Sanford Lake
Midland County, T15N, R01W
Tittabawassee River Watershed, last surveyed 2015

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Environment

Sanford Lake (Figure1) is located in north central Midland County, within the east central Lower Peninsula of Michigan. The Village of Sanford lies on the extreme southwest shore of the impoundment, near the impoundment's dam outlet. Sanford Lake is a 1250-acre impoundment of the Tittabawassee River. Sanford Impoundment is also 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 the hydroelectric dam at the lower end in the Village of Sanford. Built in1925, the dam has a height of 36 ft., a hydraulic head of 26 ft., a controlled crest length of 1,579 ft., and a spill width of 139 ft. There is no fish ladder on this dam or any of the dams upstream. Fish do pass downstream over the gates to some extent. The outlet to Sanford Lake is at the dam, through the Tittabawassee River, to the Saginaw River and eventually to Saginaw Bay. Sanford dam was licensed under FERC in 1987, but amended to be included for relicensing with the upstream 3 dams in 2028. There is a minimal flow requirement for downstream release of 210 ft3/s, except during the walleye spawning season when there is a 650 ft3/s minimal flow requirement. 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. Soils are primarily sandy loam and predominant land use in the area is mixed farm and woodland. The immediate shoreline is high-banked, sand and clay. 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 lake bottom is pulpy peat in the deeper areas and a mixture of sand, clay, and pulpy peat on the shoals. The water is often dark colored and somewhat turbid, although in recent years zebra mussels have had a general clarifying effect. The majority of the lakeshore of Sanford Lake is developed with homes and cottages. Much of the shoreline has armor.

The water quality of Sanford Lake is good, and studies have been completed for a variety of parameters over time. Limnological parameters were measured in August, 2015 including temperature, oxygen, and pH. The oxygen readings recorded showed little to no oxygen present throughout most of the water column which was suspected as erroneous as fish are clearly alive. The impoundment temperature, oxygen and pH profile showed no thermocline or variation. Sanford lake had a secchi depth of 5.8 feet. Parameters such as total phosphorous, chlorophyll a, and secchi depth can be used to calculate a Carlson's Trophic State Index, which is used for characterizing its productivity and lake type. Sanford Impoundment calculated out as 45.5, which placed it in the "mesotrophic"category. Mesotrophic lakes are typically those that have good water quality and medium biological productivity. Lakes in the mesotrophic range are moderately productive, with some chance of hypolimnetic anoxia in summer, and are fully supportive of all water uses. The pH ranged from 7.4 in the lower water column to 8.2 at the surface. Alkalinity was 170 mg/l indicating a high buffering capacity. Sanford Lake has become much clearer over the past 10 years due to increased filtration from the recently colonized zebra mussels. This increased clarity has resulted in increased

light penetration and macorphyte growth. As a result, there is much interest from property owners to annually treat Sanford Lake with chemicals to control nuisance aquatic plants.

Sanford Lake is a popular recreation lake. The lake receives a good deal 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 fishing in the main impoundment can be dangerous due to the currents and flows. Access to Sanford Lake continues to be limiting for the size of the lake. There is a county park south of US10 on the west side of the lake. This access has limited times and seasons when it is open, coinciding with the park operation. There are also a couple of private marinas 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.

History

Files indicate that the dam creating the impoundment was constructed in 1925, but fishery management records weren't kept until 1951. The only management activity prior to 1951 was sporadic fish stockings. Bluegill, walleyed-pike, smallmouth, and yearling channel catfish were stocked through 1949.

Interest in acquiring public access to Sanford Lake was documented as early as 1961, yet no state public access has been developed through present day. This still remains a high priority
Files indicate that there have been several winter mortalities in Sanford Lake. These occurred in 1961, 1965, and 2000. A larger fish kill also occurred in 1995, but this fish kill was caused by a lake weed treatment.

In 1963, seventy-five thousand one-inch channel catfish fingerlings were stocked which were provided by the U.S. Fish and Wildlife Service (USFWS). Additional catfish were stocked in 1964 through 1966. During this time period, there was also a strong emphasis on the development and operation of pike marshes on many water bodies throughout Michigan. Sanford was no exception to this. A pike marsh was constructed in 1964 and operated from 1964 through 1973, except for 1965 and 1970 due to a dam failure and vandalism. The present water-control dam structure was built in 1971 and impounds approximately 25 to 30 acres. From 1964 to 1983 annual northern pike production varied from 1000 to 40,000 fingerlings. In 1984, rearing of northern muskellunge replaced northern pike production. Muskellunge were reared and stocked into Sanford Lake throughout the 1980s and 1990s, and more recently the marsh was operated with northern pike (Table 1). Repair work was completed on the outlet and drainage in 2007. Not all the pike and muskellunge reared were stocked in Sanford Lake.

For the past several years , only northern pike have been reared. The operation consists of moving adult pike from Sanford Lake by trap and transfer and allowing them to naturally reproduce. Fingerlings are collected in a trap and stocked in priority waters within the management unit. Routine fish health testing is frequently done on adult broodstock .

Walleye management, and more recent walleye stocking, did not begin until 1986 (Table 1). Also, Sanford Lake is downstream from other stocking locations and waters, and is therefore the beneficiary of out-migrating walleye from those waters.

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.

There are periodic repairs needed for the dam and hydro facility which have resulted in drawdowns of the impoundment at various times.

Detailed historic surveys were described chronologically in the last status of the fishery report of Sanford Lake (Schrouder 2007). Surveys were conducted in 1951, 1967, 1986, 1994, 1995, 1997, 1999, and 2007. The latest surveys were conducted in 2015 including a Status and Trends survey, an angler creel survey, and additional pike netting and walleye spawning run evaluation.

The 2007 survey will be used heavily in this updated status of the fishery report to compare with the present conditions as very similar techniques were used. The status of the fishery report will also draw on additional data collected in 2015 to give the most complete status update for Sanford Lake.

