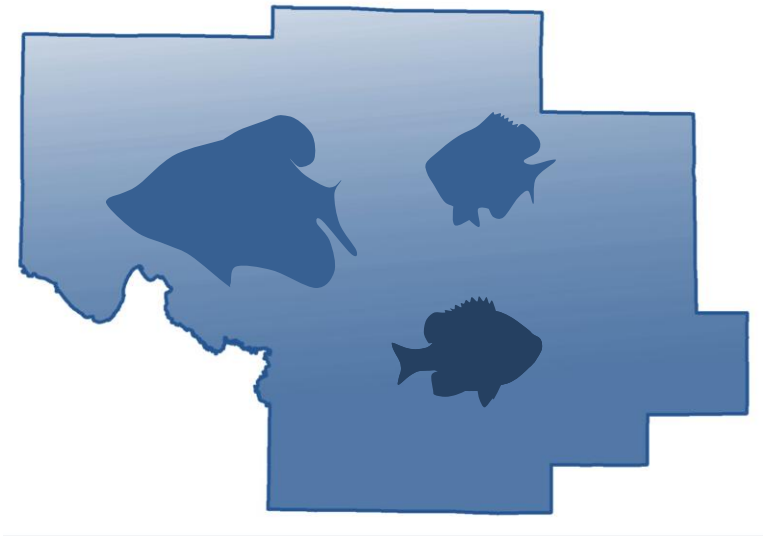
Status Review and Management Outline for Quality Bluegill and Black Crappie Populations in the Grand Rapids Area.



Revised in 2013

By

David L. Weitzel

Assistant Area Fisheries Supervisor

MN DNR, Grand Rapids Area Fisheries

Table of Contents

Introduction

Panfish angling is a very popular and important component in the recreational fishery in the Grand Rapids area and throughout Minnesota. Bluegill and black crappie are the primary sunfish species of interest to anglers in northern Minnesota. A review of creel studies by the Minnesota Department of Natural Resources (MNDNR) resulted in an estimated annual harvest of approximately 14 million bluegills and 7 million black crappies (Cook and Younk 2001). The combined harvest of the two species accounted for approximately 43% of the total statewide recreational fishery harvest. Poor or declining size structure is a common complaint from anglers. Declines in average size of harvested bluegill in Minnesota and Wisconsin have been documented (Olson and Cunningham 1989; Beard and Kampa 1999) and public interest in regulations to protect or enhance quality panfish opportunities is perceived to have increased in recent years (MN DNR fishing round table meetings, personal communications). Experimental regulations on several Grand Rapids Area lakes resulted in generally positive comments from the public and were recently changed to special regulations. Additionally, some lake associations have approached DNR Fisheries to request experimental regulations for specific lakes.

Unexploited fish populations are typically comprised of a high proportion of relatively old fish with slow individual growth rates, and low annual mortality (Clady et al. 1975, Goedde and Coble 1981). When unexploited fish populations are open to angling, length and age frequencies typically shift to younger, smaller fish, mean age declines, and mortality increases (Van Den Avyle 1993). Angler mortality is typically considered the most important factor in bluegill size structure (Goedde and Coble 1981; Coble 1988; Beard and Essington 2000). Angler exploitation rates are often high. Parsons and Reed (1998) reported angler exploitation rates of 8 to 32% for bluegill from four Minnesota lakes and Coble (1988) reported a 27% average exploitation rate across 46 estimates. Tomcko and Pierce (2005) reported that adult bluegill exhibit density dependent growth, with growth rates inversely related to population density. Size structures may change, as mortality of large individuals is accelerated due to angler harvest. A subsequent recruitment response may result in high densities of earlier maturing and slower growing bluegill (Tomcko and Pierce 1993).

Black crappie angling opportunities are often limited by inconsistent reproduction and recruitment, resulting in variable population sizes and subsequent angler success (Parsons et al. 2004). Black crappie populations are vulnerable to angler harvest. Exploitation rates ranged from 7 to 34% in four Minnesota lakes and exploitation rates as high as 50% have been documented in Wisconsin lakes (Kempinger et al. 1975). Given the relatively high rates of angler exploitation, it would appear that improvements in angler success during population peaks caused by strong year classes are often short lived, as a high proportion of acceptable sized individuals may be harvested in a short time period.

Given the potential effects of angler harvest, implementing regulations that limit angler exploitation of bluegill and black crappie may be the best approach in maintaining quality populations. Beard (1997) found that increases in the proportion of large bluegills in a population require regulations that reduce angler harvest. To be successful, the regulations must be applied to populations with the potential for

fast growth. Data from MN DNR special assessments suggest that a 5 fish bag limit has helped maintain quality bluegill in two lakes in the Grand Rapids area (MNDNR, unpublished data). Restrictive crappie regulations have been tried in the Midwest and southern United States with success when growth rates were fast and natural mortality was low (Parsons and Reed 1998).

Several lakes in the Grand Rapids area support or have the potential to support high quality bluegill and/or crappie populations. Some of these lakes have been identified during the lake management planning process. Blackwater, Cut Foot Sioux and Little Cut Foot Sioux, Dixon, Big and Little Split Hand, and Sand lakes are currently considered the highest priority lakes for quality management because of expressed public interest and/or perceived high angling pressure.

If special management for these lakes is to be considered, the development of an evaluation and management plan is a high priority for the area. Although pumpkinseed sunfish may be an important component of some fisheries, bluegill and black crappie will be the primary species of focus in specialized sampling efforts. Spring trap netting may provide the best evaluation of regulation effects in many situations. Catch rates for spring trap netting are often highly variable, as spring weather or timing of the survey greatly influence catch rates. Often, the number of sets and set locations varied to maximize sample size. Catch per effort (CPE) from spring assessments should be viewed with caution, but may still provide some insight to relative abundance. Spring trap netting is most useful for tracking trends in size structure, since summer surveys generally do not sample larger fish. Spring assessments should include data collection sufficient to determine length indices including proportional stock density of quality sized fish (PSD), relative stock density of preferred sized fish (RSD-P), and relative stock density of memorable sized fish (RSD-M) with indices based on standard lengths as described by Anderson and Neuman (1996). Age structures should be collected and growth rates and age distribution indices should be evaluated. Additional summer assessments may be required to provide catch per unit effort data that is comparable to historical assessments.

The timing of these evaluations is critically important and the number of assessments that can be done per year is therefore somewhat limited by climatic conditions and work load. It is also important to note that five lakes in the area (Bass, Graves, Deer, Battle, and Pickerel) have an existing special regulation and further assessments of these lakes should be considered in addition to any newly proposed assessments.

This report will review the status of these species as described in the lake management plans (LMP) and outline the survey history and tentative survey plan for the lakes with highest priority. The report may be a useful reference to help prioritize management needs as well as sampling schedules.

Bass Lake

Bass Lake is relatively large, with a surface area of 2,407 acres (52% littoral) and a maximum depth of 76 feet. Bass Lake is in ecological lake class #25. The lake has two distinct basins with a long, shallow channel connecting the northern and southern basins. There are six inlets and the largest three are from Stevens Lake, Little Bass Lake and Pohl Creek. Bass Lake has an outlet to the Mississippi River with a small fixed-crest dam. The lake supports a diverse aquatic plant community and many of the shoal water areas support emergent vegetation including bulrushes and wild rice.

Social considerations:

Bass Lake is one mile north of Cohasset, MN and is about six miles from Grand Rapids. The 2006 management plan noted six resorts and three public accesses. Much of the lake shore has been developed for housing, although the State owns and maintains a few parcels as aquatic management areas including Crawford Island, a large island on the north basin. Bass Lake is a popular lake for recreational boating and fishing due to its large size and close proximity to Grand Rapids.

Management Actions

The Bass Lake fisheries lake management plan (LMP) was last revised in 2011. The goals of the plan were to maintain a walleye population with a gill net catch rate of 5.0/net, maintain the northern pike population with a gill net catch of 7.0/net or less (PSD of 25,RSD-P of 10), and maintain bluegill size structure with a PSD of 80, an RSD-P of 30, and an RSD-M of 5. Walleye and bluegill were the primary management species identified in the LMP.

A winter creel survey was conducted in the winter of 1975-76 to estimate pressure and harvest, but no estimates were made for pressure or harvest of bluegill. An aerial creel survey in 2001 recorded 20.1 hours/acre of fishing pressure during the summer months and was similar to the lake class first quartile for lake class 25 lakes previously surveyed. Winter pressure was estimated at 2.9 hours/acre, with was similar to the lake class median.

Following public input, a reduced bag limit of 5 sunfish was implemented in 2001 to maintain the quality bluegill size structure in Bass Lake. The regulation was reviewed and public input was received in 2010. Only nine comments were received, 8 of which supported the regulation. The Bass Lake Association and two resort owners also supported the regulation. The regulation was made permanent, given the expressed support and biological data.

Bluegill in Bass Lake

Bluegill catches were low to moderate (Table 1) and size structure was typically favorable for angling (Table 2). Growth rates were described as faster than the lake class average with fish averaging 8 inches by age-6 (Figure 1). Reproduction and recruitment have been somewhat variable.

Table 1. Catch rates and length indices of bluegill from Bass Lake summer assessments.

Date	Trap Nets	CPE	Stock	PSD	RSD-P	RSD-M
7/11/1974	10	0.3	3	-	-	-
8/8/1977	16	1.3	21	24	0	0
7/19/1982	17	0.7	13	39	39	0
7/18/1988	12	3.2	37	54	19	3
7/12/1993	15	5.1	76	63	13	0
7/13/1998	15	2.7	41	39	17	2
Lake class 1st quartile		5.6				
Lake class median		17.2				
Lake class 3rd quartile		42.3				

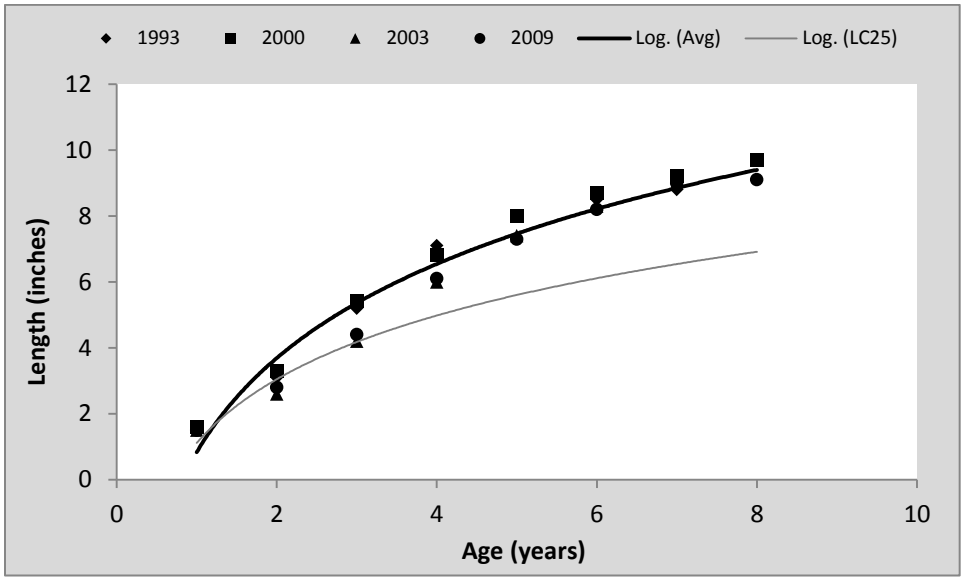
– *insufficient sample size to calculate indices, CPE-catch per net. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Table 2. Length indices of bluegill from Bass Lake spring assessments.

Year	Stock	PSD	RSD-P	RSD-M
2000	164	73	18	4
2001	224	66	18	2
2003	608	86	16	0
2005	299	91	45	<1
2006	411	87	12	0
2008	467	88	44	<1
2009	301	90	44	<1

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Figure 1. Mean back calculated length at age for bluegill from Bass Lake.



Log (Avg)= logarithmic trend line of lake average growth. Log (LC 25)= logarithmic trend line of lake class 25 average growth.

Spring trap netting was conducted six times since 2000. Over 300 bluegills (8.4/trap net) were captured in the most recent 2009 spring assessment. Size distribution remained favorable as bluegill averaged 7.6 inches and 44% of the sample exceeded 8 inches. Nine year classes were identified, but recruitment appeared somewhat inconsistent as the 2005 and 2002 year classes comprised 40% and 28% of the sample. The age distribution included older fish, as bluegill averaged 5.2 years of age and nearly 50% were age-5 or older (Table 3).

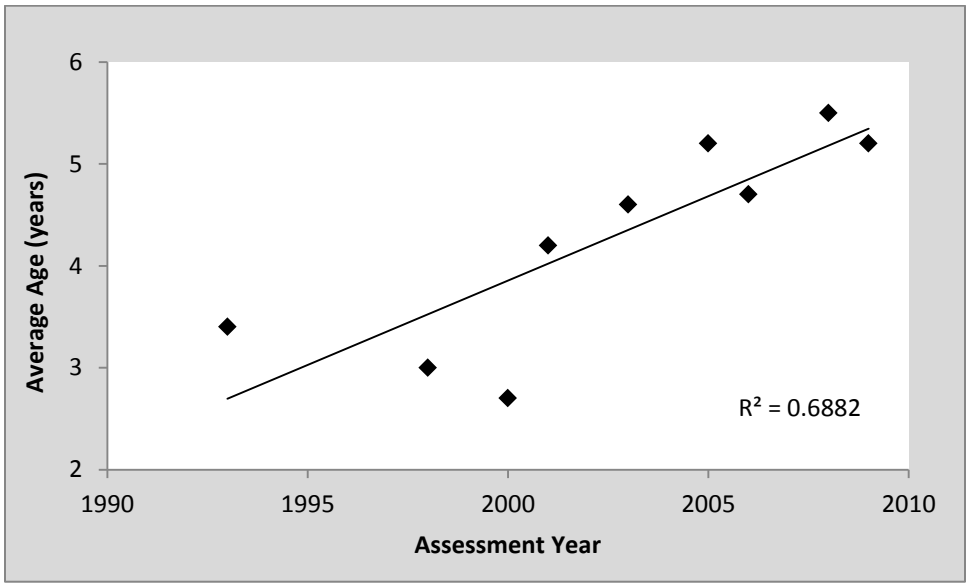
The longevity or persistence of large year classes is believed to be one of the benefits of the regulation and average age appears to have increased in recent assessments (Figure 2), suggesting that individuals remain in the lake longer. The large 1998 and 1999 year classes, for example, likely benefited through lower angler harvest and consequently lived long enough to attain a larger size than previous year classes might have without the reduced bag limit.

Table 3. Average age and proportion of sampled bluegill that exceeded select ages from Bass Lake.

Assessment Year	*N*	Average Age	%>age 5	%>age 6
1993*	74	3.4	10.8	6.8
1998*	88	3.0	8.0	2.3
2000	165	2.7	21.2	12.7
2001	224	4.2	32.6	7.6
2003	609	4.6	56.3	10.3
2005	296	5.2	59.8	45.6
2006	336	4.7	48.2	14.9
2008	464	5.5	79.5	57.1
2009	300	5.2	49.7	49.7

**Summer assessment data.*

Figure 2. Average age of bluegill from Bass Lake.



Note-The two assessments prior to 2000 were conducted in the summer and catches may not be comparable. The 5 fish bag limit regulation went into effect in 2001.

Status of the Bass Lake bluegill fishery:

The bluegill fishery generally met the goals of the special regulation and the lake management plan, although RSD-M of 5 was not achieved in the last assessment. Harvest and poor age structure likely limited the size structure in the past, but age and size structures have improved since the special regulation was implemented.

