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The Summer Sportfishery in Voyageurs National
Park and Surrounding Waters for 1977 and 1978

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The Summer Sportfishery in Voyageurs National
Park and Surrounding Waters for 1977 and 1978^{1/}

by

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Abstract

A creel census on the lakes which comprise or are associated with Voyageurs National Park was conducted during the summers' of 1977 and 1978 to provide baseline data on the sport fishery. Of the five lakes censused, two, Crane and Kabetogama, are located wholly within the U.S., and three, Namakan, Rainy and Sand Point are U.S.-Canadian border lakes. The census, a nonuniform sampling type, was quantitative except for the Canadian portion of Rainy Lake which is accessible from Canada. Total fishing effort averaged 7.4 manhours per acre. U.S. waters averaged 8.3 manhours per acre and Canadian waters averaged 1.7 manhours. Fishing pressure on individual lakes ranged from 20.8 manhours per acre on Kabetogama to 4.9 on Namakan Lake (Rainy excluded). More than half of all fishing trips were made on Kabetogama Lake. Fifty-four percent of all fishermen were non-residents. The fishery on each of the lakes was similar in that walleye and northern pike were the principal species in the catch but the yields from each lake varied widely. The highest average annual yield was from Crane Lake (8.9 lbs. per acre); the walleye yield was 5.4 lbs. per acre and the northern pike yield was 1.3 lbs. per acre. The U.S. waters of Rainy Lake yielded an average of 0.3 lbs. per acre of walleye and 0.4 lbs. per acre of northern pike; the total harvest was less than 0.8 lbs. per acre. The age class structure of the walleye harvest was similar from all lakes. Age III and IV walleye comprised the bulk of the catch. The average age of walleye harvested was about 4.5 years.

^{1/} Completion Report. Study IX, Job 1B, D-J Project FW-1-R-24

INTRODUCTION

Voyageurs National Park was authorized on January 8, 1971 when the U.S. Congress passed the enabling legislation and was established on April 8, 1975 when the Minnesota legislature provided for the transfer of necessary state lands. The boundaries of the park include nearly all or portions of the American waters of Crane, Kabetogama, Namakan, Rainy and Sand Point Lakes. The boundaries were drawn to exclude areas of the shoreline of these lakes where substantial private development was already present. The international boundary splits several of the lakes and most of the park is accessible only by boat or seaplane (Figure 1). The park and its facilities have been developed slowly over several years and as yet little in the way of new visitor facilities has been built.

The State of Minnesota has jurisdiction over waters of the park and responsibility for the management of the fishery. Because creation of the national park could be expected to generate a change in the use of the waters, the Department of Natural Resources conducted a quantitative creel census in the summers of 1977 and 1978 to determine the present characteristics of the sportfishery.

Description of the Study Area

The lakes of the area are characterized by rocky, irregular forested shorelines and numerous islands which provide a wilderness-type setting. The lake beds, particularly in the east, are primarily bedrock of the Canadian shield formation which have been subject to upheaval and tilting, while in the western part of Kabetogama low bog areas associated with the lake bed of glacial Lake Agassiz are predominant. The lakes are generally ice covered from mid-November through mid-April of each year. The area has

long been intensively used by tourists and fishermen. The access points to the lakes are intensively developed with private resorts, homes and cabins and the area is known for its walleye fishing.

The lakes censused are natural reservoirs of a drainage system which begins in northeastern Minnesota and ultimately ends in Hudson Bay. Included in this study were Crane (3,396 acres), Kabetogama (25,750 acres), Namakan (28,260 acres) and Sand Point (8,890 acres) lakes, whose levels are controlled by a dam at Kettle Falls on Namakan lake, and Rainy lake (220,800 acres) whose levels are controlled by a dam at International Falls^{2/}. Each of these waters, except Kabetogama and Crane lakes, are border lakes, parts of which lie in Canada. In addition, parts of each of the lakes lie within or border the Voyageurs National Park boundary.

Access to the lakes by road is limited. Neither Namakan nor Sand Point lakes are accessible by road. The western end of Rainy lake is accessible by road as is the south shore of Kabetogama lake. The other two access points are via road to Crane lake and the Ash River. On the Canadian side only Rainy lake is directly accessible by road.

Development is limited to the areas served by road and to scattered development on islands (primarily cabins) and other areas accessible only by boat. Users of these scattered developments must enter and exit the area through the developed areas served by roads. Although development is limited, it is concentrated. There are 29 resorts at Kabetogama lake; 5 resorts and a houseboat rental resort at the Ash River and 8 resorts

^{2/} The structures at the outlets of these lakes raise the levels of the reservoirs although natural rock "dams" are present at both locations. Thus they are natural lakes and the term reservoir is employed only to indicate that the levels of the lakes are regulated (International Joint Commission).

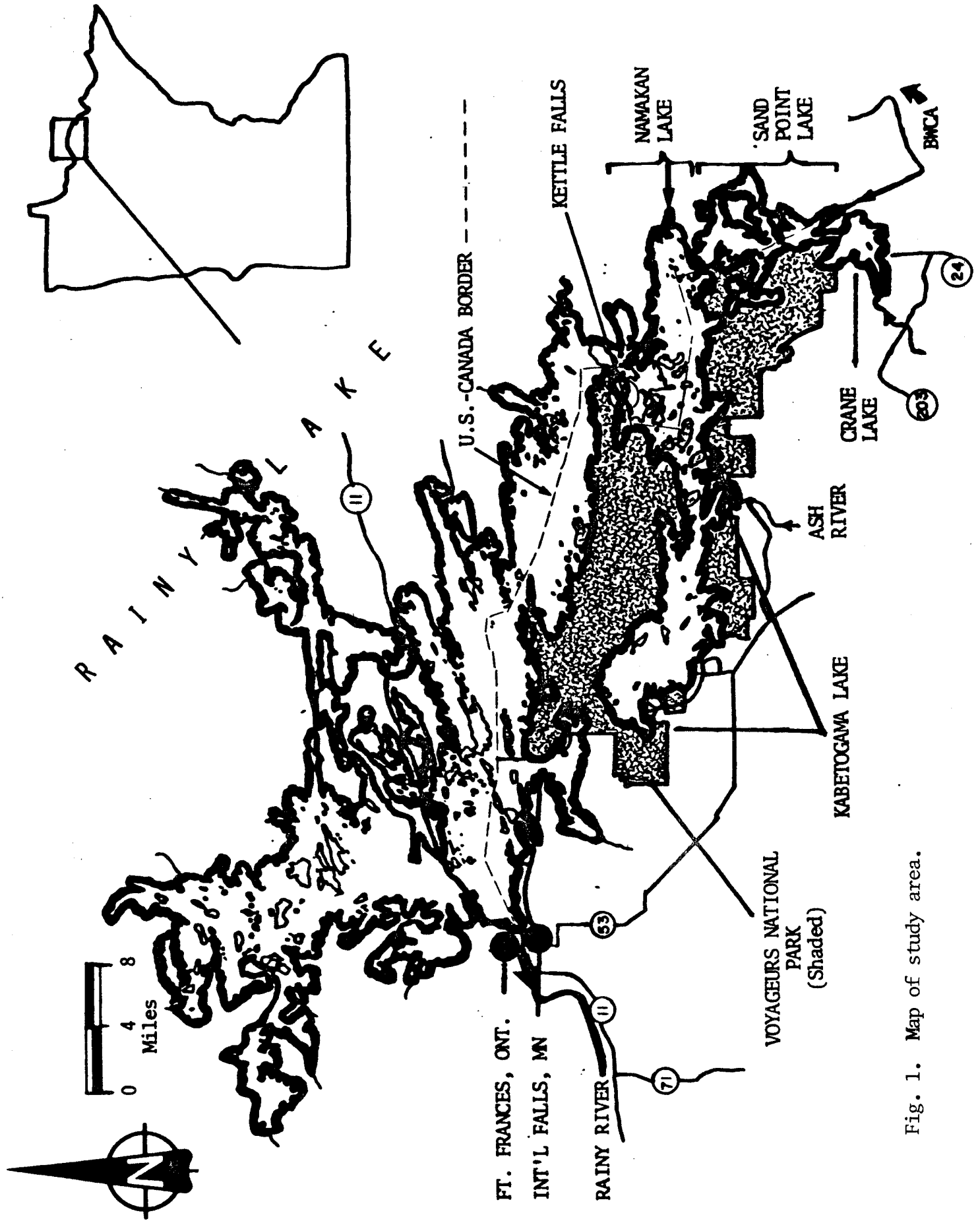


Fig. 1. Map of study area.

and a houseboat rental at Crane lake. A total of 9 resorts and 2 houseboat rental resorts are on the American side of Rainy lake.

No obstruction precludes free travel by boat between Kabetogama, Namakan, Sand Point and Crane lakes. Rainy lake is separated from these four lakes by the dam at Kettle Falls. There are portages between Rainy lake and both Kabetogama and Namakan lakes. Several of the lakes of the Boundary Waters Canoe Area to the east are also accessible from Sand Point lake via railroad portages at Loon lake and Lac La Croix.

A water quality study in March and August of 1977 (Payne, 1979) at six widely separated areas within the park boundaries, on Kabetogama, Namakan, Rainy and Sand Point lakes indicated that water fertility is low to moderate. Total phosphorus ranged from 0.00 to 0.06 with the lowest values recorded at sampling sites at the east side of the park. Total alkalinity ranged from 16 to 52 mg/l and pH from 6.6 to 8.9. Secchi disc readings ranged between 0.6 to 2.9 m.

