Report of the Lake Erie Yellow Perch Task Group

April 2023

Members:

Megan Belore (Co-chair)	Ontario Ministry of Natural Resources and Forestry
Andrew Briggs	Michigan Department of Natural Resources
Andy Cook	Ontario Ministry of Natural Resources and Forestry
Matt Faust	Ohio Department of Natural Resources
Mike Hosack	Pennsylvania Fish and Boat Commission
Peter Jenkins	Ohio Department of Natural Resources
Carey Knight	Ohio Department of Natural Resources
Heather Luken	Ohio Department of Natural Resources
Brian Schmidt	Ohio Department of Natural Resources
Sara Thomas (Co-chair)	Michigan Department of Natural Resources
Michael Thorn	Ontario Ministry of Natural Resources and Forestry
Pascal Wilkins	New York Department of Environmental Conservation
Yingming Zhao	Ontario Ministry of Natural Resources and Forestry

Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

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Introduction

From April 2022 through March 2023 the Yellow Perch Task Group (YPTG) addressed the following charges:

1. Maintain and update the centralized time series of datasets required for population models and assessment including:
    a. Fishery harvest, effort, age composition, biological and stock parameters.
    b. Survey indices of young-of-year, juvenile and adult abundance, size-at-age and biological parameters.
    c. Fishing harvest and effort by grid.

2. Report Recommended Allowable Harvest (RAH) levels for LEC TAC decisions.

3. Ensure population models are current and produce the most scientifically defensible and reliable method for estimating and forecasting abundance, recruitment, and mortality.
    a. Evaluate the impact of recruitment indices on ADMB model results.
    b. Evaluate ADMB model parameter sensitivity.

4. Supply needed technical support throughout the upcoming YPMP review process.

Charge 1: 2022 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) of Yellow Perch in 2022 was 7.185 million pounds. This allocation represented a 15% increase from a TAC of 6.238 million pounds in 2021. For Yellow Perch assessment and allocation, Lake Erie is partitioned into four management units (MUs; Figure 1.1). The 2022 TAC allocation was 3.038, 0.537, 3.082, and 0.528 million pounds for MUs 1 through 4, respectively. In March 2022 the Lake Erie Committee (LEC) applied the harvest policy within the Yellow Perch Management Plan to set the TAC. For MU1, the LEC set the TAC equal to 3.038 million pounds, which was a 20% increase from 2021. In MU2, the target fishing mortality rate was reduced to F=0.120, lowering the mean RAH and range. The target fishing mortality rate was reduced to ensure the spawning stock biomass in 2023 would not fall below the limit reference point, B_{msy}, with a probabilistic risk tolerance of 0.20 (i.e., P*). For MU2, the LEC set the TAC at 0.537 million pounds, which was equal to the mean RAH, representing a 13% decrease from 2021. For MU3, the LEC set the TAC at 3.082 million pounds, which was slightly lower than the mean RAH and a 20% increase from 2021. In MU4, the LEC set the TAC at 0.528 million pounds, which was the mean RAH and virtually unchanged from the 2021 TAC.

The lakewide harvest of Yellow Perch in 2022 was 3.400 million pounds, or 47% of the total 2022 TAC. This was a 3% increase from the 2021 harvest of 3.296 million pounds. Harvest from MUs 1 through 4 was 1.497, 0.296, 1.208, and 0.399 million pounds, respectively (Table 1.1). The portion of TAC harvested was 49%, 55%, 39%, and 76%, in MUs 1 through 4, respectively. In 2022, Ontario harvested 2.195 million pounds, followed by Ohio (0.988 million lbs.), New York (0.084 million lbs.), Michigan (0.068 million lbs.), and Pennsylvania (0.064 million lbs.).

Ontario's fraction of allocation harvested was 62% in MU1, 73% in MU2, 58% in MU3, and 103% in MU4 (see paragraph below regarding Ontario's harvest reporting and commercial ice allowance policy). Ohio fishers attained 43% of their TAC in the western basin (MU1), 40% in the west central basin (MU2), and 21% in the east central basin (MU3). Michigan anglers in MU1 attained 25% of their TAC. Pennsylvania fisheries harvested 14% of their TAC in MU3 and 1% of their TAC in MU4. New York fisheries attained 51% of their TAC in MU4. Ontario's portion of the lakewide Yellow Perch harvest in 2022 (65%) was similar to 2021 (65%; Table 1.1). Ohio's proportion of lakewide harvest was 29% in both 2021 and 2022, and harvest in Michigan, Pennsylvania, and New York waters combined represented around 6% of the lakewide harvest in 2022.

Ontario continued to employ a commercial ice allowance policy implemented in 2002, by which 3.3% is subtracted from commercial landed weight. This step was taken so that ice was not debited towards fishers' quotas. Ontario's landed weights in the YPTG report have not been adjusted to account for ice content. Ontario's reported Yellow Perch harvest in tables and figures is represented exclusively by the commercial gill net fishery. Yellow Perch sport harvest from Ontario waters is assessed periodically, which last occurred in 2014, but is not reported here. Reported sport harvests for Michigan, Ohio, Pennsylvania, and New York are based on creel survey estimates. Ohio, Pennsylvania, and New York trap net harvest and effort are based on commercial catch reports of landed fish. Additional fishery documentation is available in annual agency reports.

Harvest, fishing effort, and fishery harvest rates are summarized from 2013 to 2022 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends across a longer time series (1975 to 2022) are depicted graphically for harvest (Figure 1.2), fishing effort (Figure 1.3), and harvest rates (Figure 1.4) by management unit and gear type. The spatial distributions of harvest (all gears) and effort by gear type for 2022 in ten-minute interagency grids are presented in Figures 1.5 through 1.8.

Ontario’s Yellow Perch harvest from large mesh (3 inches or greater stretched mesh) gill nets in 2022 was 2%, 14%, 3%, and <1% of the gill net harvest in management units 1 - 4, respectively. Harvest, effort, and catch per unit effort from (1) small mesh Yellow Perch effort (2.25”=<stretched mesh<3”) and (2) larger mesh sizes, are distinguished in Tables 1.2 to 1.5. Harvest from targeted small mesh gill nets in 2022 decreased by 19% in MU1, increased 45% in MU3 and 2% in MU4, and changed less than 1% in MU2 in relative to 2021. Ontario trap nets, which primarily target white bass, harvested zero yellow perch in 2022. Ontario commercial Rainbow Smelt trawlers incidentally caught Yellow Perch in management units 3 and 4, and this harvest is included in Tables 1.4 to 1.5. In 2022, 21 pounds of Yellow Perch were harvested in trawl nets in MU3 and 782 pounds were harvested in MU4.

Targeted (i.e., small mesh) gill net effort in 2022 decreased from 2021 effort in all units (MU1 – MU4) by 18%, 24%, 5%, and 37% respectively. Targeted gill net harvest rates in 2022 decreased less than 2% relative to 2021 rates in MU1, while increasing in MU2 by 33%, MU3 by 53%, and MU4 by 62% (Figure 1.4).

Compared to 2021, sport harvest in 2022 in U.S. waters increased in MU1 (537,863 lbs.), MU2 (20,201 lbs.), and MU4 (70,019 lbs.) by 5%, 297%, and 46%, respectively, while decreasing 56% to less than 6,761 pounds in MU3 (Figure 1.2). Angling effort in U.S. waters during 2022 was highest in MU1 and lowest in MU3. Angler effort in 2022 increased 1303% from record low angling effort during 2021 in MU2 and by 64% in MU4, decreased 53% in MU3, and remained relatively unchanged from 2021 in MU1 (Figure 1.3). In 2022, angling effort in U.S. waters of MU3 at 6,120 hours was at its lowest in the time series, while effort of 26,634 hours in MU2 was the third lowest in time series (Figure 1.3).

Sport fishing harvest rates are commonly expressed as fish harvested per angler hour for those seeking Yellow Perch. These harvest rates are presented in Tables 1.2 to 1.5. Compared to 2021 rates, harvest per angler hour decreased in Michigan (-11%) and increased in Ohio waters of MU1 (+5%). In the central basin, sport angler harvest rate increased in the Ohio waters of MU2 (+513%) although the rate of 0.5 fish/hour is still one of the lowest in the time series, and decreased in the Ohio (-63%) waters of MU3 while increasing in Pennsylvania (+30%) waters of MU3. In MU4, harvest rates declined in both New York waters (-7%) and Pennsylvania waters (-100%), however there was a large difference in these MU4 areas with a 1.9 fish/hour rate in New York and near zero fish/hour in Pennsylvania.

Trap net harvest increased by 3% in MU1, 20% in MU3, and 31% in MU4 while decreasing by 16% in MU2 compared to 2021 (Tables 1.2 to 1.5). Trap net effort (lifts) in 2022 increased in MU1, MU2, MU3, and MU4 by 32%, 87%, 18%, and 76% respectively, relative to

2021 trap net effort. Total trap net effort during 2022 was highest in MU1 at 4943 lifts. Trap net harvest rates increased slightly from 2021 rates in MU3 (+2%), but declined by 22%, 55%, 25% in MU1, MU2, and MU4, respectively.

Age Composition and Growth

Lakewide, age-3 fish (2019 YC) contributed the most to the Yellow Perch harvest (47%), followed by age-2 fish (2020 YC; 26%), with age-4, age-5, and age-6-and-older fish contributing 18%, 4%, and 3%, respectively; Table 1.6). In MU1, age-2 fish (2020 year class, 41%) contributed most to the fishery, followed by age-3 (2019 year class, 27%) and age-4 fish (2018 year class, 24%). In MU2, age-3 fish (2019 year class, 53%), age-4 fish (2018 year class, 20%) and age-2 fish (2020 year class 17%) contributed most to the fishery. In MU3, age-3 fish (2019 year class, 70%) contributed most to the fishery, with all other age-classes individually accounting for less than 13% of harvest. In MU4, age-3 (2019 year class, 51%) and age-2 (2020 year class, 30%) fish contributed most to the harvest.

The task group continues to update Yellow Perch growth data in: (1) weight-at-age values recorded annually in the harvest and (2) length- and weight-at-age values taken from interagency trawl and gill net surveys. These values are applied in the calculation of population biomass and the forecasting of harvest in the approaching year. Therefore, changes in weight-at-age factor into the changes in overall population biomass projections and determination of recommended allowable harvest (RAH).

Statistical Catch-at-Age Analysis

Population size for each management unit was estimated by statistical catch-at-age analysis (SCAA) using the Auto Differentiation Model Builder (ADMB) computer program (Fournier et al. 2012). In 2022, the YPTG continued to use the ADMB model developed by the Quantitative Fisheries Center (QFC) at Michigan State University (referred to as the Peterson-Reilly or PR model) as part of the Lake Erie Percid Management Advisory Group (LEPMAG) review of Yellow Perch management on Lake Erie.

The PR model uses harvest and effort data from commercial gill net, commercial trap net, and recreational fisheries within each MU. Survey catch-at-age of age-2 and older fish from gill net and trawl surveys are also incorporated. In addition, age-0 and age-1 recruitment data are incorporated into the model as a recruitment index. The PR model estimates selectivity for all ages in the fisheries and surveys. There is a commercial gill net selectivity block beginning in 1998. Catchabilities for all fisheries and surveys vary annually as a correlated random walk. The model is fit to total catch and proportions-at-age (multinomial age composition) as separate data sets.

Running the PR model is a three-step process. In the first step, an ADMB model without recruitment data is run iteratively until the maximum effective sample size for the multinomial age composition stabilizes (i.e., does not change by more than 1-2 units). Second, age-2 abundance estimates from the first model are combined with age-0 and age-1 recruitment data (from trawl and gill net assessment surveys) in a multi-model inference (MMI) R-based model to determine parameters for estimating recruitment. Recruitment data from the last nine years are removed from the model to minimize possible retrospective effects. Further, years with missing data in one or more data sets are removed from all data sets. Surveys missing data for the projection year (e.g., 2020 year class in the 2022 TAC year) are also removed from the analysis. A list of all possible non-redundant models is generated from the survey data and fit using the R-based *glmulti* package (Calcagno 2013). All models falling within 2 AIC units of the best model are used to generate the model-averaged coefficients. Surveys are not weighted equally in the final model-averaged coefficients; each model may contain a different set of surveys and the models with lower AIC values are weighted more heavily and have greater influence on the recruitment predictions. Parameter estimates for the model-averaged coefficients for each MU are detailed in Appendix Table 2. A recruitment index is generated to estimate age-2 fish for each year class available in the recruitment data, using the age-0 and age-1 survey data. This process is repeated using just age-0 data, which is only used to estimate recruitment in two years' time. Data from trawl and gill net index recruitment series for the time period examined are presented in Appendix Table 3, and a key that summarizes abbreviations used for the trawl and gill net series is presented in Appendix Table 4.

In the third step, the recruitment index is added to the ADMB model, and this data set is used to inform age-2 abundance estimates within the objective function. This model is then run iteratively until the maximum effective sample size for the multinomial age composition stabilizes. Estimates of population size, from 2004 to 2022, and projections for 2023, are presented in Table 1.7. Abundance, biomass, survival, and exploitation rates are presented by management unit graphically for 1975 to 2022 in Figures 1.9 to 1.12. Mean weights-at-age from assessment surveys were applied to abundance estimates to generate population biomass estimates (Figure 1.10). Projections of abundance and biomass in 2023 are included in Figures 1.9 and 1.10.

Population abundance and biomass estimates are critical to monitoring the status of stocks and determining recommended allowable harvest.

Abundance estimates should be interpreted with several caveats. Inclusion of abundance estimates from 1975 to 2022 implies that the time series are continuous. Lack of data continuity for the entire time series weakens the validity of this assumption. Survey data from multiple agencies are represented only in the latter part of the time series (since the late 1980s); methods of fishery data collection have also varied. Some model parameters, such as natural mortality, are constrained to constants. This technique lessens our ability to directly compare abundance levels across three decades. In addition, with SCAA the most recent year's population estimates inherently have the widest error bounds, which is to be expected for cohorts that remain at-large under less than full selectivity in the population.

In the SCAA model, population estimates are derived by minimizing an objective function weighted by data sources, including fishery effort, fishery catch, and survey catch rates. In 2011-2012, the YPTG group determined data weightings (referred to as lambdas in ADMB) using an expert opinion approach for evaluating potential sources of bias in data sets that could negatively influence model performance (YPTG 2012). These data weightings were used during 2023 and are presented in Appendix Table 1. The additional recruitment index (generated from the glmulti process) was given a lambda weighting of 1 during the LEPMAG process.

2023 Population Size Projection

The SCAA model was used to project age-2-and-older Yellow Perch stock size in 2023 (Table 1.7). Standard errors and ranges for 2023 projections are provided for each age, and descriptions of minimum, mean, and maximum population estimates refer to the age-specific mean estimates minus or plus one standard deviation (Table 2.2).

Stock size estimates for 2022 (Table 1.7) were higher than those projected last year in MU3 and MU4, and lower in MU1 and MU2 (YPTG 2022). The largest difference was in MU1 where the 2022 age-2 and older abundance was estimated to be 65.791 million fish using the 2022 model, and 32.244 million fish using the 2023 model. The lakewide projection of age-2 and older fish using 2021 data was 173.584 million age-2 and older Yellow Perch in 2022 (YPTG 2022), while estimates using 2022 data in the 2023 model run estimated 2022 abundance of age-2 and older Yellow Perch at 146.398 million fish. Lakewide abundance of age-2-and-older Yellow Perch in 2023 is projected to be 155.251 million fish, an increase of 6% from 2022 estimates.

