WISCONSIN DEPARTMENT OF NATURAL RESOURCES

LAKE SUPERIOR SUMMER WI-2 ASSESSMENT REPORT 2022

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INTRODUCTION

The fish community of Lake Superior has gone through a series of dramatic changes over the last 100 years. Agencies responsible for the management of Lake Superior's fishery resources have 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 population dynamics of recreational and commercially-important fisheries and to assess progress toward 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 the 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 deepwater 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.

METHODS

The Wisconsin Department of Natural Resources (DNR) Summer Community Assessment rotates between sampling the Western Arm (WI-1) during odd-numbered years and the Apostle Islands region (WI-2) during even-numbered years. In 2022, 39 stations were sampled in the Apostle Islands region (Figure 1) with 1,097-meter monofilament gill net gangs. Each gang is composed of a series of 91.4-meter 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. Temperatures were recorded at the surface, bottom and 3, 6, 9, 12, 15, 18, 30, 45, 60, 75, and 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 in even years, so a time-series of geometric mean catch-per-unit-effort (CPE) was calculated using only catch data from 1980 to 2022. The geometric mean CPE+1 was calculated using stations as replicates (CPE calculated as number of fish per km of net per night). Wild (non-hatchery origin) Lean Lake Trout CPE was assessed using trout captured in all mesh sizes but excluded trout with hatchery fin clips. Juvenile Lean Lake Trout CPE was assessed using only trout captured in the 51 and 64 mm mesh sizes, excluding trout greater than 450 mm. Subadult and older Lean Lake Trout CPE was assessed using only trout captured in meshes greater than 64 mm, excluding trout less than 450 mm. Juvenile Cisco CPE was assessed using only fish captured in the 38-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. Juvenile Lake Whitefish CPE was assessed using only the 38, 51 and 64 mm mesh sizes. CPE for all other species (and total Lake Trout, Cisco and Lake Whitefish) was assessed using all mesh sizes.

The "juvenile" and "adult" nomenclature does not necessarily refer to the sexual maturity of individual fish in this case. 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. Therefore, the 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.

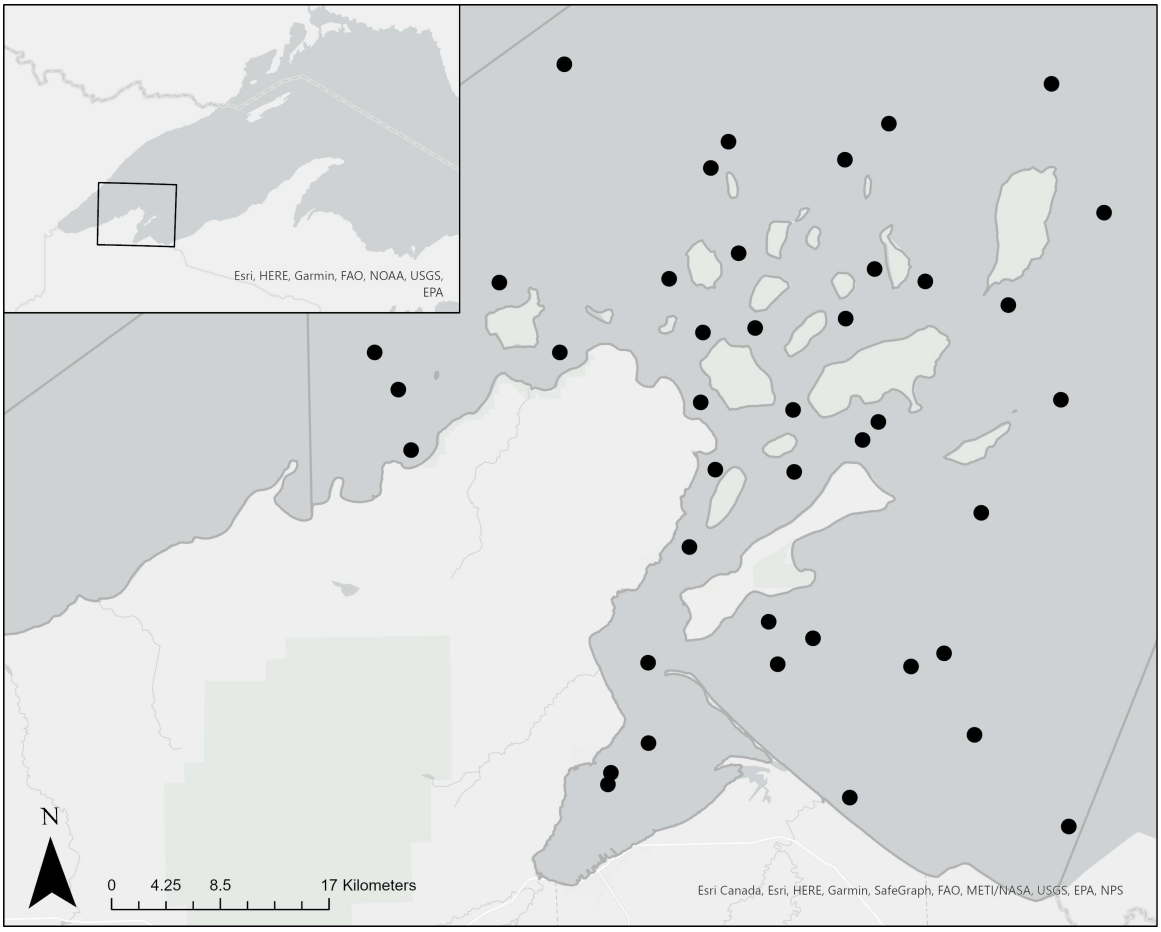

Figure 1. Map of the Apostle Islands (WI-2) region of Lake Superior and the sampling stations for the DNR Summer Community Assessment 2022.

RESULTS

The mean water temperature profile measured during sampling in 2022 was on the cooler side of the ranges observed in the summer survey since 1998 (Figure 2).

LAKE TROUT

The relative abundance of wild Lean Lake Trout in 2022 was the lowest observed in the summer community survey since 1992 (Figure 3). This trend was driven by a sharp decline in juvenile relative abundance (i.e., ages 3-5), and the relative abundance of subadult and older trout was similar to observed levels from 2010 to 2018. Juvenile Lean Lake Trout were underrepresented in the 2022 length distribution (Figure 4) and the median length increased noticably from previous years as recruited trout continued to grow, and new recruits to the summer survey were minimal (Figure 5). A similar trend was observed in Lean Lake Trout age compositions, and age structure has shifted to slightly older fish from 2018 to 2022 (Figure 6). Overall, the fishable portions of the Lean Lake Trout stock are currently maintaining higher levels, but recruitment into the fishery in the coming years may be lower than average.

