WISCONSIN DEPARTMENT OF NATURAL RESOURCES

LAKE SUPERIOR SUMMER WI-1 ASSESSMENT REPORT 2023

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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 coregonine 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 2023, we sampled 19 stations in the Western Arm region (Figure 1) with 1,097-meter monofilament gill net gangs. Each gang was composed of a series of 91.4-meter nets constructed with 38 to 178 mm mesh (stretch measure) by 13-mm increments. We measured depth profiles of gill net sites 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. We also measured a temperature profile at each site after deploying the net. We recorded temperatures at the surface, bottom and 3, 6, 9, 12, 15, 18, 30, 45, 60, 75, and 90 meter depths (Figure 2). We set all nets on the bottom for one night (24 hours) using the R/V Hack Noyes. Ultimately, we collected biological information (e.g., length, weight, sex, etc.) from fish using standardized protocols.

The modern stations used in this survey have been consistently sampled since 1981 in odd years, so we calculated a time-series of mean catch-per-unit-effort (CPE) using only catch data from 1981 to 2023. We calculated mean CPE using stations as replicates (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 wild 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 all ciscoes 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 wild lean lake trout, hatchery lean lake trout, total cisco and total 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.

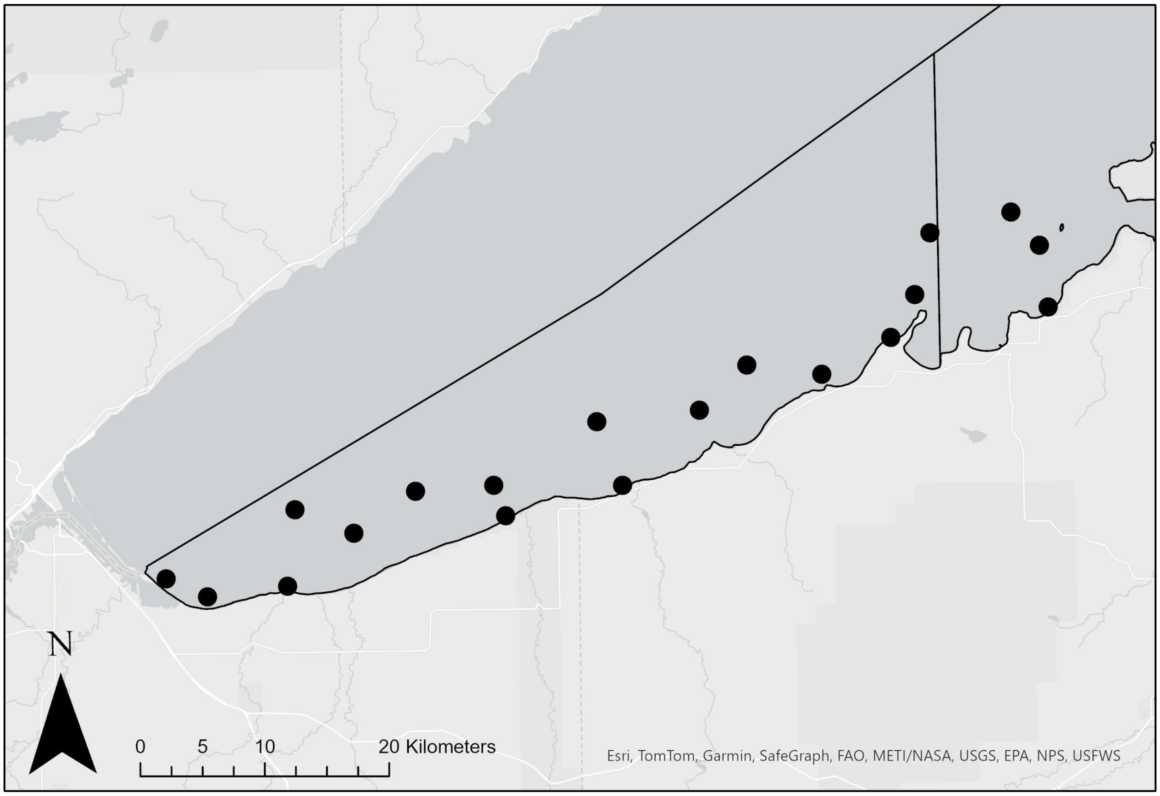

Figure 1. Map of the Western Arm (WI-1) region of Lake Superior and the sampling stations for the DNR Summer Community Assessment 2023.

RESULTS

The mean water temperature profile measured during sampling in 2023 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 2023 was the lowest observed in the summer community survey since 1987 (Figure 3). This trend was driven by a decline in juvenile wild lean lake trout relative abundance (i.e., ages 4-5) in recent years (Figure 3). Hatchery lean lake trout relative abundance was lower than 1980s and 1990s but has been stable since the 2009 survey. The relative abundance of subadult and older wild trout has been relatively stable but notably dropped in 2023 to the lowest observed value since 2001. Juvenile wild lean lake trout were underrepresented in the 2023 length distribution, but we did observe a small handful of very small fish just beginning to recruit to the survey gear (likely age-3; Figure 4). Median length of wild lean lake trout was similar to last year, as a few small fish recruited to the survey (Figure 5). We expect below-average recruitment of lake trout to the fishery in the upcoming couple years.

Siscowet lake trout relative abundance remained relatively high in the summer community survey (Figure 3), but juvenile-sized fish were underrepresented in the 2023 length distribution (Figure 4).

CISCOES

We observed the lowest total cisco *(Coregonus artedi)* relative abundance since the first year of this survey in 1981, and the juvenile cisco index indicated another year of low recruitment (Figure 6). The median length of cisco slightly decreased in the 2023 survey, as we detected a small number of cisco from the 2020 and 2022 cohorts (Figures 8 and 9). 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, which make up the majority of the fishery.

The relative abundance of bloater *(Coregonus hoyi)* was lower in the 2022 survey compared to 2021 (Figure 6). Relative abundance of bloater has been variable throughout the time series but is currently at moderate levels. The relative abundance of all ciscoes combined (*C. artedi, C. hoyi, C. kiyi C. zenithicus*, and respective crosses) was less than 2021 and overall low compared to most years in the time series (Figure 6).

