

Illinois Department of Natural Resources

Division of Fisheries

Lake Trout Monitoring in Lake Michigan: 2021 Spring and Fall Assessments

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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 restricted (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 recently under *A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan* (Dexter et al. 2011; referred to hereafter as the *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. However, due to COVID-19 restrictions on travel and offshore vessel operations, federally reared Lake Trout allocated to Illinois were stocked from shore in Wisconsin during 2020 and 2021. The *Strategy* has four Evaluation Objectives to monitor progress toward targeted rehabilitation: 1) catch per unit effort (CPUE) of >25 Lake Trout/1000 ft graded-mesh gill nets in spring stock assessments by 2019; 2) CPUE of >50 Lake Trout/1000 ft graded mesh gill nets in spawning surveys by 2019; 3) spawning populations of at least 25% female and which have ten or more age groups older than age-7; and 4) an egg deposition rate of >500 viable eggs/m² (eggs with thiamine concentrations of >4 nmol/g). Evaluation Objectives 2-4 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. (2016) found no significant differences in catch statistics between Julian's Reef and Waukegan Reef during 1999-2014. Thus, Evaluation Objectives 2 and 3 were assessed annually at Julian's Reef, when possible, and data from Waukegan Reef was considered particularly 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 began including "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.

This report covers progress towards Evaluation Objectives 1-3 in Illinois waters; Evaluation Objective 4 is not included in this report since there is currently no quantitative sampling for eggs or juveniles in Illinois waters.

METHODS

Lake Trout were sampled with gill nets during two offshore surveys. Presented data are from surveys conducted in 2002-2021.

Spring Lake Trout Survey

Graded mesh gill nets, 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). Gill nets were fished on 17-21 May 2021. One net was set at an established site within each of three depth bins (50-100, 100-150, and 150-200 ft) along two transects offshore of Waukegan, IL. A total of six nets were fished during the 2021 survey.

Fall Spawner Survey

Graded mesh gill nets, with two 100 ft panels of 4.5" to 6" (½ inch increments) mesh sizes (800 ft total) were fished overnight. Two gill nets were fished on three occasions during 18 October-04 November

2021. Four nets were set at Julian's Reef but, due to vessel mechanical issues, only two nets were set at Waukegan Reef. A total of six nets were fished during the 2021 survey.

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. CPUE values are highly dependent on standardized effort. Therefore, nets that were fished for more than 1 day in duration (since 2-day set \neq twice the number of fish of a 1 day set) or with incorrect mesh sizes were removed from CPUE analyses (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). Catch data from all net sets was used in the reporting of proportion female, number of age classes, proportion of unmarked fish, and stocking origin (CWT data) since effort and mesh size has less influence on these indices.

RESULTS AND DISCUSSION

Spring Lake Trout Survey

Spring Lake Trout CPUE was 7.7 fish/1000 ft of net in 2021. This was approximately 30% of the target (25 fish/1000 ft), which has only been achieved once in 22 years of spring LWAP sampling (Figure 3). Thus, Evaluation Objective 1 of the *Strategy* has not been achieved in Illinois waters.

Twenty-two Lake Trout (30%) were not fin clipped and presumed to be of wild origin (Figure 4), representing the highest proportion of wild fish observed in the spring survey to date. The percentage of unmarked fish in our spring catches increased after 2010 and has averaged 19% (2011-2021 average). Forty-four Lake Trout had an adipose fin clip and a coded-wire tag, though three fish were found to have no tag detected when the head was processed in the lab. A total of 39 tags were successfully decoded. A majority (28) were stocked on Julian's Reef (5 to 19 years old at capture), 10 were stocked on the Mid-lake Refuge (8 to 10 years old at capture), and one fish was stocked on the Wisconsin shoreline (6 years old at capture). Two tags were lost during the extraction process and not able to be decoded.

