A SURVEY OF THE DOMESTIC FISHERY IN THE MACKENZIE DELTA AREA, NORTHWEST TERRITORIES 1981

FISHERIES JOINT MANAGEMENT COMMITTEE

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A SURVEY OF THE DOMESTIC FISHERY IN THE MACKENZIE DELTA AREA, NORTHWEST TERRITORIES 1981

by:

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ABSTRACT

Sparling, P.D. and J.Y. Sparling. 1988. A Survey of the domestic fishery in the Mackenzie Delta Area, Northwest Territories, 1981.

This report summarizes the results of a survey conducted from June through November of 1981 to assess domestic fishing effort and harvest in the Mackenzie River Delta region. Data were obtained through interviews with domestic fishermen from Aklavik, Inuvik, Fort Macpherson and Arctic Red River; enumeration and biological sampling of fish from gillnet catches; and catch-effort determinations by species. Fish species sampled were: broad whitefish (Coregonus nasus), lake whitefish (C. clupeaformis), Arctic cisco (C. autumnalis), least cisco (C. sardinella), inconnu (Stenodus leucichthys), Arctic charr (Salvelinus alpinus), lake trout (S. namaycush), northern pike (Esox lucius), and burbot (Lota lota).

Key words: domestic fishing; commercial fishing; harvest; effort; catch; gillnets; fishery management; species composition; size distribution; age composition; Arctic; northern; fishes; Mackenzie Delta

1. give reference name for fish —

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INTRODUCTION

The Mackenzie Delta area of the Northwest Territories has highly productive fishery resources relative to other Arctic regions. Nutrient rich and most importantly, warm, water from the Mackenzie watershed lying to the south spills into the Beaufort Sea at the delta. Extensive sediment deposits have been reworked by meandering river channels to form the small lakes and waterways which play an important role in the life histories of resident and transient fish species. Utilization of fish resources has traditionally been confined to domestic fisheries as an important source of human and dog food (Bissett 1967), but there have been sporadic attempts to develop commercial fisheries in the area since the 1950's. Ongoing commercial efforts, increasing regional human populations and natural resource development activities, in the delta region, and upstream in the Mackenzie watershed, have created concern for possible adverse effects on the domestic fish harvest within the Delta.

Questions concerning the ability of the fish stocks to supply an undiminished harvest for domestic fishermen have been directed by community groups and local resource agencies to the Department of Fisheries and Oceans (DFO). In response, DFO initiated a study of existing data from domestic and commercial fisheries in the Mackenzie Delta. That study (Corkum and McCart 1981), summarized the information available and indicated major gaps in the data base in terms of the type and amount of gear used, effort expended, and the catch of each species by the domestic fishery. To obtain this information the Fish and Marine Mammal Management Division of DFO surveyed domestic fisheries in the delta from June through November, 1981. This report describes that survey and the data collected.

BACKGROUND

STUDY AREA

The Mackenzie Delta is situated at the outlet of the Mackenzie River into the Beaufort Sea (Fig. 1). Approximately 210 km long by 65 km wide, it covers an area of 9,583 sq km and is unique in geography and resources (Rowe 1974). Physically, the delta is a tree-covered lowland comprised of muskeg, many small perched basins and oxbow lakes and meandering river channels of varying size and depth. The largest of these, the Main Channel, the East Channel, West Channel and Husky Channels, and the Peel River serve as transportation routes for the communities within the delta - Aklavik, Inuvik, Arctic Red River, and Fort Macpherson (Fig. 2). Active channels within the delta are turbid for most of the year, and generally exhibit moderate to slow flow rates. Spring floodwaters deposit sediments and rework previous deposits, ~~(but the Mackenzie Delta is relatively inactive.)~~ Additional descriptions of the physical and climatic characteristics of the delta area are ~~available~~ to be found in Rowe (1974), and Rosenberg and Barton (1986).

THE FISHERY

Fish which inhabit the Mackenzie Delta are a major food source for area residents. Domestic fisheries there and in the inshore Beaufort Sea have been described historically by explorers, surveyors, whalers, missionaries, and government officials. These reports have recognized the delta as: an important migratory route for anadromous fish species; a resting, rearing, and feeding area for resident species; and a spawning site for both resident and transient species (Bissett 1967; Hunter 1975; Usher 1975, 1976; McCart and Den Beste 1975; and Ken Chang-Kue, DFO, 501 University Crescent, Wpg. MB. per. comm. 1988).

At least 63 fish species occur in the inshore Beaufort Sea and Mackenzie Delta area of which 17 are utilized for domestic, commercial, and sports fisheries (Corkum and McCart 1981). Those species most frequently encountered by the domestic fishery are broad whitefish (Coregonus nasus), lake whitefish (C. clupeaformis), Arctic cisco (C. autumnalis), least cisco (C. sardinella), inconnu (Stenodus leucichthys), Arctic charr (Salvelinus alpinus), lake trout (S. namaycush), northern pike (Esox lucius) and burbot (Lota lota). Previous reports on domestic fisheries in the western Arctic (Bissett 1974; Hunter 1975) have listed coregonids as the most exploited and desired species. Other desirable but rarely encountered species are chum salmon (Oncorynchus keta) and walleye (Stizostedion vitreum).

Species found by Jessop et al (1974) to be most frequently taken by the domestic fisheries in Aklavik and Arctic Red River were broad and lake whitefish and inconnu. Arctic charr and Arctic cisco were only taken often in Aklavik. Burbot are taken by handline through the ice in early spring and late fall. Broad whitefish is the preferred species for commercial fisheries, although Arctic charr are pursued in the western region of the delta during fall migrations (Barlishen and Webber 1973; McLeod 1973; Olesh 1979; and Corkum and McCart 1981). Effort for the domestic and commercial fishery is coincidental in time and area with target species movements (Corkum and McCart 1981).

MATERIALS AND METHODS

FISHERY SURVEY

The domestic fisheries survey was conducted in the Mackenzie Delta from July 6 until November 20, 1981. To facilitate the study the Mackenzie Delta was divided into five areas: Area 1, Aklavik and vicinity; Area 2, Inuvik north; Area 3, Inuvik south; Area 4, Fort Macpherson and vicinity;

and Area 5, Arctic Red River and vicinity (Figure 2). The boundaries were drawn to reflect the areas normally fished by residents of each community to allow comparison with data from previous community based surveys. Data collected from Inuvik north (Area 2) and Inuvik south (Area 3) were later combined since little information was available from either area.

Three methods were used to collect information: interviews with fishermen, enumeration and biological sampling of domestic catches, and experimental gillnetting. Personnel were divided into two crews, one, stationed in a tent camp on Jamison Channel 2 km north of Aklavik, was responsible for the Aklavik area. The second crew was alternately based in Inuvik, Arctic Red River and Fort Macpherson and collected data from those areas. Efforts in the Inuvik and Aklavik areas were discontinued after August 25, ~~as summer personnel were terminated.~~ A two-man crew continued the survey in the Arctic Red River and Fort Macpherson area until late November. Sampling efforts followed the domestic fishing operations as fishermen moved about the delta area in response to fish movements. Information on the numbers of fishermen active, and the total number and lengths of nets used, were collected for the Aklavik and Inuvik areas by area Fisheries Officers (DFO) and Wildlife Officers (Government of Northwest Territories).

