Sub-Indicator: Walleye

Overall Assessment

Status: Good

Trends:

10-Year Trend (2014-2023): Improving

Long-term Trend (1975-2023): Unchanging

Rationale: The status of Walleye populations across the Great Lakes is rather variable, although most lakes have Walleye populations in Good status. Walleye populations in Lakes Erie, Michigan, and Ontario are meeting or exceeding their Fish Community Goals and Objectives. These lakes have strong Walleye fisheries that are supported by naturally reproducing populations of Walleye showing relatively stable or Improving population dynamics. Walleye in Lakes Superior and Huron are not consistently meeting their Fish Community Goals and Objectives and show significant regional variations in the status of Walleye populations. For example, the Walleye population in Lake Huron's Saginaw Bay achieved its recovery targets in 2009 and is at a time-series high abundance, whereas Walleye in the North Channel and Georgian Bay are considered depressed due to high exploitation rates and inconsistent recruitment. Such regional variation in status can make lake-wide evaluations difficult. Overall, Walleye is in Good status across the Great Lakes owing to strong, naturally reproducing populations.

Lake-by-Lake Assessment

Lake Superior

Status: Fair

10-Year Trend (2014-2023): Improving

Long-term Trend (1980-2023): Improving

Rationale: Several Lake Superior Walleye populations have shown considerable improvements since the publication of the Lake Superior Walleye rehabilitation plan. The St. Louis River Estuary and nearshore areas of the Western Arm support a self-sustaining spawning stock of around 84,310 individuals (2021 estimate), which supports a large recreational fishery with total annual mortality and exploitation rates that remain below management targets. Relative abundance of Chequamegon Bay Walleye has remained stable with low exploitation. Black Bay surveys indicated the Walleye population, although not fully rehabilitated, is stable with consistent recruitment and low mortality, due in part to fishery closures and conservative regulations. Agencies have also observed similar signs of improvement in smaller Nipigon, Goulais, and Batchewana Bay populations. Recently, a large-scale acoustic telemetry project indicated Walleye in Black Bay exhibit both resident and migratory behavior, utilizing areas beyond Black Bay when conditions were suitable. Habitat improvements, conservative management of harvest, and independent monitoring remain the primary approaches for walleye rehabilitation efforts in Lake Superior.

Lake Michigan

Status: Good

10-Year Trend (2013-2022): Unchanging

Long-term Trend (1985-2022): Unchanging

Rationale: Walleye populations are highly variable across Lake Michigan, as shown by harvest patterns for Green Bay, which provide over 95% of Lake Michigan's walleye harvest. Estimates of angler harvest from Wisconsin waters of Green Bay from 2010-2022 are higher than harvest levels in the 1990s and early 2000s, while angler harvest from Michigan waters during 2010-2022 have been considerably lower than levels during the 1990s and early 2000s. Walleye recruitment in southern Green Bay is entirely from natural reproduction with consistent natural reproduction documented in most years and strong year classes produced every 3-5 years, while recruitment in northern Green Bay includes both wild and hatchery contributions. Walleye fisheries in the main basin of Lake Michigan are relatively small compared to Green Bay with limited contributions of naturally reproduced fish as well as migrant Walleyes from Green Bay (Izzo et al. 2023).

Lake Huron (including St. Marys River)

Status: Fair

10-Year Trend (2014-2023): Improving

Long-term Trend (1986-2023): Improving

Rationale: These assessments are based on a combination of fishery reporting, fishery-independent (netting) surveys, and corresponding population modeling work. There is evidence of stable to increasing recruitment of wild fish in key source populations, principally Saginaw Bay which is a source stock to the main basin. Other locations show signs of population limitation or even suppression such as truncated age and size structure, believed to stem from over harvest. These mixed trends make it difficult to assign a single overall assessment for Lake Huron as important regions such at the North Channel and Georgian Bay populations may only be stable at best.

Lake Erie (including St. Clair-Detroit River Ecosystem)

Status: Good

10-Year Trend (2014-2023): Improving

Long-term Trend (1975-2023): Unchanging

Rationale: Walleye abundance estimates in Lake Erie have fluctuated widely around the average of 55.1 million fish over the 45+ year time series, with no significant Improving or Deteriorating long-term trend (WTG 2024). In the most recent ten years (2014-2023), walleye abundance has averaged 71.8 million age-2 and older fish, much higher than the time series average of 50.5 million fish ending in 2014. Beginning in 2017, with the recruitment of an estimated 90.9 million age-2 fish, the second highest recorded recruitment in the full time series, the Walleye population has produced several additional strong year-classes in 2018, 2019, and 2021. The 2018, 2019, and 2021 cohorts should continue to maintain a high estimated abundance of Walleye in Lake Erie and support sustainable commercial and recreational fisheries for years to come. All objectives of the Lake Erie Walleye Management Plan (2015) are being met as of 2023.

Lake Ontario

Status: Good

10-Year Trend (2014-2023): Unchanging

Long-term Trend (1992-2023): Unchanging

Rationale: After declines in Walleye abundance in the 1990s due to ecosystem changes following the invasion of dreissenid mussels, the population stabilized at lower levels in the Bay of Quinte in Ontario and the binational waters of eastern Lake Ontario. Subsequently, Walleye indicators were identified in the Bay of Quinte Fisheries Management Plan (Lake Ontario Management Unit 2010), including targets for adult abundance, juvenile abundance, and recruitment. The abundance targets have been met in most years since 2000 and the recruitment (YOY abundance) target was exceeded in 14 out of 24 years and appears sufficient to sustain future population abundance given no major ecosystem changes occur. Commercial and recreational harvest have also been stable over the past two decades.

