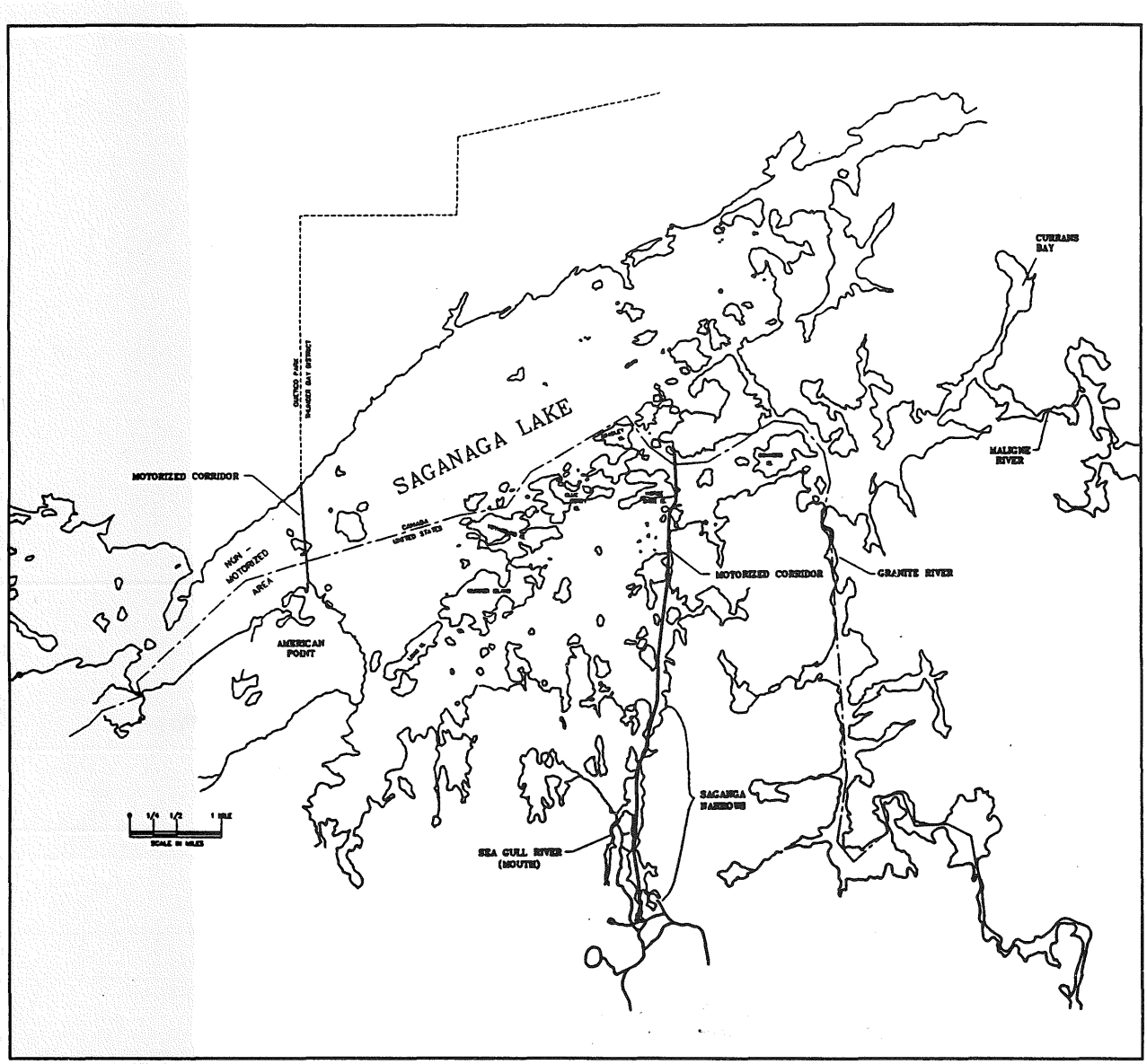
Minnesota - Ontario
Boundary Waters Fisheries Atlas
for
Saganaga Lake



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Ontario Ministry of Natural Resources

Minnesota Department of Natural Resources

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Ontario

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PREFACE

This document is a summary of fishery resource information for Saganaga Lake. Its main purpose is to identify trends in fish populations and present fisheries management options which will allow for optimum sustained yield (OSY) of major game fish species.

When fisheries management responsibilities are shared by two agencies, there are usually problems associated with different sampling methodologies and regulations which make coordination of management activities more difficult. This document will bring together information from both Minnesota and Ontario and suggest a future course for management activities.

INTRODUCTION

Saganaga Lake lies on the U.S. - Canadian border between northeast Minnesota and north central Ontario (Fig. 1). It covers an area of 17,593 acres (7,120 hectares) with 6,716 acres (2,718 hectares; 38%) in Minnesota and 10,877 acres (4,402 hectares; 62%) in Ontario. Its physical characteristics are typical of larger Canadian Shield lakes, with an abundance of rock - rubble substrate, an irregular basin, numerous islands and reefs, and maximum depth of 280 ft (85.4 m). Secchi disk transparencies have ranged from 9.0 to 11.5 ft (2.7 to 3.5 m). Major inlets include the Sea Gull River in Minnesota, the Granite River on the Minnesota - Ontario border, and the Maligne River in Ontario. The outlet is Silver Falls which flows into Saganagons Lake (Ontario) and eventually into Hudson Bay. There is no accurate depth map for Saganaga Lake; therefore, no data on mean depth or littoral area are available.

Saganaga Lake's shoreline is mostly undeveloped. Road access currently exists only in Minnesota from the Gunflint Trail, but will be available in Ontario in the future. Minnesota has two public boat landings, one resort, three outfitters, and several private cabins, all located on the "Saganaga Narrows." The Sea Gull River flows into this southern arm of the lake. The Ontario side has four small resorts and many private cabins, located in the northeast portion of the lake.

The Minnesota portion of Saganaga Lake is in the Boundary Waters Canoe Area Wilderness and access is administered by the United States Forest Service. A quota system regulates the number of people who use outboard motors during day trips and the number of overnight campers. Day motorized use quotas were not enforced because quotas were seldom exceeded when this system was first instituted. However, starting in 1990 the day motorized use quota system was strictly enforced because quotas have been exceeded in recent years. Overnight use quotas are often filled and reservations are necessary, especially during popular time periods. Outboard motors up to 25 horsepower are allowed, except west of American Point, a non-motorized area. There is also a corridor from the Gunflint Trail accesses to the Ontario border through which larger motors can be transported. Snowmobiles are also allowed on this corridor but are not allowed on any other Minnesota waters of Saganaga Lake.

The Ontario portion of Saganaga Lake has no restrictions on motorized use, except for the area west of American point in Quetico Provincial Park. No outboard motors or snowmobiles are allowed within the park and a quota system regulates the number of users.

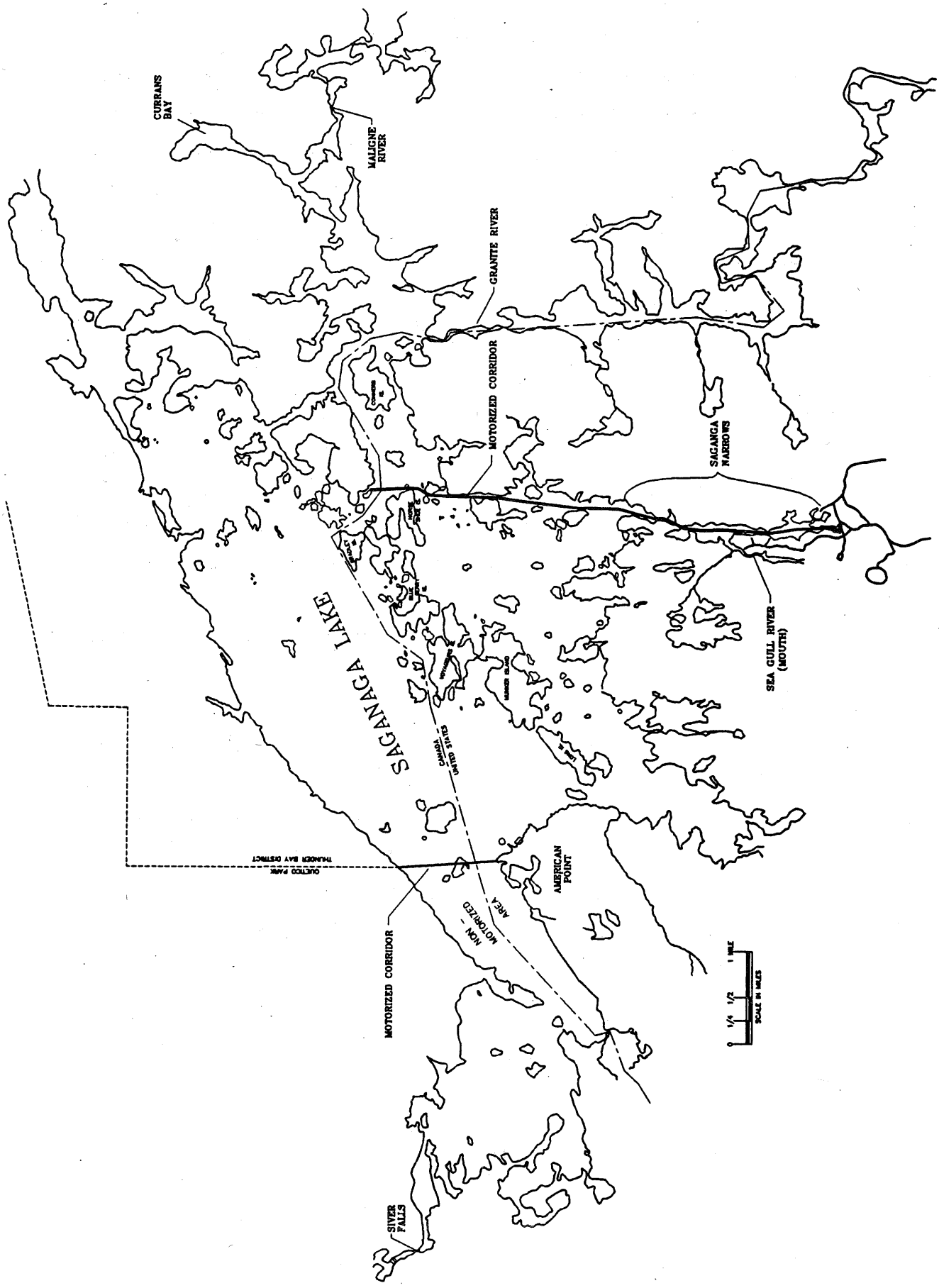

Figure 1. Saganaga Lake

DESCRIPTION OF FISHERY

Lake trout and walleye are the major components of the sport fishery in Saganaga Lake, with smallmouth bass and northern pike being minor components. There is also a commercial fishery for lake whitefish. Lake trout, northern pike, and lake whitefish are indigenous to the lake, walleye were introduced in 1934, and smallmouth bass were introduced sometime between 1935 and 1964. Natural reproduction sustains all species.

