Illinois Department of Natural Resources

Division of Fisheries

# Lake Trout Monitoring in Lake Michigan:

# 2024 Spring and Fall Assessments

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## Table of Contents



## List of Figures

## INTRODUCTION

Lake Trout *Salvelinus namaycush* was the top native predator in Lake Michigan before its decline due to a combination of overfishing and mortality caused by the invasive Sea Lamprey *Petromyzon marinus*, resulting in the extirpation of Lake Trout in Lake Michigan by the 1950s (Wells and McLain 1972; Holey et al. 1995). A Sea Lamprey control program was initiated shortly thereafter and a Lake Trout stocking program, with the goal of rehabilitation, began in 1965 (Wells and McLain 1972).

Lake-wide stocking of Lake Trout continues annually at a combination of nearshore and offshore locations. Stocking locations and harvest restrictions were first formalized in *A Lakewide Management Plan for Lake Trout Rehabilitation in Lake Michigan* (LMLTTC 1985). Primary stocking sites (areas with the best spawning habitat and where high commercial harvests of Lake Trout occurred) were established as well as refuges in the northern and mid-lake regions that were closed to all forms of harvest. In addition, secondary stocking sites were adopted which were deemed to have sub-par habitat but provided for more localized fisheries. In Illinois waters, Julian's Reef was established as a primary stocking site and regulated as a commercial refuge, where sport fishing was allowed but commercial fishing was prohibited (Figure 1). Julian's Reef was first stocked in 1981 and has received annual stocking each year with the exception of five years (Figure 2). Despite these efforts, successful natural reproduction was negligible until recently and thus the Management Plan's goal of establishing a self-sustaining Lake Trout population has been unmet for decades.

Stocking locations and numbers were revised under *A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan* (Dexter et al. 2011; referred to hereafter as the *Implementation Strategy*). Julian's Reef was retained as a First Priority stocking site and 60,000 yearling Lake Trout of Lewis Lake (LLW) strain and 60,000 yearling Lake Trout of Seneca Lake (SLW) strain have been stocked each year since 2011 (with the exception of the COVID-19 pandemic-related interruption of 2020-2021). The *Implementation Strategy* contained four Evaluation Objectives to monitor progress toward targeted rehabilitation, which were updated and supplemented in 2024 under *A Stocking Strategy and Evaluation Objectives for the Rehabilitation of Lake Trout in Lake Michigan* (Wesley et al., 2024; referred to hereafter as the *Stocking Strategy*). The *Stocking Strategy* also contained objectives that only apply to regions outside Illinois waters (Objectives 4 and 5). The relevant objectives under the *Stocking Strategy* were: 1) catch-per-unit-effort (CPUE) of >25 Lake Trout/1000 ft graded-mesh gill nets in spring stock assessments; 2) CPUE of >50 Lake Trout/1000 ft graded mesh gill nets in spawning

surveys; 3) spawning populations of at least 25% female and which have ten or more age groups older than age-7; 6) detect eggs with thiamine concentrations of >4 nmol/g; and 7) CPUE > 19 wild Lake Trout/1000 ft graded-mesh gill nets in spring stock assessments. Objectives 2, 3, and 6 are used to assess first priority stocking sites.

To assess progress toward these Evaluation Objectives in the Illinois waters of Lake Michigan, annual gill net surveys are conducted in the spring at offshore locations near Waukegan, IL and at spawning reefs in the fall. Gill nets have been used annually to sample spawning Lake Trout at both Waukegan and Julian's reefs since the early 1980s. Patterson et al. (2017) found no significant differences in catch statistics between Julian's Reef and Waukegan Reef during 1999-2014. Thus, Evaluation Objectives 2, 3, and 6 were assessed annually at Julian's Reef, with data from Waukegan Reef being used in years when no sampling occurred at Julian's Reef.

Considering the similarities between Julian's and Waukegan reefs and an increase in Lake Trout of wild origin, a change in fall Lake Trout sampling site selection was instituted. Beginning in 2017, these priority sites were sampled in alternate years to allow investigation of population parameters at other Illinois reefs where Lake Trout may be spawning. Fall Lake Trout sampling included the "non-priority sites" consisting of North Reef (2017), Wilmette Reef (2018), and Lake Bluff 10-Mile Reef (2019), which were sampled in addition to either Julian's or Waukegan reefs. However, this rotation of priority sites was interrupted in 2020, when COVID-19 restrictions prevented both spring and fall Lake Trout sampling. Both surveys resumed in 2021 and Julian's and Waukegan reefs were sampled during the fall given that neither priority reef had been visited the previous year. Due to vessel operation and lake condition issues causing an incomplete sampling of the two sites in 2021, 2022, and 2023, both reefs were sampled again in 2024.

This report covers progress towards Evaluation Objectives 1-3, 6 and 7 in Illinois waters.

## METHODS

Lake Trout were sampled with gill nets during two offshore surveys. Presented data are from surveys conducted in 2005-2024.

### Spring and Fall Lake Trout Surveys

Two graded mesh gill nets, each with two 100 ft panels of 2.5" to 6" (½ inch increments) mesh sizes (1600 ft total) were fished overnight (Schneeberger et al. 1998) on 15-17 May 2024. One net was set at an established site within two out of three targeted depth bins (50-100, 100-150, and 150-200 ft) at

each of two identified transects offshore of Waukegan, IL. Typically, all three depth bins are sampled along both transects, however adverse lake conditions limited sampling capabilities resulting in one depth bin from each transect being omitted. A total of four nets were fished during the 2024 spring survey and all depth bins were sampled at least once.

In fall, two graded mesh gill nets, each with two 100 ft panels of 4.5" to 6" (½ inch increments) mesh sizes (800 ft total) were fished overnight on two occasions and one net was fished overnight on one occasion during 23 October-08 November 2024. A total of five nets were fished during the 2024 fall survey, three at Waukegan Reef and two at Julian's Reef.

