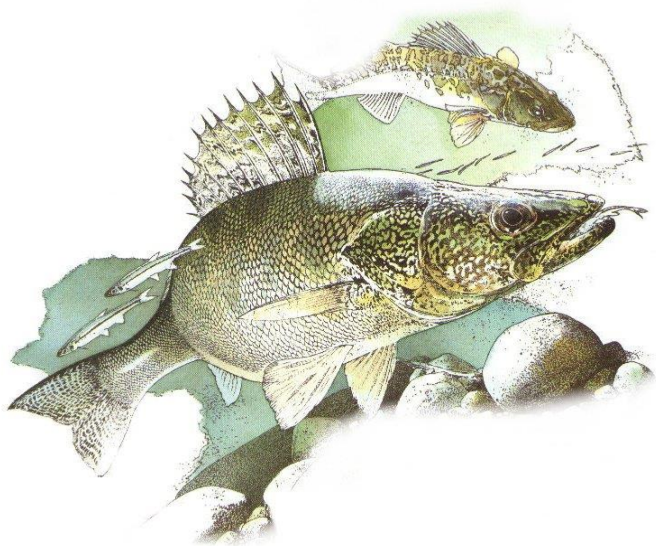
Report for 2018 by the

LAKE ERIE WALLEYE TASK GROUP

March 2019



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Note*: Data and management summaries contained in this report are provisional. Every effort has been made to ensure their correctness. Contact individual agencies for complete state and provincial data.*

Charges to the Walleye Task Group, 2018-2019

The charges from the Lake Erie Committee's (LEC) Standing Technical Committee (STC) to the Walleye Task Group (WTG) for the period of April 2018 to March 2019 were to:

1. Maintain and update the centralized time series of datasets:
    a. Required for bi-national population models and assessment and
    b. Produce the annual Recommended Allowable Harvest (RAH)
2. a. Maintain working knowledge of the most current academic and agency research related to Lake Erie walleye population assessment and modeling including estimating and forecasting:
    - Abundance
    - Age/Size/Spatial Stock structure (migration rates)
    - Recruitment, and
    - Mortality (M)

    b. Provide critical evaluation and guidance for incorporating new research into Lake Erie walleye management to produce the most scientifically sound and reliable population models

Review of Walleye Fisheries in 2018

Fishery effort and Walleye harvest data were combined for all fisheries, jurisdictions and Management Units (MUs) (Figure 1) to produce lake-wide summaries. The 2018 total estimated lake-wide harvest was 6.271 million Walleye (Table 1), of which 5.627 million were harvested in the total allowable catch (TAC) area. This TAC-area harvest represents 79% of the 2018 TAC (7.109 million Walleye) and includes Walleye harvested in commercial and sport fisheries in MU 1, 2, and 3. An additional 0.644 million Walleye (10% of the lake-wide total) were harvested outside of the TAC area in MU 4&5 (Table 1). The estimated sport fish harvest of 2.627 million Walleye in 2018 represented a 61% increase from the 2017 harvest of 1.636 million Walleye; this harvest was 16% above the long-term (1975-2017) average of 2.259 million fish (Table 2). The 2018 Ontario commercial harvest was 3.657 million Walleye lake-wide, with 3.407 million caught in the TAC area (Table 2). The 2018 Ontario angler estimates of harvest and effort were derived from the 2014 lake-wide aerial creel survey because angler creel surveys are not conducted annually in Ontario waters. It assumes 72,000 Walleye were harvested in Ontario within the TAC area during 2018; an estimate included in total Walleye harvest, but not used in catch-at-age analysis. Total harvest of Walleye in Ontario TAC waters was 3.479 million Walleye, representing 114% of the 2018 Ontario TAC allocation of 3.061 million Walleye. Ontario Ministry of Natural Resources and Forestry converts the TAC in numbers of walleye to an allocation in weight. It is the allocation in weight that is provided to the Ontario commercial fishing industry. If the weight conversion factor is not identical to the average weight of harvested walleye, this can lead to either an over-harvest or an under-harvest. In 2018, the Ontario commercial fishery did not exceed their allocated quota in weight of fish. However, more age-3 Walleye were harvested than predicted. Therefore, the actual mean harvest weight in the commercial fishery was lower than the weight conversion factor used to allocate quota to the Ontario commercial fishery, and the commercial fishery harvested a higher number of fish than TAC. In 2018, the lake-wide Ontario commercial harvest was 12% higher than in 2017, and 80% above the long-term average (1976-2017; Table 2, Figure 2).

Sport fishing effort decreased 2% from 2017 in 2018 to total 3.144 million angler hours (Table 3, Figure 3). Compared to 2017, sport effort decreased by 2% in MU 1 and 30% in MU 3 while effort increased in MU 2 (12%), and MU 4&5 (8%). Lake-wide commercial gill net effort (17,168 km) decreased 20% from 2017 and was 8% below the long-term average (Table 3, Figure 4).

The 2018 lake-wide average sport harvest per unit effort (HUE) of 0.81 Walleye/angler hour increased 67% from 2017 and was 88% above the long-term (1975-2017) average of 0.43 Walleye/angler hour

(Table 4, Figure 5). In 2018, the sport HUE increased from 2017 levels (Walleye/angler hour) in MU1 (+79%), MU 2 (+88%), MU 3 (+41%) and MU 4&5 (+56%) and were 64%, 148%, 160% 250% above long-term averages, respectively (Table 4).

The total commercial gill net HUE in 2018 (213.0 Walleye/kilometer of net) increased 33% relative to 2017 and was 76% above the long-term (1976-2017) lake-wide average (121.0 Walleye/kilometer of net; Table 4, Figure 5). Commercial gill net harvest rates increased in all MUs: by 36% MU1 (292.0 Walleye/kilometer of net), 52% MU 2 (193.1 Walleye/kilometer of net), 22% MU 3 (171.0 Walleye/kilometer of net), and 73% MU 4&5 (132.0 Walleye/kilometer of net) (Table 4).

Lake-wide harvest in the sport and commercial fisheries was composed mostly of age 3 and age 4 Walleye from the 2015 (73%) and 2014 (15%) year classes (Table 5; Table 6). Age 7 and older Walleyes were the next most harvested age group, representing 5% of the total lake-wide harvest in 2018. In the commercial fishery, the 2015 year class (age 3) comprised 74% of the harvest followed by the 2014 year class (age 4) with 13% of the harvest. Age 7 and older fish, which included the 2003 year class, comprise 3% of the lake-wide commercial harvest. In the sport fishery, harvest of the 2015 year class (age 3) was 72% of total harvest with the 2014 year class (age 4) contributing an additional 17%. Age 7 and older fish contributed 7% to the total sport harvest.

Across all jurisdictions, the mean age of Walleye harvested in 2018 ranged from 3.6 to 4.9 years old in the sport fishery, and from 3.2 to 4.2 years old in the Ontario commercial fishery (Table 7, Figure 6). The mean age in the sport and commercial fisheries remained below the long-term means (1975-2017; Table 7). Lake-wide, the mean age continued to decline in the sport fishery (3.9 yrs. old) but increased in the commercial fishery (3.3 yrs. old) and combined sport and commercial fishery (3.5 yrs. old) (Figure 6). These trends are consistent with the presence of moderate/strong 2014 and strong 2015 year classes in the fisheries and lesser dependence on older individuals from the 2003, 2007, and 2010 year classes.

Statistical Catch-at-Age Analysis (SCAA): Abundance

The WTG uses a SCAA model to estimate the abundance of Walleye in Lake Erie from 1978 to 2018. The stock assessment model estimates population abundance of age 2 and older Walleye using fishery-dependent and fishery-independent data sources. The model includes fishery-dependent data from the Ontario commercial fishery (MU 1-3) and sport fisheries in Ohio (MU 1-3) and Michigan (MU 1). Since 2002, the WTG model has included data collected from three fishery-independent gill net assessment surveys (i.e., Ontario Partnership, Michigan, and Ohio). Beginning in 2011, Michigan and Ohio gill net survey data were pooled in the SCAA because of similarities between the surveys. In 2016, Ohio switched from multifilament to monofilament gill nets[1] after completing several years (2007, 2008, 2010-2013) of comparisons between the two gear types (see Vandergoot et al. 2011 and Kraus et al. 2017). Michigan did not similarly change gear types. In 2017, to address the change in gear types, age-specific corrections of monofilament to multifilament catches were created using age-specific linear regression models for the Ohio survey data and again pooled with Michigan data in the SCAA model. The same methods were used again for this 2019 report as the WTG and the

[1] In 2016, the ODNR switched to a monofilament gill net configuration. The ODNR's multifilament gill nets were 1,300 ft (396 m) in length, 6 ft (1.8m) deep, with thirteen 100-ft (30.5 m) panels consisting of mesh sizes from 2 to 5 inches (51-127 mm stretched) and twine diameter of 0.37mm. The monofilament gill nets are 1,200 ft long (366 m) by 6 ft deep (1.8 m) with twelve 100-ft (30.5 m) panels with mesh sizes from 1.5 to 7 inches (38–178) mm and twine diameter that varies with mesh size from 0.20 to 0.33 mm. Comparisons between these multifilament and monofilament index gill net configurations are described in Vandergoot et al. (2011) and Kraus et al. (2017).

Quantitative Fisheries Center at Michigan State University continue to evaluate options for incorporating the new Ohio data set into the SCAA model.

The Lake Erie Percid Management Advisory Group (LEPMAG) developed an updated Walleye model, which the WTG began using in 2013. This model includes: 1) estimated selectivity for all ages within the model without the assumptions of known selectivity at age; 2) integrated age-0 trawl survey data into the model; 3) a multinomial distribution for the age composition data; and 4) time-varying catchability using a random walk for fishery and survey data including the age-0 trawl survey. Instantaneous natural mortality (*M*) is assumed to be constant (0.32) among years (1978-2018) and ages (ages 2 through 7and older). The abundances-at-age were derived from the estimated parameters using an exponential survival equation.

Based on the 2019 integrated SCAA model, the 2018 west-central population (MU1-3) was estimated at 49.849 million age 2 and older Walleye (Table 8, Figure 7). An estimated 30.625 million age 3 (2015 year class) fish comprised 61% of the age 2 and older Walleye population. Age 4 (2014 year class) represented the second largest (15%) and age 2 (2016 year class) the third largest (12%) components of the population. Based on the integrated model, the number of age 2 recruits entering the population in 2019 (2017 year class) and 2020 (2018 year class) are estimated to be 13.514 and 94.071 million Walleye, respectively (Table 9; Figure 8). The 2019 projected abundance of age 2 and older Walleye in the west-central population is estimated to be 45.338 million fish (Table 8; Figure 7).