The USGS (United States Geological Survey) R/V Kiyi lake-wide spring bottom-trawling survey in spring 2023 detected a large 2022 cohort of cisco (Vinson et al. 2024). We expect to detect this large year-class in the 2024 WI-2 summer community index survey when they reach age-2.

Vinson, M.R., Evrard, L., Gorman, O.T., Phillips, S.B., Yule, D.L. 2024. Status and Trends of the Lake Superior Fish Community, 2023. Great Lakes Fishery Commission, Ann Arbor, Michigan.
http://www.glfc.int/pubs/lake_committees/common_docs/USGS_LakeSuperior_2023FishSurveyReport.pdf

LAKE WHITEFISH

Total lake whitefish relative abundance in 2023 was similar to previous years (Figure 7). 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 surveys in the last couple decades. 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 8 and 9).

OTHER SPECIES

Burbot, longnose sucker and white sucker relative abundance has generally decreased over the time series (Figure 10). The relative abundance of rainbow smelt (gill netting survey only efficiently captures larger adults age 2+) has been stable over the past couple of decades and much lower than in the 1980s. Round whitefish relative abundance has been up and down throughout the time series and was higher than the previous two surveys. Eurasian ruffe relative abundance increased substantially from 1989 to 2001 but has somewhat decreased since. Brown trout relative abundance was too low and variable to determine trends. Walleye relative abundance decreased from the previous survey in 2021, which was driven by a large 2018 cohort detected in 2021. Figure 11 shows the length distributions of these other eight species captured during the 2023 summer community survey

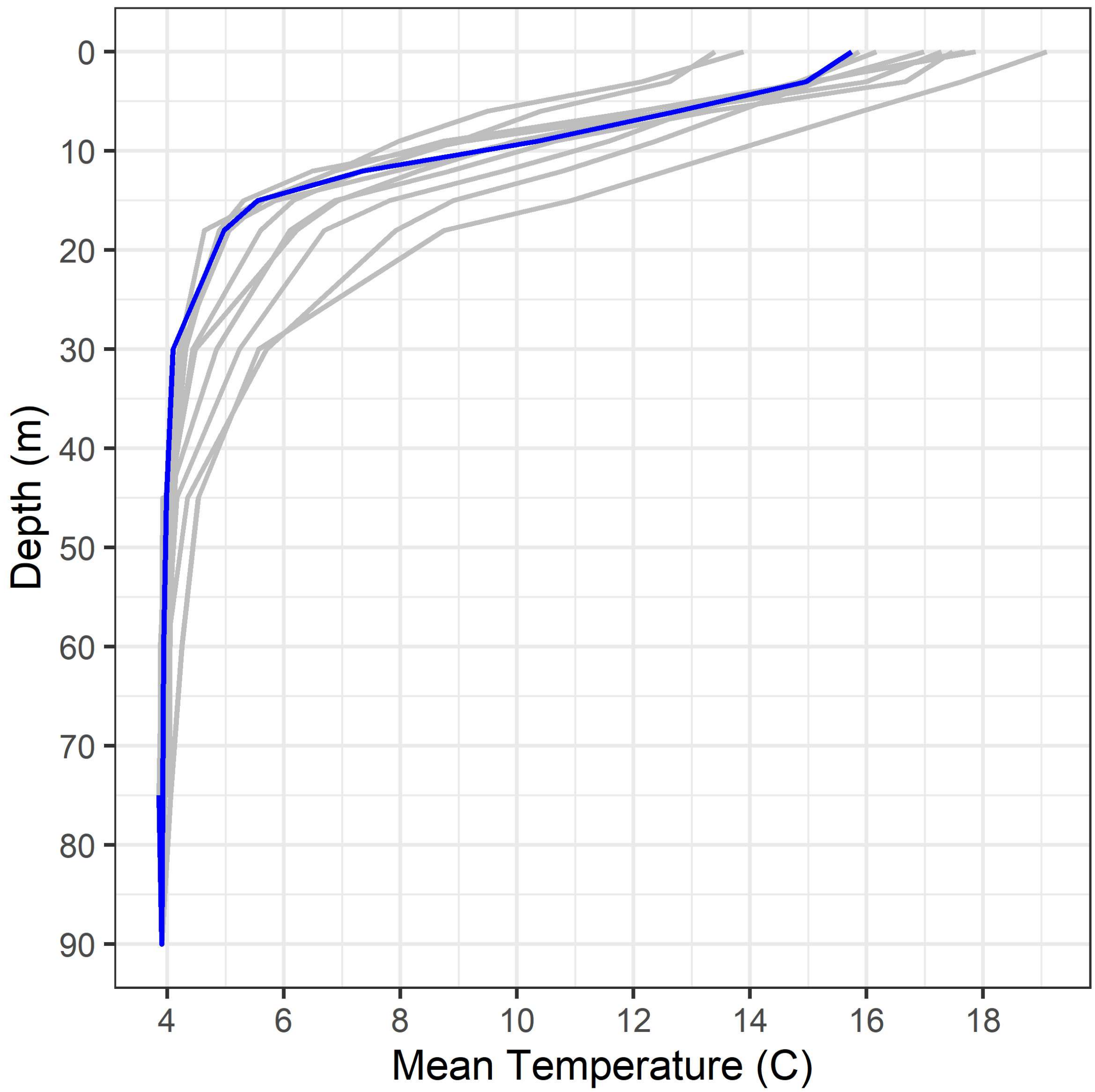

Figure 2. Mean temperature profiles measured from the 39 stations sampled during the summer community assessment in WI-1 waters of Lake Superior. The blue line represents the mean temperature profile measured in 2023, and the grey lines represent mean temperature profiles measured in odd years from 1999 to 2023.