In both surveys, fish were measured to the nearest 5 mm (maximum total length) and weighed to the nearest 50 grams. In addition, clipped fins, lamprey wounds, sex, and maturity were recorded. Lake Trout with an adipose fin clip, indicating the presence of a coded-wire tag (CWT), had the head removed for tag extraction in the laboratory.

**Data Analyses**

Lake Trout CPUE was calculated as number of fish per 1000 feet of gill net in both the spring and fall surveys. Because CPUE values are highly dependent on standardized effort, nets that were fished for more than 1 day in duration (since a 2-day set ≠ twice the number of fish of a 1-day set) or with incorrect mesh sizes were removed from CPUE analyses. For this report, all nets from the spring Lake Trout survey in 2003, two nets from the spring Lake Trout survey in 2007, and two nets from the fall spawner survey in 2011 were removed from analysis. Across the time series (1999-2024), CPUE data from 138 gillnet sets is included in the spring lake trout survey analysis, while the fall spawner survey analysis includes data from 154 gillnet sets. Catch data from all net sets and information from CWTs was used in the reporting of proportion female, number of age classes, proportion of unmarked fish, strain, and stocking origin since effort and mesh size has less influence on these indices.

## RESULTS AND DISCUSSION

**Spring Lake Trout Survey**

Spring Lake Trout CPUE was 5.0 fish/1000 ft of net in 2024. This was only 20% of the target (25 fish/1000 ft), which has only been achieved once in 23 years of spring sampling (Figure 3). Spring CPUE during 2024 was noticeably lower than in recent years, being roughly ½ the average CPUE of the previous 5 sampling years (9.7 fish/1000 ft of net) and the lowest CPUE recorded since 2014. The shallowest net (90ft) was covered with dense algae and caught zero lake trout. It is possible that unusually early algae

production led to this net being abnormally visible to lake trout and thus avoidable, resulting in the low catch and contributing to the low overall CPUE for the survey. Evaluation Objective 1 of the *Stocking Strategy* has not been achieved in Illinois waters.

Twelve Lake Trout (38%) were not fin clipped and presumed to be of wild origin (Figure 4). This represents the second highest proportion of wild fish observed in the spring survey to date (the highest proportion of wild fish [41%] occurred in 2023). The percentage of unmarked fish in spring catches increased after 2010 and has averaged 23% (2011-2024 average) since that time. The CPUE of wild fish was 1.9 wild fish/1000ft of net, only 10% of the 19 wild fish/1000ft target. The maximum CPUE of wild fish in the spring survey (3.9 wild fish/1000ft of net in 2023) was considerably below the target level (Figure 3). Thus, Evaluation Objective 7 has not been achieved in Illinois waters and the target level seems unlikely to be met.

Thirteen Lake Trout had an adipose fin clip and a coded-wire tag, and all tags were successfully decoded. A majority (11) were stocked on Julian's Reef (6 to 21 years old at capture) and two were stocked on the Mid-lake Reef Complex (12 and 13 years old at capture).

Four strains of lake trout were represented in the catch of stocked fish (containing CWTs) during the spring 2024 survey (Figure 9): nine were Lewis Lake (69%), two were Seneca Lake (15%), and one each were Green Lake (8%) and Klondike (8%). Strain composition of the spring catch has been generally consistent since 2016 after a steep decline in the abundance of Green Lake strain, which ceased to be stocked at Julian's Reef after 2006. Prior to 2016, Green Lake fish averaged 70% of the annual spring catch, but has since only averaged 5%. Lewis Lake strain comprised an average of 59% of spring catch on an annual basis since 2016, compared to 32% for Seneca Lake strain. This is despite having been stocked in roughly equal numbers at nearby Julian's Reef since 2011. Because Seneca Lake strain fish are typically more common than Lewis Lake strain in the fall survey (see below), the discrepancy in spring catches between the strains does not necessarily reflect differential survival. It could also be due to differences in depth distribution or another aspect of habitat use between the strains. In Lake Huron, Great Lakes-origin strains (including Lewis Lake) were found to occupy consistently warmer temperatures and shallower depths during stratification than Seneca Lake strain (Bergstedt et al., 2012). It is possible this difference in temperature preference plays a part in the seasonal difference in catch composition between the two primary strains.

**Fall Spawner Survey**

Fall Lake Trout CPUE was 100.0 fish/1000 ft of net in 2024 across both reefs. Fall CPUE has exceeded the 50 fish/1000 ft target in all but three years of the fall survey (Figure 5). Consistent CPUEs above the target indicate that Evaluation Objective 2 of the *Stocking Strategy* has been achieved in Illinois waters. Unseasonably warm bottom temperatures (53-58˚F) may explain the uncharacteristically low catches observed for some gill net sets in 2021-2023, as fall spawning aggregations avoided the sampled reefs during our typical fall survey period (mid-October to mid-November). Persistent west winds observed during the 2024 sampling window likely caused upwellings, helping to bring colder water up from greater depths and providing ideal temperatures to attract Lake Trout to offshore spawning reefs. Bottom temperatures measured during the 2024 survey ranged from 41.3-43.5˚F.

Evaluation Objective 3 of the *Stocking Strategy* has two components. The first is a goal of at least 25% female Lake Trout at spawning sites. This target has been met in 8 out of 21 years at Julian's Reef (Figure 6), the priority site for the assessment of progress towards evaluation objectives. In 2024, percent-female was 43% at Julian's Reef and 39% across both reef sites. Over the duration of the fall Lake Trout survey, the percentage of sampled fish that were female has been consistently higher at Waukegan Reef (mean = 35%) than at Julian's Reef (mean = 25%). In years where both reefs were sampled, percent-female has been higher at Waukegan Reef 80% of the time (16 out of 20 years). Spatial and temporal variation in sex ratio has been observed across the time series and the mechanisms are currently under investigation. While this target has been met inconsistently at Julian's Reef (the priority site) over the time series, it has been met consistently at Waukegan Reef indicating that significant progress has been made towards meeting this objective.