Harvest Policy and Recommended Allowable Harvest (RAH) for 2019

In March 2019, the WTG applied the following Harvest Control Rules as identified in the Walleye Management Plan (WMP; 2015-2024):

- *Target Fishing Mortality* of **60%** of the Maximum Sustainable Yield (60%F_{MSY});
- Threshold *Limit Reference Point* of **20%** of the Unfished Spawning Stock Biomass (20%SSB_0);
- Probabilistic Control Rule, P-star, P*= **0.05** ;
- A limitation on the annual change in TAC of ± **20%**.

Using results from the 2019 integrated SCAA model, the estimated abundance of 45.338 million age-2 and older Walleye in 2019, and the harvest policy described above, the calculated mean RAH for 2019 was 8.683 million Walleye, with a range from 6.504 (minimum) to 10.861 (maximum) million Walleye (Table 9). The WTG RAH range estimate is an AD Model Builder (ADMB, Fournier et al. 2012) generated value based on estimating ± one standard deviation of the mean RAH. AD Model Builder uses a statistical technique called the delta method to determine this standard deviation for the calculated RAH, incorporating the standard errors from abundance estimates at age and combined gear selectivity at age. The target fishing rate, (60%F_{MSY} = 0.334) in the harvest policy was applied since the probability of the projected spawner biomass in 2020 (56.410. million kg) falling below the limit reference point ($SSB_{20\%}$ = 12.184 million kg) after fishing at 60%F_{MSY} in 2019 was less than 5% ($p < 0.05$). Thus, the probabilistic control rule (P*) to reduce target fishing rate and conserve spawner biomass was not invoked during the 2019 determination of RAH.

In addition to the RAH, the Harvest Control Rule adopted by LEPMAG limits the annual change in TAC to ± 20% of the previous year’s TAC. According to this rule, the maximum change in TAC would be (+) or (-) 20% of the 2018 TAC (7.109) million fish), and the range in 2019 TAC for LEC consideration would be from 6.504 million fish to 8.531 million fish.

Other Walleye Task Group Activities

The following represents WTG progress and developments on Charge 2a and 2b. In 2018, this work focused on *(1) Movements, Migrations and Spatial Ecology, (2) Stock Structure* (3) *Recruitment, (4) Natural Mortality*, and (5) *Habitat*.

Movements, Migration and Spatial Ecology

Since 2011, WTG members have participated collaboratively in numerous Great Lakes Acoustic Telemetry Observation System (GLATOS; https://glatos.glos.us/) studies across Lake Erie. To date, these seven Walleye studies have tagged nearly 3,000 fish in the western, central, and eastern basins of Lake Erie. Although specific study objectives vary among projects, general objectives of all projects focused on (1) determining within and between lake movements of various Walleye spawning populations, (2) examine spawning site fidelity rates, estimate mortality rates, and (3) characterize the harvest composition of Lake Erie's recreational and commercial fisheries. Similar to all projects using the GLATOS network, the Walleye studies benefit from the synergy of tagged fish and receivers deployed around the lake. Data generated from these studies will help address long standing WTG charges including options for eastern basin walleye management and estimation of natural mortality (see additional details below).

Stock structure

In recent years there has been an effort to improve our understanding of Walleye stock structure at the lake-wide scale to inform future iterations of the walleye management plan. One of the major information gaps associated with Walleye stock structure is how western and eastern basin stocks interact to influence fisheries and survey results in the eastern basin. The specific goals of this initiative are to: 1) inform occupancy and migration rates at the individual spawning stock and basin scale, 2) understand the importance of spawning stocks to lake wide fisheries, and 3) understand the contributions of different walleye stocks to fishery independent indices of abundance. The acoustic telemetry studies listed above will play an important role in understanding occupancy and migration rates. Other complimentary studies have been initiated over the past two years that employ genetics and otolith microchemistry to estimate the contributions of western basin Walleye to eastern basin fisheries and fishery independent indices of abundance. Chemical signatures in otoliths of young-of-year and yearling walleye in eastern basin gillnet surveys are being used to determine the basin of origin (western or east) to inform indices of recruitment in the eastern basin. Genetics samples from recreational and commercially caught fish in the eastern basin are being used to determine the relative contributions of western, eastern, and central basin spawning stocks to the eastern basin fisheries.

Recruitment

Evidence of multiple Walleye stocks in Lake Erie exists, with decreasing stock productivity from west to east. However, migrations and mixing of stocks throughout the lake make evaluation of individual stock productivity difficult. For example, adult Walleye from western basin spawning grounds in the spring, to the cooler waters of the central and eastern basins in the summer, and then return to the west basin before spawning. While juvenile Walleye from both the western and eastern basin are believed to disperse from natal basins during the summer and fall, it is unknown if their migrations are similar to those of adults. To address uncertainty surrounding juvenile dispersal and productivity of Walleye stocks across Lake Erie, the WTG has reported basin-specific densities of yearling Walleye with standardized gill net indices since 2011 (WTG 2012).

In Figure 9, site-specific yearling Walleye catches are presented for the bottom set interagency (ON, NY) monofilament nets; the suspended (canned or kegged) Ohio monofilament nets (see footnote #1, page 3 for description); suspended Michigan multifilament nets; and suspended Ontario monofilament nets fished in 2018. Catches were standardized for net length (50 ft [15.2 m] panels) of mesh sizes ≤ 5.5” (140 mm) but correction factors were not applied to standardize fishing power between monofilament and multifilament nets. New York and Ontario monofilament nets share the same configurations with the exception that Ontario nets contain 2 panels instead of the one 50 ft (15.2 m) panel for mesh sizes ≥ 2” (51 mm). New York’s index gill nets were fished exclusively on bottom and were confined to shallower depths than nets fished in Ontario’s waters of eastern Lake Erie (Figure 9a).

In 2018, yearling Walleye catches occurred lake-wide where index nets were fished but densities were very low on the north shore of the east basin (Figures 9a and b). Yearling catches have decreased from 2016 in west and central Lake Erie, suggesting the 2016 and 2017 year classes are both smaller than the 2015 cohort for western stocks. Yearling Walleye catches in New York bottom set nets on the south shore decreased from 2017 and were similar to 2016, suggesting that the 2016 cohort was stronger than the 2015 and 2017 hatches in New York waters. When bottom set and suspended nets were fished in the same area, yearling catches in bottom set nets exceeded suspended nets in the east and central basin, whereas suspended nets exceeded bottom set nets in the west basin. In Ontario Partnership index nets, average catches of age 1 Walleye are often greater in suspended nets than in bottom nets, however this phenomenon varies by year and basin.

Currently, the young-of-the-year (YOY) index from the interagency west basin bottom trawl survey (Table 10) is integrated into the SCAA model to estimate age-2 Walleye abundance and forecast recruitment. While the interagency bottom trawl survey is considered to be a robust recruitment predictor, inclusion of additional YOY and yearling indices to form a composite recruitment index could supplement recruitment estimates. However, there are two factors limiting the integration of a composite recruitment index into the SCAA model:

1. Yearling indices are not available far enough in advance to forecast age-2 recruitment, as required for the probabilistic harvest control rule (P*) of the current Walleye Management Plan (Kayle et al. 2015). Options for overcoming this limitation would be exclusion of yearling indices from a composite recruitment index, removal of the P* control rule from the Walleye Management Plan Harvest Policy, or running two integrated SCAA models (one with YOY and yearling data and the second model using only YOY data). It is important to note that the two SCAA model options could result in conflicting abundance estimates.

2. Spatial, temporal, and gear type (bottom set vs. suspended gill nets) variability exist in Walleye YOY and yearling indices, along with inconsistencies in sampling intensity and effort. Previous examination of the available recruitment indices using a Principal Components Analysis (PCA) approach revealed challenges for integrating a composite recruitment index into the SCAA model (WTG 2016). Data transformations and missing years of data in some indices were primary concerns.

The WTG will continue to update the dataset of recruitment indices. However, composite Walleye recruitment indices will not be presented until concerns related to data transformations, missing years of data, and recent changes in index gear configuration are addressed. The WTG will also continue to explore and evaluate alternative recruitment estimation approaches to be considered for adoption in future Lake Erie Walleye Management Plans.

Natural Mortality (M)

Natural mortality is a parameter in the Walleye SCAA model that represents the fraction of the population that dies due to natural causes. As part of an ongoing WTG charge for improving the SCAA model, alternative estimates of natural mortality will be evaluated using a structured approach. The method bears similarity to the WTG approach for determining data weightings (expert opinion lambda template) in the SCAA model or for identifying Priority Management Areas (PMA template) by the Habitat Task Group. Using criteria weighted by importance, task group members will assign scores to rank studies of natural mortality for their application to Lake Erie Walleye assessment and management. Evaluation criteria relates to reliability of M estimation according to factors such as survey design, assumptions, gaps and potential bias of estimates. Additional considerations may include factors such as SCAA model complexity and retrospective stability as they relate to natural mortality assumptions. Studies have examined Lake Erie Walleye natural mortality in a variety of ways. Some studies are discussed below, which may be included in the natural mortality evaluation template or used to support the process.

The current SCAA model assumes that instantaneous natural morality is 0.32 or 27% annually. This value was derived from multi-agency Walleye jaw tagging studies on Lake Erie that began in 1978 and continued for decades (Haas et al. 2003). Reward tags were first applied to 10% of tagged Walleye during 1990 and later again in 2000 to account for the difference in reporting rates between reward ($100 US) and non-reward ($0) tags. Information from recreational and commercial fishers describing where, when and how tagged Walleye were caught was maintained in an interagency database. Analyses using the Estimate model (Brownie et al., 1985) provided estimates of survival, tag recovery, exploitation and natural mortality, M=0.32 (Haas et al. 2003). This analysis assumed that jaw tag loss did not occur. This assumption was later tested with the application of both jaw and Passive Integrated Transponder (PIT) tags on Walleye, which found evidence of tag shedding over time (Vandergoot et al 2012).

Zhao et al. (2011) estimated natural mortality for eastern basin Walleye to be M=0.22 using interagency Walleye tag data and the Program MARK (White and Burnham 1999). Interagency Walleye jaw tagging data was also used to estimate natural mortality in a spatial tag recovery model that explicitly accounted for tag loss (Vandergoot and Brendan 2014). They found that natural mortality declined with age and varied regionally under a variety of movement scenarios.

Walleye PIT tags do not rely on reported captures by fisheries but the process is dependent on extensive scanning of the harvest. Analyses of Walleye PIT tagging data (2005-2015) using the Brownie model (Brownie et al. 1985) produced M=0.29 (WTG 2016).

Integrated tag catch-at-age analyses (ITCAAN) models using interagency Walleye tagging data from Lake Erie and connecting waters estimated natural mortality to be 0.15 (SE=0.019), and 0.31 (SE=0.032) in western and eastern Lake Erie respectively (Vincent 2017). Walleye catch-at-age analysis with tagging data integrated was also explored by Zhou and Jiao (2018) using a Bayesian approach to estimate natural mortality for Lake Erie Walleye under a variety of scenarios. Preliminary results (2018) indicated that time and age varying estimates of natural mortality had the best model fit.

