Rainbow Lake

Grand River Watershed; Last Surveyed in 2023

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Environment

Rainbow Lake is a 155-acre natural lake located in northwestern Montcalm County in Michigan's Lower Peninsula (Figure 1). The lake is approximately 2.5 miles northeast of the village of Trufant. Rainbow Lake has just over 3 miles of shoreline which is predominantly developed by residential houses. The lakeshed (area that drains to the lake) around Rainbow Lake is dominated by agricultural lands (primarily cultivated crops) at 54%, followed by water at 26%, and small amounts of urban, wetland, and forested areas (Figure 2).

Rainbow Lake is a shallow water body with a maximum depth of 23 feet. The lake has one inlet - an unnamed tributary on the south end of the lake which connects Middle Lake and Rainbow Lake. Much of Rainbow Lake is less than 7 feet deep including the entire north basin, and approximately 80% of the lake is less than 10 feet in depth. The southern basin has shallow drop offs with only one small pocket of water over 20 feet deep. Organic substrate covers most of the lake bottom, with some pockets of sand in the littoral zones of the southern basin. Historically, the lake has had extensive emergent and submergent aquatic vegetation beds.

There is one public boat launch, a Michigan Department of Natural Resources (DNR) boating access site, located on the northern shore of Rainbow Lake. The boating access site has a gravel boat ramp, a pit toilet, and parking for five vehicles with trailers. The boating access site is challenging to navigate due to the location on a curve, limited parking options, and shallow water depths for launching.

History

Early fisheries management of Rainbow Lake involved stocking of Bluegill, Largemouth Bass, and Yellow Perch from 1933 through 1945 (Table 1). Throughout the state, stocking programs for these species were discontinued after 1945 when research indicated that natural recruitment was sufficient to maintain populations and supplemental stocking was unnecessary (Cooper 1948). The first fisheries survey that was conducted on Rainbow Lake was an angler creel census which occurred in 1954. Fourteen anglers were interviewed. These anglers spent 47 hours fishing and caught 128 fish including Bluegill, Pumpkinseed, Crappie (most likely Black Crappie), and Yellow Perch. The first netting survey that occurred on Rainbow Lake was September 18, 1957, with a large seine. The fish community was dominated by Bluegill, Pumpkinseed, and Black Crappie. Bluegill was the most abundant fish species caught, however all but six of the Bluegill were less than 6 inches in length. Other game fish species collected included: Yellow Perch, Largemouth Bass, Northern Pike, Green Sunfish, and Warmouth. The 1957 effort was the first survey to document presence of fish species in the lake (Table 2). Survey notes indicate that the vegetation was "highly developed" especially in the shallow north end of the lake. Another survey was conducted in 1958. Fish species collected were similar to 1957 (Table 2) and over 8,500 fish were transferred out of Rainbow Lake to Alma Pond. Most of these fish were either Bluegill or Black Crappie, but 614 Pumpkinseed also were transferred.

In September 1959, Rainbow Lake was treated with 320 gallons of rotenone to kill off the existing fish community. The fish community at the time was comprised of "carp and stunted panfish" and the goal of the rotenone treatment was to completely eradicate the fish population so it could be restocked with the proper warmwater fish species. The treatment was considered successful as 15,000 pounds of Common Carp were removed from the lake along with 5,000 pounds of stunted panfish. Prior to the treatment, Rainbow Lake was seined to salvage fish to restock in the lake as broodstock. Twenty-six Bluegill (average length 5 inches) and 39 Largemouth Bass (average length 12 inches) were restocked into the lake on October 15, 1959. In addition to these fish, 72,000 fingerling and 563 sub-legal Largemouth Bass, 12,000 fingerling Bluegill, 2,000 legal Rainbow Trout, and 136 Northern Pike (average length = 20 inches) were stocked into the lake between November 1959 and November 1960.

In October 1961, another seine survey was completed on Rainbow Lake. Small Bluegill once again were the highest captured fish with only four individuals over 6 inches in length. Whereas 13 fish species were collected each year during the 1957-1958 surveys, only six species were captured in 1961 (Table 2). Survey notes indicate that Rainbow Trout fishing was good during the winter of 1960-1961 but warmwater fish species seemed to be low in number and size. Additionally, Largemouth Bass broodstock and fingerlings appeared to have low survival rates. Limited growth data suggested that all species were growing similar to or slightly faster than statewide averages. The survey report recommended additional stocking of Northern Pike and Largemouth Bass into Rainbow Lake.

Another seine survey was conducted in October 1962. As in past surveys, Bluegill was the dominant fish species and most of the Bluegill were under 6 inches in length, and the overall fish community remained similar to that observed in 1961 (Table 2). Growth rates for Bluegill, Largemouth Bass, and Northern Pike again suggested that fish were growing similar to statewide average growth rates or even above in the case of the two age classes of Northern Pike.

The fisheries survey gear type changed in 1964 and the lake was surveyed using trap nets and fyke nets. These entrapment gears will often capture larger fish than seines. Bluegill was still the most abundant fish species captured, but unlike other surveys nearly 50% of the Bluegill caught were at least 6 inches in length. The fish community remained comparable to past years, with the addition of Rock Bass and bullheads (exact bullhead species not recorded; Table 2). Another type of fisheries survey gear was utilized during the July 1969 survey, a boom electrofishing unit. Fifteen fish species were collected, including Black Crappie and several nongame fishes such as Yellow Bullhead, and Brown Bullhead (Table 2). Bluegill were again very abundant and were noted to be in poor condition with only 6% of the fish caught at least 6 inches in length.

In May 1974, a partial antimycin treatment occurred on Rainbow Lake. The goal of this chemical treatment was to reduce abundance of Bluegill and Pumpkinseed so that growth rates would improve for remaining fish. The treatment was considered effective as nearly 22,000 pounds of fish were removed from the lake with 80% being either Bluegill or Pumpkinseed. In October 1974, a fyke and trap netting survey was conducted on the lake to evaluate effects of the antimycin treatment on the fish community. Larger panfish were observed and the treatment was considered to be a success. In May 1975, another antimycin treatment occurred on Rainbow Lake. The total pounds of fish removed was not reported, but the treatment included 86% Bluegill and Pumpkinseed removed by number. In 1976, a follow-up netting survey was completed using trap and fyke nets. Fish community structure remained the same, but some

larger Bluegill and Pumpkinseed were captured. Growth rates for these species remained comparable to statewide averages.

Trap and fyke netting surveys were conducted annually from 1976 through 1980 and then in 1985 and 1990. The fish community remained similar to past surveys with Bluegill dominating the catch and Pumpkinseed being the second most abundant fish species (Table 2). Predator fish species included Largemouth Bass and Northern Pike. Following the same pattern observed after the 1959 rotenone treatment, panfish size structure decreased across time from the last antimycin treatment. Lake residents began stocking Channel Catfish and Yellow Perch into Rainbow Lake in 1988. Following the 1985 survey, another chemical treatment was proposed but was not conducted due to public opposition and budgetary issues. Following the 1990 survey, Redear Sunfish were recommended to be stocked into Rainbow Lake. The thought behind this recommendation was that Redear Sunfish might grow to larger sizes than Bluegill and provide a more desirable panfish fishery for anglers.

In 1995 and 1999, surveys were conducted to check on the survival of the Redear Sunfish stocked during 1991 through 1993 (Table 1). Redear Sunfish were captured in both surveys. Ninety-six percent of the Redear Sunfish caught in 1995 were at least 6 inches in length, whereas only 48% of the Bluegill caught in 1995 were at least 6 inches in length. Pumpkinseed were similar to Redear Sunfish with 84% of the fish caught in 1995 over 6 inches in length. These numbers decreased in 1999 with only 58% of Redear Sunfish, 75% of Pumpkinseed, and 13% of Bluegill reaching at least 6 inches in length. Age and growth analyses in 1999 indicated that growth was below average for Black Crappie, Bluegill, Largemouth Bass, Northern Pike, Redear Sunfish, and Yellow Perch. Pumpkinseed was the only species with growth similar to the statewide average. Twenty-three percent of the Redear Sunfish collected were from the 1994-1998 year classes (i.e., non-stocking years), so it appeared that some natural recruitment was occurring. No additional fish surveys were completed between 1999 and 2023.

