WDNR Lake Superior (WI-1) Summer Assessment Report 2019

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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 and 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 towards fish community objectives in Wisconsin waters of Lake Superior. This survey is part of the Lake Superior Technical Committee (LSTC) summer small-mesh assessment which was designed to monitor juvenile Lake Trout relative abundance (recruitment) and cisco relative abundance at a lakewide scale. This dataset also serves as one of the primary inputs for a statistical catch-at-age model, which is used by state, tribal, and federal biologists to determine recommended lake trout harvest quotas.

Methods

The summer index rotates between sampling the western arm (WI-1) during odd-numbered years and the Apostle Islands region (WI-2) during even-numbered years. Prior to 1980, all stations were sampled annually. In 2019, 19 stations were sampled in the western arm (Figure 1) with 1,097 m monofilament gillnet gangs. Each gang is composed of a series of 91 m nets constructed with 38.1 to 178 mm mesh (stretch measure), by 13 mm increments. All nets were set on the bottom for one night (24 hr) using the R/V Hack Noyes. Biological information (e.g., length, weight, sex, etc.) was collected from fish using standardized protocols.

The time-series of geometric mean catch-per-unit-effort (CPE) was calculated using only catch data from the stations that were sampled in 2019 because these stations have the longest data sets and allow for a standardized assessment of trends. Geometric mean CPE (total catch + 1)/km of effort was calculated using stations as replicates. Juvenile Lake Trout and juvenile Lake Whitefish CPE were assessed using only 50.8 and 63.5 mm mesh sizes, and adult Lake Trout and Lake Whitefish CPE were assessed using 76.2 mm and larger mesh sizes. Cisco spp. (combined *C. artedi, C. hoyi, C. kiyi, C. zenithicus*, and respective crosses)) CPE was also subset into separate juvenile (38.1 mm mesh) and adult (50.8 and 63.5 mm mesh sizes) indices. CPE for all other species 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". In addition, not all agencies around Lake Superior use as many mesh sizes as WDNR during the summer assessment, so reporting relative abundance from select meshes (50.8 and 63.5 mm) allows for standardized comparisons across the lake. Analyses were conducted using Program R, and this report was formatted with the package rmarkdown.

