding were still easily distinguishable by their colour. Even the lakes not filled with river water were brimful as a result of the surface drainage.

The result upon the muskrat population of the flood accompanying the spring break-up was to render the animals homeless. The "pushups", shelters or houses built upon the ice during the winter, had collapsed into shapeless masses of soggy vegetation. The bank burrows were largely untenable through flooding.

The muskrats were seen at large in the lakes and channels at all hours of the day. Many built shallow nests of sedges in among the branches and stem bases of the partly submerged willows, others constructed makeshift nests on floating logs or piles of debris.

This was the time of the spring shoot. The time when all trappers got out their small ratting canoes, and, armed with .22 rifles, roamed at large over the Delta shooting as many rats as they were able. Daylight is constant and in consequence the muskrats have no period of the day during which they are free from molestation. It was also the height of the mating period, with the muskrats more active than at any other period of the summer.

Population Studies:-

It was deemed most important to develop criteria for determining population level also to determine longevity, population turnover (i.e. rate of replacement or mortality) and mobility of adult and of young rats.

burrow and covered with vegetation or sods. This technique proved most successful and with it as many as thirty-two rats were taken in a single evening's operations with the twenty-four traps.

The hours between 7:00 p.m. and midnight or 1:00 a.m. were found to be the most productive ones for trapping and we made successive rounds of the traps by canoe during that period. At the end of it steel traps were lifted but live traps left set.

A new hazard arose when the young rats appeared. Three of them after entering the traps dug mud through the floor and sides until their fur became matted and sodden and death from exposure ensued. This was prevented by setting the trap on a pad of vegetation and surrounding it, top and sides, with more vegetation.

Rats were handled with the use of an Aldous cone. One or two minor modifications were made that contributed to the efficiency of the cone. The base board was made about six inches longer than the netting at the broad end. The longer platform thus formed made it easier to get the rats into the cone. Instead of a plunger stick we passed a short stout stick through the netting from the side over the heels and beneath the tail of the animal, this did away with the necessity of holding or tying the plunger into position and left the operator with both hands free for examining and tagging the animal.

Tagging was done without trimming the hair from the ear and the only precaution found necessary was to insure that the ear tag was properly clinched and yet not so tightly closed as to cause undue pressure on the ear.

Tagging operations were carried on at Area 1 (Boxer's) from June 12 to 18 and July 21 and 22; at Area 2 (Reindeer Depot) between July 12 and 15; and on Area 3 (Lang's) between August 5 and 14. During this time ear tags were applied to one hundred and thirteen animals and tail tags to twenty-six of these. Subsequent field work in these three areas by Stevens alone has brought the number of tagged animals up to three hundred and one.

In prospect the task of capturing animals for tagging after the freeze-up seemed to be fraught with difficulties, but Stevens has quickly and effectively devised methods for using the live traps for taking rats in the winter "pushups" without endangering the animals by exposure to freezing during or after the operation.

To determine density of breeding population lakes on each of the experimental areas were studied. On each the occupied burrows were marked on a map and on Area 3 extensive live trapping was undertaken to determine litter size and to investigate the possibility of one family using several adjacent burrows.

Area 1. Boxer's

Number four lake, steep-sided for much of its circumference of an estimated 2,000 yards had three occupied burrows on July 20. Number three lake that in June had been heavily populated with rats had, on July 21, become three shallow ponds joined by flooded meadows of Arctophila fulva and willows. The northernmost pond had two, possibly three, occupied dens, the middle one three and the southernmost two. These two lakes (three and four) with a total shoreline of about six thousand yards and a total area of approximately one hundred acres had ten or eleven occupied burrows, on July 21.

Area 2. Reindeer Depot

Three interconnected lakes were studied for population. These had a combined shoreline of about sixty-five hundred yards and an approximate area of one hundred and thirty acres and had thirteen or fourteen burrows on July 13. These lakes were the shallow, marsh-bordered type with few high banks.

Area 3. Lang's

Two small muskeg lakes southwest of the cabins with a shoreline of about nine hundred yards and an area of about twenty acres had four occupied burrows.

A shallow lake bordered with Carex and Equisetum known to us as Grassy Lake had a perimeter of about sixteen hundred and fifty yards and an area of about twenty-eight acres, had seven occupied burrows and two others on closely adjacent sloughs.

Food:-

The plants used by the muskrat as food were remarkably few in number.

Equisetum fluviatile was the most important food plant and where it was available was eaten almost to the exclusion of other species. By the first week of June the new sprouts of this plant

were two to four inches in length and the rats travelled as far as four hundred yards from their burrows to the development beds where they dived to cut off the stems.

During the period that the young were being fed in the burrows, large quantities of Equisetum were cut and taken into the burrows, many of which became clogged with the discarded and uneaten portions. At this time certain small areas of the marsh were denuded of their Equisetum stands.

Carex aquatilis was the food plant of second importance during the summer months. It had a broader ecological tolerance than Equisetum, was highly palatable, made green growth early in the summer, and for these reasons was a most important food plant. Considerable quantities of this sedge were taken to the burrows during the weaning period. The rhizomes and stem bases were the favoured parts.