Current Status

In May 2023, Rainbow Lake was surveyed as part of the DNR's Status and Trends Program (STP). The STP uses standardized protocols and a variety of sampling gear including small-mesh fyke nets, large-mesh fyke nets, experimental gill nets, seines, and nighttime electrofishing to assess fish populations in lakes across the state (Wehrly et al. 2010). This allows the DNR to develop benchmarks for fish abundance and growth that can be compared to other similar lakes within fisheries management units, Great Lakes basins, and across the state. Effort in the 2023 survey consisted of 4 net nights of small-mesh fyke nets, 9 net nights of large-mesh fyke nets, 6 net nights of experimental gill nets, 3 net nights of trap nets, 4 seine hauls, and 30 minutes of nighttime electrofishing (Table 3; Figure 3). All fish captured in Rainbow Lake were measured for total length, and spine or scale samples for age and growth analysis were collected from the first 10 individuals per game fish species per inch group. Weights for each fish species were estimated using the length-weight regression coefficients from Schneider et al. (2000b). Weighted age frequency distributions were estimated using the procedures described by Schneider (2000b). Mean lengths-at-age for Rainbow Lake game species were compared to statewide averages presented in Schneider et al. (2000a). Water quality, shoreline development, and nearshore habitat were assessed in August 2023 following STP methods (Wehrly et al. 2010). The timing of the STP surveys and the variety of gear used were ideal for capturing mature adult Centrarchids (e.g. Bluegill and Largemouth Bass).

A total of 2,412 fish were captured during the 2023 survey (Table 4). Fish were not individually marked, so there is the potential that individuals were captured more than once. Bluegills dominated the catch with 1,516 fish captured, representing nearly 63% of the catch by number and 11% of the catch by weight (Table 4). Bluegills varied in length from 1.0 inches to 6.9 inches with 99% of the fish being less than 6 inches in length (Figure 4). Six age classes of Bluegills were captured during the survey (ages 1-6; Figure 5). Seventy-three percent of the Bluegills were age 3 and only 3% were age 5 or older. Mean growth indices were in the average range for ages 1 and 2; however, mean growth indices ranged from -1.0 to -1.3 for fish ages 3-5 (Table 5; Figure 6). The Schneider Index for Rainbow Lake Bluegills collected in trap and large-mesh fyke nets was 1.25, which is very poor and is the lowest possible score.

Black Crappie were the most impressive panfish species captured with 121 individuals. Black Crappie ranged in length from 4.0-13.9 inches in length, with 98% of the fish caught at least 7 inches in length (Figure 7). Eleven age classes of Black Crappie were present in Rainbow Lake (age 2-12; Figure 8). Growth indices were -0.5 for age 5 and -1.4 for ages 8 and 9 (Table 5). Hybrid sunfish (n = 161) was the third most abundant taxon captured during the 2023 survey (Table 4). Hybrid sunfish varied in length from 2.0 inches to 9.9 inches (Figure 9). Most hybrid sunfish appeared to be a cross between Redear Sunfish and Bluegill. Forty-six Redear Sunfish were also captured in the survey, ranging in length from 2.0-9.9 inches in length with 76% of the fish less than 6 inches in length. In addition to these panfish species, six Pumpkinseed, 22 Green Sunfish, and 23 Rock Bass were also collected in the 2023 survey.

Sixty Largemouth Bass were collected from Rainbow Lake in 2023. Largemouth Bass varied in length from 2.0 to18.9 inches with 37% of the fish being at least 14 inches making them legal for harvest (Figure 10). Ten age-classes (age 1-10) were present. Largemouth Bass in Rainbow Lake were growing similarly to other places across the state and had a mean growth index of -0.1 (Table 5).

Northern Pike (n = 112) were the dominant predators in terms of both numbers and biomass. Northern Pike captured ranged in length from 12.4 inches to 31.7 inches (Figure 11). Nine age classes of Northern Pike (age 1-9) were present (Figure 12). Growth was below average, as evidenced by the mean growth index of -3.0 (Table 5). Growth indices became progressively worse with increasing age, declining from -2.6 at age 4 to -6.2 at age 7. Only 15% of the Northern Pike captured were at least 24 inches in length, making them legal for harvest (Figure 11).

Nongame fish species captured during the 2023 survey included: Brook Silverside, Central Mudminnow, Spotfin Shiner, Tadpole Madtom, and Yellow Bullhead. Yellow Bullheads composed 8% of the total fish biomass during the survey. The other nongame species made up less than 1% of the biomass.

On August 1, 2023, the water quality and shoreline sampling were completed on Rainbow Lake. The dissolved oxygen and temperature profile was taken in 23 feet of water. The epilimnion consisted of the top 15 feet of the water column. Water temperatures in the epilimnion were warm and varied from 79.1 F to 77.1 F (Figure 13). Dissolved oxygen in the epilimnion was between 7.94 parts per million (ppm) and 3.28 ppm. The metalimnion (zone of thermal change) began at 15 feet and continued to the lake bottom. Water temperatures dropped from 77.1 F at 15 feet to 66.7 F at 21 feet. Dissolved oxygen concentrations declined quickly within the metalimnion, starting at 3.28 ppm at 15 feet and falling to 0.82 ppm by 18 feet. From 19 feet to the bottom, Rainbow Lake was hypoxic with no dissolved oxygen present. Water chemistry sampling was completed at the same location as the temperature and dissolved oxygen profile. Total alkalinity was 126 mg/L, total nitrogen was 0.388 mg/L, total phosphorus was

0.040 mg/L, and chlorophyll a was 0.0072 mg/L. The Secchi depth was 10.5 feet, indicating light penetration to 21 feet.

In addition to the temperature and dissolved oxygen profile, shoreline sampling was conducted to assess the number of dwellings, docks, submerged trees, and percentage of the shoreline that was armored. A total of 123 docks and 120 dwellings were counted on Rainbow Lake in 2023. Twenty-two percent of the shoreline of Rainbow Lake was armored. The estimated density of logs along the shoreline was 94.4 submerged logs/mile.

Analysis and Discussion

The history of fisheries management at Rainbow Lake can be summarized with a few key points. The lake is shallow and has a long history of extensive vegetation which has led to large, overabundant panfish communities which have been dominated by Bluegill. Angler complaints dating back to 1945 paint the picture of heavy vegetation, nuisance Common Carp (in the early files) and then nuisance small Bluegills across time. Intensive fisheries management occurred in the 1950s through 1990s to try to increase the size structure of panfish in the lake; however, these attempts ultimately failed. The 2023 fisheries survey documented that Rainbow Lake has a population of small, stunted panfish. Bluegill still dominate the catch and Redear Sunfish are still lingering providing a slightly larger, catchable panfish alternative to the small Bluegill in the lake. The two panfish species are actively hybridizing on the lake as well.

Shoreline habitat variables were compared to data compiled by Kevin Wehrly (DNR - Fisheries Division) for STP surveys completed from 2002 through 2007 statewide and in SLMMU. The numbers of docks and dwellings per mile on Rainbow Lake were well above the 75th percentiles for lakes statewide and lakes in SLMMU. However, the percentage of shoreline armored on Rainbow Lake (i.e., 22%) was between the 50th and 75th percentiles for other lakes in SLMMU and statewide. Surprisingly the density of submerged trees in Rainbow Lake (95.7/mile) also was above the 75th percentile for lakes in SLMMU and lakes statewide. The majority of submerged trees were found in the undeveloped shoreline areas of Rainbow Lake. The chemical composition of the lake indicates that Rainbow Lake is most likely a eutrophic lake based on the Secchi depth of 10.5 feet, chlorophyll a at 7.2 ug/L, and total phosphorus of 40 ug/L. Eutrophic lakes typically have high levels of nutrients such as phosphorus and nitrogen, increased abundance of rooted aquatic plants, and algal blooms are more common. In addition, warm water fish communities are typically found in these lake ecosystems without any coldwater fish species such as trout or whitefish species.

Compared to other lakes in SLMMU, Rainbow Lake appears to have a low to moderate population density of Bluegills 4 inches or larger based upon catch-per-unit-effort (CPUE). The CPUE provides an index of relative abundance and facilitates comparisons across lakes and sampling years. Bluegill CPUE was compared to CPUE data from other STP surveys in SLMMU and statewide from 2002 to 2021. The Bluegill CPUE in large-mesh fyke nets in Rainbow Lake in 2023 was 27.8 Bluegills/net night. This value was between the 25th percentile and the 50th percentile for Bluegills per net night when compared to lakes in SLMMU and statewide. Only three Bluegills were caught in the trap nets. By contrast, small Bluegills are highly abundant in Rainbow Lake. Rainbow Lake CPUEs were above the 75th percentiles for electrofishing and well above the 75th percentile values for seines and small-mesh fyke nets.

