Fisheries Branch Report

2022-23

Lake Winnipegosis

Fish Stock Assessment

Manitoba Economic Development, Investment, Trade and Natural Resources

2023

Manitoba

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Introduction

The Lake Winnipegosis Fisheries Management Plan was developed to effectively manage the fisheries resource of Lake Winnipegosis. The plan sets out an approach to ensure the resource is protected and conserved, provides social/economic benefits to local communities, and ensures the long-term sustainability of the fisheries resource.

The plan will be reviewed and evaluated on an annual basis by Manitoba Economic Development, Investment, Trade and Natural Resources; Lake Winnipegosis Fishermen's Association; and if applicable, Anishinaabe Agowidiiwinan (Treaty 2) and Manitoba Métis Federation (MMF); and other pertinent resource users/stakeholders, such as recreational angler groups/associations, commercial tourism lodge operators and outfitters, etc.

The plan integrates applicable federal and provincial legislation, policies and regulations, and recognizes existing constitutionally protected indigenous fishing rights to domestic/subsistence fishing, and by-laws under the Constitution of the Lake Winnipegosis Fishermen's Association.

Manitoba Economic Development, Investment, Trade and Natural Resources (Fisheries Branch) retains the right to make decisions in the best interest of conservation and the fishery resource.

Fishery Objectives

The mandate of Manitoba Fisheries Branch is to meet its Public "Trust" obligations by ensuring the rational, orderly use of our fisheries resource within the resource's capacity to produce harvestable surplus. In achieving this mandate the goals are to:

- ensure "No Net Loss" of quality and quantity of fish habitats;
- ensure that adequate supply exists to meet Constitutional obligations for indigenous people to fish for food;
- have sustainable community supported fishery management strategies;
- provide a diversity of angling opportunities;
- provide consistent, professional, high quality service to our clients and recommendations to elected decision makers; and
- facilitate public participation in resource management and decision making process.

Fisheries Branch will strive to manage the Lake Winnipegosis commercial gillnet fishery based on the following objectives:

1. The fishery must be conducted in a manner that does not lead to over-fishing or depletion of the harvested populations and, for those populations that are depleted the fishery must be conducted in a manner that demonstrates activities leading to stock recovery.

2. Fishing operations (commercial, recreational and domestic/subsistence) should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

3. The fishery is subject to an effective management system that incorporates applicable federal and provincial legislation, policies and regulations and operational frameworks that require use of the resource to be responsible and sustainable.

Governance

Legislation/Regulations/Polices

Manitoba, under *The Fisheries Act (Manitoba*), maintains constitutional jurisdiction to make laws relating to the use and allocation of fish in Crown (Manitoba) waters as part of the public property. This includes the right to determine who can fish on provincial Crown land (licensing), what conditions may be included in a licence, and what fee would be paid for the licence. This authority is exercised under *The Fisheries Act of Manitoba* and regulations to that Act.

Manitoba fisheries management activities are undertaken consistent with departmental policies, strategies, and directives in accordance with specific issues, opportunities and/or priorities.

In addition to federal and provincial legislated regulations, the Lake Winnipegosis Fishermen's Association has developed a series of by-laws pertaining to the commercial net harvest within the lake.

Enforcement / Compliance

Enforcement on Lake Winnipegosis with respect to fishery activities, inclusive of the commercial, recreational, and subsistence fisheries, is the responsibility of Manitoba Conservation Officer Service.

Precautionary Approach

Management decisions and actions, whose impacts are not entirely certain but which, on reasonable and well informed grounds appear to pose serious threats to either the economy, the environment, human health or social well being will be anticipated, mitigated and prevented as avoidance of serious threats to the fishery is less costly than rehabilitating a collapsed fish stock.

An example where Fisheries Branch has employed a precautionary approach in its decision-making process and management actions is as follows:

- *Lake Winnipegosis experimental spring mullet season* – Manitoba, with support from the majority of commercial fishers, decided not to licence a spring mullet (*Catastomus commersoni*) harvest on tributaries of Lake Winnipegosis since the spring of 2004 due to concerns that the season posed a serious disruption to the natural walleye (*Sander vitreus*) spawning run and recruitment success; as well as, impacting the overall sustainability of the lake's ecosystem.

Overview

Location

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*).

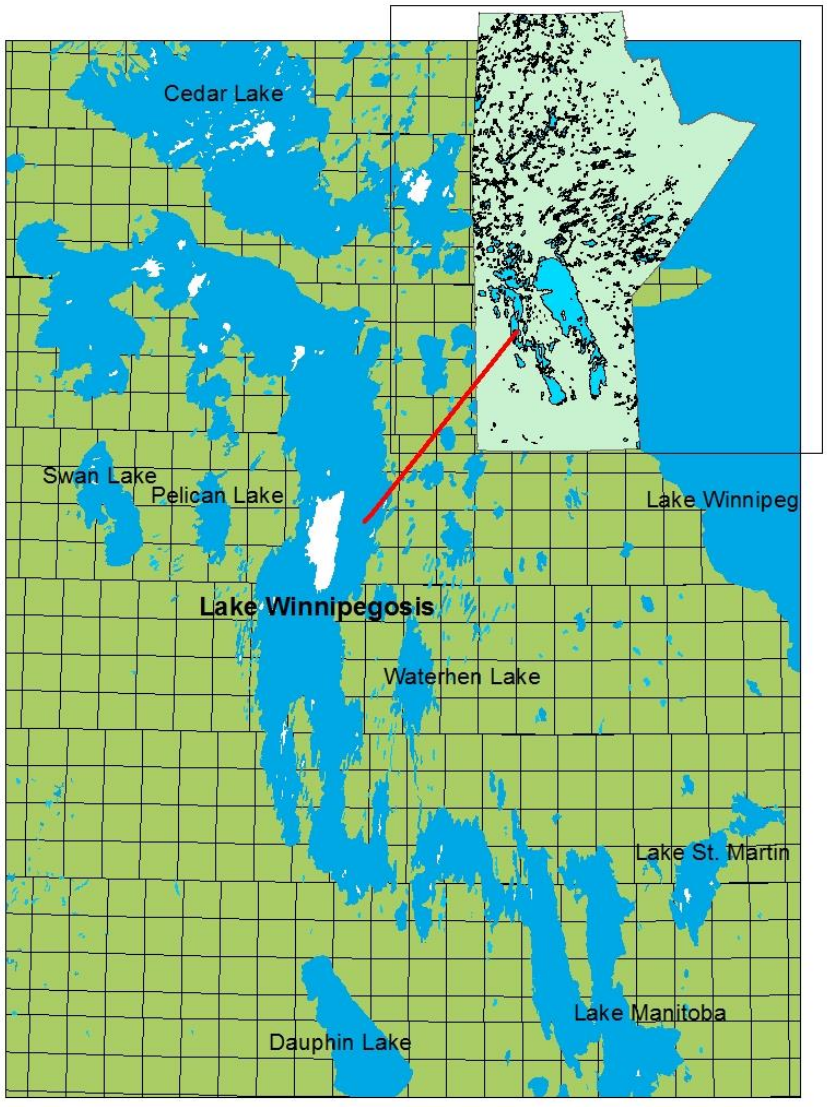


Figure 1: Map of location of Lake Winnipegosis.

Lake Winnipegosis is approximately 200 km in length, 25 km in width, with depths ranging from 1 to 12 meters. 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 continues into Lake Manitoba. Lake Winnipegosis has a number of tributaries, which include Mossy River, North Duck River, Overflowing River, Pelican River, Pine River, Point River, Red Deer River, Sclater River, Shoal River and the Steeprock River.

Communities

There are several small communities located on or near Lake Winnipegosis. These include:

- The village of Winnipegosis is located along the southern shore of Lake Winnipegosis. As of 2011, Winnipegosis had a total population of 647 residents. (Source: Winnipegosis, Manitoba under Wikipedia website: http://en.wikipedia.org/wiki/Winnipegosis,_Manitoba).

- Camperville is located along the western shore of Lake Winnipegosis. As of 2011, Camperville had a total population of 547 residents. (Source: Camperville, Manitoba under Wikipedia website: http://en.wikipedia.org/wiki/Camperville,_Manitoba).

- Pine Creek First Nation is located along the western shore of Lake Winnipegosis, between communities Duck Bay and Camperville. As of 2013, Pine Creek First Nations had a population of 3,188 residents. (Source: Pine Creek First Nation under Wikipedia website: http://en.wikipedia.org/wiki/Pine_Creek_First_Nation).

- Duck Bay is located along the western shore of Lake Winnipegosis. As of 2011, Duck Bay had population of 372 residents within 112 of its 129 private dwellings. (Source: Duck Bay under Wikipedia website: http://en.wikipedia.org/wiki/Duck_Bay,_Manitoba).

- Dawson Bay is located along the northwestern shore of Lake Winnipegosis. As of 2006, Dawson Bay had a population of 38 residents. (Source: Dawson Bay under Wikipedia website: http://en.wikipedia.org/wiki/Dawson_Bay,_Manitoba).

Fish Species

There are twenty-six fish species present throughout Lake Winnipegosis. The winter commercial fishery is based primarily on mullet and northern pike. Walleye (*Sander vitreus*) are harvested to a lesser degree and are the only species with a limited harvest under the summer lake quota of 233,810 kg. The remaining species harvested have unlimited quota including lake whitefish (*Coregonus clupeaformis*): northern pike (*Esox lucius*); yellow perch (*Perca flavescens*); sauger (*Sander canadensis*); white sucker (*Catostomus commersoni*) and shorthead redhorse (*Moxostoma macrolepidotum*) marketed as “mullet”; cisco (*Coregonus artedii*) marketed as “tullibee”; and common carp (*Cyprinus carpio*).

Types of Fisheries

Lake Winnipegosis is classified as a multi-use fishery consisting of Indigenous domestic harvest, commercial gill netting, and recreational angling. Commercial fishing however represents the main fisheries activity occurring on the lake.

1. Rights Based Harvest

Rights based harvest by Indigenous communities in the area occurs throughout the year. However, the level of harvest by sustenance fishing is unknown.

2. Commercial Harvest

There are two types of commercial gillnet fisheries on Lake Winnipegosis:

- a limited entry winter commercial fishery (maximum 174 licensed commercial fishers) using gillnets;
- a limited entry summer/fall commercial fishery using gillnets subject to harvest control rules (i.e. quota (103 QE's (2270 kg (5000lbs)/QE), seasons, and gear); and
- a year-round carp/sucker gillnet fishery.

3. Commercial Tourism

There are a few of commercial tourism lodge / outfitting operations that offer recreational angling opportunities in the area.

- *South Shore Lodge – located near the community of Winnipegosis and offering both accommodations and guiding services.*

4. Recreational Angling

Recreational fishing also occurs in the area but is confined mainly to the tributaries of the lake during the open water season. The exact level of recreational harvest is unknown, however provincial angling regulations apply.

History of the Fishery

Due to the high levels of fishing pressure on the walleye population, the size of spawning stock has been reduced to where reproduction and recruitment is limiting annual yields. For commercial catches, walleye are typically between three and five years old and few walleye aged six years or older. If there is a continuous removal of most walleye before they reach the age of six and above, there will be a suppression to develop a large and diverse spawning stock.

There are a total of nine different effects, identified by SPOF Working Group (1983), which are caused by overexploitation of fish stocks:

1. Decline in Abundance
2. Change in Yield
3. Altered Age Composition and Reduction in Mean Age
4. More Rapid Growth
5. Reduced Age at First Maturity
6. Increased Variance of Some Parameters – Recruitment
7. Increase in Fecundity
8. Change in Genetic Stocks
9. Interstock Desegregation (i.e. Stock Mixing)

Lake Winnipegosis walleye stock still exhibits several of these symptoms. Recruitment variance depends on the mean abundance of recruited walleye. While recruitment of walleye decreases, variance also decreases. The last three effects were not measured on Lake Winnipegosis. However, walleye stocks from the Saskatchewan River, Moose Lake, Cedar Lake and Cross Bay exhibited substantial stock mixing in a DNA survey (Lysack, unpublished data). These stocks have also experienced overexploitation (Lysack 2000). The abundance of walleye has improved in recent years and it is important to protect those fish that form the spawning stock for increased recruitment levels when ideal spawning conditions are present.

1. Commercial

Lake Winnipegosis depressed fish stocks are under pressure from high levels of harvest relative to the sustainable fishing levels that would allow the stocks to return to optimal levels that the lake can productively support. The fishery supports local communities where commercial fishing is the primary source of employment and is an integral part of the fisher's lifestyle.

Lake Winnipegosis has been commercially exploited since the late 1890's (Barbour). There was a limited commercial fishing operation that continued on through 1894 – stated in a report of the Manitoba Fisheries Commission. During the year of 1897, a railway reached Lake Winnipegosis and provided "...a great impetus for fishing." Over the past year, management changes related to mesh sizes, quotas, and commercial fishing seasons have been made (see Appendix 2).

The development of the ice jigger in the 1920's improved the efficiency of winter fisheries. Cotton and linen gill nets were replaced by nylon gill nets in the 1950's. This change in net type generally doubled the efficiency of gill nets (Lawlor 1950, Hewson 1951). Monofilament nets replaced nylon nets in the early 1990's. The change from nylon to monofilament gill nets also approximately doubled their efficiency for catching walleye (Henderson and Nepsy 1992).

The commercial fishery is currently in the third phase of the developing-mature-senescent history associated with exploitation of a "common property (or open access) resource" (Lysack 2006). Regulations were minimal during the developing phase. Annual quotas were liberal and access was not restricted. Uncontrolled fishing effort and the doubling of catch efficiency (when cotton and nylon nets were replaced with nylon nets in the early 1950's) caused the collapse of the walleye fishery in the 1960's.

Throughout the early years of commercial fisheries on Lake Winnipegosis, walleye and large pike were the main predators and controlled forage species such as suckers, cisco (tullibee) and perch. While the commercial fishing pressure increased, larger pike and walleye were removed. Unlike in Cedar Lake, pike are proportionately thinner in Lake Winnipegosis. Pike in Lake Winnipegosis grow at a relatively rapid pace, while those of one or two years old grow at an extremely rapid pace. Pike that are located in other lakes obtain larger sizes because they are allowed to attain older ages (Lysack 2006).

Mesh Size:
Historically, the minimum allowable mesh size of gillnets used on Lake Winnipegosis ranged between 76 millimetres and 108 millimetres.

Quota:
Individual quota entitlements were introduced during the early 1990's after an earlier "buy back" program that reduced the number of open water season vessels.

