Lake Winnibigoshish Lakeshed Assessment

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake. Criteria were developed using limnological concepts to determine the effect to lake water quality.

Lakeshed Vitals		Rating
Major Basin	Upper Mississippi River	descriptive
Major Watershed	Mississippi River - Headwaters	descriptive
Minor Watershed	7024	descriptive
Lakeshed	Lake Winnibigoshish (702400)	descriptive
Ecoregion	Northern Lakes and Forests	descriptive
Lake Area	56,470 acres	descriptive
Miles of Shoreline	69.78	descriptive
Miles of Stream	10.89	descriptive
Miles of Road	66.4	descriptive
Lake Max Depth	70 ft. (21.3 m)	descriptive
Lake Mean Depth	15 ft. (4.6 m)	-
Water Residence Time	NA	NA
Municipalities	Bena	-
Sewage Management	Individual waste treatment systems (septic systems and holding tanks) and city sewer	-
Public Drainage Ditches	None	+
Lake Management Plan	None	x
Lake Vegetation Survey/Plan	None	x
Forestry Practices	None	+
Development Classification	General Development	-
Shoreline Development Index	2.1	-
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	1.6:1	+
Public Lake Accesses	7	x
Inlets	8 – Mississippi River plus numerous tributaries	x
Outlets	1 – Mississippi River	x
Feedlots	None	+
Agriculture Zoning	None	+
Public Land : Private Land	35:1	+
Wetland Coverage	15%	+
Lake Transparency Trend	NA	NA
Exotic Species	Faucet snail	-

Rating Key:
+ *beneficial to the lake*
- *possibly detrimental to the lake*
x *warrants attention*

Lakeshed

Understanding a lakeshed requires the understanding of basic hydrology. A watershed is the area of land that drains into a surface water body such as a stream, river, or lake and contributes to the recharge of groundwater. There are three categories of watersheds: 1) basins, 2) major watersheds, and 3) minor watersheds.

Lake Winnibigoshish is found within the **Upper Mississippi River Basin**, which includes the **Mississippi River - Headwaters Major Watershed** as one of its sixteen major watersheds (Figure 1). The basin covers 20,000 square miles, while the Mississippi River - Headwaters Watershed covers 1,960 square miles (approximately 1,254,651 acres). Lake Winnibigoshish falls within **minor watershed 7024**, one of the 121 minor watersheds that comprise the Mississippi River - Headwaters Major Watershed (Figure 2).

Within this watershed hierarchy, lakesheds also exist. A lakeshed is defined simply as the land area that drains to a lake. While some lakes may have only one or two minor watersheds draining into them, others may be connected to a large number of minor watersheds, reflecting a larger drainage area via stream or river networks. Lake Winnibigoshish falls within the **Lake Winnibigoshish (702400) lakeshed**, covering 92,792 acres (includes lake area) (Figure 3). Even though Lake Winnibigoshish receives water from numerous minor watersheds, for the purpose of this assessment it is decided that only the immediate lakeshed be inventoried and assessed.

Lake Winnibigoshish Lakeshed Water Quality Protection Strategy

Each lakeshed has a different makeup of public and private lands. Looking in more detail at the makeup of these lands can give insight on where to focus protection efforts. The protected lands (easements, wetlands, public land) are the future water quality infrastructure for the lake. Developed land and agriculture have the highest phosphorus runoff coefficients, so this land should be minimized for water quality protection.

Although the majority of land within Lake Winnibigoshish's lakeshed is public, private forested uplands can be the focus of development and protection efforts in the lakeshed.