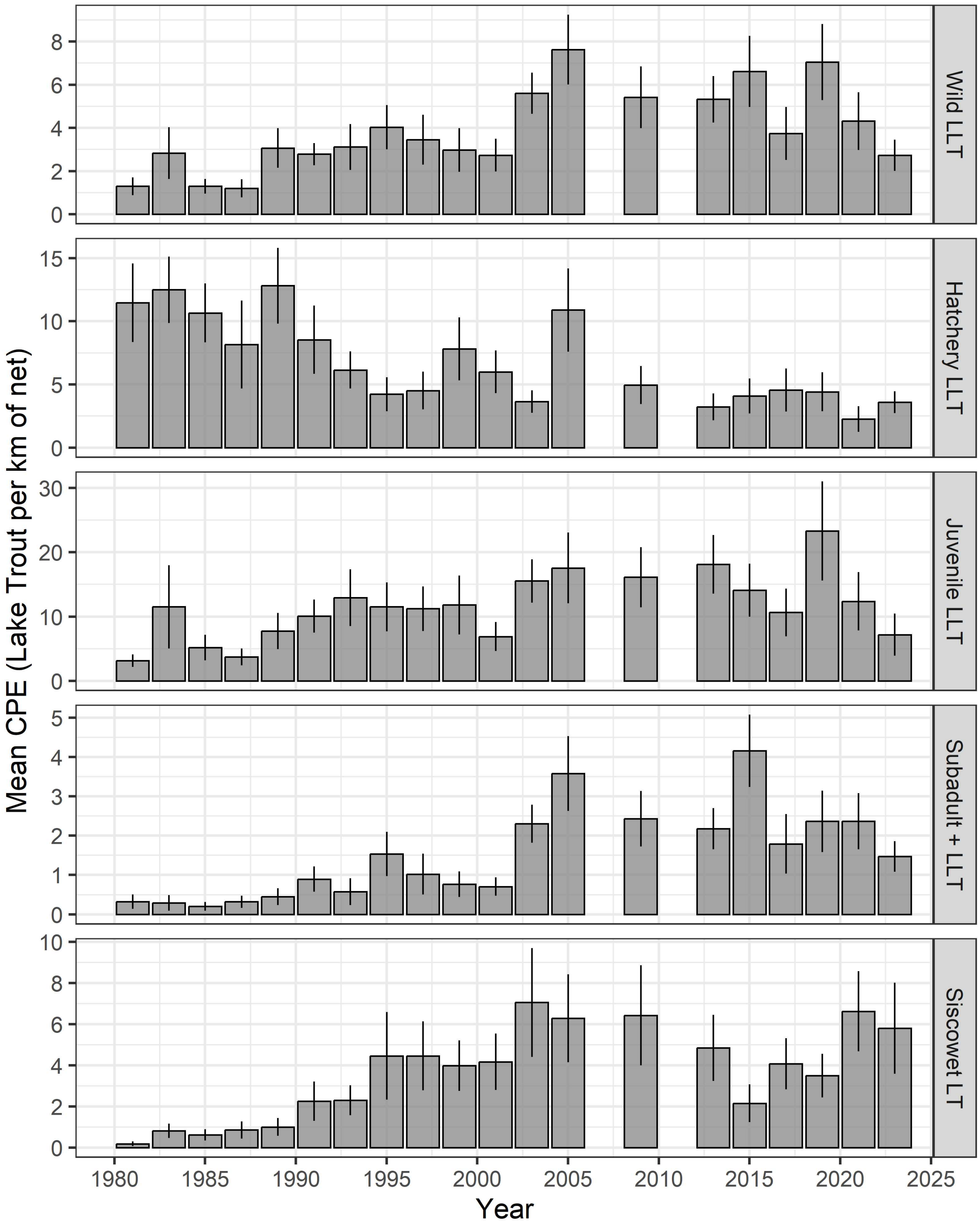

Figure 3. Time series of mean CPE for all wild lean lake trout (all meshes), all hatchery-origin lean lake trout (all meshes), wild juvenile lean lake trout (51 and 64 mm meshes, < 450 mm total length), Subadult and older wild lean lake trout (> 64 mm meshes, < 450 mm total length) and siscowet lake trout (all meshes) in the Western Arm region of Lake Superior, 1981-2023. Sampling did not occur in 2007 or 2011. Error bars represent one standard error.