Saganaga Lake has a reputation for producing trophy walleye. The Minnesota state record walleye (17.5 lb; 8.0 kg) was taken in the Sea Gull River on May 17, 1979. Most walleye fishing takes place during open water, although a small late season winter fishery has developed recently in Saganaga Narrows. This area has aggregations of walleye which are staging prior to their spawning migration up the Sea Gull River.

Lake trout fishing occurs during both winter and summer months and appears to have become more popular in recent years. Lake trout inhabit both Minnesota and Ontario waters of Saganaga Lake, but most of the best habitat is in Ontario. Although most of the Minnesota portion of Saganaga Lake is closed to snowmobiles, the existence of the motorized corridor between the Gunflint Trail and Ontario border has facilitated a substantial amount of winter angling for lake trout in Minnesota waters. Anglers typically snowmobile the corridor into Ontario, travel along the border, and walk short distances to fish Minnesota waters.

Northern cisco were present during initial survey work in 1935 and may be indigenous. They are a major forage species for lake trout and other game fish, but their importance has been somewhat eclipsed during the past decade by the establishment of the exotic rainbow smelt. Dr. David Etnier, an ichthyologist at the University of Tennessee, has been studying cisco from Saganaga Lake and feels that there are three species present: *Coregonus artedi, Coregonus zenithicus*, and *Coregonus nipigon.* Results of his studies are not final; therefore, this report will refer to all cisco as northern cisco.

Rainbow smelt were reportedly established in the late 1970's and were abundant by the early 1980's. They are thought to have entered Saganaga Lake through the Granite River system and are currently the most important forage species in the lake. Their long term impacts on native and previously established fish communities are unknown.

PAST AND PRESENT MANAGEMENT ACTIVITIES

Fisheries management responsibilities on Saganaga Lake are shared by the Minnesota Department of Natural Resources (MDNR) and the Ontario Ministry of Natural Resources (OMNR). The MDNR has been more actively involved in management on

Saganaga Lake because there is better access in Minnesota and it represents a larger percentage of Minnesota's total resource base.

Saganaga Lake has been stocked with both lake trout and walleye in past years. Lake trout were stocked frequently from the early 1930's through the early 1970's but have not been stocked since 1974. Walleye fry were stocked frequently from 1934 through the mid-1950's.

A walleye egg take operation was started by the MDNR on the Sea Gull River in 1984. Annual egg take has ranged from 23,000,000 to 118,000,000, with eggs averaging about 100,000/qt (95,000/L). Since the start of this operation, at least 10% of the annual egg take has been returned to Saganaga Lake as fry.

Spawning area closures have been utilized on Saganaga Lake in recent years to protect pre-and post-spawning concentrations of walleye. Since 1986, a permanent fishing closure has been in effect on the Sea Gull River - Saganaga Narrows area from the Minnesota walleye opening in May through the last Friday in May. The Granite River area has also been closed during this same period in recent years. In 1989, Ontario established fish sanctuaries on their portion of the Granite River area, and the Maligne River - Curran's Bay area, which are in effect from 1 April through 31 May. In 1990, Minnesota modified its closing dates for the Granite River area (1 April through 31 May) and the Sea Gull River - Saganaga Narrows area (1 April through the last Friday in May).

In 1985, Minnesota implemented a regulation which allows only one walleye over 22 in (56 cm) to be included in a bag limit. In 1990, both Minnesota and Ontario implemented a regulation which allows only one walleye over 19.5 in (50 cm) to be included in a bag limit.

There are some differences between Minnesota and Ontario game fish seasons on Saganaga Lake. A major difference exists in the winter lake trout season; Ontario has had a one month (15 February through 15 March) season since 1983 and Minnesota had a three month season (1 January through 31 March) through 1990. Starting in 1991, Minnesota will have a two month winter lake trout season (15 January through 15 March). The Minnesota open water season for lake trout and walleye begins two Saturdays before Memorial Day weekend, while the Ontario walleye season begins on the third Saturday in May and the lake trout season begins on the fourth Saturday in May. Both the MDNR and OMNR have expressed a desire to make border waters regulations as consistent as possible, but they recognize that some differences will have to be accepted for administrative and socio-political reasons.

PRESENT DATA BASE

Saganaga Lake has not been monitored as closely as the western Minnesota - Ontario boundary waters, mainly because of its remote location. Available data are difficult to interpret because of inconsistencies in sampling methodology. As a result, long term trends in fish populations have not been well documented.

Saganaga Lake was first surveyed in 1935 with seines and 4.0 in (10.2 cm) mesh 180 ft (55 m) gill nets. Fish species collected included: northern cisco, lake whitefish, lake trout, northern pike, longnose sucker, white sucker, burbot, and yellow perch. Walleye were not taken at that time but may have been present from an initial introduction in 1934.

The next survey, in 1964, utilized Minnesota's standard experimental gill nets (five 50 ft (15 m) sections of 0.8 in (2.0 cm), 1.0 in (2.5 cm), 1.2 in (3.0 cm), 1.5 in (3.8 cm), and 2.0 in (5.1 cm) mesh) and Ontario nets (two 100 ft (30 m) sections of 4.5 in (11.4 cm) and 5.0 in (12.7 cm) mesh). Walleye had become well established by this time and smallmouth bass were also collected. Lake trout were collected but appeared to be fairly low in number.

Netting assessments were done in 1971, 1979, 1982, 1985, and 1989. The 1971, 1979, 1982, and 1989 assessments were done by the MDNR and utilized standard experimental gill nets. No data from the 1971 assessment is included in this report because only three gill net sets were used. The 1982 assessment utilized 100 ft (30 m), 0.5 in (1.3 cm) mesh gill nets in addition to standard experimental gill nets and captured rainbow smelt for the first time. Gill net CPUE for lake trout was not obtained in 1982 because no deep sets were made. The 1985 assessment was a joint effort by the MDNR and OMNR. Each agency sampled a portion of the lake using their own standard experimental gill nets which differed somewhat in length and mesh sizes. Netting locations were randomly selected. The 1989 assessment established 41 netting stations with Minnesota's standard experimental gill nets. Most of these netting stations were replicated from the 1985 assessment; however, the non-motorized section of lake west of American Point was not sampled in 1989.

Creel surveys were conducted by the MDNR during the open water seasons of 1984 and 1985 and the winter seasons of 1986, 1987, and 1988. The summer creel surveys targeted walleye anglers, but did obtain data on other game fish species including lake trout. The 1986 creel survey covered a portion of the winter lake trout season and the late winter walleye fishery in the Saganaga Narrows. The 1987 creel survey covered a

portion of the winter lake trout season and the 1988 survey covered the entire lake trout season.

LAKE TROUT AND WALLEYE POPULATION TRENDS

Survey and assessment data must be viewed with some caution because of differences in the number of netting stations, netting locations, and gear types and the overall lack of data. Nevertheless, some trends in lake trout and walleye populations are obvious.

Saganaga Lake gill netting data for lake trout and walleye were stratified by shallow and deep sets to facilitate interpretation of catch-per-unit-effort (CPUE). In general, net sets above the thermocline will be referred to as shallow and those below the thermocline as deep.

Netting data indicates that the lake trout population in Saganaga Lake has shifted since the 1960's from a senile population of average to large-sized fish with low recruitment to an expanding population with a wide range of size and age-classes and high recruitment. Deep gill net CPUE for lake trout ranged from 0.7 to 2.0/lift with the highest catches occurring in 1979 and 1985 (Fig. 2). Lake trout under 20 inches appeared to make up a larger portion of the population in 1985 and 1989 than in 1964 (Table 1). The reason(s) for these changes remain open to speculation. The possibilities include: expansion of the forage base from the rainbow smelt invasion; decline in walleye numbers; and population responses to increased angler exploitation.

Lake trout growth is good compared to most northeast Minnesota lakes with age VI fish ranging from 17 to 24 in (43 to 61 cm). Rainbow smelt are providing excellent forage and are the most common food item found in lake trout stomachs. However, there is concern for the long term impacts of rainbow smelt, especially on lake trout recruitment. Rainbow smelt are piscivorous and may compete with or directly prey on young lake trout and other game fish.

Shallow gill net CPUE for walleye ranged from 4.2 to 20.8/lift with the highest catches occurring in 1964 and 1989 and the lowest catches occurring in 1982 and 1985 (Fig. 3). The higher walleye catch in 1989 was due in part to strong year-classes in 1987 and 1988. Gill netting has not captured sufficient numbers of large walleye (over 25 in, 63 cm) to document trends in the trophy fishery. Walleye abundance in the Sea Gull River trap during egg take operations has shown no clear trend (Fig. 4). The highest walleye catches occurred in 1987 and 1990; however, total catch may be influenced by the timing of the spawning run and stream conditions as well as overall abundance. Although the Sea Gull River trap effectively captures large walleye during egg take operations, size and

