Fisheries and Oceans Canada — Pêches et Océans Canada
Science — Sciences
Central and Arctic Region
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Science Advisory Report 2010/035

ASSESSMENT OF WALLEYE (*Sander vitreus*) FROM TATHLINA LAKE, NORTHWEST TERRITORIES

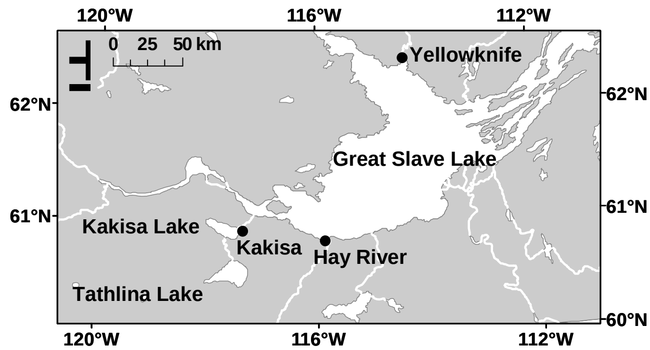

Figure 1. Location of Tathlina Lake, Northwest Territories.

Context:

Commercial fishing of Walleye (Sander vitreus) in Tathlina Lake began in the winter of 1953/54 and subsequently demonstrated multiple periods where the quota was achieved followed by poor harvest. Prior to 2001, various quotas were established for the commercial fishery but were not sustainable. The fishery was not opened in 2001 after a decline in catch-effort. An attempt to fish in 2003 produced negligible yields while a small quota in 2008 was not completely attained in part because returns would not have been worth the effort.

Tathlina Lake is large, shallow and turbid, and has been subject to winterkill in the past. Several residents of the community of Kakisa are involved in the commercial fishery which is restricted to gill nets with a minimum mesh size of 108 mm.

Fisheries and Aquaculture Management Sector of Fisheries and Oceans Canada has requested science advice on the current status of the stock, recommendations on a total sustainable harvest level for 2010/11, and the development of a long-term monitoring plan for the fishery.

SUMMARY

Stock status

- Data collected from experimental gill netting between 2001 and 2007 suggest an improvement in the status of the Walleye in Tathlina Lake.

Fishery

- A quota of 20,000 kg does not appear sustainable.
- An initial conservative commercial quota of ≤5,000 kg should pose a low risk to the population.
- Only 108 mm mesh size gillnets should be used to help protect the spawning stock.

Monitoring and future research

- Suggestions are provided for additional research and monitoring activities that would improve future assessment.

INTRODUCTION

Species Biology

Walleye is a freshwater species principally distributed in temperate and subarctic North America. In Canada, Walleye is widely distributed between the provinces of Alberta and southern Quebec. In the Northwest Territories, Walleye is mainly associated with lakes and rivers in the Taiga Plains terrestrial ecozone, and have been found as far north as the Mackenzie River Delta. Walleye spawn in the spring on shallow shoals or tributary rivers although the timing is influenced by temperature and latitude (Scott and Crossman 1973). Walleye is typically piscivorous and occupy higher trophic niches. Variables that appear to influence Walleye production include water clarity, temperature and bathymetry (Lester *et al.* 2004).

Adult Walleye are commonly from 330-508 mm total length (Scott and Crossman 1973) with females generally larger than males. They typically live 10-12 years in the south and up to possibly 20 years in the north (Scott and Crossman 1973).

Walleye is one of the most popular sport fish in North America and are commercially fished in many locations. In the Northwest Territories, Tathlina, Kakisa and Great Slave lakes are locations of the most northerly commercial fisheries for Walleye in North America.

Fishery

Commercial fishing of Walleye (*Sander vitreus*) in Tathlina Lake, Northwest Territories, began in the winter of 1953/1954 and has provided important economic benefits for residents from the nearby community of Kakisa. The history of the fishery demonstrates multiple periods where harvest has fluctuated dramatically with periods of fishery collapse (Fig. 2).

The fishery was not opened in 2001 after catches declined from a quota of 20,000 kg. After 2001, the commercial fishery was only re-opened in 2003 and 2008 with quotas of 5,000 kg and 2,000 kg, respectively. Catches were negligible in 2003 (≤500 kg, F. Taptuna pers. comm.) while only 620 kg were harvested in 2008 because fishers reported that the economic returns would not have been worth the effort due to a late start in fishing activity in combination with poor ice conditions that impeded travel. Angling does not occur on Tathlina Lake due to its remote location.