METHODS

The census presented several problems: 1) access to the lakes was limited by roads but movement by boat between most of the lakes was unrestricted; 2) access to the lakes censused was possible by boat from lakes outside the census area; 3) the study was conducted within the U.S. but access to all of the lakes from Canada was possible; 4) the nature of the recreational opportunities was such that five categories of users, each with differing fishing habits, had to be accounted for separately.

The solution to obtaining the data at a reasonable cost was the use of a nonuniform probability sampling census as described by Fleener (1971) and modified by Osborn^{3/}.

Four census clerks were employed throughout each summer. One clerk covering each access area, e.g. Ash River (3 stations in 1977, 2 in 1978), Crane lake (3 stations), Kabetogama (11 stations) and Rainy lake (9 stations^{4/}). (See Appendix Table 1 for station locations.) Clerks changed stations every two hours and recorded completed trips by method for one hour intervals. Anglers were interviewed as time permitted. Completed fishing trips were recorded in 5 categories: (1) sportfishing boat; (2) guided boat; (3) shore; (4) houseboats; and, (5) campers. For the first three methods, length of trip was determined by the difference between the time that the trip was completed and the time the angler indicated the trip began. For the other two methods, where parties were out generally over several days, inquiry was made as to time actually fished. Clerks also recorded the number of fish caught and weighed, measured and scale sampled. All anglers were asked where they had fished, both by lake and grid location (see Appendix Figure 1). The residence of anglers was also recorded. Scale samples were collected

^{3/} Osborn, T.C. "Longterm Changes in a Walleye Sportfishery and Population -- The Lake Winnibigoshish-Cutfoot Sioux Fishery for 1975-77, 1957-58, and 1939". Minn. Dept. Nat. Res. F-26-R Completion Report. In prep.

^{4/} Because certain areas of Rainy lake did not lend themselves to censusing, these areas were geographically delineated, and the number of boats, houses and resorts present on those sections were compared to the same information from censused areas nearby. As a result, we estimated that we did not census 21.8% of all completed trips on Rainy lake and the data was adjusted upward accordingly.

and pressed in clear acetate for age determination. All scales were read twice.

The transformation of field data to final estimates for each lake was complicated by a number of factors. Because five methods of fishing were involved, each with unique trip characteristics, each method required its own set of probabilities by station, hour and day as well as catch and effort data. Data was collected at four accesses but estimates were reported for five lakes and required proration. Three of the lakes required an additional separation into Canadian and U.S. waters. Catch rates were calculated monthly. The necessity of maintaining the integrity of the data by method, access, lake, political jurisdiction, and month involved a large number of complex calculations and the use of a computer.

The computer was used to expand the station counts to total estimated trips. The program adjusted hourly counts for less than complete hour census periods and multiplied the result by the inverse of the appropriate station, hourly and daily probabilities. The results and standard errors were summarized by week and weekly data was summarized by month. Manhours were calculated by multiplying the total estimated trips by the appropriate mean length of trip and mean number per party.

The manhours were then prorated by lake for each station (and separated by U.S.-Canadian jurisdiction in the case of Namakan, Rainy and Sand Point lakes) based on data from angler interviews. These data were summarized and the resulting percentages were multiplied by the appropriate manhour value to properly apportion effort from accesses to lakes. Monthly catches of fish by number and weight from each lake were estimated by

multiplying catch rates and mean weights by the summation of manhours for each lake and method.

The complex of lakes censused totaled 287,106 acres. Of this total, 166,660 acres are the Canadian waters of Rainy Lake. Because access to Rainy Lake from Canada is good, the census provided only qualitative information. Namakan and Sand Point lakes are also international waters, but access from Canada is difficult and the results of the census can be considered quantitative.

FINDINGS

Fishing effort

Fishing effort varied in amount and intensity (manhours per acre) between lakes and was considerably more intense on U.S. waters. Total fishing effort was estimated to average 886,994 hours per year or 7.4 per acre for the 102,446 acres quantitatively censused. Effort averaged 8.3 manhours per acre for the 103,026 acres of U.S. waters and only 1.7 manhours per acre for the 17,420 acres of Canadian waters.

The majority of all fishing effort occurred at Kabetogama lake. This lake accounted for 60% of all manhours fished (Table 1). Kabetogama lake was also the most intensively fished lake. Fishing effort averaged 20.5 manhours per acre, 30% more than at Crane lake, the second most intensively fished lake. Crane lake was subject to an average of 16.8 manhours of fishing per acre but because of its relatively small size fishing effort amounted to only six percent of the total for all lakes. Namakan lake was subject to an average of twice as many total manhours

as Crane lake but fishing intensity was only one-fourth that at Crane lake. Total fishing effort on Sand Point lake was greater than at Crane lake but intensity on a per acre basis was about one-half that at Crane lake. The U.S. waters of Rainy lake were the most lightly fished averaging 2.0 manhours per acre. Although the area of the U.S. portion of Rainy lake is about twice that of Kabetogama lake, total manhours fished was only about one-fourth of the total at Kabetogama lake.

Although the census could not provide a quantitative estimate of total fishing effort on Rainy lake, more fishermen gaining access on the U.S. side crossed the border to fish in Canada than stayed to fish on the U.S. side (Table 1).

Table 1. Fishing pressure expressed as total manhours and manhours per acre, summer 1977-78

Lake	Waters	Area (Acres)	Average total manhours	1977 Manhours per acre	1978 Manhours per acre
Crane	U.S.	3,396	57,053	18.4	15.2
Kabetogama	U.S.	25,760	528,080	17.6	23.4
Namakan	U.S.	14,050	104,673	6.9	8.0
	Canada	14,210	22,026	1.3	1.8
	Total	28,260	126,699	4.1	4.9
Rainy ^{a/}	U.S.	54,140	102,866	1.7	2.1
Sand Point	U.S.	5,680	63,900	11.6	10.9
	Canada	3,210	8,356	1.3	3.9
	Total	8,890	72,246	7.9	8.4

^{a/} The Canadian waters of Rainy lake (166,660 acres) were subject to an average of 149,994 manhours (0.8/acre) for the two summers from access points in the U.S.

Fishing Effort by Method

Angling from sportfishing boats (unguided boats making a daily fishing trip) was the most common fishing method. This method accounted for 9 out of 10 fishing hours. However, there was considerable variation from lake to lake in the methods used. For example, at the large lakes with remote areas (Rainy and Namakan), a larger percentage of fishing effort originated from houseboats, 30% and 14% respectively, than at the other lakes (Figure 2). No houseboat fishing manhours were tallied at smaller and more accessible Crane lake. Sand Point and Namakan lakes, accessible only by water, were favored by campers while the two most accessible lakes, Crane and Kabetogama, were used almost exclusively by small boat fishermen. Guided trips made up a small percentage of the total on each lake, but a larger percentage of this effort occurred on the more remote lakes (Rainy, Namakan, and Sand Point). Shore fishermen contributed a small amount of effort, most of which was at Kabetogama lake.

Quality of Fishing - Catch per Manhour

The variation in the intensity of fishing from lake to lake tended to reflect the quality of fishing as measured by catch per manhour. The average catch rate for all species and all lakes for both years was 0.32 fish/manhour fished or slightly over three hours of fishing per fish caught. By lake, average success ranged from 0.42 fish per manhour on Crane lake to 0.24 in Rainy lake (Figure 3).

The differences in fishing success between lakes reflects to a large

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extent the differences in walleye catch rate. Walleye were the most commonly caught species. Catch rates for walleye on the entire census area averaged 0.21 per manhour in 1977 and 0.24 in 1978 for a two-year average of 0.23. By lake, the average two-year catch rate was highest at Crane lake (0.30 walleye per manhour) and lowest at Rainy lake (0.13)^{5/}.

Walleye catch rates varied considerably on the larger lakes by area fished. For example, on Rainy lake, where data was separated into nine grid areas, the walleye catch rate varied from 0.0 for grid area 1 to 0.45 fish per manhour in grid area 5 in 1977 and from 0.02 in grid area 2 to 0.35 in grid area 3 in 1978 (see Appendix Figure 1 for grid locations and Appendix Table 2 for grid catch rates).

Northern pike were the second most commonly caught species. Northern pike catch rates were highest at Rainy and Kabetogama lakes (0.07 per manhour) and lowest at Namakan lake (0.02 per manhour).

Catch rates for other species were low. The highest average catch rates for yellow perch were at Kabetogama lake (0.03 fish/manhour) and 0.01 on Rainy lake. The highest catch rates for sauger were at Crane and Kabetogama lakes, averaging 0.03 fish per manhour. Smallmouth bass fishing was best on Crane lake (0.04/manhour) and Sand Point lake (0.03/manhour), the southeastern areas of the complex. Other fish species caught listed by descending catch rates are black crappie and rock bass, taken from all

^{5/} The relatively low catch rate on Rainy lake likely is biased toward the low side because of 1) the large amount of travel time included in the calculations for two methods, sportfishing boat and guided trips; 2) the large percentage of houseboat fishing effort involved in the calculations, a situation where recreation other than fishing is the focus of the trip.

