Arcadia Lake
Manistee County
Last surveyed 2012, Bowens Creek Watershed

Mark A. Tonello, Fisheries Biologist, Cadillac

Environment

Arcadia Lake (Fig. 1) is an inland lake with a direct connection to Lake Michigan in northwestern Manistee County. Known as a "drowned rivermouth lake", Arcadia Lake is connected to Lake Michigan via a dredged channel that is approximately 250 yards in length, with rock rip-rap breakwalls that extend out into Lake Michigan. Arcadia Lake is 275 acres in size, with a maximum depth of approximately 28 feet. The main basin of Arcadia Lake is relatively shallow, with an average depth of less than 20 feet. The north arm of the lake was historically dredged to allow larger boat traffic (possibly even ships at one time). Therefore it is characterized by steep drop offs and an average depth greater than 20 feet.

Arcadia Lake is fed primarily by Bowens Creek (Tonello 2008). Bowens Creek has a relatively small, dendritic watershed consisting of many small spring creeks originating from glacial moraines to the north, east, and south of Arcadia. As these streams flow off the moraines, they are typically very high gradient. However, in its last several miles before flowing under M-22, Bowens Creek flows through a flat, low gradient reach that is surrounded by emergent wetland. Bowens Creek and its tributaries are mostly trout streams with populations of brown trout, brook trout, migratory rainbow trout (steelhead), coho salmon and Chinook salmon. All salmonid populations in the Bowens Creek watershed are self-sustaining, given that no stocking takes place. The immediate terrain surrounding Arcadia Lake is relatively flat, with wetlands and agricultural land present. However, glacial moraines are present on all three sides of Arcadia, and these hills are primarily wooded with hardwoods.

Water levels in Arcadia Lake are controlled by water levels in Lake Michigan. When water levels are low in Lake Michigan, the level of Arcadia Lake will drop correspondingly. For example, Lake Michigan levels in 2012 were very low. Because of this, the area immediately upstream of M-22 (Fig. 1) does not have standing water except where Bowens Creek flows through. In periods of high water on Lake Michigan, that area can have standing water and a more lacustrine appearance.

Historically, Arcadia was a lumber town, with several sawmills located on the lake. Some areas of the lake still have large amounts of slabwood blanketing the lake bottom including some shoreline areas. The rest of the lake has substrates that consist of sand and organic material. Some gravel is present in and around the channel leading to Lake Michigan. One issue of concern on Arcadia Lake is that of Eurasian watermilfoil, which currently dominates the aquatic macrophyte community in the main basin of the lake, making much of it unusable for boating, swimming, and fishing. The low water levels in recent years have exacerbated the problem.

The majority of the land surrounding Arcadia Lake is privately owned. The only boat launch on Arcadia Lake is in the Village of Arcadia at Veteran's Memorial Park. The park includes a launch, marina facility, and a universally accessible fishing pier, and is operated by Arcadia Township.

History

Unlike many other inland lakes in Michigan, Arcadia Lake does not have a long fish stocking history. In fact the only known fish stocking events took place in 2011 and 2012, when lake-run brown trout were stocked by MDNR. The goal of the brown trout stocking program is to create a fishery in Lake Michigan. Prior to 2011, the brown trout that are now stocked into Arcadia Lake were stocked into Portage Lake to the south. The stocking location was moved from Portage Lake to Arcadia Lake to avoid likely walleye predation in Portage Lake. Portage Lake is stocked and managed for walleye by MDNR, while Arcadia Lake is not. The brown trout fishery created by this stocking effort is typically a spring fishery, taking place during March, April, and early May. The appeal for anglers is that the fishery is typically a shallow water, near-shore fishery that does not require large boats or expensive equipment. While much of the angling effort involves trolling along the lake Michigan shoreline, brown trout are also caught in Arcadia Lake each spring. In addition, anglers fishing the Arcadia piers and the beaches adjacent to the piers also catch the stocked brown trout.

