

Natural. Valued. Protected.



Fort Frances District – Northwest Region

ROVING CREEL SURVEYS ON RAINY LAKE, ONTARIO 2010/11

Darryl McLeod and David Denyes



**ROVING CREEL SURVEYS
ON RAINY LAKE, ONTARIO**

2010/11

Darryl McLeod and David Denyes

Ontario Ministry of Natural Resources

Fort Frances District

August, 2012

Fort Frances District Report Series No. 91

ABSTRACT

A roving creel survey was completed on the North Arm of Rainy Lake from May 21 to Sept 30th, 2011. A similar survey was conducted on Redgut Bay and the Ontario waters of the South Arm of Rainy Lake from May 15th to Sept 30th, 2010. Surveys have been completed on an irregular basis since 1956, but have followed a more intensive and standard sampling design since 1970. Angling effort and harvest was estimated for each spatial and temporal stratum (season, day-type and time period) based on instantaneous boat counts obtained from roving field crews. Incomplete trip interviews were conducted following a stratified, non-uniform probability sampling design. These open-water surveys were conducted to monitor the recreational fishery, to assess stock status and evaluate management actions, including more recent fisheries regulation changes. Specifically, angler surveys since 1994 have been designed to evaluate the effectiveness of new walleye size and catch limits, along with restrictions on non-resident use.

Total angling effort for the Ontario waters of Rainy Lake was estimated at 231,241 angler-hours \pm 38,610 (95% CI), and was lower than that observed in 2001/02 and the previous 10 year average for 1982-92. Overall, total angling effort averaged 3.3 hours/ha, with walleye effort estimated at 2.6 hours/ha (182,172 angler-hours). Effort was highest on Redgut Bay at 8.0 hours/ha (66,837 angler-hours), compared to 3.0 hours/ha (80,506 angler-hours) on the South Arm in 2010, and only 2.4 hours/ha (83,898 angler-hours) on the North Arm in 2011. Non-residents comprised 73% of all angling effort in 2010/11, with an estimated 57% originating from Ontario resorts, cottages or camping on Crown land. The remaining 16% were Minnesota-based non-resident anglers, which represent a significant decline from 51% observed in 1983. Resident effort continued to increase to a high of 63,016 angler-hours or 27% of the total effort in 2010/11. Walleye remained the target of most anglers, accounting for 79% of all angling effort and 55% of the total harvest by weight. Both northern pike and smallmouth bass angling continue to play an important role in the Rainy Lake sport fishery, with each receiving 28% and 31% of the angling effort, respectively.

Lake-wide angler harvest averaged 25,098 kg (0.36 kg/ha) for all fish species and 13,887 kg (0.20 kg/ha) for walleye. Anglers released approximately 89% of the walleye reportedly caught in 2010/11, while release rates were 93% for northern pike, 96% for smallmouth bass, 32% for black crappie, and 100% for muskellunge. In 2010, an estimated 3,920 kg (0.47 kg/ha) and 4,570 kg (0.17 kg/ha) of walleye were harvested from the sport fishery on Redgut Bay and the South Arm respectively. In 2011, 5,397 kg (0.16 kg/ha) of walleye were harvested from the North Arm. The reported catch rate for walleye continues to improve, and was highest on Redgut Bay at 1.34 fish/angler-hour followed by the South Arm at 1.12 fish/angler-hour in 2010. Walleye anglers caught an estimated 0.78 fish/angler-hour on the North Arm in 2011. The average size of walleye kept by anglers has remained relatively stable since 1983, with a mean total length of 395 mm and mean weight of 0.56 kg. The age of harvested walleye continues to increase, with a mean of 5.7 years in 2010/11. The size and catch restrictions introduced in 1994 and 2000 appear to be effective in reducing angling effort and harvest, while improving fishing quality for walleye and other species in Rainy Lake.

TABLE OF CONTENTS

	Page
LIST OF FIGURES	4
LIST OF TABLES	5
LIST OF APPENDICES.....	9
INTRODUCTION.....	10
STUDY AREA	12
METHODS	13
RESULTS	16
Angling Effort.....	17
Harvest.....	18
Population Characteristics	22
DISCUSSION.....	24
Angling Effort.....	24
Harvest.....	27
Population Characteristics	31
MANAGEMENT RECOMMENDATIONS	35
ACKNOWLEDGEMENTS	36
LITERATURE CITED	37
FIGURES	40
TABLES	51
APPENDICES.....	88

LIST OF FIGURES

1. Location of Rainy Lake, Ontario.
2. Location of creel survey sectors on Rainy Lake, Ontario.
3. Total estimated angling effort (angler-hours) from lake-wide creel surveys on Rainy Lake, Ontario from 1970 to 2011.
4. A comparison of estimated angling effort (angler-hours) by basin of Rainy Lake, Ontario for the period 1982-2011.
5. A comparison of residency and base of operations of anglers interviewed on each basin of Rainy Lake, Ontario in 2010/11.
6. A comparison of residency and base of operations of anglers interviewed on Rainy Lake, Ontario in 2010/11.
7. A comparison of walleye catch per unit effort (# fish caught/angler-hour) for each basin of Rainy Lake, Ontario for the period 1992-2011.
8. A comparison of angler release rates for walleye on Rainy Lake, Ontario from 1994, 1995, 2001/02 and 2010/11.
9. A comparison of angler release rates for smallmouth bass on Rainy Lake, Ontario from 1994, 1995, 2001/02 and 2010/11.
10. A comparison of angler release rates for major sportfish species on Rainy Lake, Ontario in 2010/11.
11. Species composition of the estimated angling harvest (kg) from Rainy Lake, Ontario in 2010/11.
12. Total estimated walleye angling harvest (kg) from lake-wide creel surveys on Rainy Lake, Ontario from 1970-2011.
13. A comparison of estimated walleye angling harvest (kg) by basin of Rainy Lake, Ontario for the period 1982 to 2011.
14. Total length at age for walleye harvested by anglers on Rainy Lake, Ontario in 2010/11.
15. Total length at age for northern pike harvested by anglers on Rainy Lake, Ontario in 2010/11.
16. Total length at age for smallmouth bass harvested by anglers on Rainy Lake, Ontario in 2010/11.
17. Total length at age for crappie harvested by anglers on Rainy Lake, Ontario in 2010/11.

LIST OF TABLES

1. Physical and chemical characteristics of Rainy Lake, Ontario.
2. Summary of creel survey information collected from the North Arm of Rainy Lake, 1956 to 2011. All data from actual angler interviews.
3. A summary of creel survey information collected from the South Arm of Rainy Lake, 1956 to 2010. All data from actual angler interviews
4. A summary of creel survey information collected from Redgut Bay of Rainy Lake, 1956 to 2010. All data from actual angler interviews.
5. A summary of angler contacts for creel surveys on Rainy Lake from 1982 to 2011.
6. Estimates of the mean length of an angler-day (complete trip) for each basin of Rainy Lake from recent creel surveys (1978 to 2011).
7. Angler residency (percent) for each basin of Rainy Lake from 1967 to 2011. Resident anglers include local, Ontario resident and Canadian resident.
8. Estimated total effort (rod-hours) with standard error (SE) by basin of Rainy Lake for the period 1967 to 2011.
9. Estimated total effort (angler-days) by basin of Rainy Lake for the period 1967 to 2011.
10. Estimated effort (rod-hours and %) by targeted fish species and basin of Rainy Lake in 2010/11.
11. Estimated effort (rod-hours) by angler residency and base of operation for the North Arm of Rainy Lake, 1983 to 2011.
12. Estimated effort (rod-hours) by angler residency and base of operation for the South Arm of Rainy Lake, 1982 to 2010.
13. Estimated effort (rod-hours) by angler residency and base of operation for Redgut Bay of Rainy Lake, 1982 to 2010.
14. Estimated effort (rod-hours) by angler residency and base of operation for all of Rainy Lake, 1983 to 2011.
15. Harvest per unit effort (HUE) for walleye (# fish kept/rod-hour by all angler (species anglers)) for each basin of Rainy Lake, 1956 to 2011.
16. Catch per unit effort (CUE) for walleye (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.

17. Harvest per unit effort (HUE) for northern pike (#fish kept/rod-hours by all anglers (species anglers)) for each basin of Rainy Lake, 1956 to 2011.
18. Catch per unit effort (CUE) for northern pike (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.
19. Harvest per unit effort (HUE) for smallmouth bass (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1956 to 2011.
20. Catch per unit effort (CUE) for smallmouth bass (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.
21. Harvest per unit effort (HUE) for black crappie (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1960 to 2011.
22. Catch per unit effort (CUE) for black crappie (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.
23. Harvest per unit effort (HUE) for sauger (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1978 to 2011.
24. Catch per unit effort (CUE) for sauger (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1982 to 2011.
25. Estimated angler catch (# caught and percent released) by fish species for each basin of Rainy Lake, 2010/11.
26. Estimated angler harvest (# kept) by fish species for each basin of Rainy Lake, 1967 to 2011.
27. Estimated angler harvest of walleye (kg) from each basin of Rainy Lake, 1967 to 2011. Confidence limits are given at the 95% level.
28. Estimated angler harvest of northern pike (kg) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.
29. Estimated angler harvest of smallmouth bass (kg) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.
30. Estimated angler harvest of black crappie (kg) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.
31. Estimated angler harvest of sauger (kg) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.
32. Estimated walleye harvest (kg) by angler residency and base of operation for the North Arm of Rainy Lake, 1983 to 2011.

33. Estimated walleye harvest (kg) by angler residency and base of operation for the South Arm of Rainy Lake, 1982 to 2010.
34. Estimated walleye harvest (kg) by angler residency and base of operation for the Redgut Bay of Rainy Lake, 1982 to 2010.
35. Estimated walleye harvest (kg) by angler residency and base of operation for Rainy Lake, 1983 to 2011.
36. A summary of population characteristics (mean age, length and weight) for walleye caught by anglers on each basin of Rainy Lake, 1963 to 2011.
37. A summary of population characteristics (mean age, length and weight) for walleye caught by anglers on Rainy Lake, 1983 to 2011.
38. A summary of population characteristics (mean age, length and weight) for northern pike caught by anglers on Rainy Lake, 1983 to 2011.
39. A summary of population characteristics (mean age, length and weight) for smallmouth bass caught by anglers on Rainy Lake, 1983 to 2011.
40. A summary of population characteristics (mean age, length and weight) for black crappie caught by anglers on Rainy Lake, 1983 to 2011.
41. A summary of population characteristics (mean age, length and weight) for sauger caught by anglers on Rainy Lake, 2011.
42. Total length frequency distribution of fish species harvested by anglers in the North Arm of Rainy Lake, 2011.
43. Total length frequency distribution of fish species harvested by anglers in the South Arm of Rainy Lake, 2010.
44. Total length frequency distribution of fish species harvested by anglers in Redgut Bay of Rainy Lake, 2010.
45. Total length frequency distribution of fish species harvested by anglers in Rainy Lake (Ontario), 2010/11.
46. Length at age observations for walleye (sexes combined) in angler catch from the North Arm of Rainy Lake, 2011.
47. Length at age observations for walleye (sexes combined) in angler catch from the South Arm of Rainy Lake, 2010.
48. Length at age observations for walleye (sexes combined) in angler catch from Redgut Bay of Rainy Lake, 2010.

49. Length at age observations for walleye (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11.
50. Length at age observations for northern pike (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11.
51. Length at age observations for smallmouth bass (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11.
52. Length at age observations for black crappie (sexes combined) in angler catch from the North Arm of Rainy Lake, 2011.

LIST OF APPENDICIES

1. Scheduled sampling intensity with spatial and temporal stratification (sector, day-type, time period and season) for the 2010 creel survey.
2. Scheduled sampling intensity with spatial and temporal stratification (sector, day-type, time period and season) for the 2011 creel survey.
3. Visitor type codes for anglers, Option 1 codes for released walleye, and Option 2 codes for released smallmouth bass on creel interview forms.
4. Total length at age for walleye harvested by anglers on the North Arm of Rainy Lake, Ontario in 2011.
5. Total length at age for walleye harvested by anglers on the South Arm of Rainy Lake, Ontario in 2010.
6. Total length at age for walleye harvested by anglers on Redgut Bay of Rainy Lake, Ontario in 2010.
7. Mean total length of walleye (age 3 to 7 years) vulnerable to angler harvest on South Arm of Rainy Lake, Ontario in 2010.
8. Mean total length of walleye (age 3 to 7 years) vulnerable to angler harvest on Redgut Bay of Rainy Lake, Ontario in 2010.
9. Mean total length of walleye (age 3 to 7 years) vulnerable to angler harvest on Rainy Lake, Ontario in 2010/11.

INTRODUCTION

Rainy Lake is a large, border lake located in the Fort Frances District, Northwest Region of Ontario. A portion of the lake is shared with the State of Minnesota and is located immediately adjacent Voyageur's National Park in the USA. Assessment information from the fishery is shared between resource agencies and through the Ontario-Minnesota Fisheries Committee.

Monitoring of the Ontario sport fishery was first initiated in 1956 as part of an early investigation of Rainy Lake (Bonde et al., 1961), and continued annually from 1958 to 1962 (Bonde et al., 1964). However, these surveys provided only catch per unit effort (CUE) data as a means of monitoring and comparing this sport fishery to other District lakes. These types of surveys continued through 1964 (Caldwell, 1964), 1966, 1967 (Thomson, 1967) and 1969 (Thomson 1969a; 1969b; 1969c). The first intensive lake-wide survey was conducted in 1970 with the establishment of a Rainy Lake Fisheries Management Unit (McGregor, 1970). In the following decade, creel surveys were completed on the North Arm in 1972, 1973, 1974 and 1979, and on Redgut Bay in 1971 and 1978.

Roving creel surveys continued more intensively from 1982 to 1985 (McLeod, 1983; McLeod, 1984; McLeod, 1988). In addition to long-term monitoring and assessment, these studies were conducted primarily to evaluate the effects of a Crown Land Recreation program introduced in 1984, as well as the Daily Angling Validation Tag (DAVT) program and a walleye stocking/rehabilitation program on the North Arm introduced in 1985. Further investigations of the angling fishery were completed on the South Arm and Redgut Bay in 1992, followed by lake-wide surveys in 1994/95 (McLeod, 1996) and 2001/02 (McLeod, 2003). The latest surveys were part of an enhanced effort to assess the status of walleye fisheries on the border waters, and to evaluate the effectiveness of walleye size and catch limits and further restrictions on non-resident anglers.

In 2000, Rainy Lake was included in a Fisheries Status of the Resource (SOR) project that covered tertiary watershed 5PB in the Northwest Region. Aerial angler counts were completed during the open-water season of 2000 and during the winter of 2001, in order to estimate current angler effort across the study area. Combined aerial and access point creel surveys

were also conducted on the Minnesota waters of Rainy Lake on an annual basis until 2011, as part of the Department of Natural Resources Large Lake Sampling Program (Schlesser, 2011; Schlesser, 2010).

In February 1994, Ontario introduced several changes to fishing regulations on Rainy Lake to help address serious walleye conservation concerns on the border waters in Northwestern Ontario. Specific changes on Rainy Lake included a reduction in the daily catch and possession limit of walleye from six to three, and the implementation of a harvest slot and trophy size limit whereby only walleye between 35 and 45 cm (13.8 to 17.8") total length, and one over 70 cm (27.5") can be legally harvested. The DAVT was also eliminated, and replaced with a South Arm Rainy Lake Border Water Conservation Tag program, where fish stocks are shared with Minnesota. Holders of non-resident fishing licenses elsewhere on Rainy Lake were restricted to catch and release fishing only unless staying overnight at an Ontario tourist establishment, houseboat, recreational fishing site, parcel of land or provincial park as prescribed in the regulations.

Daily catch and possession limits for holders of a non-resident fishing licenses with a South Arm Rainy Lake Border Water Conservation Tag affixed were: 0 walleye, 0 sauger, 2 northern pike, 2 largemouth bass, smallmouth bass or combination, 0 muskellunge, 0 lake sturgeon, 10 crappie and 12 whitefish. This tag system remained in effect from 1994 to 1999.

As part of an extensive package of regulation changes for Northwestern Ontario in 1999, the daily catch limit for angling black crappie was reduced from thirty to fifteen. Daily catch and possession limits for northern pike were reduced from six to four, along with a protected slot size, whereby no pike may be harvested between 70 and 90 cm (27.5 to 35.4") and only one fish over 90 cm (35.4')

By January 2000, the Border Water Conservation Tag was removed and replaced with a regulation that treated all non-residents of Canada in the same manner, whether they stay overnight in Ontario or fish from Minnesota. On Rainy Lake, this regulation included a non-resident daily limit of one walleye or sauger, and a possession limit of four walleye or sauger. The daily catch and possession limit for resident anglers increased from three to four walleye or

sauger in combination. The minimum size limit for angling muskellunge was also increased from 102 cm (40") to 122 cm (48").

In 2010, a roving creel survey was conducted on Redgut Bay and the Ontario waters of the South Arm of Rainy Lake. The survey began on May 15th, coinciding with the opening of the walleye season and concluded on September 30th. A similar survey was conducted on the North Arm from May 21 to Sept 30th, 2011. Funding for both projects was made available through Specially Designated Waters (SDW) funding through NW Region. Rainy Lake has been identified as an SDW within Fisheries Management Zone (FMZ) 5 as part of the Ecological Framework for Fisheries Management (EFFM) in Ontario (OMNR, 2005).

In addition to long-term monitoring and assessment, the specific objectives of these two surveys were to:

- determine the effort and success of anglers through catch per unit effort (CUE) data;
- quantify the harvest of sportfish by number and weight;
- quantify angler effort in rod-hours and angler-days;
- determine the visitor type, origin and residency of anglers;
- determine basic biological data (age, length, weight and growth) for walleye (*Sander vitreus*), northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*) and sauger (*S. canadensis*) in Rainy Lake.

The surveys should provide a base of information to help evaluate the effectiveness of angling regulation changes and other management actions, as well as the recovery of walleye populations. The information may also contribute to long-term monitoring of water level impacts (Kallemeyn, 2000), and for the management of the Rainy Lake Islands Conservation Reserve identified under Ontario's Living Legacy (OLL) program.

STUDY AREA

Rainy Lake is a large, mesotrophic lake located on the Canada-United States border between northwestern Ontario and north-central Minnesota (Figure 1). The lake covers an area of 92,110 ha of which 70,150 ha (75%) is in Ontario (MDNR and OMNR, 1998). The lake is

irregular in shape with a shoreline of 1,495 km and an additional 1,068 km of shoreline associated with approximately 1,600 islands. Rainy Lake forms three geographically distinct basins, with the North Arm (34,570 ha) and Redgut Bay (8,320 ha) located entirely in Ontario. The South Arm basin is shared with Minnesota with 27,260 ha (55%) located in Ontario. Major inflows are from the Namakan Reservoir and the Seine River, with minor inflows from Big Turtle, Little Canoe, Big Canoe, Manitou and Footprint Rivers.

In 2011, the survey covered the North Arm of Rainy Lake (sectors 1, 2 and 3). In 2010, the survey area consisted of the Ontario waters of the South Arm of Rainy Lake (sectors 4, 5 and 6) and Redgut Bay (sector 7) (Figure 2). Table 1 provides a summary of the physical and chemical characteristics of each lake basin (McLeod, 2001).

The fish community of Rainy Lake is very diverse, with a reported 55 fish species, in 16 different families (Wepruk et al., 1992). The lake has approximately 1,650 Growing Degree Days (GDD>5°C), a mean annual air temperature of 3.2°C and maximum surface water temperatures of approximately 25°C. Rainy Lake is located in tertiary watershed division 5PB, within the Lake Winnipeg drainage system.

The lake is situated within fisheries planning zone 7 of the Fort Frances District Fisheries Management Plan 1987-2000 (OMNR, 1987). Management objectives for the zone are: to enhance the quality of the coolwater fishery with particular efforts directed toward restoring the walleye stocks in Rainy Lake; manage to maintain existing angling opportunities for residents and tourism based non-residents; and manage to maintain existing tourism opportunities.

METHODS

This roving creel survey was designed according to methods outlined in the CREESYS 3.3 manual (OMNR, 1985; Orsatti et al., 1991) and FISHNET 2.0 manual (OMNR, 1995; Lester and Korver, 1996) as part of the Ontario Fisheries Information System (OFIS). Each basin of the lake was surveyed and analyzed on an individual basis using a stratified, non-uniform probability sampling technique (Alder, 1979; Malvestuto et al., 1978).

The survey was conducted by a two-person field crew following a schedule set up for the period May 15th to September 30th, 2010 and May 21 to September 30th, 2011 to coincide with the open-water fishing season for walleye. Spatial stratification included three spaces: the North Arm and South Arm with three sampling areas each, and Redgut Bay (Figure 2). Temporal stratification included three seasons, two day-types (workday and non-workday) and two time periods (0800-1400 hrs and 1400-2000 hrs). Seasons consisted of spring (May 15/21-June 30), summer (July 1-August 15) and fall (August 16-September 30). U.S. holidays were considered as non-workdays since the majority of anglers were non-residents of Canada.

In any one season, the selection of sector, day-type and time period for each sampling day was random, and number of each chosen in proportion to the amount of fishing that occurs (Appendix 1 and 2). Since aerial boat counts were not conducted in 2010/11, the temporal and spatial distribution of spring sampling effort on the South Arm and North Arm was based on equal sampling across the three areas or sectors. In 2010, Redgut Bay generally received higher sampling intensity based on the higher proportion of angling effort that has occurred there during previous surveys. Summer and fall sampling were based on stratification from roving boat counts obtained during the previous season. The target for sampling was a minimum of three samples per strata, where possible.

A minimum of one instantaneous boat (activity) count was completed for each sampling period and recorded on a standard Creel Log Form (CLF). Standard Creel Interview Forms (CIF) were completed for all angler interviews. For each interview, the number of anglers, interview time, fishing start/stop time, species sought, and the number of fish kept and released of each species was recorded. In addition to catch data, the origin and visitor type (base of operation) of all anglers was recorded (Appendix 3). Angler residency categories included locals (Fort Frances area), residents (of Ontario), non-residents (from the United States), Canadians (all other provinces) and others (all other countries). Angler visitor types included day-trippers, cottagers, commercial resorts/campgrounds, commercial houseboats, and Crown land campers. Interviewed parties were also asked two additional questions (Option Codes 1 and 2) concerning the release of walleye and smallmouth bass, consistent with previous surveys in 1994/95 and 2001/02 (Appendix 3).

Information collected from all three basins were summarized and analyzed using the FISHNET 2.0 program (OMNR, 1995; Lester and Korver, 1996). Catch per unit effort (CUE), total harvest by species and angling effort values were derived with standard error and % RSE, where appropriate.

Walleye, northern pike, smallmouth bass, black crappie and sauger were sampled during the survey period, with a minimum target of 200 samples per species per basin. This target was to be achieved over the whole survey period with samples collected from all areas of the lake basin. All samples were collected randomly by number and size from the interviewed parties. For each sample, fish were measured for total and fork length, weighed for round weight and a calcified structure removed for age determination. A dorsal spine and/or scales were removed from walleye, sauger, smallmouth bass and black crappie, while a cliethrum and/or scales were removed from northern pike. Hand-held digital scales were used for weighing fish to the nearest 0.05 kg (50 grams), and measuring boards with certified meter sticks were used for measuring fish to the nearest millimeter.

All dorsal spines collected were embedded in coloured araldite, sectioned using an isomet saw, mounted on glass slides and read under a compound microscope. Northern pike cliethra were cleaned, air dried and read in reflected light under a dissecting microscope. Scales, where required, were pressed on acetate slides and read under a trichinoscope scale projector or microfiche reader. All aging and preparation was completed at the NW Regional Aging Facility in Dryden, Ontario.

A summary and analysis of length, weight and age data was completed using the FISHNET 2.0 program (Lester and Korver, 1996). Information generated included age distributions, mean age (with standard deviations), mean length and weight at age (with standard deviations), and length frequency distributions. Each species was analyzed separately by lake basin or space, where sample sizes were appropriate.

RESULTS

Tables 2, 3, and 4 provide a summary of information collected directly from angler interviews on the North Arm, South Arm and Redgut Bay respectively since 1956. In 2010, a total of 2,171 anglers were directly contacted by the survey crew with a reported harvest of 642 walleye, 83 northern pike, 37 smallmouth bass and 405 crappie. In 2011, a total of 1,818 anglers were contacted on the North Arm with a reported harvest of 532 walleye, 132 northern pike, 87 smallmouth bass and 18 crappie.

A summary of the total number of anglers and boats contacted on the lake with the percentage of observed boats contacted is provided in Table 5. On average, the survey crew contacted 89% of the boats observed fishing on the sample days in 2010 compared to 103% in 2011. A total of 66 counts or sample days were completed on the South Arm and 36 counts on Redgut Bay in 2010. In 2011, there were 100 counts completed on the North Arm. The estimated mean length of an angler-day was estimated at 5.76 hours on Redgut Bay and 6.09 hours on the South Arm in 2010, compared to 5.70 hours on the North Arm in 2011 (Table 6). On average, anglers spent 5.85 hours/day fishing on Rainy Lake in 2010/11.