Over the past twenty years, commercial harvest typically occurred during the winter months in the western area of the lake while harvest prior to the 1990s occurred in both the winter and summer months (Roberge *et al.* 1988). Before 1980, a minimum mesh size of 114 mm was used to harvest while a combination of 108 and 114 mm mesh was used thereafter. Initially, the commercial quota was set to 91,000 kg/year and while never achieved, was reduced to 30,900 kg/year in 1967. Assessment of the stock by Roberge *et al.* (1988) resulted in a reduced quota of 20,000 kg/year. The number of fishers operating on the lake has varied, but over the decade prior to 2001 there has been as few as one and as many as four. Over the history of the fishery catch-per-unit-effort from commercial fishermen was never recorded. Although there is no data available on the level of harvest by Dene from Kakisa for subsistence, it is considered low.

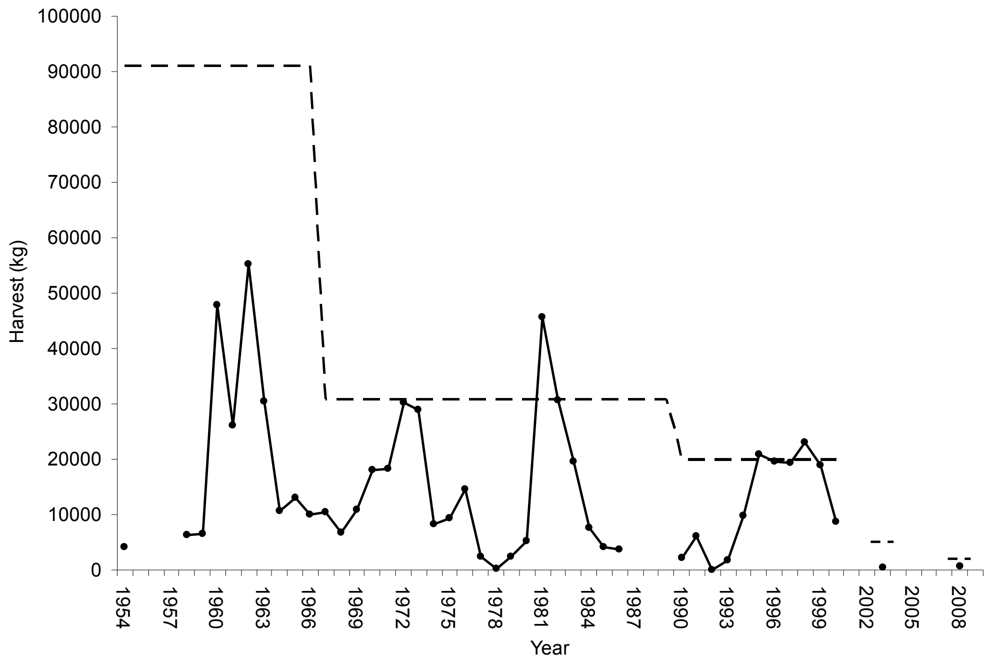

Figure 2. Total annual commercial production of Walleye from Tathlina Lake, NT, 1954-2008. The dashed line is the quota for Walleye. The fishery was not opened in 2001-2002 and 2004-2007.

Prior sampling on the lake for assessment of the population occurred in 1946 (Kennedy 1962) and 1979 (Roberge *et al.* 1988). Fisheries and Oceans Canada has been collecting biological information of Walleye from Tathlina Lake at the commercial fishing plant in Hay River periodically between 1975 and 1998. Biological and catch-effort information was obtained from an experimental gill netting program that sampled Walleye from Tathlina Lake in 2001, 2002, 2005, 2006 and 2007. Fisheries and Aquaculture Management has requested advice on the status of the stock recommendations on a total sustainable harvest level for 2010/11, and the development of a long-term monitoring plan for the fishery.

The Walleye population is likely sensitive to environmental conditions of the lake due to its large size and shallow depths. Walleye recruitment may be sensitive to variable water levels, temperature and turbidity. A severe winterkill was observed in 1943 (Kennedy 1962) which is likely attributed in part to the morphology of the lake.

