Sanford Lake
T15N, R1W, Sec Many
Tittabawassee River Watershed, Surveyed 2007

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Environment

Sanford Lake is a 1,250-acre impoundment of the Tittabawassee River created by the Sanford Dam and is located in north central Midland County within the east central Lower Peninsula of Michigan (Fig.1). The Village of Sanford lies on the extreme southwest shore of the impoundment, near the impoundment's dam outlet. Sanford Impoundment is bisected by US10 at the southern end.

Sanford Dam is the last in a series of four large hydropower dams on the Tittabawassee. Boyce Hydropower, LLC, formerly Wolverine Power, owns and operates this hydroelectric. Built in1925, it has a height of 36 ft, and a hydraulic head of 26 feet. The dam has a Michigan Department of Environmental Quality (MDEQ) high hazard rating due to the size of the dam and the development on and below the dam. Sanford dam was licensed initially by the Federal Energy Regulatory Commission (FERC) in 1987, but amended to be included for relicensing with the upstream 3 dams in 2028. The license provides for a minimal flow requirement for downstream release of 210 cubic feet per second, except during the walleye spawning season when there is a 650 cubic feet per second minimal flow requirement. There is no fish ladder on this dam or any of the dams upstream. Fish do pass downstream over the gates to some extent.

Sanford Lake outlets to the Tittabawassee River which flows to the Saginaw River and eventually to Saginaw Bay. There are many small drainages and the main Tittabawassee, which inlet to the lake. Sanford Lake is narrow and approximately 10 miles long.

The topography of the watershed varies from level to gently rolling hills. Soils are classified as sandy loam and predominant land use in the area is mixed farm and woodland. The immediate shoreline of the impoundment (lake) is high-banked, sand and clay. The littoral zone of the lake drops off steeply at the dam and gently in other areas and has a maximum depth of 29 feet near the dam. The old river channel is also evident. The bottom substrate in the deeper areas is pulpy peat and is a mixture of sand, clay, and pulpy peat on the shoals. The water is often darker colored and somewhat turbid due to both natural tannins from the swamps upstream and also due to the soils it drains. In recent years zebra mussels have generally reduced turbidity. The majority of the lakeshore of Sanford Lake is developed with homes and cottages. More than 50% of the shoreline has been armored.

The water quality of Sanford Lake is good, and studies have been made for a variety of parameters over time, most recently in 1998. The lake is quite productive and has an alkalinity ranging from 125-166 ppm. Limited limnology and habitat surveys were conducted by the Michigan Department of Natural Resources (MDNR) during the 2007 survey. Transects were made around the entire shoreline for a total of 26.89 miles. During these transects around the shoreline, relevant habitat information was recorded. There were a total of 465 small docks, 343 large docks, 713 dwellings and 423 submerged trees recorded in total. The percentage of shoreline armored averaged 53.1% in the 134 transects. In 1951, there were approximately 350 cottages. Secchi depth readings measure how turbid the water is

and was recorded as 8 feet. The lake was not stratified at the time of the survey. The temperature ranged from 71.3 degrees Fahrenheit (F)at the surface to 70.4 degrees F at the bottom (Table 1). Likewise, the dissolved oxygen was fairly uniform and adequate, ranging from 7.68 ppm at the surface to 6.42 ppm at the bottom. The pH ranged from 7.4-7.6 and the specific conductivity was 366-348 uS/cm. Increased water clarity has caused increases in light penetration and an increase in macorphyte or aquatic plant growth. As a result, Sanford Lake is undergoing extensive annual weed treatments.

The lake experiences a large amount of recreational boating and personal watercraft traffic in addition to the boating pressure it gets from anglers. Winter ice fishing is practiced, especially in the quieter waters and side channels, but ice fishing in the main impoundment can be dangerous due to the currents and flows. Access to Sanford Lake is limited for the size of the lake. There is a county park called Sanford Lake Park south of US10 on the west side of the lake. Midland County acquired the land in 1968 and subsequently constructed the current boat launch ramp. This access has limited times and seasons when it is open, coinciding with the park operation. The park has 88 vehicle/trailer parking spaces and 470 standard parking spots. There are also a couple of private marinas and campgrounds where the public can launch for a fee. At the Village of Sanford, just above the dam on the east side of the lake, there is a barrier-free fishing platform. Sanford Lake is a popular recreation lake.

History

No fishery management records exist prior to 1951, except for sporadic fish stockings. From 1937 to 1944, fifteen to twenty thousand bluegills were stocked annually. One million and 680,000 pike fry were stocked in 1942 and 1944 respectively. In 1943, five hundred smallmouth and in 1944, thirteen hundred largemouth bass were also stocked. In 1949 five hundred yearling catfish were stocked.

