WDNR Chequamegon Bay Smallmouth Bass Report 2019

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Introduction

Chequamegon Bay is an approximately 34,000 acre shallow embayment (mean depth of 28 ft) on Wisconsin's south shore that provides an important cool-water recreational fishery in Lake Superior by supporting a diverse assemblage of fishes and serving as a restricted use area from high-efficiency commercial fishing gears. The Smallmouth Bass fishery is an extremely popular fishery in Chequamegon Bay, and popularity has increased gradually through the past few decades. In the 1970's and 1980's, Lake Superior Smallmouth Bass were regulated by a 5 bag, 12 inch minimum size limit. By 1993, the WDNR enacted a closed season from March 31 to the third saturday in June, and in 1994, a 1 bag, 22 inch minimum size limit was imposed with much angler support. The conservative regulations were enacted to enhance the size structure of the Smallmouth Bass population in Chequamegon Bay and to provide a trophy fishing experience to anglers by lowering exploitation (harvest) rates. This report is an overview of the status of the Chequamegon Bay Smallmouth Bass population derived from data collected from hook-and-line, electrofishing, and gillnet surveys from 1973 to 2019.

Methods

Annual spring hook-and-line surveys have been conducted in the Kakagon and Sandcut Sloughs since 1990 (Figure 1). Hook-and-line methods vary annually but generally live bait (e.g., sucker minnows, leeches) and artificial baits (e.g., soft plastics) are used. All Smallmouth Bass sampled were measured (total length) and aging structures (scales and spines) were taken from a subsample of the fish captured. All Smallmouth Bass were tagged with uniquely numbered floy tags.

Beginning in the spring of 2018, Smallmouth Bass have been annually surveyed using electrofishing along the shorelines of Chequamegon Bay. Smallmouth Bass are vulnerable to electrofishing in late May and early June as they move to shallow spawning habitat. A boat mounted eletrofishing unit (pulsed DC current; 8-12 amps, duty=25%, speed~2.0 mph) was used at nighttime (0.5 hour after sunset) to survey three transects on the Chequamegon Bay shoreline (each transect approximatey 3.25 miles; Figure 1). When possible, replicates were done for each transect. All Smallmouth Bass were measured (total length) and tagged with uniquely numbered floy tags and returned to the water after full recovery. Dorsal spines were collected from ten Smallmouth Bass per 0.5-inch length bin and aged via cross-sections for age and growth analysis.

Age-length keys were constructed using multinomial logistic regression models (nnet R package; 0.5-inch length groupings). These keys were applied to all unaged fish. Mortality was estimated by using the standard catch curve method. Growth was assessed using von Bertalanffy growth functions.

In addition to the hook-and-line survey data and the electrofishing data, Chequamegon Bay Smallmouth Bass data has also been collected during a summer gillnet survey. The summer gillnet survey consists of 24 hour bottom sets of 3,600 ft monofilament gangs composed of a series of 300 ft nets constructed with 1.5 to 7.0-inch mesh (stretch measure), by 0.5-inch increments. This survey has been conducted since 1973 and is the only survey that has representative time-series data for relative abundance of the nearshore fishery. Data from station 227 (off Washburn, WI) is utilized in this report to analyze relative abundance of Smallmouth Bass since 1973. The relative abundance of Smallmouth Bass at station 227 was compared to Smallmouth Bass harvest trends derived from creel surveys.

Results/Discussion

Since the regulation change in 1994, the size structure of Smallmouth Bass captured during the hook-and-line survey has increased and stabilized (Figure 2). The age structure of the Smallmouth Bass captured also increased during the first several years after the regulation change. In recent years, the spread of the ages has increased which indicates a stable population with regular recruitment and low mortality (Figure 2).

Growth of Smallmouth Bass has been stable throughout the years (Figure 3). The 1990-1993 growth curve does not asymptote due to a lack of larger fish; however, for younger fish, the growth is similar to the growth of younger fish after the regulation change. The 1994-1997 growth curve is also slightly different but this is likely due to a low sample size and a small range of ages in these years. Mortality rates decreased significantly after the regulation changes, slightly increased since the 2006-2009 period, and stablilized in recent years (Figure 4). The reason for the slight increase in mortality over the past decade is unknown for sure but likely a combination of two explanations: 1) abnormally large year-classes of bass in the late 1990's were eventually removed from the population (natural mortality) and 2) large increases in popularity of Smallmouth Bass fishing in the study area may have led to a slight increase in post-release hooking mortality. However, the current population dynamics still support a trophy fishery regardless of the slight increase in mortality. The impacts of the regulation changes in 1994 have also been observed in the summmer gillnet survey. No Smallmouth Bass were captured at station 227 until after the regulation change (Figure 5).