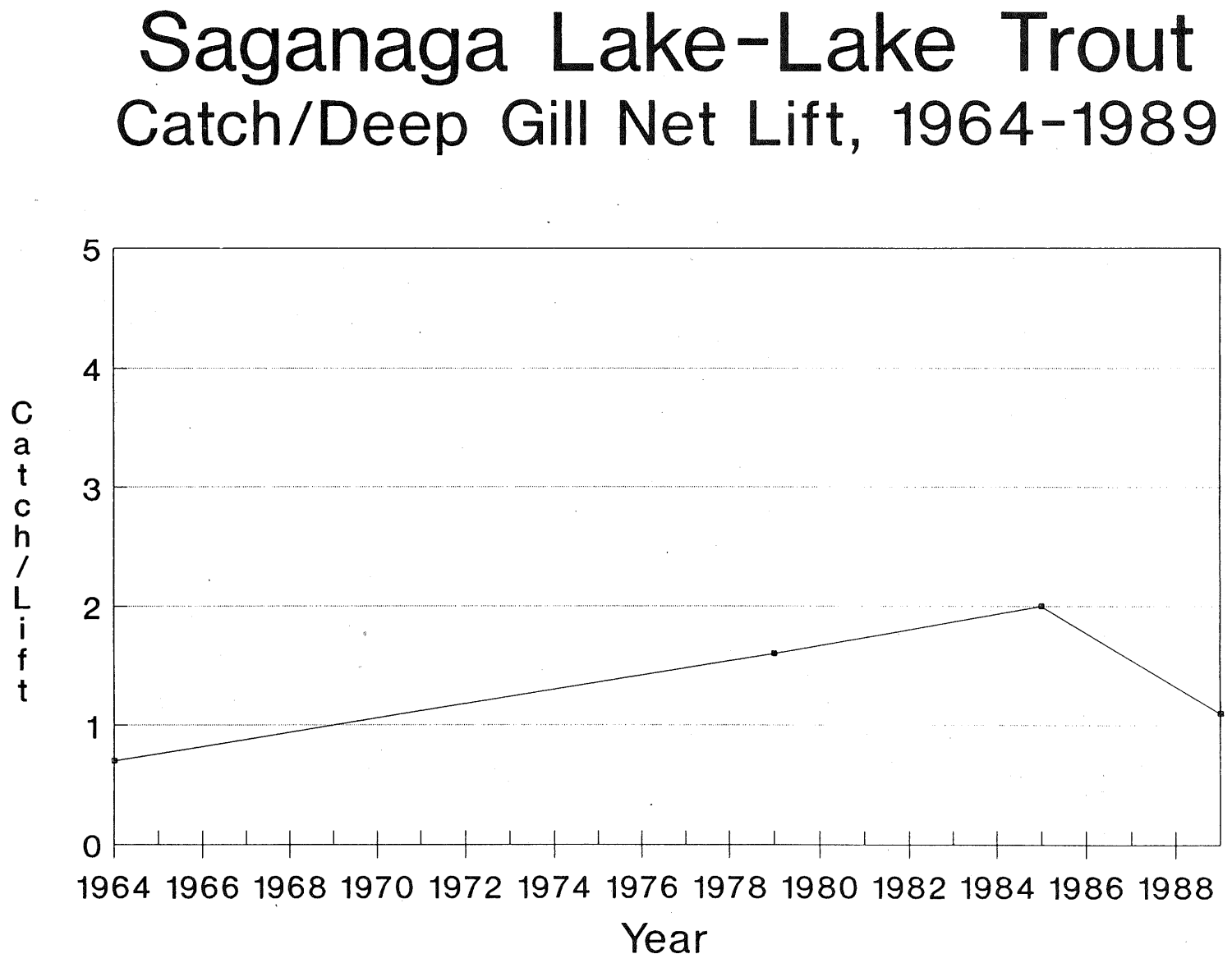

Figure 2. Catch/deep (greater than 40 ft; 12 m) gill net lift of lake trout in Saganaga Lake, 1964-1989.

Table 1. A comparison of lake trout length frequencies from 1964, 1985, and 1989 gill netting on Saganaga Lake.

Length range Inches (cm)	Year 1964	1985	1989
Less than 13.0 (33.0)	0	2	0
13.0-13.9 (33.0-35.3)	0	3	2
14.0-14.9 (35.4-37.8)	0	3	1
15.0-15.9 (37.9-40.4)	0	5	0
16.0-16.9 (40.5-42.9)	0	1	2
17.0-17.9 (43.0-45.5)	2	1	0
18.0-18.9 (45.6-48.0)	1	2	2
19.0-19.9 (48.1-50.5)	0	2	3
20.0-20.9 (50.6-53.1)	1	6	3
21.0-21.9 (53.2-55.6)	0	4	1
22.0-22.9 (55.7-58.2)	3	7	0
23.0-23.9 (58.3-60.7)	0	3	0
24.0-24.9 (60.8-63.2)	2	2	0
25.0-25.9 (63.3-65.8)	3	1	2
26.0-26.9 (65.9-68.3)	0	3	0
27.0 (68.4) or greater	5	1	0

age structure information has generally not been obtained because of insufficient personnel and concern over excessive handling of large walleye. Some aging was done on fish trapped during the 1985 egg take which indicated that male walleye reach maturity by age III and female walleye by ages V or VI.

Saganaga Lake walleye have a unique growth pattern which has facilitated development of the trophy fishery. The 1989 assessment found that both male and female walleye reach lengths of over 20 in (51 cm) within 6 years (Table 2). Walleye growth appears to slow down after age VI and fish can live to old ages (some have been aged at 29).

SPORT FISHERY STATISTICS

Estimated summer fishing pressure on Saganaga Lake was 4.9 and 3.4 angler-hours/acre (12.1 and 8.4 angler-hours/hectare) in 1984 and 1985, respectively (Fig. 5). Seventy-one and 53% of the summer fishing pressure occurred on Minnesota waters in 1984 and 1985, respectively. Seventy-four percent of the summer pressure was targeted at walleye (Fig. 6).

Estimated winter fishing pressure on Saganaga Lake was 0.7 angler-hours/acre (0.1 angler-hours/hectare) in 1988 (Fig. 7). Sixty-six percent of the winter fishing pressure occurred on Minnesota waters with almost all of the winter fishing effort targeted

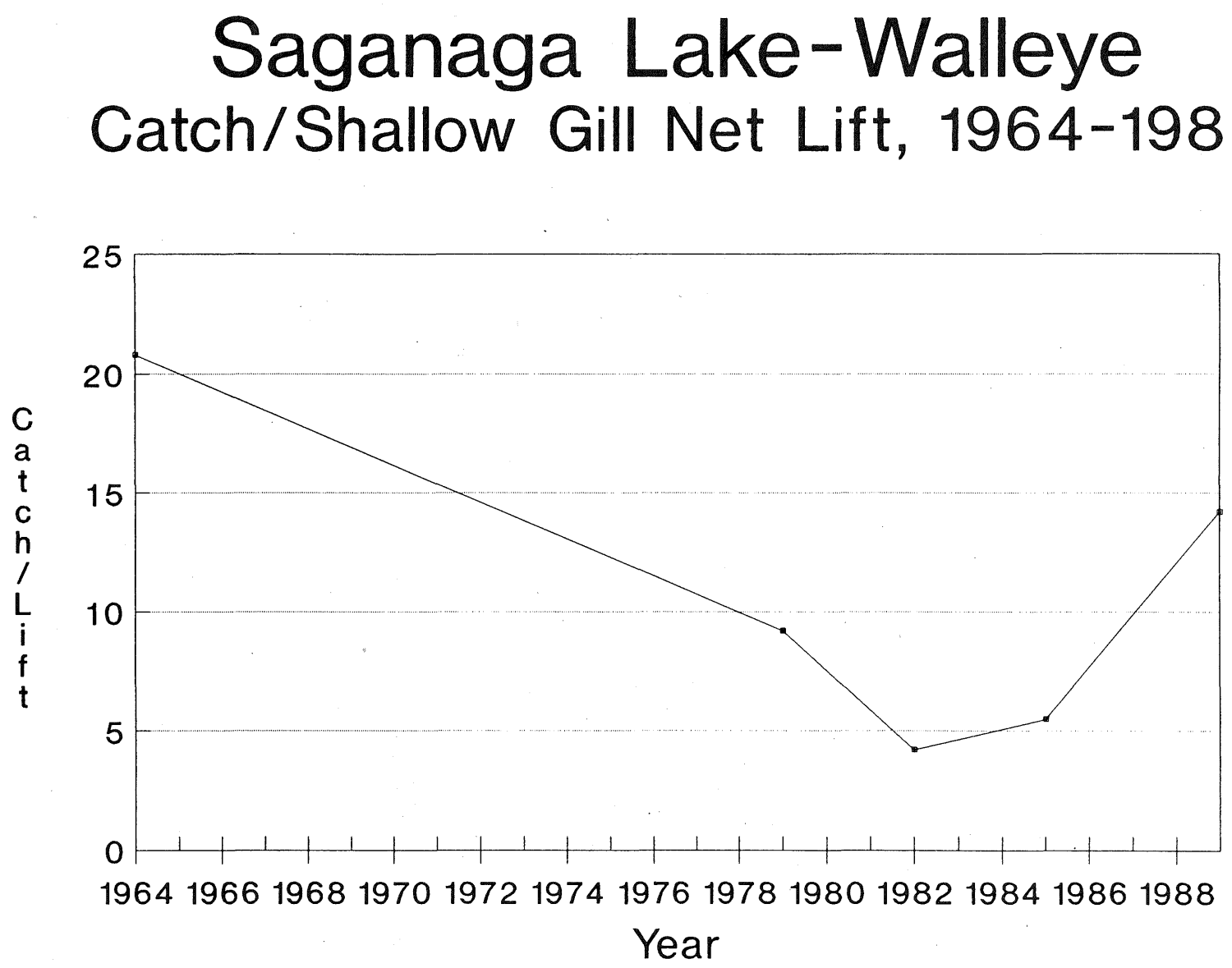

Figure 3. Catch/shallow (less than 40 ft; 12 m) gill net lift of walleye in Saganaga Lake, 1964-1989.