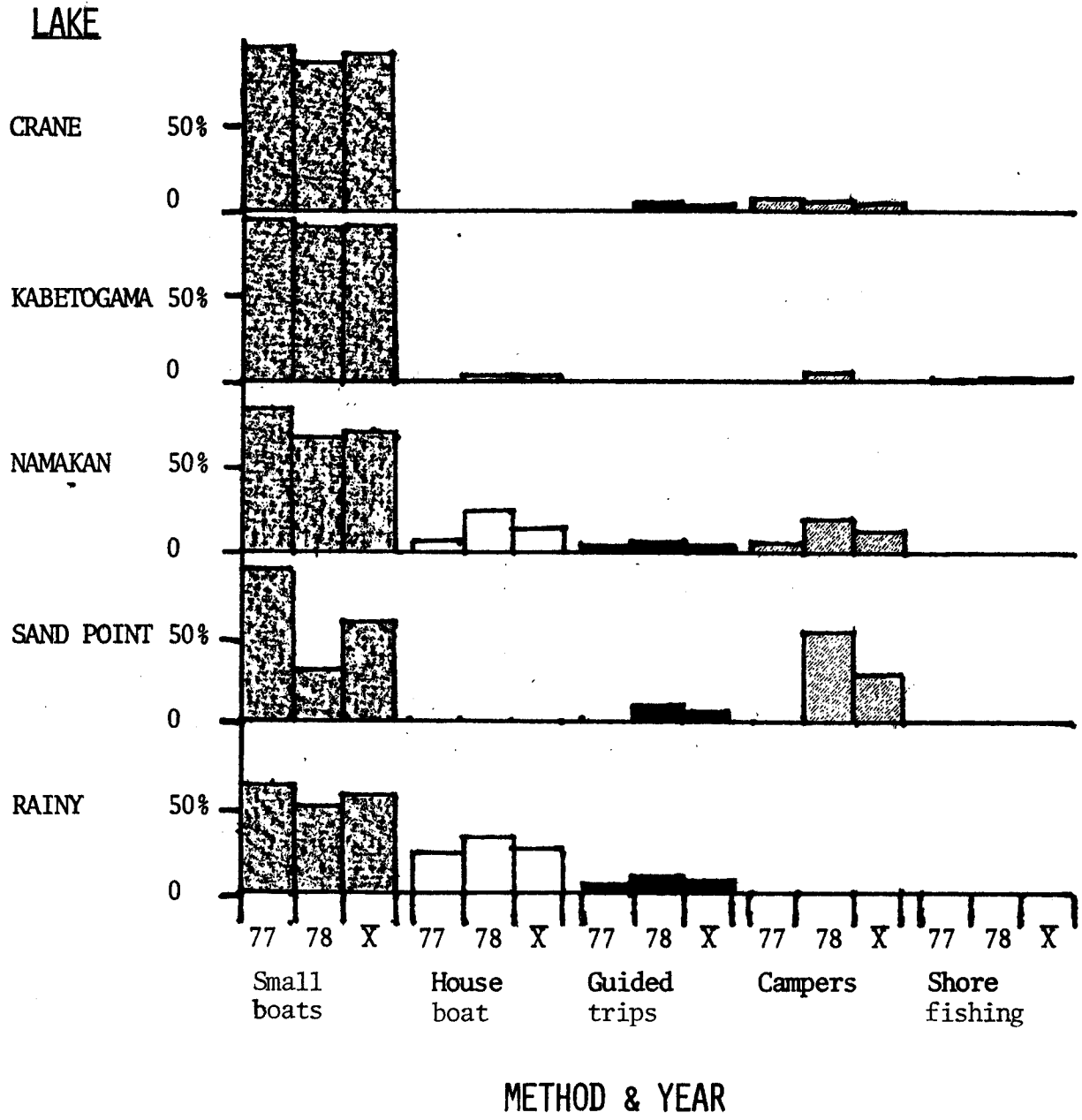


Fig. 2. Average percent of fishing effort by method and lake for the summers of 1977-78

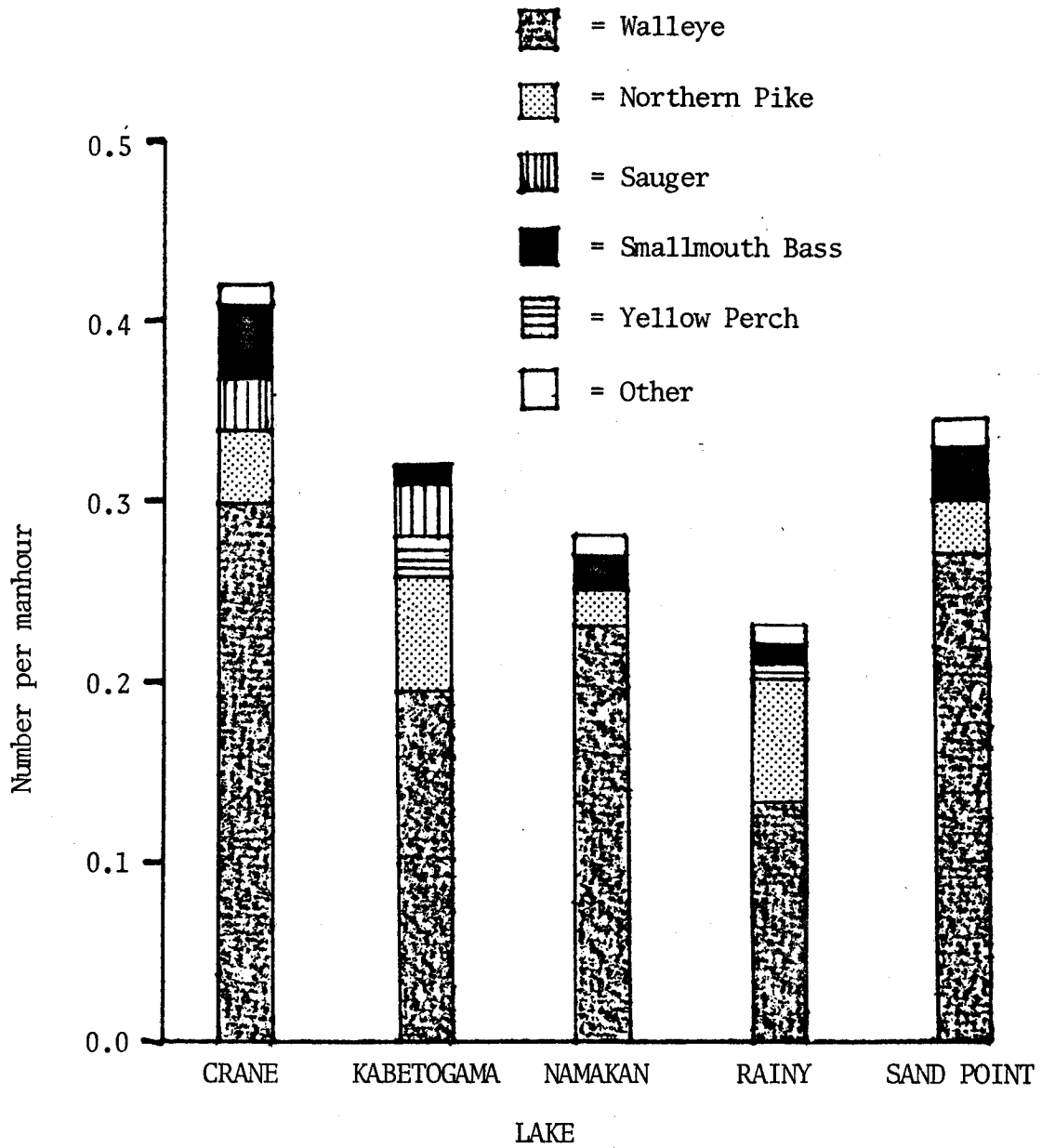


Fig. 3. Average number of fish caught per manhour fished for the summers of 1977-78

lakes; sturgeon taken from Namakan and Sand Point lakes, burbot, taken from Namakan lake, and mooneye taken from Rainy lake.

Walleye Catch Rates - Monthly

Walleye catch rates varied both by month and by year with the highest catch rates occurring in the cooler months. Highest average monthly catch rate for May was at Crane lake at 0.38 walleye per hour (Figure 4). Sand Point lake had the highest single monthly catch rate in September of 1977 at 0.57 walleye/hour. Although Crane and Sand Point lakes had the highest average and single monthly catch rates they also had some monthly rates which were poor. Rainy lake had the lowest average yearly walleye catch rate and it was consistently the lowest by month.

Quantity of Fish Caught

The catch was dominated by walleye which accounted for two of every three fish caught from U.S. waters. Northern pike were the second most numerous species caught. Together the two species accounted for 84% of the catch by number and 87% of the catch by weight (see Appendix Table 3, Yearly Catch of Fish).

Walleye yields on U.S. waters were high at Crane and Kabetogama lakes. Respective average annual yields were 5.4 and 5.0 lbs. per acre per year (Figure 5). Average yearly yields from other walleye lakes were 3.3 lbs/acre from Sand Point lake, 1.7 from Namakan lake and 0.3 lbs/acre from Rainy lake. Walleye dominated the catch by numbers on all lakes and by weight from every lake except Rainy. The average annual yield of walleye from U.S. waters of Namakan, Kabetogama, Sand Point and Crane lakes was 3.9 lbs. per acre.

Northern pike yields were also higher on Crane and Kabetogama lakes than from U.S. waters of the other lakes. The average yearly yield was 1.3 lbs. per acre from Crane lake and 2.7 lbs. per acre from Kabetogama lake. The average yearly yields from the other lakes were 1.1 from Sand Point lake, and 0.4 from Namakan and Rainy lakes. Northern pike dominated the catch by weight only at Rainy lake. Lakes of the Namakan Reservoir (Crane, Kabetogama, Namakan, Sand Point) produced an average yield of 1.8 lbs. per acre from U.S. waters.

Yields of other species were considerably lower on all lakes. Sauger contributed about 6% of the harvest from Kabetogama lake but less than 3% from the other lakes. Smallmouth bass contributed over 19% of the harvest from Crane lake and over 11% from Sand Point lake. Harvest of smallmouth bass was lowest in Kabetogama lake, contributing only 2%. No other species (including yellow perch, black crappie, rock bass, sturgeon, burbot and mooneye) made up more than 2% of the yield from any lake and all of these species combined averaged less than 5% of the total yield.