Size and age structures from the two years of electrofishing were similar indicating stability of the population (Figure 6). One way to quantify size structure and compare with other populations is using Proportional Size Distribution (PSD) indices. These are based on standards of North American lengths for Smallmouth Bass. The size structure of the Chequamegon Bay population is excellent with many fish falling within the "preferred" (14-17 inches; P) and "memorable" (17-20 inches; M) categories and some falling within the "trophy" (>20 inches; T) category (Figure 7). When compared to all Smallmouth Bass proportional stock distritubtion estimates from 105 inland Wisconsin lakes, Chequamegon Bay Smallmouth Bass fall in the 92nd percentile. When looking at the proportional size distribution of "preferred" size fish and "memorable" size fish, Chequamegon Bay Smallmouth Bass fall in the 96th and 93rd percentiles, respectively.

Electrofishing CPE was highest along the Ashland shoreline in 2018, but in 2019, the Kakagon/Sandcut shoreline had the highest CPE (Table 1). Overall electrofishing CPE was slighltly higher in 2019; however, all metrics were similar between both years (Table 2). Size and age structures from electrofishing and hook-and-line sampling are not compared due to different selectivity of gear types. The electrofishing survey is more beneficial than the hook-and-line survey due to the ability to sample more fish across a larger area, and electrofishing is less size-selective (i.e., samples a wider range of sizes). However, electrofishing during pre-spawn still biases data towards older fish since it targets mature fish moving into shallow spawning areas. Alternative gear/temporal variation should be considered in the future to survey the whole population and not just mature fish. Only two years have been completed thus far, so continuing the electrofishing survey will be beneficial to obtain a clearer picture of relative abundance and size/age structure through time.