The reduced sunfish bag limit appears to be beneficial on Bass Lake, as the size structure has remained favorable despite anecdotal reports of high angling pressure. The documented improvements in size and age structures further suggest that the regulation has been beneficial in maintaining the quality of the bluegill fishery.

Blackwater, Jay Gould, and Little Jay Gould lakes

Blackwater Lake

Blackwater Lake is a 674-acre impoundment (94% littoral) on the Mississippi River at Cohasset, MN and is representative of ecological lake class 35. The Pokegama Dam, operated by the US Army Corps of Engineers (ACE), controls the water level of the lake. The lake is broadly connected to Jay Gould Lake to the east, and is considered part of the Pokegama Reservoir system. Blackwater Lake is essentially a flooded river channel with several feet of water covering much of the adjacent lowland and backwater habitat. Aquatic vegetation is abundant, with open water confined to the area of the river channel and intake and Jay Gould bays. The mixture of river and shallow lake habitat is well suited to largemouth bass and panfish.

The Minnesota Power and Light (MP&L) Clay-Boswell electrical generating plant draws water from Blackwater Lake for cooling purposes and discharges heated water into Jay Gould Bay. The area of the warm water discharge stays ice-free during the winter months. The discharge bay also attracts and concentrates fish and is a popular spot for angling during the cooler months and in winter.

Jay Gould has a total surface area of 426 acres (69% littoral), a maximum depth of 33 feet, and is representative of ecological lake class 29. Aquatic vegetation is abundant throughout the littoral zone. The lake has two inlets and one outlet. The main inlet flows from Little Jay Gould and the other flows from Loon Lake.

Little Jay Gould belongs to ecological lake class 25, has a surface area of 150 acres (52% littoral) and a maximum depth is 56 feet. Plant surveys indicate a fairly diverse aquatic plant community with plant growth to a depth of 15 feet. The lake receives water from Pokegama Lake and outlets to Jay Gould Lake.

Social Considerations

Blackwater Reservoir is located near the population center of Grand Rapids. The MP&L discharge area provides unique open water fishing opportunities that includes both boat and shore fishing opportunities. Local anglers and Conservation Officers have reported high concentrations of anglers in the discharge area, especially during cool weather periods and winter. Sunfish are believed to be the primary target of anglers.

High residential development occurs along the lakeshores of Jay Gould and Little Jay Gould lakes. No lake association exists, although the Greater Pokegama Lake Association expressed interest in maintaining quality bluegill populations.

Management Actions

A proposal for a 5 sunfish bag limit was developed in 2011 and opened to public input in the fall of that year. The goal of the proposed regulation was to maintain quality bluegill angling opportunities with a PSD greater than 60, RSD-P greater than 20, and to improve the RSD-M to 5.

The proposal included connected Jay Gould and Little Jay Gould lakes to the County Road 63 bridge and the Mississippi River from the Pokegama dam upstream to the Highway 6 bridge. Signs were posted at the public access points in the spring, directing comments to the Grand Rapids Area Fisheries Office. Announcements were also made via television, newspaper, and DNR news releases. Public input meetings were held in Grand Rapids and Sand Lake in late September and the comment period was open until October 10, 2011. A total of 19 comments were received. Sixty-eight percent of the comments opposed the proposal and the regulation was not implemented. It should be noted that most comments were generally for or against any regulation in the area, and only three of the comments were specific to Blackwater Lake.

The LMP for Blackwater Lake was last revised in 2004. The management goals were to provide angling opportunities for largemouth bass and bluegill through natural reproduction, maintain a largemouth bass population with a minimum electrofishing catch rate of 40/hour (RSD-P of 35), and maintain a bluegill population with a minimum spring trap net RSD-P of 25. The potential plans included: consider implementing special regulations for largemouth bass and bluegill, such as a 12 to 20 inch protected slot limit for bass and a 5 fish limit for bluegill. Bluegill and largemouth bass were listed as the primary management species. Spring trap net assessments were conducted in 2009 and 2010 to further examine the characteristics of the bluegill population.

The LMP for Jay Gould Lake was last revised in 2008. Walleye and yellow perch were the primary management species. The goals of LMP were to maintain a bluegill catch of 8.0/trap net, walleye catch of 4.0/gill net, yellow perch catch of 25.0/gill net, and largemouth bass catch of 10/hour electrofishing. Size structure goals for these species were PSD and RSD-P values that range from 40-60 and 10-30.

The LMP for Little Jay Gould Lake was revised in 2009 and largemouth bass, bluegill, and black crappie were the primary management species. The goals of the plan were to maintain a quality largemouth bass fishery characterized by electrofishing catches exceeding 40 per hour (PSD > 50 and RSD-P > 20), maintain quality panfish angling opportunities with black crappie and bluegill populations characterized by trap net catches exceeding 0.2 and 4.7/net and PSD >50, maintain limited walleye angling opportunities with a walleye population characterized by a catch of 3.0/gill net and maintain a northern pike fishery characterized by a catch of 6.0/gill net. The potential plan included the consideration of a length or reduced bag limit for bluegill.

Jay Gould Lake was included in an aerial creel study in 2001 and 2002. Summer fishing pressure was estimated at 3,036 angler hours and winter fishing pressure was estimated at 5,448 angler hours.

Bluegill in Blackwater Lake

Blackwater Lake appears to support a moderate bluegill population. Historical data are very limited. A population assessment in 1987 resulted in a very low bluegill catch (0.5/trap net) and size structure indices could not be calculated due to the small sample size. It should be noted that this assessment consisted of a limited number of trap net sets and catches of all species were unusually low. The trap net catch rate for bluegill in the summer 2003 population assessment was moderate at 8.8/net and near the lake class median. Spring trap net assessments were conducted in 2009 and 2010. A total of 278 bluegill (7.7/trap net) were captured in 2009 and 188 (6.3/trap net) in 2010.

The bluegill population has generally displayed a favorable size structure (Table 4). Sampled bluegill in 2003 ranged from 3.3 to 10.2 inches, with a mean of 6.9 inches. Sampled bluegill ranged from 4.2 to 9.5 inches with a mean length of 7.3 inches in 2009 and 3.5 to 9.7 with a mean length of 6.7 inches in 2010.

Table 4. Blackwater Lake bluegill length indices.

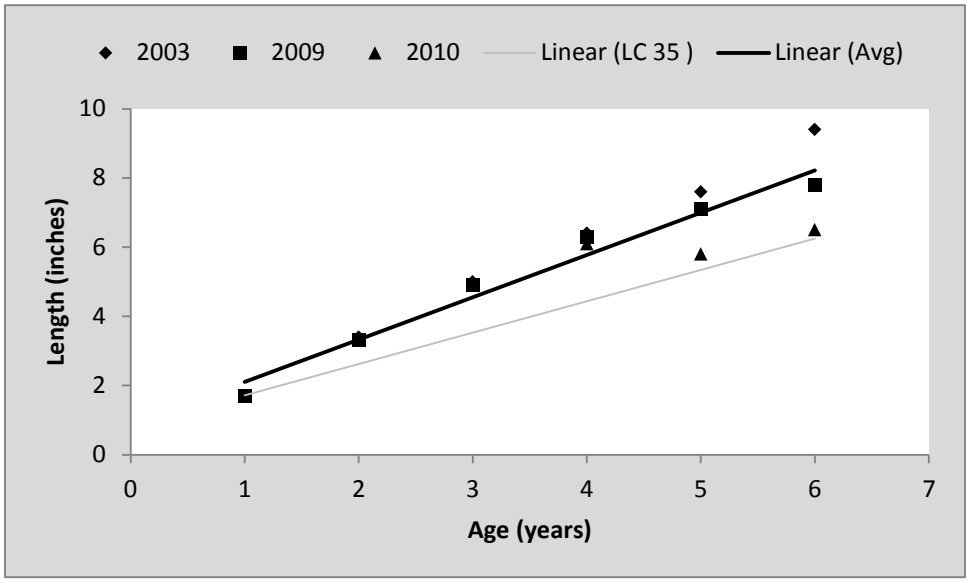
Year	Stock	PSD	RSD-P	PSD-M
2003	97	76	11	1
2009*	278	90	27	0
2010*	188	70	19	0

**Spring assessment data. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Growth rates were described as above average when compared to similar lakes (Figure 3), as bluegill generally exceeded 6 inches by age-4 and were nearly 8 inches by age-6. Recruitment appeared to be fairly consistent, with multiple year classes present in all assessments.

Age distribution analysis indicated many bluegills survive to age-5, but fewer fish exceeding age-6 have been captured (Table 5). The apparent decrease from age-5 to age-6 may suggest high natural mortality of adult bluegill, and/or may indicate high harvest rates, as bluegill from Blackwater Lake generally grow to an angler desired size in their fifth growing season.

Figure 3. Mean back calculated length at age for bluegill from Blackwater Lake.



Linear (Avg)= linear trend line of lake average growth. Linear (LC 35)= linear trend line of lake class 35 average growth.

Table 5. Average age and proportion of sampled bluegill that exceeded select ages from Blackwater Lake.

Year	*N*	Average Age	%5+	%6+
2003	97	3.5	19	2
2009*	277	4.9	50	36
2010*	178	4.4	44	14

**Spring assessment data.*

Bluegill in Jay Gould Lake

Jay Gould Lake has supported a low bluegill population compared to similar lakes. Bluegill trap net catch rates have increased in recent assessments (Table 6), although data should be viewed with caution as the number of trap nets sets have varied. The most recent catch rate of 7.9/trap net in 2007 was near the lake class first quartile and was the second highest catch on record. Bluegill size structure quality has remained relatively good, but appears to have decreased from historical peaks in the 1970s and 1980s, as a lower proportion of the sample has exceeded 6 inches in recent assessments. Decreased length indices appear to be related to increased catch rate, suggesting density dependency (Figure 4).

Ecological lake class 29 lakes typically produce slow growing bluegill. Age and growth data was not collected prior to 1990. Growth rates have varied, but have generally been favorable compared to similar lakes, as individuals neared 7 inches in 6 years (Figure 5).

Recruitment appeared consistent with multiple year classes present in each assessment. Age distributions indicated a relatively young average age (Table 7). The lack of older individuals may suggest high natural mortality of bluegill, high angler harvest of older fish, or migration of larger individuals into other parts of the system.

Table 6. Catch rates and size structure indices of bluegill from Jay Gould Lake summer assessments.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
8/14/1974	3	2.0	6	-	-	-
7/30/1979	12	2.3	28*	89	11	0
8/27/1984	8	1.5	12	67	25	0
7/30/1990	8	7.3	58	29	5	0
8/4/1997	9	9.2	83	55	11	0
8/6/2007	9	7.9	71	52	6	0
Lake class 1st quartile		8.3				
Lake class median		24.0				
Lake class 3rd quartile		50.1				

** Indicates length indices were derived from gill net and trap net lengths or unknown gears. – insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Figure 4. Catch per effort and proportional stock density of bluegill from Jay Gould Lake.

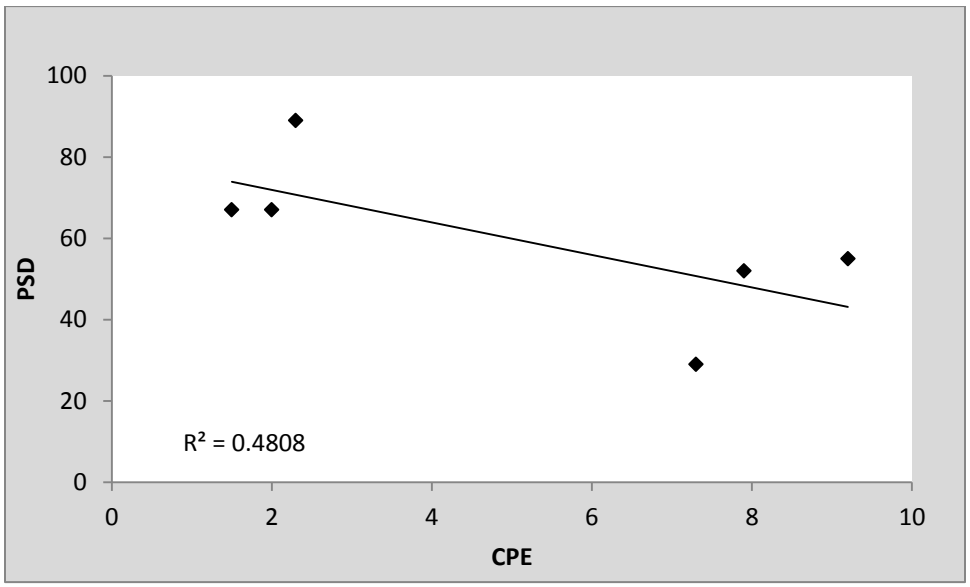
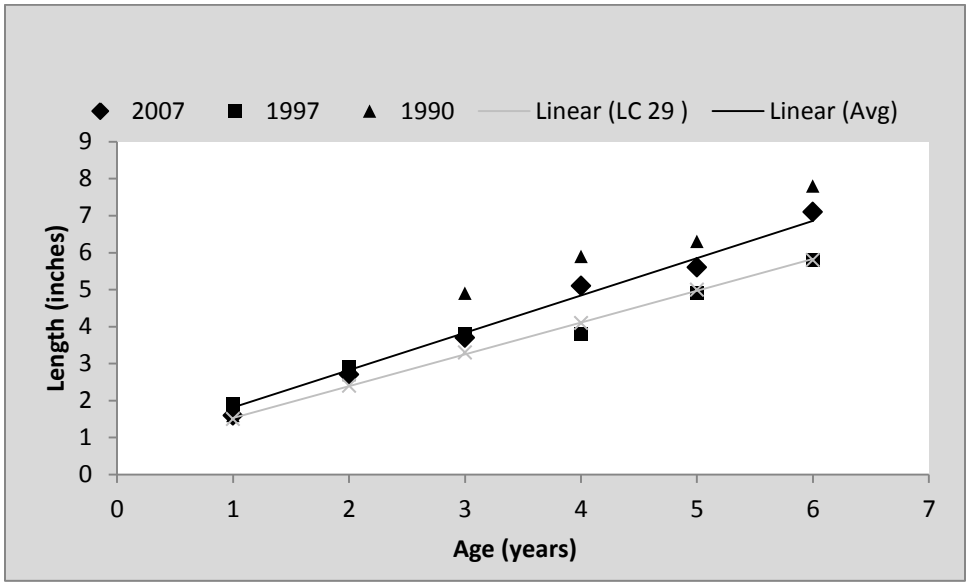


Figure 5. Mean back calculated length at age for bluegill from Jay Gould Lake.



Linear (Avg)= linear trend line of lake average growth. Linear (LC 29)= linear trend line of lake class 29 average growth.

Table 7. Average age and proportion of sampled bluegill that exceed select ages from Jay Gould Lake.

Assessment Year	*N*	Average Age	%>age 5	%>age 6
1990	51	3.2	18	8
1997	60	3.3	32	30
2007	71	3.5	34	10

Bluegill in Little Jay Gould Lake

Little Jay Gould Lake bluegill catches were low compared to similar lakes. Catches were below the lake class first quartile value in three assessments from 1974-1986 and slightly above the first quartile in 2008 (Table 8). Little Jay Gould occasionally supported bluegill populations dominated by larger individuals, as PSD was 73 and RSD-P was 13 in 1974. The size structure was moderate in the most recent assessment, as PSD was 48 and RSD-P was 5.