Status Assessment Definitions

The Walleye is a highly valued species that is usually heavily exploited by recreational fisheries and commercial fisheries (where permitted). Harvest or yield reference values established for self-sustaining populations are assumed to be proportional to annual production; as a result, harvest or yield reference values for these populations can be taken as surrogates for production reference values. Similarly, catch per unit effort reference values from fishery-independent surveys are considered to be proportional to population abundance. Status reporting will be compared to the previous three-year reporting period, although it is recommended that a longer reporting period would allow for a more accurate trend for fishery harvest across time.

Good: Meets or exceeds attainment of harvest or survey targets in all (most recent) reporting years.

Fair: Met harvest or survey target in one year and was at or above 50% of target levels in all other years.

Poor: Did not attain harvest or survey target levels in all years.

Undetermined: Data are not available or are insufficient to assess condition of the ecosystem components or harvest target not defined.

Trend Assessment Definitions

Improving: Walleye population estimates have been increasing; harvest rates have been increasing and natural reproduction has been increasing or consistently better than average during 2014-2023 and/or longer time periods. Survival and catch rate trends are positive and disease outbreaks or occurrences are infrequent even though disease is often density-dependent so it is important to recognize that high population size is representative of a Good status but higher disease transmission is more likely. Growth rates are near historic averages with the understanding that density-dependent compensation occurs.

Unchanging: Populations of Walleye have not significantly increased or decreased; fisheries and catch rate trends remain mixed; and natural reproduction has been inconsistent on an annual basis during 2014-2023 and/or longer time periods. Changes in growth rates, maturity, and fecundity have been occasionally noted and/or disease outbreaks or occurrences are present but not excessive.

No Trend: Data for a 10-year or longer period are available, but a trend cannot be confidently determined due to high variability in the data.

Deteriorating: Populations of Walleye have been decreasing and are below target levels established for the lake or water body; natural reproduction has been declining or consistently below average for 2014-2023 and/or longer time periods. Survival and/or growth have been declining and there is evidence of a decline in fisheries and catch

rate trends during 2014-2023 and/or longer periods. Disease or contaminant rates may have worsened in recent years.

Undetermined: Data for a 10-year or longer period are not available or are insufficient to assess a trend over time.

Endpoints and/or Targets

Appropriate quantitative measures of relative abundance, harvest, diversity, or biomass should be established as reference values for self-sustaining populations of Walleye in each lake. The sub-indicator target(s) can be based on the values provided in the Great Lakes Fishery Commission (GLFC)'s Fish Community Objectives (FCO) and/or for desired value(s) gained from analysis of the range and distribution of measures above compared to the ecosystem conditions. Lakes Erie and Superior also have management and rehabilitation plans, respectively, concerning Walleye from which targets can also be obtained.

Lake Superior: Maintain, enhance, and rehabilitate self-sustaining populations of Walleye and their habitat over their historical range (Horns et al. 2003).

The Lake Superior fish community will be managed to maintain, enhance, and rehabilitate habitat for self-sustaining populations of Walleye in areas where the species historically maintained populations. Management strategies will be implemented to attempt to reach objectives specific to individual Walleye populations and habitats (Rehabilitation Plan, 2001). Rehabilitation targets for Walleye populations may include:

- 7 age-0 and age-1 Walleye/electrofishing hour/index station, and 8 ages classes are represented in assessment catches in the St. Marys River (Michigan) and Tahquamenon River
- The spawning population reaches 1,000 in the Pigeon River
- The spawning population reaches 7,000 in the Bad River
- The spawning population reaches 1,000 in the St. Marys River (Ontario)
- The spawning population reaches 500 in Goulais Bay
- The spawning population reaches 500-1,000 in Batchawana Bay
- The spawning population reaches 5,000 fish in Thunder Bay
- The population reaches either 22,000 adult fish or 41,000 fish over 356 mm in Nipigon Bay
- Catches in index gill nets reach 150 kg/km in Black Bay.

Lake Michigan: Expected annual yield: 0.1-0.2 million kg (100-200 metric tonnes) (Eshenroder et al. 1995). Harvest target sustainable levels of 200,000 – 400,000 pounds.

Lake Huron: Re-establish and/or maintain Walleye with populations capable of sustaining an annual harvest of 0.7 million kg (DesJardine et al. 1995). A new Walleye recreational management plan is in development for Saginaw Bay and nearing completion. Included are a suite of metrics for sustainability and other indicators in the form of a 'dashboard'.

Lake Erie: Maintain Walleye and Yellow Perch populations that support sustainable commercial and recreational fisheries (Francis et al. 2020).

This is done within the construct of objectives stated or implied in the Lake Erie Committee's Walleye Management Plan (Kayle et al. 2015, LEC 2018). These objectives are:

- Maintain Walleye spawner biomass at levels greater than 20% of an unfished population (SSB20%) in the Total Allowable Catch (TAC) area
- Maintain sport harvest rates at or above 0.4 Walleye per angler hour
- Maintain commercial harvest at or above 4 million pounds annually.

