Fall Walleye Index Netting on Namakan and Sand Point Lakes, Ontario 2000

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SUMMARY

Fall Walleye Index Netting (FWIN) was conducted in 2000 on Namakan and Sand Point Lakes, approximately 70-km southeast of Fort Frances, Ontario. Both lakes are situated on the international border between Minnesota and Ontario. A diversity of fish species were captured in gill nets on both lakes, and detailed biological data relating to walleye were obtained. In general, walleye in both lakes exhibit slow growth rates and reach a low ultimate size. Comparisons of walleye population structure (e.g. mean age of catch, number of age classes, Shannon Diversity Index, and maximum age) to regional benchmarks indicated a stressed fishery, particularly in Namakan Lake. Few year classes were present, and adult mortality rates were high, particularly among females. As a result, large and older fish, especially females, were almost completely absent from the Namakan Lake fishery. Management strategies should be considered to allow the survival of fish into larger size and age classes to improve the health of the fishery and fishing quality.

TABLE OF CONTENTS

Summary…………………………………………………………………………….…1

List of Figures………………………………………………………………….…3
List of Tables………………………………………………………….……….4

Introduction…………………………………………………………….………5

Methods………………………………………………………………….……9

Results……………………………………………………………….…..11
Walleye……………………………………………………………….…13
Other Fish Species……………………………………………….…25

Discussion…………………………………………………………………….28

Conclusions…………………...…………………………………………………33

Acknowledgements…………….……………………………………………..34

References………………………..…………………………………………….35

Appendix…………………………..…………………………………………...38

LIST OF FIGURES

Figure 1. Location of the Namakan Reservoir; including Namakan, Sand Point, and Little Vermilion Lakes in Ontario.

Figure 2. Walleye length composition for Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Figure 3. Walleye age composition for Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Figure 4. Walleye growth (total length at age) for males, females, and combined sexes in Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Figure 5. Walleye growth (weight at age) for males, females, and combined sexes in Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Figure 6. Walleye sex ratio for Namakan and Sand Point Lakes based on data collected in Fall Walleye Index Netting (FWIN), 2000.

Figure 7. Walleye age at maturity for Namakan (a) and Sand Point (b) Lakes based on data collected in Fall Walleye Index Netting (FWIN), 2000.

Figure 8. Walleye length at maturity for Namakan (a) and Sand Point (b) Lakes based on data collected in Fall Walleye Index Netting (FWIN), 2000.

Figure 9. Comparison of walleye abundance on Namakan and Sand Point Lakes with other Fort Frances District lakes using FWIN standards, 1994-2002.

Figure 10. Comparison of walleye abundance (geometric mean catch of walleye >=450mm TL) in Namakan and Sand Point Lakes with other Ontario lakes using FWIN standards, 1994-2002.

Figure 11. Age composition of northern pike from Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Figure 12. Age composition of smallmouth bass from Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

LIST OF TABLES

Table 1. Physical and chemical characteristics of Namakan and Sand Point Lakes.

Table 2. Summary of catch data from Fall Walleye Index Netting (FWIN) in Namakan (n= 25 net sets) and Sand Point (n=20 net sets) Lakes, 2000.

Table 3. Relative Stock Density (RSD) values for Namakan and Sand Point Lakes based on Fall Walleye Index Netting (2000).

Table 4. Walleye diagnostics for Namakan and Sand Point Lakes relative to regional benchmarks based on FWIN standards.

INTRODUCTION

Namakan and Sand Point Lakes are located approximately 70 km south - east of Fort Frances, Ontario, and form part of the Namakan Reservoir which also includes Kabetogama, Crane, and Little Vermillion Lakes (Figure 1). Water levels in the two lakes are regulated by the International Rainy Lake Board of Control (IRLBC) through the International Joint Commission (IJC) from two dams at Kettle and Squirrel Falls, and are regulated based on the "rule curve". The first order of regulation for Rainy Lake and the Namakan Reservoir was established in 1949, and supplementary orders were issued in 1957 and 1970. Dissatisfaction with the 1970 order led to changes in the rule curve which were put in place in January 2000. The new curve, involved a decrease in the winter draw down by approximately 1 m (3 ft) along with earlier spring refill and a gradual summer draw down. The new curve was intended to improve fish stocks that spawn in both fall (e.g. lake whitefish, *Coregonus clupeaformis*) and spring (e.g. walleye, *Sander vitreus;* northern pike, *Esox lucius)*. The changes to the rule curve will involve a monitoring strategy to evaluate long term impacts, in which the Fall Walleye Index Netting (FWIN) program was included (IRLBC, 1999; USGS, 2000).

Both Namakan and Sand Point Lakes are located on the International border, with 51% (5,150 ha) of the 10,100 ha surface area of Namakan Lake in Ontario, and 42% (1,500 ha) of the 3,600 ha surface area of Sand Point Lake in Ontario (MDNR and OMNR, 1998). Both lakes are located in the southern range of the boreal forest in North America, and are typical of Canadian Shield lakes with soft water and little submerged aquatic vegetation. Characteristics of the two lakes, have been summarized in Table 1. A diverse coolwater fish community is present in both lakes, including 43 known species (Appendix 1). The Ontario waters of both lakes have been previously assessed (Van den Broeck, 1995), however provincial FWIN standards were not utilized.

Development on the Ontario shoreline of Namakan Lake consists of one tourist establishment, a single recreational cottage site and a number of cottages on 37 patent properties. Development on the Ontario portion of Sand Point Lake includes a Canada Customs/Immigration point of entry, a tourist lodge, a store, a boy scout camp and approximately 38 cottages. Voyageurs National Park borders both lakes on the Minnesota side, and thus development is limited to 20 cabins, 35 campsites and an old logging camp for Namakan Lake and three privately developed tracts, 21 use and occupancy tracts and 7 campsites on Sand Point Lake (MDNR and OMNR, 1998).

Table 1: Physical and chemical characteristics of Namakan and Sand Point Lakes

Parameter	Namakan Lake	Sand Point Lake
Surface Area - Ontario (ha)	5150	1500
Littoral Zone (%)	20	32
Mean Depth (m)	13.6	12.0
Maximum Depth (m)	45.7	56.1
Mean Summer Secchi Depth (m)	2.6	2.2
Greatest Length (km)	31	13
Perimeter Shoreline (km)	235	148
Island Shoreline (km)	75	36
T.D.S. (mg/L)	44	37
M.E.I.	2.8	3.2
Alkalinity (mg/l)	14	17

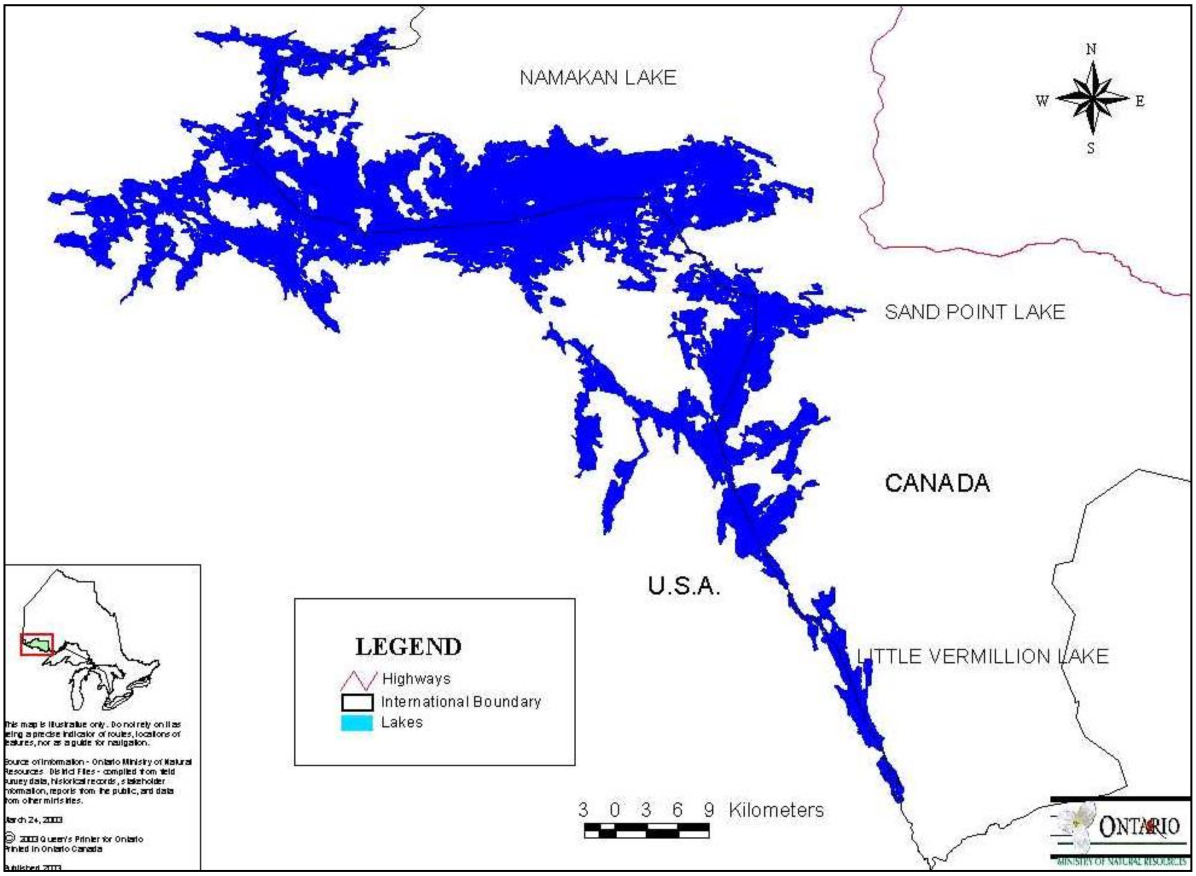

Figure 1: Location of the Namakan Reservoir; including Namakan, Sand Point, and Little Vermilion Lakes in Ontario

Commercial fishing on Namakan Lake began in 1916-17, however the commercial walleye and northern pike fishery was eliminated in Minnesota waters in 1946. Currently, a single lake whitefish operator exists on the Minnesota side. On Sand Point Lake, the first non-native commercial fishery for black crappie (*Pomoxis nigromaculatus*) and coarse fish was initiated in 1971 and restricted to Ontario waters. Quotas existed for lake whitefish, lake sturgeon (*Acipenser fulvescens)*, black crappie, walleye and northern pike. However, since 1940 the commercial harvest on Sand Point Lake has only approached quota levels for lake sturgeon. Ontario commercial fisheries were eliminated on both lakes in 2001.