Siscowet Lake Trout relative abundance has remained stable in the summer community survey (Figure 3), and lengths represented a normal distribution (Figure 4).

CISCOES

Total Cisco *(Coregonus artedi)* relative abundance increased slightly from the previous survey in 2020, driven by a slight increase in juvenile Cisco relative abundance (Figure 7). Recruitment from the 2020 cohort of Cisco was detected in this survey but at a very low magnitude (Figures 7 and 9). The median length of Cisco increased again in the 2022 survey, as the length distribution of the 2015 cohort grew larger with little recruitment of younger cohorts (Figure 5). The current Cisco population is dependent on infrequent, large year-classes to maintain the stock. It is primarily maintained by diminishing large cohorts from 2003, 2009 and 2015, and the 2015 cohort makes up the majority of the fishery.

The relative abundance of Bloater *(Coregonus hoyi)* was slightly lower in the 2022 survey compared to the past few years (Figure 7). The relative abundance of the full Cisco suite (*C. artedi, C. hoyi, C. kiyi C. zenithicus*, and respective crosses) was similar to 2020 but still the lowest observed since 1984 (Figure 7).

The USGS (United States Geological Survey) R/V Kiyi lake-wide CSMI (Coordinated Science and Monitoring Initiative) survey in late summer 2022 detected a large 2022 cohort of Cisco (Yule et al., unpublished data). We will know more about how well this cohort will recruit to the population after the annual spring USGS bottom-trawl survey (age-1) and 2024 WI-2 summer community index survey (age-2).

LAKE WHITEFISH

Total Lake Whitefish relative abundance in 2022 was lower than the previous survey (highest recorded in 2020; Figure 8). The relative abundance of mature Lake Whitefish remained high, and high catches were observed in multiple fisheries. However, the juvenile Lake Whitefish index was relatively low compared to other surveys in the last decade, suggesting recruitment to the fisheries in coming years may be lower. Median length increased from the previous survey, and the length distribution also suggested fewer juveniles with slightly larger mature fish compared to the previous survey (Figures 5 and 9).

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 areas. Burbot, Longnose Sucker and White Sucker relative abundance appears stable over the past couple of decades but possibly lower than in the 1980s (Figure 10). The relative abundance of Rainbow Smelt (gill netting survey only efficiently captures larger adults) has been stable over the past couple of decades but much lower than in the 1980s. Round Whitefish relative abundance has been up and down throughout the time series and was lower than average in 2022. Eurasian Ruffe relative abundance has increased since the late 1990s, and the highest relative abundance was observed in the 2022 survey. Splake relative abundance in 2022 was lower than the previous survey but still near average. Brown Trout, Walleye and Yellow Perch relative abundance is too variable to determine trends. Figure 11 shows the length distributions of these other ten species captured during the 2022 summer community assessment.

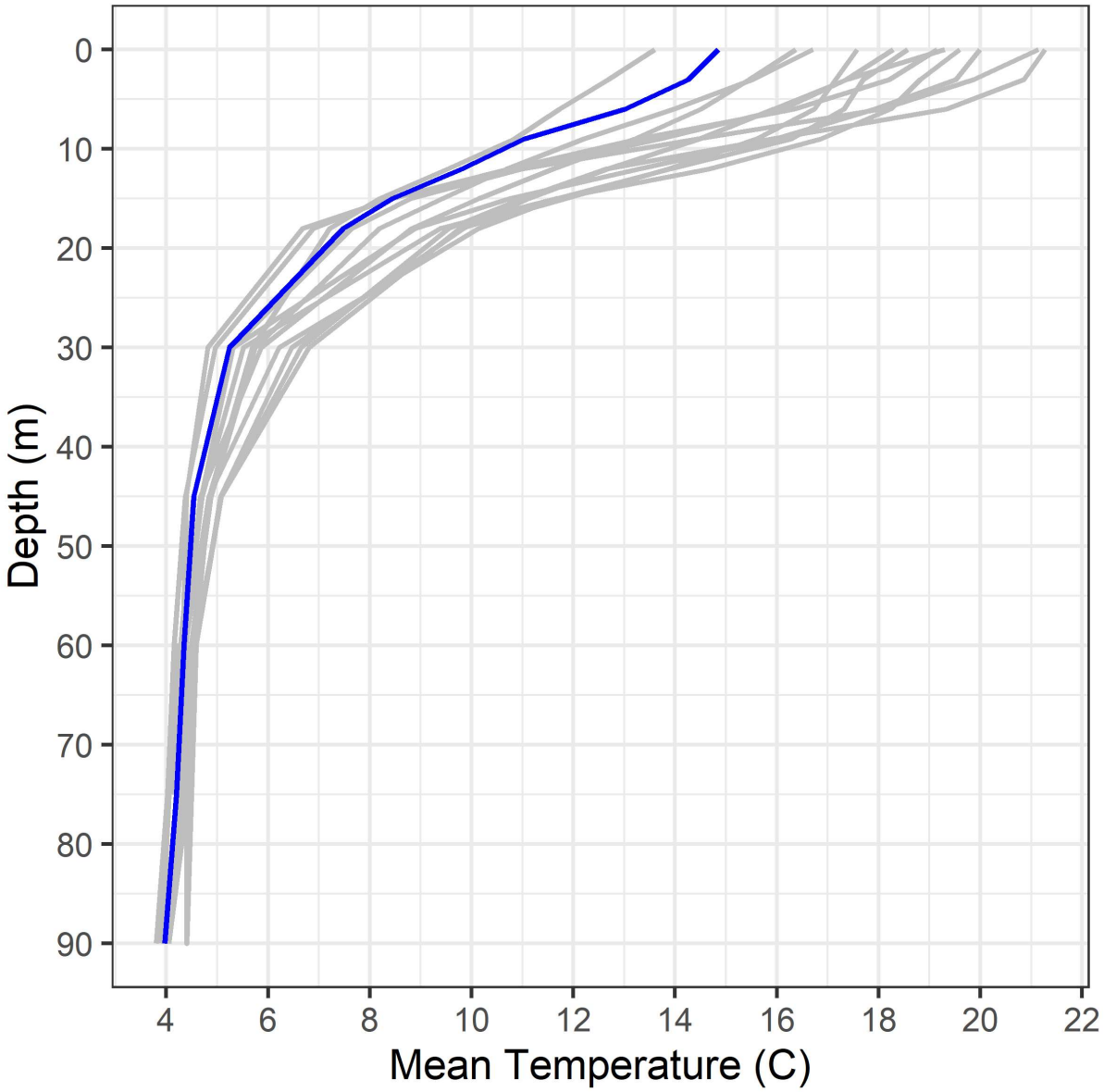

Figure 2. Mean temperature profiles measured from the 39 stations sampled during the summer community assessment in WI-2 waters of Lake Superior. The blue line represents the mean temperature profile measured in 2022, and the grey lines represent mean temperature profile measured in even years from 1998 to 2022.