Total yield of all species combined was greatest from Crane and Kabetogama lakes. These yields, 8.9 and 8.8 lbs/acre respectively, were almost twice the average summer yield of the U.S. waters of Sand Point lake (5.3 lbs/acre/year) and higher than those from Namakan (2.4 lbs/acre/year) and Rainy lake (0.7 lbs/acre/year).

Quality of Fishing - Size of Fish

Walleye and northern pike taken from the lakes were similar in size to those taken from other lakes in Minnesota censused recently. The mean length of walleye harvested ranged from 13 inches to 15 inches T.L.

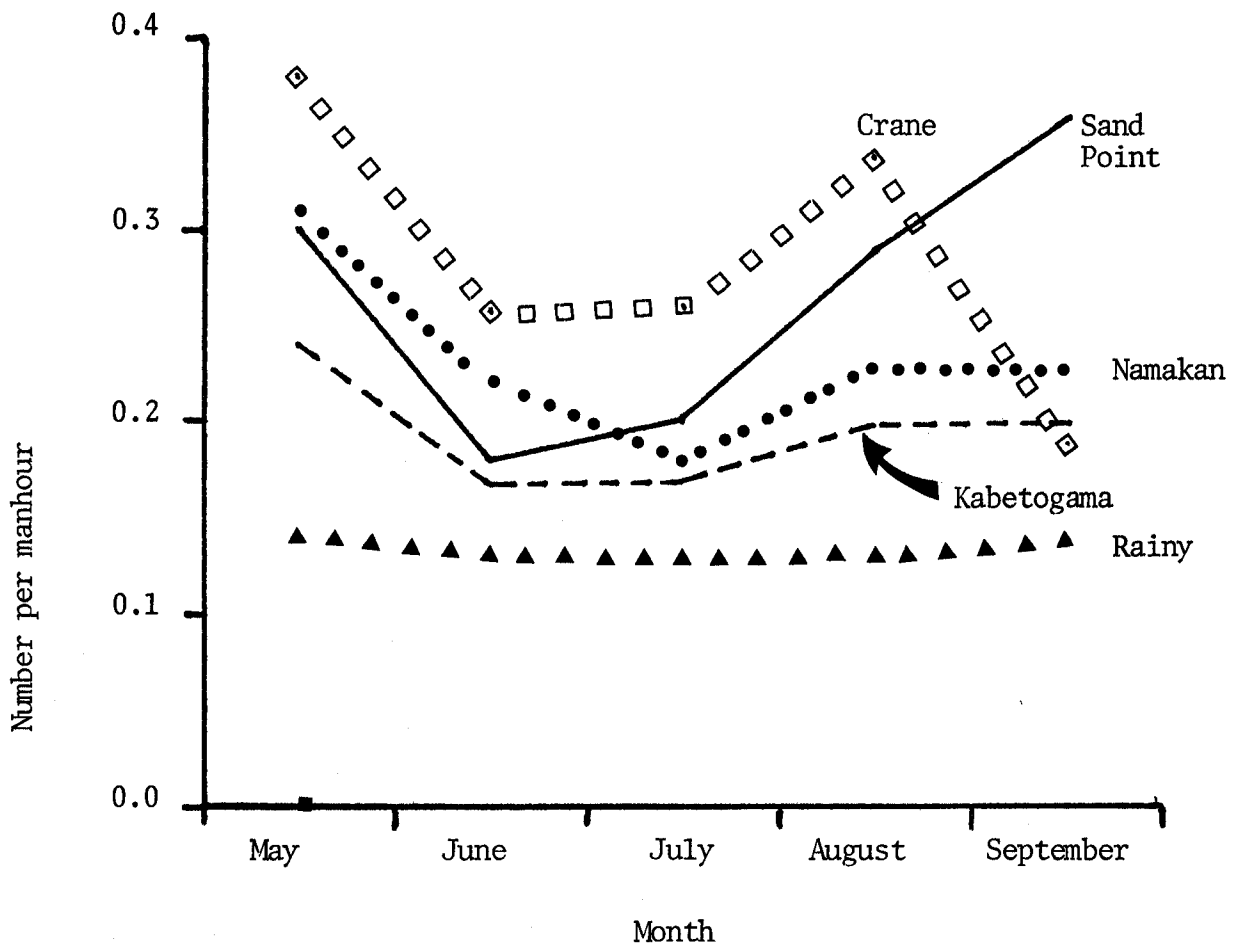


Fig. 4. Average monthly 1977-78 catch rate for walleye by lake

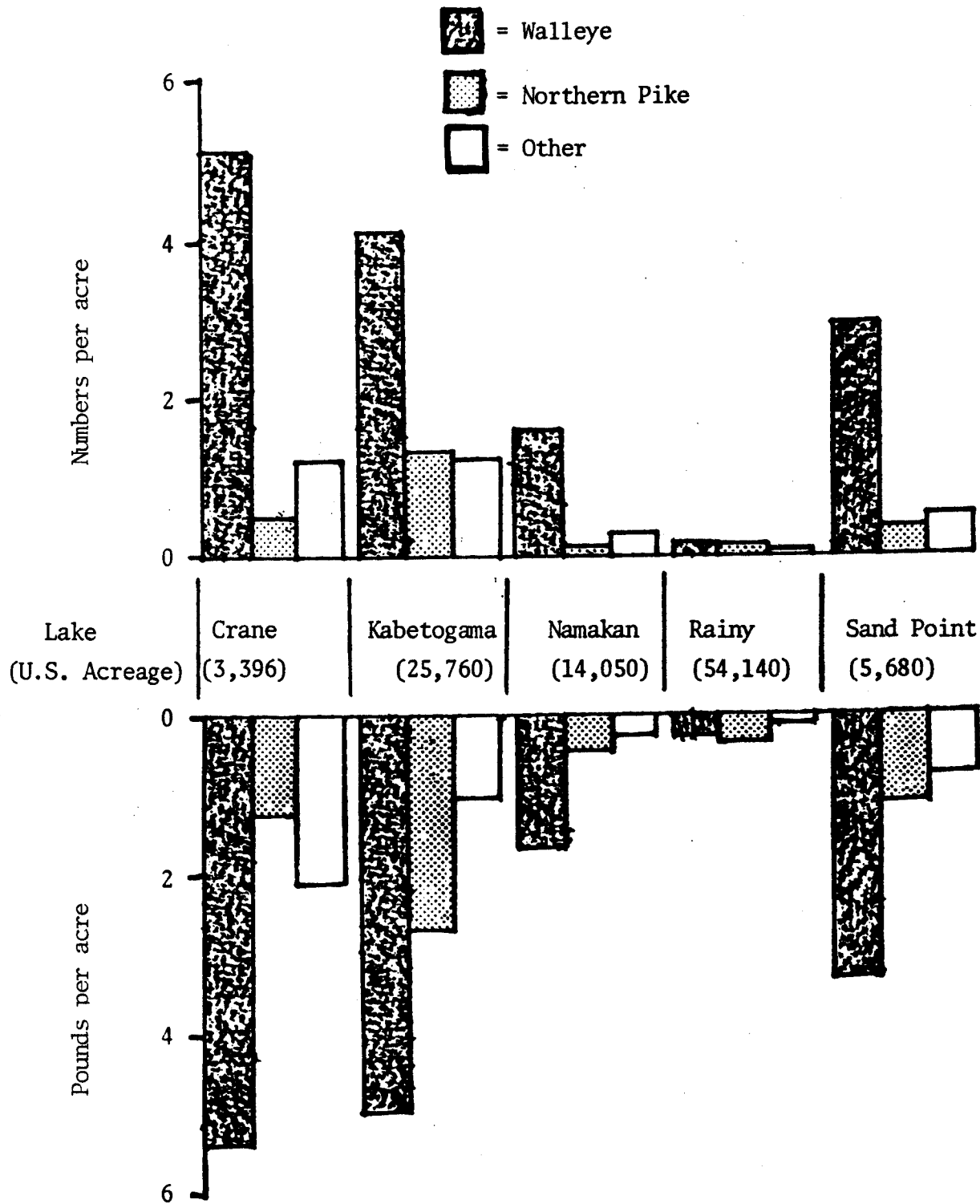


Fig. 5. Average annual yield in numbers and pounds per acre for the summers of 1977-78 from U.S. waters

(Figure 6) for the various lakes. This was similar to the average size from Lake Winnibigoshish, a 62,000 acre lake in north central Minnesota censused in 1975-77, where walleye averaged nearly 15 inches^{3/}. Walleye from Crane lake averaged slightly smaller than those from other lakes.

Adequate samples of northern pike lengths were available only from Kabetogama and Rainy lakes. The mean total length of northern pike taken from Kabetogama lake was 21.2 inches in both 1977 and 1978 and 22.5 inches from Rainy lake in 1978. These values were nearly identical to those from Lake Winnibigoshish where northern pike harvested averaged 22.4, 23.1 and 22.4 inches T.L. for the years 1975-77, respectively.

The average weight of walleye and northern pike taken also tended to be similar from lake to lake. The average weights of walleye varied by only 0.1 pounds (Table 2) among lakes and the average for all lakes (1.2 pounds) was identical to that from Lake Winnibigoshish for the years 1975-77. The average weights of northern pike were more variable, ranging from 2.1 to 3.1 pounds.