	Private (1%)					66%	Public (33%)		
	Developed	**Agriculture**	**Forested Uplands**	**Other**	**Wetlands**	**Open Water**	**County**	**State**	**Federal**
Land Use (%)	0.25%	0.1%	0.4%	0%	0.25%	66%	0%	8%	25%
Runoff Coefficient Lbs of phosphorus/acre/ year	0.45 - 1.5	0.26 - 0.9	0.09		0.09		0.09	0.09	0.09
Description	Focused on Shoreland	Cropland	Focus of develop-ment and protection efforts	Open, pasture, grass-land, shrub-land	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperatives		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

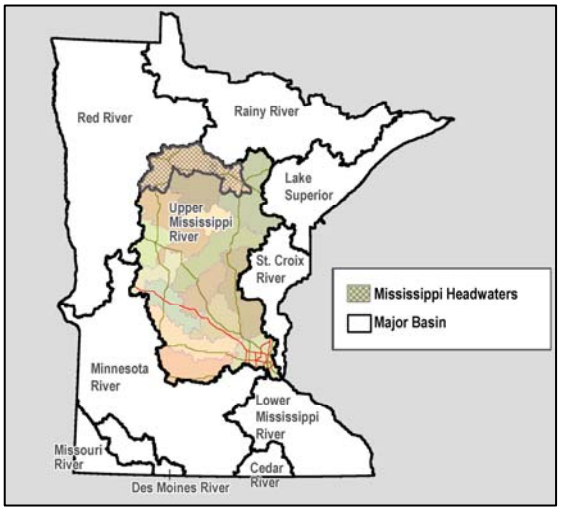


Figure 1. Upper Mississippi Basin and the Mississippi River - Headwaters Watershed.

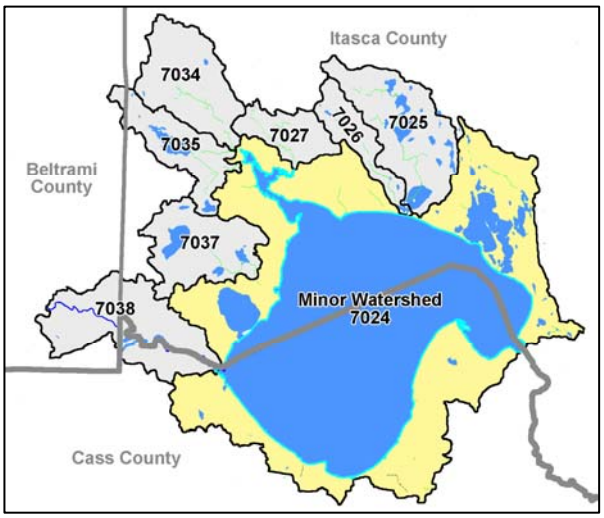


Figure 2. Minor Watersheds 7024, 7025, 7026, 7027, 7034, 7035, 7037, & 7038 contribute water to Lake Winnibigoshish.

