Report of the Lake Erie Yellow Perch Task Group

March 25th, 2020

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
Mark DuFour	Ohio Department of Natural Resources
Matt Faust	Ohio Department of Natural Resources
Mike Hosack (Co-chair)	Pennsylvania Fish and Boat Commission
Carey Knight	Ohio Department of Natural Resources
Jason Robinson	New York Department of Environmental Conservation
Brian Schmidt	Ohio Department of Natural Resources
Sara Thomas	Michigan Department of Natural Resources

Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

Table of Contents

Introduction

From April 2019 through March 2020 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. Support the development of a Yellow Perch Management Plan in conjunction with STC and LEC (STC lead).

4. Improve existing population models to produce the most scientifically defensible and reliable method for estimating and forecasting abundance, recruitment, and mortality.
   a. Examine available recruitment indices for incorporation into catch-at-age model.

Charge 1: 2019 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) of Yellow Perch in 2019 was 8.552 million pounds. This allocation represented a 19% decrease from a TAC of 10.498 million pounds in 2018. For Yellow Perch assessment and allocation, Lake Erie is partitioned into four management units (MUs; Figure 1.1). The 2019 TAC allocation was 2.425, 2.208, 3.374, and 0.545 million pounds for MUs 1 through 4, respectively. In March 2019, the process of developing a new assessment model (PR model), management strategy evaluation, and harvest policy for Lake Erie Yellow Perch was completed. For MU1, the LEC set the TAC equal to 2.425 million pounds, which was 20% below the 2018 TAC. In MU2, the probabilistic risk tolerance limit (P*) was invoked and the target fishing rate dropped to F=0.353, lowering the mean RAH and range. P* was invoked to maintain spawning stock biomass in 2020 above the limit reference point, B_{msy}. For MU2, the LEC set the TAC at 2.208 million pounds, which was equal to the maximum RAH. For MU3, the LEC set the TAC at 3.374 million pounds, which was equal to the mean RAH. And for MU4, the LEC set the TAC at 0.545 million pounds, which was a 20% increase from the 2018 TAC.

The lake-wide harvest of Yellow Perch in 2019 was 4.467 million pounds, or 52% of the total 2019 TAC. This was a 34% decrease from the 2018 harvest of 6.782 million pounds. Harvest from MUs 1 through 4 was 1.221, 1.174, 1.689, and 0.384 million pounds, respectively (Table 1.1). The portion of TAC harvested was 50%, 53%, 50%, and 70%, in MUs 1 through 4, respectively. In 2019, Ontario harvested 3.243 million pounds, followed by Ohio (1.112 million lbs.), New York (0.056 million lbs.), Pennsylvania (0.040 million lbs.), and Michigan (0.016 million lbs.).

Ontario's fraction of allocation harvested was 86% in MU1, 74% in MU2, 75% in MU3, and 103% in MU4 (see paragraph below regarding Ontario's harvest reporting and commercial ice allowance policy). Ohio fishers attained 29% of their TAC in the western basin (MU1), 36% in the west central basin (MU2), and 29% in the east central basin (MU3). Michigan anglers in MU1 attained 7% of their TAC. Pennsylvania fisheries harvested 8% of their TAC in MU3 and 2% of their TAC in MU4. New York fisheries attained 33% of their TAC in MU4. Ontario's portion of the lakewide Yellow Perch harvest in 2019 (73%) slightly increased from 2018 (68%; Table 1.1). Ohio's proportion of lakewide harvest in 2019 (25%) slightly decreased from 2018 (29%), and harvest in Michigan, Pennsylvania, and New York waters combined represented <3% of the lakewide harvest in 2019.