Creel surveys on both lakes indicated that the vast majority of fishing pressure was from non-resident (U.S.) anglers, with 99.5% and 99% of anglers surveyed residing in the U.S. for Namakan and Sand Point lakes respectively (Elder, 2001). Nearly two-thirds (65%) of anglers on Namakan Lake were based out of Minnesota in 1998, with the remainder camping on Crown Land in Ontario (3%), guests at Ontario resorts (21%), or owners of cottages in Ontario (11%). On Sand Point Lake, 57% of anglers were based in Minnesota, with the remainder camping on Crown Land in Ontario (5%), guests at Ontario resorts (19%), or owners of cottages in Ontario (19%) (Elder, 2001). Creel surveys on Minnesota waters conducted in 1999 were designed to monitor a regulation change in which harvest was limited to fish between 286 mm and 374 mm (13-17"), with only one fish exceeding 506 mm (23"). Overall, angler effort throughout most of the reservoir remained consistent between 1985-1999 (Burri, 2000).

The preferred species of anglers on both lakes was walleye, with 85% of anglers surveyed on Namakan Lake and 82% on Sand Point Lake seeking walleye over other species. On both lakes, smallmouth bass (*Microterus dolomieui*) were the second most commonly sought species, representing 38% of anglers surveyed on both lakes. On Namakan Lake, anglers targeting northern pike was decisively lower (9%), than on Sand Point Lake (29%). Overall, angling pressure on Ontario waters of Namakan Lake was 3.6 hours/ha and 9.2 hours/ha on Sand Point Lake in 1998 (Elder, 2001). The lack of resident anglers has been attributed to the low quality of the fishery relative to a number of more accessible waterbodies in the District.

Exploited walleye populations often exhibit characteristics associated with the over harvest in many fisheries. These include reductions in numbers, changes in population structure, and physiological (life history) changes (OMNR, 1983). Exploited walleye populations often exhibit inconsistent recruitment and a population structure dominated by younger fish (Morgan et al., 2003). Life history adaptations observed in exploited walleye populations which are viewed as compensatory mechanisms include increased juvenile (prematuration) growth rates, earlier age at maturity and high investment in reproduction (Lester et al., 2000).

Angling surveys in 1993 (Jackson, 1994) and 1998 (Elder, 2001) on both Sand Point and Namakan Lakes raised concern regarding the quality of the walleye fisheries, as mean age of the catch for both lakes fell below the recommendations of Colby and Nepszy's "crisis curve" (OMNR, 1983). In order to obtain more detailed biological and to determine potential management strategies, Fall Walleye Index Netting was performed on both lakes in 2000. The FWIN program will also provide data for the evaluation and monitoring of water level changes initiated by the IRLBC (IRLBC, 1999; USGS, 2000) and contribute to long-term monitoring efforts of the Ontario-Minnesota Fisheries Committee (MDNR and OMNR, 1998).

METHODS

Standard FWIN gillnetting was conducted on the lakes between September 6 and September 18, 2000 following the Manual of Instructions: Fall Walleye Index Netting Surveys (Morgan, 1998). Gear consisted of standard OMNR FWIN gillnets constructed of clear monofilament, and made up of eight 7.6m panels with stretched mesh sizes of 25mm, 38mm, 51mm, 64mm, 76mm, 102mm, 127mm, and 152mm (made by *Les Industries Fipec Inc.*, Quebec, catalog #FEX-03). Nets were set as close to perpendicular (90^o) from shore as each net site would allow.

Net sites were selected using stratified random sampling, with 2 depth strata (shallow =2-5 m, deep=5-15m). Sampling intensity in each strata was determined by the relative amount of shallow versus deep areas of the lake. As a result, 60% (15/25) of nets on Namakan Lake were in the deep strata, and 65% (13/20) were in the deep strata on Sand Point. Water temperatures during the sampling period were higher than desired, and ranged from 14 to 19 ^{o}C.

Walleye and northern pike were sexed and sampled for maturity by comparing gonad development (Duffy et al., 1999), and aging structures taken (4th dorsal spine for walleye and cleithra for pike). Aging structures were also collected from smallmouth bass (4th dorsal spine) and lake sturgeon (large pectoral fin ray). Aging structures were assessed at the OMNR Northwest Regional Aging Facility in Dryden, Ontario. All other fish species were measured for fork and total length and weighed, but no aging structures were taken. Data were compiled and analyzed using FISHNET2 (Lester and Korver, 1996) as part of the Ontario Fisheries Information System (OFIS).

Comparisons were made between the two lakes as well as to regional means for life history (Lester et al., 2000) and population structure (Morgan et al., 2003) in order to determine the overall health of the Namakan and Sand Point Lake walleye fisheries.

RESULTS

A total of 13 species were captured in 25 gill net sets on Namakan Lake. Walleye were the most abundant species, with an arithmetic mean of 7.60 fish/net (SE=1.37 fish/net) representing 33.6% of the total catch. Yellow perch (*Perca flavescens*), were captured an average of 3.20 fish/net (SE=1.29 fish/net) and represented 14.2% of the total catch. Rock bass (*Ambloplites rupestris*) represented the third most abundant species, with a mean of 3.00 fish/net (SE=0.67), comprising 13.3% of the total catch. A summary of catch data for all species can be found in Table 2. The FWIN efforts on Namakan Lake produced a more diverse community (Simpson's D=5.79) than Sand Point Lake (Simpson's D=4.92).

Fourteen species were captured in 20 gill net sets on Sand Point Lake. Again, walleye represented the most abundant species, with 209 walleyes captured (arithmetic mean of 10.45 fish/net, SE=1.70 fish/net). Yellow perch comprised 12.6% (67 fish) of the total catch (mean 3.35 fish/net, SE=1.01 fish/net). An average on 2.95 fish/net (SE=0.57 fish/net) placed white sucker (*Catostomus commersoni*) as the third most common species in Sand Point gill nets. Catch data for Sand Point Lake has also been summarized in Table 2.

Table 2: Summary of catch data from Fall Walleye Index Netting (FWIN) in Namakan (n= 25 nets) and Sand Point (n=20 nets) Lakes, 2000.

NAMAKAN LAKE						
Species	**# Nets Captured In**	**Total # Caught**	**Mean**	**Standard Error (SE)**	**% RSE**	**% of Total Catch**
Lake Sturgeon	5	8	0.32	0.14	43.2	1.4
Lake Whitefish	0	0	0.00	0.00	0.0	0.0
Lake Herring	6	1	0.44	0.17	39.5	0.2
Northern Pike	14	31	1.24	0.42	33.7	5.5
Mooneye	3	6	0.24	0.14	60.3	1.1
White Sucker	14	32	1.28	0.34	26.5	5.7
Silver Redhorse	9	30	1.20	0.50	41.9	5.3
Brown Bullhead	1	22	0.88	0.88	100.0	3.9
Rock Bass	19	75	3.00	0.62	20.6	13.3
Pumpkinseed	0	0	0.00	0.00	0.0	0.0
Smallmouth Bass	16	37	1.48	0.34	22.8	6.5
Black Crappie	5	7	0.28	0.14	48.4	1.2
Yellow Perch	13	80	3.20	1.29	40.3	14.2
Sauger	17	46	1.84	0.43	23.2	8.1
Walleye	23	190	7.60	1.37	18.1	33.6
SAND POINT LAKE						
Species	**# Nets Captured In**	**Total # Caught**	**Mean**	**Standard Error (SE)**	**% RSE**	**% of Total Catch**
Lake Sturgeon	3	4	0.20	0.12	58.5	0.8
Lake Whitefish	2	2	0.10	0.07	68.8	0.4
Lake Herring	8	27	1.35	0.60	44.1	5.1
Northern Pike	16	38	1.90	0.32	17.0	7.1
Mooneye	0	0	0.00	0.00	0.0	0.0
White Sucker	16	59	2.95	0.57	19.4	11.1
Silver Redhorse	5	6	0.30	0.13	42.6	1.1
Brown Bullhead	3	6	0.30	0.18	59.7	1.1
Rock Bass	14	33	1.65	0.42	25.4	6.2
Pumpkinseed	1	1	0.05	0.05	100.0	0.2
Smallmouth Bass	12	15	0.75	0.18	23.4	2.8
Black Crappie	10	21	1.05	0.33	31.3	3.9
Yellow Perch	13	67	3.35	1.01	30.3	12.6
Sauger	14	45	2.25	0.55	24.5	8.4
Walleye	19	209	10.45	1.70	16.4	39.2

Walleye

The length distribution of walleye captured in Namakan and Sand Point Lakes is illustrated in Figure 2. Relative to Sand Point Lake, Namakan Lake was dominated by smaller walleye. Mean total length for Namakan Lake walleye was 318 mm, with fish generally in the range of 220-420 mm total length, with almost no fish greater than 500 mm (19.5”). Sand Point Lake walleye were slightly larger, with a mean length of 365 mm, with fish in the total length of 360-550 mm generally well represented.