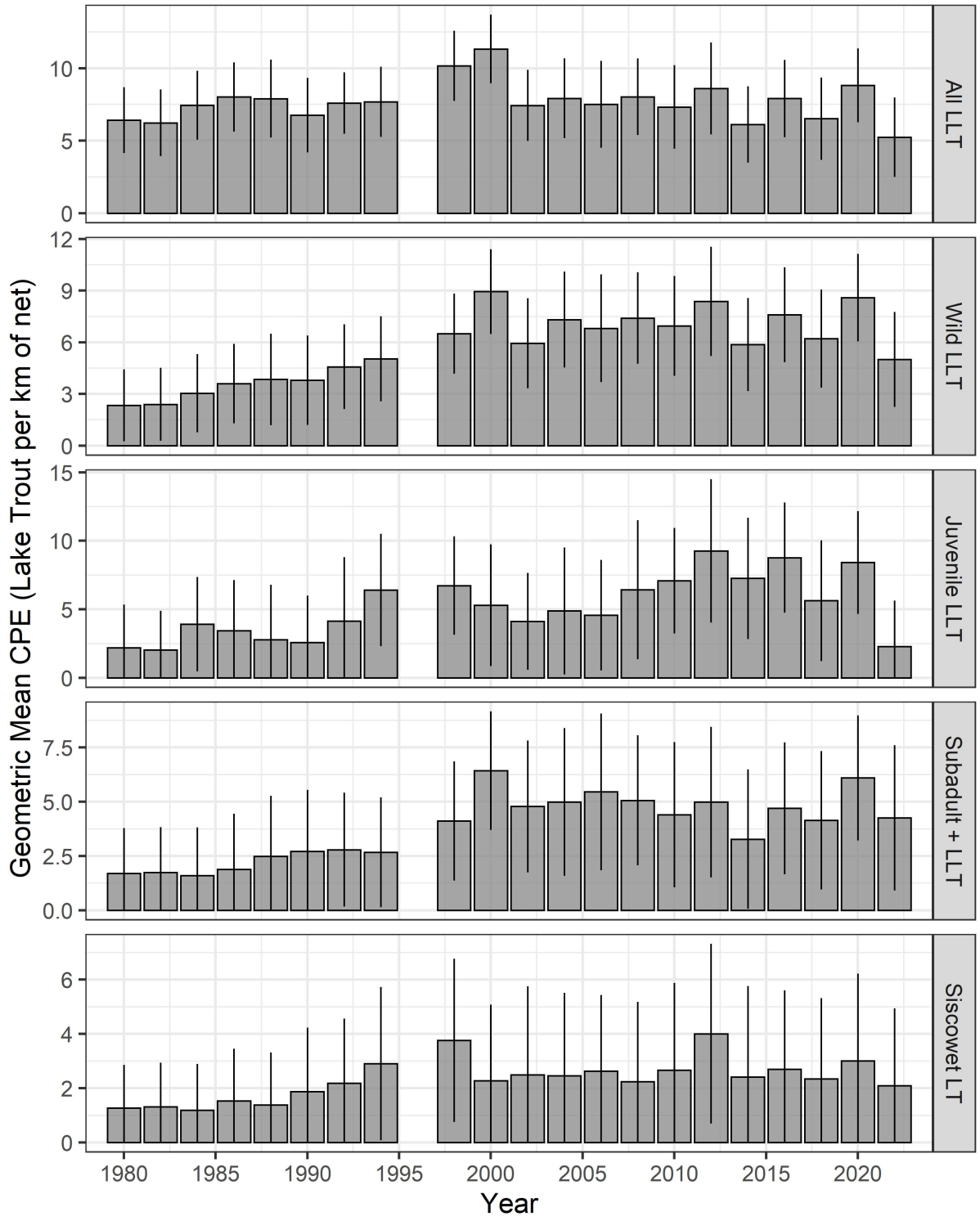

Figure 3. Time series of geometric mean CPE for all Lean Lake Trout (all meshes), wild Lean Lake Trout (non-hatchery origin, all meshes), Juvenile Lean Lake Trout (non-hatchery origin, 51 and 64 mm meshes, < 450 mm total length), Subadult and older Lean Lake Trout (non-hatchery origin, > 64 mm meshes, < 450 mm total length) and Siscowet Lake Trout (all meshes) in the Apostle Islands region of Lake Superior, 1980-2022. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.