Current Status

Sanford Lake was surveyed using a variety of gear types set forth in the Status and Trends protocol. Efforts included seining, boomshocking, trap netting, fyke netting, gill netting, and limnological surveys (Figure 2). The netting and boomshocking surveys were conducted from 6/8/2015 through 6/10/2015, and the limnological survey was conducted on 08/10/2015. Water temperatures ranged from 63-73 degrees Fahrenheit during netting. Each gear type was 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. Gill nets sample fishes that occupy offshore waters and are particularly effective at capturing perch and northern pike. Seine hauls are designed to net fish in the shallows and nursery areas and target young fish and some minnow species. Electrofishing is designed to catch fish moving into the shallows at night, and typically samples both small and large fish. Some electrofishing was done in the daytime due to the turbidity. Collectively, the catch from all these gears allow for reasonable interpretation of the fish community.

An additional Angler Creel Survey was conducted from June 1 to August 31, 2015 on Sanford Lake. The survey followed a roving (instantaneous)-access design. One clerk worked full time to collect angler survey data. Two weekend days and 3 week days were randomly selected each week of the survey season and no holidays were sampled. Months were estimated separately. Counts and interviews were done for both boat and shore anglers. This angler catch and behavior information adds important data to status and trends reports.

Supplemental survey efforts were also conducted prior to the status and trends survey to capture information on northern pike and on the walleye spawning run. Three largemesh fyke nets were set on April 6-7, 2015. Boomshocking was additionally conducted on April 8, 2015 for 9900 seconds to target the walleye potentially spawning in the upper reaches of the Tittabawassee Arm.

Status and Trends

A total of 2037 fish representing 26 species were collected from survey efforts. A comparison of species captured in the past two surveys and the origin of these species is listed in Table 3. Bluegill

were the most abundant species, comprising 35% of the total catch by number and 12% by weight (Table 3). Other fish species collected in appreciable numbers included pumpkinseed sunfish, black crappie, yellow perch, spotfin shiner and bluntnose minnow. In moderate abundance were rock bass, channel catfish, largemouth bass, northern pike, golden shiner, carp, white sucker, walleye, and bullhead. Species captured in very low numbers included banded killifish, bowfin, brook silverside, greater redhorse, green sunfish, logperch, muskellunge, smallmouth bass, stonecat, and white bass.

A total of 711 bluegill averaging 5.3 inches comprised 35% of the total survey catch (Table 3). Bluegill ranged from 1 to 8 inches with 61 % of the fish meeting or exceeding the acceptable harvest size of 6 inches. Age-growth data indicates bluegill are growing slightly above State average (Table 4). Age distribution indicates sufficient recruitment with good representation of bluegill aged 1 through 7.

A total of 209 black crappie averaging 8.3 inches comprised 10.3 % of the total survey catch (Table 3). Black crappie ranged from 4 to 12 inches with 89% of the fish meeting or exceeding the acceptable harvest size of 7 inches. Growth data indicate black crappie in Sanford Impoundment are growing somewhat below State average with a mean growth index of -0.4 (Table 4). Age distributions indicate sufficient recruitment to the fishery with good representation of fish ages 2 to 10.

Two hundred and forty-three pumpkinseed sunfish were captured (Table 3). Sixty-one percent of the captured sunfish were of desirable size for anglers (6 inches or larger). Pumpkinseed sunfish ranged from 2 to 8 inches and averaged 5.9 inches. Pumpkinseed sunfish were age 1 through 5. Pumpkinseed sunfish were growing above State average and had a mean growth index 0.9 (Table 4).

One hundred and eight yellow perch were surveyed representing 5.3% of the survey catch (Table 3). Yellow perch ranged from 2 to 9 inches and averaged 5.7 inches. Eighteen percent of the yellow perch catch exceeded the acceptable harvest size of 7 inches or larger. Five year classes were represented (Table 4). The mean growth index was -0.6 which is below State average.

Thirty-five rock bass averaging 6.6 inches comprised 1.7% of the total survey catch (Table 3). Rock bass ranged from 2 to 9 inches. Sixty-nine percent of the fish met or exceeded the acceptable harvest size of 6 inches. Rock bass are growing above State average with a mean growth index of 0.5 (Table 4). Age distribution indicates sufficient recruitment to the fishery with representation of age groups 1 to 8.

Both largemouth and smallmouth bass were found in relatively low numbers representing only 1% and .4 % of the catch by number, respectively (Table 3). Largemouth bass averaged 14.1 inches and ranged from 8 to 19 inches. Smallmouth bass averaged 11.8 inches and ranged from 8 to 16 inches. Growth for bass indicated a mean growth index of 1.2 and 0.3, respectively. Both species were exhibiting good growth above the State average (Table 4).

Thirty-five northern pike were captured representing 7.7 % of the survey catch (11.8% biomass) (Table 3). Northern pike ranged from 14 to 33 inches and averaged 23.2 inches. Forty percent of the northern pike met or exceeded the minimum harvest size of 24 inches. Northern pike were represented by age classes 1-7 (Table 4). Northern pike are growing below State average with a mean growth index of -1.5.

Early netting
Often times, Status and Trends surveys result in insufficient numbers of some species such as northern pike and walleye being captured. Since brood fish were collected for transfer to the pike marsh, additional data was collected and recorded to supplement the status and trends data. An additional ninety-two northern pike were captured for biodata. These were aged separately. The average length of northern pike captured was 23.2 inches with a range of 17 to 33 inches. Northern pike were represented by 10 year classes (ages 2-11). The mean growth index of the early netted pike was very similar to the value calculated for the Status and Trends survey. It was -1.3, indicating that northern pike are growing below State average. Thirty-seven percent of the captured pike met or exceeded the 24 inch legal length size for northern pike, which also was nearly identical to results from the Status and Trend survey.