Acoustic telemetry studies monitor movements of Walleye and other species throughout Lake Erie and connecting waters. Transmitters implanted in Walleye are detected by acoustic receivers that are part of the GLATOS network. Survival is indicated by detections over time without reliance on fisher tag reporting. Combined with fishery tag returns, this data offers a unique approach for estimating survival and natural mortality. Future analyses of this data should represent a valuable addition to the natural mortality studies evaluated.

The reviews of methods and previous estimates of Walleye natural mortality have previously been documented in a Decision Analysis (Wright et al. 2005) and a previous version of the Walleye Management Plan (Locke et al. 2005). These documents provide additional insight for parameterization of Walleye catch at age models.

Key Lake Erie M literature:

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Habitat

Walleye fishery quotas are allocated based on a presumed preferred bottom-depth of < 13m, however there is limited support for the efficacy of this designation. Members of the WTG along researchers at Michigan State University and the University of Windsor are using data generated from ongoing GLATOS projects to investigate the bottom-depth preference of Walleye throughout their seasonal lake-wide migrations. Data from > 1000 individuals during > 5 years were used to examine monthly variation in bottom-depth preference affiliated with stock, sex, and age of Walleye tagged in the western and eastern basins of Lake Erie. So far, results have identified seasonal fluctuations in bottom-depth selection across stocks, which coincided with spawning/foraging migrations. For example, shallow waters < 6m deep were preferred during spawning periods of March and April, and deep water (> 13m) were positively selected for during summer and fall, coinciding with cross-lake movements. Winter patterns favoured moderate depths (7 - 13m), when walleye returned to spawning areas. Preliminary results suggested that stock differences may exist, but there are evident lake-wide similarities in bottom-depth selection across the Walleye populations in Lake Erie despite differences in migration patterns. This work also highlights the relatively long period (~ 6 months $year^{-1}$) in which walleye live in areas not previously defined as 'Walleye habitat' using the < 13m depth definition.

WTG Centralized Datasets

WTG members currently manage several databases that consist of fishery-dependent (harvest) and fishery-independent (population) assessment surveys conducted by the respective agencies. Annually, data are compiled by WTG members to form spatially-explicit versions of agency-specific harvest data (e.g., harvest-at-age and fishery effort by management unit) and population assessment (e.g., the interagency trawl program and gill net surveys) databases. These databases are used for trends and status evaluations, estimating population size and abundance using SCAA analysis, and the decision-making process regarding RAH. Ultimately, annual population abundance estimates are used to assist LEC members with setting TACs for the upcoming year and evaluate past harvest policy decisions. Use of WTG databases by non-members is only permitted following a specific protocol established in 1994, described in the 1994 WTG Report and reprinted in the 2003 WTG Report (WTG 2003).

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Table 1. Annual Lake Erie walleye total allowable catch (TAC, top) and measured harvest (Har; bottom, bold), in numbers of fish from 1999 to 2018. TAC allocations for 2018 on are based on water area: Ohio, 51.11%; Ontario, 43.06%; and Michigan, 5.83%. New York and Pennsylvania do not have assigned quotas, but are included in annual total harvest.

Year		TAC Area (MU-1, MU-2, MU-3)				Non-TAC Area (MUs 4&5)				All Areas
		Michigan	Ohio	Ontario [a]	Total	NY	Penn.	Ontario	Total	Total
1999	TAC	477,000	4,626,000	3,897,000	9,000,000				0	9,000,000
	Har	**140,269**	**1,033,733**	**3,454,250**	**4,628,252**	**23,133**	**89,038**	**87,000**	**199,171**	**4,827,423**
2000	TAC	408,100	3,957,800	3,334,100	7,700,000				0	7,700,000
	Har	**252,280**	**932,297**	**2,287,533**	**3,472,110**	**28,599**	**77,512**	**67,000**	**173,111**	**3,645,221**
2001	TAC	180,200	1,747,600	1,472,200	3,400,000				0	3,400,000
	Har	**159,186**	**1,157,914**	**1,498,816**	**2,815,916**	**14,669**	**52,796**	**39,498**	**106,963**	**2,922,879**
2002	TAC	180,200	1,747,600	1,472,200	3,400,000				0	3,400,000
	Har	**193,515**	**703,000**	**1,436,000**	**2,332,515**	**18,377**	**22,000**	**36,000**	**76,377**	**2,408,892**
2003	TAC	180,200	1,747,600	1,472,200	3,400,000				0	3,400,000
	Har	**128,852**	**1,014,688**	**1,457,014**	**2,600,554**	**27,480**	**43,581**	**32,692**	**103,753**	**2,704,307**
2004	TAC	127,200	1,233,600	1,039,200	2,400,000				0	2,400,000
	Har	**114,958**	**859,366**	**1,419,237**	**2,393,561**	**8,400**	**19,969**	**29,864**	**58,233**	**2,451,794**
2005	TAC	308,195	2,988,910	2,517,895	5,815,000				0	5,815,000
	Har	**37,599**	**610,449**	**2,933,393**	**3,581,441**	**27,370**	**20,316**	**17,394**	**65,080**	**3,646,521**
2006	TAC	523,958	5,081,404	4,280,638	9,886,000				0	9,886,000
	Har	**305,548**	**1,868,520**	**3,494,551**	**5,668,619**	**37,161**	**151,614**	**68,774**	**257,549**	**5,926,168**
2007	TAC	284,080	2,755,040	2,320,880	5,360,000				0	5,360,000
	Har	**165,551**	**2,160,459**	**2,159,965**	**4,485,975**	**29,134**	**116,671**	**37,566**	**183,371**	**4,669,346**
2008	TAC	209,530	1,836,893	1,547,576	3,594,000				0	3,594,000
	Har	**121,072**	**1,082,636**	**1,574,723**	**2,778,431**	**29,017**	**74,250**	**34,906**	**138,173**	**2,916,604**
2009	TAC	142,835	1,252,195	1,054,970	2,450,000				0	2,450,000
	Har	**94,048**	**967,476**	**1,095,500**	**2,157,024**	**13,727**	**42,422**	**27,725**	**83,874**	**2,240,898**
2010	TAC	128,260	1,124,420	947,320	2,200,000				0	2,200,000
	Har	**55,248**	**958,366**	**983,397**	**1,997,011**	**34,552**	**54,056**	**23,324**	**111,932**	**2,108,943**
2011	TAC	170,178	1,491,901	1,256,921	2,919,000				0	2,919,000
	Har	**50,490**	**417,314**	**1,224,057**	**1,691,861**	**31,506**	**45,369**	**28,873**	**105,748**	**1,797,609**
2012	TAC	203,292	1,782,206	1,501,502	3,487,000				0	3,487,000
	Har	**86,658**	**921,390**	**1,355,522**	**2,363,570**	**36,975**	**44,796**	**28,260**	**110,031**	**2,473,601**
2013	TAC	195,655	1,715,252	1,445,094	3,356,000				0	3,356,000
	Har	**54,167**	**1,083,395**	**1,274,945**	**2,412,507**	**34,553**	**60,332**	**30,591**	**125,476**	**2,537,983**
2014	TAC	234,774	2,058,200	1,734,026	4,027,000				0	4,027,000
	Har	**42,142**	**1,303,133**	**1,324,201**	**2,669,476**	**61,982**	**84,843**	**52,675**	**199,500**	**2,868,977**
2015	TAC	239,846	2,102,665	1,771,488	4,114,000				0	4,114,000
	Har	**65,740**	**1,073,263**	**1,382,600**	**2,521,603**	**55,201**	**46,523**	**89,882**	**191,606**	**2,713,209**
2016	TAC	287,827	2,523,301	2,125,872	4,937,000				0	4,937,000
	Har	**65,816**	**855,820**	**1,959,573**	**2,881,209**	**50,963**	**32,937**	**112,743**	**196,643**	**3,077,852**
2017	TAC	345,369	3,027,756	2,550,874	5,924,000				0	5,924,000
	Har	**56,938**	**1,261,327**	**3,232,817**	**4,551,082**	**70,010**	**162,949**	**129,217**	**362,176**	**4,913,258**
2018	TAC	414,455	3,633,410	3,061,135	7,109,000				0	7,109,000
	Har	**176,089**	**1,972,295**	**3,478,713**	**5,627,097**	**123,503**	**270,189**	**250,345**	**644,037**	**6,271,134**

[a] Ontario sport harvest values were estimated from the 2014 lakewide aerial creel survey
These values are included in Ontario's total walleye harvest, but are not used in catch-at-age analysis.

Table 2. Annual harvest (thousands of fish) of Lake Erie walleye by gear, management unit, and agency from 1999 - 2018. Means contain data from 1975 to 2017.

	Sport Fishery															Commercial Fishery					
	Unit 1				Unit 2			Unit 3			Units 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4		Grand
Year	OH	MI	ON[a]	Total	OH	ON[a]	Total	OH	ON[a]	Total	ON[a]	PA	NY	Total	Total	ON	ON	ON	ON	Total	Total
1999	812	140	34	986	139	5	144	83	5	88	19	89	23	131	1,349	2,461	631	317	68	3,477	4,827
2000	674	252	34	961	165	5	170	93	5	98	19	78	29	125	1,354	1,603	444	196	48	2,291	3,645
2001	941	160	34	1,135	171	5	176	46	5	51	19	53	15	87	1,449	1,004	310	141	20	1,475	2,924
2002	516	194	34	744	141	5	146	46	5	51	19	22	18	59	1,000	937	309	146	17	1,409	2,409
2003	715	129	34	878	232	5	237	68	5	73	2	44	27	73	1,261	948	283	182	14	1,427	2,688
2004	515	115	34	664	272	2	274	72	0	72	2	20	8	30	1,040	866	334	175	11	1,386	2,426
2005	374	38	27	438	110	2	112	126	0	126	2	20	27	49	725	1,878	625	401	15	2,920	3,645
2006	1,194	306	27	1,526	503	2	505	170	0	170	2	152	37	191	2,392	2,137	784	545	66	3,532	5,924
2007	1,414	166	27	1,607	578	2	580	169	0	169	2	116	29	147	2,502	1,348	450	333	35	2,167	4,669
2008	524	121	44	689	333	2	335	225	0	225	2	74	29	105	1,354	954	335	241	35	1,565	2,919
2009	553	94	44	691	287	2	288	128	0	128	2	42	14	58	1,166	705	212	135	28	1,079	2,244
2010	587	55	44	686	257	2	259	114	0	115	2	54	37	93	1,152	607	184	147	23	962	2,115
2011	224	50	44	318	104	2	106	89	0	90	2	45	32	79	593	736	262	181	29	1,208	1,801
2012	596	87	44	726	233	2	235	93	0	93	2	45	37	84	1,138	834	285	191	28	1,338	2,476
2013	757	54	44	855	190	2	192	136	0	136	2	60	35	97	1,280	737	297	195	31	1,260	2,540
2014	909	42	45	996	177	13	190	218	13	231	13	85	62	160	1,577	756	259	238	40	1,292	2,869
2015	746	66	45	857	187	13	200	140	13	153	13	47	55	115	1,325	633	354	325	77	1,388	2,713
2016	577	66	45	688	139	13	152	140	13	153	13	33	51	97	1,090	946	594	348	100	1,988	3,078
2017	592	57	45	694	316	13	330	353	13	367	13	163	70	246	1,636	1,735	918	508	116	3,277	4,913
2018	955	176	45	1,177	666	13	679	351	13	365	13	270	124	407	2,627	1,523	1,433	451	250	3,657	6,284
Mean	1,469	250	40	1,758	268	10	275	170	12	179	8	70	39	67	2,259	1,363	445	292	41	2,037	4,296

[a] Ontario sport harvest values were estimated from the 2014 lakewide aerial creel survey. These values are included in Ontario's total walleye harvest, but are not used in catch-at-age analysis.

