DEPARTMENT OF NATURAL RESOURCES

Lake Winnibigoshish Update

A newsletter from Grand Rapids Area Fisheries

For additional questions, please contact the Grand Rapids Area Fisheries office at 1201 East Highway 2, Grand Rapids, MN 55744, or email *grandrapids.fisheries@state.mn.us.*, or call 218-328-8836.

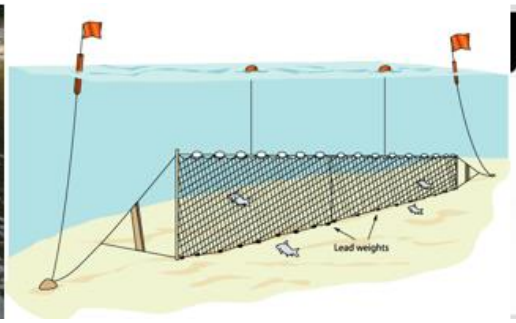
Additional information and useful links are located on the Grand Rapids Area Fisheries web page: https://www.dnr.state.mn.us/areas/fisheries/grandrapids/index.html

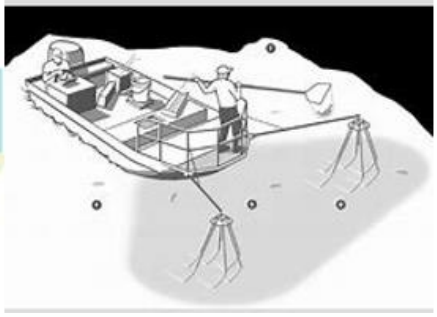
General background information

Statewide, Minnesota's ten largest Walleye lakes account for roughly 20% of annual angler pressure and 40% of annual Walleye harvest. Prior to 1983, fisheries assessments on these lakes were infrequent and highly variable in their methods. As a result, these surveys were unreliable for assessing fishery status as well as determining the appropriate management actions to take. Recognizing the importance of these systems and the need for robust data to effectively identify and evaluate trends in these fisheries, the Minnesota Department of Natural Resources initiated the Large Lake Program (LLP) in 1983. Goals of the LLP include annual fishery surveys using standardized methods to allow for comparisons among years and between lakes, to detect management needs and evaluate management actions, and to enhance public outreach. The primary focus of the LLP and its survey methods is to promote sound management of Walleye, Yellow Perch, and Northern Pike populations while also collecting additional information on other species of fish, aquatic life, and water quality.

Lake Winnibigoshish is one of the lakes in the LLP program, and has been sampled annually since 1983. The survey methods used in 2019 to evaluate the status of the lake included seining, electrofishing, standard gill netting, water sampling, zooplankton sampling, temperature monitoring, and water clarity monitoring.

Methods to target juvenile Walleye and Yellow Perch included near-shore seining in mid-August and boat electrofishing in mid-September. Thirty-two standard gill nets, which include five 50-foot panels with differing mesh sizes to target various sizes and species of fish were used in mid-September, primarily to target adult Walleye, Yellow Perch, and Northern Pike. Water samples were collected in early-August and analyzed for seven water quality metrics. Eight temperature loggers were located on a rope and spaced 5 to 10 feet apart to record hourly water temperatures throughout the water column during 2019. Zooplankton were sampled at six sites on seven occasions from mid-May through mid-September. While sampling for zooplankton, a water clarity measurement occurred monthly. Annual lake survey reports that summarize the information collected are located on the DNR website using the Lakefinder tool at **https://www.dnr.state.mn.us/lakefind/index.html**