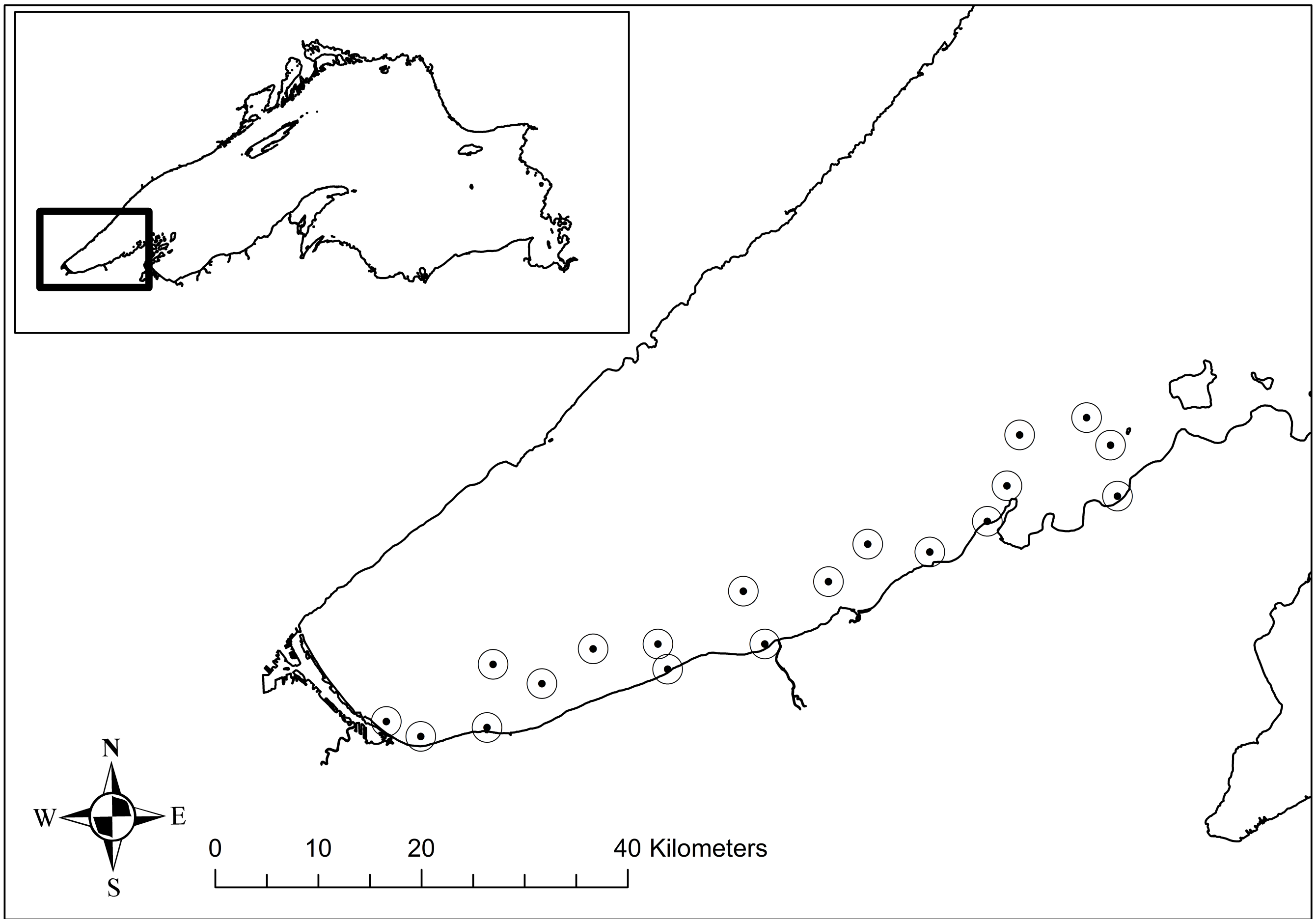

Figure 1. Map of the Western Arm region of Lake Superior and the sampling stations for the Wisconsin DNR summer community index, 2019.

Results

Lake Trout

A total of 240 Lean Lake Trout were sampled in 2019, and approximately 61.5% were native (not hatchery-origin; Figure 2). Relative abundance for adult Lake Trout was 5.5/km (Figure 3). Adult Lake Trout CPE in WI-1 increased compared to the last few survey years which reflects trends observed in SCAA model population estimates in WI-2 waters of Lake Superior. Adult Lake Trout CPE has been relatively stable throughout the time series in WI-1, although it has become less reliant on hatchery-origin fish. Relative abundance for juvenile Lake Trout (approximately 250 - 400 mm individuals; Figure 4) was relatively high in 2019 (12.39/km), indicative of better recruitment to the survey gear than the last two survey years (Figure 3). Median length of native Lake Trout was 363.2 mm, and median length of hatchery-origin Lake Trout was 527 mm (Figure 4). Median length of both native and hatchery-origin Lake Trout has increased throughout the time series; however, median length of hatchery-origin Lake Trout is much more variable on an annual basis due to variable stocking practices and recruitment (Figure 5). Median length of both native and hatchery-origin Lake Trout decreased slightly in 2019 compared to the last survey year in 2017. Before claiming full rehabilitation of Lake Trout in management unit WI-1, it will be important to pay close attention to recruitment patterns and other population dynamics of native fish.

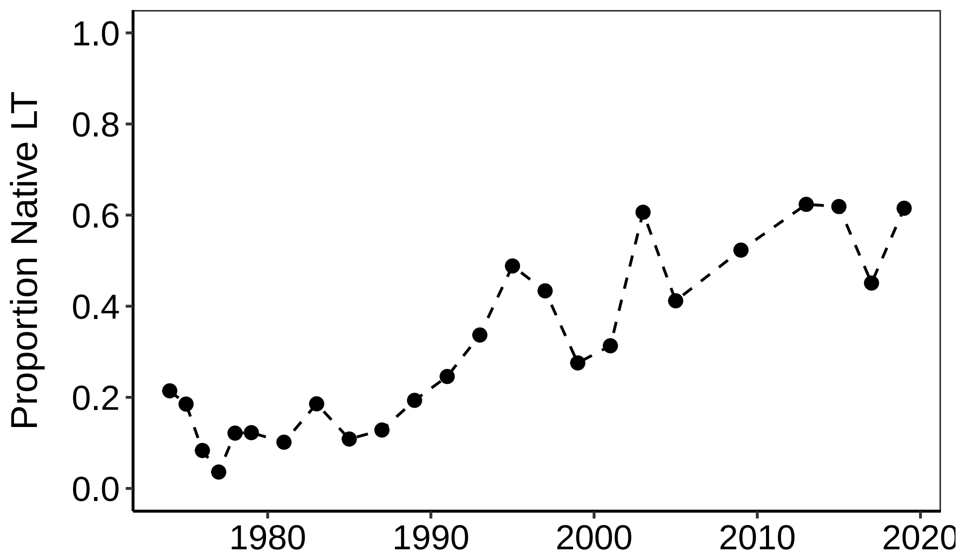

Figure 2. Proportion of native (not hatchery-origin) Lake Trout in the Western Arm region of Lake Superior, 1974-2019.