Additionally, the age and size structure of the fishery should be sufficient to:

- Promote migration of Walleye towards the eastern basin
- Provide diverse fishing opportunities to anglers

Lake Ontario: Fish-Community Objectives for Lake Ontario (Stewart et al., 2017) sanction action to "maintain, enhance and restore self-sustaining local populations of Walleye", as measured by "maintaining or increasing fisheries, populations, and recruitment of Walleye". Walleye population performance targets based on long-term assessment programs are identified in the Bay of Quinte Fisheries Management Plan (Lake Ontario Management Unit, 2010) and include the following:

- Mean number of young-of-the-year Walleye captured in the bottom trawl should be 5.9 (± 1.0 SE) over any five-year period.
- Mean number of juvenile Walleye (ages 1-4) captured in nearshore trap nets should be 3.8 (± 0.6 SE) over any five-year period.
- Mean number of juvenile Walleye (ages 1-4) captured in bottom set gill nets should be 33 (± 7.0 SE) over any five-year period.
- Mean number of adult Walleye (> age 4) captured in bottom set gill nets should be 11.5 (± 1.5 SE) over any five-year period.
- Mean angler catch rate of 0.25 Walleye per rod hour in the open water fishery.

Sub-Indicator Purpose

The purpose of this indicator is to measure status and trends in Walleye population abundance and recruitment in various Great Lakes habitats; to infer the status of cool water predator communities; and to infer ecosystem health, particularly in moderately-productive (mesotrophic) areas of the Great Lakes and through their roles in the aquatic food web.

Ecosystem Objective

Protection, enhancement and restoration of historically important, mesotrophic habitats that support natural stocks of Walleye as the top fish predator. These habitats are necessary for a stable, balanced, and properly-functioning Great Lakes ecosystem.

This indicator best supports work towards General Objective #5 of the 2012 Great Lakes Water Quality Agreement (GLWQA) which states that the Waters of the Great Lakes should "support healthy and productive wetlands and other habitats to sustain resilient populations of native species."

Methods

Since Walleye function as apex predators in several of the Great Lakes ecosystems, population abundance and demographic changes in historical, cool water, mesotrophic habitats are important metrics for assessing Great Lakes health. As such, abundance and biological measures can be used to gauge ecosystem health and understand changes over time. Reviewing short-term (i.e., previous 10 years) and long-term (i.e., over the breadth of available data) changes to these measurements is a useful approach for describing the health of Great Lakes Walleye populations. Recognizing survey and financial constraints imposed on management agencies, metrics that describe regional (i.e., discrete stocks or spawning aggregations) status and trends of these Walleye populations may be more meaningful than lake-wide indices in some circumstances. Likewise, while annual indices would be the most beneficial, information collected on an intermittent basis may be useful. Each agency makes decisions on the frequency of assessment based on factors that take into account the level of the resources available (capacity) relative to the status of the stock and the social and economic pressure on the resource.

Abundance, spawner biomass, recruitment (i.e., natural reproduction), age/length at maturity, and fishery performance (effort, catch rate, yield) are useful metrics for describing Great Lakes ecosystem and fishery health. However, in the absence of absolute abundance and spawner biomass estimates for all lakes, relative measures from fishery-dependent (i.e., harvest) and fishery-independent (i.e., population assessments) surveys are suitable metrics for reporting on Walleye population health in the event population estimates are lacking.

Data on Walleye population status was obtained from contributors representing each State or Provincial management agency in the Great Lakes. All management agencies employ some type of monitoring program to assess Walleye populations in their jurisdictions, though the gear and spatiotemporal coverage can vary. In Lake Erie, Walleye populations are assessed lake-wide on an annual basis through programs run by each management agency. The extensive assessment coverage is required in Lake Erie for two main reasons: large numbers of Walleye from the west basin migrate to the east basin and back on an annual basis (i.e., lake-wide), and the lake supports a substantial recreational and commercial fishery that requires intensive management. All other Great Lakes conduct more spatially limited annual assessment programs that are relevant to specific Walleye populations or regions. For example, in Lake Huron, Walleye populations are monitored annually in Saginaw Bay, the southern main basin, and the North Channel with other more sporadic surveys conducted in other regions such as Georgian Bay. A similar assessment regime is present in Lakes Michigan, Superior and Ontario. Despite differences in assessment programs, all jurisdictions make efforts to regularly assess the key Walleye populations present in their waters.

Discussion

The historical dominance of Walleye in mesotrophic habitats in the Great Lakes provides a good basis for a basin-wide evaluation of ecosystem health. Maintaining or re-establishing historical levels of relative abundance, biomass, or production of self-sustaining Walleye populations throughout their native range in the Great Lakes basin will help ensure the sustainability of this species in the ecosystem and the maintenance of a desirable and balanced aquatic community in cool water, mesotrophic habitats. Historical data can be used to develop status and trend information on Walleye populations. Commercial catch records for Walleye in the Great Lakes extend back to the late 1800s; recreational catch data and assessment fishing data supplement these commercial catch records in some areas in recent decades and sport fishing data are especially useful in areas where the commercial fishery for the species does not operate.

The “mesotrophic” cool-water fish community is associated with more productive waters in nearshore areas and embayments. Mesotrophic communities, along with oligotrophic and eutrophic communities are found to varying degrees in all five of the Great Lakes with more than half of Lake Erie represented by mesotrophic habitat.