Abundance projections for 2023 are 53.028, 36.365, 56.912, and 8.947 million age-2-and-older Yellow Perch in management units 1 through 4, respectively. Abundance of age-2-and-older Yellow Perch in 2023 are projected to decrease in MU3 (-17%) and MU4 (-22%) and to increase by 51% in MU1 and 16% in MU2, relative to the 2022 abundance estimates (Table 1.7, Figure 1.9).

Projected age-2 Yellow Perch recruitment in 2023 (the 2021 year class) was 36.128, 16.520, 14.648, and 2.270 million fish in management units 1 through 4, respectively (Table 1.7.).

Age-3-and-older Yellow Perch abundance in 2023 is projected to be 16.900, 19.845, 42.264, and 6.677 million fish in MUs 1 through 4, respectively. Abundance for age-3-and-older Yellow Perch for 2023 are projected to increase from the 2022 estimates in MU1 through MU4 by 38%, 25%, 10%, and 42%, respectively.

As a function of population abundance and mean weight-at-age from fishery-independent surveys, total biomass of age-2-and-older Yellow Perch for 2023 are projected to increase in management units 1 - 4 by 43%, 37%, 4% and 4%, respectively, compared to 2022 estimates (Figure 1.10).

Estimates of Yellow Perch survival for age-3-and-older in 2022 were 30%, 60%, 58%, and 51% in MUs 1 through 4, respectively (Figure 1.11). Estimates of Yellow Perch survival in 2022 for age-2-and-older fish were: 48% in MU1, 63% in MU2, 62% in MU3, and 59% in MU4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2022 were 47%, 9%, 11%, and 19% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2022 were: 24% in MU1, 5% in MU2, 6% in MU3, and 10% in MU4 (Figure 1.12). Exploitation rate for ages-2-and-older fish in MU2 during 2021 and 2022 were the lowest in the 48 year time series.

Charge 2: Harvest Strategy and Recommended Allowable Harvest

In 2023 the YPTG applied the harvest control rules finalized by the LEC and LEPMAG in 2020. The harvest control rules are comprised of:

- Target fishing mortality as a percent of the fishing mortality at maximum sustainable yield (F_{msy})
- Limit reference point of the biomass at maximum sustainable yield (B_{msy})
- Probabilistic risk tolerance, P-star, P*=0.20

- A limit on the annual change in TAC of ± 20% (when $P(SSB<B_{msy})<P^*$); see Yellow Perch Management Plan, Lake Erie Committee, 2020.

Target fishing rates and limit reference points are estimated annually using SCAA model results. Estimating reference points and recommended allowable harvest is a three-step process. First, estimated recruitment and spawning stock biomass from the SCAA model, along with maturity, weight, and average selectivity at age, are entered into an ADMB model that: 1) estimates the parameters of a Ricker stock-recruitment model and 2) calculates the theoretical spawning stock biomass without fishing (SSB_0). The stock-recruitment relationships for management units 1, 2, and 3, are fit using a hierarchical framework, while management unit 4 is fit independently. In the second step, maturity, weight, and average selectivity at age, along with the parameters of the stock-recruitment relationship are entered in an R-based model. This model estimates F_{msy} and B_{msy} for the harvest control rule. Finally, F_{msy}, F_{target} (as a percent of F_{msy}), and B_{msy} (as a percent of SSB_0), are entered into the PR ADMB model to estimate RAH in each management unit. If the model estimates that fishing at F_{target} meets or exceeds a 0.20 probability (P*) that the projected spawning stock biomass will be less than the limit reference point (B_{msy}), then the fishing rate is reduced until the probability is less than 0.20. Values of SSB_0, B_{msy}, F_{msy}, and F_{target} for each management unit can be found in Table 2.1. Target fishing rates are applied to population estimates and their standard errors to determine minimum, mean, and maximum RAH values for each management unit (Tables 2.2 and 2.3). In addition, RAH values may be subject to a ±20% limit on the annual change in TAC when $P(SSB<B_{msy}) < 0.20$ (ie: when P* harvest control rule is not invoked).

Quota allocation by management unit and jurisdiction for 2023 was determined by the same methods applied in 2009-2022, using GIS applications of jurisdictional surface area of waters within each MU (Figure 2.1). The allocation of shares by management unit and jurisdiction are:

Allocation of TAC within Management Unit and Jurisdiction, 2023:

MU1:	ONT	40.6%	OH	50.3%	MI	9.1%
MU2:	ONT	45.6%	OH	54.4%		
MU3:	ONT	52.3%	OH	32.4%	PA	15.3%
MU4:	ONT	58.0%	NY	31.0%	PA	11.0%

Charge 3: Utilize existing population models to produce the most scientifically defensible and reliable method for estimating and forecasting abundance, recruitment, and mortality.

In 2021 the Ohio fall trawl survey was not conducted due to a boat malfunction, this resulted in the loss of one year of age 2 and older data from this data set in the ADMB model. In 2022, the YPTG updated the MU1 model to account for a missing year of data in the Ohio trawl survey. In order to evaluate the impacts of the missing year of data, the 2022 model was run assuming that the survey did not occur in 2020 and using fabricated 2021 data. Changes to model estimates were negligible, and the 2023 MU1 model was run with Ohio trawl survey data from 1990 to 2020 and 2022 (missing 2021).

The YPTG has been using the current configuration of the ADMB model for 5 years. It has been found that abundance estimates in the last year of the ADMB model often decrease between the first estimate in the model and subsequent years estimates in the model. On average age 2 estimates for the various MUs decrease between 9% and 42% from the first time they are estimated by the model to the second time they are estimated by the model. This change was especially pronounced in MU1 during this year's model run. Further, age 2 estimates decrease an average of 26% to 58% between the first time they are estimated by the model to the third time they are estimated by the model, with the lowest change occurring in MU4 and the highest in MU1. Changes in random walk catchability estimates between model runs can contribute to changes in abundance estimates, with increases in catchability leading to reduced abundance estimates. Constant selectivity in the model may contribute to different abundance estimates, as changes in selectivity will not be recognized by the model when they occur. Additional work is required to evaluate retrospective patterns in model results and their causes.

Charge 4. Supply needed technical support throughout the upcoming YPMP review process

The Yellow Perch Management Plan (YPMP) runs from 2020 to 2024. A review of YPMP will begin in 2023. The review will evaluate the existing Yellow Perch assessment model and the harvest control rule. During 2022, the YPTG identified several aspects of the YPMP to incorporate into the review, including: the use of the recruitment survey data in the assessment model, methods used to estimate catchability and selectivity, the data used in the stock recruit relationship to estimate the reference points, and the harvest control rules including how to implement fishing when population abundance is low.

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Table 1.1. Lake Erie Yellow Perch harvest in pounds by management unit (Unit) and agency, 2013-2022

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	**Harvest**
Unit 1	2013	648,884	43	789,088	52	76,994	5	--	--	--	--	1,514,966
	2014	620,667	56	391,361	36	87,511	8	--	--	--	--	1,099,539
	2015	541,938	48	485,744	43	94,225	8	--	--	--	--	1,121,907
	2016	947,052	42	886,068	40	397,044	18	--	--	--	--	2,230,164
	2017	1,277,587	46	1,239,575	45	255,605	9	--	--	--	--	2,772,767
	2018	1,262,229	54	956,016	41	107,789	5	--	--	--	--	2,326,034
	2019	847,476	69	357,533	29	15,745	1	--	--	--	--	1,220,754
	2020	857,561	64	391,231	29	84,613	6	--	--	--	--	1,333,405
	2021	959,259	58	625,787	38	69,575	4	--	--	--	--	1,654,621
	2022	770,476	51	658,935	44	67,667	5	--	--	--	--	1,497,078
Unit 2	2013	1,803,684	51	1,721,668	49	--	--	--	--	--	--	3,525,352
	2014	1,679,175	52	1,543,226	48	--	--	--	--	--	--	3,222,401
	2015	1,489,433	57	1,131,993	43	--	--	--	--	--	--	2,621,426
	2016	1,283,379	62	792,869	38	--	--	--	--	--	--	2,076,248
	2017	1,498,437	70	643,554	30	--	--	--	--	--	--	2,141,991
	2018	1,271,365	69	559,122	31	--	--	--	--	--	--	1,830,487
	2019	740,490	63	433,477	37	--	--	--	--	--	--	1,173,967
	2020	407,553	60	268,213	40	--	--	--	--	--	--	675,766
	2021	205,377	63	121,200	37	--	--	--	--	--	--	326,577
	2022	177,919	60	117,860	40	--	--	--	--	--	--	295,779
Unit 3	2013	2,983,539	76	796,307	20	--	--	155,193	4	--	--	3,935,039
	2014	2,668,921	70	979,937	26	--	--	168,690	4	--	--	3,817,548
	2015	2,131,211	77	572,736	21	--	--	77,558	3	--	--	2,781,505
	2016	2,020,470	76	522,549	20	--	--	107,972	4	--	--	2,650,991
	2017	2,027,235	77	504,223	19	--	--	107,335	4	--	--	2,638,793
	2018	1,807,645	78	460,797	20	--	--	54,085	2	--	--	2,322,527
	2019	1,328,966	79	320,756	19	--	--	38,953	2	--	--	1,688,675
	2020	478,837	71	175,550	26	--	--	18,022	3	--	--	672,408
	2021	704,636	75	220,127	23	--	--	18,938	2	--	--	943,701
	2022	932,682	77	211,444	18	--	--	63,872	5	--	--	1,207,998
Unit 4	2013	496,666	72	--	--	--	--	74,277	11	119,869	17	690,812
	2014	485,899	74	--	--	--	--	16,671	3	149,669	23	652,239
	2015	297,716	77	--	--	--	--	10,055	3	76,597	20	384,368
	2016	231,063	87	--	--	--	--	6,791	3	28,078	11	265,932
	2017	179,730	76	--	--	--	--	16,078	7	39,598	17	235,407
	2018	272,733	90	--	--	--	--	1,452	0	29,159	10	303,344
	2019	326,179	85	--	--	--	--	1,485	0	56,219	15	383,883
	2020	384,737	91	--	--	--	--	2,664	1	36,083	9	423,484
	2021	311,866	84	--	--	--	--	1,677	0	57,567	16	371,110
	2022	314,039	79	--	--	--	--	533	0	84,399	21	398,971
Lakewide Totals	2013	5,932,773	61	3,307,063	34	76,994	1	229,470	2	119,869	1	9,666,169
	2014	5,454,662	62	2,914,524	33	87,511	1	185,361	2	149,669	2	8,791,727
	2015	4,460,298	65	2,190,473	32	94,225	1	87,613	1	76,597	1	6,909,206
	2016	4,481,964	62	2,201,486	30	397,044	5	114,763	2	28,078	0	7,223,335
	2017	4,982,989	64	2,387,352	31	255,605	3	123,413	2	39,598	1	7,788,958
	2018	4,613,972	68	1,975,935	29	107,789	2	55,537	1	29,159	0	6,782,393
	2019	3,243,111	73	1,111,766	25	15,745	0	40,437	1	56,219	1	4,467,278
	2020	2,128,688	69	834,994	27	84,613	3	20,685	1	36,083	1	3,105,063
	2021	2,181,138	66	967,114	29	69,575	2	20,615	1	57,567	2	3,296,009
	2022	2,195,116	65	988,239	29	67,667	2	64,405	2	84,399	2	3,399,826

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to 2022 (negating ice allowance).

Table 1.2. Harvest, effort and harvest per unit effort summaries for Lake Erie Yellow Perch fisheries in Management Unit 1 (Western Basin) by agency and gear type, 2013-2022.

		Unit 1					
		Michigan	Ohio		Ontario Gill Nets		Ontario
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trap Nets
Harvest	2013	76,994	0	789,088	608,241	40,617	26
(pounds)	2014	87,511	0	391,361	596,956	23,633	78
	2015	94,225	0	485,744	533,167	8,712	59
	2016	397,044	103,345	782,723	938,558	8,445	49
	2017	255,605	447,263	792,312	1,271,282	5,466	839
	2018	107,789	439,720	516,296	1,248,042	14,031	156
	2019	15,745	193,243	164,290	818,773	28,670	33
	2020	84,613	136,555	254,676	853,096	4,463	2
	2021	69,575	182,521	443,266	939,063	20,179	17
	2022	67,667	188,739	470,196	756,770	13,706	0
Harvest	2013	35	0	358	276	18	0.01
(Metric)	2014	40	0	177	271	11	0.04
(tonnes)	2015	43	0	220	242	4	0.03
	2016	180	47	355	426	4	0.02
	2017	116	203	359	577	2	0.38
	2018	49	199	234	566	6	0.07
	2019	7	88	75	371	13	0.01
	2020	38	62	115	387	2	0.00
	2021	32	83	201	426	9	0.01
	2022	31	86	213	343	6	0.00
Effort	2013	130,809	0	946,138	3,412	547	--
(a)	2014	76,996	0	630,989	3,398	362	--
	2015	137,246	0	659,460	4,074	508	--
	2016	251,426	2,446	824,418	6,091	431	--
	2017	204,877	3,830	775,334	5,656	600	--
	2018	137,930	3,500	500,695	5,143	667	--
	2019	57,929	3,811	284,068	6,363	714	--
	2020	151,528	3,341	500,595	9,183	393	--
	2021	113,935	3,741	628,491	10,489	1,124	--
	2022	115,916	4,943	621,067	8,588	1,354	--
Harvest Rates	2013	1.7	--	2.8	80.8	33.7	--
(b)	2014	2.2	--	3.0	79.7	29.6	--
	2015	2.7	--	3.1	59.4	7.8	--
	2016	4.8	19.2	4.1	69.9	8.9	--
	2017	4.3	53.0	3.4	101.9	4.1	--
	2018	2.3	57.0	2.9	110.1	9.5	--
	2019	0.8	23.0	1.7	58.4	18.2	--
	2020	1.8	18.5	1.6	42.1	5.2	--
	2021	1.7	22.1	2.0	40.6	8.1	--
	2022	1.5	17.3	2.1	40.0	4.6	--

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(c) the Ontario sport fishery harvested approximately 19,579 lbs of yellow perch in the 2014 creel survey
(*) large mesh catch rates are not targeted and are therefore of limited value.

Table 1.3. Harvest, effort and harvest per unit effort summaries for Lake Erie Yellow Perch fisheries in Management Unit 2 (western Central Basin) by agency and gear type, 2013-2022.

