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Pond and Lake Management

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Aquatic Weed Control

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Fish Population Surveys

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Electrofishing Surveys

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Fish for Lake Stocking

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Pond and Lake Aeration Systems

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Waterfowl Habitat Management

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Stream Surveys

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Fish Elimination

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Water Quality Management

2015

Fish Population Survey

Arrowhead Lake

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INTRODUCTION

On September 1, 2015 a fish population survey was conducted on Arrowhead Lake by Aquatic Environment Consultants, Inc. The purpose of this survey was to collect data on the fish population, identify problems with the lake and update a management plan for the lake. Data that related to water quality, fish habitat and the fish population was collected.

MANAGEMENT GOAL

Arrowhead Lake has an established fish population that has reached its carrying capacity. It is a shallow lake relative to its size and contains some areas that are difficult to access. The goal is to manage the fish population in such a way as to maintain a healthy, balanced fishery that provides an enjoyable angling experience. Special emphasis will be made on managing the predator population that consists of largemouth bass, chain pickerel and black crappie. Each species will be evaluated regarding its growth rate, size and reproductive potential.

FISH POPULATION MANAGEMENT

Freshwater lakes have fish populations that are composed of fish that fall into one of two categories. They are classified as either a predator or forage fish. The predator fish feed on the forage fish. In a "balanced" population, predator fish will prevent the forage fish from overpopulating. Also, there are about three to four pounds of forage fish for every pound of predator fish in a "balanced" population. In some fish populations, the predator fish are removed much faster than the forage fish and the population quickly shifts to one that is "out of balance". The opposite can also be true where there is an under harvest of the predator fish causing them to become stunted and slow growing. Certain predator species work better with certain forage species. In general, a forage fish works well with a predator that shares the same habitat. The spawning period for the forage fish should be shortly after the spawning period for the predator. The reason for this delay is that the young of the year predators will have a supply of newly hatched forage fish that are small enough for the predators to eat. If the forage fish hatch before the predator, the forage fish are too large for the predator fish to eat when they hatch. A good example of this relationship is that of the largemouth bass and bluegill. Bluegills spawn after the largemouth bass, share the same habitat and provide good forage for the young of the year largemouth bass.

The first goal in the management of the fish population in any water body is to match the proper predator fish with the proper forage fish. Once this is accomplished, the object is to manage the forage fish population to produce large numbers of young fish on which the predators can feed. The predator fish must also be maintained in large enough numbers to prevent the forage fish from overpopulating. As the forage fish overpopulate, they stunt out, their reproduction decreases and the fish population of the entire water body deteriorates. The opposite can also be the case where the

predator fish numbers are too high for the available forage base causing overcrowding of the predator fish resulting in stunted growth and poor weights.

FISH POPULATION SURVEY METHODS

Fish populations were sampled using an electrofishing boat equipped with a 4000 watt VVP electrofishing unit. The electrofishing boat was used to sample the lake for the various species of fish. Electrofishing took place along the shoreline and was used to sample around the structure found in the lake.

FISHES PRESENT

Common Name	Scientific Name
Largemouth Bass	*Micropterus salmoides*
Chain Pickerel	*Esox niger*
Smallmouth Bass	*Micropterus dolomieui*
Bluegill	*Lepomis macrochirus*
Pumpkinseed	*Lepomis gibbosus*
Yellow Perch	*Perca flavescens*
Black Crappie	*Pomoxis nigromaculatus*
Brown Bullhead	*Ictalurus nebulosus*
Golden Shiner	*Notemigonus crysoleucas*
White Sucker	*Catostomus commersoni*
Carp	*Cyprinus carpio*

Largemouth Bass

The largemouth bass is one of the main predator in the fish population. The majority of this fish's diet is composed of smaller forage fish in the lake. It feeds well on small sunfish and golden shiners. The largemouth thrives best in shallow, weedy lakes or in river backwaters. Largemouth bass prefer weedy habitats not only because their food supply is available in those areas, but also because aquatic plants and sunken debris furnish protection. The largemouth bass population in Arrowhead Lake is composed of various fish sizes. Largemouth bass were sampled in a variety of inch classes up to 18 inches. Fish over 11 inches were found in less than desirable numbers. Reproduction from 2015 was good. These young bass were 3 to 5 inches in length and appeared to be growing at a good rate.