Arcadia Lake is unique in that it has not been previously surveyed by MDNR Fisheries Division. Most inland lakes in Michigan have had fisheries surveys conducted on them numerous times, often starting in the 1930s or 1940s. Despite this, Arcadia Lake has long had a good reputation as a fishing lake. In addition to its spring brown trout fishery, it is known for its good fishing for yellow perch, northern pike (both summer and through the ice) and bass, both largemouth and smallmouth. It is known as a very good bowfishing lake for common carp, particularly during the June spawning period. Migratory salmonids like Chinook salmon (fall) and steelhead (late fall, winter, and early spring) can also be caught from Arcadia Lake at times.

There have been six entries into the MDNR Master-Angler program from Arcadia Lake in recent years. Species entered include three common carp, one smallmouth bass, one walleye, and one channel catfish. Arcadia Lake is a popular destination for bowfishing for carp, so the presence of Master Angler-sized carp is not surprising. The walleye and smallmouth bass were both particularly impressive. The walleye was 34 inches long, and caught in 2002. The smallmouth bass was 25 inches long and caught in 2003. Both fish were catch and release entries.

At one time, Arcadia Lake was home to the State Record brown trout. The record fish was caught in 1984 and weighed 34 lbs 6 oz. It was caught by Robert Henderson of Vestaburg, Michigan, while trolling with an Eppinger Copy Cat spoon. The Henderson brown trout stood as the Michigan state record until 1998 when a larger brown trout was caught from Lake Michigan. Mr. Henderson's brown trout was also considered the world record for several years.

Current Status

The first comprehensive fisheries survey of Arcadia Lake was conducted in the summer of 2012. Status and trends netting protocols (Wehrly et al. 2009) were used for the survey. The netting portion of the survey took place from June 4 through June 8. Gear used included one large-mesh fyke net (4 net-nights), four trap nets (17 net-nights), and three experimental graded-mesh inland gill nets (3 net-nights). Seining and electrofishing were conducted on July 16, 2012. A total of six seine hauls were completed, along with three ten-minute electrofishing transects conducted with an 18 foot

boomshocking boat. The purpose of this survey was to investigate the status of all fish populations in Arcadia Lake.

During the 2012 MDNR survey of Arcadia Lake, a total of 2,012 fish representing 32 species were caught. During the June netting portion of the survey, a total of 1,390 fish were caught, representing 21 different species (Table 1). Brown bullhead were the most frequently collected species, with a total of 581 caught (from 7-12 inches), representing 41.8% of the total catch by number and 19.1% by weight. Although not as numerically abundant, bowfin and northern pike also represented a significant proportion of the biomass, at 15.9% and 16.9% of the catch by weight respectively. Panfish species present in the 2012 netting catch (Table 1) included black crappie (56 from 5-11 inches), bluegill (86 from 4-9 inches), pumpkinseed sunfish (65 from 4-8 inches), and yellow perch (23 from 5-13 inches). Game fish species caught in the netting portion of the 2012 survey included northern pike (99 from 19-35 inches), walleye (39 from 14-29 inches), largemouth bass (25 from 9-18 inches), smallmouth bass (15 from 12-20 inches), and one 28 inch rainbow trout (steelhead).

During the July seining and electrofishing portion of the 2012 survey of Arcadia Lake, a total of 622 fish were caught, representing 22 different species (Table 2). The most frequently collected species during seining and electrofishing included smallmouth bass (163 from 1-17 inches) and yellow perch (171 from 1-11 inches). Other panfish and gamefish species captured included black crappie, bluegill, largemouth bass, northern pike, pumpkinseed sunfish, and rock bass. Other nongame species present included banded killifish, bluntnose minnow, bowfin, brown bulhead, golden redhorse, golden shiner, longnose gar, logperch, mimic shiner, round goby, sand shiner, silver redhorse, spottail shiner, and white perch.

In the 2012 Arcadia Lake survey, most species caught showed average or above-average growth (Tables 3 and 4), with the exceptions being northern pike and yellow perch. In both of those species, slower growth was seen in younger individuals, while older age groups seemed to be growing faster. Arcadia Lake walleye were growing particularly fast. Walleye aged 3, 7, and 9 were growing 2.8 inches faster than the state average for those respective age classes.