In the lakes with little or no emergent vegetation the pondweeds Potomageton richardsonii, P. vaginatus, P. gramineus and P. species were the food plants used most extensively by the muskrats during the summer months. As the ice melted in early June large quantities of thick fleshy winter buds of Potomageton richardsonii, two or three inches in length, were torn from the bottom and floated to the lakeshores in winrows. These buds were eaten by the muskrats second only to Equisetum tips.

Myriophyllum exalbescens, a codominant with the pondweeds P. richardsonii and P. species on many lake bottoms was eaten in small amounts during the summer, but to judge from the remains of "push-ups" examined, it is an important winter food plant.

Other plants eaten in smaller quantities during the summer months were Hippuris vulgaris, Menyanthes trifolium, Utricularia sp., Arctophila rufa and Lemna trisulca. Porsild (1945: 17) lists Calla palustris among the winter foods of muskrat but we saw no evidence of its use during the summer.

Reproduction:-

The reproductive season was well advanced when our field studies began and first matings had already taken place. Rats were often seen in pairs swimming together or sleeping side by side on the emergency nests built by them during the high water period.

The data on reproduction derived from the examination of thirteen females examined between June 12 and August 14, 1947, are given on Table III.

The first five animals listed were judged to be yearlings, the remainder two years old or older.

It will be apparent that considering all pregnancies as represented by foetuses in utero, or by placental scars, the mean number of young developing was 7.0. This was also the mode. In two instances resorption of embryos was certainly in progress, in a third instance resorptions had apparently taken place. Taking cognizance of these instances the mean number of implanted blastulas was 7.4. The largest litter encountered was thirteen--as represented by placental scars. Three of these apparently had been resorbed and there is a possibility that this number represented two litters. The next largest litter was ten, with one resorbing, so that the largest known effective litter as represented by foetuses in utero or by placental scars was ten, the smallest five.

In nine instances we trapped and marked what we believed to be the entire family of muskrats inhabiting a den. On the basis of these figures the mean litter size at age of independence was five, with a range of from two to nine. The number of instances is too small to be significant but the data derived suggest that there is an average loss of two young per litter between advanced pregnancy and weaning.

Our information to date concerning the number of litters per annum is conflicting. On the basis of examination of female rats the female, both yearlings and older, conceive their first litters for the season in early June. We had reports that in some seasons pregnant females were taken as early as the third week of May. The gestation period is stated to be twenty-seven days (Asdell, 1946) or nineteen to thirty-two days (Errington, 1937).

Trapping was suspended during the latter part of May and early July and thus dates of first births were not ascertained. Females that had not yet given birth were taken on June 16th and June 18th. However an animal taken on July 11 had given birth but was no longer lactating. Others taken on July 13 and July 22 at Reindeer Depot were pregnant for the second time and no longer lactating. The nursing period for muskrats in Iowa is said to be between three and four weeks (Errington, 1939), with mating taking place shortly after parturition and the second litters following the first in from nineteen to thirty-seven days.

Of eight females examined between July 16 and August 14, three were pregnant for the second time, one had a possible very early second pregnancy, although corpora lutea were not as large as they should have been, the other four all taken in August on Area 3 gave evidence of one litter only in 1947.

Table III

Data on reproduction gained in the examination of thirteen female muskrats.

Number	Date	Right Horn	Left Horn	Total	Crown rump Length	Corpora Lutea		Placental Scars	Remarks
						Rt. Ovary	Left Ovary		
2879	June 12	0	0	0					
2883	" 13	5	5	10	9.5-10.5	5	5		1 resorbing
47-7-11	July 11							6	not lactating
2974	" 13	3	3	6				7	
2990	" 22	6	0	6				6	
2900	June 16	6	2	8	10.0	6	2		
2901	" 16	5	3	8					2 resorbing
2908	" 18	4	3	7	21.0	4	3		
2988	July 21			7?				6	
3025	Aug. 6							7 or 8	
47-8-7.1	" 7							7	
47-8-7.2	" 7							7	
3037	" 14							13	3 probably resorptions

On Area 2, where we found slight evidence of second litters, subsequent trapping revealed young of two size classes. Compilation of the figures for number of young in each of the classes should serve as an indication of the relative number of second litters in 1947.

By August 8 the testes and seminal vesicles of male muskrats were showing regressive changes. A further sign of the waning of the reproductive period was that at this time the animals began to show a reduced response to calling.

If, for the purpose of discussion, it is assumed that the growth rate of young muskrats in the Mackenzie Delta approximates that in Iowa (Errington, 1939) it is possible to use the measurements of young animals obtained by us as an indication of the timing of certain events in the breeding cycle.

In Area 3 several young were measured on dates between August 7 and August 11. One litter of three young not yet weaned measured 234 mm., 250 mm., and 257 mm., and were almost certainly about twenty-one days old-- they then were the product of a mating on June 21 and had been born about July 21. On this basis they may have been young of a second litter, for a mating on May 24 or thereabout could have produced young before the present litter was conceived. However, there did not seem to be any young living apart from adult animals on this lake, and there were certainly no older young in the same burrow system.