Tathlina Lake (N 60° 32’; W 117° 31’) is a large (57,300 ha) shallow lake (with greater depths ranging between 1.5 and 1.8 m) situated in southern Northwest Territories (Fig. 3) (Kennedy 1962). The lake is part of the Kakisa River which drains an area of 14,900 km^2. The western area of the lake where the Kakisa River enters is deeper than the rest of the lake. The lake is situated in a low lying area composed mainly of muskeg (Roberge *et al.* 1988). The substrate of Tathlina Lake has been described as soft black organic bottom (Kennedy 1962). The water in most of the lake is turbid while clearer in the western area of the lake (Kennedy 1962).

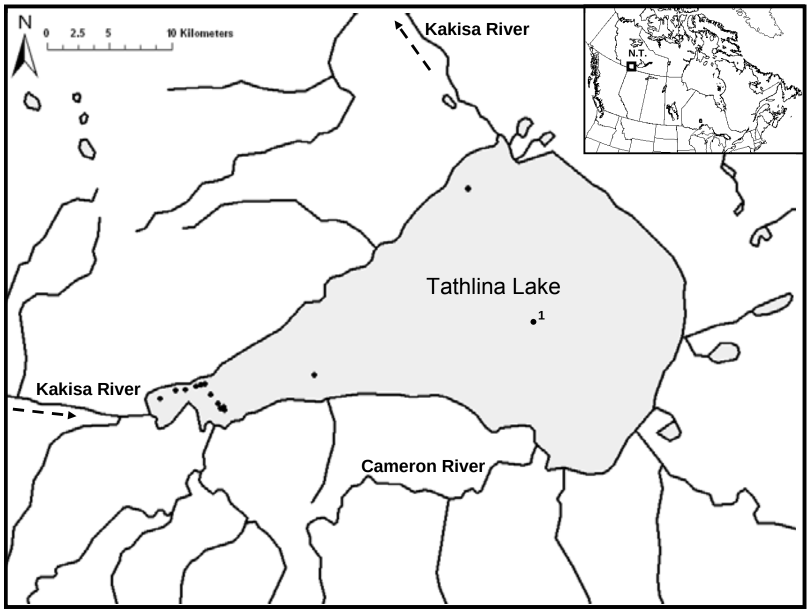

Figure 3. Locations of experimental gill nets set in Tathlina Lake, NT, in 2001, 2002, 2005-2007 (●).[1] the fish in the net were not sampled due to adverse weather conditions in 2002. Dotted arrows shows direction of flow.

Other species inhabiting the lake include Lake Whitefish (*Coregonus clupeaformis*), Northern Pike (*Esox lucius*), Longnose Sucker (*Catostomus catostomus*), White Sucker (*Catostomus commersoni*), Burbot (*Lota lota*) and Lake Cisco (*Coregonus artedi*).

ASSESSMENT

Data from the commercial plant sampling between 1990 and 1997 and the experimental gill netting conducted between 2001 and 2007 were analyzed and compared to historical results in order to evaluate the status of the stock. Data used for the assessment of Walleye included: fork length, weight, sex, age (using dorsal spines), maturity, growth, mortality, catch-per-unit-effort and percent catch composition.

Data from plant sampling included fork length and round weight (1990-1996 (round weight not recorded in 1996)), and headless length and dressed weight (1996-1998), and ageing structures (1991-1998). A correction was applied to convert headless length to fork length.

Experimental gill nets were 274.2 m long consisting of 45.7 m long and 0.6 m deep panels of 38, 64, 89, 108, 114, 140 mm mesh. Experimental gill netting occurred during winter (November or December) in all years except for 2002 when sampling was conducted in spring (June). Gill nets were set for approximately 24 hours in locations where commercial fishing typically occurred (Fig. 2). Gill nets were set in the western area of the lake in most years while in 2002 sites further north and east were also sampled. Fork length, weight, sex and maturity were recorded and ageing structures collected from Walleye captured in experimental gill nets.

Plant sampling data obtained between 1990 and 1994 demonstrated smaller mean lengths in years when harvest was relatively low and below the quota. Subsequently, mean length increased between 1995 and 1998 during a period when the quota was achieved (Fig. 4). Reliable age data was available for 1991, 1994, 1995, 1996 and 1998, the average age among years varied between 9.4 and 11.0 years. Age data from 1997 was questionable and not used in the assessment. Annual mortality was highest in 1991 (0.82) and lowest in 1998 (0.18).

Results from experimental gill netting between 2001 and 2007 indicates that the average length of Walleye in the population increased after commercial fishing ceased (Fig. 5). Females were, on average, approximately 30 mm larger than males during the winter sampling years while no differences were observed between the sexes in the spring (2002).