Crews visited the domestic fishery camps by boat and motor to conduct interviews, sample portions of the fishermen's catch, and set experimental nets. The initial interview determined the camp location, ownership, numbers of people and dogs on site, dates of occupancy, seasonal activity and projected harvest of fishes. This information was updated with each return visit to the location and data were collected on fishing activities including: the numbers, lengths, depths and mesh size of nets utilized, numbers of fish caught by species per net, how many hours gillnets were set, numbers of fish culled, utilization of fish kept, and method of fish

storage. Fish were identified to species and sampled for biological information. Northern pike and longnose suckers (Catostomus catostomus), which were the only species captured not sampled.

The experimental gillnets used were 50 m long and 1.8 m deep and consisted of 10 m panels of 38 mm, 64 mm, 89 mm, 114 mm, and 139 mm mesh sizes (stretched measure). Nets were set to augment samples from the domestic fishery and to provide data on the size range of the individual species available in each area. As sufficient domestic sample numbers were obtained in most areas, these efforts were discontinued midway through the survey.

The annual harvest of each fish species in each area was estimated from the average daily catch per fisherman, by extrapolation, taking into account variation in catch and fishing effort over the fishing season.

The weights of fish harvested were estimated by multiplying the mean weight (in kg) of each species, by the number of individuals of that species caught.

BIOLOGICAL INVESTIGATION

Fish captured by domestic or experimental gillnet were sampled for forklength (+/- 1 mm), round weight (+/- 20 g), sex and maturity. Maturity was determined by gross examination of the gonads according to the stages described in Appendix A. Sagittal otoliths or scales were removed and stored dry, in coin envelopes marked with the sample information.

Age determination was conducted in the laboratory by grinding the convex surface of the otoliths on a fine carborundum stone to expose the annual growth zones. Otoliths were then cleaned in a 3:1 solution of benzyl-benzoate placed in a depression slide, and the annual growth zones read under a dissecting microscope (X 30).

Scales were cleaned, placed between two glass slides, and the annuli counted on an image produced by an Eberbach microprojector (x 60). Scale age was recorded as being equal to the number of completed annuli.

Weight and length relationships for species sampled from the survey were determined using the following equation:

$$\log_{10} W = a + b\,(\log_{10} L)$$

where W = weight in grams

a = y intercept

b = slope of the regression line

L = fork length in millimeters

Condition factor was calculated as:

$$K = \frac{W \times 10^5}{L^3}$$

Where W = weight in grams

L = fork length in millimeters

Catch per unit effort ($\hat{CUE}$) was calculated by dividing the number of each species caught by the length of the net set (in meters) and the number of hours fished, expressed as number of fish caught per 100 m net set for 24 hours.

Data collected during the study were analyzed by staff at the Freshwater Institute (F.W.I.) using a MICRO VAX II computer. The Statistical Analysis System (1985) was used to generate length, weight, sex, and maturity summaries and to perform basic calculations. Some additional calculations were performed using a Hewlett-Packard programmable calculator (Model 9810-A).

RESULTS

During the period June 1 to November 20, 1981 a total of 134 domestic fishery interviews were conducted. Table 1 presents a summary of the numbers of fishermen observed and interviewed by area. The number missed

refers to active fishermen who were absent at the time interviewers visited their camps. The total of 71 active fishermen observed during 1981 included residents of both settlements and outlying camps (Figure 3). Most locations were mapped during June to October 1981. Additional camp locations were furnished by Fisheries and Oceans, Inuvik District Office, Inuvik, NWT.

Results of the harvest utilization survey are shown in Tables 3, 4, 5, 6 and 7. Table 3 has a breakdown of harvest utilization over the entire study area by species of fish. Tables 4, 5, 6 and 7 have this breakdown for each of the areas surveyed.

FISHING METHODS

Two types of fishing grounds were encountered, individual sites and community areas. Individual sites are close to camp residences within the Delta and are usually fished annually by the same family or group of families. Community fishing areas are "common" fishing grounds located in areas with major road or water access and are fished by residents of several communities during peak periods of fish availability. Both types of fishing areas are traditional in nature, and boundaries and residency are respected by members of the fishing community.

Nylon gillnets are the principal domestic fishing method and range from 3 m to 20 m in length, 2 to 4 m in depth, and 39 mm to 140 mm in mesh size (stretched measure). Mesh size, depth, and length vary according to the species sought, condition of the fishery area, and physical conditions at the fishery (ie. ice).

Nets are usually set in back eddies or in quiet water areas of the river channels, and are seldom moved once a good fishing area is located. The area available for fishing is restricted as gillnets cannot be fished effectively in strong currents. Net lengths are determined by this and often 3 to 4 m sections of net judiciously placed are more effective than

larger lengths. Drifting nets were not encountered during this study, although nets of this type were observed in 1985 (Sparling and Stewart 1985). Fishermen are familiar with the movements of fish in the specific areas they fish and often set their nets in the same location year after year. Resident fishermen are skilled at selecting the areas that will provide catches throughout the season.

Gillnets are generally checked twice daily, more frequently when required during periods of high activity. Fish are removed from the net and kept or culled according to their physical condition and the requirement for fish at that time.

FISHING SEASONS

The domestic fishery is seasonal in nature and although activity occurs throughout the calender year, most fishing begins after ice breakup, usually mid-June (MacKay 1963), and continues until late December or January, eight to ten weeks after freeze-up is complete. Fishing is continuous in most areas during these periods with intervals of concentrated effort corresponding to movements of desired species into or out of fishing areas. Fishing efforts can be restricted by high water and/or associated flotsam caused by spring and summer flooding. Ice conditions interfere with both spring and fall fishing. The period of best fishing for individual species varies within the Delta and generally corresponds to the upstream movement of fishes from the inshore Beaufort Sea (Jessop et al. 1973; Slaney et al. 1980; Chang-Kue, per. comm.). Observations on coregonid movements in the Mackenzie Delta (Stein 1973; Jessop et al 1974; Chang-Kue, per. comm.) indicate corresponding peak movements of lake and broad whitefish through June and July in the Inuvik and Aklavik areas.

FISHING EFFORT

Fishing efforts from all communities except Arctic Red River increased slowly during June and July and peaked during late August and early

September (Figure 4). Many family camps are operated while families are on summer holidays throughout the delta. At Arctic Red River effort was steady until early September when it increased sharply and remained higher than in other areas during October.

The fall and early winter season, September 1 to December 15, is the period of greatest fishing activity in the Delta. Large migratory runs of coregonids occur during this time when the cooler temperatures and lower water levels are more favourable for handling and preserving the fish than in the Spring and Summer. Fishing is more intense during September through November, and diminishes steadily after the end of November. Intense cold and thick ice cover discourage most fishing efforts from January until spring breakup.