In several dens the young ranged in size from 335 mm. to 345 mm. and were about forty-eight days old. These consequently had been born about June 24 and were the result of a mating about May 28.

Members of one litter of young on the lake measured 390 mm. and were probably fifty-four days old. On this basis they had been born on June 18 and the mating must have taken place about May 16.

These young were occupying a burrow system along with a pair of adult animals and at the time there was no indication of a second litter in the same burrow. It is just possible, however, that the second litter could have been present but only some seventeen days old and not yet moving about.

On the basis of size classes of young in early August it would appear that early matings took place about mid-May but that the height of the breeding season was in the last week of May and the majority of first litters born in the third and fourth weeks of June.

Pair formation:-

One of the most surprising results of the trapping conducted by us this summer was the very strong indication of monogamy that is present in the data. When we began the field study in early June it was noted that wherever we observed and trapped rats, in or adjacent to an occupied burrow, two rats of opposite sexes were obtained. At the time it was supposed that the male rats probably had more than one mate and that the females occupied separate burrow systems that the males visited from time to time.

Later, during the live-trapping of family groups on Area 3 in August, the existence of a truly monogamous mating became a strong probability. The results of this trapping are set forth below.

Table IV

Den	Location	Ad.M	Ad.F.	Yrg.M.	Yrg. F.	Remarks
1	Lang's cabin ponds	1	1			
2	" "		1			A male taken 50 yards away
3	" "	1	1			
4	Creek Lake	1	1	2	3	
5	West Lake	1	1	3	6	
6	" "		1			This rat apparently had no young
7	Grassy Lake	1	1		2	
8	" "	1	1		4	
9	" "	1	2		4	
10	" "	1	1		2	
11	" "	1	1	1	2	
12	" "	1	1	3	3	
13	" "	1	1	5	1	

It will be noted that from these thirteen dens that were trapped long enough to assure capture of all animals occupying them, in only two dens were females alone captured. In respect of den 2 a male was captured, and accidentally drowned, near the den before traps were set at the den and the female taken there. It seemed most probable that the male was the mate of the female in den 2. The lone female in den 6 apparently had no young with her and may well have been an unmated animal. Den 9 was the only one trapped by us that yielded more than a single adult pair and its young. Two females were taken in that burrow but there was apparently only one litter of young in it.

Further evidence of monogamy arises from the failure to capture marked males in the burrows of females other than the one with which they were associated when marked.

If monogamy proves to be the rule in the Mackenzie Delta, and if the sex ratio at birth is found to be approximately 1:1, it will be most pertinent to conduct an experimental removal of males from certain lakes, after the breeding season has begun, for the purpose of determining whether or not a reduction in the ratio of males to females results in polygamy or in a reduction in the number of family dens, and a reduced productivity.

Destructive Factors:-

The study is still at too early a stage to permit the formation of reliable conclusions with regard to the nature and relative importance of the various destructive influences. In general it can be said that they fall into four major categories; climate, man, predators, diseases and parasites.

Reports of several men closely concerned with trapping and the fur industry on the Mackenzie Delta suggest that climate may be the most important single factor. As has been mentioned earlier a cold winter with little snow produces ice as much as seven feet in depth and results in a freeze-out on many lakes that would otherwise carry a muskrat population through the winter. At the same time it confines the population on deeper lakes to a much smaller area. This crowding, aside from putting a heavy drain on available food supply, elsewhere results in intense intraspecific strife with consequent losses. John MacDonald, a trapper on the Delta area above Aklavik, told me that in the late winter of 1945-46, a year of great ice depth, he opened many pushups that contained rats either dead or near death. This was confirmed by the reported experience of several other trappers.

This question is one requiring much further investigation. For although climate cannot be altered, water levels can often be

raised and freeze-outs prevented in this way.

Parasites:- The external parasites of the Delta muskrats consisted of two species of mites and one species of flea. One of the mites (Lelaps multispinosus) was so abundant on occasional animals as to impart a "powdered" appearance to the pelage. There were no harmful results attributable to the external parasites.

The viscera of nineteen animals were saved and later examined for internal parasites by Miss Iola Musfeldt.

Six different helminth parasites were recovered from the digestive tracts. These were four trematodes: Plagiorchis proximus, Echinoparyphium contiguum, Notocotylus urbanensis and Quinqueserialis quinqueserialis; one cestode Hymenolepis evaginata and a nematode, Capillaria ransomia.

The numbers and distribution of these helminths in the various parts of the digestive tract are shown on Table V.

It is significant to note that these species are the same as those parasitizing the muskrat in central and southern British Columbia. This applies even to the presence of aberrant forms in Plagiorchis and Hymenolepis in both regions.

Parasitism of the sort found appears to be normal as no pathological changes were detected in the infected animals.

Banfield (1946) mentioned the presence of a cestode coenurus in the livers of some muskrats examined by him. We encountered the same parasites in three of twenty-two livers examined--the largest number of cysts in one animal was seven.