Table 3. Annual fishing effort for Lake Erie walleye by gear, management unit, and agency from 1999 to 2018. Means contain data from 1975 to 2017.

	Sport Fishery [a]															Commercial Fishery [b]				
	Unit 1				Unit 2			Unit 3			Units 4 & 5					Unit 1	Unit 2	Unit 3	Units 4&5	
Year	OH	MI	ON[c]	Total	OH	ON[c]	Total	OH	ON[c]	Total	ON[c]	PA	NY	Total	Total	ON	ON	ON	ON	Total
1999	2,368	411	--	2,779	603	--	603	323	--	323	--	397	171	568	4,273	21,432	10,955	7,630	1,444	41,461
2000	1,975	540	--	2,516	540	--	540	281	--	281	--	244	177	421	3,757	22,238	11,049	7,896	1,781	43,054
2001	1,952	362	--	2,314	697	--	697	261	--	261	--	241	163	404	3,676	9,372	5,746	5,021	639	20,778
2002	1,393	606	--	1,999	444	--	444	246	--	246	--	130	132	262	2,951	4,431	4,212	4,427	445	13,515
2003	1,719	326	--	2,045	675	--	675	236	--	236	30	159	162	321	3,277	4,476	3,946	3,725	365	12,512
2004	1,257	504	--	1,761	736	27	736	178	7	178	--	88	101	189	2,864	3,875	2,977	2,401	240	9,493
2005	1,180	212	40	1,392	573	--	573	261	--	261	--	109	142	251	2,477	7,083	4,174	4,503	174	15,934
2006	1,757	587	--	2,344	899	--	899	260	--	260	--	239	137	376	3,879	5,689	4,008	3,589	822	14,107
2007	2,076	448	--	2,524	1,147	--	1,147	321	--	321	--	232	135	367	4,358	4,509	2,927	2,665	383	10,484
2008	1,027	392	63	1,419	809	--	809	356	--	356	--	187	156	343	2,927	4,990	3,193	1,909	497	10,590
2009	1,063	310	--	1,373	777	--	777	289	--	289	--	124	100	224	2,663	3,537	2,164	1,746	478	7,925
2010	1,403	226	--	1,629	652	--	652	219	--	219	--	188	140	328	2,828	1,918	1,371	1,401	247	4,937
2011	862	165	--	1,026	346	--	346	217	--	217	--	156	145	301	1,891	2,646	1,884	1,572	489	6,591
2012	1,283	242	--	1,525	560	--	560	182	--	182	--	160	169	329	2,597	4,674	2,480	2,298	352	9,804
2013	1,424	182	--	1,606	503	--	503	236	--	236	--	154	143	297	2,641	3,802	2,774	2,624	304	9,503
2014	1,552	131	101	1,683	459	85	459	441	71	441	70	171	187	358	2,940	7,351	4,426	2,911	254	14,943
2015	1,430	165	--	1,595	564	--	564	341	--	341	--	162	215	377	2,876	6,980	6,487	5,379	792	19,637
2016	1,514	236	--	1,750	439	--	439	397	--	397	--	141	217	358	2,944	6,980	7,969	4,523	1,448	20,920
2017	1,351	187	--	1,538	726	--	726	501	--	501	--	228	213	441	3,207	8,056	7,239	3,636	1,527	20,458
2018	1,239	261	--	1,500	813	--	813	354	--	354	--	248	229	477	3,144	5,215	7,421	2,636	1,896	17,168
Mean	2,907	665	102	3,632	747	62	762	416	111	448	106	209	231	268	5,059	8,856	5,616	4,495	675	18,755

[a] Ohio, Michigan, Pennsylvania and New York sport units of effort are thousands of angler hours.

[b] Estimated Standard (Total) Effort in kilometers of gill net = (walleye targeted effort x walleye total harvest) / walleye targeted harvest.

[c] Ontario sport fishing effort was estimated from 2014 lakewide aerial creel survey, values are in rod hours

[d] Ontario sport fishing effort is not included in area and lakewide totals due to effort reporting in rod hours

Table 4. Annual harvest per unit effort for Lake Erie walleye by gear, management unit, and agency from 1999 to 2018. Means contain data from 1975 to 2017.

	Sport Fishery [a]															Commercial Fishery [b]				
	Unit 1				Unit 2			Unit 3			Units 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4	
Year	OH	MI	ON[c]	Total	OH	ON[c]	Total	OH	ON[c]	Total	ON[c]	PA	NY	Total	Total	ON	ON	ON	ON	Total
1999	0.34	0.34	--	0.34	0.23	--	0.23	0.26	--	0.26	--	0.22	0.14	0.22	0.30	114.8	57.6	41.6	47.4	83.9
2000	0.34	0.47	--	0.37	0.31	--	0.31	0.33	--	0.33	--	0.32	0.16	0.32	0.34	72.1	40.2	24.8	27.1	53.2
2001	0.48	0.44	--	0.48	0.25	--	0.25	0.18	--	0.18	--	0.22	0.09	0.22	0.38	107.1	54.0	28.1	32.1	71.0
2002	0.37	0.32	--	0.36	0.32	--	0.32	0.19	--	0.19	--	0.17	0.14	0.17	0.32	211.5	73.4	33.0	37.4	104.3
2003	0.42	0.40	--	0.41	0.34	--	0.34	0.29	--	0.29	0.07	0.28	0.17	0.21	0.37	211.8	71.7	48.9	38.4	114.1
2004	0.41	0.23	--	0.36	0.37	0.06	0.36	0.40	--	0.40	--	0.23	0.08	0.15	0.35	223.5	112.2	73.0	45.3	146.0
2005	0.32	0.18	0.67	0.31	0.19	--	0.19	0.48	--	0.48	--	0.18	0.19	0.19	0.28	265.2	149.8	89.1	86.4	183.2
2006	0.68	0.52	--	0.64	0.56	--	0.56	0.65	--	0.65	--	0.63	0.27	0.50	0.61	375.7	195.6	151.9	80.8	250.4
2007	0.68	0.37	--	0.63	0.50	--	0.50	0.53	--	0.53	--	0.50	0.21	0.40	0.57	298.9	153.8	124.9	91.4	206.7
2008	0.51	0.31	--	0.45	0.41	--	0.41	0.63	--	0.63	--	0.40	0.19	0.30	0.45	191.2	104.9	126.2	70.4	147.8
2009	0.52	0.30	--	0.47	0.37	--	0.37	0.44	--	0.44	--	0.34	0.14	0.25	0.42	199.2	97.9	77.1	58.0	136.1
2010	0.42	0.24	--	0.39	0.39	--	0.39	0.52	--	0.52	--	0.29	0.26	0.28	0.39	316.7	134.5	105.0	94.5	194.9
2011	0.26	0.31	--	0.27	0.30	--	0.30	0.41	--	0.41	--	0.29	0.22	0.26	0.29	278.3	138.9	115.0	59.0	183.3
2012	0.46	0.36	--	0.45	0.42	--	0.42	0.51	--	0.51	--	0.28	0.22	0.25	0.42	178.4	114.8	83.1	80.3	136.5
2013	0.53	0.30	--	0.51	0.38	--	0.38	0.58	--	0.58	--	0.39	0.24	0.32	0.47	194.0	107.0	74.2	100.7	132.5
2014	0.59	0.32	0.45	0.56	0.39	0.16	0.39	0.49	0.19	0.49	0.18	0.50	0.33	0.41	0.51	102.8	58.4	81.8	156.8	86.5
2015	0.52	0.40	--	0.51	0.33	--	0.33	0.41	--	0.41	--	0.29	0.26	0.27	0.43	90.6	54.5	60.3	97.3	70.7
2016	0.38	0.28	--	0.37	0.32	--	0.32	0.35	--	0.35	--	0.23	0.23	0.23	0.34	135.5	74.6	77.0	69.0	95.0
2017	0.44	0.30	--	0.42	0.44	--	0.44	0.70	--	0.70	--	0.71	0.33	0.53	0.48	215.3	126.9	139.6	76.2	160.2
2018	0.77	0.67	--	0.75	0.82	--	0.82	0.99	--	0.99	--	1.09	0.54	0.83	0.81	292.0	193.1	171.0	132.0	213.0
Mean	0.48	0.36	0.40	0.46	0.33	0.26	0.33	0.39	0.19	0.38	0.11	0.33	0.18	0.24	0.43	171.1	87.1	72.4	69.1	121.0

[a] Ohio, Michigan, Pennsylvania and New York sport HPE = Number/angler hour

[b] Commercial HPE = Number/kilometer of gill net

[c] Ontario sport fishing HPE was estimated from the 2014 lakewide aerial creel survey values are in number/rod hour

[d] Ontario sport fishing HPE is not included in area and lakewide totals due to effort reporting in rod hours

Table 5. Catch at age of walleye harvest by management unit, gear, and agency in Lake Erie during 2018. Units 4 and 5 are combined in Unit 4.