CATCH UTILIZATION

Nearly all of the fish taken by the domestic fishery in the Mackenzie Delta are used (Table 2). Fish retained for human consumption are either eaten fresh, dried on open air racks, dried in partly enclosed shelters with small smoke fires or frozen in community freezers or ice shacks built onto the permafrost. Fish utilized as dog food were either fed to dogs fresh, dried on oped air racks, made into "stickfish" or skewered on a long pole and left to hang in the cool weather, "pitted" or stored in small, deep pits constructed throughout the Delta. Fish for dogs is also frozen when weather conditions are suitable.

During the spring and summer period a high percentage of the catch is eaten fresh by the fishermen and their families. Broad whitefish and Arctic cisco were the most important in terms of human consumption, and lake whitefish were used most often as dog food (Table 3). During the period of this study, 8% of the total catch was eaten fresh by the fishermen and their families (Table 3).

Storage facilities are limited during warm weather so large catches are not sought in the Summer. Excess fish are smoked, dried, or frozen when possible (30% of total catch was preserved for later human consumption).

Spoilage occurs quickly in the warm water of the Delta during the Summer but because the fishermen remove fish from the nets at least twice a day, the observed cull rate was 5%. Fish that are drowned are Fresh drowned fish, though not utilized for human consumption but are used as dog food. Tables 4,5,6 and 7 contain a breakdown of the harvest utilization by species, and by area.

Utilization patterns were similar in all areas, except at Area 1 (Aklavik). High numbers of Arctic cisco were taken at Shingle Point and eaten by the fishermen. Catches of broad whitefish were fed to dogs.

HARVEST ESTIMATE

Because this study began after the spring fishery ended and the fall fishery was not completed when the survey ended, harvest data does not represent a total harvest figure for 1981. Harvest estimates (Table 8) show that all areas except for Area 4, took more lake whitefish than broad whitefish, although overall harvest by weight shows similar harvest by weight for lake whitefish and broad whitefish, 44,262 kg and 44,508 kg respectively. Overall inconnu numbered less than the previous two species in the harvest (14,300) but provided the greatest single weight for a species at 69,734 kg. The total estimated harvest for lake whitefish, broad whitefish and inconnu combined was 68,000 fish weighing 158,504 kg. These estimates are conservative.

BIOLOGICAL INVESTIGATION

Since much of the data for this section is not in a form suitable for inclusion at this time, the discussion has not been included in this draft report. Tables for this section are cited in the Table of Contents. Figures are not.

ACKNOWLEDGEMENTS

The authors extend thanks and recognition to D.V.Gillman who directed the domestic survey in 1981. Thanks Vic.

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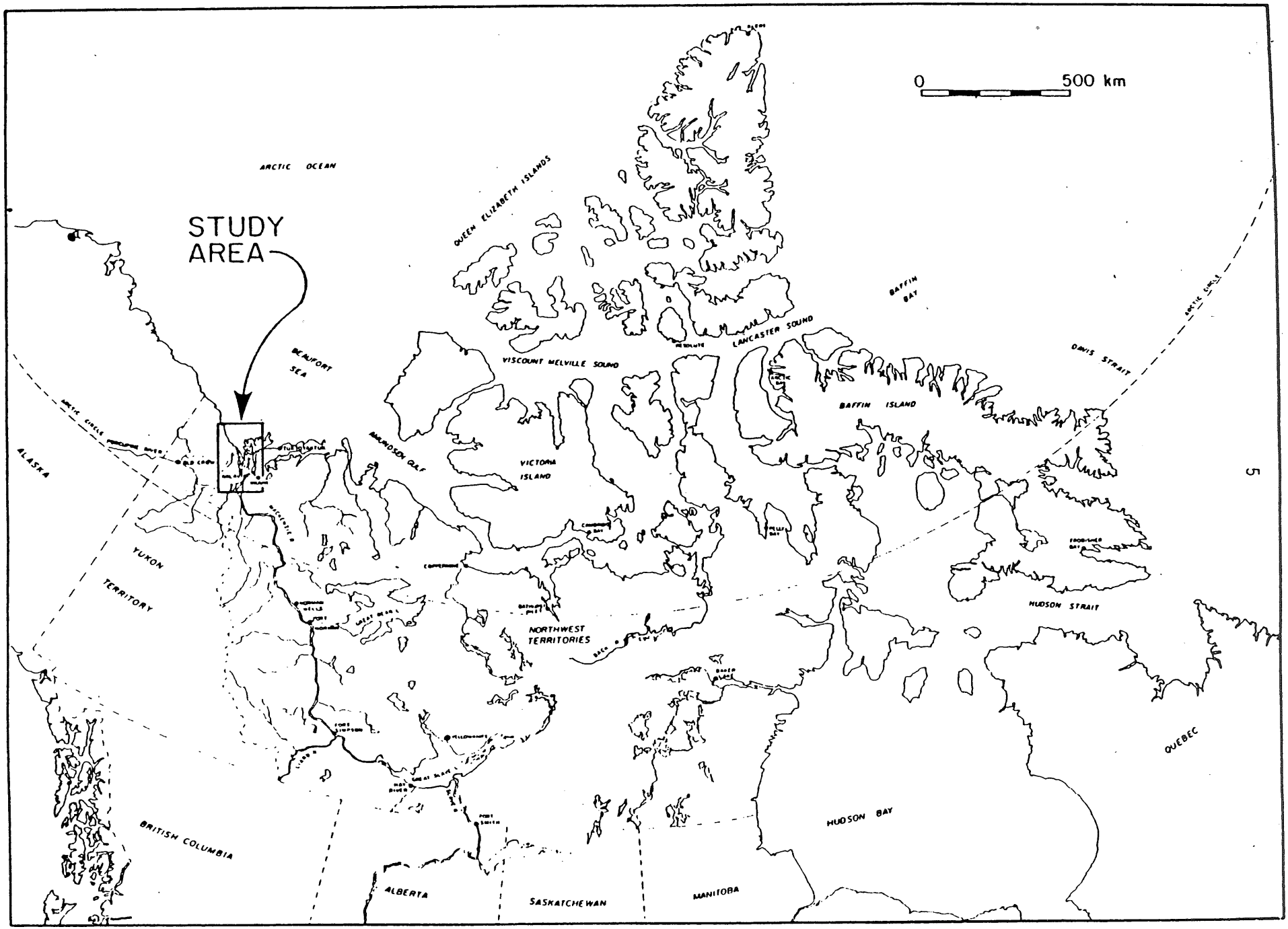

Fig. 1. Map of the Northwest Territories showing the location of the study area.