The second component of Evaluation Objective 3 is a spawning population consisting of 10 or more age classes present greater than age-7. The Lake Trout catch at Julian's Reef consisted of 11 age groups older than age-7 in 2024 (Figure 7) and there were 12 age groups older than age-7 across both reefs. Since the start of the fall survey, Lake Trout catches have consisted of 10-14 age classes older than age-7 in 12 of 24 years, indicating inconsistency in meeting the age-class target of Evaluation Objective 3. Currently, CWTs represent the only source of ages for Lake Trout collected from spawning sites in the fall survey; ages from wild Lake Trout or Lake Trout with rotational fin clips are not yet represented within the data being used to evaluate Objective 3 in Illinois waters. Furthermore, no CWTs were given to Lake Trout between 2005-2009, meaning that in the 2024 data 15–19-year-old age classes were not readily identifiable. Aging structures have been collected from Lake Trout during previous and current

annual assessments and processing of these structures is anticipated in the coming years. Future inclusion of this data, particularly from unclipped, wild Lake Trout, should provide a more complete age structure of the existing mixed stock of hatchery-reared and wild Lake Trout.

About 85% of Lake Trout sampled at Waukegan Reef (212 of 250) did not have a fin clip in 2024, while the percentage of non-clipped fish at Julian's Reef was 64% (96 of 150). The presence of unmarked, potentially wild fish has increased substantially in recent years (Figure 8).

In 2024, 38 Lake Trout sampled at Julian's Reef had an adipose fin clip and a coded wire tag. The stocking locations of those fish were closely split between Julian's Reef (19 fish, 6 to 14 years old at capture) and the Mid-Lake Reef Complex (17 fish, 10 to 30 years old at capture). Of the remaining fish, one was stocked from shore in southern Michigan (15 years old at capture), and one was stocked in the Northern Refuge (11 years old at capture). At Waukegan Reef, 24 Lake Trout were sampled with an adipose fin clip and coded wire tag. Most (19) were stocked at Julian's Reef (6 to 14 years old at capture), and five were stocked at the Mid-lake Reef Complex (8 to 30 years old at capture).

Three strains of lake trout were represented in the catch of stocked fish (containing CWTs) during the 2024 Fall Spawner survey (Figure 9): 43 were Seneca Lake (69%), 16 were Lewis Lake (26%), and three were Klondike (5%). Similar to the spring survey, the strain composition in the fall has gone from predominately Green Lake to a combination of Lewis Lake and Seneca Lake, though Seneca Lake tend to be more dominant in the fall compared to the spring. In the fall, a larger proportion of the lake trout catch with CWTs had been stocked at the Mid-Lake Refuge. Only Seneca Lake and Klondike strains are stocked at the Mid-Lake Refuge, providing one possible explanation for this discrepancy in strain composition between fall and spring.

## CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Spring Lake Trout survey CPUE was anticipated to be lower than fall CPUE when targets were set because Lake Trout aren't necessarily aggregated in the spring as they are during the fall spawning season. Spring CPUE in the Illinois waters of Lake Michigan however has remained below target in most years sampled, not reaching 25 fish/1000 ft since the mid-2000s. Similarly, the target has been met only briefly at 4 of the 12 spring sampling sites lake-wide and has not been achieved with any regularity or consistency at any site (LMLTWG 2021). Spring CPUE of wild fish is also well below the target level (19 fish/1000 ft) specified in Objective 7 of the newly updated *Stocking Strategy*.

*Recommendations: Continue participation in the spring Lake Trout survey and evaluate results toward achieving Evaluation Objective 1 of the Stocking Strategy; share results with Lake Trout Working Group of the Lake Michigan Technical Committee.*

Lake Trout population parameters for the fall spawner survey have been showing positive signs toward rehabilitation over the last decade. Catch per unit effort, proportion of females present in the spawning population, and number of older age classes have been at or above the targeted levels recently, suggesting movement toward rehabilitation success at some sites (LMLTWG 2021). The increased presence of unmarked fish in recent years indicates successful recruitment to adult life stages, especially in Illinois waters.

*Recommendations: Continue participation in the fall spawner survey at Julian's and Waukegan Reef with a special focus on presence of unmarked fish in the population as well as Objectives 2 and 3 of the Strategy, and disseminate results of progress toward rehabilitation goals with constituents and the Lake Trout Working Group of the Lake Michigan Technical Committee.*

Although no new non-priority sites were sampled in 2021-2024, bathymetric surveys have been conducted by the Illinois Natural History Survey at other reefs (e.g. Gumby Reef) along with side-scan sonar surveys used to classify benthic substrate. These surveys will allow IDNR to plan future fall spawner surveys to investigate Lake Trout rehabilitation success at other non-stocked reef locations.

*Recommendations: Expand the fall spawner survey sampling to other potential Lake Trout spawning reefs in the Illinois waters of Lake Michigan, based on Illinois Natural History Survey mapping project results*, *while maintaining an annual assessment of the Evaluation Objectives at either Waukegan or Julian's reefs. Utilize bathymetry and substrate information to target Lake Trout spawning locations on reefs.*