A variety of biotic and abiotic factors likely are responsible for the poor size structure of Bluegills in Rainbow Lake. As noted previously, nearly 80% of the lake is less than 10 feet deep. Thus, there is a large area of suitable nesting habitat in this system. Ehlinger (1997) found that an abundance of nesting habitat in shallow lakes allowed younger, smaller males to spawn successfully and that males from stunted populations matured at younger ages than Bluegills in populations without stunting. Thus, Bluegills were diverting energy from somatic growth into gonadal growth. It is possible that the same situation is occurring in Rainbow Lake.

Bluegill growth also is related to the distribution, density, and diversity of aquatic plants in a lake. Growth of rooted aquatic plants is limited by light penetration. Thus, the percentage of lake area covered with aquatic vegetation typically is higher in shallow lakes (such as Rainbow Lake) than in lakes with steep drop-offs. Cheruvelil et al. (2005) found a negative relationship between the percentage of a lake covered with aquatic vegetation and growth of Bluegills. Schneider (1981) and Theiling (1990) also observed that Bluegill stunting was most common in shallow weedy lakes. Whereas juvenile Bluegills typically reside in vegetation and feed on aquatic insects, the transition to feeding on Daphnia and Chaoborus larvae in open water seems to be necessary for rapid growth of adult Bluegills (Schneider 1999; Spotte 2007). Due to the shallow bathymetry of Rainbow Lake, opportunities for pelagic feeding on zooplankton are limited.

The age structure of the Bluegill population in Rainbow Lake was skewed towards young fish. Under statewide average growth, Bluegills reach 6 inches at age 4. Only 10% of the Bluegills caught in the 2023 survey were age 4 or older. The scarcity of older fish does not seem to be due to harvest by anglers, as Rainbow Lake Bluegills averaged 4.9 inches at age 4 and the length frequency distribution shows numbers declining at sizes too small to be of interest to anglers (Figure 4). Predation by Northern Pike and Largemouth Bass could be contributing to the skewed age structure as these two species made up 63% of the biomass. Schneider (2000a) observed that fishing quality generally was poor in lakes where predators composed more than 50% of the total fish biomass.

Black Crappie CPUE in trap nets in Rainbow Lake in 2023 was 21.7 Black Crappies/net night which is well above the 75th percentiles for lakes in SLMMU and statewide. The number of trap net nights was limited on Rainbow Lake but proved effective at capturing Black Crappie. Large-mesh fyke nets were the second most productive gear for capturing Black Crappie. The CPUE with large-mesh fyke nets in Rainbow Lake was between the 25th and 50th percentiles for SLMMU lakes and between the 50th and 75th percentiles for lakes statewide. Taken together, the CPUE data suggest that the population density of Black Crappie in Rainbow Lake is average to a little above average for lakes in this region.

Largemouth Bass population density in Rainbow Lake appears to be below average to average for lakes in southwest Michigan. The electrofishing CPUE (1.4 per minute of electrofishing) was between the 25th and 50th percentile for lakes in SLMMU. The size structure of the Largemouth Bass population was evenly spread across the length range with approximately 37% of the total catch at least 14 inches in size, making them legal for harvest.

In 2016, the DNR began requiring all bass (collectively refers to Smallmouth Bass and Largemouth Bass) tournaments to register tournaments across the state in inland waterbodies and the Great Lakes. Since the initiation of this program, Rainbow Lake has had the 115th highest number of tournaments. As part of the tournament reporting process, tournament directors must submit data on bass catches and

angler participation. From 2016 through 2024, 49 bass tournaments occurred on Rainbow Lake with an average of 22.7 anglers fishing in 11.7 boats per tournament. An average of 41 Largemouth Bass were weighed at each tournament. The statewide average number of anglers fishing is 23.4 in 13.2 boats per tournament and an average of 48 bass (Smallmouth and Largemouth collectively) are weighed at each tournament statewide.

Northern Pike continue to be the dominant predator fish species in Rainbow Lake. One hundred and twelve Northern Pike were captured across the survey with only 17 individuals at least 24 inches in length. Sixty-nine Northern Pike were captured in experimental gill nets with a CPUE of 11.5 Northern Pike per net night. Compared to other lakes statewide, this May gillnet CPUE was above the 75th percentile (3.80). The extreme number of Northern Pike captured in experimental gill nets in May reflects a high-density, slow growing Northern Pike population in Rainbow Lake. Over the past three years, anglers have also reported catching a large number of sublegal Northern Pike. The abundant shallow, aquatic vegetation is ideal for Northern Pike spawning and rearing, which is conducive to high Northern Pike natural recruitment in Rainbow Lake.

Management Direction

1. Change the Northern Pike regulation from the statewide 2 daily bag limit, 24-inch minimum size limit to the liberalized 5 daily bag limit, no minimum size limit, with 1 fish 24 inches or greater. The objectives of the proposed regulation change are to increase harvest opportunities, reduce the population density, and improve growth of Northern Pike in Rainbow Lake.

2. Work with the Michigan Department of Environment, Great Lakes, and Energy, riparian landowners, and other local partners to encourage use of best management practices within the lakeshed to reduce nutrient inputs to Rainbow Lake. Controlling nutrient inputs is necessary to minimize algal blooms and prevent unnaturally high growth of aquatic plants in the lake.

3. Do not stock additional predators such as Walleye. The lake already has a fish community that is skewed towards predators. In addition, summer water temperatures and dissolved oxygen concentrations in Rainbow Lake are not optimal for Walleye.

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Tables and Figures

Table 1. Fish stocking in Rainbow Lake from 1933 through 2023.

Stocking Year	Species	Number Stocked	Life Stage or Length (inches)	Type of Stocking Event
1933	Bluegill	3,500	5 month	
1933	Largemouth Bass	4,280	1 month	
1933	Largemouth Bass	750	4 month	
1933	Yellow Perch	4,400	7 month	
1934	Bluegill	930	Yearling	
1934	Largemouth Bass	3,000	3 month	
1935	Bluegill	4,000	4 month	
1935	Largemouth Bass	600	Yearling	
1935	Yellow Perch	4,785	7 month	
1936	Bluegill	5,700	5 month	
1936	Largemouth Bass	2,000	4 month	
1937	Bluegill	708	Adults	
1938	Bluegill	1,500	Yearling	
1939	Yellow Perch	7,000	7 month	
1940	Bluegill	3,000	4 month	
1941	Bluegill	3,000	4 month	
1941	Bluegill	5,000	4 month	
1941	Largemouth Bass	800	4 month	
1944	Largemouth Bass	320	4 month	
1945	Largemouth Bass	500	3 month	
1959	Bluegill	12,000	Fingerling	
1959	Largemouth Bass	7,200	Fingerling	
1959	Largemouth Bass	563	Sublegal	
1960	Northern Pike	136	Legal	
1960	Rainbow Trout	2,000	Legal	
1961	Largemouth Bass	66	Sublegal	
1962	Largemouth Bass	2,300	Sublegal	
1962	Northern Pike	7,300	Fingerling	
1963	Northern Pike	249	Legal	
1988	Channel Catfish	1,600	7.01	Private Plant (under permit)
1988	Yellow Perch	3,000	7.01	Private Plant (under permit)
1991	Channel Catfish	2,000	7.01	Private Plant (under permit)
1991	Redear Sunfish	52,745	1.3	State

1991	Redear Sunfish	5,000	2.09	State
1992	Channel Catfish	2,000	7.01	Private Plant (under permit)
1992	Redear Sunfish	13,251	1.57	State
1992	Redear Sunfish	3,200	1.97	State
1993	Redear Sunfish	1,985	1.5	State
1993	Redear Sunfish	10,729	1.5	State
1996	Channel Catfish	2,000	7.01	Private Plant (under permit)

Table 2. Fish species collected in Rainbow Lake during surveys conducted from 1957 through 2023.

Species	1957	1958	1961	1962	1964	1969	1974	1976	1977	1978	1979	1980	1985	1990	1995	1999	2023
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black Crappie	X	X				X		X	X	X	X	X	X	X	X	X	X
Pumpkinseed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow Perch	X	X		X	X	X				X	X					X	X
Largemouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern Pike	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common Carp	X	X															
Golden Shiner	X	X				X											
Warmouth	X	X															
Grass Pickerel	X	X															
White Sucker	X	X				X				X			X		X	X	
Green Sunfish	X		X		X										X	X	X
Lake Chubsucker		X															
Bullhead species	X	X			X												
Common Shiner			X			X											
Hybrid Sunfish				X	X	X	X	X	X		X	X					X
Rock Bass					X											X	X
Longear Sunfish						X											
Brown Bullhead						X		X	X	X	X	X	X	X			
Yellow Bullhead						X	X	X	X	X		X	X	X	X	X	X
Bowfin						X											
Central Mudminnow						X											X
Black Bullhead							X	X	X	X					X	X	
Channel Catfish														X		X	
Redear Sunfish															X	X	X

Tadpole Madtom	X
Spotfin Shiner	X
Brook Silverside	X

Table 3. Sampling period and total effort for each gear used during the 2023 Rainbow Lake Status and Trends Program survey.