Age data from 2007 were questionable and omitted from the assessment. Mean age of Walleye increased among sampling years, indicating that between 2001 and 2006 Walleye were able to attain older age classes (Fig. 6). A strong 1997 year class was observed among sampling years that first appeared as four-year-olds in 2001, five-year-olds in 2002, eight-year-olds in 2005, and nine-year-olds in 2006.

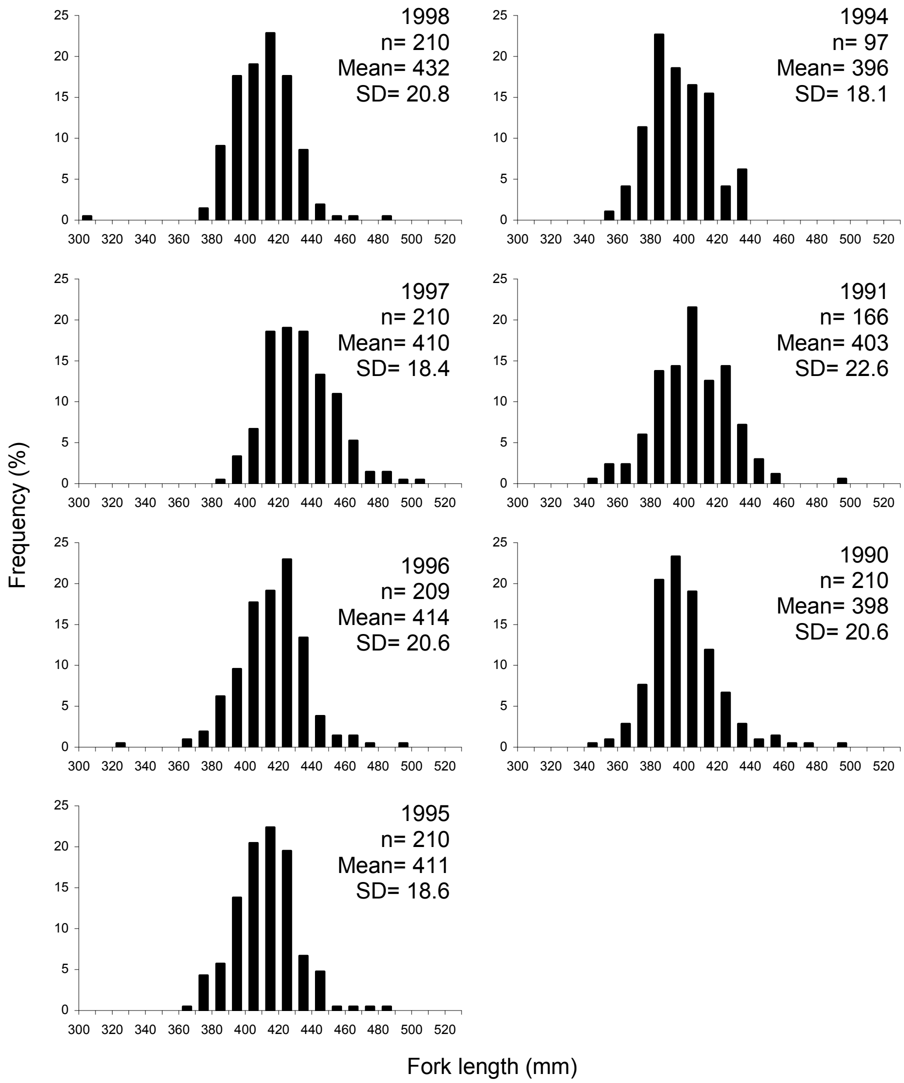

Figure 4. Length frequency distribution of Walleye from Tathlina Lake, NT, sampled from the commercial catch between 1990 and 1998.

Mean weight and condition factor increased between 2001 and 2007 (Table 1). Lower weight and condition in 2002 are likely because Walleye were post-spawners.

Table 1. Sample size (n), mean (± 1 SD) and range of weight, and mean condition factor of Walleye captured in experimental gill nets in Tathlina Lake, NT.

Year	Weight (g)				Condition
	n	Mean	SD	Range	
2007	828	875	219	195-2010	1.21
2006	399	817	208	190-1870	1.23
2005	739	792	171	245-1990	1.24
2002	569	507	186	40-2175	1.03
2001	450	601	188	195-1550	1.16
1979	696	421	104	180-660	1.06

The length-at-age of Walleye did not change considerably among sampling years (Fig. 7). On average, females had a higher growth rate than males, although no statistically significant differences were observed.