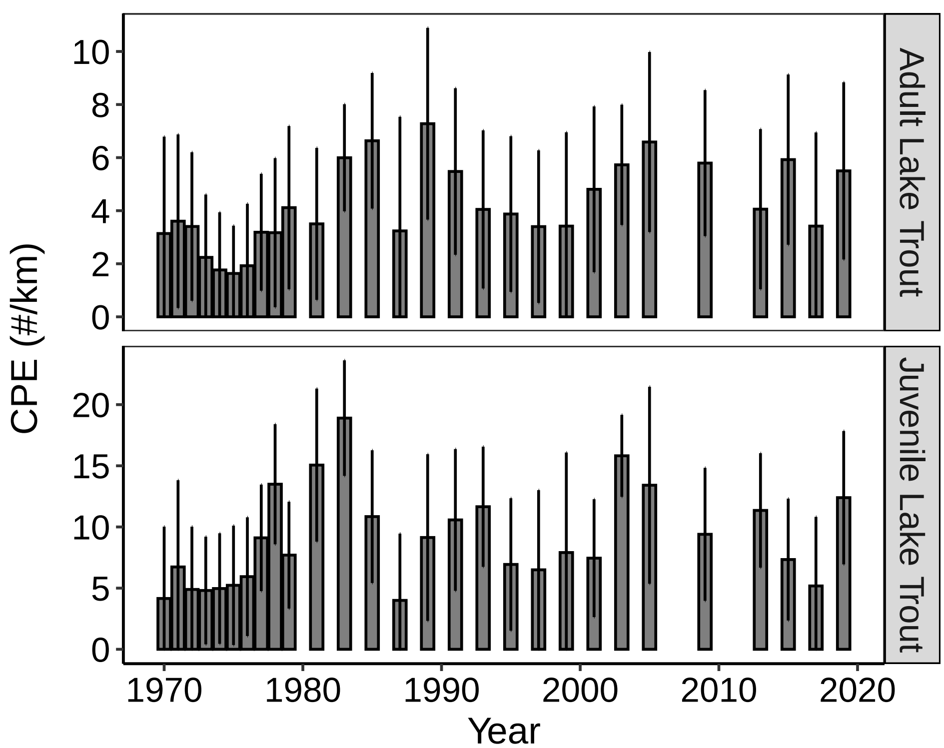

Figure 3. Time series of geometric mean CPE for adult Lake Trout (top; 76.2 mm mesh and greater) and juvenile Lake Trout (bottom; 50.8 and 63.5 mm mesh sizes) in the Western Arm region of Lake Superior, 1970-2019. Summer community assessment sampling did not occur in 2007 or 2011. Error bars represent one standard deviation.