Sampling Period	Gear	Effort
May 8-10	Experimental Gill Net	6 net nights
May 8-10	Small-Mesh Fyke Net	4 net nights
May 8-11	Trap Net	3 net nights
May 8-11	Large-Mesh Fyke Net	9 net nights
May 11	Seine	4 hauls
May 11	Nighttime Electrofishing	30 minutes

Table 4. Numbers, calculated weights, total length ranges, and percentage legal or harvestable for all fish species collected on Rainbow Lake during May 2023.

Species	Number	Percent by Number	Weight (lb.)	Percent by Weight	Length Range (in)	Percent Legal or Harvestable Size
Black Crappie	121	5	68.7	12.6	4.0-13.9	98
Bluegill	1,516	62.9	59	10.8	1.0-6.9	1
Brook Silverside	5	0.2	<0.1	<0.1	3.0-4.9	N/A
Central Mudminnow	2	0.1	<0.1	<0.1	1.0-2.9	N/A
Green Sunfish	22	0.9	0.7	0.1	1.0-6.9	9
Hybrid Sunfish	161	6.7	16.3	3	2.0-9.9	19
Largemouth Bass	60	2.5	74	13.6	2.0-18.9	37
Northern Pike	112	4.6	267	49	12.0-31.9	15
Pumpkinseed	6	0.2	0.4	0.1	3.0-5.9	0
Redear Sunfish	46	1.9	6.5	1.2	2.0-9.9	24
Rock Bass	23	1	8	1.5	1.0-9.9	83
Spotfin Shiner	170	7	1.1	0.2	1.0-3.9	N/A
Tadpole Madtom	8	0.3	<0.1	<0.1	1.0-2.9	N/A
Yellow Bullhead	88	3.6	41.4	7.6	6.0-11.9	N/A
Yellow Perch	72	3	2	0.4	2.0-7.9	1

* Harvestable size is 6 inches for Bluegill, Pumpkinseed, Green Sunfish, and hybrid sunfish, and 7 inches for Black Crappie and Yellow Perch.

Table 5. Lengths at age for Rainbow Lake game fish collected in 2023 relative to statewide averages. Statewide average lengths and growth index equations are from Schneider et al. (2000a).

Species	Age	Number Aged	Length Range (in.)	State Average Length (in.)	Weighted Mean Length (in.)	Mean Growth Index
Black Crappie	2	1	5.7	6.0	N/A	-1.1
	3	2	6.1-7.6	7.5	N/A	
	4	1	8.2	8.6	N/A	
	5	7	8.0-10.6	9.4	8.9	
	6	4	8.3-10.7	10.2	N/A	
	7	4	9.4-11.6	10.8	N/A	
	8	20	8.8-13.1	11.4	10.00	
	9	8	8.2-13.7	11.9	10.5	
	10	5	9.3-13.6	N/A	10.9	
	11	1	12.1	N/A	N/A	
	12	2	12.3-13.7	N/A	N/A	
Bluegill	1	7	1.4-1.8	1.8	1.6	-0.8
	2	14	2.2-3.7	3.8	3.5	
	3	17	3.4-5.0	5.0	3.7	
	4	8	4.6-6.1	5.9	4.9	
	5	10	5.2-6.5	6.7	5.6	
	6	3	6.0-6.6	7.3	N/A	
Largemouth Bass	1	5	2.1-4.9	4.2	2.9	-0.1
	2	8	4.5-7.6	7.1	5.9	
	3	8	7.7-11.2	9.4	9.8	
	4	14	10.8-14.1	11.6	12.6	
	5	5	12.5-15.5	13.2	13.6	
	6	8	14.9-17.3	14.7	15.9	
	7	5	14.9-16.5	16.3	15.8	
	8	5	15.6-17.8	17.4	16.5	
	9	1	18.9	18.3	N/A	
	10	1	18.2	19.3	N/A	
Northern Pike	1	1	12.4	11.7	N/A	-3.0
	2	7	14.0-17.2	17.7	16.1	
	3	13	17.4-23.8	20.8	21.00	

	4	7	18.4-24.2	23.4	20.8	
	5	14	20.1-26.2	25.5	22.2	
	6	18	20.2-25.6	27.3	22.7	
	7	10	21.4-26.1	29.3	23.1	
	8	4	19.7-31.7	31.2	N/A	
	9	1	23.8	N/A	N/A	
Yellow Perch	1	17	2.8-4.4	3.3	3.5	0
	2	8	4.4-5.5	5.2	5.0	
	3	1	6.0	6.5	N/A	
	4	2	6.3-6.7	7.5	N/A	
	5	1	7.2	8.5	N/A	

Figure 1. Rainbow Lake, Montcalm County watershed boundary.

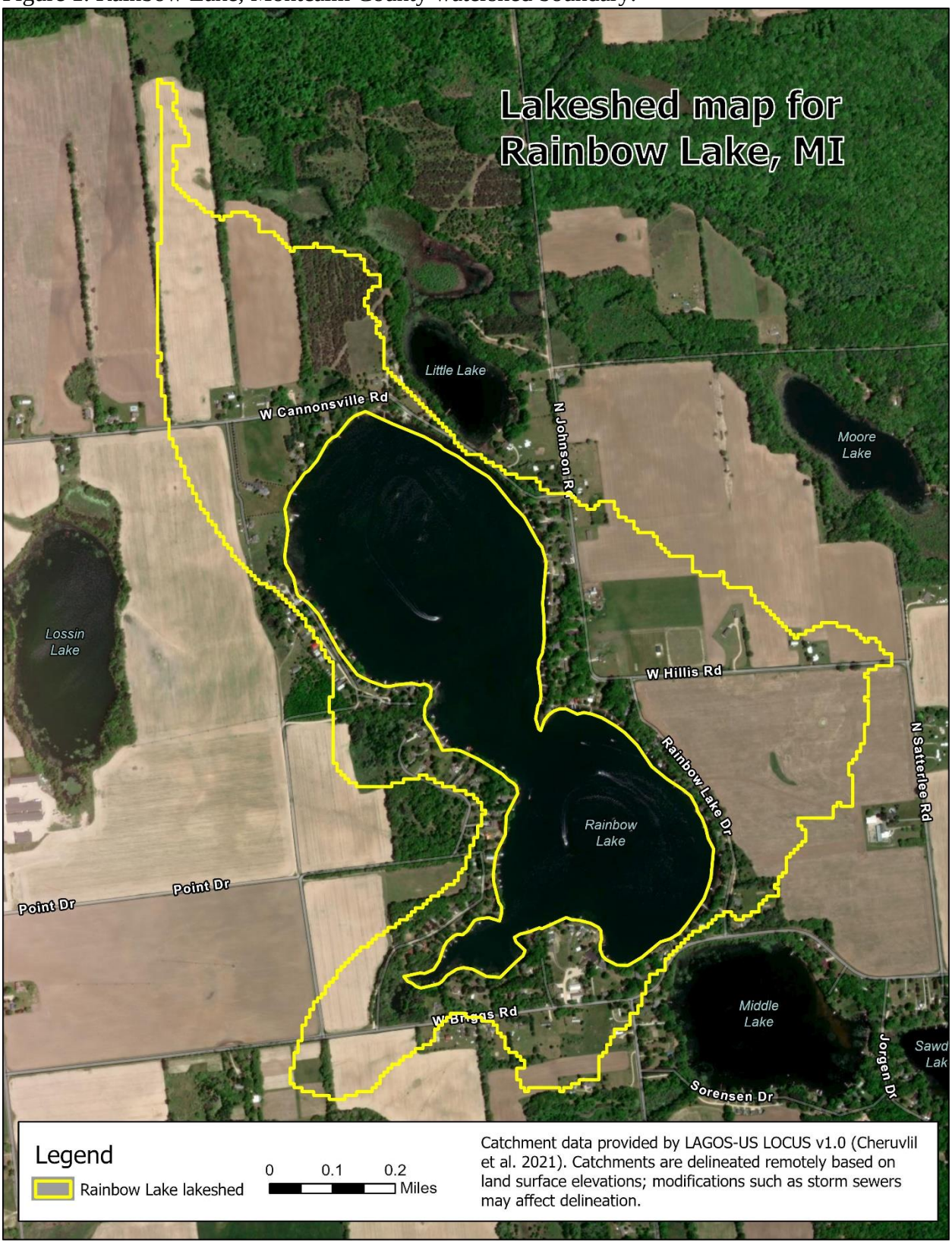


Figure 2. Land cover within the Rainbow Lake, Montcalm County lakeshed as of 2021.