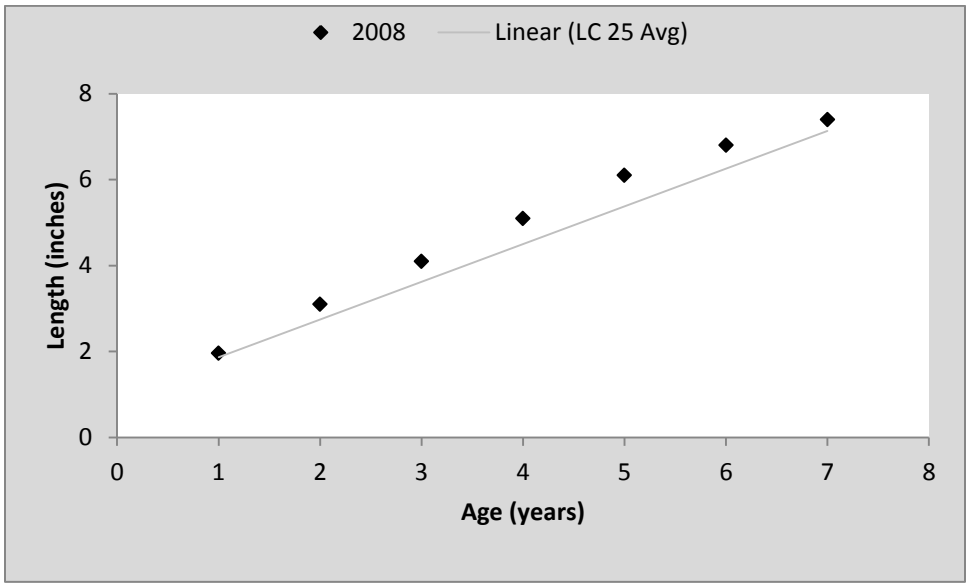
Historical age data are limited as age analysis was only conducted in 2008. Age analysis identified multiple year classes, suggesting consistent recruitment. The age distribution was balanced, as bluegill averaged 4.3 years old and 49% were age-5 or older. Twenty-five percent of the sample exceeded age-6 and the oldest individuals were age-7. Growth was moderate, and near the lake class 25 average with individuals typically achieving 6 inches by age-5 and 7 inches by age-7 (Figure 6).

Table 8. Catch rates and length indices of bluegill from Little Jay Gould Lake summer assessments.

Date	Trap nets	CPE	*N*	PSD	RSD-P	RSD-M
8/12/1974	4	3.5	15	73	13	0
8/13/1980	4	5.5	22	73	5	0
8/18/1986	4	2.8	13	15	0	0
8/18/2008	9	6.9	62	48	5	0
Lake class 1st quartile		5.6				
Lake class median		17.3				
Lake class 3rd quartile		42.3				

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Figure 6. Mean back calculated length at age for bluegill from Little Jay Gould Lake.



Linear (LC 25 Avg)= linear trend line of lake class 25 average growth.

Status of the Blackwater, Jay Gould, Little Jay Gould bluegill fishery.

The quality of the bluegill fishery across the system may be at risk of decline. Bluegill in Blackwater, Jay Gould, and Little Jay Gould lakes all failed to achieve LMP goals for length indices in the most recent assessments. Relatively fast growth rates have been documented in Blackwater and Jay Gould lakes. Similar lakes do not typically produce fast growing bluegill and size structures are often poor. Low population densities and low mortality of adult bluegill are likely required to maintain quality size structures throughout the system. Bluegill often reached age-5, but fewer apparently survived to age-6, suggesting high natural mortality or high angler mortality of adult bluegill. Historical data are limited, but suggested increased abundance in Jay Gould Lake. A continued trend of increasing density may be detrimental to quality size management in the future, due to density dependent changes in growth.

Bluegill from Little Jay Gould Lake had moderate growth rates and the age distribution included a higher proportion of bluegill exceeding age-6. The presence of older fish may suggest that slower growing fish are achieving older ages. It should be noted that bluegill from Little Jay Gould did not reach a desirable size for angler harvest until age-6 or 7.

The shallow backwater areas of Blackwater Lake likely experience low dissolved oxygen conditions in winter. Gamefish would probably be forced to migrate to areas near the river channel or the intake and discharge bays. The area of the warm water discharge attracts and concentrates fish during cooler seasons of the year and makes them more vulnerable to harvest. Anecdotal information from local anglers and Conservation Officers suggest high harvest of bluegill occurs during the cooler months in MP&Ls discharge area and has increased in recent years. Conservation officers have also indicated occasionally high harvest in Jay Gould and Little Jay Gould lakes and noted that harvest had been very high in Little Jay Gould in the 1990s, and the Little Jay Gould fishery appears to have declined dramatically.

Cut Foot and Little Cut Foot Sioux lakes

Cut Foot Sioux and Little Cut Foot Sioux lakes are located approximately 15 miles northwest of Deer River, Minnesota in the Mississippi River watershed. Cut Foot Sioux is representative of ecological lake class 22 and has a surface area of 2,768 acres (48% littoral) and a maximum depth of 78 feet. Cut Foot Sioux's main inlet/outlet is the First River flowage entering from Little Cut Foot Sioux Lake. The flowage originates at Egg Lake and terminates at Lake Winnibigoshish. Little Cut Foot Sioux Lake has a surface area of 660 acres (80% littoral) and a maximum depth of 20 feet. Little Cut Foot Sioux Lake is in ecological lake class 35. The Winnibigoshish Dam regulates the water level of these lakes.

Social Considerations

Several resorts and USFS campgrounds are located near or on Cut Foot and Little Cut Foot Sioux lakes. Anecdotal reports suggest angling pressure for panfish is high in both lakes in recent years.

Management Actions

A proposal for a 5 sunfish bag limit was developed in 2011 and opened to public input in the fall of that year. The goals of the proposed regulations were to maintain quality bluegill angling opportunities with RSD-P greater than 40 and improve the RSD-M to 5.

The proposal included connected Cut Foot Sioux and Little Cut Foot Sioux lakes. Signs were posted at the public access points in the spring, directing comments to the Grand Rapids Area Fisheries Office. Announcements were also made via television, newspaper, and DNR news releases. Public input meetings were held in Grand Rapids and Sand Lake in late September and the comment period was open until October 10, 2011. A total of 42 comments were received, of which 74% opposed the regulation. The regulation was not implemented.

The LMP for Cut Foot Sioux was revised in 2008. The management goals were to maintain a walleye fishery characterized by a gill net catch rate of 5.5 per net (PSD>40 and RSD-P>10), maintain a northern pike fishery characterized by a gill net catch rate of 5.0 per net (PSD>45 and RSD-P>20). Bluegill and black crappie were listed as secondary management species.

The LMP for Little Cut Foot was revised in 2004. Walleye and bluegill were the primary management species and black crappie was a secondary management species. The management goals were to provide a high quality bluegill fishery with trap net catch rates near the lake class median (9.1/net) and a minimum RSD-P of 50 and RSD-M of 5, and maintain a walleye population with a gill-net catch rate of 2.1/net. The potential plans for both lakes included considering a reduced bag limit for bluegill. The LMP for Little Cut Foot Sioux recommended conducting a spring trap net assessments in 2007, which was accomplished. Another spring assessment was conducted in 2012.

Both lakes are included in the Lake Winnibigoshish walleye slot regulation. This regulation requires all walleye from 17-26 inches to be released.

Bluegill in Cut Foot Sioux

The bluegill population was characterized as low to moderate density with quality size structure and fast growth. Trap net catches of Cut Foot Sioux in 1952, 1975, 2002, and 2012 failed to exceed the first quartile value. Bluegill were captured at a rate of 12.7/trap net in 2007, which approached the lake class median and was the highest bluegill catch observed for the lake. Size structure was favorable as 57% of the catch exceeded 6 inches and 23% exceeded 8 inches (Table 9). Only 8 bluegill were captured in 2012, too few to calculate length indices with confidence, although size structure appeared similar to past samples as fish exceeding 9 inches were present.

Table 9. Catch rates and size structure indices of bluegill from Cut Foot Sioux Lake summer assessments.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
6/23/1975	12	0.4	4	-	-	-
6/17/2002	14	2.9	40	83	55	0
6/18/2007	15	12.7	191	57	23	0
6/18/2012	14	0.6	8	-	-	-
Lake class 1st quartile		3.7				
Lake class median		15.3				
Lake class 3rd quartile		42.9				

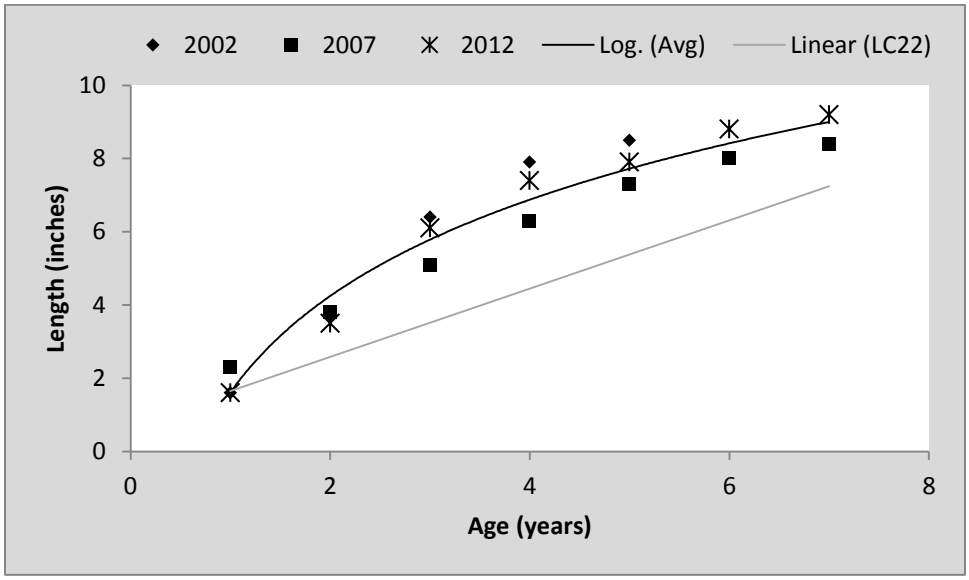
– *insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Age analysis was conducted in 2002 and 2007. Multiple year classes were present, suggesting fairly consistent recruitment. Sampled fish were generally young, and few fish older than age-5 were captured, suggesting high mortality of older fish (Table 10). Growth was fast compared to similar lakes, with individuals exceeding 6 inches by age-4 and 8 inches by age-6 (Figure 7).

Table 10. Average age and proportion of sampled bluegill that exceeded select ages from Cut Foot Sioux Lake.

Assessment Year	*N*	Average Age	%5+	%6+
2002	39	2.6	21	0
2007	189	2.7	35	15

Figure 7. Mean back calculated length at age for bluegill from Cut Foot Sioux Lake.



Log (Avg)= logarithmic trend line of lake average growth. Linear (LC 22)= linear trend line of lake class 22 average growth.

Bluegill in Little Cut Foot Sioux

Trap net catch rates have been below the lake class median in all assessments on Little Cut Foot Sioux Lake and size structure has been favorable, with individuals exceeding 10 inches sampled in most assessments (Table 11). The trap net catch for bluegill in 2002 population assessment was down from the previous assessment and below the lake class first quartile. In 2002, bluegill from trap nets varied from 7.5 to 10.1 inches with a mean length of 8.3 inches. Results from the 2007 spring special assessment were similar to previous assessments. The 2012 spring assessment resulted in a higher CPE as 233 bluegills were sampled. The size structure remained favorable.

Age analysis indicated somewhat erratic recruitment and variable year class strength. Age distribution has been moderate and variable (Table 12). Growth was fast compared to similar lakes with individuals typically exceeding the quality size of 6 inches by age-3 and the preferred size of 8 inches by age-5 (Figure 8).

Table 11. Catch rates and length indices of bluegill from Little Cut Foot Sioux Lake.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
6/16/1975	8	4.6	37	100	35	3
6/16/1985	8	1.0	8	-	-	-
6/25/1990	6	2.5	15	87	13	0
6/19/1995	12	5.9	71	100	60	3
6/24/2002	12	1.9	23	100	74	4
6/4/2007*	56	2.9	160	87	43	1
6/4/2012*	38	6.1	233	99	55	3
Lake class 1st quartile		4.0				
Lake class median		9.3				
Lake class 3rd quartile		28.1				

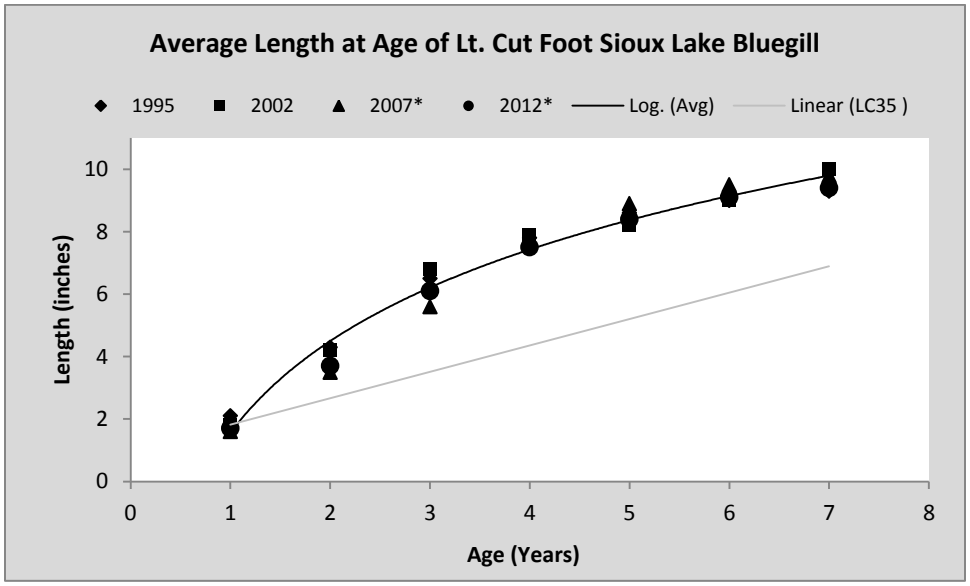
**Spring assessment data. - insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Table 12. Average age and proportion of sampled bluegill that exceeded select ages from Little Cut Foot Sioux Lake.

Assessment Year	*N*	Average Age	%>age 5	%>age 6
1995	43	4.9	33	28
2002	23	4.4	43	13
2007*	160	3.9	19	3
2012*	233	4.6	50	13

**Spring assessment data*

Figure 8. Mean back calculated length at age for bluegill from Little Cut Foot Sioux Lake.



Log (Avg)= logarithmic trend line of lake average growth. Linear (LC 35)= linear trend line of lake class 35 average growth.

Status of the bluegill fishery

The LMP for Cut Foot Sioux did not include any specific goals for sunfish. The 2007 assessment resulted in the highest catch of bluegill, while the 2012 assessment resulted in a low catch. The lake is difficult to sample and it may be difficult to track changes in bluegill abundance. The decreased catch may not indicate a population reduction, given the difficulty of trap net sampling.

Several limiting factors were identified in the LMP for Cut Foot Sioux. Fishing pressure in Cut Foot Sioux increased eight fold between the 1930's and 1970's. Fishing pressure has remained relatively stable since that time (MNDNR creel survey data). Anglers, however, have likely become more proficient at harvesting fish through the use of more sophisticated electronics and tackle. Bluegills from Cut Foot Sioux were relatively young in the two assessments with age data. A lack of older individuals in the population may suggest variable recruitment or high mortality of older individuals via natural mortality or angler harvest.