Aerial flights were not completed over the study area to assist with probability sampling and determining seasonal sampling intensities on the North Arm and South Arm. However, analysis of 2010 boat count data across all temporal strata (day-type, time period and season) provided an average activity of 21.1 boats/count on the South Arm, compared to 15.1 boats/count on Redgut Bay. On the South Arm, an average of 5.7 boats were observed per count (27.1%) on sector 4, 8.1 boats/count (38.6%) on sector 5 and 7.2 boats/count (34.3%) on sector 6. In 2011, boat count data provided an average activity of 22.4 boats/count on the North Arm. An average of 5.7 boats/count (25.4%) were observed fishing on sector 1, 10.2 boats/count on sector 2 (45.5%) and 6.5 on sector 3 (29.0%).

For survey scheduling on the South Arm in 2010 and North Arm in 2011, spring sampling intensity was based on equal probabilities across the three sectors and the two time periods. Sampling intensities for summer and fall were based on boat counts and probabilities obtained from the previous season, providing the minimum target sampling was obtained in each stratum

(Appendix 1 and 2). Redgut Bay (sector 7) was treated as a separate sampling unit with equal (50%) probability sampling over the two time periods (AM and PM), consistent with previous surveys. Non-workdays were generally sampled lower than the desired levels during spring and fall due to the reduced number of sample days available, and limitations on funding and survey crew availability.

Angling Effort

The majority of the anglers in the Rainy Lake fishery were non-resident anglers from the United States, ranging from 74% on the South Arm and North Arm to 70% on Redgut Bay. Canadian residents accounted for 26 to 30% of the total anglers contacted in 2010/11 (Table 7). The percentage of non-resident anglers has declined steadily on the South Arm and Redgut Bay since 1982, while remaining stable on the North Arm.

Total angling effort for the survey period was estimated at 231,241 angler-hours \pm 38,610 (95% confidence level), or 39,542 angler-days (Table 8 and 9). Effort has decreased since 2001/2002 and from the levels observed in 1983-86 (Figure 3). Anglers contributed an estimated 66,837 angler-hours on Redgut Bay and 80,506 angler-hours the South Arm in 2010, with an additional 83,898 angler-hours on the North Arm in 2011. Figure 4 summarizes the estimated angling effort for each basin and the entire lake in 2010/11, compared to the levels observed during the previous periods.

Walleye were the most sought after species on Rainy Lake at 79% of the total effort. Northern pike (28%) and smallmouth bass (31%) were also sought after by anglers. In addition, most of the angling effort for black crappie and muskellunge occurs in Redgut Bay. Table 10 provides a summary of fishing effort (rod-hours) by targeted species for each basin of the lake.

Estimates of angler effort, by residency and visitor type (base of operation), are provided for each basin (Tables 11, 12 and 13) and for the entire lake (Table 14). Effort or fishing pressure, expressed as angler-hours/ha, was highest in Redgut Bay at 8.0 hours/ha, compared to 3.0 hours/ha on the South Arm and only 2.4 hours/ha on the North Arm. Total effort for the Ontario waters of Rainy Lake in 2010/11 was low at an estimated 3.3 hours/ha. Ontario-based non-

resident anglers comprised the majority (57%) of all anglers on Rainy Lake in 2010/11, ranging from a high of 64% on Redgut Bay, to 63% on the North Arm and only 41% on the South Arm (Figure 5). Most of these anglers were guests of Ontario resorts and cottagers. Minnesota-based non-resident anglers represented only 16% of all anglers in Ontario waters in 2010/11, but ranged from 33% on the South Arm, 11% on the North Arm and only 6% on Redgut Bay (Figure 6). Resident anglers averaged 27% of the total effort, with 31% on Redgut Bay and 26% on both the North and South Arm.

Harvest

Tables 15 and 16 provide the observed harvest per unit effort (HUE) and catch per unit effort (CUE) for walleye respectively, based on the number of fish kept and caught per rod-hour by all anglers and species-specific anglers. The 2010 catch rates on Redgut Bay were similar to those observed in the 2001, whereas angler success rates continue to improve on the South Arm and North Arm of Rainy Lake (Figure 7). Average CUE's for anglers targeting walleye reached 1.12 walleye/rod-hour on the South Arm and 1.34 walleye/rod-hour in Redgut Bay in 2010. The CUE for walleye on the North Arm experienced a 3 fold increase to 0.78 walleye/rod-hour in 2011, compared to only 0.25 in 2002. While CUE's and HUE's calculated from anglers targeting walleye were higher than those for all anglers, both followed the same general trends. Harvest rates (HUE) were very similar across all three basins at approximately 0.13-0.14 walleye kept/rod-hour.

Release of walleye appears high on Rainy Lake, with an estimated 89% of walleye caught being released by anglers in 2010/11. This represents a modest increase from the previous level of 87% observed in 2001/02. The majority of the walleye being released are due to the restrictive harvest slot and trophy size limit in place since 1994. An estimated 61% of the fish caught in 2010/11 were released below the legal harvest size limit (<35 cm), similar to the 59% observed in 2001/02 (Figure 8). The number of fish released over the legal size limit (>45 cm) has increased since 1994 with an estimated 12% released in 2010/11, which is slightly below 2001/02 value of 14%. Few fish in the trophy size (> 70 cm) were reported caught and released in the fishery since 1994. More anglers (14%) have reported releasing walleye after reaching

their legal daily catch limit in 2010/11, with an additional 12% practicing catch and release fishing only.

The observed HUE and CUE values for northern pike by all anglers and species anglers are provided in Tables 17 and 18 respectively. Catch rates for northern pike anglers in 2010/11 were all below 0.50 fish/rod-hour, and were highest on the South Arm at 0.49 fish/rod-hour. Harvest rates (HUE) were very similar across all three basins at approximately 0.06-0.07 fish kept/rod-hour.

The observed HUE and CUE values for smallmouth bass by all anglers and species anglers are provided in Tables 19 and 20 respectively. Catch rates on the South Arm and Redgut Bay were at their highest observed level since 1969, at 0.69 and 0.55 fish/rod-hour respectively. Catch rates continue to remain high on the North Arm at 0.77 fish/rod-hour, down slightly from 2002 values. Harvest rates (HUE) for bass anglers were very low at 0.02 to 0.04 fish kept/rod-hour across all three basins suggesting high release rates. Additional angler interview questions concerning release of smallmouth bass confirm this observation (Figure 9). In 2010/11, anglers reported releasing 96% of all bass caught, consistent with 2001/02. Most bass (92%) are being released by anglers that are practicing "catch and release" fishing. In 1994, 26% of all bass released were reported as being "too small", compared to only 2% in 2010/11.

The observed HUE and CUE values for black crappie by all anglers and species anglers are provided in Tables 21 and 22 respectively. Catch rates for crappie anglers in 2010/11 were highest on the Redgut Bay at 0.52 fish/rod-hour, compared to 0.30 fish/rod-hour on the South Arm and 0.20 on the North Arm. These values were well below those observed during the 1992 peak in crappie harvests. Harvest rates (HUE) were also highest and more stable on Redgut Bay at an estimated 0.36 fish kept/rod-hour.

Observed catch rates for sauger are generally low on Rainy Lake, at only 0.18 fish/rod-hour reported by anglers on the North Arm (Tables 23 and 24). Sauger anglers on the South Arm and Redgut Bay reported higher catch rates of 0.51 and 0.41 fish/rod-hour, respectively. Harvest rates (HUE) are generally low due to the very small size, with most anglers keeping no sauger (Table 23).

The estimated total number of fish caught by species in each basin of Rainy Lake is provided in Table 25, with the percentage of fish released by anglers. Release rates are highest for muskellunge (100%) and smallmouth bass (96%), followed by northern pike (93%), walleye (89%) and black crappie (32%) (Figure 10). An estimated 89% of the 366,100 fish captured by anglers in Rainy Lake in 2010/11 were released. An estimated 218,455 walleye were caught by anglers, with release rates highest in Redgut Bay (91%) and lowest in the North Arm (83%).

Table 26 provides the estimated angler harvest (# fish kept) by fish species and basin for all creel surveys conducted from 1967 to 2011. The estimated harvest (kg) of walleye, northern pike, smallmouth bass, black crappie and sauger from each basin of the lake are also provided in Tables 27 to 31 respectively. Total angling harvest was estimated at 25,098 kg during the 2010/11 lake-wide creel survey (Figure 11). Walleye dominated the harvest of fish by number (62%) and by weight (55%) at 13,887 kg. Northern Pike are the second most important species with an estimated harvest of 5,697 kg or 23% of the total angler harvest. Both black crappie and smallmouth bass comprise a smaller portion of the harvest at 15% and 7% respectively, with sauger and yellow perch representing a very small portion at less than 1% of the total harvest by weight.

Walleye harvest in 2010/11 was highest from the North Arm at an estimated 5,397 kg, compared to 4,570 kg from the South Arm and 3,920 kg from Redgut Bay (Table 27). Total estimated angler harvest of walleye from Rainy Lake decreased slightly from 2001/02 and is still well below the historical levels observed from 1970 to 1986 (Figure 12). Walleye harvest decreased on the South Arm and Redgut Bay compared to 2001/02 and are well below the previous 10-year average from 1982-1992 (Figure 13). Estimated harvest on the North Arm is at the highest level reported since 1967.

Harvest of northern pike was highest in the North Arm at 3,013 kg or 53% of the total pike harvest, followed by Redgut Bay at 25% and the South Arm at 22% (Table 28). Pike harvest in 2010/11 was well below the levels estimated since 1983. Harvest of smallmouth bass was also lower than previously observed. Harvest was highest in the North Arm at 865 kg or 51% of the total bass harvest, followed by the South Arm at 43% and Redgut Bay at 6% (Table 29).

Angler harvest of black crappie was quite low in 2010/11, with only 3,750 kg harvested lake-wide with the majority (83%) taken in Redgut Bay (Table 30). Sauger harvest was even lower,

with an estimated harvest of only 72 kg from Ontario waters and the majority (60%) taken in Redgut Bay (Table 31).

Table 32 to 35 provide an annual comparison of the estimated walleye harvest by angler residency and base of operation for each basin of Rainy Lake and the total lake for all creel surveys conducted since 1982. Harvests and harvest rate on the North Arm were at the highest level (0.16 kg/ha) ever reported in creel surveys. The majority of walleye harvested were by Ontario-based non-resident anglers at 63% (Table 32). Walleye harvest on the South Arm and Redgut Bay were both lower than in 2001 and were well below estimated harvests between 1982 and 1992 (Figure 13). On the South Arm, the 2010 walleye harvest was 4,570 kg or 0.17 kg/ha, which is down 45% from 0.31 kg/ha in 2001/02, but equivalent to the 1994 and 1995 estimates of 0.17 and 0.16 kg/ha respectively (Table 33). The majority (41%) of walleye harvested were by Ontario-based non-resident anglers while Minnesota-based non-resident anglers represented 33% of the harvest, well below the levels of 54-82% observed during the period 1982-1992. Ontario residents represented 26% of walleye harvest on the South Arm. On Redgut Bay, the 2010 walleye harvest was 3,920 kg or 0.47 kg/ha, which is below the estimated harvest from 2001/02, but similar to levels seen in 1995 of 0.46 kg/ha (Table 34). The majority (64%) of walleye harvested were by Ontario-based non-resident anglers compared to resident anglers at 31%. Minnesota-based non-resident anglers comprised only 6%, well below the levels of 24-55% observed during the period 1982-1992.

The 2010/11 estimated walleye harvest from the Ontario waters of Rainy Lake was 13,887 kg or 0.20 kg/ha (Table 35). This is similar to the average harvest of 0.21 kg/ha observed in 2001/02, and only half the harvest estimated for the period 1983-1986. The highest walleye harvest estimated from previous lake-wide creel surveys was 34,420 kg (0.49 kg/ha) in 1983, and was equivalent to the harvest from the first creel survey in 1970. The majority of walleye harvested in 2010/11 were by Ontario-based non-resident anglers at 57% and Ontario resident anglers at 27%. Minnesota-based non-resident anglers comprised 16% of the harvest, well below the levels of 44-70% observed during the period 1983-86.

Population Characteristics

A summary of population characteristics collected from walleye (Table 36) indicates a total of 287 fish sampled from the North Arm in 2011, 107 from the South Arm and 119 from Redgut Bay in 2010. Walleye harvested from the North Arm had a mean total length of 406 mm, mean round weight of 0.59 kg and a mean age of 5.0 years. North Arm walleye were larger but younger than those observed on the South Arm and Redgut Bay under the same restrictive size regulation. On the South Arm, walleye had a mean total length of 382 mm, mean weight of 0.53 kg and a mean age of 6.3 years. Walleye from Redgut Bay were similar in size with a mean length of 382 mm and mean weight of 0.53 kg, but were slightly older with a mean age of 6.9 years. The mean ages of South Arm and Redgut Bay walleye represented the highest observed in all creel surveys since 1969. Walleye harvested by anglers on all three basins combined for 2010/11 had a mean length of 395 mm, mean weight of 0.56 kg, and a mean age of 5.7 years (n=513) (Table 37).

Table 38 provides a summary of population characteristics for northern pike for the Ontario waters. Samples for all other species other than walleye were combined across all basins due to small sample size. In 2010/11, northern pike had a mean total length of 622 mm, mean weight of 1.43 kg and a mean age of 5.3 years (n=107). Population characteristics have been relatively stable since 1983 when pike were first sampled in creel surveys.

Smallmouth bass in 2010/11 had a mean total length of 341 mm, mean round weight of 0.66 kg and a mean age of 6.0 years (n=50) (Table 39). Black crappie in 2010/11 had a mean total length of 291 mm, mean round weight of 0.47 kg and a mean age of 6.1 years (n=100) (Table 40). A small sample of only 5 sauger in 2010/11 provided a mean total length of 343 mm and mean weight 0.36 kg (Table 41), and would suggest that sauger are generally below a desired harvest size for anglers on Rainy Lake.

Tables 42 to 44 provide the total length frequency distributions for walleye, pike, bass, crappie and sauger harvested from the North Arm in 2011, and the South Arm and Redgut Bay in 2010 respectively. Across all basins and both years (Table 45), the majority of walleye harvested by anglers are between 350 and 450 mm consistent with the existing harvest slot size restriction in

effect since 1994. Only one walleye was sampled over the two year survey in the trophy size category (>700 mm). Walleye averaged 395 mm (n=513) in length which represents the middle of the existing harvest slot size for anglers. A voluntary non-compliance rate with the size restriction was estimated at 6.8% (35 of 513 fish). Reported non-compliance was highest on the South Arm in 2010 at 9.4% and lowest in Redgut Bay at 3.4%.

The majority of northern pike sampled were below the existing protected size and trophy limit of 700 to 900 mm, and no fish were sampled over 900 mm. Northern pike averaged 622 mm (n=107) in length, and the voluntary non-compliance rate with the protected size restriction was estimated at 5.6% (6 of 107 fish) (Table 45). The average size of smallmouth bass harvested by anglers was 341 mm and 62% were below the seasonal maximum size limit of 350 mm. Black crappie averaged 291 mm and almost all fish sampled were less than 350 mm total length. No size limits currently exist for crappie or sauger.

The age composition and length at age observations for walleye harvested from the North Arm in 2011, the South Arm and Redgut Bay in 2010, and Rainy Lake combined in 2010/11 are provided in Tables 46 to 49 respectively. On the North Arm in 2011, the majority (75%) of the catch was comprised of 5 year old fish and 93% of the catch was 4 to 8 years. In comparison, 84% and 82% of walleye harvested by anglers on the South Arm and Redgut Bay respectively were 4 to 8 years of age in 2010 as influenced by the existing size regulation. The dominant age class for walleye harvested on Redgut Bay was age 5 (25%) compared to age 6 (22%) on the South Arm in 2010. Maximum age of walleye sampled was 18 years. Total length at age observations suggest that walleye aged 4 to 8 years are generally available to harvest by anglers within the 350 to 450 mm harvest slot size on Rainy Lake (Figure 14). Fast growing age 3 walleye and slow growing walleye up to age 14 were also represented in the legal harvest size but at reduced numbers. Generally, walleye would need to be older than 16 years of age to be vulnerable to harvest above the 700 mm trophy size limit (Table 49).

Table 50 and Figure 15 provide the total length at age observations for northern pike sampled in 2010/11. The majority of pike kept by anglers were 3 to 7 years of age (93%), with age 5 fish being most abundant (32%). Very few northern pike were sampled over 8 years of age. Maximum age of pike sampled was only 10 years. No fish were sampled that exceeded the 900 mm trophy size limit, and these fish would generally exceed 10 years of age. Mean length

at age would suggest that the current size regulation (700-900 mm protected slot/trophy) protects pike over 8 years of age on Rainy Lake.

Table 51 and Figure 16 provide the age composition and total length at age observations for smallmouth bass sampled in 2010/11 respectively. The majority of bass kept by anglers were 5 years of age (38%). Most bass harvested by anglers are between 4 and 9 years, with very few fish harvested over 10 years of age. Maximum age of bass sampled was 12 years. Mean length at age would suggest that the current size and catch regulation (no bass >350 mm from December 1st to June 30th) protects bass over 5 years of age on Rainy Lake during the spring and winter.

Table 52 and Figure 17 provide the age composition and length at age observations for black crappie sampled in 2010/11. Most crappie harvested in Rainy Lake are 4 to 8 years of age, with age 5 and 7 fish comprising the majority (51%) of the angler catch. Maximum age of crappie sampled was 12 years.

DISCUSSION

Angling Effort

Estimated angling effort on Rainy Lake during the 2010/11 open-water season (231,240 ± 38,610 angler-hours) has increased from the levels observed in 1994/95, but remains much lower than the levels observed during the period of 1982-92. However, effort has declined by 24% since the 2001/02 survey. Sampling intensity during the 2010/11 creel surveys was sufficient to provide a reliable estimate of angling effort with a Relative Standard Error (RSE) of 8.3%.

Several factors have contributed to increased angling effort since 1994. Angler response has changed since restrictive size and catch regulations were implemented. Observations in 2001 would suggest that angler activity, primarily from Minnesota-based non-residents has increased from 0% in 1994/95 to 16% in 2010/11. Improvements in fishing quality for walleye have been observed, that coincides with the reduced effort and harvest in Ontario waters since 1994.

Minnesota-based angler use may also be responding to changes in fishing regulations in 2000 which pre-empted a U.S. based trade challenge under the North American Free Trade Agreement (NAFTA). These changes allowed a daily catch limit of 1 walleye/sauger with possession limit of 4 for all non-resident anglers, rather than the catch and release only requirement that existed for US-based anglers from 1994 to 1999. There may also be enhanced interest and demand for quality fishing opportunities in Northwestern Ontario. The recent decline in angling effort from 2001/02 to 2010/11 may be a result of economic considerations. Recent downturns in the US economy and high fuel costs may have contributed to reduced travel by non-residents of Canada and fishing-related tourism in Ontario. A similar decline in fishing effort was also reported on the Winnipeg River (Kenora District) from 2002 to 2007 (Peacock et al., 2010).

Current angling effort for all species in Ontario waters can be considered low to moderate at 3.3 angler-hours/ha. Angling effort directed at walleye was even lower at 182,170 angler-hours or 2.6 hrs/ha. This level of effort provides a management strategy designed for quality (2-5 hrs/ha) versus quantity (5-10 hrs/ha) walleye fisheries (OMNR, 1990). Fishing pressure in excess of 10 hours/ha could compromise fishing quality, and could result in spawning stocks being diminished to the point where recruitment and yield are limited (OMNR, 1983). Redgut Bay is approaching this higher level, with the 2010 effort estimated at 8.0 hrs/ha for all species, and 6.8 hrs/ha for walleye. Previous levels of total effort reached a high of 12.6 hrs/ha in 1992. In comparison, total effort on the Minnesota waters of Rainy Lake is high at an estimated 234,060 angler-hours or 10.7 hrs/ha in 2010, but below the peak levels observed in 1999/2000 (Schlesser, 2010). Effort in Minnesota had increased dramatically after major changes to angling regulations were implemented in 1994 and walleye populations have been improving.

The Recreational Fishing Survey (Hogg et al., 2010) estimated angling effort on the Ontario waters at 103,500 hours in 2005 compared to 191,700 hours in 2000. Mail surveys appear to under-estimate angler effort based on a comparison with roving creel survey results, over a similar time period.

Walleye continue to be the most important species in the Rainy Lake fishery. In 2010/11, there were an estimated 182,170 angler-hours (79%) directed at walleye, followed by smallmouth bass with 71,970 angler-hours (31%) and northern pike with 64,130 angler-hours (28%). The

importance of a quality smallmouth bass fishery continues to increase, likely a result of the annual Fort Frances Canadian Bass Championship and enhanced marketing efforts. Although angling for black crappie is improving, open-water effort remains relatively low at only 23,580 angler-hours (10%). The importance of crappie is difficult to evaluate given the seasonal and cyclic nature of the fishery. Muskellunge represent only a minor component of the fishery at 4,180 angler-hours (2%), although trophy opportunities do exist in Redgut Bay and the South Arm.

Although the Rainy Lake fishery continues to be dominated by non-resident anglers (73% lake-wide), the Ontario resident contribution of 63,020 angler-hours (32%) is above historical levels. Resident effort is almost equal across all three basins and ranges from 20,510 angler-hours (31%) on Redgut Bay to 21,080 angler-hours (26%) on the South Arm in 2010. Similarly, resident effort on the North Arm was 21,665 angler-hours (26%) in 2011. Effort by resident anglers declined since 2001/02, with the exception of the North Arm which was at the highest level observed since 1983. This increase is likely a result of continued improvements to the quality of the North Arm walleye fishery and ease of access for local residents.

A combination of fishing regulation changes in 1994 appears to have been effective in reducing the level of non-resident angling effort. These regulations included a restrictive harvest slot and trophy size limit for walleye, a reduction in the daily catch and possession limit of walleye from six to three, a South Arm Rainy Lake Border Water Conservation Tag, and a catch and release only requirement for non-resident anglers not exempted by staying overnight in Ontario. A large portion of this angling effort appeared to shift to Minnesota waters and contributed to significant increases in effort observed in this portion of Rainy Lake from 1994 to 2000. Talmage (2003) has suggested that this increase, initially related to the regulation changes in Ontario, now appears to be more a function of improvements in the walleye fishery.

Fishing regulations on Rainy Lake were revised again for the 2000 fishing season, following a package of size and catch limit changes for northern pike, bass and crappie that were implemented across the NW Region in 1999. The changes made by Ontario in 2000 relaxed the earlier restrictions on Minnesota-based non-resident anglers, while further restricting Ontario-based non-resident angler use through daily catch limits. The South Arm Rainy Lake Border Water Conservation Tag was eliminated along with the catch and release only

requirements for US-based anglers. These were replaced with a daily catch limit of one walleye for all non-resident anglers and an increase in possession limit from three to four for all regular resident and non-resident license holders. Conservation license limits remained at two walleye/sauger in combination. Angling effort, especially Minnesota-based non-resident, had increased in 2001/02 as anticipated. Lake-wide effort increased by approximately 70% from the average effort observed in 1994/95. Minnesota-based non-resident effort more than doubled from 19,640 angler-hours (11%) in 1994/95 to 42,350 angler-hours (14%) in 2001/02 and 35,910 angler-hours (16%) in 2010/11. Most of this effort occurred on the South Arm basin, which is shared with Minnesota.

Harvest

The increase in angling effort and harvest observed in 2001/02 may have also been related to increasing angler catch rates for walleye (Figure 6), and to expanding interest in the smallmouth bass fishery. However, the decline in effort and harvest observed in 2010/11 may have been related to socio-economic issues rather than biological factors related to recreational fishing. Observed catch per unit effort (CUE) for walleye anglers in 2010 ranged from 1.34 fish/rod-hour on Redgut Bay to 1.12 fish/rod-hour on the South Arm (Figure 7). In 2011, walleye CUE on the North continued to increase to 0.78 fish/rod-hour and the highest level observed since 1973. These values suggest that angling success for walleye is very good on Rainy Lake. Walleye fishing can be considered good with CUE's above 0.30 (Colby et al., 1979). Harvest (HUE) rates for walleye anglers were 0.13 fish/rod-hour on Redgut Bay and 0.14 fish/rod-hour on the South Arm and North Arm. Harvest per unit effort (HUE) is significantly lower due to the high release rates for walleye and other fish species. For comparison, catch and harvest rates for all anglers on the Minnesota waters of Rainy Lake in 2010 were 0.50 and 0.14 walleye/rod-hour (Schlesser, 2010), and 1.17 and 0.16 walleye/rod-hour on Lake of the Woods in 2008 (Mosindy, 2010).