Age-at-maturity for females appears to be between 4-6 years of age while the length-at-maturity, based on averaging mean length-at-age among study years, is approximately 381 mm. The majority of males were mature at age four; although two Walleye from the 2006 sample were mature by ages 2 and 3. The length-at-maturity for males is approximately 359 mm. The majority of female to male ratios were nearly equal while the 2006 and 2001 sample were both depauperate of females with ratios equal to 0.81 and 0.54, respectively. The age of maturity of Walleye in Tathlina Lake did not change considerably among sampling years.

Annual mortality increased among sampling years, from 0.43 in 2001 to 0.66 in 2006. These values would reflect natural mortality in the population as there was no or very negligible fishing mortality. The increase is likely due to the skewing effect of the strong 1997 year class on the age frequency distribution used to calculate catch curves among years.

The catch-per-unit-effort increased among sampling years from 11.8 Walleye/91 m/ 24 hours in 2001 to 39.2 Walleye/91 m/ 24 hours in 2007 suggesting a higher abundance of Walleye in the population during this period of time (Fig. 8).

The proportion of Walleye in the total catch among winter sampling seasons increased from 36% in 2001 to 68% in 2007.

The minimum mesh size captured few immature Walleye indicating that juveniles were not very susceptible to the fishery. The sex ratio in the 108 mm mesh size was nearly equal although females were 3-5 more vulnerable to the 114 mm mesh size compared to males.

Results from the experimental gill netting between 2001 and 2007 demonstrated a higher mean length, and a higher proportion of both younger (<5 years) and older (>9 years) age classes, higher growth rate, similar age at maturity and a probable increase in relative abundance compared to 1979 (Roberge *et al.* 1988). The experimental gill netting from the assessment by Roberge *et al.* (1988) was conducted during a period when yields were low and the fishery was considered to be in a depleted state.