The first biological inventory was conducted in 1951. Gear in these early surveys was limited to gill nets and some seines. Species recorded included northern pike, yellow perch, bluegill, pumpkinseed sunfish, rock bass, black crappie, largemouth bass, smallmouth bass, yellow bullhead, carp, common shiner, bluntnose minnow, logperch, johnny darter, blackside darter, hornyhead chub, stone roller, spotfin shiner, creek chub, and golden shiner. Black crappie appeared to be the most numerous in the survey catches, whereas no stocked catfish were recorded. The files indicated that were intermittently reported by anglers up to 1963.

Files indicate that there have been several winter mortalities in Sanford Lake. These occurred in 1961, 1965, and 2000. A large fish kill also occurred in 1995, but was caused by a lake weed treatment. The spraying company responsible paid $2,340 for the value of the fish and an additional $1,747 for the investigation time.

In 1963, seventy five thousand one-inch channel catfish fingerlings were stocked. Additional catfish were also stocked in 1964 through 1966, all courtesy of the U.S. Fish and Wildlife Service (USFWS). During this same time period, there was also a strong DNR emphasis on the development and operation of pike marshes on many water bodies throughout Michigan. A pike marsh was constructed

at Sanford Lake in 1964, and an estimated 40,000 pike fingerlings (2-3 inches) were released into the lake. The pike marsh was operated from 1964 through 1973, except for 1965 and 1970 due to a dam failure and vandalism. The present control structure and marsh was built 1971 and floods approximately 25 to 30 acres. It is located on the southwest side of Sanford Lake (T16N, R01W, Sec 1) off West River Road. Annual production of pike from 1964 to 1983 varied from 1000 to 40,000 fingerlings. Recent work was completed in 2007 on the control structure and outlet of the marsh.

The next fisheries survey was conducted in 1967 to evaluate northern pike and channel catfish stockings and also to document the status and species present in the impoundment. This was the first time trap and fyke nets were used in addition to gill nets and seines. Additional species captured included walleye, white bass, channel catfish, and brown bullhead. Channel catfish appeared to be numerous as did walleye and white bass. There were no records in the files of white bass being stocked at any time.

In 1984, rearing of northern muskellunge replaced the production of northern pike. Muskellunge were reared and stocked into Sanford Lake from this time through the 1990s, and more recently the marsh was operated in alternating years with northern pike (Table 2). Not all the pike and muskellunge reared in this marsh were stocked in Sanford Lake. Some were trucked to the more upper Tittabawassee impoundments and many of the northern pike were stocked in the southern part of the management unit.

Walleye management and did not begin in earnest until 1986 (Table 2). Since that time, a total of 475,108 walleye spring fingerlings have been stocked into Sanford Lake. The current stocking rate for walleye is 65,000 triennially based on approximately 50 per acre. Because Sanford Lake is downstream of other impoundments stocked with walleyes, it is undoubtedly a beneficiary of walleye migration downstream.

In recent years there have also been several stockings of a variety of species by private groups under a permit from the DNR including channel catfish, bluegill, walleye, pumpkinseed sunfish, and yellow perch. These are usually permitted because they initiate from clubs or organizations trying to do positive things for the lake. Fisheries staff realizes and explains to these groups that these are unnecessary, but the groups choose to pursue these stockings anyway. At the present time all precautions are being taken to prevent spread of diseases though these stockings.

A complete fish community survey was conducted in 1986. Efforts were spent trap and fyke netting as well as electrofishing. Each gear type is subject to certain biases and these must be considered when reviewing the survey catch. Trap and fyke nets were used to sample fish moving through the littoral zone. Night electrofishing is designed to catch fish moving into the shallows at night, and typically samples both small and large fish. Collectively, the catch from all these gears allows for reasonable interpretation of the fish community. Twenty species of fish were collected by the collective gear types. Black crappie were the most numerous in the survey catch. Walleye, northern pike, muskellunge, and channel catfish were also present. White crappie were captured for the first time. No white bass were recorded, and only one northern muskellunge was captured. All species aged were estimated to be growing above state average. Gamefish of size that anglers desire were present in high percentages. Survey comments indicated that carp were not a problem. Survey comments also suggested that the reservoir was top heavy with predators, perhaps due to low fishing pressure. Thirty

five walleye ranging from 5 to 13 inches were captured during the electrofishing. Young of the year walleye were growing 1.1 inches above state average.

Spring walleye runs were evaluated at Edenville dam on several occasions. Edenville Dam is the next dam upstream on the Tittabawassee. Walleye that run up from Sanford Lake to spawn congregate at this dam and are easily collected for evaluation. Many walleye of a variety of year classes have been captured. In 1987, walleyes were growing 1.5 inches below state average.

The Sanford Impoundment was drawn down (about 6 feet) in 1978 for improvements. At this time 6000 stumps were either removed or flowed out with the ice. The Sanford Lake Improvement Board planned another drawdown in 1987 to address weed control and applied for a permit to remove an additional 50 stumps. The impoundment still has ample habitat in the form of stumps, river channel, and weed beds.

