Largemouth Bass Productivity Project
Research Update
5/16/15

Overview

Changing habitats in the waters and on the land surrounding Michigan's inland lakes are affecting the fish populations. Joe Nohner, a Ph.D. student at Michigan State University, is conducting a research project to assess the impacts of habitat change on Largemouth Bass. Largemouth Bass are a common and important gamefish in Michigan, and their growth and reproduction are potentially affected by changes to their habitats. In 2014, teams of researchers from Michigan State University conducted surveys of 16 lakes in Michigan's Lower Peninsula in order to study the impacts of habitat change on Largemouth Bass populations. This update provides a glimpse into a portion of the data collected during these efforts. The information it provides is a small part of a large, project expected to be complete in 2017. Those interested in learning more about the project can read about it at Fishingforhabitat.wordpress.com.

Introduction

Largemouth Bass *Micropterus salmoides* are an economically and ecologically important game fish distributed throughout the continental United States[1]. Largemouth Bass or Smallmouth Bass were targeted by 39% of freshwater anglers in 2011[2]. Ecologically, Largemouth Bass can influence the fish community in lakes through their predation on other fishes, making them important for the entire ecosystem[3]. However, the aquatic vegetation that Largemouth Bass utilize in some north temperate lakes is changing as human development intensifies.

Lakeshore development modifies the vegetation that Largemouth Bass utilize throughout their life history[1,4]. Age-0 Largemouth Bass are subject to greater predation in habitats without vegetation, because structural habitat provides small fishes with cover in which to hide[4]. Decreased emergent and floating vegetation abundances have been observed at developed sites in highly developed Wisconsin lakes[5], a pattern that is likely also occurring in Michigan lakes. While experiments have been conducted to test the effects of aquatic plants on Largemouth Bass[6, 7], these have typically occurred in situations where dense vegetation is suspected to limit growth.

We are studying 16 Michigan lakes (Figure 1) that span a range of aquatic vegetation coverages and other habitat features to assess the relationship between vegetation and age-0 Largemouth Bass growth and survival. We hypothesize that lakes with low amounts of aquatic vegetation will have decreased production of Largemouth Bass. Evidence for this hypothesis could include fewer offspring, slower growth rates, differences in diet, and potential stunted populations in Largemouth Bass inhabiting low-vegetation lakes. This information may be important for fisheries managers and the public as decisions impacting aquatic vegetation and important Largemouth Bass fisheries are made.



Michigan State University researchers conduct an electrofishing survey on Loon Lake (Photo: Zak Kranich)

Survey methods

In order to assess the influence of aquatic vegetation and other habitat features on Largemouth Bass, we conducted fish surveys and are comparing data from these surveys to maps of aquatic vegetation, docks, woody habitat, and other characteristics.

Our fish surveys were conducted using a boat electrofisher. Electrofishing is a common fish sampling technique that utilizes electricity to temporarily stun fish. A generator on the boat creates a current, which is adjusted to the proper settings to ensure that fish are not harmed. The electricity is applied to the water through electrodes on the boat, creating an electric field that is strong enough to stun fish about 10 feet out from the front of the boat on all sides. Stunned Largemouth Bass were removed from the water and placed in a livewell until they recovered. Complete recovery was the norm; only two Largemouth Bass required greater than five minutes to recover and most recovered in 2-4 minutes. When conducting sampling at a new lake, we conducted a test sample to ensure that the correct settings were used. We started the test sample electrofisher settings at a relatively low level and gradually increasing the intensity of the electric field until fish were stunned but able to recover. After the trial run, we observed stunned individuals from multiple fish species in order to ensure recovery and minimal effects.

We conducted two electrofishing surveys on each lake (with the exception of Lake X due to mechanical problems. The name of one lake, referred to here as Lake X, has been redacted to comply with privacy requests from the residents of this private lake). The first survey occurred in July, and targeted adult Largemouth Bass. The second survey occurred in October or November, and targeted both adult and young-of-year (those that hatched the previous spring) Largemouth Bass. Electrofishing surveys were conducted during the nighttime to increase efficiency, because fish are commonly found at shallower depths than during the daytime. We conducted 3-10 sampling transects along the shallow water zone of each lake in a night's worth of sampling. Only Largemouth Bass were captured, and all adult Largemouth Bass were released. We euthanized and retained up to 20 young-of-year Largemouth Bass (typically ~2-3 inches) in order to analyze their stomach contents. We collected the stomach contents of adult Largemouth Bass using a non-lethal gastric lavage technique, whereby stomach contents are flushed into a bucket using pressurized lakewater. Before releasing the fish, we measured the length and weight of Largemouth Bass and collected a scale sample to for fish age analysis later.

Preliminary survey results

In an effort to provide insight into the types of data being collected and some basic analyses that could be conducted, the preliminary results below offer general information on the lakes they

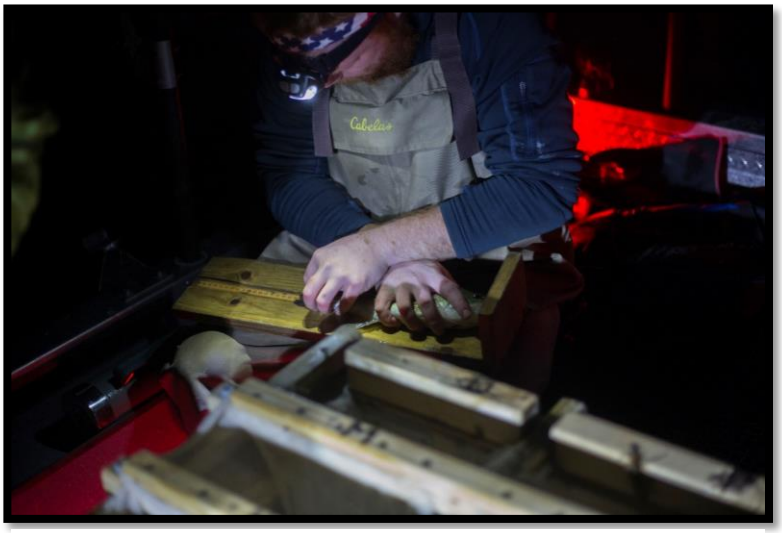
represent. It should be noted that these results are an incomplete picture, and management conclusions should not be reached without the consultation of relevant Department of Natural Resources biologists.

Fish population surveys found at least 22 fish species in the 16 lakes we surveyed. The species listed in Table 1 are those that we saw and could identify from our surveys; there are likely other species present that we did not observe. Therefore, the species list in Table 1 is likely an underestimate of the fish biodiversity in these lakes.

One way to assess the Largemouth Bass populations in each lake is to quantify how many are in the lake. Our sampling strategy didn't attempt to catch fish in all types of habitats, since we can only survey shallow areas. Therefore, we are able to produce a measure of *density* of fish in the areas we sampled. We also know that some fish will always escape despite our efforts to catch every one; therefore we know that our summaries are a *relative index of density*, not an absolute measure of how many fish were in the location sampled. Figure 2 shows our relative density indices, in terms of the number of Largemouth Bass we caught per minute of electrofishing during July 2014. Lakes with high densities included Harper, Gunn, Little Bass, Meauwataka, Reed/Rainbow, and Loon. Lakes with lower densities included Big, Hicks, Idlewild, and Pine.

The number or density of fish is not the only way to measure a population. Some lakes have high numbers of small fish while others have low numbers of large fish. We also looked at the condition of the fish in each lake. The condition factor is an indication of how heavy or light a fish is relative to its length. Fish condition can be influenced by environmental factors such as water temperature, structural habitat quality, and prey availability. We calculated the condition factor by dividing each fish's weight by the weight of an average fish of that length. Fish with condition factors greater than one are relatively heavy, while fish with condition factors less than one are relatively light for their length. Figure 2 illustrates the condition factor for fish in each lake during Fall 2014. Chief, Hicks, Todd, and Big lakes all had relatively high condition factors. Harper, Loon, North, and Gunn had lower condition factors.

The size distribution of fish in the lake provides a detailed snapshot of the Largemouth Bass population at a given time. Size distributions of Largemouth Bass in each lake from July 2014 are provided in Appendix 1. In many of the size distribution figures individual year-classes are apparent as clusters at a certain length. This is a product of fish that hatch in May or June of each year growing at a similar rate. For example, in Chief lake there were clusters of fish at 2.5, 5, 7.5, 10, 12, and 14 inches. One might assume that these age



Michigan State University researchers measure the length of a Largemouth Bass collected in a sample at Loon Lake before releasing it.

classes represent fish hatched in 2013, 2012, 2011, 2010, 2009, and 2008 respectively. However, there are a number of factors that make such assumptions unreliable. We are currently analyzing fish ages using scales to more reliably estimate growth rates. In addition, length distributions can be reviewed to estimate the effects of fishing. For example, a lake with many fish just below 14" but very few fish above 14" might show evidence for heavy fishing pressure. However, without data on the ages of fish such conclusions are just speculation. For example, such a pattern could also be explained by slow growth rates that result in fish spawning earlier and growing much slower once they reach sexual maturity.

In addition to conducting surveys of the Largemouth Bass populations in each lake, we also gathered habitat data from each lake. We mapped the aquatic vegetation, docks, and woody debris in the shallow (<5 feet depth) areas of each lake. Maps were produced during September 2014, when vegetation coverage was near its peak. We used a boat and handheld GPS unit to visually map vegetation in broad categories. Maps of vegetation and other habitat characteristics are still in production. They can be produced upon request. We collected Secchi depths at each lake, which are a measure of water clarity (Table 2).



Michigan State University researchers map aquatic vegetation in Chief Lake.

Next Steps

There is still much work to do! Our next steps for data collected in 2014 include continued work on both laboratory and computer analysis. We are continuing to analyze fish stomach contents collected in 2014 to determine their diets. We are also continuing to analyze scale samples collected during 2014 to determine the age of the Largemouth Bass we sampled. We will further analyze these fish data in comparison with habitat data to generate insights into the influence of lake habitat characteristics on Largemouth Bass.

In addition to laboratory and computer analyses, we hope to collect more data in 2015. The unusually cool and short summer that followed the cold winter of 2014 may have influenced Largemouth Bass reproduction. These conditions often lead to decreased reproductive success. Therefore, we are planning to conduct one more night of sampling on each lake in September 2015. We will contact lake associations individually as we continue to plan these surveys and in some cases request permission for access to private waters. We thank each of the lake association contacts for their efforts informing shoreline property owners of our surveys, conversations about the histories of the lakes, and other efforts to facilitate our research.