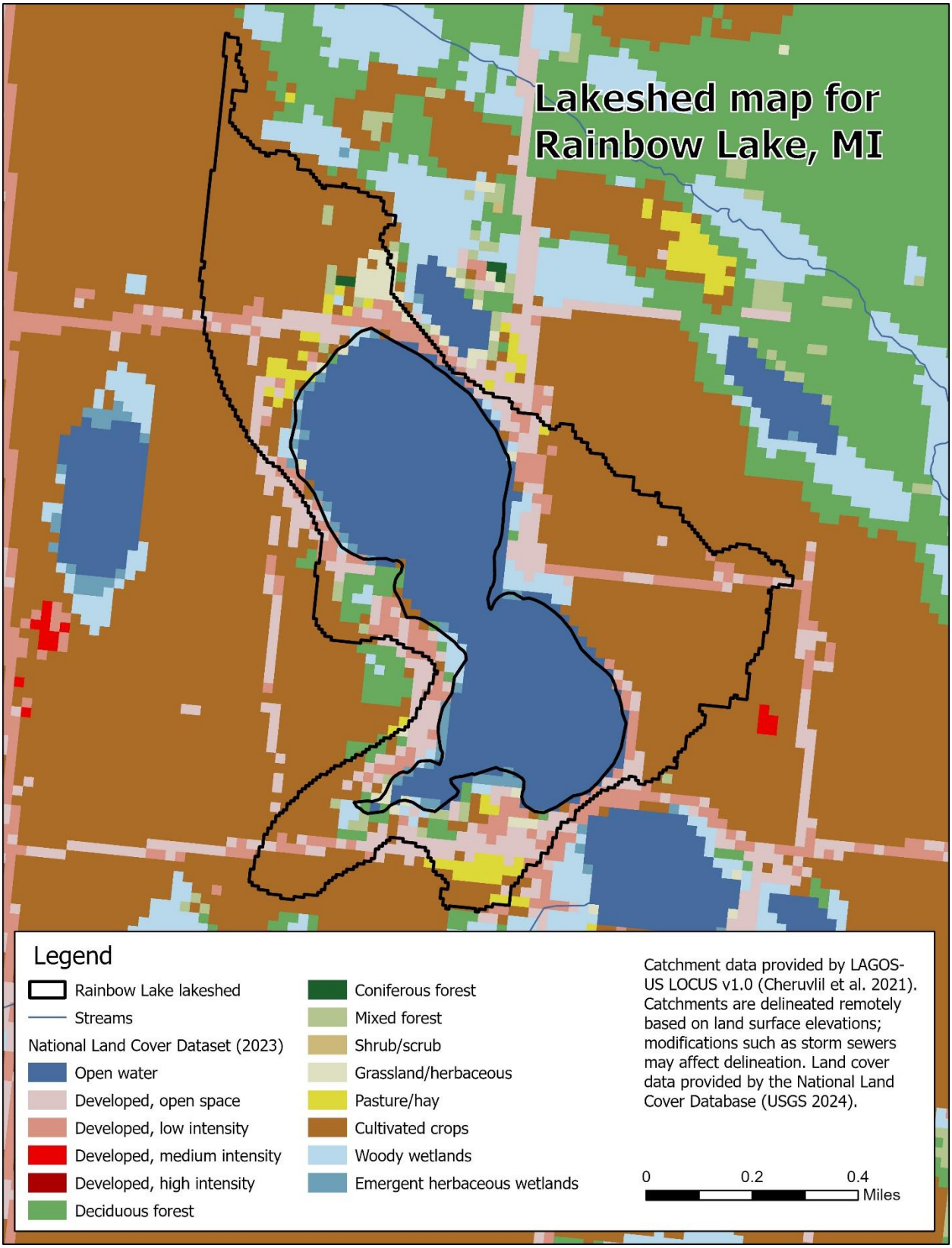


Figure 3. Map of Rainbow Lake with green circles indicating locations of large-mesh fyke nets, green and white circles indicating locations of trap nets, orange lines indicating locations of gill nets, red circles indicating locations of seines, and purple lines indicating nighttime electrofishing surveys conducted during the 2023 summer survey.

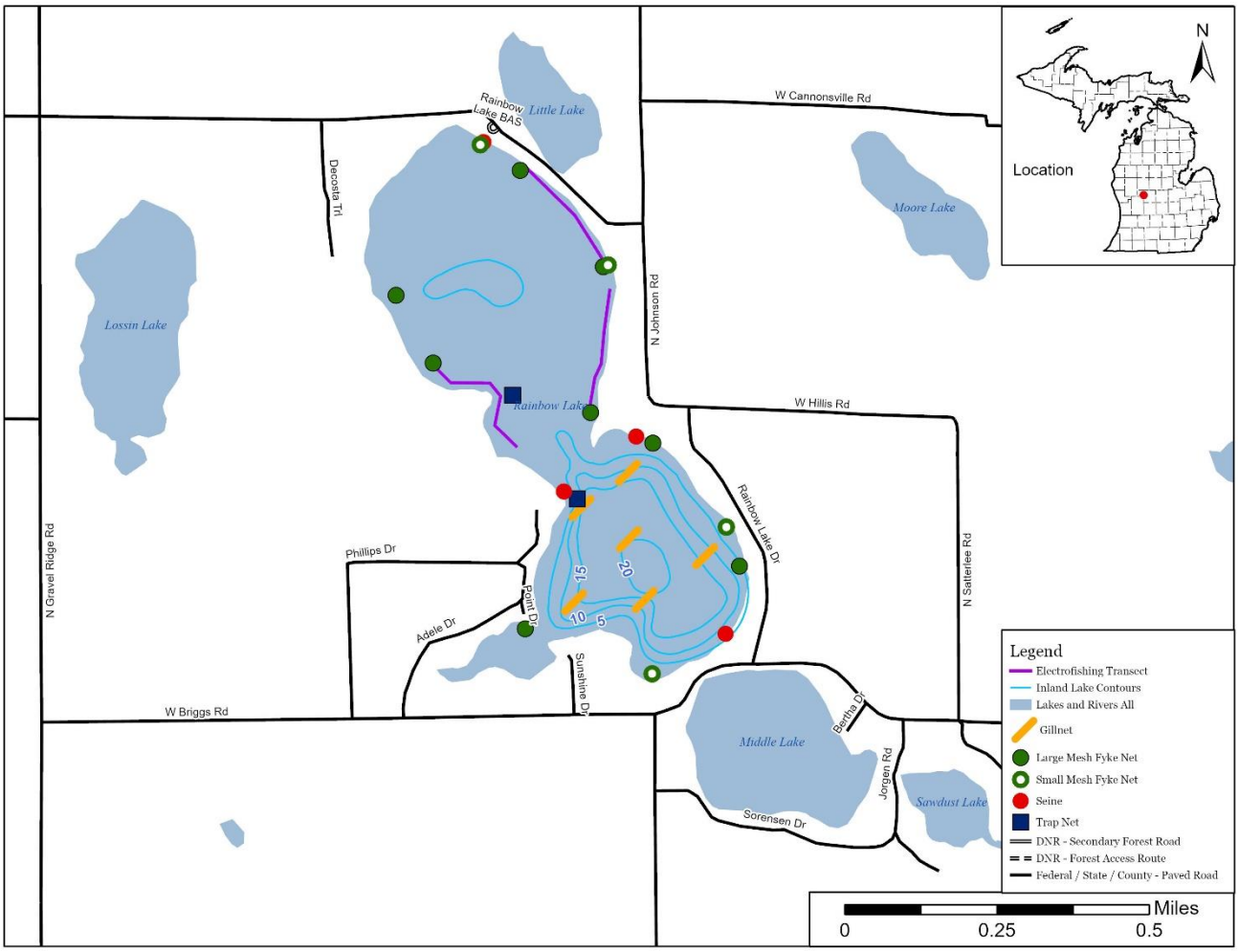


Figure 4. Length frequency distribution for Bluegills captured in Rainbow Lake during May 8-11, 2023.

