WISCONSIN DEPARTMENT OF NATURAL RESOURCES
LAKE SUPERIOR WI-2 SUMMER ASSESSMENT REPORT 2020

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INTRODUCTION

The fish community of Lake Superior has gone through a series of dramatic changes over the last century. Agencies responsible for the management of Lake Superior's fishery resources established a series of fish-community objectives, with the overarching goal to "rehabilitate and maintain a diverse, healthy and self-regulating fish community, dominated by native species while supporting sustainable fisheries" (Horns et al., 2003). Information from this survey is used to monitor the population dynamics of recreational and commercially-important fisheries and to assess progress towards fish community objectives in Wisconsin waters of Lake Superior. The nets in this survey include a wide range of mesh sizes and are fished at a wide range of depths to incorporate as much of the Lake Superior fish community and life stages of individual species as possible.

There are three primary objectives for this assessment. First, the survey is used to track changes in the Lake Superior fish community (e.g., predators, prey, benthivores, etc.). Second, the survey is used to assess population dynamics (e.g., abundance, age, size) in Coregonid species (i.e., Lake Whitefish, Cisco and Chub species) in Wisconsin waters of Lake Superior. Third, the small meshes in the survey are used to monitor Lake Trout recruitment, or the number of Lake Trout entering the "fishable" population in a given year. This aspect of the survey is part of a larger, lake-wide, small-mesh juvenile Lake Trout monitoring effort, and these Lake Trout data are also incorporated in the statistical catch-at-age (SCAA) model used to determine the safe harvest level of Lake Trout in management unit WI-2.

METHODS

The summer community survey rotates between sampling the western arm (WI-1) during odd-numbered years and the Apostle Islands region (WI-2) during even-numbered years. From 1970 to 1980, all stations were sampled annually. In 2020, 39 stations were sampled in the Apostle Islands (Figure 1) with 1,097 m mono-filament gill net gangs. Each gang is composed of a series of 91.4 m nets constructed with 38 to 178 mm mesh (stretch measure) by 13 mm increments. Depth profiles of gill net sites were measured using sonar at the inside of the gill net gang, between each 91.4-meter panel and at the outside of the gill net gang. A temperature profile was measured at each site after deploying the net, and temperatures were recorded at the surface, bottom and 3, 6, 9, 12, 15, 18, 30, 45, 60, 75, 90 meter depths (Figure 2). All nets were set on the bottom for one night (24 hours) using the R/V Hack Noyes. Biological information (e.g., length, weight, sex, etc.) was collected from fish using standardized protocols.

The modern stations used in this survey have been consistently sampled since 1980. So, the time-series of geometric mean catch-per-unit-effort (CPE) was calculated using only catch data from 1980 to 2020. Geometric mean CPE+1 was calculated using stations as replicates (CPE calculated as number of fish per km of net per night). Juvenile Lake Trout CPE was assessed using only trout captured in the 51 and 64 mm mesh sizes, excluding trout greater than 450 mm and excluding trout with hatchery fin clips. Wild (non-hatchery origin) Lean Lake Trout CPE was assessed using trout captured in all mesh sizes but excluding trout with hatchery fin clips. Juvenile Cisco CPE was assessed using only fish captured in the 25 mm mesh panel. CPE for the Cisco Suite of species was assessed by combining all *C. artedi, C. hoyi, C. kiyi, C. zenithicus*, and respective crosses. CPE for all other species (and all Lake Trout and Cisco) was assessed using all mesh sizes. The "juvenile" and "adult" nomenclature does not necessarily refer to sexual maturity of individual fish in this case; rather, it refers to the size-selective nature of graded-mesh gill net sampling, which allows separation of fish by size with known effort for each subset. Thus, examination of CPE trends from small mesh sizes may allow insight into recruitment patterns or a relative "year-class strength". Analyses were conducted using Program R, and this report was formatted with the package RMarkdown.