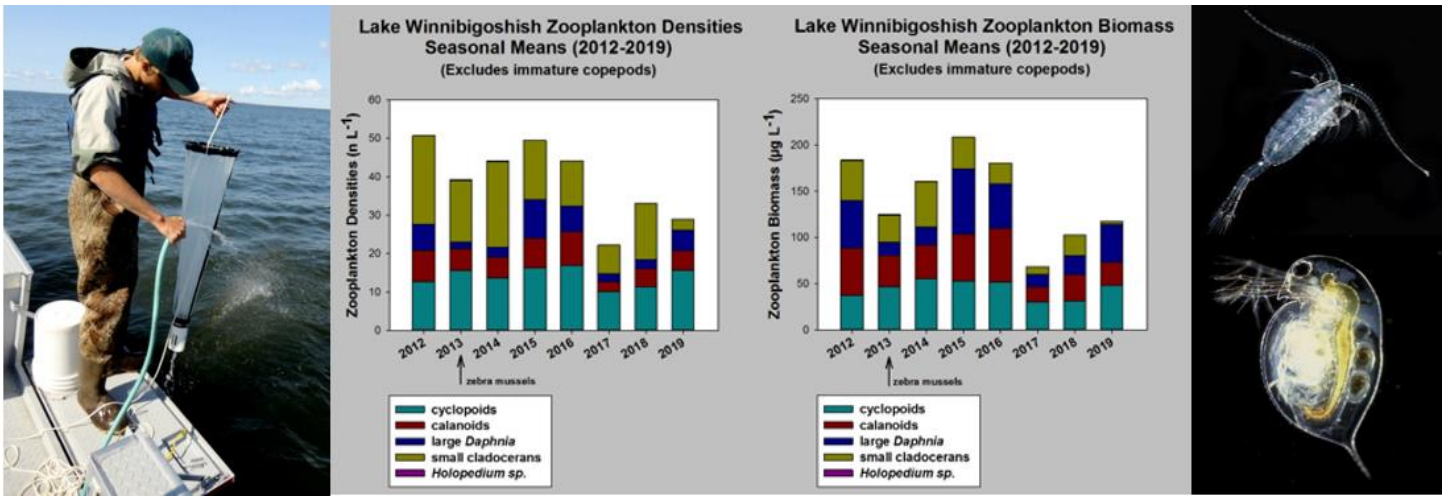


Seining, gill netting, and boat electrofishing, were three of the ways biologists evaluated the Lake Winnibigoshish fishery in 2019.

Zooplankton, water clarity, and temperature trends

Zooplankton are the first prey item commonly consumed by almost all fish species during their initial weeks or months of life. Zooplankton are microscopic sized organisms that often resemble creatures from science fiction movies. They are an essential part of the diet for all juvenile gamefish. Much like adult gamefish choose to consume specific species of fish (i.e. Yellow Perch, Cisco, White Sucker), juvenile gamefish also choose to consume specific species of zooplankton during early stages of development. Zooplankton are commonly categorized into two groups, Copepods and Cladocerans (see images below). Most diet selectivity studies of juvenile gamefish demonstrate that when given the choice, Cladocerans are selected over Copepods. In general, gamefish need to consume smaller bodied Cladocerans initially until their mouth gets large enough and they can swim fast enough to prey on larger Cladocerans.

One trend commonly observed in lakes when zebra mussel populations become established, is the decline in smaller bodied Cladocerans. Zebra mussels are filter feeders and can effectively filter and consume these small individuals. This trend has been observed on other large lakes in Minnesota, and is now being observed on Winnibigoshish. Zebra mussel veligers (juveniles) were first sampled in Winnibigoshish in 2012, and zebra mussel adults were considered established lakewide by 2016. Although the overall zooplankton density and biomass numbers on Winnibigoshish are typically higher than those observed on adjacent large lakes (i.e. Leech and Cass lakes), a decline in overall zooplankton density and biomass has occurred post zebra mussel establishment on Winnibigoshish. Additionally, lower numbers of small bodied Cladocerans are noteworthy. This trend will likely result in gamefish having to select alternate and less preferable prey items.



The average density (number/liter) and biomass (µg/liter) of zooplankton sampled by year on Winnibigoshish, 2007-2019. Cyclopoids and Calanoids are Copepods, Daphnia are Cladocerans, and Holopedium species are water fleas. Images of a zooplankton sampling net being used by a DNR employee (left) and a Copepod (top right) and Cladoceran (bottom right) are shown.

Water clarity has had an increasing trend since the mid-2000s, which is consistent with the time-period faucet snails and then zebra mussels became established. Both species are filter feeders and known for improving water clarity. Water clarity was commonly around seven to eight feet throughout the 1980s and 90s, which was helpful for daytime Walleye anglers. While readings up to 20 feet have occurred in recent years, readings have more commonly been between 10 and 14 feet. However, seasonal and even daily changes to water quality occur. Changes in water clarity have also resulted in changes to the aquatic vegetation. Vegetation now grows at deeper depths and aquatic plant species diversity and distribution are changing.

