Fisheries Branch Report

Lake Winnipegosis

Fish Stock Assessment 2024

Manitoba Natural Resources and Indigenous Futures
Published 2026

Manitoba

Lake Winnipegosis Fish Stock Assessment 2024

Summary

Data collected from index gill netting between 2008 and 2024 suggest an improvement in the status of the Walleye stock, but little change for Northern Pike stock in Lake Winnipegosis. There has been variability in catch rates for both species because of varying year class strength, with few signs of stress in the population.

For walleye, the modeled MSY is 335,000 kg for 2024-25. The increase of the 2024–25 winter Walleye total allowable catch to 217,000 kilograms (kg) is due to large year-classes being susceptible to commercial fishing gear, fewer active summer fishers, and summer fishers not filling all 98 active quota entitlements (222,460 kg). Based on Walleye production during the 2024 summer season, minus the prior year overage, the resulting 2024–25 total allowable catch is 402,000 kg. This is well within the MSY plus surplus biomass available for harvest.

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Introduction

Lake Winnipegosis is located west of Lake Winnipeg, northwest of Lake Manitoba, and is south of Cedar Lake in the province of Manitoba (*see Figure 1.1*).

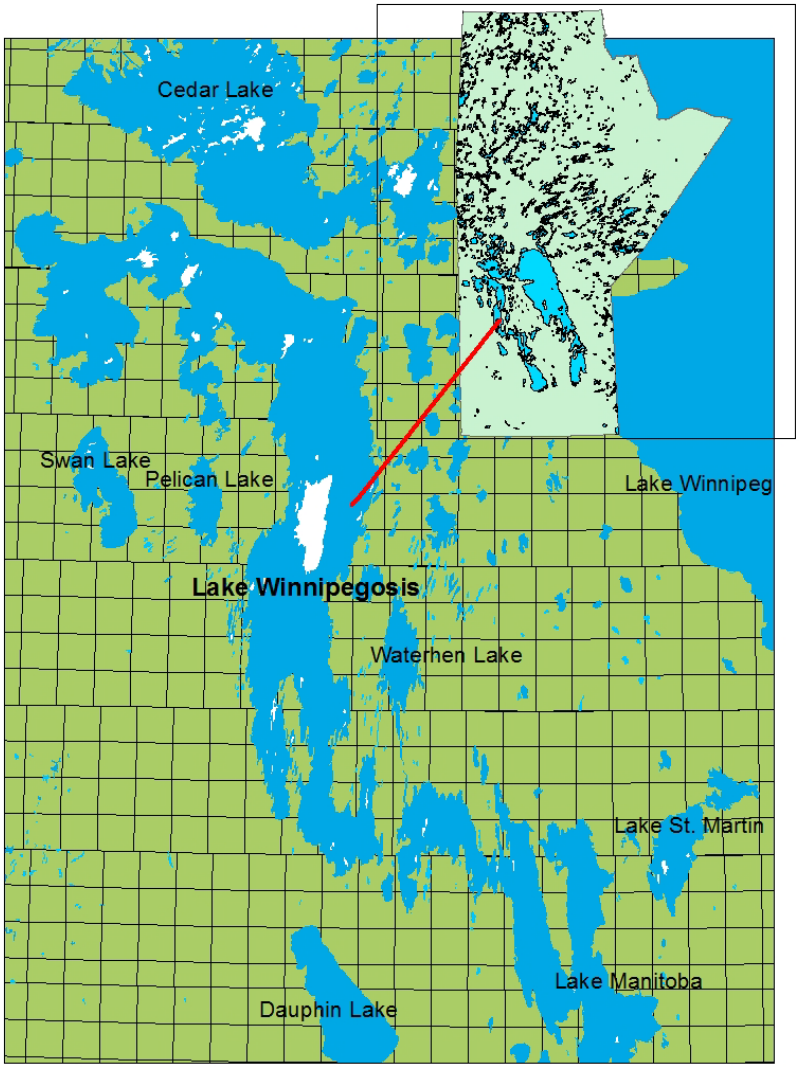


Figure 1.1: Map of location of Lake Winnipegosis.

Lake Winnipegosis is approximately 200 km long, 25 km in wide, and up to 12 meters deep. Birch Island takes up 806 km² of the 5,370-km² lake. Lake Winnipegosis drains into Waterhen Lake, passing through both the Little Waterhen and West Waterhen Rivers and then continuing into Lake Manitoba. Lake Winnipegosis has several tributaries, which include Mossy River, North Duck River, Overflowing River, Pelican River, Pine River, Point River, Red Deer River, Sclater River, Shoal River and Steeprock River.

Lake Winnipegosis has a diverse fish community that supports commercial, subsistence, and recreational fisheries. There are 30 fish species present throughout the lake. The winter commercial fishery is based primarily on White Sucker (Catostomus commersoni) and Shorthead Redhorse

(Moxostoma macrolepidotum), both marketed as ‘mullet’, which have unlimited quota, and Northern Pike (Esox lucius) which is managed by setting annual quota. Walleye (Sander vitreus) is primarily harvested by the summer fishers, and is also managed using commercial fishery quotas. The remaining species harvested have unlimited quota, including Lake Whitefish (Coregonus clupeaformis), Yellow Perch (Perca flavescens), Sauger (Sander canadensis), Cisco (Coregonus artedii), marketed as ‘tullibee’, and Common Carp (Cyprinus carpio).

History of the Fishery

Lake Winnipegosis fish resources have been managed since the early 1900s. Individual and occasionally multi-species commercial fishery quotas were used to manage for Walleye, Lake Whitefish, Northern Pike, and sometimes Goldeye (Hiodon alosoides). Fishing regulations have been revised several times affecting the opening and closing season dates, mesh size restrictions, and lake-wide species quotas.

Prior to the 1990s, Manitoba assessed fish stocks through experimental test netting using various mesh sizes and yardage (length of net fished). To produce more reliable and comparable quantitative fishery data, Manitoba standardized index netting in 1990 and again in 2008. These improvements were complemented by the Freshwater Fish Marketing Corporation (FFMC) Fish Production System (FPS) database, which began capturing more comprehensive commercial data for all species captured since 1996.

Due to high levels of fishing pressure on the Walleye population in the mid to late 1900s, spawning stock was reduced to a point where reproduction and recruitment were limiting annual yields. The Walleye population decline persisted and, in an effort to recover the population, Manitoba government made major investments to develop and operate Walleye rearing ponds from 1972 to 1987, conduct various biological and socioeconomic studies, and commission an independent review that mobilized development of the Lake Winnipegosis Management Board in 1997 (Lysack 2006).
A synthesis of fisheries studies by Strategic Planning for Ontario Fisheries (SPOF) Working Group (1983) identified nine distinct effects that are typical of overexploited fish stocks:

- Decline in abundance
- Change in yield
- Altered age composition and reduction in mean age
- More rapid growth
- Reduced age at first maturity
- Increased variance of some parameters – recruitment
- Increase in fecundity
- Change in genetic stocks
- Inter-stock desegregation (i.e. stock mixing)

The Lake Winnipegosis Walleye stock has overcome most of the concerning effects in the fishery present before 2010. Recruitment variance depends on the mean abundance of recruited Walleye. While recruitment decreases, variance also decreases. Prior generations’ Walleye age demographics were less healthy than current stocks. Prior to 2010, spawning stock biomass was quickly cropped off upon entry to the fishery at age-4 to age-5, or even sooner between 1987 and 2006 when the 76 mm (3”) perch fishery operated.

Lack of Walleye population modelling limited the capacity of fisheries managers to understand population dynamics, assess stock status, and evaluate different harvest policies. A recent review of all existing data from 1910 to 2024 documented that the Walleye population and broader fish community has been highly dynamic and operated in a stressed/collapsed state for decades in the southern portion of the lake until around 2010.

Periods of strong recruitment in parts of the lake has withstood fishing pressure, and Walleye stock continues to improve. Walleye are typically between three- and six-years old when caught in commercial fisher nets, with few Walleye aged seven years or older being caught. If there is a continuous removal of most Walleye before they reach the age of six and above, there will be less likelihood to develop a large and diverse spawning stock, as was the case for the period from 1960 to 2010. In the past decade there have been indications that the Walleye population is improving as there has been an increase in abundance of spawning stock and more consistent recruitment.

Commercial

Lake Winnipegosis has been commercially exploited since the late 1890s (Barbour 2010). There was a limited commercial fishing operation that continued through 1894, as stated in a report of the Manitoba Fisheries Commission. Railway accessibility reached Lake Winnipegosis in 1897 and provided “...a great impetus for fishing.” Management changes related to mesh sizes, quotas, and commercial fishing seasons have been made over the history of the fishery in response to population status and marketable fish species demand. Initial fishing efforts using 140 mm (5.5”) mesh were basically targeting/catching Lake Whitefish until 1922 when 108 mm (4.25”) mesh was allowed for Walleye. In 1954, fishers requested a change to use 102 and 108 mm (4” and 4.25”) mesh for all species, which has been used ever since with some slight deviations for a limited 76 mm (3”) perch fishery.

Lake Winnipegosis has production records dating back to the early 1900s (see *Figure 2.1*). After the last collapse of the Walleye fishery in the early 1960s, there had not been a recovery of the population did not recover to moderately productive levels until the late 2000s. Regulation changes, and several high-water years have created the foundation for improvements in the Walleye fishery and the population has recovered in most areas of the lake (Figure 2.2).

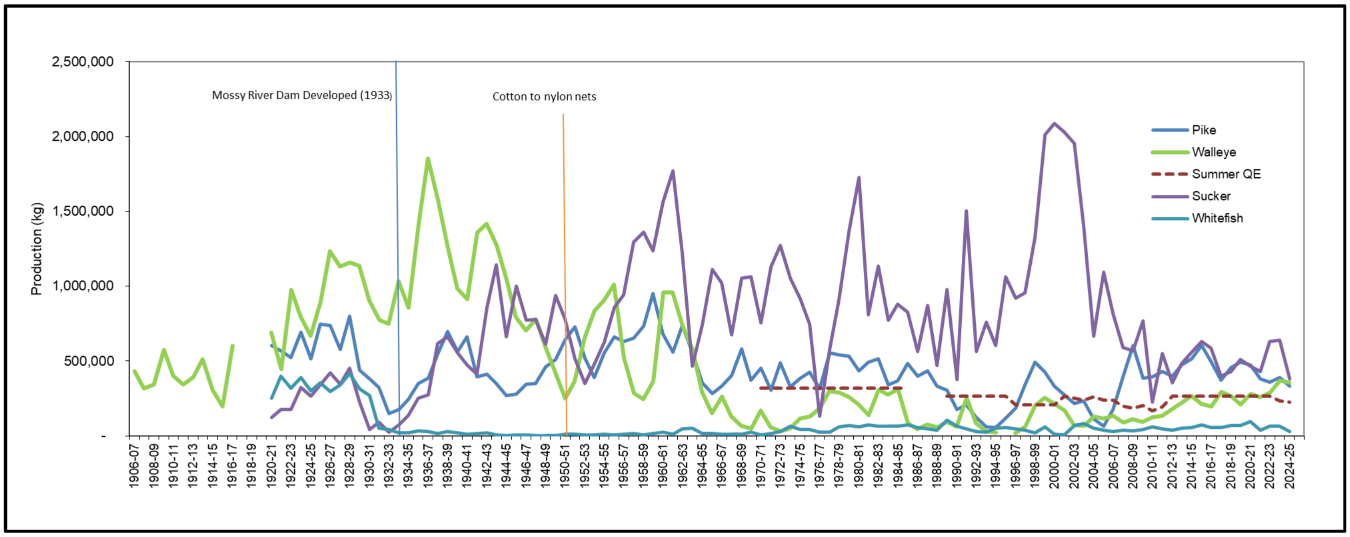


Figure 2.1. Lake Winnipegosis Walleye and Northern Pike production from 1906 to 2024 commercial fishing season.

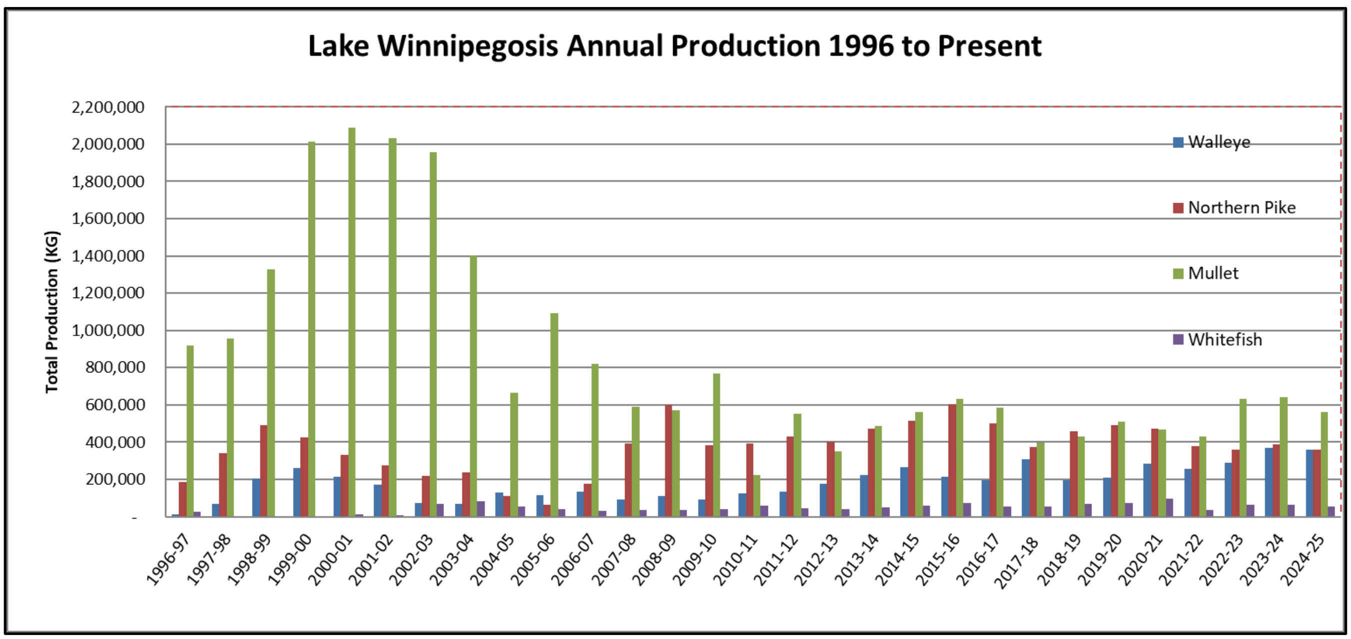


Figure 2.2. Lake Winnipegosis primary catch production from 1996 to 2024.

Subsistence

Walleye and Northern Pike are the main target species of the commercial fishers and support subsistence harvest by First Nations and Métis communities around the lake.

Recreational

Recreational fishing is not very popular due to the distance of Lake Winnipegosis to major centers and the periodic history of the lake being a collapsed fishery. Local community residents are the main recreational users of the lake. In 2007, Manitoba implemented conservation measures to reduce recreational angling retention limits from six to four Walleye and introduce a 'no harvest' slot limit on Walleye between 45 centimetres(cm) and 70 cm to further conserve Walleye spawning stock. In 2023, the slot size restriction was removed and replaced by a lowered province-wide Walleye maximum size limit of 55 cm.

Stock Monitoring

The Lake Winnipegosis fishery monitoring program has been carried out annually since 1990, with standardized sampling conducted under the Coordinated Aquatic Monitoring Program (CAMP) from 2008 to present. This program is comprised of two components:

- Index gill netting provides independent estimates of fish abundance, fish species diversity and descriptions of Walleye growth maturity and mortality regimes.
- Commercial catch sampling and production analysis provides a description of ages and body size classes of commercially caught Walleye.

In more recent years, variable amounts of index netting have been added from the collaborative stock monitoring program.

Methodology

Annual Index Gill Netting

Fisheries Branch conducts annual index-gillnet surveys to assess the status of fish stock in Lake Winnipegosis. Sampling locations were selected based on historical data netting sites on the lake with 12 sites (six located in northern portion and six located in south) currently being assessed as part of the Coordinated Aquatic Monitoring Program (CAMP 2017). The Collaborative Stock Monitoring Program (CSMP), operating in cooperation with local community members, samples up to 12 additional sites. Additional netting was incorporated for some assessments, where available. Fisheries Branch carried out supplemental test netting in 2023 and 2024 to assess areas not typically covered by the index program and experiment with other types of gillnets and mesh size composition (North American Standard, mid-size (44, 57, and 70 mm), and large-size mesh tie-ons (140 and 152mm). Supplementary data were gleaned from a bycatch netting program using nets similar to commercial sets in material, mesh size, and fishing style. Where indices of abundance are calculated, areas are weighted as though effort was equal in all areas. Actual soak time of nets set varies, but nets are always in the water for at least a dusk period and the following dawn. Effort among the sampling areas varies from year to year with the number of net sets ranging from 8 to 29.

The index netting program provides population data to inform the surplus production modeling and biological performance metrics. Each fish is measured by fork length to the nearest 2 mm on a measuring board. The weight is also measured to the nearest 10 grams. When the age of the fish species is to be determined, an aging structure (i.e. otoliths, cleithrum, operculum) is collected. The sex and state of maturity (immature or mature) are determined.

Relative Weights

Relative weight is a measure of weight at length compared to a standard weight. The standard weight equations used in this assessment are:

Walleye	Wr = 3.180(log10(Length)) - 5.453	(Murphy et al 1990)
Northern Pike	Wr = 3.059(log10(Length)) - 5.369	(Willis 1989)

Relative weights of individual fish between 50 and 150 were retained to calculate summary values, reasoning that values outside that range were unlikely and represented errors in observation or deformed/non-typical fish.