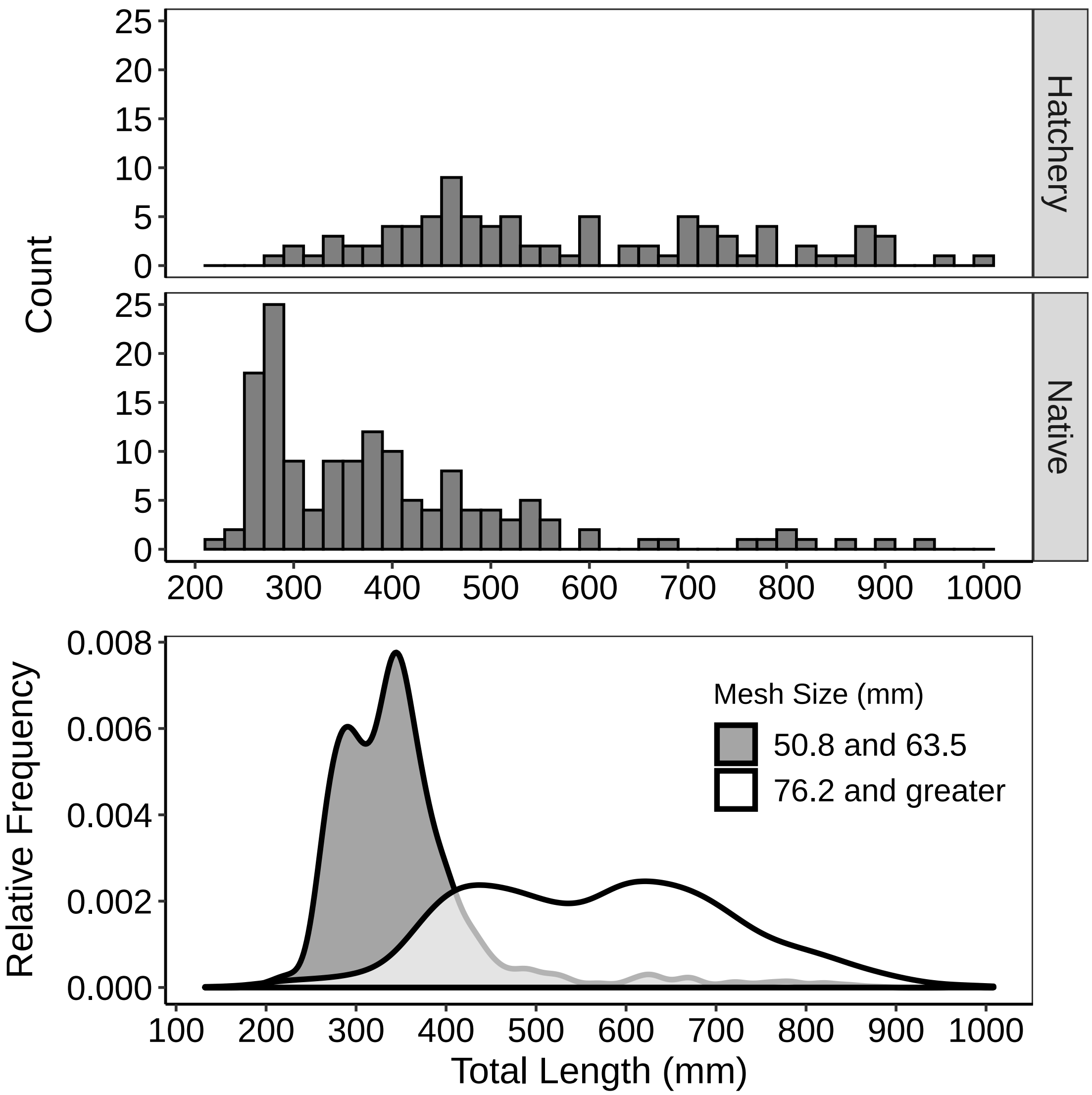

Figure 4. Length frequency histograms of hatchery-origin (top) and native (middle) Lake Trout caught in the Western Arm region of Lake Superior during the 2019 summer community assessment and density plot representing mesh size-selectivity of "juvenile" (grey) and "adult" (white) Lake Trout relative abundance indices from all survey years.

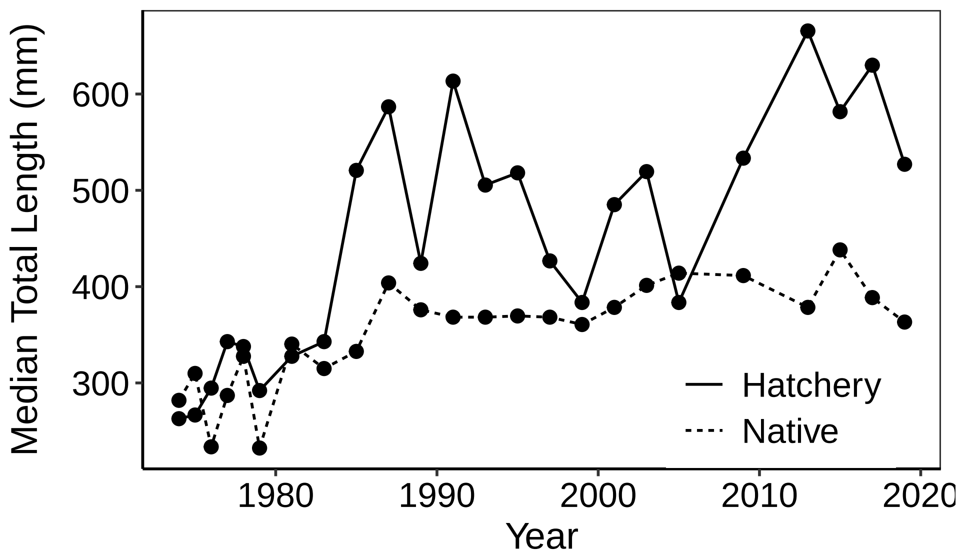

Figure 5. Time series of native (dashed line) and hatchery-origin (solid line) Lake Trout median length, 1974-2019. Summer community assessment sampling did not occur in 2007 or 2011.

Coregonids

A total of 365 Lake Whitefish were sampled in 2019, and the geometric mean CPE of adult Lake Whitefish was 9.14/km (Figure 6). This was the highest relative abundance on record for adult Lake Whitefish in WI-1 during the summer community assessment. Juvenile Lake Whitefish (approximately 250 - 400 mm individuals; Figure 7) CPE was 9.14/km, indicative of better recruitment to the survey gear than the last two survey years (Figure 6). Both adult and juvenile Lake Whitefish relative abundance has increased considerably since the 1970's and has been fairly stable during recent years. Median length for Lake Whitefish was 416.6 mm (Figure 7). This survey should be used in combination with other independent assessments to monitor Lake Whitefish population dynamics and could also serve as an input for future stock assessment models.

A total of 1244 Cisco spp. (227 *C. artedi*, 529 *C. hoyi*, 6 *C. kiyi*, 1 *C. zenithicus*, and 481 respective crosses) were sampled in 2019, and the geometric mean CPE of adult Cisco spp. was 21.9/km (Figure 6). Adult Cisco spp. relative abundance is higher than the 1970's when the forage base was dominated by Rainbow Smelt in WI-1 waters, but abundance appears to be declining at a lake-wide scale since the early 1990's (Figure 6; USGS, unpublished data). Juvenile Cisco spp. relative abundance (i.e., recruitment) has been sporadic since the 1990's, with recent evidence of a relatively larger 2014 year-class (Figure 6). As expected, juvenile Cisco spp. (approximately 175 - 250 mm individuals; Figure 7) CPE in 2019 was lower than the spike in relative abundance in 2017 (106.06/km). The bottom-set gill nets of this survey are selective toward juvenile Cisco due to the pelagic life history of adult Cisco, and median length for Cisco spp. was 238.8 mm (Figure 7). This assessment is useful for tracking recruitment strength of Cisco in the Western Arm of Lake Superior and should be used in combination with other fishery-indpendent assessments (i.e., hydroacoustics, USGS trawling) to monitor population trends.