The Walleye is the top predator in the cool nearshore and offshore waters of the Great Lakes and is selected as an indicator because they represent one of the original fish species in these different habitats. As a native apex predator, Walleye balance the fish community through top-down processes -adding value to the ecosystem and to fisheries, and they are the focus of fisheries management and restoration efforts. Being co-evolved with the rest of the fish community and the natural ecosystem of the Great Lakes, Walleye represent an important component to the natural biodiversity of the lakes. They have been subjected to the full slate of environmental effects resulting from human disruption of the Great Lakes ecosystem including habitat loss, nutrient pollution, exploitation, and water quality degradation, persistent toxic pollutants, and invasive species. While restoration efforts like stocking can complicate interpretation of their status, the successes of this species are indicative of progress toward the goals of the GLWQA. Walleye support large commercial and recreational fisheries throughout Lakes Erie and Huron; consequently, trends in harvest are useful for assessing ecosystem health. However, in Lakes Michigan, Ontario, and Superior, where Walleye are constrained to less abundant cool water habitats, harvest information may not be as reflective of ecosystem health as in Lakes Erie and Huron due to their limited spatial distribution. Rather, harvest trends may only reflect the ecosystem health of areas of suitable habitat in Lakes Michigan, Ontario or Superior because of the limited data available.

Lake Superior

Walleye populations in Lake Superior are limited to shallow embayments and lower gradient tributaries. As such, population assessments are conducted at appropriate scales. Thunder Bay (Kaministiquia River, ON) contains a small but healthy self-sustaining population, with evidence of consistent recruitment. In Black Bay, assessment work is showing an increase in the relative abundance of Walleye along with consistent recruitment and low mortality. Ongoing acoustic telemetry work suggests Walleye from Black Bay exhibit a range of movement patterns, including extended forays outside of Black Bay. In Nipigon Bay and Nipigon River, Walleye are low in abundance, but assessment work is showing signs of increasing density (high growth rates and low mortality). The St. Louis River (Minnesota/Wisconsin) supports one of the largest self-sustaining Walleye stocks in the Lake Superior basin, with an estimated population size of 50,000 adult Walleye (Olson et al, 2018). Populations in Chequamegon Bay, WI are comprised primarily of hatchery strain Walleye, while surveys indicate low levels of mortality. Due to limited assessment surveys, it is difficult to assess if population targets were met in other parts of the lake during the reporting period.

Lake Michigan

Lake-wide Walleye population trends in Lake Michigan are largely driven by populations in the Wisconsin and Michigan waters of Green Bay, which constitute over 90% of the lake-wide harvest. A strong north-south productivity gradient in Green Bay has resulted in contrasting trends in Walleye abundance and harvests. For instance, estimates of angler harvest of Walleye from Wisconsin’s portion of Green Bay over the last 10-15 years were the highest since creel surveys began in 1986 and continue to increase, while the lowest estimates of walleye harvest from Michigan waters of Green Bay during this period have occurred in the last decade (Zorn and Kramer 2022). Walleye recruitment in southern Green Bay is entirely from natural reproduction, while that in northern Green Bay includes both wild and hatchery contributions. Young-of-year Walleye assessments in the Wisconsin waters of Green Bay continue to show consistent production in most years with strong year classes produced every 3-5 years (Breeggemann 2023) whereas catch-at-age based estimates of age-1 abundance in Little Bay de Noc, the primary Walleye fishery in northern Green Bay, show relatively weak year classes during the

2010's despite significant stocking contributions (Zorn 2015). Consistently low densities of zooplankton available to larval Walleye in Little Bay de Noc and Big Bay de Noc suggest prey availability as a potential limitation to strong year classes of Walleye (Zorn et al. 2020). Walleye remain very sparse in Wisconsin waters of Lake Michigan's main basin, with harvest of fewer than 1,000 Walleyes in most years. The most likely source of Walleyes in Wisconsin waters of Lake Michigan's main basin is migrants from Green Bay (Izzo et al. 2023), since no natural reproduction is known to occur in the main basin and no stockings have taken place since 2007. Similarly, angler harvest estimates of Walleyes from Michigan waters of the main basin have remained at relatively low levels compared to the 1990s, with harvest estimates of fewer than 1,000 Walleyes per year in 7 of 10 years during 2013-2022.

Lake Huron

The Saginaw Bay population is the largest source stock for the main basin of Lake Huron. A statistical-catch-at-age model for the Saginaw Bay population indicates a steep increase in age 2+ Walleye abundance from several large recruitment events in recent years to an estimate of over 10 million age-2+ fish in 2022 (Figure 1). Past telemetry work suggests that as much as 37% of this population will reside in the main basin from June through October contributing to fisheries there. The recovery dynamics of the stock is believed to be driven primarily by the collapse of the invasive Alewife (Fielder et al. 2007). Lake Huron's Alewife population declined dramatically in 2003. Now after 20 years of low Alewife abundance, it appears the forces behind its decline are on-going and resurgence seems increasingly unlikely. However, if Alewives were to become abundant again, it is expected that the Saginaw Bay stock of Walleye would decline and fall back into a depressed status and would likely require stocking to sustain. Changes in existing invasive species or new invasions remain the single largest threat to the status of the Saginaw Bay stock and probably all Walleye in Lake Huron. Walleye reproduction appears to remain dependent on tributary spawning but a reef restoration project (Coreyon Reef) in Saginaw Bay was completed in 2019 and subsequent research has confirmed its use by spawning Walleye. Two more reef restoration projects are in planning stages with an expectation of construction in 2025.

Spatially, Ontario's Walleye populations in Lake Huron are expansive and diverse. The mixed stock aggregation in the southern main basin is comprised of dynamic inputs from western Lake Erie and Saginaw Bay and supports commercial harvests in the order of 100,000 kilograms annually. Stocks distributed throughout the North Channel and Georgian Bay are characterized by variable status and trends (UGLMU 2019) with only a few showing signs of improved recruitment and most found at depressed levels of abundance and experiencing high mortality rates. Walleye are harvested recreationally, commercially, and by Indigenous fisheries. The exact extent of the mixing of some of these reproductive sources is difficult to assess such that determining impacts of exploitation on localized stocks is difficult. Assessment netting provides trend information on localized reproductive stocks at specific spawning tributaries. Increased efforts to mark and tag spawning aggregations of Walleye (UGLMU 2019a) have provided insights into home ranges and stock mixing in nearshore and offshore waters but more work is required.