Electrofishing for spawning walleye
Electrofishing effort, used to evaluate the walleye spawning run and supplement the data collected, indicated walleye were spawning in the upper sections of the Tittabawassee River and most likely the Tobacco River arm. The water levels were low and the shocking boat was unable to access the dam tailrace. However, an additional 49 walleye were captured, providing a sample size large enough for age-growth analysis. Walleye ranged from 6 to 26 inches and averaged 19.3 inches. They were represented by 14 year classes (age 1 to 14). Walleye are exhibiting excellent growth, well above State average. The calculated mean growth index is 1.6. Ages indicate represented year classes from both stocked and unstocked years.

Angler Creel Survey (June, July and August)
Results indicate that anglers target and catch more bluegill and black crappie than any other species which is consistent with the abundance of these species. Angler catch estimates were highest for black crappie. Boat and shore anglers harvested an estimated 19, 821 black crappie and 10,393 bluegill from Sanford Lake from May - August. These species also had the highest catch rates. Other species harvested included pumpkinseed sunfish, rock bass, northern pike, largemouth bass, smallmouth bass, walleye, and channel catfish (Table 6). Table 6 also provides an estimate of the species that were released, showing very similar trends. Anglers (combined boat and shore fishing) made an estimated 6,261 trips and fished for 21,814 angler hours during the months of June-August. The majority of the angling on Sanford Lake is done by boat anglers.

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 adjective ranking system ranging from "very poor" to "superior". Using the Schneider Index for classifying bluegill populations, Sanford Lake (2015) scored 4.25 for a ranking between satisfactory and good. (Table 7). This is almost identical to the index calculated in 2007. Bluegill size structure was considered excellent in 1994, and acceptable in 1999. The sample sizes previously for Sanford Lake were small but we sampled a larger number in 2015.

Typically, bluegill populations with poor size structure are the result of an overabundance 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. The size structure of Sanford Lake's bluegill population declined in 1999 but rebounded in 2007 and remains similar to 2007 presently. The initial changes in Sanford Lake may be due to changes in water clarity resulting from zebra mussel establishment. Since 2007 the water clarity has been consistent. The predator base of muskellunge, northern pike, bass, bass, walleye, and channel catfish should be able to control the over-abundance of young bluegills. With less competition, bluegills are able to exhibit improved growth. Mean growth indices have changed from 1.2 in 1994 to 1.7 in 1999, -0.3 inches in 2007, and to 0.1 in 2015. 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 aging techniques. Angler pressure probably removes a good portion of the older parental fish. Even though the bluegill growth and size structure were somewhat lower from 2007, plenty were caught during the survey and 61 % of the total catch (of 711) were of acceptable size (=6 inches) to anglers.

Black crappie have also been an important component of the sport fishery in Sanford Lake for many years. The 2015 Creel Survey showed they were the most sought after species and the species harvested the most, at least as sampled from June through August. There is also a moderate sport fishery through the ice in the winter and in the early spring when the crappie congregate in the shallows to spawn. They have typically been the second most abundant species collected in assessments. Two-hundred nine crappie were collected in 2015. Black crappie tend to suspend in summer and the late timing of this survey may have underestimated their abundance. Size structure and average length have remained fairly consistent over the years and generally indicate an acceptable fishery for large fish. Eighty-nine percent were of desirable size (=7 inches) to anglers, and anglers clearly come to Sanford Lake for them. Many reach 10 to 12 inches.

In early surveys, white crappie were regularly caught. None were captured in 2007 or 2015 (Table 2) and (Table 8). This may be because white crappie prefer more turbid waters. The increased water clarity may not favor white crappie. Two-hundred seven white crappie were captured in 1994. Only two were captured in 1999, a time of post zebra mussel colonization and increasing water clarity. No white crappie have been recorded since then.

White bass showed a similar trend as white crappies although the relative abundance of white bass was much less than white crappie (Table 2) and (Table 8). Fifteen were captured in 1994, ten in 1999, and none in 2007. Six young white bass were captured in 2015.

Walleye are an important component of the predator community and highly desirable sportfish. The capture of 17 walleye in 2015 was down from the 2007 assessment (Table 8), but additional shocking collection indicated that there is a fairly strong population that runs up the river to spawn. Forty-nine additional walleye were shocked. This allowed for age-growth analysis. There were 15 year classes of walleyes represented in the early shocking during the spawning run. Walleyes were growing well above State average. A mean growth index of 1.6 indicates great condition for walleye. Walleye age distribution is excellent.

Ninety-two additional northern pike were captured in early netting to better evaluate the population. Lake many northern pike populations, they are slow growing. Adequate numbers do reach legal size and are providing angler enjoyment. There are several tournaments specifically for pike held on Sanford Lake.

Sanford Lake has been stocked with northern muskellunge for a long time and more recently with Great Lakes muskellunge (Table 1), and many have reportedly been caught by anglers. The Creel Survey did not record any muskellunge and the netting survey only documented one. Muskellunge fishing has become more popular in the last decade. It takes many hours to record muskellunge catches and many or most are released. There is no evidence of an improved muskellunge population or fishery since changing to Great Lakes strain but with overall sample numbers being so low, it is difficult to draw any conclusions. Volunteer postcards have been placed at the lake as well. Very few responses have been returned statewide from a variety of locations to draw solid conclusions. The overall catch rates for all muskellunge is low, most angling is by casting followed by trolling, and almost all the muskellunge caught are released.

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 not usually represented in high abundance in netting catches. Both largemouth bass and smallmouth bass are growing above state average, and a large percentage of them (48% of largemouth and 13% of smallmouth) are larger than legal size (= 14 inches). Both populations are exhibiting good recruitment and have multiple year classes represented in the survey catch.