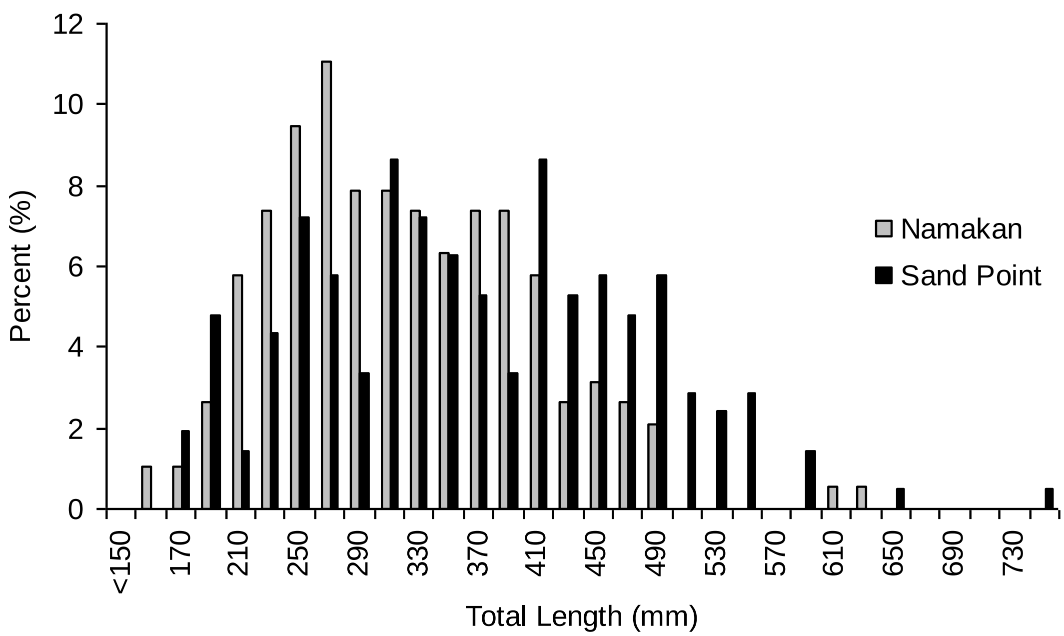

Figure 2: Walleye length composition for Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Namakan and Sand Point Lakes showed very similar patterns in terms of age distribution, as illustrated in Figure 3. Both lakes were dominated by age 2 and age 4 fish (1998 and 1996 year classes respectively), representing 68.9% and 62.0% of the total catch on Namakan Lake and Sand Point Lake respectively. The 1997 (age 3), 1992 and 1993 year classes were generally weak on both lakes, and no young-of-year were collected, suggesting a weak 2000 year class. On average, Namakan Lake walleye were younger (mean = 3.44 yrs) than Sand Point Lake (mean = 4.18 yrs). Namakan Lake had fewer age classes (10) than Sand Point Lake (16), as well as a lower maximum age (11 and 23 years for Namakan and Sand Point respectively). Only seven year classes in Namakan Lake and ten in Sand Point Lake were represented by more than one fish. Mortality rates among both adult (5+ years) were higher for Namakan Lake walleye (41% for males and 53% for females), than Sand Point Lake (25% for males and 37% for females).

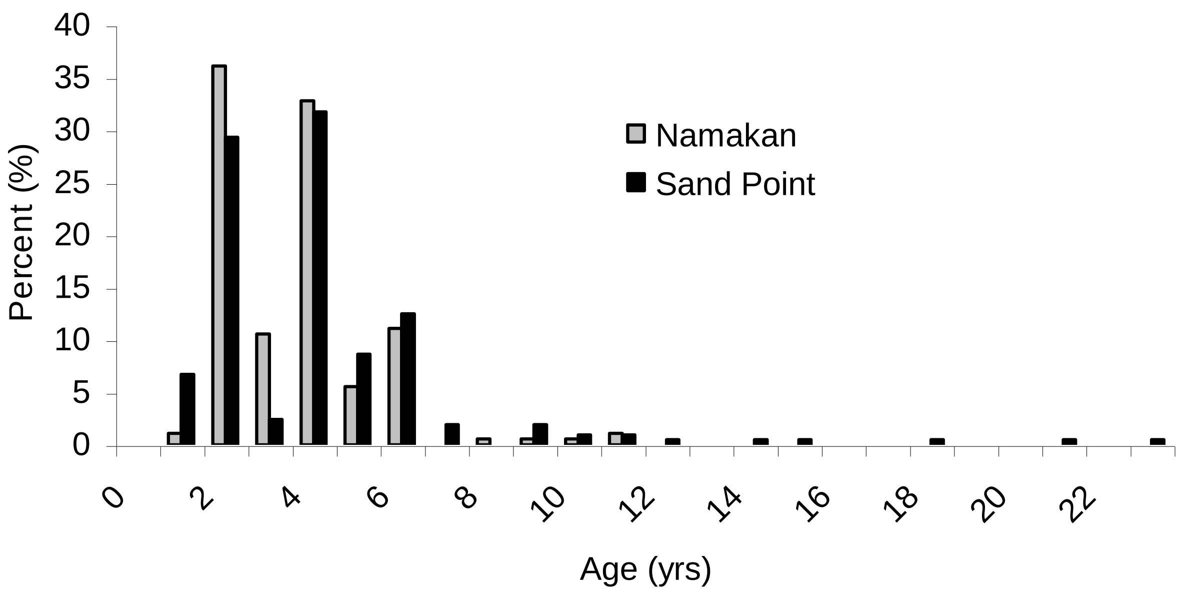

Figure 3: Walleye age composition for Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000.

Both Namakan and Sand Point Lake walleye exhibited typical walleye growth patterns, with males and females growing at a very similar rate during the first 6 years, with male growth leveling off and females continuing to grow larger in terms of both length (Figure 4) and weight (Figure 5).

The sex ratio of walleye (Figure 6) captured in FWIN sampling varied between the two lakes. Up to age seven, males were more abundant in Namakan Lake than females. Only one fish was collected from each age class older than seven, and making interpretation beyond this point difficult. Males were more abundant in Sand Point Lake up to about age 5, after which the sex ratio became biased towards females to a greater extent than Namakan Lake between ages six and ten. Beyond age 11, too few fish were collected from each age class to interpret any trends. Shannon Diversity Index for age 5+ females was slightly lower on Namakan (0.55) than Sand Point Lake (0.59), although both lakes were below the level of healthy Ontario populations (0.70).

Walleye in Namakan Lake are maturing at an age (Figure 7) and size (Figure 8) that is consistent regional benchmarks. Age at 50% maturity was 4.32 years for males on Sand Point Lake, and 4.75 years for females. Fifty percent of Namakan Lake males are mature at 4.42 years, while female 50% maturity is delayed until 5.81 years. Low sample size and inconsistent maturity estimates of age 5 and 6 females likely skew the calculated age at maturity on Namakan Lake. The total length at 50% maturity was 369 mm for males and 452 mm for females on Namakan Lake compared to 394 mm for males, and 461 mm for females on Sand Point Lake.

Fishing Quality Index (FQI) values based on Relative Stock Density (RSD) (Gabelhouse, 1984) were substantially lower on Namakan Lake (33) than on Sand Point Lake (63), reflecting the differences in age and size distribution. RSD values for each category have been summarized in Table 3. In both cases, the FQI values are indicative of quantity fisheries (FQI range 25-100), in which management for numbers of fish rather than trophy size is most appropriate (OMNR, 1990).

Table 3: Relative Stock Density (RSD) values for walleye in Namakan and Sand Point Lakes based on Fall Walleye Index Netting (2000).

Category (Total Length)	Namakan Lake RSD	Sand Point Lake RSD
Quality (380-510 mm)	0.320	0.520
Preferred (510-630 mm)	0.014	0.102
Memorable (630-760 mm)	0.000	0.011
Trophy (> = 760 mm)	0.000	0.000

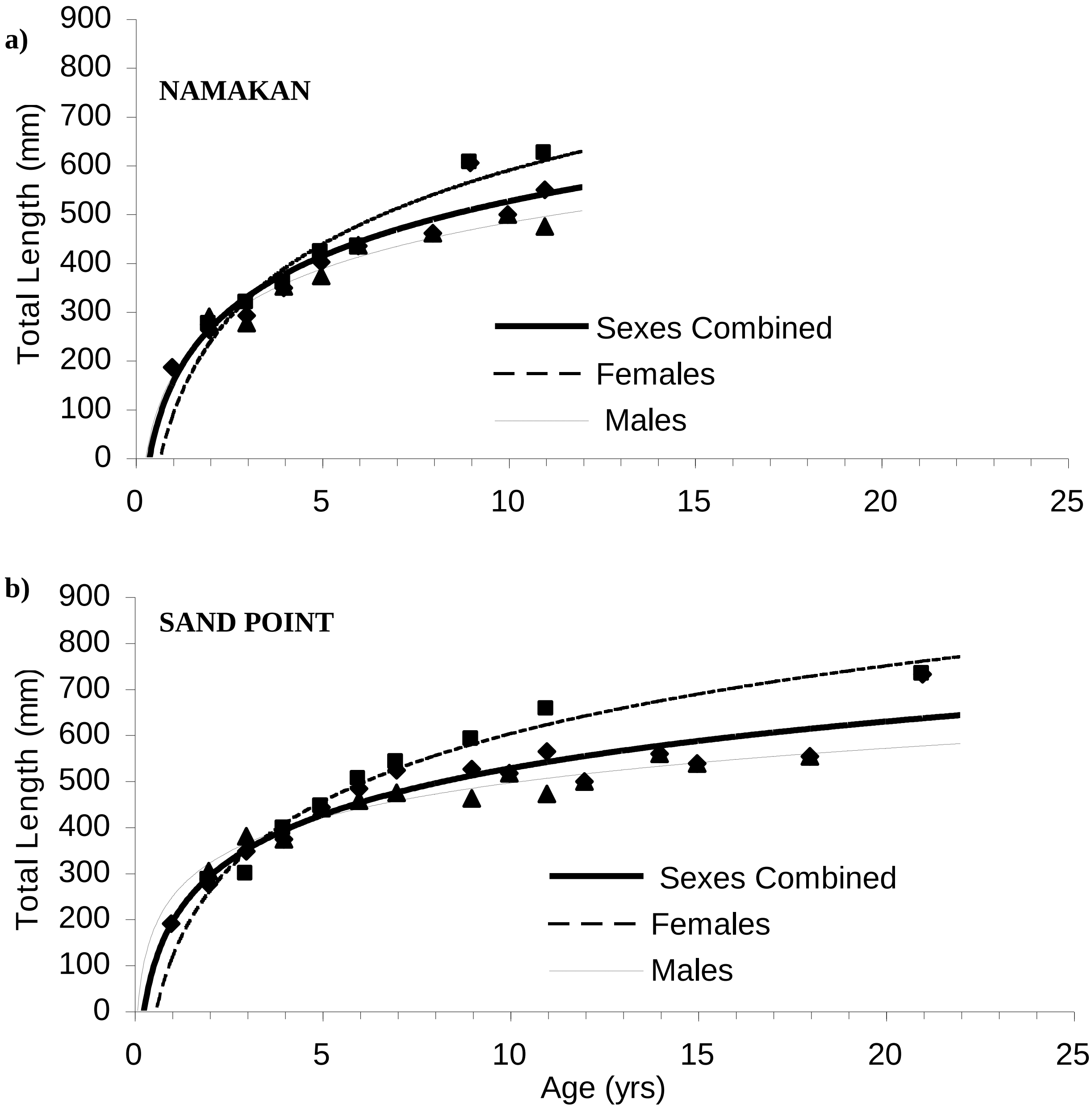

Figure 4: Walleye growth (total length at age) for males, females, and combined sexes in Namakan (a) and Sand Point (b) Lakes based on Fall Walleye Index Netting (FWIN), 2000.