Season:
The commercial gillnet fishery on Lake Winnipegosis has been predominantly a winter fishery. Historically, the commercial fishing season was open from *November 11th to, and including, February 15th*. However, starting in the 1960s the opening and closing dates of the commercial fishery began to change. Firstly, in 1960/1961, the opening date of the fishing season was moved from November 11th to the *first day ice makes after November 1st*. Then in 1961/1962, the commercial fishing season was extended by moving the last open date from February 15th to March 10th. Subsequently, throughout most of the 1960s, the commercial fishing season commenced on *the first day ice makes after November 1st to, and including, March 10th*. The last change to the winter commercial fishing season occurred in 1968/1969, when the last open day of fishing was extended from March 10th to March 31st. Therefore it can be stated that since 1968/1969 up to the present day the winter commercial fishing season has been open as follows: "*when ice makes on or after November 1st to, and including, March 31st*".

In 2002, a permanent year-round common carp and sucker fishery was established on Lake Winnipegosis.

2. Recreational

In 2007, conservation measures were implemented and recreational angling retention limits were reduced from six to four walleye and a "no harvest" slot limit on walleye between 45 centimetres (17.7 inches) and 70 centimetres (27.6 inches) was introduced to further conserve walleye spawning stock harvest. In 2023, the slot size restriction was removed and replaced by a lowered provincial wide walleye maximum size limit of 55 cm.

Current Regulations

1. Commercial

The commercial fishing seasons on Lake Winnipegosis are established under the *Manitoba Fishery Regulations, 1987.*

The winter walleye season is open from "*when ice makes on or after November 1st to March 31st*". Commercial harvest during the winter fishing season is limited to the use of gill nets with a mesh size not less than 102 millimetres and a maximum length of 11,100 metres.

The summer walleye season dates are open from June 15 until October 15. The summer/fall walleye quota is 233,810 kilograms with a mesh size not less that 102 millimetres and a maximum length of 4,600 metres.

The carp/sucker gill net fishery operates year round with a minimum mesh size of 203 millimetres with an unlimited annual quota.

2. Recreational

Under Manitoba Angling Regulations, Lake Winnipegosis is part of the Southern Division and current General Limits. Walleye restricted to "no harvest" over 55 centimetres.

Licensing

1. Commercial

In order to participate in the commercial fishery, individuals are required to be a member of the Lake Winnipegosis Fishermen's Association. Since the start of the 1989/90 commercial fishing season, the Lake Winnipegosis Fishermen's Association has operated within the bounds of a series of by-laws. One of these by-laws has set a limit on the number of commercial fishers to a maximum of 174 license holders.

Table 1: Number of individuals licenced to commercially fish showing production on a yearly basis from the 1931/32 to 1962/63 and 1999/00 to present commercial fishing season.

Fishing Season	Number of Fishers (Summer and Winter)	Fishing Season	Number of Fishers
1931-1932	372	1959-1960	410
1932-1933	276	1960-1961	549
1933-1934	246	1961-1962	599
1934-1935	297	1962-1963	619
1935-1936	389	1999-00	149
1936-1937	449	2000-01	127
1937-1938	520	2001-02	129
1938-1939	573	2002-03	117
1939-1940	555	2003-04	129

1940-1941	491	2004-05	89
1941-1942	468	2005-06	83
1942-1943	607	2006-07	75
1943-1944	801	2007-08	77
1944-1945	748	2008-09	90
1945-1946	759	2009-10	88
1946-1947	717	2010-11	77
1947-1948	658	2011-12	80
1948-1949	683	2012-13	80
1949-1950	501	2013-14	89
1950-1951	386	2014-15	95
1951-1952	486	2015-16	98
1952-1953	473	2016-17	92
1953-1954	466	2017-18	101
1954-1955	584	2018-19	91
1955-1956	613	2019-20	92
1956-1957	481	2020-21	65
1957-1958	353	2021-22	78
1958-1959	390	2022-23	79

Commercial Harvest Production

Lake Winnipegosis has been commercially fished since late 1800's, with production records dating back to the early 1900's (see *Figures 2&3*). After the last walleye fishery collapse in the early 1960's there has not been a recovery of the walleye population to healthy levels (Lysack 2006). Recent improvements in the walleye fishery show potential for a recovery if additional harvest restrictions are implemented.

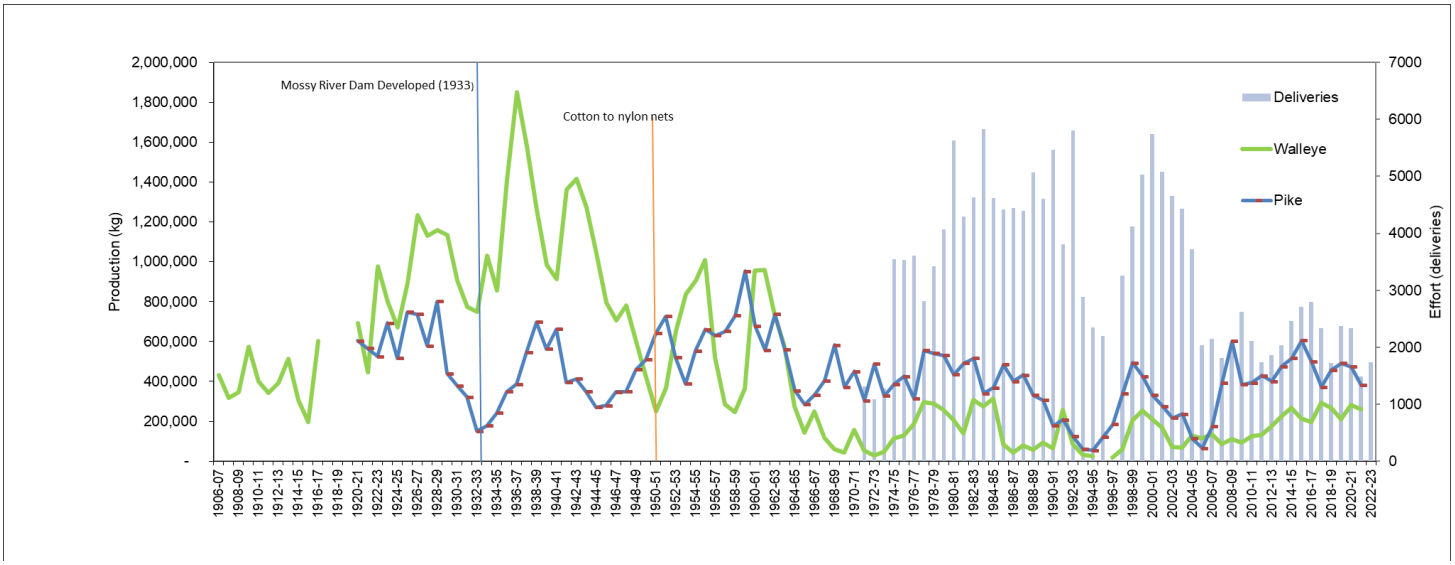


Figure 2: Lake Winnipegosis walleye and pike production from 1906 to 2022 commercial fishing season.

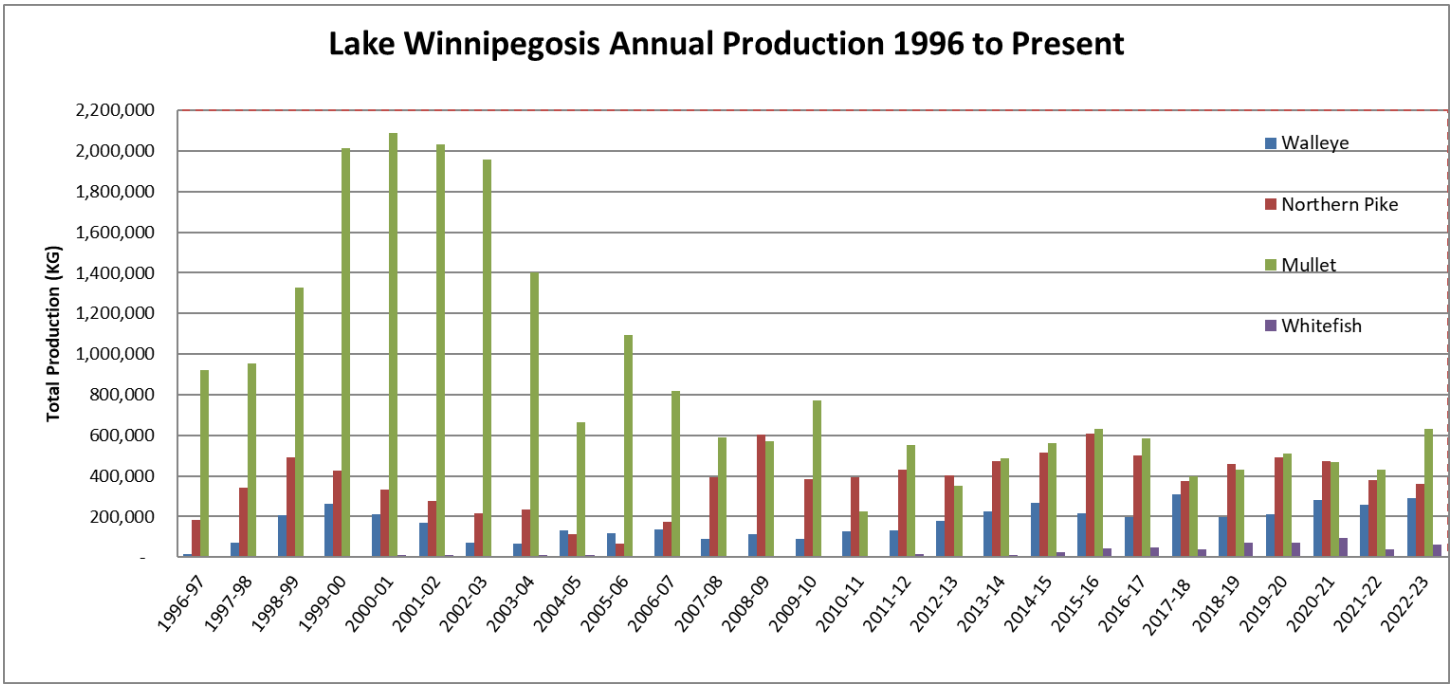


Figure 3: Lake Winnipegosis primary catch production from 1996 to present commercial fishing season.

Stocking

Lake Winnipegosis has been stocked with walleye fry for decades and for a period in the 1980's rearing ponds were developed to produce fingerlings (see Appendix 1).

Harvest Strategy

The Lake Winnipegosis commercial fishery targets two species: walleye (*Sander vitreus*) and northern pike (*Esox lucius*). There is no formal harvest strategy governing the fishery at present time. The walleye population in the lake is considered to be stressed and under pressure from the limited amount of walleye reaching over 5 years of age. The northern pike fishery in Lake Winnipegosis is considered sustainable, because female pike will have spawned two or three times before they are susceptible to the minimum mesh size allowed in the Winnipegosis fishery.

Mullet and lake whitefish are the only bycatch making up more than 5% of the harvest. In Manitoba, mullet is the name given to any combination of species in the genera *Catostomus* and *Moxostoma*. In Lake Winnipegosis, mullet refers to white sucker (*Catostomus commersoni*) and shorthead redhorse (*Moxostoma macrolepidotum*). Redhorse are called 'red fin mullet'. Mullet are retained bycatch in the Winnipegosis fishery having some low market value relative to the target species. High white sucker populations are sometimes considered deleterious to more desirable walleye and yellow perch (*Perca flavescens*) (Johnson 1977, Hayes et al 1992) implying competition, so it could be expected productive percid populations could negatively impact mullet.

Stock Assessment

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. The index gill netting component provides independent estimates of fish abundance, fish species diversity and descriptions of walleye growth maturity and mortality regimes. The commercial catch sampling and production analysis component, which provides a description of ages and body size classes of commercially caught walleye.

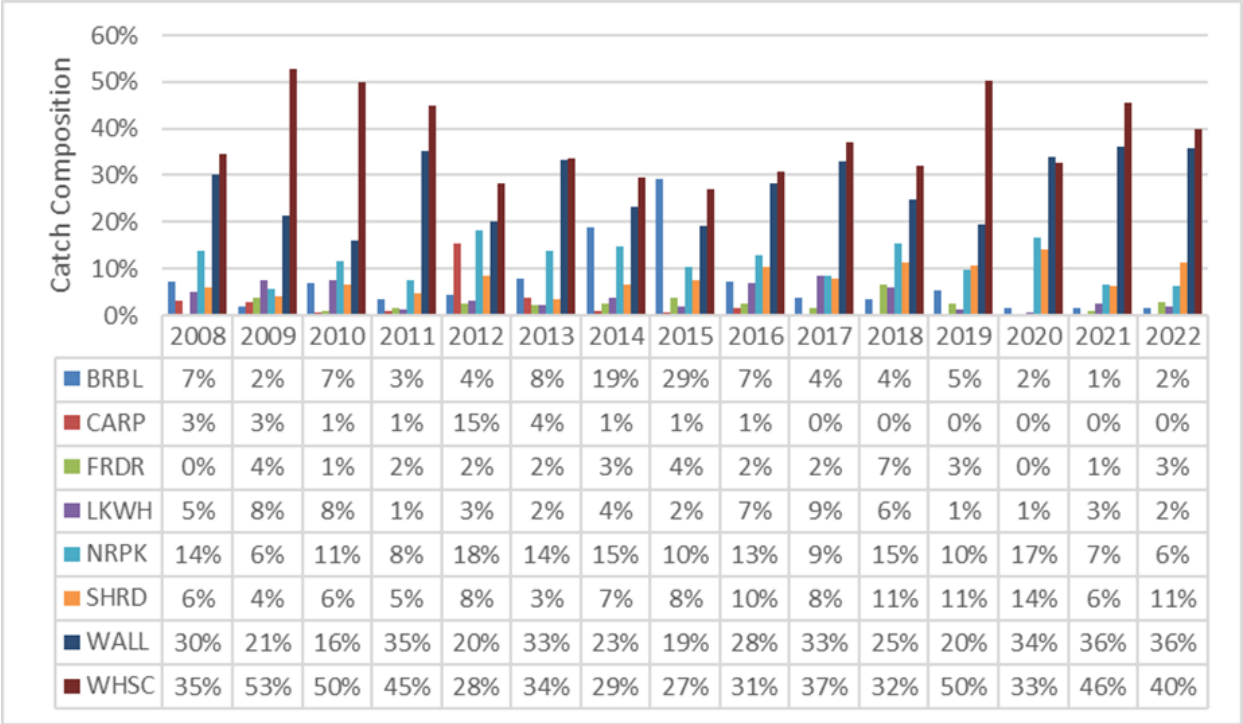
The objectives of this report are to:

1. describe temporal trends in growth, maturity and mortality regimes of walleye in Lake Winnipegosis;
2. describe temporal trends in age compositions and associated statistics of walleye sampled from the commercial catch;
3. describe temporal trends in walleye yield, fishing effort and CUE, catch per unit of fishing effort, from the Lake Winnipegosis fishery data provided by the Freshwater Fish Marketing Corporation (FFMC) and other sellers;
4. determine if temporal trends in index and commercial walleye abundance indices are related;
5. describe temporal trends in fish species diversity.