The following length-based size classes were used to compare condition (Gabelhouse 1984):

Class	**Walleye**	**Pike**
Stock	250-380 mm	350-530 mm
Quality	380-510 mm	530-710 mm
Preferred	510-630 mm	710-860 mm
Memorable	630-760 mm	860-1020 mm

Growth

Growth rates were modeled using the von Bertalanffy growth function:

$$L_t = L^{\infty} - (L^{\infty} - L^0)e^{-kt}$$

Where Lt is the length at time t. $L\infty$ is the estimated length asymptote if fish were to achieve infinite age. Priors for $L\infty$ were set at 650 mm for the south, 700 mm for the north basin, and standard error for $L\infty$ was set at 10 mm. L0 is the length at age zero which was set at 120 mm, and standard error for L0 was set at 5 mm. k is the Brody growth coefficient, which had no prior. Growth rates were modeled using the BayesGrowth package in R (Smart 2023).

Data for modeling Walleye growth rates were restricted to those collected in 2019-2024. Dwarf form Walleye were not included in the analyses. Growth was modeled over four chains. Each chain used 5000 draws from the posterior using Hamiltonian Monte Carlo (HMC) and the no U-turn sampling algorithm (NUTS). The first 2500 draws from each chain were tossed as warm-up leaving a total of 10,000 draws. No thinning was imposed on the posterior draws.

Abundance

Abundance was measured in two different ways: the total abundance for use as an index of abundance in biomass dynamics modeling; and the abundance by age for use in mortality estimates and per recruit modeling. Bulk abundances for biomass dynamics modeling were measured as either a) the number of individual fish or the total weight of all fish in the index netting program above a given mesh size, or b) the commercial catch per daily catch record. Age-specific abundances were measured by lake basin (north and south) and lake-wide.

Maturity

Maturity ogives were modeled with logistic regression for both 50% maturity at age and 50% maturity at length using the Aquatic Life History package in R.

Spawning Female Age Diversity

The reference limits for Shannon diversity (H) of mature female ages come from the Gangl and Pereira study (2003) of Minnesota's ten large lakes (Figure 2.3). Shannon diversity index is being used as the measure of spawning female age diversity, calculated as:

$$H = (n\log n - \sum(k_i \log k_i))/n$$

Where 'n' is the total number of mature females in index nets, and 'k' is the number of mature females of age 'i'.

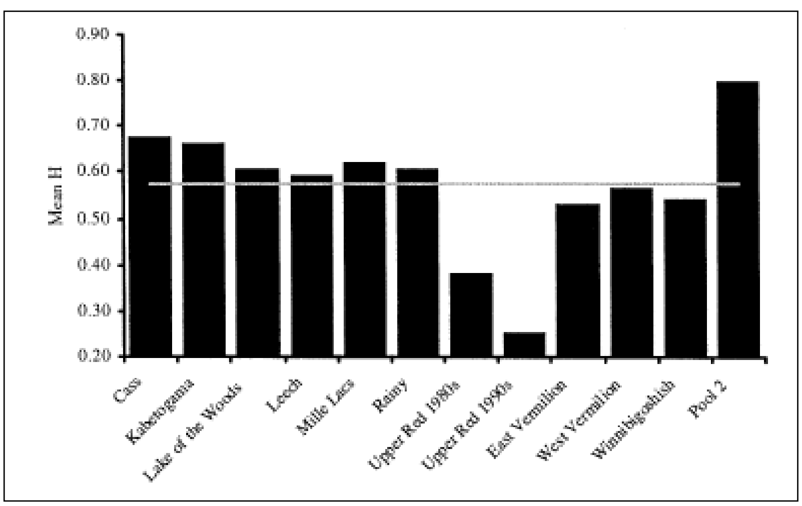


Figure 2.3. Shannon diversity index values for Minnesota's ten large lakes with Upper Red Lake shown pre- and post-Walleye stock collapse and Pool 2 of the Mississippi representing an unharvested Walleye stock. The line at H = 0.58 represents the lower boundary of the 80% confidence interval around the mean of 0.60 for the ten large lakes (Gangl and Pereira 2003).

Natural mortality

Natural mortality rates were estimated using the natural mortality tool (Hamel and Cope 2022). The estimator based on the Fish Life database was set to only a 25% weighting because it was consistently optimistic about the natural mortality rate. This overestimation was likely due to the northern location relative to most stocks that would have informed Fish Life.
Spawner Potential Ratio (SPR) – Lake Whitefish

Total annual survival for whitefish was calculated using the Chapman-Robson estimator (Chapman and Robson 1960):

$$\hat{S} = \frac{T}{n+T-1}$$

Where $\hat{S}$ is the annual survival rate, n is the total number of fish caught, and T is the sum of the products of the catch at age, where age has been rescaled so that the start of the descending limb of the catch curve is zero, and ages greater than the start of the descending limb are the difference between the actual age and the new starting age.

Selectivities were determined for the 102, 108, and 127 mm meshes first by calculating the average weight of each age group of female fish. The number of individuals equal to or smaller than the average weight for each year class were tallied, and those numbers were divided by the number of fish smaller than the modal weight for that mesh size. The samples that were used to estimate selectivity were fish from all programs between 2008 and 2024 where a mesh size and a weight were available.

The spawning potential ratio was calculated using modeled weights at age of female whitefish, the maturity schedules estimated from the fitted curves of percent maturity, the mean natural mortality estimates, and the Robson-Chapman estimates of survival for all whitefish. The survival estimates were adjusted to values between the natural mortality estimate and the Robson-Chapman estimate of mortality according to the selectivity of the minimum allowable mesh size in use in each fishery. The minimum allowable mesh size is 102 mm stretch measure in the north basin and south basin. Beyond the modal value of each mesh catch, selectivity was assumed to be one.

Length-Based Spawner Potential Ratio (LBSPR) – Walleye

The Walleye age-based Spawner potential ratio (SPR) F35% (Clark 1993) compared poorly with modeled maximum sustainable yield (MSY) due to the age profile being very truncated with few normal growing individuals surviving over 8 years old. Instead, length-based SPR (LBSPR) (Prince et al. 2015; Hordyk et al. 2016) was used to model MSY based on the recruitment to the gear given various growth parameters and observed lengths captured in commercial and larger sized mesh gillnet (4”+) and commercial replicate netting.

Schaefer surplus production modeling (Walleye, Northern Pike, Whitefish, and Mullet)

The fundamental estimands of the surplus production model are the intrinsic growth rate, the carrying capacity, and the catchability:

$$B_t = B_{t-1} + rB_{t-1}\left(1 - \frac{B_{t-1}}{K}\right) - C_{t-1}$$

$$\frac{C}{E} = qB_t$$

Where B_{t-1} is the biomass in the year preceding year t, r is the intrinsic growth rate of the stock, K is the carrying capacity of the habitat, C_{t-1} is the catch in the year preceding the year t, and q is catchability. Surplus production modeling was completed using the Bayesian Schaefer model in CMSY++ (Froese et al. 2021; Froese et al. 2023).

Total catch, Ct, is the total amount of round-weight caught during the fishing year. The fishing year begins May 1 and ends the following April 30. Catch per unit effort, C/E, is based on fisher declarations of their daily catch. Daily catch of each fisher who makes a delivery is provided to Fisheries Branch as a daily catch record. Daily catch records are submitted by the first buyer of the fish. The fisher and the date of the delivery are identified along with the catch delivered at that time. The catch is broken out by species, form, and for some species, size grade. Culled fish and discards are not included in the daily catch record. The unit of effort is the delivery. It is not known how many nets were fished, or how long they soaked to produce the fish appearing on the daily catch record. The weights appearing on the daily catch record are converted to their round-weight equivalents and then summed for all sizes and forms of fish to generate the total weight for that delivery.

The modelling requires some index of abundance to approximate how much effort it takes to harvest the total catch. For species with sufficient catch in index nets (pike and suckers) the biomass CUE was used. The estimated composition of each sucker species for the Mullet category of commercial harvest was taken from their respective index catch by year. For other species (Walleye and whitefish) the geometric mean weight of daily catch records for each year or season was used in combination with index netting CUE as the index of abundance for modelling. Pike and Lake Whitefish are relatively high value species, so we assumed there were no discards, and that all, or most caught were delivered.

Most daily catch records contained no whitefish. We ignored catch records <2 kg to calculate the geometric mean. We assumed a one percent effort creep in the model, meaning that we assumed fishers become slightly better at their vocation each year due to technological advances in equipment and knowledge gained in the industry. One percent is at the low end of the typical range of effort creep in fisheries (Palomares and Pauly 2019). For index netting based abundance modelling there was no effort creep. Priors were used to inform the model based on information about the Walleye fishery with initial relative biomass set at 0.1 - 0.4 and final relative biomass set at 0.6 - 0.8.

Walleye Assessment

The regression method of estimating annual mortality could not be used due to the distortion of the catch curve by large year-classes, especially as they approached age of recruitment to the fishery (~5 years of age). Total annual mortality was challenging to estimate among Walleye. Individual large year-classes distort the catch curve and attempting to calculate mortality rates by sex was not possible in years with low catch rates. Mortality rates were highly variable year-to-year. As a result, for some years, sex-based differences in mortality rates were abandoned some years and mortality rates were estimated only for both sexes together.

Since most of the available fish in the fishery were from the strong recruitment year-classes, the decision was made to estimate mortality as the mortality exerted on individual large year-classes (cohort-based) and potentially use annual estimates when the distortion of descending age-class catch curve are absent.

Northern Pike Assessment

The catch rate of pike in the index program appears to have varied by a large amount during CAMP program (2008–2024). Calculating annual mortality rates by sex was not possible in most years with low catch rates, and mortality rates were highly variable year-to-year. As a result, sex-based differences in mortality rates were abandoned and mortality rates were estimated only for both sexes together. Even then, estimates are poor given the lower abundance of pike captured in the index program compared to what commercial fishers are catching, primarily during the winter season.

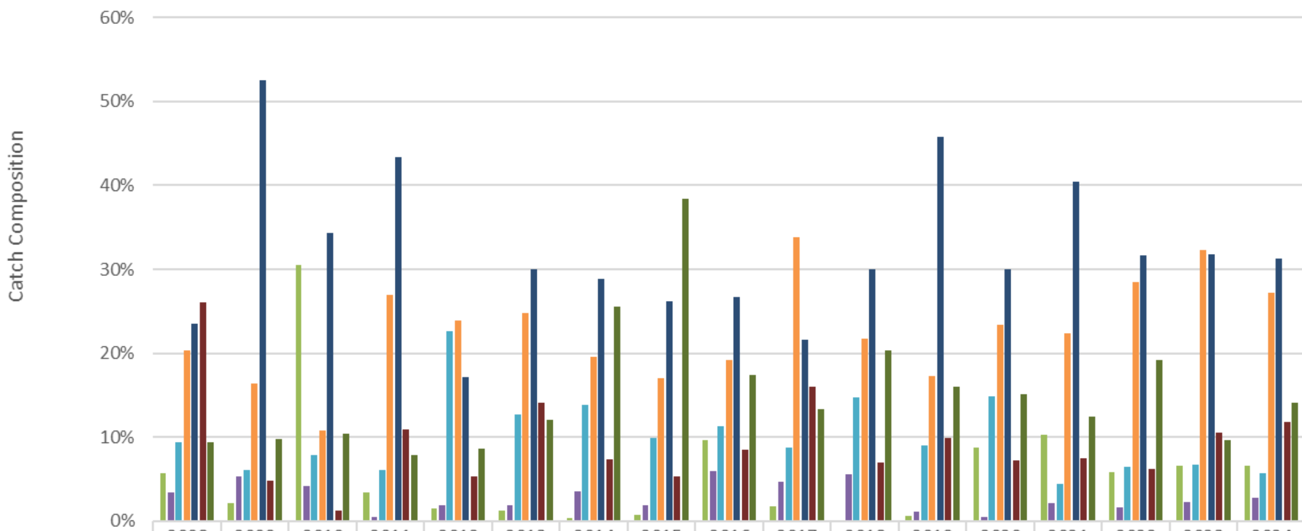
Commercial Catch Sampling

Commercial sampling has been conducted on Lake Winnipegosis since 1961 to better understand the stock structure of fish communities when assessment data is limited. Each fish is measured by fork length to the nearest 2 mm on a measuring board. The weight is also measured to the nearest 20 or 25 grams. When the age of the fish is to be determined, an aging structure (i.e. dorsal spine, fin ray, scales) is collected. Sampling is carried out at various times throughout the year to assess ages of target fish being captured in commercial gill nets and delivered to a FFMC packing plant. The sex and state of maturity (immature or mature) is not possible for commercially caught fish as they are typically field dressed. To assist in filling in some of the blanks for by-catch, sex, maturity, and establishing conversion ratios of headless dressed length to total length, additional commercial-sized mesh nets have been added to the index netting program since 2023 to collect this information.

Results

Index Gillnetting

Catch composition from index gill net surveys for 2008 to 2024 are illustrated in Figure 3.1. White Sucker were the dominant species in the catch in most years, with Walleye coming in a close second in most years and surpassing in 2012, 2017, and 2023.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cisco	6%	2%	31%	3%	2%	1%	0%	1%	10%	2%	0%	1%	9%	10%	6%	7%	7%
Lake whitefish	3%	5%	4%	1%	2%	2%	3%	2%	6%	5%	6%	1%	1%	2%	2%	2%	3%
Northern pike	9%	6%	8%	6%	23%	13%	14%	10%	11%	9%	15%	9%	15%	4%	6%	7%	6%
Walleye	20%	16%	11%	27%	24%	25%	20%	17%	19%	34%	22%	17%	23%	22%	28%	32%	27%
White sucker	24%	53%	34%	43%	17%	30%	29%	26%	27%	22%	30%	46%	30%	40%	32%	32%	31%
Yellow perch	26%	5%	1%	11%	5%	14%	7%	5%	8%	16%	7%	10%	7%	8%	6%	11%	12%
Other	9%	10%	10%	8%	9%	12%	26%	38%	17%	13%	20%	16%	15%	12%	19%	10%	14%

Figure 3.1. Catch composition of large-bodied fish species from index gill netting 2008 to 2024.

<u>Walleye</u>

Relative weight

Walleye size classes were analyzed using relative weights to see if any trends could be detected in condition of individual Walleye given changes in community composition, abundance, and fishing pressure. As seen in Figure 3.2, Walleye relative weight has remained in good condition (> 85), with less volatility in the past 5 years. Stock, Quality, and Preferred fish have averaged relative weights of 87.7, 89.0, and 91.7. Relative weights have returned to around the global average.

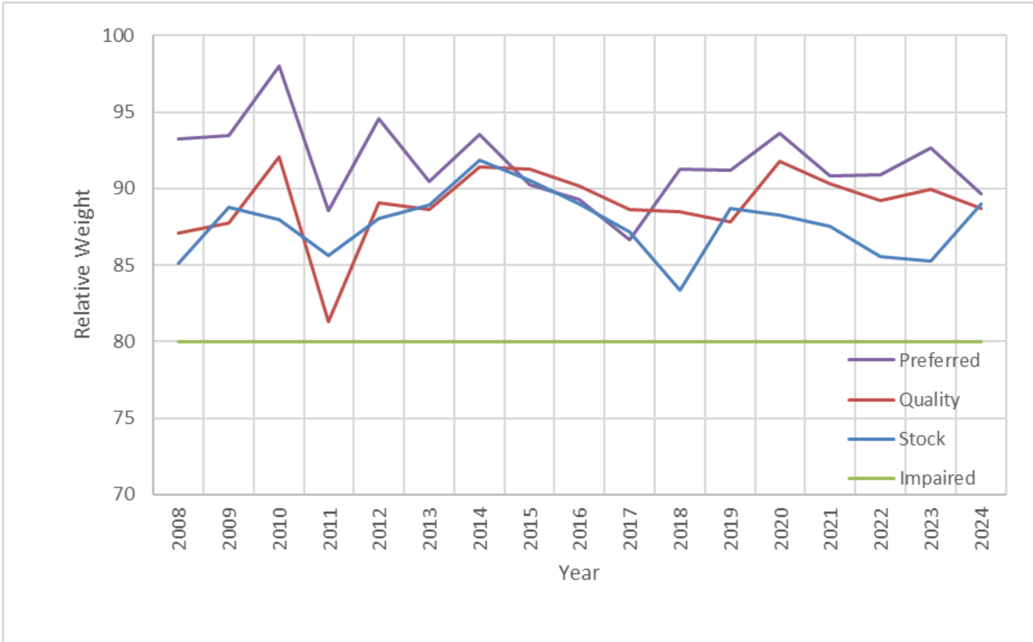


Figure 3.2. Walleye size class average relative weights in Lake Winnipegosis 2008 to 2024.

Growth

From 2019 to 2024, female Walleye grew quickly until maturity (~age-5). Growth leveled out for some of the remaining survivors, while others continue to grow in a linear trend (Figure 3.3). Walleye growth is faster in the north basin stock than in the south basin stock. Growth coefficients for females in the north basin were 0.211 yr-1 (Table 1). In the south basin stock, growth coefficients for females were 0.236 yr-1 (Table 2). The growth coefficient and modeled length at an infinite age are strongly correlated. In the north stock, female Walleye have an ultimate average length of 688 mm (Table 1). In the southern stock, females top out at an average 635 mm. From 2019 to 2024, the index netting program caught few normal growing Walleye older than ten years. There were older fish of the diminutive growth form in the southern basin, but these were not included in the modeling. Among the groups, the von Bertalanffy growth function was a good fit for female specimens up to 10 years in the north and 8 years in the south. In all cases, older fish were smaller than the model suggested.

Table 1. Parameter estimates of the von Bertalanffy growth function (Equation 2) by percentile for north basin female Walleye. n eff is the number of effective samples and $\hat{\boldsymbol{r}}$ is the potential scale reduction factor.