Trappers informed us that in some winters the incidence of this parasite was very high. We found also a general impression that muskrats not infrequently succumbed to the infection. However no evidence was adduced as to the effect of the parasite upon its host.

This coenurus is of a species of tapeworm of the genus Gladotaenia and is not identifiable to species in the absence of the adult stage. It has been suggested that the mink or some other carnivorous mammal serves as the terminal host for the parasites. Such may be the case but to the best of my knowledge all described species of Cladotaenia in the adult stage have occurred in hawks. It would be worthwhile to examine the viscera of certain of the

Table V

Helminth Parasites of Muskrat

Region of Intestinal Tract	Parasite	No. of Carcasses Infected	No. of Parasites Total	No. of Parasites Av.Inf.	Per Cent Infection
Stomach	Cestoda Hymerolepis evaginata	1	1	-	5.26
Upper small Intestine	Trematoda Plagiorchis proximus	12	676	56.3	63.16
	Echinoparyphium contiguum	1	1	-	5.26
	Cestoda Hymenolepis evaginata	13	122	9.4	68.42
	Nematoda Capillaria ransomia	5	23	4.6	26.32
Lower Small Intestine	Trematoda Notocotylus urbanensis	1	1	-	5.26
	Plagiorchis proximus	3	7	2.3	15.79
	Cestoda Hymenolepis evaginata	5	70	14.0	26.32
	Nematoda Capillaria ransomia	1	1	-	5.26
Cecum	Trematoda Quinqueserialis quinqueserialis	19	5754	202.8	100.00
	Nematoda Capillaria ransomia	1	1	-	5.26
Colon	Trematoda Notocotylus urbanensis	9	199	22.1	47.37
	Nematoda Capillaria ransomia	1	1	-	5.26

hawks of the Delta region, particularly the rough-legs, red tail and bald eagle for the presence of the adult worms. However, it seems that the parasite is so widespread in the muskrat population that some terminal host more abundant than these must be involved. Horned owls, and snowy owls, suggest themselves as possibilities. It seems worthwhile also to examine the records to see if there is any correlation between the years of abundance of horned and snowy owls and the years of high infection of muskrats with Cladotaenia cysts.

An attempt was made to send out living cysticerci by air in nutrient solution. These were to have been fed to mink in an attempt to establish the host, however, they died in transit and the experiment could not be made.

Predators:- No evidence was seen that the predatory animals and raptorial birds were taking an important part in muskrat predation. However predation may be more serious or more noticeable during the winter months and it is too early to advance any conclusions.

Examination of six red fox scats revealed the remains of muskrats in three.

There is a local conviction among the inhabitants of the Mackenzie Delta that mink destroy so many muskrats that they fall almost into the vermin class. Certainly few men desire to increase the mink population.

Mink were encountered twice only. On June 25, forty miles northwest of Aklavik the den of a female mink was discovered. The ground around the burrow entrance was littered with droppings and these were saved for study. The results are given on Table VI.

The den from which these scats were taken was situated on the edge of a shallow tundra lake in the midst of one of the only areas seen by us in which varying hares had been in "plague" proportions during the previous winter. Muskrats were not present on this lake.

These circumstances should be taken into consideration when interpreting the data set forth on the table.

Table VI

Food of Mink as represented by 49 Scats from one den, 32 miles north of Aklavik, N.W.T.

Common Name	Technical Name	Number of Occurrences	Percentages of Occurrences
Varying hare	Lepus americanus	19	32
Meadow mouse	Microtus pennsylvanicus	16	27
Brown lemming	Lemmus trimuoronatus	9	15
Red-backed mouse	Clethrionomys dawsoni	7	12
Tundra mouse	Microtus operarius	3	5
Black lemming	Dicrostonyx groenlandicus	2	3
Unit microtine		2	3
Fish		1	2
Total		59	99

It will be noted that the varying hare is the most important single food item, followed by Microtus pennsylvanicus and Lemmus trimucronatus. In total the microtines contributed 65 per cent of the food eaten by this mink.

On August 13 an adult male mink entered one of our muskrat live traps set in a muskrat den. This den harboured a litter of very small rats but the stomach and intestine of this mink were empty.

Bears apparently prey upon muskrat in the Delta region. On July 10, 1947, at a lake near Reindeer Depot, a black bear dug out an occupied muskrat burrow but whether or not it captured the occupants was not apparent. A month later, on Peel Channel, thirty miles above Aklavik, a similar occurrence was noted.

Certain of the raptorial birds of the Delta are known to prey upon muskrat. The remains of a muskrat was among food debris below a bald eagle's nest near Reindeer Depot on July 14.

In the same vicinity a pair of horned owls was haunting the lakeshores and on two occasions one of the owls was seen carrying a muskrat.

There is a possibility that northern pike (Esox lucius) may prey upon young muskrats that are just beginning to forage away from the home burrow. Twenty-nine pike up to twenty-five inches in length were examined in the lakes near Reindeer Depot on July 10 to 25 but no muskrat kits had been taken by them. However this was prior to the time that we saw the first young muskrats and the negative result is probably of little significance. There was no opportunity of further netting of pike in late July and in August but the project is contemplated for 1948.