References

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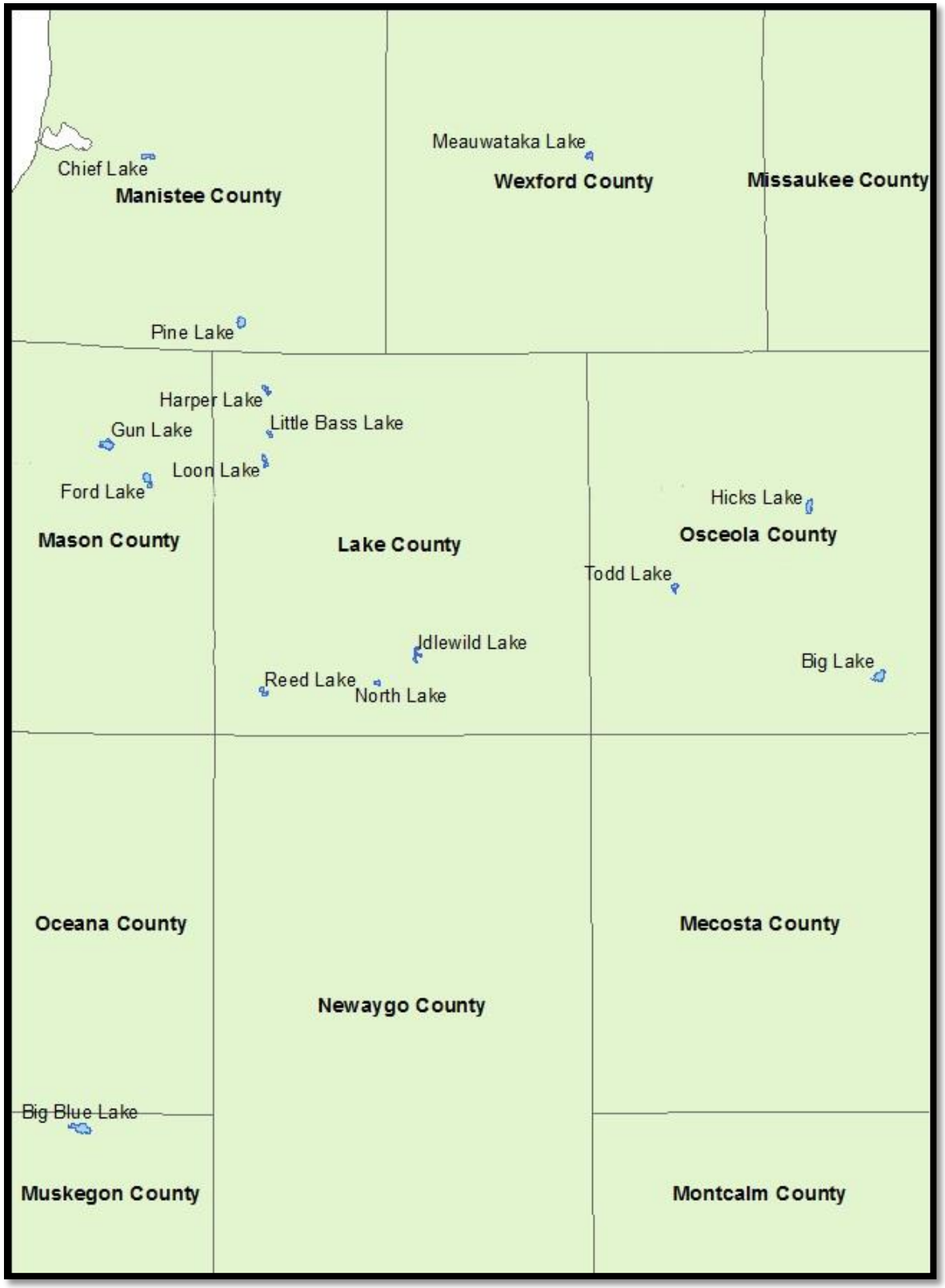


Figure 1. Study lakes for the Largemouth Bass productivity project in the Lower Peninsula of Michigan.

Table 1. Species encountered during Fall 2014 electrofishing surveys in each lake.

	Big	Big Blue	Chief	Ford	Gunn	Harper	Hicks	Idlewild	Little Bass	Loon	Meauwataka	North	Pine	Reed/Rainbow	Todd
Black Crappie	X	X	X		X		X	X			X	X			X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bowfin	X			X											
Brook Silverside				X					X						
Bullhead[1]	X	X	X	X	X	X	X	X		X					X
Carp[1]		X		X				X				X	X		
Darters[1]	X	X	X				X				X		X		
Golden Shiner	X		X				X						X		X
Lake Trout															
Lamprey															X
Largemouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mudminnow		X				X	X		X	X	X			X	X
Northern Pike	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Pumpkinseed	X	X		X			X	X	X	X	X				X
Rock Bass	X		X	X	X	X	X	X	X	X	X	X	X	X	
Sand Shiner	X					X						X		X	
Other Shiners[1]								X		X	X				
Smallmouth Bass										X	X				
Walleye	X			X											
Warmouth	X								X						
White Sucker	X	X	X	X			X	X		X	X	X	X		X
Yellow Perch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

[1]Some fishes were not able to be identified to the species level based on our observations of them in the water; thus they are grouped at the lowest possible taxonomic level.

Figure 2. Relative density of Largemouth Bass in the shallow waters of 16 Michigan Lakes as determined by electrofishing sampling in July 2014. The white boxes represent the interquartile range (lower 25% to upper 75% of fish sampled) while the horizontal lines in the boxes represents the median (50%) fish. Vertical lines extend across the range of approximately 95% of the data for each lake. Data outside this ranger are designated as outliers and represented by individual points.

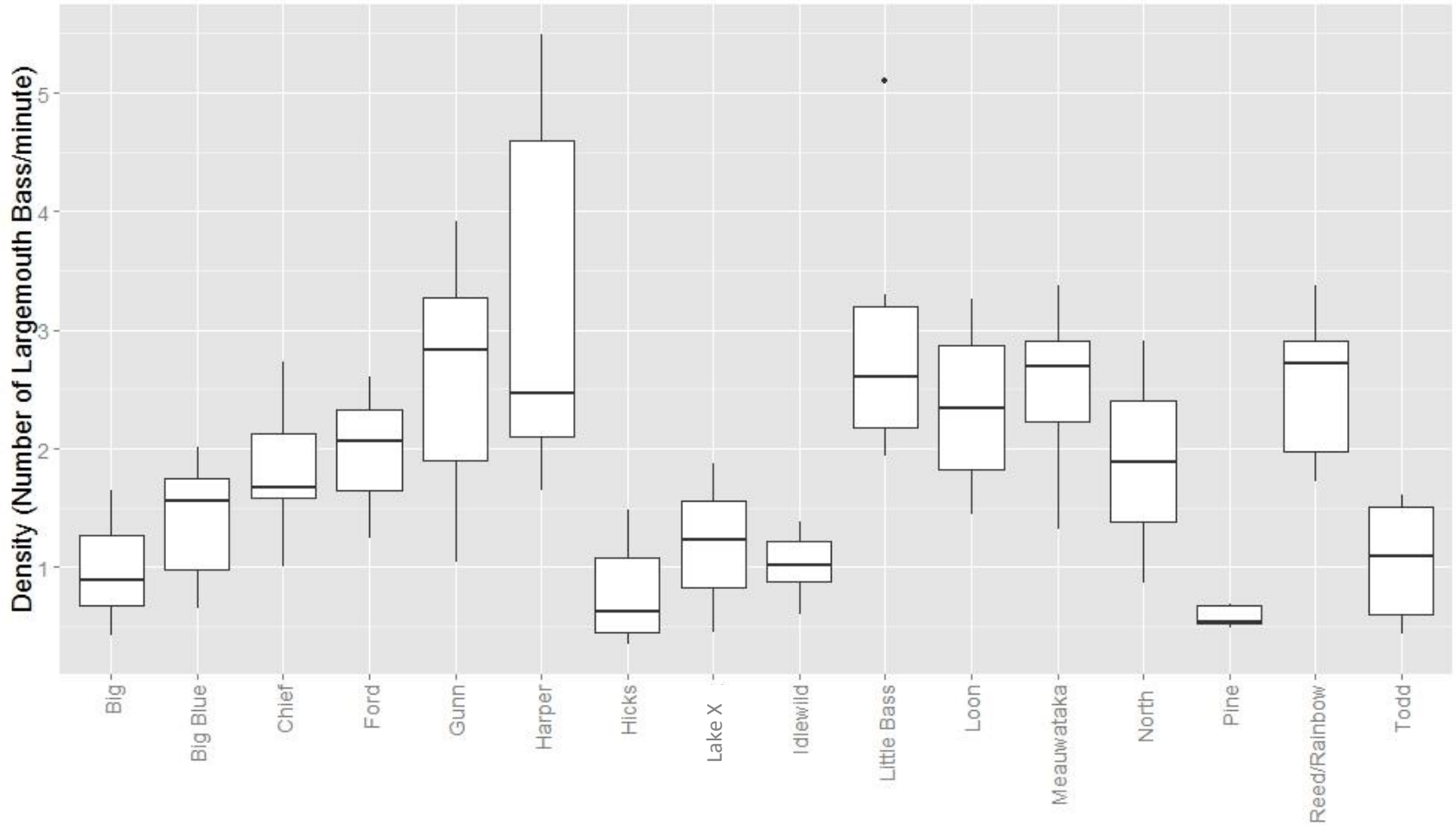


Figure 2. Condition factor of Largemouth Bass in 15 Michigan Lakes as determined by electrofishing sampling in October and November 2014. The white boxes represent the interquartile range (lower 25% to upper 75% of fish sampled) while the horizontal lines in the box represent the median (50%) fish. Vertical lines extend across the range of approximately 95% of the data for each lake. Data outside this ranger are designated as outliers and represented by individual points; in 8 cases outliers above values of 2.0 were removed due to suspected measurement error.