The bluegill fishery of Little Cut Foot Sioux exceeded the management goals of the 2004 LMP (RSD-P>50 and RSD-M>5) in the most recent 2012 spring assessment. Growth rates remained fast and age distribution was favorable. Little Cut Foot Sioux has occasionally experienced low dissolved oxygen conditions in winter. A moderate to severe winterkill was documented in the winter of 1995-96. Cattail stands presently exist in areas where they did not historically occur. As the reservoir has aged, cattails have encroached on and degraded potential walleye spawning areas. It is unclear to what extent cattails have displaced native vegetation or affected centrarchid spawning conditions.

Deer, Pickerel, and Battle lakes

Deer Lake is located 14 miles east of Effie, MN. Deer Lake is a 1,748-acre lake (76% littoral), has a maximum depth of 50 feet, and is representative of ecological lake class 27. Deer Lake lies downstream from Pickerel and Battle lakes in a chain of three lakes that flow west to the Bigfork River. Pickerel Lake has a total surface area of 293 acres (52 % littoral) and a maximum depth of 70 feet. Pickerel Lake is in Ecological Lake Class 25. Battle Lake is in ecological class 39 and has a total surface area of 199 acres (100% littoral area), and a maximum depth of 15 feet. One inlet and one outlet had beaver dams that could reduce fish movement while it was unknown whether the other inlet was obstructed. The man-made outlet to Pickerel Lake was not obstructed and is used by boaters to access Battle Lake.

Social Considerations

The state administered public accesses are located on the Deer Lake's south shore and on the west shore of Pickerel Lake. Access to Battle Lake is available through the channel from Pickerel Lake. Boat traffic through the culvert is limited to small crafts due to shallow water.

Lake shore development is moderate around Deer and Pickerel lakes and relatively minor on Battle Lake. The Deer Lake LMP noted one resort on the lake. Residents from around the lakes formed an active watershed association that has been helpful with regulations and habitat issues.

Management Actions

The three lakes were assessed in 2010 and the lake management plans were revised in 2011. Walleye and bluegill were the primary management species in Deer Lake. The long range goals were to improve the walleye population to a gill net catch of 6.8/set with a RSD-P of 30 and a RSD-M of 10 and maintain the quality bluegill population at 6.0/trap net with a PSD of 80 and the presence of fish ≥ 10 inches.

Walleye and bluegill were the primary management species in Pickerel Lake. The LMP goals were to increase walleye gill net abundance to 2.5/gill net and maintain a quality bluegill population with a spring or summer trap net catch of 6.0/net with a PSD and RSD-P values of 50 and 30. Memorable size bluegill (>10 inches) should be present.

Bluegill was the primary management species in Battle Lake. The LMP goals were to maintain a summer bluegill trap net catch of 3.0/net and improve size structure to a PSD of 80 and an RSD-P of 40, maintain a walleye gill net catch of 2.0/net, and maintain a northern pike population of less than 7.0/gill net.

A walleye slot limit was enacted in 2005. This regulation requires walleye from 17 to 26 inches to be released.

An experimental 5-fish bag limit regulation was proposed for sunfish in 2005. At the public input meeting there was support for reducing the sunfish bag limit, but most felt reducing the bag limit to 5 fish was too low. Based on these comments, a 10 fish bag limit for sunfish was implemented in 2006.

The goal of the regulation is to maintain quality size structure with a PSD of 80 and the presence of 10 inch fish.

In the fall of 2013, a public meeting will be held to report the results of the walleye and bluegill experimental regulations and to determine whether these regulations should be kept, changed, or discontinued. Signs will be posted at the public accesses requesting public comments on the regulations. Although the bluegill experimental regulation does not expire until 2015, no new surveys would be conducted and there would likely be more public comments if the two meetings were held at the same time.

Bluegill in Deer Lake

Bluegills were historically sampled in low numbers prior to 1975. Catches generally increased from 1975 to 2010, but remained similar to the lake class first quartile (Tables 13 & 14). Sample size and catch rate increased in three spring assessments and the 2011 spring assessment resulted in the largest sample size on record (354 bluegill, 15.4/trap net).

Bluegills were typically of quality length in prior assessments. Recruitment was variable and growth was relatively fast (Figure 9). Age distribution varied, apparently due to year class strength, and may have improved in recent years. The age distribution included a relatively high proportion of individuals exceeding age-5 in more recent assessments (Table 15).

Table 13. Catch rates and size structure indices of bluegill from Deer Lake summer assessments.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
7/19/1954	6	0.0	0	-	-	-
6/6/1969	16	0.2	3	-	-	-
7/8/1975	20	0.0	0	-	-	-
6/21/1976	15	1.4	21	67	10	0
7/13/1987	8	1.3	12	83	75	0
7/20/1992	12	4.4	55	65	15	0
7/27/1998	15	1.0	15	100	76	24
7/26/2004	15	6.1	110	44	17	0
7/26/2010	15	5.3	78	78	18	0
Lake class 1st quartile		4.4				
Lake class median		16.2				
Lake class 3rd quartile		49.0				

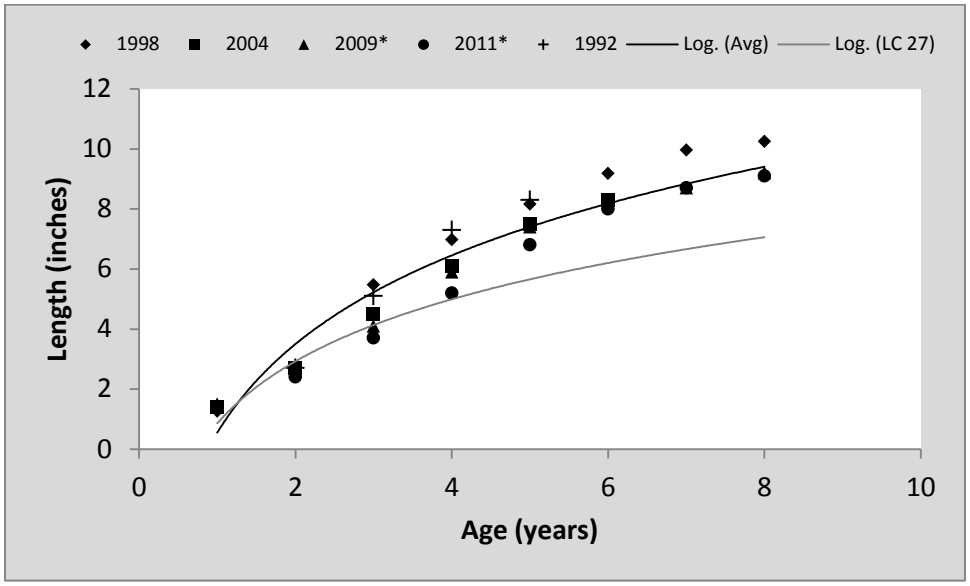
- insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Table 14. Length indices of bluegill from Deer Lake spring assessments.

Year	Stock	PSD	RSD-P	RSD-M
2005	173	66	25	0
2009	234	60	26	1
2011	354	93	37	1

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Figure 9. Mean back calculated length at age for bluegill from Deer Lake.



*Log (Avg)= logarithmic trend line of lake average growth. log(LC 27)= logarithmic trend line of lake class 27 average growth. * indicates spring special assessments.*

Table 15. Average age and proportion of sampled bluegill that exceed select ages from Deer Lake.

Assessment Year	*N*	Average Age	%5+	%6+
1992	51	3.2	4	2
1998	15	5.9	73	73
2004	92	3.1	15	5
2005*	172	4.3	31	23
2009*	233	4.7	34	32
2011*	354	5.9	96	56

**Spring assessment data. Note-1998 assessment included only 15 fish.*

Bluegill in Pickerel Lake

Bluegills were sampled in very low numbers prior to 1987. The population appears to have increased since that time, although seasonal sampling bias makes direct comparisons problematic. Three of the four lowest catches occurred when the lake was sampled in late August or early September. In contrast, the three highest catches occurred during the middle part of July.

Catches remained relatively low compared to other class 25 lake, as catch rate never approached the lake class median. Size structure has varied considerably, but the population has typically produced a favorable size structure (Table 14, 15). Bluegill were captured at a rate of 7.9/trap net in the most recent 2010 summer assessment, within the expected range for the lake class. The 2011 spring assessment resulted in the highest sample size on record and documented a favorable size structure.

Table 14. Catch rates and size structure indices of bluegill from Pickerel Lake summer assessments.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
8/22/1960	11	0.6	6	100	50	0
7/14/1969	10	0.8	8	100	100	0
9/2/1981	4	0.0	0	-	-	-
8/31/1987	6	1.5	9	67	11	0
7/20/1992	9	7.3	65	29	2	0
7/20/1998	9	5.8	50	78	40	0
7/19/2004	9	11.8	106	58	31	0
7/12/2010	9	7.9	71	8	0	0
Lake class1st quartile		5.6				
Lake class median		17.3				
Lake class 3rd quartile		42.3				

- insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches

Table 15. Length indices of bluegill from Pickerel Lake spring assessments.

Year	Stock	PSD	RSD-P	RSD-M
2005	179	71	33	0
2009	275	54	10	0
2011	358	86	19	0

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Age distribution appeared poor in 1992, as few captured fish exceeded age-5. The proportion of bluegill exceeding age-5 and the average age of bluegill have increased in recent assessments (Table 16). Few bluegills younger than age-5 were captured in the most recent spring assessment (2011) and bluegill averaged 5.6 years of age. Growth was faster than the lake class average in all assessments with age

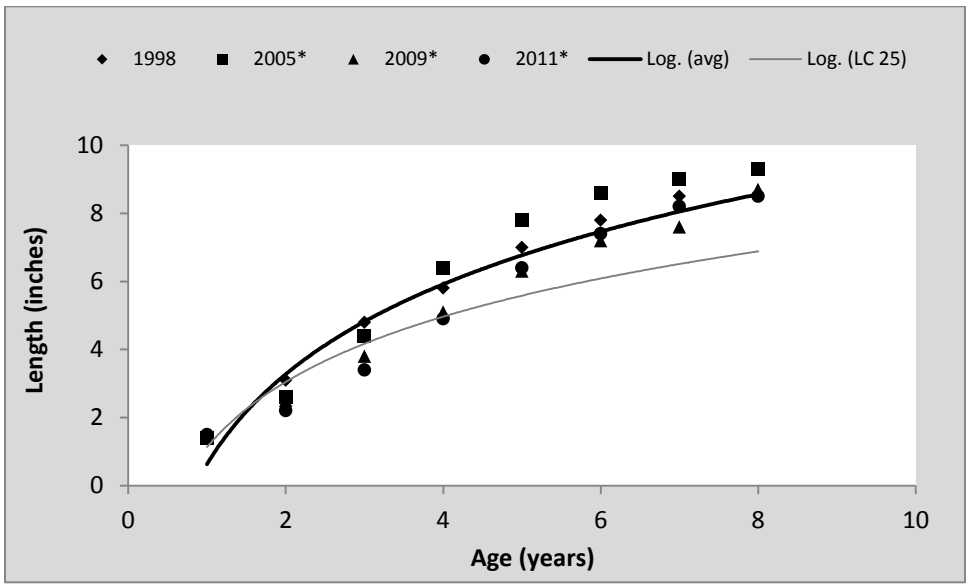
data. Recruitment has been described as moderate and fairly consistent. Bluegills from Pickerel Lake have typically exceeded 6 inches by age-5 and 8 inches by age-7 (Figure 10).

Table 16. Average age and proportion of sampled bluegill that exceed select ages from Pickerel Lake.

Assessment Year	*N*	Average Age	%5+	%6+
1992	43	2.8	0	0
1998	50	4.0	38	30
2005*	179	4.9	50	35
2009*	276	5.1	58	52
2011*	358	5.6	97	35

**Spring assessment data.*

Figure 10. Mean back calculated length at age for bluegill from Pickerel Lake.



*Log (avg)= logarithmic trend line of lake average growth. log(LC 25)= logarithmic trend line of lake class 25 average growth. * indicates spring special assessments.*

Bluegill in Battle Lake

Bluegill trap net catch rates were relatively low prior to 2004, as catches were generally near the lake class first quartile. Like Deer and Battle lakes, the population appears to have increased in recent years, as catches exceeded the lake class median in 2004 and 2010. Catches increased in each spring assessment and the 2011 assessment resulted in the highest sample size (316) and catch rate (18.6/trap net) recorded for the lake. A quality size structure was noted in most assessments (Table 17). Spring

sampling was conducted in 2005, 2009, and 2011. A quality size structure was noted in 2005, when PSD was 85 and RSD-P was 66. The two subsequent spring assessments (Table 18) and the 2010 population assessments resulted in moderate size structures, as PSD failed to exceed 65.

Table 17. Catch rates and size structure indices of bluegill from Battle Lake summer assessments.

Date	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
8/22/1960	13	2.8	38	82	24	0
7/18/1977	8	4.3	36	97	78	0
8/31/1981	4	0.2	5	-	-	-
7/21/1986	4	2.5	22*	73	41	0
7/22/1992	9	3.9	35	74	40	0
7/20/1998	9	3.4	31	94	94	0
7/19/2004	8	15.6	126	78	29	0
7/12/2010	8	9.1	73	63	4	0
Lake class1st quartile		2.5				
Lake class median		7.1				
Lake class 3rd quartile		25.0				

**Gill and trap net combined. - insufficient sample size to calculate indices. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches*

Table 18. Length indices of bluegill from Battle Lake spring special assessments

Year	Stock	PSD	RSD-P	RSD-M
2005	140	85	66	0
2009	287	64	11	0
2011	316	64	15	0

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

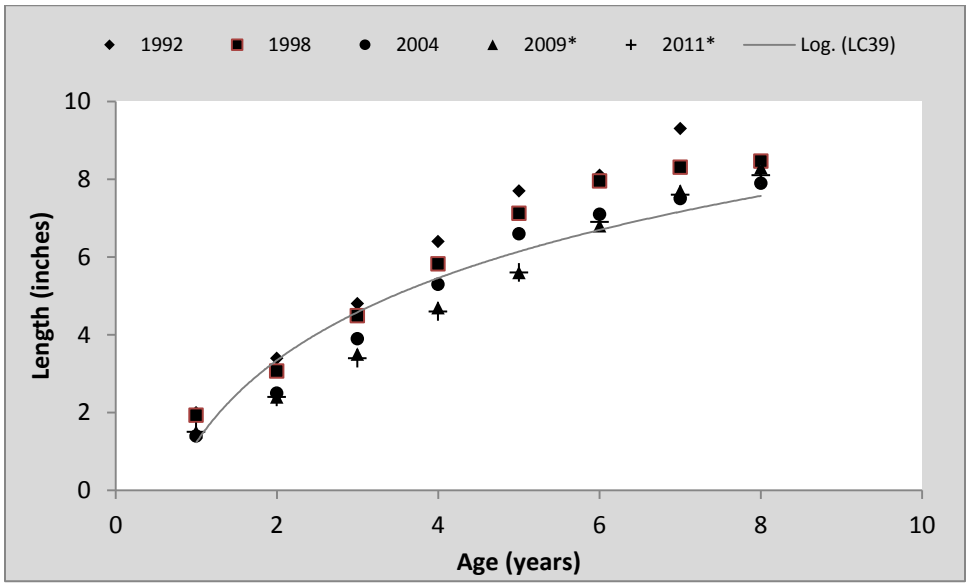
Age analysis was conducted several times since 1992. Age analysis suggests inconsistent recruitment in recent years. Battle Lake has consistently produced a high proportion of bluegill exceeding age-5, suggesting limited harvest pressure and low adult mortality (Table 19), which makes sense, given the lake is more remote and likely receives less angling pressure. Growth rates have varied and appear to have declined. Growth was faster than the lake class average in 1992, as individuals achieved 6 inches by age-4. Growth rates appear to have declined in each subsequent assessment and growth was slower than the lake class average in 2009, with individuals achieving 6 inches by age-6. In 2011, growth was similar to 2009 (Figure 11).