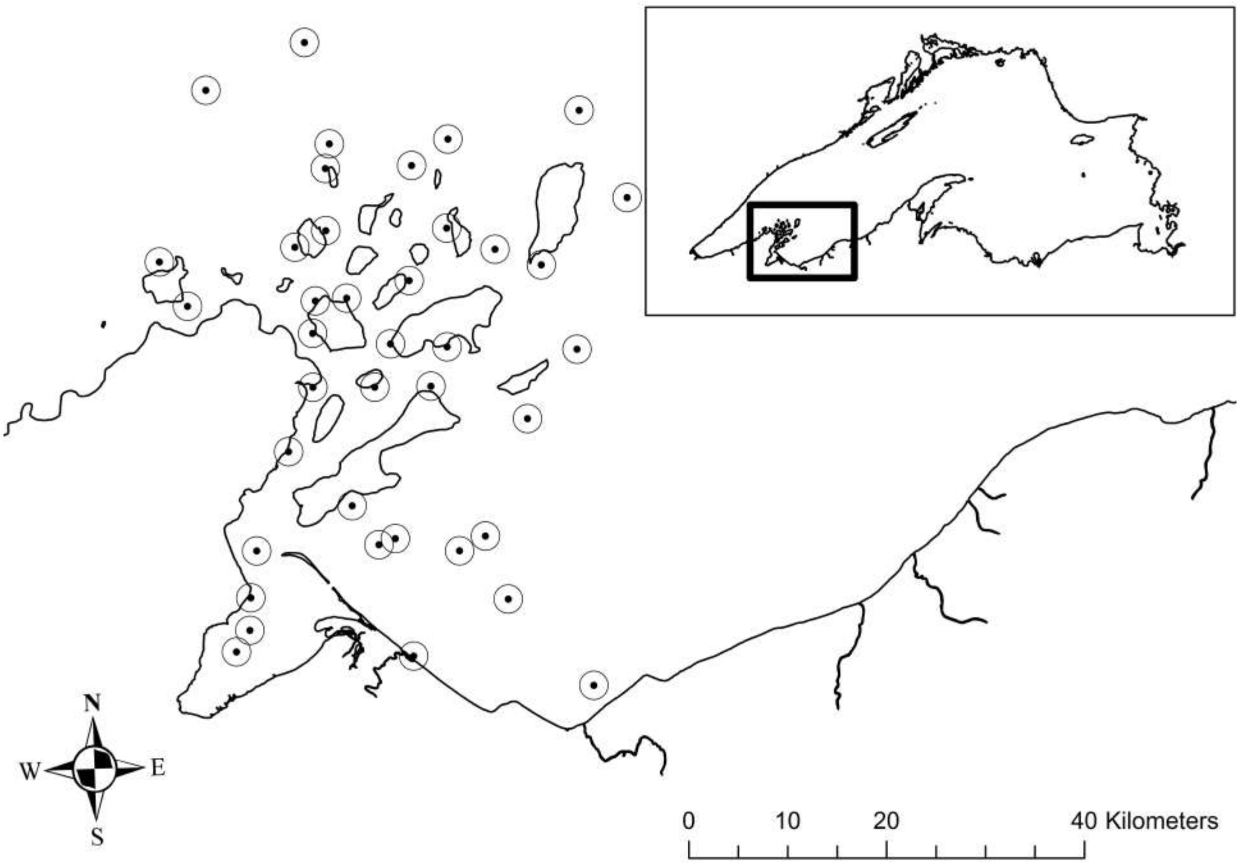

Figure 1. Map of the Apostle Islands region of Lake Superior and the sampling stations for the Wisconsin DNR summer community assessment, 2020.

RESULTS

Lake Trout

Relative abundance for all Lean Lake Trout was higher in 2020 compared to the last several sampling years, but lower than a peak in 1998 and 2000 (Figure 3). Likewise, wild Lean Lake Trout (non-hatchery origin) CPE in WI-2 increased compared to the last few survey years. Relative abundance of wild Lean Lake Trout in the summer assessment increased from 1980 to 2006 and since has stabilized. Geometric mean CPE for juvenile Lean Lake Trout in the summer assessment generally increased from 1980 to 2012. Juvenile Lean Lake Trout relative abundance in 2020 was near average for the past decade. Siscowet Lake Trout catches in the summer assessment are more variable and difficult to interpret. However, geometric mean CPE of Siscowet Lake Trout appears higher than in the 1980s.

The median length of Lean Lake Trout in the 2020 summer assessment was 493 mm, and median length of Siscowet Lake Trout was 498 mm (Figure 4). The median length of fish in the juvenile Lean Lake Trout CPE index was 361 mm. The median length of Lean Lake Trout has increased from 2014 to 2020 (Figure 5).

Coregonids

Relative abundance of Cisco *C. artedi* in 2020 was the lowest recorded in the WI-2 summer assessment since 1984 (Figure 6). This is reflective of lake-wide trends of a Cisco population decline since the early 1990s. The Wisconsin Department of Natural Resources' hydroacoustic surveys have also indicated a decline in adult Cisco biomass in recent years in Wisconsin waters. Geometric mean CPE of juvenile Cisco was also very low in 2020, indicating little recruitment to the fishery in the next couple years. The current Cisco population is maintained by diminishing large year-classes from 1998 and 2003 and small year-classes from 2009 and 2015. The population is dependent on infrequent, large year-classes similar to those in the 1980s and early 1990s to maintain historical population sizes of the past couple decades. Median length of Cisco in the 2020 summer assessment was 318 mm and median length of fish in the juvenile Cisco CPE index was 236 mm (Figure 7). The median length of Cisco in the WI-2 summer assessment has increased dramatically from 2016 to 2020, indicating growth of the 2015 year-class and little recruitment in years prior (Figure 5).

Bloater *C. hoyi* relative abundance varies more since it inhabits chiefly deeper water that is not sampled as intensively in the WI-2 summer assessment (Figure 6). However, geometric CPE of Bloater appears to have increased slightly over the past few years. Relative abundance of the combined Cisco Suite of species (i.e., *C. artedi*, *C. hoyi*, *C. kiyi*, *C. zenithicus* and respective crosses) has been relatively stable over the past decade but much lower than the 1980s and early 1990s, which was driven by Cisco trends. The median length of Bloater in the 2020 summer assessment was 236 mm (Figure 7).

Relative abundance of Lake Whitefish in 2020 was the highest recorded in the WI-2 summer assessment (Figure 6). This was similar to the trend in the WI-1 summer assessment in 2019, which also observed the highest recorded relative abundance of the time series. Until 2020, geometric mean CPE of Lake Whitefish in WI-2 had been stable over the past decade after a slight decline from the previous peak in 2000. Relative abundance in recent decades is much higher than relative abundance in the 1980s. The median length of Lake Whitefish in the 2020 summer assessment was 399 mm (Figure 7). The median length of Lake Whitefish decreased in 2020 after an increasing trend from 2014 to 2018, possibly indicating an influx of younger, smaller fish into the population (Figure 5). This survey should be used to monitor Lake Whitefish population dynamics and could also serve as an input for future stock assessment models.