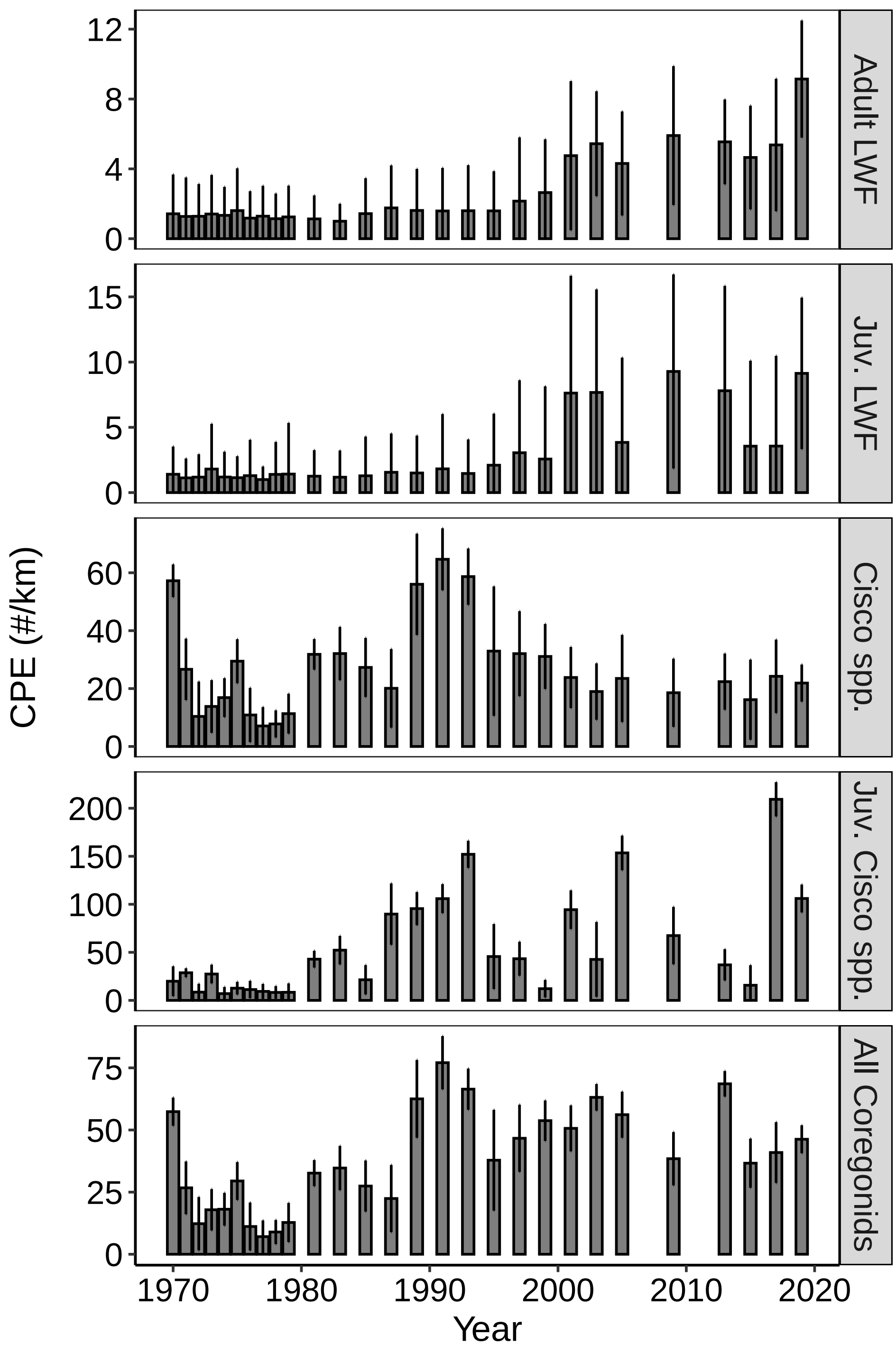

Figure 6. Time series (1970-2019) of geometric mean CPE for adult Lake Whitefish (76.2 mm mesh and greater), juvenile Lake Whitefish (50.8 and 63.5 mm mesh), adult Cisco spp. (50.8 and 63.5 mm mesh), juvenile Cisco spp. (38.1 mm mesh), and all Coregonids combined (all mesh sizes). Summer community assessment sampling did not occur in 2007 or 2011. Error bars represent one standard deviation.