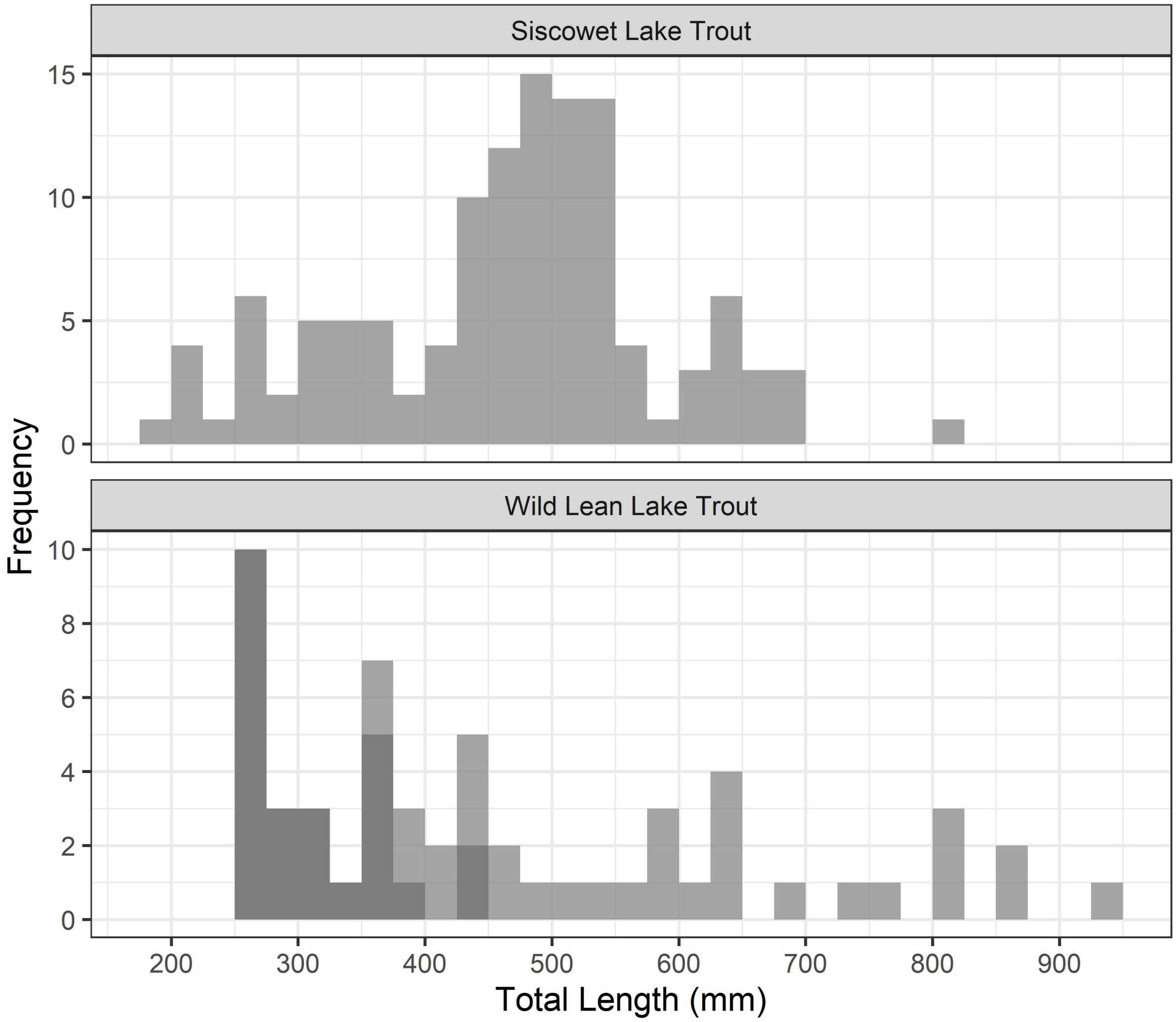

Figure 4. Length frequency histograms of lean lake trout (top) and siscowet lake trout (bottom) caught in the Western Arm region of Lake Superior during the 2023 summer community assessment. Darker grey bars represent fish that were counted in the juvenile lean lake trout CPE index (i.e., non-hatchery origin, caught in 51 or 64 mm mesh, < 450 mm total length).

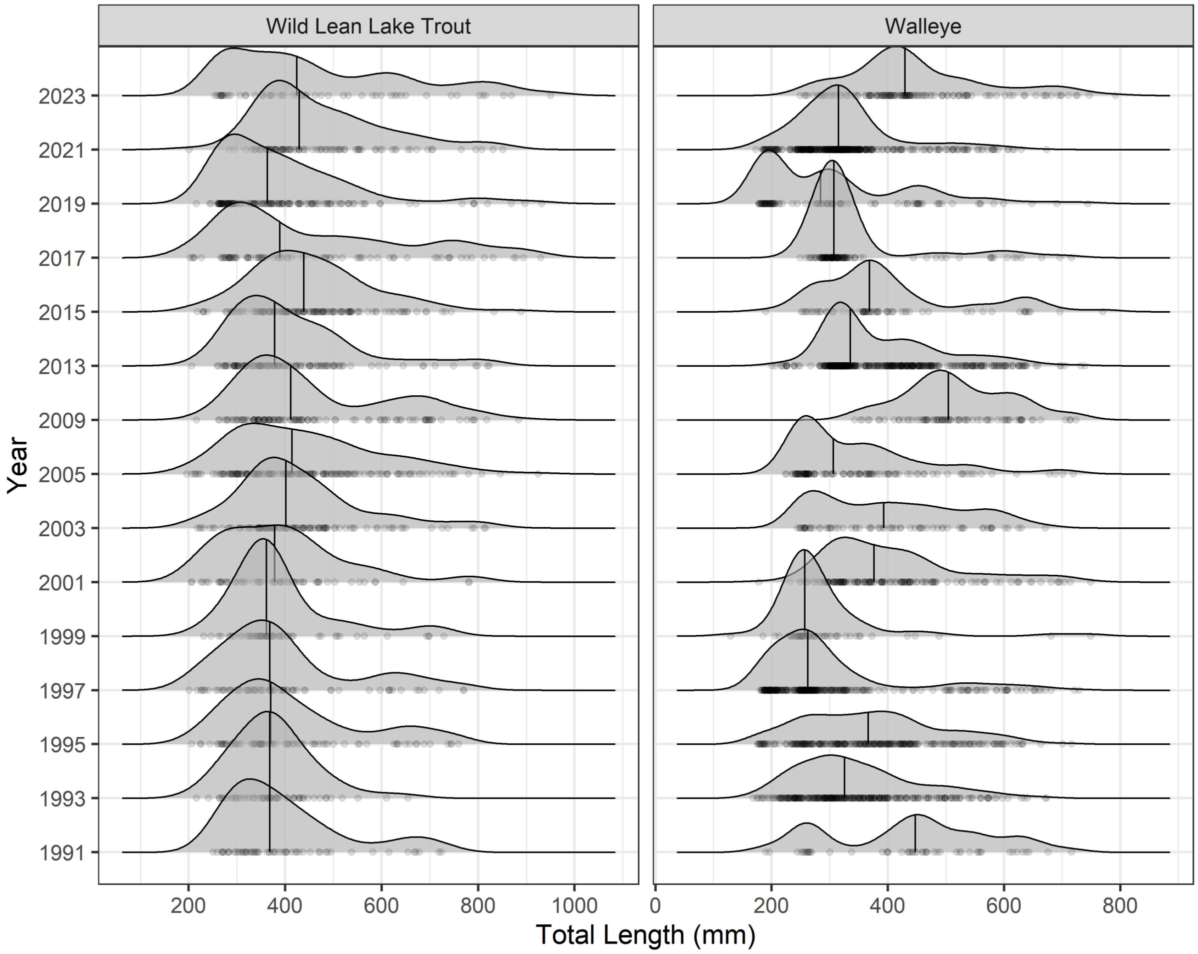

Figure 5. Time series of wild lean lake trout, siscowet lake trout and walleye length distributions from 1991 to 2023 captured during the summer community assessment in the Western Arm region of Lake Superior. Vertical lines represent the median total length sampled in a given year.