Other Species

Other species encountered during the summer community assessment in WI-2 have much higher variability in relative abundance estimates due to either: 1) they are captured in low numbers, or 2) they are only captured in a few sites out of the 39 sampled sites. Burbot relative abundance appears stable over the past couple decades but lower than the 1980s (Figure 8). Longnose Sucker relative abundance appears stable throughout the time series. Rainbow Smelt relative abundance has been stable over the past couple decades but much lower than the 1980s. Round Whitefish relative abundance has been up and down throughout the time series and was lower than average in 2020. Eurasian Ruffe relative abundance has increased since the late 1990s but likely stabilized. Splake relative abundance in 2020 was high compared to the last two decades. Brown Trout, Walleye, White Sucker and Yellow Perch relative abundance is too variable to determine trends. Figure 9 shows the size structure of these other eight species captured during the 2020 summer community assessment.

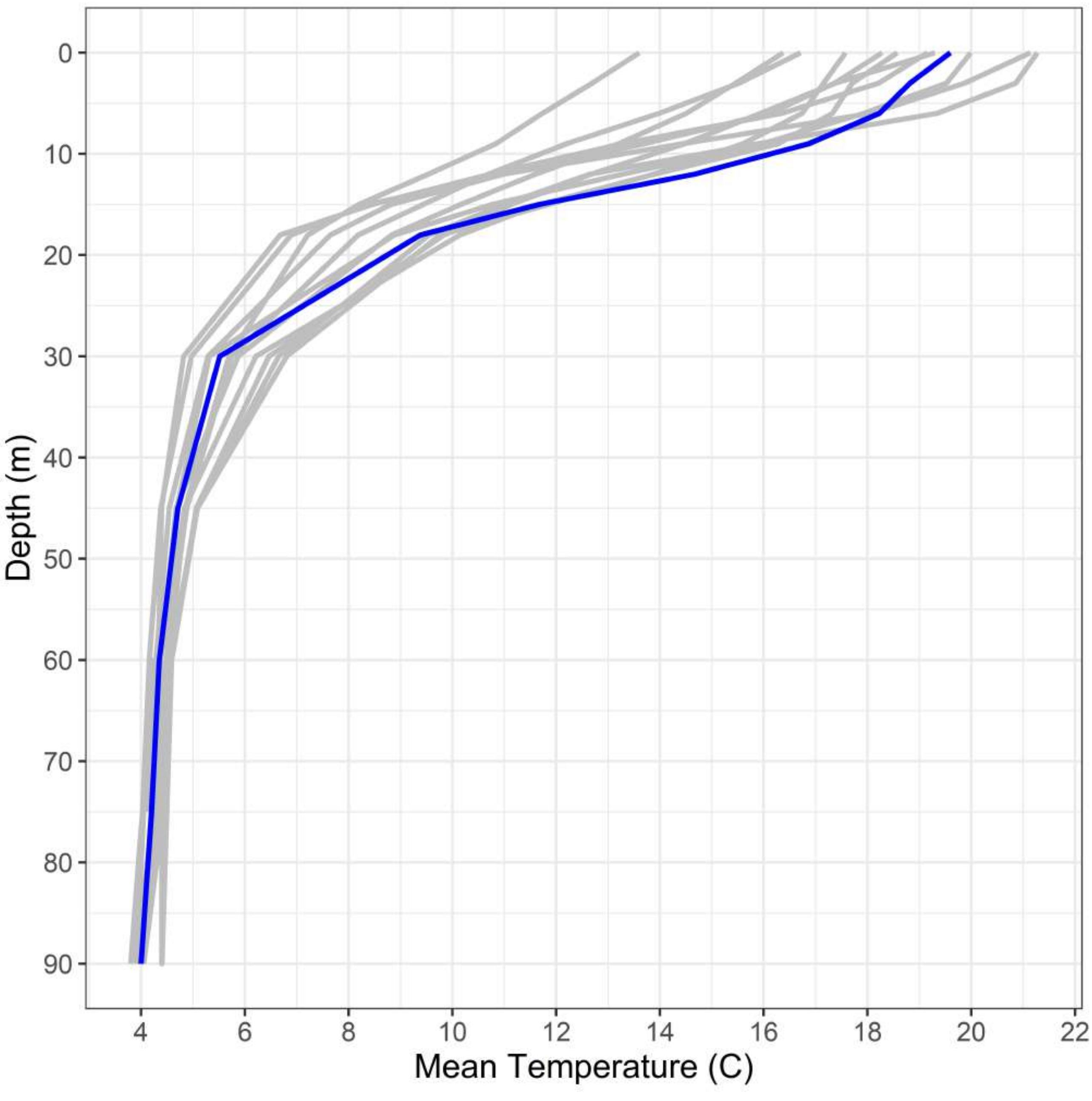

Figure 2. Mean temperature profiles measured from the 39 stations sampled during the summer community assessment in WI-2 waters of Lake Superior. The blue line represents the mean temperature profile measured in 2020 and the grey lines represent mean temperature profile measured in even years from 1998 to 2018.