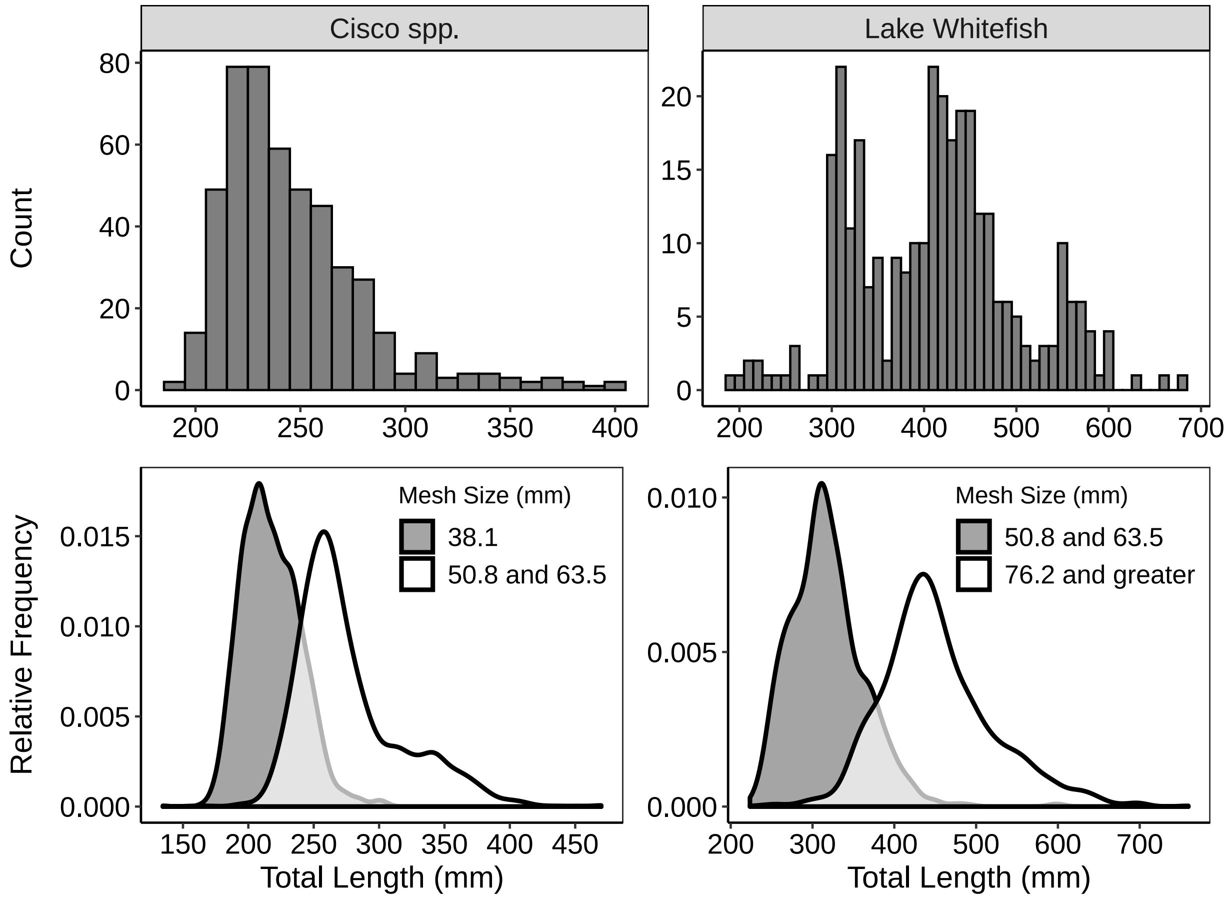

Figure 7. Length frequency histograms of Cisco spp. (top-left) and Lake Whitefish (top-right) from the 2019 summer community assessment and density plots representing mesh size-selectivity of the “juvenile” (grey) and “adult” (white) relative abundance indices for Cisco spp. (bottom-left) and Lake Whitefish (bottom-right) from all survey years.

Other Species

A total of 73 Burbot were sampled in 2019, and the geometric mean CPE was 3.01/km (Figure 8). Burbot relative abundance is variable due to low catches but appears to be slightly lower than the 1980’s. Median length for Burbot was 480.1 mm (Figure 9).

A total of 4 Lake Sturgeon were sampled in 2019, and the geometric mean CPE was 1.15/km (Figure 8). Lake Sturgeon relative abundance is variable due to very low catches, and targeted surveys in the nearby St. Louis River, Bad River, and Chequamegon Bay should alternatively be used to assess population dynamics. Median length for Lake Sturgeon was 1145.5 mm (Figure 9).

A total of 653 Longnose Suckers were sampled in 2019, and the geometric mean CPE was 8.83/km (Figure 8). Longnose Sucker relative abundance is variable from year-to-year likely due to environmental conditions at the time of sampling but appears to be relatively stable throughout the time series. Median length for Longnose Sucker was 383.5 mm (Figure 9).

A total of 37 Rainbow Smelt were sampled in 2019, and the geometric mean CPE was 1.76/km (Figure 8). Rainbow Smelt relative abundance is currently much lower than the high numbers during the 1970’s in WI-1 waters of Lake Superior. However, Rainbow Smelt are still an important component of many piscivorous fish diets in Lake Superior. Median length for Rainbow Smelt was 185.4 mm (Figure 9).

A total of 105 Round Whitefish were sampled in 2019, and the geometric mean CPE was 2.52/km (Figure 8). Round Whitefish relative abundance is variable due to low catches but appears to be relatively stable throughout the time series. Median length for Round Whitefish was 317.5 mm (Figure 9).