Fall Spawner Survey

Fall Lake Trout CPUE was 63.3 fish/1000 ft of net in 2021. Fall CPUE has exceeded the 50 fish/1000 ft target of Evaluation Objective 2 in all but three years of the fall survey (Figure 5). Consistent CPUEs above the target indicate that Evaluation Objective 2 of the *Strategy* has been achieved in Illinois waters. Atypically, catch per unit effort differed dramatically between Julian's Reef (85.6 fish/1000 ft of net) and Waukegan Reef (18.8 fish/1000 ft of net) in 2021. Unusually warm water, known to affect Lake Trout presence on spawning grounds (DeRoche 1969), may have impacted catch rates in 2021. Temperatures were above 55°F during five out of six net sets, whereas the average (standard deviation) water temperature during fall gillnet sets since 1998 has been 47.7°F (4.9°).

Evaluation Objective 3 of the *Strategy* has two components. The goal of at least 25% female Lake Trout at spawning sites has been met in nine years, including four of the last five years of sampling (Figure 6). Although the percent-female target has been met or exceeded in some years, there is inconsistency in attaining the target such that we cannot consider that the percent female portion of Evaluation Objective 3 has been achieved at this time. The catch consisted of 9 age groups older than age-7 in 2021 (Figure 7). Since 2006, Lake Trout catches have consisted of 10-14 age classes older than age-7 in 11 of 15 years, satisfying the age-class portion of Evaluation Objective 3. Currently, coded-wire tags represent the only source of ages for Lake Trout collected from spawning sites in the fall survey; ages from wild Lake Trout are not yet represented within the data being used to evaluate Objective 3 in Illinois waters. Aging structures have been collected from Lake Trout during previous and current annual assessments and processing of these structures over the next couple years is anticipated. 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 60% of Lake Trout sampled at Waukegan Reef (18 of 30) did not have a fin clip in 2021, while 55% at Julian's Reef (151 of 274) did not have a fin clip. The presence of unmarked, potentially wild fish has increased substantially in recent years (Figure 8). In 2021, 86 Lake Trout sampled at Julian's Reef had an adipose fin clip and a coded wire tag. Most (59) of the tagged fish were stocked at Julian's Reef (5 to 18 years old at capture), 21 were stocked at the Mid-lake Refuge (6 to 32 years old at capture), and four were stocked from the shoreline in Indiana (one fish, 6 years old at capture), Michigan (one fish, 12 years old at capture), and Wisconsin (two fish, both 6 years old at capture). Two tags were lost during the extraction process and not able to be decoded. At Waukegan Reef, six Lake Trout were sampled

with an adipose fin clip and coded wire tag. Most (5) were stocked at Julian's Reef (4 to 8 years old at capture), and one was stocked at the Mid-lake Refuge (30 years old at capture).

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Spring Lake Trout survey CPUEs were anticipated to be lower than fall CPUEs, and targets were set accordingly, since Lake Trout aren't necessarily aggregated in the spring as they are during the fall spawn. Spring CPUEs in the Illinois waters of Lake Michigan however have remained below the target in a majority of years sampled, not reaching 25 fish/1000 ft since the mid-2000s. Similarly, the target has been met only briefly at four of the twelve spring sampling sites lakewide and has not been achieved with any regularity or consistency at any site (LMLTWG 2019).

Recommendations: Continue participation in spring Lake Trout survey and evaluate results toward achieving Evaluation Objective 1 of the 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 we may be close to declaring rehabilitation at some sites (LMLTWG 2019). The increased presence of unmarked fish in recent catches indicates successful recruitment to adult life stages, especially in Illinois waters.

Recommendations: Continue participation in 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; share results with the Lake Trout Working Group of the Lake Michigan Technical Committee.

Although no new non-priority sites were sampled in 2021, 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 rehabilitation 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.

ACKNOWLEDGEMENTS

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Figure 1. Location of the spring Lake Trout survey sites (white squares) and fall spawning Lake Trout surveys (Open Circles) in the Illinois waters of Lake Michigan.