Analysis and Discussion

Arcadia Lake possesses a relatively healthy and diverse fish community that is similar to other "drowned rivermouth lakes" along the northwestern coast of Michigan, including Manistee Lake (Tonello 2010) and Betsie Lake (Seites and Tonello 2009). It has a well-represented population of popular panfish species, including bluegill, pumpkinseed, black crappie, and yellow perch. All of these species had a high percentage of "catchable" sized fish caught in the 2012 survey. It is likely that yellow perch in particular migrate into Arcadia Lake from Lake Michigan for spawning purposes. There does also seem to be a "resident" population of yellow perch in Arcadia Lake as well. The resident fish are sometimes distinguishable from Lake Michigan fish by their smaller size and darker yellow coloration. The Lake Michigan yellow perch tend to be larger and more silvery. Arcadia Lake has a very good reputation for its yellow perch fishery.

The gamefish populations of Arcadia Lake are also very healthy. The 2012 survey showed that the northern pike population is very robust. Arcadia Lake has long been known for its northern pike fishery. Largemouth and smallmouth bass fishing opportunities are also very good based on angler

reports, although the netting survey did not find large numbers of adult bass present. The Eurasian milfoil infestation makes fishing (and survey netting) for bass difficult in the main basin of the lake. The bass fishery would likely be improved if the Eurasian milfoil was brought under control.

Although anglers have reported catching the occasional walleye in Arcadia Lake, the presence of large numbers of walleye in Arcadia Lake was not anticipated. All the walleye caught in the 2012 survey were caught during the early June netting effort, while none were caught in the July electrofishing effort. Also, most of the fish caught were larger adults (the average size was 22 inches), with the smallest fish caught being 14 inches. Therefore we suspect that these fish are transient and not year-round residents of Arcadia Lake. Nearby lakes including Portage, Upper Herring, and Lower Herring Lakes are stocked regularly with walleye, and Manistee Lake also has a very large natural walleye population. Most likely some of the fish from these lakes migrate out to Lake Michigan after spawning, move into Arcadia Lake seeking warmer water and richer forage opportunities, and then move back out to Lake Michigan, possibly to seek cooler water. A similar phenomenon has been observed on Pere Marquette Lake (Fisheries Division Files, Cadillac). Walleye growth rates on "connected" lakes like Arcadia (+2.8), Pere Marquette (+3.9), and Portage (+3.7; Seites 2009) were much greater than those typically observed in true inland lakes in the northwestern Lower Peninsula.

The biggest issue negatively impacting Arcadia Lake is Eurasian milfoil. By late spring the main basin of the lake becomes virtually unfishable, except for a small, deeper area located near the outlet channel. Once the milfoil reaches the surface, other activities like swimming, boating, and waterskiing become very difficult or impossible. Although the fish populations of Arcadia Lake are very good, they could be even better if the Eurasian milfoil was brought under control.

Management Direction

Arcadia Lake should be managed primarily for its native gamefish and panfish species, including largemouth bass, smallmouth bass, northern pike, bluegill, pumpkinseed sunfish, black crappie, and yellow perch. Walleye will likely remain a seasonal component of the fish community, but Arcadia Lake does not possess the appropriate habitat for a self-sustaining population to form. The stocking of brown trout into Arcadia Lake should continue as the brown trout fishery on Lake Michigan is very popular, and the fishery is based almost entirely on stocked brown trout. The brown trout stocking effort provides opportunity for Lake Michigan anglers in March, April, and May when other species (like Chinook and coho salmon) are not typically found in the area.

Although fishing for the native fish species in Arcadia Lake is already good, controlling the Eurasian milfoil infestation would improve the both the fish populations and the fishing opportunities on Arcadia Lake. This endeavor would likely involve the use of a systemic herbicide like 2,4-D. Mechanical harvesting is usually ineffective for Eurasian milfoil, as it is capable of rapid regrowth. Also, Eurasian milfoil can reproduce by fragmentation, so fragmentation that occurs during harvesting can spread the species to new areas.