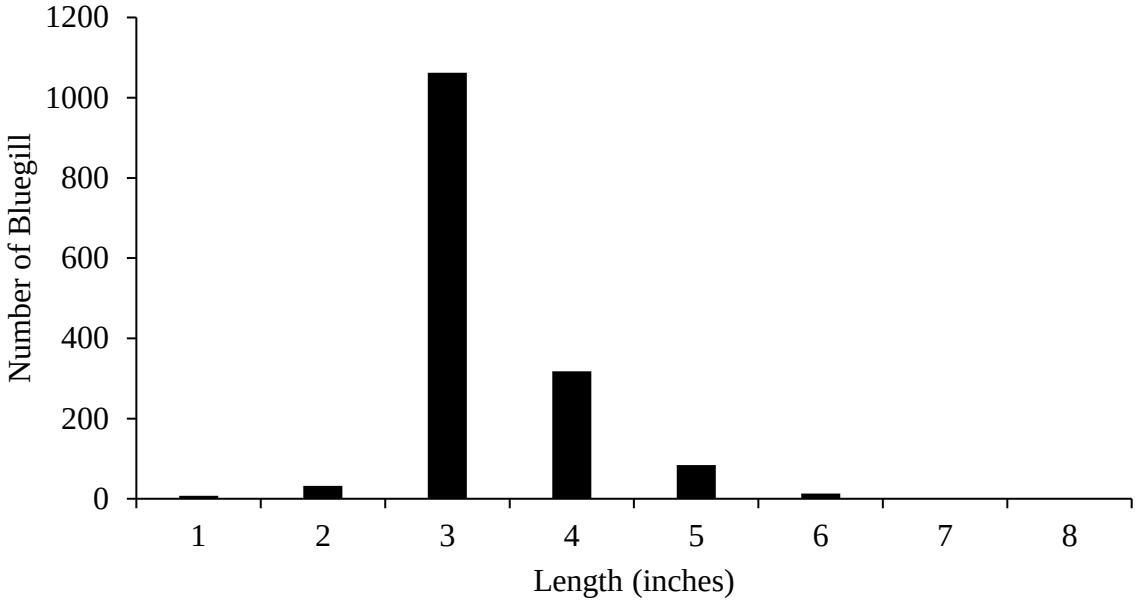


Figure 5. Age frequency distribution for Bluegills captured in Rainbow Lake during May 8-11, 2023.

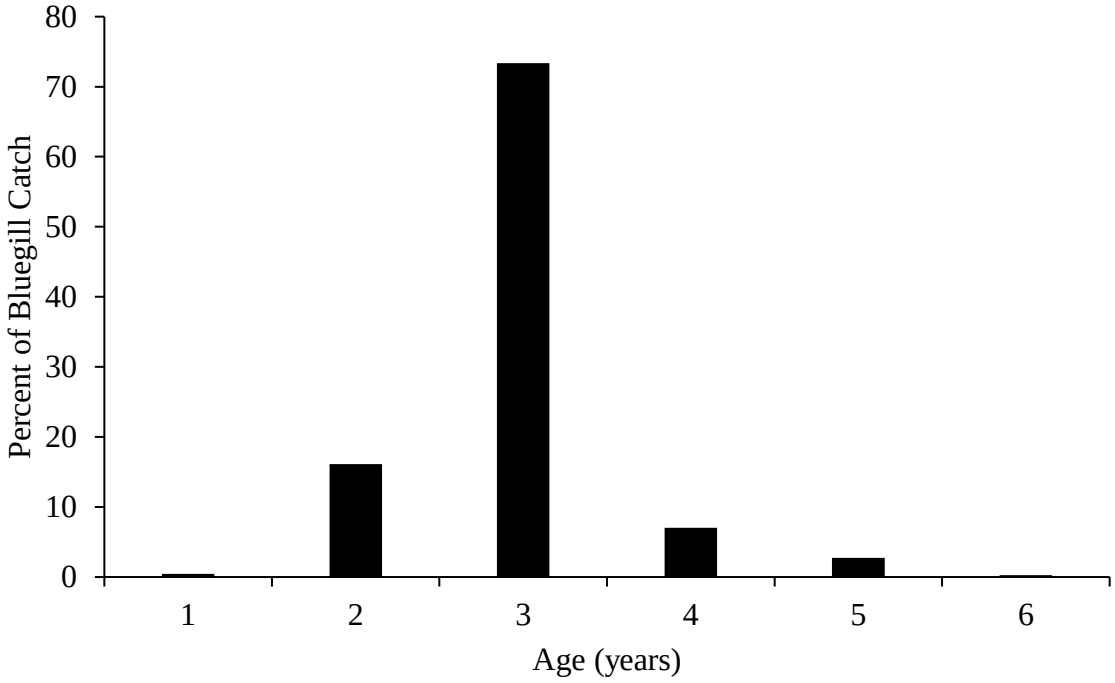


Figure 6. Mean length at age for Bluegill caught in Rainbow Lake in 2023 (gray dotted line) versus Bluegill caught statewide (black solid line).

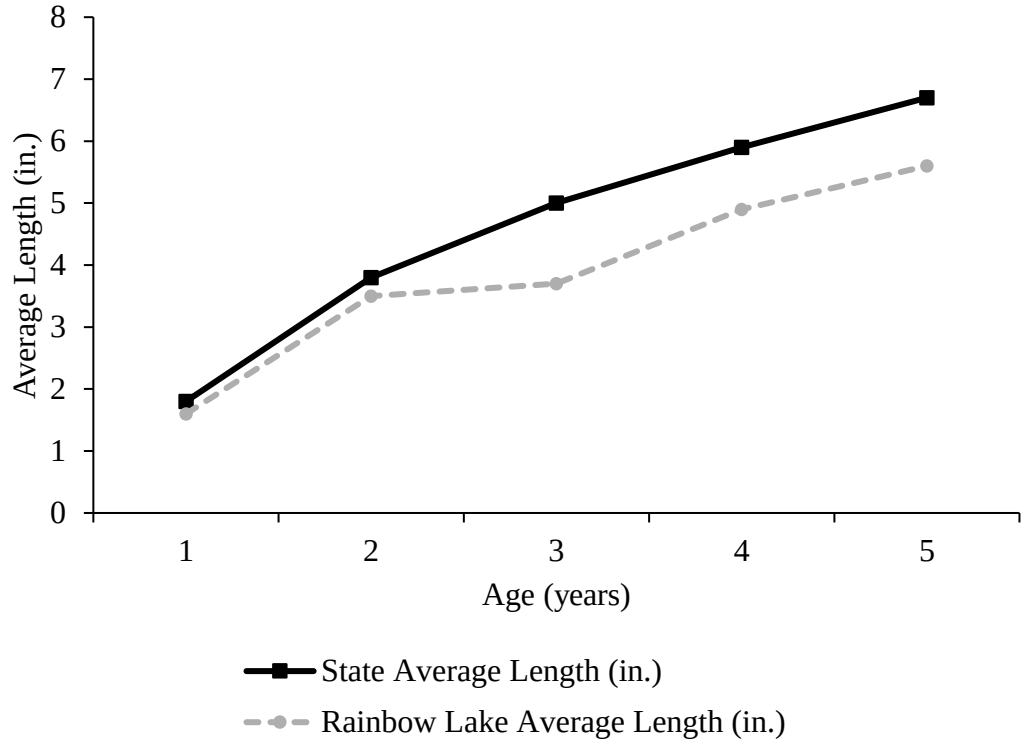


Figure 7. Length frequency distribution for Black Crappies captured in Rainbow Lake during May 8-11, 2023.

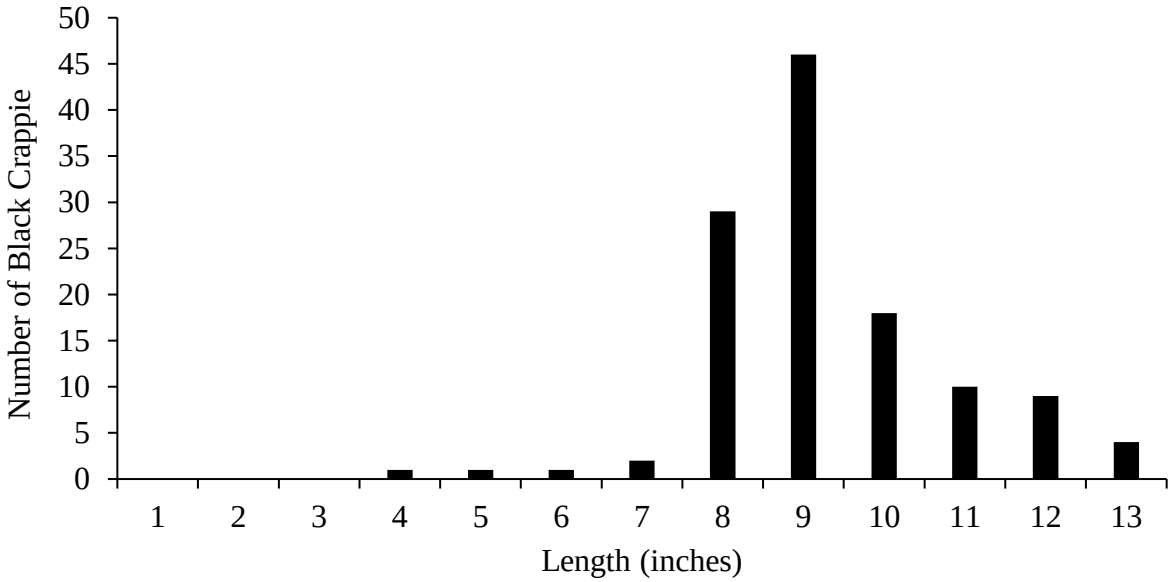


Figure 8. Age frequency distribution for Black Crappies captured in Rainbow Lake during May 8-11, 2023.