Water temperatures throughout the water column have been recorded hourly, year-round since 2007. This water temperature data is used to better understand changes in seasonal temperature trends within and between the large lakes. Temperature data can allow for a better understanding of the lake conditions that result in fish kills (i.e. temperatures at specific depths for specific amounts of time). These data also indicate when stratification can occur intermittently during July and August. Temperature data are also used to determine the growing season lengths for gamefish species, also known as ‘growing degree days’. Walleye growth and year class

strength are related to growing degree days on several large lakes. Additionally, temperature data is used to determine when to start the fall gill net survey, ice on and off dates, and estimate hooking mortality during creel surveys, among other uses.

Changes to water clarity, vegetation amounts, and water temperature are monitored on Winnibigoshish.

Yellow Perch trends

Yellow Perch are the primary prey species for most predator gamefish. Additionally, anglers harvest more Yellow Perch (by number) than any other species throughout both the summer and winter on Winnibigoshish. Perch catches on the lake have declined in recent decades, which is consistent with statewide trends. Biologists attribute statewide declines to increased predation by gamefish, increased competition at early life stages by insectivores such as Bluegills, and near shore spawning habitat losses of wood and aquatic vegetation. Relatively high numbers of predator gamefish and food web effects of invasive zebra mussels are potentially two factors influencing perch population declines on Winnibigoshish.

Yellow Perch were the most frequently sampled fish in the 2019 gillnet survey. The catch of 14.7 per net was typical for lakes with similar habitats, but below average for Winnibigoshish. Catch rates have previously ranged from 46.9 per net (2016) to 16.6 per net (2011), and the 2019 catch was the lowest on record. Variations in perch catch rates are common and may represent changes in year class strength, angling or predation pressure, or gill net catchability. Age analysis identified 8 year classes (ages 1-8). Ages 2 and 3 fish were most common, making up 31% and 33% of the sample. Growth was similar to past surveys and near the statewide average. Perch averaged 8.3 inches at age 5.

Lake Winnibigoshish has a history of producing larger perch, making it an angling destination for this species. Summer and winter anglers start harvesting perch on Winnibigoshish at 8 inches. Perch lengths sampled in gill nets ranged from 5.4 to 11.7 inches and averaged 7.2 inches in 2019. Much like the overall gill net catch rate, there is no clear trend for the catch rate of perch that are of a size angler's harvest. The catch rate of perch over 8 inches has previously ranged from 5.9 per net (2013) to 13.0 per net (2017), but declined to 3.0 per net in 2019, representing 20% of perch sampled. These values are below average for Winnibigoshish, but indicate that opportunities for catching larger perch continue to exist.

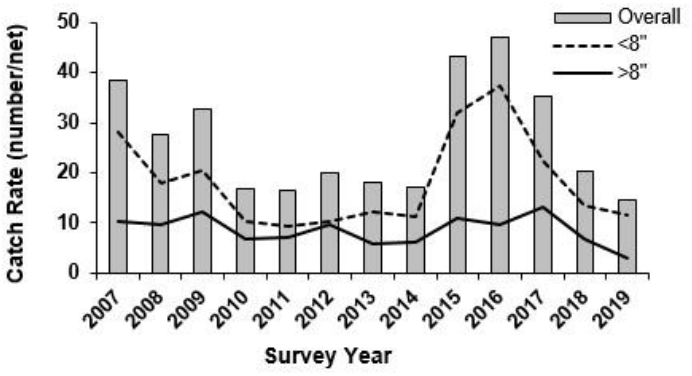


Image of an adult Yellow Perch and annual gillnet catch rates (number/net) of perch from Lake Winnibigoshish, 2007-2019. Catch rates displayed include overall, less than 8 inches, and greater than 8 inches.

Cisco (Tullibee) trends

Cisco are an important prey species and an indicator of environmental change. Cisco catch rates are often highly variable, and high catches are typically associated with strong year classes of age-1 and/or age-2 fish. Juvenile Cisco can comprise large proportions of predator diets when large year classes are present, thereby providing predation relief to Yellow Perch and other prey species.