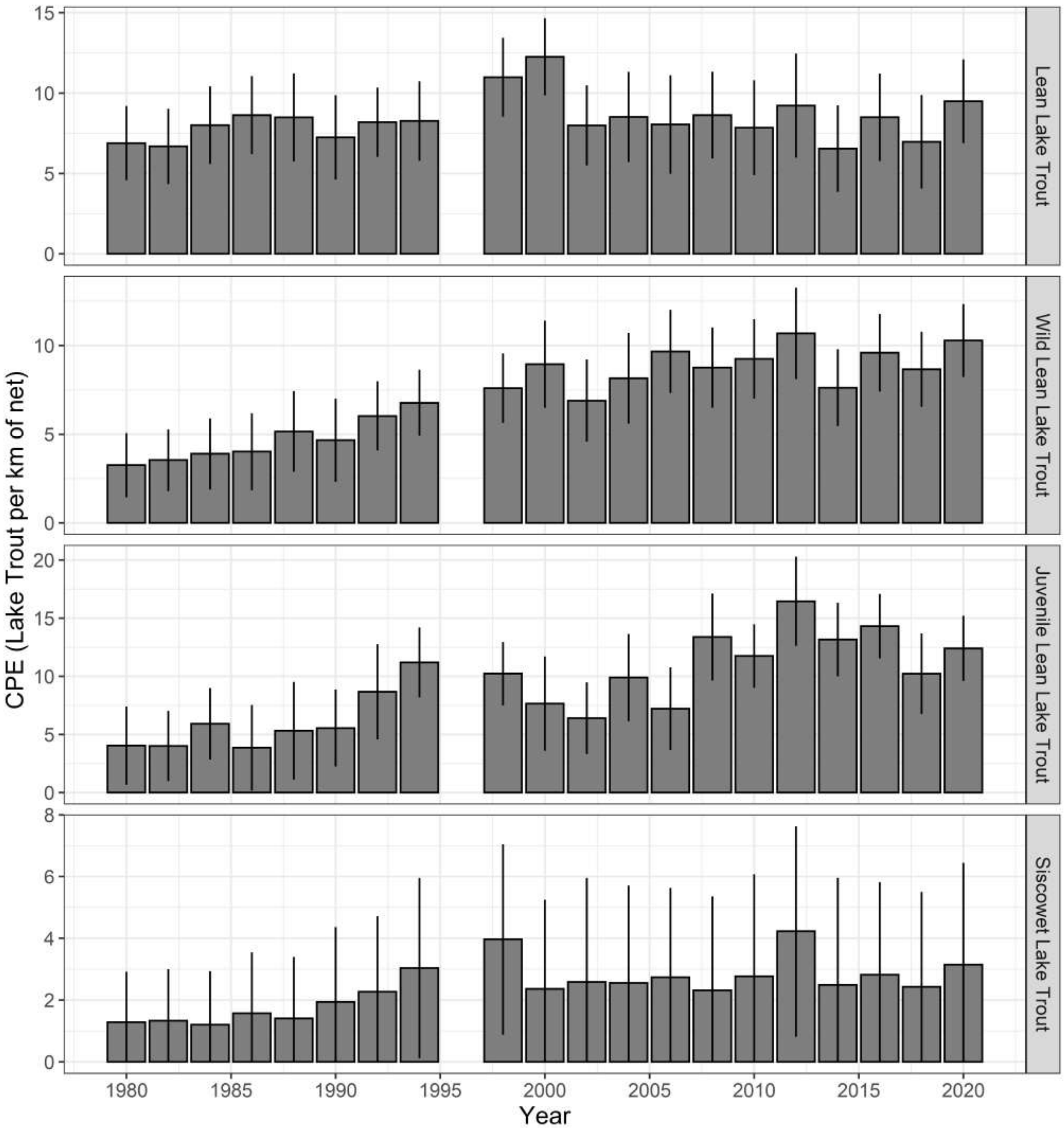

Figure 3. Time series of geometric mean CPE for all Lean Lake Trout (all meshes), wild Lean Lake Trout (non-hatchery origin, all meshes), Juvenile Lean Lake Trout (non-hatchery origin, 51 and 64 mm meshes, < 450 mm total length) and Siscowet Lake Trout (all meshes) in the Apostle Islands region of Lake Superior, 1980-2020. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.