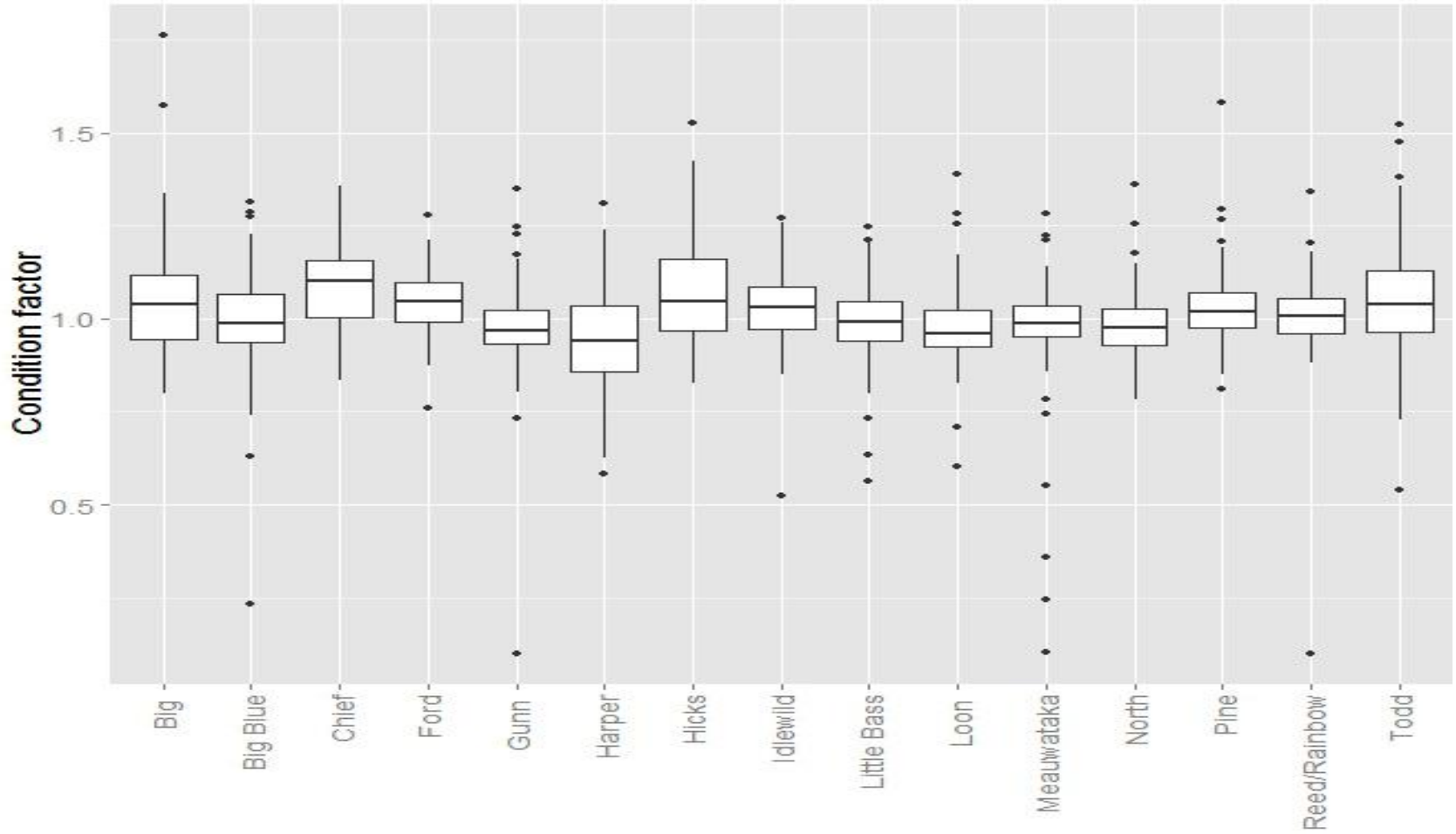
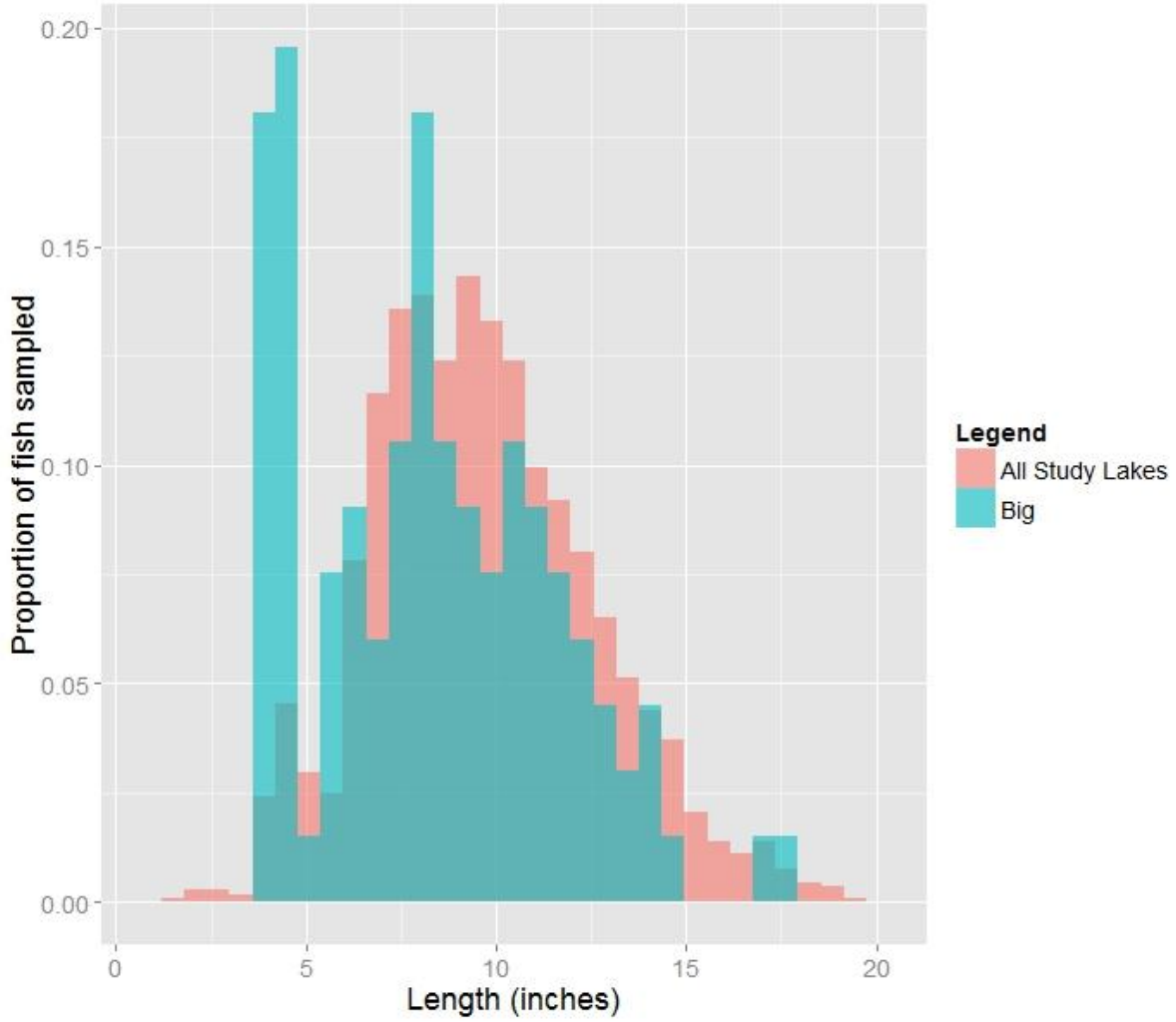


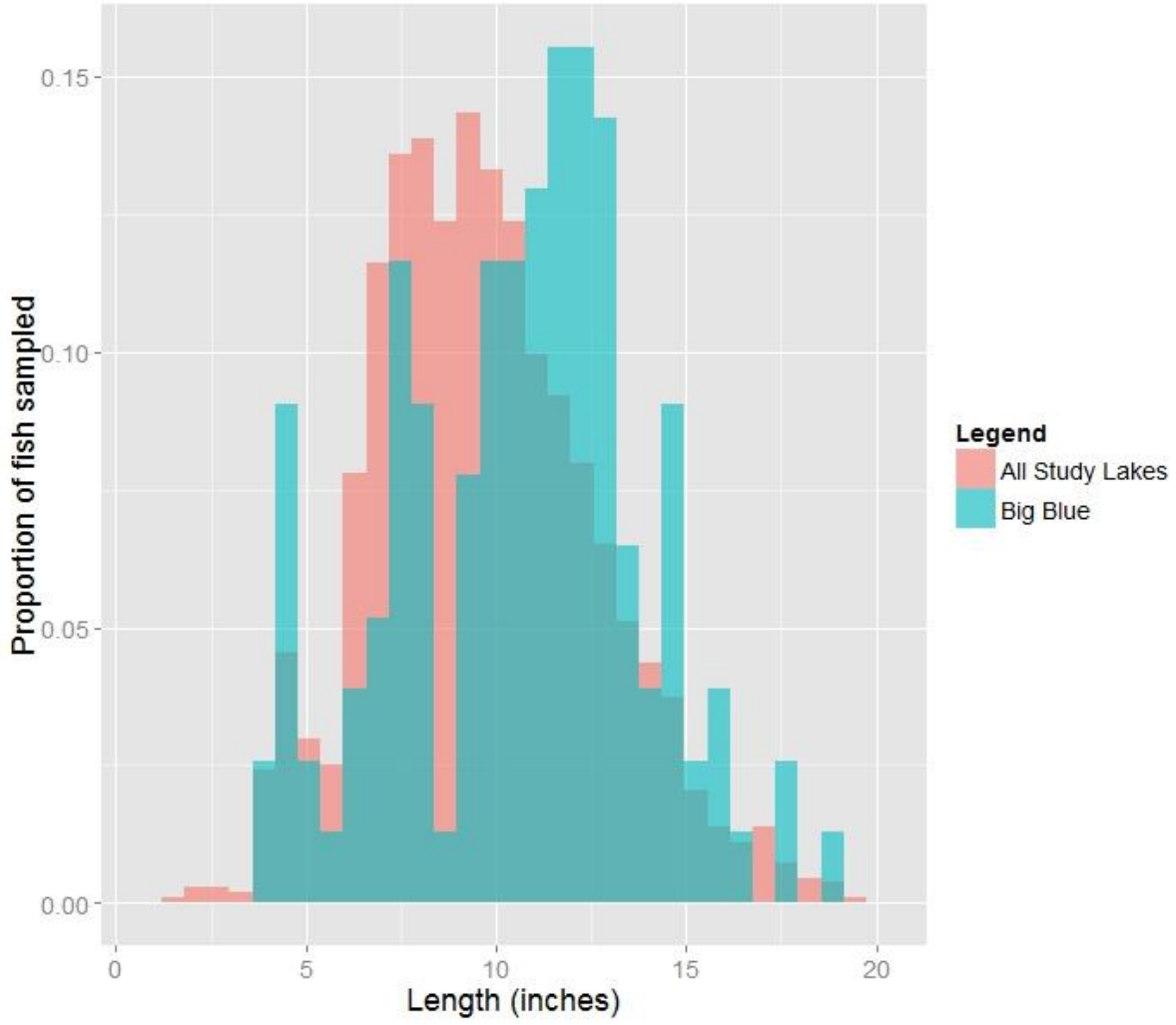
Table 2. Secchi depths taken from 16 Michigan lakes in September 2014. Secchi depths represent the maximum depth at which a Secchi disk can be seen from the surface. They are a measure of water clarity.