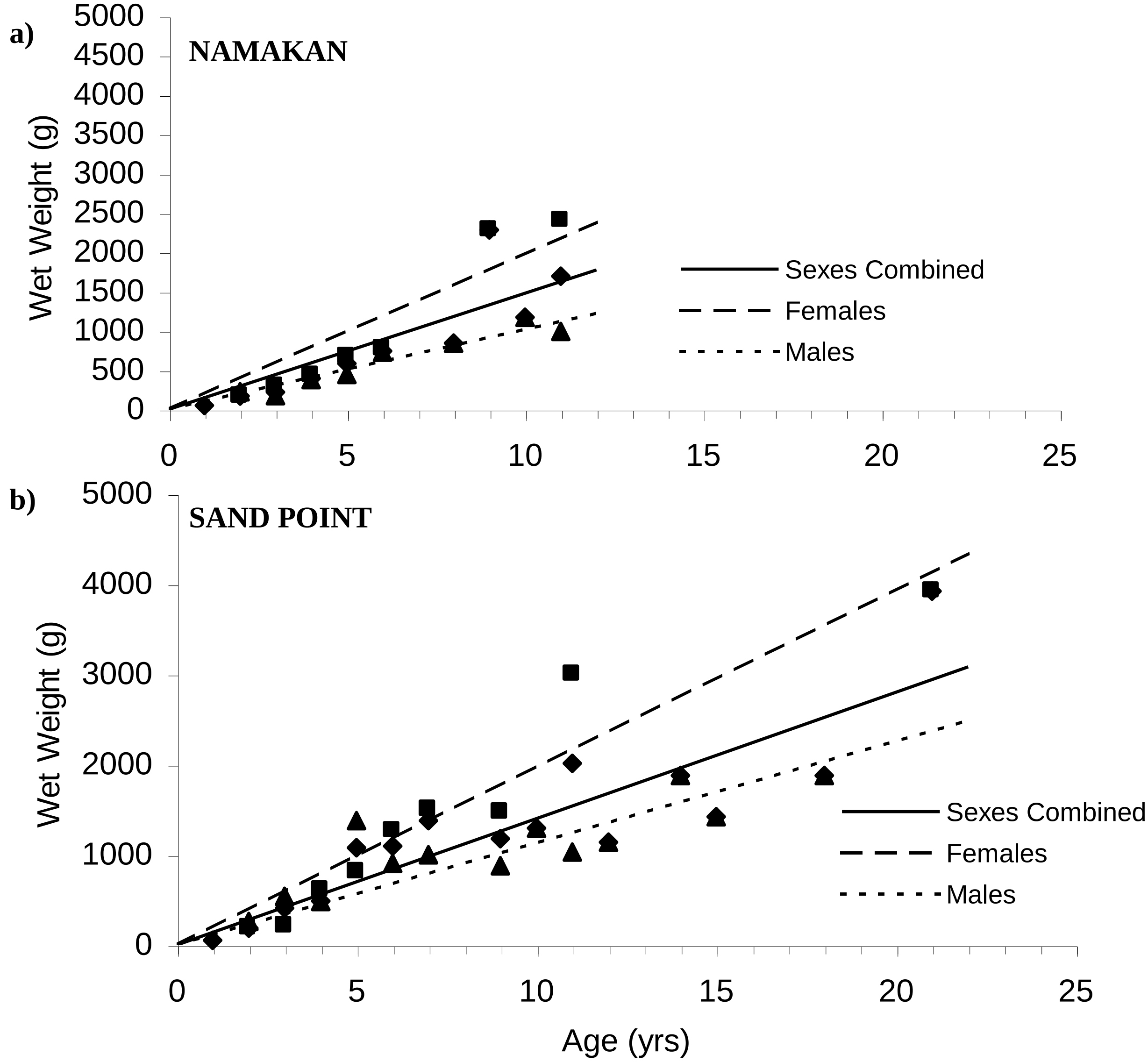

Figure 5: Walleye growth (weight at age) for males, females, and combined sexes in Namakan (a) and Sand Point (b) Lakes based on Fall Walleye Index Netting (FWIN), 2000.

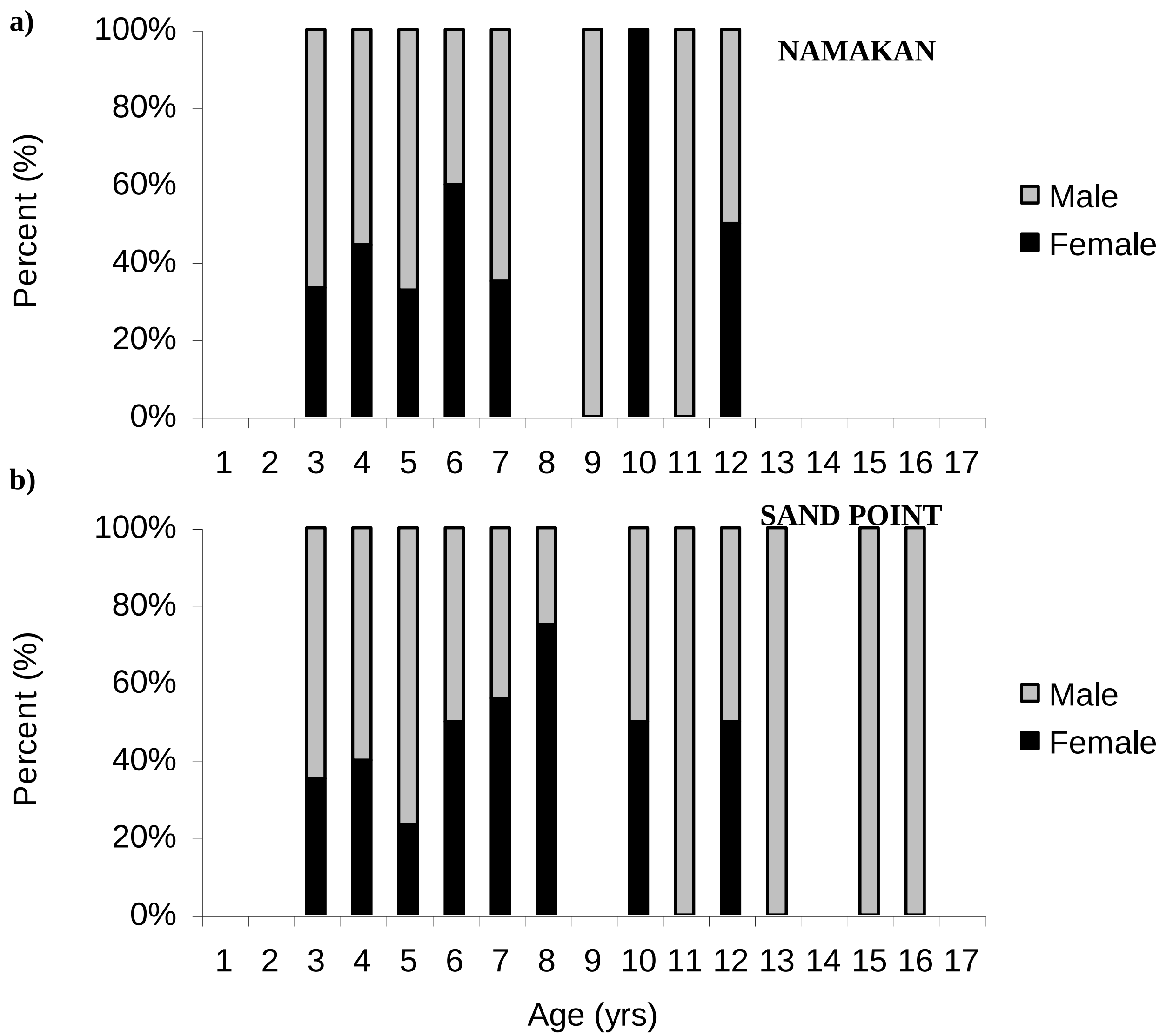

Figure 6: Walleye sex ratio for Namakan (a) and Sand Point (b) Lakes based on Fall Walleye Index Netting (FWIN), 2000.

a)

b)