Another fish community survey was conducted in 1994 using the same gear as the 1986 survey. Twenty species of fish were collected. Again, black crappie were the most numerous species caught in the survey. The number of white crappie captured also increased. Fifteen white bass were captured during the 1994 survey. Most fish species were of "acceptable" size, and most species had an increased average length compared to 1986. Fifteen walleyes were captured ranging from 9 to 25 inches. Thirty-six channel catfish were collected ranging from 9 to 30 inches. No muskellunge were collected. The spring electrofishing at Edenville Dam was conducted to assess the spawning run. Over 100 adult walleyes were captured during a few hours. August electrofishing at Verity Shores additionally turned up about 20 small walleye, indicating survival of fingerlings through their first summer. One 27.3 inch northern muskellunge was observed during the shocking. Walleyes were found to be growing 0.7 inches below state average from the early electrofishing; however, the netted walleyes were growing slightly above state average, at +0.6 inches. With the exception of northern pike and smallmouth bass, gamefish were growing above state average.

Spring electrofishing was conducted again in 1995 to monitor the spawning run below Edenville Dam. One-hundred and nine males and only 11 females were captured. Not enough females were taken to calculate a mean growth index. Male walleyes were aged from 3 to 9 years old and were growing 0.25 inches above state average.

Serns (1982) developed standardized methods for estimating the recruitment of walleye at three life stages: fall young-of-the-year (yoy), spring yearling, and fall yearling. Electrofishing transect surveys are conducted in fall when water temperatures range from 40ºF to 70ºF. The number of fall yoy is calculated per acre or mile shocked. This index provides relative year class strength. A Serns index was conducted on October 15, 1997 (Serns, 1982). Fifty-nine young of the year walleye were collected in 1.99 miles of shocking (29.6 fish per mile). This was considered good for an impoundment like Sanford, even though Serns suggests it to be poor for an inland lake. Five year classes of walleye were present in the total catch, and the mean growth index was 1.4 inches above state average.

The last survey prior to the present one was conducted in May 1999. The purpose was to assess the general fish population and to document whether any changes had taken place since the colonization of zebra mussels. Twenty-three species were captured during this survey using trap nets, fyke nets and

electrofishing gear. There was an increase in channel catfish captured from the 1994 survey. Four muskellunge and 27 northern pike were captured. More smallmouth bass were also captured. Only 10 white bass were caught. Black crappie were still very numerous, but only two white crappie were netted, showing a great decline from the over two hundred captured in 1994. Nineteen walleyes were collected. All gamefish species were growing above state average with the exception of walleye. Walleye were growing at state average (-0.1.inches).

Current Status

The most recent survey was conducted in May, 2007 using standard trap nets, standard large mesh fyke nets, experimental gill nets, night-time DC boomshocking, and seining as recommended by the Division's status and trends protocol. Information from spring netting for pike and fall electrofishing was included for this evaluation. Survey locations are identified in figure 1.

The fish community found in 2007 did not differ significantly from any previous survey with the exception of the large increase of northern pike. A total of 2,479 fish weighing 4064 lbs and representing 24 species were enumerated (Tables 3 and 4).

The 640 bluegill captured were the most abundant species collected representing 26% by number in the survey. Over 38% of the bluegill collected were of acceptable size (6 inches or above). Bluegill ranged in length from 2 to 8 inches, and averaged 5.5 inches. Growth rates were 0.3 inches below the state average (Table 5). Five year classes of bluegills were represented in the survey catch, but this excluded the smaller fish less than 3 inches which were not aged or recorded on the age-growth table. No bluegills were aged older than age VI, possibly indicating high fishing mortality of larger bluegill.

Black crappie were also abundant. We captured 265 crappie which represented 10.7 % of the catch by number. These fish ranged from 4 to 15 inches and averaged 8.7 inches. Over 84% of those collected are considered as acceptable size for anglers (7 inches or larger). Nine year classes were present (Table 5). Again, no crappie less than 3 inches were aged or represented in the age-growth tables. Growth rates were 0.4 inches below state average. No white crappie were captured.

One hundred and twenty-three pumpkinseed sunfish were also collected representing 5% of the total catch by number (Table 4). They ranged from 2 to 7 inches and averaged 5.2 inches. Twenty-eight percent of the sunfish collected were of acceptable size for anglers (6 inches or larger).

Only 18 rock bass were captured accounting for 0.7% of the total catch by number (Table 4). They averaged 7.8 inches in length and ranged from 4 to 10 inches. Eighty-nine percent were of acceptable size to anglers (6 inches or larger).