It is recommended that follow up fisheries surveys of Arcadia Lake be conducted in the future. Periodic fisheries surveys will allow fisheries personnel to monitor the fish population dynamics occurring in the lake. However, current budgetary and personnel constraints on DNR Fisheries Division will likely not allow for more frequent sampling in the near future. Unless major changes

occur within Fisheries Division, it is unlikely that another netting survey will be conducted on Arcadia Lake within the next ten years.

Any remaining riparian wetlands adjacent to Arcadia Lake should be protected as they are critical to the continued health of the lake's aquatic community. Future unwise riparian development and wetland loss may result in deterioration of the water quality and aquatic habitat. Healthy biological communities in inland lakes require suitable natural habitat. Human development in the Bowens Creek watershed, along the Arcadia Lake shoreline, and in the lake proper has a tendency to change and diminish natural habitat. Appropriate watershed management is necessary to sustain healthy biological communities, including fish, invertebrates, amphibians, reptiles, birds and aquatic mammals. Generally for lakes this includes maintenance of good water quality, especially for nutrients; preservation of natural shorelines, especially shore contours and native shoreline vegetation; and preservation of bottom contours, native aquatic vegetation, and wood structure within a lake. Guidelines for protecting fisheries habitat in inland lakes can be found in Fisheries Division Special Report 38 (O'Neal and Soulliere 2006).

References

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Fig. 1. Arcadia Lake, Manistee County, MI.