Overall, the lake-wide status of Walleye is hard to determine because of significant regional differences in population dynamics and productivity. In Saginaw Bay, the Walleye population has experienced a significant recovery and is at a time-series high population abundance. In Ontario waters, there are many regional populations that are of varying status. Walleye populations in the North Channel and Georgian Bay require further improvement from their current depressed abundance, while Walleye in the southern main basin are stable and of Good status. With this significant regional variation in status in mind, the yield of Walleye across all sources lake-wide has not fully achieved the historic average or the Fish Community Objective of 0.7 million kilograms/year (Figure 2) since the 1940's.

Lake Erie

Since 2014, Lake Erie's Walleye population has increased in abundance thanks to consistent, strong recruitment (WTG 2024). These recent strong year classes have led to increased abundance estimates, which in turn have led to increased harvest for the lake's commercial and recreational fisheries following the current Walleye management plan's harvest control rule (Kayle et al. 2015; LEC 2018). Not surprisingly, spawning stock biomass has remained above the management plan's limit reference point of 20% of the unfished spawner biomass during the past 10 years (WTG 2024).

The annual Total Allowable Catch (TAC, or international fishery quota) set for the West and Central basins of Lake Erie has been consistently increasing since 2013 (no TAC is set for the East Basin), resulting in increased Walleye harvest for both sport and commercial fisheries. Since 2011, the commercial harvest has annually exceeded the 4 million pound management objective identified in the 2015-2019 Walleye Management Plan (Kayle et al. 2015), which was extended through 2024. Commercial gill net effort has increased during the past 10 years as Walleye abundance as associated annual TACs have increased, and generally remained within 15-20 thousand km of gill net during this period. Lake-wide commercial harvest rates (i.e., walleye per km of gill net) increased since 2014 and have remained at all-time highs since 2021 and well above the long-term average of 136 fish/km of gill net (WTG 2024). Similarly, angler harvest rates have exceeded the 0.40 fish per hour objective from the current management plan since 2017 (WTG 2024). Across Lake Erie, annual sport fishing effort remains below the long-term mean of nearly 5 million angler hours and has fluctuated between 4.0 and 4.9 million hours since 2019.

East Basin Walleye stocks remain difficult to independently evaluate largely because migration of West and Central Basin Walleye stocks masks trends of East Basin stocks when using traditional assessment approaches (Kayle et al. 2015). Research continues to examine the variability in the migration rates of fish among Lake Erie's basins to help address this issue (Euclide et al. 2021). In the East Basin, sport fishing effort has remained above the long-term mean (412 thousand hours) for each of the past three years (2021-2023) and reached a peak of 736 thousand hours of effort in 2019. Similarly, harvest rates in the sport fishery for 2021-2023 (0.58-0.68 fish/angler hour) have remained higher than the long-term mean of 0.31 fish/angler hour. Commercial catch rates in the east end of the lake for 2021-2023 reached record levels, attaining a peak of 306.3 fish/km of gillnet in 2023, substantially above the long-term average of 86.7 fish/km of gillnet.

Walleye populations in the St Clair River, Lake St. Clair, and Detroit River (collectively the St. Clair – Detroit River System; SCDRS) support large Walleye fisheries within each respective waterbody as well as serve as a source of migrants that also contribute to Lake Erie fisheries. The SCDRS Walleye populations generally receive sporadic survey and creel efforts, which makes assessing their status difficult. In 2023, a creel survey was conducted on the Ontario side of the Detroit River. Anglers were estimated to have harvested 124,225 Walleye in the Detroit River with an open water catch rate of 0.73 per angler hour (i.e., catch rate from boat anglers). The 2023 open water catch rate was well above those estimated in past surveys conducted on the Ontario side of the Detroit River (1975-2009 = 0.275 fish/rod hour). In Lake St. Clair, the mean number of Walleye captured per trap net (24 hour soak) was 4.59 and 4.44 in 2021 and 2022, respectively, which is well above the time-series mean of 2.54 Walleye/trap net (2002-2022; MDNR 2022). No surveys or creels were conducted in the St. Clair River from 2021-2023. Though limited, creel and survey information available suggests that Walleye in the SCDRS are doing well and likely increasing in recent years.

Lake Ontario

Walleye trends in Lake Ontario are predominantly driven by the Bay of Quinte spawning stock. These fish overwinter in the Bay of Quinte before spawning in the spring in rivers (i.e., the Trent, Moira and Napanee rivers)

and on shoals. Most adult Walleye subsequently move out into the eastern basin (and in some cases other areas) to forage predominantly on alewife throughout the summer while juvenile Walleye generally remain in the Bay (Elliott et al. 2022, Bowlby and Hoyle 2011, Hoyle et al. 2017). The eastern basin of Lake Ontario contains ideal Walleye habitat providing nursery areas, feeding opportunities, and optimal thermal conditions and therefore is the focus of recreational and commercial fishing effort as well as population assessment effort. Assessment programs include annual summer bottom trawling in the Bay of Quinte to monitor young of year (age 0) abundance as well as annual summer gillnetting the Bay of Quinte and the eastern basin of Lake Ontario (Ontario and New York waters) to monitor juvenile and adult abundance. After declines in the 1990s attributed to the invasion of dreissenid mussels and subsequent phosphorus reductions, the population appears to have stabilized based on assessment data trends. A destination recreational Walleye fishery exists in the Bay of Quinte and is monitored periodically by summer open water and winter ice creel surveys. Recreational harvest averaged 52,500 pounds annually between 2014-2023 and has been stable since the early 2000's, however the fishery was not monitored every year. A small commercial fishery exists in the lower Bay of Quinte and eastern basin (annual quota of 48,000) and on average harvested 24,300 pounds annually between 2014-2023.