Possibilities of Management:-

The present situation seems to me to have two inherent weaknesses. The first of these is that many trappers, not being confined to one area for their harvest, enter into the harvest in a spirit of competition and with no thought for, or incentive toward, conservation. As a result, the harvest by shooting is limited largely by opportunity. It is considered to be imperative that a proprietary interest in conservation be established and that the registered trapping area offers the best opportunity for accomplishing this. Such a system, however, will require accompanying

educational effort to instil into the native trappers the realization that they must conserve or suffer the consequences. At the present time, many of them confront you with the statement that the Government will see that they are looked after whether they conserve their fur or not, and many will produce a printed circular in substantiation.

This attitude is highly destructive to the entire ideal of conservation.

The idea behind the relief program for indigent natives was an admirable one but its application will have to be made with care and with due reference to attendant circumstances if it is not to hamper the education of the natives away from exploitation of the fur resources with regard only for the day.

An Indian agent or other relief officer, unsympathetic toward the conservation program, or ill-informed concerning it, has it in his power to render the work of the Wildlife Service and its representatives most difficult and ineffective. This situation serves to emphasize the essential need of real co-operation at all levels between the several agencies concerned with the administration of the Delta region.

However, even under the most intelligent care the ultimate limits set upon the population of muskrats, and the size of the area inhabited by them, is probably governed largely by climate and consequently little subject to remedy except in such areas as may be suited to controlling the water level.

If it were possible to devise harvesting regulations that were flexible enough to permit the taking of muskrats prior to the freeze-out on lakes that characteristically freeze-out, even if that entailed fall trapping on these lakes, it should be possible to salvage some fur values from them.

However, decision on this point must await the findings of the winter research program. Before constructive decision will be possible, it will be necessary to understand more of the winter conditions on lakes of different depths and bottom conformation; whether any rats leave lakes that are about to freeze-out and find shelter in adjoining, deeper lakes without causing serious overcrowding there.

An experimental area might very profitably be set up somewhere near Aklavik where experiments in control of water level could be undertaken and the results, as reflected in the muskrat population, measured.

It is hoped that winter studies now in progress will shed some light on the possibility of establishing a conversion factor whereby the number of "pushups" can be used as an indication of population and consequently of advisable harvest.

The feasibility of eliminating altogether the shooting of muskrats will rest upon the results of studies designed to determine if there are lakes upon which harvest by traps only is impossible.

The elimination of shooting would have several advantages. It would produce pelts of a higher average value, would make administration of registered areas easier, and would spread the effort, and consequently the income, over a longer period.

In the overall plan the wildlife manager should be alert for under-harvesting as well as for the reverse condition. Both are equally destructive if continued over several years.

Beaver

Beaver on the Mackenzie Delta have been protected by a total closed season for ten years or more, and more recently (1940) the entire Delta region was set apart as a beaver sanctuary.

At one time beavers must have been widely distributed in the Delta for old cuttings were noted by us in localities from the east side to the west side at the level of Aklavik.

The legal protection has had little effect in improving the beaver stock on the Delta proper, but there are apparently many more beaver in the less travelled areas adjoining the Delta than there were at the time Porsild (1945) conducted his studies. There is now a small and scattered beaver population situated near the mountains on either side of the Delta.

Fred Cardinal, an Eskimo trapper with an area in the vicinity of 134° west and 68° north, reported to me that beaver were abundant on his trapline. In the same general region Adolphus Norris reported beaver upon his trapline.

In the vicinity of Reindeer Depot on July 10 we examined a colony occupying a bank lodge in a small lake about a mile north of the station. This was said to contain nine adult beavers together with the kits of 1947. The colony was established about

1943. On July 11 we found another colony on a lake some two miles up-river from the Reindeer Station.
Pat Hogan, Reindeer foreman, told us that his herders informed him of a beaver colony in the Holmes Creek, on the east branch north of the Depot and that one was seen in the early summer of 1947 at Kidliut Bay at the north end of Richards Island.
On the Peel Channel we saw sign ten or more years old on Bert Boxer's area and Ed Dick reported to us a lodge occupied in 1946 near the intersection of Peel River with 68 degrees north latitude.
Further down Peel Channel, about thirty-six to fifty miles northwest of Aklavik, we examined sites of three small colonies and saw one beaver.
Beavers, probably from these marginal colonies, occasionally wander far out into the Delta. One was seen in Schooner Channel, nine miles above Napoyak Channel, on July 2, 1947, and other scattered animals have been seen elsewhere during the last two or three years.
There is a widespread opinion that many beavers are shot for food and that this is the principle reason for the failure of the animals to spread more rapidly. This opinion seems to be based upon reasonably reliable evidence.
The colonies examined were feeding almost entirely upon willow and alder. More than one species of willow is involved but the only species identified as Salix planifolia. The alder is Alnus crispa.
Well preserved trees are dominant over wide areas of the Delta providing for an abundance of food. Water depths necessary for successful wintering constitutes another possible limiting factor. Depths immediately in front of the occupied bank lodges at Reindeer Station was nine feet. This colony had survived at least one winter of heavy ice and it can be considered that this water depth is satisfactory. These conditions of food and water are met in many parts of the Delta and there seems to be no biological reason why the area cannot be more ...annual harvest of beaver.
It should be stated, however, that the trees on the Delta are a small size and growth is relatively slow, consequently, the capacity of ...the area with respect to beaver will probably improve and allow in time...comes beaver harvesting will have to under understood with this in mind.