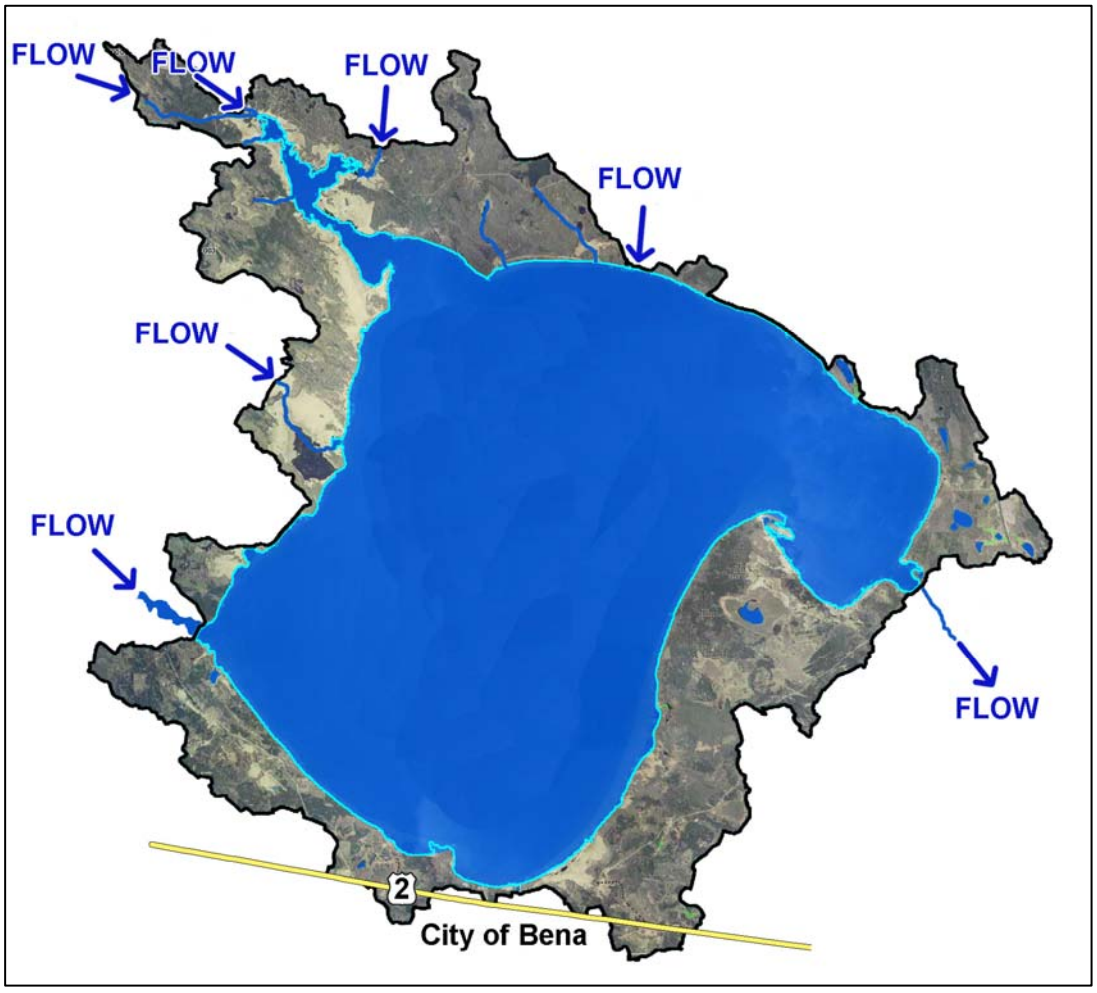


Figure 3. The Lake Winnibigoshish (702400) Lakeshed (Aerial Imagery 2008 1M).

Land Cover / Land Use

The activities that occur on the land within the lakeshed can greatly impact a lake. Land use planning helps ensure the use of land resources in an organized fashion so that the needs of the present and future generations can be best addressed. The basic purpose of land use planning is to ensure that each area of land will be used in a manner that provides maximum social benefits without degradation of the land resource.