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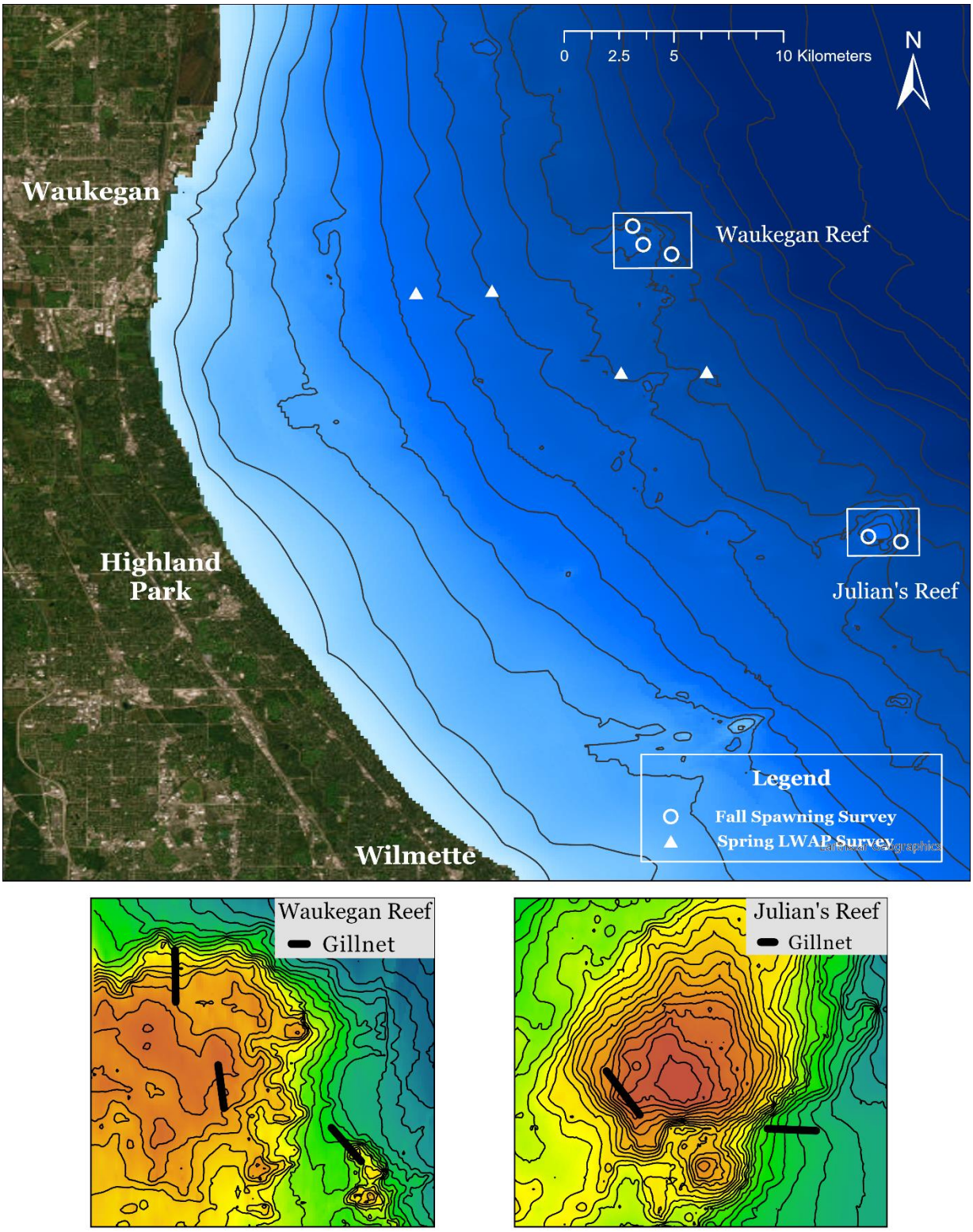


Figure 1. Location of the spring Lake Trout survey sites (white triangles) and fall spawning Lake Trout surveys (Open Circles) in the Illinois waters of Lake Michigan in 2024. Bottom insets show bathymetric placement of fall survey nets on Waukegan and Julian's Reefs.

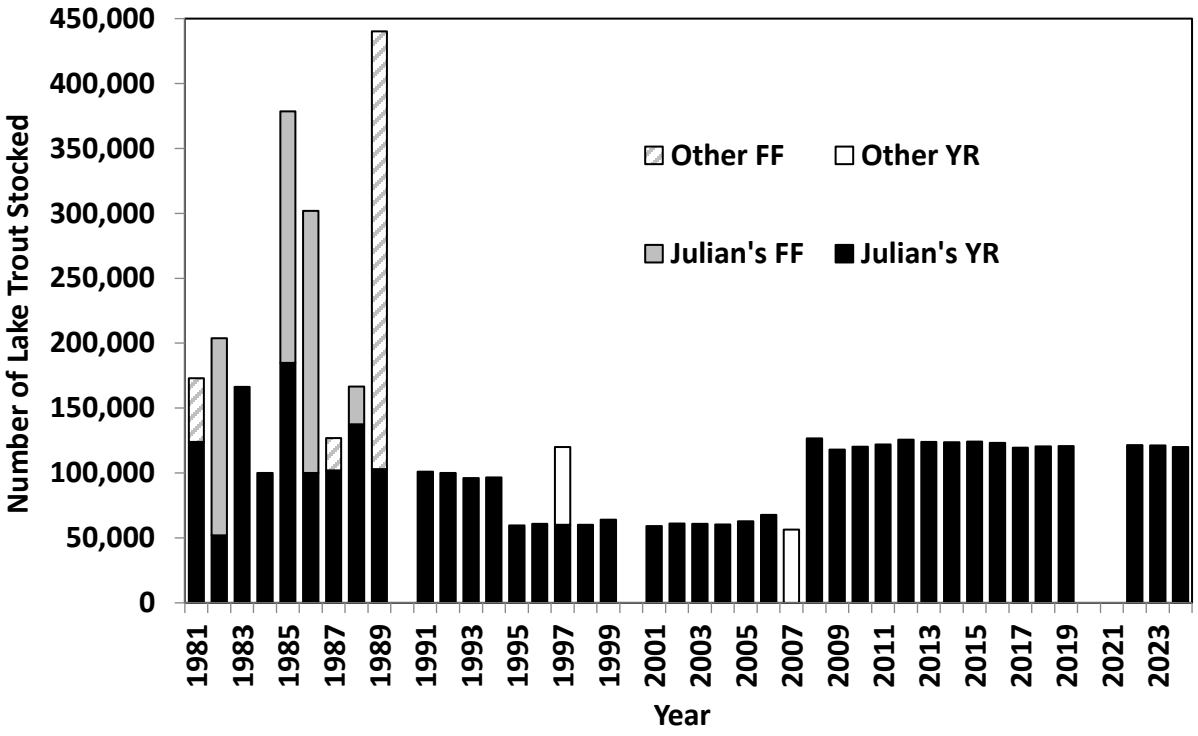


Figure 2. Lake Trout stocking in Illinois waters of Lake Michigan, 1981 to 2024 (FF = fall fingerling, YR = yearling). Due to COVID-19 restrictions, federally reared Lake Trout allocated to Illinois were stocked from shore in Wisconsin during 2020 and 2021. The number of fish stocked in 2024 had not been officially reported at the time of writing of this report, thus the number displayed (120,000) represents the target total.