FURTHER STUDIES

Studies in progress or projected during the course of the present investigation of the ecology of the muskrat on the Mackenzie Delta will cover broadly the general biology of that animal. However special attention will be given to six major aspects.

1. Population Studies:-

The tagging program will be continued and retrapping of areas now bearing tagged animals undertaken. Arrangements have already been made for the muskrat harvest upon the study areas to be conducted either by Mr. Stevens or under his close direction to the end that the maximum amount of data upon survival and population movements may be derived from this operation.

Studies of the population dynamics during the winter months are of paramount importance. Several important phases of this matter will be given special study. Tolerable winter densities on lakes of different types; the details of winter population compression; levels and degree of intraspecific strife and the importance of this to the winter carrying capacity; the relationship of the number of "pushups" to the population; and the survival of the young through the first winter will be included among these.

2. Food:-

The major question to be answered is whether there is any habitat or season in which food supply serves as a limiting factor. Winter studies on shallow lakes and upon deep lakes with differing population densities will be undertaken in an effort to determine this.

The situation on tundra lakes may be particularly pertinent in this regard.

3. Reproduction:-

Research into the details of reproduction in the muskrat of the western Arctic will concern litter size, the relation of litter size and number of litters per year with age of mother, density of population and conditions of the environment. The existence of monogamy will be tested and, if possible, an experiment with reduction of the number of males in a breeding population undertaken.

4. Predation:-

The influence of mink, fox and owls on the muskrat population under different conditions of environment and of density will be made the subject of special observation. If conditions and time permit a survey of the mid-summer diet of northern pike on muskrat-inhabited lakes will be undertaken. An indication of the possible importance of pike as a muskrat predator may be had obliquely by means of a comparison of the survival of young on lakes containing pike, in comparison with that on pike-free lakes.

5. Parasites and Disease:-

No special search will be made for diseases of the muskrat unless circumstances encountered in the field suggest that such a disease exists and is occasioning important losses.

A careful account of the incidence of Cysticercosis Cladotaenia will be kept, and an attempt made to secure the adults of this cestode either from native carnivores, domestic dogs or raptorial birds.

6. Harvest:-

Certain facts essential to the understanding of the possibilities of manipulating the harvest for management purposes will be sought. Among these will be season of priming; opportunities for selective removal of one sex or the other; possibilities of trapping on lakes with a post-freeze-up drop in water level; the proportion of young animals in the population as an indicator of potential harvest.

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APPENDIX

Waterfowl Conditions on the Mackenzie Delta - 1947

The present precarious waterfowl situation in North America renders most pertinent the investigation of breeding populations of waterfowl in the better-watered parts of northern Canada. With this in mind every opportunity was taken during the summer of 1947 to make observations on waterfowl conditions on the Mackenzie River Delta.

Our information upon the waterfowl values of this area in other years is derived from the reports of Preble (1908) covering the years prior to 1908, or Porsild (1935) concerning 1927-28 and 1932-34 and of J. J. Lynch (1940) which deals incidentally with waterfowl in an unpublished report on the floral ecology of the hydrosere of the Mackenzie Delta.

The period during which the following observations were made began on June 8 and ended on August 14, 1947. In this time we were almost constantly on the rivers and lakes of the timbered parts of the Delta but spent a total of about ten days on the tundra regions of the northern Delta. Waterfowl observations were made on thirty-three days.

Since the primary purpose of the field work was a study of muskrat ecology, we were working the marshes and riparian associations in such a way as to bring us into contact with any waterfowl inhabiting the parts of the Delta included in our study.

We did not reach the fringe of islands on the seaward margin of the Delta, and inasmuch as the nesting grounds of the lesser Canada, white-fronted and lesser snow geese and black brant are known to be closely confined to these islands, the virtual absence of these birds from our counts has no significance.

Preble (1908) summarizing his own records and those of earlier workers along the Mackenzie River during the 19th century records, exclusive of the eiders, five pond ducks -- the mallard, baldpate, pintail, green-winged teal and shoveller; seven diving-ducks -- the lesser scaup, bufflehead, American goldeneye, old squaw, harlequin, white-winged scoter and surf scoter; and one merganser -- the red-breasted merganser.

Of these only the first three and the lesser scaup, old squaw and scoters are spoken of as abundant.

Porsild (1943) writing of conditions on the Mackenzie Delta in 1927-28 and 1931-35 found the same species to be abundant, saw no bufflehead and harlequin ducks and added the greater scaup and the canvasback to the list, the latter on the basis of a sight record in 1942 by C. H. D. Clarke.

Lynch (1940) makes only incidental mention of the ducks seen by him on the Delta in 1940 and implies that baldpate, pintail, green-winged teal and scaup were reasonably abundant.