		Unit 2				
		Ohio		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2013	1,230,249	491,419	1,657,811	145,475	398
(pounds)	2014	1,280,184	263,042	1,550,722	128,453	0
	2015	1,005,061	126,932	1,471,107	18,268	58
	2016	688,033	104,836	1,248,729	34,631	19
	2017	590,447	53,107	1,435,508	62,872	57
	2018	528,234	30,888	1,204,621	66,744	0
	2019	419,631	13,846	569,850	170,640	0
	2020	248,721	19,492	376,946	30,604	3
	2021	116,109	5,091	151,859	53,518	0
	2022	97,659	20,201	152,490	25,429	0
Harvest	2013	558	223	752	66	0.2
(Metric)	2014	581	119	703	58	0.0
(tonnes)	2015	456	58	667	8	0.0
	2016	312	48	566	16	0.0
	2017	268	24	651	29	0.0
	2018	240	14	546	30	0.0
	2019	190	6	258	77	0.0
	2020	113	9	171	14	0.0
	2021	53	2	69	24	0.0
	2022	44	9	69	12	0.0
Effort	2013	5,851	428,187	6,821	1,951	--
(a)	2014	5,713	280,018	6,653	1,816	--
	2015	6,309	217,637	9,459	1,207	--
	2016	4,510	204,745	6,424	1,934	--
	2017	2,567	119,163	6,094	1,946	--
	2018	1,551	45,683	5,964	2,155	--
	2019	2,192	24,826	4,431	4,050	--
	2020	2,177	27,006	4,294	1,920	--
	2021	839	1,898	1,951	2,999	--
	2022	1,571	26,634	1,479	1,881	
Harvest Rates	2013	95.4	2.6	110.2	33.8	--
(b)	2014	101.6	2.7	105.7	32.1	--
	2015	72.2	1.5	70.5	6.9	--
	2016	69.2	1.2	88.2	8.1	--
	2017	104.3	0.8	106.8	14.7	--
	2018	154.5	0.8	91.6	14.0	--
	2019	86.8	0.4	58.3	19.1	--
	2020	51.8	1.1	39.8	7.2	--
	2021	62.8	0.1	35.3	8.1	--
	2022	28.2	0.5	46.8	6.1	--

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(c) the Ontario sport fishery harvested approximately 6,825 lbs of yellow perch in the 2014 creel survey
(*) large mesh catch rates are not targeted and therefore of limited value

Table 1.4. Harvest, effort and harvest per unit effort summaries for Lake Erie Yellow Perch fisheries in Management Unit 3 (eastern Central Basin) by agency and gear type, 2013-2022.

		Unit 3						
		Ohio		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2013	300,346	495,961	790	154,403	2,818,241	164,712	586
(pounds)	2014	265,963	713,974	506	168,184	2,597,079	71,136	706
	2015	266,030	306,706	6,854	70,704	2,084,595	43,072	3,544
	2016	349,844	172,705	51,148	56,824	2,003,842	16,459	169
	2017	449,979	54,244	45,741	61,594	1,964,728	61,127	1,380
	2018	439,233	21,564	51,093	2,992	1,743,484	63,902	259
	2019	318,089	2,667	34,323	4,630	1,261,586	67,230	150
	2020	171,180	4,370	14,961	3,061	403,720	75,102	15
	2021	206,384	13,743	17,303	1,635	622,917	81,711	8
	2022	207,890	3,554	60,665	3,207	904,990	27,671	21
Harvest	2013	136	225	0.4	70	1,278	75	0.3
(Metric)	2014	121	324	0.2	76	1,178	32	0.3
(tonnes)	2015	121	139	3.1	32	945	20	1.6
	2016	159	78	23.2	26	909	7	0.1
	2017	204	25	20.7	28	891	28	0.6
	2018	199	10	23.2	1	791	29	0.1
	2019	144	1	15.6	2	572	30	0.1
	2020	78	2	6.8	1	183	34	0.0
	2021	94	6	7.8	1	283	37	0.0
	2022	94	2	27.5	1	410	13	0.0
Effort	2013	1,014	232,234	25	83,739	6,037	968	--
(a)	2014	581	336,607	186	90,024	5,678	422	--
	2015	1,067	212,226	310	70,490	5,000	560	--
	2016	2,000	181,622	604	57,545	5,964	798	--
	2017	1,679	58,119	262	98,302	4,775	1,206	--
	2018	2,233	16,805	324	7,836	5,204	1,031	--
	2019	2,901	2,475	382	5,668	6,956	1,264	--
	2020	1,811	5,022	241	1,697	3,968	1,275	--
	2021	2,075	9,688	92	3,301	5,191	1,519	--
	2022	2,405	2,341	150	3,779	4,942	788	--
Harvest Rates	2013	134.3	5.0	14.3	5.2	211.7	77.2	--
(b)	2014	207.6	4.0	1.2	4.7	207.4	76.4	--
	2015	113.1	3.2	10.0	2.8	189.1	34.9	--
	2016	79.3	1.9	38.4	2.0	152.4	9.4	--
	2017	121.5	1.4	79.2	2.1	186.6	23.0	--
	2018	89.2	1.6	71.5	0.3	151.9	28.1	--
	2019	49.7	0.1	40.7	0.6	82.2	24.1	--
	2020	42.9	1.4	28.2	0.7	46.1	26.7	--
	2021	45.1	1.2	85.3	0.5	54.4	24.4	--
	2022	39.2	0.4	183.4	0.6	83.0	15.9	--

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(c) the Ontario sport fishery harvested approximately 132,585 lbs of yellow perch in the 2014 creel survey
(*) large mesh catch rates are not targeted and therefore of limited value

Table 1.5. Harvest, effort and harvest per unit effort summaries for Lake Erie Yellow Perch fisheries in Management Unit 4 (Eastern Basin) by agency and gear type, 2013-2022.

		Unit 4						
		New York		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2013	15,814	104,055	0	74,277	492,233	2,778	1,665
(pounds)	2014	10,356	139,313	0	16,671	482,925	1,160	1,814
	2015	12,565	64,032	0	10,055	295,833	1,083	800
	2016	11,465	16,613	0	6,791	230,333	65	665
	2017	12,366	27,232	0	16,078	177,475	32	2,223
	2018	10,657	18,502	0	1,452	271,795	583	355
	2019	18,750	37,469	0	1,485	326,075	58	46
	2020	14,837	21,246	0	2,664	384,684	39	14
	2021	11,354	46,213	0	1,677	305,463	6,254	149
	2022	14,913	69,486	0	533	312,847	410	782
Harvest	2013	7.2	47.2	0	33.7	223.2	1.26	0.8
(Metric)	2014	4.7	63.2	0	7.6	219.0	0.53	0.8
(tonnes)	2015	5.7	29.0	0	4.6	134.2	0.49	0.4
	2016	5.2	7.5	0	3.1	104.5	0.03	0.3
	2017	5.6	12.4	0	7.3	80.5	0.01	1.0
	2018	4.8	8.4	0	0.7	123.3	0.26	0.2
	2019	8.5	17.0	0	0.7	147.9	0.03	0.0
	2020	6.7	9.6	0	1.2	174.5	0.02	0.0
	2021	5.1	21.0	0	0.8	138.5	2.84	0.1
	2022	6.8	31.5	0	0.2	141.9	0.19	0.4
Effort	2013	364	65,743	0	48,093	1,932	14.5	--
(a)	2014	213	76,817	0	13,959	2,016	8.3	--
	2015	357	44,029	0	18,638	1,774	44.7	--
	2016	248	27,436	0	11,934	1,303	11.2	--
	2017	208	26,154	0	12,843	565	6.0	--
	2018	135	19,035	0	3,940	887	58.7	--
	2019	224	30,166	0	2,730	947	29.7	--
	2020	136	18,677	0	1,294	1,492	34.4	--
	2021	137	29,237	0	1,598	2,081	67.1	--
	2022	241	49,968	0	600	1,317	33.6	
Harvest Rates	2013	19.7	2.59	--	2.9	115.5	87.1	--
(b)	2014	22.0	2.78	--	2.3	108.6	63.4	--
	2015	16.0	2.01	--	1.2	75.6	11.0	--
	2016	21.0	0.95	--	1.3	80.1	2.6	--
	2017	27.0	1.35	--	1.2	142.3	2.4	--
	2018	35.8	1.53	--	0.4	139.0	4.5	--
	2019	38.0	1.81	--	0.6	156.1	0.9	--
	2020	49.5	1.55	--	1.2	117.0	0.5	--
	2021	37.6	2.04	--	0.4	66.6	42.3	--
	2022	28.1	1.90	--	0.0	107.7	5.5	--

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(c) the Ontario sport fishery harvested approximately 21,361 lbs of yellow perch in the 2014 creel survey
(*) large mesh catch rates are not targeted and therefore of limited value

Table 1.6. Estimated 2022 Lake Erie Yellow Perch harvest by age and numbers of fish by gear and management unit (Unit).

		Unit 1		**Unit 2**		**Unit 3**		**Unit 4**		**Lakewide**	
Gear	Age	Number	%	Number	%	Number	%	Number	%	Number	%
Gill Nets	1	34,600	1.4	2,274	0.4	5,255	0.2	0	0.0	42,129	0.6
	2	1,269,487	50.1	78,778	15.4	207,283	7.0	309,392	33.6	1,864,940	27.0
	3	700,035	27.6	312,772	61.2	2,191,877	74.2	496,279	53.8	3,700,963	53.5
	4	464,878	18.3	72,461	14.2	326,182	11.0	88,177	9.6	951,697	13.8
	5	40,396	1.6	29,561	5.8	147,511	5.0	3,548	0.4	221,016	3.2
	6+	24,814	1.0	14,835	2.9	74,483	2.5	24,486	2.7	138,619	2.0
	Total	2,534,210	*55.8*	510,681	*67.1*	2,952,591	*84.3*	921,882	*87.0*	6,919,364	*70.1*
Trap Nets	1	263	0.1	140	0.1	0	0.0	0	0.0	403	0.0
	2	91,083	17.7	51,504	22.9	54,780	10.1	673	2.0	198,040	15.1
	3	153,202	29.8	85,442	38.0	261,500	48.2	17,281	51.3	517,426	39.4
	4	234,984	45.7	63,713	28.4	109,207	20.1	4,264	12.7	412,167	31.4
	5	21,066	4.1	10,376	4.6	62,275	11.5	2,918	8.7	96,635	7.4
	6+	13,106	2.6	13,486	6.0	54,844	10.1	8,528	25.3	89,964	6.8
	Total	513,703	*11.3*	224,661	*29.5*	542,606	*15.5*	33,664	*3.2*	1,314,634	*13.3*
Sport	1	163,113	10.9	365	1.4	0	0.0	0	0.0	163,478	10.0
	2	509,188	34.1	2,023	7.8	255	2.9	5,260	5.0	516,725	31.6
	3	375,404	25.1	6,447	24.8	1,451	16.6	30,500	29.3	413,802	25.3
	4	379,333	25.4	11,969	46.0	1,397	16.0	9,772	9.4	402,472	24.6
	5	34,074	2.3	2,304	8.9	1,707	19.5	9,057	8.7	47,142	2.9
	6+	33,930	2.3	2,916	11.2	3,923	44.9	49,671	47.6	90,440	5.5
	Total	1,495,042	*32.9*	26,024	*3.4*	8,734	*0.2*	104,260	*9.8*	1,634,060	*16.6*
All Gear	1	197,975	4.4	2,779	0.4	5,255	0.1	0	0.0	206,010	2.1
	2	1,869,758	41.2	132,305	17.4	262,318	7.5	315,324	29.8	2,579,705	26.1
	3	1,228,642	27.0	404,661	53.1	2,454,828	70.1	544,060	51.3	4,632,191	46.9
	4	1,079,194	23.8	148,143	19.5	436,786	12.5	102,213	9.6	1,766,336	17.9
	5	95,536	2.1	42,241	5.5	211,494	6.0	15,523	1.5	364,793	3.7
	6+	71,850	1.6	31,237	4.1	133,250	3.8	82,686	7.8	319,023	3.2
	Total	4,542,955	46.0	761,367	7.7	3,503,931	35.5	1,059,806	10.7	9,868,058	100.0

Note: Values in *italics* delineate harvest percentage by gear in each Unit, while the values in the 'All Gear' boxes are for lakewide harvest percentage by Unit.

Table 1.7. Yellow Perch stock size (millions of fish) in each Lake Erie management unit. Estimated abundance in the years 2004 to 2022 and projected abundance in 2023 from the ADMB catch-age analysis.

	Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Unit 1	2	3.863	44.030	2.227	10.634	13.276	28.720	22.192	8.642	10.603	2.223	5.760	16.197	35.490	9.731	3.080	4.758	23.182	13.794	22.990	36.128
	3	23.040	2.421	27.702	1.403	6.719	8.548	18.164	13.784	5.361	6.467	1.312	3.465	9.560	19.951	5.577	1.827	2.858	13.176	7.768	13.253
	4	2.446	11.926	1.273	14.607	0.769	3.931	4.655	9.313	7.053	2.653	2.842	0.605	1.494	3.430	7.603	2.352	0.763	0.967	4.288	2.799
	5	4.830	0.997	5.014	0.537	6.944	0.412	1.838	1.952	3.892	2.962	0.905	1.015	0.193	0.335	0.831	2.113	0.583	0.129	0.151	0.816
	6+	4.282	3.655	2.081	2.819	1.715	4.539	2.516	1.882	1.616	2.291	1.845	1.070	0.697	0.244	0.139	0.225	0.445	0.165	0.048	0.031
	2 and Older	38.461	63.029	38.296	30.000	29.422	46.150	49.364	35.572	28.525	16.597	12.664	22.353	47.434	33.690	17.229	11.274	27.830	28.231	35.244	53.028
	3 and Older	34.598	18.999	36.069	19.365	16.147	17.430	27.172	26.930	17.922	14.374	6.904	6.155	11.944	23.959	14.149	6.517	4.649	14.437	12.254	16.900
Unit 2	2	6.386	174.596	7.131	23.148	24.500	55.818	42.016	7.254	17.957	10.925	26.282	7.955	25.711	10.781	4.955	4.891	13.244	13.709	15.598	16.520
	3	64.554	4.168	113.147	4.637	15.271	16.176	36.549	27.599	4.764	11.740	7.082	17.004	5.076	16.512	6.921	3.178	3.128	8.560	9.060	10.350
	4	4.049	36.810	2.290	63.070	2.815	9.378	9.378	21.674	16.321	2.735	6.381	3.755	8.174	2.547	8.309	3.469	1.544	1.629	5.211	5.647
	5	8.016	1.932	16.483	1.057	34.201	1.579	4.659	4.870	11.197	7.900	1.185	2.601	1.245	2.964	0.941	3.070	1.185	0.606	0.893	2.980
	6+	4.449	5.278	2.898	8.110	4.635	20.563	10.162	7.109	5.720	7.337	5.792	2.466	1.370	0.792	1.180	0.684	1.065	0.758	0.711	0.870
	2 and Older	87.454	222.785	141.949	100.023	81.423	103.514	102.763	68.506	55.958	40.638	46.722	33.781	41.576	33.595	22.305	15.292	20.166	25.261	31.472	36.365
	3 and Older	81.068	48.189	134.818	76.875	56.923	47.695	60.747	61.252	38.002	29.713	20.440	25.826	15.865	22.815	17.350	10.400	6.923	11.553	15.874	19.845
Unit 3	2	6.208	129.435	8.827	35.119	44.476	61.149	52.056	12.427	28.205	21.636	40.311	7.883	34.137	12.298	17.455	12.169	15.109	41.913	29.897	14.648
	3	34.134	4.132	86.170	5.867	23.398	29.675	40.760	34.674	8.273	18.749	14.380	26.723	5.225	22.574	8.151	11.538	7.985	10.033	27.840	19.886
	4	3.699	21.663	2.611	53.002	3.721	15.061	18.964	25.697	21.755	5.098	11.590	8.691	15.994	3.033	13.401	4.665	6.073	4.808	6.065	17.075
	5	7.504	2.149	12.409	1.382	30.606	2.242	8.895	10.774	14.416	11.637	2.749	5.878	4.288	7.268	1.462	5.833	1.611	3.038	2.431	3.197
	6+	8.530	8.580	5.609	8.553	5.280	20.549	12.463	11.151	11.243	12.267	11.535	6.225	5.131	3.529	4.461	2.088	2.025	1.582	2.051	2.106
	2 and Older	60.075	165.959	115.625	103.924	107.481	128.675	133.138	94.724	83.892	69.387	80.564	55.399	64.775	48.702	44.930	36.293	32.804	61.375	68.284	56.912
	3 and Older	53.867	36.524	106.798	68.805	63.005	67.526	81.081	82.297	55.687	47.751	40.254	47.516	30.638	36.404	27.475	24.124	17.694	19.462	38.387	42.264
Unit 4	2	0.788	5.597	0.614	5.945	4.001	4.548	5.781	0.582	6.213	1.286	2.437	0.375	2.347	3.098	9.045	1.025	1.845	5.901	6.686	2.270
	3	2.457	0.521	3.659	0.399	3.905	2.624	2.963	3.727	0.372	3.950	0.808	1.509	0.233	1.466	1.988	5.604	0.640	1.152	3.640	4.255
	4	0.604	1.552	0.312	2.142	0.245	2.378	1.548	1.673	2.031	0.197	1.987	0.383	0.726	0.115	0.811	0.946	2.742	0.315	0.538	1.938
	5	0.702	0.356	0.825	0.159	1.199	0.135	1.224	0.738	0.739	0.848	0.074	0.671	0.133	0.266	0.052	0.280	0.342	1.008	0.104	0.227
	6+	1.424	1.226	0.868	0.899	0.623	1.016	0.618	0.910	0.777	0.673	0.613	0.307	0.364	0.228	0.238	0.138	0.166	0.210	0.430	0.257
	2 and Older	5.975	9.251	6.279	9.543	9.973	10.701	12.135	7.629	10.131	6.953	5.919	3.246	3.803	5.174	12.134	7.994	5.735	8.585	11.398	8.947
	3 and Older	5.187	3.654	5.665	3.599	5.972	6.153	6.354	7.048	3.919	5.668	3.482	2.871	1.456	2.076	3.090	6.969	3.889	2.684	4.711	6.677