Yellow perch were most abundant species collected using electrofishing. Yellow perch represented 7% of the total catch by number (Table 4). They ranged from 3-8 inches in length and averaged 4.6 inches. Most of these were ages II and III (Table 5). Five age groups were present in the survey catch.

More largemouth bass than smallmouth bass were collected. A total of 30 largemouth bass ranging from 3-17 inches and averaging 11.1 inches were collected (Table 4). Thirty percent were of legal size

or larger (14 inches or larger). There were eight year classes collected, and growth rates were 1.9 inches above state average (Table 5).

A total of 23 smallmouth bass were collected ranging in size from 4-19 inches and averaging 15.4 inches (Table 4). Growth rates were 0.5 inches above state average, and 78% of the catch was over the legal size (14 inches or larger). Six year classes were collected. Recruitment and survival appear to be consistent among year classes (Table 5).

Six hundred and sixty-nine northern pike were captured, mostly during the special early targeted effort which was added on before the May survey to collect brood stock and data. When added to the results of the May survey, pike made up the largest percentage of the total catch by number and weight (27 and 43% respectively, table 4.) Thirty-two percent of the pike were over the legal size limit (24 inches or larger), and growth rates were 0.8 inches below the state average (Table 5). Eight year classes were present.

Twenty-two northern muskellunge were also captured during the survey. Muskie ranged from 29-50 inches and averaged 40.4 inches (Table 4). Muskellunge survival appears to be good. The muskellunge stocking program dates back to 1984 as discussed in the history section. Muskellunge are growing 0.6 below state average (Table 5). Eleven year classes of muskellunge were represented in the survey catch.

Only 34 walleye were collected representing 8 age classes. Walleye ranged from 14 to 26 inches and averaged 22.4 inches (Table 5). Almost 100% of the walleye captured were legal size or larger (15 inches or larger) (Table 4). Fall electrofishing evaluations in the past have indicated limited natural reproduction but in 2007, a non stocked year, no young of the year were captured when fall electrofishing was added as a targeted effort.

As is common with many impoundments, the population of channel catfish appears to be very high. The 189 channel catfish captured represented 7.6 % of the survey catch by number and 18.9% by weight (Table 4). Catfish ranged from 15 to 30 inches and averaged 22.7 inches. These abundant large catfish provide excellent angling opportunity and also provide beneficial predatory control on prolific panfish.

The remaining fish community sampled included black bullhead, brown bullhead, yellow bullhead, white sucker, golden redhorse, silver redhorse, greater redhorse, logperch, bowfin, carp, golden shiners, brook silverside and bluntnose minnow. Brown and yellow bullhead were the most abundant of the bullhead and they were generally large. Forty-eight carp were also captured ranging from 17 to 33 inches. Thirteen large bowfin were caught ranging from 18 to 29 inches. Redhorse species were not numerous, but they were large. Only one white sucker was netted. This appears to be consistent with past surveys.

The fall electrofishing did reveal a large population of brook silverside present in the lake.

Analysis and Discussion

In mid- Michigan warmwater lakes, bluegill are typically one of the most abundant fish species present and play a key role in community structure and overall sportfishing quality (Schneider 1981). Schneider (1990) suggests indices of bluegill characteristics can be used to classify populations. The "Schneider Index" uses size scores of length frequency and growth data and relates them to an objective ranking system ranging from "very poor" to "superior". Using this index, Sanford Lake scored 4.25 for a "good" rank (Table 6). Bluegill size structure was considered excellent in 1994, and acceptable in 1999. The sample sizes in Sanford Lake are somewhat small when compared with the large numbers of bluegill caught in typical southern Michigan lake surveys. We captured a much higher percentage of the bluegill using other gear types such as fyke nets but for comparative purposes in using the Schneider index, only the trap net gear was included.

Typically, bluegill populations with poor size structure are the result of an over abundance of young fish which exhibit poor growth due to competition, an absence of adult fish due to high mortality, and an imbalanced predator-prey ratio. Sanford's bluegill population and size structure declined in 1999 but has rebounded. Changes in their status may be due to changes in water clarity resulting from zebra mussel establishment. The predator base of muskellunge, northern pike, bass, and channel catfish should be able to control the over abundance of young bluegills. With less competition, bluegills are able to exhibit improved growth. Growth has changed from a mean growth index of +1.2 inches above state average to +1.7 inches in 1999 and -0.3 inches in 2007. The ages were determined using spines in 2007 which may provide for better accuracy and certainly a change from the past. Bluegill growth in Sanford Lake is still near state average and is considered acceptable, and some of the differences with past surveys may be due to different aging techniques. Even though the bluegill growth and size structure were somewhat lower in 2007, plenty were caught during the survey and almost 40 % of the total catch (of 640) were of acceptable size to anglers.