Additional local Walleye fisheries exist in several Lake Ontario embayments (i.e., Weller's Bay, West Lake, Hamilton and Toronto Harbour). Unlike areas with self-sustaining populations, Toronto and Hamilton Harbour have been stocked with Walleye in an effort to restore a native top predator in these degraded ecosystems. At this point these populations are not self-sustaining, however, the urban location of these embayments has the potential to create and sustain Walleye fisheries.

Linkages

Walleye populations across the Great Lakes are affected by many other biotic (e.g., prey fish abundance) and abiotic (e.g., annual ice cover) variables.

Habitat and Species

- Aquatic Habitat Connectivity

A potential impediment to the continued health of Walleye populations in the Great Lakes is the connectivity between riverine spawning grounds and juvenile habitat. Often this phenomenon may be the result of human-induced alterations (e.g., dam construction) to the landscape.

- Phytoplankton, Zooplankton and Native Prey Fish Diversity

Phytoplankton, zooplankton, and prey fish collectively form the base of each Great Lakes' food web. Consequently, any changes in their population dynamics (e.g., seasonal abundance) and demographics (e.g., condition) may affect predatory fishes such as Walleye (including fish at larval, juvenile and adult stages), which are dependent on these as forage.

Nutrients and Algae

- Nutrients in Lakes
- Algal Bloom Extent

Nutrient loading (e.g., phosphorous runoff) and their associated consequences, such as algal blooms, can impact Walleye in some of the Great Lakes. For instance, algal blooms in Lake Erie alter the foraging environment for Walleye and create areas of hypoxia (reduced dissolved oxygen) that fish must navigate to find preferred habitat.

Invasive Species

- Impacts of Aquatic Invasive Species
- Dreissenid Mussels
- Sea Lamprey

Walleye across the Great Lakes are impacted by aquatic invasive species and the changes these species have brought about. For instance, establishment of Dreissenid mussels has caused shifts in nutrient cycling and water quality, which in turn alter phytoplankton, zooplankton, and prey fish abundance. Similarly, Sea Lamprey act as predators of large-bodied fishes such as Walleye, despite a successful control program administered by the Great Lakes Fishery Commission.

- Watershed Impacts and Changes in Physical Conditions Surface Water Temperature
- Ice Cover

Changing physical conditions will likely increase water temperatures and reduce ice cover across the Great Lakes, which will alter the amount of preferred thermal habitat available to cool-water fishes such as Walleye and allow spawning to occur earlier in the year at sub-optimal conditions.

Assessing Data Quality

Data Characteristics	Agree	Neutral or Unknown	Disagree	Not Applicable
Data are documented, validated, or quality-assured by a recognized agency or organization	All Lakes			
Data are from a known, reliable and respected generator of data and are traceable to original sources	All Lakes			
Geographic coverage and scale of data are appropriate to the Great Lakes Basin	LO, LE, LM	LH, LS		
Data obtained from sources within the U.S. are comparable to those from Canada	LE	LO, LS	LH	LM
Uncertainty and variability in the data are documented and within acceptable limits for this sub-indicator report	LE	LO, LH, LS, LM		

Data used in assessment are openly available and accessible	Yes	Lake Ontario: http://www.glfc.org/loc_mgmt_unit/ https://dec.ny.gov/things-to-do/freshwater-fishing/fisheries-management-research/lake-ontario Lake Erie: http://www.glfc.org/pubs/lake_committees/erie/WTG_docs/annual_reports/WTG_report_2024.pdf Lake Michigan: https://dnr.wisconsin.gov/sites/default/files/topic/Fishing/LM_GLFCReport2023V2.pdf

Notes on Accessing Data

The links provided above will take the user to publicly accessible reports that contain some of the data used to assess Walleye populations. For jurisdictions and lakes not listed above, data on Walleye populations was obtained directly from contributors. Data obtained from contributors can be accessed by contacting an agency directly.

Data Limitations

Walleye abundance can be significantly reduced by overfishing; harvest restrictions designed to promote sustained use are required if the species is to be used as an indicator of ecosystem health. The Walleye sub-indicator cannot reliably diagnose causes of degraded ecosystem health. Target reference values have not been developed for all management objectives in the Great Lakes. The use of yield (especially in metric tonnes harvested) as a target reference value is problematic in that annual yield is not the most commonly assessed parameter across all Great Lakes. For instance, not all components of each lake's Walleye fisheries are assessed annually or on a regular basis (e.g., eastern basin recreational fisheries in Lake Ontario, recreational fisheries in Ontario waters of Lake Erie), which makes use of yield as an indicator potentially less useful compared to long-term fishery-independent surveys.

In Lake Huron, Ontario lacks estimates of recreational Walleye harvest limiting full assessment and comparison of that source of extraction. Both Michigan and Ontario regularly use variable mesh gillnets as assessment gears in Lake Huron with Ontario conducting spring and fall assessments while Michigan limits assessment to fall. Due to spatial limitations, Ontario cannot regularly assess all source populations in Lake Huron which trace back to

numerous river sources throughout Georgian Bay and the North Channel where Michigan principally has only Saginaw Bay to monitor. Ontario and Michigan cooperate on a periodic assessment of the shared St. Marys River (most recently in 2022) and data from their identical gear is pooled for a river-wide analysis. Despite the assessment differences, population level metrics derived from both Ontario and Michigan are comparable (e.g., mortality rates).