Table 2.1. Parameters of the stock-recruitment relationship, spawning stock biomass, limit reference point and target fishing rate for each management unit. F_{actual} may be reduced from F_{target} if P(SSB<Bmsy) ≥ P*).

	Spawn/ Recruit Relationship Parameters			Spawning Stock Biomass (Unfished Population)		Spawning Stock Biomass (kgs)		Biomass at MSY (Limit Reference Point)			Fishing Rate			
Unit	**log(alpha)**	**beta**	**sigma**	**SSB_0**	**sd($logSSB_0$)**	**2023**	**2024[a]**	**B_{msy}**	**%SSB_0**	**P**	**F_{msy}**	**% F_{msy}**	**F_{target}**	**F_{actual}[b]**
MU1	2.57	3.20E-07	0.97	6,491,579	0.22	2,902,510	4,527,930	1,812,720	28%	0.00	1.93	28%	0.540	0.540
MU2	2.16	1.38E-07	0.97	13,901,030	0.21	4,083,770	3,917,690	3,871,245	28%	0.49	1.68	35%	0.588	0.106
MU3	2.24	1.43E-07	0.97	13,179,037	0.20	6,906,140	5,779,340	3,713,957	28%	0.03	2.00	32%	0.640	0.640
MU4	2.02	1.16E-06	1.02	1,695,040	0.22	1,394,620	1,188,450	483,010	28%	0.00	1.64	34%	0.558	0.558

(a) Spawning stock biomass when population is fished at target fishing rate

(b) In MU2 fishing at F_{target} exceeds a 0.20 probability (P) that the projected spawning stock biomass will be equal to or less than the limit reference point (B_{msy}), therefore the fishing rate was reduced until the probability was less than 0.20.*

Table 2.2. Estimated harvest of Lake Erie Yellow Perch for 2023 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

		2023 Stock Size (millions of fish)			2023 Mean Biomass	Exploitation Rate				2023 Catch (millions of fish)			3-yr Mean Weight in	2023 Harvest Range Catch (millions of lbs)		
	Age	**Min.**	**Mean**	**Max.**	**mil. lbs**	**F [a]**	**s(age)**	**F(age)**	**(u)**	**Min.**	**Mean**	**Max.**	Harvest (kg)	**Min.**	**Mean**	**Max.**
Unit 1	2	23.858	36.128	48.398	9.000	0.540	0.141	0.076	0.061	1.446	2.190	2.934	0.128	0.408	0.618	0.828
	3	10.653	13.253	15.853	4.763	0.540	0.475	0.257	0.188	2.006	2.495	2.985	0.154	0.681	0.847	1.013
	4	2.177	2.799	3.421	1.481	0.540	0.799	0.432	0.293	0.638	0.820	1.003	0.183	0.257	0.331	0.405
	5	0.562	0.816	1.071	0.491	0.540	1.000	0.540	0.350	0.197	0.286	0.375	0.216	0.094	0.136	0.179
	6+	0.017	0.031	0.046	0.021	0.540	0.560	0.303	0.217	0.004	0.007	0.010	0.248	0.002	0.004	0.005
	Total	37.267	53.028	68.788	15.756				0.109	4.290	5.798	7.306	0.151	1.439	1.936	2.430
	(3+)	13.409	16.900	20.390	6.756				0.214	2.844	3.608	4.372	0.166	1.034	1.318	1.602
Unit 2	2	11.973	16.520	21.066	4.334	0.106	0.081	0.009	0.007	0.084	0.116	0.148	0.140	0.026	0.036	0.046
	3	8.710	10.350	11.989	4.609	0.106	0.399	0.042	0.034	0.297	0.353	0.409	0.157	0.103	0.122	0.142
	4	4.811	5.647	6.482	3.705	0.106	0.762	0.081	0.064	0.308	0.362	0.415	0.203	0.138	0.162	0.186
	5	2.516	2.980	3.443	2.257	0.106	1.000	0.106	0.083	0.209	0.247	0.286	0.210	0.097	0.115	0.132
	6+	0.690	0.870	1.050	0.822	0.106	0.970	0.103	0.081	0.056	0.070	0.085	0.276	0.034	0.043	0.052
	Total	28.699	36.365	44.031	15.728				0.032	0.954	1.149	1.343	0.188	0.397	0.477	0.557
	(3+)	16.726	19.845	22.964	11.394				0.052	0.870	1.032	1.195	0.194	0.371	0.441	0.511
Unit 3	2	9.783	14.648	19.514	2.691	0.640	0.025	0.016	0.013	0.126	0.188	0.251	0.131	0.036	0.054	0.072
	3	16.250	19.886	23.523	6.094	0.640	0.229	0.146	0.113	1.833	2.244	2.654	0.152	0.614	0.752	0.889
	4	14.138	17.075	20.013	8.244	0.640	0.592	0.379	0.263	3.722	4.495	5.269	0.180	1.477	1.784	2.091
	5	2.620	3.197	3.773	2.227	0.640	0.852	0.545	0.353	0.924	1.127	1.330	0.200	0.407	0.497	0.587
	6+	1.646	2.106	2.566	2.022	0.640	1.000	0.640	0.398	0.655	0.838	1.021	0.247	0.357	0.456	0.556
	Total	44.436	56.912	69.389	21.279				0.156	7.260	8.892	10.524	0.181	2.886	3.543	4.195
	(3+)	34.654	42.264	49.874	18.588				0.206	7.134	8.704	10.274	0.182	2.855	3.489	4.123
Unit 4	2	1.452	2.270	3.088	0.617	0.558	0.093	0.052	0.042	0.060	0.095	0.129	0.138	0.018	0.029	0.039
	3	3.356	4.255	5.153	2.132	0.558	0.415	0.232	0.172	0.576	0.731	0.885	0.155	0.197	0.250	0.302
	4	1.528	1.938	2.347	1.265	0.558	0.862	0.480	0.319	0.488	0.619	0.750	0.172	0.185	0.235	0.284
	5	0.165	0.227	0.288	0.177	0.558	1.000	0.558	0.359	0.059	0.081	0.103	0.190	0.025	0.034	0.043
	6+	0.176	0.257	0.339	0.235	0.558	0.696	0.388	0.268	0.047	0.069	0.091	0.241	0.025	0.037	0.048
	Total	6.678	8.947	11.215	4.426				0.178	1.232	1.595	1.958	0.166	0.450	0.584	0.718
	(3+)	5.226	6.677	8.128	3.809				0.225	1.171	1.500	1.829	0.168	0.432	0.555	0.678

(a) In MU2 fishing at F_{target} exceeds a 0.20 probability (P*) that the projected spawning stock biomass will be equal to or less than the limit reference point (B_{msy}), therefore the fishing rate was reduced until the probability was less than 0.20.

Table 2.3. Lake Erie Yellow Perch fishing rates and the Recommended Allowable Harvest (RAH; in millions of pounds) for 2023 by Management Unit (Unit). RAH values may be subject to a limit on the annual change in TAC (±20%).

	Fishing	Recommended Allowable Harvest (millions lbs.)			±20% of previous year TAC	
Unit	**Rate**	**MIN**	**MEAN**	**MAX**	MIN (-20%)	MAX (+20%)
1	0.540	1.439	1.936	2.430	2.430	3.646
2	0.106	0.397	0.477	0.557	0.430	0.644
3	0.640	2.886	3.543	4.195	2.466	3.698
4	0.558	0.450	0.584	0.718	0.422	0.634
Total		5.172	6.540	7.899	5.748	8.622

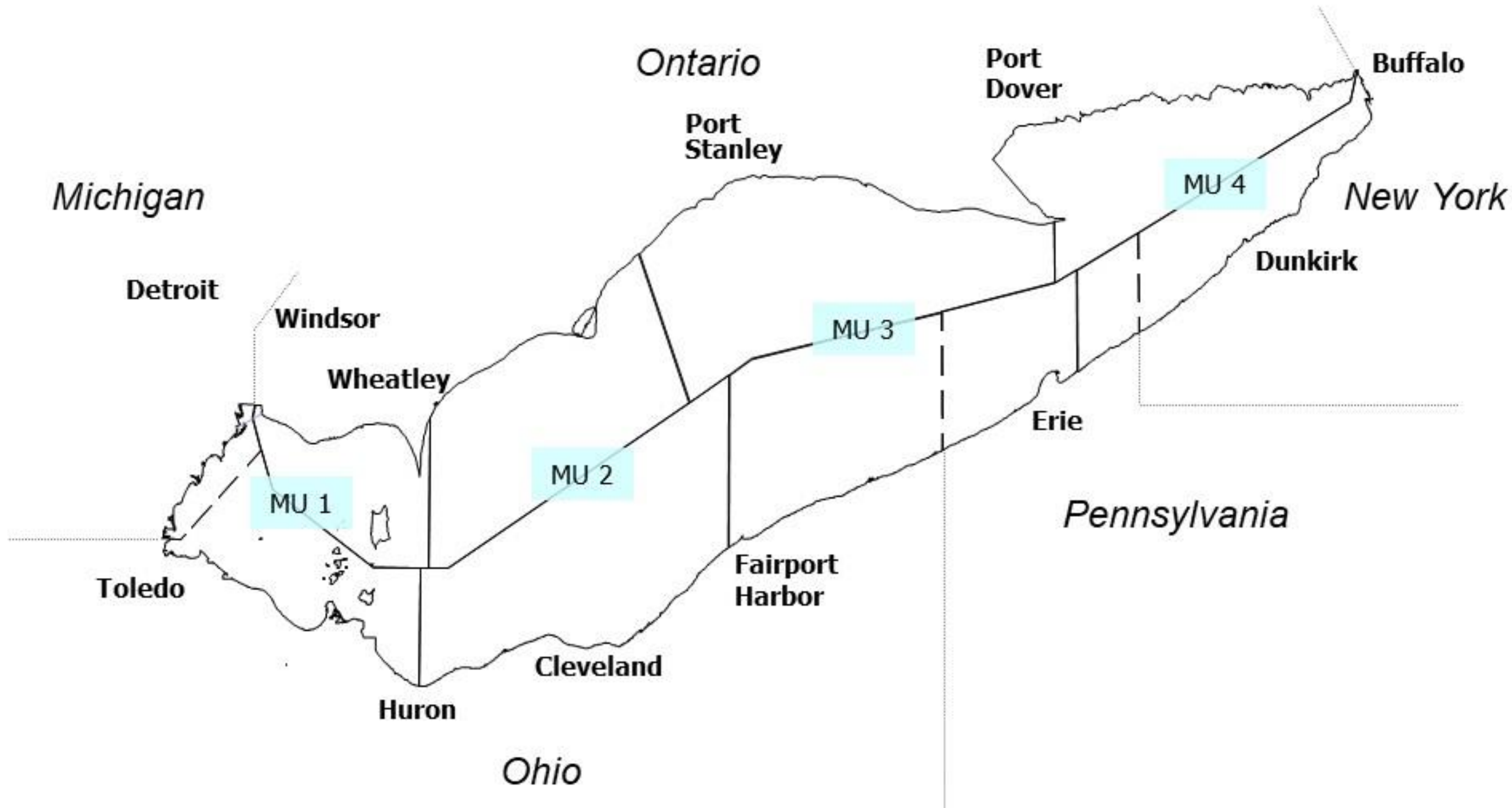


Figure 1.1. The Yellow Perch Management Units (MUs) of Lake Erie defined by the YPTG and LEC, for illustrative purposes.