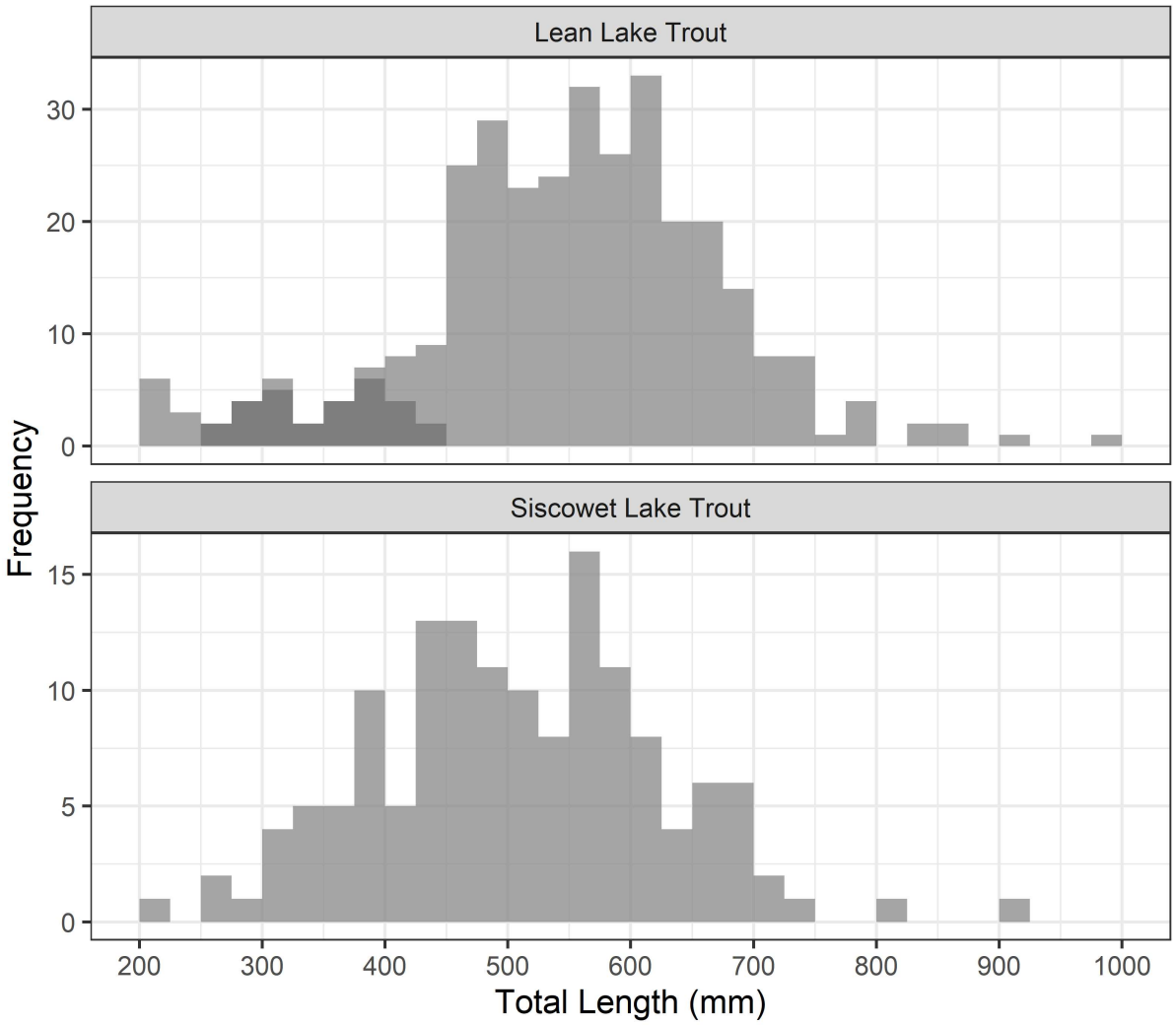

Figure 4. Length frequency histograms of Lean Lake Trout (top) and Siscowet Lake Trout (bottom) caught in the Apostle Islands region of Lake Superior during the 2022 summer community assessment. Darker grey bars represent fish that were counted in the Juvenile Lean Lake Trout CPE index (i.e., non-hatchery origin, caught in 51 or 64 mm mesh, < 450 mm total length).

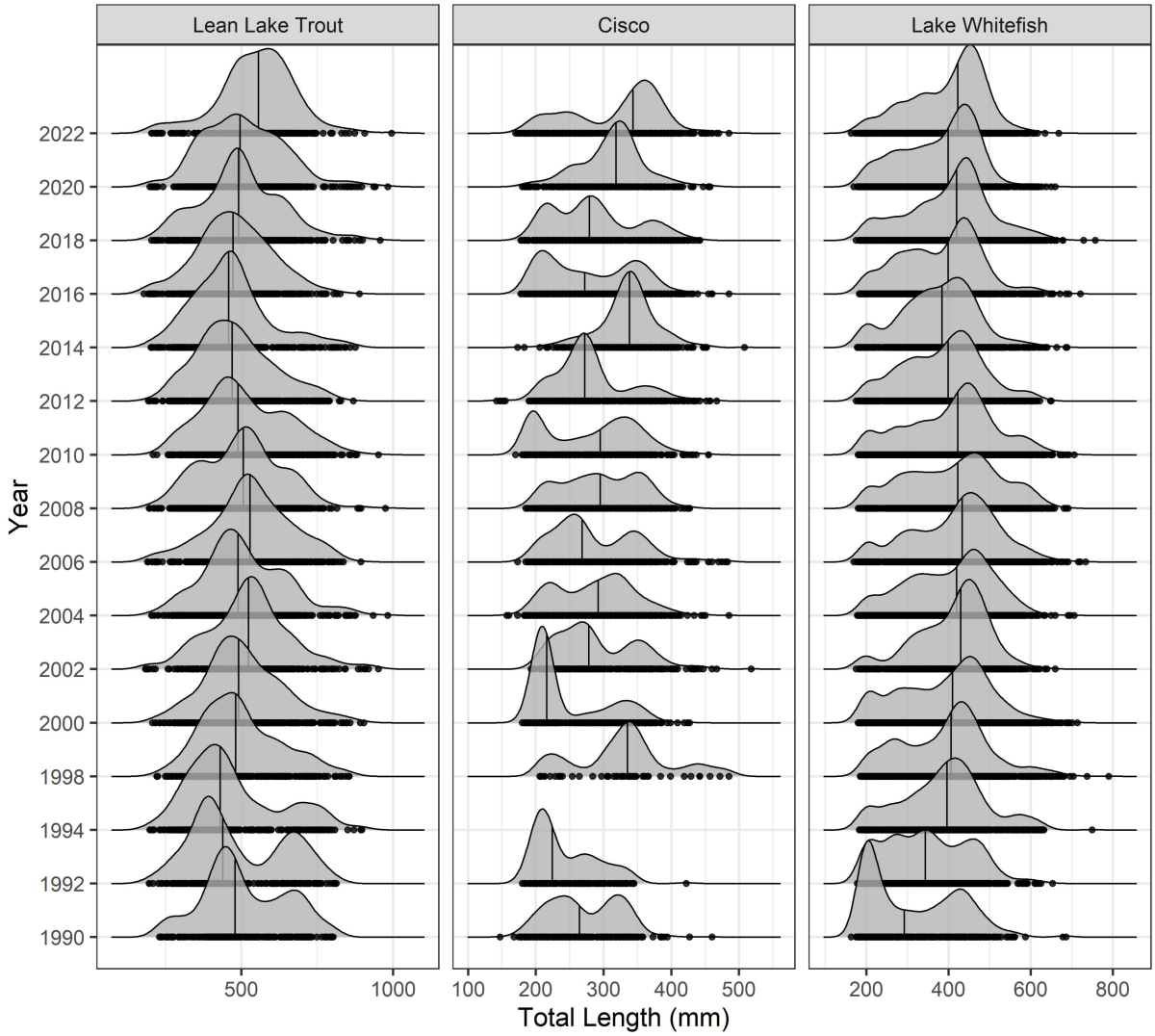

Figure 5. Time series of Lean Lake Trout, Cisco and Lake Whitefish length distributions from 1990 to 2022 captured during the summer community assessment in the Apostle Islands region of Lake Superior. Vertical lines represent the median total length sampled in a given year.