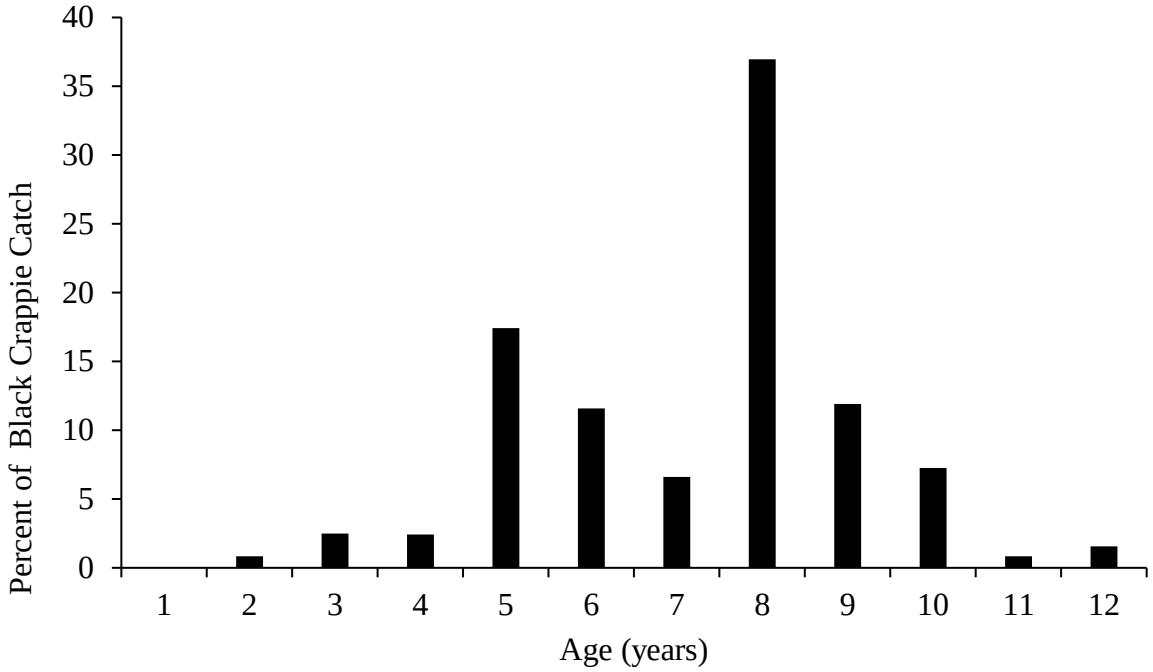


Figure 9. Length frequency distribution for hybrid sunfish captured in Rainbow Lake during May 8-11, 2023.

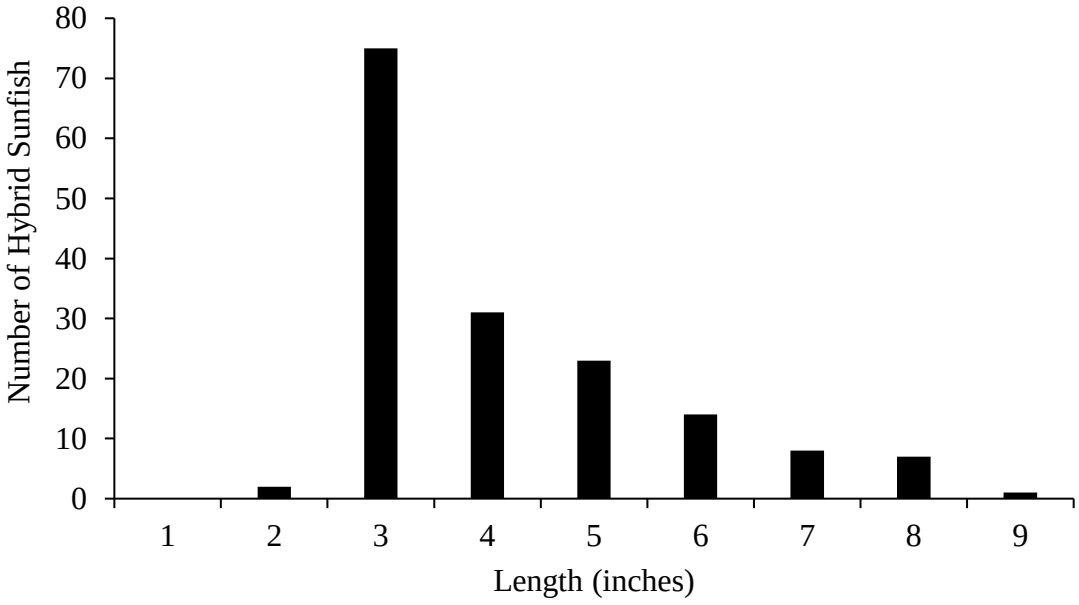


Figure 10. Length frequency distribution for Largemouth Bass captured in Rainbow Lake during May 8-11, 2023.

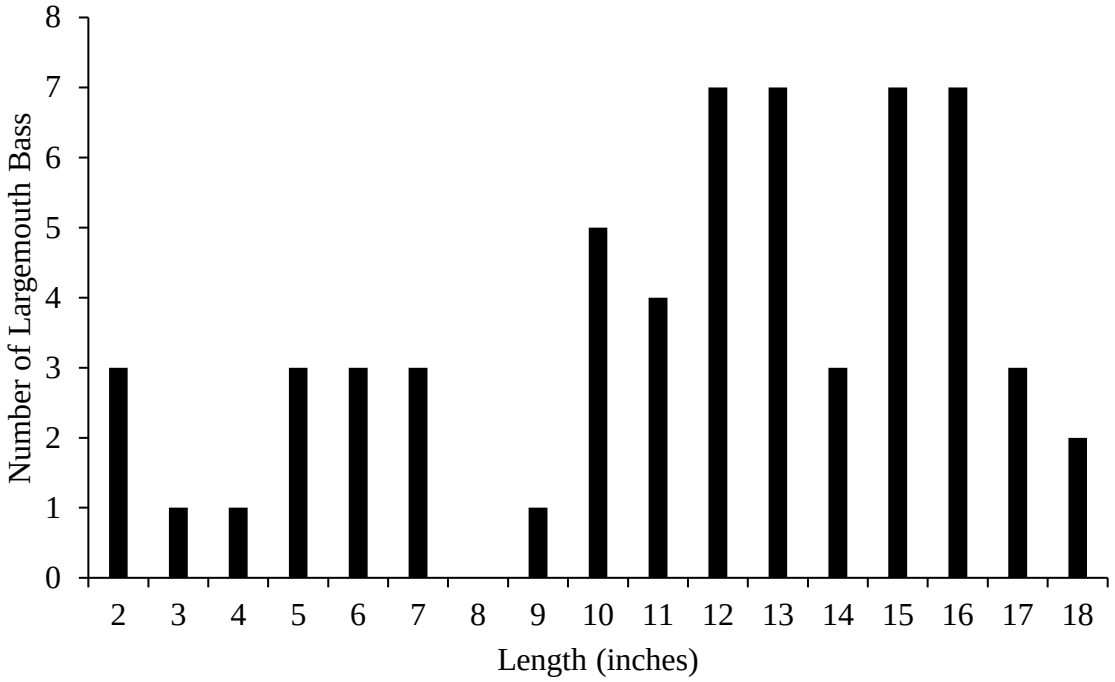


Figure 11. Length frequency distribution for Northern Pike captured in Rainbow Lake during May 8-11, 2023.