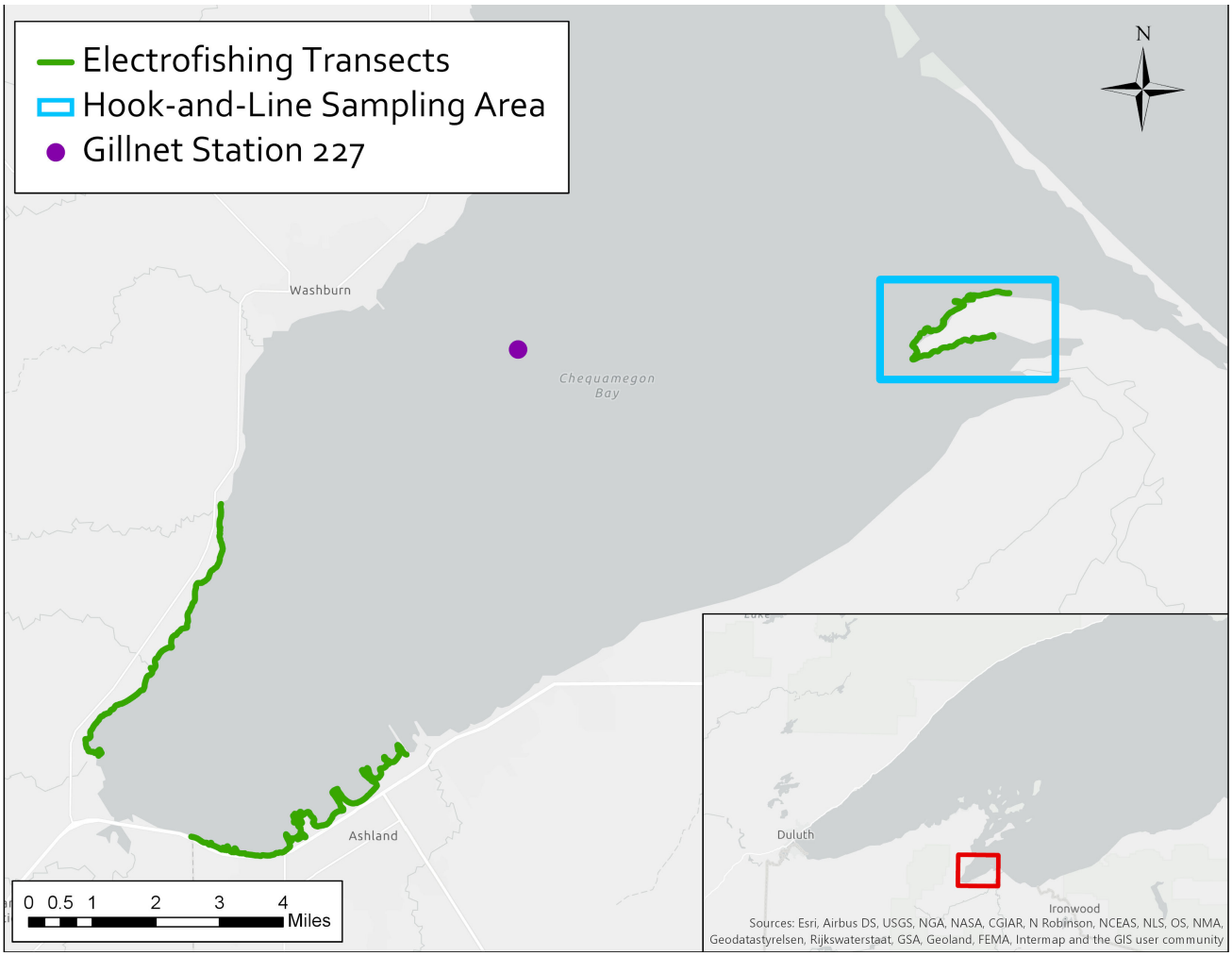

Figure 1. Electrofishing transects and the hook-and-line sampling area for the smallmouth assessments in Chequamegon Bay. Also shown is the gillnet station 227 from the summer gillnet index survey.