1. Annual Index Netting

The Lake Winnipegosis fish community 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: 1) index gill netting component, provides independent estimates of fish abundance, fish species diversity and descriptions of Walleye growth maturity and mortality regimes; and the commercial catch sampling and production analysis component, which provides a description of ages and body size classes of commercially caught Walleye.

Fisheries Branch conducts annual index gill net surveys and sampling of commercially caught Walleye to assess the status of the Walleye stock in Lake Winnipegosis. Sampling locations were selected based on historical data collection around the lake with 12 sites (6 located in northern portion and 6 located in south) currently being assessed as part of the Coordinated Aquatic Monitoring Program (CAMP) and 12 additional sites being assessed as part of the Collaborative Stock Monitoring Program (CSMP). Supplemental test netting was carried out in 2023 to assess areas not typically covered by the index program and experimented with other types of gillnets and mesh size composition (North American Standard, sauger panels (44, 57, and 70mm) and large mesh tie-ons (140 and 152mm). The index netting program furnishes population data to action the harvest strategy. Figure 4, shows the catch composition from index gill net surveys in 2008-2022. White sucker were the dominant species in the catch in most years, although walleye narrowly surpassed sucker in 2020.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
BRBL	7%	2%	7%	3%	4%	8%	19%	29%	7%	4%	4%	5%	2%	1%	2%
CARP	3%	3%	1%	1%	15%	4%	1%	1%	1%	0%	0%	0%	0%	0%	0%
FRDR	0%	4%	1%	2%	2%	2%	3%	4%	2%	2%	7%	3%	0%	1%	3%
LKWH	5%	8%	8%	1%	3%	2%	4%	2%	7%	9%	6%	1%	1%	3%	2%
NRPK	14%	6%	11%	8%	18%	14%	15%	10%	13%	9%	15%	10%	17%	7%	6%
SHRD	6%	4%	6%	5%	8%	3%	7%	8%	10%	8%	11%	11%	14%	6%	11%
WALL	30%	21%	16%	35%	20%	33%	23%	19%	28%	33%	25%	20%	34%	36%	36%
WHSC	35%	53%	50%	45%	28%	34%	29%	27%	31%	37%	32%	50%	33%	46%	40%

Figure 4: Catch composition of large bodied fish species from index gill net surveys from 2008 to 2022.

Walleye Population Analysis

Figure 5.a shows the age composition of walleye stocks from 2022 and Figure 6.b for walleye from 2012to 2021 index netting. A total of 14 age groups were caught during 2022, ranging in age from 0 to 17 years. The number of age groups in the walleye population in Lake Winnipegosis (more than 8 age classes) is one indicator of a healthy stock (Sullivan 2003). The strong 2016 year class (age 6) was the third most abundant year class in the sample and provides the large spawning stock year class an opportunity to rebuild stocks if not over-exploited in coming years.

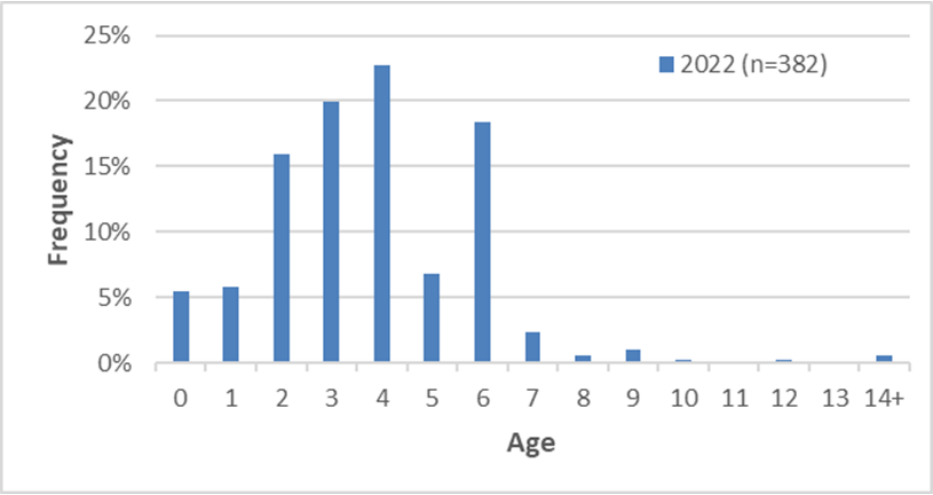


Figure 5.a: Age composition of walleye from 2022 index gillnet survey.

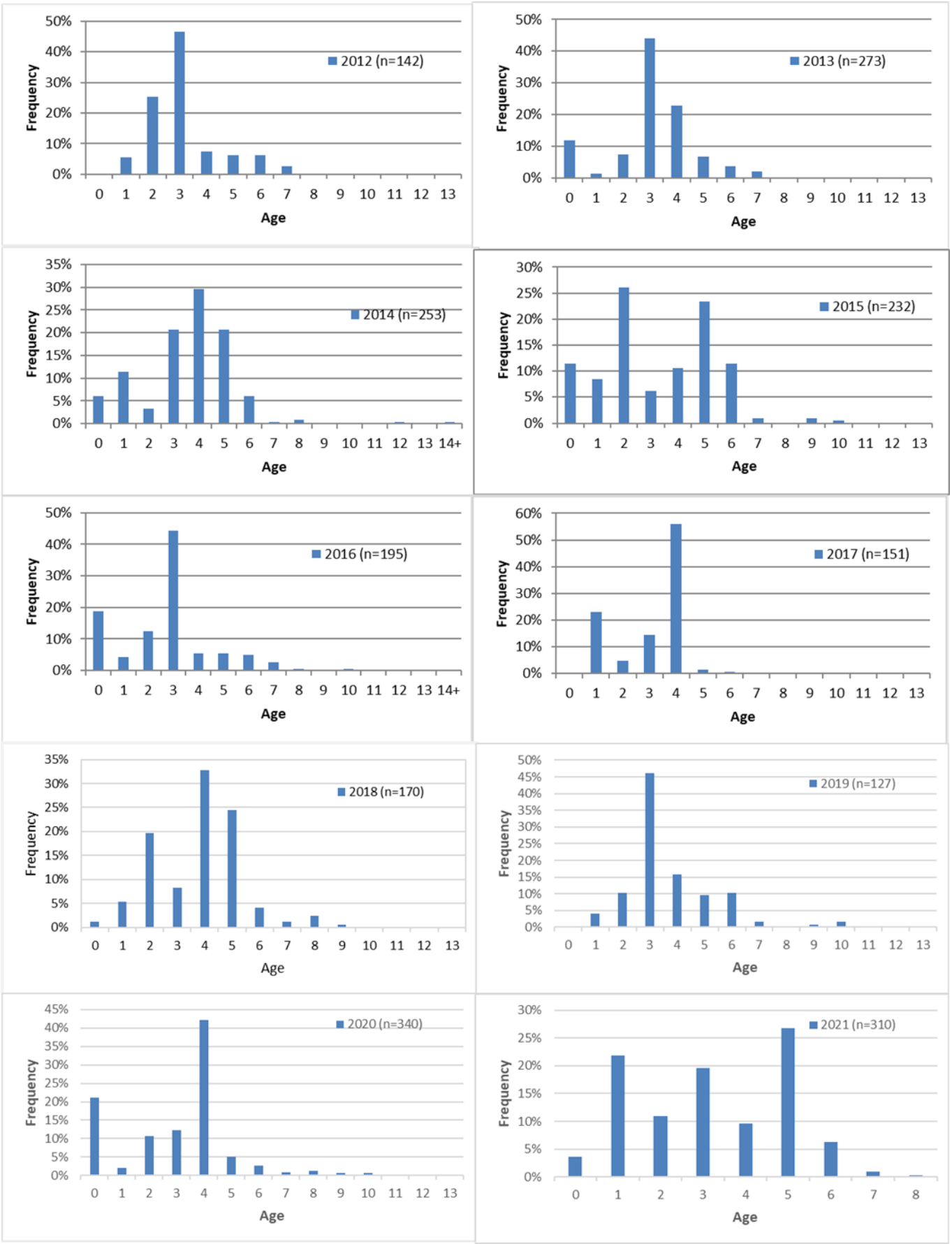


Figure 5.b: Age composition of walleye from 2012 to 2021 index gillnet surveys.

Relative weight of walleye was analyzed to see if any trends could be detected in health of individual walleye given changes in community composition, abundance, and fishing pressure. As seen in Figure 6, walleye relative weight has remained in good shape (> 85).

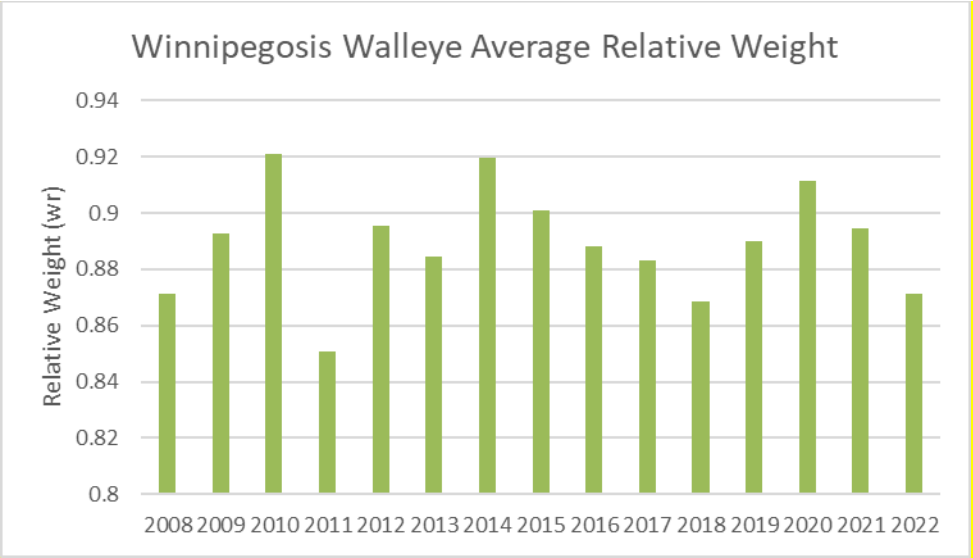


Figure 6. Average walleye relative weight in Lake Winnipegosis 2008-2022.

In 2022, the mean age of walleye captured in the stock monitoring program increased from 3.4 to 3.8 years of age (Figure 7). 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).

Reproductive rate of walleye populations increase 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 2022, mean age of mature female walleye was 5.4 years old (Figure 7).

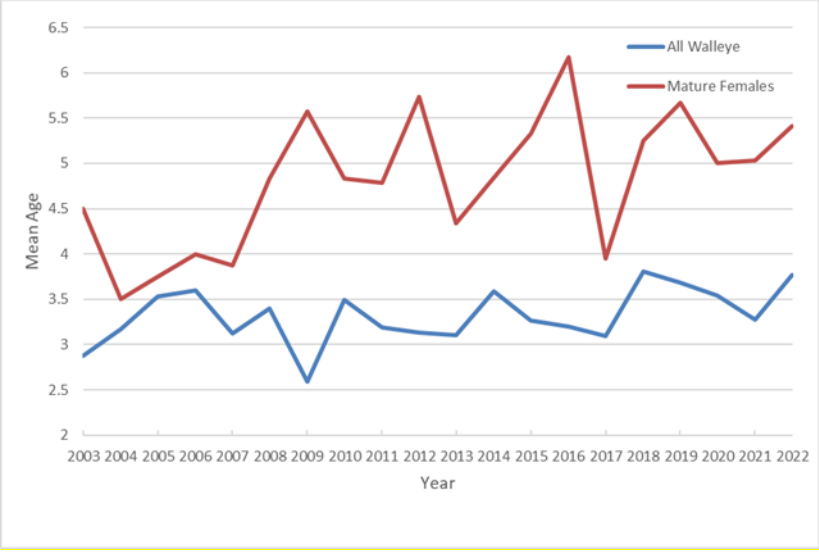


Figure 7: Mean age of mature walleye (sexes combined and females only) from 2003 to 2022.

Biologically, mature female walleye are considered to be more important than mature males for the production of future year classes. In the Valley River, walleye larval abundance was positively related to mature female biomass in Dauphin Lake (Johnston et al. 1995). The relative abundance of immature and mature female walleye in Lake Winnipegosis increased in 2022 (Figure 8). The biomass of mature female walleye catch-per-unit effort also increased, but is still in a stressed/unstable state (Figure 9).

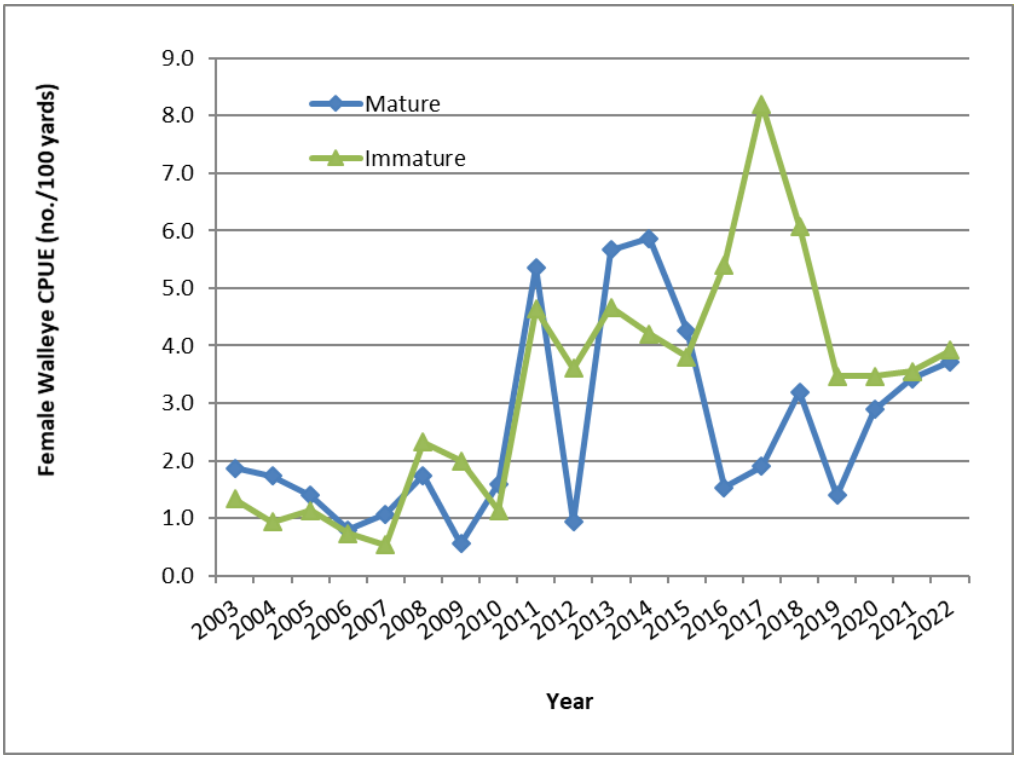


Figure 8: Catch-per-unit-effort of mature and immature female walleye caught during annual monitoring 2003 to present.