In 2010/11, anglers released an estimated 89% of the walleye captured lake-wide (Table 25). This represented a continued increase from 82% observed in 1994/95 and 87% in 2001/02. A greater proportion of the fish released are walleye larger than the current harvest slot size (>45 cm total length) and more fish are being released by anglers that have already taken their legal

catch and/or possession limit (Figure 8). These high release rates are likely in response to the restrictive size limit implemented in 1994, as well as the lower daily catch limit for all non-resident anglers in 2000. In comparison, walleye release rates were 73% on Minnesota waters of Rainy Lake in 2010 (Schlesser, 2010), and 76% on Lake of the Woods in 2008 (Mosindy, 2010).

Angler harvest of walleye in 2010/11 was slightly below the levels observed in 2001/02, but has been increasing on the North Arm while declining on the South Arm and Redgut Bay. A total angler harvest of 13,890 kg was still higher than the levels observed in 1994/95, but well below that observed in 1970 and 1983-1986 (Figures 12 and 13). Walleye represented 55% of the estimated total angling harvest by weight on Rainy Lake, but 60% of the total catch by number. Management actions taken by Ontario since 1994 appear to have been very effective in reducing walleye harvest to allow population recovery and to improve fishing quality. However, the estimated angler harvest of 5,180 kg from Redgut Bay in 2010 remains above the current management objective of 3,800 kg/yr (OMNR and MDNR, 2004). On the South Arm, the 2010 walleye harvest of 4,570 kg was well below the management objective of 20,500 kg/yr for Ontario waters. Walleye harvest by anglers from the North Arm continued to increase to a high of 5,400 kg in 2011, compared to the current management objective of 6,800 kg/yr (OMNR and MDNR, 2004). The current walleye angler harvest level of 0.20 kg/ha is sustainable lake-wide, with harvests ranging from a high of 0.47 kg/ha on Redgut Bay, to 0.17 kg/ha on the South Arm and 0.16 kg/ha on the North Arm.

Catch rates for northern pike have recently declined on all three basins of the lake since 1969. Observed catch per unit effort (CUE) for pike anglers ranged from 0.49 fish/rod-hour on the South Arm, to 0.48 fish/rod-hour on the North Arm and 0.38 fish/rod-hour on Redgut Bay. A mean CUE value greater than 0.12 fish/rod-hour is considered good pike fishing (OMNR, 1990). However, the range of CUE values observed on Rainy Lake in 2010/11 would also be representative of a quantity rather than a trophy fishery for pike. Harvest per unit effort (HUE) is considerably lower due to the high release rates, ranging from 0.06 to 0.07 fish/rod-hour. Northern pike are often caught incidental while fishing for other species. Catch (CUE) rates for all anglers were slightly lower at 0.17 fish/rod-hour on Redgut Bay, 0.28 on the South Arm, and 0.32 on the North Arm.

In 2010/11, anglers released an estimated 89% of the northern pike captured lake-wide. These high release rates are likely the result of the protected slot and trophy size limit (70-90 cm, one >90 cm), and the lower daily catch and possession limit established since 1999. Release rates were very similar to the 84% observed in the Minnesota waters of Rainy Lake (Schlesser, 2010). Angler harvest of northern pike in 2010/11 was very low, but most apparent on the North Arm and South Arm. A lake-wide angler yield of 5,700 kg is considerably lower than the harvest levels reported in 1994/95 and 2001/02, and well below the levels observed from 1983 to 1986. Northern pike represented the second highest proportion (23%) of the estimated total angler harvest by weight on Rainy Lake in 2010/11, but only 17% of the reported angler catch by number. The lake-wide angler harvest of 0.08 kg/ha is very low and sustainable, although commercial and subsistence harvests are significant additions to total harvest on the North Arm and Redgut Bay. An upper limit for harvest of 1.0 kg/ha is typical for ensuring northern pike fishing quality on most mesotrophic and eutrophic lakes in Ontario (OMNR, 1990). Management objectives are generally established at 85% of the available potential yield which is equivalent to 0.74 kg/ha lake-wide (OMNR and MDNR, 2004).

Angling for smallmouth bass has increased in popularity with the success and promotion of the Fort Frances Canadian Bass Championship since 1995. Observed catch per unit effort (CUE) for bass anglers ranged from 0.69 fish/rod-hour on the South Arm, to 0.64 fish/rod-hour on the North Arm and 0.55 fish/rod-hour on Redgut Bay. These 2010 values are the highest observed compared to previous surveys on the South Arm and Redgut Bay. Harvest (HUE) rates of bass were very low ranging from 0.02 fish/rod-hour on Redgut Bay to 0.04 fish/rod-hour on the North Arm. Harvest per unit effort (HUE) is considerably lower due to the very high release rates for smallmouth bass.

In 2010/11, anglers released an estimated 96% of the bass captured in Ontario waters. Although equal to 2001/02 rates, this does represent an increase from the 78% observed in 1994, and 89% observed in 1995. A high proportion (90%) of the anglers are practicing catch and release only fishing for smallmouth bass (Figure 9). A seasonal maximum size limit and a reduced daily catch/possession limit introduced in 1999 may have contributed to this higher level of catch and release fishing. For comparison, release rates of bass were similar at 97% on Minnesota waters of Rainy Lake (Schlesser, 2010). Bass represented only 7% of the estimated total angler harvest by weight on Rainy Lake, but 15% of the reported angler catch by number.

Angler harvest of bass in 2010/11 remained very low across all three basins of Rainy Lake. A lake-wide angler yield of 1,690 kg has declined and is below the levels observed in 1994, 1995 and 2001/02, and well below that observed from 1983 to 1986. The estimated yield for 2010/11 was well below the management objective established for each of the three lake basins. The lake-wide angler harvest of 0.02 kg/ha is well below sustainable levels, and should help ensure the maintenance of a quality bass fishery.

Angling for black crappie has fluctuated annually, based largely on the status of the populations. Observed catch per unit effort (CUE) for crappie anglers in 2010/11 was highest on Redgut Bay at 0.52 fish/rod-hour, compared to 0.30 fish/rod-hour on the South Arm and 0.20 fish/rod-hour on the North Arm. These values represent the lowest angler success rates from past surveys and would suggest a reduced abundance of crappie across all three lake basins. The highest CUE's previously reported were 1.37 and 0.97 fish caught/rod-hour in 1992, and 1.43 fish/rod-hour in 1974 on the North Arm. Harvest (HUE) rates of crappie were only slightly lower in 2010/11 at 0.36 fish kept/rod-hour on the Redgut Bay, 0.24 fish/rod-hour on the North Arm and 0.22 fish/rod-hour on the South Arm. Harvest per unit effort (HUE) is only slightly lower due to the lower release rates for black crappie observed during the open-water fishery.

In 2010/11, anglers released only 32% of the crappie captured in Ontario waters. For comparison, release rates of crappie were even lower at 21% for the Minnesota waters of Rainy Lake (Schlessner, 2010). Crappie represented 15% of the estimated total angler harvest by weight on Rainy Lake, and only 3% of the reported angler catch by number. Angler harvest of crappie in 2010/11 remained very low across all three basins of Rainy Lake. A lake-wide angler yield of 3,750 kg was very similar to 2001/02 but much lower than the levels observed in 1994 and 1995. Current harvests are well below the peak harvest of 10,670 kg in 1983 or the 12,290 kg from Redgut Bay alone in 1992. The estimated yield for 2010/11 was well below the management objectives established for each of the three lake basins, with most of the harvest taken annually from Redgut Bay. The lake-wide angler harvest of 0.05 kg/ha is very sustainable, although this does not consider winter angler harvest or annual commercial harvests from the North Arm or Redgut Bay.

Other fish species provide a very minor component of the Rainy Lake sport fishery. Although catch rates for sauger and yellow perch are reasonable, they comprise less than 1% each to the

total angler harvest by weight. Other species (perch, sauger, rock bass, mooneye, lake herring, whitefish and burbot) caught by anglers represented only 5% of the total catch by number, with 95% of these fish being released. Observed catch rates (CUE) for sauger anglers in 2010 were 0.51 fish/rod-hour on the South Arm and 0.41 fish/rod-hour on Redgut Bay. Very few sauger were reported caught by anglers on the North Arm in 2011, with a low CUE of 0.18 fish caught/rod-hour. Lake-wide harvest of sauger was very low at only 72 kg/yr, with the majority taken from Redgut Bay. Muskellunge comprised a very small portion of the fishery with an estimated catch of 203 fish from Redgut Bay and 39 from the South Arm in 2010, with a release rate of 100%. As expected, the observed CUE for muskellunge was quite low at 0.04 fish caught/rod-hour, but this is similar to the FMZ 5 mean of 0.05 fish/rod-hour. No lake sturgeon were reported in the angler catch from any of the survey years.

Population Characteristics

Walleye harvested and sampled from anglers across Rainy Lake in 2010/11 averaged 395 mm total length, 0.56 kg in weight and 5.7 years of age. The size and weight of harvested fish was very similar to previous surveys since 1994, when the harvest slot and trophy size restrictions were implemented. However, size and weight is larger than that observed from 1983-1992. The mean age of walleye in the angler catch in 2010/11 was higher than that observed in any creel survey since 1969, and was highest on Redgut Bay at 6.9 years. A mean age of the catch lower than 4.5 years could be indicative of a "problem" fishery (OMNR, 1983; OMNR, 1990). Prior to the implementation of size restrictions in 1994, the mean age of the angler catch ranged from 3.3 to 4.9 years on Redgut Bay, 3.9 to 4.5 years on the South Arm and 3.9 to 4.7 on the North Arm. These values reflect a period during which a walleye conservation issue was apparent on all basins of Rainy Lake.

On the North Arm, an historical high of 287 walleye were sampled in 2011 with a mean total length of 406 mm, mean weight of 0.59 kg and mean age of 5.0 years. This mean age was the second highest observed since 1969. Increased growth rates of walleye on the North Arm may be contributing to earlier recruitment of fish into the recreational fishery. The mean total length and weight of fish harvested is also higher than that observed in the South Arm or Redgut Bay

in 2010. The largest and oldest walleye sampled was a legally harvested fish, with a total length of 721 mm and 18 years of age from the North Arm in 2011.

The size and age of the walleye catch is strongly influenced by the harvest slot and trophy size regulation in place since 1994. Although some harvest and sampling of protected size fish did occur, the total length distribution was mostly comprised of legal size fish from 350 to 450 mm. In 2010/11, only one walleye was sampled that was over the trophy size of 700 mm total length. Of the 513 walleye sampled, 21 were in the upper protected size range (460-700 mm) while 14 additional fish were in the lower protected size range (<350 mm). This is lead to an estimated non-compliance rate of 6.8% based on voluntary reporting. In Minnesota waters of Rainy Lake, Schlessler (2010) indicated that <1% of all walleye encountered were non-legal length fish within the protected slot size limit of 432-711 mm (17 to 28 inches).

In 2010/11, the majority (74%) of fish sampled within the legal harvest slot size consisted of 4 to 6 year old fish, compared to 83% in 2001/02. The largest single age group in the catch was 5 year olds (52%), followed by age 4 (11%) and age 6 (11%). Age 3 and age 7 fish comprised a minor component at 3% and 9% respectively. Age 5 fish (2006 year class) dominated the catch on the North Arm at 75% in 2011, but this same year class was not highly represented in the catch on the South Arm and Redgut Bay as age 4 fish in 2010. Age composition of the catch also indicates a difference between basins that may be related to growth. The angler harvest of fish is highly influenced by the restrict harvest slot size of 350-450 mm. This length interval generates harvest of age 3 to 6 walleye on the North Arm, compared to age 3 to 11 fish on the South Arm and age 4 to 13 fish on Redgut Bay. This suggests that elevated growth rates continue on the North Arm, while slower growth is evident on the South Arm and Redgut Bay. Appendices 7 to 9 also suggest there has been a slowing of growth for ages 3 to 7 years which are vulnerable to harvest, especially on Redgut Bay and the South Arm.

Compliance with the existing walleye size regulation appears to showing continuous improvement since it was implemented in 1994. The estimated compliance rate in 2010/11 was 93%, compared to 92% in 2001/02 and 84% in 1994, the first year of the regulation. These compliance rates are a maximum based on fish randomly sampled and voluntarily reported from the interviewed angling parties. Actual compliance with the size limits would be lower than those reported. In comparison, compliance with an identical harvest slot and trophy size limit for

the Winnipeg River in Kenora District was much lower at 80% in 2007 (Peacock et al., 2010). Compliance with the experimental walleye (protected slot size) regulation in Minnesota waters of Rainy Lake was estimated at 99% in 2010 (Schlesser, 2010), but varied from 94% in 1994 to 91% in 1996 (Talmage, 2003).

Northern pike kept by anglers from Rainy Lake in 2010/11 averaged 622 mm total length, 1.43 kg and 5.3 years of age. In comparison, pike were slightly smaller in 2001/02 averaging 607 mm, 1.39 kg and 4.1 years old. The largest and oldest pike sampled was a legally harvested fish, with a total length of 894 mm and 10 years of age. Large trophy fish appear to be relatively low in abundance with few pike harvested by anglers over the combined protected/maximum size limit of 700 to 900 mm (only one >900 mm) established in 1999. However, many of the fish could have been released by anglers and were not encountered by the survey crews. In 2010/11, the majority (95%) of pike legally harvested by anglers were less than 700 mm, and no fish were sampled over 900 mm. In comparison, 9 fish (2%) were sampled above the trophy size limit in 2001/02, with the largest fish measuring 974 mm and 11 years of age. All ages from 3 to 10 years were represented in the 2010/11 catch, although age 5 fish dominated the harvest at 32%. Based on the mean total length at age, pike up to age 7 years could be legally harvested by anglers under the current size regulation. However, this might also include some of the slower growing fish within age 8. Generally, it would require 10 years for northern pike on Rainy Lake to reach the trophy (one over maximum) size limit of 900 mm total length.

Smallmouth bass harvested by anglers in 2010/11 averaged 341 mm total length, 0.66 kg and 6.0 years of age. In comparison, bass were slightly larger and heavier in 2001/02 averaging 364 mm and 0.80 kg. Large trophy bass were low in the angler harvest with no fish sampled over 500 mm. The largest fish sampled was only 473 mm and 12 years of age. In 2010/11, a high proportion of the catch (40%) exceeded 350 mm. However, most of these fish were harvested after June 30 when the maximum size limit no longer applied. Since 1999, regulations allow no bass to be kept over 350 mm total length during the period of December 1 to June 30 each year. Based on the mean total length at age, smallmouth bass over 6 years of age would be protected from angler harvest under this seasonal size regulation. However, this might also include some of the faster growing age 5 fish.

All age groups from 3 to 12 years were represented, although age 5 fish dominated the harvest from Rainy Lake at 38%, followed by age 6 fish at 18%. Further investigation and analysis will be required to fully evaluate the effectiveness of both the smallmouth bass and northern pike regulation changes implemented in 1999.

Black crappie harvested by anglers in 2010/11 averaged 291 mm total length, 0.47 kg and 6.1 years of age, although sample size was considerably lower than in previous surveys since 1992. Age groups from 3 to 12 years were represented in the catch, with no fish older than 12 years being kept and sampled. By comparison, fish were slightly smaller and younger in 2001/02 averaging 273 mm, 0.39 kg and 4.9 years old. Large crappie were relatively low in both surveys with very few fish sampled over 350 mm. The largest fish sampled was 364 mm and 12 years of age. Spring trap netting in Minnesota waters has indicated that the black crappie population is doing well, although fishing and natural mortality may have reduced the population of strong year classes produced in the mid-1990's. However, recent recruitment in 2003 and 2005 should result in an abundant fishery with exceptional opportunities to catch preferred size crappie (Schlesser, 2011).

Although muskellunge were caught and released by anglers in Redgut Bay in 2001, no fish were actually sampled by field crews. In 2001, the minimum size limit for muskellunge was changed from 1020 mm (40") to 1220 mm (48") total length, and may have influenced the observed release rate of 100%. All muskellunge angling was reported in Redgut Bay with an estimated total catch of 168 fish. However, muskellunge angling is known to occur in the South Arm, especially in the vicinity of Seine Bay and the Seine River. Fish up to 1400 mm (55") or 21.80 kg (48 lbs) have been previously documented from this area of the lake.

Sauger were sampled from the angler catch for the first time in 2001, but sample size remained very low in 2010/11 (n=5) due to very few fish reaching desirable size. In Minnesota waters, only 27% of sauger were kept by anglers, and 96% of all anglers indicated that they had not harvested any sauger (Schlesser, 2010). Sauger kept by anglers in Ontario waters averaged 0.34 kg round weight and 343 mm total length, with a length range of 262 to 391 mm. No age data was available from these fish.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor walleye population recovery and fish community composition on each basin of the lake through regular FWIN or index fishing programs. Continue roving creel surveys as proposed in the long-term fisheries assessment strategy for Rainy Lake (McLeod, 2001), ideally two consecutive years every 5 years or at minimum every 10 years.
2. Retain the existing harvest slot/trophy size limit for walleye, along with current catch and possession limits for resident and non-resident anglers, until a complete review of walleye stock status and total harvest occurs during preparation of the next Boundary Waters Fisheries Atlas. Further assessment of the size and catch regulations are recommended as part of any SDW fisheries management planning process for Rainy Lake. This would follow after completion of the FMZ 5 fisheries management plan.
3. Similarly retain the existing protected/trophy size limit and catch limits for northern pike and smallmouth bass, until a complete review of stock status and total harvest occurs during preparation of the next Boundary Waters Fisheries Atlas. Further assessment of the size and catch regulations are recommended as part of a future SDW fisheries management planning process.
4. Further investigation into the status of muskellunge populations in Rainy Lake and the Seine River is warranted. Additional techniques (e.g. postcard surveys of anglers, trap netting, etc) may be required to fully evaluate the effectiveness of the revised minimum size limit, growth potential and the availability of trophy angling opportunities.
5. Continue to evaluate the increase in Minnesota-based angler effort and harvest, and consider angler origin in any future allocation decisions and planning processes
6. Continue enforcement efforts and angler education programs to improve compliance with existing size limits for walleye, northern pike and smallmouth bass.

ACKNOWLEDGEMENTS

The 2010 and 2011 creel surveys of Rainy Lake were made possible through the combined efforts of many staff from the Fort Frances District Office. Seasonal staff, including Alex Crichton, Alyson Bisson, Megan Veniot and Travis Stromness collected most of the boat count, angler interview and fish sampling data with the assistance of other District staff throughout the survey. Participating field staff included Dan Fox, Wayne Nixon, Tony Elders and Melissa Mosley from the Fort Frances Area; and Conservation Officers Mike Veniot, Dave Saunders, Mark Gadawski and Andrew Jourdain from the Enforcement Team. Fort Frances Fire provided daily radio coverage and weather updates/alerts throughout the field season. Without hesitation, our Summer Experience students helped out with several trips out on the lake. These dedicated staff endured inclement weather and enjoyed the good weather while on the water from May to September each year. Special thanks to Ed Taylor at Taylor's Cove and the Town of Fort Frances – Sorting Gap Marina for boat docking and fuel arrangements. As always, Susan Mann of the Northwest Regional Aging Facility in Dryden provided excellent service in aging all the fish structures collected. Jeff Wieme and Steve Bobrowicz reviewed the final document.

LITERATURE CITED

- Alder, J. 1979. *Creel Census of Lake of the Woods, 1977*. Ontario Ministry of Natural Resources. Lake of the Woods-Rainy Lake Assessment Unit Report 1979-1. 27 p.
- Bonde, T.J.H., C.A. Elsey and B. Caldwell. 1961. *A preliminary investigation of Rainy Lake, 1959*. Minnesota Department of Conservation. Invest. Report No. 234. 41 p.
- Bonde, T.J.H., C.A. Elsey and B. Caldwell. 1965. *A Second Rainy Lake Report, 1957-1963*. Minnesota Department of Conservation. Invest. Report No. 284. 42 p.
- Caldwell, B. 1959. *Fort Frances District Creel Census - 1956-1959*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 12 p.
- Caldwell, B. 1964. *Fort Frances District Creel Census - 1964*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 3 p.
- Chevalier, J.R. 1977. *Changes in walleye (Stizostedion vitreum vitreum) population in Rainy Lake and factors in abundance, 1924-75*. J. Fish. Res. Board Can. 34:1696-1702.
- Colby, P.J., R.E. McNicol, and R.A. Ryder. 1979. *Synopsis of biological data on walleye Stizostedion vitreum vitreum (Mitchell 1818)*. FAO Fisheries Synopsis No. 119, Rome. 139 p.
- Kallemeyn, L.W. 2000. *Proceedings of the Rainy Lake – Namakan Reservoir Ecological Monitoring Workshop – A Report to the International Joint Commission*. U.S. Geological Survey. International Falls Biological Station. Service Order 1761-900422. 60 p.
- Lester, N.P. and R.M. Korver. 1996. *FISHNET 2.0 analyses of index fishing and creel surveys. Part B. Fish Statistics (FR 52)*. Ontario Ministry of Natural Resources. Maple. 23 p.
- Malvestuto, S.P., W.D. Davis and W.L. Shelton. 1978. *An evaluation of the roving creel survey with non-uniform probability sampling*. Trans. Am. Fish. Soc. 107(2):255-262.
- McGregor, D.B. 1970. *Rainy Lake Creel Census - 1970*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 73 p.
- McLeod, D.T. 1983. *The 1982 creel census conducted on Redgut Bay and the Ontario portion of the South Arm of Rainy Lake*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 5. 53 p.
- McLeod, D.T. 1984. *Rainy Lake Creel Survey 1983*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 11. 55 p.
- McLeod, D.T. 1988. *A summary and interpretation of creel surveys on Rainy Lake for the period 1956-1986*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 24. 79 p.

- McLeod, D.T. 1996. *Rainy Lake Creel Survey – Data Summary 1956-1995*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 57. 40 p.
- McLeod, D.T. 2001. *A Fisheries Assessment Strategy for Rainy Lake and the Namakan Reservoir (Ontario)*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 49. 35 p.
- McLeod, D.T. 2003. *Roving Creel Surveys on Rainy Lake, Ontario 2001/02*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 53. 84 p.
- Mosindy, T. 2010. *Lake of the Woods Open Water Creel Survey: 2008*. Ontario Ministry of Natural Resources. NWSI Aquatic Update. 2010-2. 6 p.
- OMNR and MDNR. 2004. *Ontario-Minnesota Boundary Waters Fisheries Atlas for Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake and Sand Point Lake*. Ontario Ministry of Natural Resources and Minnesota Department of Natural Resources. Published Report. 95 p.
- OMNR. 1983. *The identification of over-exploitation*. Report of SPOF Working Group No. 15. Ontario Ministry of Natural Resources. Published Report. 84 p.
- OMNR. 1985. *CREESYS User Manual – Ontario Fisheries Information System*. Ontario Ministry of Natural Resources. Manual. 185 p.
- OMNR. 1988. *Fort Frances District Fisheries Management Plan 1987-2000*. Ontario Ministry of Natural Resources, Fort Frances District. Published Report. 43 p.
- OMNR. 1990. *A proposal for the management of recreational fishing quality in the Northwestern Region*. Ontario Ministry of Natural Resources. Unpublished Report. 61 p.
- OMNR. 1992. *Strategic Plan for Ontario Fisheries – SPOF II*. Ontario Ministry of Natural Resources. Published Report. 22 p.
- OMNR. 1995. *FISHNET 2.0 User Manual (Draft) - Ontario Fisheries Information System*. Ontario Ministry of Natural Resources. Manual. 142 p.
- OMNR. 1999. *Ontario's Living Legacy Land Use Strategy*. Ontario Ministry of Natural Resources. Published Report. 136 p.
- OMNR. 2005. *A New Ecological Framework for Recreational Fisheries Management in Ontario*. Fisheries Section, Fish and Wildlife Branch. Ontario Ministry of Natural Resources. 16 p.
- OMNR. 2011. *Northwest Region Fisheries Management Action Plan 2011-2016*. Ontario Ministry of Natural Resources. Unpublished Report. 28 p.
- Orsatti, S., N.P. Lester and M. Daniels. 1991. *CREESYS: A software system for management of Ontario creel survey data*. Am. Fish Soc. Symposium.

- Peacock, J., B. Corbett and T. Mosindy. 2010. *State of the Resource Report for Upper Winnipeg River – A Specially Designated Water*. Ontario Ministry of Natural Resources. Kenora District Report. 38 p.
- Schlesser, N. 2011. *Large Lake Sampling Program: Rainy Lake 2010*. Minnesota Department of Natural Resources. Section of Fisheries Completion Report, F-29-R(P)-29(2), Study 2, Job 4, St. Paul, Minnesota. 60 p.
- Schlesser, N. 2010. *An angler survey of the Minnesota waters of Rainy Lake, summer of 2010*. Minnesota Department of Natural Resources. Section of Fisheries Completion Report, F-29-R(P)-29(2), Study 4, Job 859, St. Paul, Minnesota. 40 p.
- Talmage, P. 2003. *An angler creel survey of the Minnesota waters of Rainy Lake, summer of 2002*. Minnesota Department of Natural Resources. Section of Fisheries Completion Report , F-29-R(P)-22, Study 4, Job 611, St. Paul, Minnesota. 46 p.
- Thomson, R. 1967. *Creel Census of Redgut Bay, Rainy Lake*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 13 p.
- Thomson, R. 1969a. *Creel Census of the North Arm, Rainy Lake*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 13 p.
- Thomson, R. 1969b. *Creel Census of the South Arm, Rainy Lake*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 13 p.
- Thomson, R. 1969c. *Creel Census of Redgut Bay, Rainy Lake*. Ontario Department of Lands and Forests, Fort Frances District. Unpublished Report. 13 p.
- Wepruk, R.L., W.R. Darby, D.T. McLeod and B.W. Jackson. 1992. *An analysis of fish stock data from Rainy Lake, Ontario, with management recommendations*. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 41. 196 p.