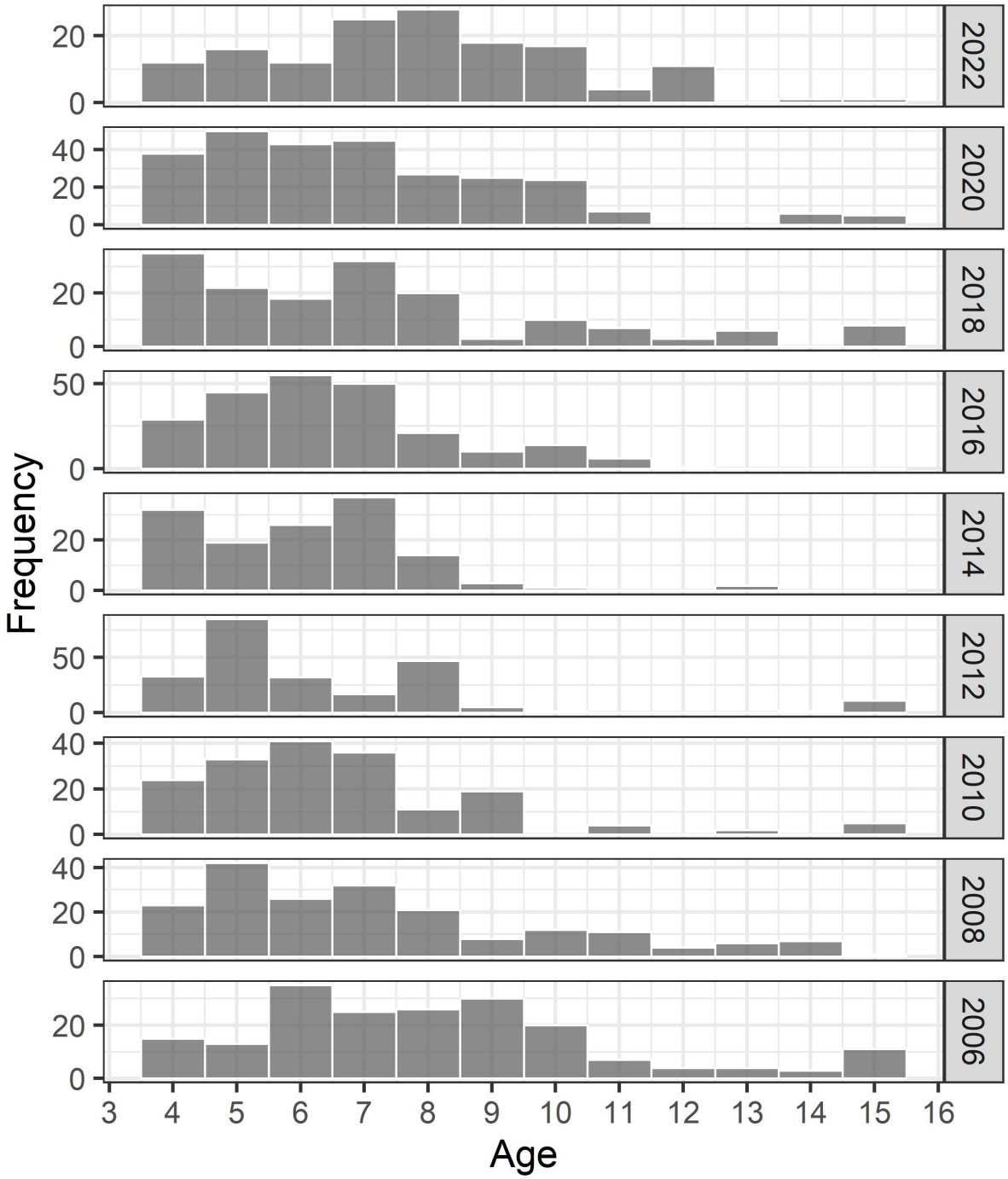

Figure 6. Age frequencies of wild Lean Lake Trout captured during the summer community assessment in the Apostle Islands region of Lake Superior from 2006 to 2022.