In Lake Michigan's Green Bay, fishery-independent assessment of Wisconsin Walleye populations employs spring and fall boat electrofishing, while Michigan conducts an experimental mesh gill net survey in fall. Regardless, both surveys provide comparable long-term indices of population abundance and structure.

In Lake Ontario, creel surveys are conducted periodically because it is not logistically possible to monitor the recreational fishery on an annual basis and, as a result, total harvest is not available for all years. Some years, due to a lack of sampling, appear to have no recreational harvest or only account for spring/summer harvest resulting in an underestimation of total harvest in multiple years. Fishery-independent surveys are extensive in the eastern basin of Lake Ontario in both Ontario and New York waters. Although netting is not standardized between New York and Ontario, this standardization could be accomplished analytically if warranted, however, this is not currently a concern. Assessment sites have expanded beyond the sites identified in the Bay of Quinte Fisheries Management Plan and the incorporation of additional sites appears to increase certainty in the data and may be incorporated in the future.

Additional Information

Fishery yields (Figure 3) are appropriate indicators of Walleye health but only in a general sense. Yield was estimated for the recreational fisheries by multiplying the number of fish harvested by estimating the average size of fish harvested and extrapolating an estimated weight of harvested fish to the total number harvested. Fishery-dependent (i.e., effort and harvest) and fishery-independent (i.e., standard population surveys) assessments are lacking for some Walleye stocks in some years for all the studied areas. Moreover, measurement units are not standardized among fishery types (i.e., commercial fisheries are measured by mass while recreational fisheries are typically measured in numbers of fish), which means additional conversions are necessary which reduce accuracy. Also, "zero" values need to be differentiated from "missing" data in any figures. Therefore, trends in fishery yields across time (blocks of years) are probably better indicators than absolute values within any year, assuming that any introduced bias is relatively constant over time.

Many agencies have developed, or are developing, population estimates for many Great Lakes fishes. Walleye population estimates for selected areas (i.e., Lakes Erie and Huron) would probably be a better assessment of Walleye population health than harvest estimates, thus to the extent that it is possible, future efforts should focus on developing these capabilities.

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Source: Michigan Department of Natural Resources

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Source: Baldwin et al. 2009, Michigan Department of Natural Resources, and Ontario Ministry of Natural Resources and Forestry.

Figure 3: Walleye harvest, reported in metric tonnes, split into contributions from tribal, recreational, and commercial fisheries in the five Great Lakes, 1975–2023. The following harvest information was not available for 2023: all harvest in Lake Michigan, and recreational and tribal harvest in Lake Superior. Fish community goals and objectives for Walleye are: Lake Superior, maintain, enhance, and rehabilitate self-sustaining populations over their historical range; Lake Michigan, maintain self-sustaining stocks, expected annual yield should be 100-200 metric tonnes; Lake Huron, reestablish and/or maintain walleye as the dominant cool-water predator over its traditional range with populations capable of sustaining a harvest of 700 metric tonnes; Lake Erie, maintain populations that support sustainable commercial and recreational fisheries; Lake Ontario, maintain, enhance, and restore self-sustaining local populations.

Source: Michigan Department of Natural Resources, Minnesota Department of Natural Resources, New York State Department of Environmental Conservation, Ontario Ministry of Natural Resources and Forestry, Ohio Department of Natural Resources, Pennsylvania Fish and Boat Commission, Wisconsin Department of Natural Resources.

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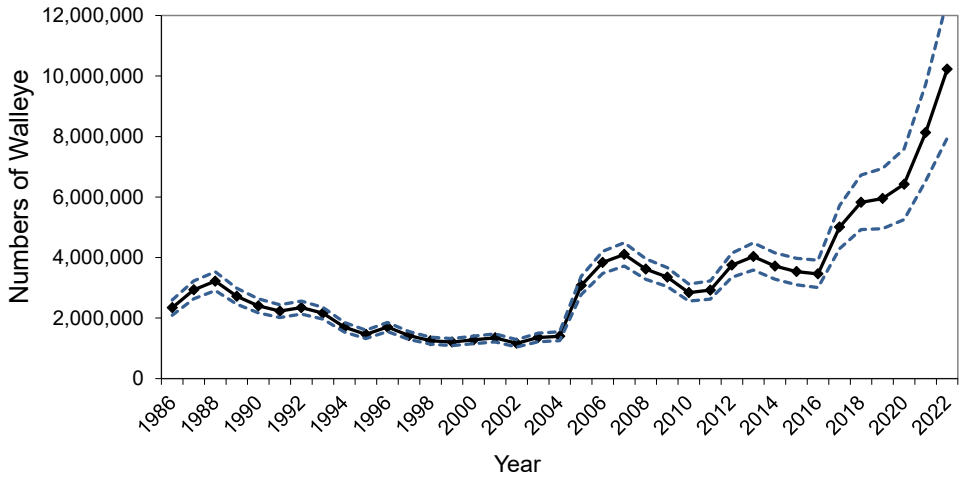