FIGURES

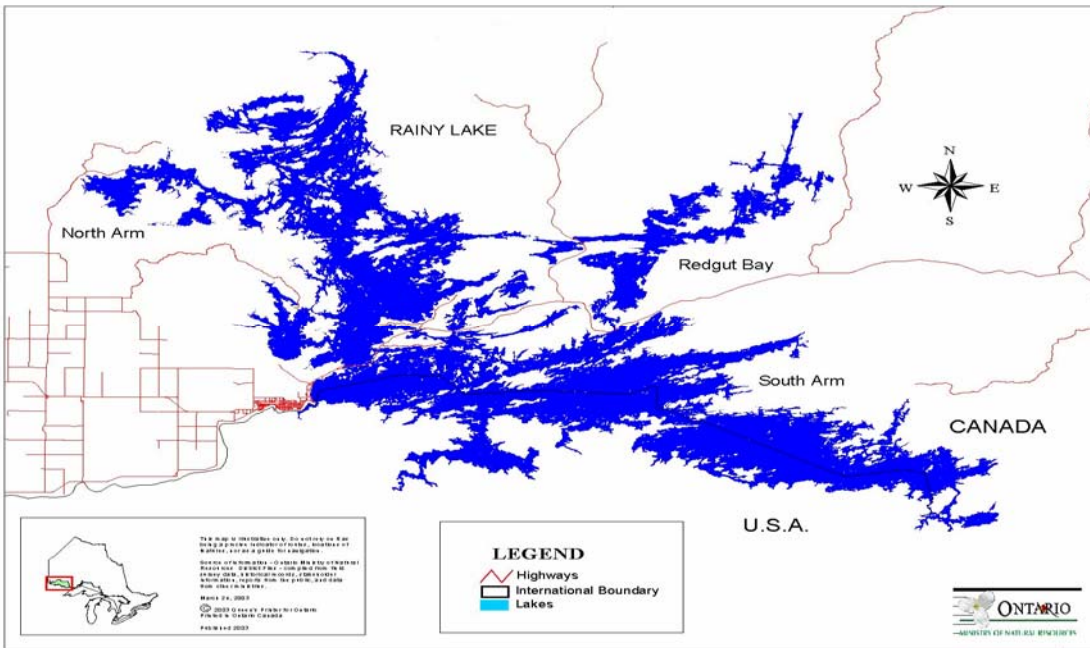


Figure 1: Location of Rainy Lake, Ontario.

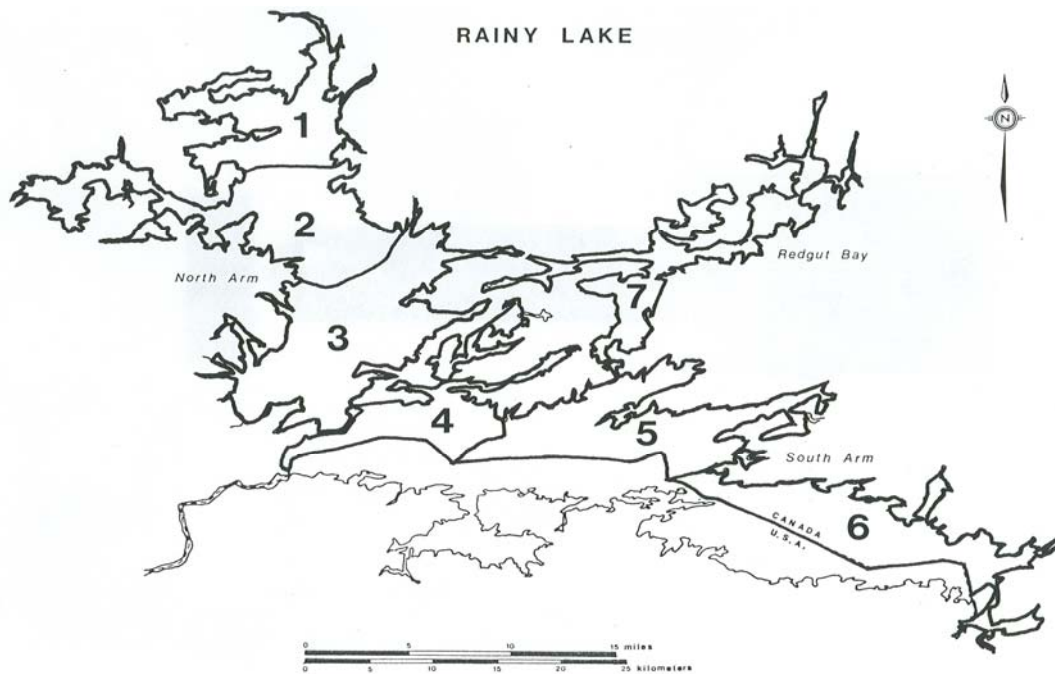


Figure 2: Location of creel survey sectors on Rainy Lake, Ontario.

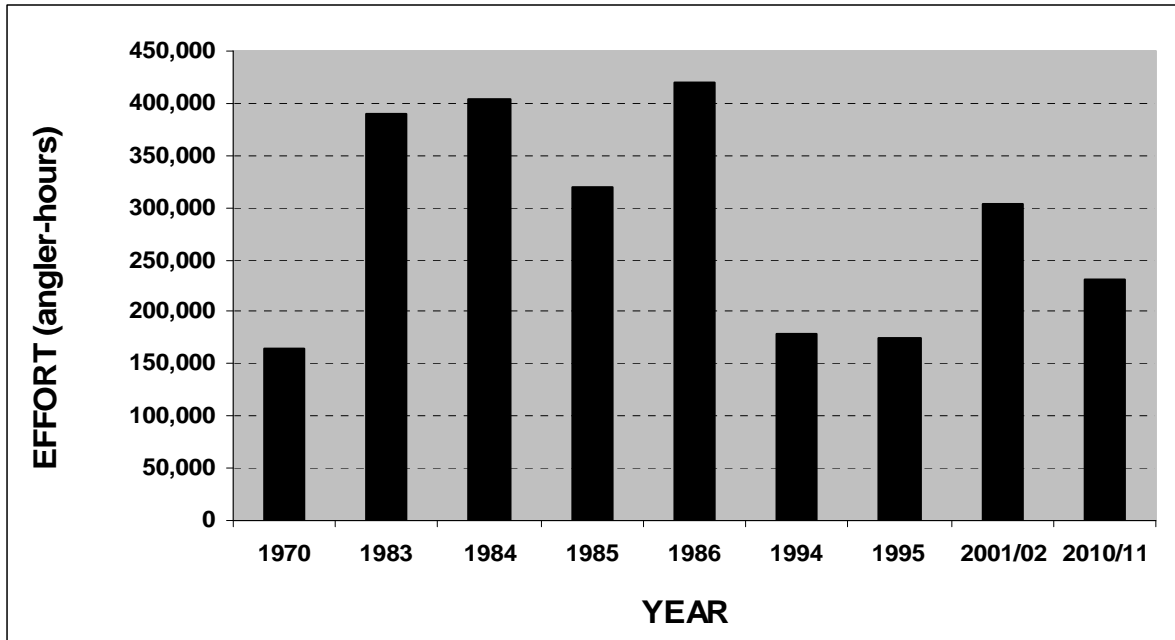


Figure 3: Total estimated angling effort (angler-hours) from lake-wide creel surveys on Rainy Lake, Ontario from 1970 to 2011.

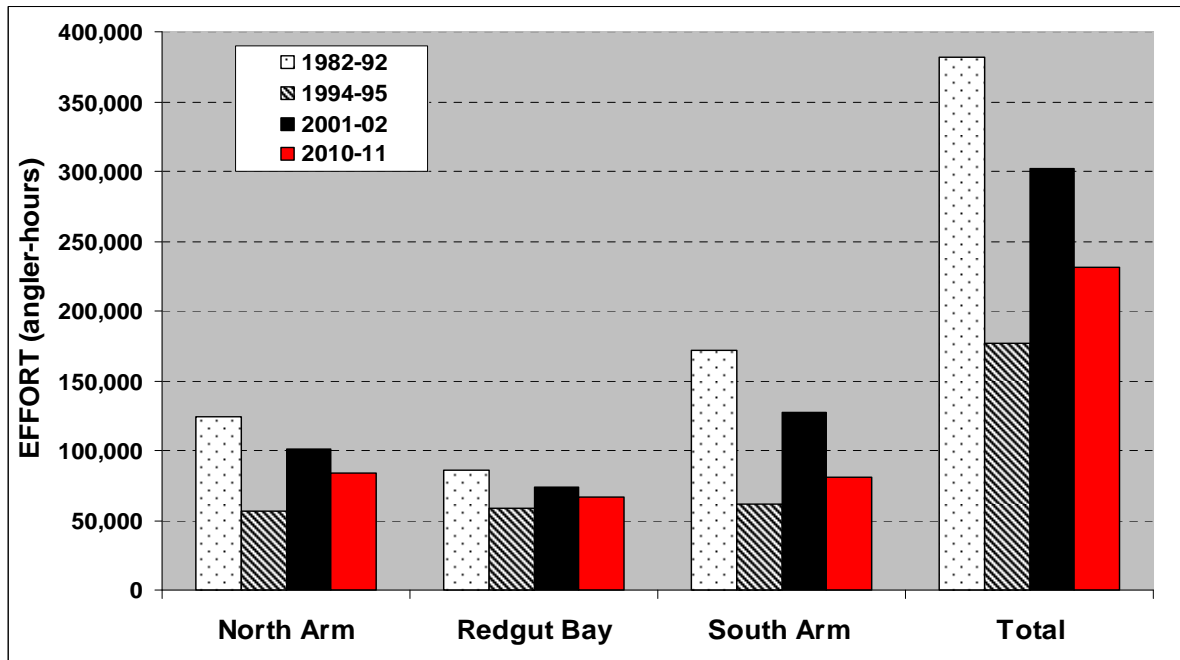
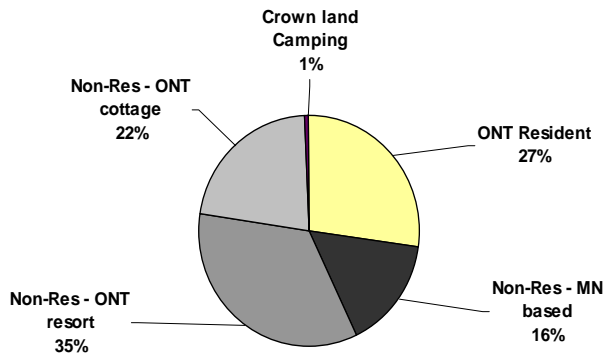
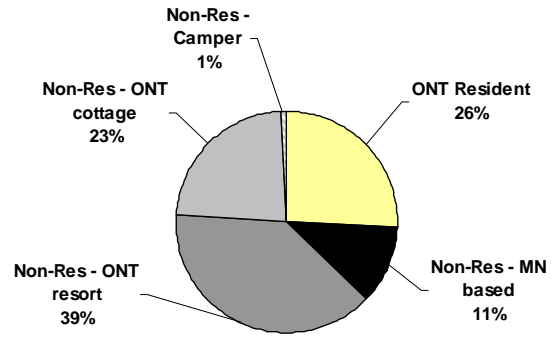


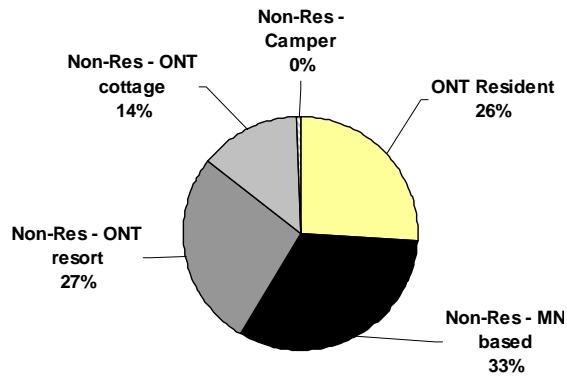
Figure 4: A comparison of estimated angler effort (angler-hours) by basin of Rainy Lake, Ontario for the period 1982- 2011.



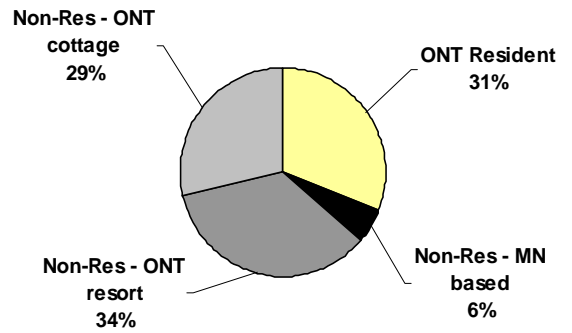
Rainy Lake



North Arm



South Arm



Redgut Bay

Figure 5: A comparison of residency and base of operations of anglers interviewed on each basin of Rainy Lake, Ontario in 2010/11.

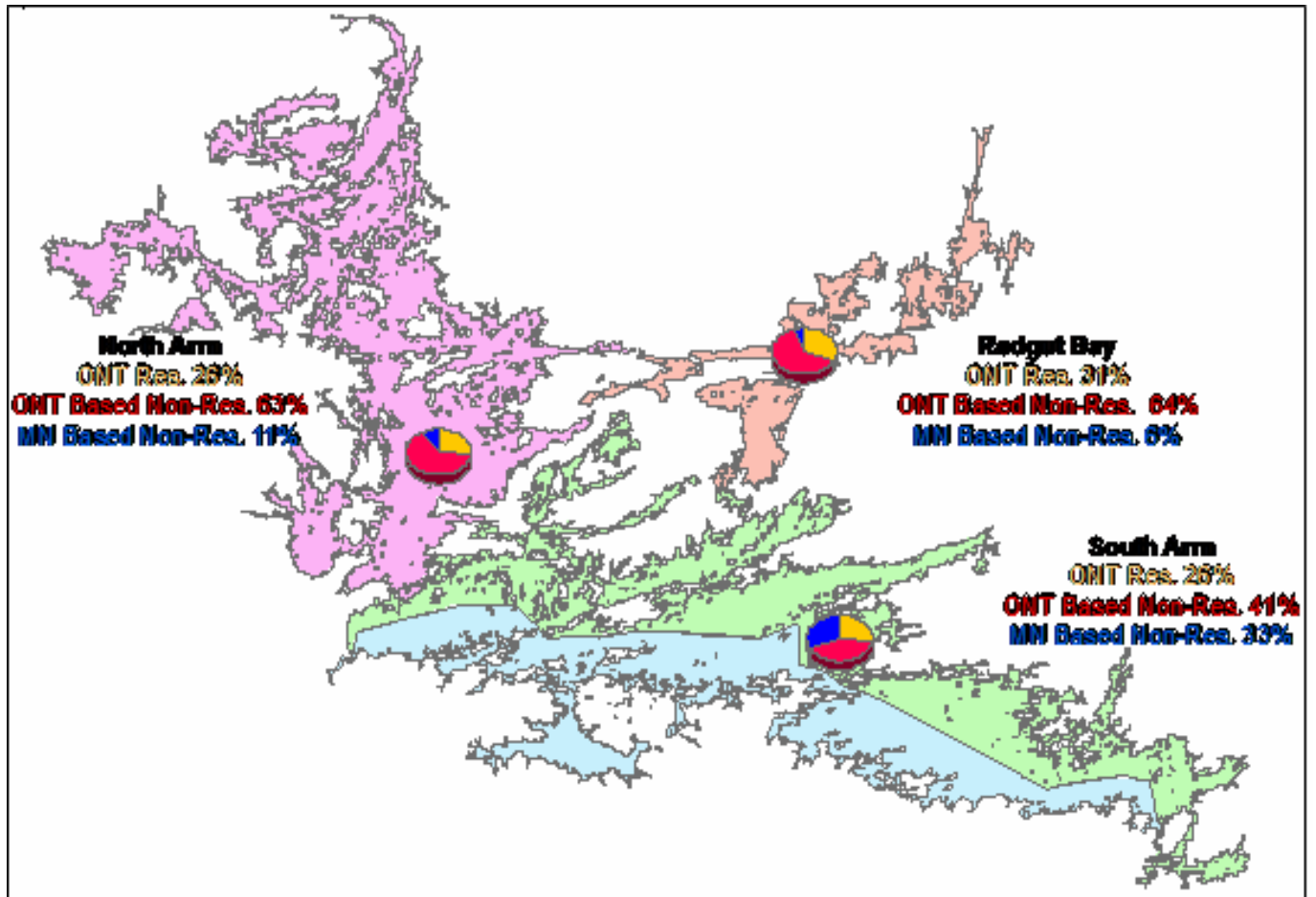


Figure 6: A comparison of residency and base of operations of anglers interviewed on Rainy Lake, Ontario in 2010/11.

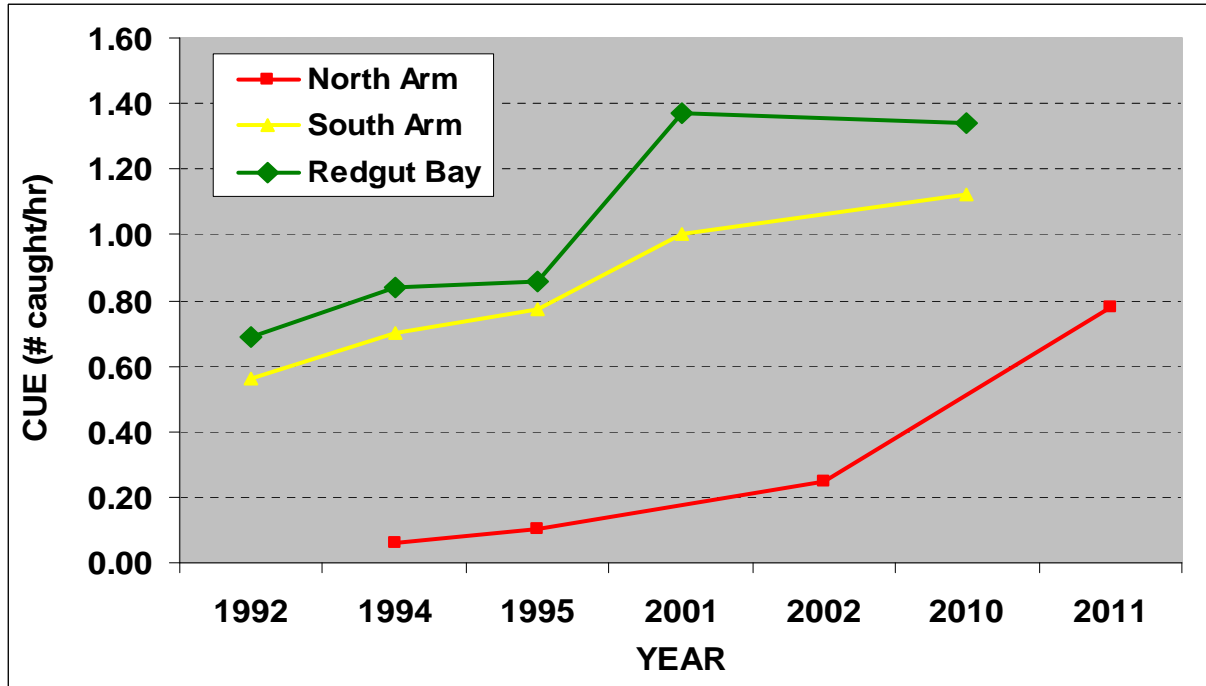


Figure 7: A comparison of walleye angler catch per unit effort (# fish caught/angler-hour) for each basin of Rainy Lake, Ontario for the period 1992-2011.

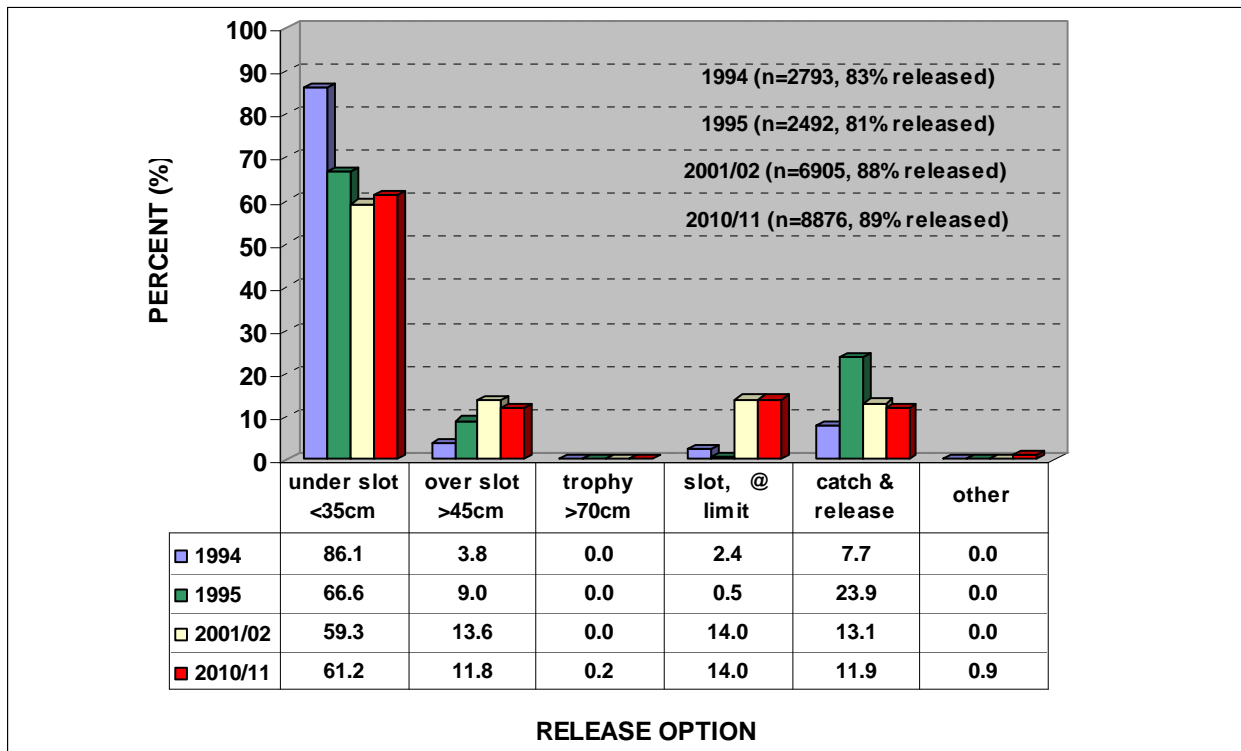


Figure 8: A comparison of angler release rates for walleye on Rainy Lake, Ontario from 1994, 1995, 2001/02 and 2010/11.

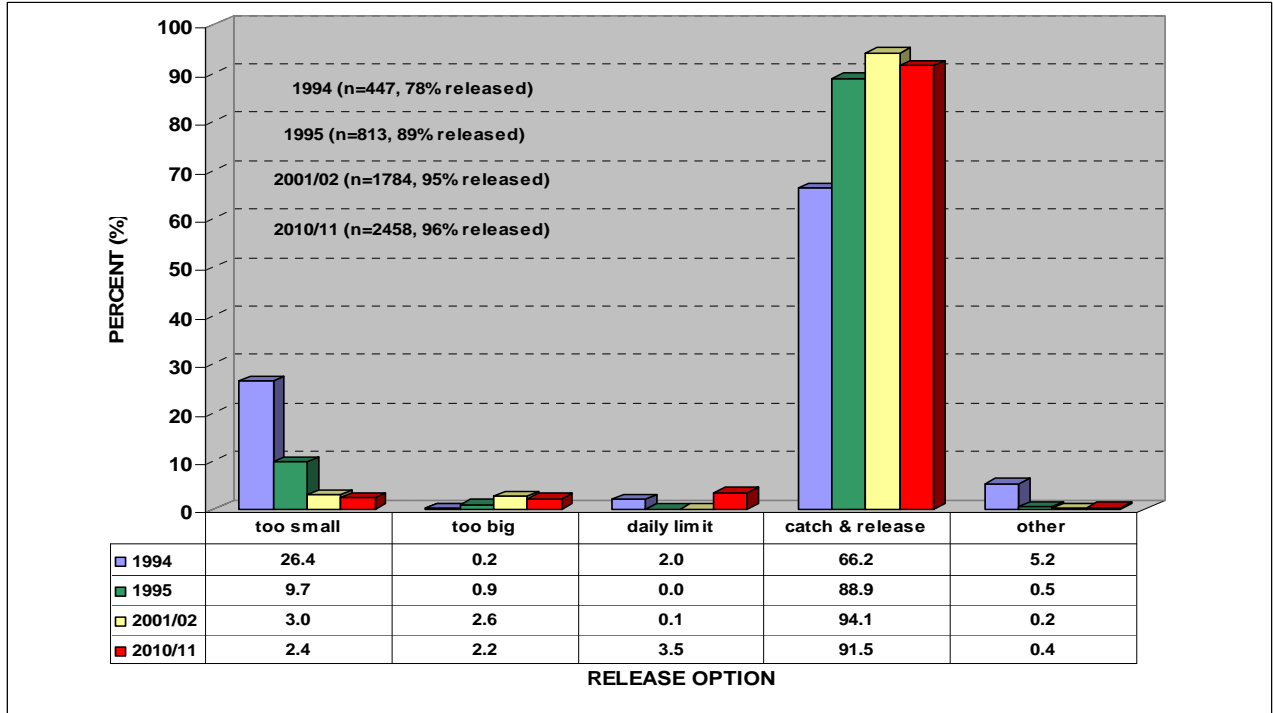


Figure 9: A comparison of angler release rates for smallmouth bass on Rainy Lake, Ontario from 1994, 1995, 2001/02 and 2010/11.