A total of 73 Siscowet Lake Trout were sampled in 2019, and the geometric mean CPE was 2.79/km (Figure 8). Siscowet relative abundance has been higher in the past couple decades as compared to the beginning of the time series. However, it is important to note that this survey does not specifically target Siscowet, and the variability in estimates is likely a product of sample design (e.g., stratified depths among set locations). Increasing relative abundance could also represent Siscowet encroachment into shallower habitat rather than increasing abundance. The LSTC Siscowet Survey likely provides a better representation of Siscowet relative abundance than this survey. Median length for Siscowet was 467.4 mm (Figure 9).

A total of 112 Walleye were sampled in 2019, and the geometric mean CPE was 1.55/km (Figure 8). Walleye relative abundance is variable in the Western Arm because Walleye are are often transients from the St. Louis River and only encountered in a few locations of the survey. Timing of Walleye movements within WI-1 from the St. Louis River can vary based on environmental factors (e.g., water temperature). Walleye continue to be an important spieces in the recreational fishery in WI-1; however, other surveys in the St. Louis River and estuary should be used to evaluate population dynamics. Median length for Walleye was 285.8 mm (Figure 9).

A total of 165 White Sucker were sampled in 2019, and the geometric mean CPE was 2.39/km (Figure 8). White Sucker relative abundance is variable within each year because it is only encountered in shallow water; however, CPE appears relatively stable throughout the time series. Median length for White Sucker was 401.3 mm (Figure 9).

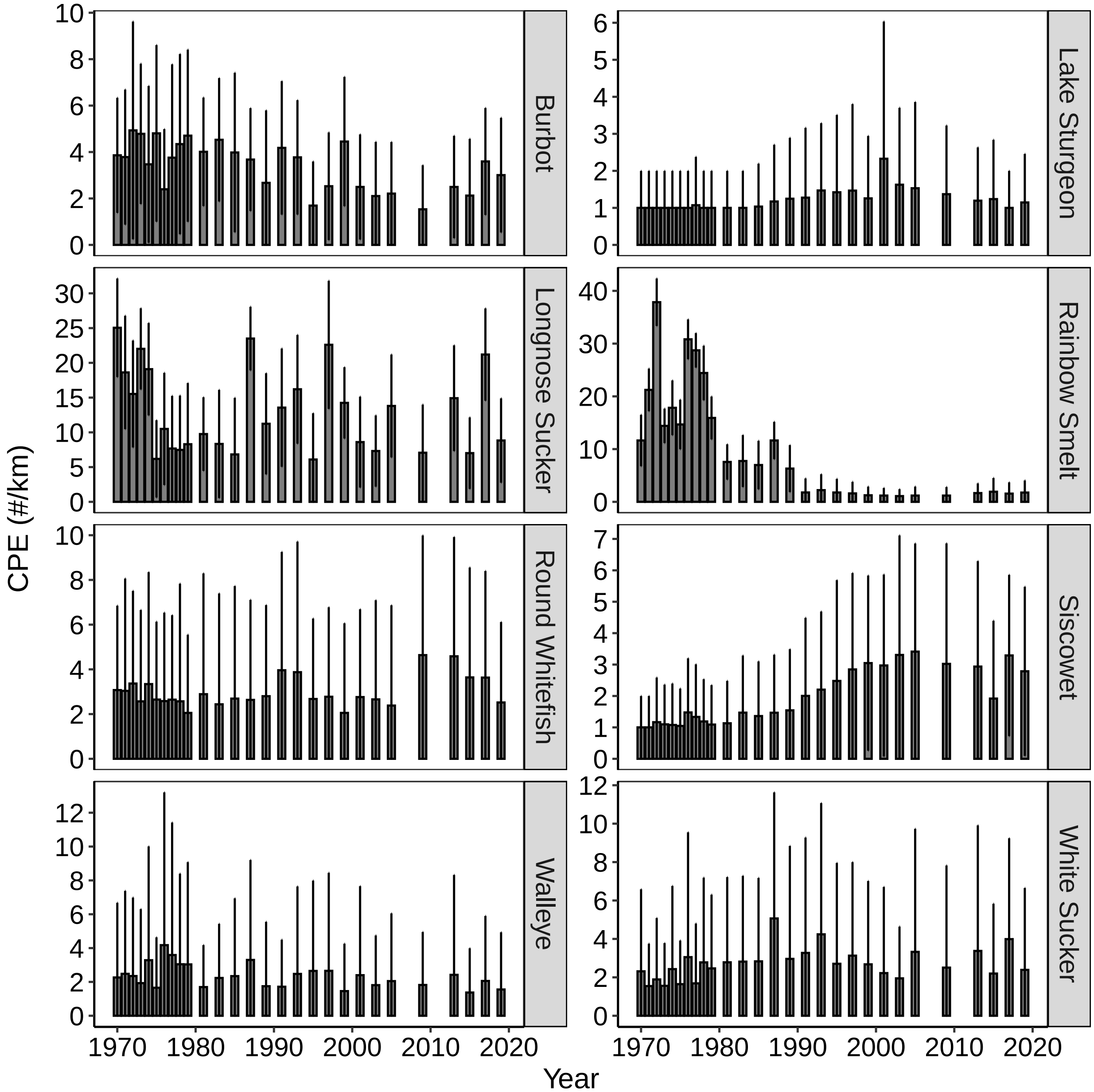

Figure 8. Time series (1970-2019) of geometric mean CPE for six common species in the Western Arm region of Lake Superior including: Burbot, Longnose Sucker, Lake Sturgeon, Rainbow Smelt, Round Whitefish, Siscowet, Walleye, and White Sucker. Summer community assessment sampling did not occur in 2007 or 2011. Error bars represent one standard deviation.