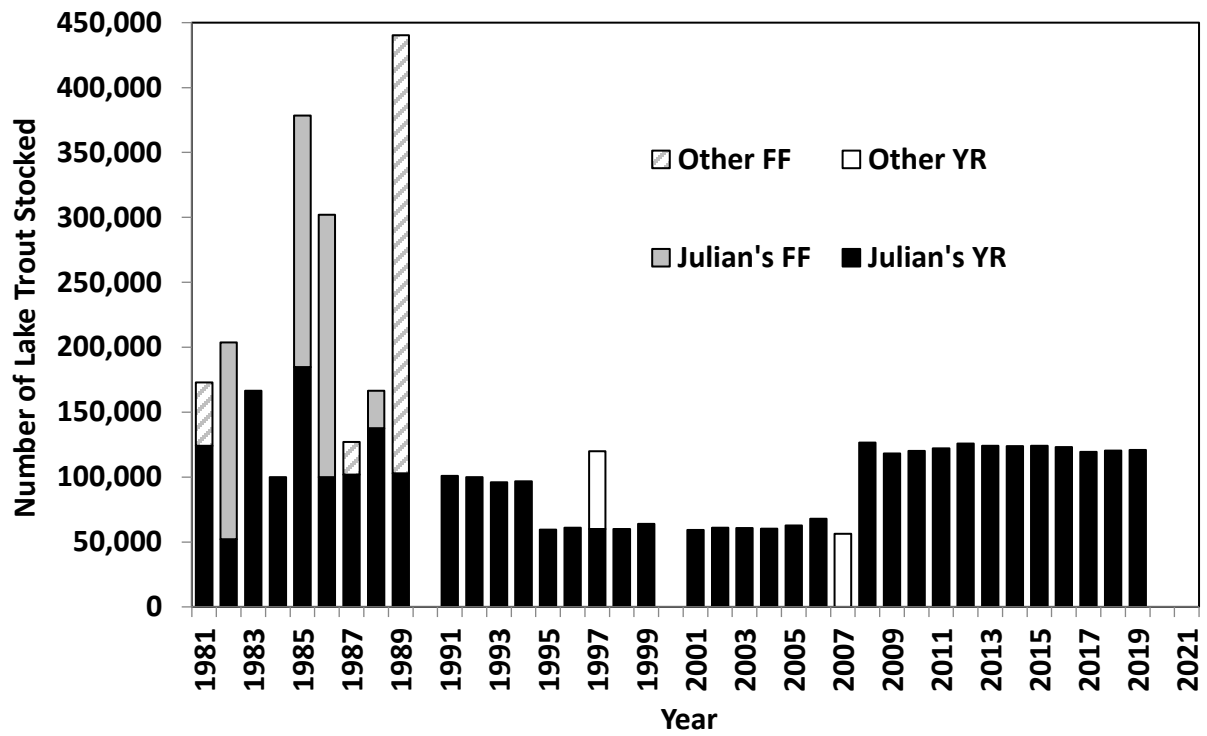


Figure 2. Lake Trout stocking in Illinois waters of Lake Michigan, 1981 to 2021 (FF = fall fingerling, YR = yearling). Due to COVID-19 restrictions, federally reared Lake Trout allocated to Illinois were stocked from shore in Wisconsin during 2020 and 2021.