Lake Name	Secchi depth (ft)
Big Blue	12.5
Big Lake	14
Chief	11.5
Ford	18.5
Gunn	12.5
Harper	14
Hicks	6
Idlewild	14
Little Bass	14
Loon	13
Meauwataka	13.5
North	10
Pine	14
Reed/Rainbow	13
Todd	9
Lake X	7

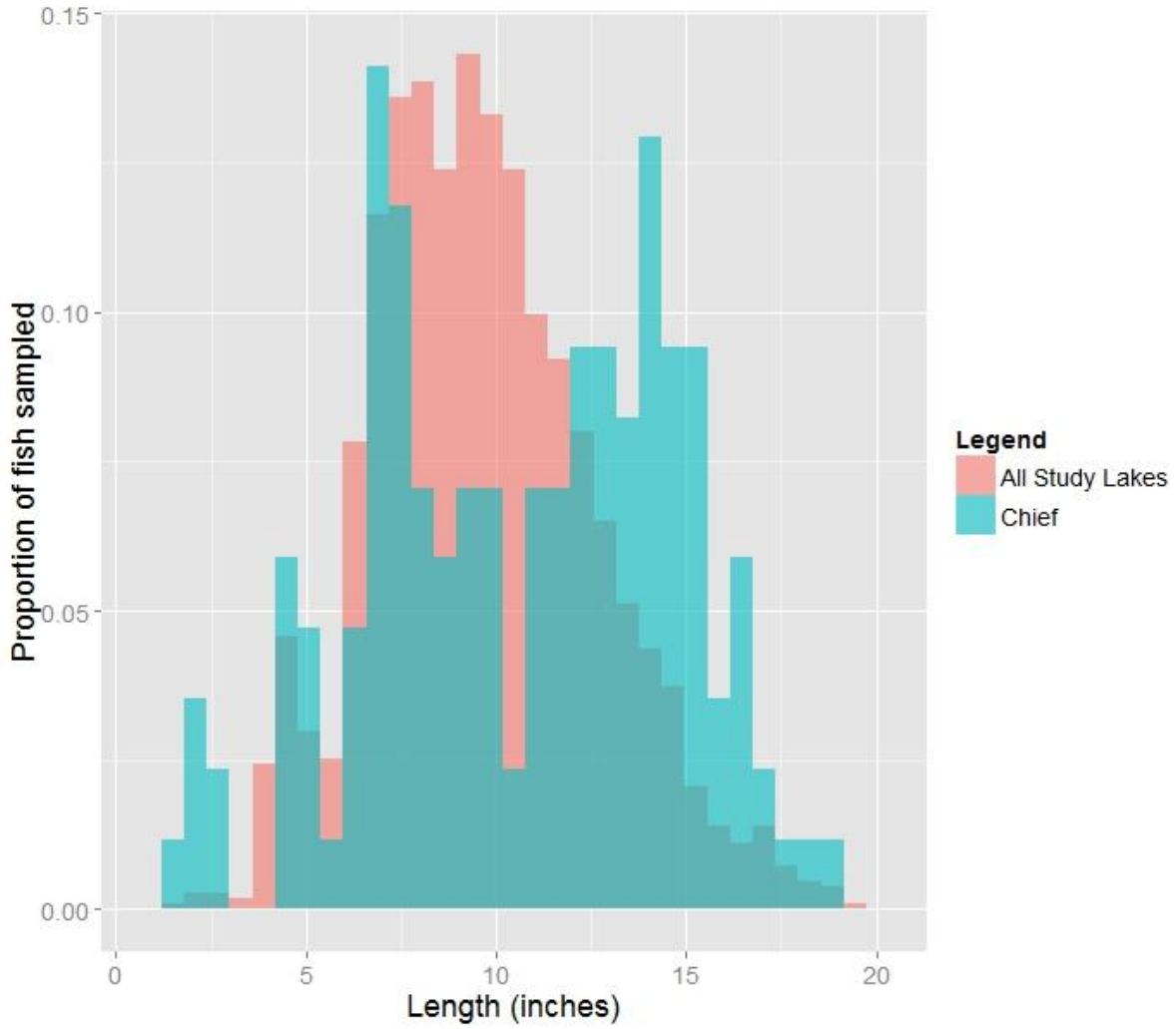
Appendix 1. Distribution of fish sizes by length in Big Lake from electrofishing samples in July 2014. Blue bars represent Big Lake while red bars represent data from all 16 study lakes for comparison.



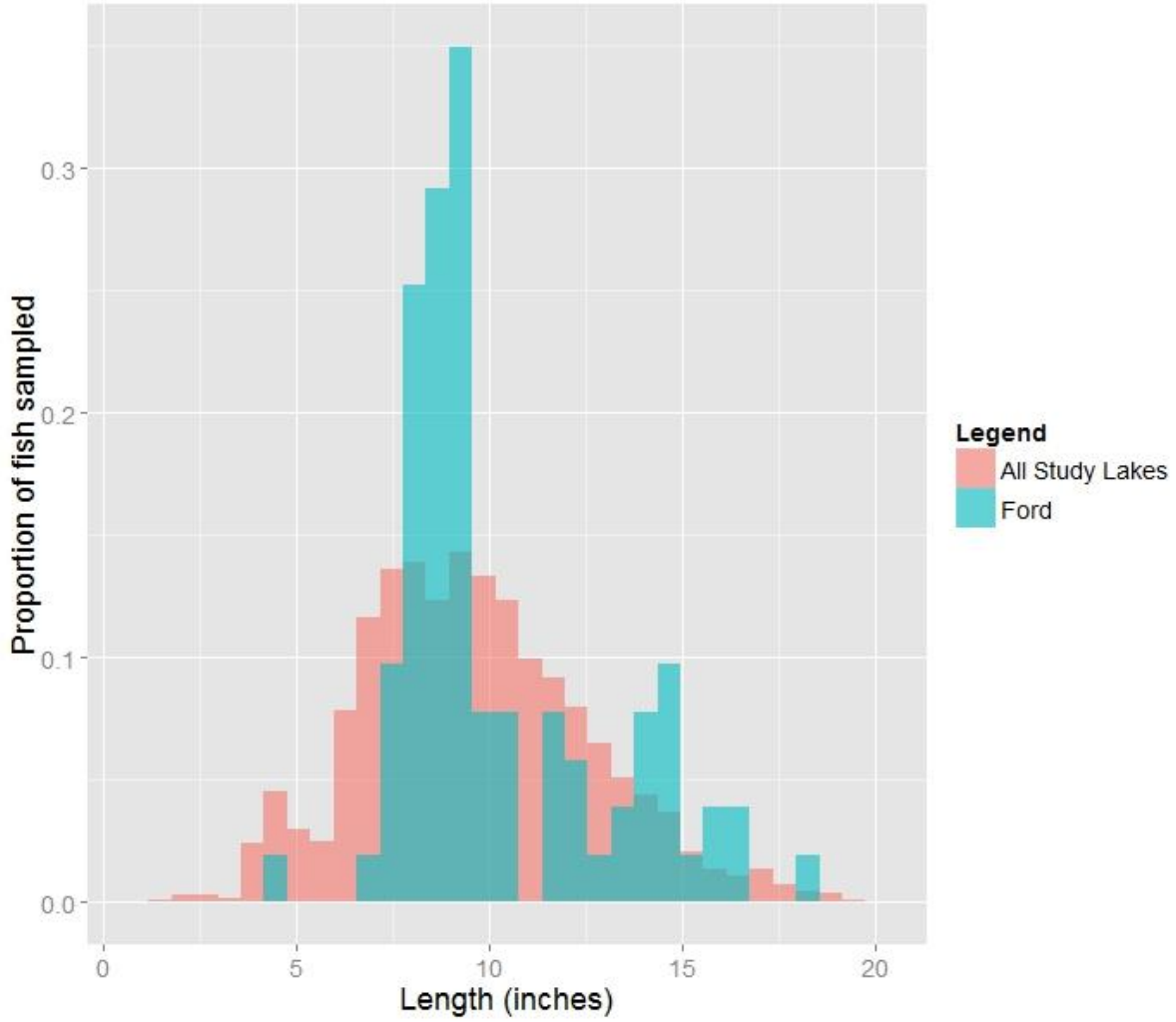
Appendix 1 cont. Distribution of fish sizes by length in Big Blue Lake from electrofishing samples in July 2014. Blue bars represent Big Blue Lake while red bars represent data from all 16 study lakes for comparison.



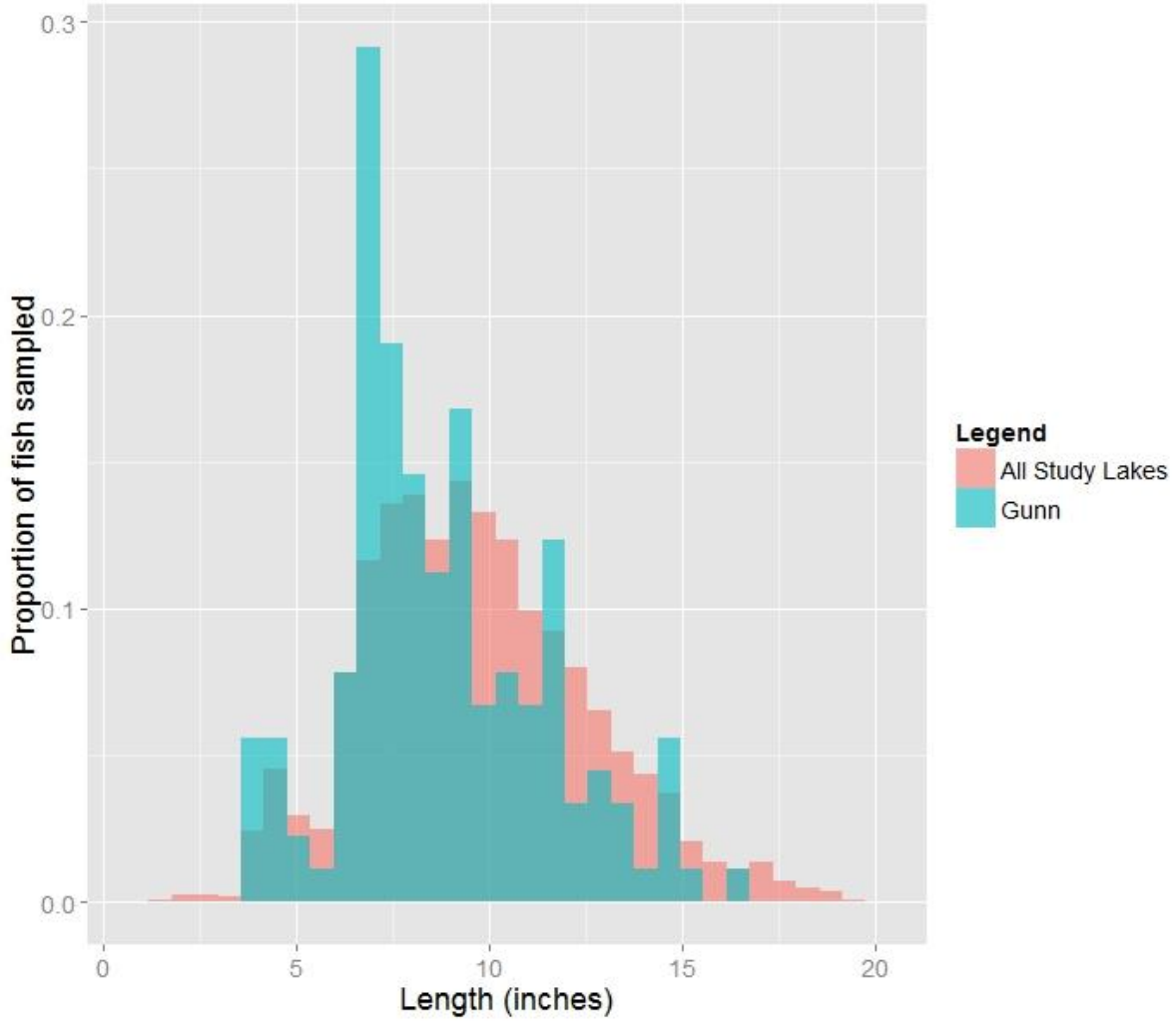
Appendix 1 cont. Distribution of fish sizes by length in Chief Lake from electrofishing samples in July 2014. Blue bars represent Chief Lake while red bars represent data from all 16 study lakes for comparison.