Table 19. Average age and proportion of sampled bluegill that exceed select ages from Battle Lake.

Assessment Year	Stock	Average Age	%5+	%6+
1992	34	3.8	29	15
1998	30	6.1	97	83
2004	125	5.2	76	50
2005*	138	6.2	86	86
2009*	287	5.7	77	71
2011*	314	5.9	85	54

**Spring special assessments.*

Figure 11. Mean back calculated length at age of bluegill from Battle Lake.



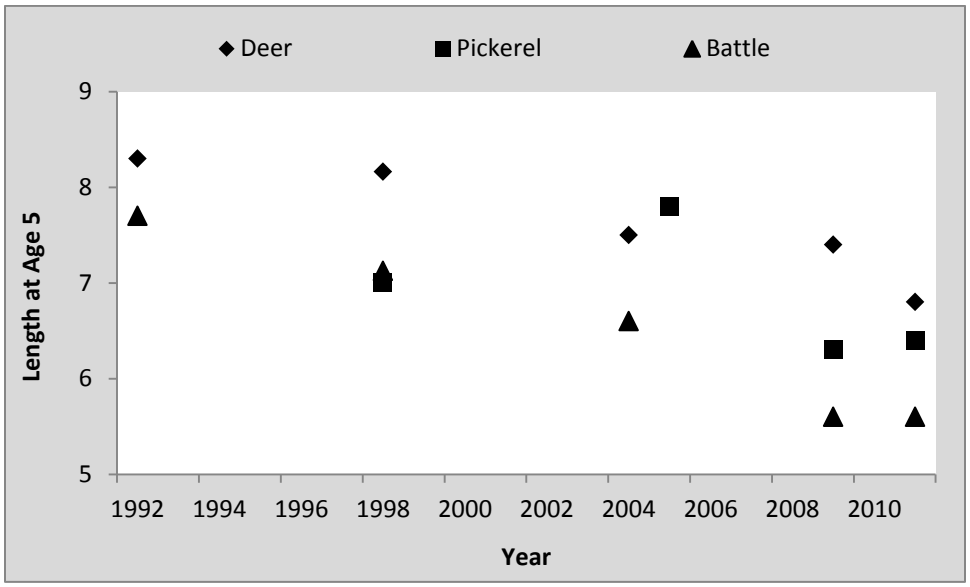
*log(LC 39)= logarithmic trend line of lake class 39 average growth. * indicates spring special assessments.*

Status of the bluegill fishery

Historical data are limited, but suggest that the system historically supported very few bluegills. Bluegill populations in all three lakes have apparently increased in recent years. Bluegills in Deer, Pickerel, and Battle lakes continued to support quality size structures, although catches from Pickerel and Battle lakes failed to achieve the LMP length indices goals in 2011. Size structure apparently declined in Battle Lake, as the three most recent assessments resulted in the lowest PSD and RSD-P values recorded for the lake. A continued trend of increasing density may be detrimental to quality size management in the future,

due to density dependent changes in growth. Growth rates appear to have declined on all three lakes in recent years (Figure 12) and may be a function of density dependency.

Figure 12. Back-calculated average length of bluegill at age-5 from Deer, Pickerel, and Battle Lakes.



Age data are limited, but suggest improved age distributions in Deer and Pickerel lakes in recent years. Battle Lake has a history of supporting a high proportion of relatively old bluegill and age distributions were relatively stable in the past five assessments with age data.

Dixon Lake

Dixon Lake is representative of ecological lake class 34 and is in the Mississippi River Watershed. Dixon has a surface area of 616 acres (78% littoral) and a maximum depth of 29 feet. The Third River enters Dixon Lake on the northwest side of the lake, outlets on the south end, and flows about seven miles to Lake Winnibigoshish. Three other inlets are located on the lake (Otter, Sioux Lake, and Unnamed creeks).

Much of the lake is relatively shallow and low oxygen levels often occur during severe winters. Dixon Lake has a history of poor water quality and was placed on the 303(d) list of impaired waters by the Minnesota Pollution Control Agency in 2008 due to excessive nutrients. The lake historically supported a diverse aquatic plant community. Dense aquatic plant growth and algae blooms periodically nuisance lake users and property owners given the lake's nutrient load and shallow depth. The infestation of curly-leaf pondweed in the early 2000's has impacted the aquatic plant community and if untreated, may limit aquatic recreation.

Social Considerations

The Dixon Lake Association has voiced concern about high angler harvest of panfish and is supportive of reduced bag limits for bluegill and possibly for crappie (Dick LeVasser, pers. comm). One resort operates on the lake and provides the primary access point for open water fishing. A special walleye regulation is in place on Dixon Lake. Approximately 30% of the lakeshore is public owned and the remainder is private. Development is moderate and several large parcels with limited development are located along the shoreline.

Management Actions

A proposal for a 5 sunfish bag limit and a 5 black crappie bag limit was developed in 2011 and opened to public input in the fall of that year. The goals of the proposed regulations were to maintain quality bluegill angling opportunities with a RSD-P greater than 40 and improve the RSD-M to 5. The goals of the crappie proposal were to maintain black crappie angling opportunities, with catches exceeding 1.5/trap net and 1.0/gill net from summer assessments, protect spawning stock and produce a population where at least 50% of the trap net sampled fish are age-4 or older, and maintain a quality size structure with a trap net PSD of 50 and RSD-P of 15.

Signs were posted at the public access points in the spring, directing comments to the Grand Rapids Area Fisheries Office. Announcements were also made via television, newspaper, and DNR news releases. Public input meetings were held in Grand Rapids and Sand Lake in late September and the comment period was open until October 10, 2011. A total of 76 comments were received, 79% of which supported the regulation proposals. The sunfish regulation was implemented in 2012, but the crappie regulation was not implemented due to biological concerns.

The LMP was revised in 2010. Walleye and black crappie were the primary management species and northern pike and sunfish were the secondary species. The management goals were to maintain

northern pike at the lake class median of 5.1/gill net and black crappie at the lake class median of 2.5/gill net and continue to provide a seasonal walleye fishery characterized by a catch of 2.0/gill net. The potential plan included conducting spring sunfish assessments to better document population characteristics. Spring special assessments targeting bluegill and crappie were conducted in 2011 and 2012.

Dixon Lake was included in an aerial creel study in 2001 and 2002. Summer fishing resulted in more pressure than winter fishing (9,742 angler hours in the summer versus 593 angler hours in the winter). Local residents suggest winter fishing pressure has increased dramatically since that time.

Dixon Lake is included in the Lake Winnibigoshish walleye slot regulation. This regulation requires all walleye from 17-26 inches to be released.

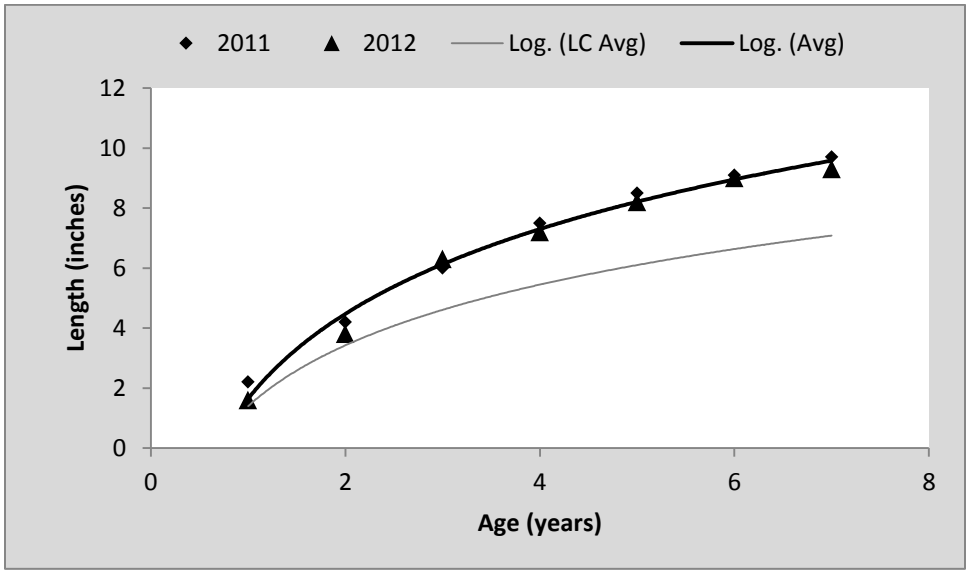
Bluegill in Dixon Lake

Little data exist for bluegill from Dixon Lake, but reports from the Dixon Lake Association (DLA) and local Conservation Officers suggest they are an important component of the fishery. Hybrid sunfish and pumpkinseed sunfish were sampled intermittently prior to 2009. Bluegills were captured at a rate of 1.2/trap net in 2009, a low rate compared to similar lakes. Although abundance appeared low, bluegills were generally large, as most individuals exceeded 8 inches and some exceeded 10 inches.

Spring assessments are regarded as the best method to evaluate panfish population characteristics. Caution should be used when interpreting catch rate data. Thirty-seven bluegills were captured from 90 sets during the 2011 spring assessment resulting in a catch of 0.4 per net. Bluegill ranged from 3.3 inches to 10.1 inches with a mean length of 9.0 inches. Sample size was too low to calculate standard length indices, but the size structure appeared good as 95% of the sampled bluegill exceeded 8 inches and 3% exceeded 10 inches. Growth was fast compared to similar lakes, with individuals exceeding 8 inches by age-5 (Figure 13). Recruitment appeared inconsistent, as 62% of the sampled bluegills were from a strong 2005 year class. Captured bluegill averaged 5.8 years old. Ninety-five percent of the sampled individuals exceeded age-5, but only 13% exceeded age-6.

A total of 93 bluegills were captured in 47 net sets resulting in catches of 2.0 per net in the 2012 assessment. The 2012 bluegill catch was the highest observed for the lake. The 2012 special assessment suggests that bluegill are present in catchable numbers and that the size structure remains dominated by large individuals, as bluegill ranged from 5.7 to 10.8 inches in length with a mean length of 8.1 inches. The proportional stock density (PSD) of bluegill exceeding the quality size of 6 inches was 98, the relative stock density of angler preferred bluegill (RSD-P, >8 inches) was 35, and the relative stock density of memorable -sized bluegill (RSD-M, >10 inches) was 11. Age and growth indices were similar to the previous assessment. Recruitment was inconsistent, as the 2009 year classes comprised 49% of the sample. The age distribution was balanced, as ages ranged from 2 to 10 years and bluegill averaged 4.7 years old, suggesting relatively low mortality of adult bluegill compared to other area lakes. Thirty-eight percent exceeded age-5 and 27% exceeded age-6.

Figure 13. Mean back calculated length at age for bluegill from Dixon Lake.



Log. (LC Avg)= logarithmic trend line fitted to the lake class 34 average. Log (Avg)= logarithmic trend line fitted to the lake average.

Pumpkinseed in Dixon

Pumpkinseed sunfish have generally been caught in higher numbers than bluegill from Dixon Lake. Dixon Lake is known to periodically winter kill. Pumpkinseeds are more tolerant to low oxygen than are bluegill, which may explain their higher relative abundance in most assessments.

The 2011 assessment captured 112 pumpkinseeds (1.2 per net). A quality population was described as pumpkinseed ranged from 6.3 inches to 8.8 inches with a mean length of 7.6 inches. Twenty-two percent of the sampled pumpkinseed exceeded the angler preferred length of 8 inches. Growth was relatively fast, as individuals typically exceeded 8 inches by age 6. Recruitment appeared somewhat inconsistent, as the 2006 year class comprised 58% of the sample.

The 2012 spring assessment resulted in a catch of only 25 pumpkinseeds (0.5 per net). The two species have slightly different spawning behaviors and the weather and timing of the assessment may influence the catch ratio of bluegill to pumpkinseed. Although the sample size was too small to calculate reliable length indices, the lake appeared to support a quality population, as lengths ranged from 3.8 inches to 8.4 inches with a mean of 7.0 inches. Ten hybrid sunfish were captured, indicating that some mixing of bluegill and pumpkinseed sunfish occurs in Dixon Lake. The presence of hybrids is not uncommon in lakes where both species occur. Hybrid sunfish tended to be large, ranging from 8.1 to 10.0 inches.

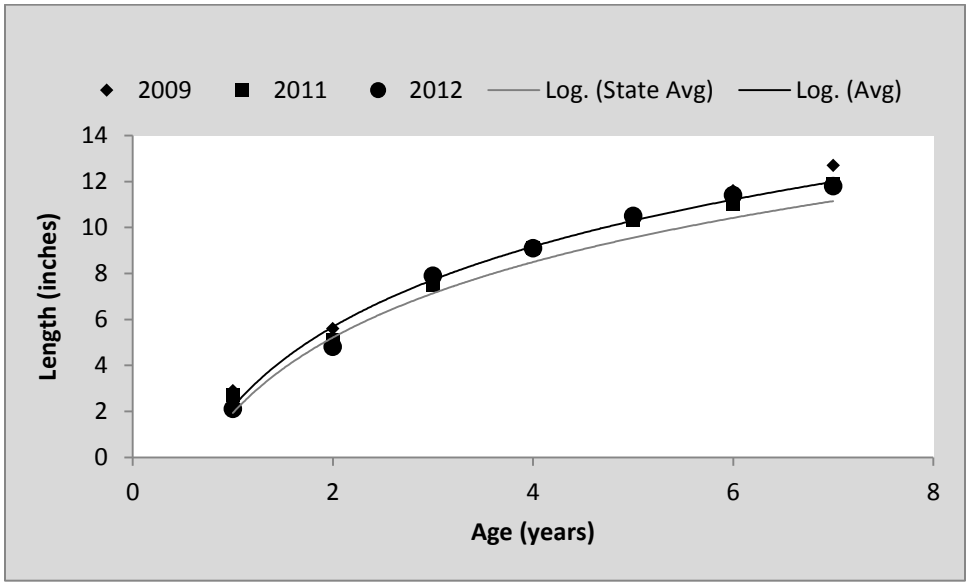
Black crappie in Dixon Lake

Crappie catches and size structure have varied on Dixon Lake (Table 20). Inconsistent recruitment has resulted in dramatic shifts in catch rate and size structure, typical of many northern Minnesota crappie populations. The population appeared to peak in catch and size structure in 2009, as a strong 2005 year class dominated the population. Black crappies were captured at a rate of 2.2/gill net and 5.1/trap net in 2009, both within the expected range for the lake type. A quality size structure was noted as PSD=95 and RSD-P=10. The largest black crappie exceeded 13 inches. Growth was near the statewide average as individuals typically exceeded 9 inches by age-4 (Figure 14).

Table 20. Black crappie catches from Dixon Lake (1979-2009).

Date	No. of nets gill/trap	Trap Net CPE	Gill Net CPE
7/30/1979	10/12	0.3	0.0
7/30/1984	9/0	-	0.9
7/25/1988	9/6	1.2	2.0
7/27/1992	9/12	0.4	2.4
7/28/1997	11/12	0.8	0.1
7/28/2003	11/12	0.9	0.6
7/13/2009	9/12	5.1	2.2
Lake class 1st quartile		0.9	0.8
Lake class median		3.2	2.5
Lake class 3rd quartile		8.0	8.4

Figure 14. Mean back calculated length at age for black crappie from Dixon Lake.