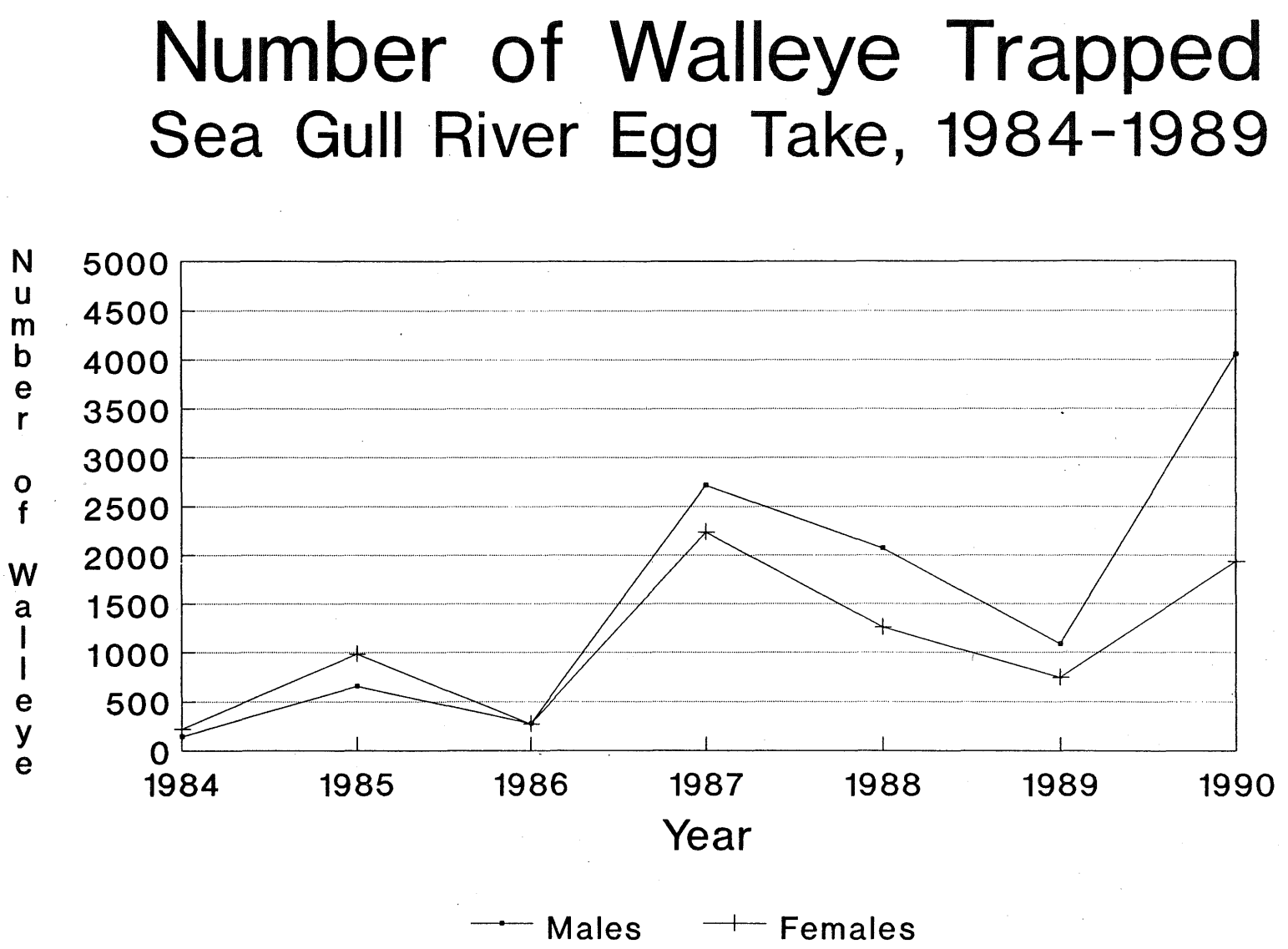

Figure 4. Number of walleye trapped during egg take operations on the Sea Gull River, 1984-1990.

Table 2. Estimated mean length (in and cm) at time of last annulus formation for male and female walleye collected by gill nets in Saganaga Lake, August 1989.

	Age																	
	I			II			III			IV			V			VI		
Sex	in	cm	(N)	in	cm	(N)	in	cm	(N)	in	cm	(N)	in	cm	(N)	in	cm	(N)
Male	5.3	13.5	(44)	11.0	27.9	(42)	14.0	35.6	(10)	16.1	40.9	(10)		--		19.3	49.0	(2)
Female	5.3	13.5	(37)	11.6	29.5	(48)	14.9	37.8	(12)	17.7	45.0	(14)	19.8	50.3	(7)	20.3	51.6	(2)

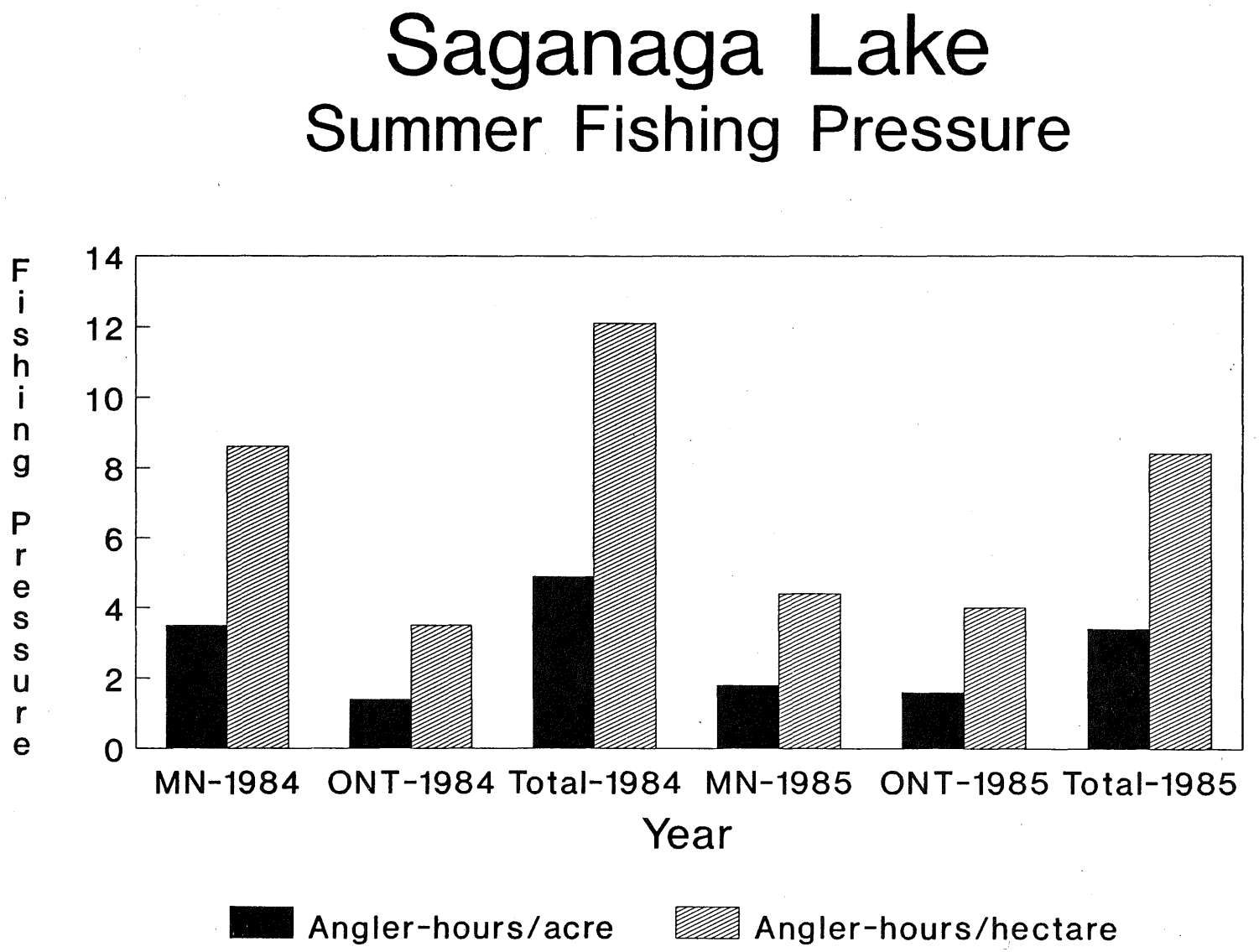

Figure 5. Estimated fishing pressure on Minnesota and Ontario waters of Saganaga Lake during the summers of 1984-1985.

Saganaga Lake-Species Sought
Summer Fishery

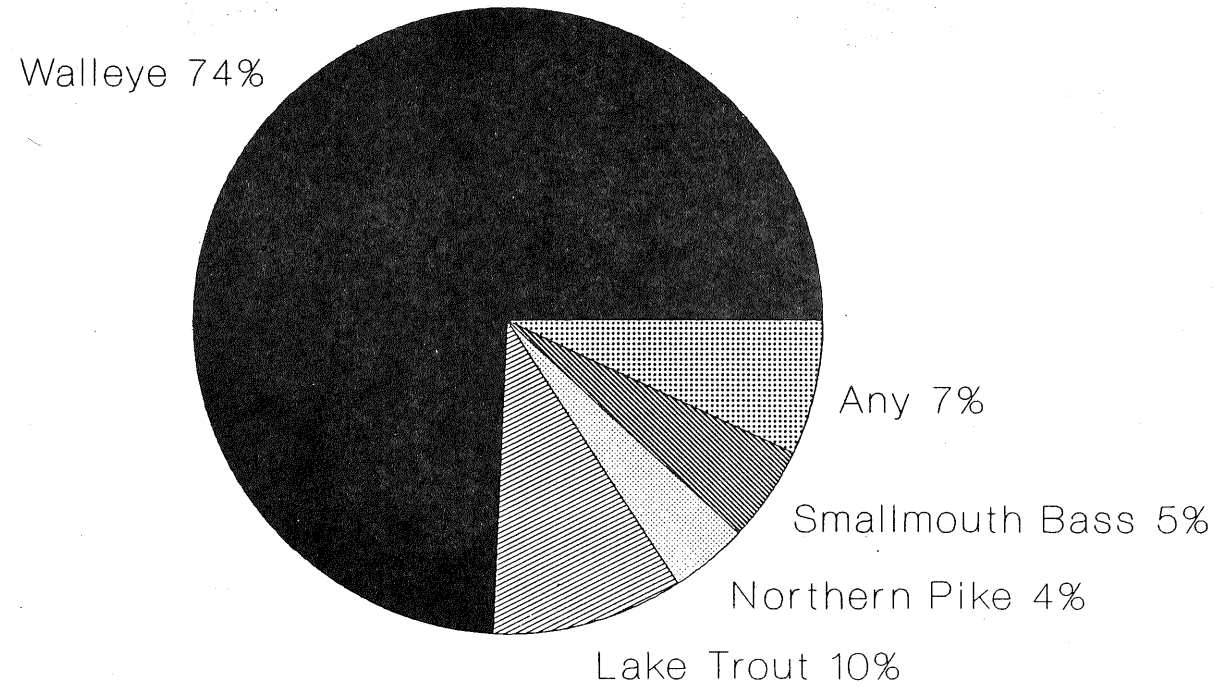

Figure 6. Species sought by anglers during the summers of 1984-1985, Saganaga Lake.