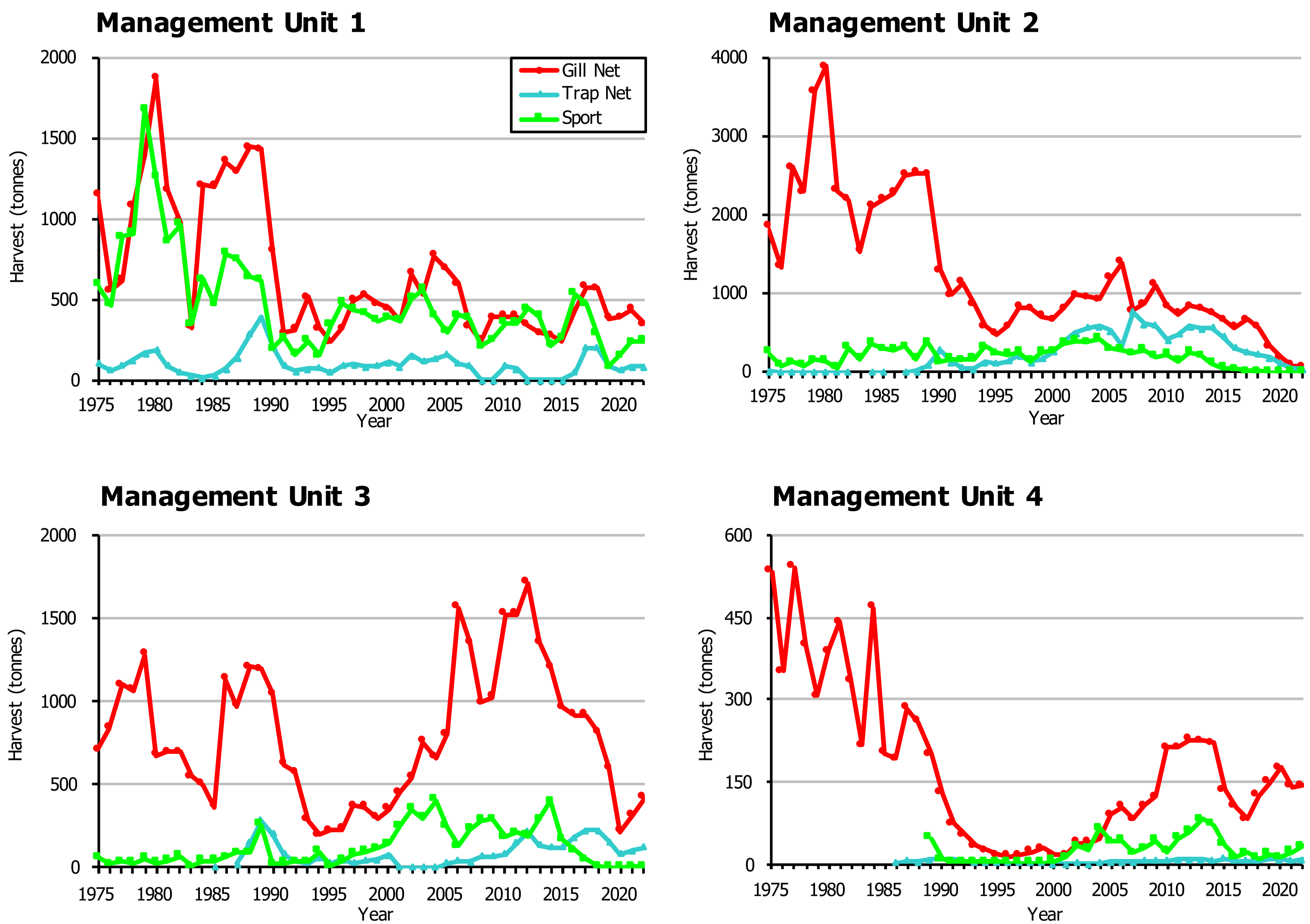


Figure 1.2. Historic Lake Erie Yellow Perch harvest (metric tonnes) by management unit and gear type.

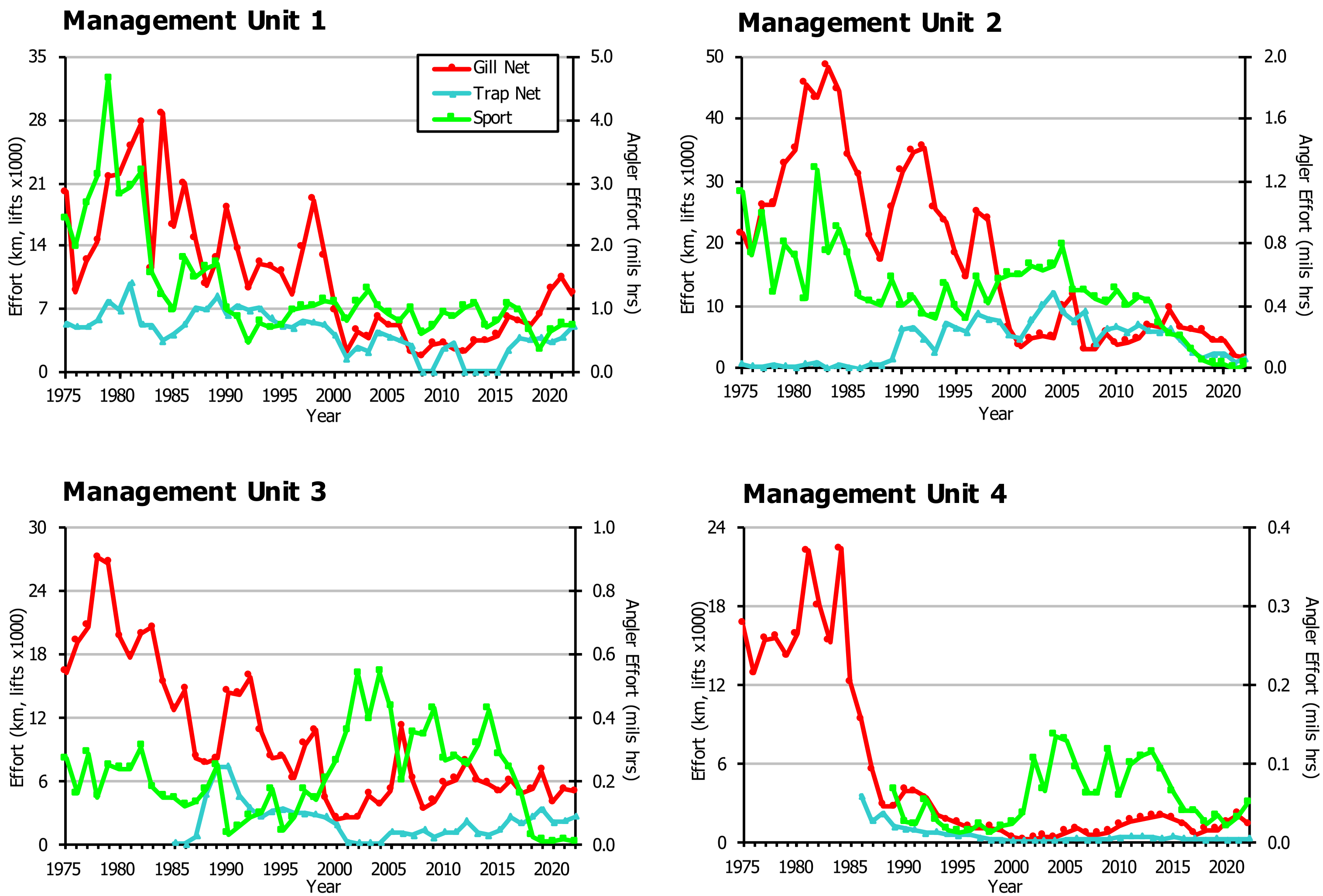


Figure 1.3. Historic Lake Erie Yellow Perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh (< 3″).

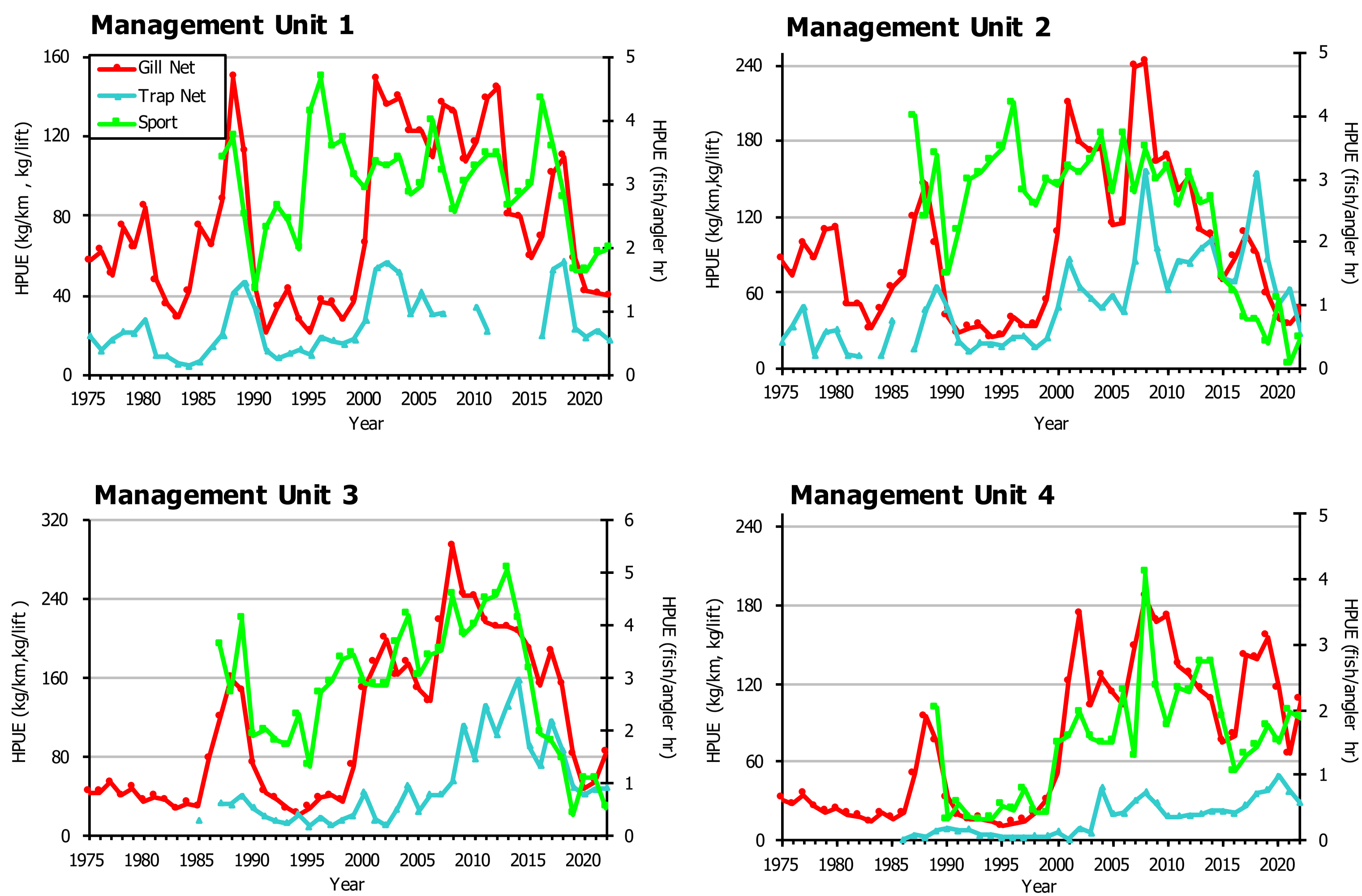


Figure 1.4. Historic Lake Erie Yellow Perch harvest per unit effort (HPUE) by management unit and gear type. Note: gill net CPUE for 2001 to 2021 is for small mesh (< 3") only.

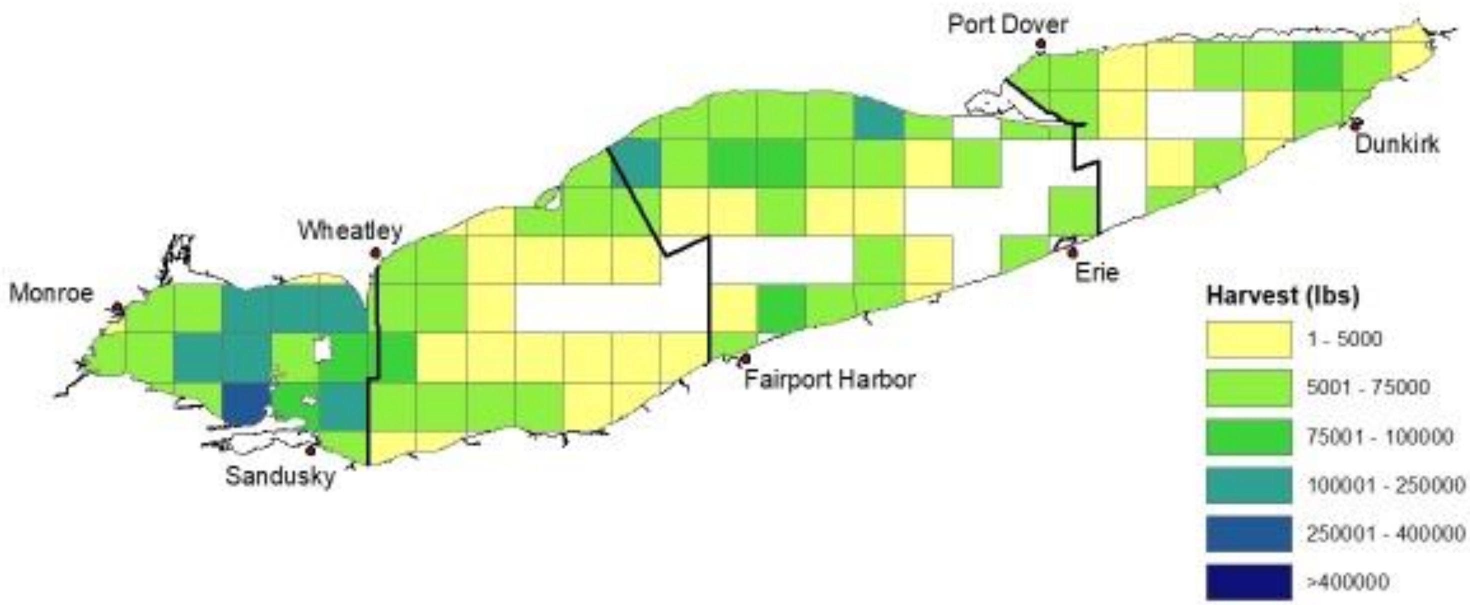


Figure 1.5. Spatial distribution of Yellow Perch total harvest (lbs.) in 2022 by 10 -minute grid.

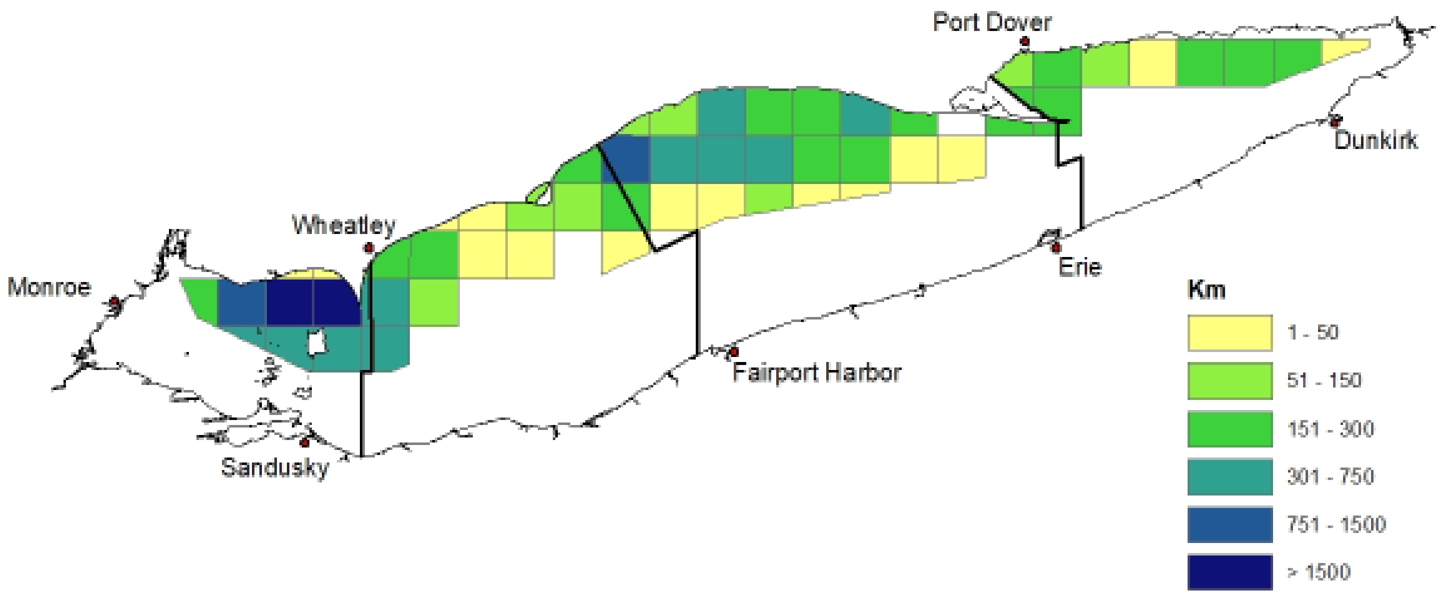


Figure 1.6. Spatial distribution of Yellow Perch small mesh gill net effort (km) in 2022 by 10-minute grid.