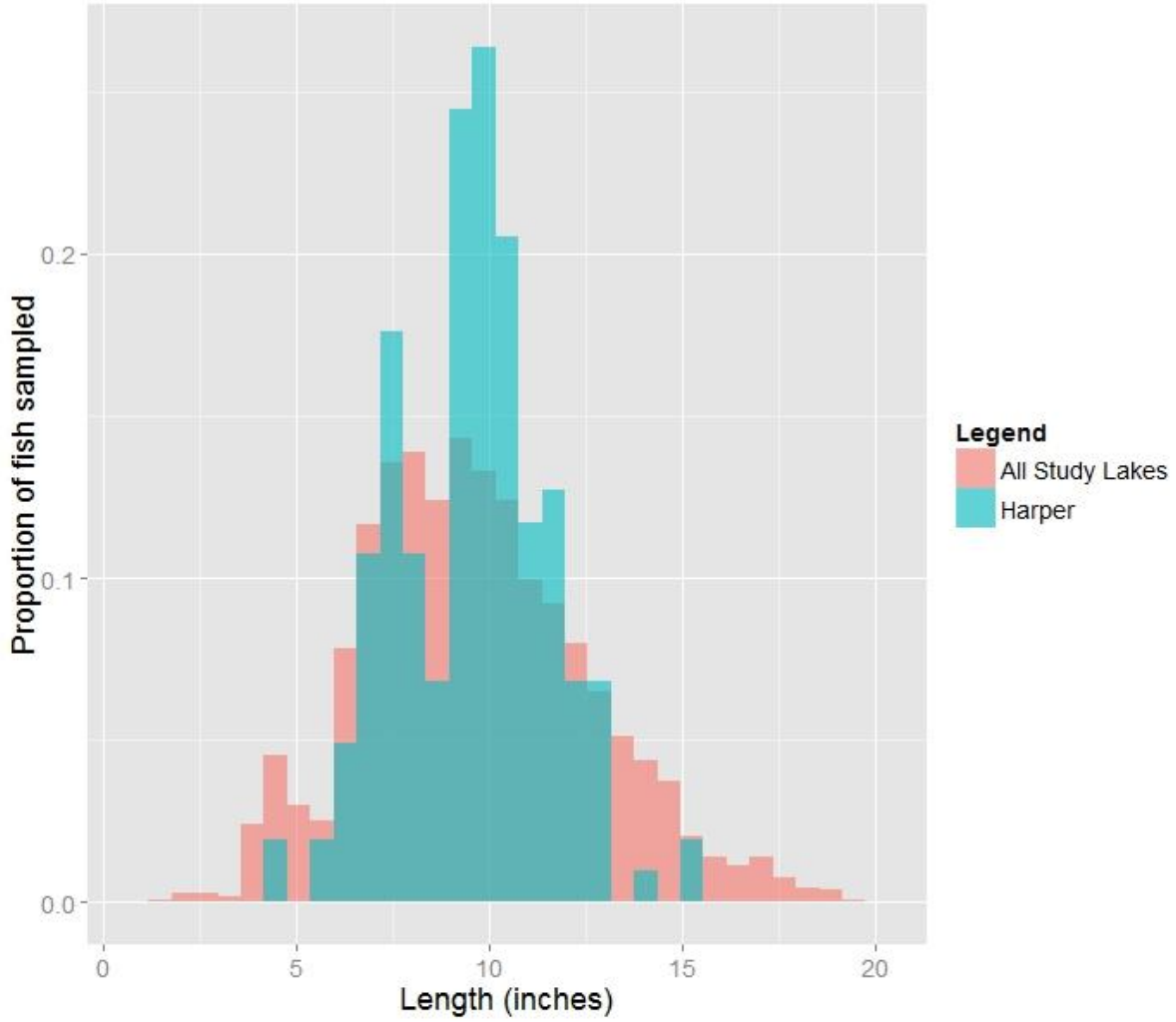
Appendix 1 cont. Distribution of fish sizes by length in Ford Lake from electrofishing samples in July 2014. Blue bars represent Ford Lake while red bars represent data from all 16 study lakes for comparison.



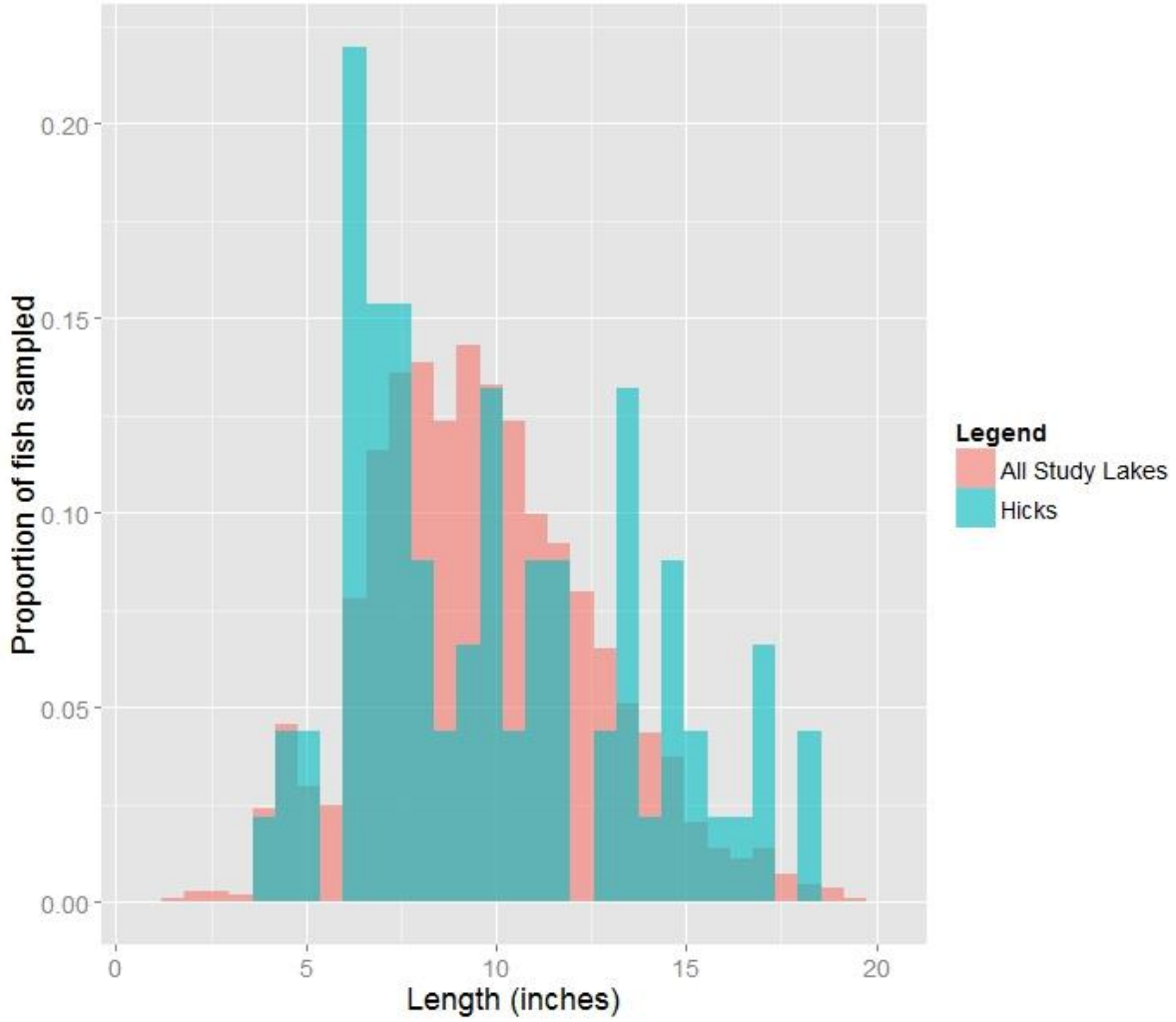
Appendix 1 cont. Distribution of fish sizes by length in Gunn Lake from electrofishing samples in July 2014. Blue bars represent Gunn Lake while red bars represent data from all 16 study lakes for comparison.