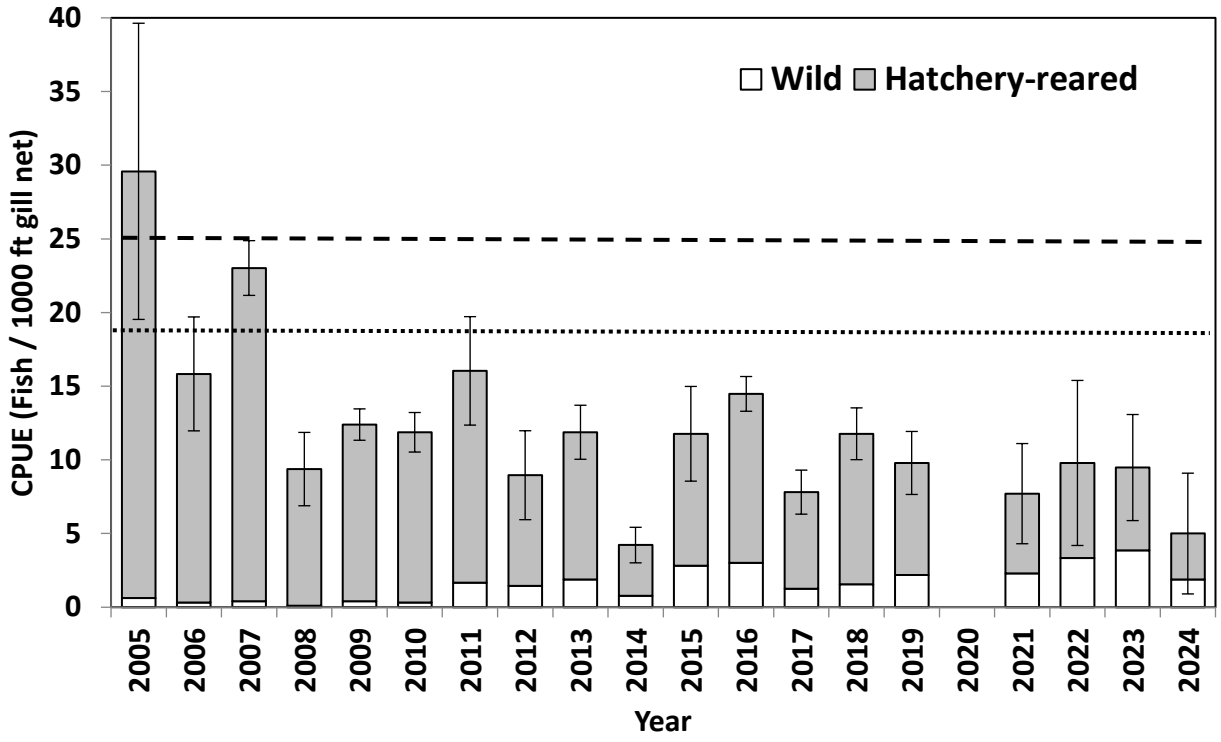


Figure 3. Catch per unit effort (CPUE) of Lake Trout sampled in spring 2005-2024 broken into the portion of the catch consisting of wild (white) and hatchery-reared (grey) fish. The dashed line represents the CPUE goal (>25 fish/1000 ft of gill net) of Evaluation Objective 1 in A Stocking Strategy and Evaluation Objectives for the Rehabilitation of Lake Trout in Lake Michigan, while the dotted line represents the wild CPUE goal (>19 fish/1000ft of gill net) of Evaluation Objective 7. Error bars represent the standard error for the total CPUE (not accounting for hatchery or wild origin). Due to COVID-19 restrictions no sampling occurred in 2020.