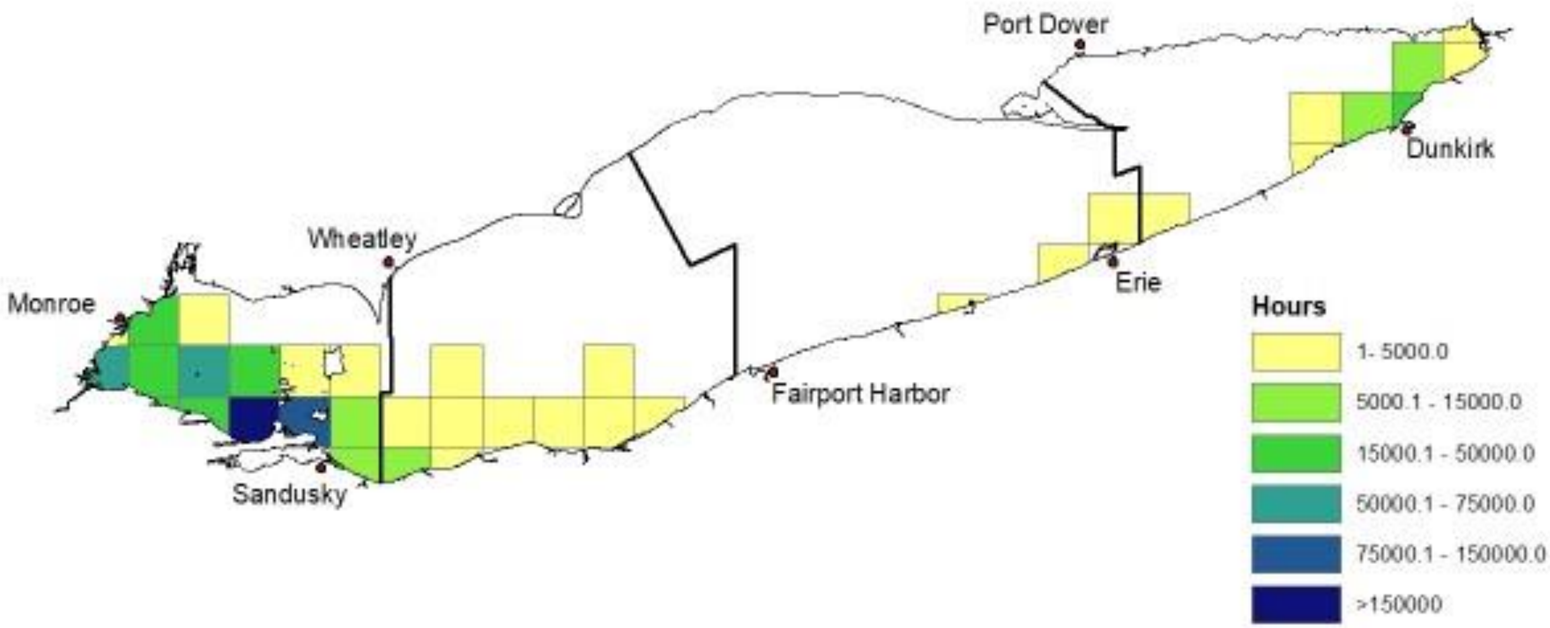


Figure 1.7. Spatial distribution of Yellow Perch sport effort (angler hours) in 2022 by 10 -minute grid.

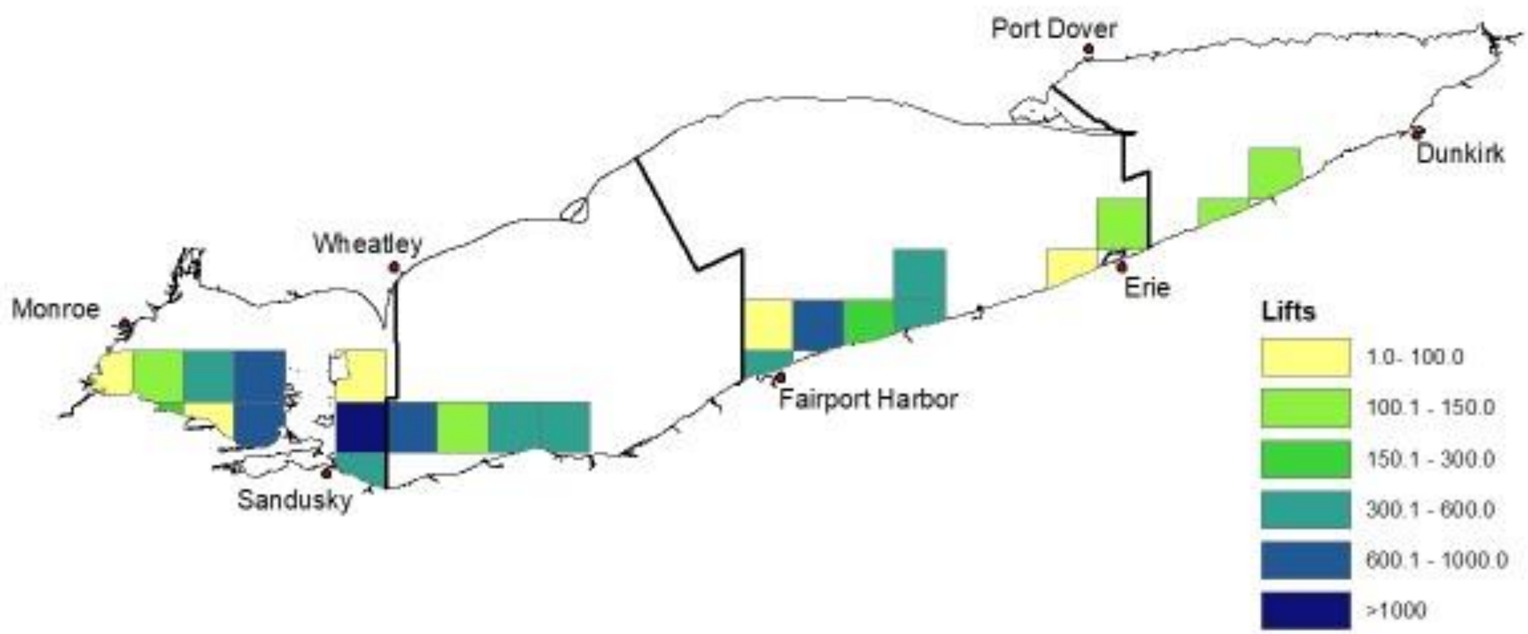


Figure 1.8. Spatial distribution of Yellow Perch trap net effort (lifts) in 2022 by 10 -minute grid.

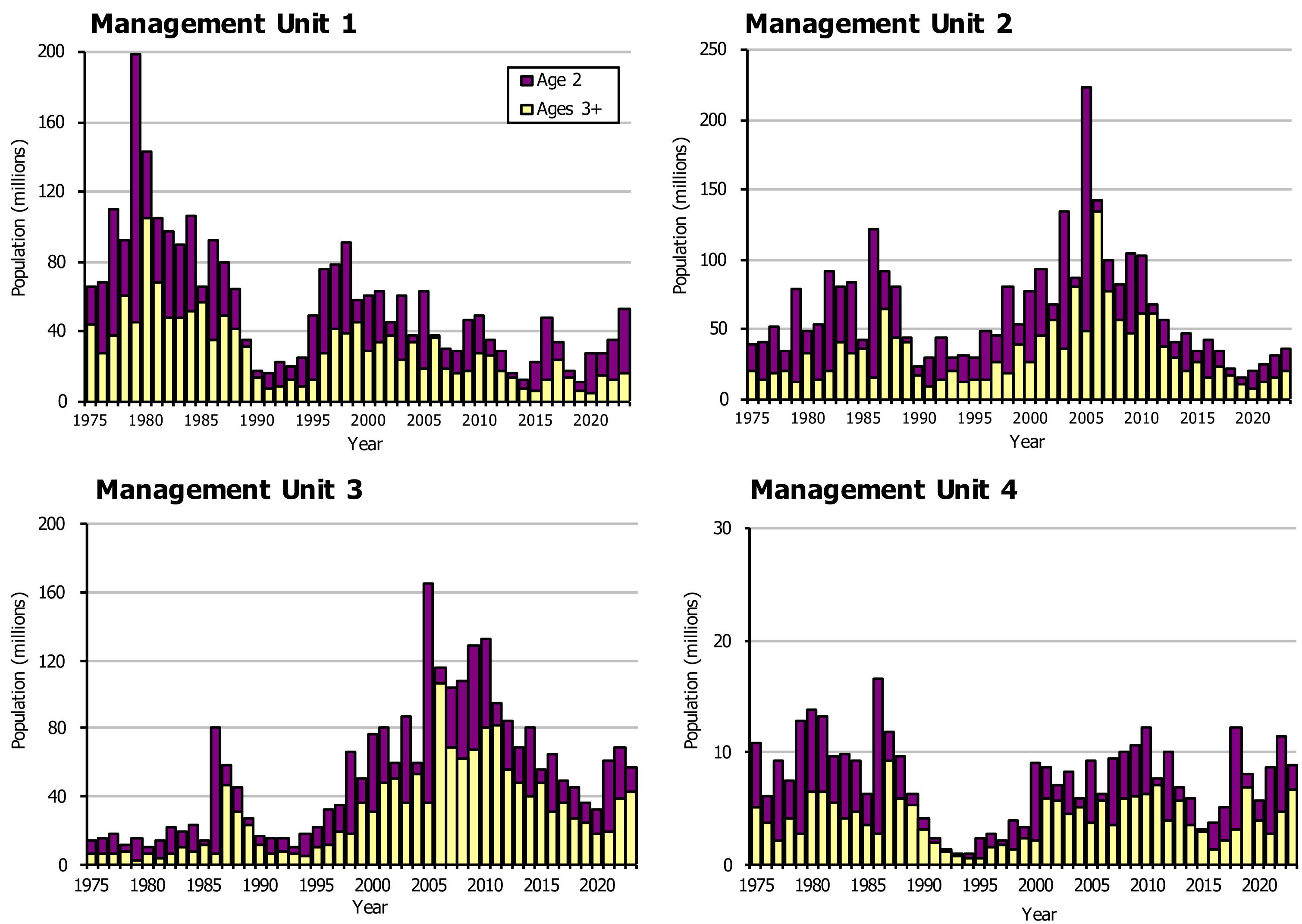


Figure 1.9. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2023, from the ADMB model.

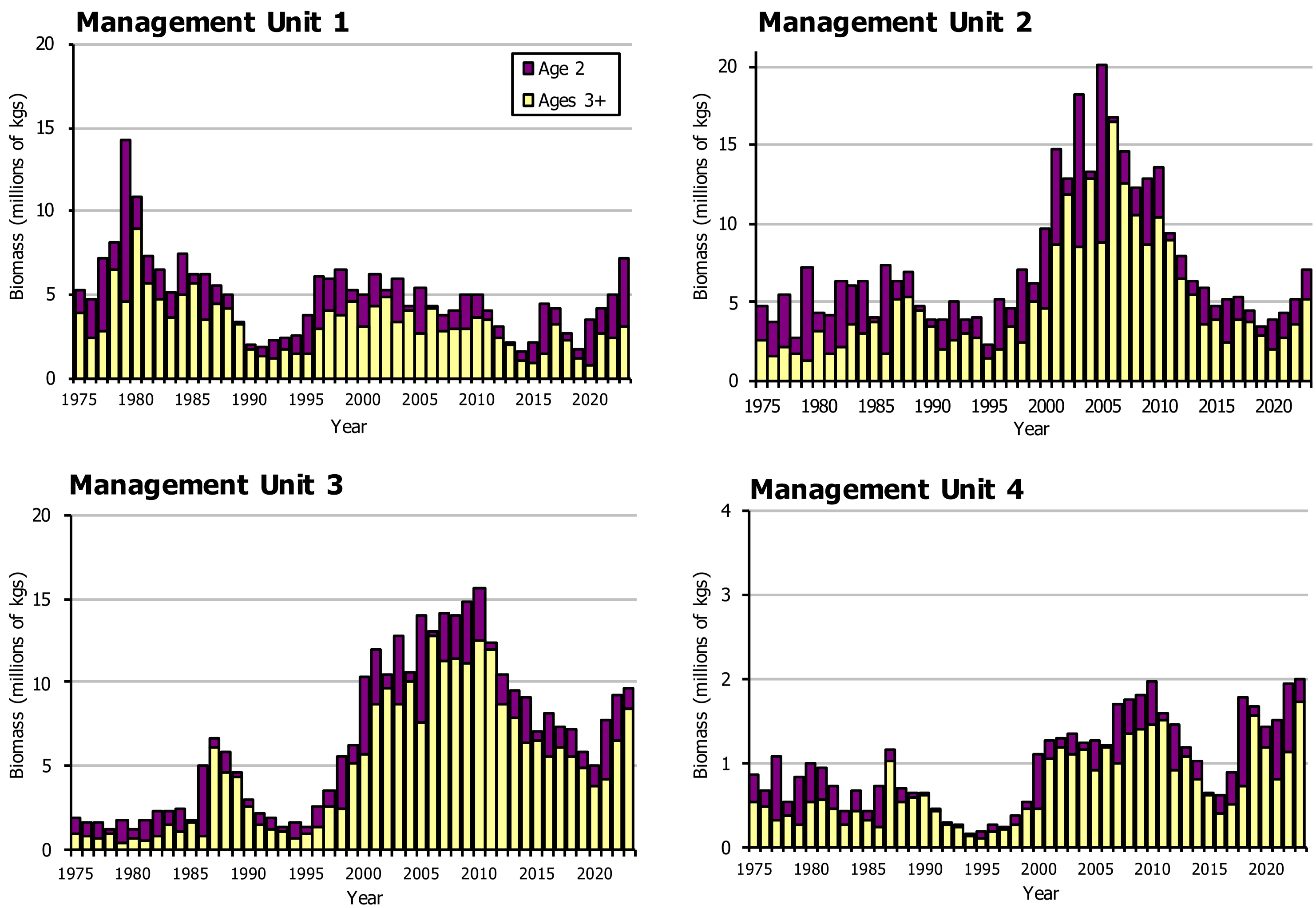


Figure 1.10. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2023, from the ADMB model.