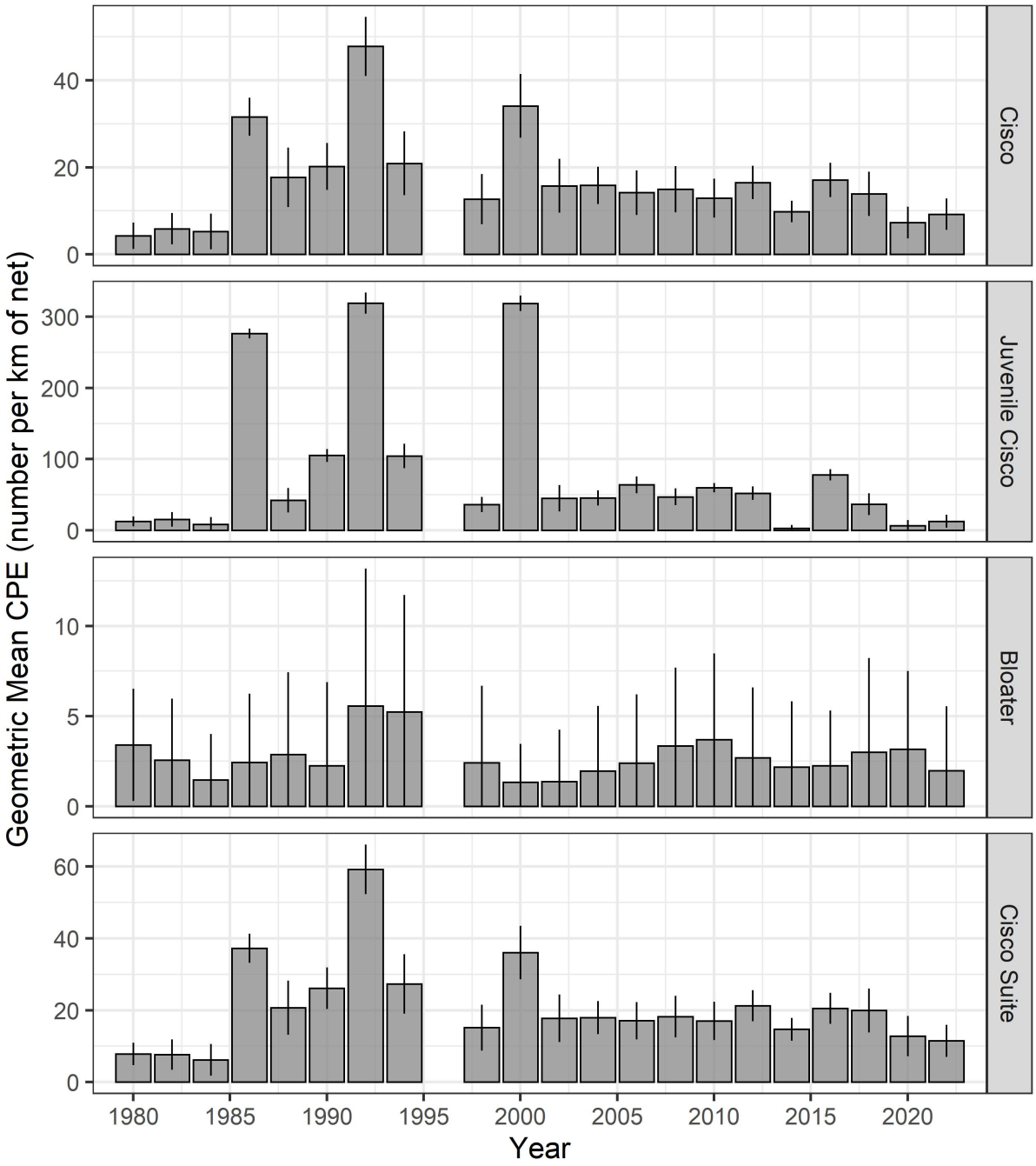

Figure 7. Time series of geometric mean CPE for all Cisco C. artedi *(all meshes), Juvenile Cisco (fish captured in the 38 mm mesh panel), Bloater* C. hoyi *(all meshes), and the Cisco Suite of species, including* C. artedi, C. hoyi, C. kiyi *and* C. zenithicus *(all meshes) in the Apostle Islands region of Lake Superior, 1980-2022. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.*

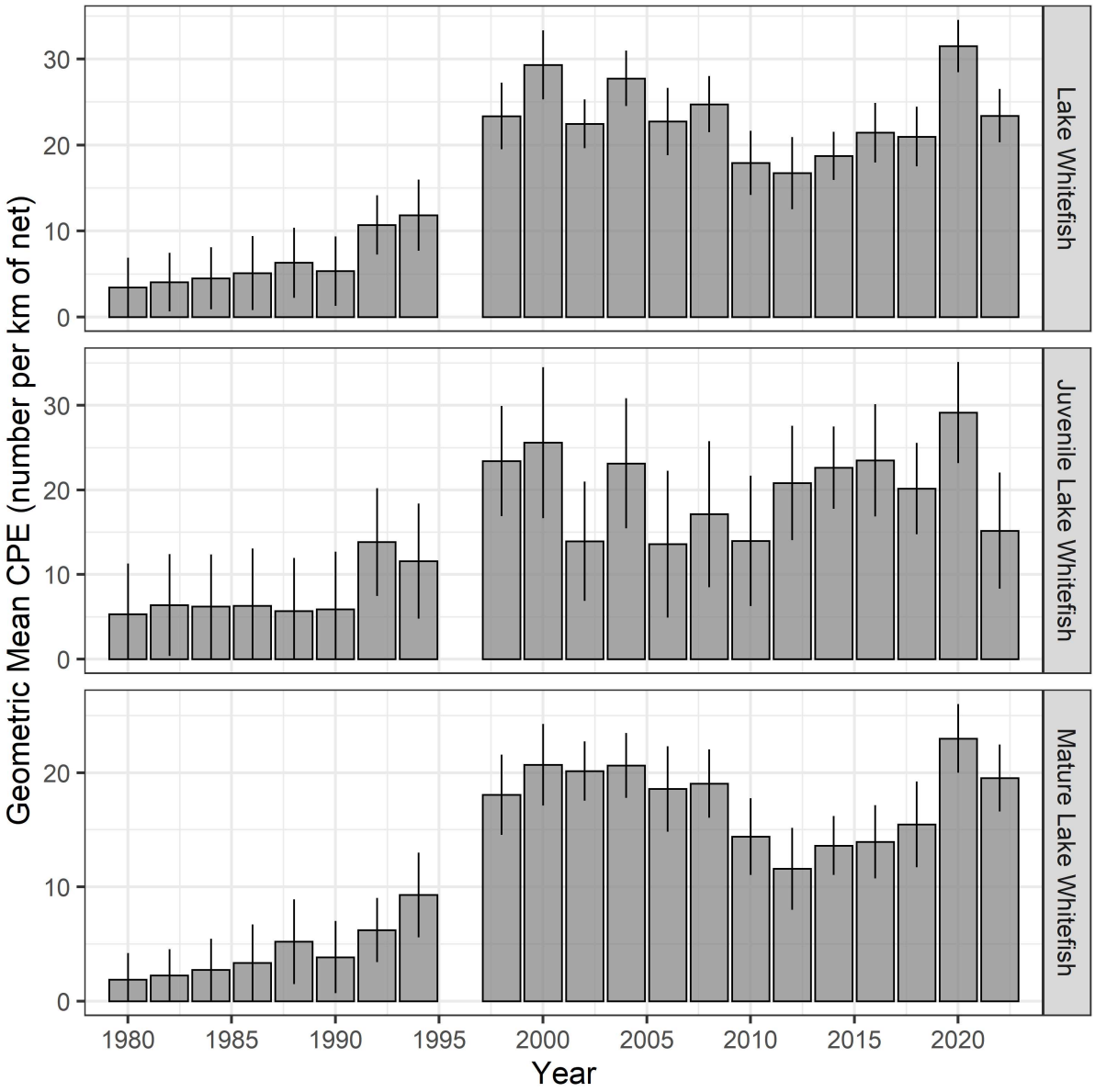

Figure 8. Time series of geometric mean CPE for all Lake Whitefish C. clupeaformis *(all meshes), juvenile Lake Whitefish (fish captured in the 38, 51 and 64 mm mesh panels) and mature Lake Whitefish (panels > 64 mm mesh size) in the Apostle Islands region of Lake Superior, 1980-2022. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.*