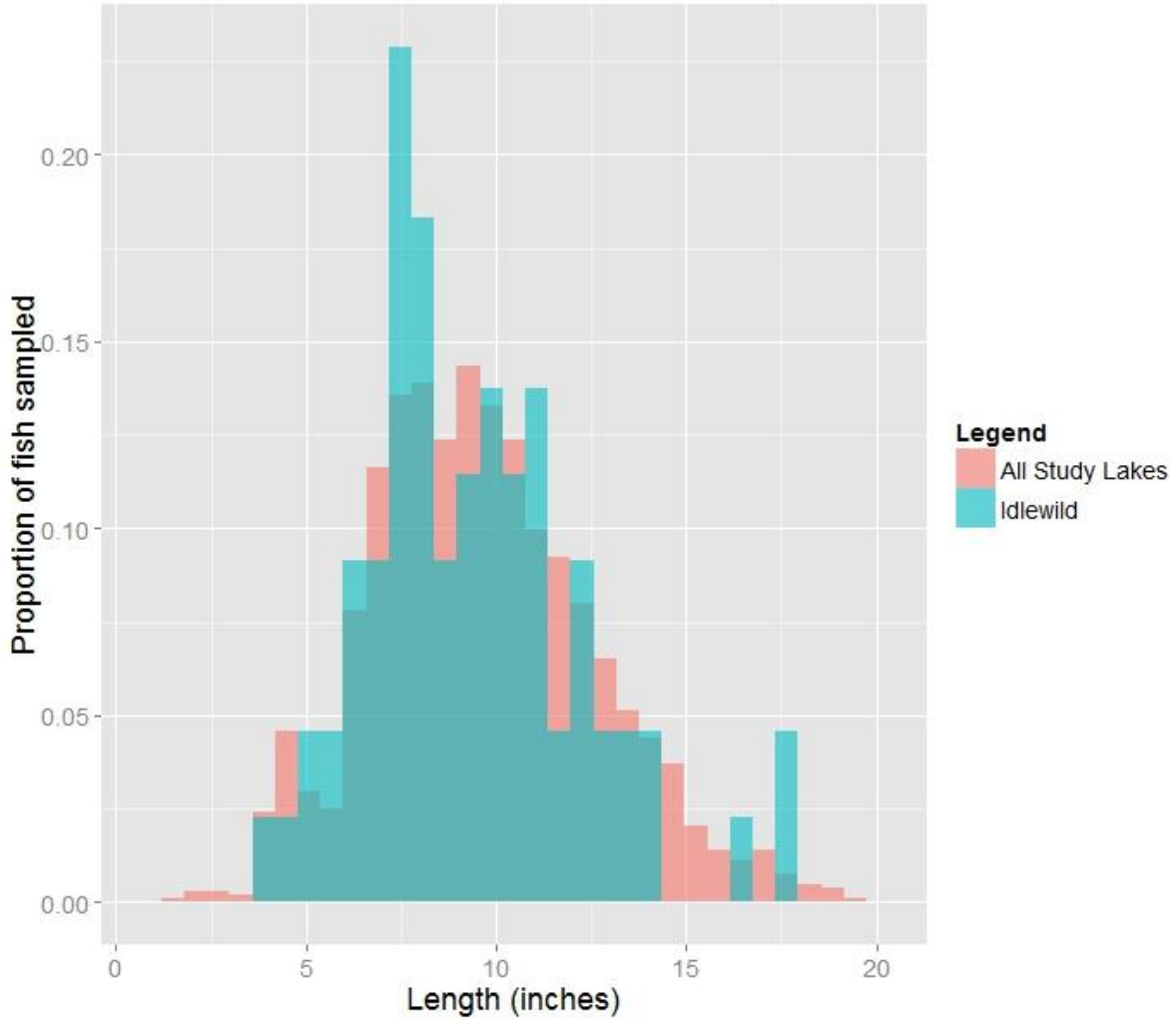
Appendix 1 cont. Distribution of fish sizes by length in Harper Lake from electrofishing samples in July 2014. Blue bars represent Harper Lake while red bars represent data from all 16 study lakes for comparison.



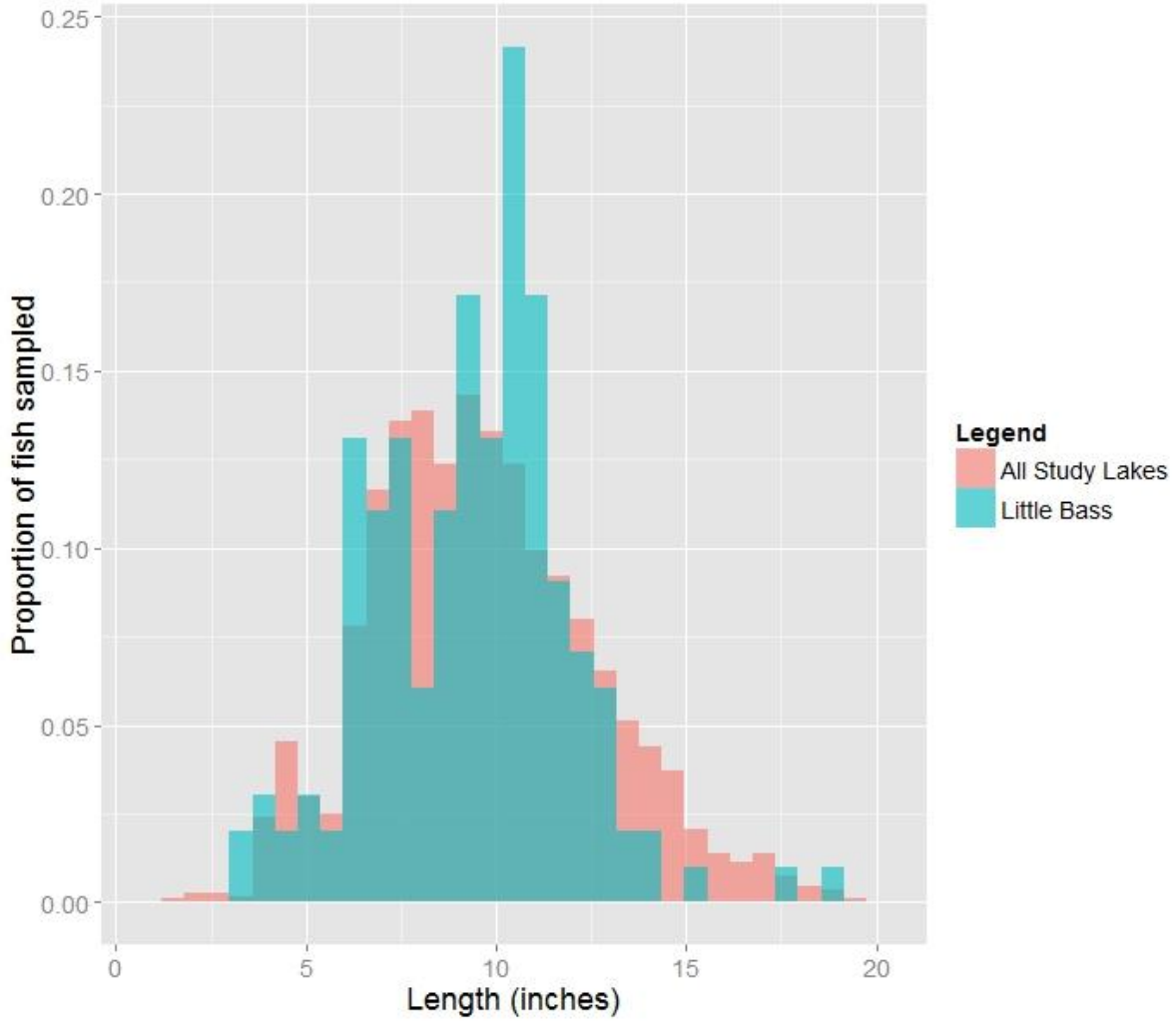
Appendix 1 cont. Distribution of fish sizes by length in Hicks Lake from electrofishing samples in July 2014. Blue bars represent Hicks Lake while red bars represent data from all 16 study lakes for comparison.



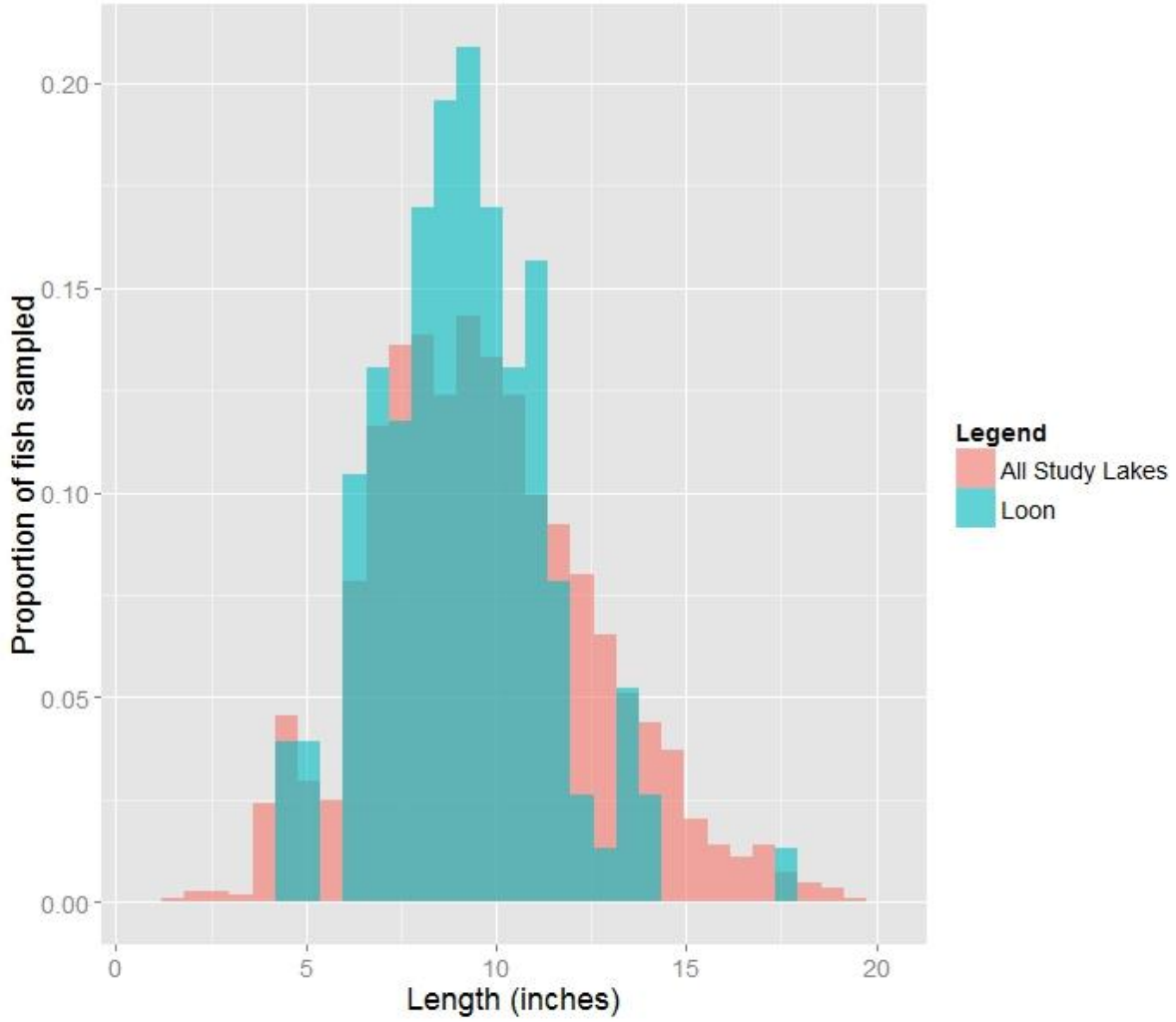
Appendix 1 cont. Distribution of fish sizes by length in Idlewild Lake from electrofishing samples in July 2014. Blue bars represent Idlewild Lake while red bars represent data from all 16 study lakes for comparison.