Cisco numbers are typically constrained by the amount of cool oxygenated water in the lake. As a coldwater species, Cisco require higher oxygen levels and cooler water temperatures. During warm summers, oxygen levels in the main basin of Winnibigoshish decrease due to the reduced ability of water to retain oxygen at higher temperatures and the lack of stratification. Additionally, as coldwater species such as Cisco become stressed by warmer water temperatures, oxygen demand for an individual fish increases. Under these conditions without an adequate oxygenated cool refuge, Cisco can experience periodic summer die offs. Consequently, the Cisco population in Winnibigoshish is constrained by summer climate trends. The abundance of Cisco has the potential to affect other species, specifically the growth rates of predatory species including Walleye, Northern Pike, and Muskellunge.

Cisco catches have declined dramatically on Winnibigoshish in recent decades, which is consistent with trends observed statewide. Biologists attribute statewide declines to longer and warmer summers, resulting in reduced cool oxygenated refuges. Likely influences of current population trends on Winnibigoshish include sub-optimal summer thermal regimes, food web effects of invasive zebra mussels, and higher numbers of predator gamefish.

A total of 28 Cisco were sampled with gillnets in the fall of 2019. The catch rate of 0.9 fish/net was the lowest observed and the seventh consecutive survey with a below average catch (11.0 fish/net). The length distribution of fish sampled favored large individuals, as lengths ranged from 11.3 to 17.5 inches. The lack of smaller Cisco suggest poor recruitment in recent years. Previous catch rates ranged from 2.1 fish/net (2018) to 33.0 fish/net (2009). Based on these trends and future climate forecasts, gamefish species will have to continue to rely more heavily on perch as a prey source.

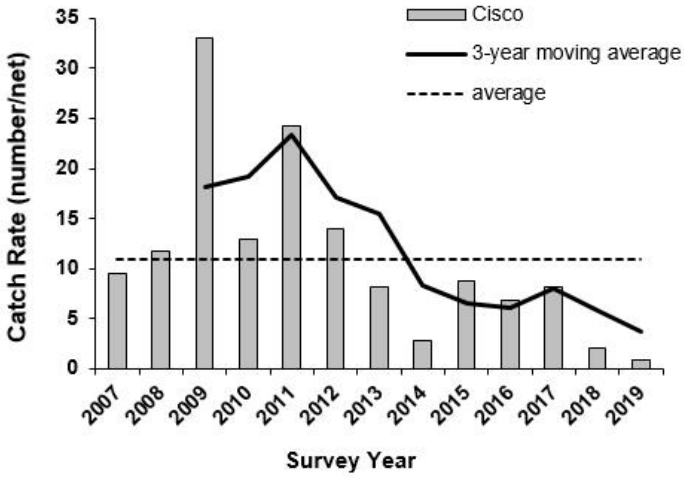


Image of an adult Cisco (left) and annual gillnet catch rates (number/net) of Cisco from Lake Winnibigoshish, 2007-2019 (right). The overall average and the 3-year moving average is displayed.

Northern Pike trends

Northern Pike are the second most harvested species (by pounds) during the summer and winter periods on Winnibigoshish. The lake is also a popular destination for darkhouse spearers, with effort averaging 23,000 hours per winter the past three decades. Catch rates for pike on Winnibigoshish are moderate. Higher catch rates are generally undesirable, as they are typically indicative of higher density populations with poor size structure, slow growth, and lower harvest potential. In general, higher catch rates of pike can also result in fewer Yellow Perch and Walleye, and lower recruitment of stocked Walleye. The 2019 gill net catch of 3.5 per net was

typical for lakes with similar habitat and for Winnibigoshish. Previous catches have varied from 2.9 per net (2010) to 6.4 per net (2017). While the catch rates of pike within and above the 22-26 inch protected slot limit currently have no trends, modified regulations enacted in 2018 should result in higher catch rates of medium and larger sized fish as time allows the population to respond.

Overall pike size structure is moderate, with larger pike over 28 inches sampled in all surveys. Angler opportunities consistently exist to catch larger pike. Lengths ranged from 10.4 to 32.7 inches in 2019, and averaged 22 inches. On average, 5.4% of pike sampled exceed 28 inches. As in past surveys, recruitment was consistent, with ages 0 to 8 present. Growth was similar to past surveys and near the statewide average, as pike averaged 23.6 inches by age 4.