Parameter	mean	se_mean	sd	2.50%	25%	50%	75%	97.50%	n_eff	Rhat
Linf	687.92	0.14	8.66	671.48	681.81	687.83	693.79	705.01	3914	1.000
k	0.211	<0.01	0.007	0.199	0.207	0.211	0.216	0.225	3635	1.000
L0	123.64	0.06	4.33	115.18	120.66	123.64	126.61	132.08	5785	1.000
sigma	45.67598	0.01572	1.30065	43.21441	44.77232	45.64461	46.53865	48.33012	6844	1.000

Table 2. Parameter estimates of the von Bertalanffy growth function (Equation 2) by percentile for south basin female Walleye. n eff is the number of effective samples and $\hat{r}$ is the potential scale reduction factor.

Parameter	mean	se_mean	sd	2.50%	25%	50%	75%	97.50%	n_eff	Rhat
Linf	635.15	0.12	8.972	617.929	628.952	635.000	641.251	652.936	5494	1.001
k	0.236	<0.01	0.009	0.219	0.230	0.236	0.242	0.253	5091	1.001
L0	125.403	0.05	4.503	116.444	122.349	125.440	128.471	134.167	7064	1.000
sigma	62.753	0.018	1.576	59.800	61.668	62.728	63.808	65.973	7376	1.000

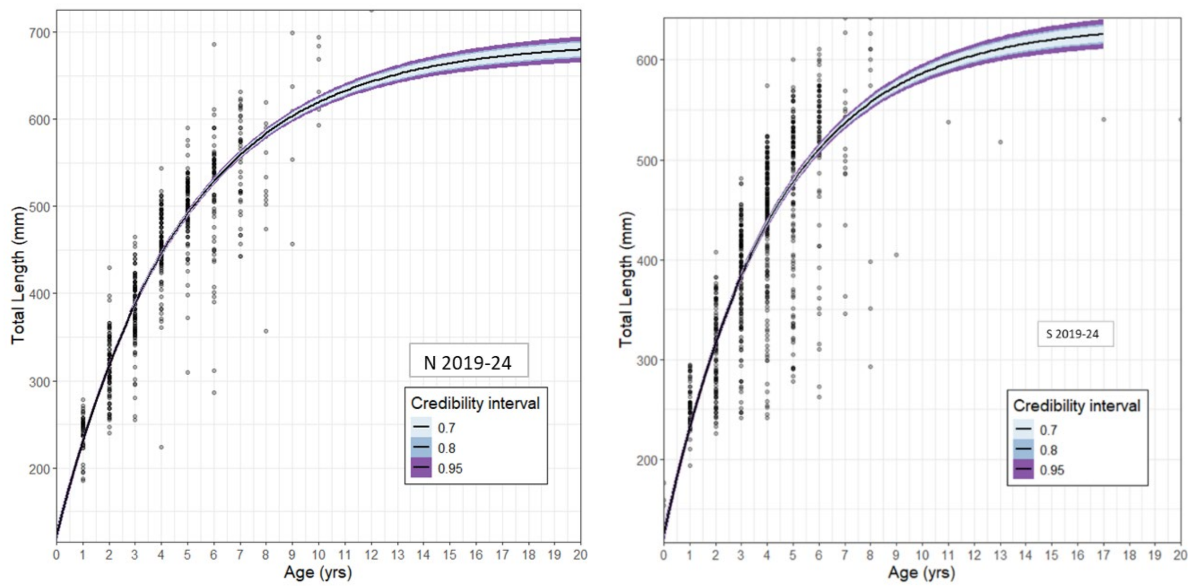


Figure 3.3. Von Bertalanffy growth function of female Walleye total length at age from Lake Winnipegosis (2019 to 2024) north basin (left) and southern basin (right).

Abundance

Relative abundance of all Walleye (Figure 3.4) and mature Walleye (>450mm) (Figure 3.5) are in good condition but are quite variable year-to-year depending on recruitment and intensity of commercial efforts.

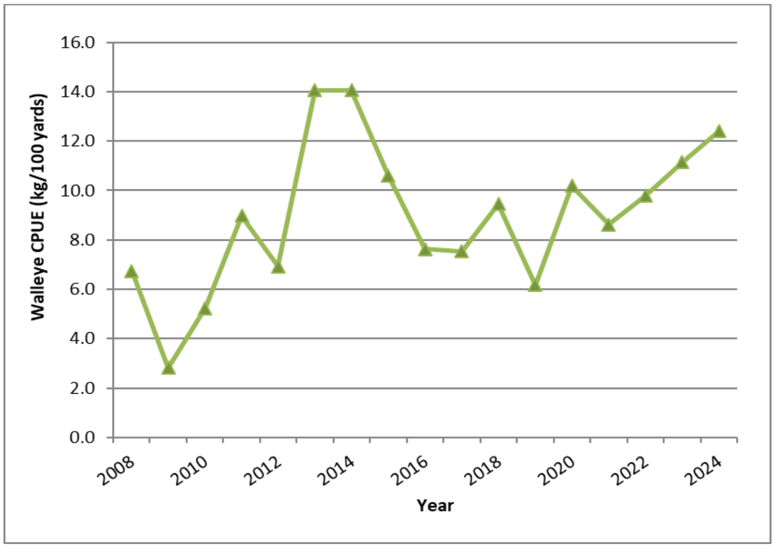


Figure 3.4. Relative abundance of Walleye from annual monitoring on Lake Winnipegosis, 2008 to 2024.

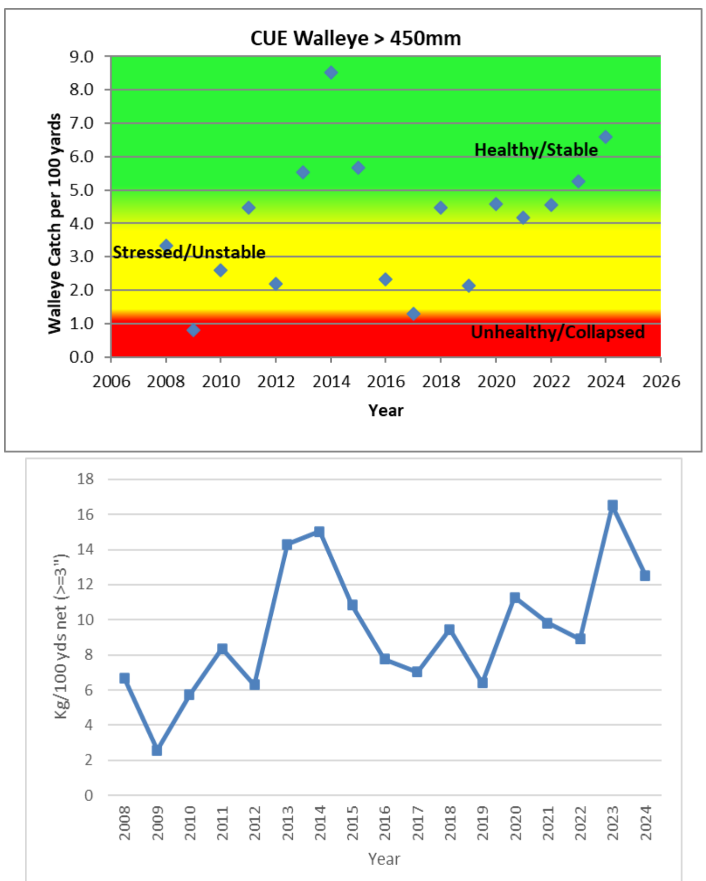


Figure 3.5. Relative abundance of mature Walleye (>450mm, male and female) from annual monitoring on Lake Winnipegosis, 2008 to 2024 (left); and weight of Walleye from 100 yards of index gillnet 3" and greater, 2008 to 2024 (right).

Biologically, mature female Walleye are considered to be more important than mature males for the production of future year-classes. The relative abundance of immature and mature female Walleye in Lake Winnipegosis increased in 2024 (Figure 3.6). Biomass of mature female Walleye catch-per-unit effort has been increasing over the past 15 to 20 years (Figure 3.7).

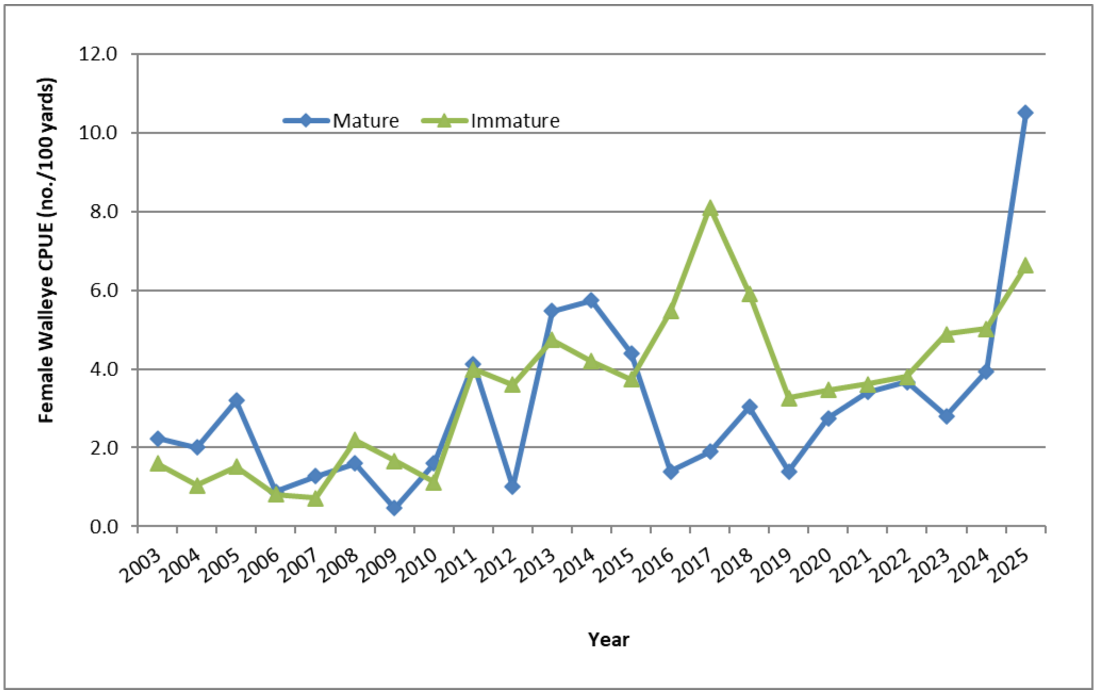


Figure 3.6. Catch-per-unit-effort of mature and immature female Walleye caught during annual monitoring 2003 to 2024.

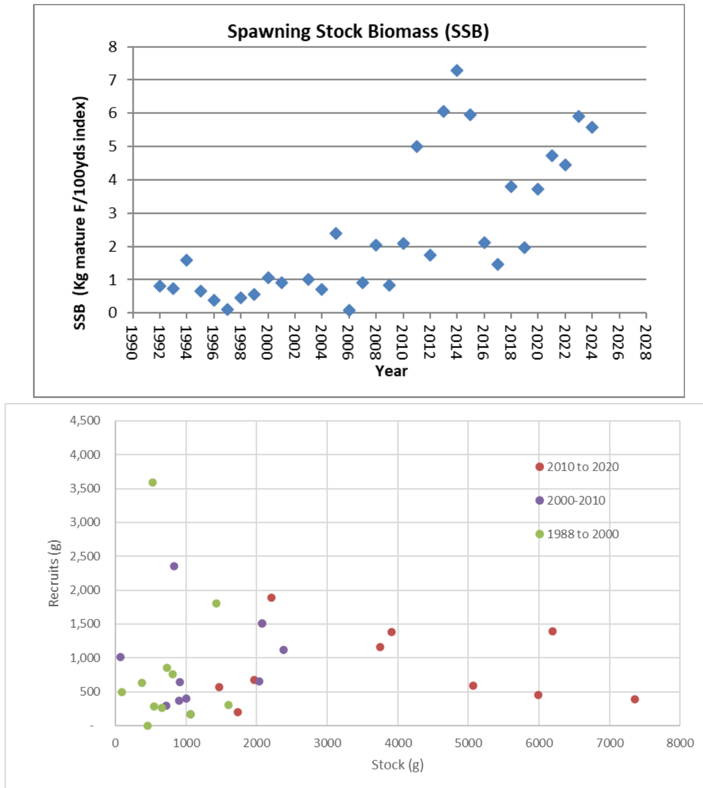


Figure 3.7. Spawning stock biomass of mature female Walleye caught during annual monitoring 1990 to 2024 (left). Stock/recruitment plots of prior decades annual recruitment to ages 4 to 6 (right).

Age composition abundance of the Walleye stock from north and south basins for 2023 and 2024 is illustrated in Figure 3.8. A total of 13 age-classes were caught during 2024 index netting, ranging in age from 0 to 13 years. The difference by basin is evident with stronger year-classes some years in one area and only average in the other. Occasional year-class poor recruitment is also evident, like the 2021-year-class (age-3 in 2024 histogram).

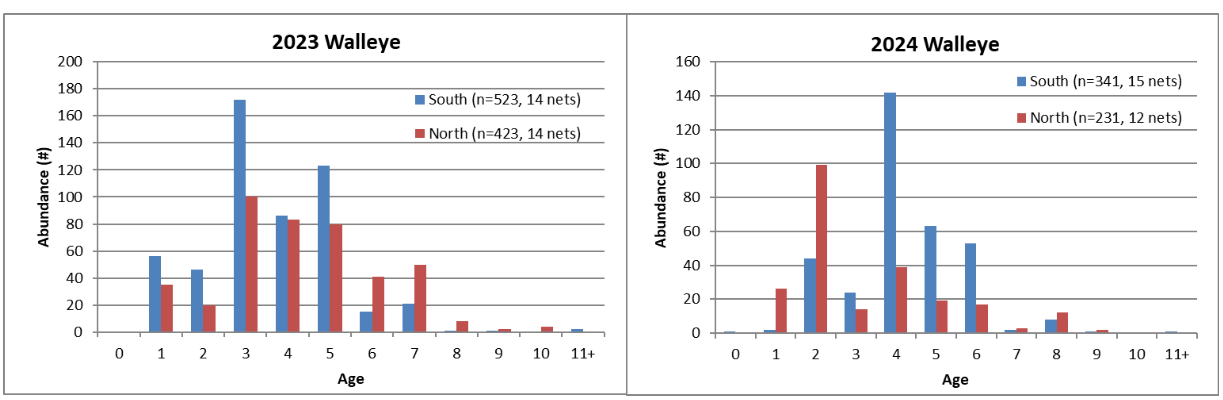


Figure 3.8. Walleye age-class abundance from 2023 (left) and 2024 (right) index netting by basin.

Prior generations' Walleye age demographics were not as healthy as current stocks as they were quickly cropped off upon entry to the fishery at age-4 to age-5, or even sooner during years when the 3" perch fishery operated (1987-2006) (Figure 3.9).

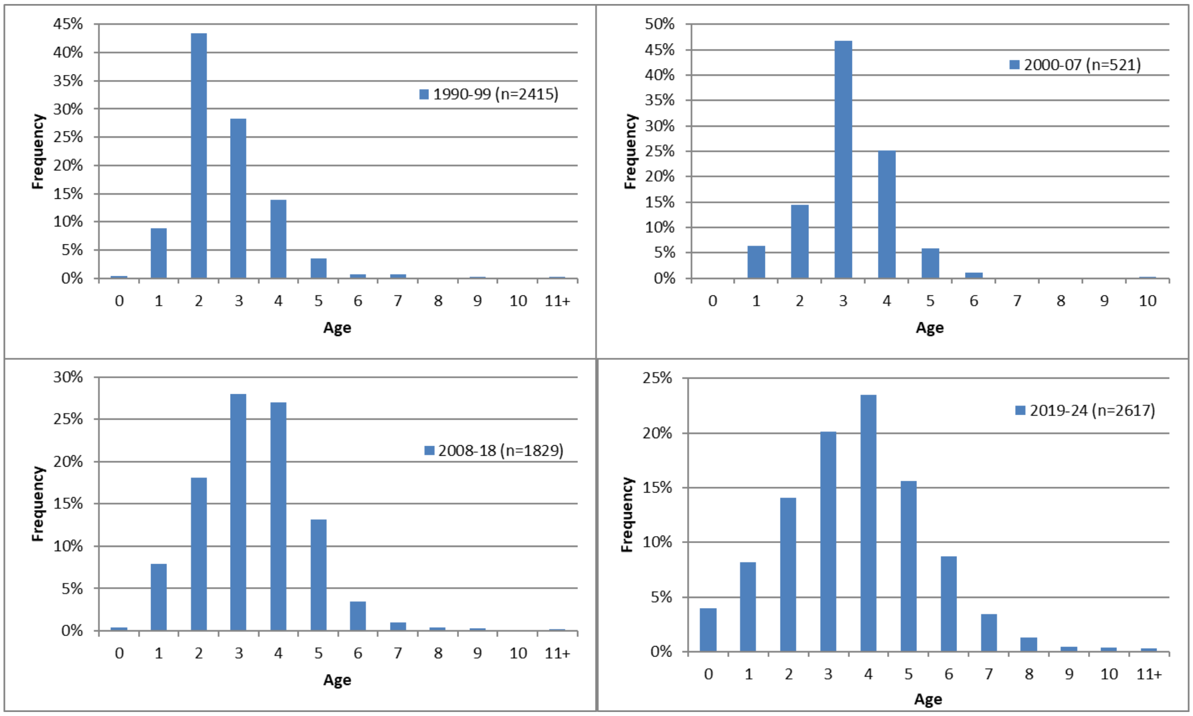


Figure 3.9. Age composition of Walleye from 1990 to 1999*, 2000 to 2007, 2008 to 2018, and 2019 to 2024 Lake Winnipegosis index gillnet surveys.[1]

Maturity

In 2024, logistic regression for 50% maturity at age of females had an Age50 of 5.14 years (S.E. 0.107) and Len50 of 464 mm (S.E. 7.85) (Figure 3.10). The predicted total length at 50% maturity (Gangl and Pereira 2003) for Lake Winnipegosis was 470 mm, roughly where the fishery is at.