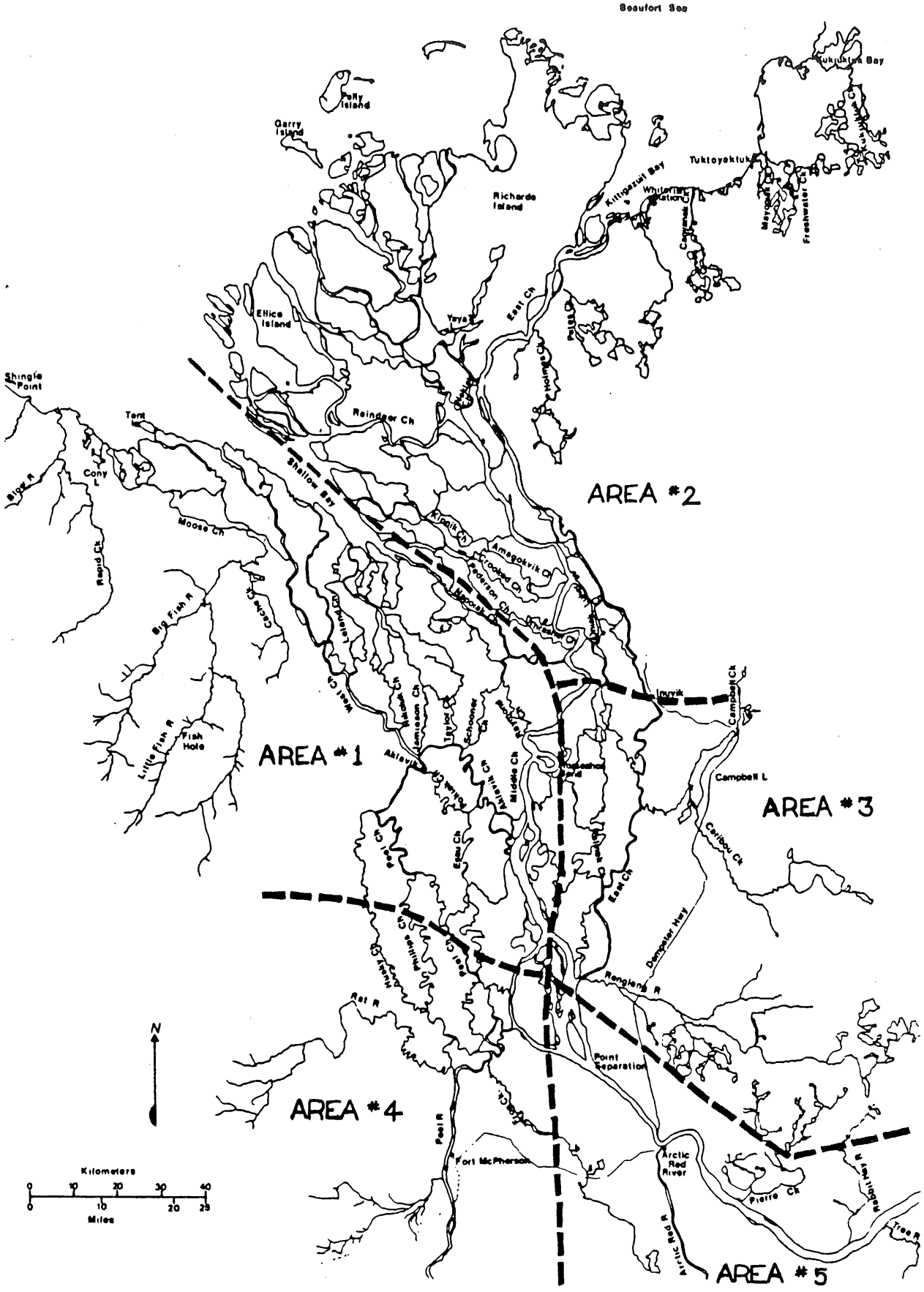

Figure 2. Map of the Mackenzie Delta study area indicating boundaries of the areas evaluated during this study.

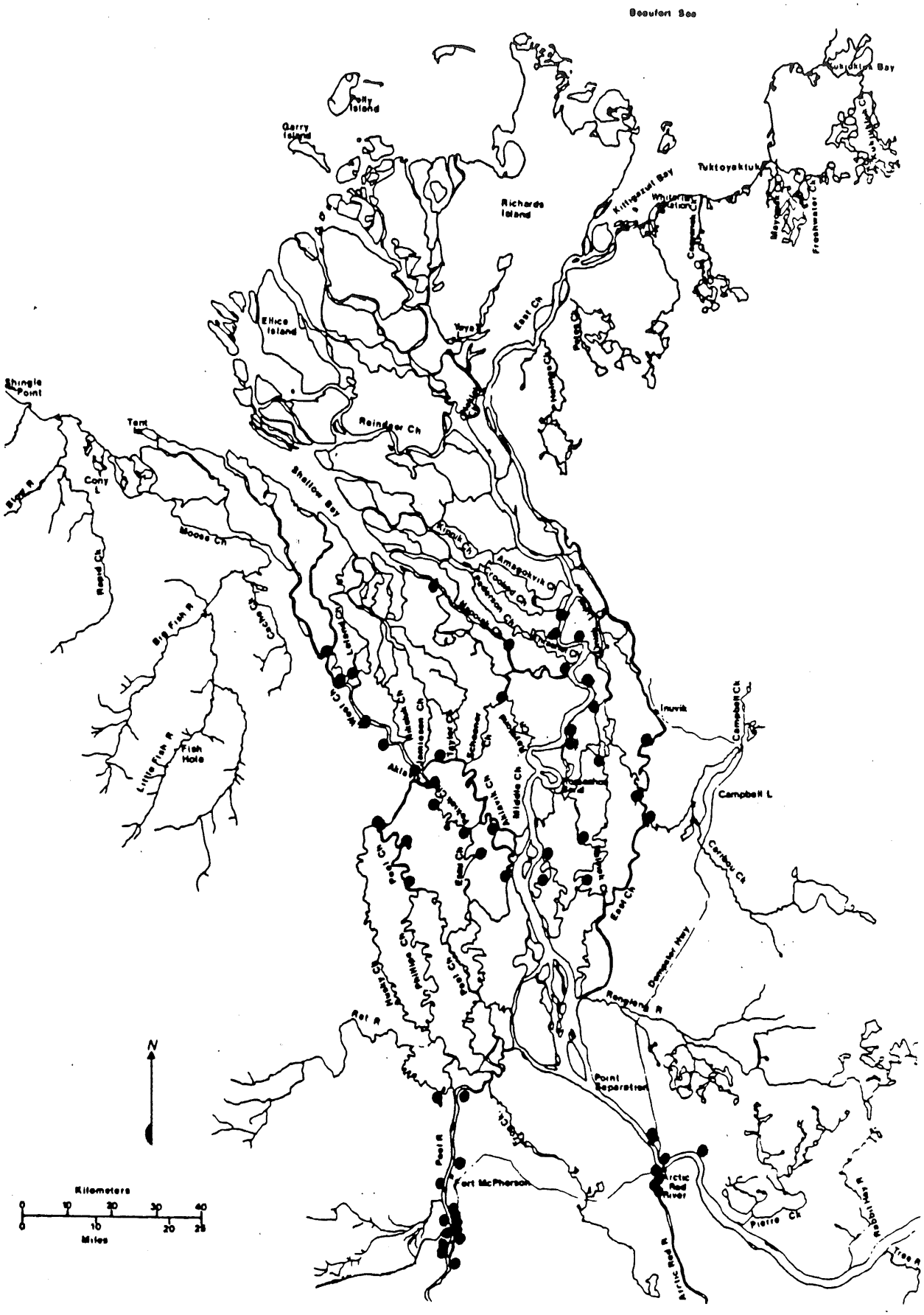

Figure 3 Map of Mackenzie Delta showing locations of domestic fishing camps.