Chain Pickerel

Chain Pickerel are usually found where larger species of pike are either rare or absent. Chain Pickerel grow rather quickly and can reach 14 inches in 3 years. It takes about 6 years to attain a length of 20 inches and if it survives to the probable maximum of 10 years, it should be 36 inches long and weigh approximately 9 pounds. Chain pickerel sampled during the survey were a variety of sizes. Older fish

(over 1 year old) ranged in size from 9 to 18 inches. The 2015 reproduction sampled during the survey was fair. These small fish ranged in size from 4 to 6 inches and were observed throughout the lake. Their growth rate for the summer of 2015 was normal for northeastern Pennsylvania. Lower than desirable numbers of chain pickerel were sampled during the survey. The chain pickerel are good predators and should remain in the lake.

Smallmouth Bass

The smallmouth bass is usually found in rocky locations in lakes and streams. They prefer clear, rocky lakes with a minimum depth of 25 to 30 feet and temperatures in the summer no less than 60°F and no more than 80°F. In streams, this bass prefers a good percentage of riffles flowing over gravel, boulders or bedrock. Smallmouth bass prefer a slightly different food supply than largemouth bass. The first food for smallmouth consists of minute crustaceans and later it graduates into insect larvae, crayfish and fish. Several smallmouth bass were found during the survey. This is the first time that smallmouth bass have been sampled in Arrowhead Lake. One large fish (21 inches) and two smaller fish (7-9 inches) were collected during the survey. They appear to be healthy and growing at a good rate.

Bluegill

The bluegill is a species of sunfish that prefers quiet, weedy waters where they can hide and feed. In the daytime the smaller fish are close to shore in coves and under docks. The larger bluegills prefer the adjacent deeper waters in the daytime but move into shallow areas in the morning and evening to feed. Bluegills also work well in a predator-prey relationship with largemouth bass. Bluegills also spawn after the bass, which gives the young of the year bass a good supply of food for growth their first year. Bluegills tend to spawn more often during the summer than pumpkinseeds, resulting in a larger food supply for the young bass. The bluegill population is in good balance with the predator fish population. Bluegills are spawning very well and the adult bluegills are large and healthy. Many one to two inch bluegills were sampled during the survey.

Pumpkinseed

The pumpkinseed is a species of sunfish that inhabits standing water with soft bottoms covered with sunken plant material. It prefers weed patches, docks and logs for cover, and is most often found in these locations. These sunfish are a species that work well in a predator-prey relationship with the largemouth bass. Pumpkinseeds spawn after the bass, which gives the young of the year bass a good supply of food for growth that first year. The pumpkinseed population appears to be very healthy with a good growth rate. The pumpkinseed population is comparable in size to that of the bluegill. Pumpkinseeds are reproducing at a desirable rate.

Yellow Perch

This is the most widely distributed member of the perch family. The perch is at home in small and large lakes alike and though found in rivers, it is considered primarily a lake fish. Lakes with cool, clean, water and ample amounts of sandy or rocky bottom make better perch lakes. The yellow perch works well as a forage fish with chain pickerel and walleye. They do not work as well with largemouth bass since they prefer a slightly different habitat. Yellow perch in a variety of sizes were sampled during the survey. Large numbers of yellow perch were sampled in the 3 to 6 inch ranges and are overcrowded.

Black Crappie

The black crappie is another predator species found in Arrowhead Lake. The black crappie is a popular freshwater panfish found throughout the United States. The black crappie likes quiet waters and prefers more vegetated areas than the white crappie. The black crappie is strictly carnivorous, feeding on small fishes, aquatic insects and crustaceans. Large numbers of black crappie are present in the lake. In fact, the crappie population is present in such high numbers that it is competing with the largemouth bass population. Most crappies in the sample were 7 to 14 inches in size.