[1] 5" mesh was not used prior to 2003 index.

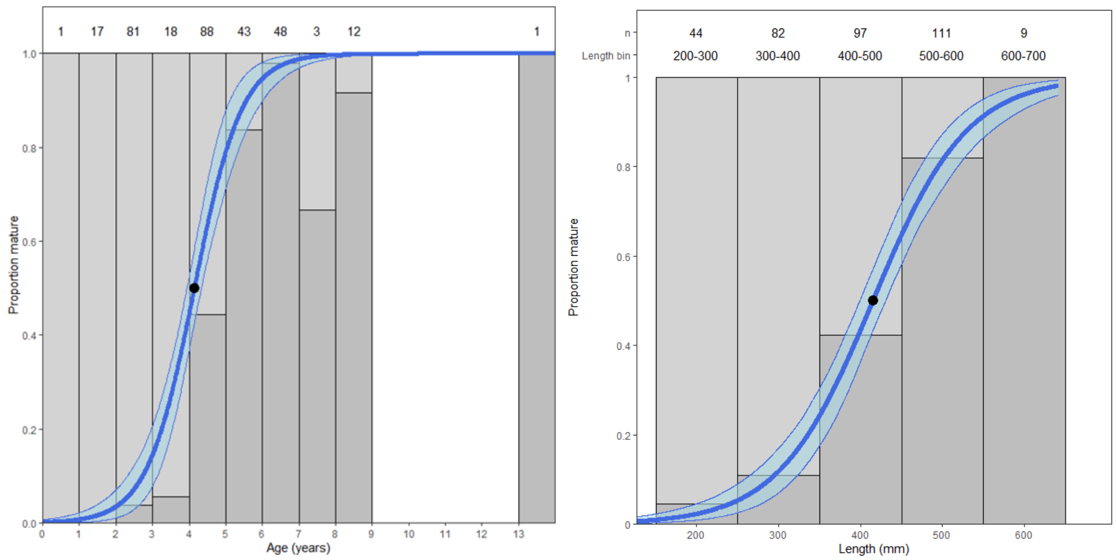


Figure 3.10. Age at maturity (left) and total length at maturity (right) of walleye (females only) from annual monitoring in Lake Winnipegosis, 2024.

In 2024, mean age of mature female Walleye was 5.3 years old (Figure 3.11). Mean age of all Walleye was 3.9 years. The increasing age trend is positive for the fishery.

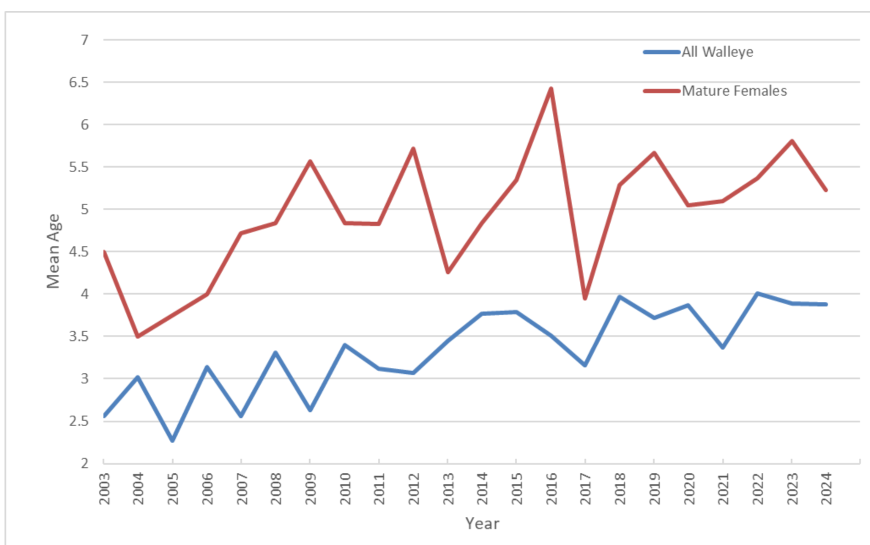


Figure 3.11. Mean age of mature Walleye (sexes combined and females only) from 2003 to 2024.

Mortality

The Natural Mortality Tool suggest a higher natural mortality than expected for some model estimates. The median value of mortality rates in lake-wide stock is M = 0.292 (Figure 3.12). Hamel and Cope (2022) developed a method to generate a weighted mean estimate of mortality. The weighted mean value of natural mortality was M = 0.31, with credibility intervals from 0.30 to 0.32.

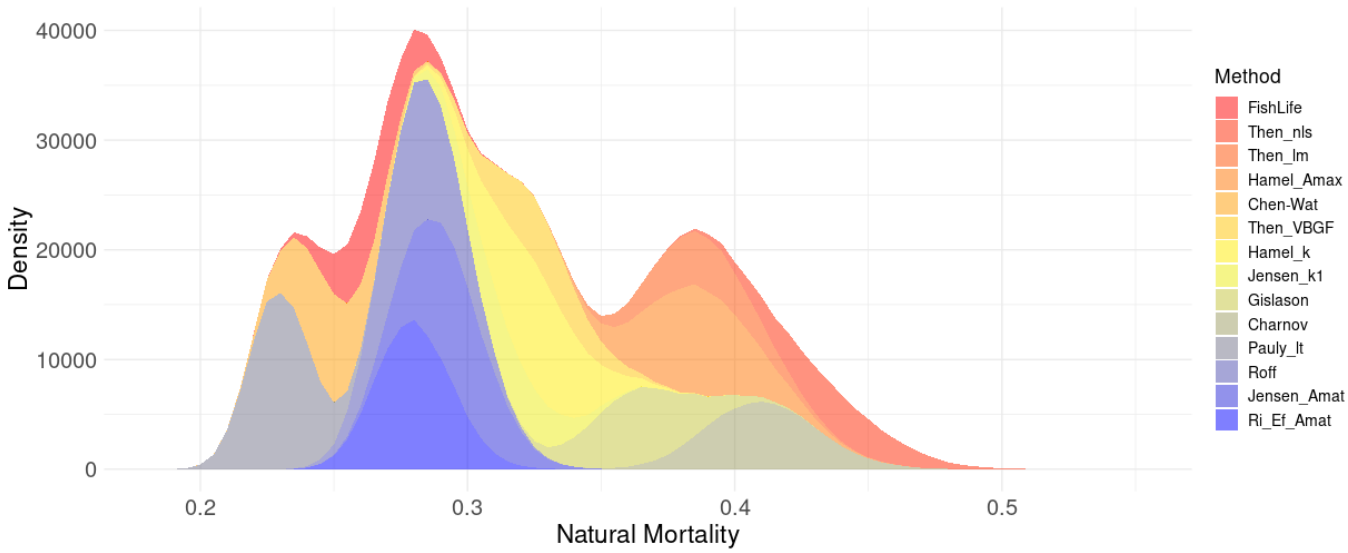


Figure 3.12. Composite of thirteen estimates of natural mortality rates for female Walleye of Lake Winnipegosis. The median estimate is M = 0.31.

Based on 2024 index stock monitoring results, the total mortality rate of Walleye ages 4 to 8 was estimated at Z = 0.7124 (standard error = 0.31359, 95% confidence interval = -0.2855492 - 1.710445). This is equivalent to a total annual mortality rate of A 50.9% (95% C.I. = 33.0% - 81.9%). (Figure 3.13).

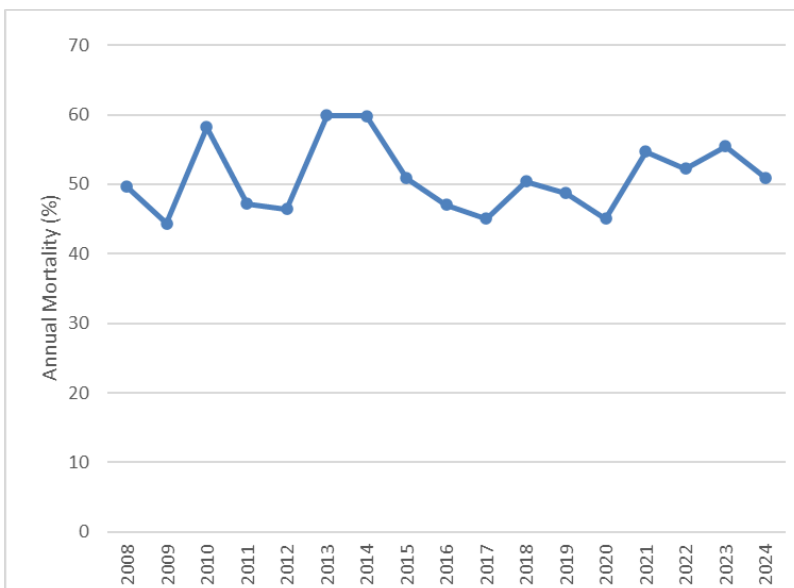


Figure 3.13. Annual mortality of Walleye from annual monitoring on Lake Winnipegosis, 2008-2024.

Using the strong 2016 Walleye year-class, cohort-based mortality seemed to be a better estimate that takes the variable recruitment factor out of the equation. The eight years following this age-class provided a regression of ages 4 to 8 estimated mortality of 43.5% mortality in the south and 49.5% in the north.

Spawning Female Age Diversity

Spawning female Walleye of different ages confer different fitness to their eggs due to differences in egg size and quality (Johnson et al 2012). As seen in Figure 3.14, there have been occasional years when index netting effort or total catch has been insufficient to find enough older mature females, resulting in an isolated year poor 'H' score. The rest of the 2008 to 24 time series has scores around the healthy-stressed threshold.

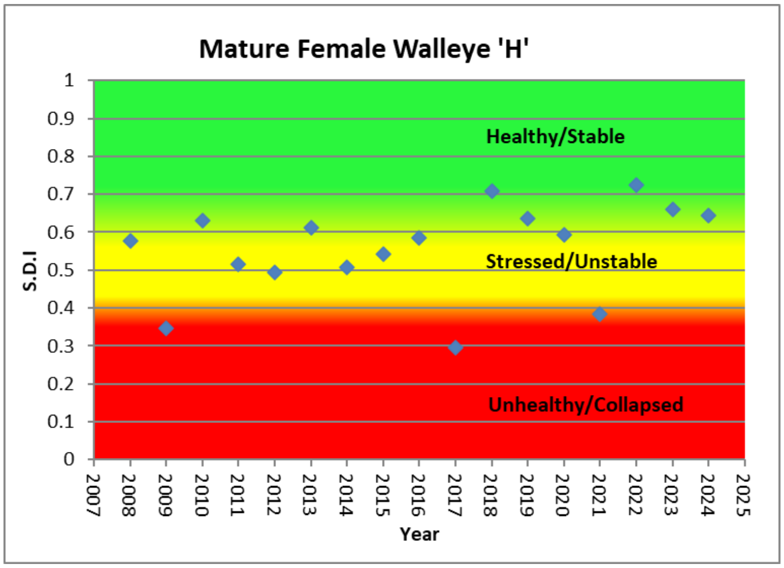


Figure 3.14. Spawning stock diversity index of mature female Walleye in Lake Winnipegosis 2008 to present.

Walleye Stock Status Relative to Recruitment Impairment

The SPR function at MSY was lower than the F20% threshold when using a higher estimate of the von Bertalanffy growth coefficient for K (2019 to 2024 average = 0.28) (Figures 3.15 to 3.17). When using a 2020 to 2024 estimate of K=0.21, the modelled SPR landed at 39%, which is slightly lower than the target reference point of F40% (Figure 3.18). The stock is slightly into the zone where recruitment impairment can occur. Below F20% threshold is where it is highly likely that recruitment impairment is occurring. Commercial fishing mesh size selectivity are greater than the length at maturity, which is positive. Walleye will spawn at least one or two times before potentially being caught (Figure 3.16).

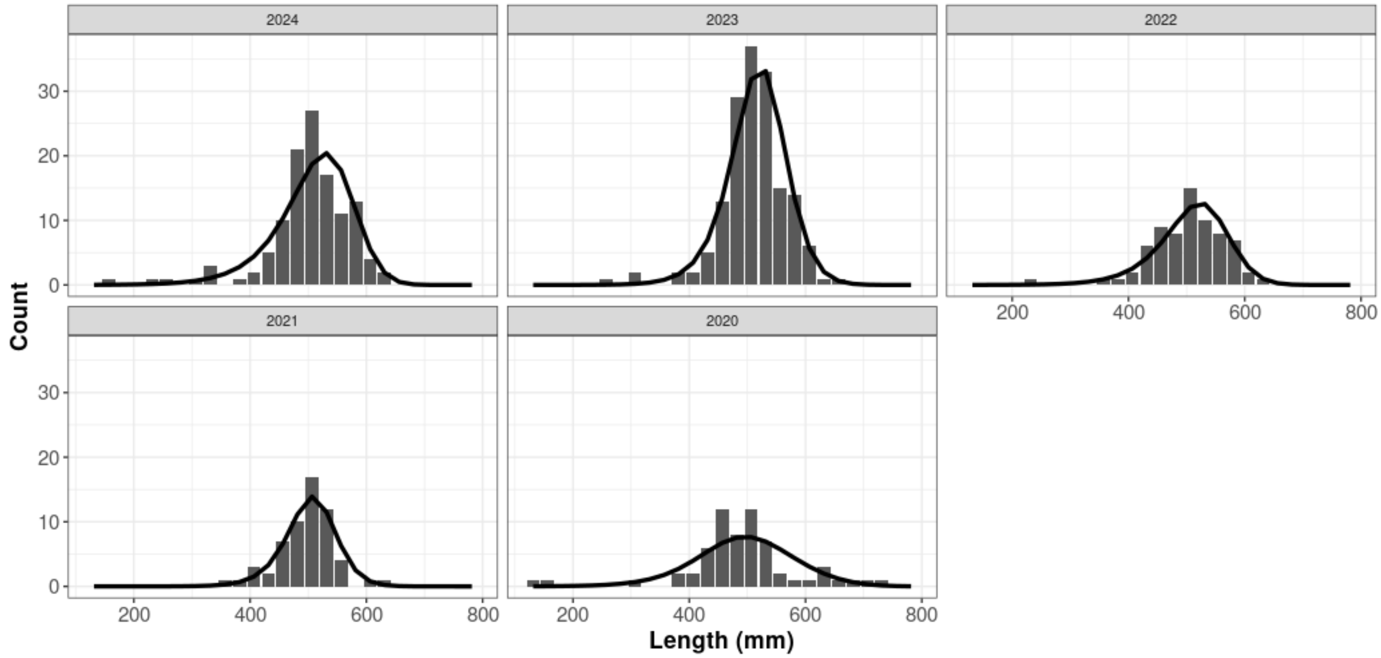


Figure 3.15. Histograms of length selectivity data for Lake Winnipegosis Walleye (2020-2024).

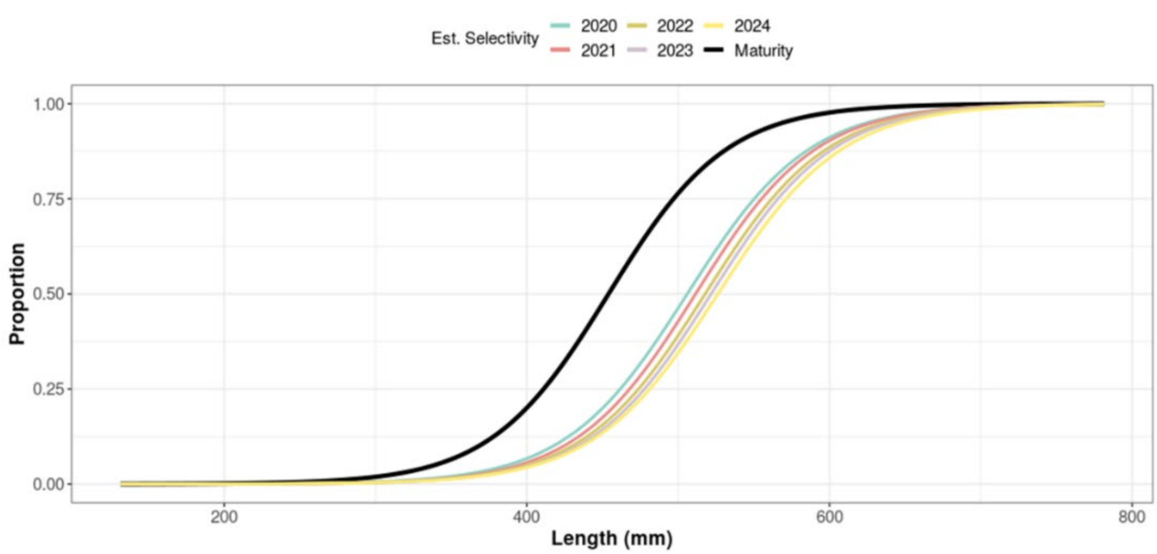


Figure 3.16. Walleye length at maturity and selectivity from 4” and 4.25” index gillnets (2020-2024).