Table 2. Average weight (lbs.) of walleye and northern pike taken by anglers in summers of 1977 and 1978

Species	Crane	Kabetogama	Namakan	Sand Point	Rainy	Winnibigoshish ^{3/}
Walleye	1.1	1.2	1.1	1.1	1.2	1.2
N. Pike	2.2	2.1	2.5	3.1	2.3	2.9

Age of Walleye Harvested

Sufficient scale samples were taken to reliably estimate the age class structure of the harvest from Kabetogama and Rainy lakes in both 1977 and

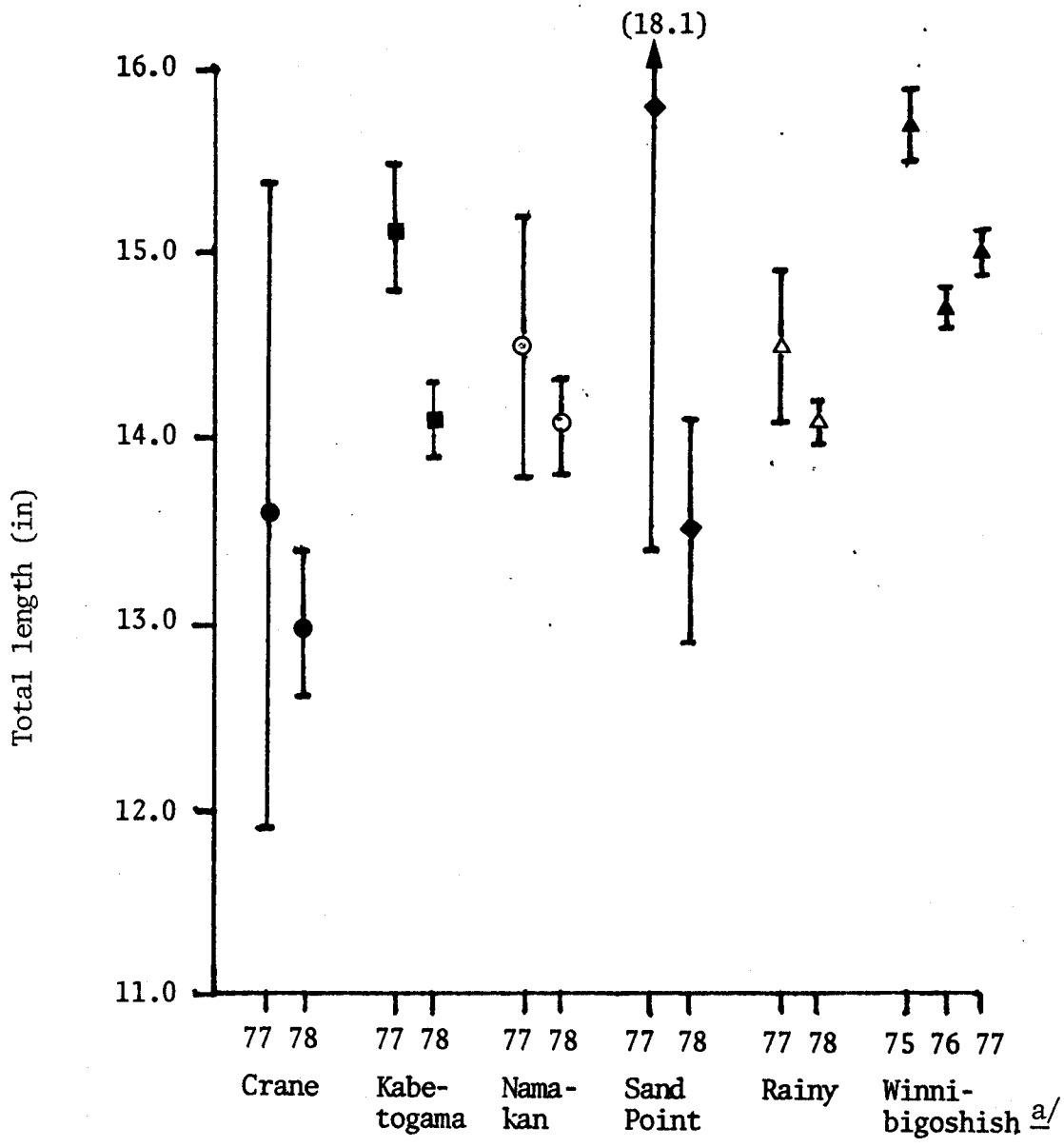


Fig. 6. Mean T.L. of walleye (inches) by year and lake and 95% C.I. for estimates

^{a/} From research files at Grand Rapids

1978 and from Namakan lake in 1978. Ages represented in the catch ranged from one to sixteen and averaged 4.7 for Kabetogama lake, 4.4 for Namakan lake and 4.0 for Rainy lake (Table 3). In each lake, walleye aged II through IV comprised the majority of the catch. Age IV was the dominant age group. These findings are nearly identical to that from Lake Winnibigoshish where the average age of walleye harvested was Age IV for the years 1975-77.

Table 3. Percentages of walleye harvested by age, lake, and year, summer 1977-78

Lake	Year	Sample Size	Percent of Harvest by Age Class								Average Age ^{b/}
			I	II	III	IV	V	VI	VII	VIII+	
Kabetogama	77	323 ^{a/}	1	3	28	26	13	10	10	10	4.9
	78	316	-	13	11	42	9	11	5	9	4.5
Namakan	78	233	-	6	19	36	16	15	6	1	4.4
Rainy	77	173 ^{a/}	-	14	27	32	13	6	5	4	4.1
	78	215	-	1	41	38	15	3	1	2	3.9

a/ Scales collected in each month but not necessarily in amounts proportionate to catch.

b/ Average age computed from actual ages, no lumping of VIII+.

User Patterns - Access

The interconnection of the lakes allowed anglers to fish lakes other than where they launched their boats. Accesses on American soil are confined to four areas -- Ash River, Crane lake, the southern shore of Kabetogama lake and the western end of Rainy lake. These access areas include both public and private (resort) access to the lakes. The

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Kabetogama access was the point of origin for more fishing trips than the other three areas combined with an average of about 42,000 trips per summer (Table 4). More than 12,000 fishing trips originated from each of the other access areas.

The preference for the Kabetogama access area appears to be for two reasons: 1) amount and type of development on the lake, and 2) proximity to good fishing areas. Kabetogama lake has 33 resorts^{6/} which cater to sportfishing boats. These account for 56% of all such facilities in the census area (Table 5). All of these are located on the lake. In contrast, Namakan lake can only be reached by boat or plane. Rainy lake has only one facility for small sportfishing boats per 4,512 surface areas whereas Kabetogama lake has one per 805 surface acres. The concentration of resorts on Kabetogama lake also accounted for the majority of shore fishing trips most of which were from docks.

The type of development also influenced fishing methods at other access areas. Approximately twice as many houseboat trips were made on Rainy lake as from other accesses, but there were also twice as many houseboats available for rental. The access at Crane lake had the most canoe outfitters and was also the point of origin for most camping trips.

Anglers using each of the four access areas tended to fish on the lakes nearest the access. On Crane and Sand Point lakes, all fishing effort began at the nearest access -- Crane lake. On Rainy lake, 99% of all fishing began at facilities on the lake. Fishing effort at Kabetogama lake originated from two accesses, Ash River and the southwest shore of Kabetogama lake, with most trips (85%) beginning from resorts

^{6/} Resorts and boat launching ramps.

Table 4. Estimated mean number of completed trips by method and landing for lakes in Voyageurs National Park and adjacent waters, summer 1977-78

Access Point	Average Completed Trips during Summer						Total (+)
	S.F. Boat (+)a/	Houseboat (+)	Guide (+)	Campers (+)	Shore (+)		
Ash River	11,662 (17.3%)	176 (43.1%)	9 (70.7%)	107 (70.4%)	13 (92.3%)		11,967 (18.2%)
Crane Lake	9,025 (23.1%)	55 (82.4%)	743 (78.3%)	2,009 (64.1%)	14 (100.0%)		11,846 (33.8%)
Kabetogama	39,614 (18.4%)	0 (-)	193 (91.8%)	851 (69.1%)	1,121 (78.8%)		41,779 (21.3%)
Rainy Lake	10,347 (25.2%)	511 (70.0%)	898 (78.1%)	9 (100.0%)	97 (99.0%)		11,862 (31.7%)
TOTALS	70,648 (21.0%)	742 (65.2%)	1,843 (79.7%)	2,976 (75.9%)	1,245 (92.5%)		77,454 (26.0%)
Percent of Total Trips by Method	91.2%	1.0%	2.4%	3.8%	1.6%		

a/ (+) is the 2 year average standard error of the estimate in percent.

on the lake. Most anglers on Namakan lake began their trip at Ash River, which accounted for 70% of all trips on the lake; others started from Crane lake (25%) or Kabetogama lake (5%).

Table 5. Recreational development by type for each access area for lakes in Voyageurs National park and adjacent waters

Area	Resorts	Houseboat Rental Resorts	Boat Launching Ramps	Canoe Outfitters	All
Crane	8	1	1	2	12
Kabetogama	29	0	3	1	33
Ash River	5	1	1	0	7
Rainy Lake	9	2	3	1	15
Totals	51	4	8	4	67

Residency of Anglers

Minnesota residents made up less than half the anglers fishing these lakes (Table 6). About one-half of the non-resident anglers were from Illinois and Iowa.

Table 6. Residency of anglers by access area expressed as a percentage of the total, summer 1977-78

Residency	Access Area				Average
	Crane	Kabetogama	Ash River	Rainy	
Minnesota	59.2	39.0	35.2	50.6	46.0
Illinois	13.2	21.8	16.1	11.6	15.7
Iowa	4.1	18.5	10.6	13.2	11.6
Indiana	3.8	3.6	12.3	0.8	5.1
Wisconsin	2.8	2.3	2.7	2.0	2.5
Foreign	0.2	0.1	0.3	TR	0.2
Other	16.7	14.7	22.8	21.8	18.9

In both years, a similar pattern was observed in the seasonal use of the area by Minnesota residents (Figure 7). Minnesota anglers made up 65% of the total in May. It was the only month when Minnesotans outnumbered non-residents. Minnesotans made up 43% of all anglers in July, but in June, August and September they made up less than 40% of the totals.