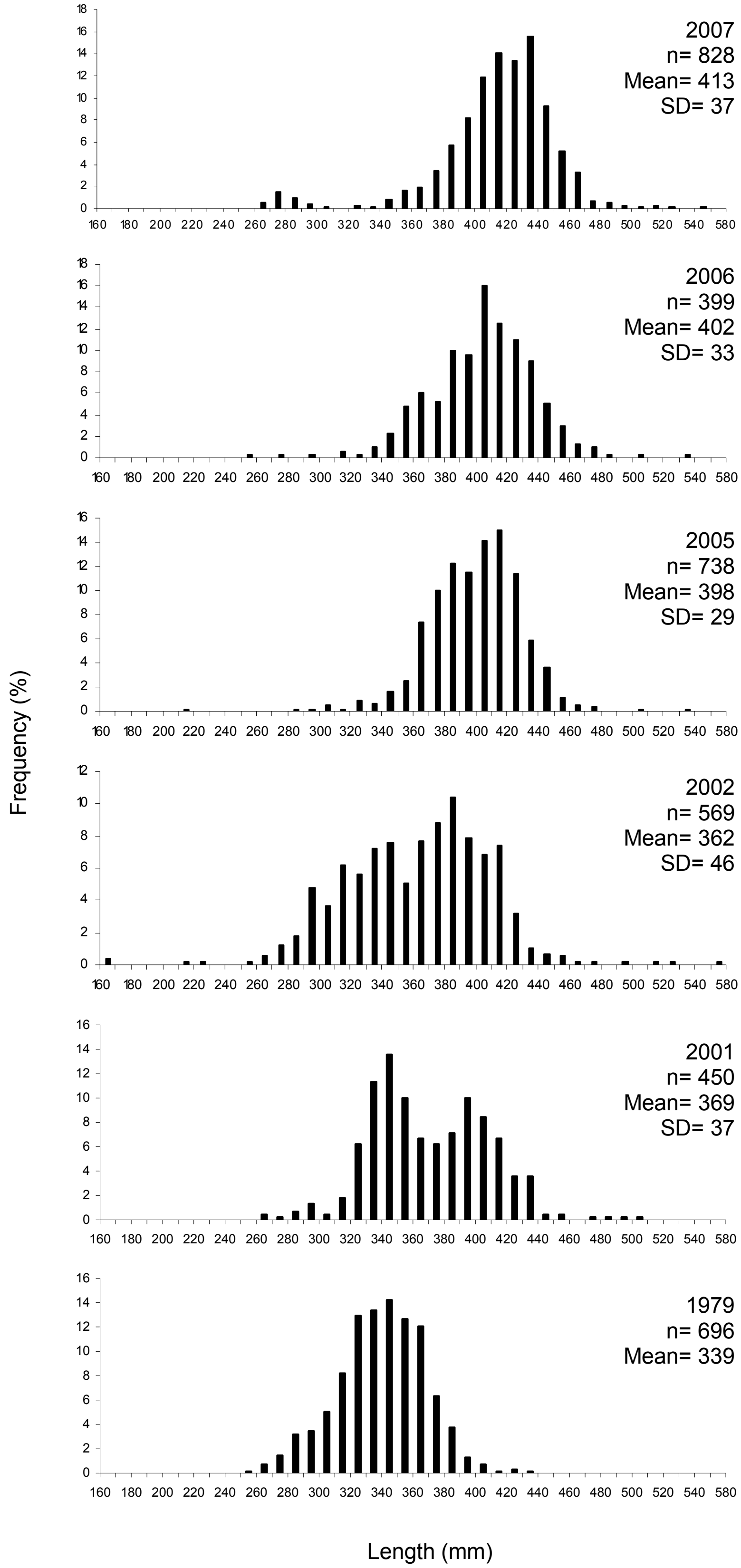

Figure 5. Length frequency distribution of Walleye from Tathlina Lake captured in experimental gill nets in 2007-2005, 2002-2001 and 1979.