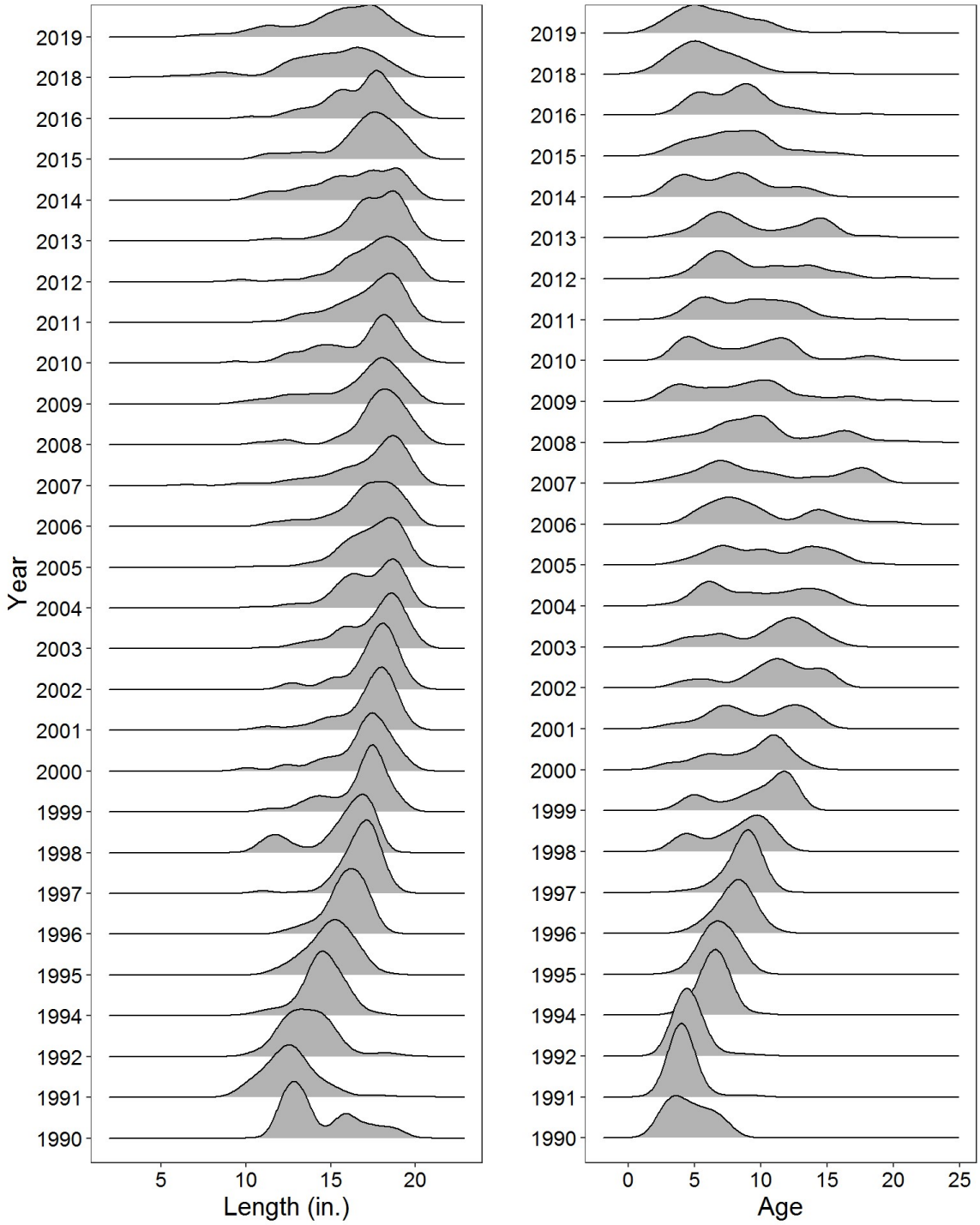

Figure 2. Length and age frequency distributions from the hook-and-line assessments (1990-2016) and the electrofishing asessments (2018-2019).

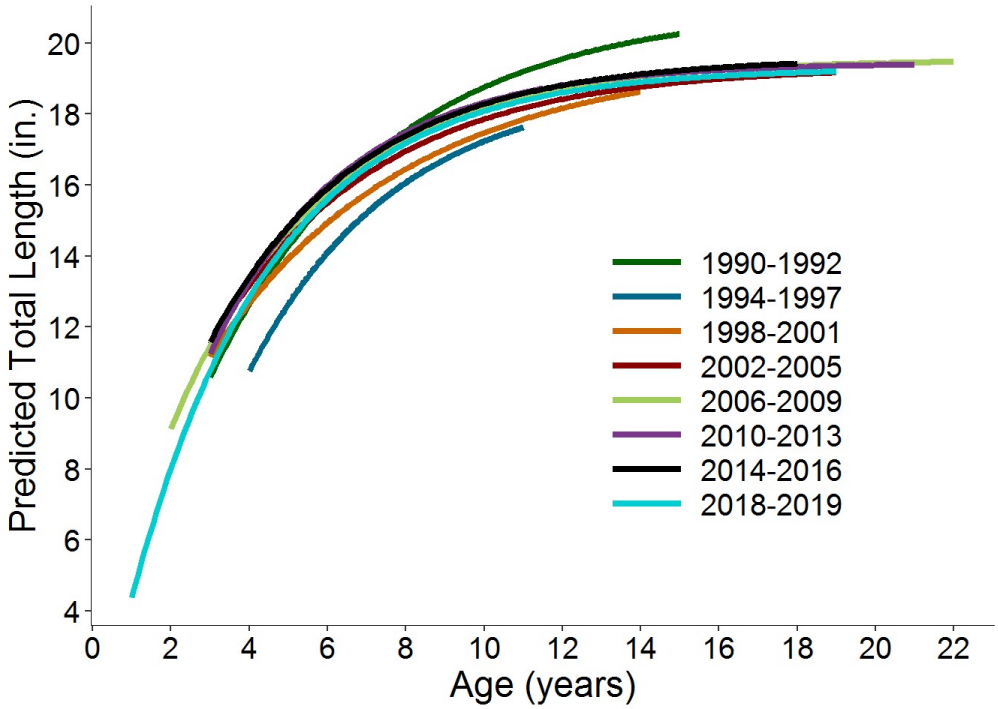

Figure 3. Smallmouth Bass von Bertalanffy predicted growth trajectories (solid lines) for different periods starting in 1990. Age and length data from 1990-2016 were collected during hook-and-line sampling. A transition from hook-and-line to electrofishing occurred in 2018. No age data was available from 1993 and 2017.