Brown Bullhead

Brown bullheads are a medium size slender-bodied catfish. Bullheads are an omnivorous feeder and will feed on anything from plant material to fish. Being a bottom feeder, however, a major portion of its diet is composed of insect larvae and mollusks. All bullheads sampled during the survey were 10 to 12 inches in size. The population appears healthy and not a real concern in the management of the lake.

Golden Shiner

The golden shiner is a fish found in relatively clear, weedy lakes and quiet streams. Although schools may be found in openwaters, they are not often far from weed beds. Golden shiners are a desirable forage fish for largemouth bass. Bass can eat a large shiner, which aids in a faster growth rate. Most of the golden shiners were sampled in the 4 to 6 inch size ranges. Golden shiners in these size ranges are ideal forage for the predator fish in the lake.

White Sucker

The white sucker is quite tolerant of a great variety of conditions. It prefers large streams and the deeper water of impoundments. White suckers feed on a variety of foods, including aquatic insect larvae, crustaceans, mollusks and algae. Numerous white suckers were sampled during the survey.

Common Carp

Common carp were sampled during the survey. They are commonly found in lakes in the Pocono region. No recommendations are being made for the management of this species as they are not having a significant impact on the fishery.

FISH MANAGEMENT ARROWHEAD LAKE

Results of the fish population survey indicate that the fish population in Arrowhead Lake is what would be classified as balanced but leaning towards having too few predators. The predator fish (largemouth bass and black crappie) population is in relatively good balance with the sunfish (bluegill and pumpkinseed) population. While there is a desirable number of predator fish in the lake, it is composed of a higher number of black crappie than largemouth bass. This is not necessarily a bad thing it just means that there is a low number of bass to be caught. Usually largemouth bass will outnumber the black crappie. As figure 1 indicates, largemouth bass are spawning well, but there are less than a desirable number of larger bass present. While there has been some stocking of medium sized largemouth bass, they do not seem to be surviving very well. The bass that were stocked during the summer of 2015 were silver colored which made them noticeably different from the native bass. They also contained fungus on their fins and were present in poor numbers. The best time to stock bass is in the fall of the year when water temperatures are cooler and fish are less susceptible to stress. They should also be obtained from a supplier that has fingerlings from similar water quality.

The yellow perch is a forage species that works better in a relationship with predators such as chain pickerel and walleye. While largemouth bass will feed on yellow perch, bluegills and pumpkinseeds are a better forage fish for them. Largemouth bass prefer softer non-spiny forage such as small sunfish and golden shiners. While they will eat yellow perch, they are not a preferred forage species due to their rough spiny texture. Results of the survey show that there are very high numbers of 3 to 6 inch yellow perch in Arrowhead Lake. Over population of yellow perch will continue if the proper predator population is not maintained in the lake. While chain pickerel feed on yellow perch, walleye are a better suited predator. Walleye were stocked in the fall of 2013 and 2104 to help manage the yellow perch population. Walleye are members of the perch family and share the same habitat. Walleye were not sampled during the 2015 survey. The main reason for not finding them during the survey is that their relative numbers are low and they can be difficult to sample in some lakes. No walleye were stocked in 2015. Our recommendation is that you continue stocking 1000, 6 to 8 inch walleye in the fall of the year for the next three years.

In order for Arrowhead Lake to sustain a high quality fish population, a proper management plan must be followed. The main goal of the management plan is to maintain a desirable number of predator fish in the lake. A desirable number of predators will result in a desirable number of forage fish in the lake. By controlling the number of forage fish, they will not over populate and stunt out; but rather continue to

grow and reproduce well. The higher reproduction will result in an increase in the food supply for young of the year predator fish. This process will maintain a healthy predator population.