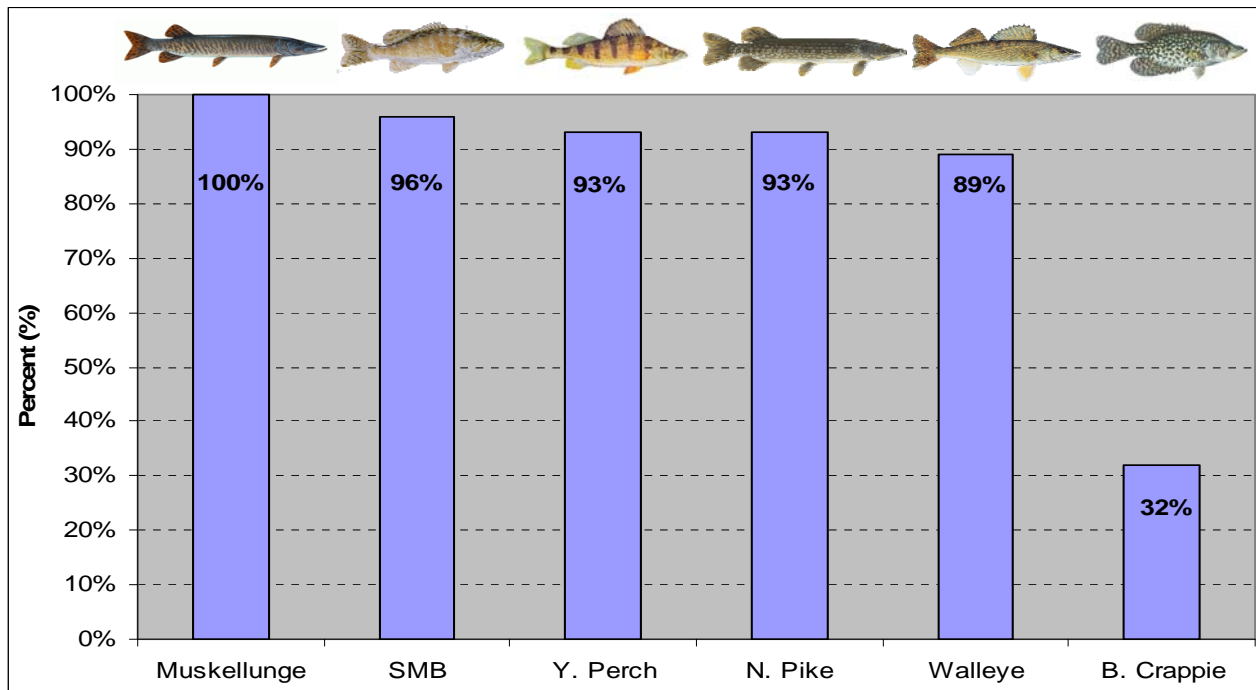


Figure 10: A comparison of angler release rates for sportfish species on Rainy Lake, Ontario in 2010/11.

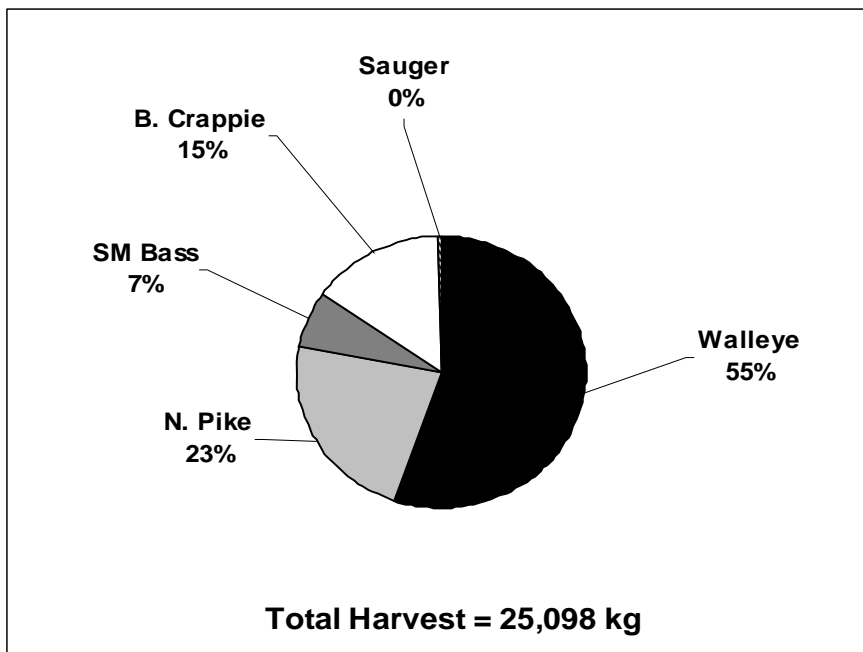


Figure 11: Species composition of the estimated angling harvest (kg) from Rainy Lake, Ontario in 2010/11.

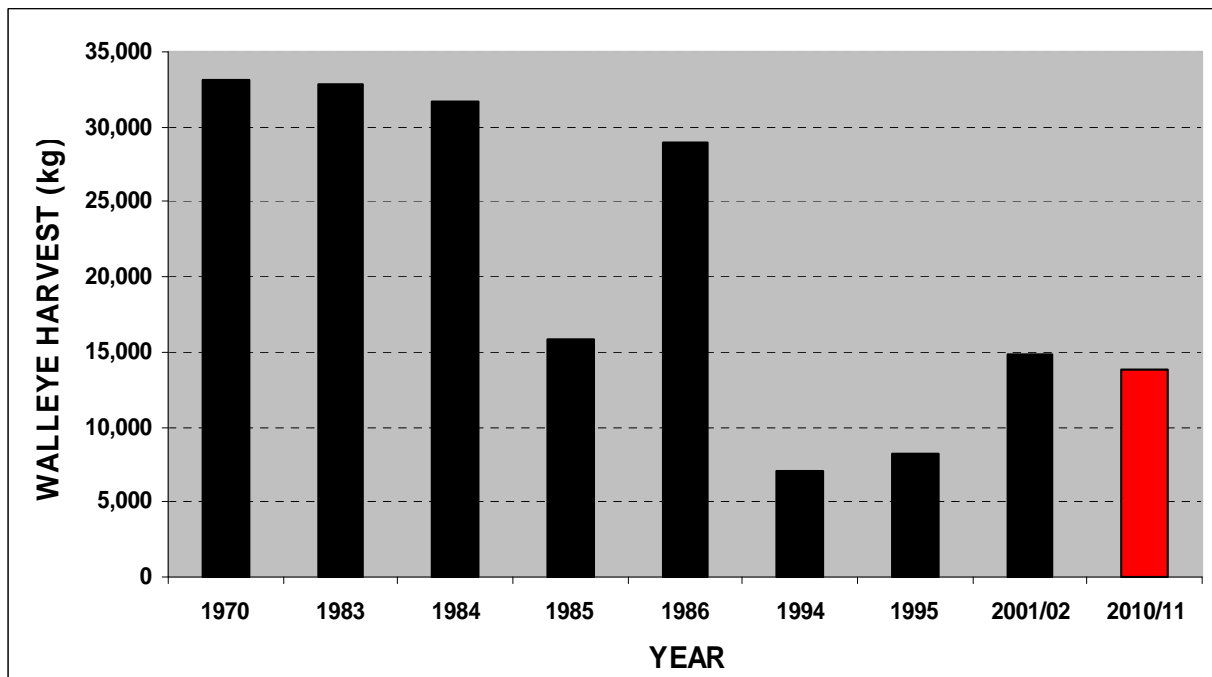


Figure 12: Total estimated walleye angling harvest (kg) from lake-wide creel surveys on Rainy Lake, Ontario from 1970 to 2011.

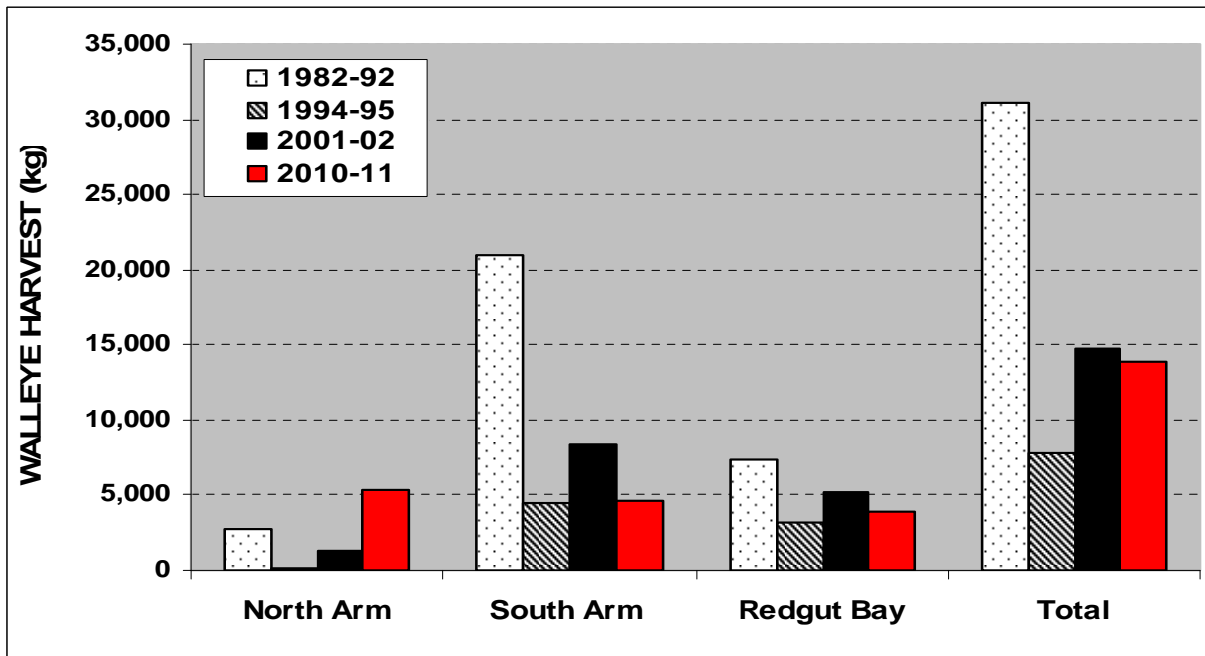


Figure 13: A comparison of estimated walleye angling harvest (kg) by basin of Rainy Lake, Ontario for the period 1982 to 2011.

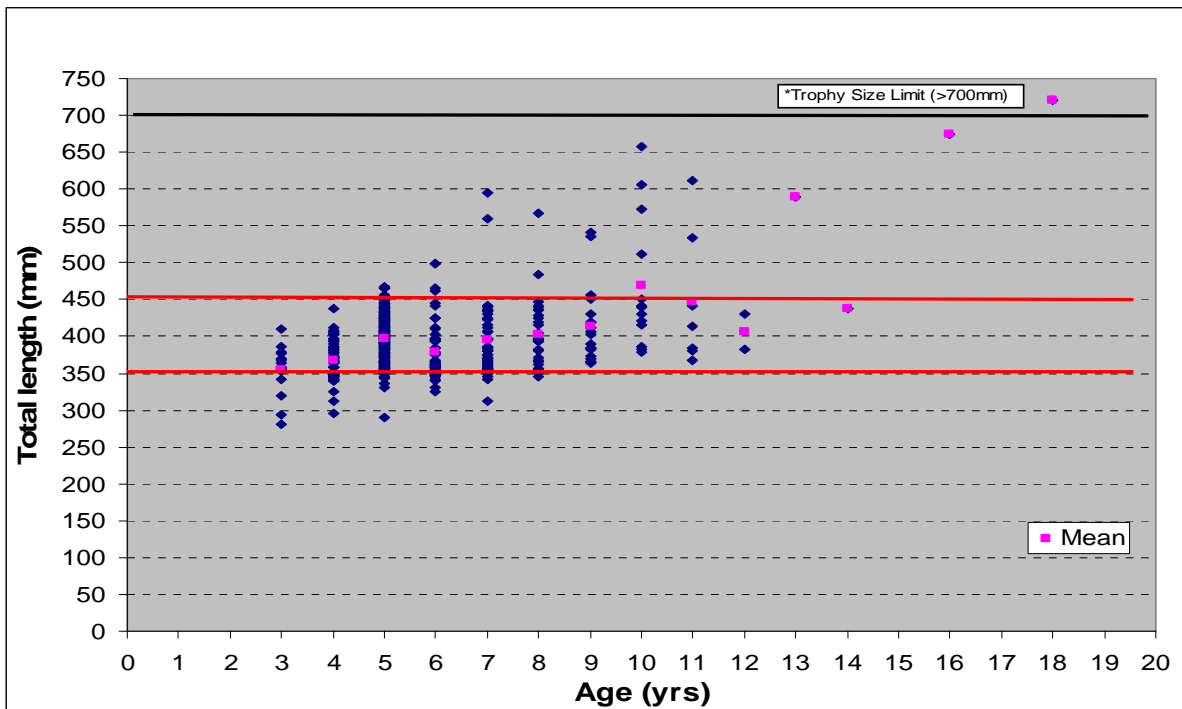


Figure 14: Total length at age for walleye harvested by anglers on Rainy Lake, Ontario in 2010/11, in relation to harvest slot/trophy size limits.

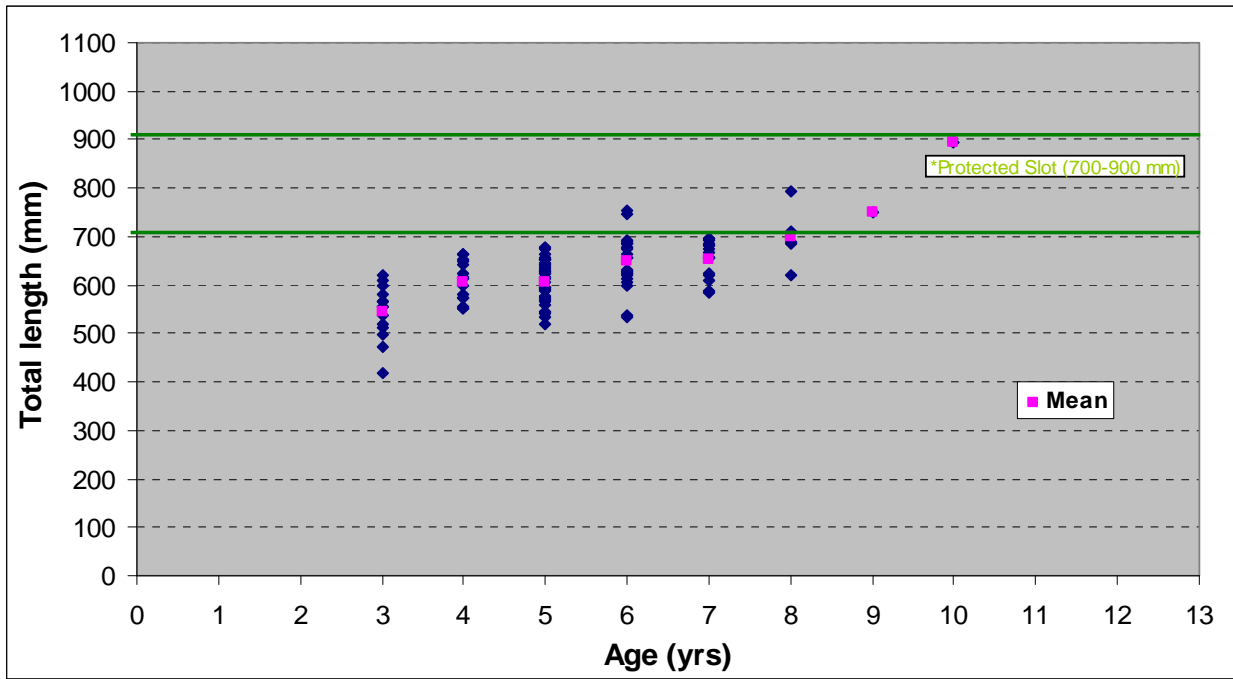


Figure 15: Total length at age for northern pike harvested by anglers on Rainy Lake, Ontario in 2010/11, in relation to protected slot/trophy size limit.

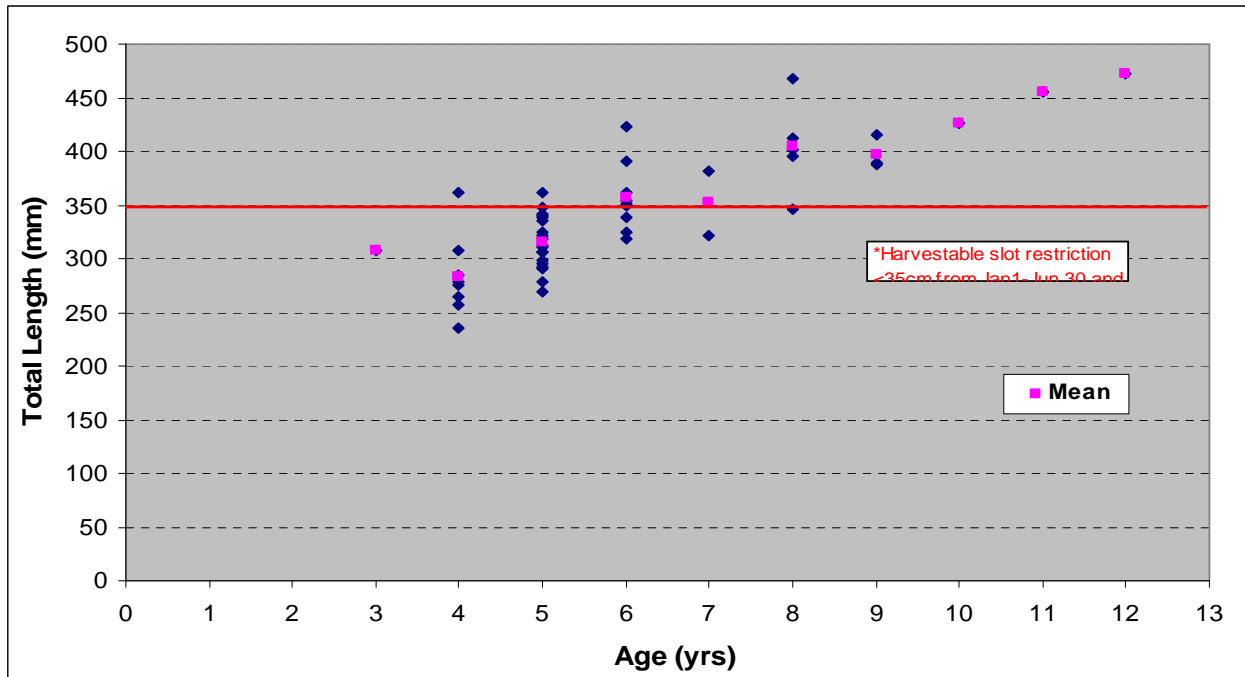


Figure 16: Total length at age for smallmouth bass harvested by anglers on Rainy Lake, Ontario in 2010/11, in relation to seasonal maximum size limit.

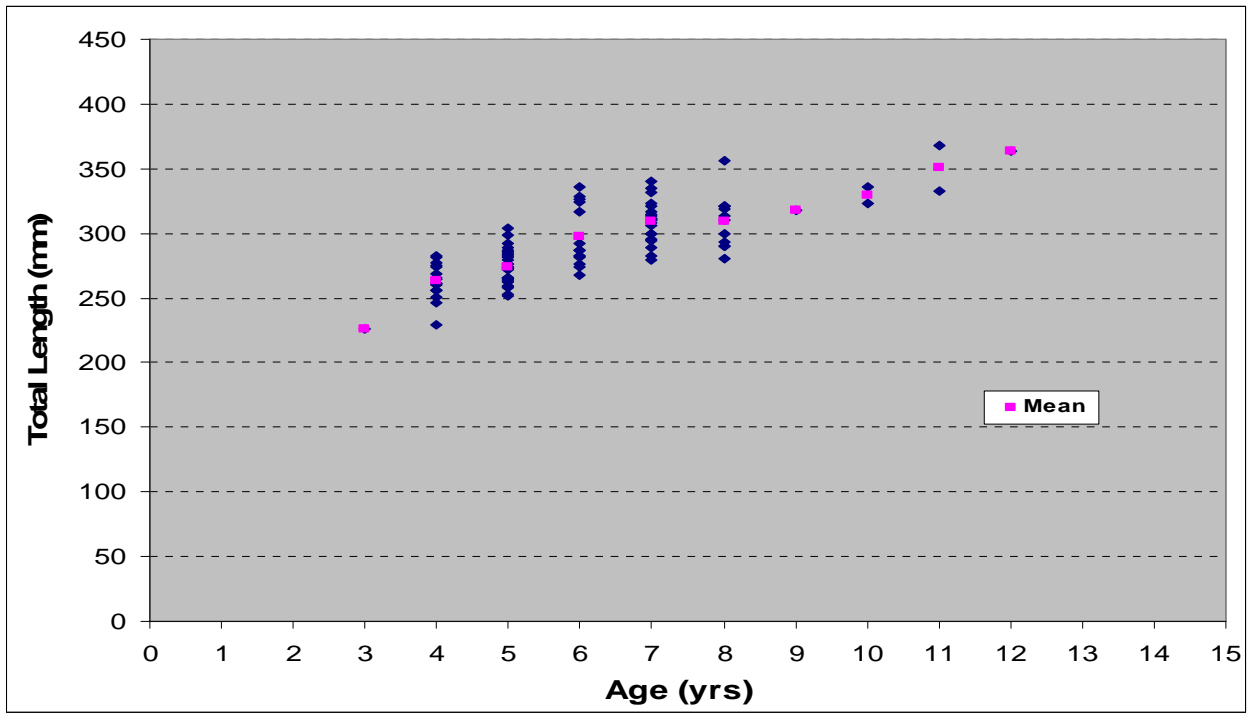


Figure 17: Total length at age for crappie harvested by anglers on Rainy Lake, Ontario in 2010/11.

TABLES

Table 1: Physical and chemical characteristics of Rainy Lake, Ontario.

PARAMETER	NORTH ARM	SOUTH ARM (ONTARIO)	REDGUT BAY	RAINY LAKE (ONTARIO)
Area (ha)	34,570	27,260	8,320	70,150
Perimeter (km)	583	439	276	1,298
Island Perimeter (km)	440	396	55	891
Maximum Depth (m)	41.0	49.1	31.2	49.1
Mean Depth (m)	8.0	11.5	6.9	9.3
Mean Secchi Depth (m)	3.3	2.7	2.1	2.7
T.D.S. (mg/L)	55	43	35	53
MEI	6.9	3.7	5.1	5.7

Table 2: A summary of creel survey information collected from the North Arm of Rainy Lake, 1956 to 2011. All data from actual angler interviews.

Year	No. Anglers Contacted	Total Rod-hrs	No. of fish kept				
			Walleye	Pike	Bass	Crappie	Other*
1956	142	318	385	92	9		
1958	242	679	403	177	13	18	22
1959	448	1807	913	206	44	24	
1960	133	624	267	32	8	5	26
1961	185	872	117	91		18	11
1962	326	1206	342	126	17	13	
1964	343	1179	240	265	129	15	
1966	152	341	121	105	42	36	
1969	1451	4030	517	1392	261	518	
1970	267	713	95	108	140	25	
1972	613	1531	185	299	65	93	
1973	1216	2733	480	503	110	95	75
1974	863	1956	324	388	86	127	26
1979	434	1403	84	185	81	46	20
1983	774	2189	57	407	218	301	13
1984	708	2372	113	309	235	260	15
1985	508	1477	60	241	158	88	1
1986	769	2269	147	301	167	82	11
1994	675	1924	10	261	55	56	0
1995	681	2025	13	272	47	84	0
2002	1198	4103	88	265	85	31	4
2011	1818	5183	532	132	87	18	15

* Other includes yellow perch, sauger and rock bass.