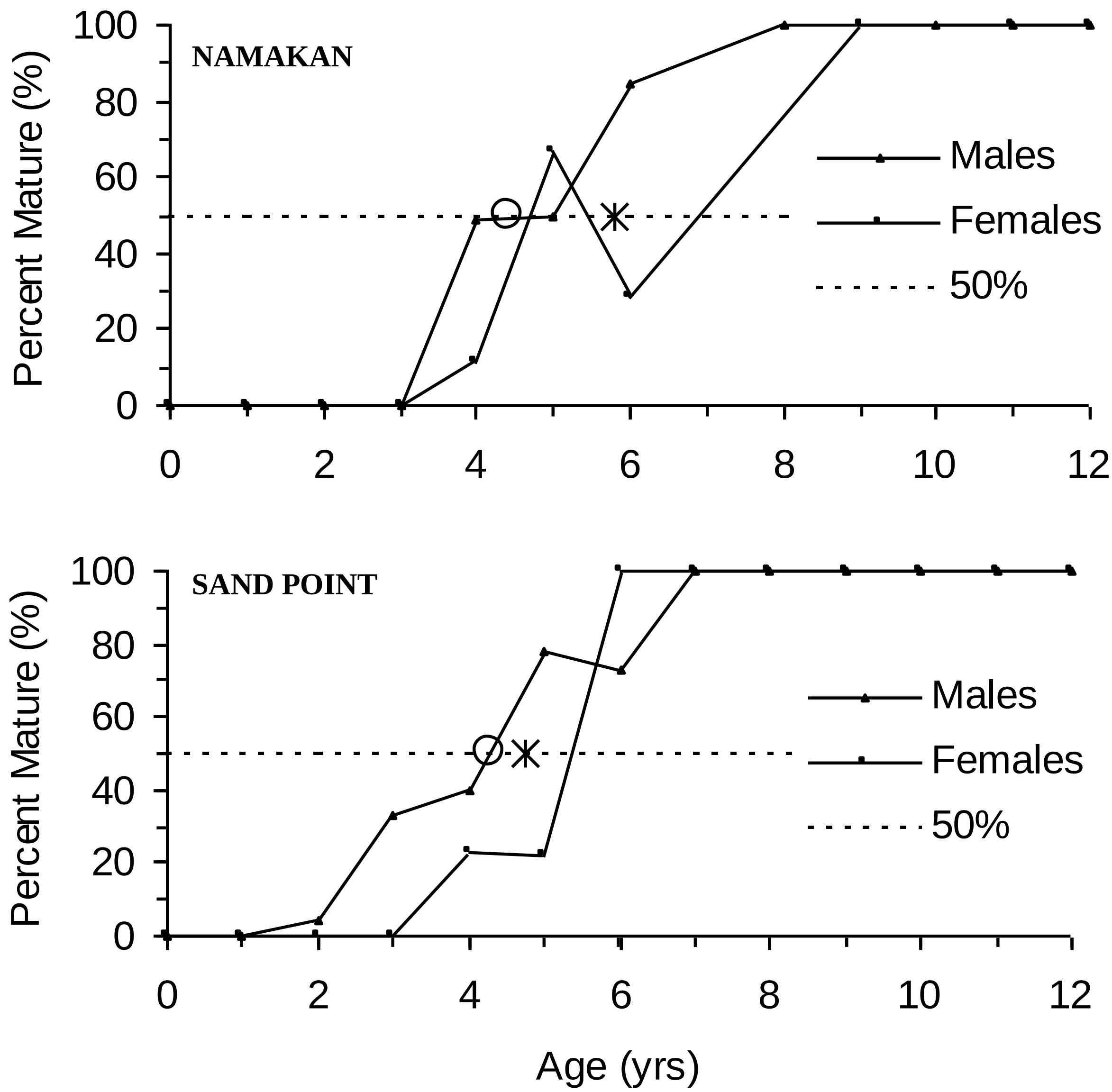

Figure 7: Walleye age at maturity for Namakan (a) and Sand Point (b) Lakes based on Fall Walleye Index Netting (FWIN), 2000. Calculated age at 50% maturity is indicated by (o) for males and (*) for females.

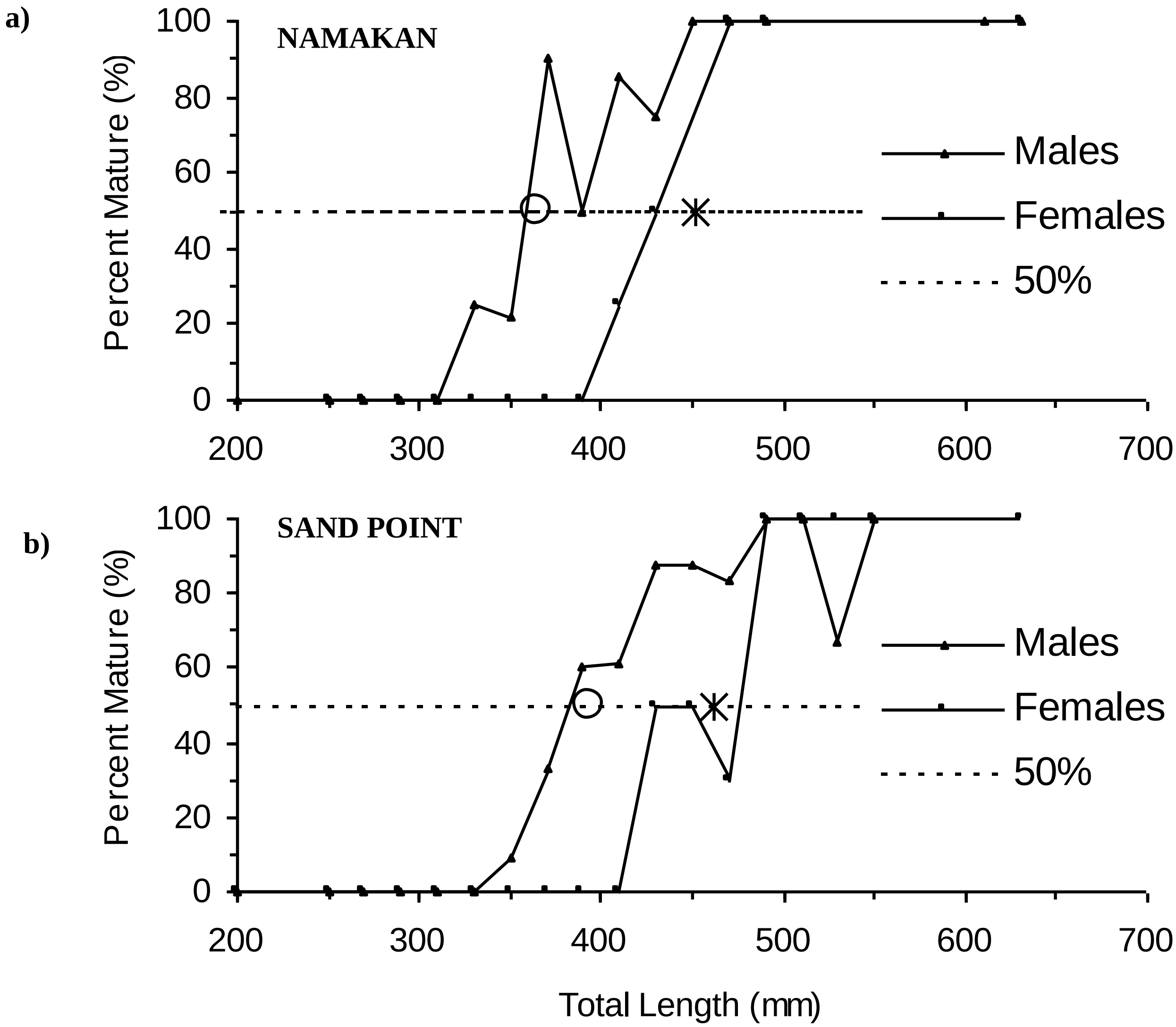

Figure 8: Walleye length at maturity for Namakan (a) and Sand Point (b) Lakes based on Fall Walleye Index Netting (FWIN), 2000. Calculated length at 50% maturity is indicated by (o) for males and (*) for females.

Comparison to Northwest Ontario Walleye Benchmarks

Walleye catch per unit effort for both Namakan and Sand Point lakes falls into the category of low average in comparison to other Fort Frances District lakes using FWIN standards (Figure 9). Mean number of walleye per net values of 7.60 and 10.45 fall below Northwest Region large lake averages. In addition, many of these fish are young, as reflected by the relatively low average age.

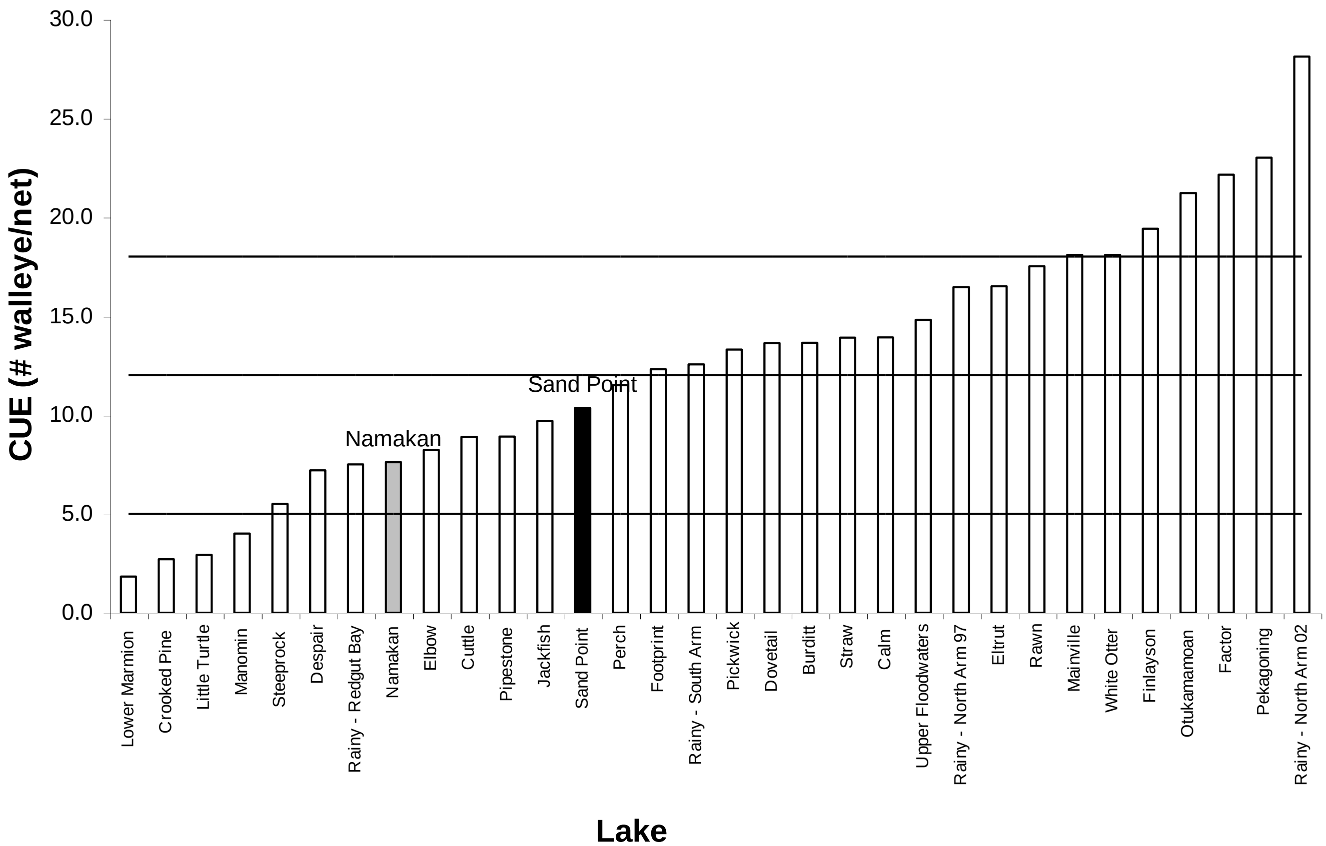

Figure 9: Comparison of walleye abundance on Namakan and Sand Point Lakes with other Fort Frances District lakes using FWIN standards, 1994-2002. Walleye catch-per-unit-effort (CUE) between 0-5 are low, 5-12 low-average, 12-18 high average, and >18 high walleye abundance.