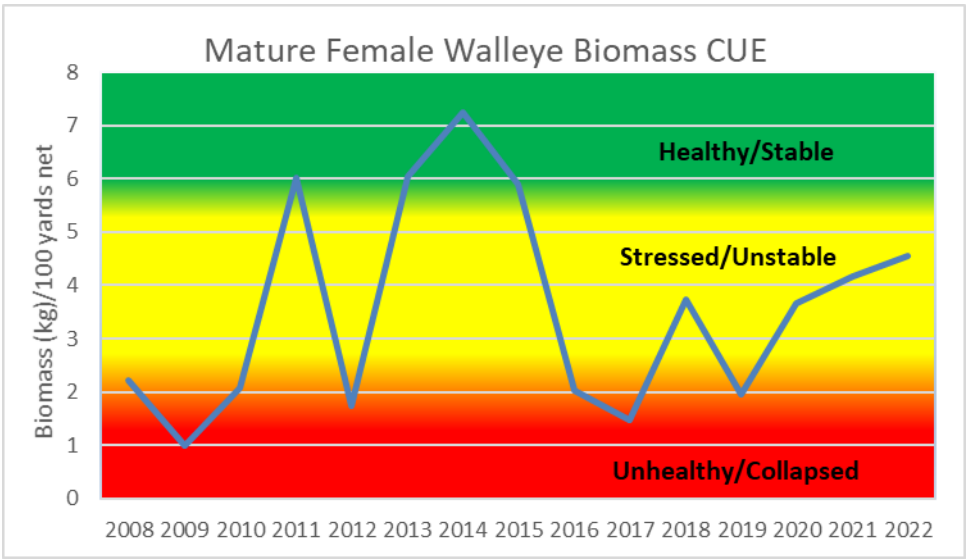


Figure 9: Biomass catch-per-unit-effort of mature female walleye caught during annual monitoring 2008 to present.

The age-at-maturity of female walleye generally increased from 2013 to 2016, but has since declined (Figure 10). Age-at-maturity in 2022 (5.0 years) has increased from 2013 (4.2 years) lows. Age-at-maturity is influenced by the strength of year classes ages 3, 4, and 5 which are mature. In 2022, age-at-maturity of female walleye (5.0 years) was slightly lower than a published threshold of 5.1 years, based on growing season length (Gangl and Pereira 2003). Failing to exceed a threshold of a biological performance indicator is considered a negative indicator of stock status.

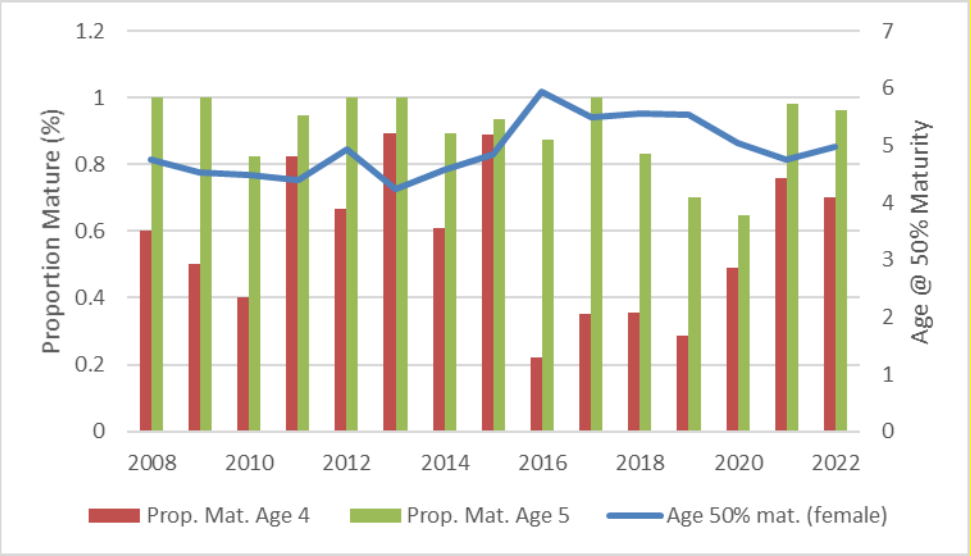


Figure 10: Age at maturity of walleye (females only) and proportion mature of age 4 and 5 year classes from annual monitoring in Lake Winnipegosis, 2008 to 2022.

Female total length at 50 % maturity was smaller than expected (i.e. females reached maturity at smaller sizes than expected, based on how quickly walleye in Lake Winnipegosis grew since age 3). From Gangl and Pereira (2003), predicted total length at 50 % maturity for Lake Winnipegosis was 470 mm. Female total length at 50 % maturity was 431.8 mm in 2022.

Based on 2022 stock monitoring results, the annual mortality rate of walleye ages 4 to 10 was 52.3% (Figure 11). This mortality rate is higher than published sustainable exploitation rates of 32.4% annual mortality (Lester et al. 2014). However, when we looked at the Walleye caught in the northern part of the lake for the past decade, there seems to be some distinct differences in age and size composition of the catch. Mortality was also consistently lower in the northern basin as well. This is likely due to the reduced number of fishers that reside in the north, but occasionally south/central area summer fishers will travel to the northern area to fish due to the increased Walleye densities in the north and central portions of the lake.

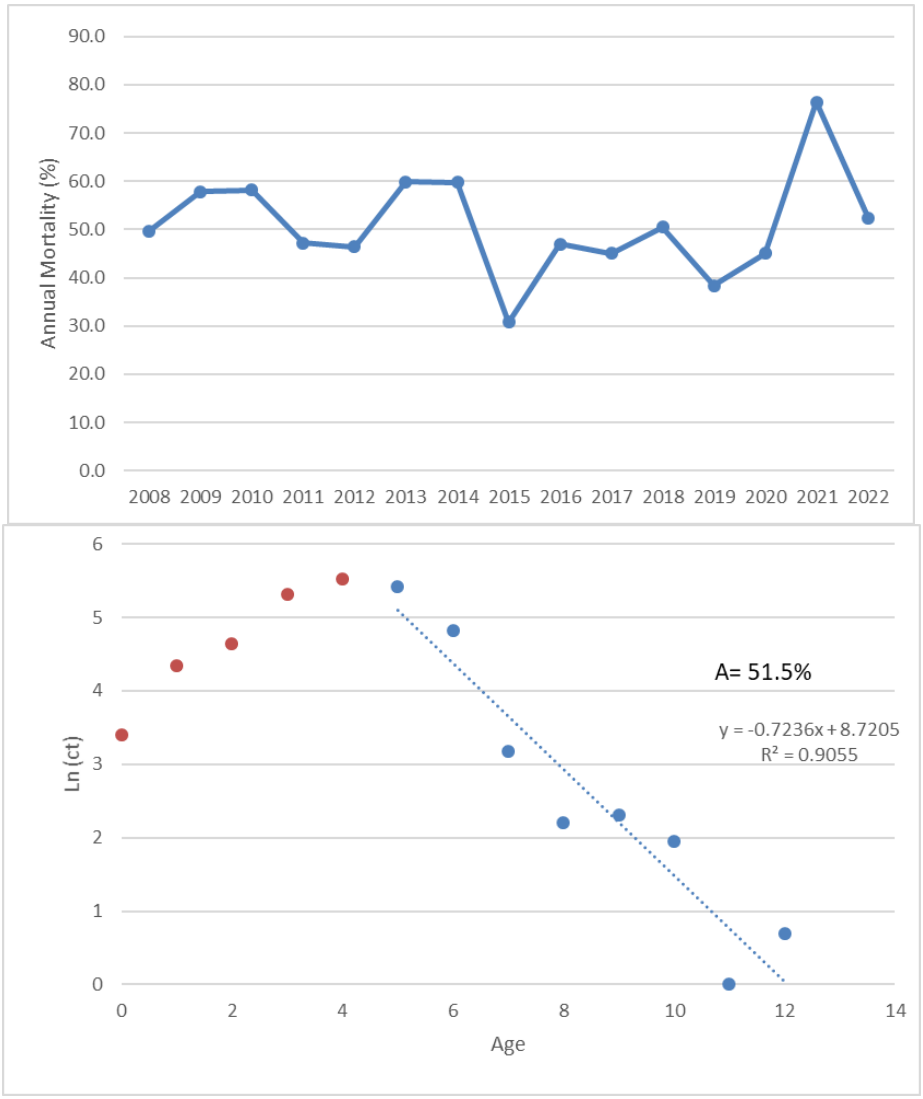


Figure 11: Annual mortality of all walleye from annual monitoring on Lake Winnipegosis, 2008 to 2022; and regression line estimate of total instantaneous mortality of walleye for 2015 to 2022.

Relative abundance of all walleye from index netting generally exhibited an upward trend from 2007 to present, but had experienced a period of decline from 2015 to 2019 (Figure 12). The decline is likely due to more people fishing the lake (both commercial and rights based), as conditions for recruitment have been favourable during most years this past decade. Relative abundance of mature (>450mm) walleye was also looking healthy in 2022, but is quite variable year to year depending on catch (Figure 13).

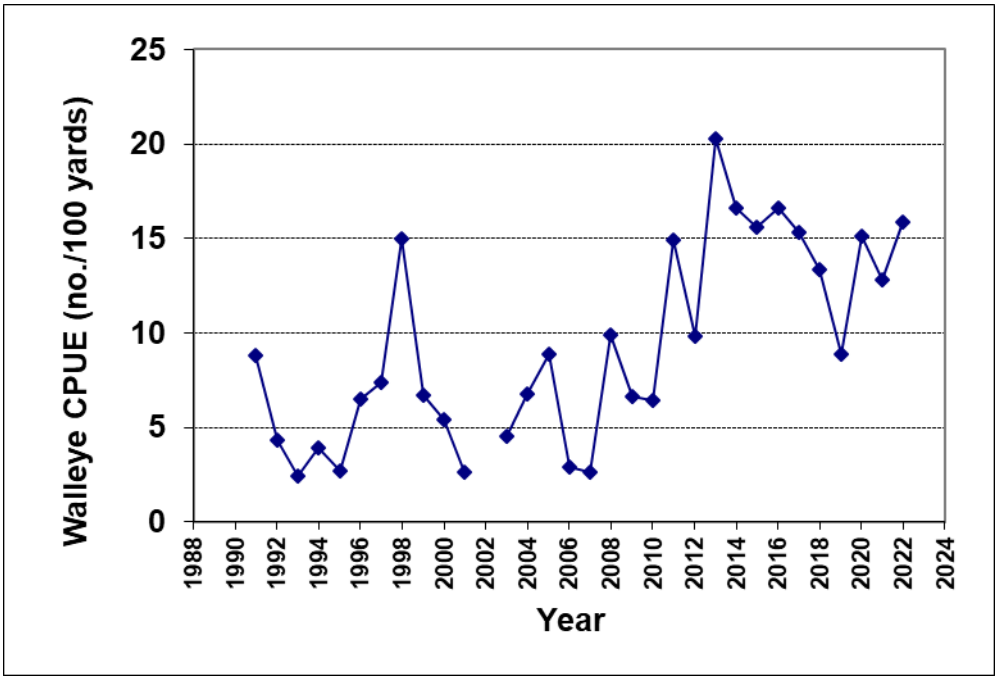


Figure 12: Relative abundance of walleye from annual monitoring on Lake Winnipegosis, 1991 to 2022.

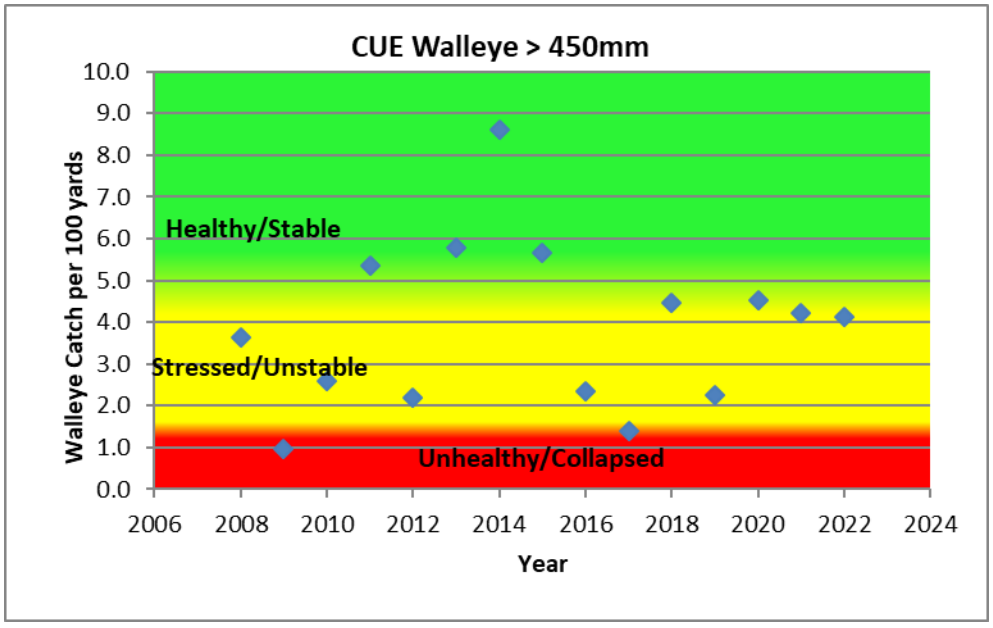


Figure 13: Relative abundance of mature walleye (>450mm) from annual monitoring on Lake Winnipegosis, 2008 to 2022.

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). 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). The reference limits for Shannon Diversity (H) of mature female ages come from Gangl and Pereira's (2003) study of Minnesota's ten large lakes (Figure 14). Shannon's 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 the index nets, and k is the number of mature females of age i.