		Commercial	Sport					All Gear
Unit	Age	Ontario	Ohio	Michigan	New York	Pennsylvania	Total	Total
1	1	31,762	0	10			10	31,772
	2	154,626	2,630	2,035			4,665	159,291
	3	1,007,129	677,207	117,554			794,761	1,801,890
	4	250,771	173,216	36,919			210,135	460,906
	5	31,532	23,972	7,790			31,762	63,294
	6	12,593	7,346	2,086			9,432	22,025
	7+	34,460	70,994	9,696			80,690	115,150
	Total	1,522,873	955,365	176,089	--	--	1,131,454	2,654,327
2	1	33,867	0				0	33,867
	2	34,628	2,802				2,802	37,430
	3	1,182,305	514,013				514,013	1,696,318
	4	134,984	107,283				107,283	242,267
	5	12,572	11,583				11,583	24,155
	6	7,041	3,091				3,091	10,132
	7+	27,832	26,908				26,908	54,740
	Total	1,433,229	665,680	--	--	--	665,680	2,098,909
3	1	2,385	0				0	2,385
	2	7,419	623				623	8,042
	3	375,477	243,741				243,741	619,218
	4	52,031	64,437				64,437	116,468
	5	8,413	10,467				10,467	18,880
	6	2,249	3,162				3,162	5,411
	7+	2,860	28,821				28,821	31,681
	Total	450,834	351,251	--	--	--	351,251	802,085
4	1	0			0	0	0	0
	2	5,419			5,721	2,785	8,506	13,925
	3	152,616			66,322	200,553	266,875	419,491
	4	41,593			16,857	33,425	50,283	91,876
	5	10,375			3,701	2,785	6,487	16,862
	6	8,967			9,427	5,571	14,998	23,965
	7+	31,375			21,475	25,069	46,544	77,919
	Total	250,345	--	--	123,503	270,189	393,692	644,037
All	1	68,014	0	10	0	0	10	68,024
	2	202,092	6,055	2,035	5,721	2,785	16,596	218,688
	3	2,717,527	1,434,961	117,554	66,322	200,553	1,819,389	4,536,916
	4	479,379	344,936	36,919	16,857	33,425	432,138	911,517
	5	62,892	46,022	7,790	3,701	2,785	60,299	123,191
	6	30,850	13,599	2,086	9,427	5,571	30,682	61,532
	7+	96,527	126,723	9,696	21,475	25,069	182,963	279,490
	Total	3,657,281	1,972,296	176,089	123,503	270,189	2,542,077	6,199,358

Table 6. Age composition (in percent) of walleye harvest by management unit, gear, and agency in Lake Erie during 2018. Units 4 and 5 are combined in Unit 4.

Unit	Age	Commercial Ontario	Sport Ohio	Sport Michigan	Sport New York	Sport Pennsylvania	Sport Total	All Gears Total
1	1	2.1	0.0	0.0	--	--	0.0	1.2
	2	10.2	0.3	1.2	--	--	0.4	6.0
	3	66.1	70.9	66.8	--	--	70.2	67.9
	4	16.5	18.1	21.0	--	--	18.6	17.4
	5	2.1	2.5	4.4	--	--	2.8	2.4
	6	0.8	0.8	1.2	--	--	0.8	0.8
	7+	2.3	7.4	5.5	--	--	7.1	4.3
	Total	100.0	100.0	100.0	--	--	100.0	100.0
2	1	2.4	0.0	--	--	--	0.0	1.6
	2	2.4	0.4	--	--	--	0.4	1.8
	3	82.5	77.2	--	--	--	77.2	80.8
	4	9.4	16.1	--	--	--	16.1	11.5
	5	0.9	1.7	--	--	--	1.7	1.2
	6	0.5	0.5	--	--	--	0.5	0.5
	7+	1.9	4.0	--	--	--	4.0	2.6
	Total	100.0	100.0	--	--	--	100.0	100.0
3	1	0.5	0.0	--	--	--	0.0	0.3
	2	1.6	0.2	--	--	--	0.2	1.0
	3	83.3	69.4	--	--	--	69.4	77.2
	4	11.5	18.3	--	--	--	18.3	14.5
	5	1.9	3.0	--	--	--	3.0	2.4
	6	0.5	0.9	--	--	--	0.9	0.7
	7+	0.6	8.2	--	--	--	8.2	3.9
	Total	100.0	100.0	--	--	--	100.0	100.0
4	1	0.0	--	--	0.0	0.0	0.0	0.0
	2	2.2	--	--	4.6	1.0	2.2	2.2
	3	61.0	--	--	53.7	74.2	67.8	65.1
	4	16.6	--	--	13.6	12.4	12.8	14.3
	5	4.1	--	--	3.0	1.0	1.6	2.6
	6	3.6	--	--	7.6	2.1	3.8	3.7
	7+	12.5	--	--	17.4	9.3	11.8	12.1
	Total	100.0	--	--	100.0	100.0	100.0	100.0
All	1	1.9	0.0	0.0	0.0	0.0	0.0	1.1
	2	5.5	0.3	1.2	4.6	1.0	0.7	3.5
	3	74.3	72.8	66.8	53.7	74.2	71.6	73.2
	4	13.1	17.5	21.0	13.6	12.4	17.0	14.7
	5	1.7	2.3	4.4	3.0	1.0	2.4	2.0
	6	0.8	0.7	1.2	7.6	2.1	1.2	1.0
	7+	2.6	6.4	5.5	17.4	9.3	7.2	4.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7. Annual mean age (years) of Lake Erie walleye by gear, management unit, and agency from 1999 to 2018. Means include data from 1975 to 2017.

	Sport Fishery															Commercial Fishery					All Gears
	Unit 1				Unit 2			Unit 3			Units 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4		
Year	OH	MI	ON	Total	OH	ON	Total	OH	ON	Total	ON	PA	NY	Total	Total	ON	ON	ON	ON	Total	Total
1999	3.72	3.16	3.43	3.63	5.35	9.17	5.48	5.95	10.00	6.18	8.15	--	10.29	9.32	4.55	3.41	4.29	5.28	6.76	3.81	3.89
2000	3.94	3.27	--	3.76	4.12	--	4.12	6.36	--	6.36	--	--	9.75	9.75	4.55	3.69	4.67	5.65	6.46	4.11	4.12
2001	3.66	3.02	--	3.57	4.09	--	4.09	6.14	--	6.14	--	7.70	9.09	8.01	3.99	3.19	3.77	5.52	6.00	3.57	3.75
2002	3.80	3.83	--	3.81	4.57	--	4.57	5.46	--	5.46	--	6.59	8.05	7.25	4.21	3.22	3.50	5.37	5.80	3.54	3.78
2003	4.67	4.16	--	4.59	4.67	--	4.67	5.87	--	5.87	6.50	7.50	10.01	8.40	4.90	3.68	4.36	5.58	6.59	4.09	4.46
2004	4.77	4.41	--	4.70	5.11	6.56	5.12	6.42	--	6.42	--	5.86	11.11	7.41	5.01	2.96	2.59	3.49	6.07	2.96	3.82
2005	5.33	4.26	3.35	5.12	4.21	--	4.21	5.53	--	5.53	--	6.61	6.72	6.68	5.15	3.61	3.16	4.64	4.70	3.66	3.96
2006	3.86	3.24	--	3.73	3.68	--	3.68	4.57	--	4.57	--	4.10	6.38	4.55	3.85	3.19	3.19	3.44	4.82	3.26	3.50
2007	4.64	4.42	--	4.62	4.79	--	4.79	4.89	--	4.89	--	4.89	6.80	5.27	4.71	4.20	4.29	4.25	6.55	4.26	4.50
2008	5.42	5.60	--	5.46	5.90	--	5.90	5.21	--	5.21	--	5.67	7.21	6.10	5.57	5.21	5.38	5.06	8.28	5.29	5.42
2009	5.39	4.78	--	5.30	6.14	--	6.14	6.43	--	6.43	--	6.47	6.84	6.56	5.70	4.67	5.17	5.40	7.45	4.93	5.33
2010	5.72	5.38	--	5.69	6.37	--	6.37	7.30	--	7.30	--	7.16	7.16	7.16	6.12	4.11	4.82	6.14	7.79	4.64	5.44
2011	5.98	4.35	--	5.68	7.79	--	7.79	8.03	--	8.03	--	8.40	7.76	8.13	6.74	4.86	5.26	6.73	8.33	5.31	5.78
2012	4.97	4.46	--	4.91	5.78	--	5.78	8.13	--	8.13	--	8.92	7.65	8.35	5.60	4.86	5.33	7.15	7.25	5.34	5.47
2013	5.16	4.26	--	5.10	6.91	--	6.91	8.09	--	8.09	--	8.79	8.13	8.55	5.95	4.91	4.64	7.09	7.36	5.24	5.60
2014	5.79	6.05	--	5.80	7.13	--	7.13	8.30	--	8.30	--	8.29	8.00	8.17	6.57	5.26	5.80	8.29	8.35	6.02	6.31
2015	6.23	5.85	--	6.20	6.88	--	6.88	8.73	--	8.73	--	7.43	8.29	7.89	6.74	4.57	6.30	8.58	8.08	6.14	6.42
2016	5.17	4.98	--	5.15	5.46	--	5.46	6.91	--	6.91	--	7.48	8.06	7.83	5.68	3.25	4.07	4.97	8.69	4.07	4.61
2017	4.54	4.39	--	4.52	3.52	--	3.52	3.67	--	3.67	--	4.17	5.68	4.63	4.14	2.90	2.65	2.86	5.86	2.93	3.32
2018	3.91	3.73	--	3.88	3.56	--	3.56	3.95		3.95	--	4.09	4.92	4.35	3.88	3.25	3.18	3.18	4.19	3.28	3.53
Mean	4.21	3.88	3.66	4.16	4.49	6.58	4.53	5.51	6.72	5.56	8.07	6.83	7.47	7.03	4.45	3.60	3.86	4.96	6.91	3.84	4.09

Table 8. Estimated abundance at age, survival (S), fishing mortality (F) and exploitation (u) for Lake Erie walleye, 1984-2019 (from ADMB 2019 catch at age analysis recruitment integrated model, M=0.32).