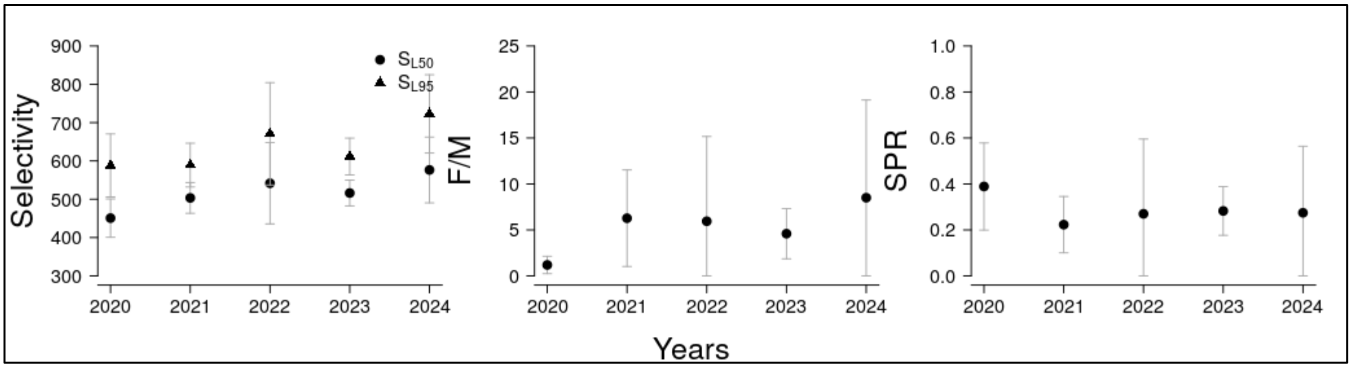


Figure 3.17. Length Based Selectivity, Fishing Mortality (F)/Natural Mortality (M), and SPR Estimates by Year (with 95% confidence intervals).

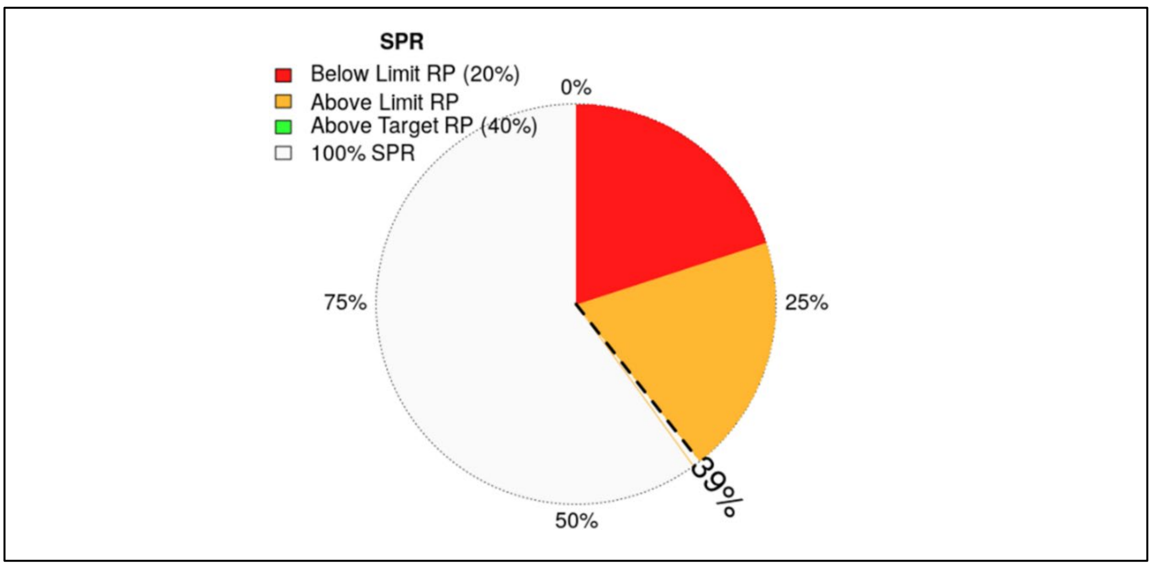


Figure 3.18. Estimated Spawning Potential and Reference Points for Lake Winnipegosis Walleye. The orange line represents the target reference point of $F_{40\%}$. The black-dash line (z-current) is the current SPR (2020-24).

Walleye Surplus Production Modeling

Surplus production modelling was conducted using commercial harvest and a combination of geometric mean summer and winter delivery CUE from the commercial harvest and CUE from the Index program. A Bayesian Schaefer model in the CMSY++ package (Froese et al. 2023) was used for the period of 1997 to 2024 to gauge the stock status.

The combination produced a median estimate of the intrinsic growth rate (r) of 0.338 (95% C.I.: 0.248 – 0.457). The median estimate of the carrying capacity (K) is 3,777,000 kg (95% C.I.: 2,486,000 – 6,010,000 kg). The median estimate of catchability (q) is 0.00332 (95% C.I.: 0.00195 – 0.00537).

The model believes with almost complete certainty (99.9%) that the stock size is currently larger than the size required to produce the maximum sustainable yield. The model also believes with 79.1% certainty that the harvest fraction is lower than the rate that would support the maximum sustainable yield (Figure 3.19).

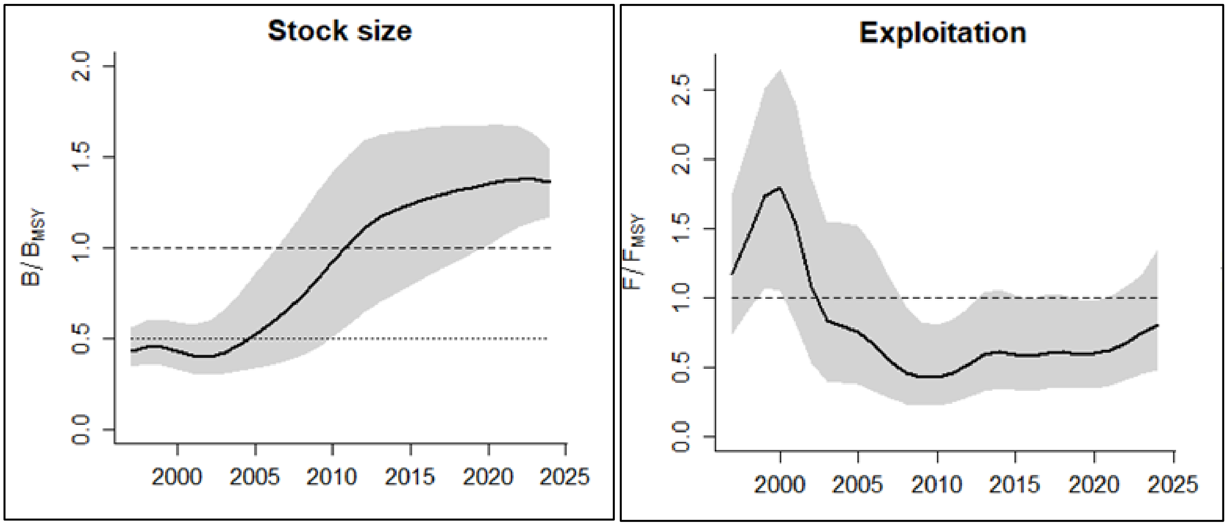


Figure 3.19. Estimated stock size relative to the biomass required for maximum sustainable yield and the estimated harvest rate relative to the rate at MSY for Walleye in Lake Winnipegosis. Shaded areas are the 95% credibility intervals of the estimate.

The most recent 14 years of fishing (2011 to 2024) demonstrated slightly higher CUEs than what had been a stretch of flat CUEs from 2006 to 2011. The model had no trouble straddling the jumps in CUE and never found any unacceptably high/low residuals (>3 standard deviations (s.d.)) from the model (Figure 3.20).

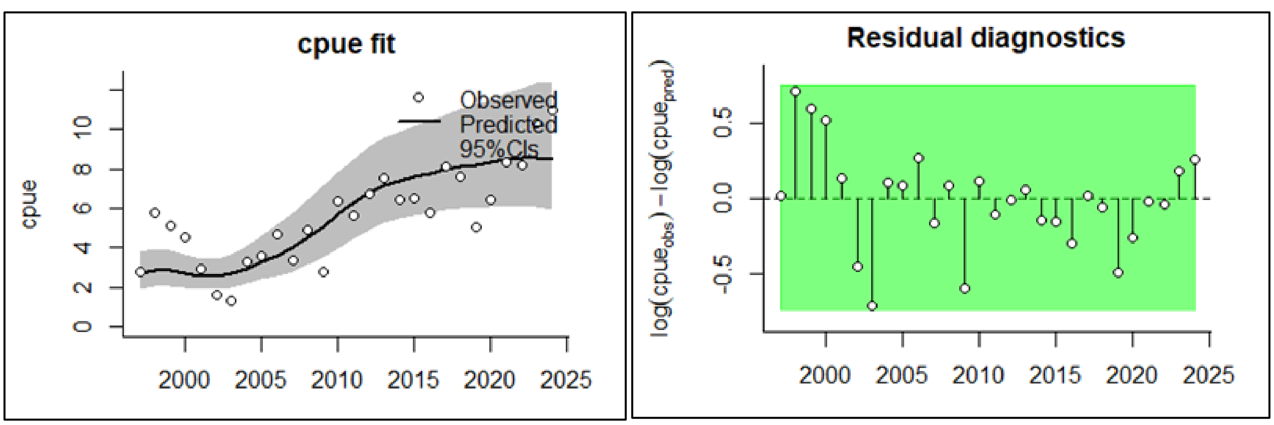


Figure 3.20. Left panel shows the model fit of catch per unit effort data to total catch (open circles are the CUE combination of geometric mean weights (kg) of Walleye deliveries and index netting CUE). The shaded area represents the 95% credibility interval of the model. Right panel shows the residuals of the model fit from the left panel.

The model suggests that the maximum sustainable yield for Walleye in Lake Winnipegosis is 318,000 kg (95% credibility interval = 246,000 – 437,000 kg). If this is accurate, it is slightly above where the production has varied over the past 5 years (310,945 kg average). The biomass required to generate the maximum sustainable yield would be 1,888,000 kg (95% C.I. = 1,243,000 – 3,005,000 kg), and the estimated biomass in the 2024 season was 2,576,000 kg (95% C.I. 1,612,000 – 4,248,000 kg). The relative abundance and harvest rate land the status of the fishery in the 'not overfished' and 'overfishing not occurring' quadrant of stock status. The trajectory of the fishery suggests the Lake Winnipegosis Walleye fishery has been in the quadrant since 2011 (Figure 3.21).

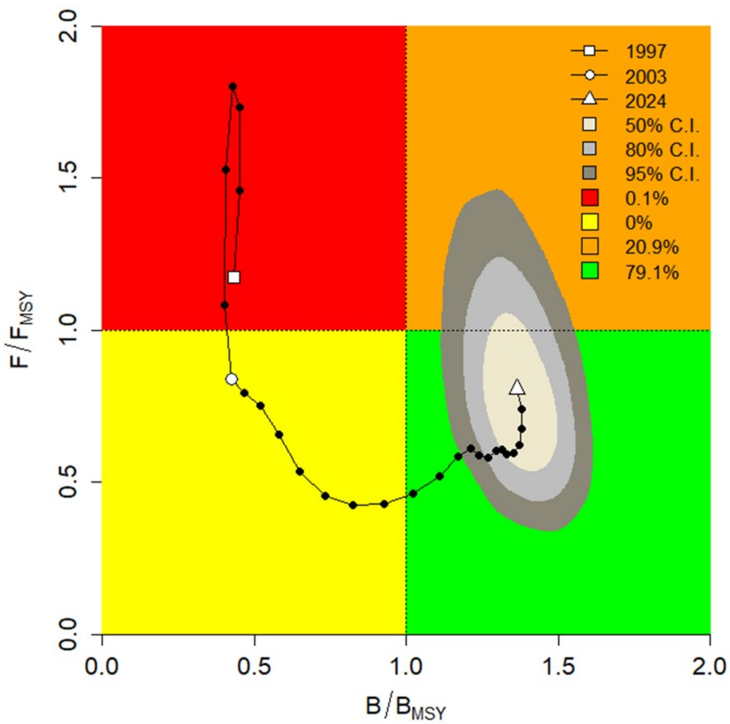


Figure 3.21. Kobe plot of Bayesian Schaefer surplus production model of Winnipegosis Walleye using index of abundance from the daily catch records.

Northern Pike

Relative Weight

Relative weights of pike size-classes were analyzed to see if any trends could be detected in health of size class pike given changes in community composition, abundance, and fishing pressure. As seen in Figure 4.1, Northern Pike relative weight declined in 2024, resuming the general decline for quality and preferred size-classes, but are still in good condition (> 85).

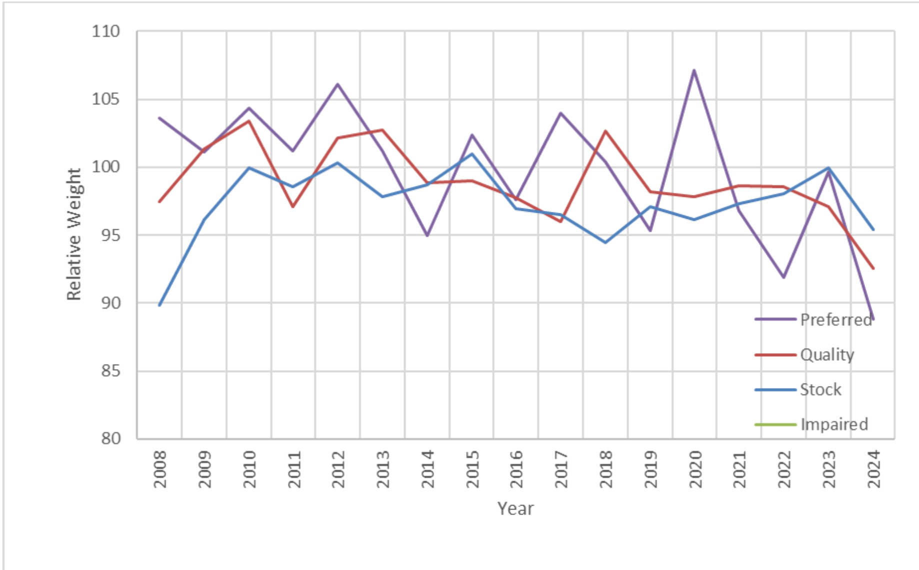


Figure 4.1. Northern Pike size-class relative weights from 2008 to 2024 index netting.

Abundance

Age-class relative abundance of pike is illustrated in Figure 4.2 for north and south populations for 2023 and 2024. A total of six age groups were caught during 2024 index netting, ranging in age from 1 to 6 years. The strong 2022 year-class (age-2) was the most abundant year class in the sample (32%).

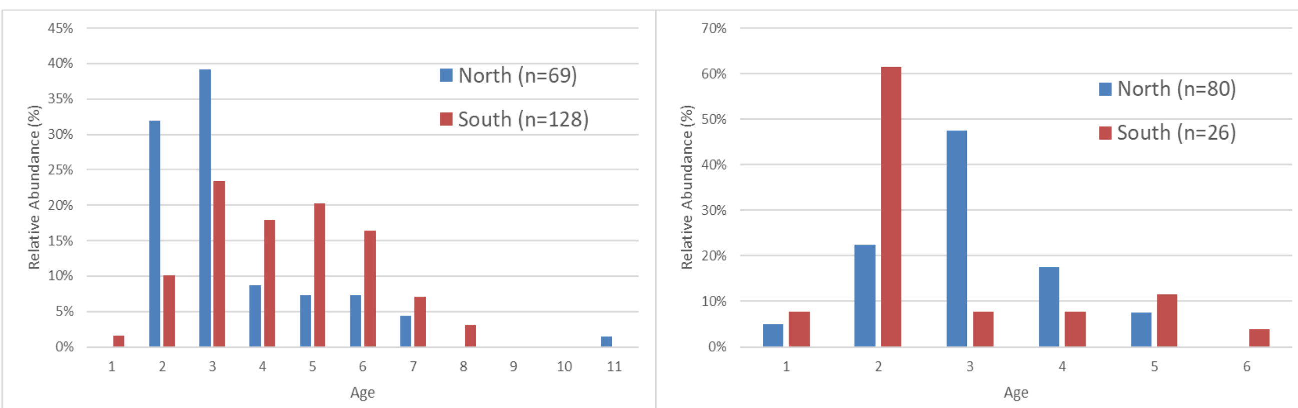


Figure 4.2. Age composition comparison of Northern Pike from north vs. south Winnipegosis 2023 (left) and 2024 (right) index netting.

Prior generations of pike age abundance demographics were sustainable and have improved with time since the 3" mesh perch fishery ended in 2007. Pike are also living to an older age with more fish reaching 6 years of age and older (13%) (Figure 4.3).

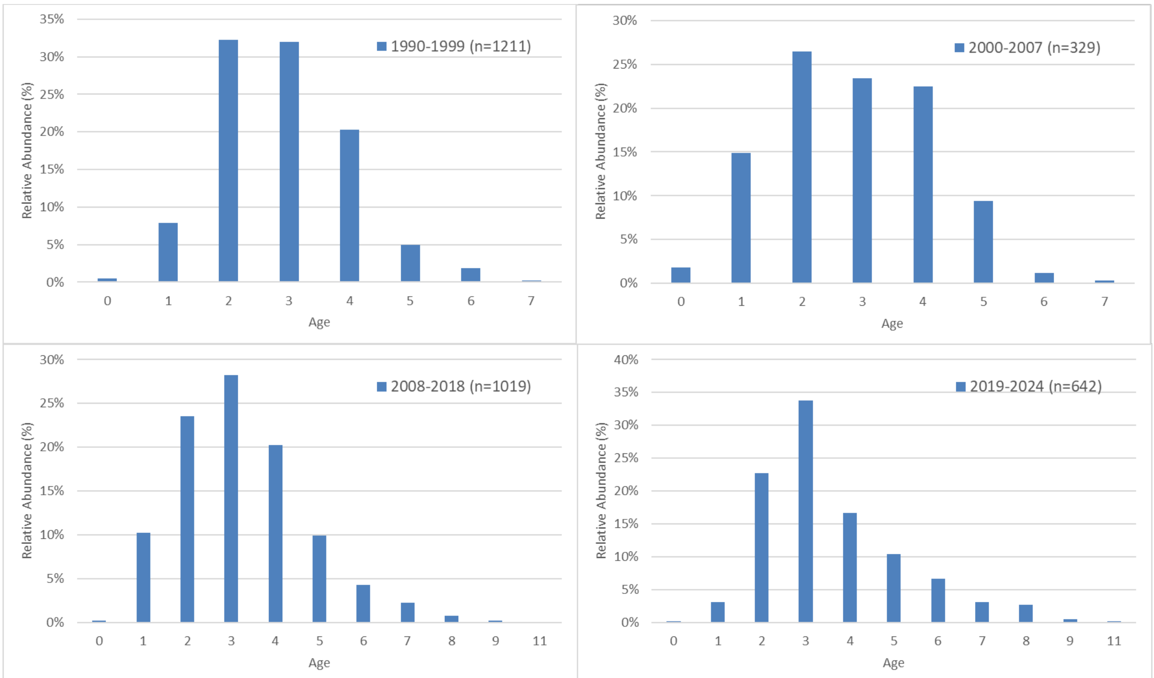


Figure 4.3. Age composition of Northern Pike from 1990 to 1999, 2000 to 2007, 2008 to 2018, and 2019 to 2024 Lake Winnipegosis index gillnet surveys.