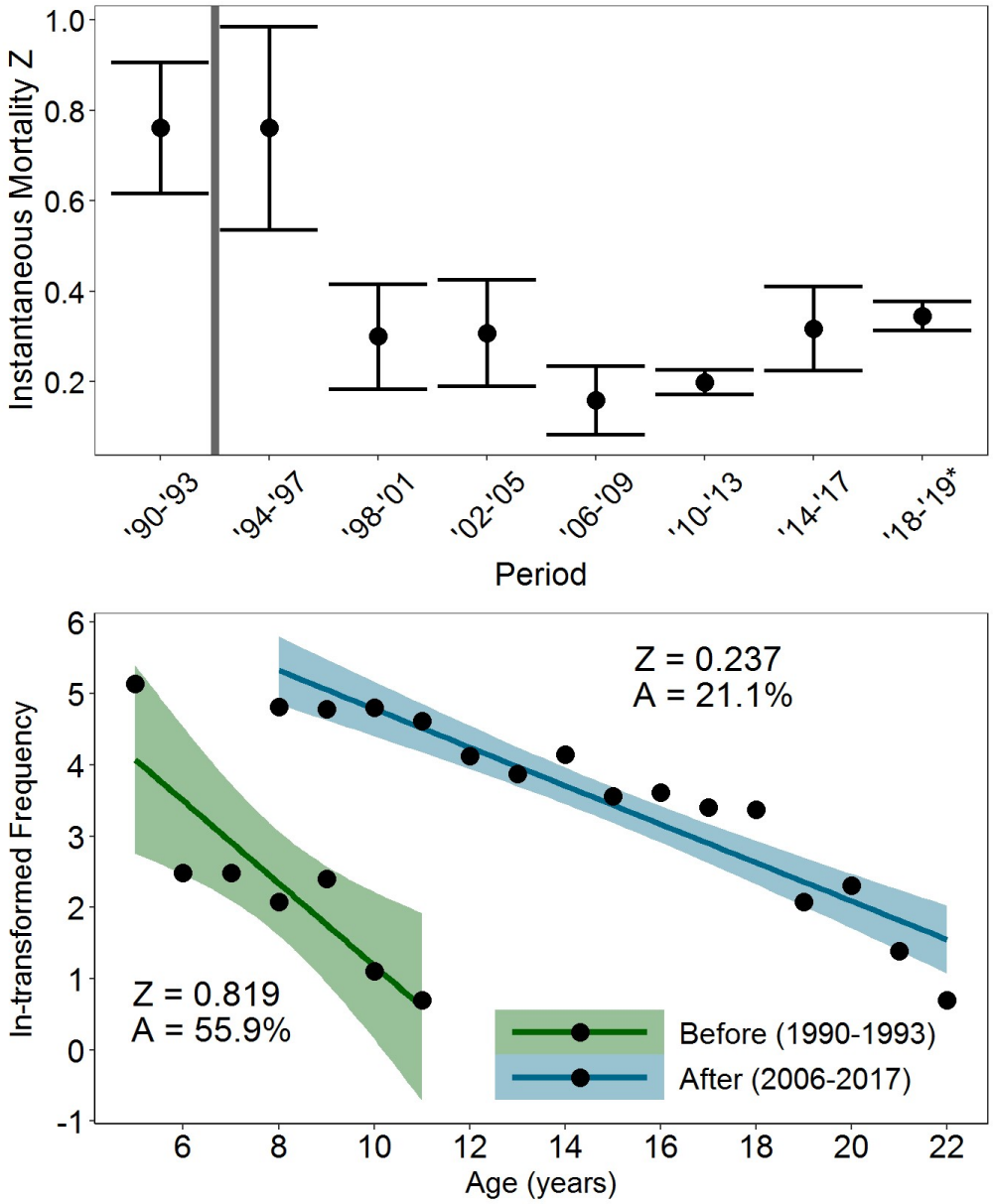

Figure 4. Top: Instantaneous mortality of Smallmouth Bass through time derived from hook-and-line survey data. *2018 and 2019 mortality derived from electrofishing survey data. Bottom: Catch curves of Chequamegon Bay Smallmouth Bass from before the regulations changes and after the regulation changes. 1994-2005 data was excluded since this is seen as a transition period for the population.