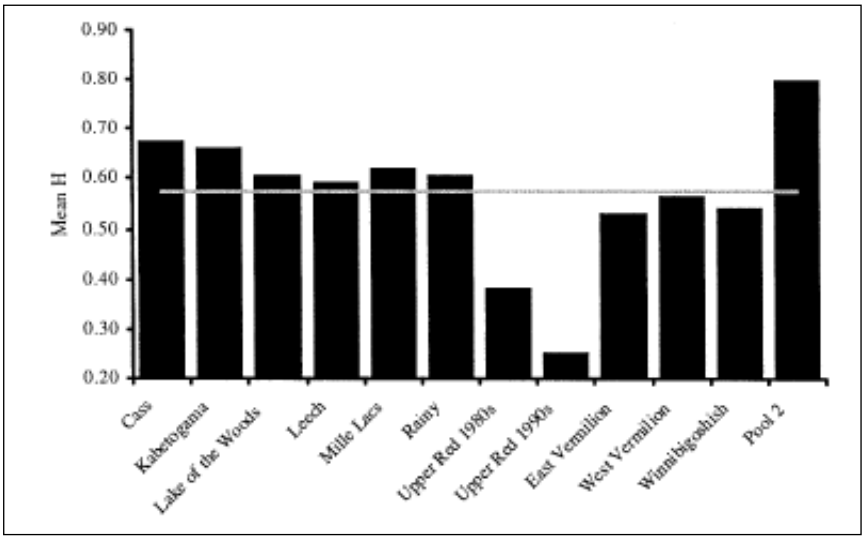


Figure 14: Shannon Diversity Index values for Minnesota's ten large lakes with Upper Red Lake shown pre and post walleye stock collapse and Pool 2 of the Mississippi representing an unharvested Walleye stock. The line at H = 0.58 represents the lower boundary of the 80 % confidence interval around the mean of 0.60 for the ten large lakes (from Gangl and Pereira, 2003).

The Target Reference Point of H = 0.60 (determined by Gangl and Pereira) is the mean value of the studied stocks and H = 0.58 the lower threshold of the 80% confidence interval, is selected as the Upper Stock Reference Point. The Lower Limit Reference Point of H = 0.31, the average of the Red Lakes' diversities before and after collapse, was selected as the Lower Limit Reference Point (Figure 15). Monitoring of the volatility of H will continue through the index netting program. When the performance indicator, H, is above 0.58 no maximum gillnet mesh will be implemented. However, when values fall below 0.58 into the "medium risk" (yellow) zone a maximum mesh size regulation will be in place to conserve and enhance age diversity among spawning females by protecting larger females from harvest. If the Lower Limit Reference Point of 0.31 is reached a more restrictive maximum gillnet mesh size will be imposed. If the harvest control rules for SSB and Female Age Diversity are both in the critical zone we defer to the harvest control rule for SSB.

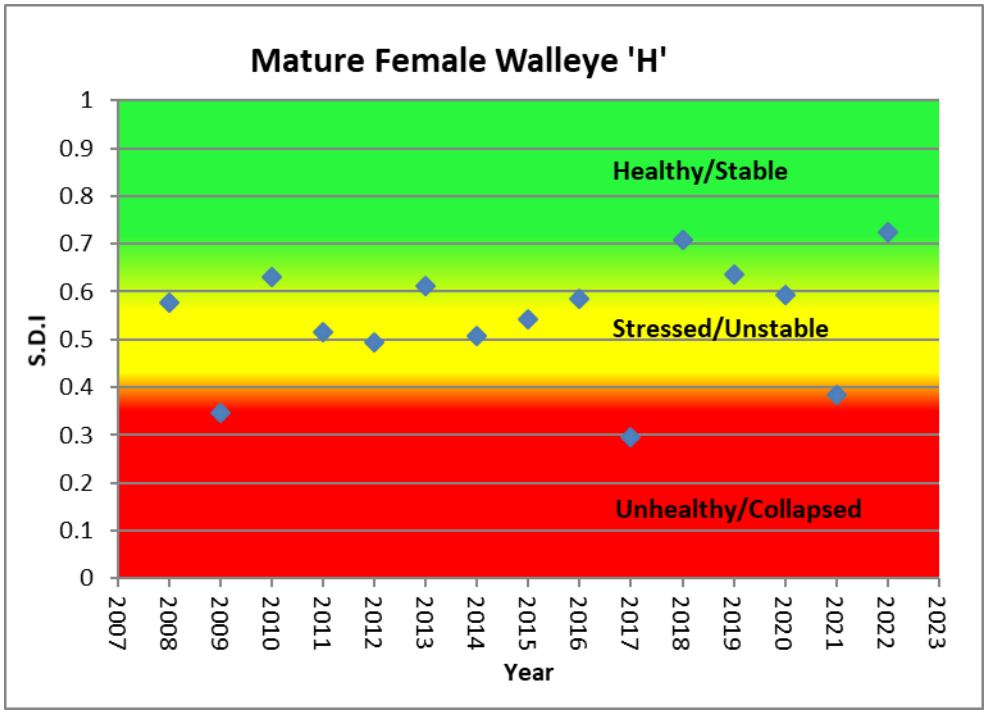


Figure 15: Spawning stock diversity of mature female walleye in Lake Winnipegosis 2008 to present.

The Von Bertalanffy growth function for male, female and all walleye averaged for 2008 to 2021 seems to show that young male walleye grow quickly and reach a maximum total length at age 8 compared to females that continued to grow (Figure 16). The growth overall is good with male walleye typically being harvested near their upper growth limit.

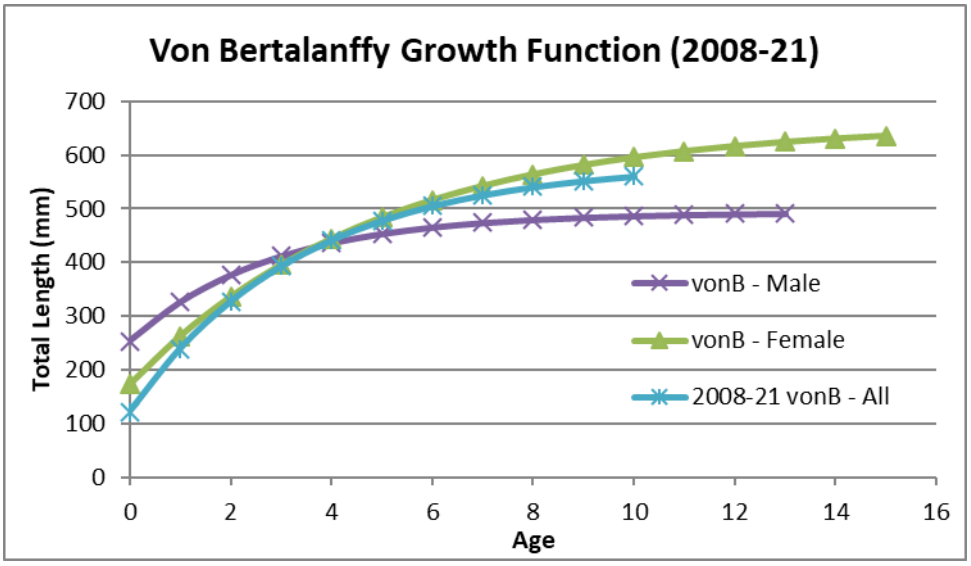


Figure 16: Von Bertalanffy growth function of walleye age at total length from Lake Winnipegosis averaged 2008 to 2021.

Northern Pike Population Analysis

The northern pike population has been relatively steady over the past 10 years and is still in good condition with limited targeted fishing pressure. Due to limited cleithra aging preparation the 2022 structures have yet to be aged. The age composition of pike stocks is illustrated in Figure 17 for 2021 and Figure 18 for 2009 to 2020 stocks. A total of 7 age groups were caught during 2021 index netting, ranging in age from 1 to 7 years. The strong 2017-year class (age 4) was the most abundant year class in the sample (40%).

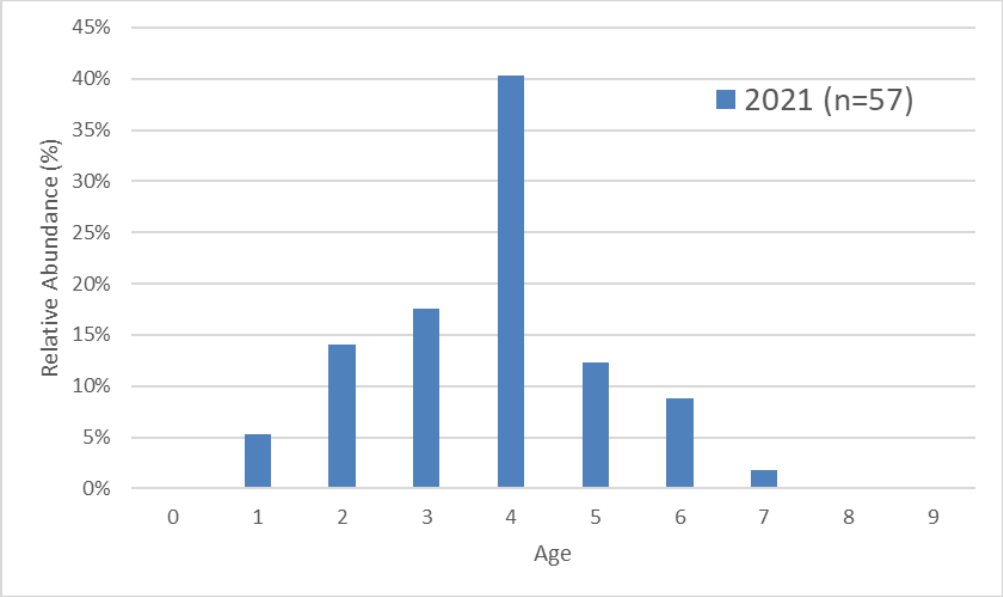


Figure 17: Age composition of northern pike from 2021 index gillnet survey.

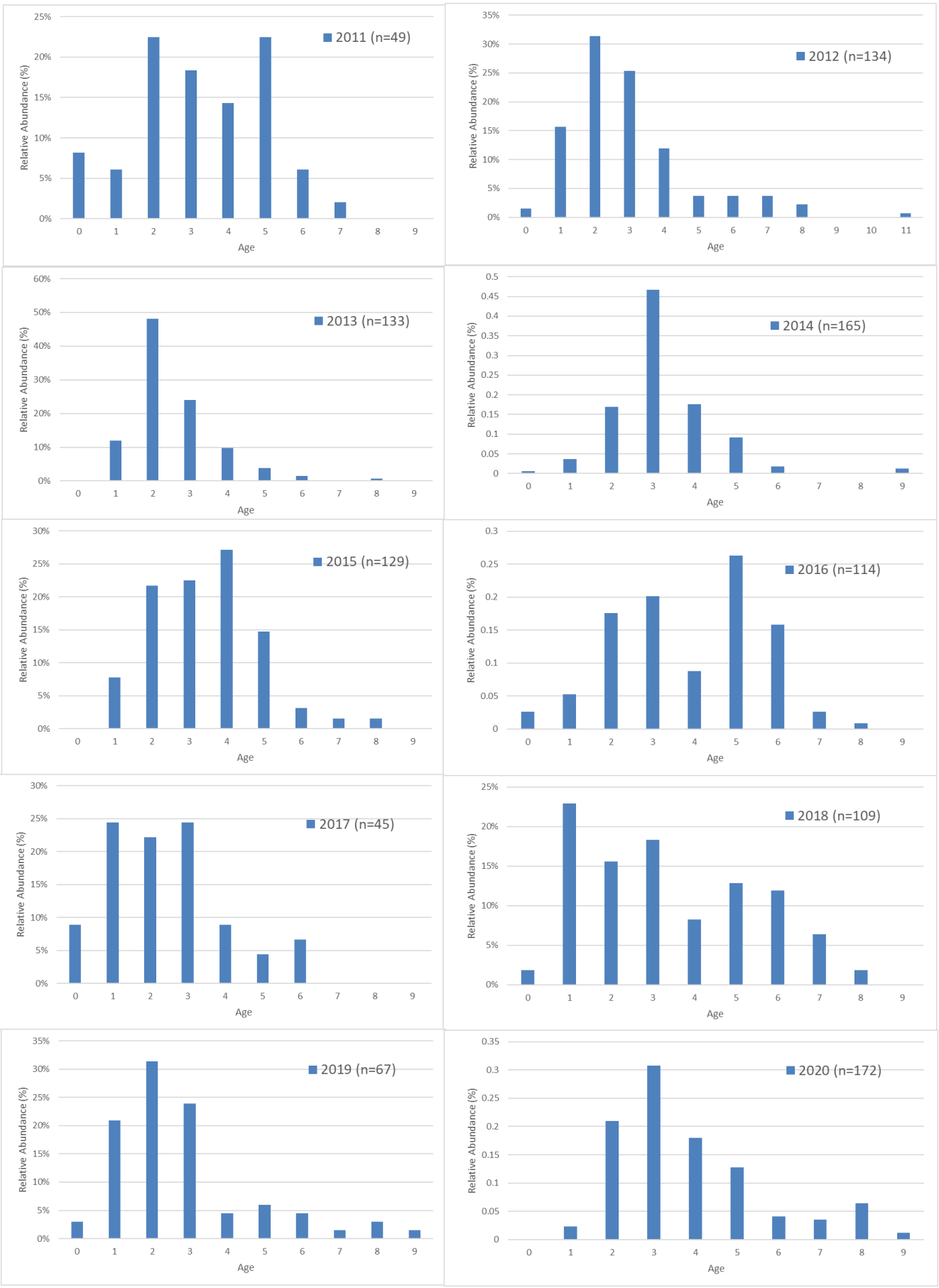


Figure 18: Age composition of northern pike from index gillnet surveys from 2011 to 2020.

Relative weight of pike was analyzed to see if any trends could be detected in health of individual pike given changes in community composition, abundance, and fishing pressure. As seen in Figure 19, northern pike relative weight declined in 2022, resuming the general decline since 2010 peak, but is still in good shape (> 0.8).