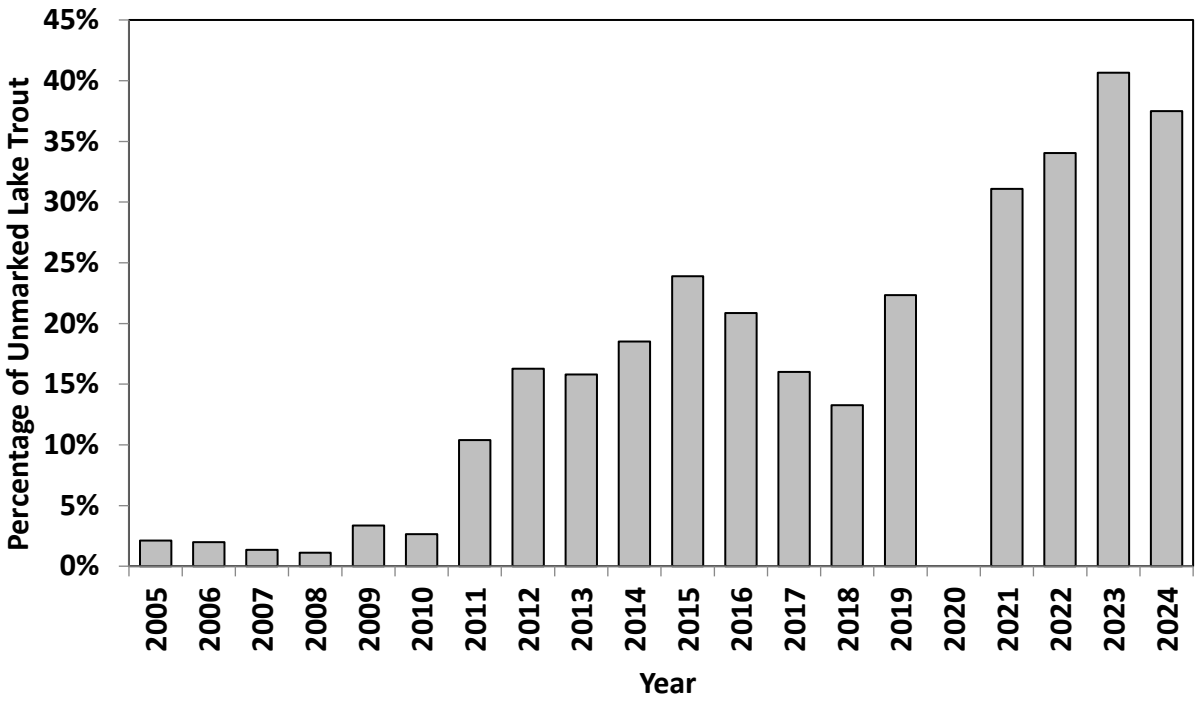


Figure 4. Percentage of unmarked Lake Trout sampled in spring 2005-2024 near Waukegan, IL. Due to COVID-19 restrictions no sampling occurred in 2020.

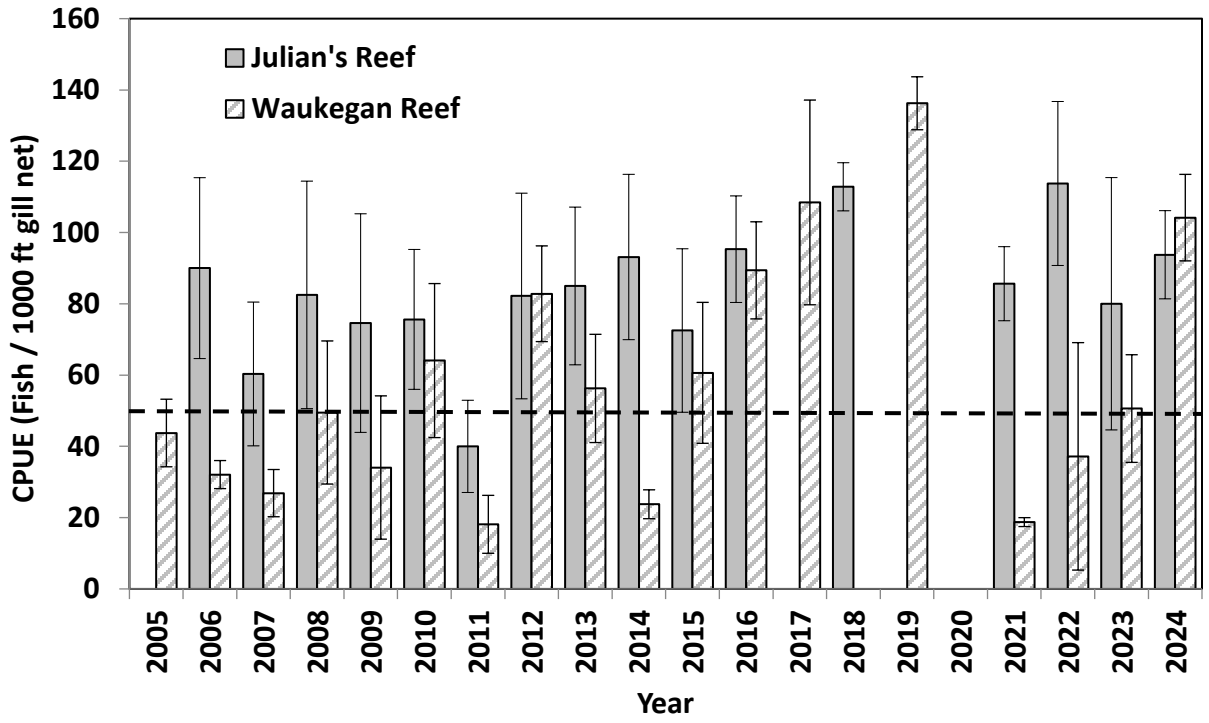


Figure 5. Catch per unit effort (CPUE) of Lake Trout sampled in fall 2005-2024 at Julian's Reef (sold gray bars) and Waukegan Reef (crosshatched). The dotted line represents the CPUE target (>50 fish/1000 ft of gill net) of Evaluation Objective 2 in A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan. No sampling occurred in 2020.