	Age							Ages 2+		
Year	2	3	4	5	6	7+	Total	S	F	u
1984	79,644,600	6,939,070	6,896,400	1,582,470	1,254,620	1,236,540	97,553,700	0.667	0.086	0.070
1985	6,761,020	53,835,200	4,350,500	4,307,270	993,464	1,543,680	71,791,134	0.652	0.107	0.087
1986	24,058,600	4,645,680	34,961,800	2,813,510	2,794,100	1,623,900	70,897,590	0.638	0.130	0.105
1987	24,070,600	16,182,100	2,890,970	21,642,000	1,756,840	2,732,300	69,274,810	0.642	0.123	0.099
1988	56,017,700	16,217,700	10,119,500	1,797,010	13,577,800	2,778,370	100,508,080	0.639	0.128	0.103
1989	12,030,600	37,192,700	9,859,200	6,108,070	1,100,900	9,974,490	76,265,960	0.635	0.134	0.108
1990	10,207,400	8,125,220	23,353,400	6,162,500	3,867,710	6,927,980	58,644,210	0.643	0.122	0.098
1991	5,131,390	6,943,140	5,152,770	14,792,100	3,947,670	6,873,770	42,840,840	0.653	0.107	0.087
1992	16,705,000	3,524,680	4,480,850	3,327,170	9,627,530	7,004,490	44,669,720	0.647	0.116	0.094
1993	22,732,200	11,302,100	2,203,520	2,803,030	2,104,150	10,473,600	51,618,600	0.622	0.155	0.124
1994	3,449,850	14,971,800	6,651,230	1,301,200	1,681,800	7,488,060	35,543,940	0.610	0.174	0.138
1995	19,162,800	2,294,500	8,977,160	4,008,590	797,215	5,603,720	40,843,985	0.619	0.159	0.127
1996	21,002,300	12,554,000	1,326,140	5,232,740	2,380,880	3,796,150	46,292,210	0.595	0.200	0.156
1997	2,391,640	13,435,700	6,891,980	735,056	2,968,510	3,500,930	29,923,816	0.586	0.214	0.166
1998	22,355,100	1,562,430	7,731,880	3,995,280	434,158	3,815,570	39,894,418	0.600	0.190	0.149
1999	11,021,000	14,231,800	847,510	4,239,790	2,244,390	2,382,920	34,967,410	0.614	0.167	0.132
2000	10,124,300	7,272,220	8,358,950	501,767	2,556,740	2,793,230	31,607,207	0.627	0.147	0.118
2001	31,397,600	6,753,170	4,375,160	5,065,630	309,445	3,306,160	51,207,165	0.677	0.070	0.058
2002	3,724,410	21,693,300	4,409,530	2,860,030	3,337,730	2,369,850	38,394,850	0.676	0.071	0.059
2003	25,036,200	2,608,170	14,582,100	2,966,590	1,937,310	3,862,860	50,993,230	0.686	0.057	0.048
2004	368,719	17,517,800	1,750,180	9,790,380	2,002,850	3,902,440	35,332,369	0.683	0.061	0.050
2005	104,853,000	262,410	11,946,800	1,193,740	6,708,800	4,035,270	129,000,020	0.701	0.036	0.030
2006	3,585,780	74,060,600	176,539	8,059,900	810,440	7,296,080	93,989,339	0.674	0.075	0.062
2007	7,076,600	2,536,980	49,735,600	118,665	5,450,250	5,462,670	70,380,765	0.675	0.073	0.060
2008	1,850,820	5,015,060	1,703,740	33,379,500	80,019	7,328,130	49,357,269	0.680	0.065	0.054
2009	18,147,800	1,311,830	3,388,860	1,152,530	22,707,600	5,023,980	51,732,600	0.692	0.048	0.040
2010	6,668,920	12,898,800	892,025	2,305,240	787,734	18,937,800	42,490,519	0.689	0.052	0.044
2011	6,760,180	4,756,740	8,842,170	611,178	1,584,960	13,489,100	36,044,328	0.690	0.051	0.043
2012	11,169,500	4,804,450	3,248,720	6,049,070	420,224	10,352,100	36,044,064	0.675	0.073	0.061
2013	8,487,010	7,849,800	3,167,590	2,145,310	4,024,080	7,136,990	32,810,780	0.670	0.081	0.067
2014	4,198,290	5,968,430	5,160,530	2,082,610	1,419,350	7,344,390	26,173,600	0.646	0.118	0.095
2015	6,015,220	2,918,620	3,793,100	3,281,530	1,335,180	5,568,570	22,912,220	0.644	0.120	0.097
2016	17,119,200	4,155,430	1,824,170	2,374,250	2,074,780	4,330,790	31,878,620	0.661	0.095	0.078
2017	44,454,800	11,808,400	2,589,450	1,139,060	1,498,770	4,020,790	65,511,270	0.668	0.084	0.069
2018	6,108,620	30,624,600	7,335,990	1,612,240	716,773	3,450,550	49,848,773	0.638	0.129	0.104
2019	13,514,200	4,232,720	19,300,300	4,628,990	1,027,220	2,635,050	45,338,480			

Table 9. Estimated harvest of Lake Erie walleye for 2019, and population projection for 2020 when fishing with 60% Fmsy. The 2019 and 2020 projected spawning stock biomass values are from the ADMB-2019 recruitment-integrated model. The range in the RAH was calculated using ± one standard deviation from the mean RAH.

SSB_0=	60.918	million kilograms
20% SSB_0=	12.184	million kilograms
F_{msy} =	0.556	

	2019 Stock Size (millions of fish)	60% F_{msy}		Rate Functions			2019 RAH (millions of fish)			Projected 2020 Stock Size (millions)
Age	**Mean**	**F**	**Sel(age)**	**(F)**	**(S)**	**(u)**	**Min.**	**Mean**	**Max.**	**Mean**
2	13.514		0.300	0.100	0.657	0.082	0.809	1.105	1.401	94.071
3	4.233		0.970	0.324	0.525	0.239	0.768	1.010	1.252	8.878
4	19.300		0.978	0.326	0.524	0.240	3.508	4.638	5.769	2.224
5	4.629		0.913	0.305	0.535	0.227	0.781	1.049	1.317	10.113
6	1.027		0.921	0.307	0.534	0.228	0.172	0.235	0.297	2.478
7+	2.635		1.000	0.334	0.520	0.245	0.466	0.645	0.825	1.919
Total (2+)	45.338	0.334				0.192	6.504	8.683	10.861	119.684
Total (3+)	31.824						5.695	7.577	9.460	25.613
SSB	49.777	mil. kgs								56.410 mil. kgs

probability of 2020 spawning stock biomass being less than 20% SSB_0 = 0.000%

Table 10. Western basin age 0 walleye recruitment index observed in bottom trawls by the Ontario Ministry of Natural Resources (ONT) and Ohio Department of Natural Resources (OH) between 1988 and 2018.

Year Class	Year of Recruitment to Fisheries	OH+ONT Trawl Age-0 CPHa
1988	1990	18.280
1989	1991	6.094
1990	1992	39.432
1991	1993	59.862
1992	1994	6.711
1993	1995	108.817
1994	1996	63.921
1995	1997	2.965
1996	1998	85.340
1997	1999	24.185
1998	2000	14.313
1999	2001	44.189
2000	2002	4.113
2001	2003	28.499
2002	2004	0.139
2003	2005	183.015
2004	2006	5.402
2005	2007	12.665
2006	2008	2.051
2007	2009	25.408
2008	2010	7.238
2009	2011	7.107
2010	2012	26.260
2011	2013	6.502
2012	2014	6.417
2013	2015	10.584
2014	2016	29.050
2015	2017	84.105
2016	2018	9.224
2017	2019	22.852
2018	2020	255.581

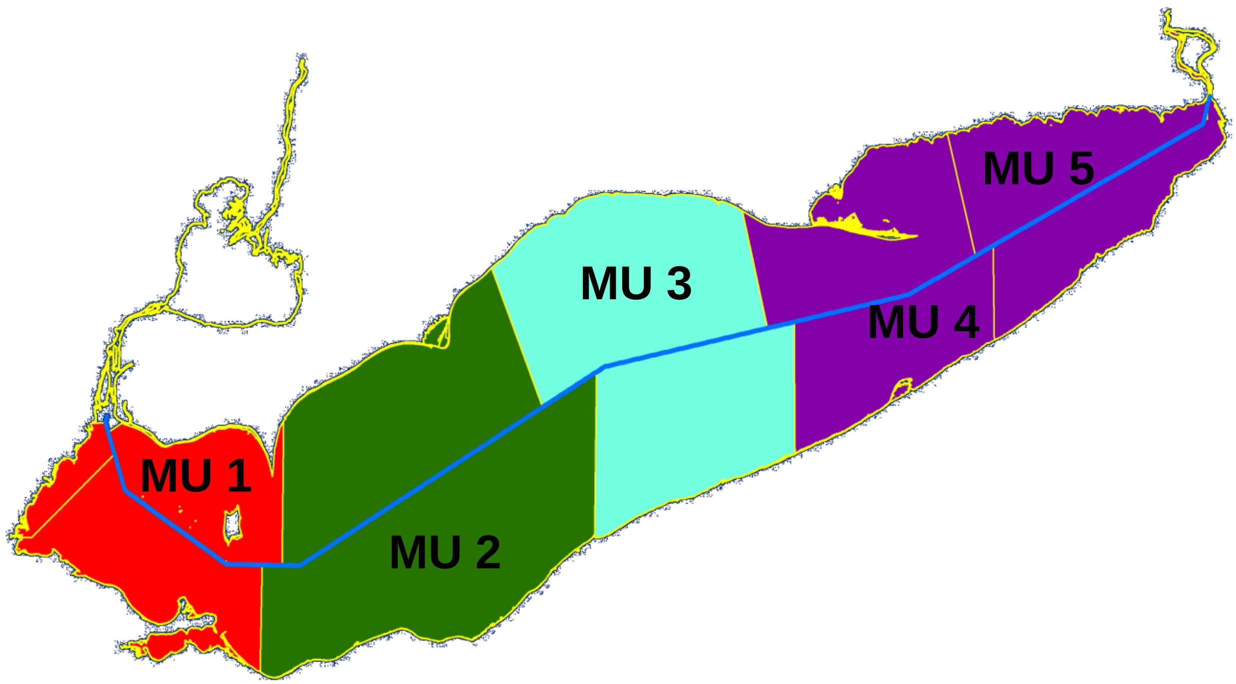


Figure 1. Map of Lake Erie with management units (MU) recognized by the Walleye Task Group for interagency management of Walleye.

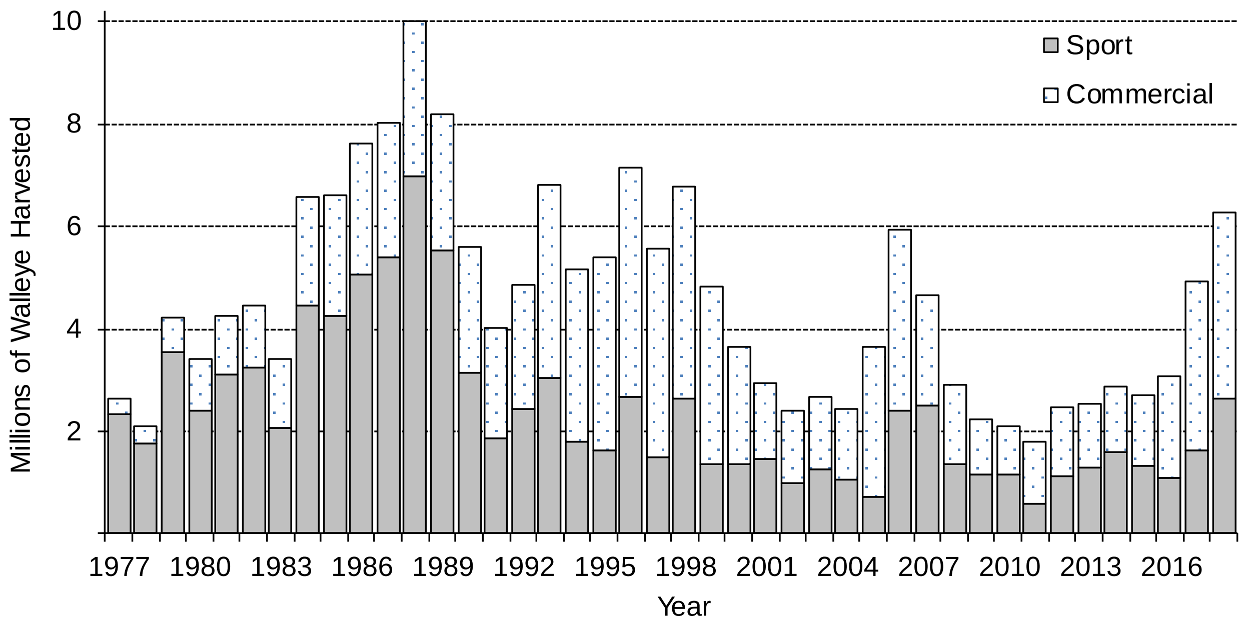


Figure 2. Lake-wide harvest of Lake Erie Walleye by sport and commercial fisheries, 1977-2018.