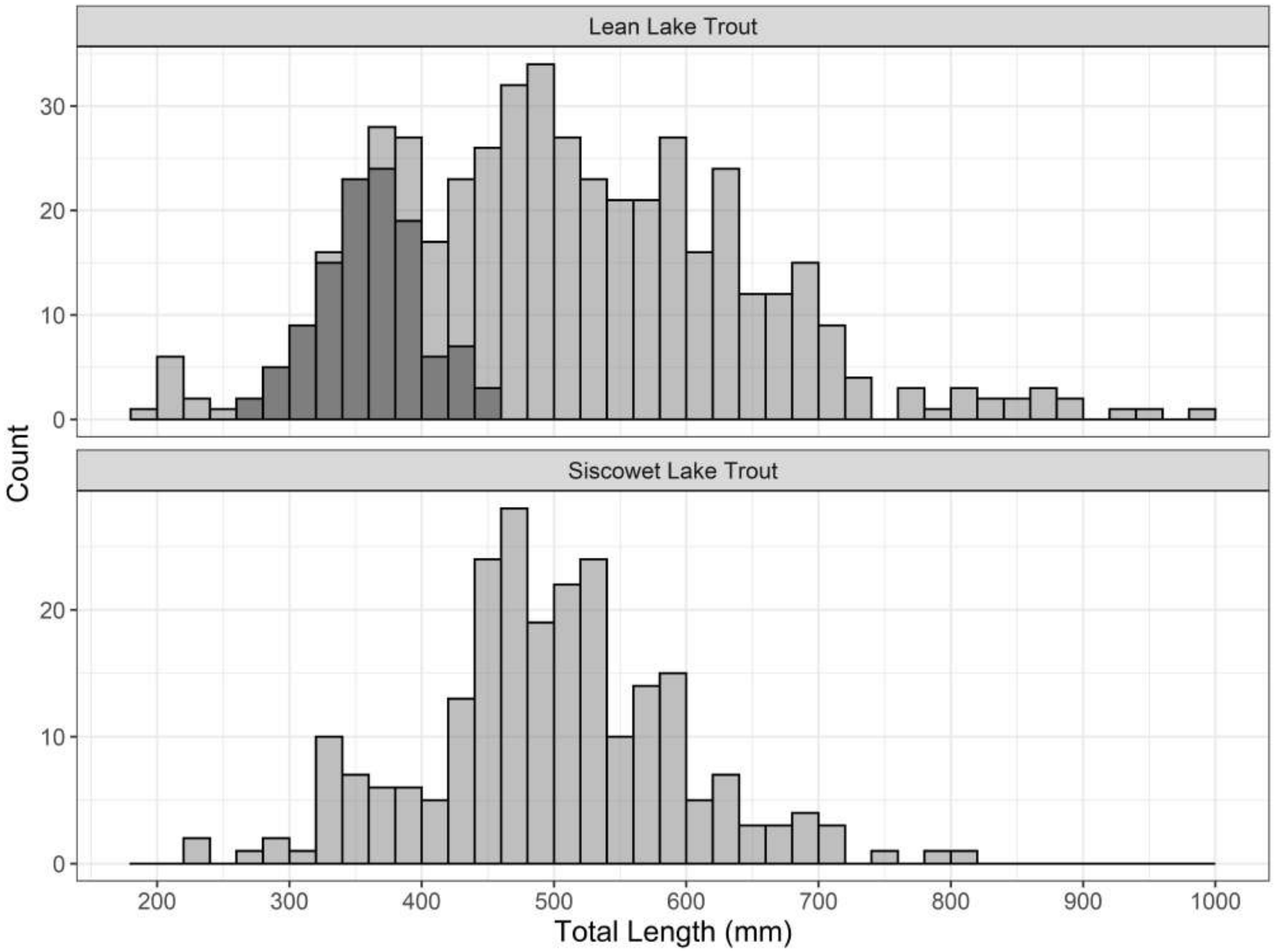

Figure 4. Length frequency histograms of Lean Lake Trout (top) and Siscowet Lake Trout (bottom) caught in the Apostle Islands region of Lake Superior during the 2020 summer community assessment. Darker grey bars represent fish that were counted in the Juvenile Lean Lake Trout CPE index (i.e., non-hatchery origin, caught in 51 or 64 mm mesh, < 450 mm total length).

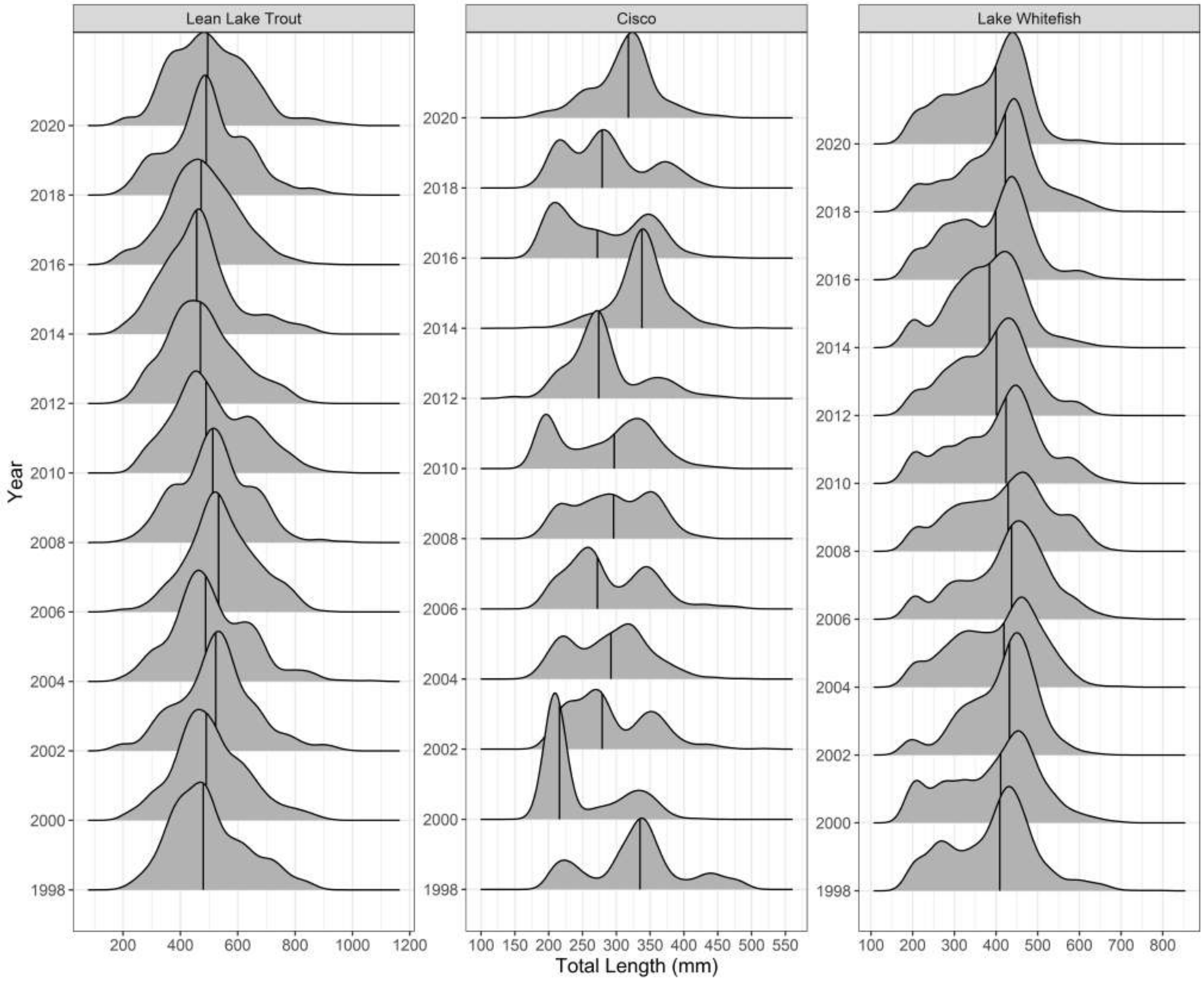

Figure 5. Time series of Lean Lake Trout, Cisco and Lake Whitefish length frequency from 1998 to 2020. Vertical lines represent the median total length sampled in a given year.