The final predator which may be the most important component in controlling the fish community structure is the ever increasing channel catfish population. Like most impoundments, the abundance of channel catfish has increased. The 2015 survey recorded 34 channel catfish ranging from 5 to 36 inches. This is down from 2007 but the later timing of the survey may have influenced the catch. These channel catfish prey heavily on small panfish and young fish of all species. Channel catfish made up 15.2% of the survey catch biomass. 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. Overall fish species composition and relative abundance has not changed substantially since 2007 (Table 8). 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.

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 and improve the size structure of bluegill and other panfish. Presently, these top predators and panfish occur in sufficient numbers, appear healthy, and no additional management actions beyond current harvest regulations need to be implemented at the present time. Continued management for walleye is desirable. Currently, there is limited natural reproduction or representation from non-stocked years of walleye but not adequate to sustain a fishery. Therefore, continued stocking is recommended. Management recommendations are to stock spring fingerling walleye at a rate of roughly 50/acre or 65,000 biennially.

There also have been recent changes in the muskellunge rearing program, and currently only the Great Lakes strain is being reared. The Great Lakes strain fall fingerlings are somewhat smaller than the Northern strain, as the egg-take occurs a bit later in the spring. The Great Lakes strain is thought to be a better match for our systems in Michigan. Recommended stocking rates for muskellunge is 1.5 fall fingerlings per acre in most waters, and 2 fall fingerlings per acre in open systems where food is more plentiful. The new stocking prescription for Sanford Lake recommends stocking 2500 fall fingerlings biennially if available (2 fish/acre). Other strains would also be accepted if available. Follow up evaluation of this stocking effort is planned, but is often difficult due to low numbers surveyed or harvested.

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. But this one is subject to county park rules and fees. There are additional places to launch for a fee including campgrounds and private launches located around the impoundment. Both the County Park and the private launches have limited times when they are open.

References

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Figure 1. Location of Sanford Lake, Midland County.

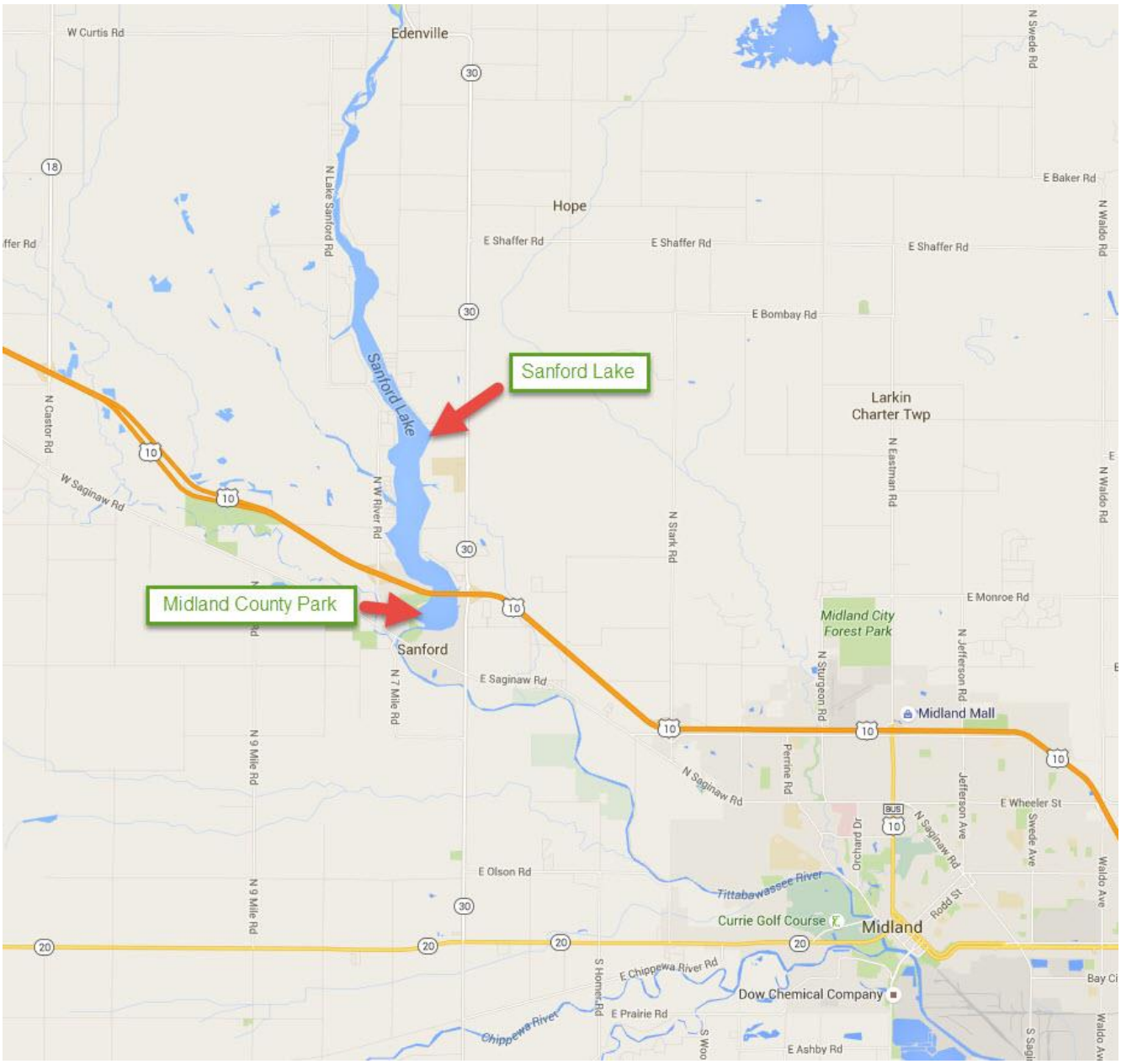

Figure 2. North Sanford Lake, with sampling locations.