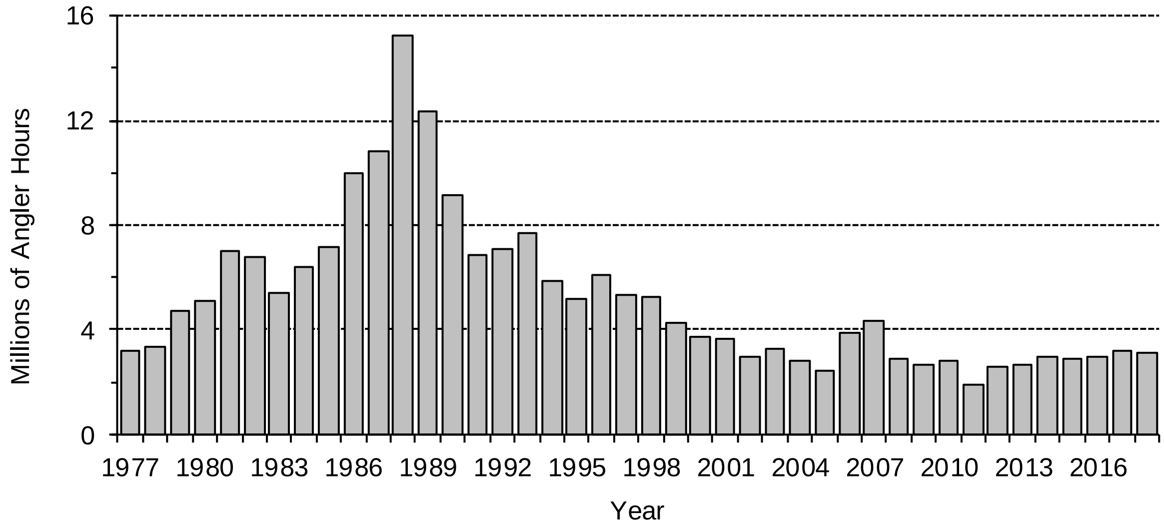


Figure 3. Lake-wide total effort (angler hours) by sport fisheries for Lake Erie Walleye, 1977-2018.

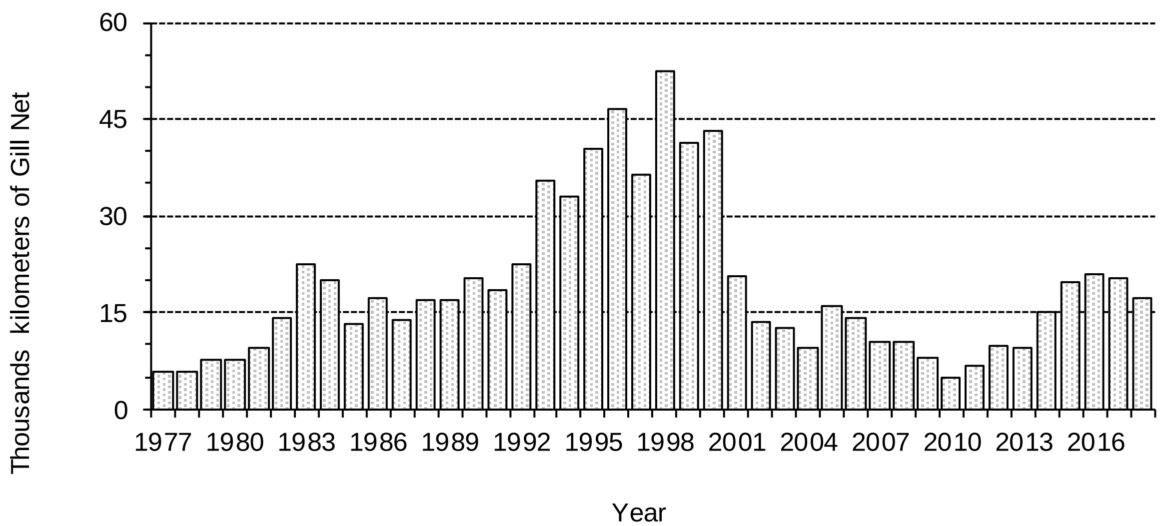


Figure 4. Lake-wide total effort (thousand kilometers of gill net) by commercial fisheries for Lake Erie Walleye, 1977-2018.

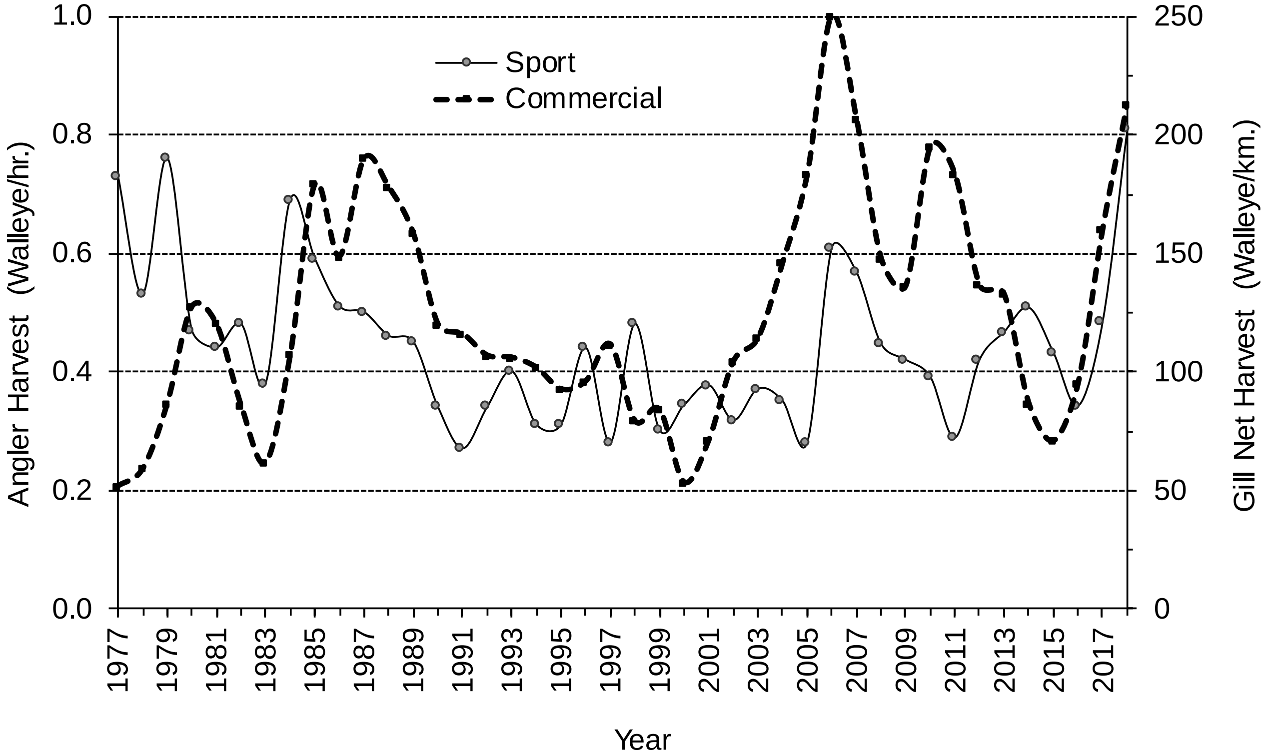


Figure 5. Lake-wide harvest per unit effort (HPE) for Lake Erie sport and commercial Walleye fisheries,1977-2018.

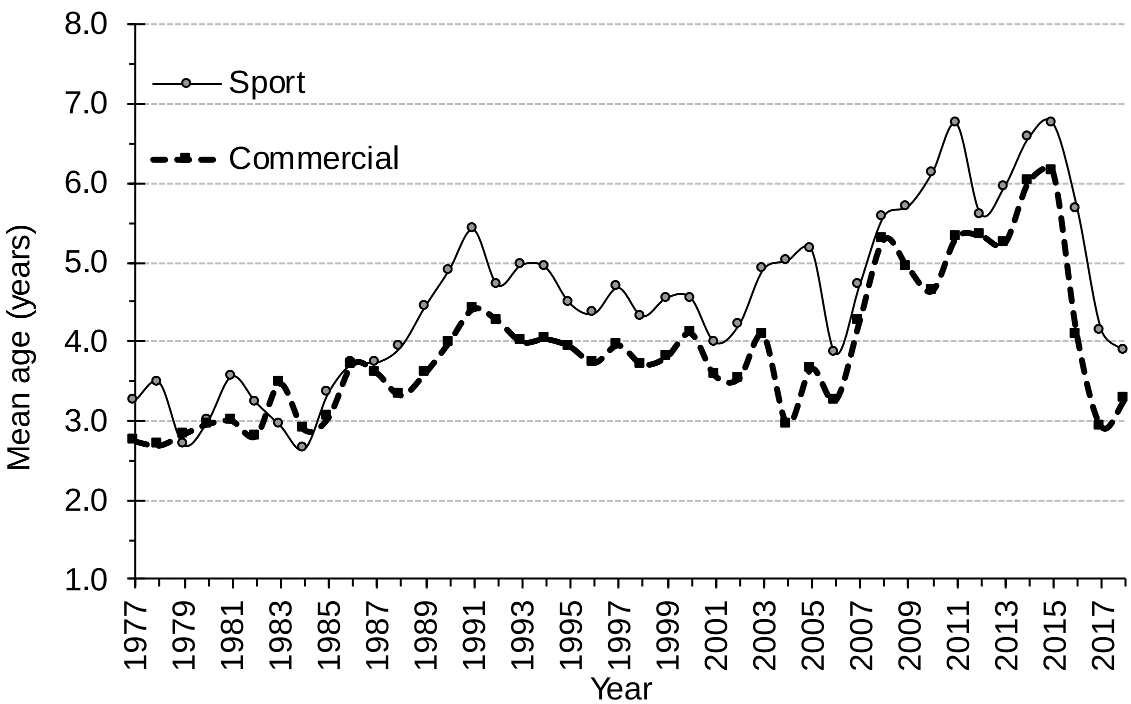


Figure 6. Lake-wide mean age of Lake Erie Walleye in sport and commercial harvests, 1977-2018.