Table 3: A summary of creel survey information collected from the South Arm of Rainy Lake, 1956 to 2010. All data from actual angler interviews.

Year	No. Anglers Contacted	Total Rod-hrs	No. of fish kept				
			Walleye	Pike	Bass	Crappie	Other*
1956	823	5186	1609	351	236		
1958	67	191	49	59	25	1	3
1959	69	201	83	35	65	1	
1960	91	315	133	58	20		
1961	68	263	71	24			
1962	245	952	386	37	8		
1964	149	637	382	22	17		
1966	256	728	378	146	45	56	
1969	219	679	328	64	35		
1970	1411	3390	1517	354	126	16	
1982	775	2383	923	74	63	55	56
1983	1332	4692	1536	284	162	46	141
1984	1589	4855	1682	364	154	103	87
1985	935	2906	731	219	116	11	55
1986	1358	3952	1151	326	99	50	49
1992	1270	3114	852	148	114	153	27
1994	719	1693	179	56	47	35	8
1995	844	2146	211	100	34	64	5
2001	1898	5404	545	141	55	66	10
2010	1039	3169	300	44	29	25	14

* Other includes yellow perch, sauger, rock bass, mooneye, lake whitefish, brown bullhead and burbot

Table 4: A summary of creel survey information collected from Redgut Bay of Rainy Lake, 1956 to 2010. All data from actual angler interviews.

Year	No. Anglers Contacted	Total Rod-hrs	No. of fish kept				
			Walleye	Pike	Bass	Crappie	Other*
1956	708	3381	2653	219	132		
1958	124	435	301	44	4	1	16
1959	277	1396	803	123	465	2	9
1960	278	1044	889	66	20		11
1961	111	383	169	99	4		
1962	190	602	397	44	8	3	
1964	664	2286	1269	128	29	31	
1966	607	1979	1266	168	80	13	
1967	1155	3916	2115	366	95	137	149
1969	433	1151	557	121	20	13	93
1970	451	1079	623	44	4	9	
1971	965	2089	1079	95	12	20	47
1978	1223	3480	1554	216	39	114	21
1982	850	2303	1003	90	26	228	32
1983	1059	3033	595	129	51	330	54
1984	990	3034	694	128	76	268	51
1985	829	2281	528	108	74	158	45
1986	1061	3219	529	136	52	486	56
1992	1218	3094	698	70	56	1069	39
1994	836	2148	182	53	28	523	15
1995	1083	2835	372	39	22	487	25
2001	1504	4035	518	52	23	268	28
2010	1132	3252	342	39	8	380	16

* Other includes yellow perch, sauger, rock bass, mooneye, muskellunge, lake herring, lake whitefish and burbot.

Table 5: A summary of angler contacts for creel surveys on Rainy Lake from 1982 to 2011.

Year	Total # Anglers Contacted	Total # Boats Contacted	Total # Boats Observed	% Contacted	# Anglers/ Boat
1982*	1625	523	1071	48.8	3.11
1983	3165	1109	2253	49.2	2.85
1984	3287	1121	1996	56.2	2.93
1985	2272	858	1629	52.6	2.65
1986	3188	1217	2147	56.7	2.62
1992*	2488	977	1819	53.7	2.55
1994	2230	914	1441	63.4	2.44
1995	2608	1063	1380	77.0	2.45
2001*	3406	1375	2273	60.5	2.48
2002**	1198	516	990	52.1	2.32
2010*	2171	895	1010	88.6	2.43
2011**	1818	764	739	103.4	2.38

* South Arm and Redgut Bay only

** North Arm only

Table 6: Estimates of the mean length of an angler-day (complete trip) for each basin of Rainy Lake from recent creel surveys (1978 to 2011).

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1978			5.69	
1982		6.20	5.46	
1983	5.46	7.04	5.73	6.26
1984	6.70	6.12	6.12	6.24
1985	5.82	6.22	5.50	5.87
1986	5.52	5.85	5.85	5.92
1992		4.90	5.08	
1994	5.70	4.71	5.14	5.17
1995	5.95	5.09	5.24	5.37
2001		5.62	5.37	
2002	6.85			5.95
2010		6.09	5.76	
2011	5.70			5.85
MEAN	5.96	5.78	5.54	5.76

**Table 7: Angler residency (percent) for each basin of Rainy Lake from 1967 to 2011.
Resident anglers include local, Ontario resident and Canadian resident.**

Year	North Arm		South Arm		Redgut Bay	
	% Res.	% Non-Res.	% Res.	% Non-Res.	% Res.	% Non-Res.
1967					20.0	80.0
1969	26.5	73.5	0.9	99.1	8.1	91.9
1970	20.2	79.8	14.9	85.1	11.1	88.9
1971					5.6	94.4
1972	20.4	79.6				
1973	31.1	68.9				
1974	30.0	70.0				
1978					18.6	81.4
1979	26.7	73.3				
1982			4.6	95.4	13.5	86.5
1983	9.6	90.4	5.3	94.7	13.6	86.4
1984	11.9	88.1	13.9	86.1	15.4	84.6
1985	13.6	86.4	15.8	84.2	21.8	78.2
1986	20.4	79.6	11.4	88.6	15.1	84.9
1992			20.5	79.5	16.4	83.6
1994	15.1	84.9	24.4	75.6	22.3	77.7
1995	11.3	88.7	22.9	77.1	26.2	73.8
2001			29.5	70.5	32.4	67.6
2002	14.3	85.7				
2010			25.7	74.3	30.1	69.9
2011	26.4	73.6				

Table 8: Estimated total effort (rod-hours) with standard error (SE) by basin of Rainy Lake for the period 1967 to 2011.

Year	North Arm	South Arm	Redgut Bay	Total
1967			39,160	
1969	80,590			
1970	43,690	85,096	36,294	165,710
1971			45,496	
1972	48,220			
1982		193,571	79,916	
1983	121,941	169,827	98,353	390,121
1984	115,115	190,382	97,550	403,047
1985	116,500	148,165	55,261	319,926
1986	141,748	200,117	78,412	420,277
1992		128,979 (9,377)	104,711 (9,781)	
1994	67,257 (5,621)	59,296 (4,105)	52,224 (3,509)	178,777 (7,795)
1995	45,503 (4,940)	64,010 (4,865)	65,196 (6,417)	174,709 (9,477)
2001		127,237 (5,763)	73,733 (5,161)	
2002	101,499 (5,869)			302,469 (16,793)
2010		80,506 (7,246)	66,837 (5,347)	
2011	83,898 (6,712)			231,241 (19,305)

Table 9: Estimated total effort (angler-days) by basin of Rainy Lake for the period 1967 to 2011.

Year	North Arm	South Arm	Redgut Bay	Total
1967			11,550	
1969	14,510			
1970	8,186	17,324	7,717	33,227
1971			10,483	
1972	9,655			
1982		31,221	14,637	
1983	22,333	24,123	17,194	63,650
1984	17,181	31,108	15,940	64,229
1985	20,017	23,820	10,047	53,884
1986	23,855	34,384	12,939	71,178
1992		26,322	20,612	
1994	11,799	12,589	10,160	34,548
1995	7,648	12,576	12,442	32,666
2001		22,640	13,370	
2002	14,817			50,827
2010		13,219	11,604	
2011	14,719			39,542

Table 10: Estimated effort (rod-hours and %) by targeted fish species and basin of Rainy Lake in 2010/11.

Species	North Arm	South Arm	Redgut Bay	Total
Walleye	63,003 (75.1%)	62,823 (78.0%)	56,346 (84.3%)	182,172 (78.8%)
N. Pike	30,446 (36.3%)	19,511 (24.2%)	14,170 (21.2%)	64,127 (27.7%)
SM Bass	31,175 (37.2%)	31,096 (38.6%)	9,695 (14.5%)	71,966 (31.1%)
Crappie	1,760 (2.1%)	2,576 (3.2%)	19,245 (28.8%)	23,581 (10.2%)
Muskellunge	0 (0.0%)	250 (0.3%)	3,933 (5.9%)	4,183 (1.8%)
Other*	1,510 (1.8%)	1,674 (2.1%)	6,764 (10.1%)	9,948 (4.3%)
All (Combined)	83,898(100%)	80,506 (100%)	66,837 (100%)	231,241 (100%)

* Other includes yellow perch, sauger, rock bass, and largemouth bass

Table 11: Estimated effort (rod-hours) by angler residency and base of operation for the North Arm of Rainy Lake, 1983 to 2011.

Base of Operation	1983	1984	1985	1986	1994	1995	2002	2011
RESIDENT								
Ont. Resort	366		466	1276	1798	1394	1320	663
Crown land camper	488							221
Cottager	1341	345	1398	1559	1398	253	2030	4311
Ont. Houseboat	1341	691	466	283				
Day-tripper	8170	12663	5592	17010	6892	3358	11063	16470
Subtotal	11706	13699	7922	20128	10088	5005	14413	21665
(%)	(10)	(12)	(7)	(14)	(15)	(11)	(14)	(26)
NON-RESIDENT ONTARIO BASED								
Ont. Resort	63531	48579	71531	77678	42525	28331	64654	32609
Crown land camper	1219	2072	1747	2693	303	875	1015	663
Cottager	15609	8633	10951	14458	6970	7402	17052	19344
Ont. houseboat	7682	29700	18290	21546	5353	1615	1320	
Subtotal	88041	88984	102519	116375	55151	38223	84041	52616
(%)	(72)	(77)	(88)	(82)	(82)	(84)	(83)	(63)
NON-RESIDENT MINNESOTA BASED								
Minn. resort	3780	1151	4544	993	183	1209	1827	2211
Cottager	1098			426	1009	498	203	774
Day-tripper	732	2302	350	141	459	213	1015	6522
Minn. houseboat	16584	8979	1165	3685	367	355		111
Subtotal	22194	12432	6059	5245	2018	2275	3045	9618
(%)	(18)	(11)	(5)	(4)	(3)	(5)	(3)	(11)
TOTAL	121941	115115	116500	141748	67257	45503	101499	83898
(rod-hours/ha)	3.5	3.3	3.4	4.1	1.9	1.3	2.9	2.4

Table 12: Estimated effort (rod-hours) by angler residency and base of operation for the South Arm of Rainy Lake, 1982 to 2010.

Base of Operation	1982	1983	1984	1985	1986	1992	1994	1995	2001	2010
RESIDENT										
Ont. resort		340		889	401	807	1213	1895	1528	364
Crown land camper	1742								636	
Cottager	581	2717	1142	889	2201	3330	1294	1684	3308	6724
Ont. houseboat		170	571	1481	801	404	81			
Day-tripper	7162	5774	24750	10224	11207	21492	11643	12423	32063	13993
Subtotal	9485	9001	26463	13483	14610	26033	14231	16002	37535	21081
(%)	(5)	(5)	(14)	(9)	(7)	(20)	(24)	(25)	(30)	(26)
NON-RESIDENT ONTARIO BASED										
Ont. resort	2323	8491	16563	15706	14208	12650	16676	16287	28755	21626
Crown land camper	12969	4416	1713	2223	2802	4352	1561	142	1018	363
Cottager	9679	10529	9900	10075	16210	13965	11337	10526	22648	11267
Ont. houseboat			3427	1630	4602	1923	3039	1850	2418	
Subtotal	24971	23436	31603	29634	37822	32890	32613	28805	54839	33256
(%)	(13)	(14)	(17)	(20)	(19)	(26)	(55)	(45)	(43)	(41)
NON-RESIDENT MINNESOTA BASED										
Minn. resort	98334	33796	39599	25484	48028	16752	1086	3910	15650	11631
Cottager		3397	1904	2518	3001	5652	2089	2793	3435	2726
Day-tripper	60781	48740	35412	23410	39423	19174	4764	7192	7125	9086
Minn. houseboat		51457	55401	53636	57233	28458	4513	5308	8653	2726
Subtotal	159115	137390	132316	105048	147685	70036	12453	19203	34863	26169
(%)	(82)	(81)	(69)	(71)	(74)	(54)	(21)	(30)	(27)	(33)
TOTAL	193571	169827	190382	148165	200117	128979	59296	64010	127237	80506
(rod-hours/ha)	7.1	6.2	7.0	5.4	7.3	4.7	2.1	2.3	4.7	3.0

Table 13: Estimated effort (rod-hours) by angler residency and base of operation for Redgut Bay of Rainy Lake, 1982 to 2010.

Base of Operation	1982	1983	1984	1985	1986	1992	1994	1995	2001	2010
RESIDENT										
Ont. resort		787	1561	166	549	601	737	1135	1180	1328
Crown land camper	1918	984	585	110	78	258	184	120		590
Cottager	719	1279	2439	1326	1176	4894	3809	2271	1843	10624
Ont. houseboat	400	590	878	774		258	245		221	148
Day-tripper	7671	9737	9560	5747	6508	11162	6513	13686	20645	7820
Subtotal										
(%)	10708 (13)	13377 (14)	15023 (15)	8123 (15)	8311 (11)	17173 (16)	11489 (22)	17212 (26)	23889 (32)	20,510 (31)
NON-RESIDENT ONTARIO BASED										
Ont. resort	10869	25767	30045	15750	31208	45770	30478	34999	35392	23312
Crown land camper	4635	2656	1951	1713	1568	3785	372	836	74	
Cottager	10229	16622	15120	11217	12703	10926	8132	7466	10322	19181
Ont. houseboat			2926	2155	3137	775	186	119		
Subtotal	25733	45045	50042	30835	48616	61256	39168	43420	45788	42493
(%)	(32)	(46)	(51)	(56)	(62)	(59)	(75)	(67)	(62)	(64)
NON-RESIDENT MINNESOTA BASED										
Minn. resort		5213	976	2929	4783	1374			295	590
Cottager	29010		976	221	941	948	313	2883	590	590
Day-tripper		19965	11023	4587	7293	9276	1254	1681	1180	2656
Minn. houseboat	14465	14753	19510	8566	8468	6184			1991	
Subtotal	43475	39931	32485	16303	21485	26282	1567	4564	4056	3836
(%)	(55)	(40)	(34)	(29)	(27)	(25)	(3)	(7)	(6)	(6)
TOTAL	79916	98353	97550	55261	78412	104711	52224	65196	73733	66837
(rod-hours/ha)	9.6	11.8	11.7	6.6	9.4	12.6	6.3	7.8	8.9	8.0

Table 14: Estimated effort (rod-hours) by angler residency and base of operation for all of Rainy Lake, 1983 to 2011.

Base of Operation	1983	1984	1985	1986	1994	1995	2001/02	2010/11
RESIDENT								
Ont. resort	1493	1561	1521	2226	3641	4433	3932	2376
Crown land camper	1472	585	110	78	243	130	605	838
Cottager	5337	3926	3613	4936	7444	4302	7259	20679
Ont. houseboat	2101	2140	2721	1084	405		303	140
Day-tripper	23681	46973	21563	34725	25810	29920	67753	38983
Subtotal	34084	55185	29528	43049	37543	38785	79852	63016
(%)	(9)	(14)	(9)	(10)	(21)	(22)	(26)	(27)
NON-RESIDENT ONTARIO BASED								
Ont. resort	97789	95187	102987	123094	89917	80660	125525	79921
Crown land camper	8291	5736	5683	7063	2258	1893	2117	1118
Cottager	42760	33653	32243	43371	27257	24994	49302	51278
Ont. houseboat	7682	36053	22075	29285	7500	3393	3327	
Subtotal	156522	170629	162988	202813	126932	110940	180271	132317
(%)	(40)	(42)	(51)	(48)	(71)	(64)	(60)	(57)
NON-RESIDENT MINNESOTA BASED								
Minn. resort	42789	41726	32957	53804	1153	4762	17241	12296
Cottager	4495	2880	2739	4368	3076	6197	4235	3633
Day-tripper	69437	48737	28347	46857	5613	8741	9679	17745
Minn. houseboat	82794	83890	63367	69386	4460	5283	11191	2236
Subtotal	199515	177233	127410	174415	14302	24983	42346	35910
(%)	(51)	(44)	(40)	(42)	(8)	(14)	(14)	(16)
TOTAL	390121	403047	319926	420277	178777	174709	302469	231241
(rod-hours/ha)	5.6	5.7	4.6	6.0	2.5	2.5	4.3	3.3

Table 15: Harvest per unit effort (HUE) for walleye (# fish kept/rod-hour by all angler (species anglers)) for each basin of Rainy Lake, 1956 to 2011.

Year	North Arm	South Arm	Redgut Bay
1956	1.21	.31	.78
1958	.59	.26	.69
1959	.51	.41	.58
1960	.43	.42	.85
1961	.13	.27	.44
1962	.28	.40	.66
1964	.21	.60	.56
1966	.35	.51	.63
1967			.54 (.54)
1969	.13 (.16)	.48 (.50)	.48 (.53)
1970	.13 (.19)	.45 (.50)	.58 (.60)
1971			.52 (.52)
1972	.12 (.41)		
1973	.18 (.74)		
1974	.17 (.69)		
1978			.44 (.45)
1979	.06 (.06)		
1982		.37 (.39)	.42 (.48)
1983	.03 (.08)	.33 (.37)	.20 (.24)
1984	.05 (.13)	.35 (.39)	.23 (.27)
1985	.04 (.14)	.25 (.29)	.23 (.28)
1986	.06 (.17)	.29 (.33)	.16 (.22)
1992		.27 (.33)	.23 (.34)
1994	.01 (.02)	.11 (.16)	.09 (.11)
1995	.01 (.03)	.10 (.17)	.13 (.17)
2001		.11 (.15)	.14 (.16)
2002	.02 (.05)		
2010		.11 (.14)	.11 (.13)
2011	.11 (.14)		

Table 16: Catch per unit effort (CUE) for walleye (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.

Year	North Arm	South Arm	Redgut Bay
1969	.14 (-)	.54 (-)	.64 (-)
1970	.14 (-)	.53 (-)	.76 (-)
1972	-. (.47)		
1973	-. (.78)		
1977	-. (.70)		
1982		.48 (-)	.58 (-)
1992		.47 (.56)	.48 (.69)
1994	.02 (.06)	.50 (.70)	.62 (.84)
1995	.02 (.10)	.49 (.77)	.72 (.86)
2001		.77 (1.00)	1.17 (1.37)
2002	.08 (.25)		
2010		.95 (1.12)	1.17 (1.34)
2011	.60 (.78)		

Table 17: Harvest per unit effort (HUE) for northern pike (#fish kept/rod-hours by all anglers (species anglers)) for each basin of Rainy Lake, 1956 to 2011.

Year	North Arm	South Arm	Redgut Bay
1956	.29	.07	.06
1958	.26	.31	.10
1959	.11	.17	.09
1960	.05	.18	.06
1961	.10	.09	.26
1962	.10	.04	.07
1964	.23	.03	.06
1966	.30	.20	.08
1967			.09 (.09)
1969	.55 (.55)	.09 (1.92)	.11 (.46)
1970	.15 (.21)	.10 (.36)	.04 (.52)
1971			.05
1972	.20 (.32)		
1973	.18 (.38)		
1974	.20 (.48)		
1978			.05 (.19)
1979	.14		
1982		.04 (.09)	.04 (.15)
1983	.19 (.27)	.06 (.15)	.04 (.12)
1984	.13 (.25)	.07 (.17)	.04 (.13)
1985	.16 (.24)	.08 (.19)	.05 (.16)
1986	.13 (.21)	.08 (.21)	.04 (.13)
1992		.05 (.19)	.02 (.09)
1994	.14 (.16)	.03 (.08)	.03 (.05)
1995	.13 (.18)	.05 (.10)	.01 (.05)
2001		.04 (.10)	.01 (.08)
2002	.07 (.09)		
2010		.01 (.06)	.01 (.06)
2011	.02 (.07)		

Table 18: Catch per unit effort (CUE) for northern pike (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.

Year	North Arm	South Arm	Redgut Bay
1969	.53 (-)	.10 (-)	.19 (-)
1970	.56 (-)	.38 (-)	.11 (-)
1972	-. (.72)		
1973	-. (.91)		
1974	-. (.67)		
1982		.08 (-)	.09 (-)
1992		.16 (.40)	.10 (.33)
1994	.51 (.56)	.25 (.34)	.16 (.32)
1995	.46 (.54)	.41 (.72)	.18 (.42)
2001		.45 (.87)	.26 (.59)
2002	.45 (.50)		
2010		.28 (.49)	.17 (.38)
2011	.32 (.48)		

Table 19: Harvest per unit effort (HUE) for smallmouth bass (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1956 to 2011.

Year	North Arm	South Arm	Redgut Bay
1956	.03	.05	.04
1958	.02	.13	.01
1959	.02	.32	.33
1960	.01	.06	.02
1961			.01
1962	.01		
1964	.11	.03	.01
1966	.12	.06	.04
1967			.02
1969	.33 (.33)	.05 (1.12)	.02 (.58)
1970	.04 (.09)	.01 (.26)	.01 (.20)
1971			.01
1972	.04 (.30)		
1973	.04 (.56)		
1974	.04 (.54)		
1978			.01 (.16)
1979	.06		
1982		.03 (10)	.01 (.11)
1983	.10 (.24)	.03 (.13)	.02 (.11)
1984	.10 (.20)	.03 (.17)	.03 (.15)
1985	.11 (.24)	.04 (.18)	.03 (.20)
1986	.07 (.20)	.03 (.15)	.02 (.11)
1992		.04 (.15)	.02 (.17)
1994	.03 (.07)	.03 (.08)	.01 (.05)
1995	.02 (.06)	.02 (.04)	.01 (.05)
2001		.01 (.03)	.01 (.03)
2002	.02 (.03)		
2010		.01 (.03)	>.01 (.02)
2011	.02 (.04)		

Table 20: Catch per unit effort (CUE) for smallmouth bass (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.

Year	North Arm	South Arm	Redgut Bay
1969	.07 (-)	.05 (-)	.03 (-)
1970	.04 (-)	.06 (-)	.01 (-)
1972	-.41)		
1973	-.65)		
1974	-.55)		
1982		.04 (-)	.02 (-)
1992		.11 (.44)	.06 (.48)
1994	.12 (.29)	.15 (.40)	.05 (.22)
1995	.18 (.49)	.18 (.43)	.07 (.39)
2001		.26 (.62)	.10 (.37)
2002	.51 (.77)		
2010		.31 (.69)	.09 (.55)
2011	.28 (.64)		

Table 21: Harvest per unit effort (HUE) for black crappie (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1960 to 2011.

Year	North Arm	South Arm	Redgut Bay
1960	.01		
1961	.02		
1964	.01		.01
1966	.10	.07	.01
1967	.02		.03
1969	1.25 (1.25)		.01 (.33)
1970	.20 (1.69)	.04 (.64)	.01
1971			.01
1972	.06 (.94)		
1973	.03 (.87)		
1974	.06 (1.43)		
1978			.02 (.30)
1979	.03		
1982		.02 (.35)	.10 (.41)
1983	.14 (.64)	.01 (.16)	.11 (.54)
1984	.11 (.42)	.02 (.18)	.09 (.36)
1985	.06 (.28)	.01 (.20)	.07 (.32)
1986	.03 (.27)	.01 (.23)	.15 (.60)
1992		.05 (1.33)	.35 (.69)
1994	.03 (.20)	.02 (.32)	.24 (.49)
1995	.04 (.40)	.03 (.47)	.17 (.46)
2001		.01 (.27)	.08 (.47)
2002	.01 (.26)		
2010		.01 (.22)	.10 (.36)
2011	.01 (.24)		

Table 22: Catch per unit effort (CUE) for black crappie (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1969 to 2011.

Year	North Arm	South Arm	Redgut Bay
1969	.13 (-)	.00 (-)	.01 (-)
1970	.20 (-)	.01 (-)	.01 (-)
1972	- (1.29)		
1973	- (.87)		
1974	- (1.43)		
1982		.04 (-)	.14 (-)
1992		.05 (1.37)	.49 (.97)
1994	.04 (.26)	.03 (.46)	.33 (.63)
1995	.04 (.41)	.05 (.79)	.22 (.59)
2001		.02 (.29)	.12 (.72)
2002	.01 (.30)		
2010		.01 (.30)	.17 (.52)
2011	.01 (.20)		

Table 23: Harvest per unit effort (HUE) for sauger (# fish kept/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1978 to 2011.

Year	North Arm	South Arm	Redgut Bay
1978			.00 (.11)
1982		.02 (.27)	.01 (.14)
1983	.00 (.10)	.01 (.18)	.01 (.19)
1984	.00 (.06)	.01 (.20)	.01 (.17)
1985	.00 (.00)	.01 (.19)	.02 (.20)
1986	.00 (.13)	.01 (.15)	.01 (.26)
1992		.01 (.38)	.01 (.21)
1994	.00 (.00)	.00 (.04)	.00 (.09)
1995	.00 (.00)	.00 (.10)	.00 (.07)
2001		.00 (.04)	.00 (.15)
2002	.00 (.00)		
2010		.00 (.05)	.00 (.02)
2011	.00 (.18)		

Table 24: Catch per unit effort (CUE) for sauger (# fish caught/rod-hour by all anglers (species anglers)) for each basin of Rainy Lake, 1982 to 2011.