Walleye life history characteristics in Namakan and Sand Point lakes were consistent with regional averages. Both populations showed slow juvenile growth rates, as indicated by the age and length at maturity of both sexes (Table 4). Prematuration growth rates, were below benchmark values (8.9 cm/yr) on Namakan Lake (6.9 cm/yr), but reasonably close to average on Sand Point Lake (8.4 cm/yr). These life history parameters are known to act as a compensatory mechanism for exploitation allowing populations to mature earlier and invest more heavily in reproduction when exploited.

The geometric mean CUE for Namakan (5.4 fish/net) and Sand Point (8.1 fish/net) were low relative to regional benchmarks. More importantly, the geometric mean catch of walleye >= 450 mm TL for Sand Point Lake was 1.6 fish/net, and only 0.3 fish/net for Namakan Lake. Relative to other Ontario water bodies (Figure 10), this could characterize both populations as “stressed” or “unhealthy”. In addition, the mean age of each lake falls below the average for healthy populations of 4.20 years and greater. The Shannon Diversity Index values of 0.55 and 0.59 for Namakan and Sand Point respectively also fall into the “stressed” or “unhealthy” category (0.5-0.7) for walleye populations, indicating that the population lacks the diversity of adult female age classes to be considered healthy. A summary for each of the two lakes based a number of population and life history parameters relative to regional means has been presented in Table 4.

Table 4: Summary for Namakan and Sand Point lakes relative to regional benchmarks for life history and population structure parameters based on FWIN standards.

VARIABLE	NW MEAN (all lakes)	NW MEAN (large lakes)	NAMAKAN (2000)	SAND POINT (2000)
SECCHI (m)	3.1	2.7	2.6	2.2
MEI (kg/ha/yr) - all fish species	8.7	6.4	2.8	3.2
MSY (kg/ha/yr)			0.81	1.04
MSY Ref. (log10 FWIN/MSY)			0.52	0.78
DEGREE DAYS (GDD>5C)	1414	1394	1646	1646
MEAN CUE (kg/net)			2.69	6.24
MEAN CUE (#/net)	14.1	17.9	7.6	10.5
CUE <300 mm	4.1	5.9	3.5	3.3
CUE >350 mm	7.5	8.0	3.7	5.9
CUE >450 mm	3.1	3.5	0.7	2.8
MEAN CUE (WALLEYE AND SAUGER)		20.3	9.4	12.6
MEAN CUE (GEO) (#/net)	10.7	13.1	5.4	8.1
CUE>450 MM (GEO) (#/net)	2.3	2.5	0.3	1.6
TL @ 50% MATURITY (females) (mm)	441	458	451	461
AGE @ 50% MATURITY (females) (yrs)	4.80	5.24	5.81	4.75
TL @ 50% MATURITY (males) (mm)	360	369	365	394
AGE @ 50% MATURITY (males) (yrs)	3.49	3.81	4.42	4.32
MALE MORTALITY (5+ yrs)	0.30	0.29	0.41	0.25
FEMALE MORTALITY (5+ yrs)	0.28	0.30	0.53	0.37
MORTALITY >300 mm		0.34	0.54	0.28
MORTALITY (Female @ age 5)	0.28	0.28	0.45	0.37
NUMBER OF AGE CLASSES (all)		14	10	16
NUMBER OF AGE CLASSES (n>1)	10	13	7	10
MEAN AGE (yrs)	4.20	3.89	3.44	4.18
MAXMUM AGE (yrs)	16	18	11	23
AGE CLASSES >8	5	8	3	9
AGE CLASSES >10	4	6	1	7
SHANNON INDEX (mature females)	0.65	0.79	0.55	0.59
PRE MATURATION GROWTH (h)	89	90	69	84
FEMALE BRODY COEFFICIENT (K)	0.155	0.158	0.190	0.148
FEMALE TL INF (mm)	733	741	656	768
MALE TL INF (mm)	613	635	566	639
FISHING QUALITY INDEX (FQI)			33	63
MEAN TOTAL LENGTH (mm)	376	351	318	365
MEAN ROUND WEIGHT (g)	705		354	597
TL @ AGE 2 (mm)	302	293	261	274

HEALTHY
STRESSED
UNHEALTHY

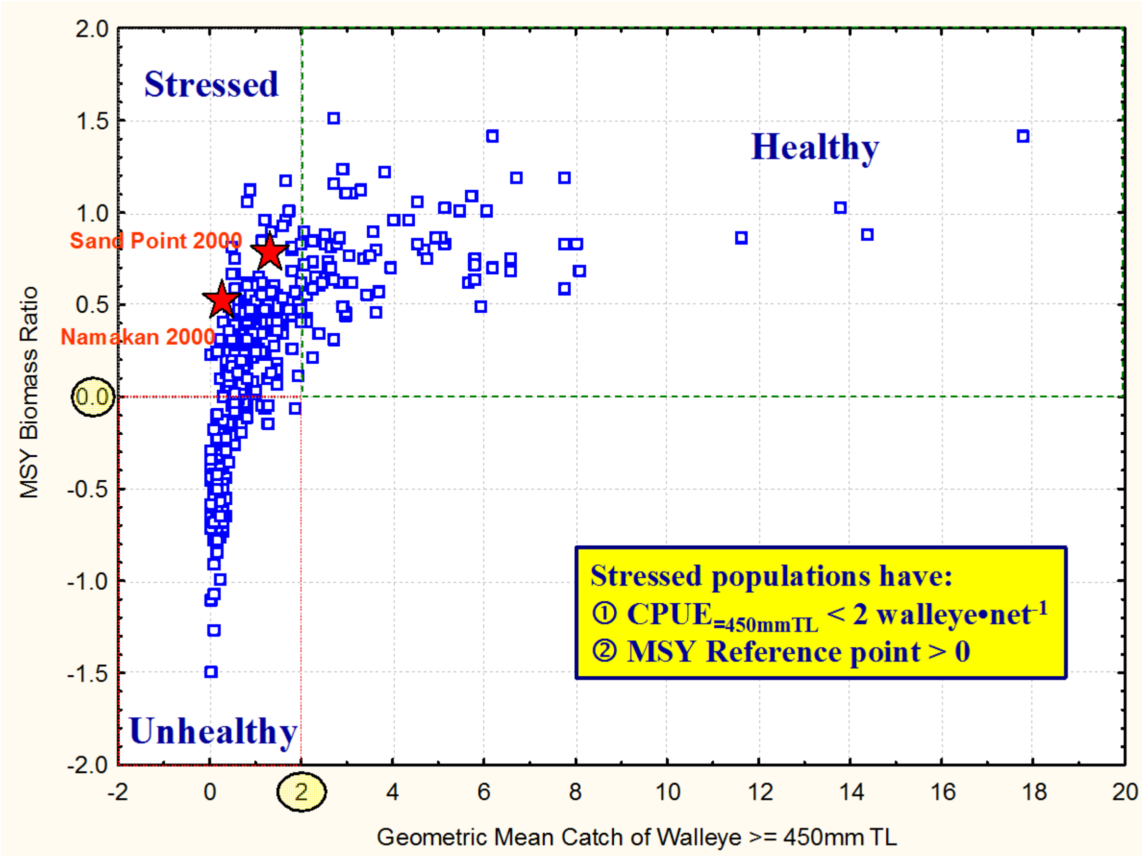

Figure 10: Comparison of walleye abundance (geometric mean catch of walleye >=450mm TL) in Namakan and Sand Point Lakes with other Ontario lakes using FWIN standards, 1994-2002.

Other Fish Species

Northern pike were captured at an average of 1.2 fish/net on Namakan Lake (total =31), and 1.9 fish/net on Sand Point Lake (total =38). Pike ranged in age from age 1-5 on Namakan Lake and age 2-10 on Sand Point Lakes with older year classes absent on both lakes (Figure 11). The average age of northern pike was 2.90 years (SE = 0.23 years) on Namakan Lake, much lower than the average age of 3.95 years (SE=0.30 years) on Sand Point Lake. Differences in mean age were also reflected in mean size, with pike in Sand Point Lake averaging 659 mm total length (SE=22 mm) and Namakan Lake pike averaging 603 mm (SE=20 mm)

Smallmouth bass were more abundant in Namakan Lake, with a CUE of 1.5 fish/net (37 fish total) compared to 0.8 fish/net in Sand Point Lake (15 fish total). Age classes 1-9 were generally represented on Namakan Lake, with a single 13-year old fish collected. Only a single bass older than age four was collected on Sand Point Lake (Figure 12). Mean length and age of smallmouth bass were similar between the two lakes. The average age was 3.27 years (SE=0.53 years) on Sand Point and 3.35 years (SE=0.40 years) on Namakan Lake. The average total length was 285 mm (SE=22 mm) and 294 mm (SE=14 mm) on Sand Point Lake and Namakan Lake respectively.

A total of twelve lake sturgeon were captured in the study (eight from Namakan Lake and four in Sand Point Lake). Sturgeon between age 6-27 were caught in Namakan Lake, with total length ranging from 490 – 1110 mm. Sand Point Lake sturgeon were between 14-35 years old, and 850-1130 mm total length. A length frequency tally for all fish species sampled has been included in Appendix 2.