Figure 4. Fishing pressure, by area, exerted by the domestic fishery in the Mackenzie Delta study area, 1981.

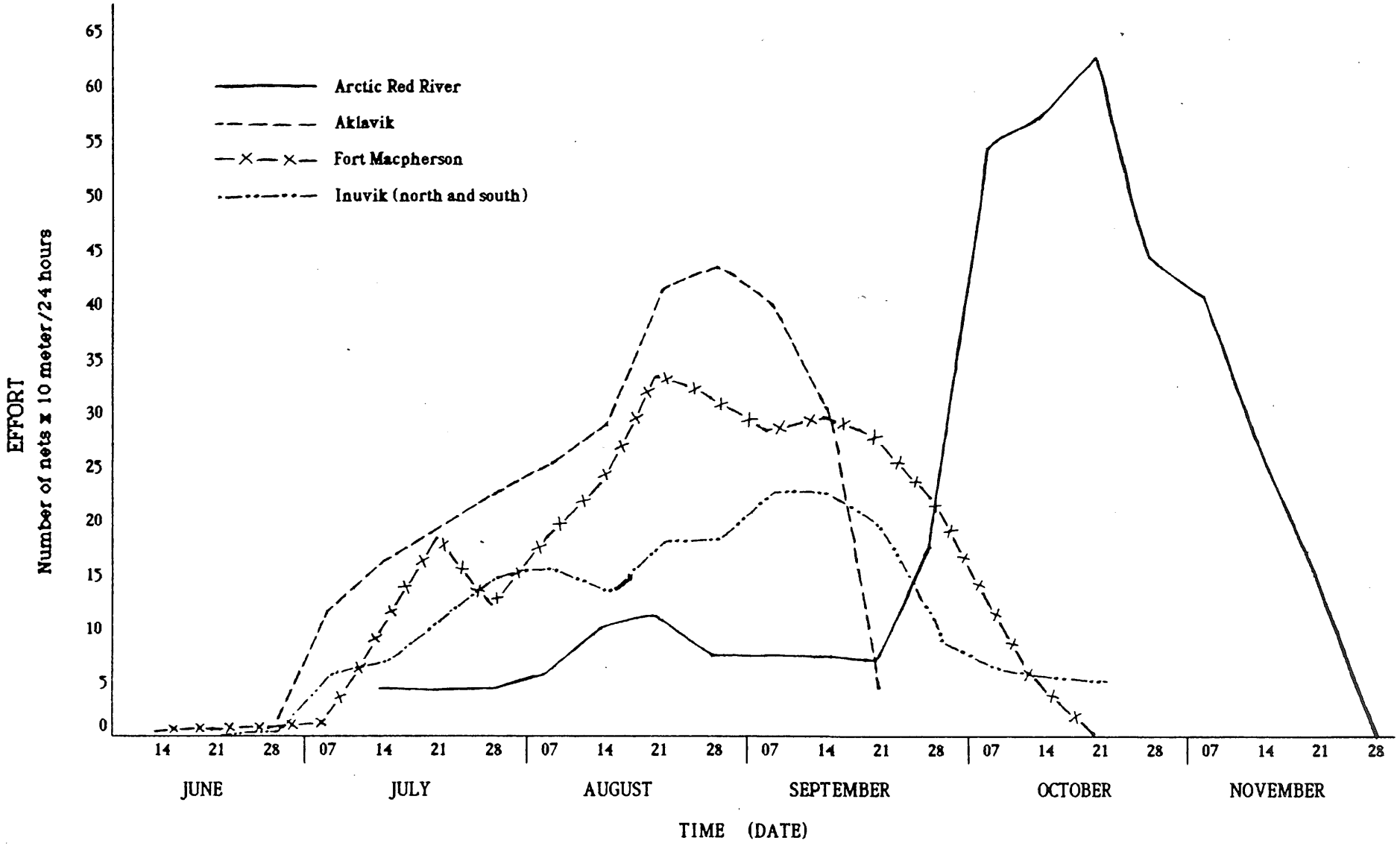

Figure 5. Fishing pressure exerted by species during the domestic fishery in area 1 (Aklavik), 1981.

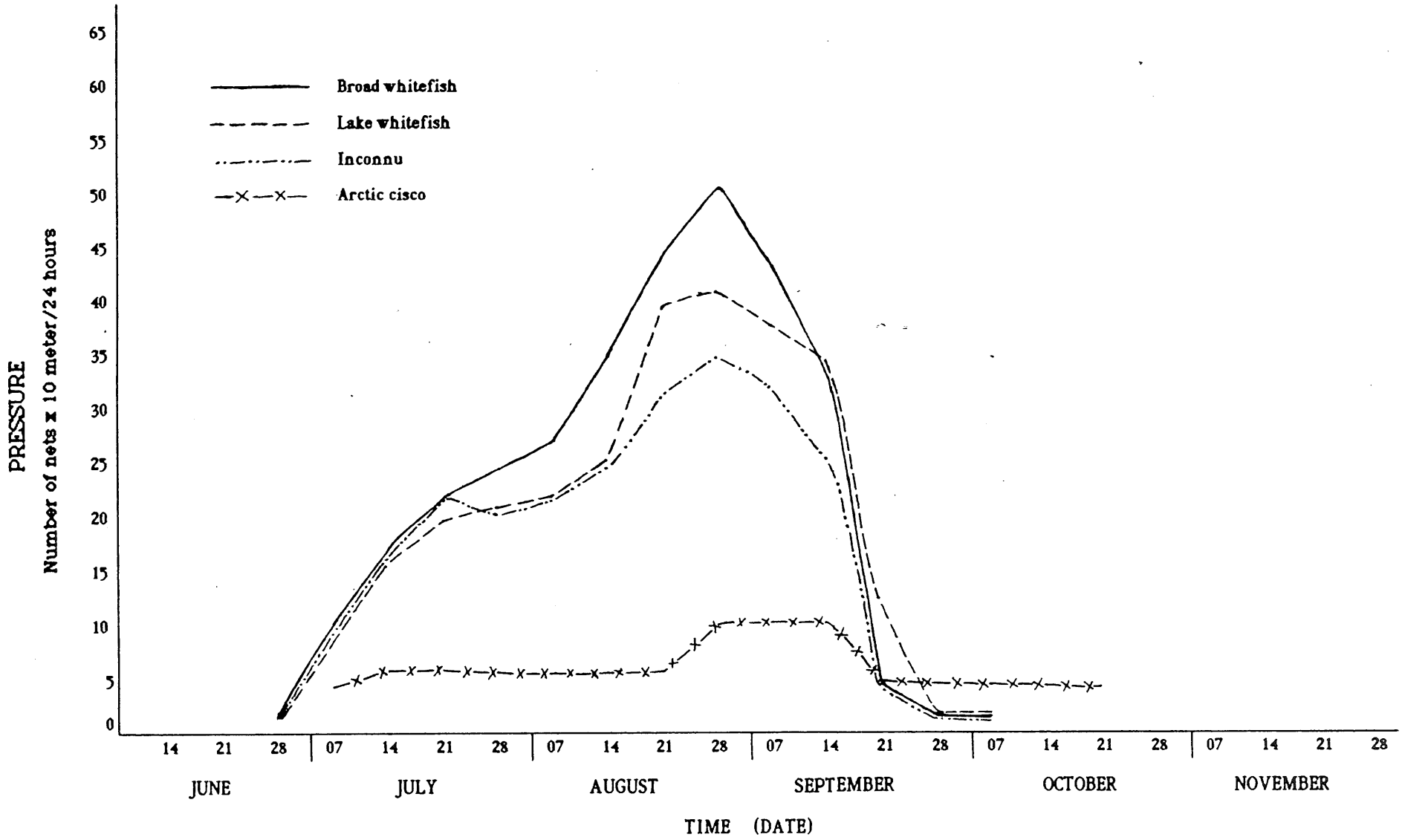

Figure 6. Fishing pressure exerted by species during the domestic fishery in area 2/3 (Inuvik north and south), 1981.