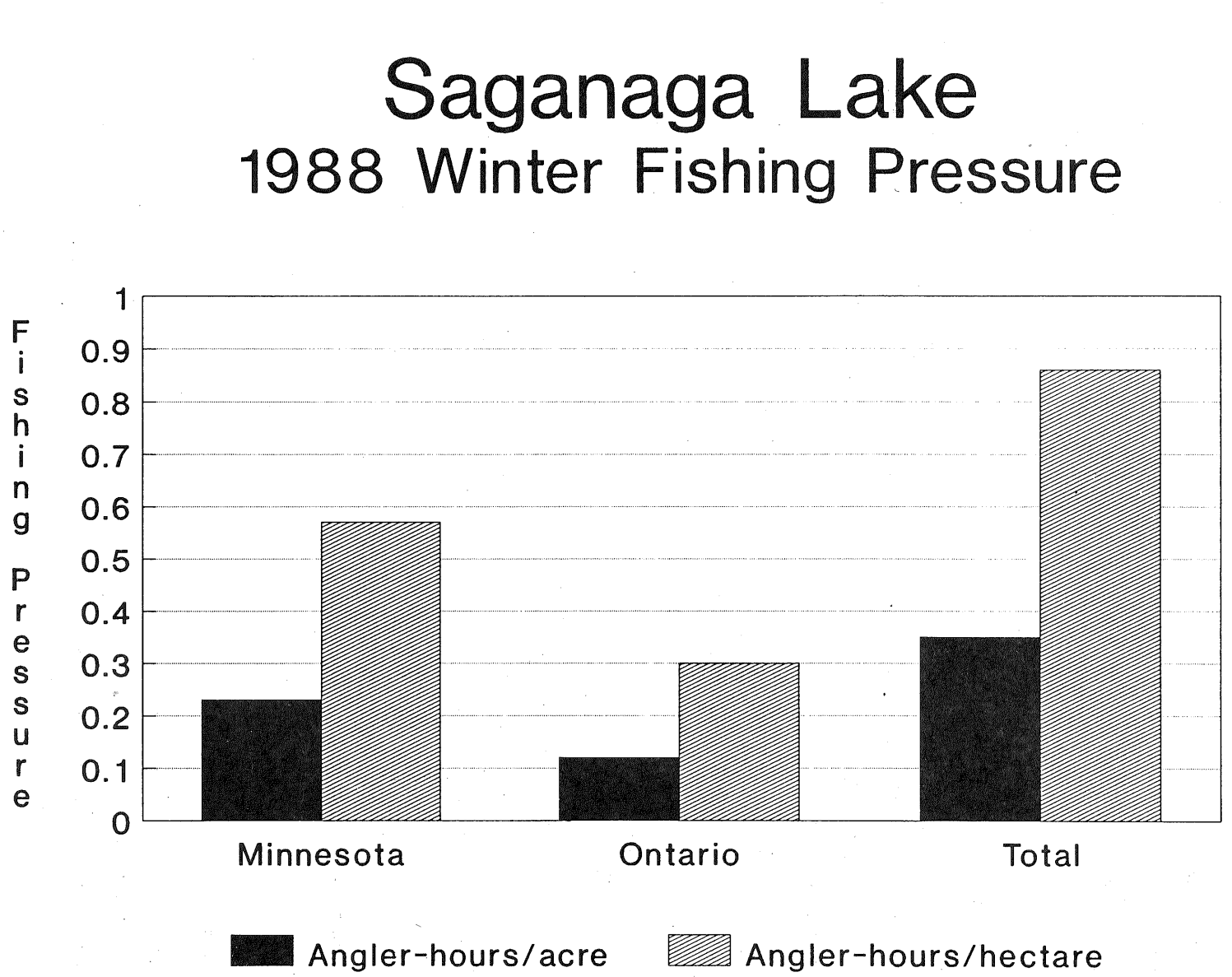

Figure 7. Estimated fishing pressure on Minnesota and Ontario waters of Saganaga Lake, winter, 1988.

at lake trout.

Walleye dominated the summer harvest, but lake trout, northern pike, and smallmouth bass were also taken (Table 3). The estimated walleye harvest was 8,749 and 7,947 fish in 1984 and 1985, respectively. The estimated walleye yield was 0.6 and 0.5 lb/acre (0.7 and 0.6 kg/hectare) in 1984 and 1985, respectively. Mean length of harvested walleye was 14.8 and 14.6 in (37.6 and 37.1 cm) in 1984 and 1985, respectively. As with assessment netting, creel surveys have been largely unsuccessful in sampling trophy walleye. Current angler reports from Saganaga Lake indicate that both the quantity and quality of walleye have diminished in the 1980's.

The summer lake trout harvest was estimated to be 1,166 and 530 fish in 1984 and 1985, respectively (Table 3). The estimated lake trout yield was 0.2 and 0.1 lb/acre (0.2 and 0.1 kg/hectare) in 1984 and 1985, respectively. Mean length of harvested lake trout was 21.2 and 18.8 in (53.8 and 47.8 cm) in 1984 and 1985, respectively.

The summer lake trout fishery appears to be growing in popularity, probably as a result of declining walleye and improved lake trout fishing success. If this is the case, lake trout pressure and harvest data from the 1984 and 1985 creel surveys may be an underestimate of current levels.

The estimated 1988 winter lake trout harvest was 1,355 fish with a yield of 0.3 lb/acre; 0.3 kg/hectare (Table 3). Lake trout harvest rates were estimated at 0.22 fish/angler-hour. Mean length of harvested lake trout was 22.7 in; 57.7 cm (Table 3). Lake whitefish were the most commonly harvested fish in the winter after lake trout but were a minor part of the total catch. A few walleye and northern pike were also harvested during the winter season (Table 3).

Lake trout were recruited to the winter fishery at ages V or VI. The 1980-1982 year-classes accounted for over 80% of the winter harvest in 1987 and 1988. Data from voluntary angler returns during the winter and summer of 1989 showed that the 1983 and 1984 year- classes were present; however, it is not known how their abundance compares to the year-classes from 1980 through 1982.

The winter lake trout angler was more efficient than the summer angler. About 10% of the estimated summer angling pressure (16,407 angler-hours) was targeted at lake trout in 1984 and 1985 (Fig. 7). This resulted in an estimated harvest of 1,696 fish (Table 2). In contrast, estimated 1988 winter angling pressure of 6,213 angler-hours (approximately 100% for lake trout) resulted in a lake trout harvest of 1,355 fish (Table 2).

Table 3. Estimated sport harvest (with ± 95% confidence limits in parentheses), yield (lb/acre, kg/hectare), and mean length (in, cm) for lake trout, walleye, northern pike, and smallmouth bass, on Saganaga Lake during the summers of 1984-1985 and winter of 1988.

Year	Number harvested	Yield lb/acre	Yield kg/hectare	Mean Length in	Mean Length cm
Summer 1984					
Walleye	8,749 (3,954)	0.6	0.7	14.8	37.6
Smallmouth bass	3,143 (1,815)	0.2	0.2	10.7	27.2
Lake trout	1,166 (1,017)	0.2	0.2	21.2	53.8
Northern pike	1,353 (850)	0.4	0.4	21.9	55.6
Summer 1985					
Walleye	7,947 (5,108)	0.5	0.6	14.6	37.1
Smallmouth bass	2,679 (2,198)	0.2	0.2	12.9	32.8
Lake trout	530 (715)	0.1	0.1	18.8	47.8
Northern pike	638 (605)	0.1	0.1	23.5	60.0
Winter 1988					
Walleye	tr	tr	tr	19.7	50.0
Lake trout	1,355 (446)	0.3	0.3	22.7	57.7
Northern pike	tr	tr	tr	28.2	71.6

The winter lake trout fishery on Saganaga Lake was excellent compared to other lake trout fisheries in Minnesota. The combination of a winter harvest rate of 0.22 fish/angler-hour and mean length of 22.7 in (57.7 cm) is higher than documented for any other Minnesota lake trout lakes. Saganaga Lake may be the best lake trout fishery in Minnesota and is currently the only lake in the state which is accessible by road and supports a high quality lake trout fishery without stocking.

Fishing pressure on Saganaga Lake is generated almost entirely Minnesota-based. The summer fishery draws heavily from the St. Paul - Minneapolis metropolitan area and other states (Fig. 8). In contrast, the winter fishery draws heavily from Cook County (Fig. 9). The development of road access from the Ontario side will likely result in some fishing pressure originating from Ontario.

Most anglers utilize public access to fish Saganaga Lake in the summer, but a substantial number also go through resorts (Fig. 10). Winter anglers use the Gunflint Trail accesses exclusively, although some do utilize an Ontario resort after accessing the lake.

COMMERCIAL FISHERY STATISTICS

Minnesota waters of Saganaga Lake have supported a commercial fishery for lake whitefish since 1979 (Fig. 11). One operator using gill nets fishes during the fall lake

Saganaga Lake-Angler Origin
Summer Fishery

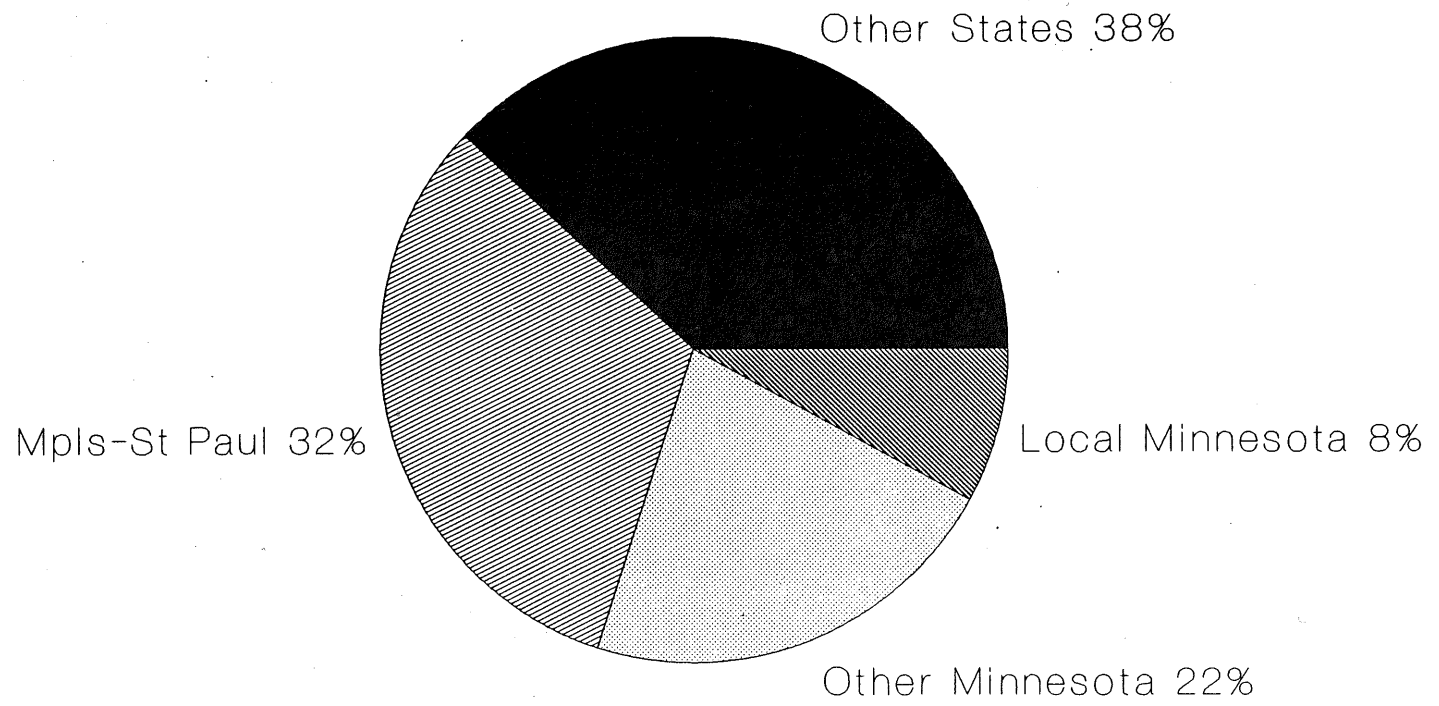

Figure 8. Angler origin during the summer of 1985, Saganaga Lake.