Year	North Arm	South Arm	Redgut Bay
1982		.08 (-)	.03 (-)
1992		.02 (.38)	.03 (.33)
1994	.00 (.00)	.04 (.25)	.03 (.28)
1995	.00 (.00)	.01 (.51)	.02 (.32)
2001		.01 (.33)	.04 (.25)
2002	.00 (.00)		
2010		.01 (.51)	.05 (.41)
2011	.00 (.18)		

Table 25: Estimated angler catch (# caught and percent released) by fish species for each basin of Rainy Lake, 2010/11.

Species	North Arm	South Arm	Redgut Bay	Total
Walleye	55,371 (83%)	83,208 (90%)	79,876 (91%)	218,455 (89%)
N. Pike	24,369 (92%)	23,521 (95%)	12,811 (93%)	60,701 (93%)
SM Bass	23,676 (94%)	24,971 (97%)	7,676 (97%)	56,323 (96%)
Crappie	589 (28%)	928 (40%)	10,073 (31%)	11,590 (32%)
Muskellunge	0 (-%)	39 (100%)	203 (100%)	242 (100%)
Other*	4,439 (95%)	5,025 (93%)	9,327 (96%)	18,791 (95%)
Total	108,444 (88%)	137,692 (92%)	119,966 (87%)	366,102 (89%)

* Other includes yellow perch, sauger, rock bass, and largemouth bass

Table 26: Estimated angler harvest (# kept) by fish species for each basin of Rainy Lake, 1967 to 2011.

NORTH ARM

Year	WA	SA	NP	MU	SMB	RB	BC	YP	MO	TOTAL
1969	5170	230	13920	-	2590	-	5180	-	-	-
1970	5826	-	6624	-	1534	-	8586	-	-	-
1972	5828	-	9420	-	2088	-	2930	-	-	-
1983	2819	146	24990	-	13712	-	15960	-	-	-
1984	4928	-	19872	-	13514	-	9369	-	-	-
1985	2978	-	13886	-	11614	-	5630	-	-	-
1986	5943	-	22441	-	10604	-	2466	-	-	-
1994	307	0	8198	0	1894	0	3160	0	0	13559
1995	201	0	6151	0	1341	0	1270	0	0	8963
2002	2379	0	8034	0	2269	0	1412	33	0	14127
2011	9116	61	2054	0	1395	0	426	186	0	13238

SOUTH ARM

Year	WA	SA	NP	MU	SMB	RB	BC	YP	MO	TOTAL
1970	37718	-	8022	-	3264	-	342	-	-	49346
1982	75268	5270	7353	-	5940	-	6870	-	-	100701
1983	69399	2474	15840	-	7315	-	3152	-	-	98180
1984	75114	-	15350	-	6516	-	3402	-	-	100383
1985	34925	-	13586	-	4896	-	707	-	-	54114
1986	40306	-	18920	-	4781	-	3521	-	-	67528
1992	36067	989	6463	0	4492	0	6185	406	0	54602
1994	6728	132	2080	0	1853	128	2757	26	0	13704
1995	7622	469	2962	0	1035	0	3789	105	0	15982
2001	13329	53	4512	0	1299	0	1520	343	0	210563
2010	8689	36	1136	0	797	0	560	345	0	11563

REDGUT BAY

Year	WA	SA	NP	MU	SMB	RB	BC	YP	MO	TOTAL
1967	21115	1190	3660	-	950	-	1370	-	-	28285
1970	21320	-	1506	-	136	-	308	-	-	23270
1982	32414	769	3236	-	657	-	6820	-	-	43896
1983	19085	1423	3551	-	1529	-	8791	-	-	34379
1984	21087	-	3618	-	2835	-	8289	-	-	35829
1985	13845	-	2094	-	1442	-	4298	-	-	21679
1986	9590	-	3055	-	1630	-	12316	-	-	26591
1992	23893	1104	2278	0	1935	0	38149	88	0	67447
1994	4634	1071	1244	0	783	29	12422	97	15	20295
1995	8412	188	754	0	462	40	10838	152	33	20879
2001	9792	326	1073	0	468	55	5810	169	0	17693
2010	7452	111	918	0	216	0	6917	243	0	15857

RAINY LAKE

Year	WA	SA	NP	MU	SMB	RB	BC	YP	MO	TOTAL
1970	64864	-	16152	-	4934	-	9236	-	-	95186
1983	91303	-	44381	-	22556	-	27903	-	-	186143
1984	92961	-	42525	-	25137	-	22937	-	-	183560
1985	51748	-	29366	-	17952	-	10635	-	-	109701
1986	55839	-	44416	-	17015	-	18303	-	-	135573
1994	11669	1203	11522	0	4530	156	18338	123	15	47556
1995	16234	658	9867	0	2839	40	15896	257	33	45824
2001/ 02	25500	379	13619	0	4036	55	8742	545	0	52876
2010/ 11	25257	208	4108	0	2408	0	7903	774	0	40658

LEGEND

WA – Walleye
 SA – Sauger
 NP – Northern Pike
 MU – Muskellunge
 SMB – Smallmouth Bass
 RB – Rock Bass
 BC – Black Crappie
 YP – Yellow Perch
 MO - Mooneye

Table 27: Estimated angler harvest of walleye (kilograms) from each basin of Rainy Lake, 1967 to 2011. Confidence limits are given at the 95% level.

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1967			7499	
1969	2538			
1970	2860	20232	10078	33170
1982		27974 ± 11748	8705 ± 2949	
1983	1224 ± 625	25376 ± 8751	7820 ± 2517	32877 ± 1874
1984	2767 ± 1227	22558 ± 6710	8451 ± 2333	31671 ± 2505
1985	2326 ± 1505	9357 ± 3287	4270 ± 1645	15912 ± 2927
1986	4754 ± 2250	20153 ± 4819	4795 ± 1645	28948 ± 3768
1992		20389 ± 3898	10313 ± 2234	
1994	224 ± 191	4579 ± 1644	2465 ± 810	7012 ± 1704
1995	144 ± 119	4492 ± 1626	3796 ± 836	8241 ± 1674
2001		8369 ± 1232	5180 ± 932	
2002	1243 ± 941			14792 ± 3105
2010		4570 ± 3128	3,920 ± 1788	
2011	5397 ± 1823			13887 ± 6739

Table 28: Estimated angler harvest of northern pike (kilograms) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1983	18345 ± 6650	9975 ± 4486	2221 ± 989	33130 ± 4145
1984	13379 ± 8786	10246 ± 3828	3213 ± 1921	29025 ± 3089
1985	7045 ± 2874	9221 ± 4307	1142 ± 525	16946 ± 3919
1986	17139 ± 5763	18111 ± 11236	1945 ± 903	43456 ± 9126
1992		8926 ± 3504	2366 ± 946	
1994	14469 ± 4043	3152 ± 1338	1570 ± 1052	19349 ± 4297
1995	8721 ± 2955	4306 ± 1553	1036 ± 346	14038 ± 3310
2001		5652 ± 2507	1436 ± 689	
2002	11998 ± 3766			19086 ± 6962
2010		1270 ± 318	1414 ± 477	
2011	3013 ± 739			5697 ± 1534

Table 29: Estimated angler harvest of smallmouth bass (kilograms) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1983	3963 ± 1629	1915 ± 799	731 ± 449	6996 ± 992
1984	5575 ± 2273	1620 ± 766	488 ± 426	8950 ± 1522
1985	4760 ± 3831	1333 ± 929	762 ± 525	7330 ± 3378
1986	3740 ± 1561	1534 ± 708	260 ± 232	7234 ± 1748
1992		3897 ± 1285	1112 ± 646	
1994	1624 ± 698	1853 ± 922	597 ± 357	4015 ± 1158
1995	952 ± 507	762 ± 616	318 ± 240	2027 ± 808
2001		1220 ± 550	269 ± 161	
2002	1842 ± 777			3331 ± 1488
2010		728 ± 399	99 ± 289	
2011	865 ± 977			1692 ± 1665

Table 30: Estimated angler harvest of black crappie (kilograms) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1983	6384 ± 4285	1263 ± 1110	2859 ± 1618	10666 ± 2844
1984	1701 ± 1386	675 ± 540	2657 ± 1553	5440 ± 694
1985	1700 ± 1163		653 ± 411	2434 ± 946
1986	932 ± 895	1110 ± 1256	1959 ± 1227	3822 ± 1180
1992		2311 ± 1857	12288 ± 4483	
1994	1795 ± 878	1644 ± 1439	5244 ± 1737	8630 ± 2222
1995	726 ± 497	2046 ± 2302	3914 ± 1855	6579 ± 2719
2001		649 ± 555	2099 ± 923	
2002	790 ± 695			3538 ± 2173
2010		398 ± 179	3120 ± 2490	
2011	232 ± 673			3750 ± 3342

Table 31: Estimated angler harvest of sauger (kilograms) from each basin of Rainy Lake, 1983 to 2011. Confidence limits are given at the 95% level.

Year	North Arm	South Arm	Redgut Bay	Rainy Lake
1995	0	47 ± 84	59 ± 50	155 ± 204
2001		16 ± 25	97 ± 80	
2002	0	5 ± 155		113 ± 105
2010		11 ± 50	43 ± 115	
2011	18 ± 122			72 ± 287

Table 32: Estimated walleye harvest (kilograms) by angler residency and base of operation for the North Arm of Rainy Lake, 1983 to 2011.

Base of Operation	1983	1984	1985	1986	1994	1995	2002	2011
RESIDENT								
Ont. resort	4		19	86	6	5	16	43
Crown land camper	5			14	-	-	-	14
Cottager	13	8	47	81	5	1	25	277
Ont. houseboat	13	17	5	14	-	-	-	-
Day-tripper	82	304	243	775	24	12	135	1059
Subtotal	117	329	314	970	35	18	176	1393
(%)	(10)	(12)	(13)	(20)	(16)	(13)	(14)	(26)
NON-RESIDENT ONTARIO BASED								
Ont. resort	638	1168	1228	2220	146	93	792	2098
Crown land camper	12	50	56	105	1	3	12	43
Cottager	157	207	298	542	24	24	209	1244
Ont. houseboat	77	714	270	713	18	6	16	
Subtotal	884	2139	1852	3580	189	126	1029	3385
(%)	(72)	(77)	(80)	(75)	(84)	(87)	(83)	(63)
NON-RESIDENT MINNESOTA BASED								
Minn. resort	38	28	114	62			22	142
Cottager	11			19			3	50
Day-tripper	8	55	23	14			12	420
Minn. houseboat	166	216	23	109			-	7
Subtotal	222	299	160	204	0	0	37	619
(%)	(18)	(11)	(7)	(5)	(0)	(0)	(3)	(11)
TOTAL	1224	2767	2326	4754	224	144	1243	5397
(kg/ha)	(0.04)	(0.08)	(0.07)	(0.14)	(0.01)	(<0.01)	(0.04)	(0.16)

Table 33: Estimated walleye harvest (kilograms) by angler residency and base of operation for the South Arm of Rainy Lake, 1982 to 2010.

Base of Operation	1982	1983	1984	1985	1986	1992	1994	1995	2001	2010
RESIDENT ONTARIO BASED										
Ont. resort	-	51	-	56	81	122	119	192	100	21
Crown land camper	252	-	-	-	-	-	-	-	42	-
Cottager	84	406	135	112	524	530	128	170	218	381
Ont. houseboat		25	68	103	101	61	9	-	-	-
Day-tripper	1035	863	2932	1207	1592	3405	1149	1256	2109	794
Subtotal	1371	1345	3135	1478	2298	4118	1405	1618	2469	1196
(%)	(5)	(5)	(14)	(16)	(12)	(20)	(31)	(36)	(30)	(26)
NON-RESIDENT ONTARIO BASED										
Ont. resort	336	1269	1963	833	1512	1998	1621	1625	1891	1228
Crown land camper	1874	660	203	178	302	694	151	14	67	21
Cottager	1399	1573	1173	870	2176	2202	1104	1050	1490	640
Ont. houseboat			406	112	524	306	298	185	159	
Subtotal	3609	3502	3745	1993	4514	5200	3174	2874	3607	1889
(%)	(13)	(14)	(17)	(21)	(22)	(26)	(69)	(64)	(43)	(41)
NON-RESIDENT MINNESOTA BASED										
Minn. resort		5050	4692	1610	4252	2651			1029	660
Cottager	14183	508	226	206	302	897			226	155
Day-tripper		7282	4196	1338	4192	3017			469	516
Minn. houseboat	8811	7689	6564	2732	4595	4506			569	155
Subtotal	22994	20529	15678	5886	13341	11071	0	0	2293	1486
(%)	(82)	(81)	(69)	(63)	(66)	(54)	(0)	(0)	(27)	(33)
TOTAL	27974	25376	22558	9357	20153	20389	4579	4492	8369	4570
(kg/ha)	(1.10)	(0.93)	(0.83)	(0.34)	(0.74)	(0.75)	(0.17)	(0.16)	(0.31)	(0.17)

Table 34: Estimated walleye harvest (kilograms) by angler residency and base of operation for the Redgut Bay of Rainy Lake, 1982 to 2010.

Base of Operation	1982	1983	1984	1985	1986	1992	1994	1995	2001	2010
RESIDENT ONTARIO BASED										
Ont. resort		63	135	56	43	60	35	71	83	78
Crown land camper	209	78	51	26	10	20	10	8	-	35
Cottager	78	102	211	196	158	468	187	142	130	623
Ont. houseboat	44	47	76	46	10	20	12	-	15	9
Day-tripper	836	774	828	606	503	1065	321	856	1450	459
Subtotal	1167	1064	1301	930	724	1633	565	1077	1678	1204
(%)	(13)	(14)	(16)	(22)	(15)	(16)	(23)	(28)	(32)	(31)
NON-RESIDENT ONTARIO BASED										
Ont. resort	1184	2048	2603	939	1755	4352	1479	2192	2487	1367
Crown land camper	505	211	169	124	77	358	17	52	5	-
Cottager	1114	1322	1310	1008	901	1035	394	467	725	1125
Ont. houseboat			253	141	173	80	10	8	-	-
Subtotal	2803	3581	4335	2212	2906	5825	1900	2719	3217	2492
(%)	(32)	(46)	(51)	(52)	(61)	(59)	(77)	(72)	(62)	(64)
NON-RESIDENT MINNESOTA BASED										
Minn. resort		415	85	154	192	130			21	35
Cottager	3160		85	30	96	906			41	35
Day-tripper		1587	955	393	474	886			83	156
Minn. houseboat	1575	1173	1690	551	403	578			140	-
Subtotal	4735	3175	2815	1128	1165	2500	0	0	285	226
(%)	(55)	(40)	(33)	(26)	(24)	(25)	(0)	(0)	(6)	(6)
TOTAL	8705	7820	8451	4270	4795	9958	2465	3796	5180	3920
(kg/ha)	(1.05)	(0.94)	(1.02)	(0.51)	(0.58)	(1.20)	(0.30)	(0.46)	(0.62)	(0.47)

Table 35: Estimated walleye harvest (kilograms) by angler residency and base of operation for Rainy Lake, 1983 to 2011.

Base of Operation	1983	1984	1985	1986	1994	1995	2001/02	2010/11
RESIDENT								
Ont. resort	118	135	131	210	154	244	192	142
Crown land camper	83	51	26	24	8	7	30	50
Cottager	521	354	355	763	315	237	355	1241
Ont. houseboat	85	161	154	125	14	-	15	8
Day-tripper	1719	4064	2056	2870	1101	1649	3313	2341
Subtotal	2526	4765	2722	3992	1592	2137	3905	3782
(%)	(7)	(14)	(17)	(13)	(23)	(26)	(26)	(27)
NON-RESIDENT ONTARIO BASED								
Ont. resort	3955	5734	3000	5487	3843	4438	6139	4800
Crown land camper	883	422	358	484	98	104	103	67
Cottager	3052	2690	2176	3619	1164	1375	2411	3079
Ont. houseboat	77	1373	523	1410	315	187	163	
Subtotal	7967	10219	6057	11000	5420	6104	8816	7946
(%)	(23)	(30)	(39)	(37)	(77)	(74)	(60)	(57)
NON-RESIDENT MINNESOTA BASED								
Minn. resort	5503	4805	1878	4506			843	738
Cottager	519	311	236	417			207	218
Day-tripper	8877	5206	1754	4680			474	1066
Minn. houseboat	9028	8470	3306	5107			547	135
Subtotal	23927	18792	7174	14710	0	0	2071	2157
(%)	(70)	(56)	(44)	(50)	(0)	(0)	(14)	(16)
TOTAL	34420	33776	15953	29702	7012	8241	14792	13887
(kg/ha)	(0.49)	(0.48)	(0.23)	(0.42)	(0.10)	(0.12)	(0.21)	(0.20)

Table 36: A summary of population characteristics (mean age, length and weight) for walleye caught by anglers on each basin of Rainy Lake, 1963 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	NORTH ARM Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1969	194	3.9 (-)	386 (-)	354 (-)	540 (-)
1983	37	4.4 (1.2)	-	419 (50)	800 (310)
1984	54	4.9 (1.2)	-	379 (61)	700 (350)
1985	39	4.0 (1.4)	-	415 (66)	900 (440)
1986	87	4.7 (1.4)	-	391 (60)	800 (460)
1994	8	5.1 (3.2)	458 (116)	430 (111)	1105 (1077)
1995	18	4.0 (2.2)	430 (75)	403 (73)	822 (448)
2002	49	3.1 (0.6)	437 (42)	412 (40)	841 (469)
2011	287	5.0 (1.4)	406 (48)	381 (46)	592 (296)

Year	Sample Size (n)	Age (years) Mean (S.D.)	SOUTH ARM Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1963	103	5.9 (-)	-	389 (-)	-
1969	36	3.9 (-)	356 (-)	336 (-)	410 (-)
1970	155	3.9 (-)	369 (-)	349 (-)	460 (-)
1982	183	4.1 (1.4)	361 (-)	341 (58)	470 (290)
1983	284	4.4 (1.6)	-	355 (56)	500 (290)
1984	203	4.5 (1.6)	-	353 (61)	500 (310)
1985	190	4.0 (1.8)	-	350 (67)	500 (370)
1986	402	4.8 (1.5)	-	340 (61)	500 (320)
1992	353	4.1 (1.8)	379 (75)	355 (67)	540 (338)
1994	149	5.1 (1.2)	405 (48)	380 (46)	682 (295)
1995	211	4.8 (1.4)	402 (39)	377 (37)	592 (241)
2001	358	5.3 (1.5)	401 (49)	375 (47)	616 (315)
2010	107	6.3 (2.1)	382 (45)	357 (43)	526 (263)

Year	Sample Size (n)	Age (years) Mean (S.D.)	REDGUT BAY		
			Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1967	28	3.8 (-)	335 (-)	315 (-)	350 (-)
1969	59	3.4 (-)	346 (-)	326 (-)	380 (-)
1970	54	3.7 (-)	355 (-)	335 (-)	420 (-)
1978	290	4.0 (1.1)	339 (-)	319 (54)	380 (270)
1982	184	3.9 (1.4)	340 (-)	320 (53)	370 (260)
1983	179	4.1 (1.9)	-	345 (76)	500 (400)
1984	199	4.4 (1.6)	-	330 (62)	400 (280)
1985	168	3.3 (1.9)	-	319 (65)	400 (340)
1986	152	4.9 (1.8)	-	338 (66)	500 (360)
1992	204	3.7 (1.4)	337 (69)	315 (66)	405 (324)
1994	170	5.1 (1.4)	373 (44)	349 (42)	545 (337)
1995	325	4.7 (1.0)	371 (32)	347 (30)	436 (145)
2001	328	5.3 (1.1)	382 (38)	357 (35)	523 (252)
2010	119	6.9 (2.1)	382 (40)	356 (38)	526 (204)

Table 37: A summary of population characteristics (mean age, length and weight) for walleye caught by anglers on Rainy Lake, 1983 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1983	500	4.3 (1.7)	381	356 (66)	500 (350)
1984	456	4.5 (1.6)	368	346 (63)	500 (310)
1985	397	3.7 (1.8)	366	343 (72)	500 (400)
1986	641	4.8 (1.6)	368	346 (65)	500 (360)
1992	547	3.9 (1.7)	363 (76)	340 (68)	489 (339)
1994	327	5.1 (1.4)	389 (52)	365 (50)	621 (366)
1995	554	4.7 (1.2)	385 (40)	360 (39)	506 (219)
2001/02	686	5.3 (1.3)	392 (45)	367 (43)	572 (291)
2010/11	513	5.7 (1.8)	395 (47)	370 (45)	563 (271)

Table 38: A summary of population characteristics (mean age, length and weight) for northern pike caught by anglers on Rainy Lake, 1983 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1983	217	4.0 (1.3)	566	529 (69)	1000 (470)
1984	224	4.7 (2.0)	578	541 (106)	1200 (950)
1985	129	5.6 (1.6)	600	563 (100)	1400 (900)
1986	224	6.9 (2.3)	590	553 (87)	1300 (700)
1992	234	4.8 (1.2)	596 (81)	559 (76)	1290 (650)
1994	294	5.0 (1.8)	619 (40)	583 (88)	1683 (789)
1995	324	5.1 (1.7)	616 (80)	580 (77)	1411 (665)
2001/02	323	4.1 (1.4)	607 (83)	572 (80)	1387 (716)
2010/11	107	5.3 (1.5)	622 (67)	586 (67)	1431 (485)

Table 39: A summary of population characteristics (mean age, length and weight) for smallmouth bass caught by anglers on Rainy Lake, 1983 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1983	116	5.4 (2.0)	337	321 (54)	600 (380)
1984	168	5.1 (1.6)	320	302 (53)	500 (300)
1985	75	5.4 (2.3)	365	346 (56)	800 (410)
1986	84	5.5 (2.2)	336	320 (52)	700 (360)
1992	68	5.3 (2.2)	355 (64)	337 (61)	744 (416)
1994	109	6.9 (2.1)	365 (61)	346 (59)	903 (467)
1995	85	5.7 (1.9)	346 (56)	330 (55)	700 (385)
2001/02	108	6.0 (2.6)	364 (55)	346 (52)	804 (410)
2010/11	50	6.0 (1.9)	341 (55)	323 (51)	663 (376)

Table 40: A summary of population characteristics (mean age, length and weight) for black crappie caught by anglers on Rainy Lake, 1983 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
1983	148	6.8 (1.7)	303	288 (30)	400 (130)
1984	103	7.2 (2.2)	288	275 (31)	400 (150)
1985	97	5.2 (1.9)	282	268 (29)	400 (120)
1986	110	6.9 (2.4)	295	281 (31)	400 (130)
1992	234	5.1 (1.2)	265 (29)	252 (27)	319 (107)
1994	398	7.1 (1.4)	282 (30)	268 (29)	433 (153)
1995	392	7.3 (1.9)	294 (34)	280 (33)	412 (160)
2001/02	204	4.9 (1.8)	273 (38)	260(35)	387 (144)
2010/11	100	6.1 (1.7)	291 (28)	279 (27)	473 (134)

Table 41: A summary of population characteristics (mean age, length and weight) for sauger caught by anglers on Rainy Lake, 2001 to 2011. Standard deviations for each mean are provided.

Year	Sample Size (n)	Age (years) Mean (S.D.)	Total Length (mm) Mean (S.D.)	Fork Length (mm) Mean (S.D.)	Round Weight (g) Mean (S.D.)
2001	10	-	333 (29)	312 (27)	308 (77)
2010/11	5	6.6 (2.9)	343 (55)	321 (51)	335 (136)

Table 42: Total length frequency distribution of fish species harvested by anglers in the North Arm of Rainy Lake, 2011.

Total Length (cm)	Walleye	N. Pike	SM Bass	Black Crappie	Sauger
18.0-19.9					
20.0-21.9					
22.0-23.9					
24.0-25.9			1		
26.0-27.9			3	3	
28.0-29.9	1		3	2	
30.0-31.9	2		8	3	
32.0-33.9	1		6	5	
34.0-35.9	27		6	1	1
36.0-37.9	47		3	1	
38.0-39.9	64		5		
40.0-41.9	59		1		
42.0-43.9	51		1		
44.0-45.9	17		1		
46.0-47.9	5				
48.0-49.9	2	1			
50.0-51.9	1	2			
52.0-53.9	2	3			
54.0-55.9	2	5			
56.0-57.9	2	7			
58.0-59.9		9			
60.0-61.9	2	8			
62.0-63.9		12			
64.0-65.9	1	12			
66.0-67.9		7			
68.0-69.9		10			
70.0-71.9		1			
72.0-73.9	1				
74.0-75.9		2			
76.0-77.9					
78.0-79.9					
80.0-81.9					
82.0-83.9					
84.0-85.9					
86.0-87.9					
88.0-89.9		1			
90.0+					
Total	287	80	38	15	1
Mean	40.6	62.7	33.7	31.1	35.6
Min	28.0	49.7	25.7	26.1	35.6
Max	72.1	89.4	45.5	36.4	35.6

Table 43: Total length frequency distribution of fish species harvested by anglers in the South Arm of Rainy Lake, 2010.