Northern Pike angling and spearing regulations changed statewide on the 2018 fishing opener. Changes established three zones, each with different regulations. Lake Winnibigoshish is located in the north-central zone (NC zone). The regulation in this zone allows anglers to keep 10 pike, but not more than two longer than 26 inches, and all from 22 to 26 inches must be released. Pike taken by spear follow the same rules except one may be between 22 and 26 inches and one may be longer than 26 inches. This regulation provides better harvest opportunities for sizes of pike that make good table fare, around 26 to 28 inches. The regulation also reflect anglers' concerns about the high numbers of small pike in much of central to north-central Minnesota.

In addition to reducing the number of small pike in the NC zone, the regulation has the objective of allowing medium sized pike to grow larger. The advantages of growing pike slightly larger are twofold. While protected, these medium sized pike will eat additional smaller pike, further reducing their number. Additionally, when medium sized pike grow slightly larger they will be a more desirable size to fillet. Anglers that plan to keep pike will need to be prepared to measure them and familiarize themselves with filleting techniques. For more information visit **mndnr.gov/pike**.

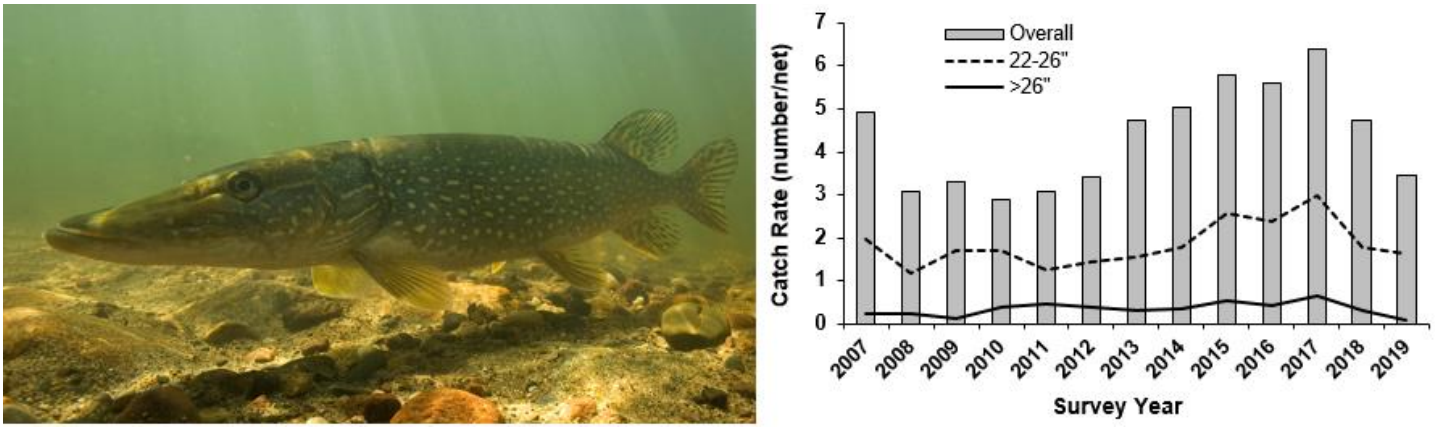


Image of an adult Northern Pike and annual gillnet catch rates (number/net) of pike from Lake Winnibigoshish, 2007-2019. Catch rates displayed include overall, 22-26 inches, and greater than 26 inches. The regulation changed on the 2018 fishing opener.

Walleye trends

Walleye are a primary management species on Winnibigoshish because they are well suited for the lake, are actively managed through stocking and regulation, and are popular with anglers. Walleye are consistently the highest harvested species (by pounds) throughout the summer angling period. The population is maintained by natural reproduction and fry stocking. Walleye eggs are collected each spring at the Cut Foot Sioux egg take site and ten percent of the eggs are annually returned to the system as newly hatched fry. The relative contribution of stocked and/or natural fry is difficult to determine because there are no non-stocked year classes to evaluate. Harvest has been regulated with special regulations since 2000. The original 17-26 inch protected slot limit (PSL) was modified to an 18-23 inch PSL in 2015. Walleye from 18 to 23 inches must be immediately released, the possession limit is six, and only one over 23 inches is allowed in possession. The goal of this

regulation is to provide higher angler catch and harvest rates. The number of female spawners is as high as it has been in recent decades, and the population can support additional harvest while maintaining quality.