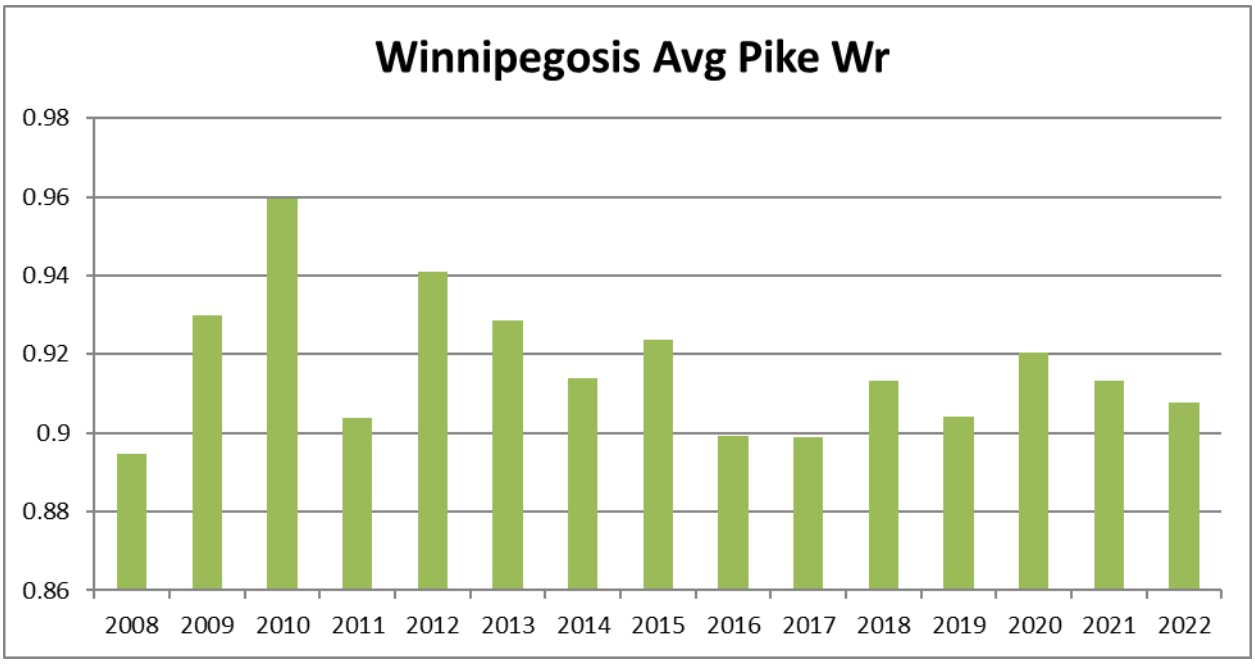


Figure 19. Average northern pike relative weight in Lake Winnipegosis 2008-2022 index netting.

In 2021, the mean age of northern pike captured in the stock monitoring program decreased from 4.0 in 2016 index to 3.6 years of age.

Relative abundance of female northern pike from index netting, by frequency, generally exhibited a decreasing trend after 2014 (Figure 20). Relative abundance of all northern pike from index netting, by weight (kg), generally exhibited a similar trend of a peak in 2014 and subsequent decline (Figure 21).

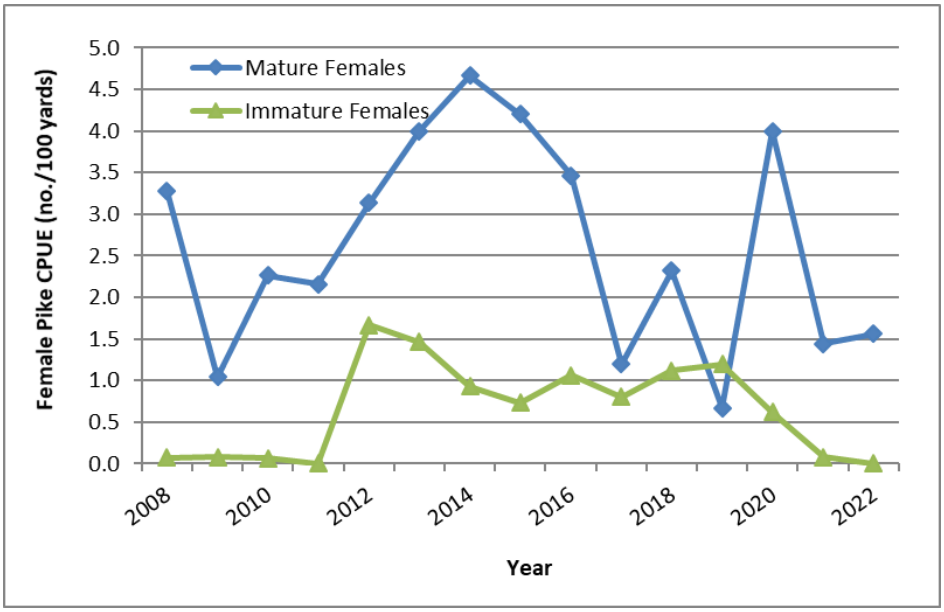


Figure 20: Catch-per-unit-effort of female northern pike caught during index netting.

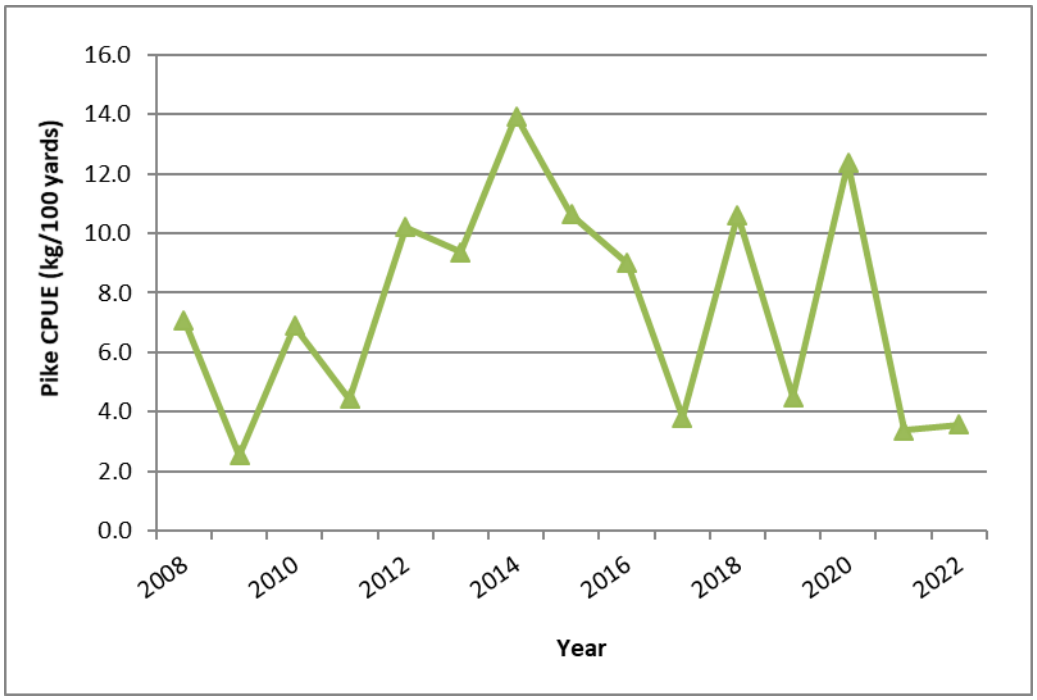


Figure 21: Catch-per-unit-effort by weight (kg) of northern pike caught during index netting.

Based on 2021 stock monitoring results, the annual mortality rate of pike ages 3 to 7 was 46% (Figure 22). This mortality rate is below the target reference point of 50% annual mortality, and well within the sustainable exploitation rate, which is estimated to be around 65%.

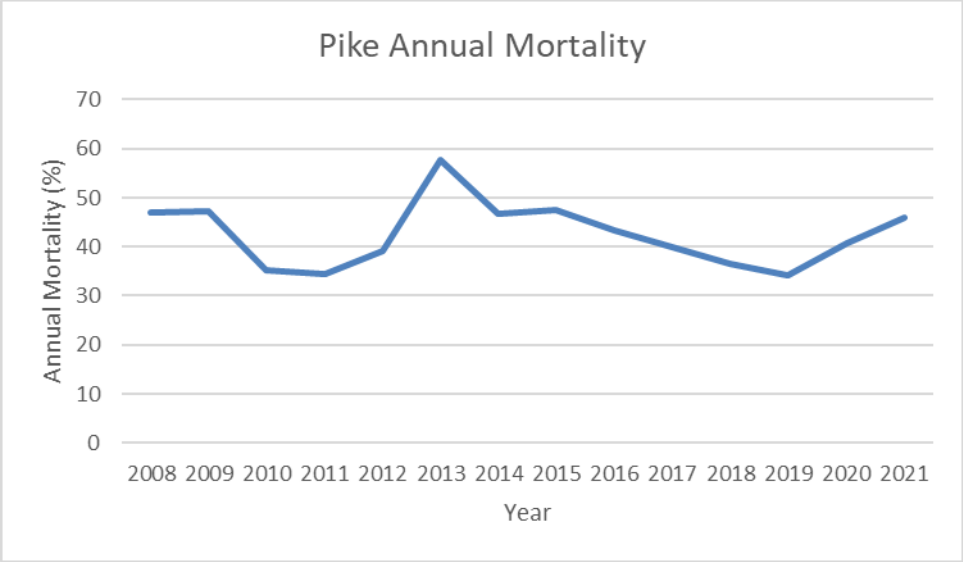


Figure 22: Annual mortality of all pike from annual monitoring on Lake Winnipegosis, 2008 to 2021.

2. Commercial Catch Sampling

Info Note: Commercial catch sampling is a management tool used by fisheries staff as part of the overall stock monitoring program. Commercial catch sampling is undertaken to collect ageing structures (e.g. fin spine/ray, otoliths, scales, cleithrum) for different commercially harvested fish species. Commercial catch sampling provides information to determine year class strengths in the fishery and is occasionally used to monitor fish populations in the lake.

Commercial catch sampling has historically been conducted on Lake Winnipegosis as far back as 1961 to better understand the stock structure of walleye when assessment data is limited. Sampling is carried out at various times throughout the year to assess the walleye being captured in commercial gill nets and delivered to a FFMC packing plant (Figure 23). Each fish is measured by fork length to the nearest 2mm on a measuring board. The weight is also measured to the nearest 20 or 25gm on a Chatillon spring scale (Chatillon, Mississauga, Ontario). When the age of the fish is to be determined, a dorsal spine of each fish is collected. The sex and state of maturity (immature or mature) is not possible for commercially caught fish as they are typically field dressed.

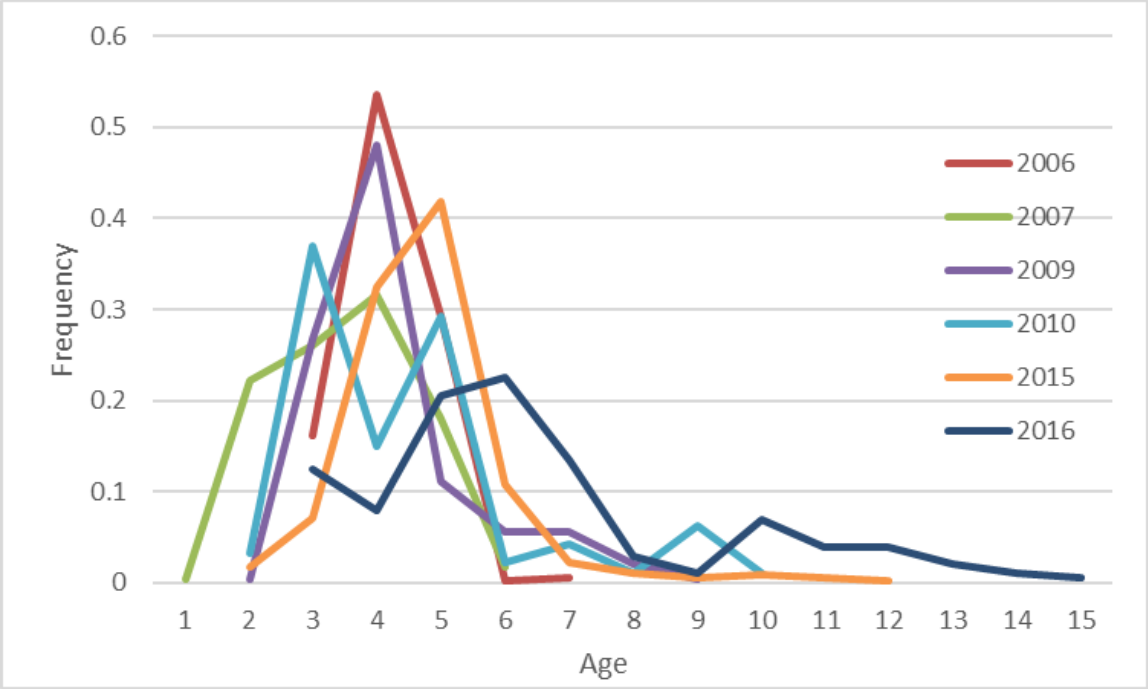


Figure 23: Age composition of walleye from commercial sampling from 2006, 2007, 2009, 2010, 2015, and 2016.

The age composition of walleye sampled from the commercial fishery indicated that fish ages 3 to 6 supported the fishery. A large percentage of the catch was four year old fish for most years sampled. Age four comprised over 30% of the commercial catch in 4 of the last 6 sampling years. The mean (average) age of the commercial catch in 2016 was 6.47 years old, higher than the mean age in 2015 (4.81 years). Walleye production size class information from FFMC shows that medium and large sized walleye have increased and mediums are the majority composition of summer and winter

fisheries since the removal in 2007 of the limited 76mm (3”) mesh used for the perch fishery (Figure 24 and 25).