Saganaga Lake-Angler Origin
Winter Fishery

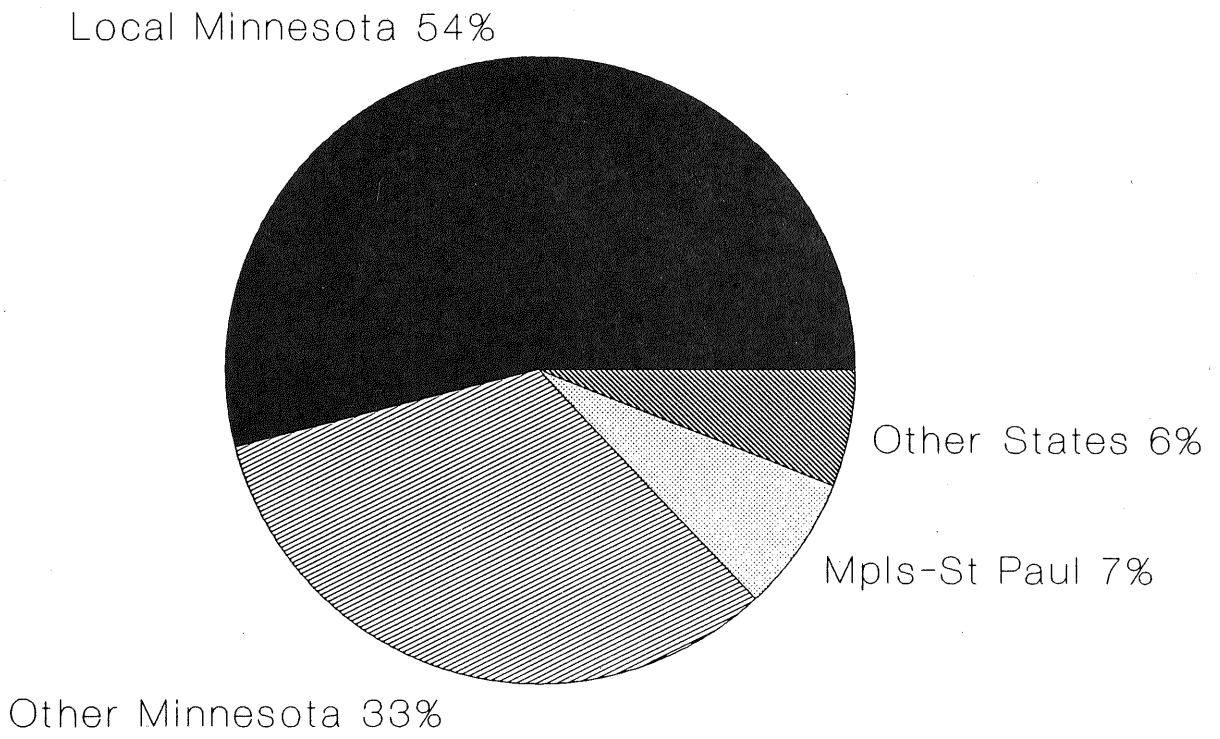

Figure 9. Angler origin during the winter of 1988, Saganaga Lake.

Saganaga Lake-Access Use
Summer Fishery

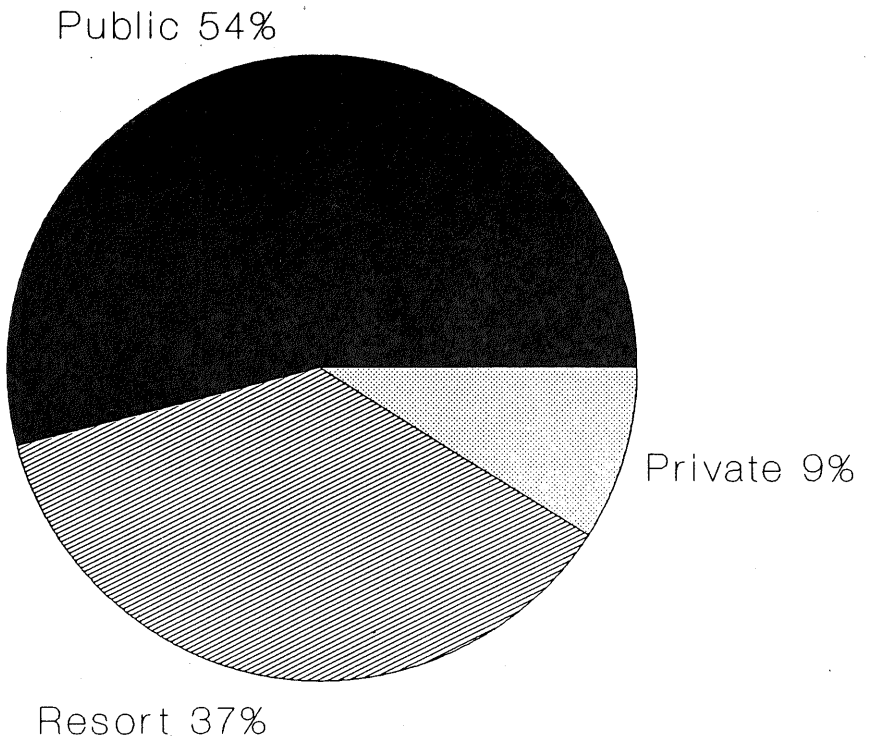

Figure 10. Access used by anglers during the summers of 1984-1985, Saganaga Lake.

Saganaga Lake-Lake Whitefish
Commercial Fishery, 1979-1988

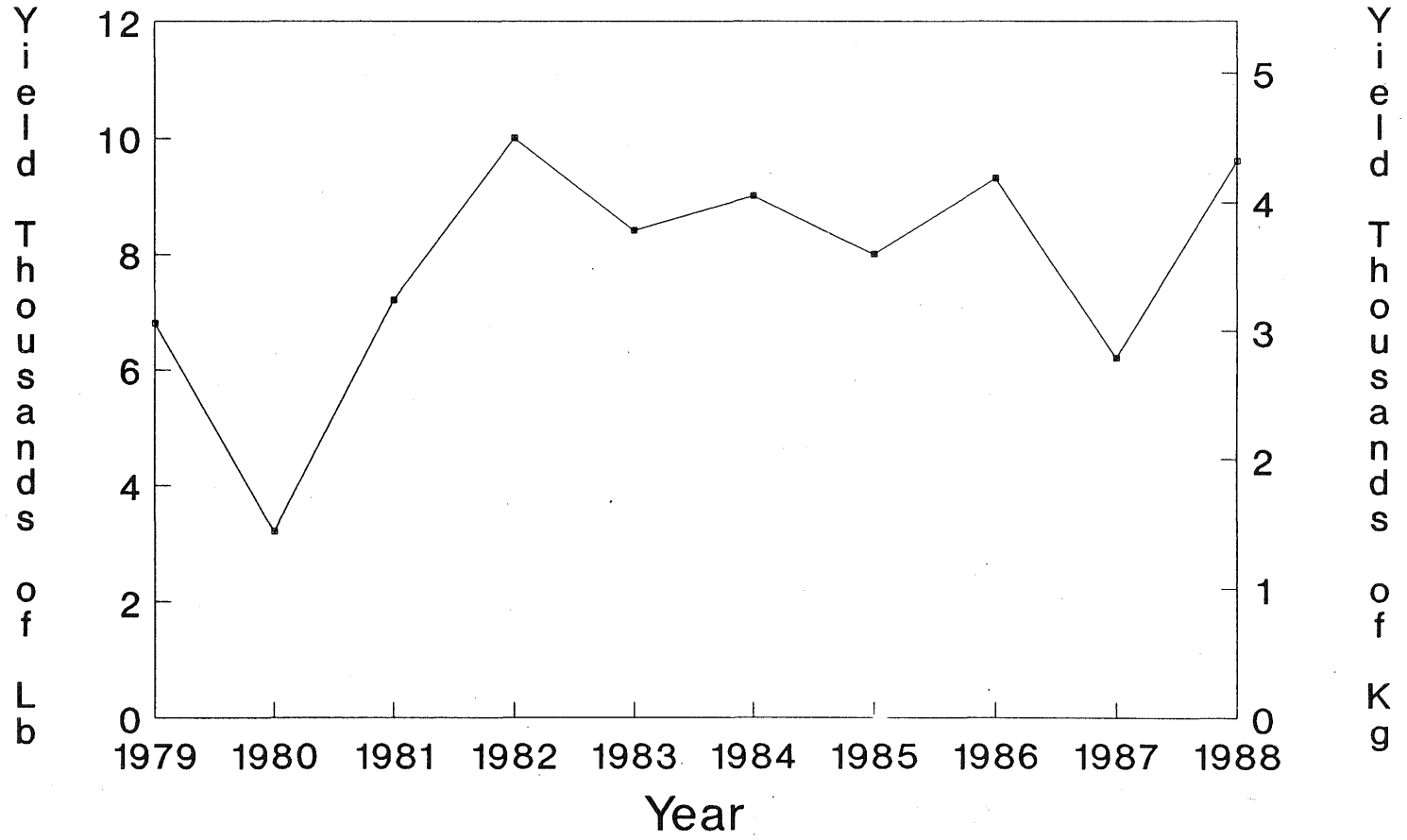

Figure 11. Annual commercial yield of lake whitefish in Saganaga Lake, 1979-1988.

whitefish spawning period. Average annual yield has been about 7,800 lb (3,500 kg; 0.4 lb/acre, 0.4 kg/hectare). Small amounts of white sucker are harvested incidentally but are not considered marketable. Incidental take of game fish during commercial netting is negligible.