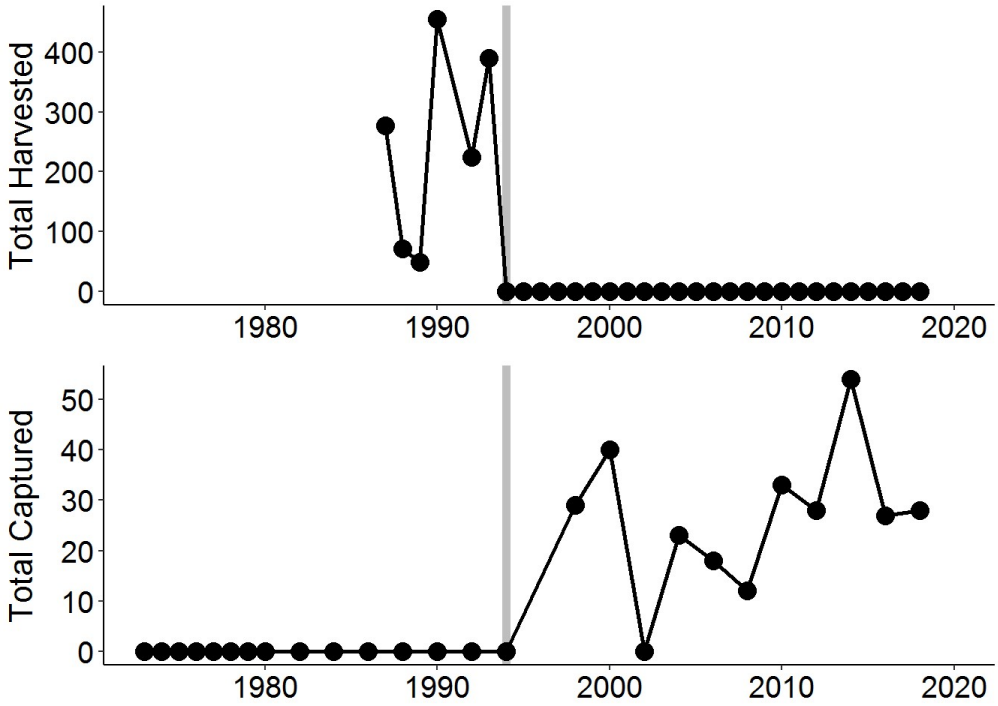

Figure 5. Number of harvested Smallmouth Bass (top) and the number of Smallmouth Bass captured in Chequamegon Bay during the summer index gillnet assessment (at the Washburn Station; bottom) through time. The vertical grey line represents the 1994 transition to the conservative 22 inch minimum.