Of all the observers to make observations upon waterfowl on the Mackenzie Delta only Porsild (1935) gives figures of actual counts of waterfowl that can be used to draw comparisons with the 1947 populations.

Throughout his report Porsild refers repeatedly to seeing large rafts of ducks on the various rivers and channels of the Delta. This is a condition completely absent in 1947. An even more graphic comparison of duck population in 1934 and 1947 is possible on the basis of counts made by him on transects of the Delta along the seventy-mile route from Aklavik to Reindeer Station. I travelled the same route on several occasions and at comparable seasons. The counts made by Porsild and myself are set forth for comparison on Table VII. It will be readily apparent that the population of ducks summering in the Mackenzie Delta region in 1947 had decreased so radically as compared with that of 1934 that there are very real grounds for concern. The decline has been small in the less abundant species but very great in pintail and baldpate each with a decline approaching 99%.

On the basis of his late June counts, Porsild estimated that twenty ducks of all species per mile of river constituted the mid-summer population of 1934. On the same route at the same season in 1947 there was less than one duck per mile of river. In both seasons of course these counts refer not to breeding females but to post-nesting concentrations of males and non-breeding females.

In the two months of field work during June, July and August, 1947, a complete tally was kept of all waterfowl seen during travels that took us a distance of 80 miles north and south along the Peel Channel, across the Delta from east to

west three times and out to Kidliut Bay on the northeastern extremity of Richards Island. The aggregate of all ducks seen during this period was 2233. Expressed in terms of waterfowl seen per day during the thirty-three days upon which waterfowl observations were made, this amounts to slightly more than 66 birds per day.

In two months, spent in large part on the Delta lakes and waterways, we saw in 1947 just 50% more ducks than Porsild did in 1934 in a single crossing of the Delta made in one six-hour period.

It should be remembered that this decline has taken place in a region in which water is abundant and waterfowl food of the finest type is present in profusion.

On the basis of our observations, the six most abundant species of ducks in 1947 were, in order of numbers seen: baldpate, surf scoter, white-winged scoter, scaup (greater and lesser together), old squaw and pintail.

During the summer fourteen broods of pond ducks were counted with an average of six young per brood. Just four broods of diving ducks were seen and these had an average number of seven young.

More detailed notes on the different species of waterfowl are given below:

Whistling Swan, Cygnus columbianus (Ord)

We found no evidence of swans nesting far inside the timbered part of the Mackenzie Delta although one brood was hatched in the vicinity of Reindeer Station. For the most part this is a tundra species and even there it was not numerous in comparison with the nesting territory available.

On June 25, 1947, fifty-five miles northwest of Aklavik, the first nest was found. It contained four eggs in an early stage of incubation. In this vicinity three pairs of mesting swans were seen in an area of about nine square miles.

Another population count was made on July 29, during a flight up the east bank of the Mackenzie River along the Caribou Hills from the river mouth to the Reindeer Station. The strip surveyed was thirty-three miles long and about two miles wide and on it five pairs of swans were seen. Only one pair

Table VII

Waterfowl counts (Porsild, 1934, and Cowan, 1947, on 70 miles of River, Aklavik and Reindeer Station.

Species	Late June 1934	July 7 1947	July 18 1947	July 23 1947	August 27 1934
Baldpate	1000 -	13	11	0	500 -
Pintail	300 +	1	2	0	
Mallard	a few	1	0	0	6
Green-winged Teal	1	0	0	0	0
Scaup	a few	0	26	10	6
Old Squaw	25	0	2	13	6
Surf Scoter	100 +	39	0	0	0
White-winged Scoter	50 +	8	6	17	a few
American Goldeneye	a few	3	0	0	0
Red-breasted Merganser	4	1	3	1	24
Total	1500 +	66	50	41	550 +

was accompanied by young. This would suggest a population roughly of a swan per seven square miles.

The first cygnets of the summer were seen at Reindeer Station on July 17, 1947.

Some indication of nesting success may be had from our counts of swans seen after the time of hatching. Nine pairs of swans were seen, four of them with broods, one of four cygnets, two with three and one with two.

Lesser Canada Goose, Branta leucopareia (Brant)

Just six geese were seen during the summer, three on June 24, thirty miles north of Aklavik and three in the same vicinity four days later.

Mallard, Anas platyrhynchos Linnaeus

This duck was distributed, in small numbers, throughout the forested parts of the Delta but was not seen on the tundra. A total of fifty-eight birds was seen during the summer.

One nest was found eight miles north of Aklavik on June 13 when it contained eleven eggs. Two half grown young were caught and banded on August 7. These were the only nests or broods seen.

Pintail, Anas acuta Linnaeus

Pintail were uncommon in the forested parts of the Delta and a total of just one hundred and seventeen were counted. Two broods were seen, one of six small young at Reindeer Station on July 14, and another of two young thirty-six miles south of Aklavik on August 5.

Green-winged Teal, Anas carolinensis Gmelin

Thirty-one teal were seen during the two months of field work, all of them in the forested parts of the Delta. One brood of eight large young was seen thirty-six miles south of Aklavik on August 7. A company of seven drakes in eclipse plumage was seen at the same place on August 9.