Walleye were the second most common fish captured in gill nets 2019. The catch was typical for lakes with similar habitats, but below average for Winnibigoshish. In nature, Walleye do not produce strong year classes annually, producing both a mix of strong and weak year classes. This influences population cycles, angler success, and gill net catch rates. Recruitment patterns strongly influence the number of Walleye. Recruitment was poor between 2014 and 2017, resulting in below average gill net catches and reduced availability of harvestable fish for anglers. The good number of Walleye from the 2018 and 2019 year classes was confirmed in the 2019 gill net survey and are expected to contribute to higher catch rates in the near future.

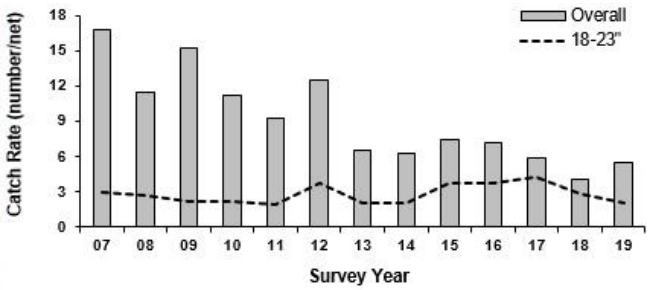


Image of an adult Walleye and annual gillnet catch rates (number/net) of Walleye from Lake Winnibigoshish, 2007-2019. Catch rates displayed include those for all Walleye and those from 18 to 23 inches.

Winnibigoshish supports a quality size distribution for Walleye, but harvest regulations used to protect spawners can effect angler harvest during periods of reduced recruitment. Over 70% of the Walleye sampled in 2017 and 2018 surveys were within the 18-23 inch protected slot. Improved recruitment of the 2018 and 2019 year classes resulted in higher catches of fish under 18 inches in the 2019 gill net survey, as 62% of sampled fish were less than 18 inches. These fish were generally too small to interest anglers in 2019, but will grow to an acceptable size by 2020 and provide harvest opportunities.

Biological measurements continue to indicate a healthy Walleye population with appropriate harvest levels. In 2019, Walleye lengths ranged from 6.9 to 26.1 inches and averaged 14.5 inches indicating a diverse size structure. By the fall of 2019, Walleye produced in the spring of 2019 averaged 6.0 inches. Walleye sampled that were age-1 to age-5 averaged 10.9, 14.5, 17.1, 18.8, and 20.0 inches. Growth rates for all of these age-classes were above the lake and statewide averages the past three years. Age analysis indicated 15 year classes were present, ranging from age 0 to 14. The 2018 and 2019 year classes were well represented, comprising 14% and 43% of the sample, suggesting good initial survival from these years. The 2013 year class remains the strongest class of adult fish, and comprised 16% of the sample.

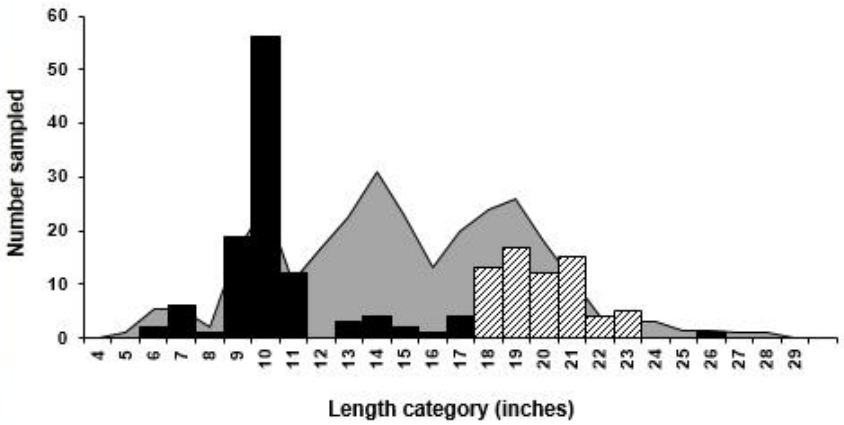


Image of young-of-the-year Walleye in a live well sampled while electrofishing in the fall of 2019, and the length-frequency distribution of Walleye sampled with gill nets in Lake Winnibigoshish, 2019. The dashed bars represent the fish sampled that were within the 18-23 inch protected slot (PSL), the black bars represent fish sampled not within the PSL, while the grey shaded background area represents the average number sampled per length category from 2007-2018.