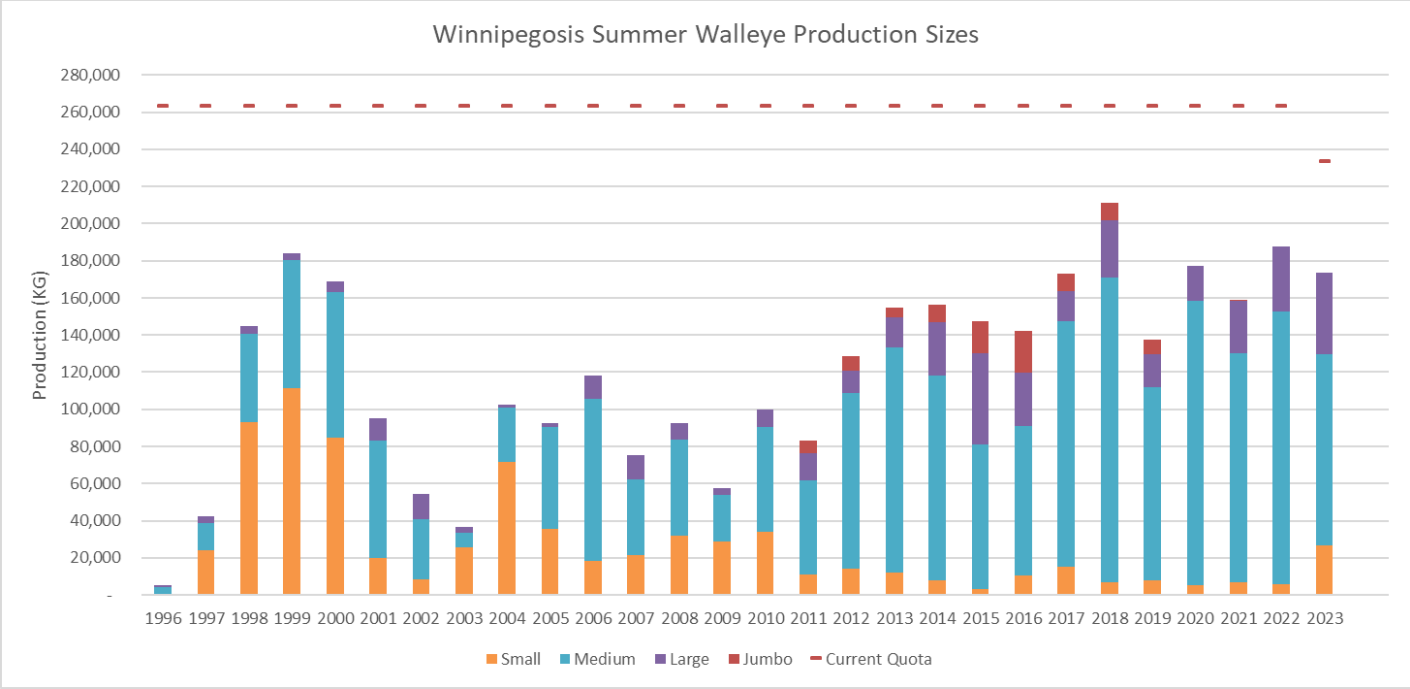


Figure 24: Lake Winnipegosis walleye production and size class presence from 1996 to 2023 summer commercial fishing season. The jumbo size class was only used from 2011 – 2019. Jumbo class walleye before and since that period are graded as large.

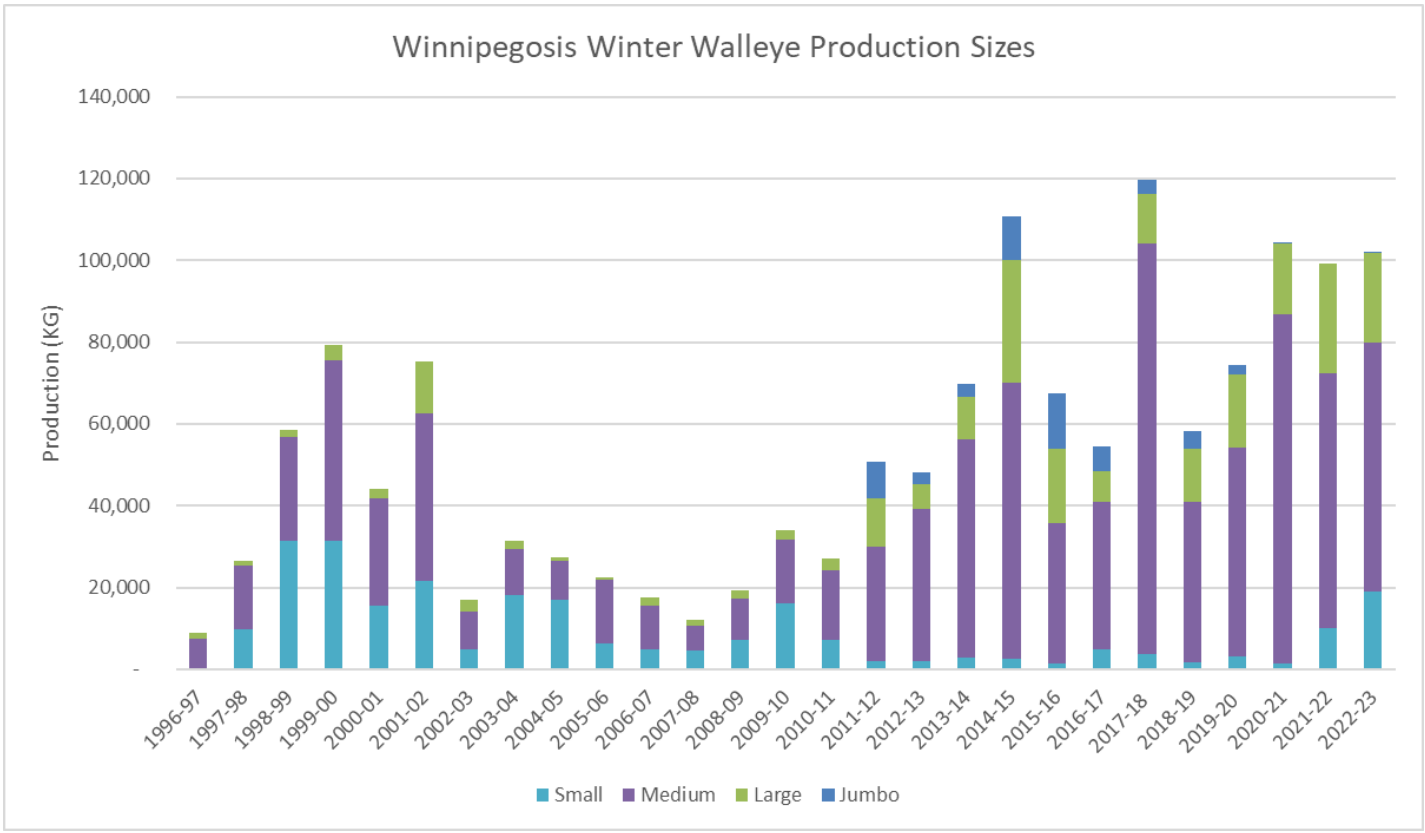


Figure 25: Lake Winnipegosis walleye production and size class presence from 1996 to 2022/23 winter commercial fishing season. The jumbo size class was only used from 2011 – 2019. Jumbo class walleye before and since that period are graded as large.

Harvest Control Measures

Four performance indicators have been selected to guide the commercial and recreational walleye harvest on Lake Winnipegosis. They are:

- catch-per-unit-effort;
- spawning stock biomass;
- spawning female age diversity; and
- total mortality.

The performance indicators selected to govern the management of the Lake Winnipegosis walleye and northern pike gillnet fishery are assessed using lower and upper stock reference points. Individual performance indicators will be assessed as either "Low Risk" (highlighted as **green**), "Medium Risk" (highlighted as **yellow**) or "High Risk" (highlighted as **red**). Harvest control measures are implemented in response to changes in performance indicators estimated from annual stock monitoring. Three of the harvest control measures are input controls involving mesh size and total allowable yardage, and the fourth is an output control, quota reduction. The reference points selected for the Catch-per-unit-effort (CPUE) and Spawning Stock Biomass (SSB) are based on the rationale that harvest over the past nine years has been at a sustained high level, and that the values measured for those performance indicators are therefore desirable (Table 2).

Table 2: Summary table of performance indicators selected to govern the Lake Winnipegosis walleye and pike fishery.

Index	Lower Limit	Upper Stock
Catch-Per-Unit-Effort (Walleye/100 yards/net night)	8	20
Spawning Stock Biomass	2 kg/100 yards	5 kg/100 yards
Spawning Female Diversity	0.31	0.58
Total Mortality (walleye)	60%	40%
Total Mortality (pike)	75%	65%

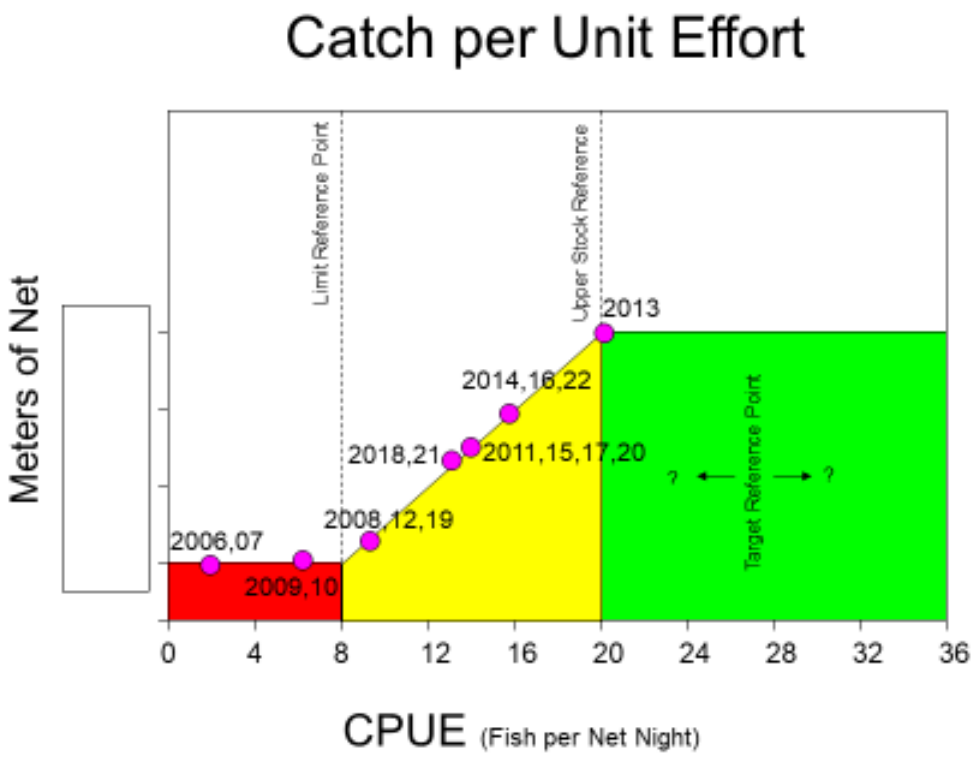


Figure 26: Proposed harvest control measure governing allowable yardage for the Lake Winnipegosis commercial walleye fishery. Pink circles mark the catch-per-unit effort (CPUE) from the past 16 years of index netting. If CPUE fell into the medium risk zone, allowable yardage in the commercial fishery would diminish. Allowable net yardages will be established following public consultation.

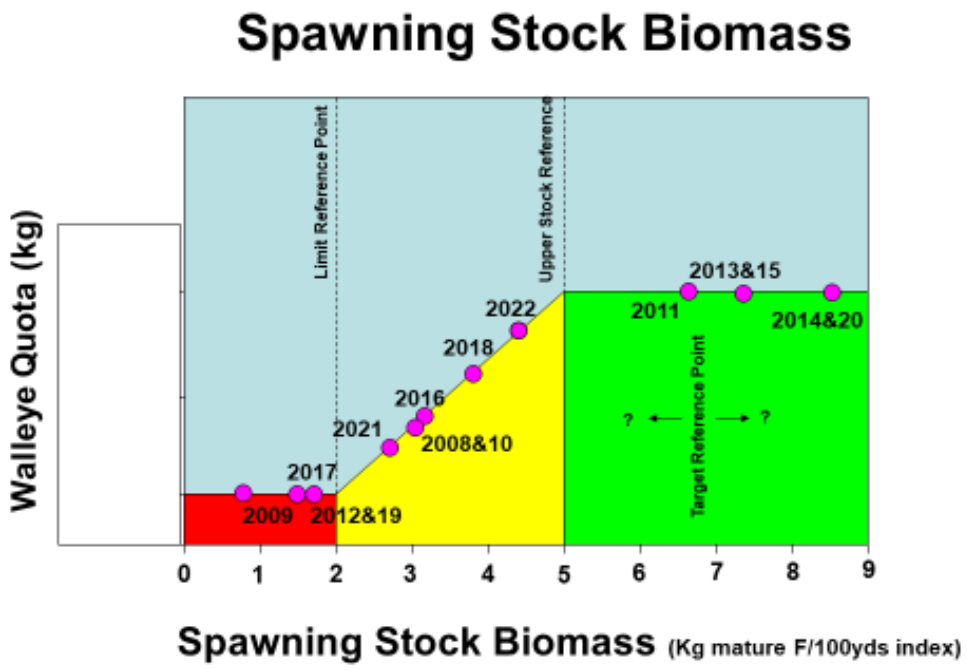


Figure 27 Proposed harvest control measure to avoid recruitment overfishing in the Lake Winnipegosis commercial walleye fishery. Pink circles mark the spawning stock biomass which is reflected as the total kilograms of gravid female walleye caught in annual index program nets over the past 14 years. As spawning stock biomass decreases, the quota will be reduced to help build stocks and increase the total amount of mature fish. After the fishery establishes a sustainable quota level the SSB HCR will be tied to the maximum mesh size allowed in the commercial fishery to vary (102mm to 108mm) based on the amount of females recruits available.

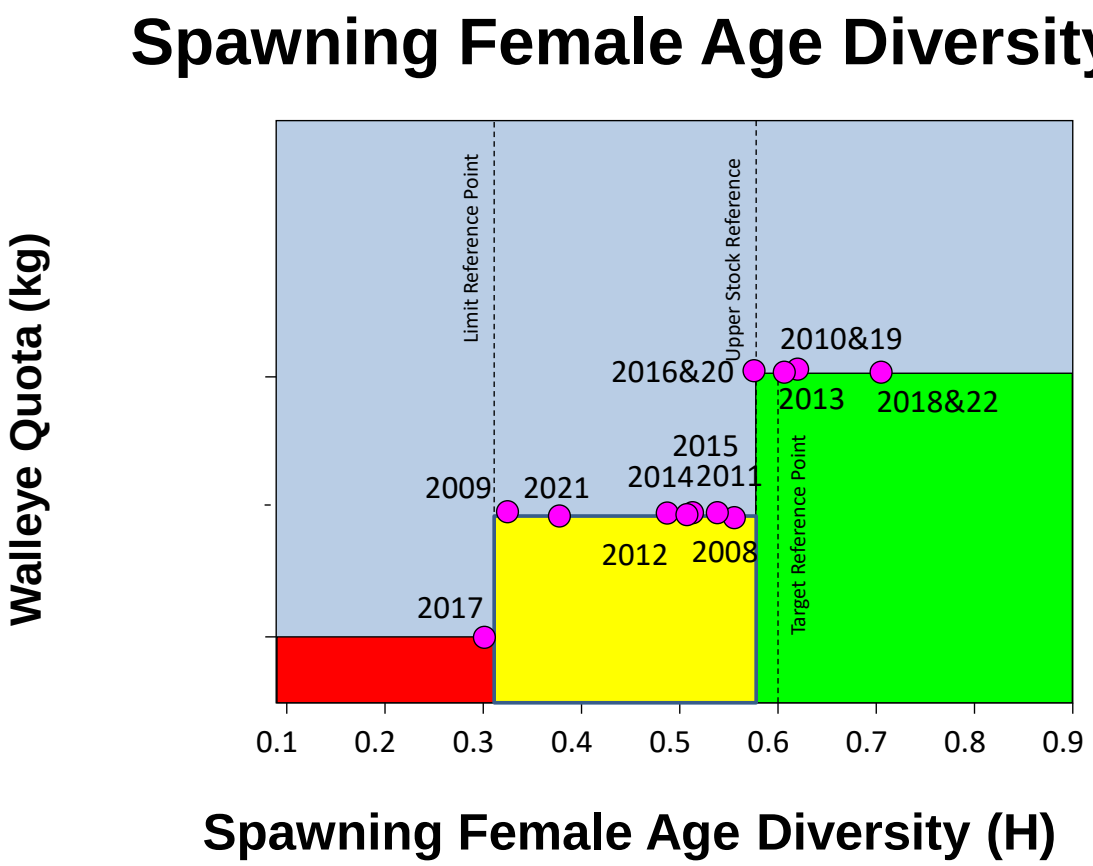


Figure 28: Proposed harvest control measure for Shannon's Diversity Index for spawning female Walleye ages. When the performance indicator, H, is below 0.58 there is a reduced quota to help allow fish to grow and build a larger spawning stock. In the future when stocks are healthy and quota has established a longer term sustainable level, H will be ruled by mesh size so when is above 0.58, no maximum gillnet mesh size, but values in the cautionary zone will result in a maximum mesh size to conserve and enhance age diversity among spawning females.