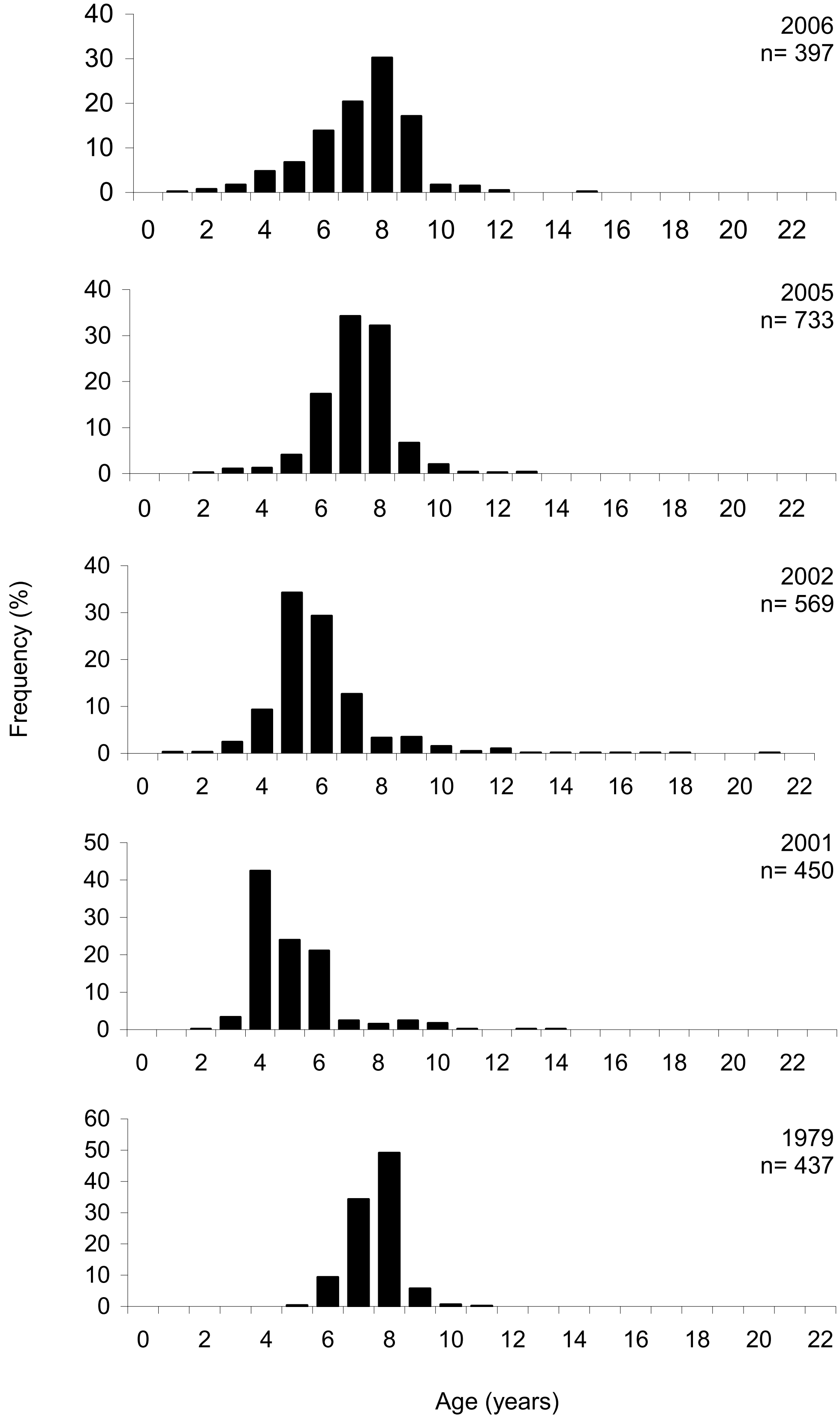

Figure 6. Age frequency distribution of Walleye from Tathlina Lake, NT, captured using experimental gill nets in 2006-2005, 2002-2001 and 1979.

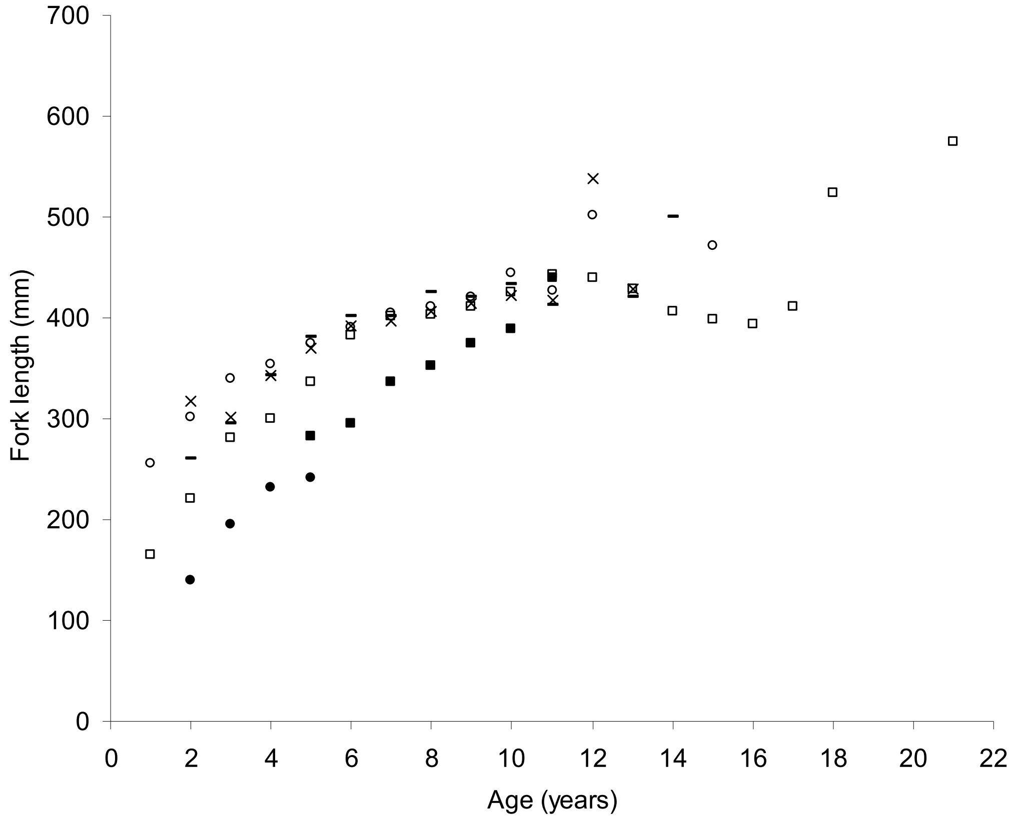

Figure 7. Mean length-at-age of Walleye from Tathlina Lake, NT, captured using experimental gill nets in 1946 (●), 1979 (■), 2001 (—), 2002 (□), 2005 (x) and 2006 (○).