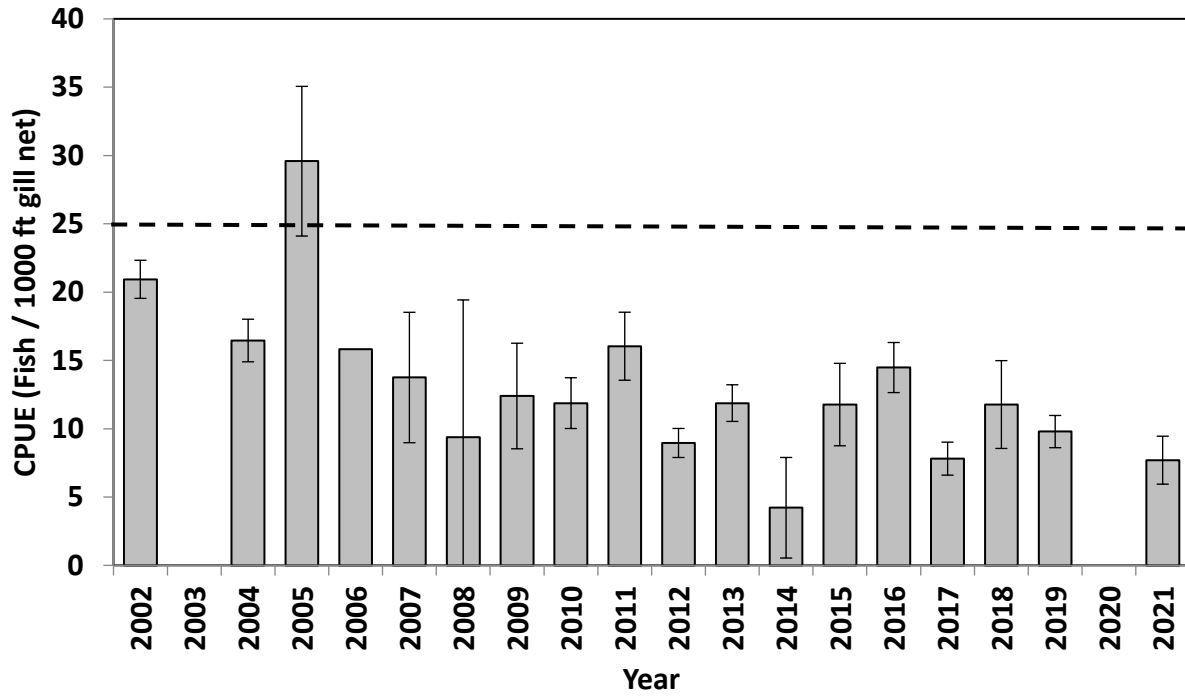


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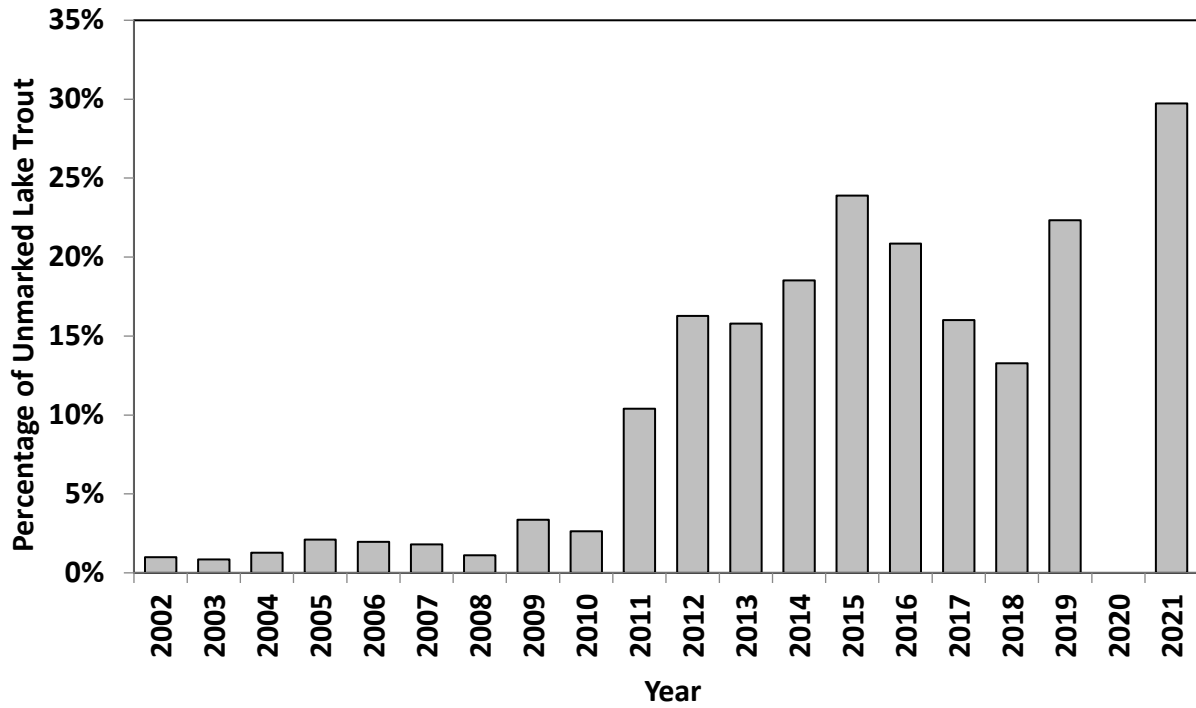