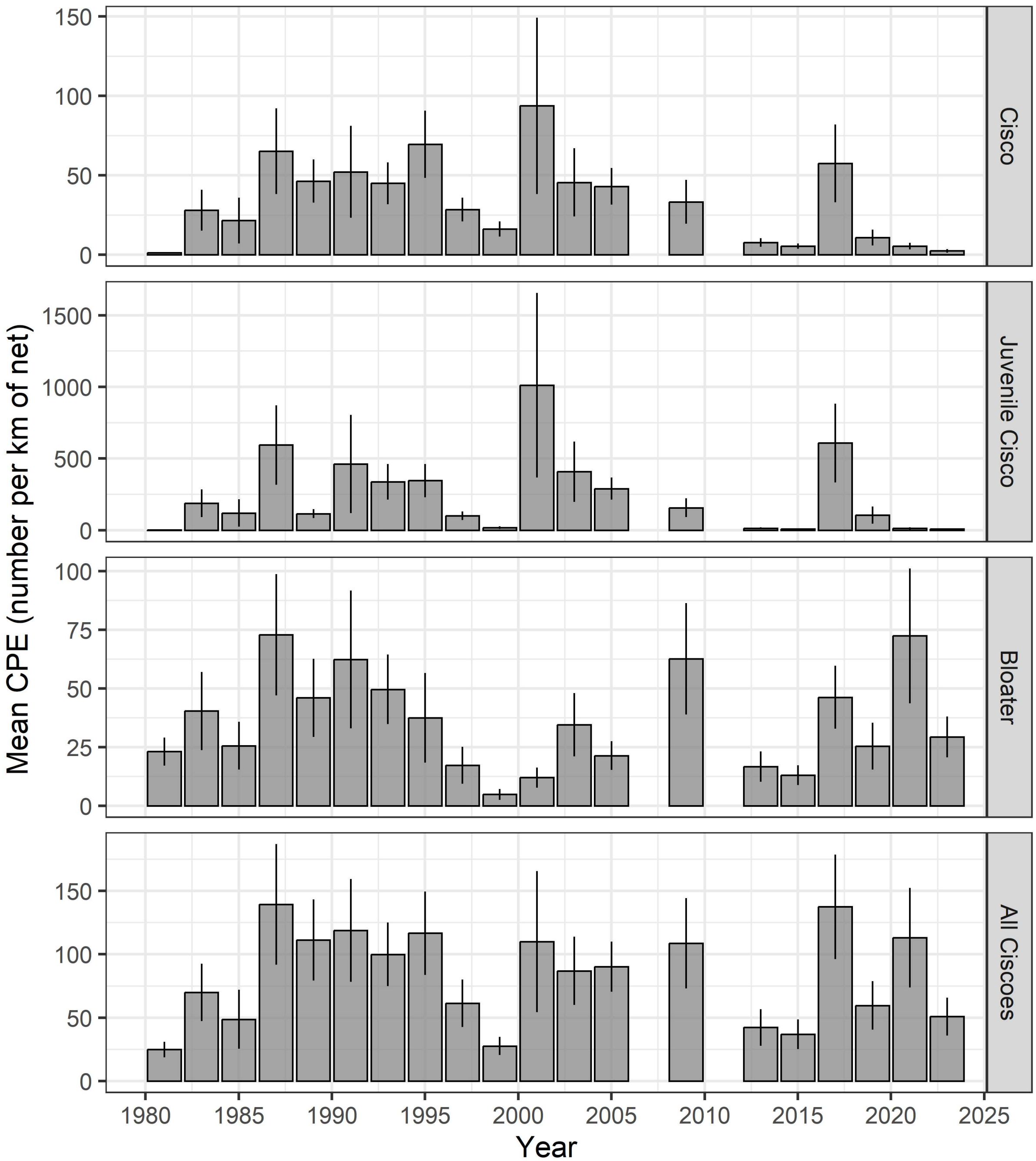

Figure 6. Time series of mean CPE for all cisco C. artedi *(all meshes), Juvenile cisco (fish captured in the 38 mm mesh panel), bloater* C. hoyi *(all meshes), and all ciscoes, including* C. artedi, C. hoyi, C. kiyi *and* C. zenithicus *(all meshes) in the Western Arm region of Lake Superior, 1981-2023. Sampling did not occur in 2007 or 2011. Error bars represent one standard error.*