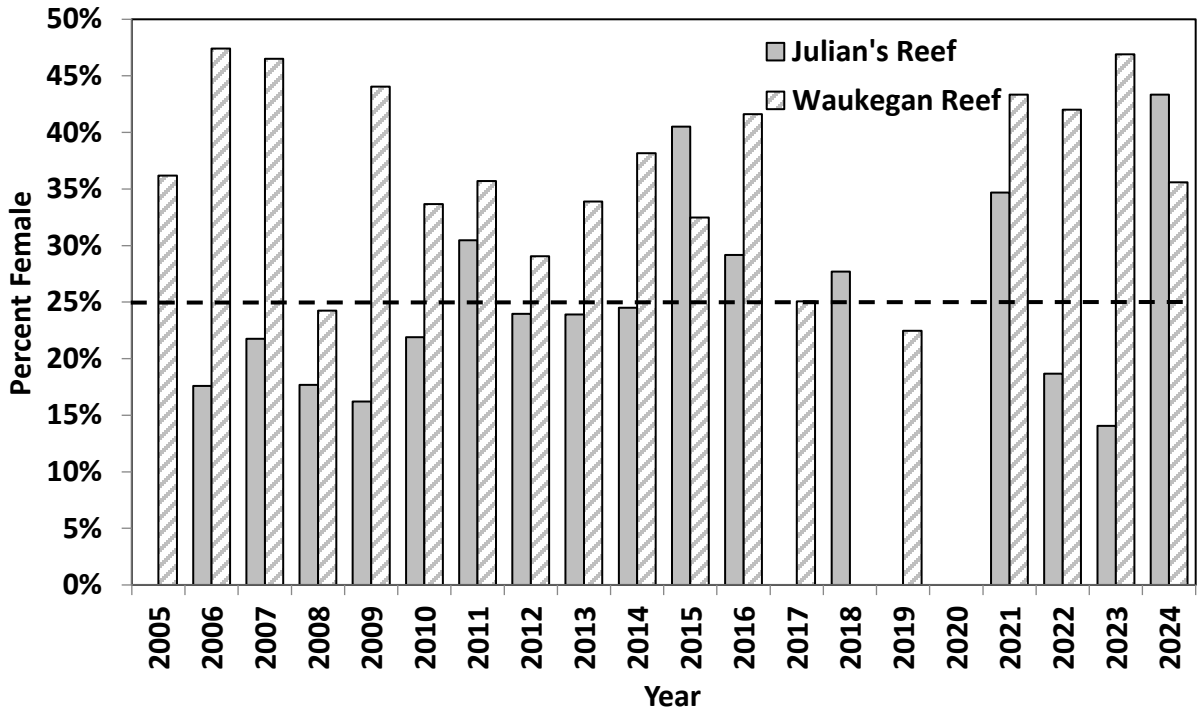


Figure 6. Percent female Lake Trout sampled in fall 2005-2024 at Julian's Reef (sold gray bars) and Waukegan Reef (crosshatched). The dotted line represents the female proportion target (>25% female for spawning populations) of Evaluation Objective 3 in A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan. No sampling occurred in 2020.

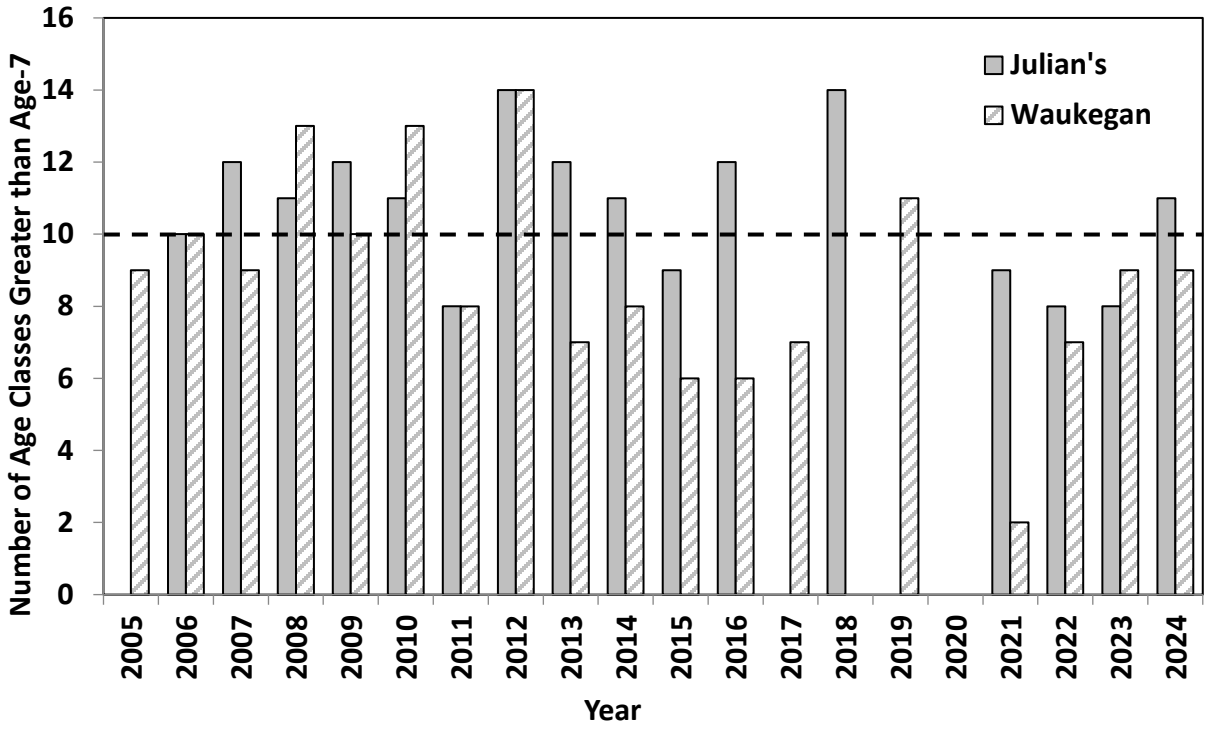


Figure 7. Number of Lake Trout age classes greater than age-7 sampled in fall 2005-2024 at Julian's Reef (sold gray bars) and Waukegan Reef (crosshatched). The dotted line represents the age class target (≥10 age groups older than age-7 for spawning populations) of Evaluation Objective 3 in A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan. No sampling occurred in 2020.