Log. (State Avg)= logarithmic trend line fitted to the State-wide average. Log (Avg)= logarithmic trend line fitted to the lake average

A total of 139 black crappies (1.5/trap net) were sampled in the 2011 spring special assessment. Black crappie ranged from 6.6 to 13.1 inches, with a mean length of 11.4 inches. Ninety-nine percent of the sampled crappie exceeded the angler preferred length of 10 inches and 19% exceeded the memorable length of 12 inches. Growth remained similar to the 2009 population assessment with individuals typically exceeding 9 inches by age-4. The 2009 population assessment indicated inconsistent recruitment, as most crappie belonged to the 2004, 2005, and 2006 year classes. These year classes were again well represented in the 2011 sample, and 46% of the sampled crappies were from the particularly strong 2005 year class. Unlike 2009, when only 29% of the sampled crappies exceeded age-5, crappies from the 2011 sample were relatively old, averaging 6.4 years of age. Only one crappie younger than age-5 was sampled. Thirty-five percent of the sample exceeded age-7, indicating survival of adult black crappie.

Fewer black crappie were captured in 2012 than in the 2011 assessment, but the catch rates were similar as fewer nets were set in 2012 (1.7 per net). Crappie ranged from 5.0 to 13.1 inches, with a mean of 10.0 inches. The PSD of quality sized crappie (>8 inches) was 91, RSD-P (>10 inches) was 45, and RSD-M (>12inches) was 20, indicating a size structure dominated by relatively large individuals and the potential to produce exceptionally large crappies. The 2011 assessment resulted in few crappies less than 10 inches, as the population was dominated by fish older than age 5. The increased proportion of crappie from 8.0 to 10.0 inches suggests recent recruitment to the adult population. Spring trap netting may be a poor tool to evaluate year class strength, however, as juvenile crappies (younger than age 4) are not likely to be caught. Growth was similar to past assessments, as individuals exceeded 9 inches by

age 4. Inconsistent reproduction and recruitment is a common trait for many crappie populations and past sampling indicates that Dixon Lake crappie recruit sporadically. Recruitment appeared inconsistent in 2012, as 34% of the catch belonged to the 2009 year class and 20% of the catch belonged to the 2006 year class.

Status of the sunfish and crappie fisheries

Inconsistent recruitment of black crappie is a common life history trait for many populations, often resulting in "boom and bust" angling cycles. Past assessments have reported that large crappies were caught by anglers, particularly in the spring of the year. Creel data are limited, but anecdotal information suggests that angling pressure for both species has increased dramatically in recent years, particularly during the winter (Dick LeVasser, pers. comm).

Low bluegill numbers may limit the popularity of the fishery. Pumpkinseed were more abundant then bluegill in most assessments of Dixon Lake and may be more important to the sunfish fishery.

Dixon Lake occasionally experiences low winter oxygen levels and partial winter kill events likely impact recruitment and subsequent year class strength. Low oxygen levels were observed in the late winter of 2011, and some dead fish, primarily crappies, were observed after ice out. Water levels in the lake vary by 4 feet because of a large watershed. Water level variation may impact fish reproduction and recruitment.

Grave Lake

Grave Lake is representative of ecological lake class 25 and is located seven miles south of Marcell, Minnesota in the Big Fork River watershed. Grave Lake has a total surface area of 500 acres (61% littoral) and a maximum depth of 39 feet. The lake has one inlet and one outlet. The inlet originates from Boy Lake and the outlet flows into Little Bowstring Lake. The inlet and outlet culverts have been plugged by either debris or beaver dams at times.

Social Considerations

There were 46 homes or cabins on the lake as of 1994, occupying approximately 30% of the shoreline. Of the remaining shoreline, approximately 50% is undeveloped forest or woodland, most of which is US Forest Service land around the south basin. The remaining shoreline is bog.

Management Actions

Following public input, a reduced bag limit of 5 sunfish was implemented in 2001 to maintain the quality bluegill size structure in Grave Lake. The regulation was reviewed and public input was received in 2010. Only six comments were received, five of which supported the regulation. The regulation was made permanent, given the expressed support and biological data.

The LMP was revised in 2008. Bluegill and walleye were the primary management species. The goals of the LMP were to maintain summer bluegill catch of 5.0/trap net with PSD and RSD-P values of 60 and 25, walleye catch of 5.0/gill net, northern pike catch of 6.0/gill net, and largemouth bass of 10/hour electrofishing.

Grave Lake was one of 90 lakes included in an aerial creel survey during the summer of 2001 and winter of 2001-02. Pressure counts were made on 28 randomly selected days for the summer and 17 days during the winter. Grave Lake had the third lowest total recreational pressure at 3,777 craft-hours for the seven class 25 lakes. Fishing pressure (7,651 angler-hours, 15.3 angler-hr/acre) was the fourth of seven class 25 lakes sampled. The estimate was well below the 1st quartile value (20 angler hours/acre) for other previously sampled class 25 lakes (DNR data summarized by M. Cook). Fishing represented 93% of the total estimated recreational pressure.

The winter fishing pressure estimate (847 angler-hours, 1.7 angler-hr/acre) was average when compared to the other seven class 25 lakes sampled. Similar to the summer pressure estimate, the winter estimate was well below the 1st quartile value (4.5 angler-hours/acre) for previously sampled class 25 lakes.

Bluegill in Grave Lake

Bluegill trap net catch rates have been near the first quartile in all summer assessments (Table 21) and the population has typically had a favorable size distribution. Several spring trap net assessments have been conducted and length indices are summarized in Table 22.

Table 21. Catch rates and size structure indices of bluegill from Grave Lake summer assessments.

Year	Trap nets	CPE	Stock	PSD	RSD-P	RSD-M
7/23/1974	8	6.6	54*	72	30	4
8/17/1988	8	4.8	58	5	23	0
8/15/1994	9	3.2	29	66	33	0
8/14/2000	9	5.9	53	36	21	0
8/20/2007	9	7.0	63	71	39	0
Lake class1st quartile		5.6				
Lake class median		17.0				
Lake class 3rd quartile		42.3				

** Indicates length indices were derived from gill net and trap net lengths or unknown gears. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

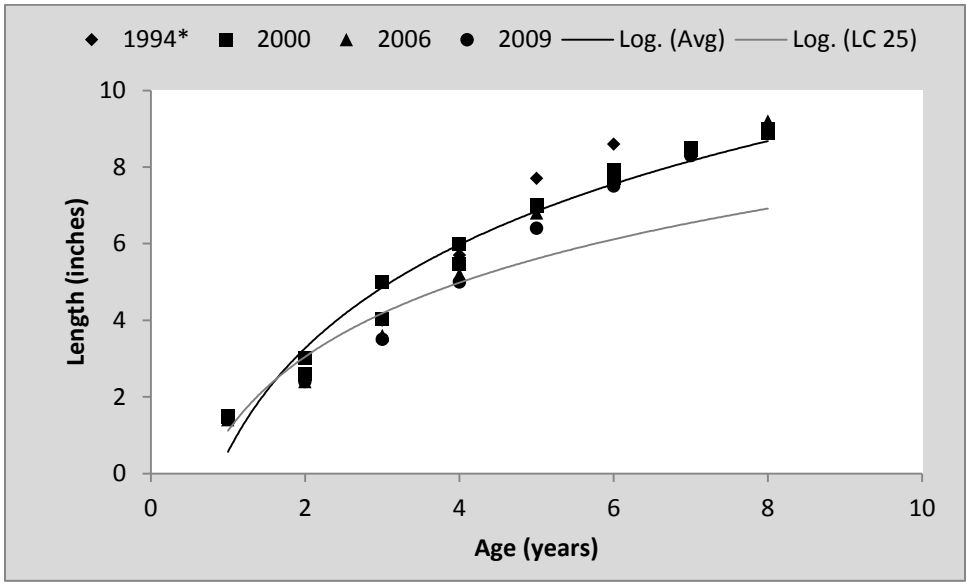
Table 22. Length indices of bluegill from Grave Lake spring assessments.

Year	Stock	PSD	RSD-P	RSD-M
2000	128	55	19	0
2001	294	90	28	6
2002	279	71	15	1
2004	429	96	55	1
2006	408	73	30	<1
2007	431	77	28	0
2009	904	90	36	1

PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.

Age and growth analysis indicated highly variable recruitment. Growth was fast compared to similar lakes, with individuals typically exceeding 6 inches by age-5 and 8 inches by age-7 (Figure 15). The age distribution has typically been balanced, as fish over age-5 were relatively common in most samples (Table 23). Average age has increased in recent years (Figure 16).

Figure 15. Mean back calculated length at age for bluegill from Grave Lake.



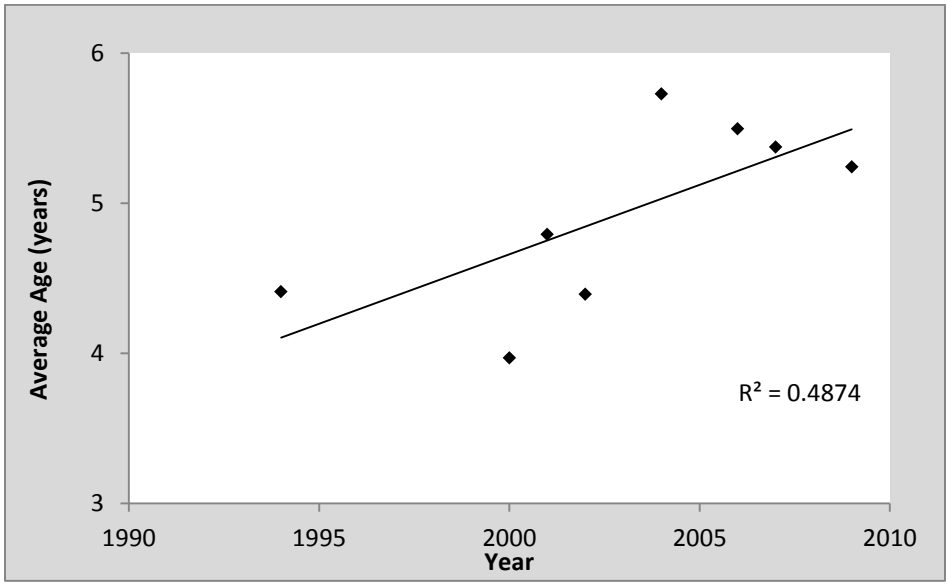
Log. (Avg)= logarithmic trend line fitted to the lake average. Log (LC 25)= logarithmic trend line fitted to the lake class 25 average.

Table 23. Average age and proportion of sampled bluegill that exceeded select ages from Grave Lake.

Assessment Year	*N*	Average Age	%5+	%6+
1994*	39	4.4	38	18
2000	130	4.0	20	17
2001	294	4.8	39	18
2002	275	4.4	33	7
2004	415	5.7	95	66
2006	408	5.5	67	48
2007	431	5.4	78	31
2009	905	5.2	83	36

**Summer assessment data.*

Figure 16. Average age of bluegill from Grave Lake.



Note-The two assessments prior to 2000 were conducted in the summer and catches may not be comparable. The 5 fish bag limit regulation went into effect in 2001.

Status of the bluegill fishery.

Factors limiting the bluegill population were not identified in the LMP. The bluegill fishery is meeting the goals of the special regulation and the lake management plan. The increase in average age may be attributed to year class maturation, reduced angler mortality, or a combination of the two. The shift in average age may indicate that the 5 fish bag limit is beneficial in maintaining a quality size structure. Growth may have slowed somewhat in recent years but remains well above the lake class average.

Split Hand and Little Split Hand Lakes

Split Hand and Little Split Hand lakes are situated in the Mississippi River watershed in southern Itasca County near Grand Rapids. They are connected to the Mississippi River via the Little Split Hand outlet, Split Hand Creek, and several small upstream water bodies including Carlson, Mud, and Cook lakes via Moody's Creek.

Split Hand Lake is an ecological lake class 27 lake with a surface area of 1,420 acres (36% littoral) and a maximum depth of 34 feet. The 2008 survey noted that much of the shoreline was in a natural state, consisting primarily of forest and secondarily of wetland. Little Split Hand Lake is in ecological lake class 29 and has a total surface area of 223 acres (63% littoral) and a maximum depth of 25 feet. Both lakes feature diverse plant communities, high nutrient levels, occasionally poor water clarity, and frequent algae blooms.

Social Considerations

The Split Hand Lake Association has voiced concern about high angler harvest of panfish and is supportive of special regulations for panfish. A special walleye regulation is in place on Split Hand Lake. Each lake historically supported a small resort with private access as well as a public access.

Management Actions

Proposals for 5 sunfish bag limit and 5 black crappie bag limit were developed for Split Hand Lake. The goals of the proposed regulations were to maintain quality bluegill angling opportunities measured by spring trap net catches with a RSD-P greater than 25 and improve the RSD-M to 5. The goals of the crappie proposal were to maintain black crappie angling opportunities with spring trap net catches exceeding 8.0/trap net, protect spawning stock and produce a population where at least 50% of the trap net sampled fish are age-4 or older, and maintain a quality size structure with a trap net PSD of 60 and RSD-P of 15.

A proposal for a 5 sunfish bag limit was developed for Little Split Hand Lake in 2011. The goals of the proposed regulations were to maintain quality bluegill angling opportunities with a PSD greater than 60 and improve the RSD-P to 25.

Signs were posted at the public access points in the spring, directing comments to the Grand Rapids Area Fisheries Office. Announcements were also made via television, newspaper, and DNR news releases. Public input meetings were held in Grand Rapids and Sand Lake in late September and the comment period was open until October 10, 2011. Over 80 comments were received for each of the proposals and approximately 60% of the comments favored the proposals. The regulation was therefore implemented in 2012.

The lake management plan for Split Hand Lake was revised in 2009. Walleye and black crappie were the primary management species and bluegill and northern pike were the secondary species. The

management goals were to maintain the walleye gill-net catch above 6.0 fish/net (PSD and RSD-P values of 30 and 10), maintain a quality black crappie population with a trap net catch of 3.0 fish/net and a RSD-P of 50, maintain a quality bluegill population with a trap net catch of 4.0 fish/net and a RSD-P of 25 and maintain a quality northern pike population with a catch of 3.0 fish/gill net and an RSD-P of at least 7. The potential plan included the consideration of a black crappie reduced bag limit.

The LMP for Little Split Hand was revised in 2005. The primary management species were bluegill and black crappie. The management goals were to maintain bluegill trap net abundance at 9.0/set with a PSD of 50, maintain black crappie at a gill net catch of 10.0/set and trap net catch of 6.0/set, and maintain walleye at 1.5/gill net by natural reproduction and/or immigration. Special spring trap net assessments were conducted in 2010 and 2012 on both lakes.

A walleye slot regulation was implemented on Split Hand Lake in 2005. This regulation requires all walleye from 17-26 inches to be released.

Creel data indicate that Split Hand Lake is a popular fishery. Creel survey information from the mid-1950s and mid 1970s indicated summer fishing pressure on Split Hand Lake remained relatively stable between the mid-1950s (averaged 18,730 angler hours/year) and the mid-1970s (averaged 19,034 angler hours/year). Winter fishing pressure increased 6.3 times during the same period and the 1976 creel report indicated 92.1% of all winter anglers targeted black crappie. The increased fishing pressure corresponded to an 800% increase in black crappie harvest from 161 in 1954-55 to 1,302 in 1975-76. Meanwhile, mean weight of the harvested fish declined from over 1.0 pound to 0.72 pounds per fish.