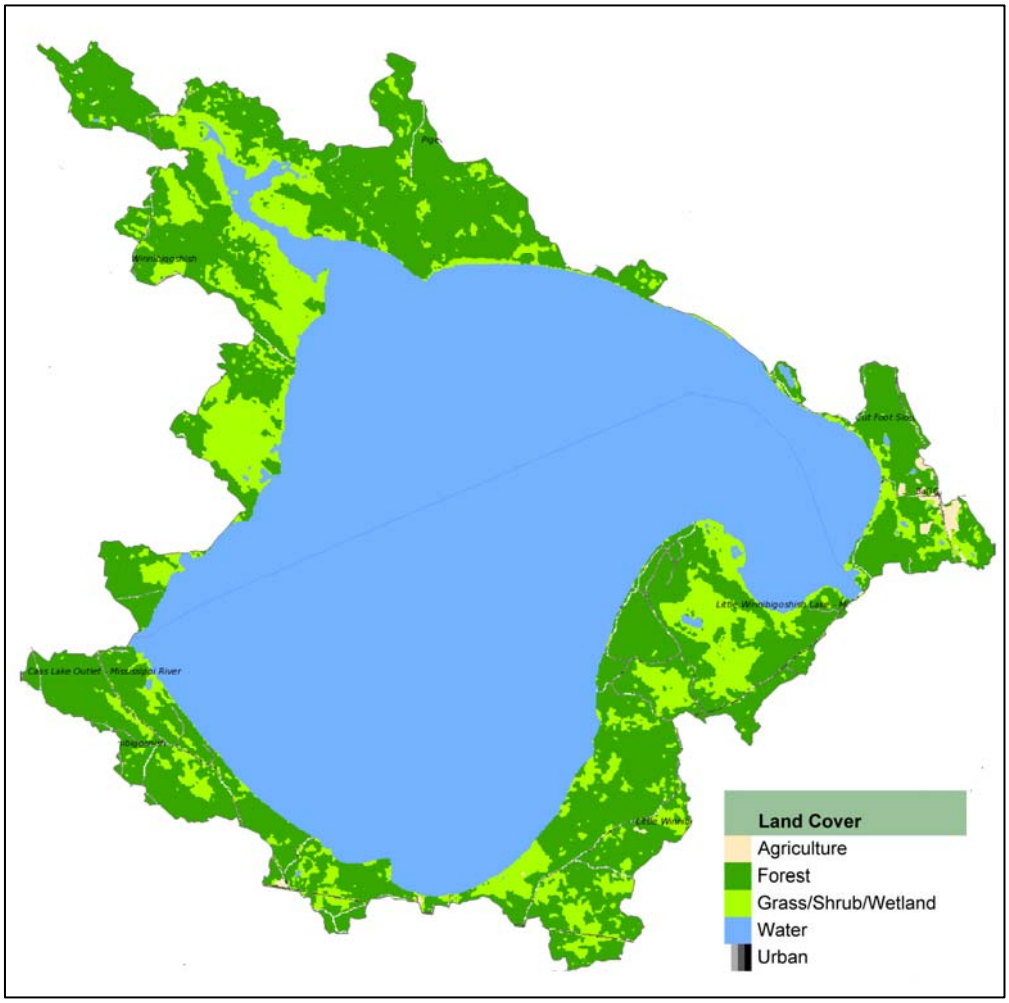


Figure 5. The Lake Winnibigoshish (702400) lakeshed land cover (http://land.umn.edu).

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the lands ability to absorb and store water rather than cause it to flow overland (gathering nutrients and sediment as it moves) towards the lowest point, typically the lake. Impervious intensity decribes the lands inability to absorb water, the higher the % impervious intensity the more area that water cannot penetrate in to the soils. Monitoring the changes in land use can assist in future planning procedures to address the needs of future generations.

Phosphorus export, which is the main cause of lake eutrophication, depends on the type of land cover occurring in the lakeshed. Figure 5 depicts Lake Winnibigoshish's lakeshed land cover.

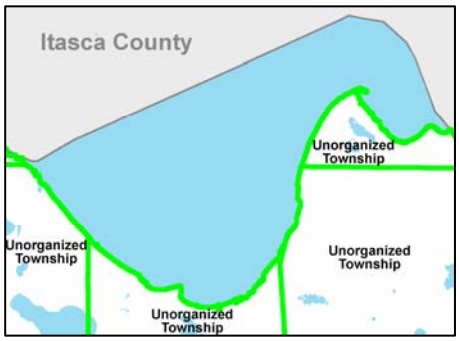
The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (http://land.umn.edu). Table 1 describes Lake Winnibigoshish's lakeshed land cover statistics and percent change from 1990 to 2000. Due to the many factors that influence demographics, one cannot determine with certainty the projected statistics over the next 10, 20, 30+ years, but one can see the transition within the lakeshed from agricultural and water acreages to forest, grass/shrub/wetland, and urban acreages. The largest change in percentage is the decrease in agriculture (64.8%); however, in acreage, forest cover has increased the most (952 acres). In addition, the impervious intensity has increased, which has implications for storm water runoff into the lake.

Table 1. Lake Winnibigoshish's lakeshed land cover statistics and % change from 1990 to 2000 (http://land.umn.edu).