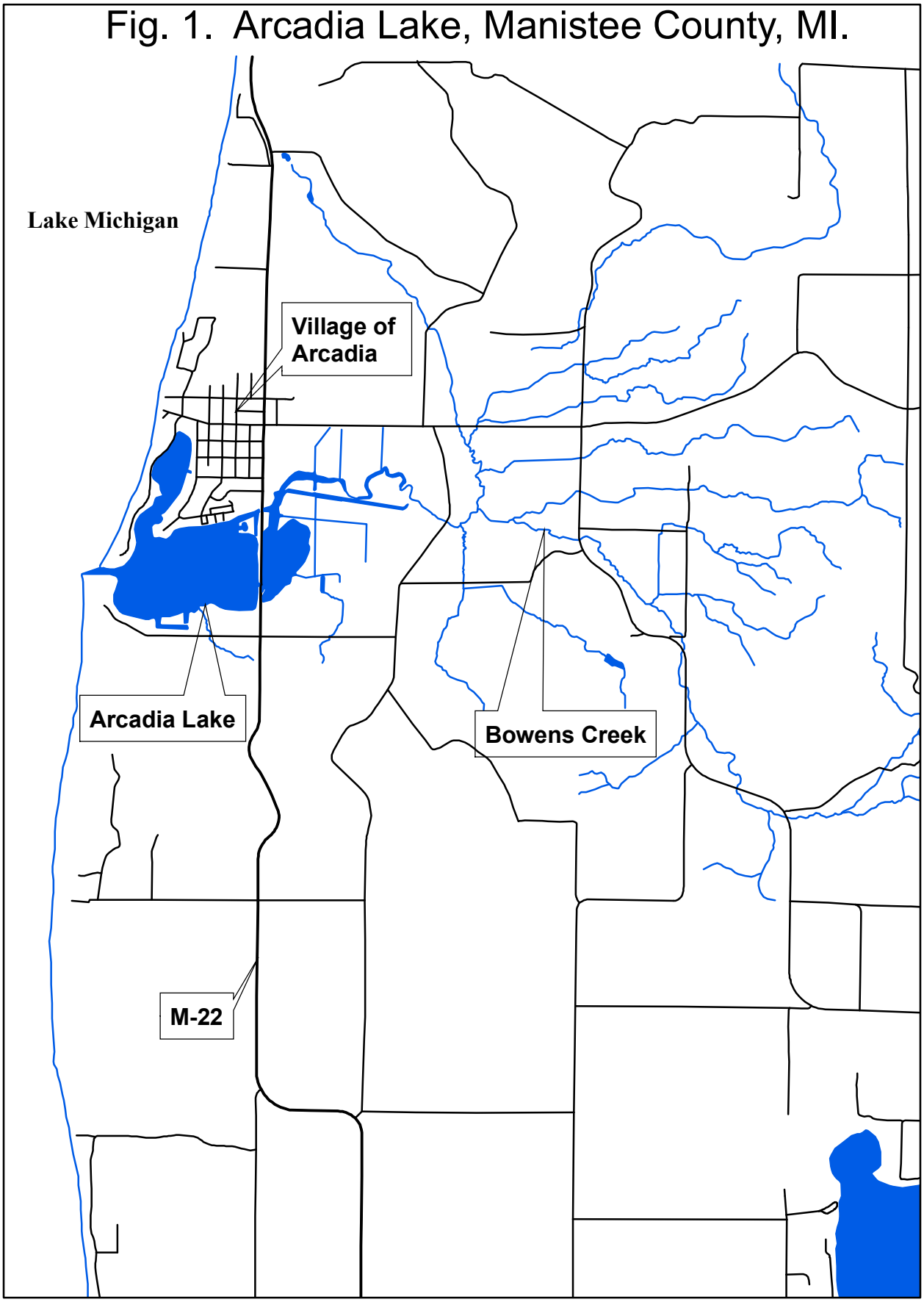

Table 1. Number, weight, and length of fish collected from Arcadia Lake with large mesh fyke nets, trap nets, inland gillnets, on June 4-8, 2012.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
alewife	8	0.6	0.5	0.0	5-6	6.4	
black crappie	56	4.0	18.4	1.0	5-11	8.2	93 (7")
bluegill	86	6.2	20.2	1.1	4-9	6.8	76 (6")
bowfin	54	3.9	301.2	15.9	19-31	24.9	
brown bullhead	581	41.8	361.1	19.1	7-12	10.9	
common carp	10	0.7	108.3	5.7	19-34	28.1	
freshwater drum	21	1.5	50.4	2.7	15-21	17.4	
gizzard shad	6	0.4	15.9	0.8	16-20	19.0	
largemouth bass	25	1.8	42.6	2.3	9-18	14.2	60 (14")
longnose gar	16	1.2	44.9	2.4	26-35	30.8	
northern pike	99	7.1	319.9	16.9	19-35	24.1	44 (24")
pumpkinseed	65	4.7	20.4	1.1	4-8	7.1	92 (6")
rainbow trout	1	0.1	8.4	0.4	28-28	28.5	100 (8")
rock bass	180	12.9	89.0	4.7	4-10	8.5	91 (6")
shorthead redhorse	5	0.4	14.5	0.8	14-24	18.9	
silver redhorse	57	4.1	176.8	9.4	14-26	21.2	
smallmouth bass	15	1.1	38.0	2.0	12-20	16.7	93 (14")
walleye	39	2.8	149.9	7.9	14-29	21.9	95 (15")
white sucker	33	2.4	93.0	4.9	14-22	19.0	
yellow bullhead	10	0.7	5.7	0.3	9-11	9.6	100 (7")
yellow perch	23	1.7	10.6	0.6	5-13	8.7	83 (7")
Total	1,390	100	1889.7	100			

[1]Note some fish were measured to 0.1 inch, others to inch group: e.g., "5"=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