Baldpate, Mareca americana (Gmelin)

This species was more than twice as numerous as any other species of waterfowl observed by us and about twice as numerous as all other sporting waterfowl combined. The total count for the summer was eight hundred and seventy-three birds. Most of them occurred in small parties of drakes and unmated hens along the larger water courses or on the shallow lakes with their dense beds of Potomageton and thick marginal stands of Equisetum fluviatile and Arctophila.

The first brood was seen at Reindeer Station on July 11 on which date the single chick was estimated to be about four days old. Eleven broods were counted between July 11 and August 9. They ranged in size from one to eight, with an average of 5.3 young.

Shoveller, Spatula clypeata (Linnaeus)

A rare summer visitant to the Mackenzie Delta with just five individuals seen during the summer.

A nest of eleven eggs was found near Aklavik on June 9 but it was later destroyed by a dog or fox. None was seen after June 25.

Canvasback, Aythya valisineria (Wilson)

Three males near Aklavik on June 12 and a hen with three newly-hatched young on July 21 at the same place were the only canvasbacks seen.

This constitutes the first record of the species nesting along the Mackenzie River north of Great Slave Lake.

Lesser Scaup, Aythya affinis (Eyton)

This species was fairly common in the wooded parts of the Delta where it stayed to nest. In making our counts of waterfowl, this species and the next were tallied together and one hundred and ninety-six individuals of the two species seen.

Pairs were present and very tame on many of the large and small lakes near Aklavik from the date of our arrival there until mid-July. On July 12, the first flock of males was seen and from that time on the majority of the observations were of males and occasional unmated females.

The first brood was seen on August 7 at which time the ten ducklings composing it were judged to be almost two weeks old. A second brood, of two young, was seen on August 9.

A flock of thirteen drakes in eclipse plumage was seen on a large grassy lake thirty miles south of Aklavik on August 9.

Greater Scaup, Aythya marila (Linnaeus)

This species was seen on June 12-15 in about the same numbers as was the lesser scaup, but except for two drakes seen on the Peel River south of Aklavik on July 3 it was not positively identified during the nesting season.

Common Goldeneye, Glaucionetta clangula (Linnaeus)

The Goldeneye was a scarce summer visitant to the region and only fifty-three were seen during the summer. Two broods, each consisting of eight young, were seen thirty miles south of Aklavik on Peel Channel on August 12 and 13.

Old Squaw, Clangula hyemalis (Linnaeus)

This was one of the most obvious ducks over the entire area during the month of June when pairs in noisy courtship were present on most of the smaller lakes.

On the tundra of the Caribou Hills and on Richards Island near Kidliut Bay the old squaw was almost the only duck present. One hundred and fifty-three were counted.

A brood of nine newly-hatched ducklings was seen on July 13 on a small lake on the top of Caribou Hills near Reindeer Station.

Harlequin, Histrionicus histrionicus (Linnaeus)

Mr. Knud Lang gave the writer an adult male in the flesh taken by him near his trading post on Peel Channel in May, 1947. This appears to be the only specimen record for the Delta, although Preble (1908) mentions the species from as far east as Anderson River.

King Eider, Somateria spectabilis (Linnaeus)

A single adult female was collected at Kidliut Bay, Richards Island, on July 25. Four other eiders, believed to

be of this species, were seen near the same place on July 26.

White-winged Scoter, Melanitta deglandi (Bonaparte)

This was the third most abundant species of waterfowl on the Delta where it was seen both in the forested parts and on the Arctic coast.

Three hundred and eleven birds were counted, one hundred and seventy-six of them on one day, July 24, at Kidliut Bay, Richards Island. Small companies of males were moving across the Delta as early as June 15 but it was not until July 24 that any large flocks were seen. On that date one hundred and seventy males and six females were counted, all flying westward along the coast.

There was nothing to suggest that the species was nesting in the Delta.

Surf Scoter, Oidemia perspicillata (Linnaeus)

The surf scoter was second in abundance to the baldpate with four hundred and eight individuals counted during the two months.

Flocks of drakes began moving across the Delta on June 12, and had two periods of abundance, June 12 to 25 and July 11 and 12. After July 12 only scattered birds were seen.

During the June flight it was noticed that the scoters, and indeed all the diving ducks, congregated on certain lakes that had not flooded. Doubtless the clear water in these rendered food-getting much easier than it would have been in the silt-clouded waters of the lakes flooded with river water.

On a lake thirty miles south of Aklavik on Peel Channel two female surf scoters on July 1 manifest such disturbance at our presence that there can be little doubt that they were nesting or had broods in the vicinity. This was the only indication of nesting seen.

Red-breasted Merganser, Mergus serrator (Linnaeus)

A scarce summer visitant to the Delta and out onto the Arctic coast. Just seventeen individuals were seen.

No broods were seen but a female was accidentally caught in a trap set in a burrow in an earth bank on Egg Island in Kidliut Bay. She was evidently nesting in the burrow.

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