Black crappie have also been an important component of the sport fishery in Sanford Lake for many years. They have typically been the second most abundant species collected in assessments. Size structure and average length have remained fairly consistent over the years. Anglers have complained recently about declining catches, but our survey indicates that the fish are present. Reductions in catches are perhaps more attributable to changes in water clarity and aquatic weed growth, and the changes in fish behavior associated with those issues.

Historic surveys found white crappie were captured fairly regularly. None were captured however in 2007 (Tables 3 and 4). This may be because white crappie seem to prefer more turbid waters. The increased water clarity may not favor white crappie any more and they may be extirpated from this system.

White bass also showed a similar trend as white crappies although the relative abundance of white bass was much less than white crappie historically (Table 3). Fifteen were captured in 1994, ten in 1999, and none in 2007. Apparently, recruitment has failed in recent years.

Walleye are an important component of the predator community and a highly desirable sportfish. The capture of 34 walleye in the 2007 assessments demonstrates survival of stocked fingerlings and indicates a fishery can be provided with stocking. As stated in the history section, indices have shown limited natural reproduction and good survival of stocked year classes in previous investigations.

Recent changes in water clarity may also be affecting the catches especially during electrofishing in the fall.

The 2007 survey has allowed for an excellent evaluation of the northern pike population. Sanford was more closely examined in this survey to see if the potential existed to use the lake as a broodstock source for Lower Michigan. Northern pike were also tested for diseases at this time. Pike tested negative for all diseases in 2007 and the population is large enough that an egg take operation could be conducted in the future. This impoundment may not have enough coolwater refuge for larger pike.

Sanford Lake has been stocked with northern muskellunge for a long time (Table 2), and many have reportedly been caught by anglers. Muskellunge fishing has become more popular in the last decade.

Sanford Lake has maintained a good reputation for its largemouth bass and smallmouth bass fisheries. Although not caught in very high numbers in any surveys, Sanford continues being popular for many tournaments. Bass are never represented in high abundance in netting catches; however, both populations are exhibiting good recruitment and have multiple year classes represented in the survey catch.

The predator which may be the most important for controlling the fish community structure is the ever increasing channel catfish population. Like many impoundments, the abundance of channel catfish has increased. Channel catfish prey heavily on small panfish and young fish of all species. Channel catfish also provide a fun large fish for anglers to target as well as providing top down predatory control.

Currently, a good fishery exists for most game species. Large crappie, bluegill, abundant and large rock bass and pumpkinseed sunfish provide a decent panfish fishery. Anglers can also catch a variety of large predators including largemouth bass, smallmouth bass, northern pike, walleye, channel catfish, and even an occasional trophy muskellunge. The fish community is similar to that of the impoundments upstream of Sanford but generally more productive as it receives the added nutrients from above. The species composition is more diverse than similar large impoundments on other rivers such as Mott and Holloway reservoir on the Flint River.

Management Direction

Presently, Sanford Lake is in good condition in terms of its overall fishery. The lake offers very good angling opportunities for several species including bluegill, black crappie, rock bass, sunfish, largemouth bass, smallmouth bass, walleye, northern pike, and northern muskellunge. Additional opportunities are available for channel catfish and non-game species.

Fisheries management of Sanford Lake should continue to focus on warm and coolwater species. Sustainable populations of largemouth bass, northern pike, and channel catfish as top predators will help maintain an improved bluegill size structure. Presently, these species occur in sufficient numbers and appear healthy and no management actions need to be directed toward them at the present time. Continued management for walleye is desirable. Currently, there is negligible natural reproduction of walleye to sustain a fishery and continued stocking is recommended. Management recommendations

are to stock spring fingerling walleye at a rate of roughly 50 spring fingerlings per acre/acre or 65,000 triennially. Likewise, there is insufficient natural reproduction of northern muskellunge to sustain a fishery and continued stocking is recommended. Management recommendations are to stock 4,800 fall fingerlings triennially or at nearly 4 per acre and to supplement with spring fingerling production if available when reared in the management unit. Sanford Lake has received muskellunge regularly but mostly short of the recommended rates. The stocking guidelines suggest a rate of 2-4 (10-inch fingerlings per acre for three years consecutively and then backing off to a biennial schedule (Dexter and O'Neal, 2004).

Efforts should also be made to secure additional access to Sanford Lake as there is currently only one public access on the south end of Sanford Lake located in the Midland County Park. There are additional places to launch for a fee and a few camp grounds and private launches located around the impoundment. Both the County Park and the private launches have limited times where they are open, and may be space limited at times.

References

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Figure 1. Map of Sanford Lake, Midland County with survey locations marked.