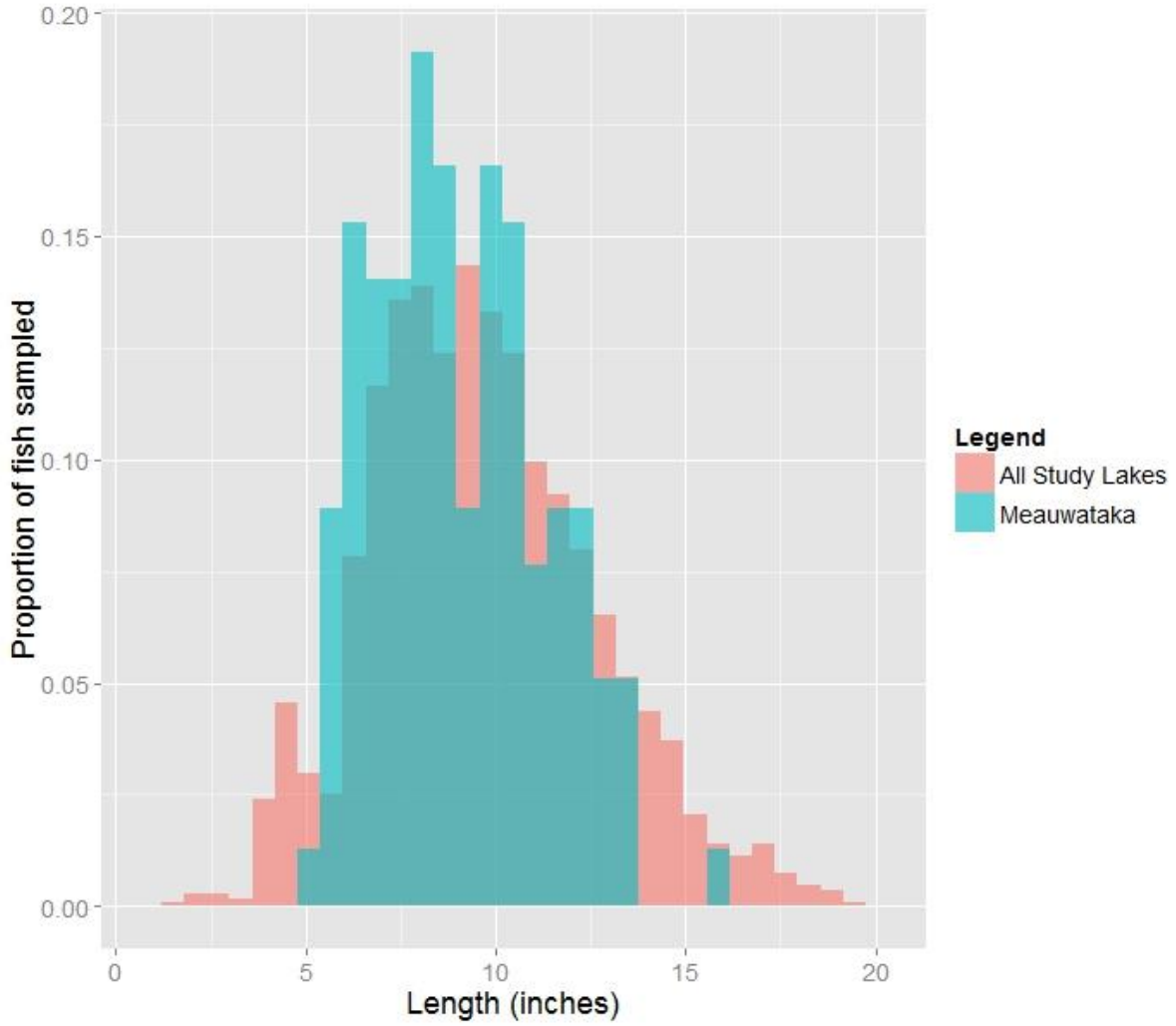
Appendix 1 cont. Distribution of fish sizes by length in Little Bass Lake from electrofishing samples in July 2014. Blue bars represent Little Bass Lake while red bars represent data from all 16 study lakes for comparison.



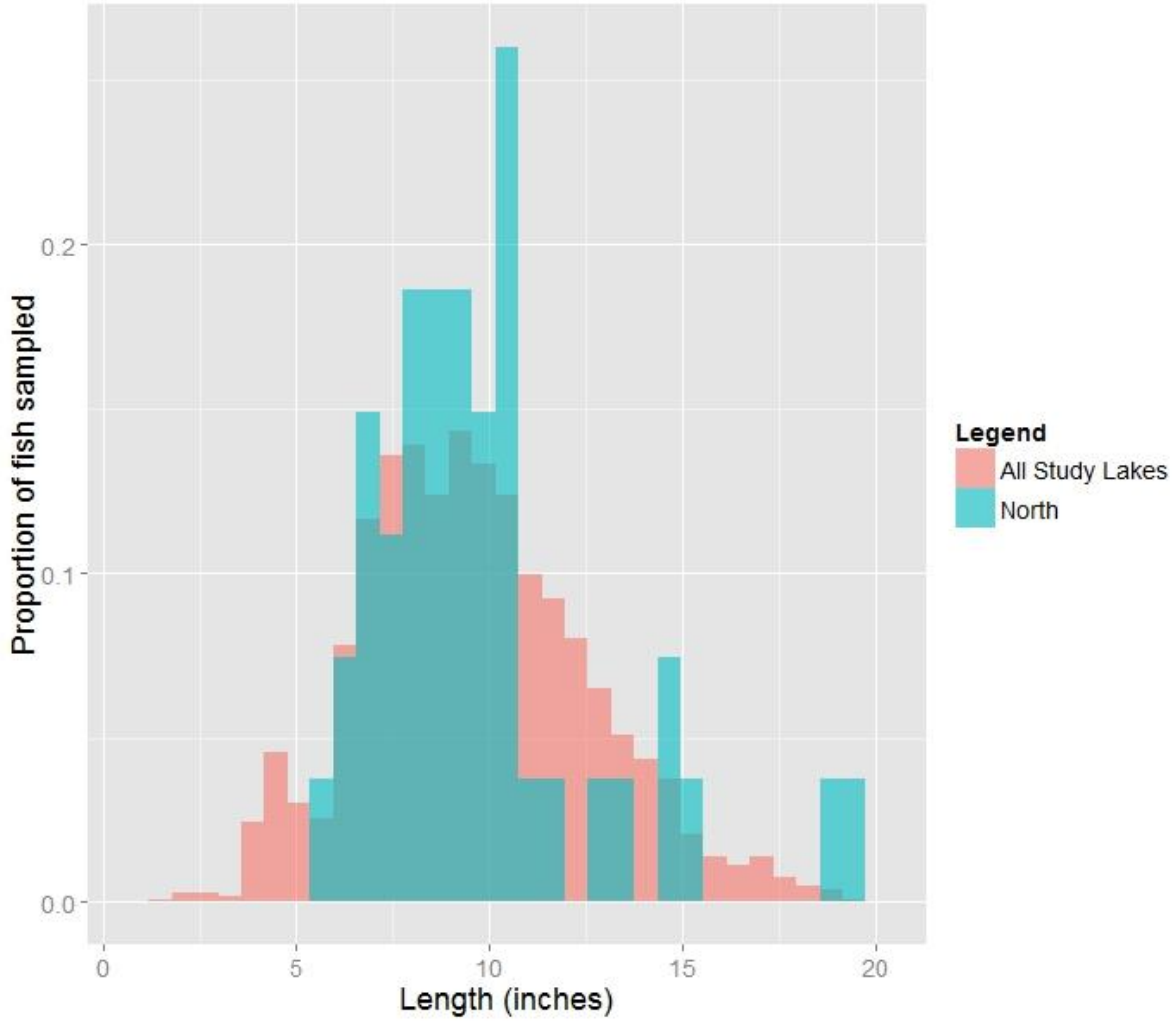
Appendix 1 cont. Distribution of fish sizes by length in Loon Lake from electrofishing samples in July 2014. Blue bars represent Loon Lake while red bars represent data from all 16 study lakes for comparison.