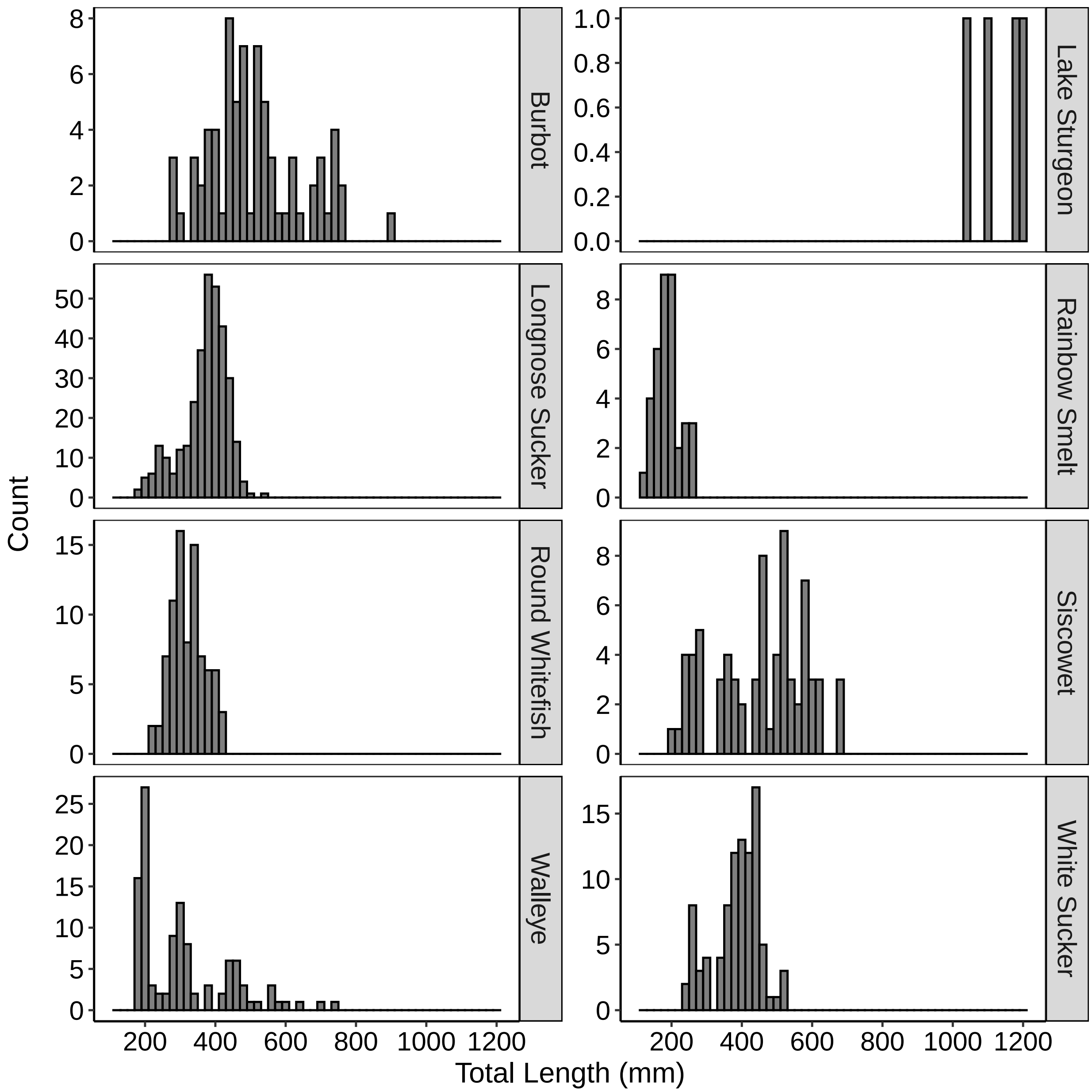

Figure 9. Length-frequency histograms for six common species sampled during the 2019 summer community assessment in the Western Arm region of Lake Superior including: Burbot, Lake Sturgeon, Longnose Sucker, Rainbow Smelt, Round Whitefish, Siscowet, Walleye, and White Sucker.

References

Horns, W.H., Bronte, C.R., Busiahn, T.R., Ebener, M.P., Eshenroder, R.L., Gorenflo, T., Kmiecik, N., Mattes, W., Peck, J.W., Petzold, M., Schreiner, D.R. 2003. Fish-community objectives for Lake Superior [online]. Available at: http://www.glfc.org/pubs/SpecialPubs/Sp03_1.pdf .