Figure 4. Percentage of unmarked Lake Trout sampled in May 2002-2021 near Waukegan, IL. Due to COVID-19 restrictions no sampling occurred in 2020.

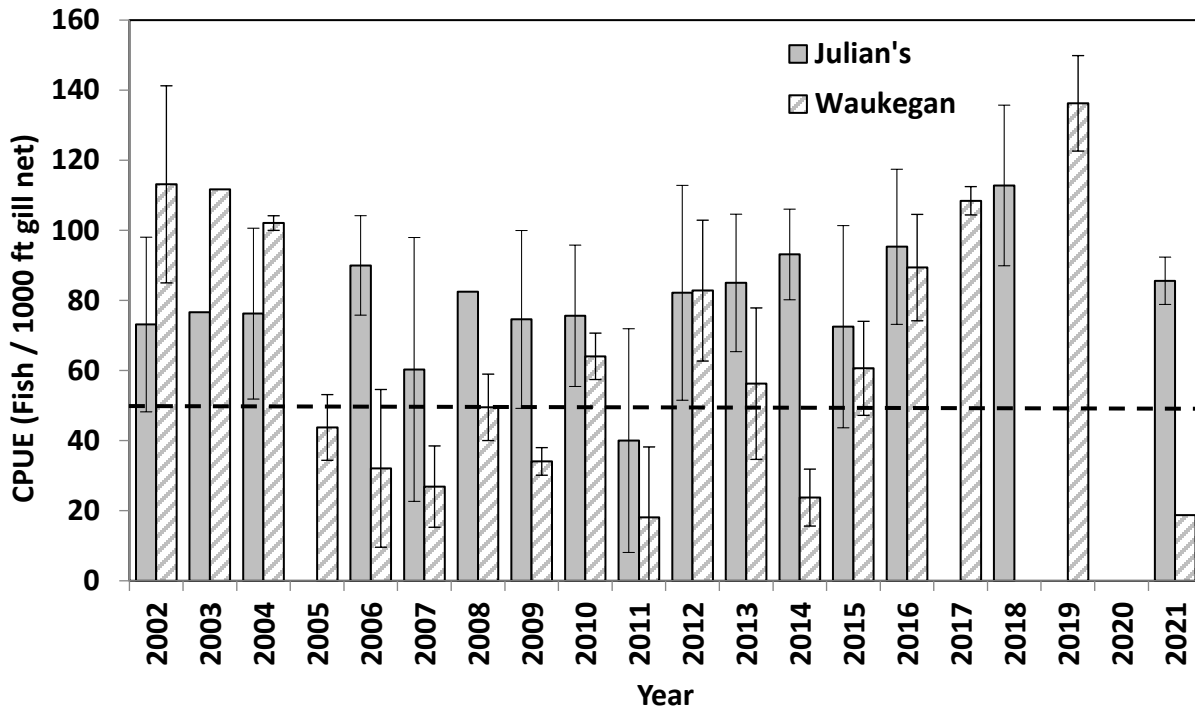