A commercial fishery also existed from 1959 through 1964. Varying amounts of lake whitefish, northern cisco, white sucker, and burbot were harvested from Minnesota waters during this period.

STATUS OF FISHERIES RESOURCE

The morphoedaphic index (MEI) can be used to predict a lake's productivity or potential yield. The MEI is derived from mean depth and total dissolved solids. In the absence of a figure for mean depth, one third of the maximum depth can be used as an approximation. Shallow lakes or lakes with high dissolved solids levels are more productive than deep lakes or lakes with low dissolved solids levels.

Examination of exploited fish communities has led to guidelines for partitioning the potential yield among harvested species. The following mean percentages of the potential yield are recommended for listed species: lake trout - 25; walleye - 32; northern pike - 25; smallmouth bass - 17 to 50; and lake whitefish - 24. In multi-species fisheries somewhat lower values should be used; however, there have been insufficient data collected on Saganaga Lake to determine what values are appropriate. All potential yields derived in this report are based on the above percentages; however, it should be kept in mind that these figures may be somewhat high.

Saganaga Lake's MEI is 0.514 (English units) which is indicative of a relatively infertile system. The potential yield is 1.4 lb/acre (1.6 kg/hectare). Partitioned potential yields for lake trout and walleye are about 0.4 lb/acre (0.4 kg/hectare) each.

Total sport and commercial yield for Saganaga Lake is above the theoretical potential yield (Fig. 12). Sport yields for lake trout and walleye (taken from 1984 summer and 1988 winter data) are slightly higher than theoretical levels and commercial yield of lake whitefish is substantially higher than the theoretical level.

The Saganaga Lake lake trout population has not shown obvious signs of over harvest, but there are indications that this is a distinct possibility in the future. Based on summer and winter creel survey data, the estimated annual lake trout yield is about 0.5 lb/acre (0.6 kg/hectare; Table 3, Fig. 12) which is at or above what is often considered to be a sustainable level for natural populations. Furthermore, the annual lake trout yield may be greater than 0.5 lb/acre (0.6 kg/hectare) if the summer fishery has expanded since

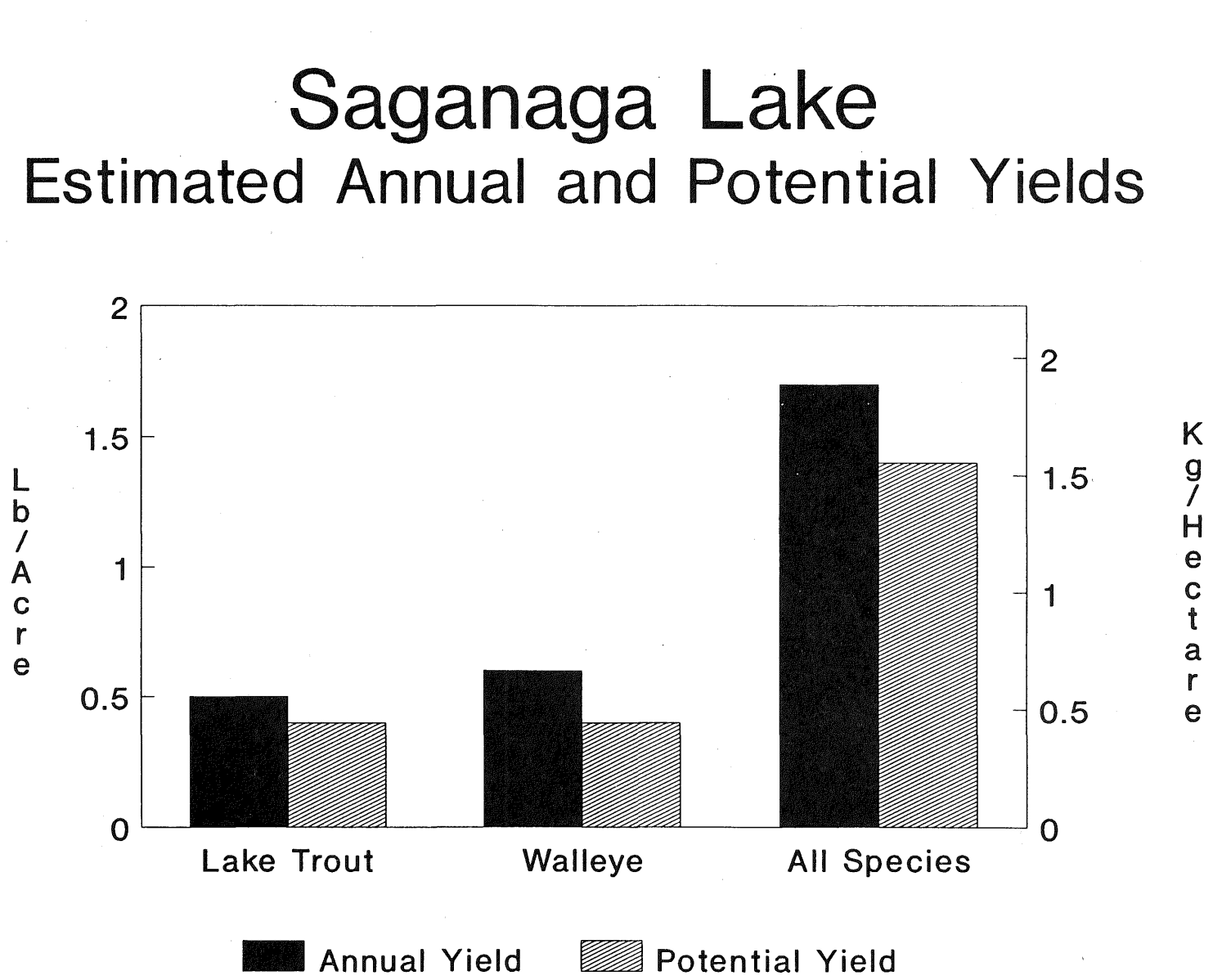

Figure 12. Estimated annual (from 1984 summer and 1988 winter data) and theoretical potential yields for lake trout, walleye, and all species combined on Saganaga Lake.

1985. The efficiency of the summer angler may be increasing due to the use ofdownriggers. Fishing pressure on the lake trout population will probably continue to increase as long as fishing success continues to be good. Lake trout yield estimates on Saganaga Lake may be somewhat misleading since not all of the lake is suitable for lake trout during the summer stratification period. Hence, lake trout yield in suitable water would be higher than indicated.

The heavy reliance of the 1987 and 1988 winter fisheries on three year-classes of lake trout is a major concern. The occurrence of two or more weak year-classes in a four or five year period could seriously destabilize the lake trout population and fishery.

The potential for inter-specific competition between young lake trout and rainbow smelt makes it imperative that lake trout stocks are not overexploited. Rainbow smelt mature early in life, are prolific, and have a potentially high rate of population expansion. In contrast, lake trout mature later in life and have a low potential for population expansion. Reduced lake trout numbers could offset the predator-prey balance, and if rainbow smelt adversely affect lake trout recruitment, this balance could be difficult or impossible to restore.

Management goals based on OSY cannot be realized if the lake trout population is exploited at or above the maximum sustained yield (MSY). The current situation on Saganaga Lake indicates a need to reduce lake trout harvest to, if not below, theoretical levels. While it cannot be known for certain if theoretical yields are true indications of the MSY, a conservative approach is justified to guard against collapse of this important sport fishery.

The apparent decline in walleye numbers in Saganaga Lake which occurred from the 1960's to the 1980's was most likely a result of over-harvest; however, the expanding lake trout and rainbow smelt populations may also have had some influence. Many of the symptoms of over-harvest such as reduction in mean age, increased growth rate, and reduced age at maturity have not been identified in Saganaga Lake walleye. However, the failure to document over-harvest of walleye could be due to insufficient monitoring or the influence of other variables such as expanding rainbow smelt and lake trout populations. It remains to be seen if the higher gill net CPUE from the 1989 assessment represents a reversal of the downward trend in walleye abundance.

The effect of Minnesota's trophy walleye regulation has not been evaluated because of difficulties in sampling large walleye. This regulation has been valuable in promoting a conservation ethic but modeling on other large walleye lakes in Minnesota has indicated

that it probably has had minimal biological impact because few anglers catch more than one large walleye. The recent inclusion of the trophy regulation in Ontario waters and the lowering of the length limit to 19.5 in (50 cm) may somewhat increase the impact of the regulation; however, it is unlikely that it will have a major effect. Additional harvest restrictions may be needed if the trophy status of the Saganaga Lake walleye population is to be preserved.

MANAGEMENT RECOMMENDATIONS

Management strategies on Saganaga Lake need to address the inadequacy of past sampling. Netting assessments should be done at a minimum interval of 3 years and, ideally, should be done annually. Gear types and netting station locations must be standardized. Although a variety of sampling gear types would be useful, recommendations must keep in mind practical constraints of time and manpower. Standard experimental gill nets should be the major gear type used. In addition, small mesh gill nets should be used to sample rainbow smelt and young age-classes of lake trout.

Summer and winter creel surveys should be done at a minimum interval of three years. Summer creel surveys should target both the lake trout and walleye fisheries. Night and early morning time periods will have to be sampled in the summer to adequately assess the walleye fishery.

Further reductions of the lake trout season on Minnesota waters are currently not possible for socio-political reasons. Methods to reduce lake trout harvest will probably be limited to bag and size limit restrictions. More information on the size and age structure of summer harvested lake trout is needed before size limits could be considered and implemented. Reduced bag limits could substantially lower the lake trout harvest, because 14% of the summer anglers and 22% of the winter anglers who are seeking lake trout succeed in getting a limit of three fish (Fig. 13). Data indicate that a lake trout harvest reduction approximating 18% could be realized by lowering the bag limit to two fish. This does not take into account possible compensatory factors which may occur, such as increased sorting by anglers which could lead to increased mortality of released fish.