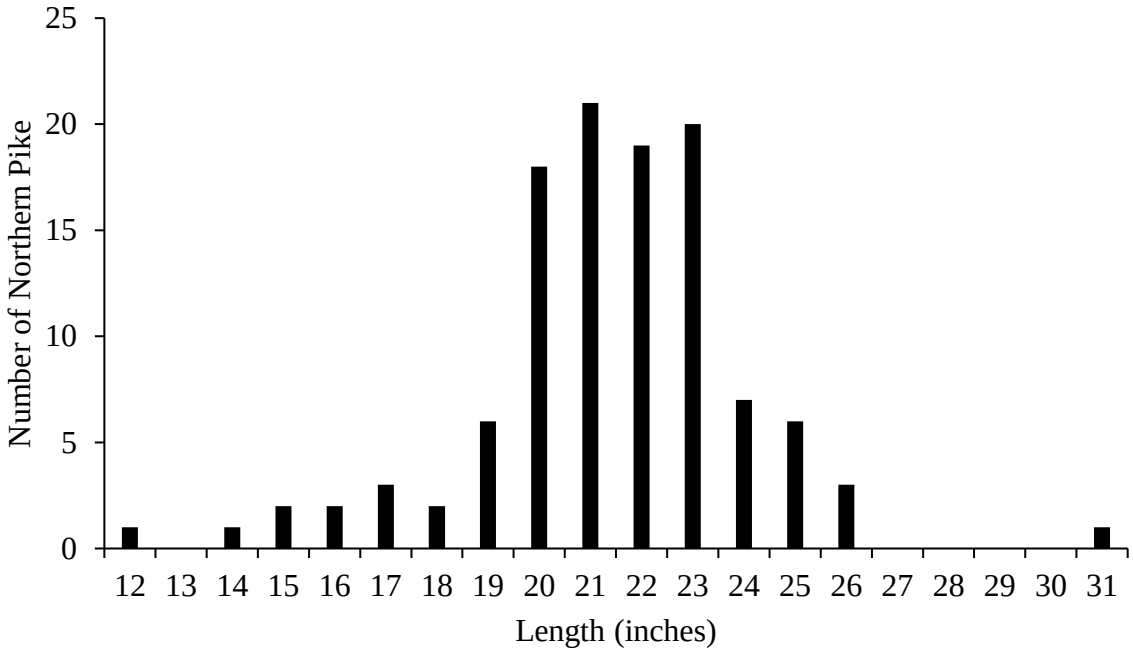


Figure 12. Age frequency distribution for Northern Pike captured in Rainbow Lake during May 8-11, 2023.

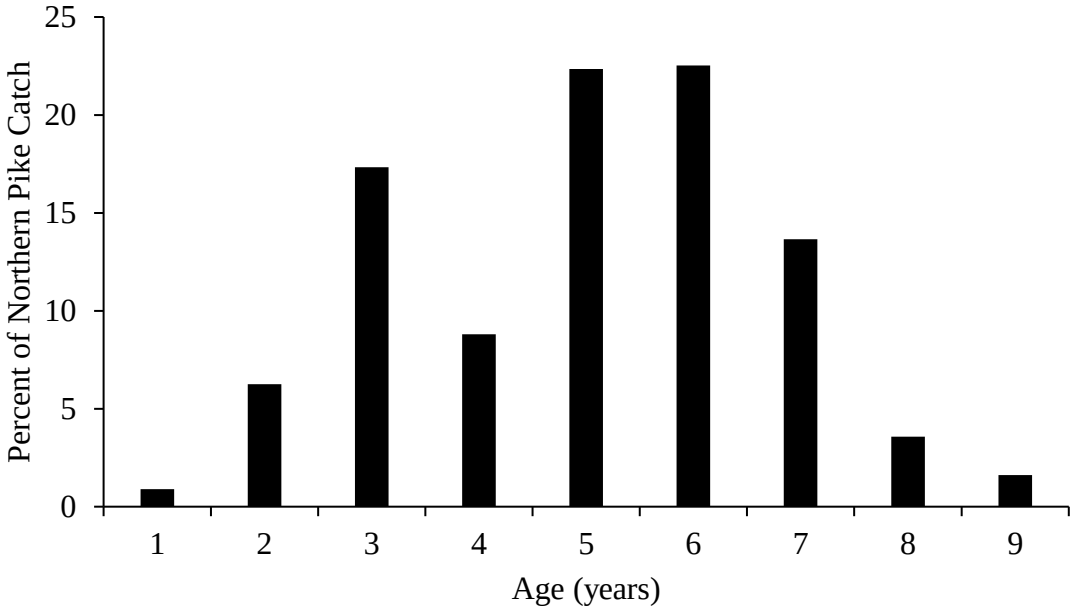
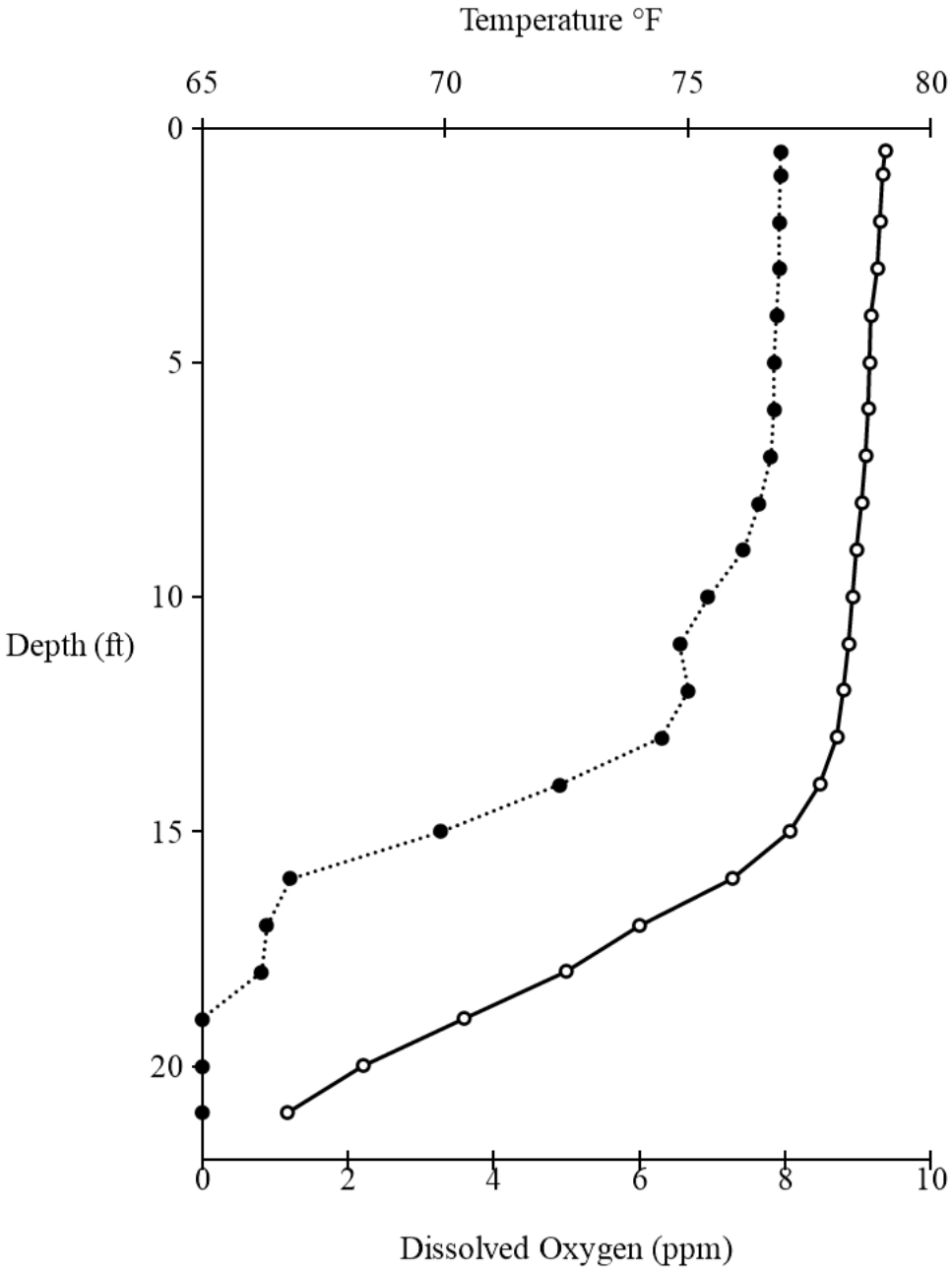


Figure 13. Water temperature and dissolved oxygen profile for the deepest basin in Rainbow Lake on August 1, 2023. The hollow circles with solid line represent temperature and the solid circles with dashed line represent the dissolved oxygen concentration.



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