Relative biomass of all Northern Pike from index netting peaked in 2014 and subsequently declined but has shown some recovery in 2023 from recent lows (Figure 4.4). The peak and following two years correspond with the success of recruitment during high-water spring levels on the lake starting in 2011 through 2014.

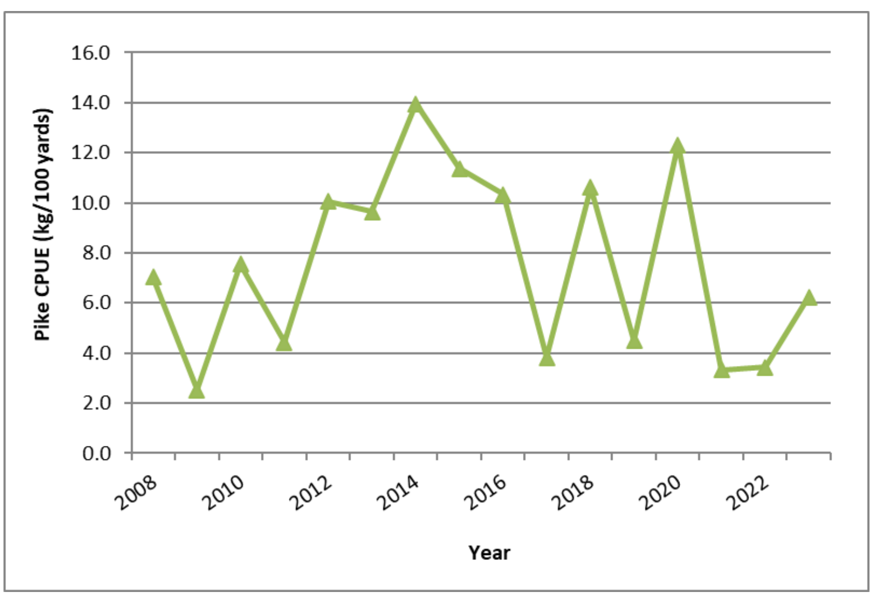


Figure 4.4. Catch-per-unit-effort by weight (kg) of Northern Pike caught during index netting.

Mortality

Based on 2024 stock monitoring results, the annual mortality rate of pike ages 3 to 11 was 51.5% (Figure 4.5). This mortality rate is below the target reference point of 60% annual mortality, and well within the estimated sustainable exploitation rate of 64%.

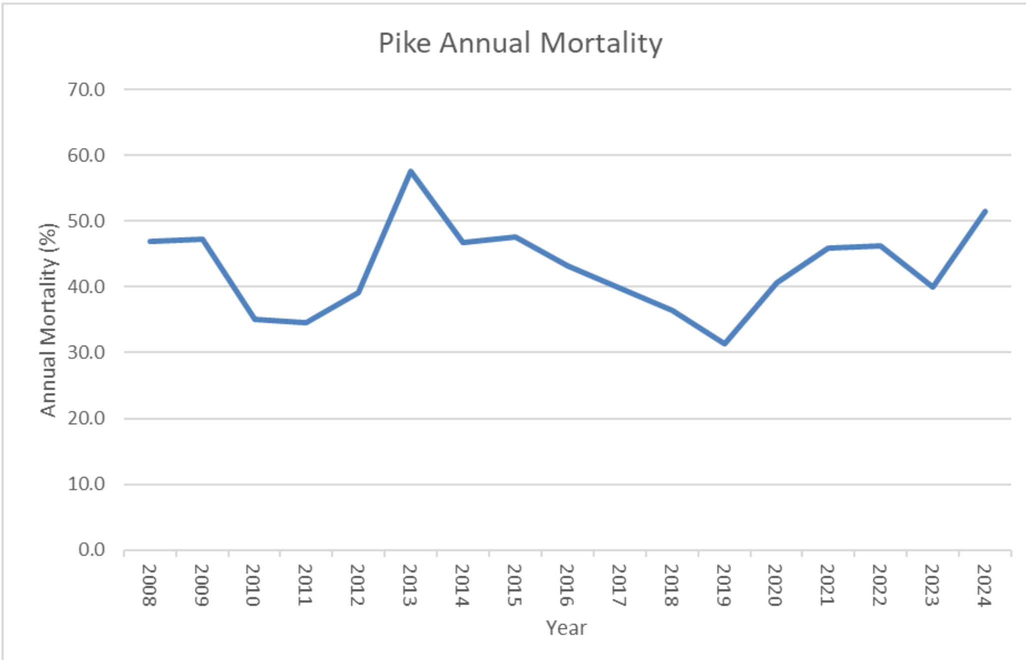


Figure 4.5. Annual mortality of all pike from annual monitoring on Lake Winnipegosis, 2008 to 2024.

Northern Pike Surplus Production Modeling

Surplus production modelling was carried out using 1990 to 2024 commercial harvest production and index netting CUE of pike weights from 3" and larger meshes in the Bayesian Schaefer model in the CMSY++ package to gauge the stock status.

The combination produced a median estimate of the intrinsic growth rate (r) of 0.316 (95% C.I.: 0.183 – 0.538). The median estimate of the carrying capacity (K) is 5,132,000 kg (95% C.I.: 2,943,000 – 9,803,000 kg). The median estimate of catchability (q) is 0.00161 (95% C.I.: 0.000806 – 0.00304). The model believes with a moderate level of certainty (73.8%) that the stock size is currently larger than the size required to produce the maximum sustainable yield. The model also believes with 72.4% certainty that the harvest fraction is smaller than the rate that would support the maximum sustainable yield (Figure 4.6).

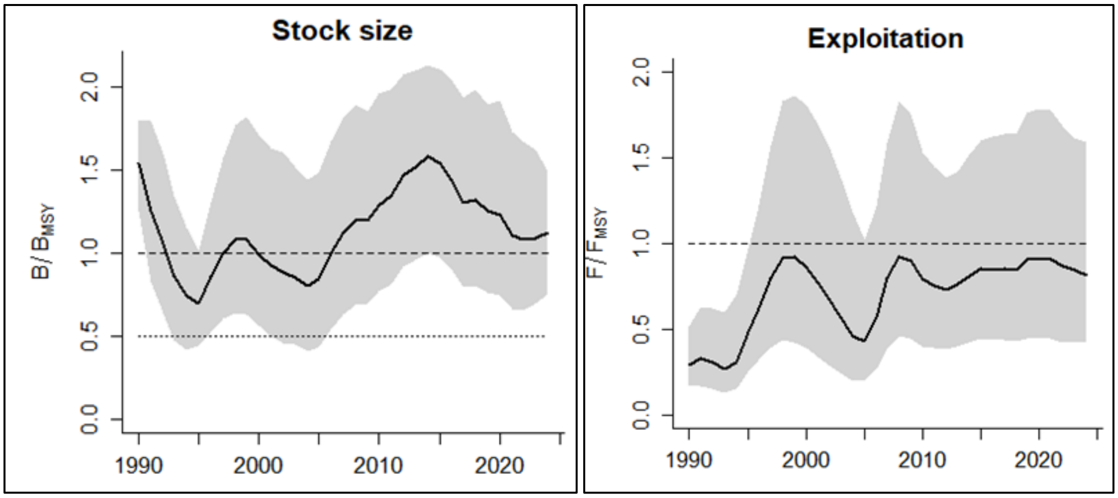


Figure 4.6. Estimated stock size relative to the biomass required for maximum sustainable yield and the estimated harvest rate relative to MSY for pike in Lake Winnipegosis. Shaded areas are the 95% credibility intervals of the estimate.

The entire time series demonstrated somewhat variable catch rates in relation to CUE index values. The high index catches from 2013 to 2015 did not result in much of an increase in fishery yield. The model had no trouble straddling the jumps in CUE and passed a runs test (Figure 4.7).

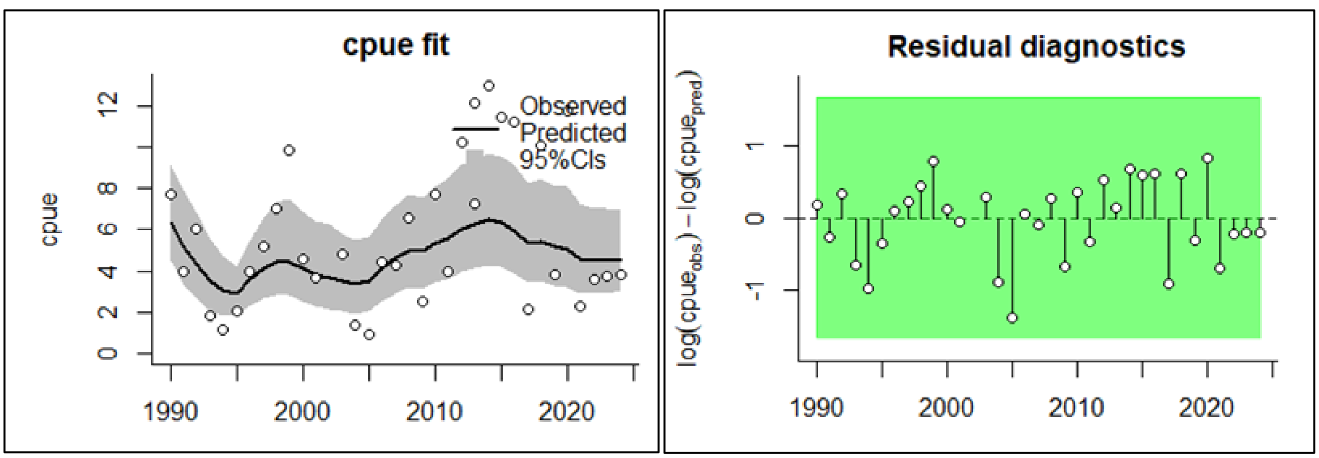


Figure 4.7. Left panel shows the model fit of catch per unit effort data to total catch (open circles are the mean weights of pike from mesh sized 3" and larger from annual index nets). The shaded area represents the 95% credibility interval of the model. Right panel shows the residuals of the model fit from the left panel.

The model suggests that the maximum sustainable yield for Northern Pike in Lake Winnipegosis is 407,000 kg (95% credibility interval = 292,000 – 601,000 kg). This is approximately where the production has varied for the past 8 years (average = 410,416 kg). The biomass required to generate the maximum sustainable yield would be 2,566,000 kg (95% C.I. = 1,471,000 – 4,901,000 kg), and the estimated biomass in the 2024–25 season was 2,871,000 kg (95% C.I. 1,448,000 – 5,955,000 kg). The relative abundance and harvest rate land the status of the fishery in the 'not overfished' and 'overfishing not occurring' quadrant of stock status. The trajectory of the fishery suggests the Lake Winnipegosis pike fishery has been in that quadrant since 2007 (Figure 4.8).

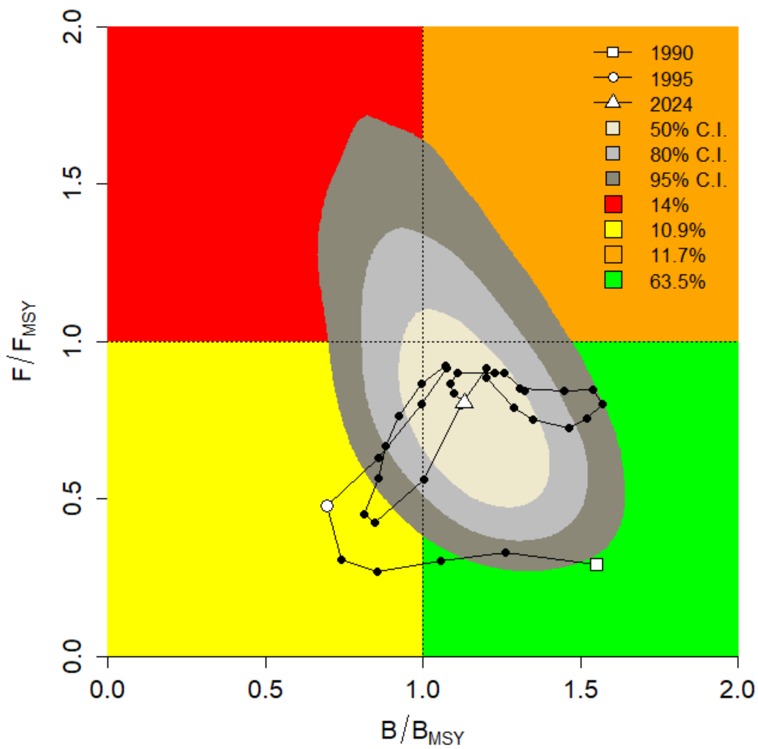


Figure 4.8. Kobe plot of Bayesian Schaefer surplus production model using index of abundance from the annual index netting.

Lake Whitefish

Population Analysis

For most years, the index netting program did not catch enough whitefish to meaningfully assess the abundance, mortality or maturity schedule of the population. With increased netting effort in 2023 and 2024 there were 64 and 58 fish caught and aged, respectively, to analyze the population age composition (Figure 5.1).

Abundance

A total of 10 age groups were caught during 2024 index netting, ranging in age from 2 to 11 years. The strong 2018 year-class (age-6) was the most abundant year class in the sample (28.8%).

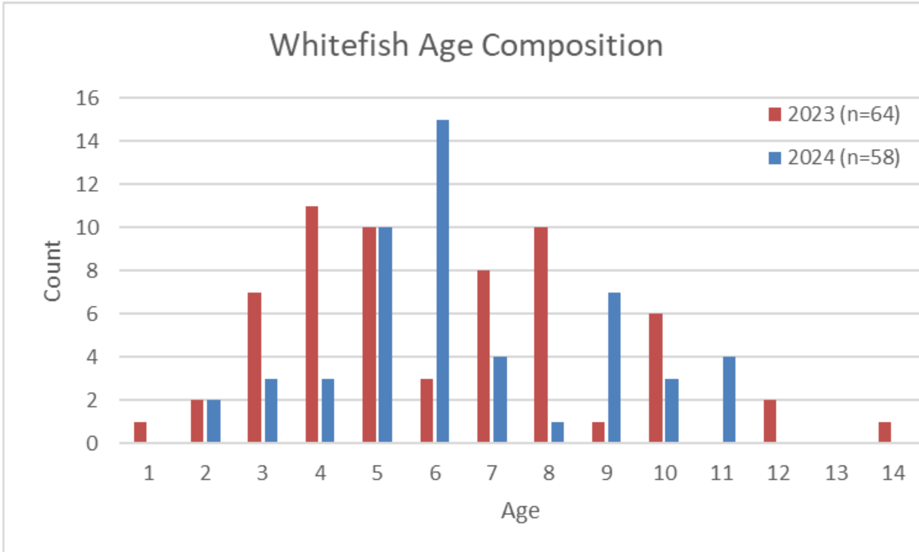


Figure 5.1. Age composition of Lake Whitefish from index gillnet surveys 2023 and 2024.

Mortality

Total mortality rate is 42.7% when looking at the 2008 to 24 period as the species has a limited catch in annual index netting to provide a meaningful estimate.

Lake Whitefish Stock Status Relative to Recruitment Impairment

Spawner potential ratio (SPR) F40% (Clark 1993) compared well with modeled maximum sustainable yield (MSY) (Figure 5.2). The maximum age of whitefish from the limited number aged in the index netting program to date has been 14, but the species is known to live past 20 years, so the SPR was modeled out to that age. The 2019 to 2024 series of index netting were used to construct a catch curve from which current total annual mortality was calculated. The catch curve of whitefish from 2019 to 2024 peaked at age-6. Counts against age on the descending limb of the catch curve were regressed in two parts. Once for ages 6 to 10 where data was abundant, and the fit was good (unweighted coefficient of determination = 0.811), and again for ages 10 to 12 where the fit was less good due to increased susceptibility to the commercial fishing gear and lower abundance (unweighted coefficient of determination = 0.04). Weighted regressions were calculated to reduce the influence of rare older fish on the slope of regressions (Maceina and Bettoli 1998). Weighting increased the estimated total instantaneous mortality rates, because there was a small amount of concavity in the catch curve.

Female weights used in SPR calculations were modeled using all years' data in two phases to reflect pre- and post-maturation differences in somatic growth. The current SPR (z-current=40.7%) is above the target reference point of F40%, but lower that the modelled MSY. The stock is above the point where recruitment impairment would occur.