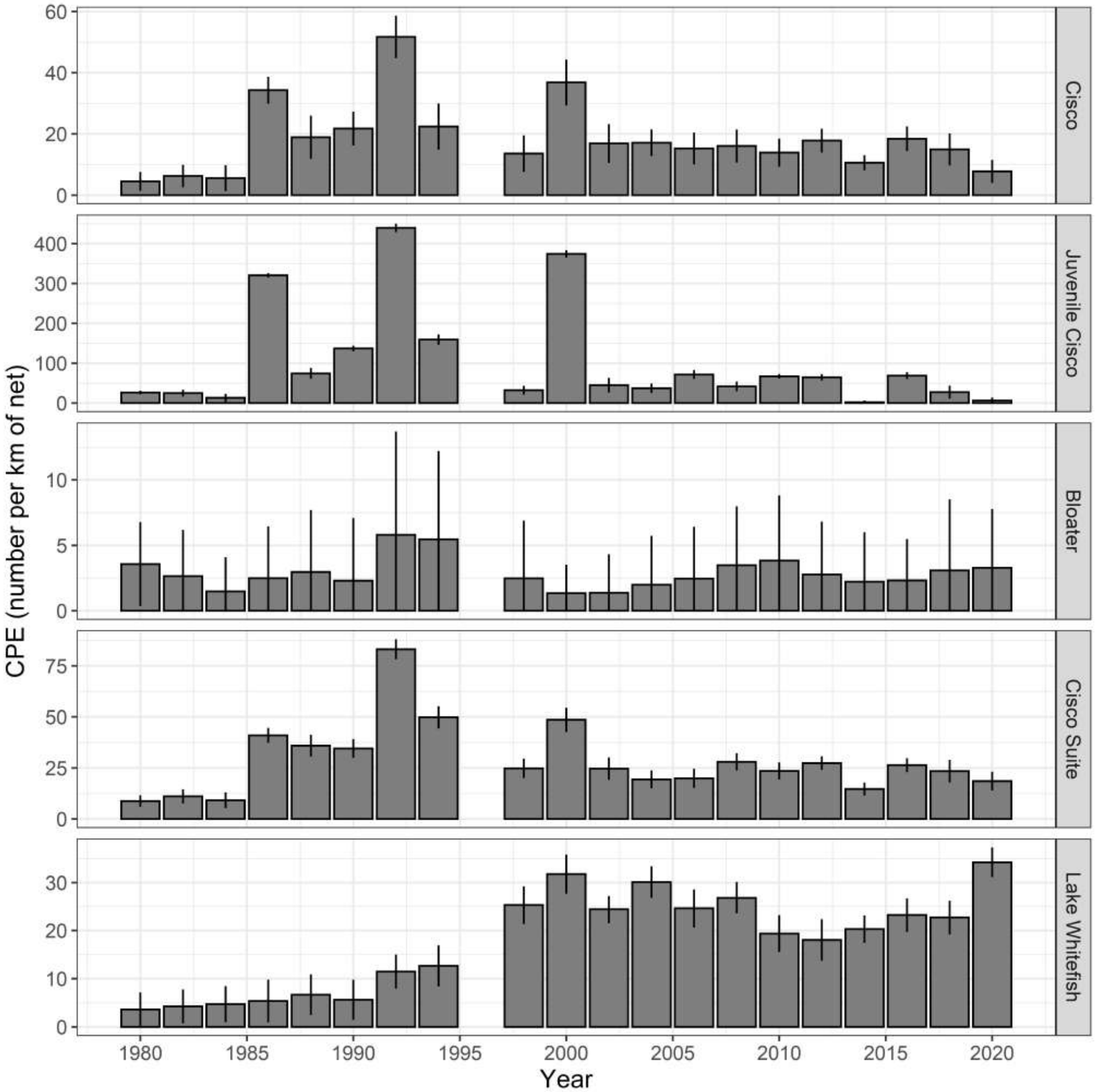

Figure 6. Time series of geometric mean CPE for all Cisco C. artedi (all meshes), Juvenile Cisco (captured in the 38 mm mesh panel), Bloater C. hoyi (all meshes), the Cisco Suite of species including C. artedi, C. hoyi, C. kiyi, and C. zenithicus (all meshes) and Lake Whitefish C. clupeaformis (all meshes) in the Apostle Islands region of Lake Superior, 1980-2020. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.