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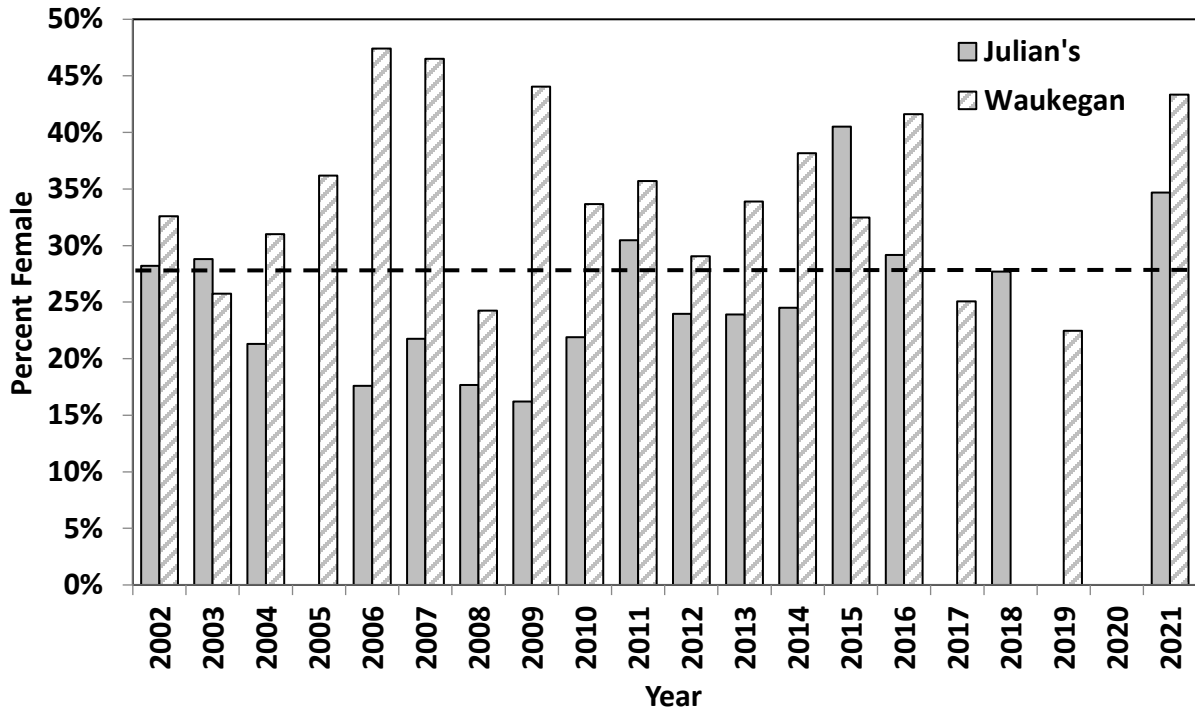


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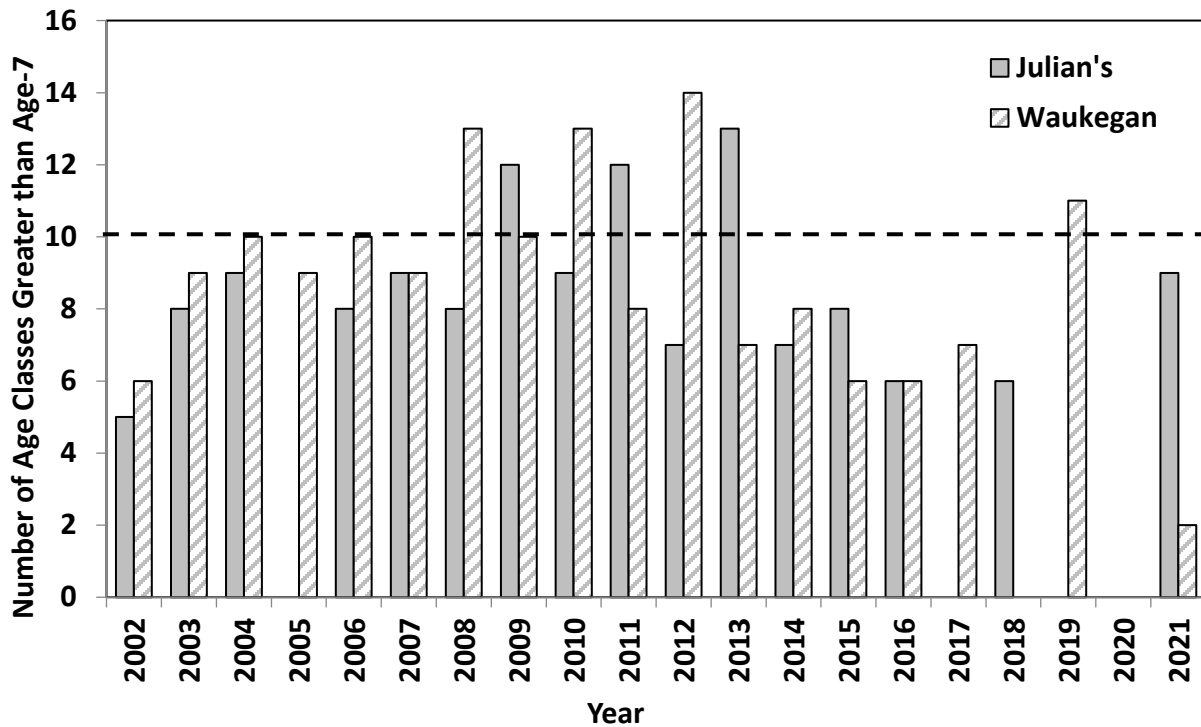