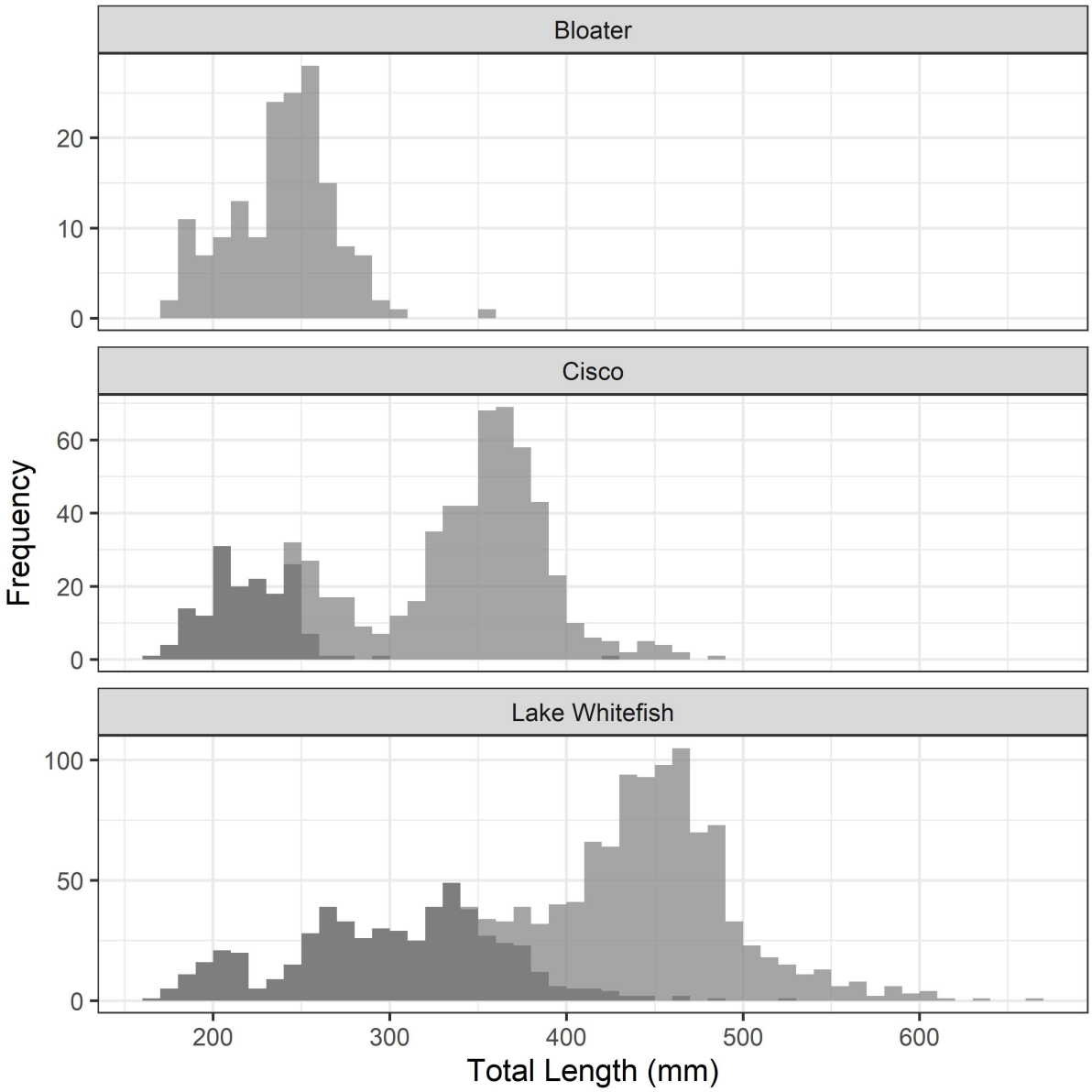

Figure 9. Length frequency histograms of Bloater C. hoyi *(top), Cisco* C. artedi *(middle) and Lake Whitefish* C. clupeaformis *(bottom) caught in the Apostle Islands region of Lake Superior during the 2022 summer community assessment. Darker grey bars represent fish that were counted in the Juvenile Cisco or Juvenile Lake Whitefish indices.*