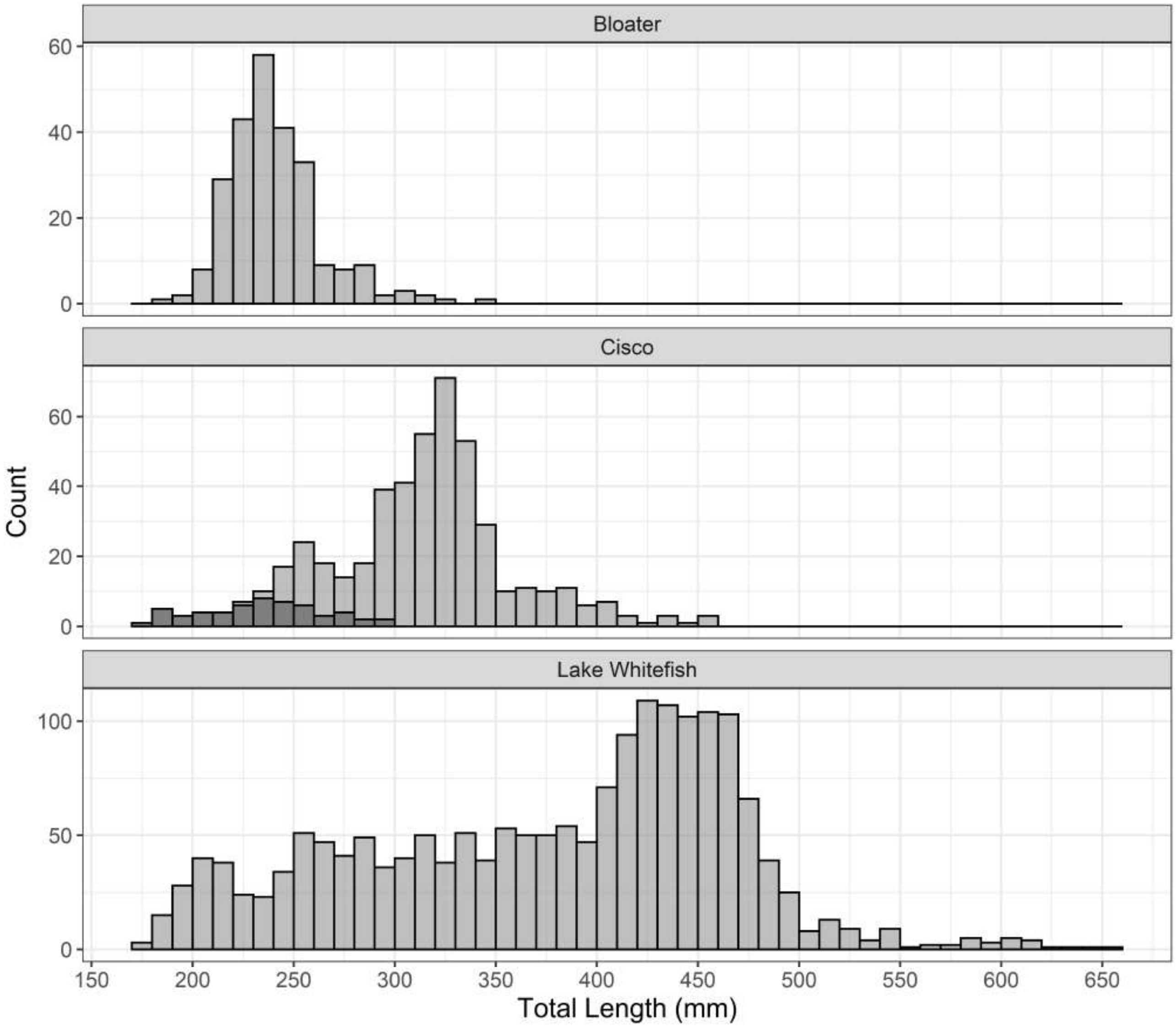

Figure 7. Length frequency histograms of Bloater C. hoyi (top), Cisco C. artedi (middle) and Lake Whitefish C. clupeaformis (bottom) caught in the Apostle Islands region of Lake Superior during the 2020 summer community assessment. Darker grey bars represent fish that were counted in the Juvenile Cisco CPE index (i.e., caught in the 38 mm mesh panel).