More than 80% of all Minnesota anglers were from the eight county metropolitan area of St. Paul-Minneapolis or the two counties in which the lakes are located. The Ash River-Kabetogama lake access areas were favored by metropolitan anglers and residents of outstate counties, while the Crane lake and Rainy lake access areas had a greater proportion of local anglers (Table 7) and fewer residents from outstate counties.

Table 7. Use of access areas by 1,223 Minnesota residents from selected counties for the summers of 1977-78 in percent

Residence	Crane	Ash River	Kabetogama	Rainy	Unweighted Average
St. Paul-Minneapolis Eight County Metro	33.4%	44.1%	44.6%	38.0%	40.1%
Koochiching & St. Louis Counties (Local)	51.1%	15.8%	41.0%	51.8%	42.4%
Other 77 Counties	15.5%	40.1%	13.3%	10.1%	17.5%

DISCUSSION

In general, the harvests from these lakes were similar to those of other large walleye lakes in Minnesota. Catch rates for walleye and northern pike from the combined census lakes were almost identical to

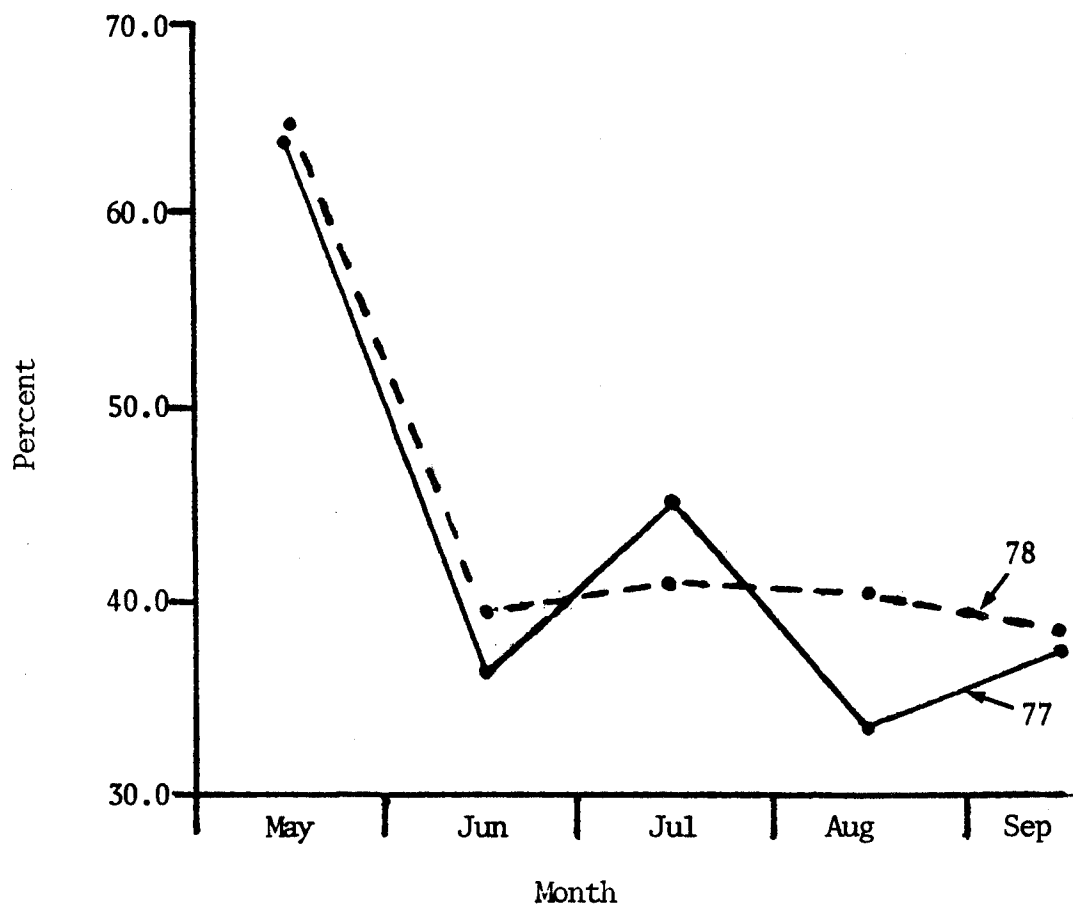


Fig. 7. Average monthly percentage of anglers from Minnesota for the summers of 1977 and 1978 (all accesses combined), Voyageurs National Park and adjacent waters

those from Lake Winnibigoshish for the summers of 1975-77^{3/}. Fishing pressure (manhours/acre) on the American waters was slightly lower than at Lake Winnibigoshish. The average weights of the principal species, walleye and northern pike, were similar to those from Lake Winnibigoshish.

The individual lakes differed substantially in the amount of fishing effort and the quality of the fishery. These differences were partially related to the accessibility of the lakes and development of resort facilities. Crane and Kabetogama lakes provide relatively good fishing from well-developed, accessible areas and were favored by small-boat fishermen. These lakes could be fished under most weather conditions and required less travel time to good fishing areas.

The Rainy lake sport fishery was considerably smaller and the walleye catch rate was lower than that of the other lakes. However, the quantitative results of the Rainy lake census are not comparable to those from the other lakes since only a part of the fishery at Rainy lake was sampled while virtually the entire fishery on the other lakes was censused. Numerous Canadian access points are available to anglers at Rainy lake but access to the other lakes from Canada is difficult.

The creation of a national park could be expected to lead to an increase in use of the area by tourists and thus affect sportfishing, but it seems likely that this influence was minimal during the study. Although open to visitors, the park created no new boat access areas nor did it restrict activities related to the sport fishery. The few facilities built to date are as much a convenience as they are a new service. It appears the park area was used for the same purposes before creation of

the park as it is at present.

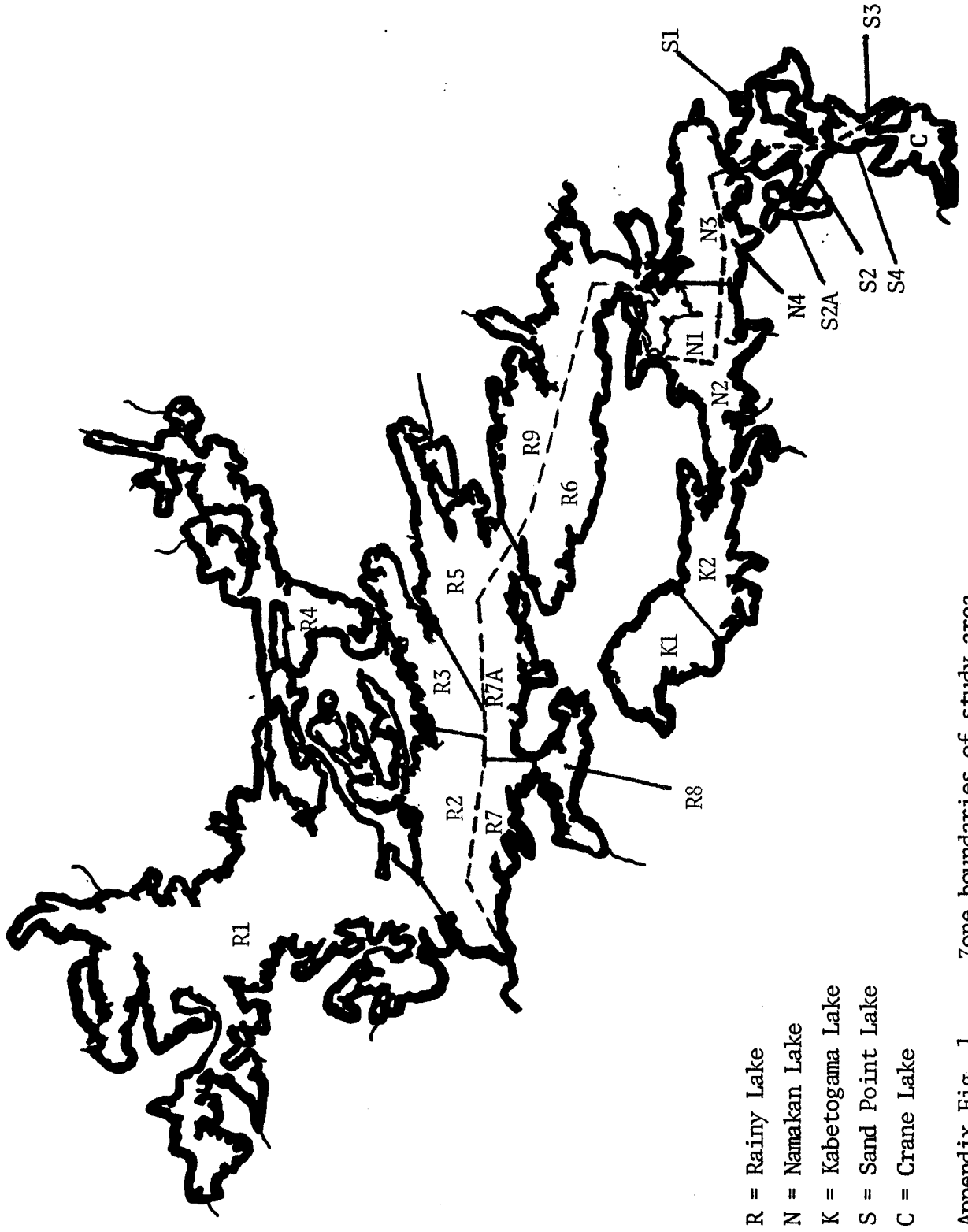
In the long term the park will probably increase tourism, but whether increases in use will focus on the aesthetics of the park or on sportfishing are unknown. However, it is expected that the fishery will follow the trends observed at other lakes in the state where fishing pressure has increased.