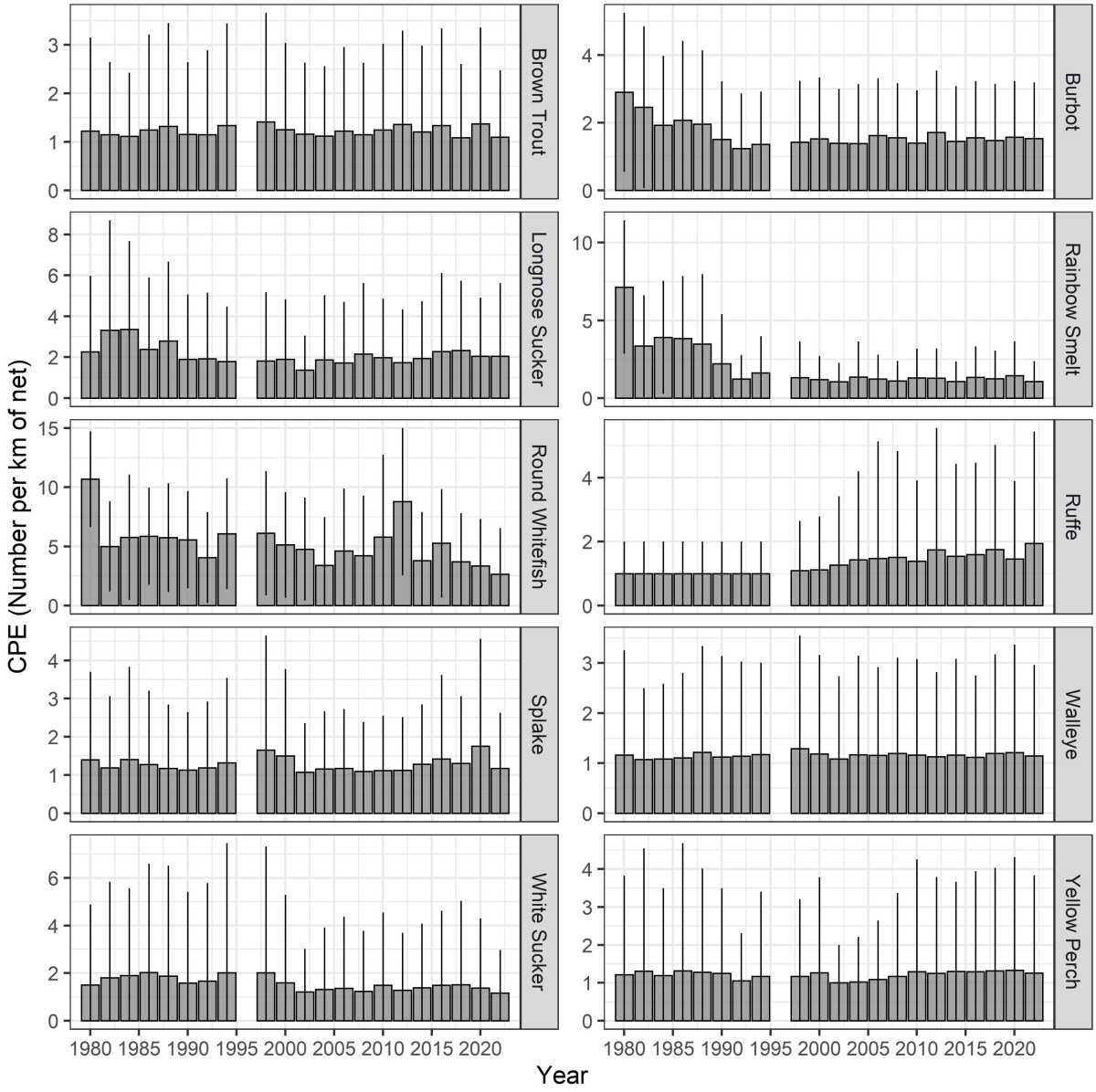

Figure 10. Time series (1980-2022) of geometric mean CPE for ten common species in the Apostle Islands region of Lake Superior including: Brown Trout, Burbot, Longnose Sucker, Rainbow Smelt, Round Whitefish, Eurasian Ruffe, Splake, Walleye, White Sucker and Yellow Perch. Summer community assessment sampling did not occur in 1996. Error bars represent one standard deviation.

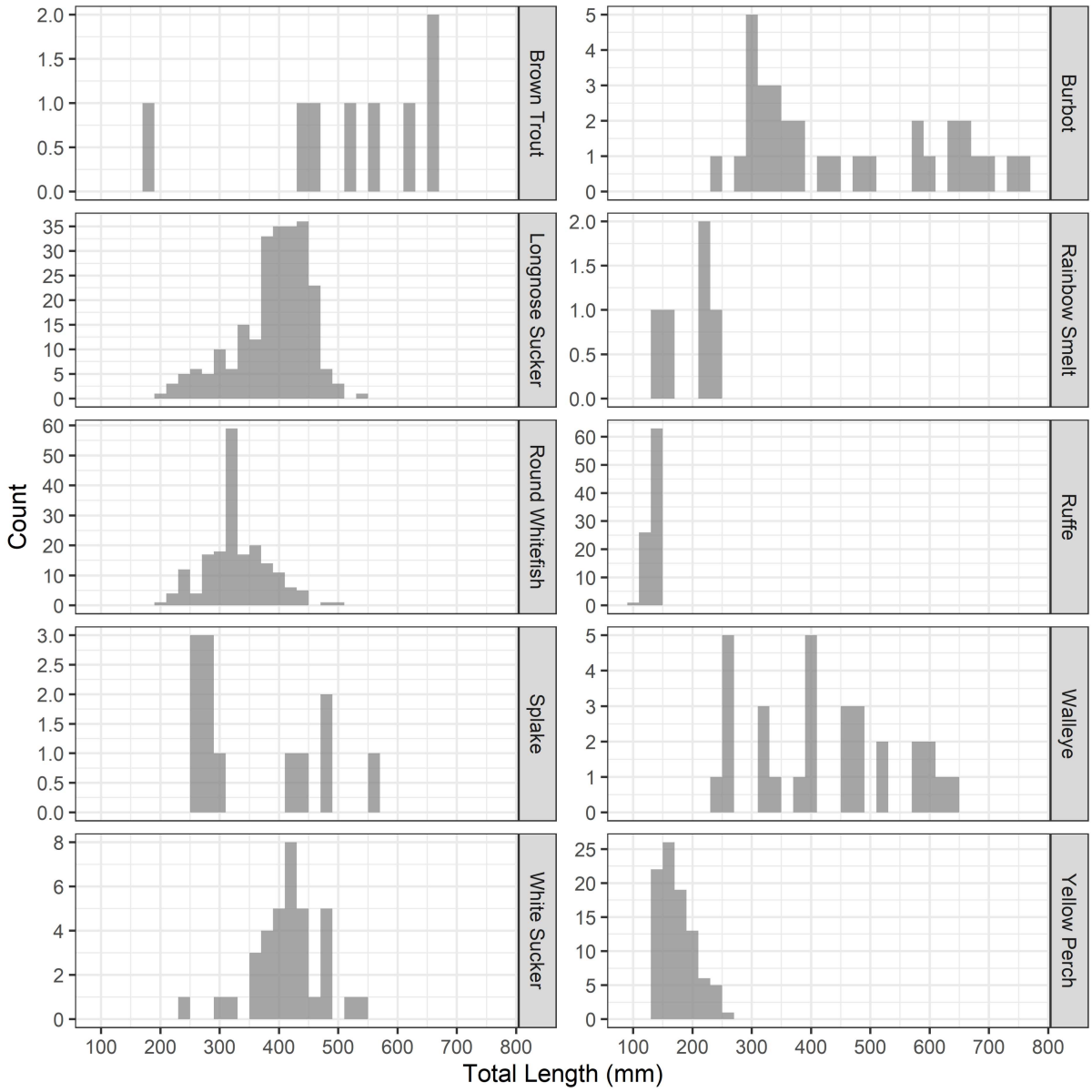

Figure 11. Length frequency histograms of ten common species captured in the Apostle Islands region of Lake Superior in the 2022 summer community assessment including: Brown Trout, Burbot, Longnose Sucker, Rainbow Smelt, Round Whitefish, Eurasian Ruffe, Splake, Walleye, White Sucker and Yellow Perch.