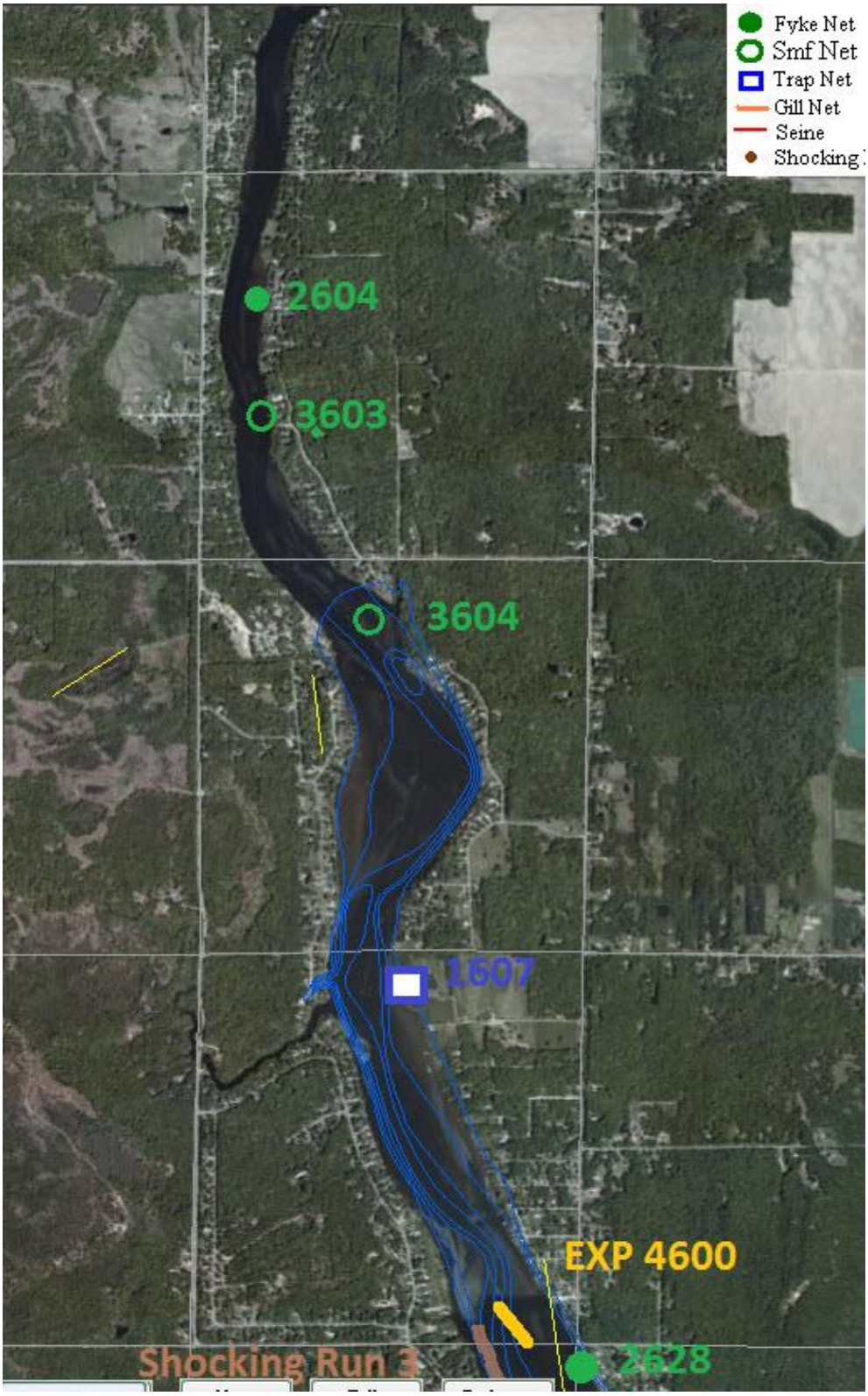

Figure 3. South Sanford Lake, with sampling locations.

Table 1. Fish stocked into Sanford Lake, Midland County (1980- 2015).

Year Stocked	Species	Strain	Number	Avg. Length (in.)
1980	Northern pike		800	----
1981	Northern pike		1000	5.04
1982	Northern pike		2000	5.24
1983	Northern pike		5000	4.57
1984	Muskellunge	Northern	459	4.76
1985	Muskellunge	Northern	1802	4.49
1986	Walleye		65600	2.52
	Muskellunge	Northern	385	5
1987	Muskellunge	Northern	120	4.49
1988	Channel catfish		400	10
	Bluegill		100	4.49
	Northern pike		532	4.49
	Bluegill		550	4.02
1989	Muskellunge	Northern	579	3.39
	Muskellunge	Northern	69	7.99
	Bluegill		125	4.02
	Channel catfish		45	5
	Bluegill		200	4.02
1990	Walleye	Muskegon	64330	1.57
	Muskellunge	Northern	456	4.57
1991	Walleye		2500	3.78
1992	Muskellunge	Northern	726	5.71
1993	Muskellunge	Northern	60	4.02
	Walleye		3100	3.66
	Muskellunge	Northern	1998	11.18
1994	Walleye	Muskegon	921	1.85
	Muskellunge	Northern	293	2.8
	Walleye	Muskegon	65479	20.47
	Channel catfish		250	5.51
	Channel catfish		150	6.5
	Bluegill		100	2.48
1995	Muskellunge	Northern	2371	2.4
	Muskellunge	Northern	1494	8.19
1996	Muskellunge	Northern	788	9.29
	Bluegill		887	7.99
	Yellow Perch		93	7.99
1997	Walleye	Tittabawassee	64376	1.77
	Walleye	Tittabawassee	1589	1.93
	Muskellunge	Northern	753	2.99
	Muskellunge	Northern	2000	10.94
	Bluegill		4500	3.94