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Appendix Fig. 1. Zone boundaries of study area

Appendix Table 1. Creel Census Stations^{a/}

Voyageur's Park Area		
Area	Station No.	Location
Crane	1	<u>Handberg's Resort</u> , State Forestry
	2	Resort area (Channel), <u>Olson's Resort</u>
	3	Public dock, Congdons, <u>Scott's landing</u>
Ash River	4	Meadwood Resort ^{b/}
	5	<u>Whispering Pines</u> , also boat count Ash R. Ash River - <u>Frontier Resort</u>
Kabetogama	6	<u>Gappa's Landing</u> , 4 resorts, private cabins
	7	<u>Four Wind's Resort</u> , Pine Aire, Cedar Cove
	8	<u>Tomahawk Resort</u> to Harmony Beach (8 resorts)
	9	<u>Northern Lights</u> , State Point private homes
	10	<u>Moosehorn & Voyageur's Park resorts</u>
	11	Tall Timber to <u>Park Point Resort</u>
	12	<u>Arrowhead Resort</u> , Grandview, <u>Woodenfrog Campground</u>
	13	<u>Calm Bay</u> access, Kec's Kove & <u>Woodenfrog Campground</u>
	14	<u>Rocky Point Resort</u>
	15	<u>Chippewa Lodge</u> , Whaley's Resort
16	<u>Pinecrest Lodge</u> , Lost Acres Resort	
Rainy Lake	17	<u>Ranier Public Dock</u> & downstream, private homes
	18	<u>Birch Point Campground</u> - Ranier to point at Crystal Bay (private homes)
	19	Crystal Beach private homes, 3 resorts & Rainy Lake Marina, <u>Camp Idlewood</u>
	20	<u>Northern Aire Floating Lodge</u> & private homes
	21	<u>Jackfish Bay</u> (private homes) <u>County Road 135</u>
	22	<u>Rainy Lake Lodge</u> , Spring Lake
	23	<u>Thunderbird Lodge</u> , Rainy Lake Houseboats & <u>Sportsman's Dock</u>
	24	<u>Island View Lodge</u> , Dove Island landing
	25	<u>Sha Sha Resort</u> & <u>Four Island Resort</u>

^{a/} Underlined landings are the major contacts for each station.

^{b/} Closed in 1978.

Appendix Table 2. Sportfishing boat catch rates by lake, year and zone for Boundary lakes

Lake Grid Number	Year	Contact		Walleye		N.Pike		Y.Perch		Sauger		SM Bass		Others		All Species Combined	
		Manhr	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr
Namakan Lake 1 (Canadian)	1977	196.2	0.38	0.08	--	--	0.08	--	--	--	0.08	--	--	--	--	0.54	0.47
	1978	173.3	0.43	0.01	--	--	0.01	0.02	0.01	0.01	0.01	0.01	--	--	--	0.43	0.34
3 (Canadian)	1977	270.2	0.40	0.02	--	--	0.02	--	--	--	0.01	0.01	--	0.01	--	0.43	0.34
	1978	148.0	0.28	0.03	--	--	0.03	--	--	--	0.02	0.02	--	0.01	--	0.43	0.34
2 (American)	1977	2484.4	0.26	0.03	0.01	0.01	0.03	0.01	0.01	TR	0.02	0.02	TR	TR	0.33	0.33	0.26
	1978	1980.8	0.22	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	TR	TR	0.26	0.26	0.26
4 (American)	1977	226.2	0.32	0.02	--	--	0.02	0.01	0.01	0.01	0.03	0.03	TR	TR	0.38	0.38	0.51
	1978	74.3	0.51	--	--	--	--	--	--	--	--	--	--	--	0.51	0.51	0.51
Sand Point Lake 1 (Canadian)	1977	102.5	0.42	0.03	0.01	0.01	0.03	0.01	0.01	--	--	--	--	0.01	0.47	0.47	0.53
	1978	146.0	0.37	0.05	0.01	0.01	0.05	0.01	0.01	0.01	0.07	0.07	0.01	0.01	0.53	0.53	0.53
3 (Canadian)	1977	52.5	0.50	0.04	--	--	0.04	--	--	--	--	--	--	--	0.53	0.53	0.55
	1978	61.5	0.50	0.03	--	--	0.03	--	--	--	--	--	--	0.02	0.55	0.55	0.55
2 (American)	1977	281.5	0.26	0.03	--	--	0.03	--	--	0.01	0.01	0.01	--	--	0.30	0.30	0.62
	1978	347.5	0.50	0.03	TR	TR	0.03	TR	TR	--	--	0.06	0.03	0.03	0.62	0.62	0.62
2A (American)	1977	35.0	0.23	0.04	--	--	0.04	--	--	--	0.03	0.03	--	--	0.30	0.30	0.26
	1978	54.5	0.15	0.04	--	--	0.04	--	--	0.02	--	--	0.06	0.06	0.26	0.26	0.26
4 (American)	1977	290.0	0.46	0.01	--	--	0.01	--	--	0.01	0.04	0.04	0.04	--	0.51	0.51	0.41
	1978	78.5	0.23	0.10	--	--	0.10	--	--	0.04	0.03	0.03	0.03	0.01	0.41	0.41	0.41
Rainy Lake 1 (Canadian)	1977	99.6	--	0.07	0.02	0.02	0.07	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.13	0.13	0.64
	1978	26.8	0.11	0.26	0.11	0.11	0.26	0.04	0.04	0.04	--	--	--	0.11	0.64	0.64	0.64
2 (Canadian)	1977	124.1	0.09	0.27	0.02	0.02	0.27	0.02	0.02	0.02	0.02	0.02	0.02	--	0.41	0.41	0.45
	1978	603.8	0.02	0.41	0.15	0.15	0.41	--	--	--	--	0.01	0.01	0.08	0.45	0.45	0.45

Appendix Table 2. (continued)

Lake Grid Number	Year	Contact Manhr	Walleye		N. Pike		Y. Perch		Sauger		SM Bass		Others		All Species Combined	
			Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr	Catch	Manhr
Rainy Lake 3 (Canadian)	1977	95.1	0.32	0.06	--	--	--	--	0.01	--	0.01	--	--	--	0.39	
	1978	17.0	0.35	--	--	--	--	--	--	--	--	--	--	--	0.35	
4 (Canadian)	1977	113.8	0.16	0.01	0.01	0.01	0.01	0.01	0.01	0.01	--	0.01	0.01	0.18		
	1978	160.8	0.26	0.05	--	--	--	--	--	--	--	--	--	--	0.31	
5 (Canadian)	1977	139.3	0.45	0.11	--	--	--	--	0.04	0.04	0.04	0.04	--	0.62		
	1978	536.5	0.28	0.02	TR	TR	TR	TR	TR	TR	TR	TR	--	0.32		
9 (Canadian)	1977	144.8	0.30	0.10	--	--	--	--	0.03	0.03	0.03	0.03	--	0.44		
	1978	39.0	0.24	0.03	--	--	--	--	0.01	0.01	0.01	0.01	--	0.28		
6 (American)	1977	101.1	0.08	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.06	0.31		
	1978	87.0	0.24	0.02	--	--	--	--	--	--	--	--	--	0.28		
7 (American)	1977	477.1	0.04	0.15	0.04	0.04	0.04	0.04	TR	TR	0.01	0.01	TR	0.24		
	1978	507.5	0.05	0.05	0.02	0.02	0.02	0.02	--	--	TR	TR	TR	0.12		
7A (American)	1977	363.8	0.16	0.07	0.04	0.04	0.04	0.04	0.02	0.02	0.01	0.01	--	0.29		
	1978	445.8	0.10	0.06	--	--	--	--	--	--	0.02	0.02	--	0.19		
8 (American)	1977	326.3	0.06	0.14	0.01	0.01	0.01	0.01	TR	TR	0.01	0.01	--	0.22		
	1978	729.0	0.16	0.04	0.03	0.03	0.03	0.03	0.01	0.01	TR	TR	0.01	0.25		

Appendix Table 3. Estimated catch of fish by number and weight by lake for the summers of 1977 and 1978

Lake	Waters (Acreage)	Year	Walleye		N. Pike		Sauger		S.M. Bass	
			No.	Weight	No.	Weight	No.	Weight	No.	Weight
Crane	U.S. (3,396)	1977	15,085	16,895	3,117	6,421	935	--	2,244	--
		1978	19,346	20,001	823	2,144	1,686	1,120	2,086	5,590
Kabetogama	U.S. (25,760)	1977	73,203	85,648	35,010	68,620	12,276	--	3,637	--
		1978	138,306	172,109	31,276	71,533	17,764	16,863	3,679	4,471
Namakan	U.S. (14,050)	1977	25,541	23,754	2,525	5,883	97	--	2,525	--
		1978	20,675	22,857	2,098	5,519	1,130	1,787	1,762	2,232
	Can. (14,210)	1977	4,861	4,520	481	1,120	19	--	481	--
		1978	4,935	5,586	471	1,188	69	111	635	759
Rainy	Total (28,260)	1977	30,402	28,274	3,006	7,004	116	--	3,006	--
		1978	25,610	28,443	2,569	6,707	1,199	1,898	2,397	2,991
	U.S. (54,140)	1977	9,394	12,306	5,918	13,020	376	--	1,503	--
		1978	14,405	16,668	11,625	27,671	521	460	986	1,987
	Can. (166,660)	1977	17,356	22,736	10,934	24,055	694	--	2,777	--
		1978	23,901	26,049	9,139	20,626	578	454	1,647	2,671
Sand Point	Total (220,800)	1977	26,750	35,043	16,852	37,074	1,070	--	4,280	--
		1978	38,306	42,717	20,764	48,297	1,099	914	2,632	4,658
	U.S. (5,680)	1977	18,556	21,119	2,040	4,202	--	--	1,711	--
		1978	14,832	16,765	2,167	8,701	137	151	2,784	4,105
	Can. (3,210)	1977	1,222	1,369	134	276	--	--	113	--
		1978	3,904	4,134	333	1,330	45	52	548	815
	Total (8,890)	1977	19,782	22,156	2,174	4,481	--	--	1,824	--
		1978	18,736	20,900	2,500	10,031	182	203	3,332	4,920

NOTE: Catch of fish from lakes having Canadian waters are low as estimates given are for fish landed on U.S. accesses only.