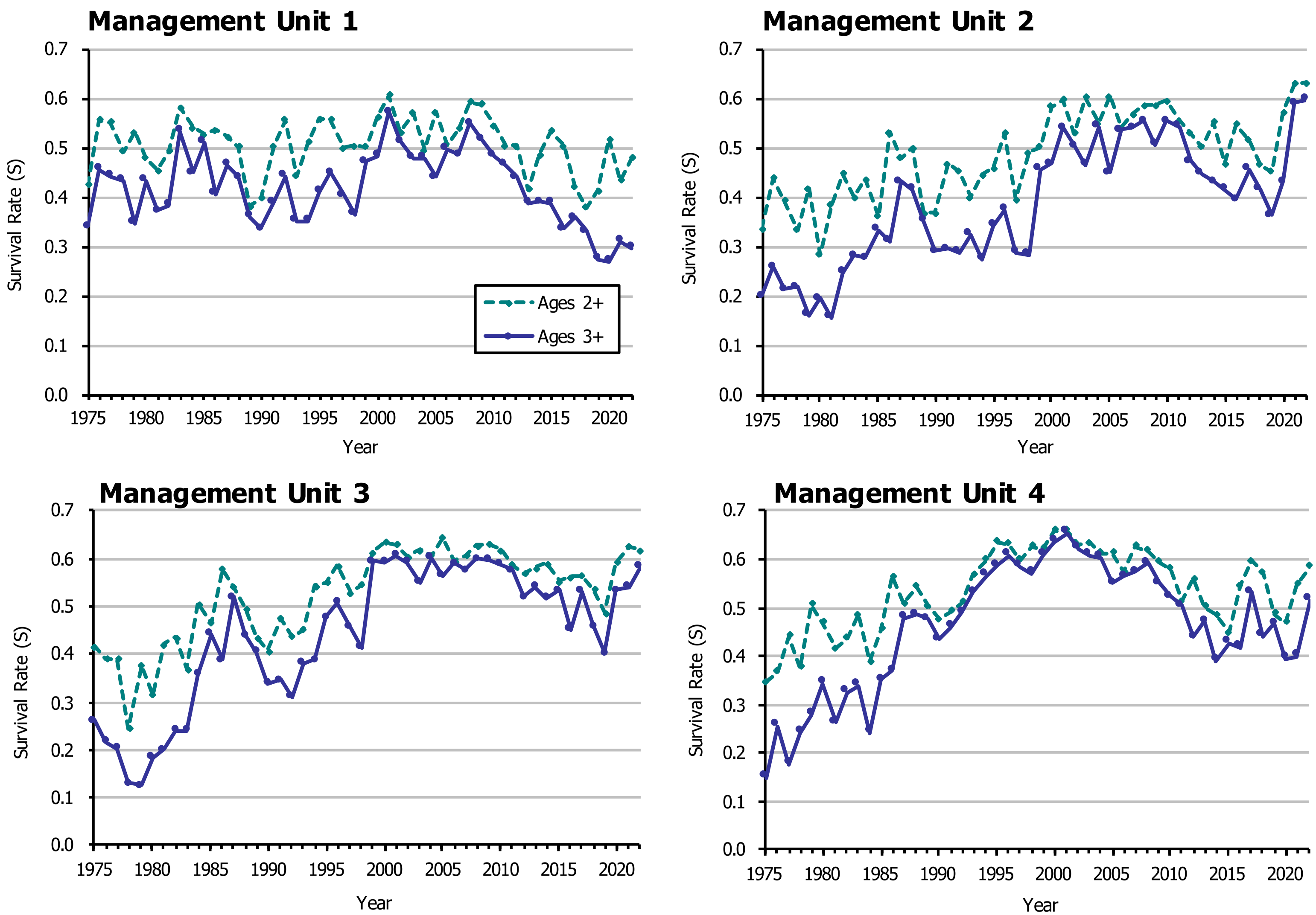


Figure 1.11. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).

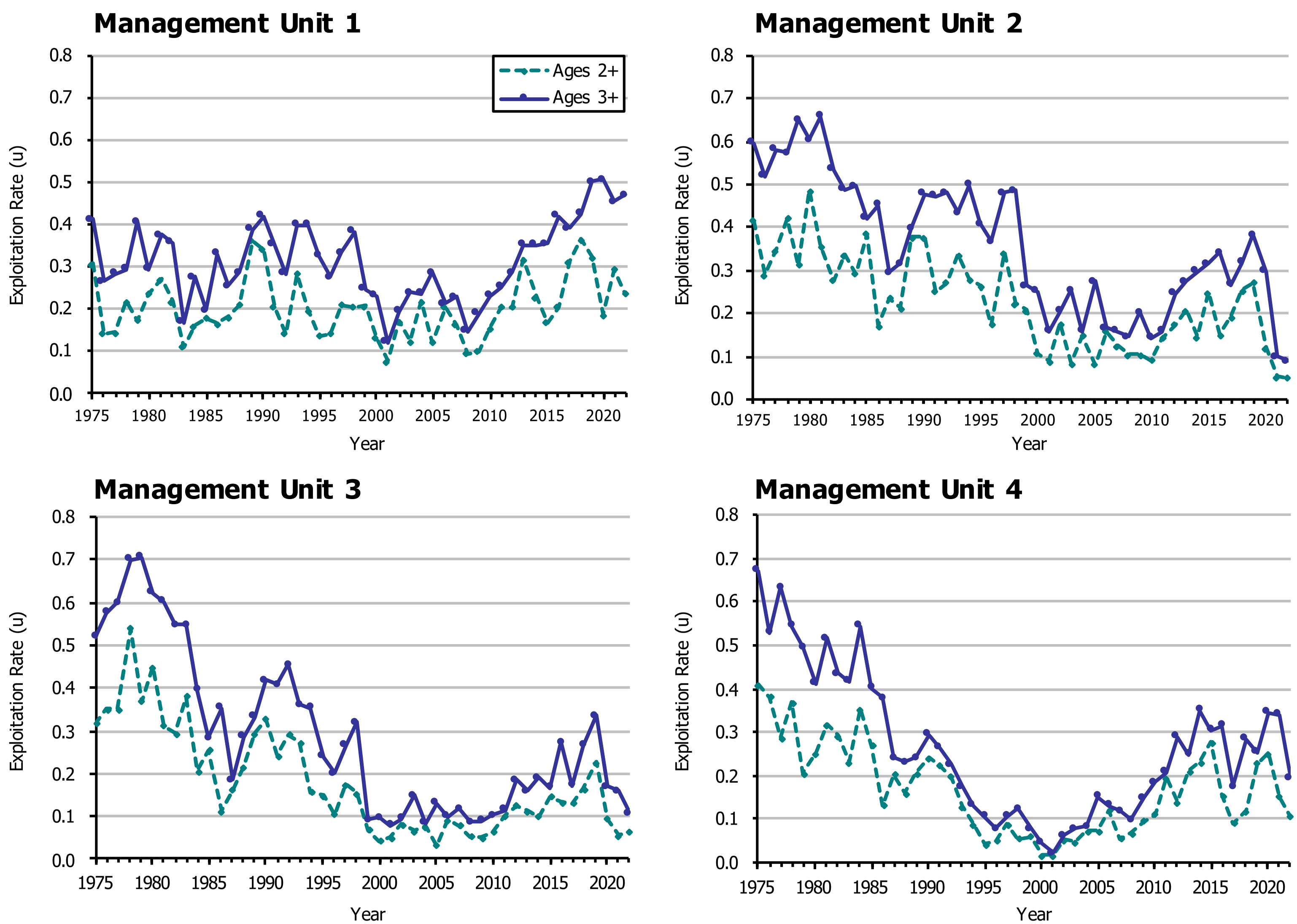
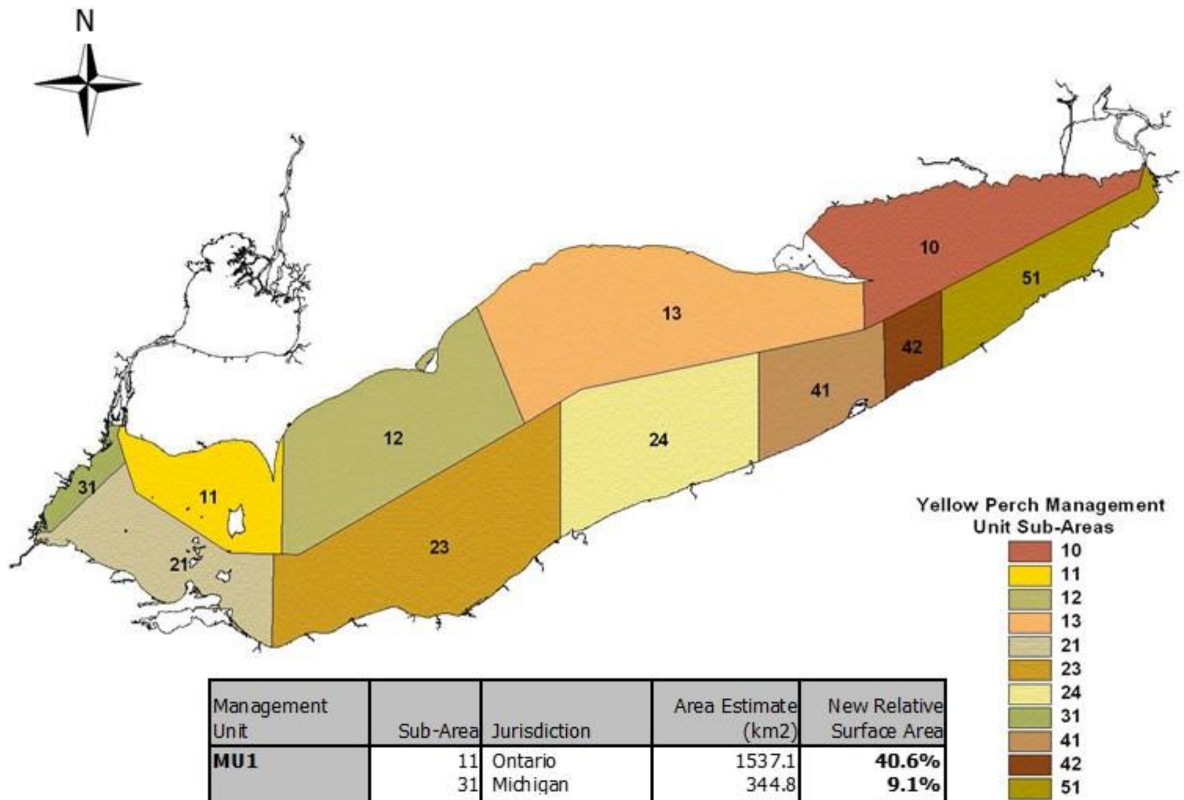


Figure 1.12. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).



Management Unit	Sub-Area	Jurisdiction	Area Estimate (km2)	New Relative Surface Area
MU1	11	Ontario	1537.1	**40.6%**
	31	Michigan	344.8	**9.1%**
	21	Ohio	1905.6	**50.3%**
		MU1 Total	**3787.5**	
MU2	12	Ontario	3497.4	**45.6%**
	23	Ohio	4175.3	**54.4%**
		MU2 Total	**7672.7**	
MU3	13	Ontario	4749.9	**52.3%**
	24	Ohio	2943.7	**32.4%**
	41	Pennsylvania	1385.8	**15.3%**
		MU3 Total	**9079.4**	
MU4	10	Ontario	2818.7	**58.0%**
	42	Pennsylvania	535.6	**11.0%**
	51	New York	1507.2	**31.0%**
		MU4 Total	**4861.4**	

Figure 2.1. Calculations for subunit areas in the Yellow Perch Task Group Management Units.

Appendix Table 1. Expert Opinion (EO) Lambda (λ) values and relative number of terms associated with catch-at-age analysis data sources by management unit (Unit).

Unit	Data Source	λ	Relative Number of Terms
1	Commercial Gill Net Effort	0.8	1
	Sport Effort	0.7	1
	Commercial Trap Net Effort	0.5	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.9	5
	Commercial Trap Net Harvest	0.7	5
	Trawl Survey Catch Rates	1.0	5
	Partnership Gill Net Index Catch Rates	1.0	5
2	Commercial Gill Net Effort	0.8	1
	Sport Effort	0.8	1
	Commercial Trap Net Effort	0.6	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.9	5
	Commercial Trap Net Harvest	0.7	5
	Trawl Survey Catch Rates	0.9	5
	Partnership Gill Net Index Catch Rates	1.0	5
3	Commercial Gill Net Effort	0.8	1
	Sport Effort	0.8	1
	Commercial Trap Net Effort	0.6	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.8	5
	Commercial Trap Net Harvest	0.6	5
	Trawl Survey Catch Rates	1.0	5
	Partnership Gill Net Index Catch Rates	1.0	5
4	Commercial Gill Net Effort	0.8	1
	Sport Effort	0.7	1
	Commercial Trap Net Effort	0.6	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.7	5
	Commercial Trap Net Harvest	0.6	5
	NY Gill Net Survey Catch Rates	1.0	5
	Partnership Gill Net Index Catch Rates	0.9	5

Appendix Table 2. Surveys selected by multi-model inference (MMI) age-2 recruitment

MU	Survey	Parameter Estimate	Number of Models
MU1	OOS10	0.047	1
	OPSF11	0.016	1
	OOS11	0.707	3
	(Intercept)	13.713	3
MU2	OHF21	0.040	1
	OHF20	0.290	2
	OPSF21	0.289	2
	(Intercept)	14.798	2
MU3	OHJ31A	0.278	1
	OPSF31	0.312	1
	(Intercept)	14.860	1
MU4	NYGN41	-0.031	1
	NYF41	0.427	2
	LPC41	0.274	2
	(Intercept)	13.201	2

Appendix Table 3a. Interagency trawl surveys indices. All trawl series are reported in arithmetic mean catch per hectare, all gill net series are in numbers of fish per lift.