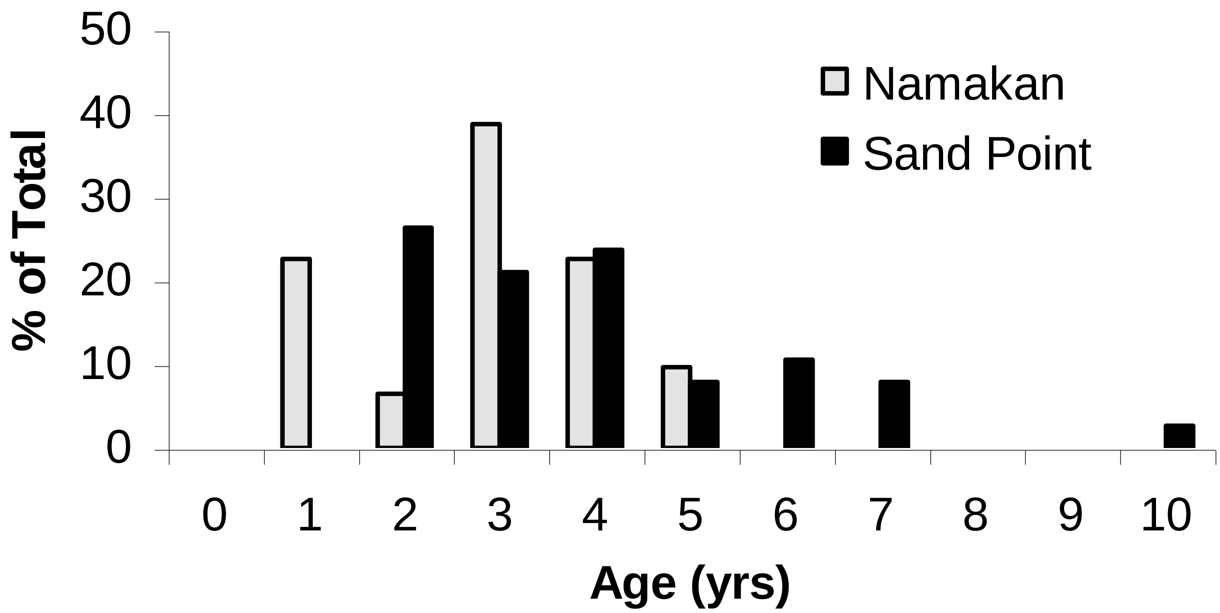

Figure 11: Age composition of northern pike from Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000. Mean age was 2.90 years on Namakan Lake (SE=0.23 years) and 3.95 years (SE = 0.30 years) on Sand Point Lake.

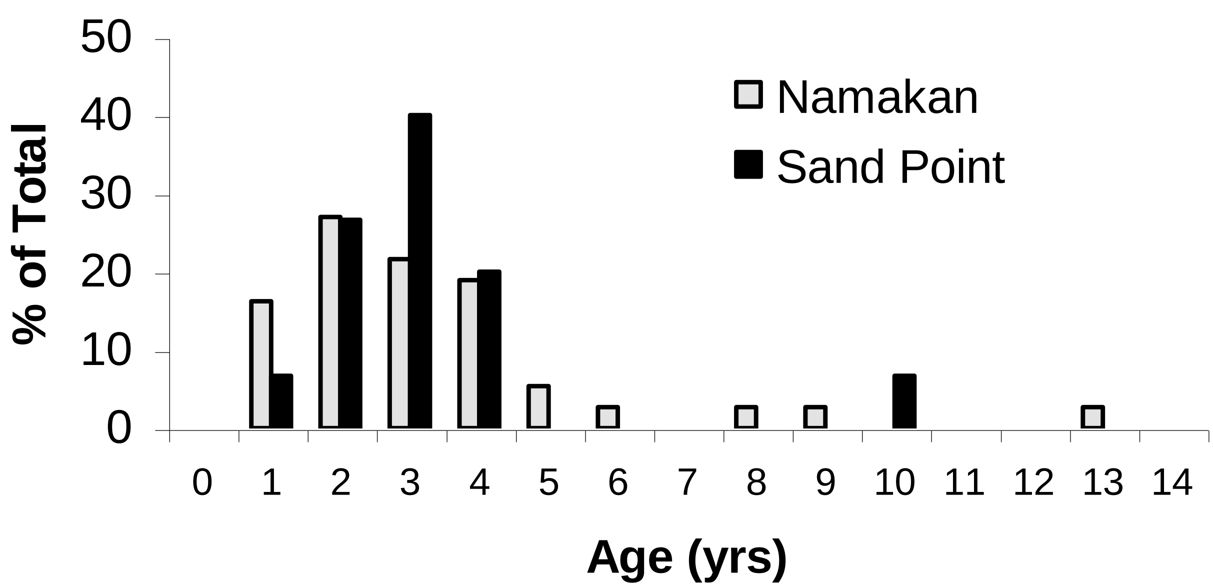

Figure 12: Age composition of smallmouth bass from Namakan and Sand Point Lakes based on Fall Walleye Index Netting (FWIN), 2000. Mean age was 3.35 years on Namakan Lake (SE=0.40 years) and 3.27 years (SE = 0.53 years) on Sand Point Lake.

DISCUSSION

Both Namakan and Sand Point lakes support a diversity of fish species, and community composition between the two lakes were similar, as expected given direct water flows between the two lakes that help comprise the Namakan Reservoir. Species such as northern pike, smallmouth bass, yellow perch, lake whitefish, and black crappie which are known to compete with walleye are present in both lakes (Scott and Crossman, 1998).

Rapid early growth and early maturity are often characteristic of exploited fish populations (Lester et al., 2000). Generally, the life history characteristics of walleye populations from both lakes did not deviate from regional means. Walleye in both Sand Point and Namakan Lakes have relatively slow growth rates prior to maturity, and mature at a later age than many exploited populations. The data suggest that factors contributing to apparent population declines in both lakes are not having an influence on prematuration growth characteristics. Namakan Lake females are maturing an average of one year later than Sand Point Lake, but is likely attributable to the low sample size of age 5 and 6 females from Namakan Lake. The absence of data associated with fecundity and relative condition pose limitations on the ability to draw definitive conclusions regarding reproductive investment of walleye populations. Neither Sand Point Lake nor Namakan Lake walleye exhibit increased juvenile growth rates and earlier maturity despite other indications of stress. Growth in fishes is constrained by a combination of environmental and biological parameters, and the apparent inability of both populations to increase their respective early growth rates suggests there may be other limiting factors.

Any number of physical and biological factors could contribute to the relatively slow growth rate prior to maturity of walleye from both Namakan and Sand Point lakes. Both lakes are relatively deep, and therefor may not provide the same proportion of productive or optimal habitat as other lakes in the Northwest Region. In addition, northern pike, yellow perch, smallmouth bass, and lake whitefish are known to compete with walleye for food (Scott and Crossman, 1998), and are present in both lakes included in this study. This interspecific competition may limit the juvenile growth rates of walleyes in both lakes, and their ability to exhibit typical life history plasticity associated with exploitation described by Lester et al. (2000). Further study of the lakes and the fish communities is required to determine these causative agents.

The low sample size, particularly for older fish in both lakes may impact the interpretation of data presented in Table 4. The low prematuration growth is inconsistent with the high growth coefficient (k) reported for Namakan Lake. The absence of upper year classes, or those represented by very few fish can skew maturity schedules and growth rates if the fish sampled are not representative of the entire population.

Examination of walleye population structure in Namakan and Sand Point Lakes provides indications of stress in both populations. Low Shannon Diversity Index values for adult females, as well as poor representation from a number of year classes, are indicators of stressed fisheries. Overall mean age was also low and the maximum age and number of age classes both fall below regional averages on Namakan Lake. The age structure of walleye populations on both lakes suggests inconsistent recruitment, a characteristic of many exploited walleye populations throughout the province (Morgan et al., 2003). High adult mortality rates on both lakes, particularly for female fish, likely contributed to declines in overall fishing quality. High mortality rates were also observed in both lakes during a 1998 angler (creel) survey (Elder, 2001). Exploitation has been high, with harvest in Minnesota waters exceeding the estimated Maximum Sustainable Yield (MSY) until around 1998 (MDNR and OMNR, 1998).

Factors contributing to low levels of recruitment and/or poor year classes include: low abundance of spawning fish (Colby et al., 1979), the absence of suitable spawning habitat (Auer and Auer, 1990), spring warming rate (Busch et al., 1975; Koonce et al., 1977; Madenjian et al., 1996; Hansen et al., 1998) and cannibalism by adults (Forney, 1976). In addition, a number of fish species known to compete with, or prey upon, larval walleye are present in both water bodies, and collectively may limit the reproductive success of individual years classes. Larger fish were generally absent from both populations, but Namakan Lake more so than Sand Point Lake. Walleye fecundity and spawning success is positively related to female body size (Johnston, 1997), and the absence of large females from the population likely contributes to the inconsistent recruitment trends observed. The mechanism for poor year classes is likely dependent on the interaction between the physical, environmental and biological characteristics at a given time. Clearly, the fishery must be managed in order to allow a greater number of larger fish to contribute to future recruitment.

Typically, walleye populations exhibit unbalanced sex ratios. Prior to maturity, males outnumber females (Colby et al., 1979) and Seyler (1998) reported a ratio of immature males to females of approximately 1.30:1 in Lake Nipissing, ON. Male: female ratio in this study was 1.77 in

Namakan Lake and 2.21 in Sand Point Lake between the ages 2-4. Typically, differences in vulnerability to exploitation and greater female longevity result in a shift to a female dominated sex ratio among mature individuals, a trend not apparent in either Namakan Lake or Sand Point Lake (age 5+ female: male ratio of 0.61 and 0.73 for Namakan Lake and Sand Point Lake respectively). The apparent absence of large females from both populations raises concerns regarding the sustainability and quality of the walleye fishery. The trends observed in this study regarding the low abundance of large walleyes, particularly in Namakan Lake, were consistent with the results of a creel survey two years prior to the current study (Elder, 2001), as well as assessment by the Minnesota Department of Natural Resources (MDNR and OMNR, 1998).