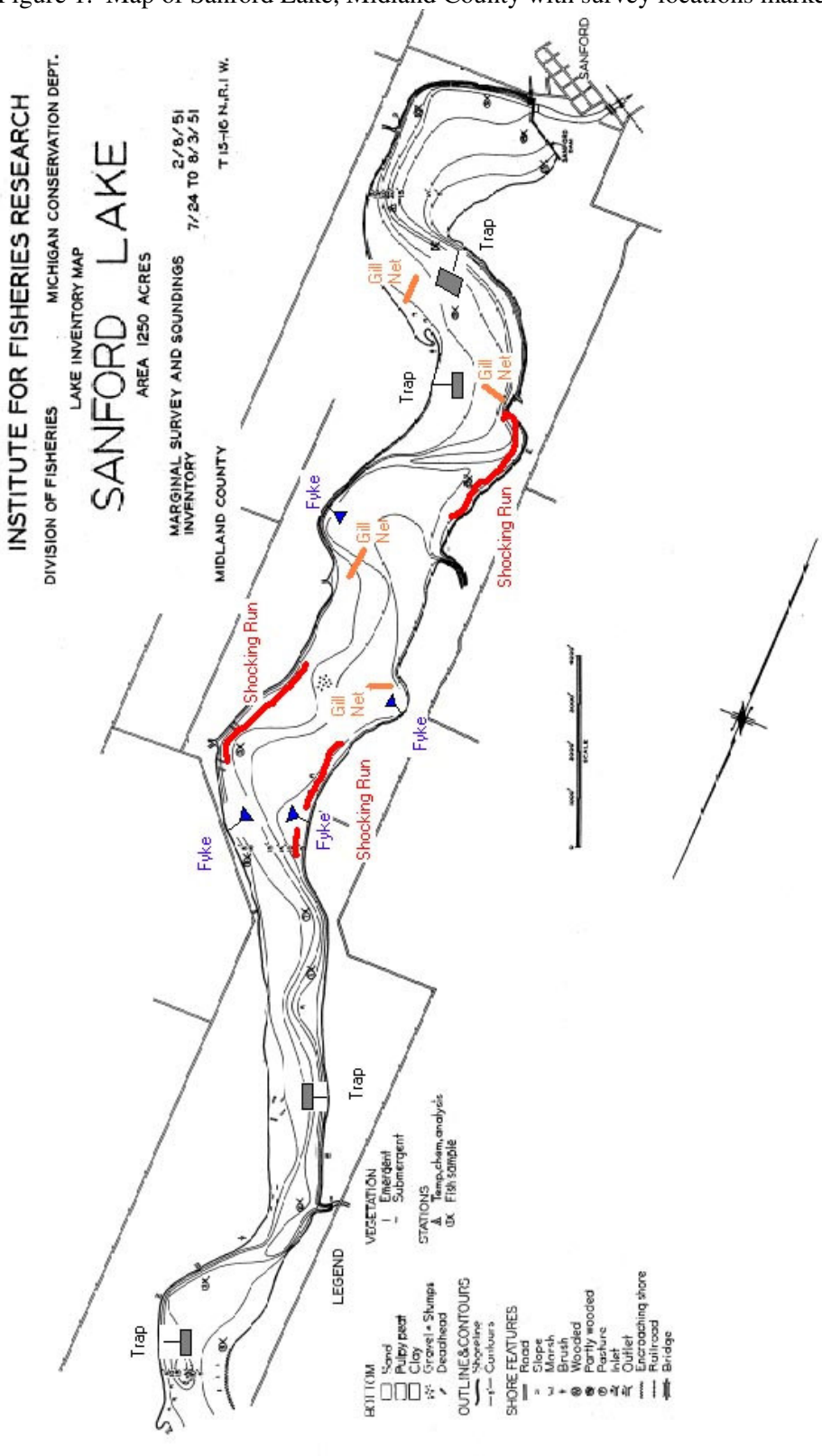

Table 2. Fish stocked into Sanford Lake, Midland County (1980 to present).

Year	Species	Number	Rate (#/acre)	Size (in)
1980	northern pike	800	.64	--
1981	northern pike	1,000	.80	5.12
1982	northern pike	2,000	1.60	5.32
1983	northern pike	5,000	4.0	4.64
1984	muskellunge (no)	459	.37	4.84
1985	muskellunge (no)	1,802	1.44	4.56
1986	walleye	65,600	52	2.56
	muskellunge (no)	385	.31	5.08
1987	muskellunge (no)	120	.10	4.56
1988	bluegill	100	.08	4.56
	channel catfish	400	.32	10.16
	northern pike	532	.43	4.56
	bluegill	550	.44	4.08
1989	muskellunge (no)	579	.46	3.44
	muskellunge (no)	69	.05	8.12
	bluegill	125	.10	4.08
	channel catfish	45	.04	5.08
	bluegill	200	.16	4.08
1990	walleye	64,330	51	1.6
	muskellunge (no)	456	.36	4.64
1991	walleye	2,500	2.0	3.84
1992	muskellunge (no)	726	.58	5.80
1993	muskellunge (no)	60	.05	4.08
	walleye	3,100	2.5	3.72
	muskellunge (no)	1,998	1.6	11.36
1994	walleye	921	.74	1.88
	muskellunge (no)	293	.23	2.84
	walleye	65,479	52	2.08
	channel catfish	250	.20	5.60
	channel catfish	150	.12	6.6
	bluegill	100	..08	2.52
1995	muskellunge (no)	2,371	1.90	2.44
	muskellunge (no)	1,494	1.20	8.32
1996	muskellunge (no)	788	.63	9.44
	bluegill	887	.71	8.12
	yellow perch	93	.07	8.12
1997	walleye	64,376	52	1.8
	walleye	1,589	1.27	1.96
	muskellunge (no)	753	.60	3.04
	muskellunge (no)	2000	1.60	11.12
	bluegill	4,500	3.60	4.0