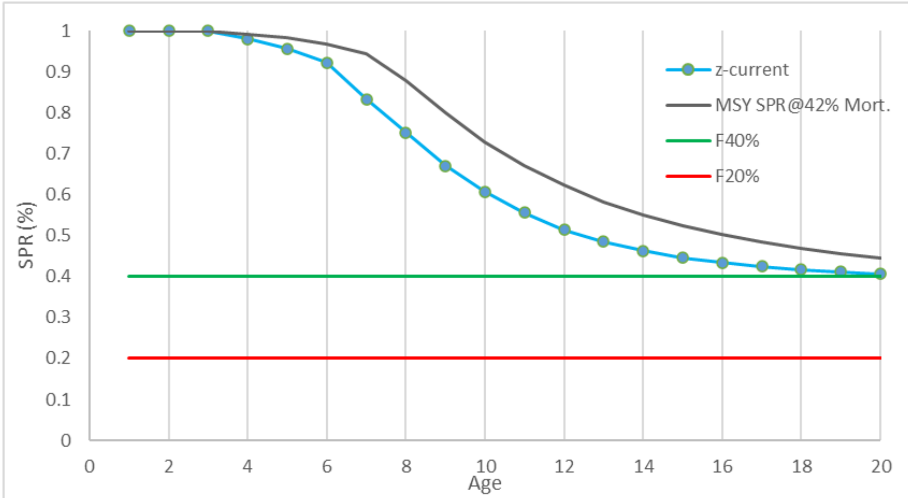


Figure 5.2. Spawner per recruit of Lake Winnipegosis whitefish. The green line represents the target reference point of $F_{40\%}$ and the red line is the limit reference point of $F_{20\%}$. The blue-dotted line (z-current) is the current SPR (2019-24) and the black line is the modelled MSY at 42% mortality.

Lake Whitefish Surplus Production Modeling

The model believes with 84.4% certainty that the stock size is currently smaller than the size required to produce the maximum sustainable yield. The model also believes with some certainty (70.9%) that the harvest fraction is larger than the rate that would support the maximum sustainable yield (Figure 5.3).

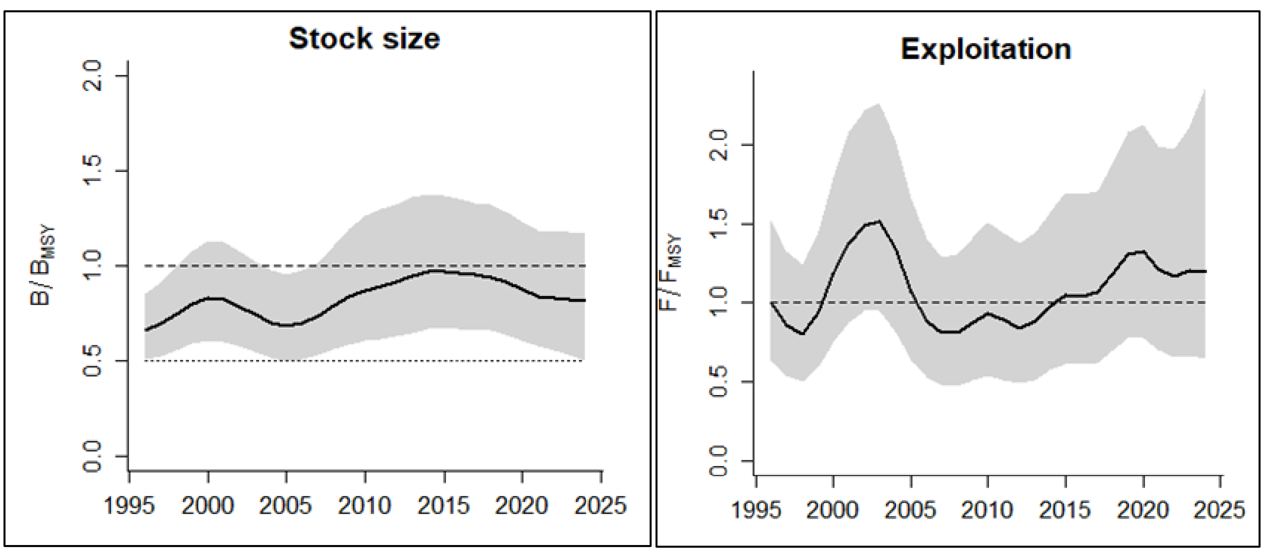


Figure 5.3. Estimated stock size relative to the biomass required for maximum sustainable yield and the estimated harvest rate relative to the rate at MSY for Lake Whitefish in Lake Winnipegosis. Shaded areas are the 95% credibility intervals of the estimate.

The previous nine years of fishing (2016-2024) demonstrated slightly negative trend line of CUEs. The model had some trouble straddling the jumps in CUE and the 2005 residual was more than 3 s.d. from the mean (Figure 5.4).

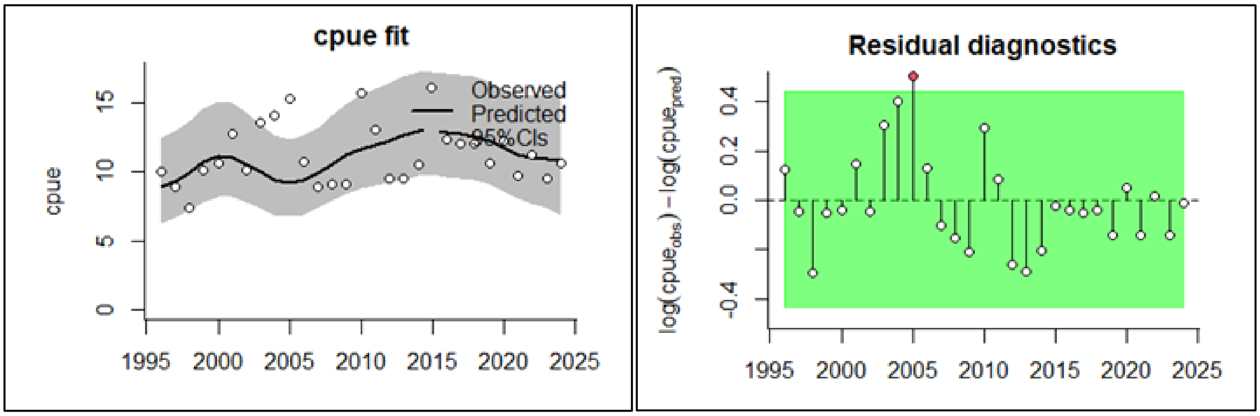


Figure 5.4. Left panel shows the model fit of catch per unit effort data to total catch (open circles are the geometric mean weights of whitefish on daily catch records each year). The shaded area represents the 95% credibility interval of the model. Right panel shows the residuals of the model fit from the left panel.

The model suggests that the maximum sustainable yield for whitefish in Lake Winnipegosis is 60,500 kg (95% credibility interval = 51,600 - 74,500 kg). The biomass required to generate the maximum sustainable yield would be 376,000 kg (95% C.I. = 198,000 – 736,000 kg), and the estimated biomass in 2024/25 was 300,000 kg (95% C.I. = 140,000 – 649,000 kg). The abundance and harvest rate land the status of the fishery in the 'overfished' and 'overfishing occurring' quadrant of stock status. The trajectory of the fishery suggests the Lake Winnipegosis whitefish fishery has been operating in the quadrant the past 6 seasons (Figure 5.5).

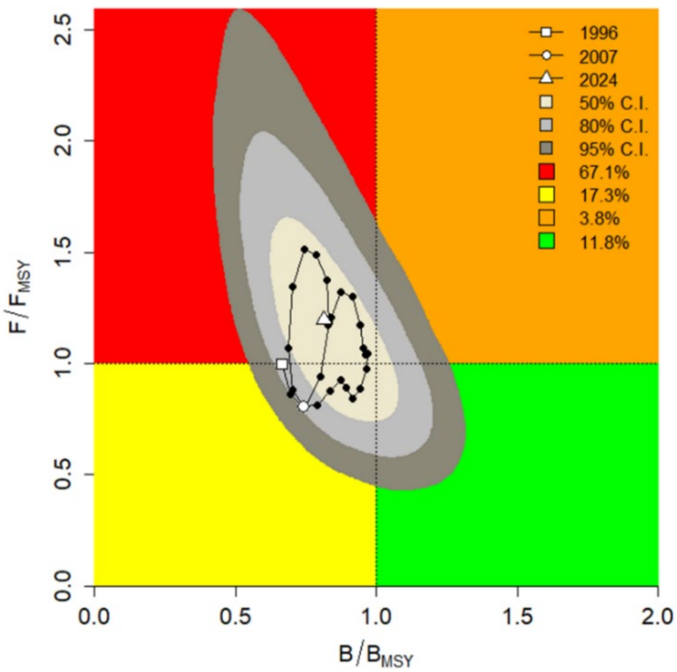


Figure 5.5. Kobe plot of Bayesian Schaefer surplus production model using index of abundance from the commercial daily catch records.

White Sucker/Mullet Population Analysis

Abundance

White Sucker recruitment has been consistent over the past 10 years with well populated age-classes. A total of 17 age-classes were caught during 2024 index netting, ranging in age from 1 to 20 years (Figure 6.1). The strong 2019 year-class (age-5) was the most abundant year class in the sample (21.6%). Total mortality is estimated to be 42.6%. Due to strong and consistent trends in recruitment, that population seems to be able to sustain the high rates of harvest and mortality. It is also a benefit to the primary target species to have lower abundance of sucker, which compete for common food sources when Walleye are young.

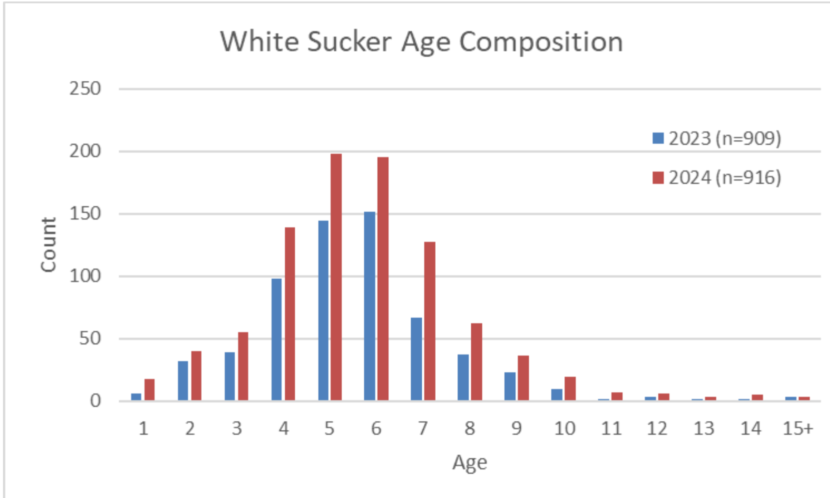


Figure 6.1. Age-class abundance of White Sucker from 2023 and 2024 index gillnet surveys.

White Sucker Surplus Production Modeling

Surplus production modelling was carried out using commercial harvest and index netting CUE of White Sucker and Shorthead Redhorse counts in the Bayesian Schaefer model in the CMSY++ package for the period of 1990 to 2024 to gauge the stock status.

For White Sucker the model believes with complete certainty (100%) that the stock size is currently smaller than the size required to produce the maximum sustainable yield. The model also believes with 59.7% certainty that the harvest fraction is larger than the rate that would support the maximum sustainable yield (Figure 6.2).

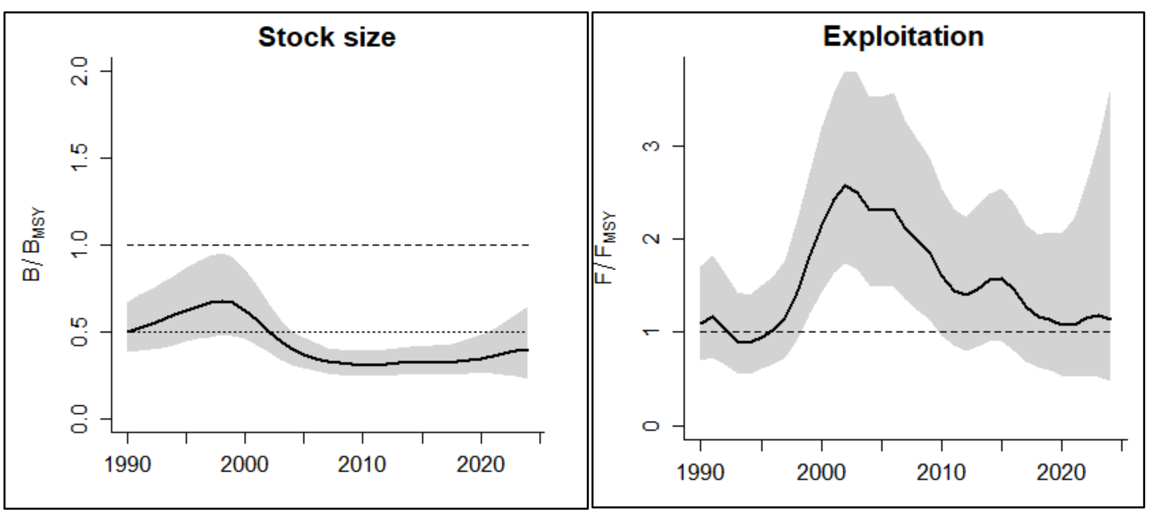


Figure 6.2. Estimated stock size relative the biomass required for maximum sustainable yield and the estimated harvest rate relative to the rate at MSY for White Sucker in Lake Winnipegosis. Shaded areas are the 95% credibility intervals of the estimate.

The previous decade of fishing demonstrated slightly higher CUEs than what had been a period of declining to flat CUEs in the early 2000s. The model seemed to track the jumps in CUE and a runs test found more runs than expected (if randomly positive or negative) and two residuals greater than three standard errors (Figure 6.3).

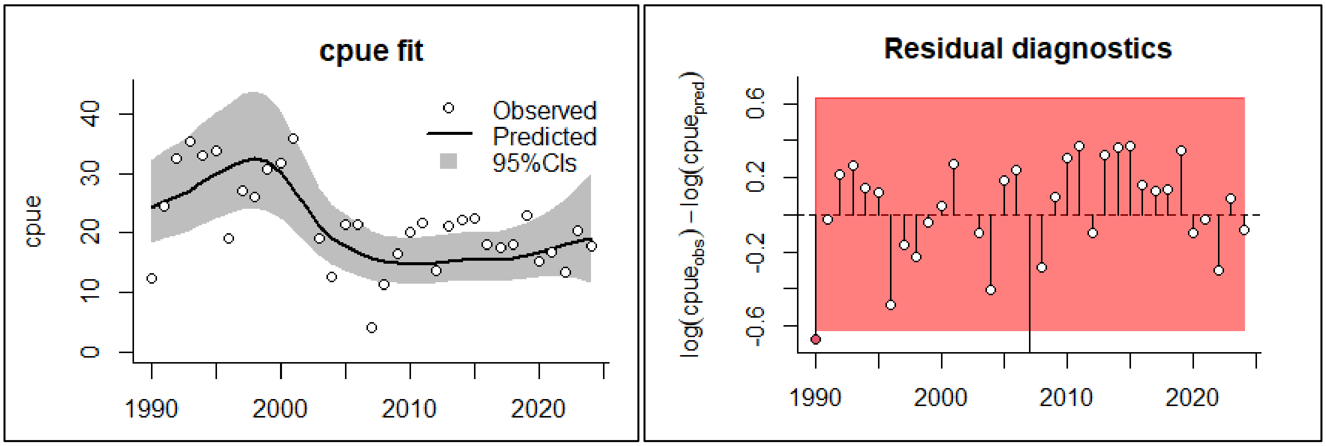


Figure 6.3. Left panel shows the model fit of catch per unit effort data to total catch (open circles are the index netting total count of White Sucker by year). The shaded area represents the 95% credibility interval of the model. Right panel shows the residuals of the model fit from the left panel.

The model suggests that the maximum sustainable yield for White Sucker in Lake Winnipegosis is 1,392,000 kg (95% credibility interval = 1,074000 – 1,914,000 kg). The estimate is more than double where mullet production has been in recent years. The last year mullet production was over one million kilograms was the 2005–06 season. The late 1990s and early 2000s had mullet production peaking at over 2 million kilograms, but the fishery mainly attained these levels of production by operating a spring mullet trap-net fishery in Lake Winnipegosis tributaries. The biomass required to generate the maximum sustainable yield would be 12,717,000 kg (95% C.I. = 7,296,000 – 23,110,000 kg), and the estimated biomass in 2024–25 was 5,088,000 kg (95% C.I. = 2,428,000 – 10,155,000 kg). The relative abundance and harvest rate land the status of the fishery in the ’overfished’ and ‘overfishing occurring’ quadrant of stock status. The trajectory of the fishery suggests the Lake Winnipegosis White Sucker fishery has been in that quadrant for all but three years of the timeseries (Figure 6.4).

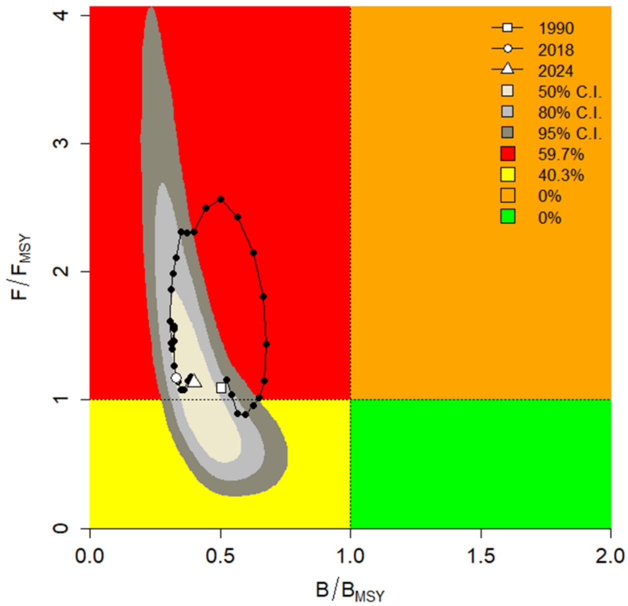


Figure 6.4. Kobe plot of Bayesian Schaefer surplus production model using index of abundance from annual index netting White Sucker counts.