	1990		2000		% Change
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**1990 to 2000**
Agriculture	727	0.78	256	0.28	64.8 % Decrease
Forest	24,634	26.55	25,586	27.57	3.9 % Increase
Grass/Shrub/Wetland	9,872	10.64	10,175	10.97	3.1 % Increase
Water	56,717	61.12	55,932	60.28	1.4 % Decrease
Urban	837	0.9	838	0.9	0.1 % Increase
Impervious Intensity %					
0	92,293	99.47	92,120	99.28	0.2 % Decrease
1-10	151	0.16	149	0.16	1.3 % Decrease
11-25	218	0.23	293	0.32	34.4 % Increase
26-40	91	0.1	147	0.16	61.5 % Increase
41-60	22	0.02	68	0.07	209.1 % Increase
61-80	6	0.01	5	0.01	16.7 % Decrease
81-100	5	0.01	6	0.01	20 % Increase
Total Area	92,792		92,792		
Total Impervious Area (Percent Impervious Area Excludes Water Area)	93	0.26	150	0.41	61.3 % Increase

Demographics

Lake Winnibigoshish is classified as a general development lake. General development lakes usually have more than 225 acres of water per mile of shoreline and 25 dwellings per mile of shoreline, and are more than 15 feet deep.



The Minnesota Department of Administration Geographic and Demographic Analysis Division extrapolated future population in 5-year increments out to 2035. These projections are shown in Figure 6 below. As a whole, Cass County has a positive extrapolated growth projection over the next 30 years, whereas the city of Bena has a negative extrapolated growth projection. Within Cass County, Lake Winnibigoshish lies within four unorganized townships, so no extrapolated population growth projections are available at the township level.

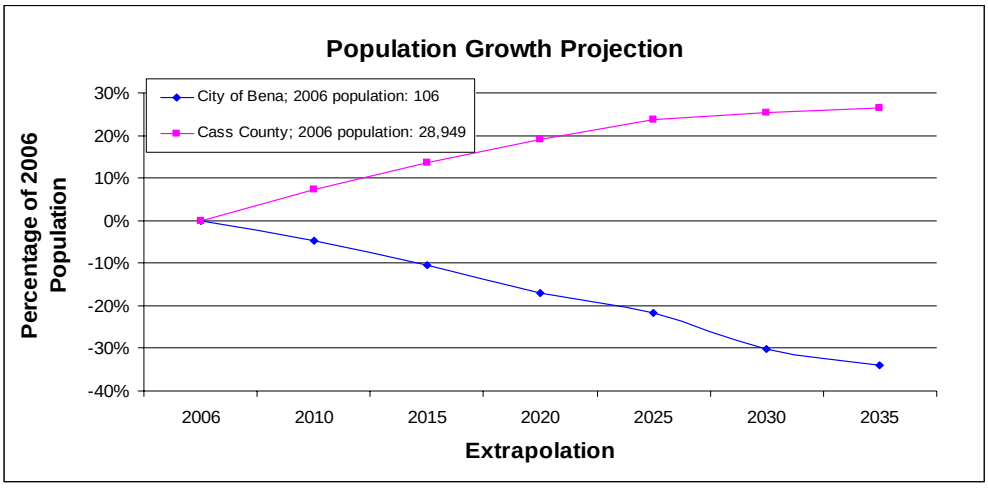


Figure 6. Population growth projection for the city of Bena and Cass County. Figure excludes four unorganized townships (Cass County only) that lack individual population data (source: http://www.demography.state.mn.us/resource.html?Id=19332).

Status of the Fishery (DNR, as of 06/25/2007)

Two sets of gill nets (near-shore and mid-lake) were used for this assessment. Near-shore and mid-lake gill nets catches will be discussed here, however, catch information for mid-lake nets is not presented in this document. Catch rates for the 2007 mid-lake gill nets are available in the Lake Winnibigoshish assessment dated 06/26/2007. Additionally, seining and trawling were used to sample various life stages of walleye and yellow perch in 2007. Near-shore and mid-lake gill nets were used to evaluate relative abundance of all other species.