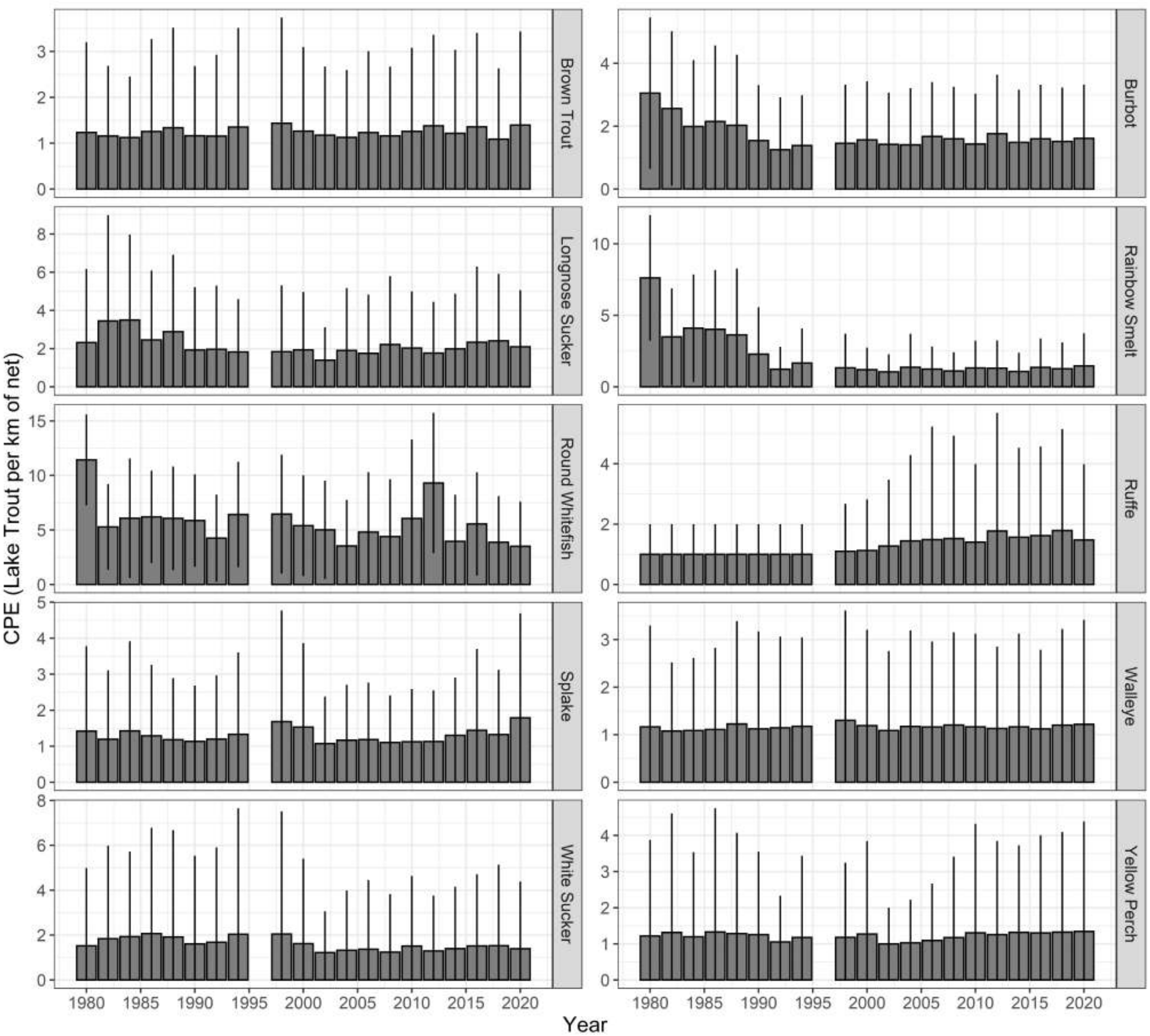

Figure 8. Time series (1980-2020) of geometric mean CPE for ten common species in the Apostle Islands region of Lake Superior including: Brown Trout, Burbot, Longnose Sucker, Rainbow Smelt, Round Whitefish, Eurasian Ruffe, Splake, Walleye, White Sucker and Yellow Perch. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.

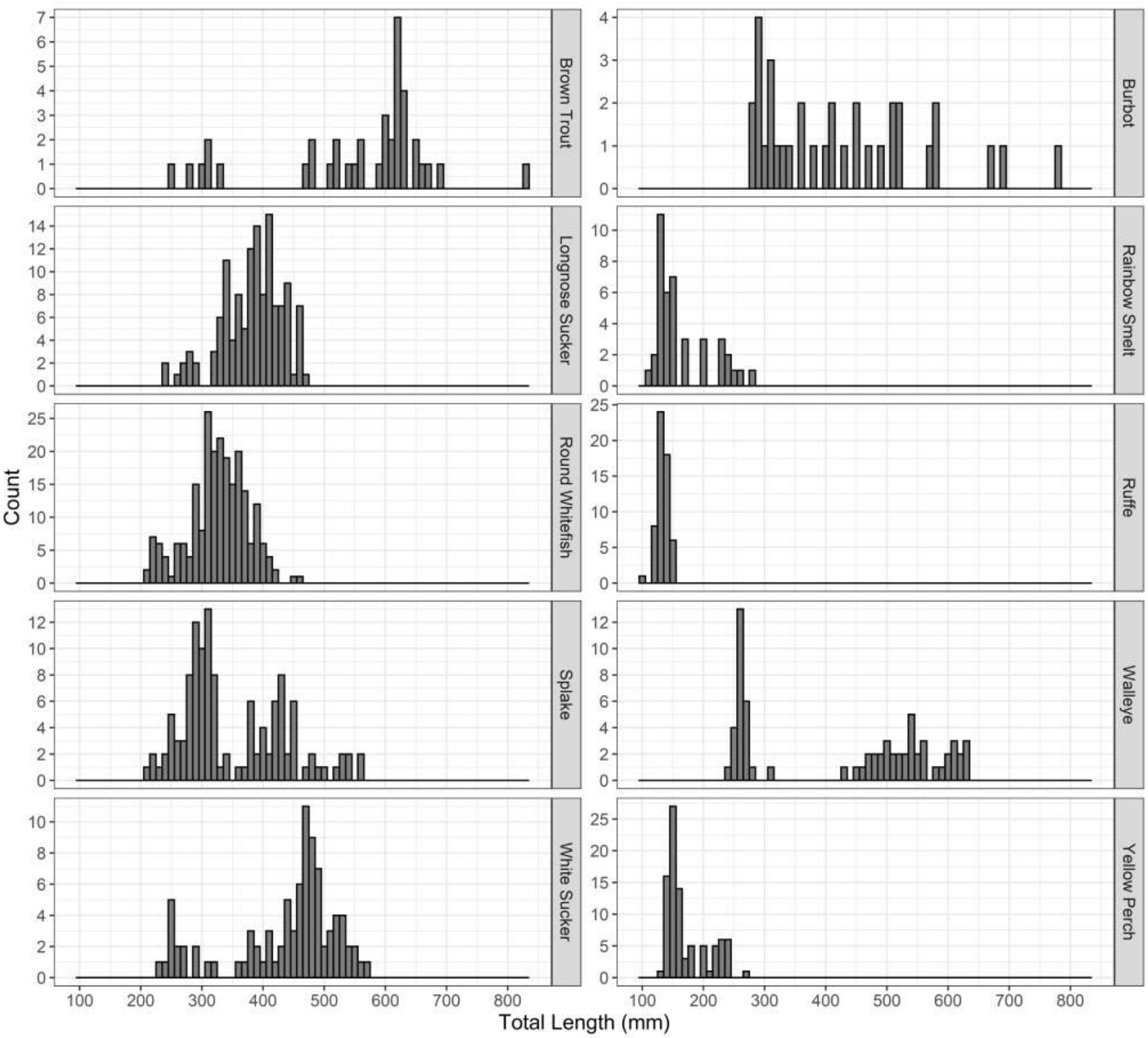

Figure 9. Length frequency histograms of ten common species captured in the Apostle Islands region of Lake Superior in the 2020 summer community assessment including: Brown Trout, Burbot, Longnose Sucker, Rainbow Smelt, Round Whitefish, Eurasian Ruffe, Splake, Walleye, White Sucker and Yellow Perch.