Measures to reduce walleye harvest also need to be considered. Spring closures of walleye spawning areas are justified, especially in light of the importance of the trophy walleye fishery. In contrast to lake trout, slight reductions in the walleye possession limit of six would have little if any impact on harvest, as almost 70% of the anglers seeking walleye catch zero or one fish (Fig. 14). Shortened seasons are currently not recommended for socio-political reasons and because there are no data on summer walleye

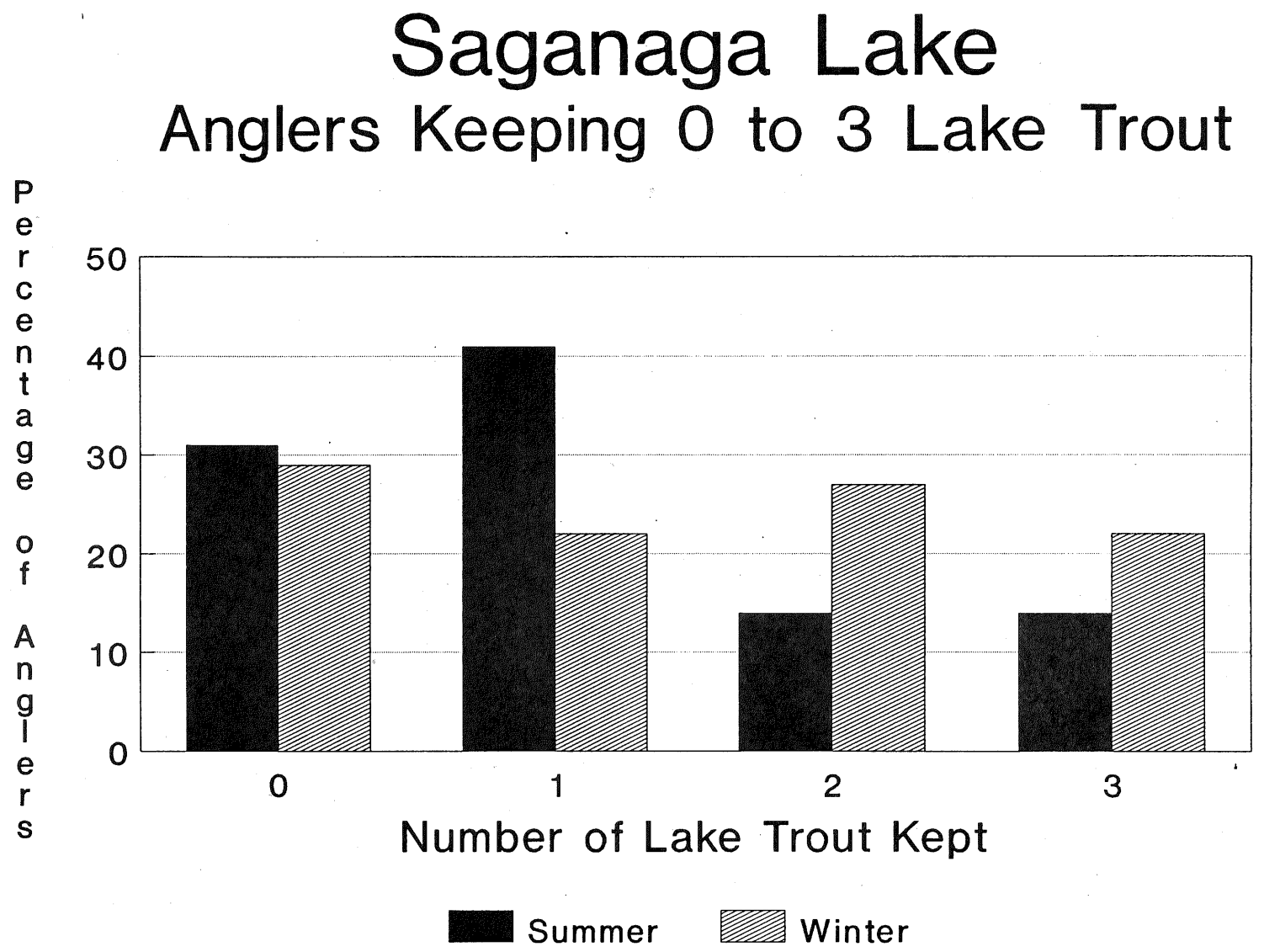

Figure 13. Percentage of lake trout anglers keeping zero to three lake trout during the summers of 1984-1985 and winters of 1986-1988, Saganaga Lake.

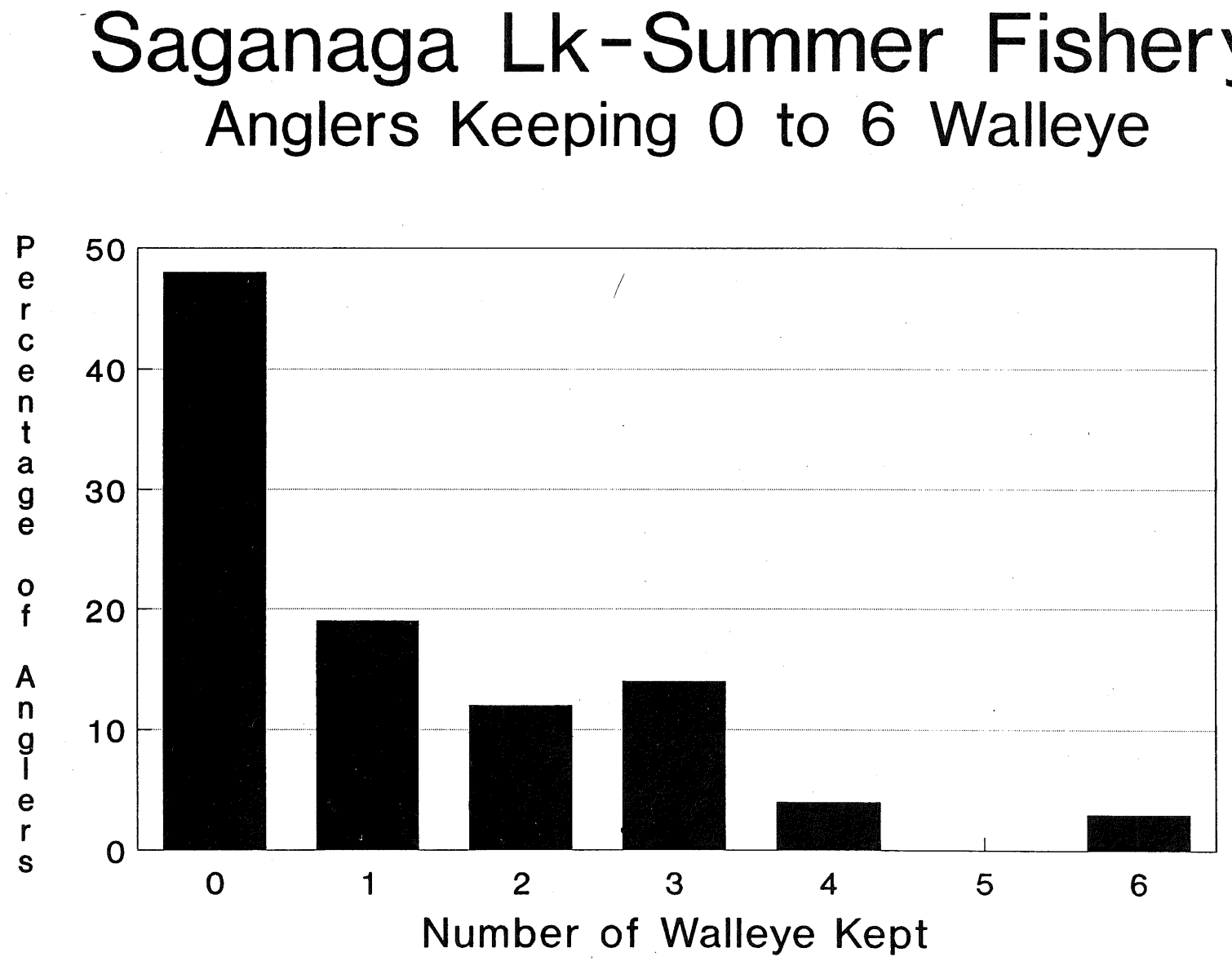

Figure 14. Percentage of walleye anglers keeping zero to six walleye during the summers of 1984-1985, Saganaga Lake.

harvest by time period. Additional size limit restrictions have the most promise for reducing walleye harvest and improving the population. A slot size limit which covers the period of rapid walleye growth may have potential to improve the fishery, e.g. 17 to 20 in (43 to 51 cm), and would complement the proposed size limit of one fish over 19.5 in (50 cm). Studies done by the MDNR indicate that hooking mortality of released walleye is low enough for size limit restrictions to be effective.

An additional year of summer creel survey data should be collected prior to proposing changes in walleye size restrictions. Increased information on the size and age structure of the walleye harvest would result and other possibilities for restricting walleye harvest may be found.

Saganaga Lake has a good population of smallmouth bass which are currently under-utilized in the sport fishery. Consideration should be given to promoting the smallmouth bass fishery to help reduce pressure on lake trout and walleye.

SOCIO-ECONOMIC STATUS

The economic impact of sport fishing for Minnesota-Ontario border waters east of Rainy Lake has been described in a recent report by the MDNR and OMNR. This information was not compiled for individual lakes; therefore, it can only be used as a general indication of the importance of sport fishing to Saganaga Lake businesses.

The total estimated gross revenue of the border water businesses east of Rainy Lake for 1989 was 19.2 million U.S. dollars (22.6 million Canadian dollars). Ninety-one percent of this sport fishing induced revenue went to U.S. businesses. Forty-nine percent of this revenue was derived from sport fishing on the border waters.

Based on creel survey data there are an estimated 9,500 summer fishing trips and 1,400 winter fishing trips annually on Saganaga Lake. Based on the figure of 26 U.S. dollars (31 Canadian dollars) per fishing trip from the 1980 National survey of Fishing, Hunting, and Wildlife-Associated Recreation, the annual economic value of these trips would be approximately 0.3 million U.S. dollars (0.4 million Canadian dollars).

The average annual commercial yield of lake whitefish on Saganaga Lake is about 7,800 lb (3,500 kg). With a current dockside value of $0.50 U.S. dollars ($0.60 Canadian dollars) per lb, the total annual value of the commercial lake whitefish fishery is about 3,900 U.S. dollars (4,600 Canadian dollars).

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