1998	Walleye		2000	5
2000	Walleye	Tittabawassee	65014	1.46
	Muskellunge	Northern	6000	0.94
	Bluegill		245	3.5
	Pumpkinseed		15	3.5
	Muskellunge	Northern	2500	10.83
	Walleye		1700	5
2001	Muskellunge	Northern	35	3.19
2003	Walleye	Tittabawassee	64840	1.57
	Muskellunge	Northern	1059	10.67
2004	Muskellunge	Northern	3800	12.87
2006	Walleye	Tittabawassee	32482	1.6
	Walleye	Tittabawassee	33806	1.6
2007	Muskellunge	Iowa	3228	11.48
2010	Muskellunge	Northern	4800	9.59
2011	Walleye	Muskegon	63600	1.8
	Walleye	Muskegon	44137	2.01
2013	Walleye	Muskegon	43052	1.39
	Walleye	Muskegon	106252	1.49
	Muskellunge	Great Lakes	1875	7.87
2015	Walleye	Muskegon	24969	1.61
	Walleye	Muskegon	70103	1.85
	Muskellunge	Great Lakes	1875	9.17

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. Data from: Michigan Department of Natural Resources, Fisheries Division records.

Common name	Scientific name	Origin	Status (07)	Status (15)
Common carp	*Cyprinus carpio*	C	P	P
Banded killifish	*Fundulus*	I	U	P
Black bullhead	*Ameiurus melas*	N	P	U
Black crappie	*Pomoxis nigromaculatus*	N	P	P
Bluegill	*Lepomis macrochirus*	N	P	P
Bluntnose minnow	*Pimephales notatus*	N	P	P
Bowfin	*Amia calva*	N	P	P
Brook silverside	*Labidesthes sicculus*	N	P	P
Brown bullhead	*Ameiurus nebulosus*	N	P	P
Channel catfish	*Ictalurus punctatus*	N, I	P	P
Common shiner	*Luxilus cornutus*	N	U	U
Golden redhorse	*Moxostoma erythrurum*	N	P	U
Golden shiner	*Notemigonus crysoleucas*	N	P	P
Greater redhorse	*Moxostoma valenciennesi*	N	P	P
Green Sunfish	*Lepomis cyanellus*	N	U	P
Largemouth bass	*Micropterus salmoides*	N	P	P
Great Lakes muskellunge	*Esox masquinongy*	I	U	P
Northern muskellunge	*Esox masquinongy*	N, I	P	U
Northern logperch	*Percina caprodes*	N	P	P
Northern pike	*Esox lucius*	N	P	P
Pumpkinseed	*Lepomis gibbosus*	N	P	P
Quillback	*Carpiodes cyprinus*	N	U	U
Rock bass	*Ambloplites rupestris*	N	P	P
Silver redhorse	*Moxostoma anisurum*	N	P	U
Smallmouth bass	*Micropterus dolomieu*	N	P	P
Spotfin shiner	*Cyprinella spiloptera*	N	U	P
Spottail shiner	*Notropis hudsonius*	N	U	U
Stonecat	*Noturus flavus*	N	U	P
Walleye	*Sander vitreus*	N, I	P	P
White bass	*Morone chrysops*	N	U	P
White crappie	*Pomoxis annularis*	N	U	U
White sucker	*Catostomus commersoni*	N	P	P
Yellow bullhead	*Ameiurus natalis*	N	P	P
Yellow perch	*Perca flavescens*	N	P	P

Table 3. Total catch (all gear) from Sanford Lake, June 2015.

Species	Number	Percent by number	Weight (lb.)	Percent by weight	Length range (in.)*	Average length (in.)	Percent legal size**
Black crappie	209	10.3	66.1	7.4	4-12	8.3	89
Banded killifish	1	0.0	0.0	0.0	2-2	2.5	100
Bluegill	711	34.9	106.3	11.9	1-8	5.3	61
Bluntnose minnow	276	13.5	2.4	0.3	1-3	2.6	100
Bowfin	3	0.1	13.8	1.5	22-24	23.5	100
Brown bullhead	14	0.7	9.5	1.1	5-13	10.3	86
Brook silverside	9	0.4	0.0	0.0	3-3	3.5	100
Common carp	20	1.0	176.6	19.8	5-36	24.5	100
Channel catfish	34	1.7	135.5	15.2	7-32	20.8	94
White sucker	14	0.7	21.4	2.4	12-18	15.9	100
Golden shiner	24	1.2	3.3	0.4	3-8	7.1	100
Greater redhorse	6	0.3	18.2	2.0	12-25	18.7	100
Green sunfish	5	0.2	0.5	0.1	4-5	5.0	0
Largemouth bass	21	1.0	34.8	3.9	8-19	14.1	48
Logperch	1	0.0	0.0	0.0	3-3	3.5	100
Muskellunge Great Lakes	1	0.0	2.2	0.2	21-21	21.5	0
Northern pike	35	1.7	105.2	11.8	14-33	23.2	40
Pumpkinseed	243	11.9	49.6	5.6	2-8	5.9	61
Rock bass	35	1.7	8.7	1.0	2-9	6.6	69
Spotfin shiner	104	5.1	1.2	0.1	1-4	3.1	100
Smallmouth bass	8	0.4	8.3	0.9	8-16	11.8	13
Stonecat	3	0.1	0.0	0.0	2-3	3.2	100
Walleye	17	0.8	42.9	4.8	6-29	18.3	65
White bass	6	0.3	0.9	0.1	5-10	7.5	17
Yellow Perch	108	5.3	11.6	1.3	2-9	5.7	18
Yellow bullhead	129	6.3	74.1	8.3	3-14	9.8	96
All species totals:	2,037	100	892.8	100			

Table 4. Age and growth of various fish species in Sanford Lake, June 2015.