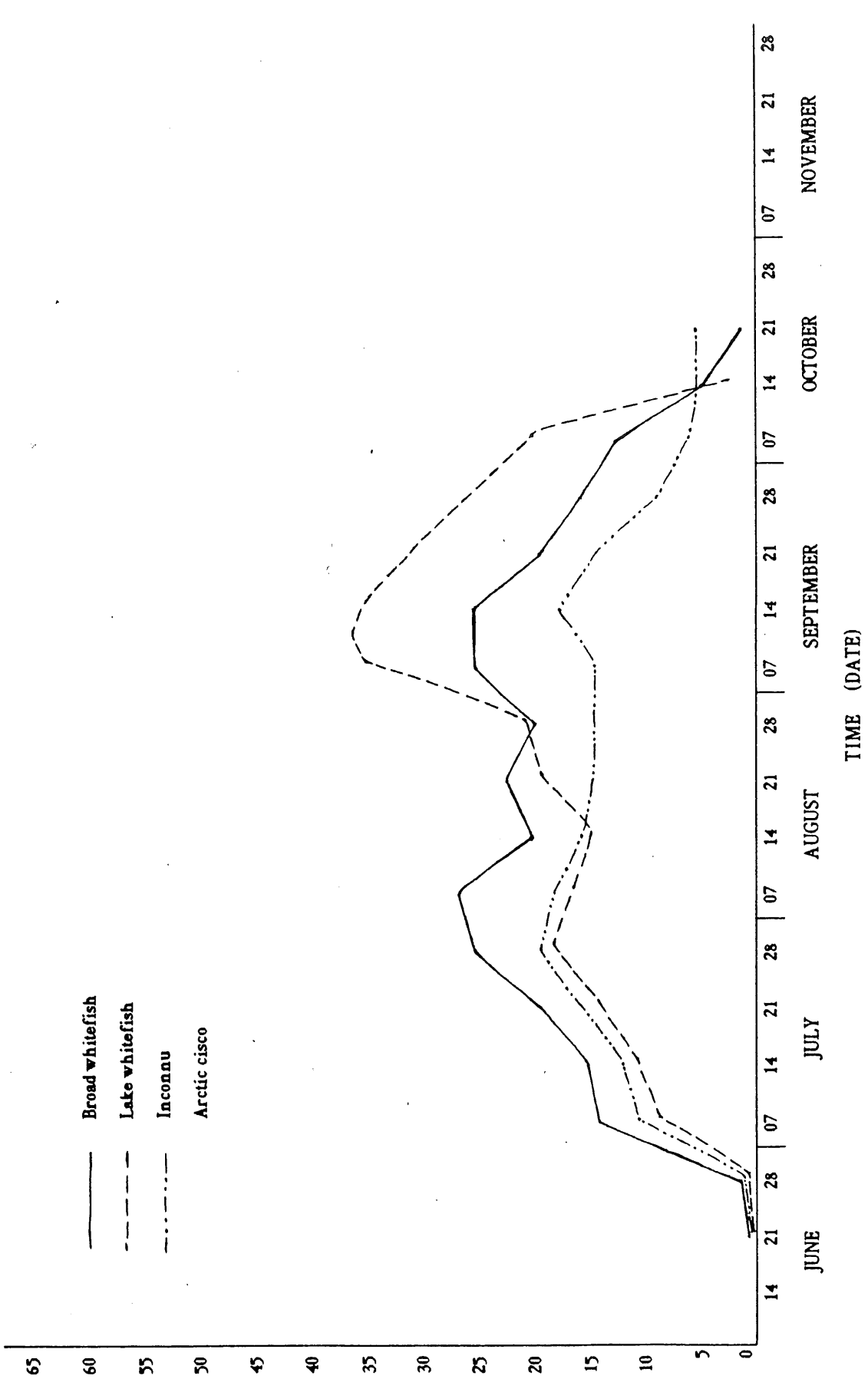

Figure 7. Fishing pressure exerted by species during the domestic fishery in area 4 (Fort Macpherson), 1981.