Walleye Near-shore gill nets Walleye were sampled at a rate of 4.6 per net, which was average for Lake Winnibigoshish. Walleye sampled varied from 6.5 to 26.3 inches with a mean length of 14.8 inches and mean weight of 1.4 pounds. The walleye population appeared to be healthy with most age classes sampled between age 1 and 12. Year class strength was computed for walleye from age 2 to age 7. One weak year class (2000), four average year classes (1999, 2002, 2003, and 2004), and two strong year classes (2001 and 2005) were sampled. Walleye catch rates were near average for most length groups in 2007. Mean back-calculated growth was similar to the Lake Winnibigoshish and statewide average for all ages, attaining 17.4 inches after five growing seasons.

Mid-lake gill nets A strong mid-lake movement of walleye was documented for the first time in 2007. The mean walleye catch rate for mid-lake nets was 80% larger than catch rates from near-shore nets. The mean catch of 8.3 walleye per gill net was the second highest catch rate observed, and exceeded the third quartile for Lake Winnibigoshish. Walleye sampled varied from 6.7 to 26.9 inches. The mean length and weight of walleye in mid-lake nets was larger than near-shore sets at 15.4 inches and 1.7 pounds, respectively.

Seine and trawl Relatively few age 0 walleye were sampled by seine in 2007. Seine catch rates have not correlated to ultimate year class strength for walleye in Lake Winnibigoshish. Growth rates of age 0 walleye has been a better predictor of year class strength. Rapid spring warming and above average summer temperatures appear to have resulted in faster than average growth and relatively large size of age-0 walleye. Fast growth and large size of fingerling walleye often correspond to strong year classes. Mean lengths of age 0 walleye varied from 3.3 to 4.4 inches from July 7 to July 30.

The mean trawl catch rate for age 0 walleye in 2007 was nearly double the highest catch rate observed since 1972. Age 0 walleye growth recorded through the first week of August was faster than mean growth since 1983, reaching a mean length of 4.7 inches on August 7. High trawl catch rates of age 0 walleye have not resulted in strong year classes, however, high catch rates combined with faster than average growth may result in above average abundance.

Yellow perch Near-shore gill nets Yellow perch were captured at a rate of 86.4 per net. This catch rate was considerably higher than the catch of 56.3 per net in 2006, and was near average for Lake Winnibigoshish. Perch sampled in 2007 varied from 2.3 to 11.7 inches with a mean length of 7.1 inches and mean weight of 0.18 pounds. Catch rates and size structure of sampled perch have changed recently. Catch rates started a slow decline in the late 1990s, but were within historic norms until 2003. Catch rates from 2003 through 2006 were below the first quartile for Lake Winnibigoshish due to weak 2000 and 2002 year classes. Catch rates recovered to average in 2007 due to increased abundance of small, young perch.

Age classes 1 through 8 were sampled by gill net. An index of yearclass strength was computed for ages 3 through 7. The 2001 and 2004 year classes were average, the 2000 and 2002 year classes were weak, and the 2003 year class was strong. The catch was heavily biased towards younger perch with 88% of the catch made up of age 2 through age 4 fish. Yellow perch growth

was relatively slow through age 2, increased to near average from age 3 to age 9, with perch attaining a mean length of 9.2 inches at age 6.

Relative health of the yellow perch population has been described by the percent of perch longer than 9 inches in the gill net catch. As perch catch rates decreased the proportion of large perch (longer than 9 inches) increased. The proportion of large perch peaked as gill net catch rates fell below the first quartile. In 2005, the proportion of large perch sampled in near-shore gill nets declined for the first time since 1998. The proportion of perch longer than nine inches was stable in 2005 and 2006 at 16.9 percent, then declined to 9.8% in 2007 as young perch were recruited to the fishery.

The microsporidian parasite heterosporis has been documented in Lake Winnibigoshish yellow perch. Of 180 perch examined in 2007 no evidence of heterosporis was observed.