Table 2. continued

Year	Species	Number	Rate (#/acre)	Size (in)
1998	walleye	2,000	1.60	5.08
2000	walleye	65,014	52	1.48
	muskellunge (no)	6,000	4.8	0.96
	pumpkinseed	15	.01	3.56
	bluegill	245	.20	3.56
	muskellunge (no)	2,500	2.0	11.0
	walleye	1,700	1.36	5.08
2001	muskellunge (no)	35	.03	3.24
2003	walleye	64,840	52	1.60
	muskellunge (no)	1,059	.85	10.8
2004	muskellunge (no)	3,800	3.04	13.08
2006	walleye	32,482	26	1.62
	walleye	33,806	27	1.62
	muskellunge (no)	3,228	2.58	11.66

Table 1.-Temperature, oxygen, and pH profile from deep basin of Sanford Lake, Midland County. Data collected August, 2007 by MDNR, Fisheries Division.

Depth (ft.)	Temperature (ºF)	Oxygen (ppm)	pH
3	71.3	7.6	7.5
4	71.3	7.6	7.5
5	71.3	7.6	7.5
6	71.2	7.6	7.5
7	71.2	7.6	7.5
8	71.2	7.6	7.5
9	71.2	7.5	7.5
10	71.2	7.4	7.5
11	71.2	7.1	7.5
12	71.2	7	7.4
13	71.1	6.9	7.4
14	71.1	6.8	7.4
15	71.1	6.8	7.4
16	71.0	6.8	7.4
17	70.9	6.8	7.4
18	70.9	6.8	7.4
19	70.9	6.8	7.4
20	70.9	6.8	7.4
21	70.9	6.8	7.4
22	70.9	6.6	7.4
23	70.8	6.6	7.4
24	70.8	6.6	7.4
25	70.7	6.6	7.4
26	70.7	6.6	7.4
27	70.7	6.6	7.4
28	70.6	6.7	7.4
29	70.6	6.7	7.4
30	70.6	6.4	7.4

Table 3.–List of fishes (1986 – present) in Sanford Lake, Midland County. Origin: N= native, I= introduced, C= colonized. Status: P= recent observations. U= Not found in 2007. Data from: Michigan Department of Natural Resources, Fisheries Division records.

Common name	Scientific name	Origin	Status
Common carp	*Cyprinus carpio*	C	P
Black bullhead	*Ameiurus melas*	N	P
Black crappie	*Pomoxis nigromaculatus*	N	P
Bluegill	*Lepomis macrochirus*	N	P
Bluntnose minnow	*Pimephales notatus*	N	P
Bowfin	*Amia calva*	N	P
Brook silverside	*Labidesthes sicculus*	N	P
Brown bullhead	*Ameiurus nebulosus*	N	P
Channel catfish	*Ictalurus punctatus*	N, I	P
Common shiner	*Luxilus cornutus*	N	U
Golden redhorse	*Moxostoma erythrurum*	N	P
Golden shiner	*Notemigonus crysoleucas*	N	P
Greater redhorse	*Moxostoma valenciennesi*	N	P
Largemouth bass	*Micropterus salmoides*	N	P
Northern muskellunge	*Esox masquinongy*	N, I	P
Northern logperch	*Percina caprodes*	N	P
Northern pike	*Esox lucius*	N	P
Pumpkinseed	*Lepomis gibbosus*	N	P
Quillback	*Carpiodes cyprinus*	N	U
Rock bass	*Ambloplites rupestris*	N	P
Silver redhorse	*Moxostoma anisurum*	N	P
Smallmouth bass	*Micropterus dolomieu*	N	P
Spottail shiner	*Notropis hudsonius*	N	U
Walleye	*Sander vitreus*	N, I	P
White bass	*Morone chrysops*	N	U
White crappie	*Pomoxis annularis*	N	U
White sucker	*Catostomus commersoni*	N	P
Yellow bullhead	*Ameiurus natalis*	N	P
Yellow perch	*Perca flavescens*	N	P

Table 4.-Number, weight, and length range of fishes collected with trap net, gill net, seine, and electro-fishing gear from Sanford Lake, Midland County in April and May, 2007. Data from Michigan Department of Natural Resources, Fisheries Division records.