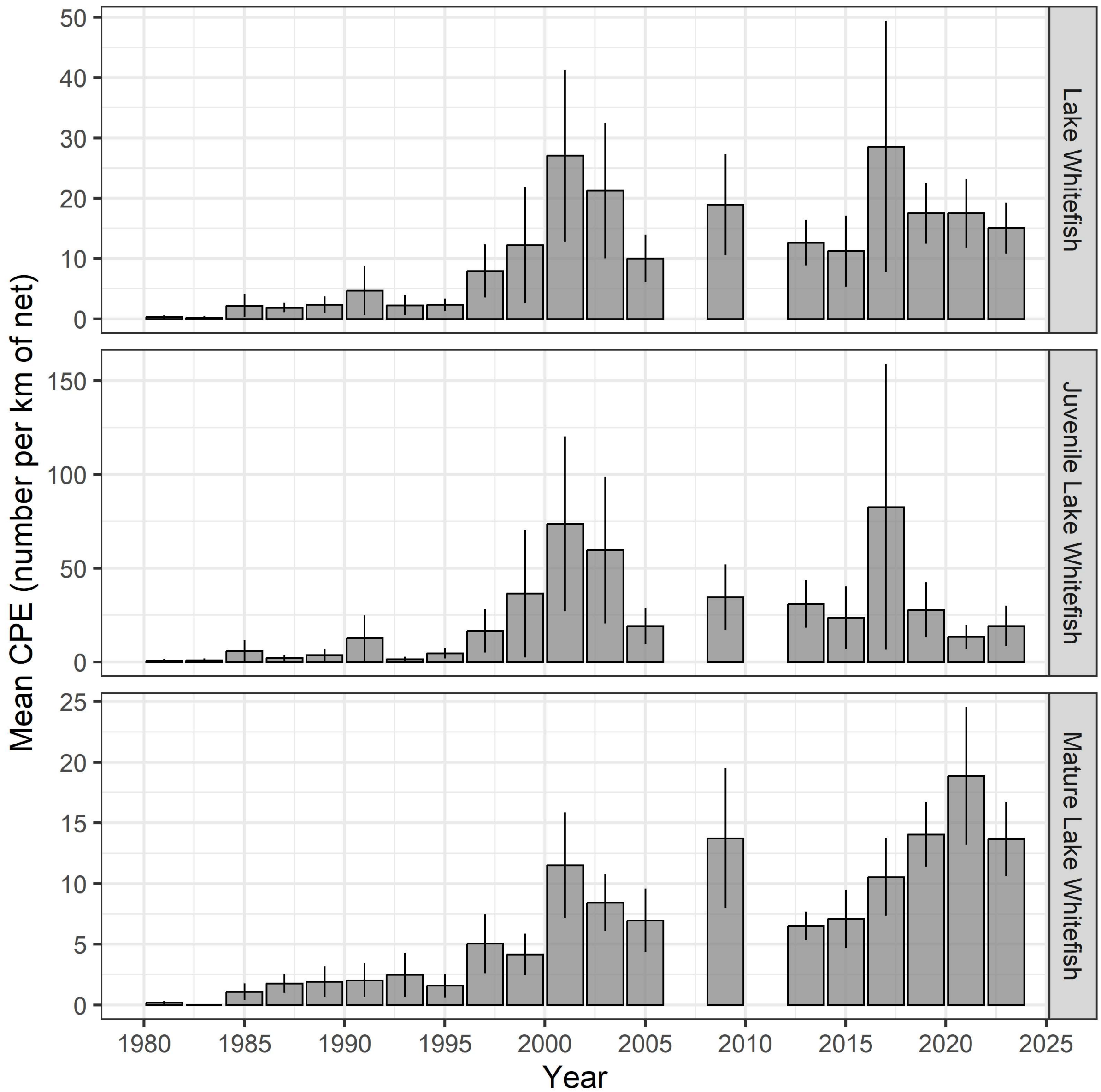

Figure 7. Time series of mean CPE for all lake whitefish C. clupeaformis *(all meshes), juvenile lake whitefish (fish captured in the 38, 51 and 64 mm mesh panels) and mature lake whitefish (panels > 64 mm mesh size) in the Western Arm region of Lake Superior, 1981-2023. Sampling did not occur in 2007 or 2011. Error bars represent one standard error.*

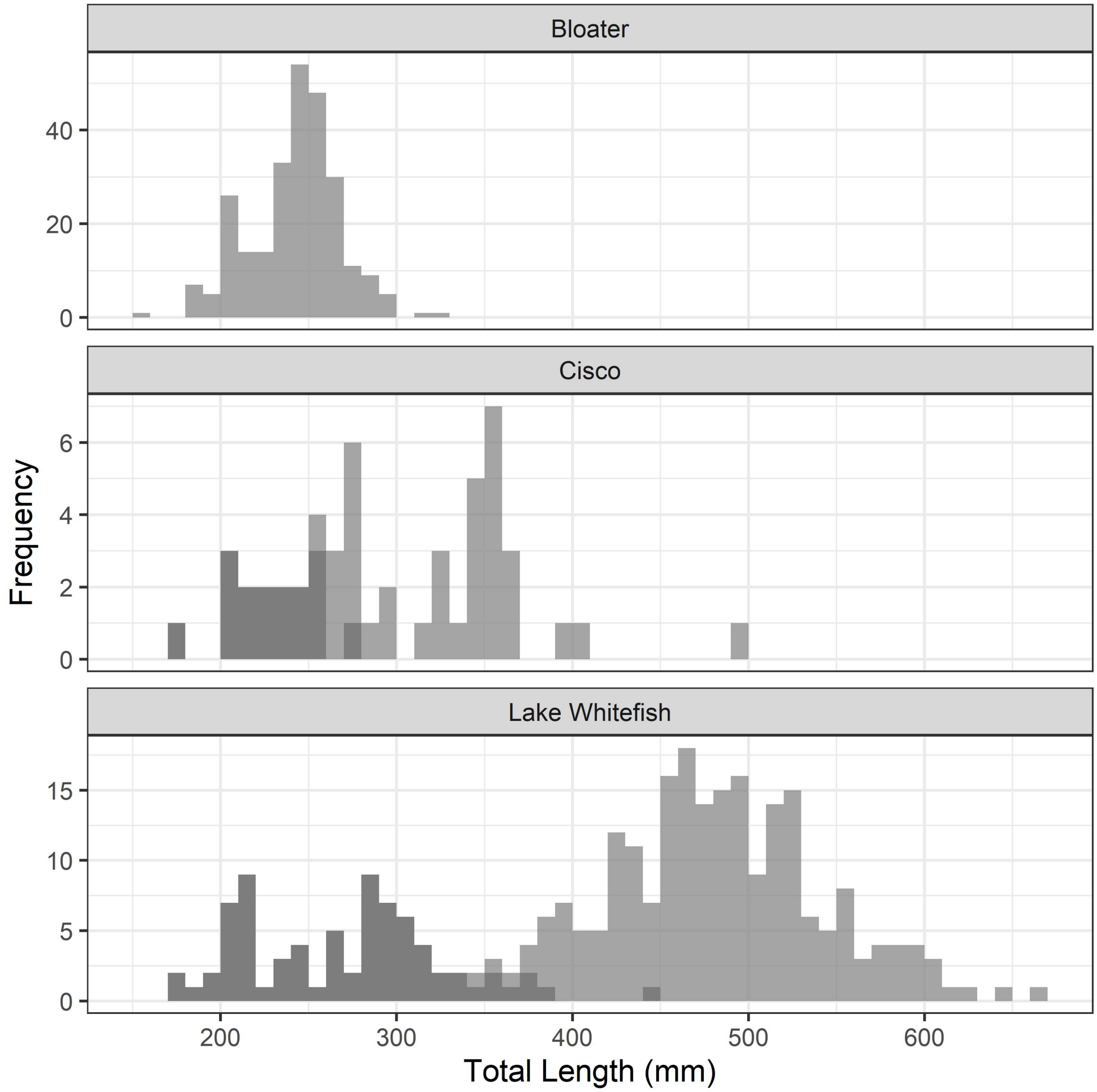

Figure 8. Length frequency histograms of bloater C. hoyi *(top), cisco* C. artedi *(middle) and lake whitefish* C. clupeaformis *(bottom) caught in the Apostle Islands region of Lake Superior during the 2023 summer community assessment. Darker grey bars represent fish that were counted in the juvenile cisco or juvenile lake whitefish indices.*