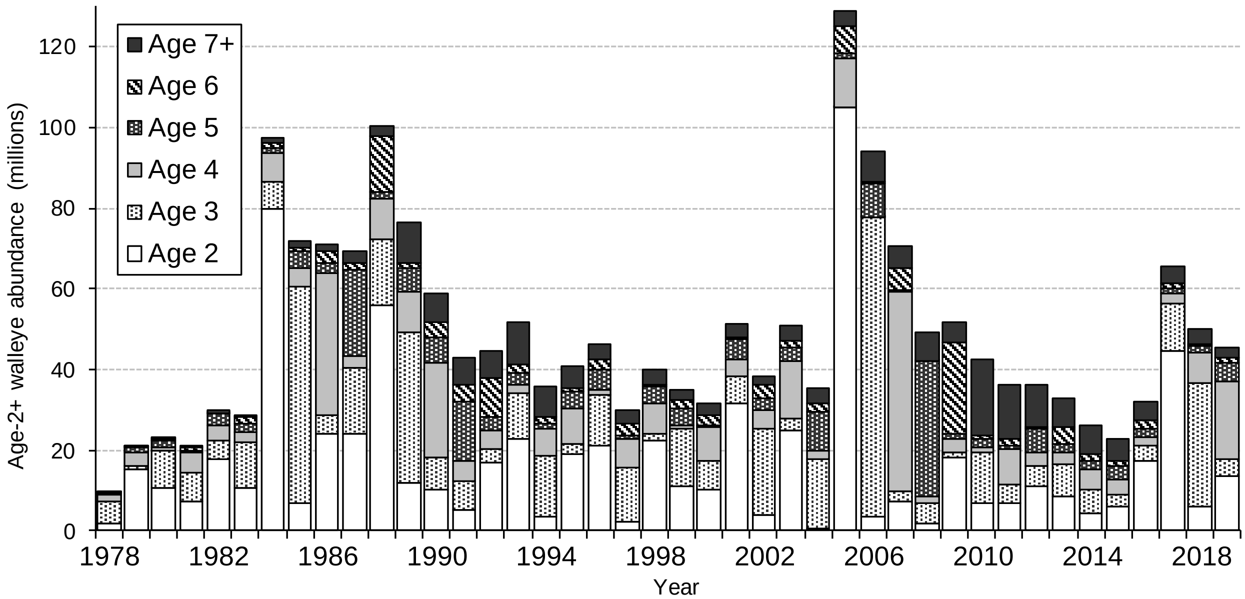


Figure 7. Abundance at age for age-2 and older Walleye in Lake Erie's west and central basins from 1978-2019, estimated from the latest ADMB integrated model run. Data shown are from Table 8.

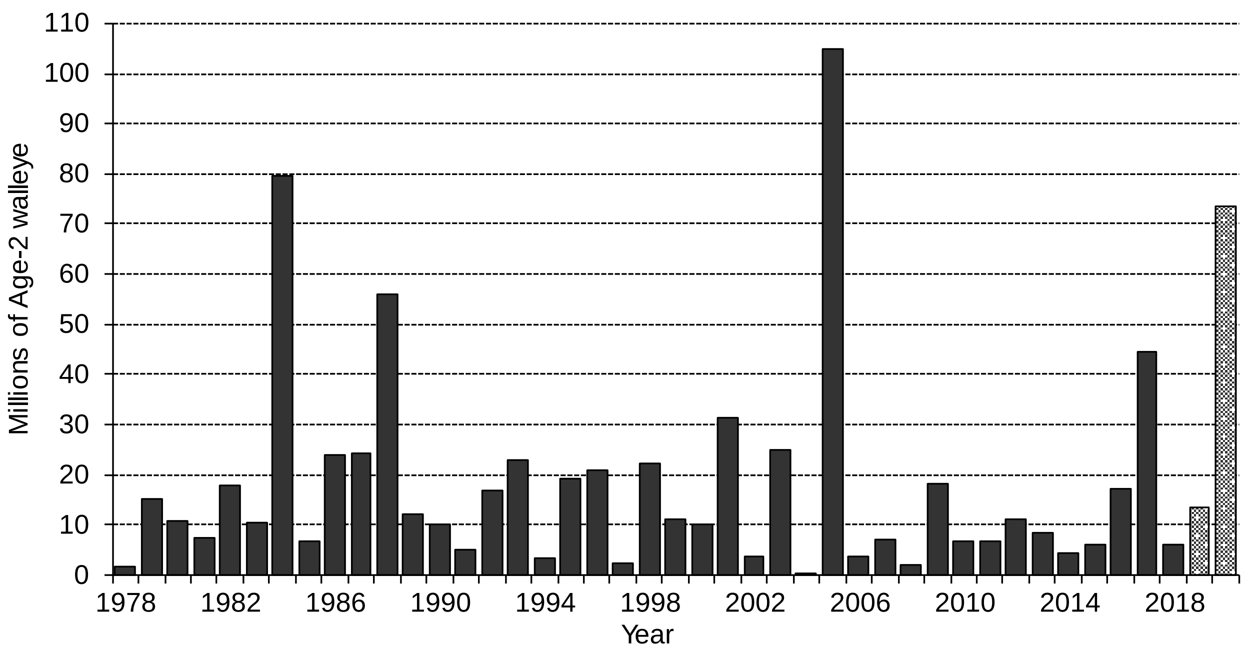
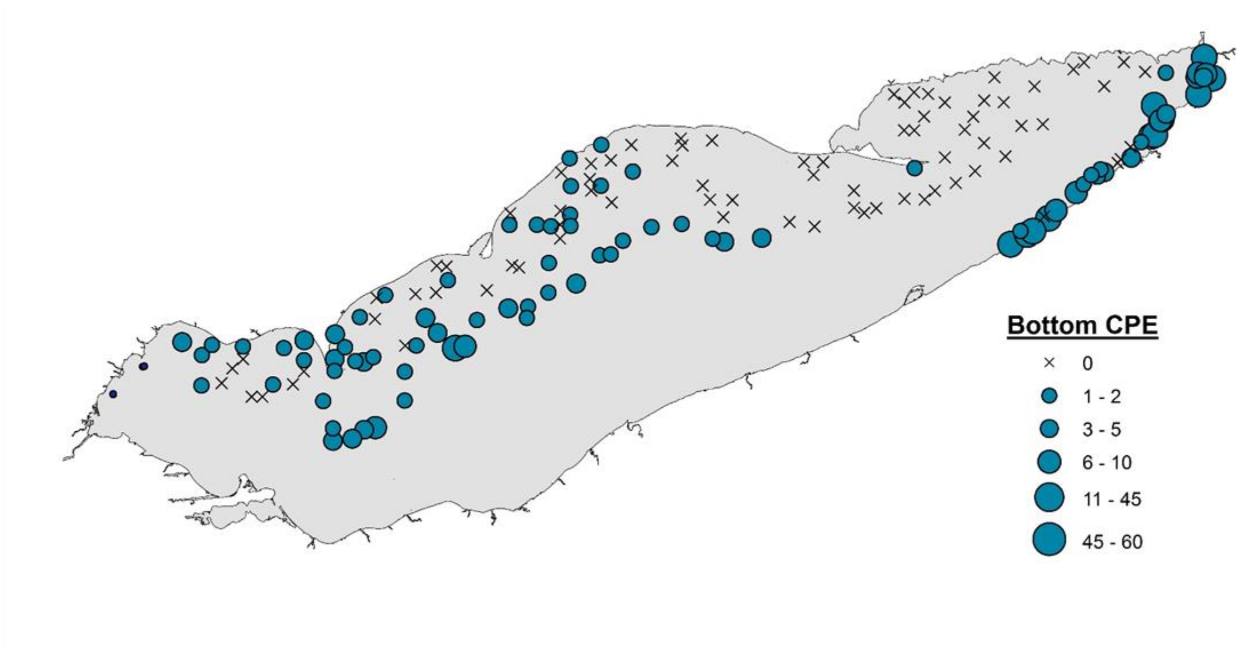


Figure 8. Estimated (1978 – 2018) and projected (2019 and 2020) number of age-2 Walleye in the west-central Lake Erie Walleye population from the latest ADMB integrated model run.



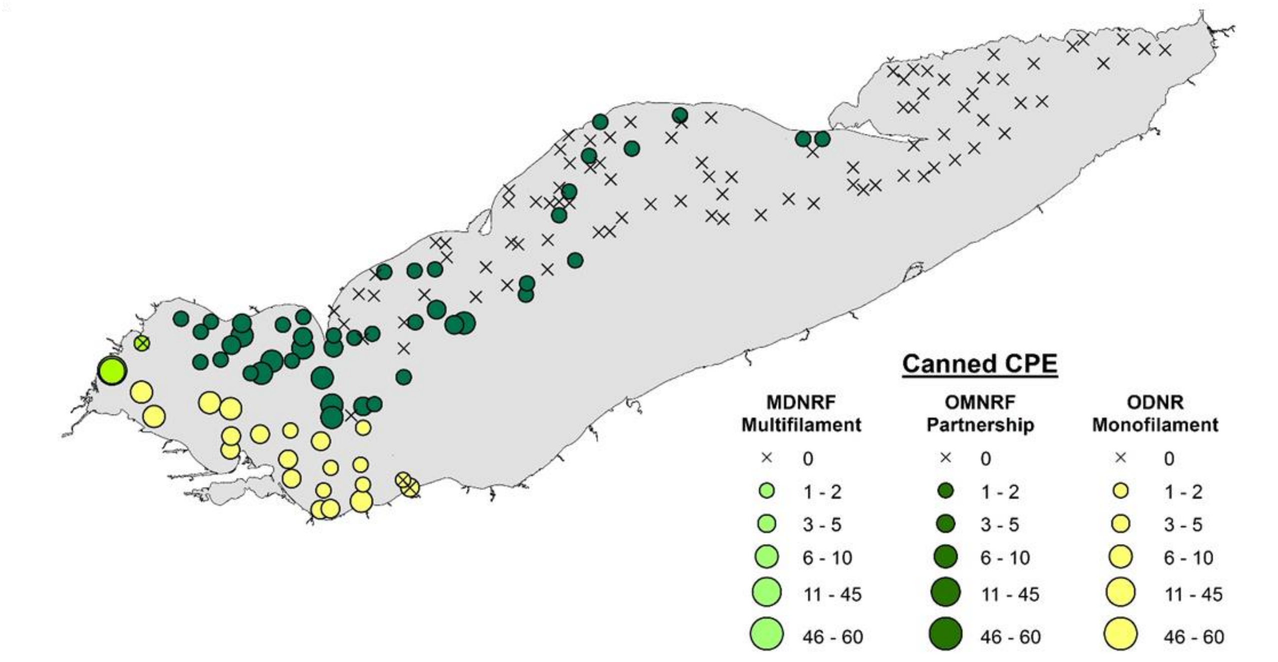


Figure 9. Relative abundance of yearling Walleye captured in bottom-set (A) and suspended or kegged (canned) multifilament (B) gillnets from Michigan, Ohio, New York, and Ontario waters in 2018. Catches have been adjusted to reflect panel length (standardized to 50 ft panels) and differences in the presence of large mesh (>5.5” excluded).