Aerial creel studies were conducted in 2001 and 2002. Fishing pressure on Split Hand was estimated at 21,118 angler hours/year (12,497 angler hours in the summer and 8,621 angler hours in the winter). Fishing pressure on Little Split Hand was estimated at 8,531 angler hours/year. Winter pressure was higher than summer pressure (3,643 angler hours in the summer and 4,888 angler hours in the winter).

Bluegill in Split Hand

Bluegill trap net catch rates were below the lake class medians in all assessments (Table 24). Bluegills in Split Hand have typically been large (Table 25). The 1956 Split Hand Lake assessment documented the potential to produce bluegill longer than 10 inches, although fish of memorable length have not been sampled since. Age analysis indicated relatively fast growth compared to other class 27 lakes (Figure 17), with individuals typically exceeding 6 inches by age-4 and 8 inches by age-7. Age distributions have included a high proportion of individuals exceeding age-5. The average age of bluegill from the 2010 spring assessment was 6.1 years, but average age decreased to 4.4 years in 2012, an apparent result of recent recruitment (Table 26). Age analysis indicated generally inconsistent recruitment as year class strengths tended to vary considerably.

Table 24. Catch rates of crappie and bluegill from Split Hand Lake.

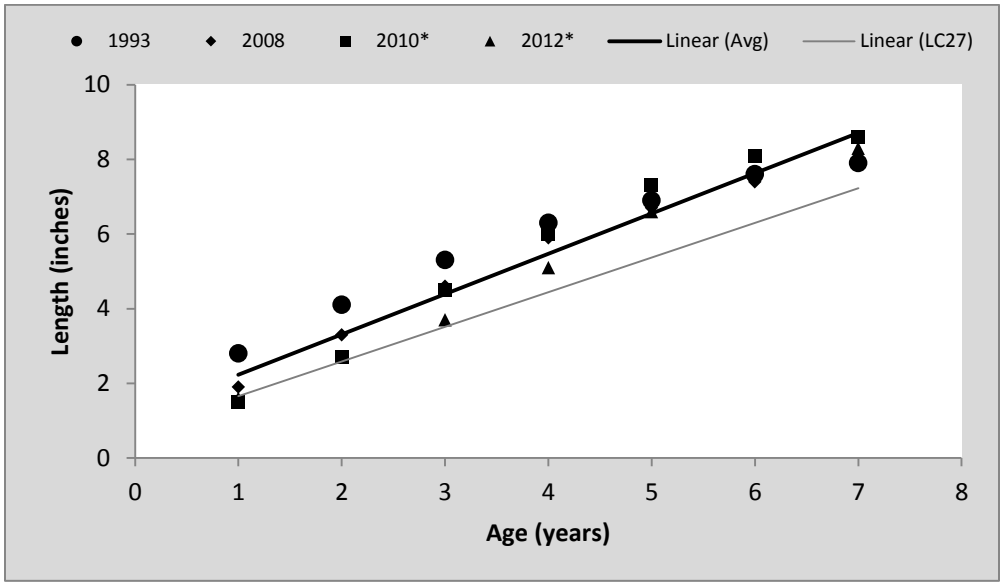
Date	No. of Nets (Gill/trap)	Black Crappie (Gill net)	Black Crappie (Trap net)	Bluegill (Trap net)
9/8/1953	12/9	0.7	3.6	1.0
8/3/1954	16/0	0.7	-	-
8/1/1955	9/9	0.2	6.8	0.4
8/1/1956	6/9	0.8	5.2	3.0
8/25/1975	12/16	0.2	0.4	0.0
8/25/1980	12/0	0.1	-	-
8/20/1984	12/9	0.1	0.2	1.7
9/22/1986	12/0	0.3	-	-
8/17/1987	12/0	0.7	-	-
8/20/1990	10/8	2.9	0.6	3.8
8/2/1993	12/12	0.6	0.4	1.9
8/3/1998	12/12	5.5	6.8	1.3
8/2/2004	12/12	0.3	2.6	4.6
7/28/2008	12/12	2.4	1.9	3.2
7/23/2012	12/0	2.3		
Lake class 1st quartile		0.4	0.4	4.4
Lake Class Median		1.0	0.9	16.2
Lake Class 3rd quartile		2.7	2.3	49.0

Table 25. Split Hand Lake bluegill length indices.

Year	Stock	PSD	RSD-P	RSD-M
1956	18*	100	94	6
1984	15*	100	27	0
1990	29*	17	0	0
1993	23*	91	26	0
1998	19	21	5	0
2004	54	46	26	0
2008	42	71	21	0
2010**	361	100	53	0
2012**	278	37	33	0

** Indicates length indices were derived from gill net and trap net lengths or unknown gears. **Spring assessment data. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Figure 17. Mean back calculated length at age for bluegill from Split Hand Lake.



*Linear (avg)= linear trend line of lake average growth. Linear (LC 27)= linear trend line of lake class 27 average growth. * indicates spring special assessments.*

Table 26. Average age and proportion of sampled bluegill that exceeded select ages from Split Hand Lake.

Assessment Year	Stock	Average Age	%>age 5	%>age 6
1993	21	4.9	62	33
2008	42	4.4	80	35
2010*	359	6.1	96	61
2012*	278	4.4	36	34

**Spring assessment data*

Black crappie in Split Hand

Black crappie have been sampled in all assessments and catch rates have been variable. The population could be characterized as low to moderate density with favorable size structure in most assessments (Table 27).

Age analysis identified inconsistent reproduction and recruitment, and age distributions have varied with year classes (Table 28). Growth was near the statewide average with individuals typically exceeding 8 inches by age-4 (Figure 18).

Spring trap netting maybe a useful evaluation tool for crappie on Split Hand Lake. A total of 289 black crappies (8.3/trap net) were captured in the 2010 spring assessment. Size ranged from 6 to 13.3 inches

with a mean of 9.1 inches. The size structure was moderate as PSD was 66, RSD-P was 18, and RSD-M was <1. The 2012 assessment captured 125 black crappie. Length ranged from 4.3 to 12.2 inches with a mean of 7.1 inches. PSD was 38, RSDP was 19, and RSD-M was 1.

Table 27. Length indices of Black Crappie from Split Hand Lake Summer Assessments

Year	Stock	PSD	RSD-10	RSD-12
1953	32	100	78	3
1954	37*	92	92	24
1955	35	97	97	31
1956	30*	97	83	63
1975	9*	100	100	56
1990	19*	0	0	0
1993	12*	25	25	0
1998	64	36	28	0
2004	31	100	87	29
2008	16	100	31	0

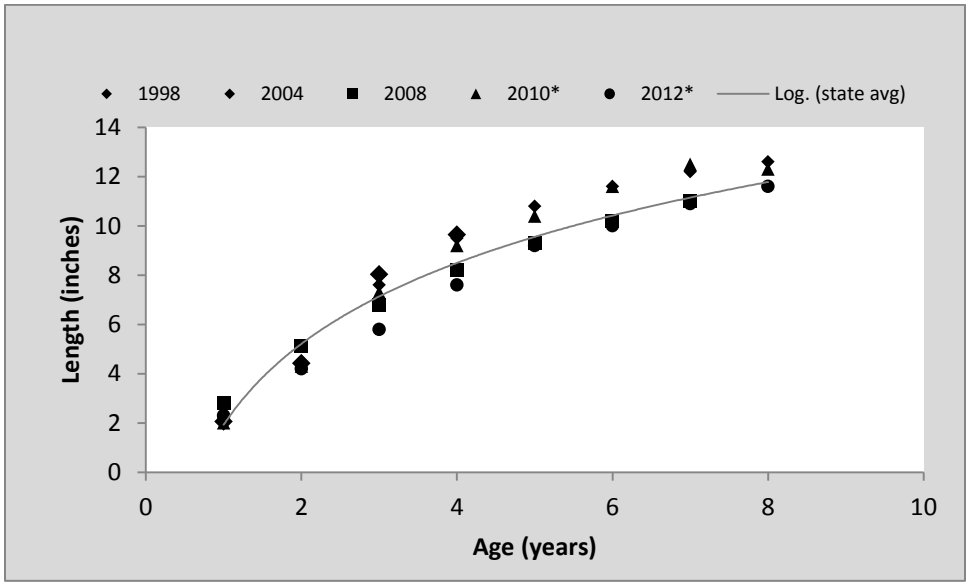
** Indicates length indices were derived from gill net and trap nets. Standardized lengths were used to calculate length indices (Stock length = 5 in., Quality length = 8 in., Preferred length = 10 in., Memorable length = 12 in.)*

Table 28. Average age and proportion of sampled black crappie exceeding select ages from Split Hand Lake.

Year	Stock	Average age	%5+	%6+
1990	22	1.0	0	0
1998	82	2.3	0	0
2004	31	5.4	87	32
2008	54	2.2	32	7
2010*	288	4.0	23	2
2012*	126	3.4	30	16

**Summer assessment data*

Figure 18. Mean back calculated length at age for black crappie from Split Hand Lake.



*Log (state Avg)= logarithmic trend line of state-wide average growth. * indicates spring special assessments.*

Bluegill in Little Split Hand

Bluegill catches have varied, but have generally been low, as catch rates were below the lake class first quartile in all assessments except 2004 (Table 29). The population has had a favorable size structure in most assessments, suggesting a quality fishery exists (Table 30).

Table 29. Catch rates of crappie and bluegill from Little Split Hand Lake.

Date	No. of Nets (Gill/trap net)	Black Crappie (Gill net)	Black Crappie (Trap net)	Bluegill (Trap net)
7/21/1961	4/10	11.3	4.5	0.7
6/10/1975	3/7	7.0	1.6	1.0
6/30/1980	6/4	20.3	0.5	0.5
6/18/1985	5/4	8.2	2.5	5.8
6/17/1991	5/4	11.6	1.8	6.3
6/17/1996	6/9	1.0	0.9	0.9
6/14/2004	6/9	17.3	6.6	9.0
6/11/2012	6/9	17.0	2.3	4.0
Lake class 1st quartile		1.0	0.8	8.3
Lake Class Median		2.2	1.8	24.0
Lake Class 3rd quartile		4.8	4.3	50.1

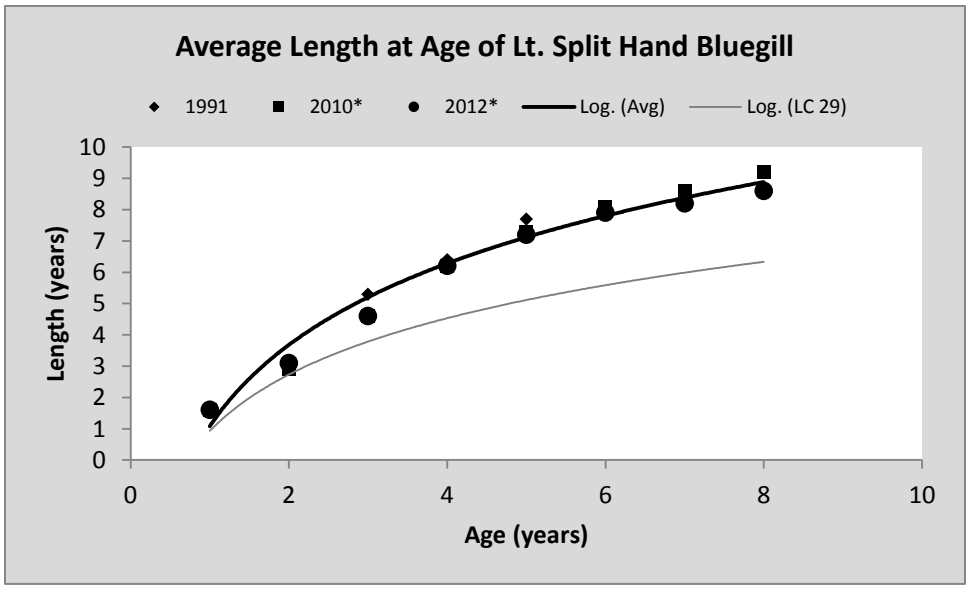
Table 30. Size structure indices of bluegill from Little Split Hand Lake.

Year	Stock	PSD	RSD-P	RSD-M
1985	26	76	4	0
1996	25	56	4	0
2004	81	74	43	0
2010*	351	96	14	<1
2012*	235	82	28	0
2012	36	14	0	0

**Spring assessment data. PSD based on a quality size of 6 inches, RSD-P based on a preferred size of 8 inches, RSD-M based on a memorable size of 10 inches.*

Age data were only collected in 1991, 2010, and 2012. Age analysis suggested fairly consistent recruitment in recent years. Growth rate was fast compared to similar lakes, with individuals exceeding 6 inches by age-4 and 8 inches by age-6 (Figure 19). The age distribution appeared favorable in recent spring assessments, as 81% of the sample exceeded age-5 in 2012, indicating good survival to adult sizes (Table 31).

Figure 19. Mean back calculated length at age for bluegill from Little Split Hand Lake.



*Log (Avg)= logarithmic trend line of lake average growth. Log (LC 29)= logarithmic trend line of lake class 29 average growth. * indicates spring assessments.*

Table 31. Average age and proportion of sampled bluegill exceeding select ages from Little Split Hand Lake.

Assessment Year	Stock	Average Age	%>age 5	%>age 6
1991	25	3.4	8	0
2010*	351	4.9	62	21
2012*	235	5.1	81	42

**Spring assessment data.*

Black crappie in Little Split Hand

Little Split Hand Lake has a history of producing high catches of small crappie (Table 32), as gill net catches typically exceeded the third quartile for the lake class.

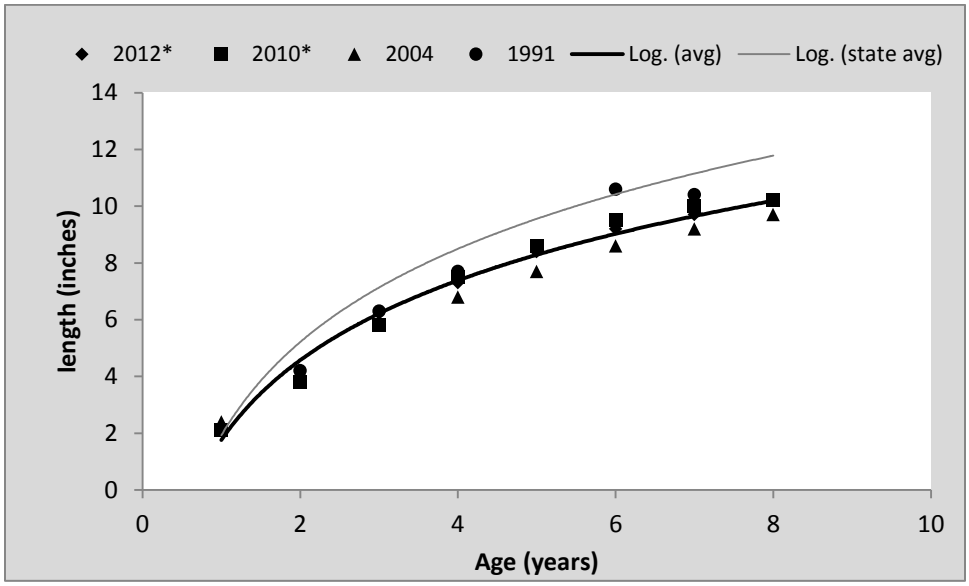
Table 32. Size structure indices of Black Crappie from Little Split Hand Lake

Year	Gear	Stock	PSD	RSD-P	RSD-M
1980	Gill and trap net	44	34	5	0
1985	Gill and trap net	51	41	2	0
1991	Gill net	58	16	3	0
2004	Gill net	104	33	4	0
2010*	Spring Trap net	669	24	2	0
2012*	Spring Trap net	203	66	6	0
2012	Gill net	102	47	2	0

*Standardized lengths were used to calculate length indices (Stock length = 5 in., Quality length = 8 in., Preferred length = 10 in., Memorable length = 12 in.) *Spring trap net assessments.*

Growth was described as poor in all assessments with aging data (Figure 20). Crappies did not typically attain 8 inches until age-5 and 10 inches until age-7. Age distributions have varied with year class strength and have generally been dominated by younger fish with few fish exceeding age-5 (Table 33).