Appendix Table 3. (continued)

Lake	Waters	Year	Y. Perch		B. Crappie		R. Bass		Other	
			No.	Weight	No.	Weight	No.	Weight	No.	Weight
Crane	U.S.	1977	125	122	561	--	187	--	--	--
		1978	57	32	338	270	250	--	--	--
Kabetogama	U.S.	1977	11,822	7,318	1,819	--	--	--	--	--
		1978	10,558	6,085	1,633	1,633	41	--	41	-- (Sturgeon)
Namakan	U.S.	1977	583	241	97	--	97	--	--	--
		1978	388	201	84	79	17	12	43	152 (Burbot)
Can.	Can.	1977	111	46	19	--	19	--	--	--
		1978	19	10	6	6	3	2	2,3	7,- (Bur, Stur)
Total	Total	1977	694	286	116	--	116	--	--	--
		1978	399	211	90	85	20	14	45,3	159,- (Bur, Stur)
Rainy	U.S.	1977	1,691	998	939	--	--	--	--	--
		1978	1,369	873	556	556	--	--	--	--
Can.	Can.	1977	3,124	1,843	1,736	--	--	--	--	--
		1978	876	527	651	718	12	4	14	14 (Mooneye)
Total	Total	1977	4,815	2,841	2,675	--	--	--	--	--
		1978	3,245	1,400	1,207	1,274	12	4	14	14 (Mooneye)
Sand Point	U.S.	1977	66	38	66	--	66	--	--	--
		1978	20	11	847	763	20	--	44	1199 (Sturgeon)
Can.	Can.	1977	4	2	4	--	4	--	--	--
		1978	9	5	218	197	9	--	--	--
Total	Total	1977	70	40	70	--	70	--	--	--
		1978	28	16	1,065	960	29	--	44	1199 (Sturgeon)

NOTE: Catch of fish from lakes having Canadian waters are low as estimates given are for fish landed on U.S. accesses only.

Appendix Table 4. Length-frequency of angler caught walleye by lake and year

Total Length (inches)	Crane		Sand Pt		Namakan		Kabetogama		Rainy	
	77	78	77	78	77	78	77	78	77	78
< 8.0										
8.0 - 8.9						1	1	3		
9.0 - 9.9		8			1	11	1	38		6
10.0 - 10.9	1	17	1	6	8	18	7	74	10	39
11.0 - 11.9	3	21		7	7	40	21	74	19	115
12.0 - 12.9	3	27	2	12	14	38	46	83	32	254
13.0 - 13.9	3	13	1	10	17	49	66	138	28	274
14.0 - 14.9	1	13	1	5	8	54	42	161	31	205
15.0 - 15.9		10	1	10	6	44	35	104	32	153
16.0 - 16.9		6	1	2	7	23	33	52	11	80
17.0 - 17.9				1	11	15	29	62	17	52
18.0 - 18.9		3		1	2	14	27	64	3	49
19.0 - 19.9	1	1	1	1	2	9	10	26	7	18
20.0 - 20.9						1	5	16	4	9
21.0 - 21.9	1		2			1	5	4	1	4
22.0 - 22.9		1			1		1	12		
23.0 - 23.9		1			1		2	1		4
24.0 - 24.9					1		5	1		1
25.0 - 25.9					1			1	1	
26.0 - 26.9							2	2		2
27.0 - 27.9								1		
28.0 - 28.9										
TOTAL	13	121	10	55	87	318	338	917	196	1265
MEAN	13.62	12.98	15.75	13.50	14.53	14.05	15.17	14.05	14.48	14.12
STD. DEV.	3.13	2.50	3.83	2.09	3.21	2.45	2.96	2.46	2.51	2.22

Appendix Table 5. Length-frequency of angler caught northern pike by lake and year

Total Length (inches)	Crane		Sand Pt		Namakan		Kabetogama		Rainy	
	77	78	77	78	77	78	77	78	77	78
13.0 - 13.9										
14.0 - 14.9								1		
15.0 - 15.9					1		1	1		1
16.0 - 16.9					2		5			8
17.0 - 17.9							16	12	2	12
18.0 - 18.9					1		12	18		22
19.0 - 19.9					2		16	26	1	35
20.0 - 20.9		2			1	1	15	22	1	67
21.0 - 21.9					1	4	17	20	2	69
22.0 - 22.9						3	14	8		55
23.0 - 23.9	1				3	5	6	11		50
24.0 - 24.9					1	4	6	7		33
25.0 - 25.9	2				2	2	3	4	1	22
26.0 - 26.9		1					1	2	1	18
27.0 - 27.9							2	3	1	7
28.0 - 28.9									1	7
29.0 - 29.9				1					1	4
30.0 - 30.9						1	1	2		3
31.0 - 31.9						1	1			1
32.0 - 32.9										
33.0 - 33.9										5
34.0 - 34.9										
35.0 - 35.9										1
36.0 - 36.9										
37.0 - 37.9							1			1
38.0 - 38.9							2	1		
39.0 - 39.9										
40.0 - 40.9										
41.0 - 41.9										
42.0 - 42.9	1				1					
TOTAL	4	3	0	1	15	21	119	138	11	421
MEAN	29.20	22.45		29.75	22.65	23.94	21.15	21.20	23.18	22.54
STD. DEV.	8.88				7.13		3.95		4.41	

Appendix Table 6. Length-frequency of angler caught sauger and perch by lake and year

Total Length (inches)	Sauger						Perch			
	Crane		Kabetogama		Namakan ^{a/}	Rainy ^{a/}	Kabetogama		Namakan ^{a/}	
	77	78	77	78	78	78	77	78	78	
< 8.0									2	
8.0 - 8.4							1	5		
8.5 - 8.9								6	1	
9.0 - 9.4				1	3		2	4	1	
9.5 - 9.9		1		4	1	1		4	3	
10.0 - 10.4		1		5	4	1	2	6	2	
10.5 - 10.9	1		1	2	1	2	1	6		
11.0 - 11.4		1		3	2	3	6	3	2	
11.5 - 11.9	2	3	4	3	6	6	2	6	1	
12.0 - 12.4		2	5	3	1	9	3	1		
12.5 - 12.9			2	4	4	3	1	1		
13.0 - 13.4			13	10	1	4	1			
13.5 - 13.9	1		9	14	1	4		2		
14.0 - 14.4			13	18		2		2		
14.5 - 14.9			2	11	1					
15.0 - 15.4			4	8		2				
15.5 - 15.9			4	9	1	1				
16.0 - 16.4			2	3		1				
16.5 - 16.9			1							
17.0 - 17.4			2							
17.5 - 17.9										
TOTAL	4	8	62	98	26	39	19	48	10	
MEAN	11.95	11.33	13.87	13.56	11.66	12.60	11.09	10.29	10.15	
STD DEV.	1.26	0.92	1.38	1.74	1.66	1.46	1.26	1.70	0.96	

a/ None were measured in 1977

Appendix Table 7. Length-frequency of angler caught smallmouth bass and crappie lake and year

Total Length (inches)	Smallmouth Bass						Crappie			
	Crane		Namakan		Kabetogama		Rainy ^{a/}	Sand Pt. ^{a/}	Kabetogama ^{b/}	Rainy
	77	78	77	78	77	78	78	78	77	78
8.0										
8.0 - 8.4										
8.5 - 8.9					1	3				
9.0 - 9.4						4				
9.5 - 9.9			1		1	5	1	1		
10.0 - 10.4		2				8				
10.5 - 10.9		3	2	6		4	1	2		5
11.0 - 11.4		2	1	1	1	1	5	1	2	3
11.5 - 11.9		1	1	4	1	4	3	1	2	2
12.0 - 12.4				4	1	2	2	3	1	4
12.5 - 12.9		1	1	3	2	1	4	1		1
13.0 - 13.4	1		1	2	3		3	1	1	2
13.5 - 13.9	1			1		1	2		1	
14.0 - 14.4		1	1	2		1	2	2		
14.5 - 14.9				1		1	1		1	
15.0 - 15.4					1	1		1		
15.5 - 15.9		1						3		
16.0 - 16.4						1				
16.5 - 16.9							1			
17.0 - 17.4				1				1		
17.5 - 17.9										
18.0 - 18.4							2			
18.5 - 18.9	1						2			
19.0 - 19.4										
TOTAL	3	11	8	25	11	37	29	17	8	17
MEAN	15.20	11.75	11.76	12.38	12.15	10.94	13.36	13.20	12.45	11.67
STD. DEV.	3.04	1.77	1.50	1.57	1.80	1.87	2.50	2.17	1.28	0.87

a/ None were measured in 1977

b/ None were measured in 1978