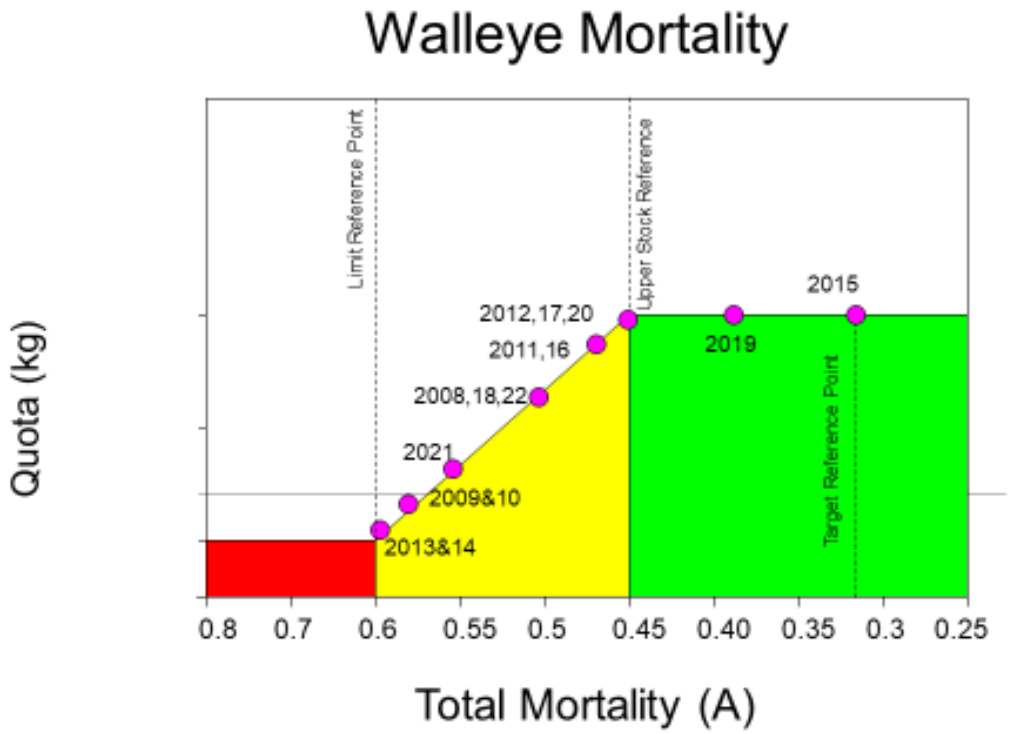


Figure 29: Proposed harvest control measure for walleye total mortality. When total mortality climbs above 0.45, the walleye quota for the Lake Winnipegosis commercial fishery will be decreased to allow the stock to rebuild.

When the fishery is in good shape in the green category (<0.45), limits and harvest rules can be relaxed to allow harvest of the 'surplus' while maintaining sufficient walleye stock for sustainability and a high quality fishery.

Northern Pike Mortality

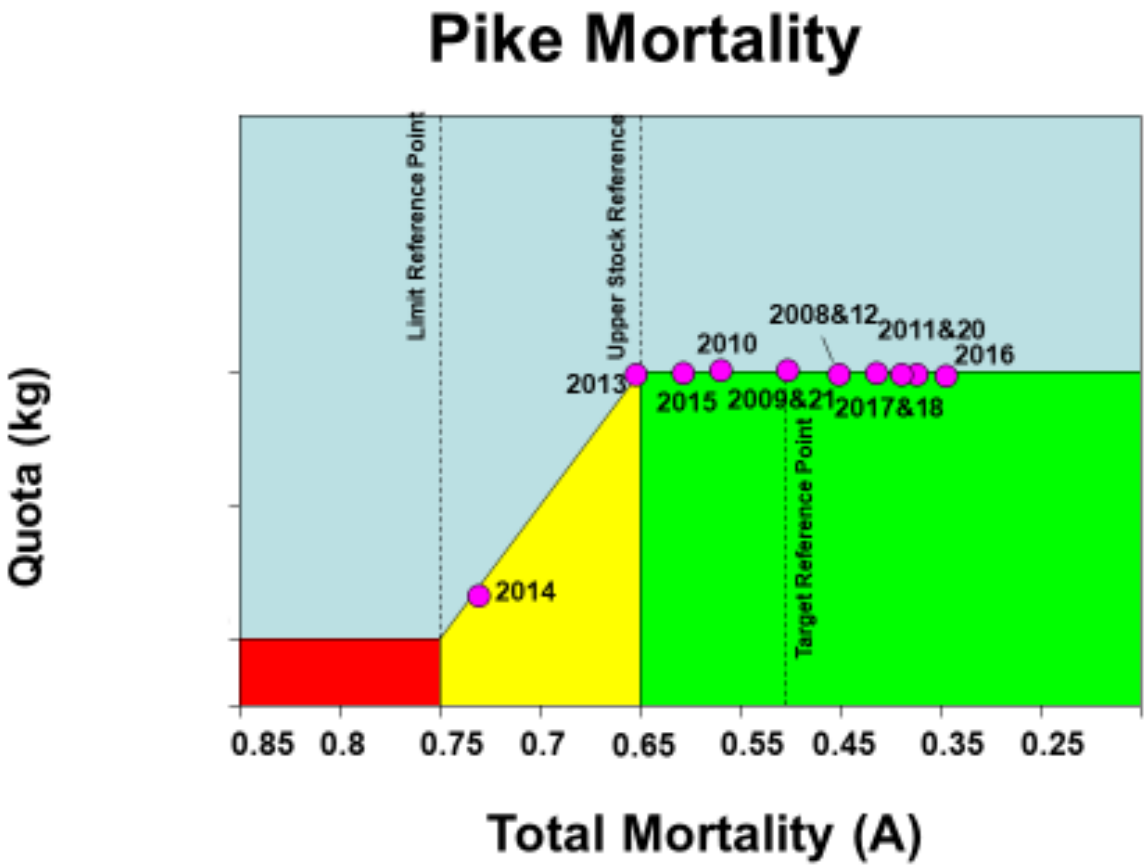


Figure 30: Proposed harvest control measure for northern pike total mortality. When total mortality climbs above 0.65, the pike quota for the Lake Winnipegosis commercial fishery will decrease to allow the stock to rebuild.

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Appendices

Appendix 1: Historical Summary of Stocking Efforts, Test Netting and Commercial Harvest on Lake Winnipegosis.

I. Background

Table I - Annual Stocking of Walleye Fry in Lake Winnipegosis.

Year	No. of Walleye Fry
1967	15,200,000
1968	3,000,000
1969	12,700,000
1970	17,400,000
1971	44,000,000
1972	43,950,000
1973	20,750,000
1974	41,900,000
1975	48,790,000
1976	4,200,000
1977	19,200,000
1978	37,600,000
1979	14,750,000
1980	12,150,000
1981	10,486,250/ 1,400,000 eyed eggs
1982	10,000,000/ 165,519 fingerlings
1983	4,529,000(eggs)
1984	1,300,000
1985	4,750,000
1986	18,850,000
1987	35,300,000
1988	16,500,000
1989	20,000,000

1990	2,000,000
1991	3,050,000
1993	5,000,000
1994	750,000
1995	5,650,000
1999	1,000,000
2000	10,400,000
2001	4,300,000
2002	5,000,000
2003	5,200,000
2004	5,000,000
2005	5,000,000
2006	3,900,000
2007	5,000,000
2008	5,000,000
2009	1,200,000
2010	1,500,000
2011	1,600,000
2012	3,300,000
2013	300,000
2015	2,100,000
2016	2,900,000
2017	2,600,000
2020	2,000,000
2021	3,700,000

Table II – Season Dates, Net Size and Number of Nets.

Season	Season Opens	Season Closes	Net Size (mm)	Max. amt of Nets
Winter	November 1	March 31	102	11,100m
Summer	June 15	October 15	102	4,600m

Appendix 2: Lake Winnipegosis Research / Assessment Bibliography

I. **Research Studies**:

- Edwards, G.A. and W. N. Howard. 1980. *Little Waterhen River Fish Movement and Walleye Tagging Study, 1971-1972*. Manitoba Department of Natural Resources. Fisheries Branch MS Report No. 80-8, 53 pp.

    - Fluctuating Walleye stocks in Lake Winnipegosis and the contention by Lake Winnipegosis commercial fishers that Walleye were migrating downstream from and out of Lake Winnipegosis led to the fish movement study.

    - Tagging was conducted from June 2, 1971 to June 6, 1972. Two trap nets were used for the project. The traps were set facing one another in the river which served to trap fish which moved either upstream or downstream. The trap nets, located at the mouth of the Little Waterhen River near Skownan First Nation, were removed during freeze-up for the months of November and December, 1971, and were reset on January 18, 1972. The trap nets were again removed during the spring break up from April 11 to May 4, 1972.

    - Results:
        - For most Little Waterhen River species, movement was greatest in the open water period.
        - During the entire project 5,349 Walleyes were caught in the traps; 1,394 moving upstream and 3,955 downstream. Of these fish, 1,327 were tagged from the upstream trap and 3,653 from the downstream trap for a total of 4,980 tagged fish. The difference of 369 fish was caused by the recurrence of tagged fish in the traps.
        - Greatest Walleye numbers were captured during the summer and fall of 1971. During this period, 4,676 Walleyes were captured which represents 87.5% of the total number caught during the project. Most of these (78.7%) were captured in the downstream trap.
        - A total of 4,860 Northern Pike were captured from both traps for the whole project with 74.5% being caught in the downstream trap and 25.5% in the upstream.
        - An insignificant number of Sauger was caught during the project. Only 44 were captured and 20 of these caught in the downstream trap during May of 1972.
        - Throughout most of the year, Lake Whitefish movements were minimal. During September and October of 1971, 640 were captured in the upstream trap which represented almost 87% of the 737 Lake Whitefish caught during the project. Only 20 Lake Whitefish were captured in the downstream trap throughout the year.
        - The Cisco catch totalled 3,169 fish for the whole project, and 81% of them were captured in the downstream trap.
        - Only 492 Yellow Perch were captured during the project. Yellow Perch movement was light and random throughout most of the year.
        - Only 164 Goldeye (*Hiodon alosoides*) were captured and 160 of these were caught during the summer of 1971.
        - The suckers captured during the project were comprised of two species; the White Sucker and Shorthead Redhorse. No separate tally of each sucker species were kept, however, White Suckers represented the highest percentage of the total catch (approximately 95%). Suckers were the most numerous fish caught in the traps; more than 133,000 suckers were captured.

- A total of 12,389 Burbot (*Lota lota*) were captured during the project; with 69% captured in the downstream trap. Major Burbot movements occurred in the late fall, winter and early spring. During the other four months a total of only 38 Burbot were captured.
- Four other fish species were captured during the project:
  - ✓ Five Common Carp were captured during June and July of 1971.
  - ✓ One Channel Catfish (*Ictalurus punctatus*) appeared in June of 1971.
  - ✓ Three Quillback (*Carpiodes cyprinus*) were caught in July 1971.
  - ✓ 54 Freshwater Drum (*Aplodinotus grunniens*) were captured during June, July and August of 1971; 49 of these moving upstream.
- Tagging Results:
  - ✓ Waterhen Lake reported the highest number of Walleye recaptures (22.8% of the total tagged) followed by the Waterhen River (6.8%). Lake Manitoba and Lake Winnipegosis produced only 4.3% of the total tagged.
  - ✓ Of the 4,980 Walleyes tagged, 1,808 (36%) were recovered between 1971 and 1976. Only 1,686 of the recaptured were returned with known recovery dates. Lake Manitoba and Lake Winnipegosis commercial fisheries were the most lax at providing complete recapture information.

- Inland Waters Directorate, 1988. *Historical Streamflow Summary Manitoba to 1987*. Water Survey of Canada, Environment Canada, Ottawa.

- Valiant, H. 1978. *Angler creel census in the Lake Winnipegosis, Waterhen, Lake Manitoba, and Dauphin areas in 1977 and 1978*. Manitoba Department of Mines and Natural Resources, Environment MS Report No. 78-68, 88pp.

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  - An intensive summer creel census was carried out in 1977 in Lake Winnipegosis, Lake Waterhen, Lake Manitoba, Dauphin River and the Fairford-St. Martin area. In 1978, the census was repeated in part of the Waterhen and in the Fairford-Dauphin River area.

  - In a stratified sampling procedure, all fishing parties were interviewed on each sampling day as they left the angling site. Catch by species, hours spent angling, number of anglers per party and angler's place of residence were recorded. For each area, a sample of walleye were measured, weighed and scale samples taken.

  - Angler's place of residence were as follows: Local residents ranged from 0.6% to 54.9%; other Manitobans ranged from 48.0% to 91.1%; Canadians (non-Manitoban) ranged from 0.3% to 8.1%; and Americans ranged from 5.8% to 19.6% of the total numbers of anglers sampled for each area.

  - Success in 1977 ranged from 0.12 to 0.57 Walleye per angler-hour over the selected areas.

- In 1978, production at Dauphin River was similar to that estimated for 1977, while Waterhen production declined. It appeared that this decrease was due to decreased effort by anglers. Total estimated angler-hours went from 55,000 in 1977 to 31,000 in 1978.

- Average number of walleye caught per angler-hour, however, increased from 0.36 in 1977 to 0.60 in 1978.