Figure 20. Mean back calculated length at age for black crappie from Little Split Hand Lake.



*Log (avg)= logarithmic trend line of lake average growth. Log (state avg)= logarithmic trend line State-wide average growth. * Spring trap net assessments.*

Table 33. Average age and proportion of sampled black crappie exceeding select ages from Little Split Hand Lake.

Year	*N*	Average age	%>5	%>6
1991	49	3.0	6	6
2004	104	3.9	32	29
2010*	669	4.0	26	12
2012*	205	4.8	60	13
2012	101	4.5	44	12

**Spring Assessment data*

Status of the bluegill and crappie fisheries.

The Split Hand LMP goal (RSD-P>25) for bluegill was exceeded in the most recent spring assessment (2012), while the crappie goal (RSD-P of 50) was not met. Length indices of crappie vary with year class strength so length based goals may be difficult to meet on a consistent basis. The bluegill population of Split Hand Lake has included a relatively high proportion of fish exceeding age-5, suggesting good survival and somewhat limited recruitment. The 2012 assessment of Little Split Hand also noted a high proportion of fish exceeding age-5. The percentage of fish exceeding age-6 were favorable in both lakes, but were nearly 40% lower than the proportion exceeding age-5. Consistent marked declines from age-5 to age-6 may represent mortality of older individuals. Harvest may impact the age structure, as bluegills from these lakes generally reach a desirable size for anglers in their fifth year.

The two assessments conducted on Little Split Hand Lake in 2012 provided contradictory results. The LMP goal (PSD>50) was exceeded and RSD-P was favorable (RSD-P = 28) in the 2012 spring assessment, as the catch exceeded 200 bluegill. Summer trap netting a few weeks later caught surprisingly few bluegills (4/trap net), although the catch rate was typical compared to past summer assessments. The summer netting suggested a poor size structure, as most fish failed to exceed 6 inches. The discrepancies in the test netting suggests that the timing of assessments is important to describe the bluegill population, and that targeted spring assessments are needed to document changes in size and age structure. Spring assessments likely provide a poor index of abundance, however, and summer trap net assessments at standard locations may be the best method to track changes in population density.

Spring trap netting and summer gill netting provided similar results, as both methods described high crappie abundance, poor size structure, and slow growth. Age distribution and size structure varied somewhat, as the trap net captured a higher proportion of age 5 individuals and produced a higher PSD value (PSD was 66 from spring trap nets and 47 from summer gill nets). Some dead crappies were observed during test netting. The decreased proportion of age-5 crappie in the gill net may suggest higher mortality of post spawn crappie, or may simply be a product of gill net length selectivity bias, trap netting bias associated with age of maturity, or aging errors. When the data is view holistically, Little Split Hand Lake is a poor candidate for quality crappie management given the history of poor size structures and slow growth rates.

Sand Lake

Sand Lake is located in Itasca County about six miles east of Squaw Lake, within the Leech Lake Reservation, Chippewa National Forest, and the Bigfork River Watershed. Sand Lake is the second lake in a chain of lakes that includes Bowstring, Little Sand, Rice and Dora lakes. Fish can migrate freely between the lakes and throughout the river system. Sand Lake has a surface area of 4,328 acres, a littoral area of 1,897 acres (44%), a maximum depth of 70 feet, and is in ecological lake class 22.

Social Considerations

Much of the shoreline of Sand Lake has been developed for residencies and the local property owners have formed an active lake association. The Sand Lake Association Board has polled their membership and found support for a reduced bag limit for bluegill and black crappie. The board has requested that DNR fisheries submit a proposal. Several resorts operate on Sand Lake and resort guest are perceived to be a major user group.

Management Actions

The Sand Lake LMP was revised in 2012. Walleye, northern pike and yellow perch were the primary management species and bluegill and black crappie were the secondary species.

Proposals for 5 sunfish bag and 5 black crappie bag limits were developed for Sand Lake and connected waters including upstream to CSAH 35 bridge, Portage Lake, Birdseye Lake, Little Sand Lake, Rice Lake, Unnamed Lake (31-0881) and the Bowstring River downstream to the County Road 145 bridge. The goals of the proposed regulations were to maintain quality bluegill angling opportunities with a RSD-P greater than 15 and improve the RSD-M to 5. The goals of the crappie proposal were to maintain black crappie angling opportunities with a trap net RSD-P of 50 and RSD-M of 20.

Signs were posted at the public access points in the spring of 2011, directing comments to the Grand Rapids Area Fisheries Office. Announcements were also made via television, newspaper, and DNR news releases. Public input meetings were held in Grand Rapids and Sand Lake in late September and the comment period was open until October 10, 2011. Over 120 comments were received for each regulation. Approximately 60% of the comments opposed the regulations and they were not implemented. It should be noted that lakeshore residents were generally supportive of the proposals but non-lakeshore residents and resort owners opposed the regulations.

Bluegill in Sand

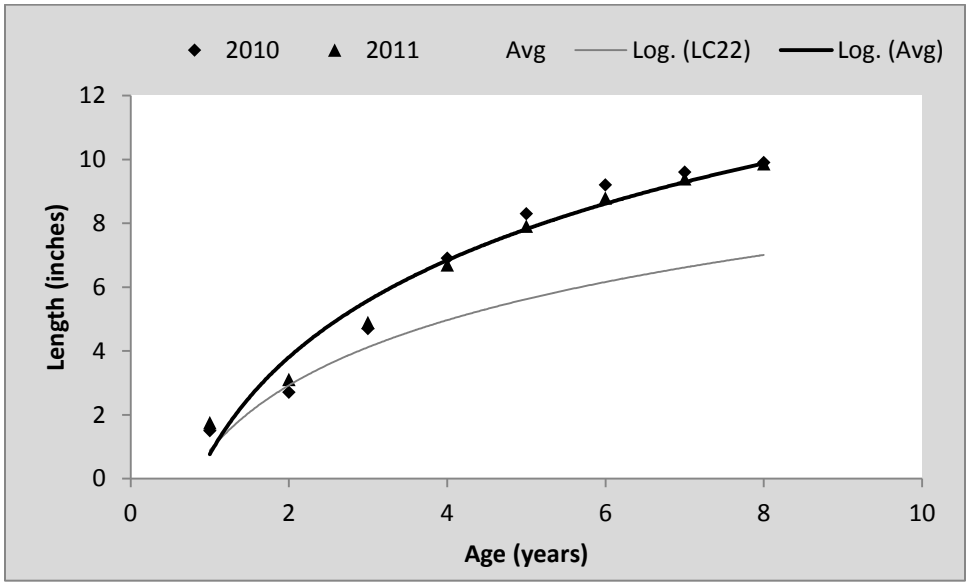
Data on Sand Lake bluegill are limited. Bluegill catch rates have historically been low. Bluegill were sampled at a rate of 3.5 fish/trap net in 2006, below the lake class first quartile and a quality size structure was noted (PSD=64, RSD-P=15) with individuals up to 10 inches being sampled. Spring bluegill trap net assessments were conducted in 2010 and 2011 because of interest expressed by the Sand Lake Association. The 2010 assessment resulted in a catch of 402 bluegill (8.2 /trap net) and the 2011 survey

resulted in a catch of 158 bluegill (3.0/trap net). A quality size structure was observed in both assessments (Table 34). Age analysis indicated variable recruitment, as a strong 2006 year class comprised 54% of the sample in 2010 and 44% of the sample in 2011. Age distribution was favorable, as 33% of the sample exceeded age-5 in 2010 and 78% exceeded age-5 in 2011. Bluegill averaged 4.3 years old in 2010 and 5.2 years old in 2011. Growth was fast compared to similar lakes (Figure 21) with individuals exceeding 6 inches by age-4 and nearing 8 inches by age-5.

Table 34. Size structure indices of bluegill from Sand Lake spring trap net assessments.

Year	Stock	PSD	RSD-P	RSD-M
2010	402	86	28	2
2011	158	98	56	1

Figure 21. Mean back calculated length at age for bluegill form Sand Lake



Log (Avg)= logarithmic trend line of lake average growth. Log (LC 22)= logarithmic trend line lake class 22 average growth.

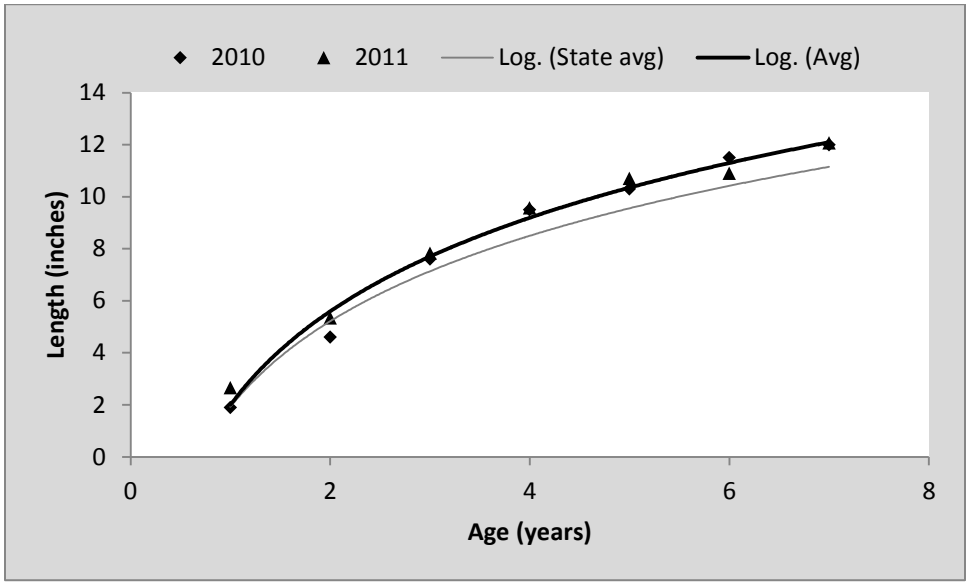
Black crappie in Sand

Black crappie catch rates have traditionally been low. The 1988 assessment had the highest gill net catch rate of 1.1 per net. The 1975 assessment had the highest trap net catch rate of 9.3 per net. Back-calculated lengths at age from the 2006 assessment were similar to the statewide average for all ages, with fish up to age 7 present.

Summer test netting may not accurately reflect the true abundance of black crappie due to the schooling nature of the fish. Spring trap netting resulted in low catches of 17 in 2010 (0.4/trap net) and 12 in 2011 (0.2/trap net). Size structure appeared favorable, as the mean length was 10 inches and fish

exceeding 12 inches were present in both surveys. Growth was examined in 2010 and 2011. Growth was somewhat faster than the statewide average in both assessments (Figure 21). The poor catches in spring and summer assessments make assessing crappie trends in Sand Lake difficult, better sampling methods may exist for crappie in Sand Lake.

Figure 21. Mean back calculated length at age for black crappie from Sand Lake.



Log (Avg)= logarithmic trend line of lake average growth. Log (State avg)= logarithmic trend line for State-wide growth average.

Status of the bluegill and crappie fisheries

Data on Sand Lake is limited, but the lake appears to support a moderate bluegill population with a favorable size distribution. Growth rates were fast and the age distribution was moderate in the most recent assessment. Crappies have been captured in low numbers but have generally been large.

The LMP identified several limiting factors. Sand Lake has a high density of northern pike. A high density of predators can impact prey species abundance. Fishing reports suggest that black crappie are an important component of the sport fishery in Sand Lake and may be periodically subject to high harvest rates. Angler interest in bluegill was perceived to be low in the past but has recently increased.

Citations

Anderson, R.O. and Neuman. 1996. Length, weight, and associated structural indices. Pages 447-482 *In* Fisheries Techniques, second addition. B.R. Murphy and D.W. Willis, editors. American Fisheries Society. Bethesda, Maryland.

Beard, T. D., Jr., and T. E. Essington. 2000. Effects of angling and life history processes on bluegill size structure: insights from an individual-based model. Transactions of the American Fisheries Society 129: 561–568.

Beard, T. D., Jr., and J. M. Kampa. 1999. Changes in bluegill, black crappie, and yellow perch populations in Wisconsin during 1967–1991. North American Journal of Fisheries Management 19:1037–1043.

Beard, T.D., M.T. Drake, J.E. Breck, and N.A. Nate. 1997. Effects of simulated angling regulations on stunting in bluegill populations. North American Journal of Fisheries Management 17:525-532.

Clady, M.D., D.E. Campbell, and G.P. Cooper. 1975. Effects of trophy angling on unexploited populations of smallmouth bass. Pages 425-129 *in* R.H. Stroud and H. Clepper, editors. Black bass biology and management. Sport Fishing Institute. Washington D.C.

Coble, D. W. 1988. Effects of angling on bluegill populations: management implications. North American Journal of Fisheries Management 8:277–283.

Cook, M.F. and J.A. Younk. 2001. A recalculation of the annual statewide recreational fishing effort and harvest in Minnesota Lakes. Minnesota Department of Natural Resources Investigational Report 493.

Goedde, L. E., and D.W. Coble. 1981. Effects of angling on a previously fished and an unfished warmwater fish community in two Wisconsin lakes. Transactionsof the American Fisheries Society 110:594–603.

Kempinger, J. J., W.S. Churchill, G.R. Priegel, and L.M. Christenson. 1975. Estimate of abundance, harvest, and exploitation of the fish populations of Escanabe Lake, Wisconsin, 1946-1969. Wisconsin Department of Natural Resources Technical Bulletin 84.

Olson, D. E., and P. K. Cunningham. 1989. Sport-fisheries trends shown by an annual Minnesota fishing contest over a 58-year period. North American Journal of Fisheries Management 9:287–297.

Parsons, B.G., J.R. Reed, H.G. Fullhart, and V.A. Snook. 2004. Factors affecting black crappie recruitment in four west-central Minnesota lakes. Minnesota Department of Natural Resources Investigational Report 514.

Parsons, B. G. M., and J. R. Reed. 1998. Angler exploitation of bluegill and black crappie in four westcentral Minnesota lakes. Minnesota Department of Natural Resources Section of Fisheries Investigational Report 468.

Tomcko, C.M. and R.B. Pierce. 2005. Bluegill Recruitment, Growth, Population Size Structure, and Associated Factors in Minnesota Lakes. North American Journal of Fisheries Management, 25 (1) 171 – 179.

Tomcko, C.M. and R.B. Pierce. 1993. The relation of male bluegill reproductive strategies to exploitation and population size structure in twelve Minnesota Lakes. Minnesota Department of Natural Resources. Investigational Report 432.

Van Den Avyle, M.J. 1993. Dynamics of exploited fish populations. Pages 105-134 *in* Inland Fisheries Management, second addition. C.C. Kohlor and W.A. Hubert, editors. American Fisheries Society. Bethesda, Maryland.