Evaluation of spawning stock biomass (i.e. the pounds of mature female spawners in the lake; or SSB) is useful to determine appropriate harvest levels and establish safeguards to maintain an adequate adult population for natural reproduction. A female SSB of one to two pounds per acre is considered appropriate for natural reproduction on Winnibigoshish. Surveys in 2018 and 2019 resulted in estimates of 1.1 pounds per acre. Age and length at maturity are also useful indicators to determine appropriate harvest levels and relative population status. Since 2007, female Walleye on Winnibigoshish typically reached maturity in 3.5 years and at 17.3 inches. Both values are near statewide standards and suggest appropriate harvest levels are occurring.

Invasive Species

Aquatic invasive species are increasing in prevalence throughout Minnesota and pose a risk to native ecosystems. Invasive species known to be present in Winnibigoshish include zebra mussels, banded mystery snails, Chinese mystery snails, faucet snails, and starry stonewort, while both curly leaf pondweed and rusty crayfish are in upstream connected water bodies. Movement of any type of equipment (boats, boat trailers, boat lifts, docks, personal watercraft, bait containers, etc.) between lakes may transfer invasive species if precautions are not taken. To avoid being an accomplice to the spread of these unwanted species, people should ensure that all equipment is thoroughly cleaned and dried before moving it to a new body of water. More information regarding invasive species is available at **www.dnr.state.mn.us/invasives/index.html**.

The three snail species: (i.e. banded mystery, Chinese mystery, and faucet) have become established since 2000. While effects of both species of mystery snail are unknown, the faucet snail carries a parasitic trematode that can kill several species of ducks if ingested. Consumption of these snails resulted in thousands of ducks dying during the falls of 2007 and 2008. The faucet snail is a filter feeder and may also be responsible for increased water clarity prior to the introduction of zebra mussels.

Juvenile zebra mussels (veligers) were discovered while sampling for zooplankton during the summer of 2012. Adults were first found on near shore submersed wood in early summer 2016, then found by divers on mid lake rock structure during August 2016. Zebra mussels were present on nearly every firm surface by the summer of 2017. Zebra mussel veliger counts increased rapidly, and were higher than typically observed in Minnesota in 2017. Veliger densities have decreased slightly the past few years. Zebra mussels appear to be contributing to some ecosystem changes in Winnibigoshish, similar to other established waters in Minnesota. The density and biomass of small Cladocerans have been lower the past three years and now are the lowest observed. These are common prey items of zebra mussels. Winnibigoshish zooplankton communities have displayed typical seasonal patterns where both densities and biomass peak in the early summer after the spring algal bloom. A second, smaller peak often occurs in late summer in north temperate lakes. Winnibigoshish also displayed this pattern prior to zebra mussel establishment, but the second peak has not occurred in recent years. This late-summer peak coincides with the time of year when filtering rates of adult mussels are highest. The long-term impact of zebra mussels on the fish community is still unknown. Winnibigoshish is a fertile lake and continues to produce relatively high overall zooplankton density and biomass compared to other large lakes, despite the presence of zebra mussels.

Zebra mussels, faucet snails, banded mystery snails, and Chinese mystery snails (images left to right) are all invasive species that have become established in Winnibigoshish.

Starry Stonewort (an algae) was discovered in Cass Lake during the summer of 2016. The discovery upstream of Winnibigoshish prompted an investigation on Winnibigoshish. Starry Stonewort was discovered along the south and west shores of the lake in 2016, and appears to have been established for several years. Starry Stonewort has continued to spread in 2017, and was identified along the east shore near Birches public access.

Rusty Crayfish are present in Cass Lake, and curly leaf pondweed is present in Dixon Lake. Both of these lakes are connected to and upstream of Winnibigoshish. Introduction into Winnibigoshish in the near future is likely. Emerald Shiners (often used as bait) are not native to Winnibigoshish, were first sampled in 2005, and have been sampled each year since. Each of these invasive or non-native species were likely introduced through human activities. Please dispose of any unused live bait after fishing is done, as unintentional consequences to native ecosystems can occur.

While starry stonewort (left image) was discovered in Winnibigoshish in 2016, curly leaf pondweed, and rusty crayfish have yet to be discovered but are in connected water bodies upstream.