Largemouth bass should be stocked in the fall of each year. Our recommendation is that you stock 750, 6 to 8 inch largemouth bass on an annual basis. Aquatic Environment Consultants, Inc. can provide these fish from a reliable hatchery. The fish population should also be sampled again in August or September of 2018. By studying the fish population on a regular basis, adjustments can be made to the management recommendations.

WATER QUALITY DATA

Total Alkalinity 19.2 mg/liter

Total alkalinity refers to the total concentration of bases in water expressed as milligrams per liter of equivalent calcium carbonate. Waters with total alkalinity of less than 20 mg/liter usually have little available carbon dioxide to permit growth of plankton which is the main source of food for bluegills and other forage fish in your lake. Since the alkalinity in your lake is less than 20 mg/liter, the growth of plankton may be limited. This limited growth of plankton will cause the pounds per acre of fish to be less than that of lakes with higher total alkalinity.

Total Hardness 22.0 mg/liter

The calcium concentration in water is normally expressed as calcium hardness in terms of equivalent calcium carbonate. Desirable levels for total hardness for fish production usually fall in the range of 20 to 300 milligrams per liter. Hardness is not as important as alkalinity but should be about the same numeric value. The hardness of your water is within the range of the total alkalinity.

pH 6.5

The desirable range for fish production is pH 6.5 to 9.0. Any pH value found in the range pH 4.0 to 6.5 is in the slow growth range. Very little if any reproduction will occur if the pH is in the range of pH 4.0 to 5.0. The acid death point for fish is around pH 4.0 or less. The pH in a lake will vary during the day based on weather conditions. Usually a lake's pH will be higher on a sunny day in the afternoon than it is in the morning. This variation is a result of the photosynthetic process of phytoplankton and other plants that are present in the lake. The pH of your water falls within the desired range and should continue to be checked on an annual basis.

WATER QUALITY MANAGEMENT

The water quality parameters that were tested during the survey indicate that the water quality is suited for fish production. However, the levels indicate that fish will grow at a slow rate and the carrying capacity for the water body will be reduced. The greatest concern that you should have at this time is preventing nutrients from entering the lake. The faster nutrients enter a lake, the faster it will age, resulting in more management problems. Management of nutrients entering Arrowhead Lake should be one of your greatest concerns for the long-term management of the lake.

CONCLUSION

Arrowhead Lake is a valuable resource that with proper management can produce exceptional recreational opportunities for years to come. The overall condition of the fish population is good; however, there is room for improvement. Management guidelines for the fish population should be followed in order to keep the population in balance. Water quality in the lake is good and very similar to other lakes located in the same region of the state. All nutrients entering the lake need to be controlled as much as possible. Aquatic Environment Consultants, Inc. will continue to work with Arrowhead Lake Community Association on the proper management of Arrowhead Lake.

RECOMMENDATIONS TO FOLLOW

- Stock 750, 6-8 inch Largemouth Bass each fall on an annual basis
- Stock 1000, 6-8 inch walleye in the fall of the year for 3 years.
- No harvest of any Largemouth Bass under 20 inches.
- Survey the fish population in August or September 2018.
- Strictly enforce harvest recommendations.
- Control nutrients that enter the lake.

TABLE 1

Survey Data on Arrowhead Lake taken 9-1-15

SPECIES	NUMBER SAMPLED	LARGEST FISH	MOST COMMON SIZE
Largemouth Bass	24	18"	4"-5"
Chain Pickerel	9	20"	18"-19"
Smallmouth Bass	3	21"	7"-9"
Bluegill	31	9"	1"-2"
Pumpkinseed	45	7"	1"-2"
Yellow Perch	117	11"	4"-6"
Black Crappie	31	14"	12"-13"
Brown Bullhead	4	12"	10"-12"
Golden Shiner	16	10"	4"-6"
White Sucker	7	17"	15"-16"
Carp	3	30"	