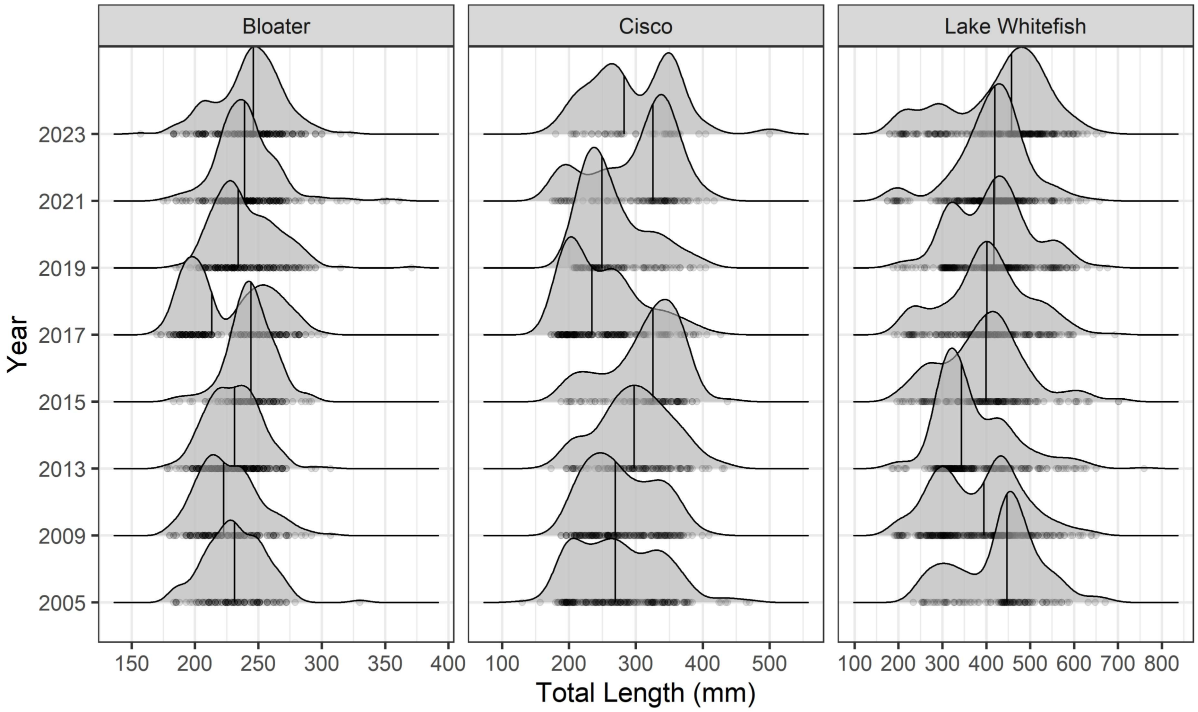

Figure 9. Time series of bloater, cisco and lake whitefish length distributions from 2005 to 2023 captured during the summer community assessment in the Western Arm region of Lake Superior. Vertical lines represent the median total length sampled in a given year.