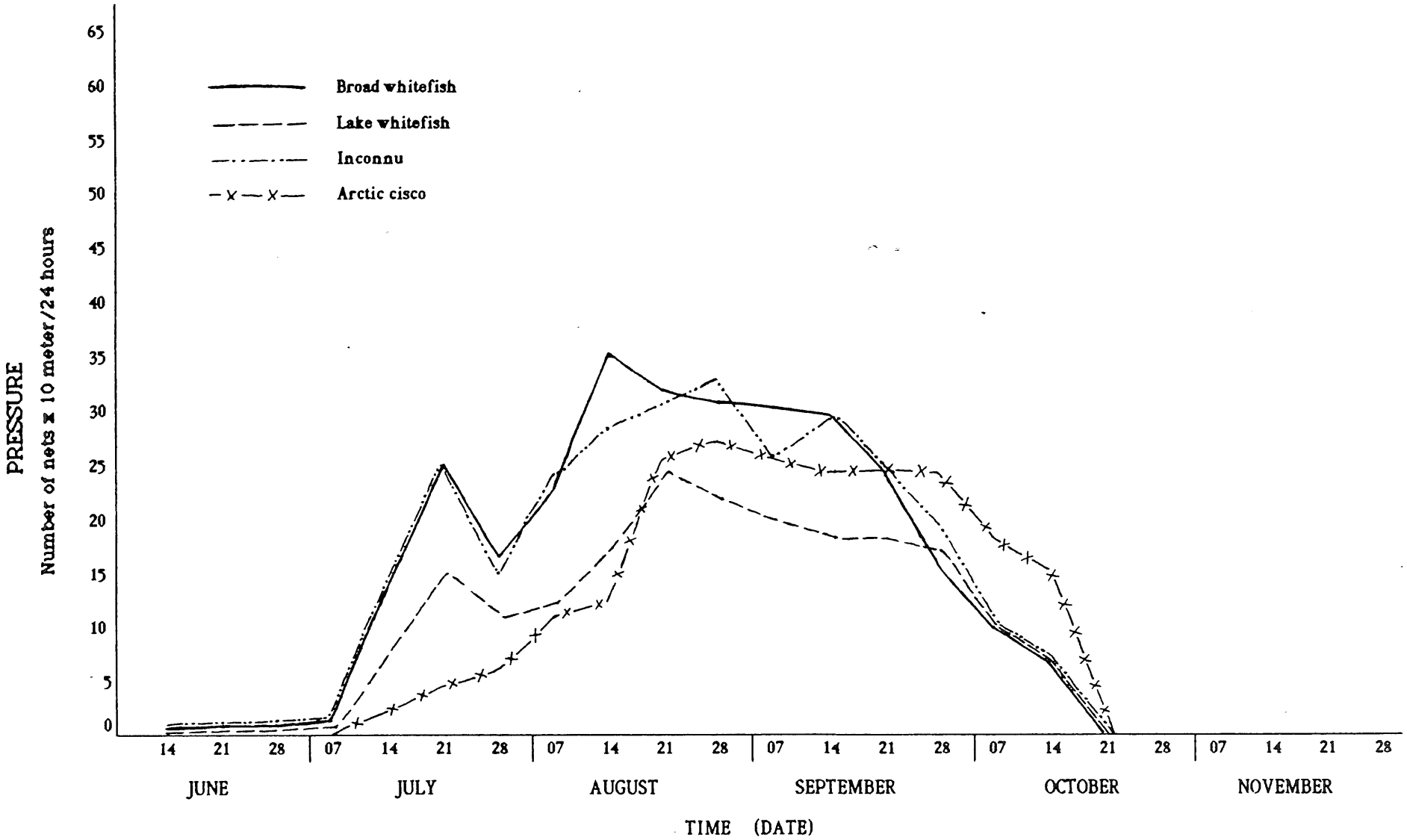

Figure 8. Fishing pressure exerted by species during the domestic fishery in area 5 (Arctic Red River), 1981.

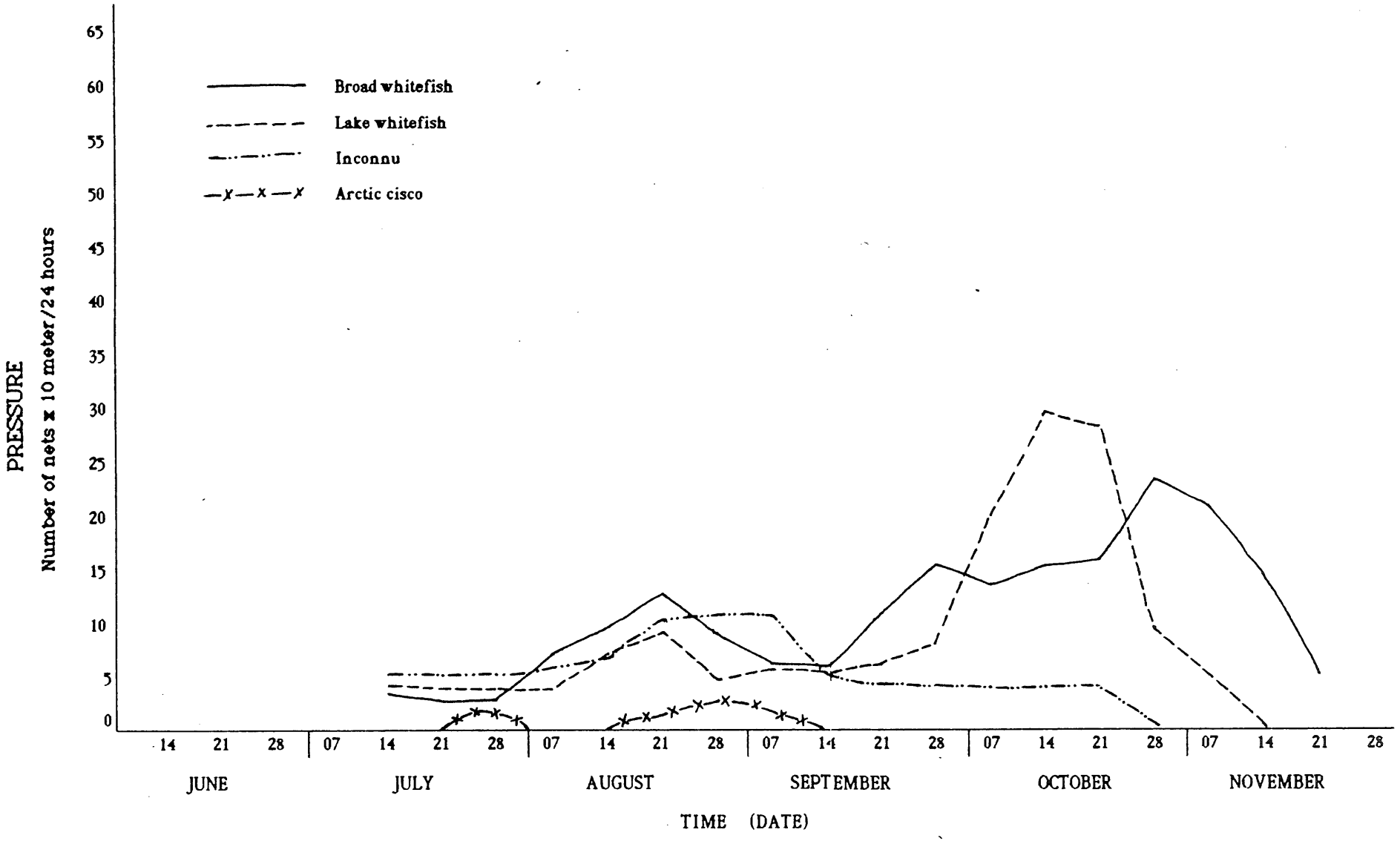

TABLE 1: Number of fishermen in the Mackenzie Delta study area, and the number interviewed during the study, 1981.

Area	Location	Period	Number of Fishermen Observed	Number of Fishermen Missed	Number of Interviews
1	Aklavik	July 6 - Aug. 25	16	2	49
2	Inuvik (north)	July 6 - Aug. 25	2	0	4
3	Inuvik (south)	July 6 - Aug. 25	7	0	13
4	Fort Macpherson	July 6 - Nov. 20	16	1	28
5	Arctic Red River	July 6 - Nov. 20	30	2	40
Total			71	5	134

TABLE 2: Domestic harvest utilization by area, in the Mackenzie Delta study area,1981.

			Human Consumption				Dog Consumption				
Area	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
1	1055	33	99	341	0	440	492	12	48	31	583
%		3	9	32	0	42	47	1	5	3	55
2/3	176	39	8	39	2	49	12	4	72	0	88
%		22	5	22	1	28	7	2	42	0	50
4	333	3	33	80	0	113	51	23	141	0	215
%		1	10	24	0	34	15	7	42	0	65
5	408	29	9	108	17	134	91	0	14	141	246
%		10	2	27	4	33	22	0	3	35	60
Total	1972	104	149	568	19	736	646	39	275	172	1132
%		6	8	29	1	37	33	2	14	9	57

TABLE 3: Domestic harvest utilization by species from the Mackenzie Delta study area, 1981.