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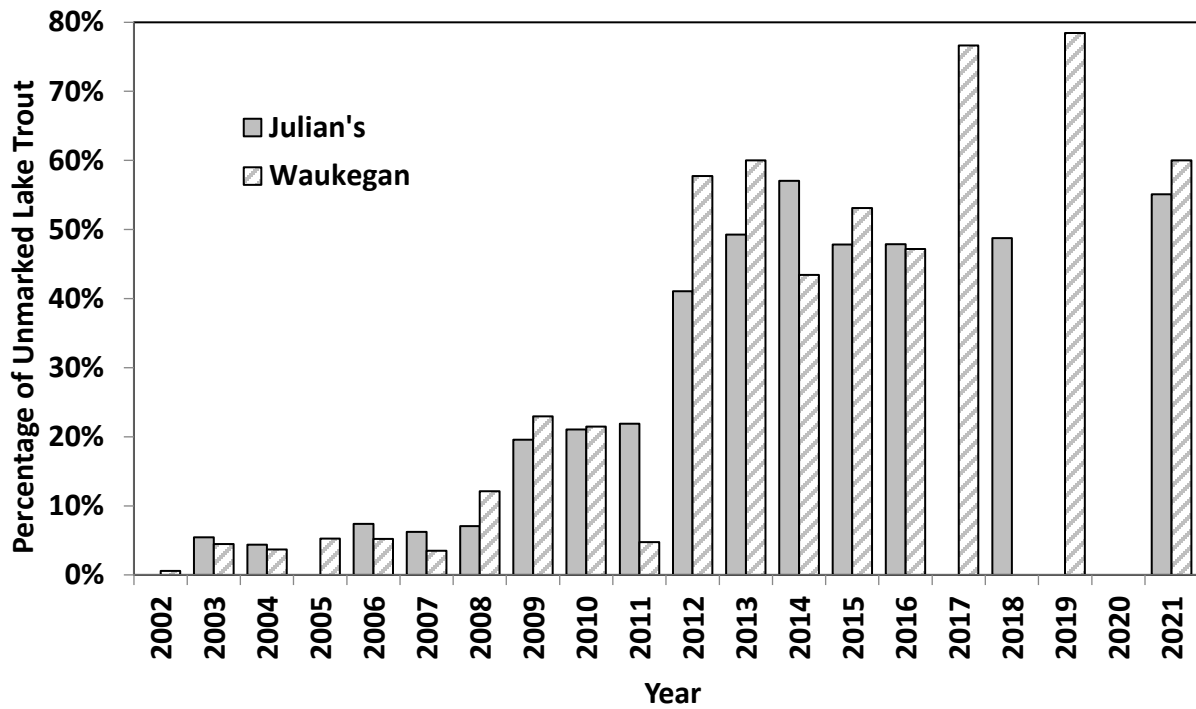


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