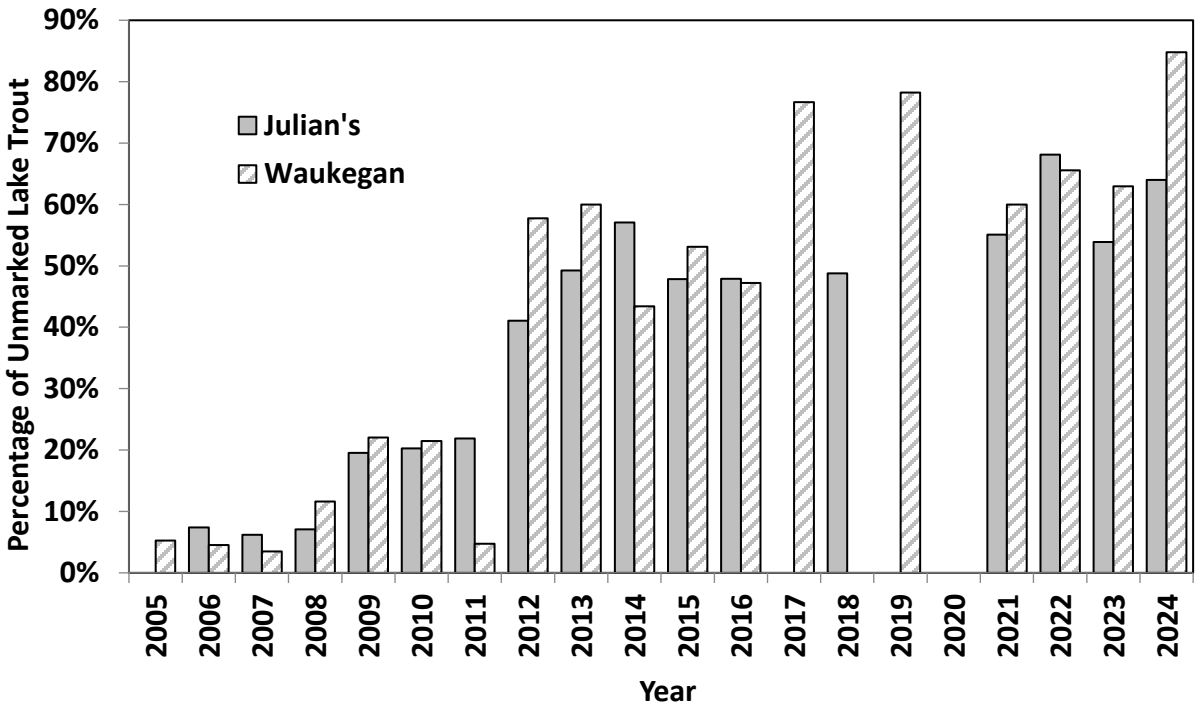


Figure 8. Percent of unmarked Lake Trout sampled in fall 2005-2024 at Julian's Reef (sold gray bars) and Waukegan Reef (crosshatched). No sampling occurred at Julian's Reef in 2005, 2017, and 2019 or Waukegan Reef in 2018 and neither site was sampled in 2020.

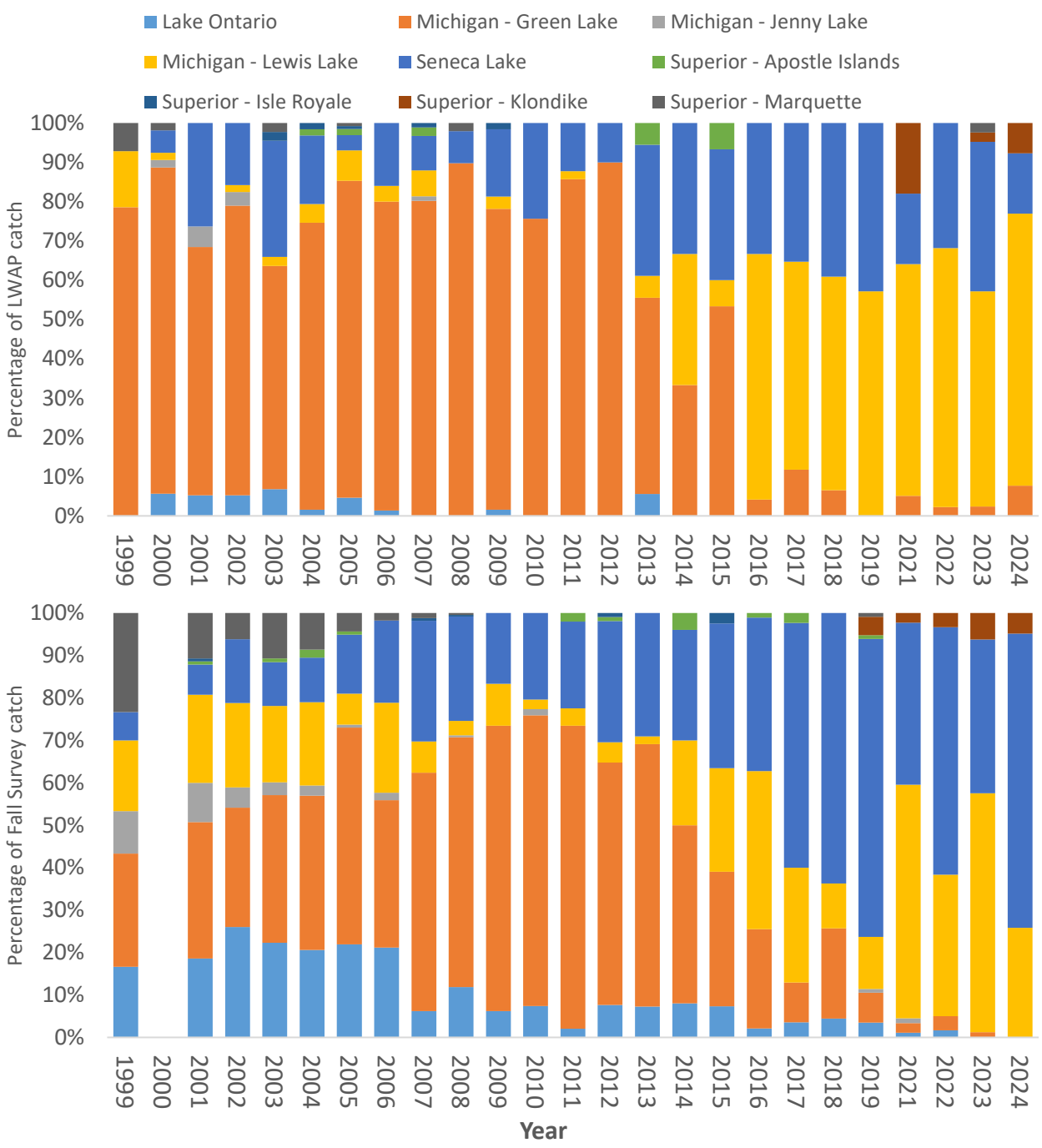


Figure 9. Lake trout strain composition of the catch of hatchery-reared fish with CWTs in the spring (top) and fall spawner (bottom) surveys. No fall sampling occurred in 2000 (empty space) and no spring or fall sampling occurred in 2020 (data point omitted).