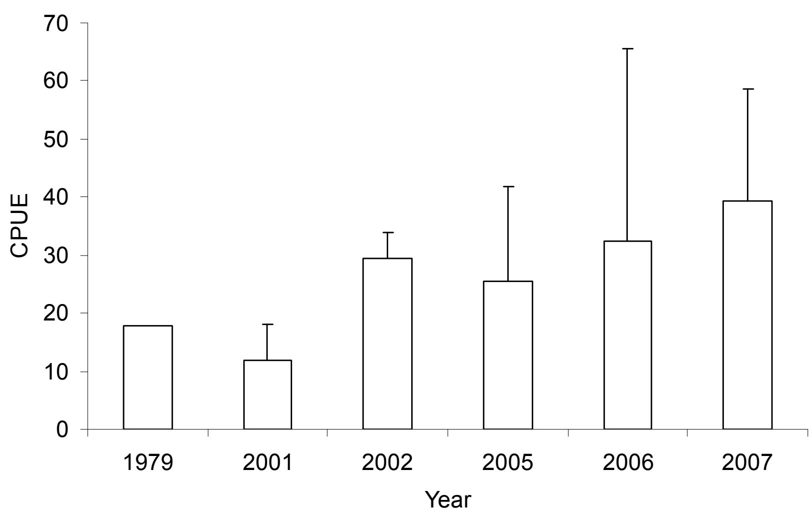

Figure 8. Mean and standard deviation of CPUE (# Walleye/ 91 m/ 24 hours) of Walleye from Tathlina Lake, NT, captured in experimental gill nets in 1979 (standard deviation was not available), 2001-2002, 2005-2007.

The population status of Walleye of Tathlina Lake appears to have improved between 2001 and 2007. The mean size (length and weight) of Walleye and age of Walleye has increased, while the increase in catch-per-unit effort of and proportion of Walleye in the total catch suggests an increase in Walleye biomass in the lake. The presence of the strong 1997 year class that reached sexual maturity in 2003 was left to spawn multiple times without considerable harvest has likely helped improve the status of the population.

Sources of Uncertainty

There are multiple sources of uncertainty that are relevant to the assessment of Walleye from Tathlina Lake. Although the data indicates an improvement in the status of the population, the extent of the improvement is unknown. Without population estimates or catch-per-unit-effort information from a period when the population was stable or in high abundance, it is difficult to establish with certainty the degree of recovery. Additionally, although it is considered to be low, knowing the level of the subsistence harvest would have improved the assessment. The experimental sampling sites were not distributed throughout the lake and were chosen principally because locations were in the same areas where commercial fishing occurred. The bias in sampling sites may not have provided a representative sample of Walleye from Tathlina Lake.

CONCLUSIONS AND ADVICE

Based on the results from the assessment that indicate an improvement in the stock, the fishery should be re-opened with a conservative quota that would pose a low risk to the population. Considering that 20,000 kg does not appear sustainable, a cautious approach would be to allow a quota ≤5,000 kg. The commercial fishery should re-open using gill nets with a mesh size of 108 mm. Due to the susceptibility of large females to the 114 mm mesh, it is advised not to use this mesh size in order to help protect the spawning stock.

In order to improve future assessment of Walleye from Tathlina Lake:

- Subsistence harvest levels should be reported;
- Fishers should use log books to record catch and effort information (e.g., mesh size, net length, location, depth, fishing duration, species, discards);
- Continue plant sampling or direct purchasing of Walleye in order to obtain biological information;
- A traditional knowledge project lead by the community that includes information on Walleye ecology, the lake and the history and importance of the fishery would be beneficial;
- Water quality variables that have a strong correlation with Walleye productivity (e.g., secchi depth, total dissolved solids, temperature) should be measured;
- Experimental gill netting consistent with methods between 2001 and 2007 should continue, although sampling should occur throughout the lake;
- Year-class strength and climate information should be examined in order to determine if environmental conditions influence recruitment;
- The samples collected in 1997 and 2007 should be re-aged and ageing study should be conducted using multiple ageing structures (e.g., spines, scales, otoliths, pelvic fin ray) of Walleye from Tathlina Lake in order to investigate whether there are any differences in ages among structures.

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FOR MORE INFORMATION

Contact: Colin Gallagher
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, Manitoba
R3T-2N6
Tel: (204) 983-8893
Fax: (204) 984-2403
E-Mail: Colin.Gallagher@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, Manitoba
R3T 2N6

Telephone:(204) 983-5131
Fax: (204) 984-2403
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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