The Shorthead Redhorse population is caught to a lesser degree than White Sucker. The age composition is illustrated in Figure 6.5 for the past two years. A total of 11 age groups were caught during 2024 index netting, ranging in age from 1 to 13 years (n=225). The strong 2019 year-class (age 5) was the most abundant year class in the sample (32%). Total mortality is estimated to be 52%. Due to strong and consistent trends in recruitment, the population seems to be able to sustain the high rates of harvest and mortality.

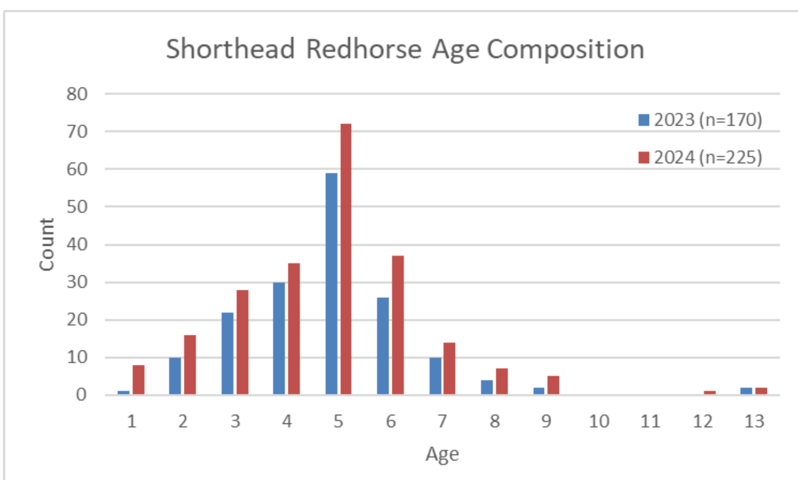


Figure 6.5. Age composition of Shorthead Redhorse from index gillnet surveys 2023 and 2024.

Shorthead Redhorse Surplus Production Modeling

The model believes with 72.1% certainty that the stock size is currently smaller than the size required to produce the maximum sustainable yield. The model also believes with 61.9% certainty that the harvest fraction is smaller than the rate that would support the maximum sustainable yield (Figure 6.6).

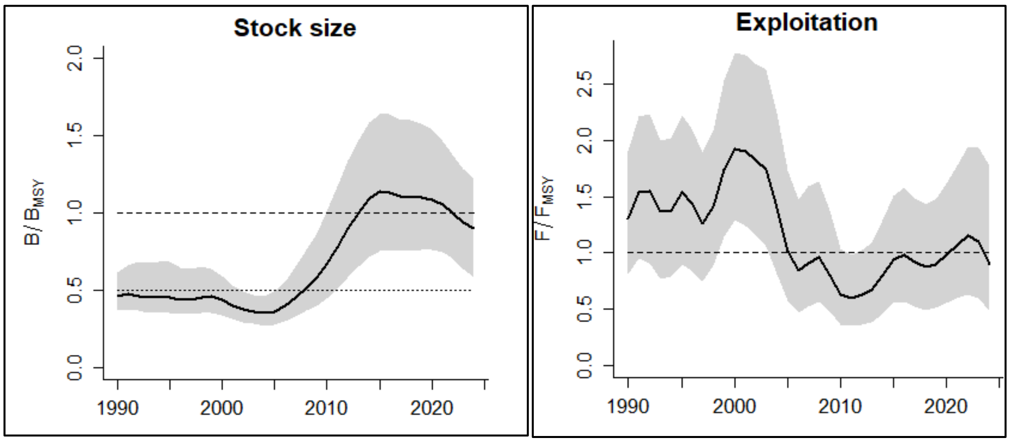


Figure 6.6. Estimated stock size relative the biomass required for maximum sustainable yield and the estimated harvest rate relative to the rate at MSY for Shorthead Redhorse in Lake Winnipegosis. Shaded areas are the 95% credibility intervals of the estimate.

The previous decade of fishing demonstrated slightly higher CUEs than what had been a period of declining to flat CUEs in the early 2000s. The model had some trouble straddling the jumps in CUE and a runs test found two unacceptably low residuals from the model (Figure 6.7).

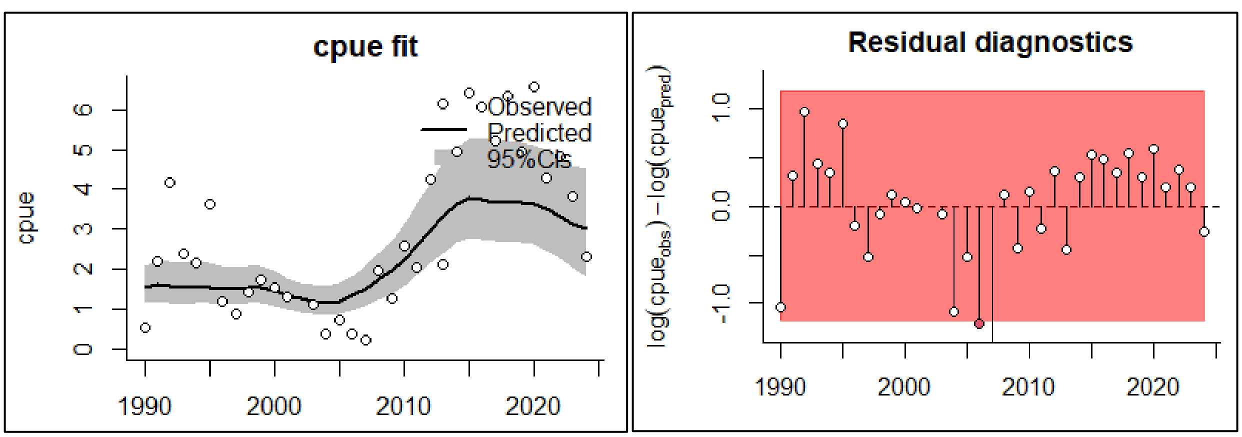


Figure 6.7. Left panel shows the model fit of catch per unit effort data to total catch (open circles are the index netting total count of Shorthead Redhorse by year). The shaded area represents the 95% credibility interval of the model. Right panel shows the residuals of the model fit from the left panel.

The model suggests that the maximum sustainable yield for Shorthead Redhorse in Lake Winnipegosis is 110,000 kg (95% credibility interval = 86,000 – 149,000 kg). The biomass required to generate the maximum sustainable yield would be 552,000 kg (95% C.I. = 318,000 – 1,123,000 kg), and the estimated biomass in 2024 was 503,000 kg (95% C.I. = 227,000 – 1,086,000 kg). The relative abundance and harvest rate land the status of the fishery in the 'overfished' and 'overfishing not occurring' quadrant of stock status. The trajectory of the fishery suggests the Lake Winnipegosis Shorthead Redhorse fishery has been in that quadrant for the past year and has been overfished for most of the time-series (Figure 6.8).

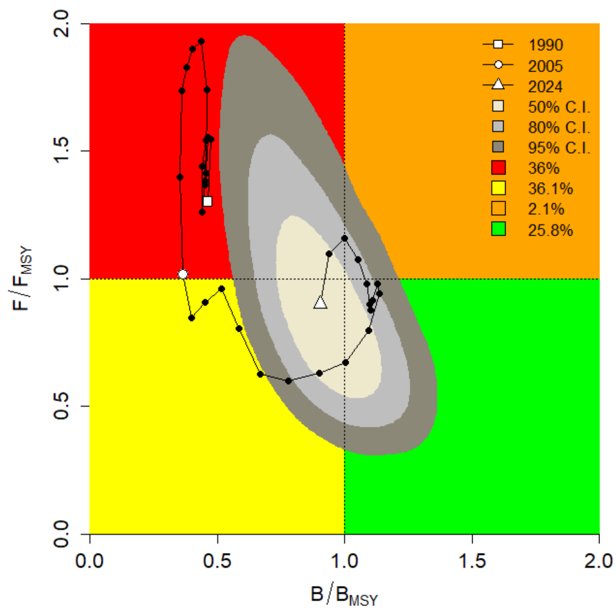


Figure 6.8. Kobe plot of Bayesian Schaefer surplus production model using index of abundance from annual index netting Shorthead Redhorse counts.

Commercial Catch Sampling

Walleye are fully recruited to the fishery around 5-years-of-age based off periodic commercial catch or commercial sized net sampling in the past decade (Figure 7.1).

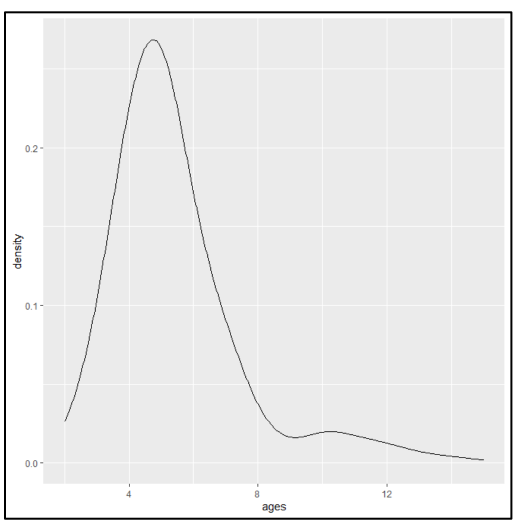


Figure 7.1. Commercial sampling age density of Lake Winnipegosis Walleye from 2015 to 2024.

The age composition of Walleye sampled from the commercial fishery indicated that fish ages 4 to 6 primarily support the fishery. A large percentage of the catch was four-year-old fish for most years sampled (Figure 7.2).

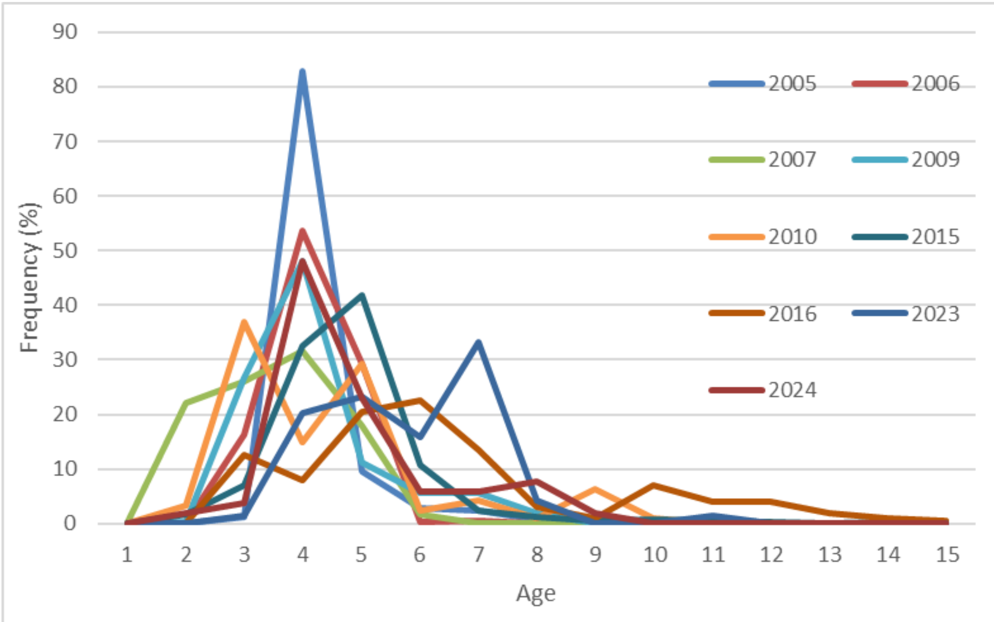


Figure 7.2. Age composition of Walleye from commercial sampling from 2005-2024.

Discussion

Fishing pressure and ecosystem productivity influence the fishery, and having information about each helps in the interpretation of fishery independent biological data. Relative weight is a measure of the weight at a given length of a fish relative to a standard weight. The standard weight has been developed for target species across a variety of populations. Fish with a heavier weight relative to the standard can be considered to have access to abundant resources, or have less competition for limited forage base, whereas a leaner fish might struggle to acquire resources due to lack of system productivity and/or competition. Environmental variability will influence how data can be used to deduce measures such as maturity schedules.

Walleye

Relative weights of south basin Walleye stock have been trending downward slightly, whereas relative weights of the north basin Walleye stock have been increasing slightly. This is likely due to competition from the increased Walleye population and pike in the south as substantial portions of their trophic niches overlap. The north basin Walleye increase could be due to from more nutrient inputs from higher flows in the Red Deer River several times over the past five years, which has also increased recruitment success.

Relative abundance of all Walleye from index netting generally exhibited an upward trend from 2007 to 2024, but south and north basin walleye stocks experienced a period of decline from 2015 to 2019. A total of 13 age-classes (age-0 to age-13) were caught during 2024 index netting. The number of age-classes in the Walleye population (more than 8 age-classes) is one indicator of a healthy stock (Sullivan 2003). This improvement in mature fish age-class abundance has helped to stabilize the population by having more consistent and higher levels of recruitment when ideal conditions are present. A mean age between six to nine years is an indicator of a stable population, in combination with other positive stock status indicators (Sullivan 2003).

The presence of older Walleye in a population is known to result in higher recruitment (Colby and Nepszy 1981; Venturelli et al. 2010). Studies of some marine species with weak spawner-recruit relationships, as Walleye typically exhibit, have also shown that greater age diversity among spawning females has enhanced the spawner-recruit relationship (Marteinsdottir and Thorarinsson 1998). Conditions for recruitment have been favourable during most years over the past few decades, with the increase in spawning stock and diversity of mature female ages combined with above average spring flows and lake levels that can boost spawning success.

The reproductive rate of Walleye populations increases with the mean age of adult female Walleye, in part because older female Walleye produce larger and potentially higher quality eggs (Venturelli et al. 2010). In Lake Winnipegosis, Walleye age-at-maturity is influenced by the strength of mature year-classes, which are 4 to 6 years old. In 2024, age-at-maturity of female Walleye (5.14 years) was slightly above the published threshold of 5.1 years, which is positive based on growing season length (Gangl and Pereira 2003). Female total length at 50% maturity was as expected; females reached maturity at expected length, based on how quickly Walleye in Lake Winnipegosis grew since age-3). Failing to exceed a threshold of a biological performance indicator is considered a negative indicator of stock status.

Walleye metrics were not homogenous throughout the lake. Analysis of Walleye caught in the north basin for the past decade revealed distinct differences in age and size composition. Annual mortality estimates were also consistently lower in the north. This is likely due to the reduced number of fishers that reside in the north, but south/central area summer fishers will occasionally travel to the northern area to fish due to the increased Walleye densities in the north and central portions of the lake.

An increase of the winter total allowable catch to 217,000 kg for the 2024–25 season appears attainable at current time due to large year-classes recruited to commercial fishing gear, fewer active summer fishers, and summer fishers not filling all 98 active quota entitlements (222,460 kg). Only 166,091 kg of summer walleye quota were harvested during the 2024 season. The total 2024-25 quota entitlements for Lake Winnipegosis walleye, minus the 2023-24 overage, results in an annual allowable catch of 402,000 kg. This is well within the MSY plus surplus biomass available for harvest.

A conservative commercial quota of ≤335,000 kg is more inline with current modelled MSY, should pose a low risk to the population once the large year-classes pass the 7-year-old mark and grow to a size less susceptible to entanglement, and should allow the spawning stock diversity to build. Only 102 to 108 mm mesh size gillnets should be used for the Walleye/pike fisheries to help protect the spawning stock.

Northern Pike

The pike population has been relatively steady over the past 10 years and is still in good condition with limited targeted fishing pressure. Fishing pressure increases when the roe condition and market price/demand are optimal during the winter fishing season. Setting the annual pike quota at a high level (500,000 kg) helps keep the population low and prevent predation of the target Walleye fishery.

Whitefish

The whitefish population has been relatively steady over the past 10 years with some occasional poor recruitment, but it is still in good condition with limited targeted fishing pressure. The whitefish stock may appear diminished due to fisher preference for targeting Walleye that have recently become more available due to a growing stock.

White Sucker/Mullet

The sucker population has been relatively steady with good recruitment owing to the resilient nature of suckers, but some sucker species that tend to grow larger (like the silver redhorse) have declined in composition of the mullet catch. Some doubt exists for total commercial production in prior decades due to the unknown amount of sucker ‘bushing’ given their low price relative to other fish, limited fisher capacity for transportation, and limited fisher desire to process and deliver sucker species.

Commercial Catch Sampling

Prior decades sampling efforts (1970s to early 90s) found that Walleye catch recruited at younger ages (age-3 and age-4) or only had those ages available, and age-3 and age-4 walleye made up the majority of production most years at the various locations sampled.

Summary

Walleye stocks in the north and south are being fished at or near sustainable levels. Surplus production modelling found the population is not overfished in recent years and over-fishing is not occurring.
For Northern Pike, the stock is neither overfished, nor is overfishing occurring.

For Northern Pike, the stock is neither overfished, nor is overfishing occurring.

Lake Whitefish stocks are not well known due to low abundance in both index netting programs and commercial production. The limited production information indicates that the stock is overfished, and overfishing is occurring.

Separation of the mullet catch for modeling found that White Sucker were over-harvested, with a slight probability overfishing is occurring. Shorthead Redhorse were doing slightly better with just a slight amount of over-harvest, and over-fishing is not occurring. These harvest levels and stock status over-fishing indicators should be viewed as positive for the target fish communities since there are fewer mullet utilizing the shared food sources.

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