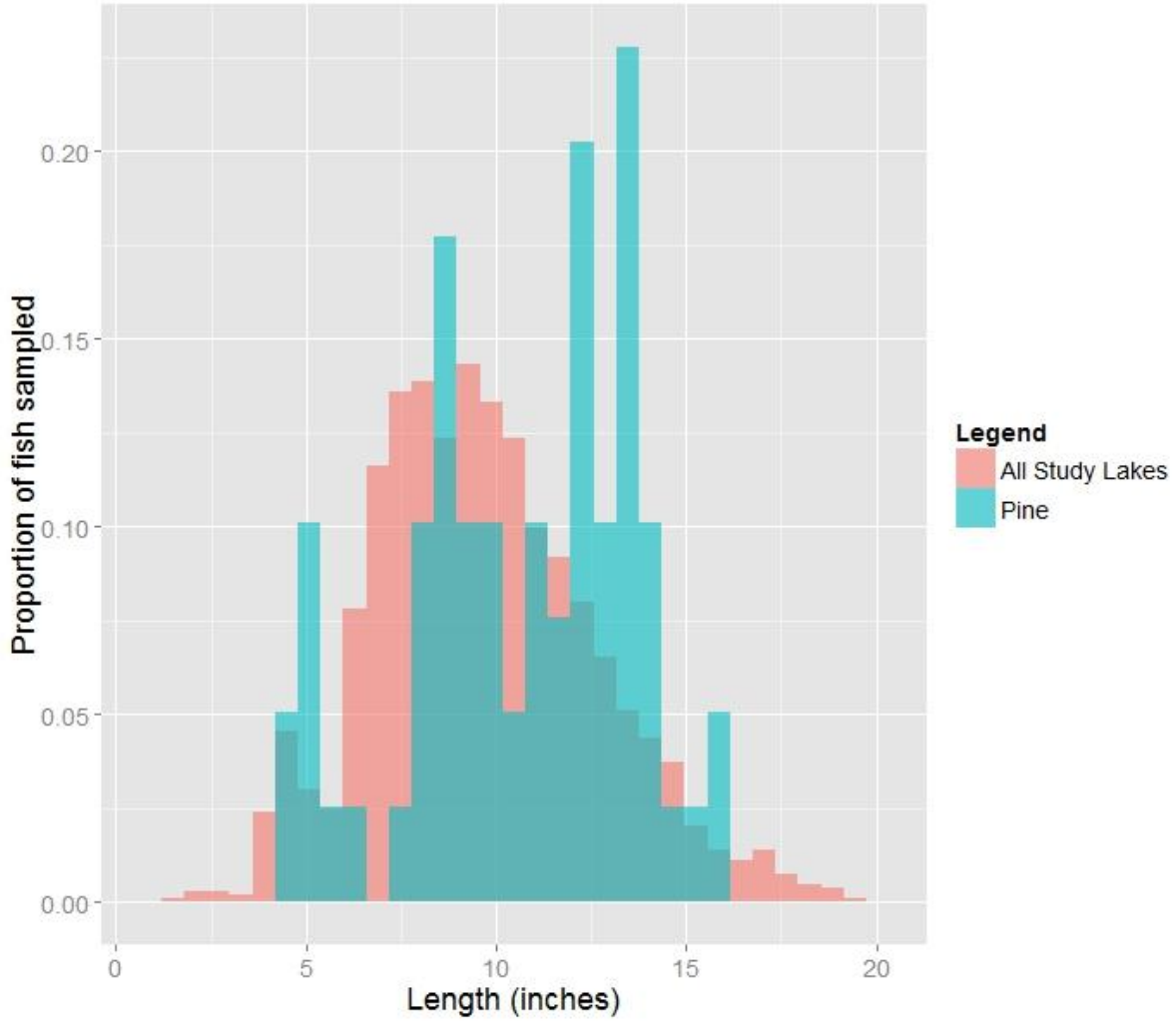
Appendix 1 cont. Distribution of fish sizes by length in Meauwataka Lake from electrofishing samples in July 2014. Blue bars represent Meauwataka Lake while red bars represent data from all 16 study lakes for comparison.



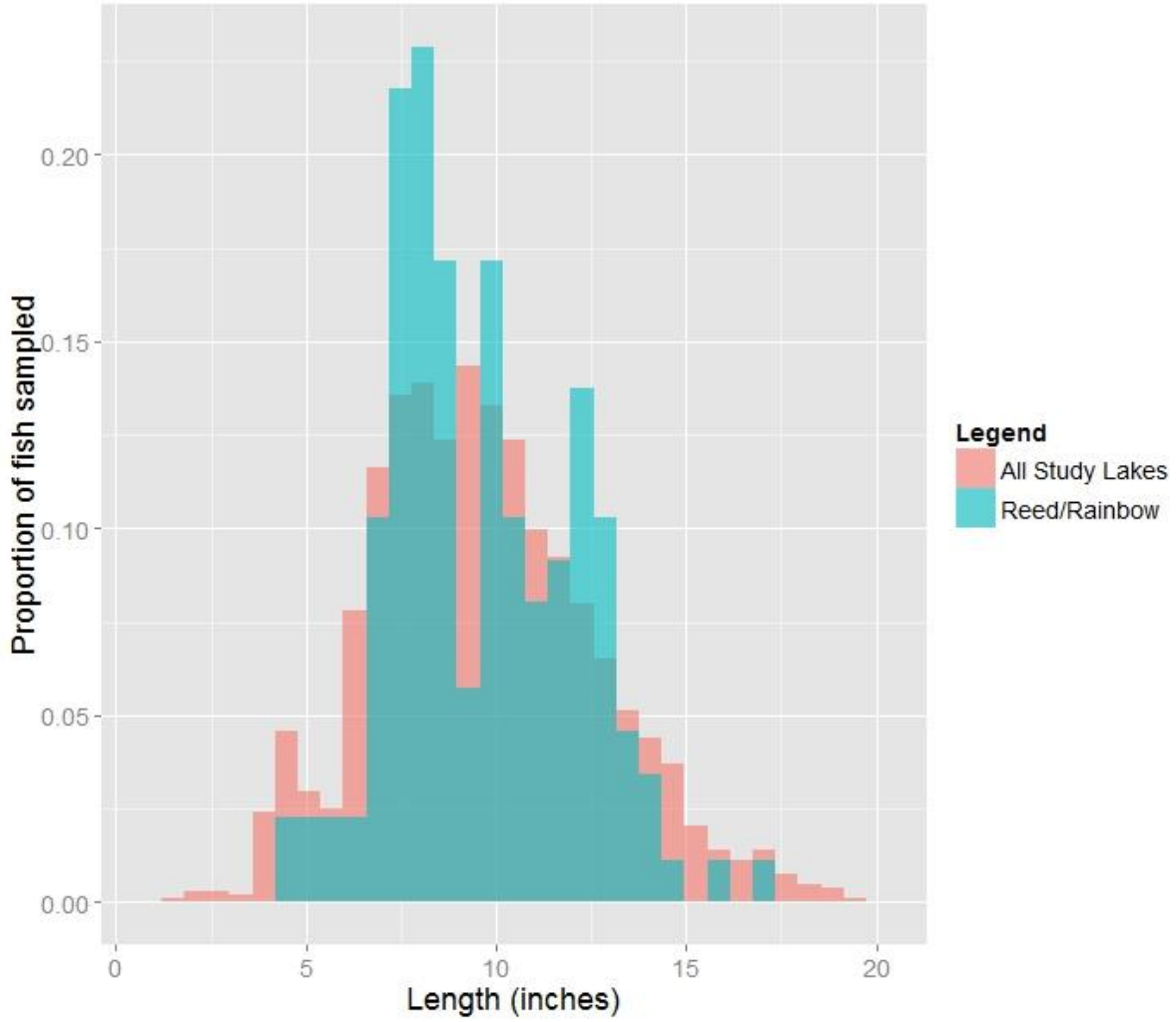
Appendix 1 cont. Distribution of fish sizes by length in North Lake from electrofishing samples in July 2014. Blue bars represent North Lake while red bars represent data from all 16 study lakes for comparison.



Appendix 1 cont. Distribution of fish sizes by length in Pine Lake from electrofishing samples in July 2014. Blue bars represent Pine Lake while red bars represent data from all 16 study lakes for comparison.



Appendix 1 cont. Distribution of fish sizes by length in Reed/Rainbow Lakea from electrofishing samples in July 2014. Blue bars represent Reed/Rainbowa Lake while red bars represent data from all 16 study lakes for comparison.



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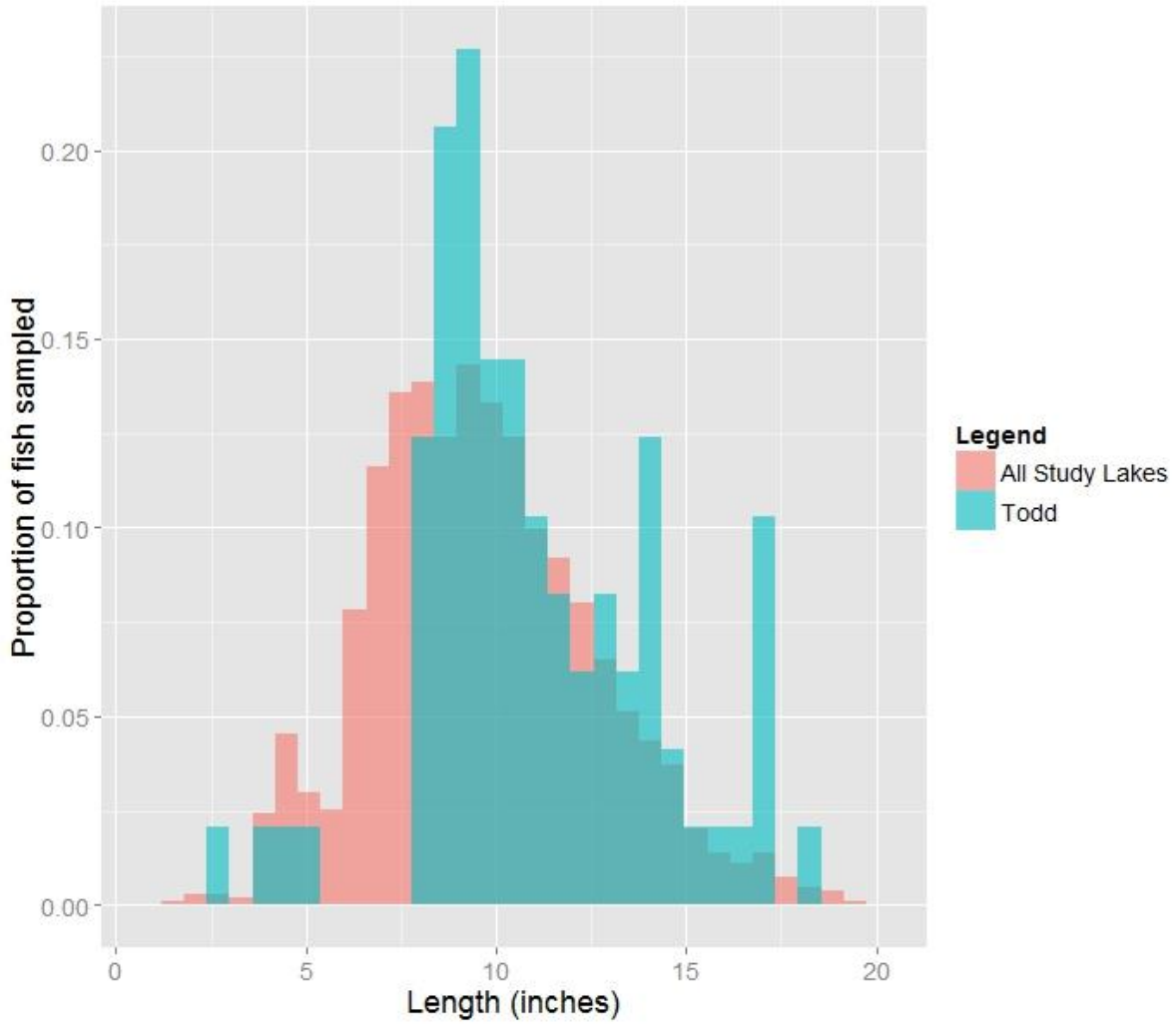

Appendix 1 cont. Distribution of fish sizes by length in Lake X from electrofishing samples in July 2014. Blue bars represent Lake X while red bars represent data from all 16 study lakes for comparison.