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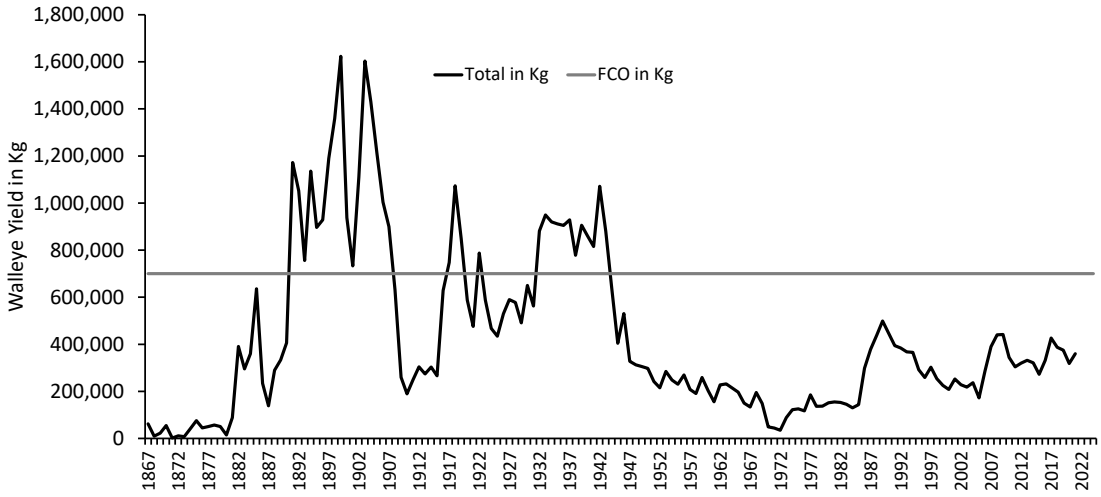

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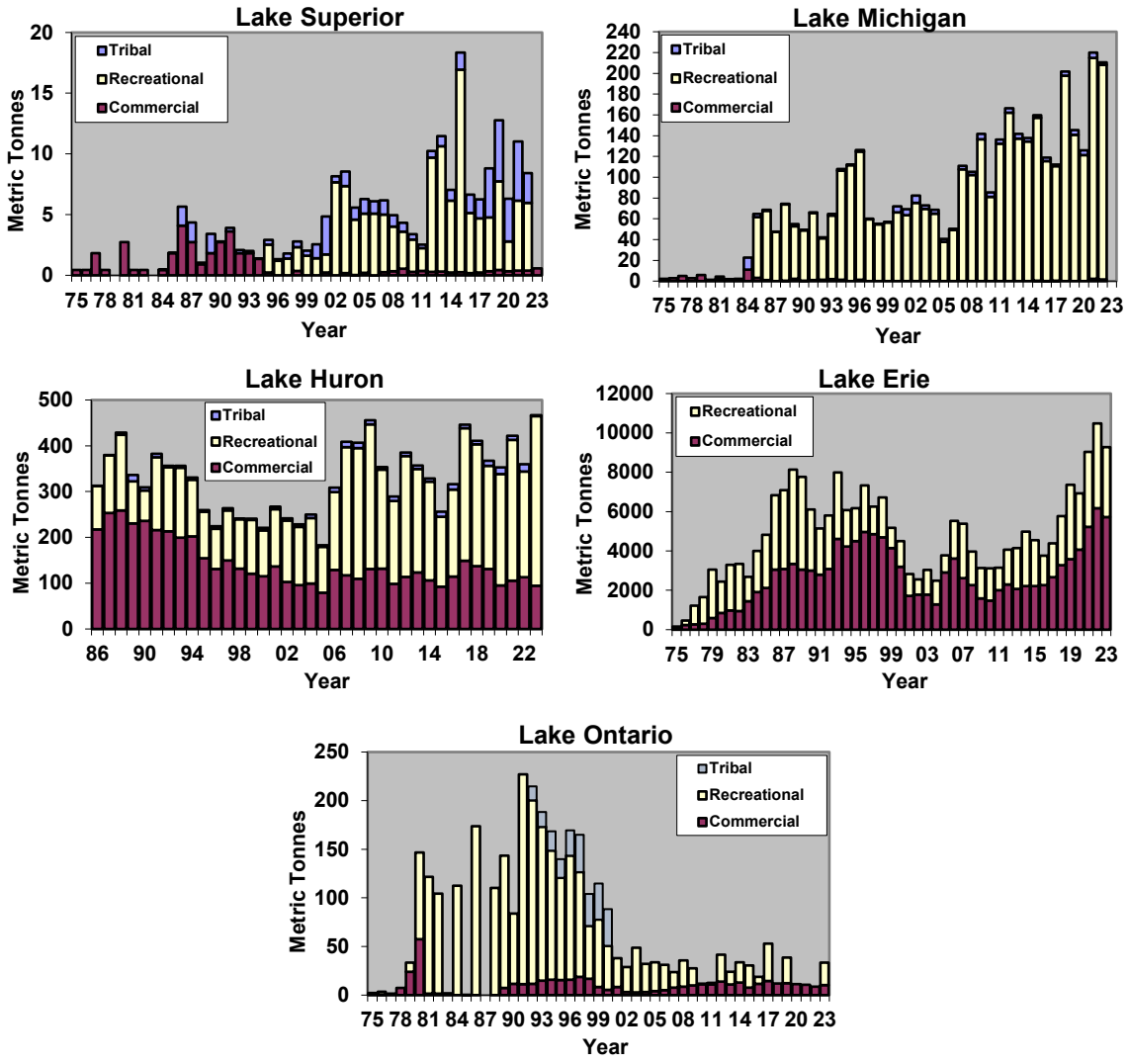

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