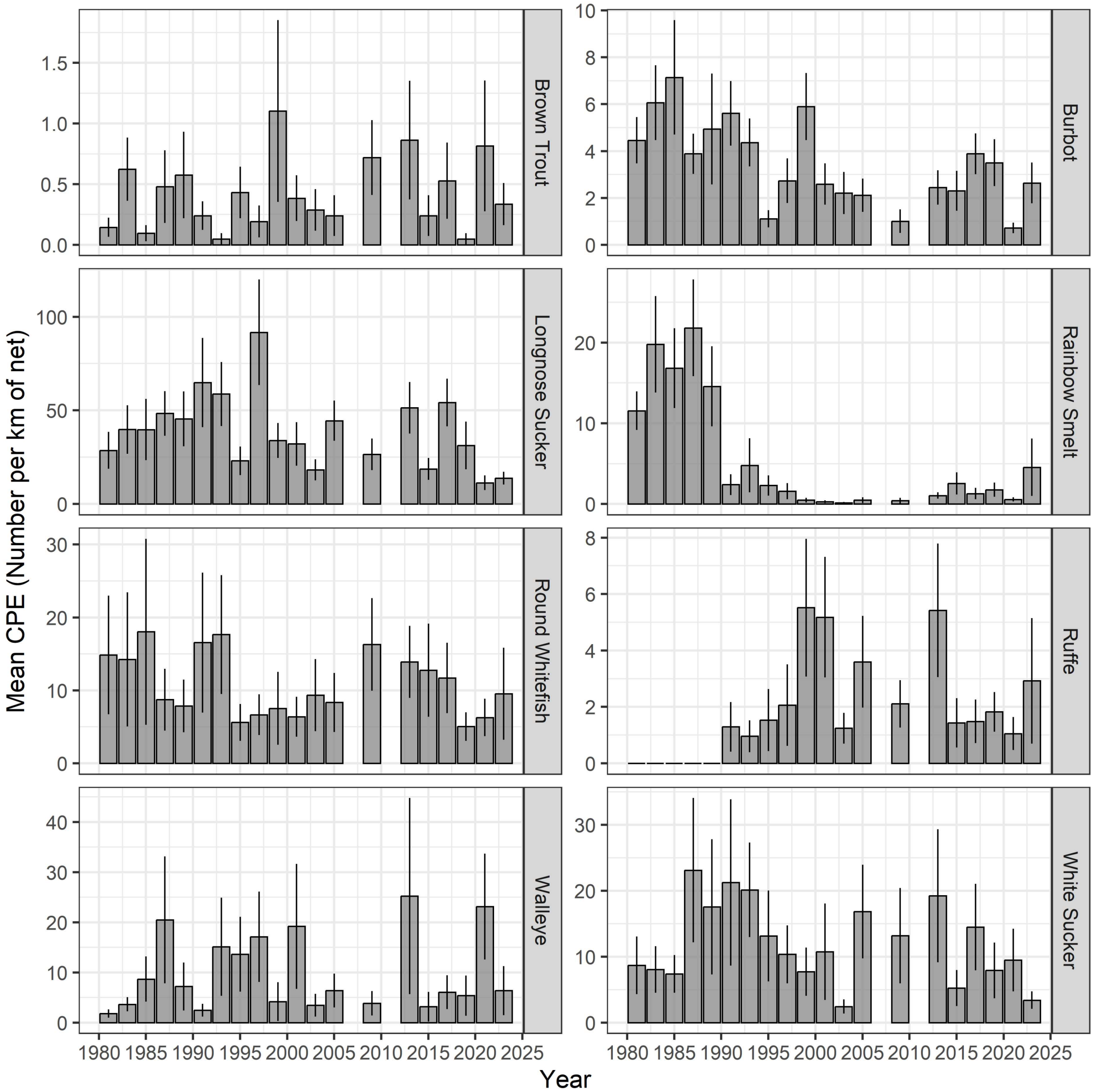

Figure 10. Time series (1981-2023) of mean CPE for eight common species in the Western Arm region of Lake Superior including: brown trout, burbot, longnose sucker, rainbow smelt, round whitefish, eurasian ruffe, walleye and white sucker. Sampling did not occur in 2007 or 2011. Error bars represent one standard error.

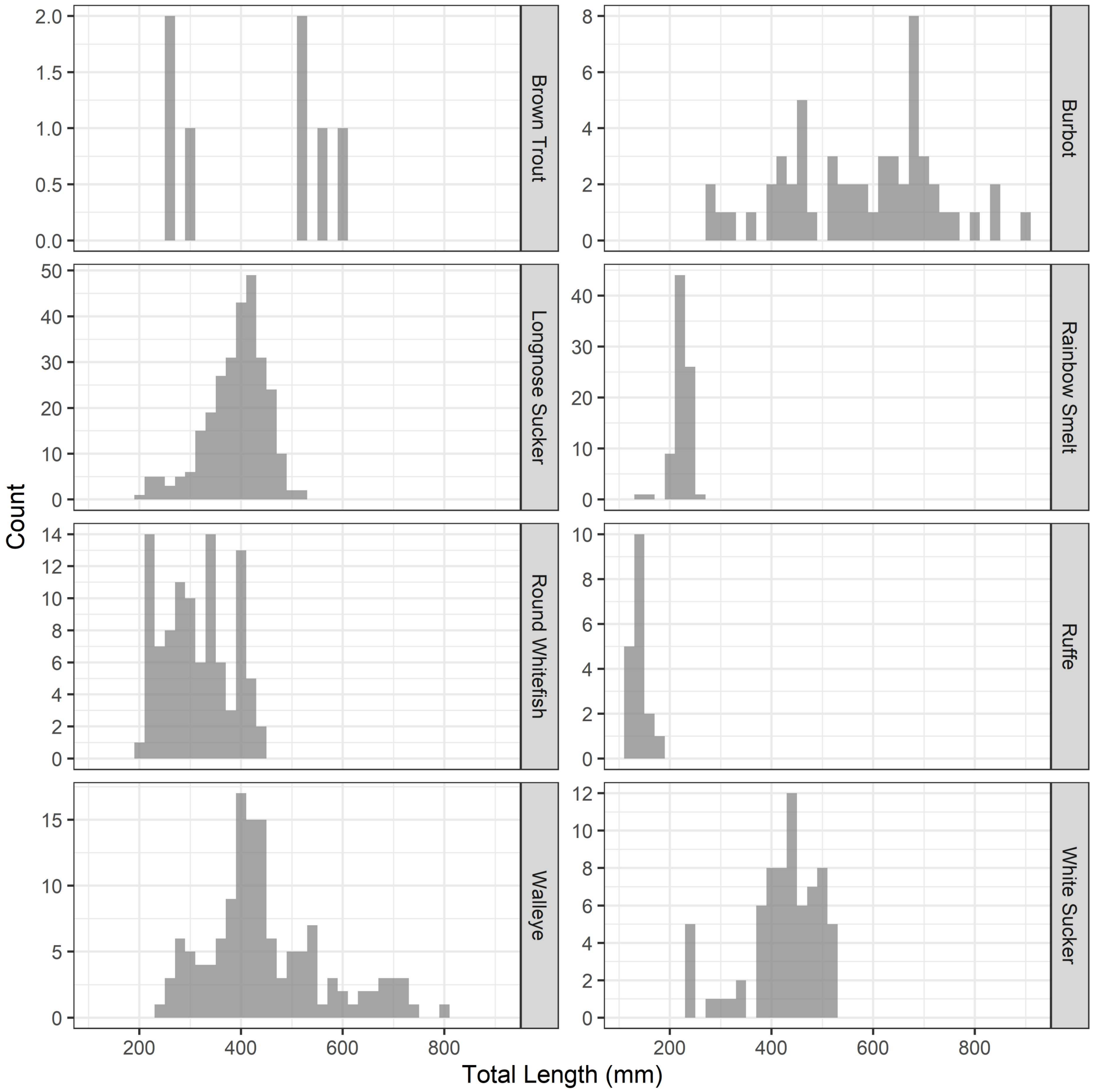

Figure 11. Length frequency histograms of eight common species captured in the Western Arm region of Lake Superior in the 2023 summer community assessment including: brown trout, burbot, longnose sucker, rainbow smelt, round whitefish, eurasian ruffe, walleye and white sucker.