[2]Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 2. Number, weight, and length of fish collected from Arcadia Lake by seining and electrofishing on July 16, 2012.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
banded killifish	9	1.4	0.0	0.0	2-2	2.5	
black crappie	6	1.0	2.5	1.9	8-9	9.2	100 (6")
bluegill	10	1.6	1.4	1.1	3-7	5.6	30 (6")
bluntnose minnow	3	0.5	0.0	0.0	2-3	2.8	
bowfin	4	0.6	10.0	7.6	10-25	17.3	
brown bullhead	6	1.0	3.4	2.6	9-11	10.5	
golden redhorse	2	0.3	2.4	1.8	14-15	15.0	
golden shiner	4	0.6	0.1	0.1	2-5	3.3	
largemouth bass	54	8.7	30.7	23.5	1-16	6.1	26 (14")
longnose gar	2	0.3	0.4	0.3	6-17	12.0	
logperch	6	1.0	0.1	0.1	3-4	3.7	
mimic shiner	8	1.3	0.0	0.0	1-2	2.4	
northern pike	1	0.2	2.5	1.9	22-22	22.5	0 (24")
pumpkinseed sunfish	57	9.2	9.8	7.5	1-7	5.9	44 (6")
round goby	37	5.9	0.0	0.0	1-3	2.4	
rock bass	58	9.3	11.2	8.6	3-9	6.1	47 (6")
sand shiner	8	1.3	0.0	0.0	2-2	2.5	
silver redhorse	6	1.0	14.9	11.4	14-21	19.5	
smallmouth bass	163	26.2	35.4	27.0	1-17	4.8	4 (14")
spottail shiner	2	0.3	0.0	0.0	1-1	1.5	
white perch	5	0.8	0.8	0.6	6-7	6.9	20 (7")
yellow perch	171	27.5	5.3	4.0	1-11	3.1	3 (7")
Total	622	100	130.9	100			

[1]Note some fish were measured to 0.1 inch, others to inch group: e.g., "5"=5.0 to 5.9 inch, 12=12.0 to 12.9 inches; etc.

[2]Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 3. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Arcadia Lake with trap nets, fyke nets, and inland gill nets, June 4-8, 2012. The number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary or calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

				Age									Mean Growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Index
Black crappie		6.1 (7)	8.0 (21)	8.5 (3)	10.2 (6)	11.9 (2)								+0.1
Bluegill			5.4 (10)	6.4 (14)	7.3 (9)	7.9 (8)	8.7 (4)	9.5 (1)						+0.3
Largemouth bass		9.6 (2)	11.7 (5)	13.2 (4)	15.0 (4)	15.5 (2)	16.0 (6)	17.8 (1)	18.0 (1)					+0.2
Northern pike			21.2 (21)	23.8 (41)	25.8 (15)	28.3 (2)	32.3 (3)	35.1 (1)						-0.4
Pumpkin-seed			4.5 (1)	5.8 (4)	6.8 (14)	7.5 (6)	8.0 (1)	8.1 (2)						+0.6
Rock bass		4.2 (1)	5.1 (5)	6.4 (18)	7.6 (10)	8.2 (7)	9.0 (8)	9.4 (7)	9.9 (2)	10.0 (5)	10.2 (4)	10.4 (4)	10.6 (1)	+0.1
Smallmouth bass				14.3 (4)	15.8 (4)	17.0 (1)	17.6 (2)	18.3 (1)	19.0 (1)		20.3 (1)			-
Walleye			16.4 (9)	19.1 (3)	20.7 (4)	21.2 (4)	23.7 (7)	25.3 (3)	26.1 (5)	25.8 (3)				+2.8
Yellow perch			6.1 (3)	6.1 (3)	7.9 (5)	9.3 (1)	10.4 (4)	11.6 (3)	12.8 (2)	13.5 (2)				-0.8

Table 4. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Arcadia Lake by electrofishing and seining, July 16, 2012. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

	Age										Mean Growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	XIII	Index
Black crappie			8.7 (4)	9.2 (2)							-
Bluegill		5.4 (3)	5.6 (1)	6.0 (2)		7.4 (2)					-
Largemouth bass			13.3 (1)	14.4 (3)	15.6 (2)	15.5 (5)	16.0 (5)				-0.1
Northern pike			22.5 (1)								-
Pumpkinseed		4.8 (2)	5.6 (9)	6.8 (10)	7.3 (7)	7.4 (2)					+0.8
Rock bass		4.3 (3)	5.6 (12)	6.4 (10)	7.4 (10)	8.2 (3)	8.7 (3)			9.6 (1)	+0.2
Smallmouth bass	5.3 (19)	9.4 (27)	12.4 (6)	15.3 (3)	17.6 (1)	17.2 (3)					+0.6
Yellow perch	4.2 (4)	5.1 (15)	5.8 (6)	7.5 (1)	7.0 (1)		10.2 (2)		11.7 (1)		-0.8