Species / Age	No. aged	Length range (in.)	State avg. length (in.)	Weighted mean len. (in.)	Weighted age freq.	Mean growth index*
Black crappie	-2	5				-0.4
Age II:	21	4.70-6.90	6.5	5.51	42.41%	
Age III:	19	6.70-8.20	7.9	7.76	25.38%	
Age IV:	14	7.50-9.50	8.9	8.52	11.60%	
Age V:	8	9.00-10.50	9.7	9.75	6.22%	
Age VI:	9	9.20-12.10	10.4	9.85	8.23%	
Age VII:	3	10.20-11.90	11.1	11.74	4.51%	
Age VIII:	2	10.20-12.90	11.6	12.3	1.35%	
Age X:	1	10.80-10.80		10.8	0.30%	
Bluegill						0.1
Age I:	32	1.70-2.50	2.4	2.07	46.66%	
Age II:	8	3.20-4.30	4.2	3.63	9.28%	
Age III:	30	4.30-7.70	5.3	5.61	30.19%	
Age IV:	16	5.60-7.50	6.2	6.9	9.25%	
Age V:	5	7.20-7.80	6.9	7.5	3.04%	
Age VI:	1	7.80-7.80	7.4	7.8	0.12%	
Age VII:	1	8.20-8.20	8	8.2	1.46%	
Largemouth bass						1.2
Age III:	8	10.50-14.00	10.6	11.79	25.15%	
Age IV:	13	8.20-15.00	12	13.49	29.78%	
Age V:	10	13.60-16.00	13.7	14.94	18.80%	
Age VI:	5	15.10-18.00	15	17.06	4.95%	
Age VII:	6	16.00-18.00	16.7	17.11	9.37%	
Age VIII:	5	17.00-19.00	17.6	18.44	11.56%	
Age IX:	1	17.40-17.40	18.6	17.4	0.40%	
Muskellunge						--
Age I:	1	21.30-21.30	15.7	21.3	100.00%	
Northern pike						-1.5
Age I:	3	14.10-17.40	14.5	15.8	13.51%	
Age II:	1	20.50-20.50	19	20.5	1.13%	
Age III:	5	18.50-24.50	21.8	19.9	13.51%	
Age IV:	8	19.50-27.90	24.2	22.43	15.17%	
Age V:	14	20.70-30.30	26.1	25.02	37.39%	
Age VI:	5	22.20-28.80	27.8	26.74	13.66%	
Age VII:	1	26.10-26.10	30	26.1	1.13%	
Age VIII:	1	33.40-33.40		33.4	4.50%	
Pumpkinseed						0.9
Age I:	1	2.20-2.20	2.4	2.2	1.93%	
Age II:	17	3.40-4.70	4.2	4.06	32.74%	
Age III:	34	5.00-7.20	5.2	6.22	57.48%	
Age IV:	8	5.90-8.00	5.8	7.64	7.70%	
Age V:	1	7.50-7.50	6.3	7.5	0.15%	

Rock bass						0.5
Age I:	1	2.40-2.40	3	2.4	5.18%	
Age II:	5	4.20-6.90	4.3	4.52	21.35%	
Age III:	9	5.00-6.90	5.4	6.15	32.74%	
Age IV:	7	6.20-8.40	6.4	7.68	13.37%	
Age V:	7	5.50-7.90	7.2	7.33	16.57%	
Age VI:	5	7.10-9.70	8.1	8.44	8.20%	
Age VIII:	1	9.70-9.70	9.4	9.7	2.59%	
Smallmouth bass						0.3
Age III:	4	8.70-14.00	11.1	11.25	14.42%	
Age IV:	10	10.60-16.00	13	13.26	45.73%	
Age V:	3	16.20-18.00	14.7	16.91	9.96%	
Age VI:	4	18.00-19.00	15.5	18.31	18.50%	
Age VIII:	2	20.00-21.00	17.4	20.33	8.54%	
Age IX:	1	21.00-21.00	18.3	21	2.85%	
Walleye						--
Age I:	2	6.50-6.60	8.2	6.55	13.33%	
Age II:	4	12.50-14.00	11.4	13	23.33%	
Age III:	3	14.40-17.90	14.4	17.2	16.67%	
Age IV:	3	18.40-20.10	16.2	19.27	20.00%	
Age VII:	1	22.20-22.20	20.8	22.2	6.67%	
Age IX:	1	21.50-21.50	22.6	21.5	3.33%	
Age X:	2	21.10-29.00	23.1	26.37	10.00%	
Age XI:	1	27.00-27.00		27	6.67%	
Yellow Perch						-0.6
Age I:	15	2.90-3.90	4	3.53	41.43%	
Age II:	5	4.30-6.00	5.7	5.36	11.21%	
Age III:	18	6.20-7.70	6.8	6.54	35.24%	
Age IV:	6	6.90-7.30	7.8	7.09	4.05%	
Age V:	6	7.00-8.10	8.7	7.64	8.07%	

Table 6.–Estimated harvest, catch per hour, and fishing pressure for the Sanford Lake combined fishery. Two standard errors are given below the estimates.