Figure 1

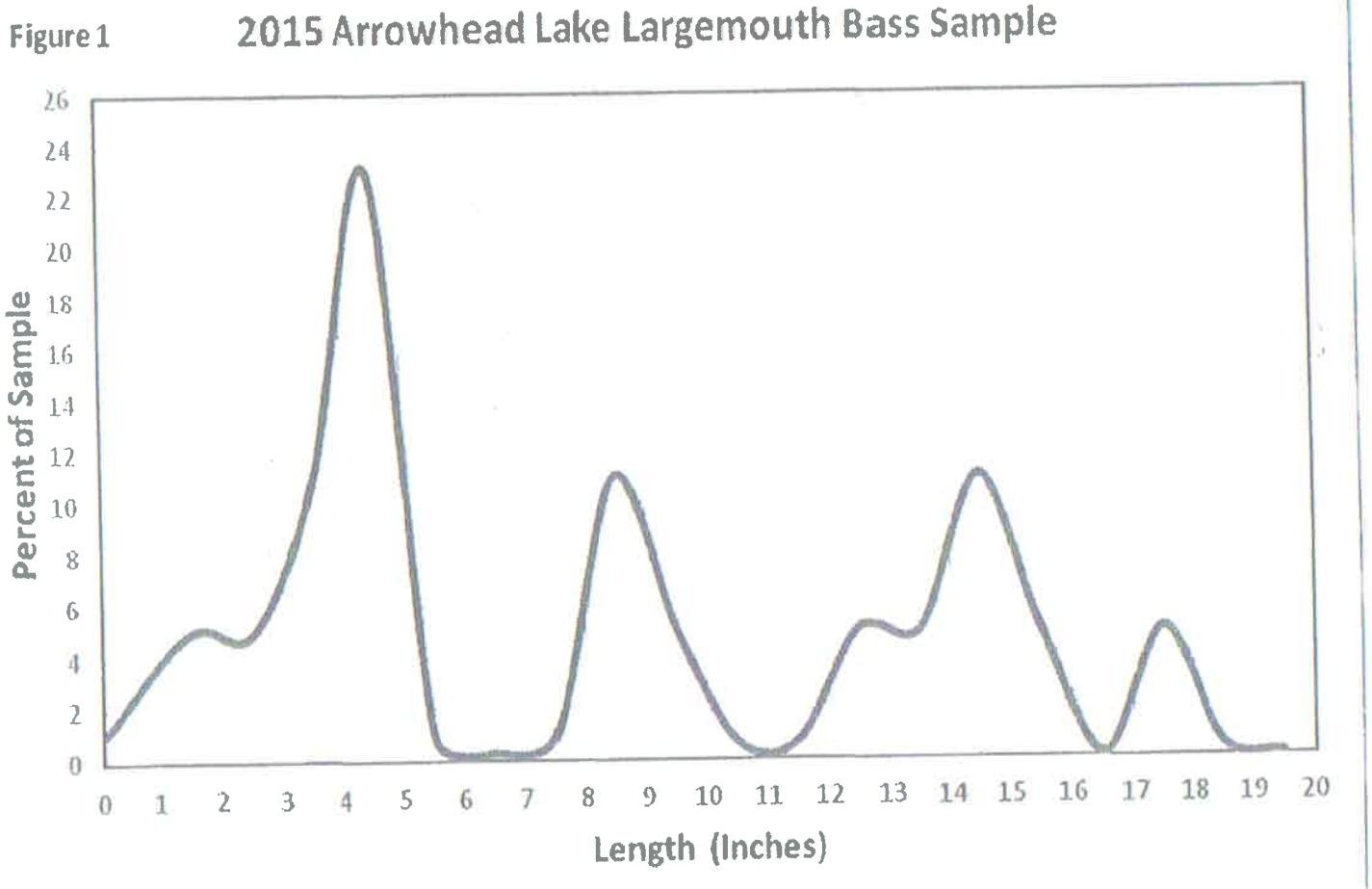

2015 Arrowhead Lake Largemouth Bass Sample
Percent of Sample
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Length (Inches)