Mid-lake gill nets Yellow perch were captured at a rate of 75.6 per net, which was lower than the first quartile for Lake Winnibigoshish. Perch sampled in 2007 varied from 4.9 to 11.5 inches with a mean length of 7.6 inches and mean weight of 0.23 pounds. Growth of yellow perch sampled in near-shore and mid-lake nets from previous surveys were compared and no significant difference was found, consequently samples were pooled in 2007.

Perch size structure has been compared between near-shore and mid-lake gill nets using the percent longer than 9 inches. Mid-lake nets typically have a larger contribution of large perch than near-shore nets. Perch size structure for near-shore nets has varied from 5.5 percent in 1991 to 34.5 percent in 1989, 9.8 percent of near-shore gill net captured perch were longer than nine inches in 2007. Perch size structure for mid-lake nets has varied from 16.7 percent in 2007 to 45.9 percent in 2003. The low contribution of perch longer than 9 inches in 2007 is due to the weak 2000 and 2002 year classes combined with recruitment of the strong 2003 year class to the gill net catch.

Seine and trawl Catch rates of age-0 yellow perch were near average for both seine and trawl. No correlation is evident between catch rates of age-0 yellow perch and ultimate year-class strength.

Northern pike Near-shore gill nets Catch rates of northern pike increased from 1999 through 2005 and exceeded the third quartile in four of six years since 2002. Northern pike catch rates increased to 9.7 per near-shore gill net in 2007. Pike sampled in near-shore gill nets varied from 12.0 to 31.1 inches with a mean length of 21.0 inches. All age classes between age 1 and 8 were sampled by gill net. Age two, three, and four pike were most abundant and pike exhibited growth rates that were similar to state wide averages through all ages.

Mid-lake gill nets Northern pike were sampled at a near average rate of 6.0 per mid-lake gill net. Pike sampled in mid-lake gill nets varied from 17.9 to 33.1 inches with a mean length of 22.9 inches. Growth rates of pike sampled in near-shore and mid-lake gill nets were compared for the 1997 to 2004 time period. No significant difference was observed consequently near-shore sampled fish were used for age and growth computations. Growth of near-shore gill net sampled northern pike was similar to statewide averages, attaining a back-calculated mean length of 22.9 inches at age 5.

Cisco Near-shore gill nets Gill net catch rates of cisco were within historic bounds for both near-shore and mid-lake nets in 2007. The catch rate of 21.2 per near-shore net was near the first quartile. Cisco were not aged in 2007, however, examination of the length frequency indicates that at least one year class was poorly represented in the catch. Cisco sampled in near-shore gill nets varied from 6.6 to 16.5 inches with a mean length of 8.0 inches.

Mid-lake gill nets The mid-lake gill net catch rate of 21.1 cisco per net was near the first quartile for Lake Winnibigoshish. Air and water temperatures were higher than average during the summer of 2006 and a summer kill of cisco was observed. Examination of the length frequency distribution shows reduced abundance of cisco larger than 10.5 inches and no cisco between 8.5 and 10.5 inches. Reduced catch of cisco larger than 10.5 inches likely shows the impact of the 2006 summer kill, and lack of cisco between 8.5 and 10 inches indicates poor reproduction for at least one year class. Cisco less than 8.5 inches were relatively abundant indicating good reproduction (probably the 2004 year class). Cisco sampled in mid-lake gill nets varied from 6.8 to 16.1 inches with a mean length of 9.2 inches.

Water Quality Water samples were taken on August 6, 2007. Physical and chemical parameters measured were within the range observed since 1983 . Five temperature and dissolved oxygen profiles were taken from June 25 to July 23, 2007. Dissolved oxygen stratification was evident on July 5, July 9, and July 23. No evidence of thermal stratification was found in 2007. Thermal and dissolved oxygen stratification may result during periods of high air temperatures and low wind. When wind speeds increase to moderate levels (15 mph) the entire water column appears to mix.

See the link below for specific information on gillnet surveys, stocking information, and fish consumption guidelines. http://www.dnr.state.mn.us/lakefind/showreport.html?downum=11014700