Common name	Number	Percent by number	Length range (inches)	Weight (lbs.)	Percent by weight	Percent legal size	Average size (inches)
Black crappie	265	11	4-15	109.4	3	84	8.7
Black bullhead	4	< 1	6-10	1	< 1	100	7.8
Bluegill	640	26	2-8	82.2	2	38	5.5
Bluntnose minnow	23	< 1	1-3	0.2	< 1	100	2.6
Bowfin	13	< 1	18-29	70.8	2	100	24.4
Brook silverside	2	< 1	3-4	0	< 1	100	4
Brown bullhead	89	4	5-12	50.2	1	100	10.5
Channel catfish	189	8	15-30	767.3	19	100	22.7
Common carp	48	2	17-33	422.3	10	100	26.6
Golden redhorse	5	< 1	20-26	26.1	< 1	100	24.7
Golden shiner	5	< 1	4-7	0.3	< 1	100	5.7
Greater redhorse	1	< 1	24	5	< 1	100	24.5
Largemouth bass	30	1	3-17	32	< 1	30	11.1
Logperch	11	< 1	2-3	0.1	< 1	100	3.3
Muskellunge	22	< 1	29-50	446.6	11	32	40.4
Northern pike	669	27	13-38	1767.1	44	32	22.2
Pumpkinseed	123	5	2-7	16.7	< 1	28	5.2
Rock bass	18	< 1	4-10	7.1	< 1	89	7.8
Silver redhorse	4	< 1	23-25	18.7	< 1	100	24.8
Smallmouth bass	23	< 1	4-19	49.8	1	78	15.4
Walleye	34	1	14-26	131	3	97	22.4
White sucker	1	< 1	15	1.5	< 1	100	15.5
Yellow bullhead	87	4	8-13	52	1	100	10.7
Yellow perch	173	7	4-8	6.8	< 1	1	4.6

Table 5.-Weighted mean length (inches) at age, and growth relative to the State average for fish sampled from Sanford Lake with trap nets, gill nets, and electro-fishing gear, April and May, 2007. Number of fish aged is in parentheses. Data from Michigan Department of Natural Resources, Fisheries Division records.

	Age/Length															
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Mean growth index[1]
Black crappie		5.3 (13)	6.7 (6)	8.2 (7)	8.5 (21)	9.7 (13)	11.5 (8)	11.5 (6)	12.2 (4)	14.6 (2)						-0.4
Bluegill		3.8 (13)	4.4 (5)	5.6 (15)	6.5 (18)	8.3 (1)										-0.3
Largemouth bass	3.8 (1)	8.9 (8)	11.3 8)	15.1 (3)	14.0 (2)	17.1 (1)	16.8 (2)	17.5 (2)								+ 1.4
Northern muskellunge				30.0 (2)	30.3 (1)	33.0 (1)	38.6 (6)	37.7 (2)	42.7 (3)	41.6 (1)	43.3 (2)	45.6 (3)	44.6 (2)		50.0 (1)	-0.6
Northern pike		18.3 (46)	19.9 (18)	22.6 (31)	24.8 (21)	26.7 (39)	27.0 (14)	29.8 (3)			38.2 (1)					-0.8
Smallmouth bass		6.1 (2)	11.2 (1)	13.7 (3)	15.2 (5)	16.1 (2)	18.1 (4)	17.6 (5)	19.6 (1)							+0.5
Walleye				15.7 (2)		21.0 (3)	20.3 (5)	23.1 (6)	22.8 (8)	23.2 (6)		24.8 (1)		26.7 (1)		+0.5
Yellow perch		4.3 (23)	5.8 (7)	8.0 (1)	8.6 (1)											-0.8

[1] Mean growth index is the average deviation from the state average length at age.

Table 6.-Sanford Lake bluegill classification using trap net data and the Schneider Index (Schneider 1990). Size score is given in parentheses. Data from Michigan Department of Natural Resources, Fisheries Division records.

Sample date	5/16/94	5/17/99	5/14/07
Sample size	34	57	49
Average length (inches)	7.2 (6)	4.7 (1)	6.4 (4)
% ≥ 6 inches	91 (6)	12 (2)	67 (4)
% ≥ 7 inches	53 (6)	11 (4)	27 (4)
% ≥ 8 inches	32 (6)	5 (5)	2 (5)
Schneider Index	6	3	4.25
Rank[1]	Excellent	Acceptable	Good

[1]Rank: 1 = Very poor, 2 = Poor, 3 = Acceptable, 4 = Good, 5= satisfactory, 6 = Excellent, 7 = Superior