Year	OHF10	OHF11	OOS10	OOS11	OHF20B	OHF21B	OHF30B	OHF31B	OHJ21B	OHJ31B	NYF40	NYF41	NYGN41	LPC40	LPC41	OPSF11	OPSF21	OPSF31	OPSF41
1988	.	.	212.6	13.3	.	.	.	.	.	.	.	.		105.8	0.4	.	.	.	.
1989	.	.	265.4	12.5	.	.	.	.	.	.	.	.		82.1	16.4	.	.	6.8	76.6
1990	310.1	0.0	259.2	35.2	52.2	23.0	21.2	12.4	.	.	.	.		26.7	5.6	41.3	68.9	29.7	0.6
1991	58.1	0.4	113.2	42.1	9.3	50.0	1.2	19.7	216.5	19.7	.	.	.	17.8	3.2	63.3	56.6	3.8	1.6
1992	90.9	0.7	94.1	16.5	36.3	15.0	31.3	3.3	18.5	0.8	10.7	2.4	.	70.3	4.6	47.5	8.0	5.7	6.3
1993	256.4	3.7	862.5	39.5	10.6	49.0	27.3	12.1	9.7	5.8	113.0	3.1	0.2	30.6	2.6	146.9	112.0	93.2	0.1
1994	287.1	73.1	469.7	62.9	71.9	12.0	16.1	3.4	23.3	10.2	49.0	8.6	0.6	34.7	6.2	317.8	22.5	39.7	7.4
1995	82.4	0.1	478.7	113.5	2.8	73.5	14.1	27.5	.	.	5.9	13.6	0.6	4.3	10.9	362.5	81.3	55.2	9.6
1996	579.3	82.3	2544.9	122.8	129.6	13.2	116.5	3.5	8.9	0.9	105.8	0.3	0.1	33.6	1.1	198.4	70.8	.	.
1997	33.7	104.9	55.2	93.8	11.6	147.3	2.6	40.0	493.9	64.0	0.2	5.7	0.0	4.4	7.1	139.3	350.5	177.9	.
1998	250.9	16.0	170.6	8.2	72.6	6.0	38.1	3.7	21.5	16.2	1.3	0.4	0.0	127.8	1.7	17.5	6.7	6.2	0.0
1999	155.3	47.1	330.0	75.0	68.3	41.8	25.7	41.7	402.8	97.3	35.9	33.3	13.1	16.1	110.0	440.6	107.6	67.9	119.9
2000	41.5	38.0	102.5	113.6	18.2	56.9	1.6	19.4	51.4	10.2	23.9	7.0	3.3	3.6	11.3	106.1	162.4	55.5	36.9
2001	246.3	10.3	398.4	11.3	119.2	5.3	13.6	0.4	279.8	4.3	100.4	11.7	2.2	69.4	2.0	12.9	9.6	1.9	9.5
2002	30.4	86.5	26.4	59.5	3.3	46.1	3.0	51.9	239.6	37.7	9.5	16.0	0.9	1.0	6.6	198.7	245.2	186.6	19.7
2003	1111.6	7.1	1620.8	12.3	136.9	2.9	53.2	1.0	9.5	2.5	484.8	2.0	2.0	222.8	2.3	2.7	2.6	7.2	3.2
2004	9.3	127.7	45.2	240.7	7.7	224.2	1.9	45.2	410.3	42.7	1.5	29.4	2.9	0.1	12.4	976.2	1187.6	332.5	7.6
2005	62.3	2.0	114.8	5.2	43.9	19.2	156.2	132.3	51.2	19.3	59.3	5.6	0.4	124.4	0.1	0.0	2.2	2.5	0.2
2006	121.9	12.5	222.8	12.4	11.3	4.3	18.9	12.5	29.7	113.6	290.6	40.9	32.6	30.1	12.1	15.7	28.5	94.8	129.7
2007	631.5	23.6	444.6	18.8	151.0	20.7	177.8	37.0	287.6	281.8	412.0	42.3	16.1	63.5	7.9	184.4	203.9	202.5	43.4
2008	74.7	15.3	387.2	142.1	32.1	55.0	52.8	26.4	303.5	97.2	1116.7	45.5	16.4	279.4	20.8	333.1	310.6	150.6	87.0
2009	69.4	57.0	136.6	88.4	1.6	20.2	0.5	139.4	125.9	48.2	11.9	64.1	42.4	0.4	10.7	265.2	121.4	190.0	30.6
2010	26.9	17.8	96.9	26.4	41.1	11.9	96.3	12.4	29.2	12.1	197.7	4.2	1.6	51.8	0.2	49.5	18.1	36.2	15.7
2011	12.0	10.0	178.0	25.9	10.3	6.3	15.1	55.5	70.8	41.7	89.5	141.8	105.9	176.7	2.6	158.7	101.8	218.6	95.4
2012	35.0	6.0	68.1	4.0	69.2	7.4	134.4	23.3	42.5	76.5	280.0	16.7	8.0	27.4	2.0	53.1	21.9	48.7	117.8
2013	337.0	3.7	315.6	17.8	8.9	34.9	8.9	109.5	84.2	116.2	4.4	24.4	16.0	0.5	0.8	64.1	71.4	152.1	30.4
2014	521.7	17.8	859.6	51.1	37.7	15.4	49.1	24.2	.	.	274.2	2.9	0.9	28.4	0.02	315.0	34.7	16.4	2.2
2015	224.0	53.0	494.3	117.2	19.6	41.3	18.6	30.2	.	.	68.6	57.3	2.0	58.5	1.6	424.3	66.5	212.7	170.9
2016	146.8	22.9	404.1	33.2	0.5	5.0	1.6	8.7	46.5	149.4	2178.2	53.0	10.4	360.6	91.7	105.6	50.4	35.1	298.2
2017	125.5	1.0	493.7	4.4	19.0	3.7	39.1	7.6	7.2	17.6	247.0	129.5	77.4	65.5	4.4	90.3	65.3	104.8	414.1
2018	429.6	17.4	959.3	21.6	28.4	7.9	50.8	6.6	14.9	50.4	662.4	11.4	1.7	328.8	2.9	78.5	28.3	130.2	23.3
2019	161.1	69.8	518.7	95.1	0.2	4.5	6.8	7.4	26.2	22.3	169.1	2.5	0.9	227.0	18.9	332.0	42.5	23.7	26.2
2020	99.9	14.2	566.4	23.1	5.7	4.9	3.9	0.6	.	.	91.6	56.2	17.2	73.7	21.1	93.5	31.7	87.5	314.3
2021	.	.	1358.0	39.6	13.0	13.0	2.2	4.8	13.9	3.7	284.2	33.5	15.3	14.0	8.1	145.9	27.7	96.3	252.2
2022	148.8	40.1	571.5	102.1	3.0	4.8	2.7	2.8	78.2	17.6	297.1	26.8	24.1	40.5	1.6	345.1	33.7	15.0	144.7

Appendix Table 3b. Interagency trawl surveys indices. All trawl series are reported in arithmetic mean catch per hectare, all gill net series are in numbers of fish per lift. *Trawl series in italics are not used to estimate age-2 recruitment.*

Year	*OHS10*	*OHS11*	*OLPN40*	*OLPN41*	*ILP40*	*ILP41*	*OLPO40*	*OLPO41*	*OHJY20B*	*OHJY21B*	*OHJY30B*	*OHJY31B*	*LPS41*	*OHS20B*	*OHS21B*	*OHS30B*	*OHS31B*
1988	*188.6*	*11.2*	*667.7*	*0.8*	*305.0*	*2.9*	*0.4*	*0.0*					*1.1*	.	.	.	.
2010	*58.2*	*22.2*	*13.2*	*0.6*	*5.7*	*0.6*	*63.5*	*0.0*	*33.6*	*5.0*			*1.7*				
2011	*29.9*	*15.5*	*3.9*	*1.9*	*3.9*	*12.8*	*224.6*	*1.3*	*25.7*	*32.3*	*49.1*	*45.5*	*5.0*	*7.1*	*34.5*	*14.1*	*41.3*
2012	*74.5*	*2.3*	*11.3*	*1.1*	*1.6*	*1.7*	*33.2*	*2.2*	*133.4*	*19.0*	*164.6*	*32.5*	*13.7*	*65.9*	*9.2*	*154.3*	*23.5*
2013	*398.7*	*10.3*	*1.8*	*0.5*	*2.1*	*5.6*	*0.1*	*0.1*	*3.9*	*49.1*	*0.6*	*45.3*	*2.2*	*2.6*	*52.2*	*3.5*	*272.9*
2014	*668.9*	*17.4*	*80.1*	*0.2*	*4.7*	*0.0*	*24.6*	*0.0*					*0.9*	*33.6*	*2.8*	*45.8*	*15.4*
2015	*264.9*	*61.7*	*78.5*	*0.3*	*326.0*	*3.0*	*18.7*	*1.6*					*4.0*				
2016	*329.4*	*13.5*	*20.2*	*1.8*	*121.2*	*13.8*	*440.8*	*115.0*	*327.8*	*333.1*	*86.9*	*83.4*	*31.7*	*0.2*	*91.3*	*156.9*	*184.0*
2017	*279.5*	*2.7*	*84.4*	*3.0*	*52.1*	*0.9*	*64.7*	*5.1*	*328.4*	*4.7*	*454.3*	*13.2*	*37.6*	*191.8*	*3.3*	*1399.9*	*65.1*
2018	*514.1*	*10.5*	*739.9*	*1.4*	*818.3*	*19.9*	*204.1*	*0.8*	*60.9*	*4.6*	*308.6*	*31.5*		*11.9*	*17.6*	*77.7*	*15.6*
2019	*466.9*	*64.3*	*265.5*	*9.1*	*532.6*	*105.6*	*179.4*	*8.2*	*133.0*	*14.9*	*20.2*	*364.0*		*1.1*	*5.5*	*15.6*	*13.1*
2020	*535.8*	*14.9*	*56.4*	*3.6*	*231.8*	*35.2*	*54.2*	*21.6*	*79.0*	*0.7*	*15.2*	*1.1*		*2.8*	*8.0*	*2.8*	*2.5*
2021			*65.9*	*8.2*	*45.7*	*42.3*	*2.4*	*3.4*	*61.4*	*0.6*	*15.8*	*5.7*		*1.1*	*1.7*	*379.7*	*28.8*
2022			*73.6*	*0.8*	*152.0*	*2.0*	*20.5*	*1.6*	*58.8*	*5.5*	*7.5*	*30.8*		*3.1*	*20.0*	*142.8*	*13.0*

Appendix Table 4. Lakewide trawl index codes and series names used in Appendix Tables 2 and 3.
All series are reported in arithmetic mean catch per hectare, except LPS41, NYGN41, and OPSF11-41, gill net indices which are reported in mean catch per lift. Abbreviations in Appendix Table 3 ending with a 'B represent survey indices blocked by depth strata.
Reasons for inclusion or exclusion of surveys from the multi-model inference (MMI) process are included.

Abbreviation	Series	Used in 2023 MMI process	Reason for inclusion / exclusion (for next 5 years or until further research assessment)
OHS10	Ohio Management Unit 1 summer age 0	no	Data used in OOS10
OHS11	Ohio Management Unit 1 summer age 1	no	Data used in OOS11
OHF10	Ohio Management Unit 1 fall age 0	yes	consistent collection, broad spatial coverage, high selectivity, reduced mortality influence
OHF11	Ohio Management Unit 1 fall age 1	yes	consistent collection, broad spatial coverage, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OOS10	Ontario/Ohio Management Unit 1 summer age 0	yes	consistent collection, broadest spatial coverage, high selectivity, reduced mortality influence
OOS11	Ontario/Ohio Management Unit 1 summer age 1	yes	consistent collection, broadest spatial coverage, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHS20	Ohio Management Unit 2 summer age 0	no	hypoxic, 26 indices in 28 years, higher variability, low selectivity, influenced from mortality,
OHF20	Ohio Management Unit 2 fall age 0	yes	normoxic, 28 indices in 28 years, broad spatial coverage, lower variability, high selectivity, reduced mortality influence
OHS21	Ohio Management Unit 2 summer age 1	no	hypoxic, 26 indices in 28 years, higher variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHF21	Ohio Management Unit 2 fall age 1	yes	normoxic, 28 indices in 28 years, broad spatial coverage, lower variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHS30	Ohio Management Unit 3 summer age 0	no	hypoxic, 25 indices in 28 years, higher variability, low selectivity, influenced from mortality,
OHF30	Ohio Management Unit 3 fall age 0	yes	normoxic,28 indices in 28 years, broad spatial coverage, lower variability, high selectivity, reduced mortality influence
OHS31	Ohio Management Unit 3 summer age 1	no	hypoxic, 25 indices in 28 years, higher variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHF31	Ohio Management Unit 3 fall age 1	yes	normoxic, 28 indices in 28 years, broad spatial coverage, lower variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHJ21	Ohio Management Unit 2 June age 1	yes	normoxic,consistent collection, broad spatial coverage, lower variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHJ31	Ohio Management Unit 3 June age 1	yes	normoxic,consistent collection, broad spatial coverage, lower variability, high selectivity, reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHJY20	Ohio Management Unit 2 July age 0	no	some hypoxic, 23 indices in 28 years, higher variability, low selectivity, influenced from mortality,
OHJY30	Ohio Management Unit 3 July age 0	no	some hypoxic, 23 indices in 28 years, higher variability, low selectivity, influenced from mortality,
OHJY21	Ohio Management Unit 2 July age 1	no	some hypoxic, 23 indices in 28 years, higher variability, high selectivity,reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OHJY31	Ohio Management Unit 3 July age 1	no	some hypoxic, 23 indices in 28 years, higher variability, high selectivity,reduced mortality influence, temporally adjacent to spring Age-2 abundance (the target prediction)
OLPN40	Outer Long Point Bay Nearshore Management Unit 4 age 0	no	Data used in LPC40
OLPN41	Outer Long Point Bay Nearshore Management Unit 4 age 1	no	Data used in LPC41

Appendix Table 4 continued

Abbreviation	Series	Used in 2023 MMI process	Reason for inclusion / exclusion (for next 5 years or until further research assessment)
OLPO40	Outer Long Point Bay Offshore Management Unit 4 age 0	no	Data used in LPC40
OLPO41	Outer Long Point Bay Offshore Management Unit 4 age 1	no	Data used in LPC41
ILPF40	Inner Long Point Bay Management Unit 4 age 0	no	Data used in LPC40
ILPF41	Inner Long Point Bay Management Unit 4 age 1	no	Data used in LPC41
LPC40	Long Point Composite Management Unit 4 age 0	yes	The composite index is the most complete indicator of the state of age-0 yellow perch in Long Point Bay, as it encompasses all depth strata and has greater spatial coverage.
LPC41	Long Point Composite Unit 4 age 1	yes	The composite index is the most complete indicator of the state of age-1 yellow perch in Long Point Bay, as it encompasses all depth strata and has greater spatial coverage.
LPS41	Long Point Bay Management Unit 4 summer Gill Net age 1	no	Exclude from model due to change in survey design 2018
NYF40	New York Management Unit 4 fall trawl age 0	yes	This continuous 28-year index, has broad spatial coverage, consistent methodology, and is the only age-0 recruitment index for the south shore waters of MU4
NYF41	New York Management Unit 4 fall trawl age 1	yes	This continuous 28-year index, has broad spatial coverage, consistent methodology, and is one of two age-2 recruitment indicies for the south shore waters of MU4
NYGN41	New York Management Unit 4 gill net age 1	yes	This continuous 27-year index, has broad spatial coverage, consistent methodology, and is one of two age-2 recruitment indicies for the south shore waters of MU4
OPSF11	Ontario Partnership Gill Net Management Unit 1 fall age 1	yes	West basin age 1 index gill net catch rate (bottom nets) adjusted to equal effort among mesh sizes and for size selective bias of mesh configuration (Helser et al. 1998 normal gillnet selectivity retention curve); N usually 22 most years September
OPSF21	Ontario Partnership Gill Net Management Unit 2 fall age 1	yes	West central basin age 1 index gill net catch rate (bottom nets) adjusted to equal effort among mesh sizes and for size selective bias of mesh configuration (Helser et al. 1998 normal gillnet selectivity retention curve); N usually 36 Most years Oct, Nov
OPSF31	Ontario Partnership Gill Net Management Unit 3 fall age 1	yes	East central age 1 basin index gill net catch rate (bottom nets) adjusted to equal effort among mesh sizes and for size selective bias of mesh configuration (Helser et al. 1998 normal gillnet selectivity retention curve); N usually 36, Most years Oct, Nov
OPSF41	Ontario Partnership Gill Net Management Unit 4 fall age 1	yes	East basin index age 1 gill net catch rate (bottom nets < 30 m) adjusted to equal effort among mesh sizes and for size selective bias of mesh configuration (Helser et al. 1998 normal gillnet selectivity retention curve); N usually 20 @ depths < 30m, Most years Aug-Sep
MIS10	Michigan Management Unit 1 summer trawl age 0	no	West basin age 0 trawl index conducted during August, susrvey begins in 2014. Excluded from model due to short time series
MIS11	Michigan Management Unit 1 summer trawl age 1	no	West basin age 1 trawl index conducted during August, susrvey begins in 2014. Excluded from model due to short time series