Species	C/H	June	July	August	Season
HARVEST					
Walleye	0.0033	53	19	–	72
	0.0041	79	39	–	88
Northern Pike	0.0054	30	26	61	117
	0.0056	60	51	91	120
Largemouth Bass	0.0016	–	36	–	36
	0.0025	–	54	–	54
Smallmouth Bass	0.0014	30	–	–	30
	0.0028	60	–	–	60
Yellow Perch	0.0014	–	–	31	31
	0.0028	–	–	62	62
Bluegill	0.4764	5,918	1,459	3,016	10,393
	0.2932	4,977	1,374	3,267	6,110
Pumpkinseed	0.0422	520	199	200	920
	0.0396	732	264	338	848
Rock Bass	0.0139	60	65	177	302
	0.0168	84	80	344	363
Black Crappie	0.9086	6,904	9,838	3,078	19,821
	0.3736	5,238	4,120	3,008	7,312
Channel Catfish	0.0014	–	16	15	31
	0.0021	–	32	31	45
TOTAL HARVEST	1.4556	13,517	11,658	6,579	31,753
	0.5125	7,264	4,353	4,469	9,575
RELEASED					
Walleye	0.0056	57	66	–	123
	0.0047	80	61	–	100
Northern pike	0.0784	1,008	565	136	1,709
	0.0442	815	368	179	912
Largemouth bass	0.2109	1,951	1,223	1,426	4,600
	0.1004	1,189	566	1,537	2,024
Smallmouth bass	0.0872	883	526	492	1,901
	0.0408	639	292	424	821
Yellow Perch	0.0170	43	–	327	370
	0.0257	62	–	554	557
Bluegill	0.4050	6,332	1,083	1,420	8,835
	0.2814	5,739	901	1,163	5,925
Pumpkinseed	0.0308	202	133	336	671
	0.0278	286	125	506	594
Rock bass	0.0541	880	53	247	1,180
	0.0401	754	54	385	849
Black crappie	0.4337	4,396	4,730	335	9,461
	0.2011	3,085	2,564	447	4,036
TOTAL RELEASED	1.3225	15,751	8,380	4,719	28,850
	0.4248	6,753	2,819	2,200	7,641
TOTAL CATCH	2.7782	29,268	20,038	11,298	60,604
	0.7551	9,918	5,186	4,981	12,250
ANGLER HOURS		9,630	6,363	5,822	21,814
		2,520	1,211	2,809	3,963
ANGLER TRIPS		3,063	1,785	1,413	6,261
		868	421	677	1,178

Table 7. Sanford Lake bluegill classification using trap and standard fyke net data and the Schneider Index (Schneider 1990). Size score is given in parenthesis.

Sample Date	5/16/94	5/17/99	5/14/07	6/8/15
Sample size	34	57	49	511
Average Length (in)	7.2	4.7	6.4	6.4
	(6)	(1)	(4)	(4)
Percent > or = 6 in.	91	12	67	77
	(6)	(2)	(4)	(4)
Percent > or = 7 in.	53	11	27	15
	(6)	(4)	(4)	(4)
Percent > or =8in.	32	5	2	.1
	(6)	(5)	(5)	(4)
Schneider Index	6	3	4.25	4.25
Rank *	Excellent	Acceptable	Satisfactory-good	Satisfactory-good

*Rank: 1 = Very poor, 2 = Poor, 3 = Acceptable, 4 = Satisfactory, 5 = Good, 6 = Excellent, 7 = Superior

Table 8. Comparisons of the 2007 and 2015 surveys of Sanford Lake, Midland County.

Species	Number		Percent by number		Weight (lb.)		Percent by weight		Average Length (in)		Percent legal size	
	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015	2007	2015
Banded killifish	-	1	-	<1	-	0	-	<1	-	2.5	-	100
Black crappie	265	209	10.7	10.3	109.4	66.1	2.7	7.4	8.8	8.3	84	89
Black bullhead	4	-	<1	-	1	-	<1	-	7.5	-	50	-
Bluegill	640	711	25.8	34.9	82.2	106.3	2	11.9	5.6	5.3	38	61
Bluntnose minnow	23	276	<1	13.5	0.2	2.4	<1	<1	2.6	2.6	100	100
Bowfin	13	3	<1	<1	70.8	13.8	1.7	1.5	25.4	23.5	100	100
Brown bullhead	89	14	3.6	<1	50.2	9.5	1.2	1.1	10.8	10.3	99	86
Brook silverside	2	9	<1	<1	0	0	<1	<1	4.0	3.5	100	100
Common carp	48	20	1.9	1	422.3	176.6	10.4	19.8	27.4	24.5	100	100
Channel catfish	189	34	7.6	<1	767.3	135.5	18.9	15.2	22.6	20.8	100	94
Golden redhorse	5	-	<1	-	26.1	-	<1	-	24.5	-	100	-
Golden shiner	5	24	<1	1.2	0.3	3.3	<1	<1	5.8	7.1	100	100
Greater redhorse	1	6	<1	<1	5	18.2	<1	2	24.5	18.7	100	100
Green sunfish	-	5	-	<1	-	0.5	-	<1	-	5	-	0
Largemouth bass	30	21	1.2	1	32	34.8	<1	3.9	11.7	14.1	30	48
Logperch	11	1	<1	<1	0.1	0	<1	<1	3.3	3.5	100	100
Muskellunge (GL)	-	1	-	<1	-	2.2		<1	-	21.5	-	0
Muskellunge (No)	22	-	<1	-	446.6	-	11	-	40.7	-	32	-
Northern pike	669	35	27	1.7	1,767.10	105.2	43.5	11.8	23	23.2	32	40
Pumpkinseed	123	243	5	11.9	16.7	49.6	<1	5.6	5.6	5.9	28	61
Rock bass	18	35	<1	1.7	7.1	8.7	<1	1	7.4	6.6	89	69
Silver redhorse	4	-	<1	-	18.7	-	<1	-	24.5	-	100	-
Smallmouth bass	23	8	<1	<1	49.8	8.3	1.2	<1	15.3	11.8	78	13
Spotfin shiner	-	104	-	5.1	-	1.2	-	<1	-	3.1	-	100
Stonecat	-	3	-	<1	-	0	-	<1	-	3.2	-	100
Walleye	34	17	1.4	<1	131	42.9	3.2	4.8	22.8	18.3	97	65
White Bass	-	6	-	<1	-	0.9	-	<1	-	7.5	-	17
White Sucker	1	14	<1	<1	1.5	21.4	<1	2.4	15.5	15.9	100	100
Yellow Perch	173	108	7	5.3	6.8	11.6	<1	1.3	5.1	5.7	1	18
Yellow bullhead	87	129	3.5	6.3	52	74.1	1.3	8.3	10.8	9.8	100	96
All species totals:	2,479	2,037	100	100	4,064.20	893.1	100	100				