Figure 2 2015 Arrowhead Lake Largemouth Bass Length / Weight Ratio

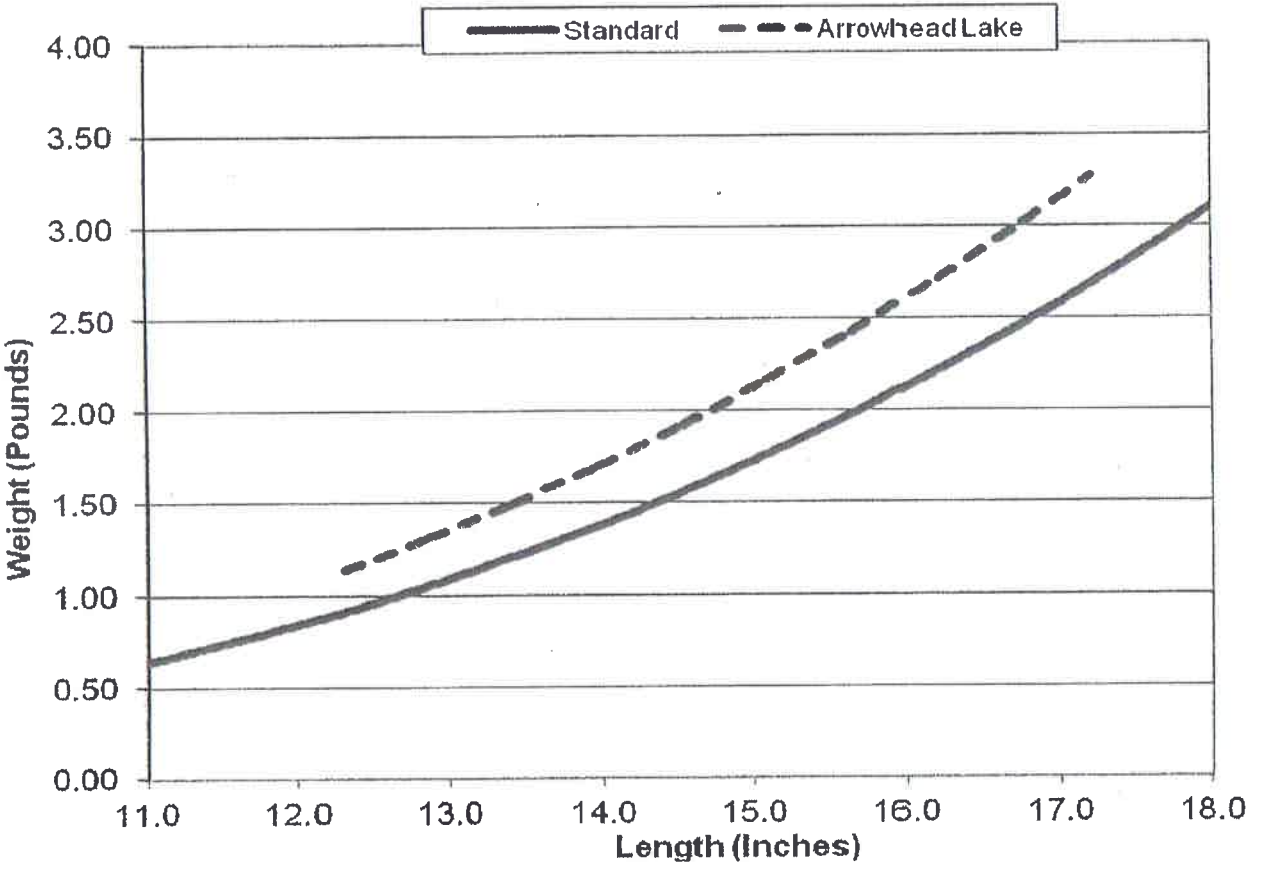
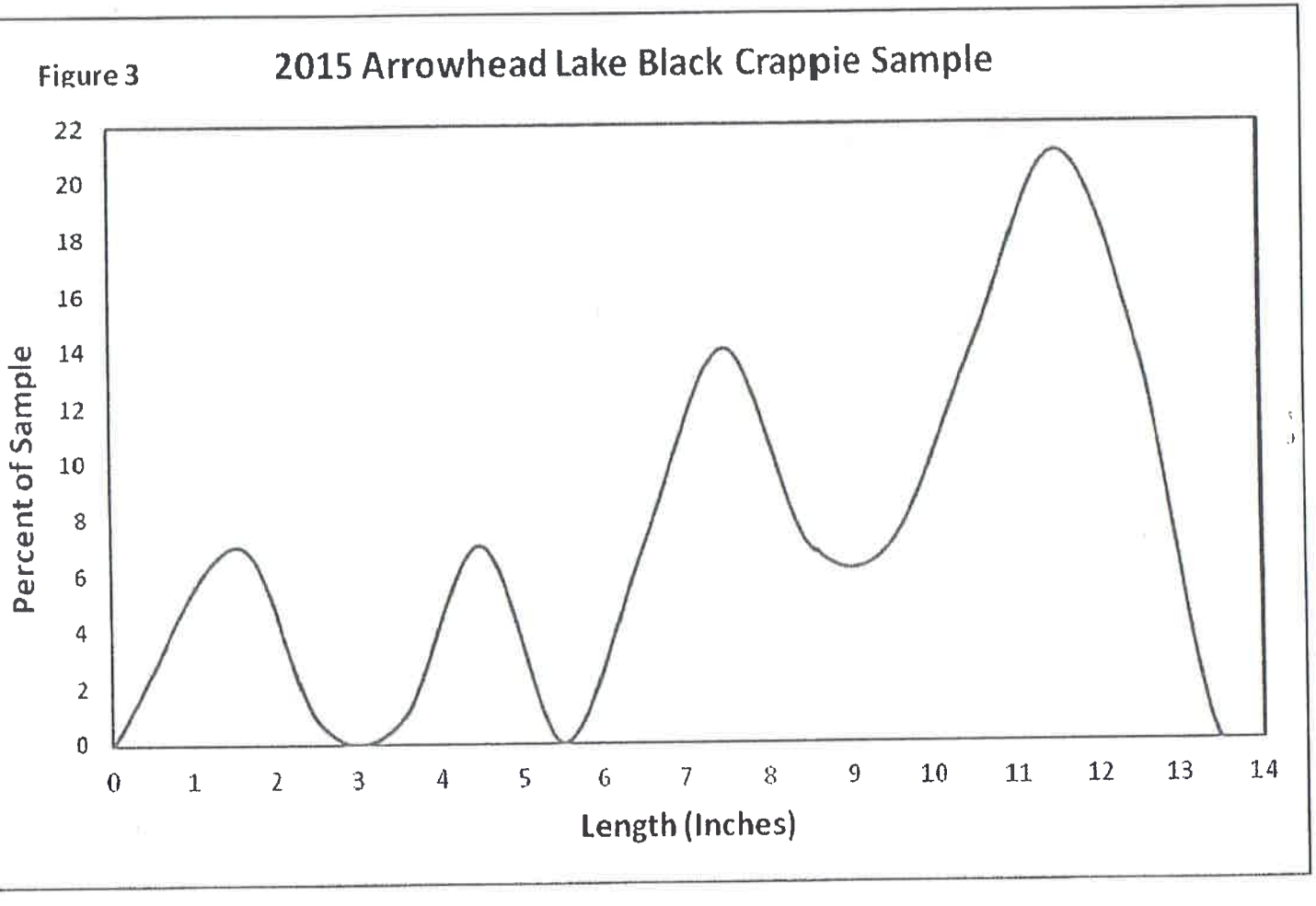


Figure 3


2015 Arrowhead Lake Black Crappie Sample
Percent of Sample
22
20
18
16
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Length (Inches)