			Human Consumption				Dog Consumption				
	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
LWF	549	50	8	32	0	40	246	2	76	137	461
%		9	1	6	0	7	45	<1	14	25	84
BWF	483	11	63	171	11	245	186	12	25	4	227
%		2	13	36	2	51	39	2	5	1	47
AC	584	10	50	306	0	358	60	0	153	1	214
%		2	9	52	0	61	10	0	26	<1	37
LC	61	4	4	0	0	4	50	0	0	3	53
%		7	7	0	0	7	82	0	0	5	87
B	6	3	0	0	0	0	3	0	0	0	3
%		50	0	0	0	0	50	0	0	0	50
NP	54	21	0	0	0	0	20	0	9	4	33
%		39	0	0	0	0	54	0	17	7	61
C	5	0	4	1	0	5	0	0	0	0	0
%		0	80	20	0	100	0	0	0	0	0
I	230	5	18	58	8	84	81	25	12	23	141
%		2	8	25	3	37	35	11	5	10	61
Total	1972	104	149	568	19	736	646	39	275	172	1132
%		5	8	29	1	37	33	2	14	9	58

TABLE 4: Domestic harvest utilization by species, Area 1 (Aklavik), 1981.

			Human Consumption				Dog Consumption				
	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
LWF	285	11	4	8	0	12	210	0	29	25	264
BWF	239	6	25	39	0	64	145	11	10	2	168
AC	355	0	52	288	0	340	15	0	0	0	15
LC	54	0	4	0	0	4	50	0	0	0	50
B	4	2	0	0	0	0	2	0	0	0	2
NP	31	13	0	0	0	0	14	0	2	2	18
C	5	0	4	1	0	5	0	0	0	0	0
I	82	1	10	5	0	15	56	1	7	2	66
Total	1055	33	99	341	0	440	492	12	48	31	583
%		3	9	32	0	42	47	1	5	3	55

TABLE 5: Domestic harvest utilization by species, Area 2/3 (Inuvik), 1981.

			Human Consumption				Dog Consumption				
	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
LWF	94	36	3	5	0	8	3	0	47	0	50
BWF	57	3	5	29	1	35	5	0	14	0	19
NP	10	0	0	0	0	0	3	0	7	0	10
I	15	0	0	5	1	6	1	4	4	0	9
Total	176	39	8	39	2	49	12	4	72	0	88
%		22	5	22	1	28	7	2	42	0	50

TABLE 6: Domestic harvest utilization by species for Area 4 (Ft. Macpherson), 1981.

			Human Consumption				Dog Consumption				
	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
LWF	9	0	0	5	0	5	2	2	0	0	4
BWF	83	0	28	47	0	75	7	1	0	0	8
AC	199	3	0	11	0	11	42	0	141	0	183
I	42	0	5	17	0	22	0	20	0	0	20
Total	333	3	33	80	0	113	51	23	141	0	215
%		1	10	24	0	34	15	7	42	0	65

TABLE 7: Domestic harvest utilization by species, Area 5 (Arctic Red River), 1981.

			Human Consumption				Dog Consumption				
	Catch	Cull	Fresh	Dried	Frozen	Total	Fresh	Dried	Pit	Frozen	Total
LWF	161	3	1	14	0	15	31	0	0	112	143
BWF	104	2	5	56	10	71	29	0	1	2	32
AC	30	7	0	7	0	7	3	0	12	1	16
LC	7	4	0	0	0	0	0	0	0	3	3
B	2	1	0	0	0	0	1	0	0	0	1
NP	13	8	0	0	0	0	3	0	0	2	5
I	91	4	3	31	7	41	24	0	1	21	46
Total	408	29	9	108	17	134	91	0	14	141	246
%		7	2	27	4	33	22	0	3	35	60

TABLE 8: A summary of the catch per unit effort (# / 24 hrs / 100 m net) by area for fish captured by domestic gillnets in the Mackenzie Delta study area, 1981.

	Mesh (mm)	LWF	BWF	INC	AC	All Species Combined
Area 1	64	26.8	97.9	72.0	281.8	320.8
	89	0	0	30.0	15,450.0	16,995.0
	114	41.4	32.5	8.6	1.7	85.4
	127	131.4	112.1	12.7	0	256.2
Area 2	114	190.4	68.4	0	0	274.8
Area 3	114	45.2	58.2	24.2	0	140.1
Area 4	89	0	0	0	3,460.1	3,460.1
	114	9.1	65.5	35.6	23.4	159.9
Area 5	64	14.5	15.2	14.2	147.9	211.4
	114	98.2	88.8	76.6	3.0	283.6
	127	23.7	48.1	53.6	3.8	131.7

TABLE 9: Estimated total domestic harvest of broad whitefish, lake whitefish, and inconnu from the Mackenzie Delta study area, 1981.

Species	Area 1		Area 2/3		Area 4		Area 5	
	kg.	no.	kg.	no.	kg.	no.	kg.	no.
Broad Whitefish	4,288	2,400	12,250	5,500	13,389	5,700	14,581	6,600
Lake Whitefish	6,566	5,200	18,844	13,300	769	850	18,083	14,100
Inconnu	3,626	900	5,468	1,100	11,545	2,600	49,095	9,700
Total	14,480	8,500	36,562	19,900	25,694	9,150	81,759	20,400

Total harvest estimate for all areas of the delta:

Broad Whitefish	44,508 kg.	20,200 fish
Lake Whitefish	44,262	33,450
Inconnu	69,734	14,300
Total	**158,504**	**68,000**

Appendix 1. A flow chart and code for the determination of the maturity stages of Arctic charr.

MATURITY FLOW CHART

IMMATURE — MATURE — RIPE — SPENT — RESTING

FISH MATURITY CODE

Maturity State	Female		Male	
Immature (virgin)	1	- ovaries granular in texture - hard and triangular in shape - up to full length of body cavity - membrane full - eggs distinguishable	6	- testes long and thin - tubular and scalloped shape - up to full body length - putty-like firmness
Mature	2	- current year spawner - ovary fills body cavity - eggs near full size but not loose - not expelled by pressure	7	- current year spawner - testes large and lobate - white to purplish color - centers may be fluid - milt not expelled by pressure
Ripe	3	- ovaries greatly extended and fill body cavity - eggs full size and transparent - expelled by slight pressure	8	- testes full size - white and lobate - milt expelled by slight pressure
Spent	4	- spawning complete - ovaries ruptured and flaccid - developing oocytes visible - some retained eggs in body cavity	9	- spawning complete - testes flaccid with some milt - blood vessels obvious - testes violet-pink in color
Resting	5	- ovary 40-50% of body cavity - membrane thin, loose, and semi-transparent - healed from spawning - developing oocytes apparent with few atretic eggs - some eggs may be retained in body cavity	10	- testes tubular, less lobate - healed from spawning - no fluid in center - usually full length - mottled and purplish in color
Unknown (virgin)	0	- cannot be sexed - gonads long or short and thin - transparent or translucent		
Unknown (non-virgin)	11	- resting fish - has spawned but gonads regenerated - sexing not possible		