Comparison of abundance and population structure from walleyes collected in the FWIN program on Namakan and Sand Point Lakes in 2000 suggests that the populations are both stressed. Catch rates are below regional averages, particularly in Namakan Lake, and the characteristics of the population raise concern regarding the health of the fishery. In general, fish are younger, and many year classes are weak or absent. The walleye population in Namakan Lake appears to be more stressed than Sand Point Lake. These trends are consistent with those observed by Elder (2001) in an angler survey of both lakes performed in 1998. Populations in both lakes were young, with Namakan walleye smaller on average then those from Sand Point Lake. Trends in age and length distribution in this study are consistent with those observed in annual assessment programs implemented by the Minnesota Department of Natural Resources for the Minnesota portion of each water body (MDNR and OMNR, 1998).

Catch rates of large fish fall well below the Northwest regional means for walleye populations identified by Morgan et al. (2003). Namakan Lake populations grow slowly, and reach a lower ultimate body size for both sexes. This smaller size of adult fish reduces the quality of the spawning population and can contribute to recruitment variability. In addition, fishing quality, and in turn the economic value of the fishery is greatly reduced by the absence of large, ‘memorable’ or ‘trophy’ class fish.

CONCLUSIONS

- Namakan and Sand Point lake walleye populations exhibit slow juvenile growth rates and mature at ages and lengths that are consistent with populations in the Region.
- Walleye in Namakan and Sand Point lakes both indicate signs of stressed or unhealthy populations based on comparison of population structure relative to other Ontario waters.
- The number of age classes present on Namakan Lake is precariously low, with only seven age classes represented by more than a single fish.
- Low Fishing Quality Index (FQI) based on Relative Stock Density (RSD) are indicative of poor fishing quality, especially on Namakan Lake
- Adult mortality rates on both lakes are relatively high, and must be lowered to improve the health and quality of the fishery
- Both populations exhibit a number of weak or absent year classes, suggesting recruitment related problems or over-exploitation. Identification of the mechanisms for poor recruitment in both lakes should be the focus of future research.
- Exploitation of both fisheries (Namakan Lake in particular) needs to be reduced to allow the fishery to recover. The Ontario commercial fishery was eliminated in 2001, and harvest levels and angler effort have declined through experimental regulations in Minnesota since 1998. Lower non-resident catch limits introduced in 2000, lower maximum size and catch restrictions implemented in Ontario in 1999, as well as the new water level management regime introduced in 2000 (IRLBC, 1999) should contribute to the improvement in quality of the fishery.

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Appendix I: Fish Species Present in the Namakan Reservoir

Common Name	*Scientific Name*	MNR Species Code
Silver Lamprey	*Ichtymyzon unicuspis*	013
Lake Sturgeon	*Acpines fulvescens*	031
Lake Whitefish	*Coregonus clupeaformis*	091
Cisco (Lake Herring)	*Coregonus artedii*	093
Rainbow Smelt	*Osmerus mordax*	121
Northern pike	*Esox lucius*	131
Mooneye	*Hiodon tergisus*	152
White Sucker	*Catostomus commersoni*	163
Silver Redhorse Sucker	*Moxostoma anisurum*	168
Shorthead Redhorse Sucker	*Moxostoma macrolepidotum*	171
Northern Redbelly Dace	*Phoxinus eos*	182
Finescale Dace	*Phoxinus neogaeus*	183
Golden Shiner	*Notemigonus crysoleucas*	194
Emerald Shiner	*Notropis atherinoides*	196
Common Shiner	*Notropis cornutus*	198
Blackchin Shiner	*Notropis heterodon*	199
Blacknose Shiner	*Notropis herolepis*	200
Spottail Shiner	*Notropis hudsonius*	201
Mimic Shiner	*Notropis volucellus*	206
Bluntnose Minnow	*Pimephales notatus*	208
Fathead Minnow	*Pimephales promelas*	209
Blacknose Dace	*Rhinichthys atratulus*	210
Longnose Dace	*Rhinichthys cataractae*	211
Black Bullhead	*Ictalurus melas*	231
Brown Bullhead	*Ictalurus nebulosus*	233
Tadpole Madtom	*Noturus gyrinus*	236
Burbot	*Lota lota*	271
Brook Stickleback	*Culaea inconstans*	281
Trout-Perch	*Percopsis omiscomaycus*	291
Rock Bass	*Amboloplites rupestris*	311
Pumpkinseed	*Lepomis macrochirus*	313
Bluegill	*Lepomis macrochirus*	314
Smallmouth Bass	*Micropterus dolomieui*	316
Largemouth Bass	*Micropterus salmoides*	317
Black Crappie	*Pomoxis nigromaculatus*	319
Yellow Perch	*Perca flavescens*	331
Sauger	*Sander canadensis*	332
Walleye (Yellow Pickerel)	*Sander vitreus*	334
Iowa Darter	*Etheostoma exile*	338
Johnny Darter	*Etheostoma nirgrum*	341
Logperch	*Percina caprodes*	442
Mottled Sculpin	*Cottus bairdi*	381

Total Species: 43

Appendix II: Total length frequency distribution of fish species captured in 20 FWIN gill net sets on Sand Point Lake, 2000.

Length (mm)	Walleye	N. Pike	SM Bass	Sauger	Yellow Perch	Lake Herring	Whitefish
0 – 99					7		
100-119					31	4	
120-139				6	5	2	
140-159			1	8	12		
160-179	4			3	11	1	
180-199	10		2	3	3	6	
200-219	3		1	4	4	2	
220-239	9		1	5			
240-259	15		1	2		1	
260-279	12			2			
280-299	7		3	4		4	
300-319	18			3		2	
320-339	15		1	3		2	
340-359	13		4	1		1	
360-379	11			1		2	
380-399	7						
400-419	18						
420-439	11						
440-459	12						
460-479	10						1
480-499	12	4	1				
500-519	6						
520-539	5	2					
540-559	6	7					
560-579		1					
580-599	3	1					1
600-619		2					
620-639		1					
640-659	1	3					
660-679		4					
680-699		1					
700-719		2					
720-739	1	1					
740-759		2					
760-77.9		2					
780-799		1					
800+		6					
Total	**209**	**38**	**15**	**45**	**73**	**27**	**2**
Mean	**365**	**659**	**285**	**220**	**130**	**230**	**530**
Min	**167**	**485**	**155**	**120**	**50**	**100**	**460**
Max	**730**	**1052**	**486**	**379**	**219**	**379**	**599**

Appendix II: (cont'd)

Length (cm)	White Sucker	Red-horse Sucker	Brown Bullhead	Rock Bass	Pumpkin Seed	Black Crappie	Sturgeon
0 – 99				1			
100-119				2		2	
120-139				4		1	
140-159				1			
160-179				6	1	3	
180-199			3	12		5	
200-219	1		2	5		2	
220-239	2		1	1		1	
240-259	7			1		2	
260-279	2						
280-299						1	
300-319	1					2	
320-339	1					1	
340-359	5						
360-379	1						
380-399							
400-419	2						
420-439	8	1					
440-459	5						
460-479	9						
480-499	5						
500-519	1	2					
520-539	6						
540-559	3	1					
560-579	1						
580-599							
600-619		2					
620-639							
640-659							
660-679							
680-699							
700-719							
720-739							
740-759							
760-77.9							
780-799							
800+							4
Total	**60**	**6**	**6**	**33**	**1**	**20**	**4**
Mean	**414**	**503**	**203**	**188**	**170**	**211**	**938**
Min	**200**	**420**	**180**	**50**	**170**	**100**	**840**
Max	**579**	**619**	**239**	**259**	**170**	**339**	**1130**

Appendix II (cont'd): Total length frequency distribution of fish species captured in 25 FWIN gill net sets on Namakan Lake, 2000.

Length (cm)	Walleye	N. Pike	SM Bass	Sauger	Yellow Perch	Lake Herring
0 – 99					3	
100-119					50	
120-139					1	
140-159	2		4	1	6	1
160-179	2			2	13	
180-199	5		2	1	2	
200-219	11		1	10	2	
220-239	14		4	6		
240-259	18		2	3	2	
260-279	21		3	5		
280-299	15		3	4		
300-319	15		4	7		
320-339	14		1	2		1
340-359	12		3	1		2
360-379	14		5	1		4
380-399	14		1		1	3
400-419	11	1	1	1		
420-439	5	1	2	1		
440-459	6	2				
460-479	5	2				
480-499	4		1			
500-519		2				
520-539						
540-559		2				
560-579						
580-599		3				
600-619	1	4				
620-639	1	2				
640-659		4				
660-679		2				
680-699		2				
700-719		1				
720-739		1				
740-759		1				
760-77.9						
780-799						
800+		1				
Total	**190**	**31**	**37**	**46**	**80**	**11**
Mean	**318**	**603**	**294**	**237**	**132**	**348**
Min	**144**	**401**	**142**	**140**	**50**	**140**
Max	**622**	**949**	**494**	**439**	**399**	**399**

Appendix II: (cont'd)

Length (cm)	White Sucker	Red -horse Sucker	Brown Bullhead	Mooneye	Rock Bass	Black Crappie	Sturgeon
0– 99							
100-119					12		
120-139			1		11		
140-159					13	3	
160-179			5		26		
180-199			9		9		
200-219	1		6		3	2	
220-239	4				1		
240-259	4		1				
260-279						1	
280-299							
300-319						1	
320-339				2			
340-359	2			2			
360-379							
380-399	1			1			
400-419				1			
420-439	3	1					
440-459	3	1					
460-479	9	1					
480-499		6					1
500-519	1						
520-539	2	1					
540-559	2	2					
560-579		2					
580-599		4					
600-619		8					1
620-639		3					
640-659		1					
660-679							
680-699							
700-719							
720-739							
740-759							2
760-77.9							
780-799							1
800+							3
Total	**32**	**30**	**22**	**6**	**75**	**7**	**8**
Mean	**400**	**540**	**191**	**360**	**156**	**207**	**774**
Min	**200**	**420**	**120**	**320**	**100**	**140**	**484**
Max	**559**	**659**	**259**	**419**	**239**	**319**	**1110**