Total Length (cm)	Walleye	N. Pike	SM Bass	Black Crappie	Sauger
18.0-19.9					
20.0-21.9					
22.0-23.9			1		
24.0-25.9					
26.0-27.9			2		1
28.0-29.9	3			1	
30.0-31.9					
32.0-33.9	5				
34.0-35.9	21		1	1	
36.0-37.9	27			1	
38.0-39.9	21				1
40.0-41.9	17		2		
42.0-43.9	6	1	1		
44.0-45.9	5				
46.0-47.9		1	2		
48.0-49.9	1				
50.0-51.9					
52.0-53.9		2			
54.0-55.9		1			
56.0-57.9		1			
58.0-59.9		2			
60.0-61.9		1			
62.0-63.9		2			
64.0-65.9		1			
66.0-67.9	1	2			
68.0-69.9					
70.0-71.9					
72.0-73.9					
74.0-75.9					
76.0-77.9					
78.0-79.9					
80.0-81.9					
82.0-83.9					
84.0-85.9					
86.0-87.9					
88.0-89.9					
90.0+					
Total	107	14	9	3	2
Mean	38.2	57.9	36.9	33.1	32.7
Min	29.0	42.0	23.5	28.5	26.2
Max	67.5	67.5	47.3	36.8	39.1

Table 44: Total length frequency distribution of fish species harvested by anglers in Redgut Bay of Rainy Lake, 2010.

Total Length (cm)	Walleye	N. Pike	SM Bass	Black Crappie	Sauger
18.0-19.9					
20.0-21.9					
22.0-23.9				2	
24.0-25.9				9	
26.0-27.9				24	
28.0-29.9			2	22	
30.0-31.9	1			16	
32.0-33.9	1		1	9	
34.0-35.9	34				2
36.0-37.9	35				
38.0-39.9	22				
40.0-41.9	7				
42.0-43.9	13				
44.0-45.9	4				
46.0-47.9					
48.0-49.9					
50.0-51.9					
52.0-53.9					
54.0-55.9		3			
56.0-57.9					
58.0-59.9	2	1			
60.0-61.9		1			
62.0-63.9		2			
64.0-65.9		1			
66.0-67.9		1			
68.0-69.9		2			
70.0-71.9					
72.0-73.9					
74.0-75.9		1			
76.0-77.9					
78.0-79.9		1			
80.0-81.9					
82.0-83.9					
84.0-85.9					
86.0-87.9					
88.0-89.9					
90.0+					
Total	119	13	3	82	2
Mean	38.1	64.2	30.1	28.6	35.3
Min	31.2	54.4	28.4	22.6	35.1
Max	59.5	79.4	32.2	33.6	35.4

Table 45: Total length frequency distribution of fish species harvested by anglers in Rainy Lake (Ontario), 2010/11.

Total Length (cm)	Walleye	N. Pike	SM Bass	Black Crappie	Sauger
18.0-19.9					
20.0-21.9					
22.0-23.9			1	2	
24.0-25.9			1	9	
26.0-27.9			5	27	1
28.0-29.9	4		5	19	
30.0-31.9	3		8	12	
32.0-33.9	7		7	5	
34.0-35.9	82		7	2	3
36.0-37.9	109		3	2	
38.0-39.9	107		5		1
40.0-41.9	83		3		
42.0-43.9	70	1	2		
44.0-45.9	26		1		
46.0-47.9	5	1	2		
48.0-49.9	3	1			
50.0-51.9	1	2			
52.0-53.9	2	5			
54.0-55.9	2	9			
56.0-57.9	2	8			
58.0-59.9	2	12			
60.0-61.9	2	10			
62.0-63.9		16			
64.0-65.9	1	14			
66.0-67.9	1	10			
68.0-69.9		12			
70.0-71.9		1			
72.0-73.9	1				
74.0-75.9		3			
76.0-77.9					
78.0-79.9		1			
80.0-81.9					
82.0-83.9					
84.0-85.9					
86.0-87.9					
88.0-89.9		1			
90.0+					
Total	513	107	50	100	5
Mean	39.5	62.2	34.1	29.1	34.3
Min	28.0	42.0	23.5	22.6	26.2
Max	72.1	89.4	47.3	36.8	39.1

Table 46: Length at age observations for walleye (sexes combined) in angler catch from the North Arm of Rainy Lake, 2011. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	11	3.8	350	9
4	39	13.6	368	3
5	215	74.9	404	2
6	9	3.1	449	12
7	2	0.7	498	62
8	1	0.3	567	0
9	3	1.0	512	27
10	4	1.4	587	30
11	2	0.7	573	39
12				
13				
14				
15				
16				
17				
18	1	0.3	721	0
19				
20				
Total	287	100	-	-

Table 47: Length at age observations for walleye (sexes combined) in angler catch from the South Arm of Rainy Lake, 2010. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	4	3.8	367	26
4	12	11.3	369	12
5	26	24.5	362	4
6	19	17.9	368	6
7	18	17.0	387	7
8	14	13.2	408	10
9	7	6.6	400	10
10	4	3.8	421	13
11	1	0.9	414	0
12				
13				
14				
15				
16	1	0.9	675	0
17				
18				
19				
20				
Total	106	100.0	-	-

Table 48: Length at age observations for walleye (sexes combined) in angler catch from Redgut Bay of Rainy Lake, 2010. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	1	0.8	354	0
4	7	5.8	355	6
5	23	19.8	372	4
6	28	23.1	362	4
7	25	20.7	392	11
8	15	12.4	388	8
9	8	7.4	394	9
10	5	4.1	412	14
11	4	3.3	394	16
12	2	1.7	407	24
13	1	0.8	590	0
14				
15				
16				
17				
18				
19				
20				
Total	119	100.0	-	-

Table 49: Length at age observations for walleye (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	16	3.1	355	8
4	58	11.3	367	3
5	264	51.6	398	2
6	56	10.9	379	5
7	45	8.8	395	8
8	30	5.9	403	8
9	18	3.5	413	12
10	13	2.5	469	25
11	7	1.4	448	35
12	2	0.4	407	23
13	1	0.2	590	0
14				
15				
16	1	0.2	675	0
17				
18	1	0.2	721	0
19				
20				
Total	512	100.0	-	-

Table 50: Length at age observations for northern pike (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	14	13.1	544	15
4	15	14.0	608	11
5	34	31.8	608	7
6	21	19.6	648	12
7	16	15.0	654	10
8	5	4.7	700	28
9	1	0.9	749	0
10	1	0.9	894	0
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Total	107	100.0	-	-

Table 51: Length at age observations for smallmouth bass (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	1	2.0	308	0
4	8	16.0	283	13
5	19	38.0	315	6
6	9	18	357	11
7	2	4.0	352	30
8	5	10.0	405	19
9	3	6.0	397	9
10	1	2.0	426	0
11	1	2.0	455	0
12	1	2.0	473	0
13				
14				
15				
16				
17				
18				
19				
20				
Total	50	100.0	-	-

Table 52: Length at age observations for black crappie (sexes combined) in angler catch from Rainy Lake (Ontario), 2010/11. Standard errors for each mean total length are provided.

AGE (years)	No. of Fish (n)	Percent (%)	Mean Total Length (mm)	SE
0				
1				
2				
3	1	1.0	226	0
4	16	16.0	263	4
5	29	29.0	274	2
6	14	14.0	297	6
7	22	22.0	309	3
8	12	12.0	310	6
9	1	1.0	318	0
10	2	2.0	330	6
11	2	2.0	351	18
12	1	1.0	364	0
13				
14				
15				
16				
17				
18				
19				
20				
Total	100	100.0	-	-

APPENDICES

Appendix 1: Scheduled sampling intensity with spatial and temporal stratification (sector, day-type, time period and season) for the 2010 creel survey.

SPRING: May 15 to June 30

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
4	2	2	2	2	8	12
5	2	2	2	2	8	12
6	2	2	1	1	6	12
SUBTOTAL	6	6	5	5	22	36
7	4	3	2	2	11	12
TOTAL	10	9	7	7	33	*
TARGET	12	12	12	12	*	48

Summer: July to August 15

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
4	2	2	2	1	7	12
5	3	2	2	1	8	12
6	2	1	1	2	6	12
SUBTOTAL	7	5	5	4	21	36
7	4	4	3	1	12	12
TOTAL	11	9	8	5	33	*
TARGET	12	12	12	12	*	48

Fall: August 16 to September 30

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
4	3	2	1	1	7	12
5	3	3	1	1	8	12
6	4	2	2	0	8	12
SUBTOTAL	13	7	4	2	23	36
7	4	5	2	2	13	12
TOTAL	17	12	6	4	36	*
TARGET	12	12	12	12	*	48

Appendix 2: Scheduled sampling intensity with spatial and temporal stratification (sector, day-type, time period and season) for the 2011 creel survey.

SPRING: May 21 to June 30

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
1	2	3	2	2	9	12
2	4	3	1	2	10	12
3	3	4	2	2	11	12
TOTAL	9	10	5	6	30	*
TARGET	9	9	9	9	*	36

Summer: July 1 to August 15

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
1	3	3	2	2	10	12
2	5	2	3	1	11	12
3	4	3	3	2	12	12
TOTAL	12	8	8	5	33	*
TARGET	9	9	9	9	*	36

Fall: August 16 to September 30

SECTOR	AM WD	PM WD	AM NWD	PM NWD	TOTAL	TARGET
1	4	3	1	2	10	12
2	3	4	3	2	12	12
3	4	3	2	2	11	12
TOTAL	11	10	6	6	33	*
TARGET	9	9	9	9	*	36

Appendix 3: Visitor type codes for anglers, option 1 codes for released walleye, and option 2 codes for released smallmouth bass on creel interview forms.

Visitor Type Code:

- | | |
|-------------------------------|------------------------|
| 1. Ontario Commercial Camp | 5. Minnesota Cottager |
| 2. Minnesota Commercial Camp | 6. Ontario Houseboat |
| 3. Crown land Camper- Ontario | 7. Minnesota Houseboat |
| 4. Ontario Cottager | 8. Day-Tripper |

Option 1 Code:

What was the main reason your fishing party released walleye today?

(Note # of fish in each code if possible)

1. Under slot < 35cm
2. Over slot > 45cm, < 70 cm
3. Trophy > 70cm
4. Daily catch limit
5. Catch and release fishing only
6. Other (disease, etc.)

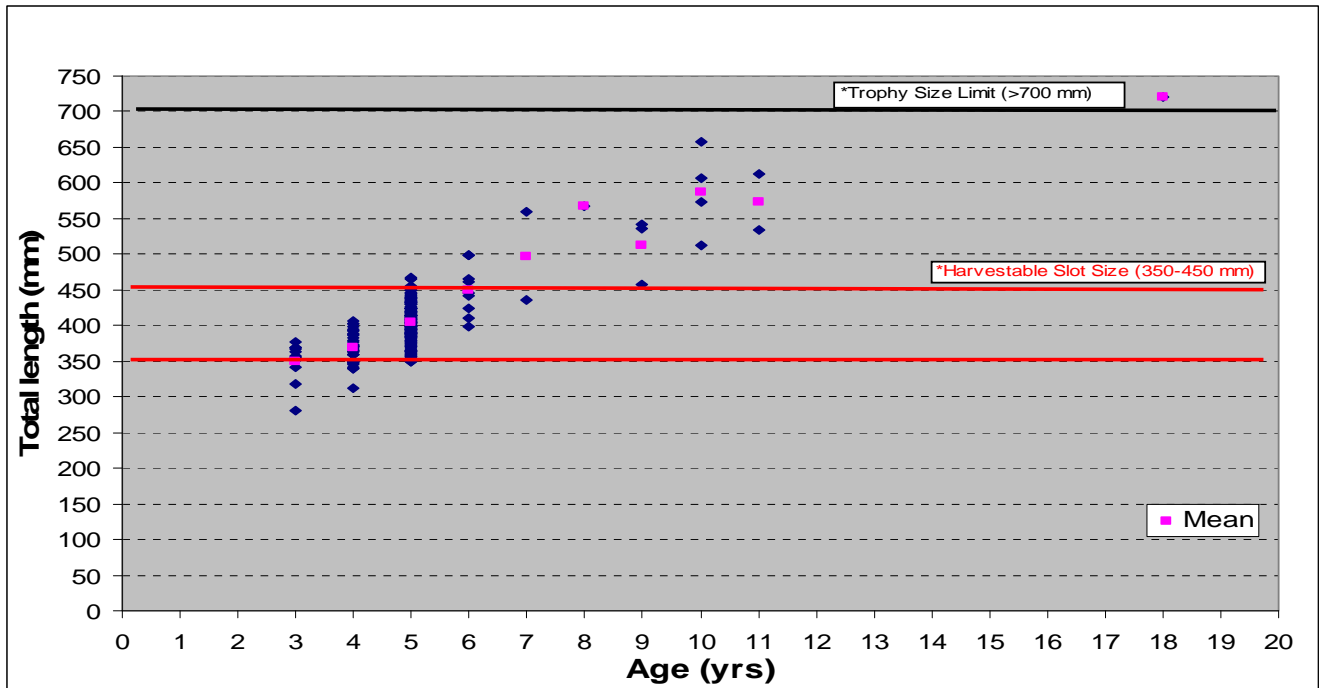
Option 2 Code:

What was the main reason your fishing party released smallmouth bass today?

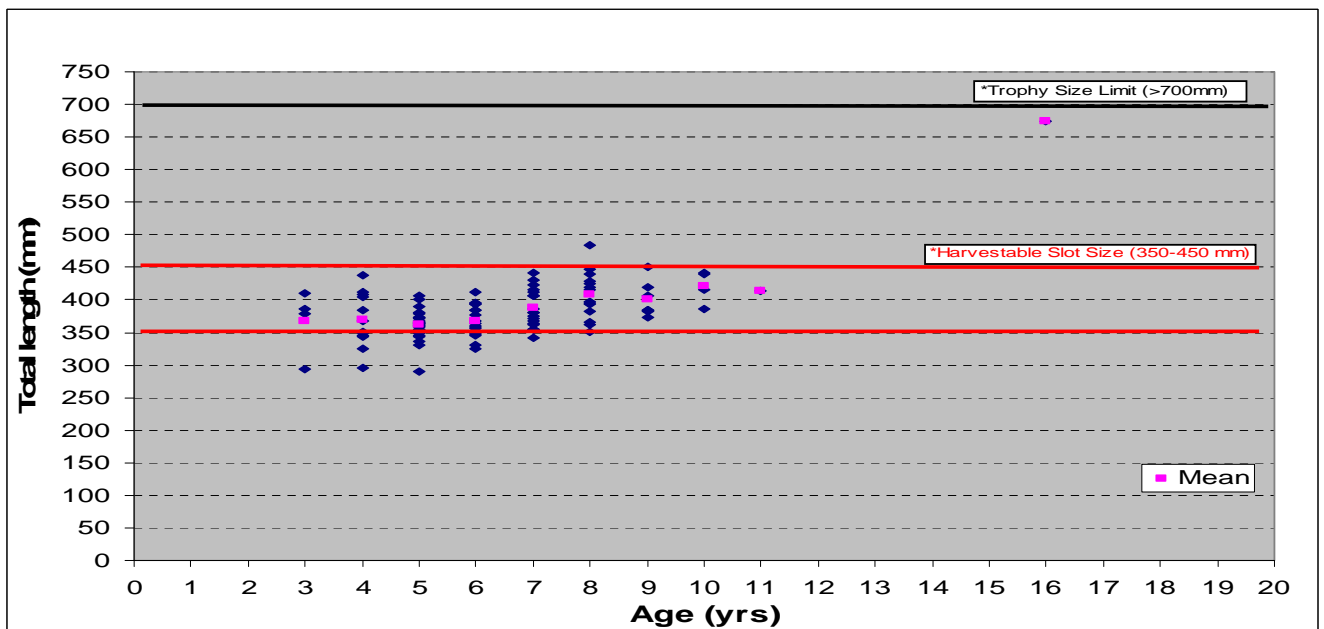
(Note # of fish in each category if possible)

1. Too small
2. Too big
3. Daily catch limit
4. Catch and release fishing only
5. Other (disease, etc.)

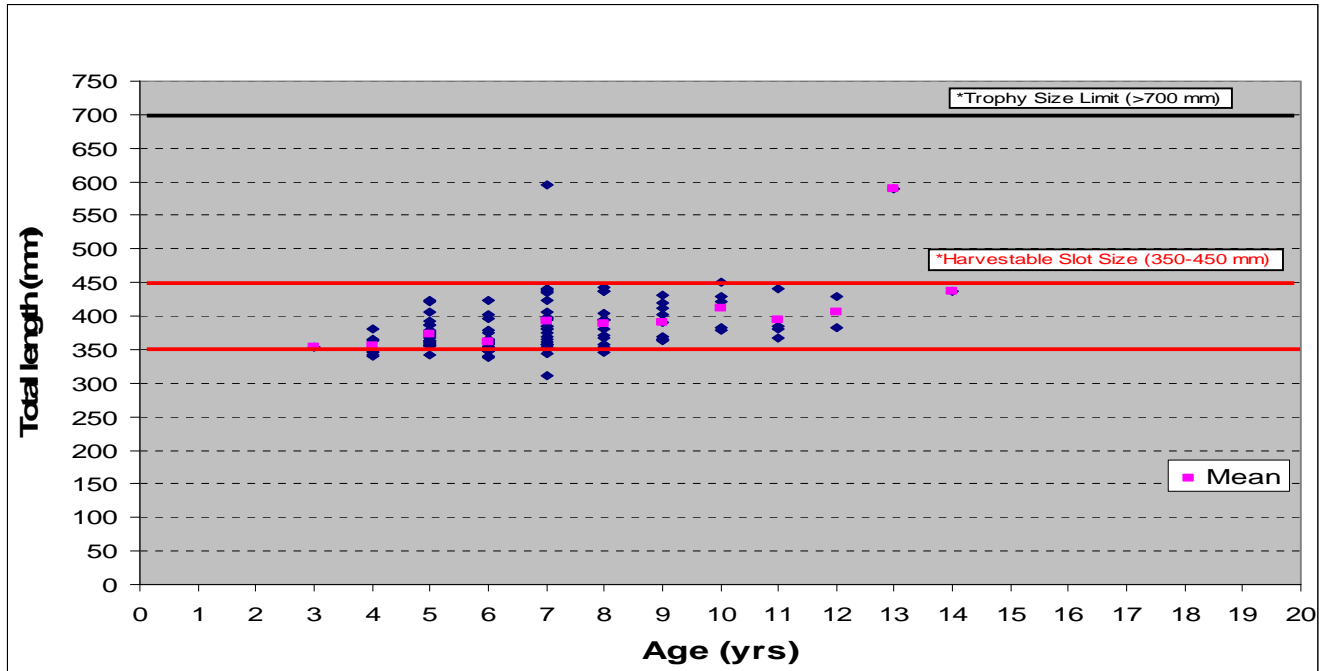
Appendix 4: Length at age for walleye harvested by anglers on North Arm of Rainy Lake, Ontario in 2011.



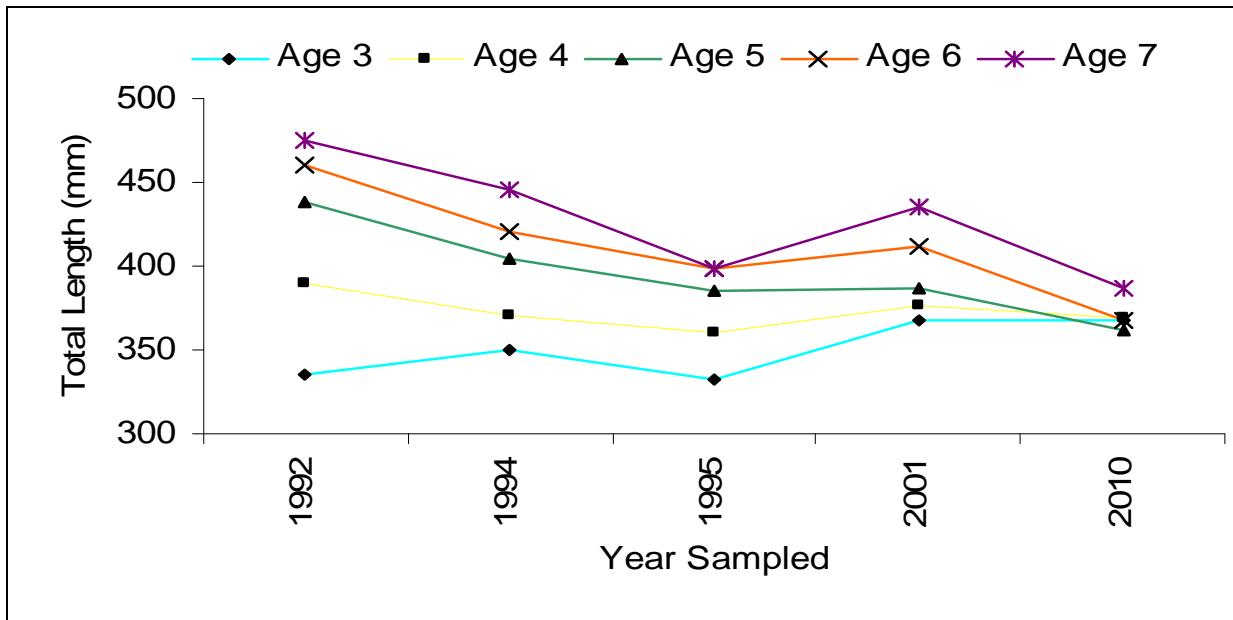
Appendix 5: Length at age for walleye harvested by anglers on South Arm of Rainy Lake, Ontario in 2010.



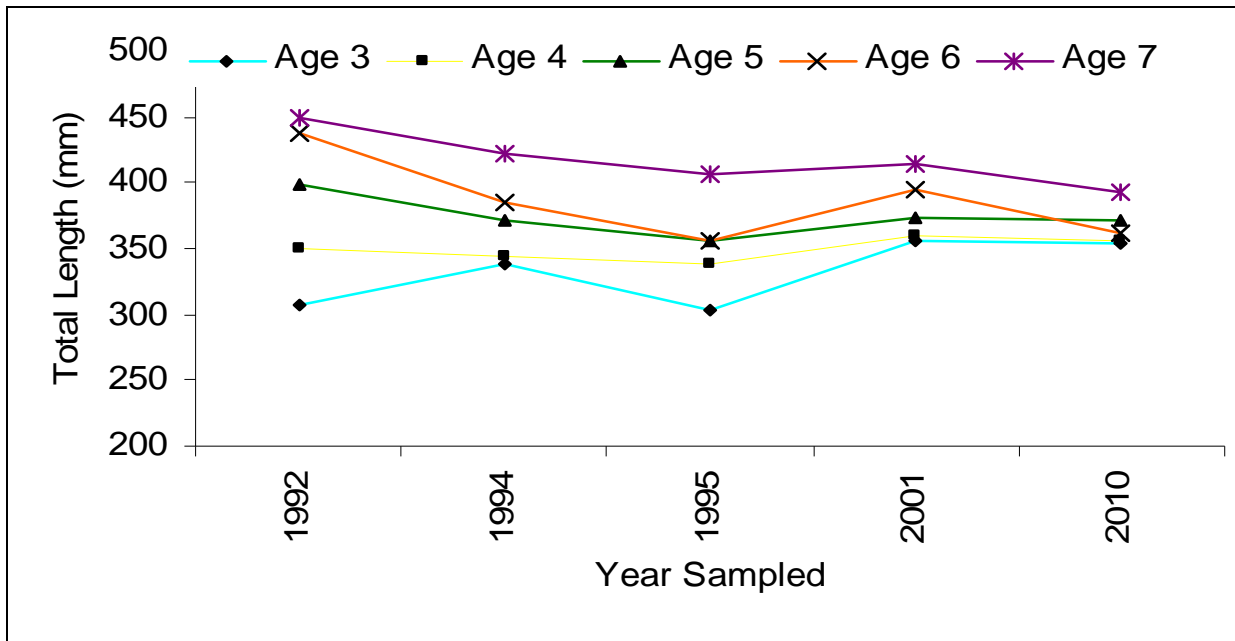
Appendix 6: Length at age for walleye harvested by anglers on Redgut Bay of Rainy Lake, Ontario in 2010.



Appendix 7: Total length of walleye (age 3 to 7 years) vulnerable to angler harvest on South Arm of Rainy Lake, Ontario.



Appendix 8: Mean total length of walleye (age 3 to 7 years) vulnerable to angler harvest on Redgut Bay of Rainy Lake, Ontario.



Appendix 9: Total length of walleye (age 3 to 7 years) vulnerable to angler harvest on Rainy Lake, Ontario.