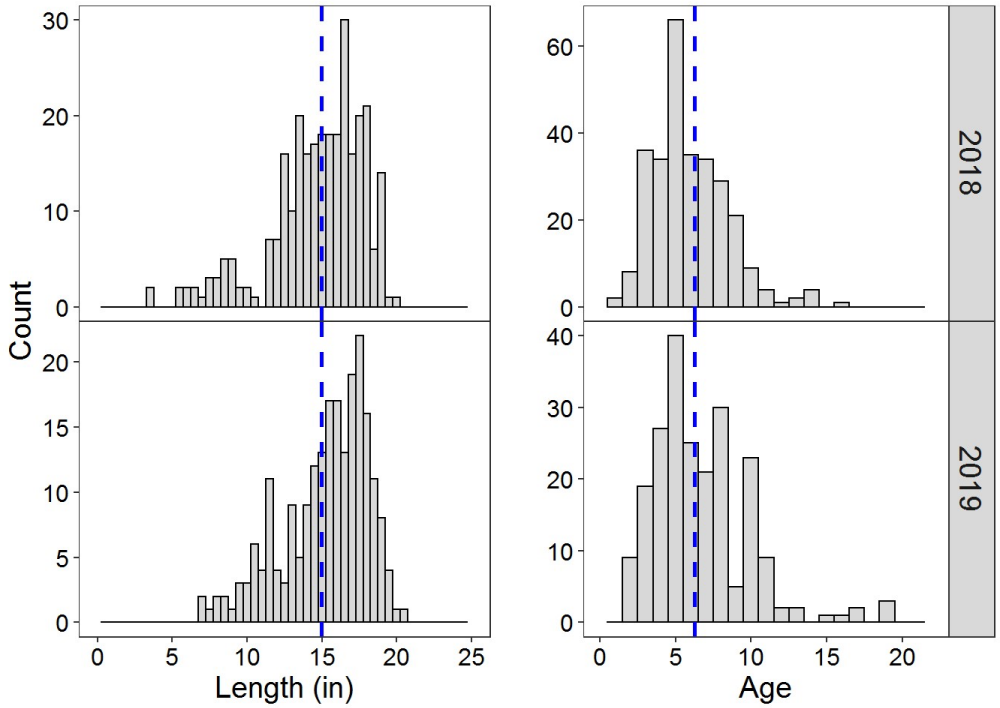

Figure 6. Length and age frequency distributions of Smallmouth Bass captured during electrofishing assessments. The blue line represents the mean of all bass from both years.

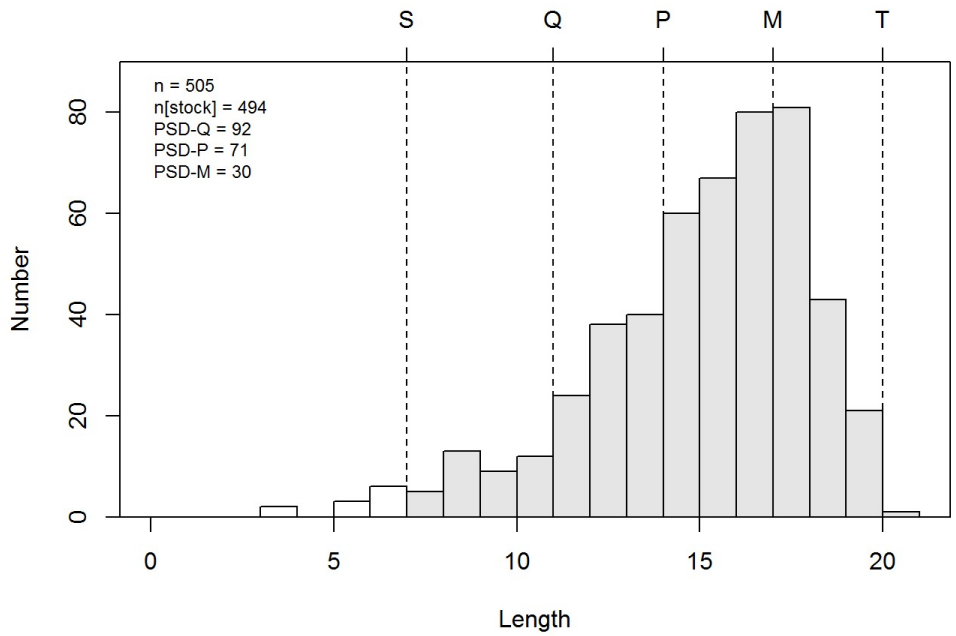

Figure 7. Proportional size distribution (PSD) of 2018 and 2019 Chequamegon Bay Smallmouth Bass collected during electrofishing surveys.

Table 1. Mean CPE (fish/mile) estimates for each transect, including confidence intervals and error estimates from the 2018 and 2019 spring Smallmouth Bass electrofishing survey. Each transect was replicated except the Western transect.

Transect	Mean	Miles	RSE	SE	L 95% CI	U 95% CI
2018						
Ashland	19.49	9.39	9.90	1.93	15.71	23.27
Western	3.65	3.29	NA	NA	NA	NA
Kakagon	8.31	6.62	34.54	2.87	2.68	13.94
2019						
Ashland	9.90	6.26	38.69	3.83	2.39	17.41
Western	1.82	3.29	NA	NA	NA	NA
Kakagon	22.81	6.62	93.38	21.30	-18.94	64.56

Table 2. Overall mean CPE (fish/mile) estimates for each year, including confidence intervals and error estimates.

Year	Mean	Miles	RSE	SE	L 95% CI	U 95% CI
2018	10.48	19.30	44.85	4.70	1.27	19.69
2019	11.51	16.17	53.08	6.11	-0.47	23.49