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 2010 to 2019 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends across a longer time series (1975 to 2019) 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 2019 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 2019 was 3%, 23%, and 5% of the gill net harvest in management units 1, 2 and 3, respectively, and was negligible (0.02%) in MU4. Harvest, effort, and catch per unit effort from (1) small mesh Yellow Perch effort (<3 inch stretched mesh) and (2) larger mesh sizes, are distinguished in Tables 1.2 to 1.5. Harvest from targeted small mesh gill nets in 2019 decreased by 34% in MU1, 53% in MU2, and 28% in MU3, but increased by 20% in MU4 relative to 2018. Ontario trap net harvest was minimal (33 pounds in 2019) and is included in the total harvest of Yellow Perch in MU1 (Tables 1.1 and 1.2). Ontario commercial Rainbow Smelt trawlers incidentally catch Yellow Perch in management units 2, 3 and 4, and this harvest is included in Tables 1.3 to 1.5. In 2019, 150 pounds of Yellow Perch were harvested in trawl nets in MU3, and 46 pounds were harvested in MU4.

Targeted (i.e., small mesh) gill net effort in 2019 increased from 2018 in MU1, MU3, and MU4 by 24%, 34%, and 7%, respectively, while decreasing in MU2 by 26%. Targeted gill net harvest rates in 2019 decreased relative to 2018 rates in MU1, MU2, and MU3 by 47%, 36%, and 46%, respectively, while increasing by 12% in MU4 (Figure 1.4).

In 2019, sport harvest in U.S. waters decreased in MU1, MU2, and MU3 by 71%, 55%, and 70% respectively, while increasing by 95% in MU4 compared to the 2018 harvest (Figure 1.2). Similarly, angling effort in U.S. waters decreased in 2019 from 2018, in MU1, MU2, and MU3 by 46%, 46%, and 67%, respectively, while increasing by 44% in MU4 (Figure 1.3). In 2019, angling effort in U.S. waters was at its lowest in the time series in MU1, MU2 and MU3 (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 2018 rates, harvest per angler hour decreased in Michigan (-63%) and Ohio waters of MU1 (-41%), in the Ohio waters of MU2 (-47%), and the Ohio waters of MU3 (-93%), while increasing in the Pennsylvania waters of MU3 (+80%), and the New York and Pennsylvania waters of MU4 (+18% and +72%, respectively). Angler harvest rates in kilograms per angler hour are presented graphically in Figure 1.4 for each management unit by pooling jurisdictions' harvest weights and effort. In 2019, the sport harvest rate (in kg/hr) decreased in MU1 (0.24; -46%), MU2 (0.25; -18%), and MU3 (0.41; -10%), and increased in MU4 (0.54; +36%) from 2018 rates. Differences between harvest rates reported in fish per angler hour and kg per angler hour reflect the influence of size and age composition on harvest rates.

Trap net harvest decreased by 56% in MU1, 21% in MU2, and 28% in MU3, and increased by 76% in MU4. Compared to 2018, trap net effort (lifts) in 2019 increased by 9% in MU1, 41% in MU2, 28% in MU3, and 66% in MU4. Trap net harvest rates decreased by 60% in MU1, 44% in MU2, 44% in MU3, and increased by 6% in MU4.

Age Composition and Growth

Lakewide, age-5 fish contributed the most to the Yellow Perch harvest (35%), followed by age-3 fish (27%), with age-4 and age-6-and-older fish contributing 19% and 11%, respectively; Table 1.6). In MU1, age-5 fish (2014 year class, 34%), and age-4 fish (2015 year class, 23%) contributed most to the fishery. In MU2, age-5 fish (2014 year class, 42%) and age-4 fish (2015 year class, 28%) contributed most to the fishery. In MU3, age-5 fish (2014 year class, 37%) and age-3 fish (2016 year class, 29%) contributed the most to the harvest. In MU4, age-3 fish (2016 year class, 84%) dominated 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 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 2020, the YPTG continued to use the ADMB model developed by the Quantitative Fisheries Centre (QFC) at Michigan State University (referred to as the Peterson-Reilly or PR model) as part of the now completed 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. 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 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 added to age-0 and age-1 recruitment data 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., 2018 year class in the 2020 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 2000 to 2019, and projections for 2020, are presented in Table 1.7. Abundance, biomass, survival, and exploitation rates are presented by management unit graphically for 1975 to 2019 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). 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 2019 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 2020 and are presented in Appendix Table 1. The additional recruitment index (generated from the glmulti process) was given a lambda weighting of 1.

2020 Population Size Projection

Stock size estimates for age-2-and-older Yellow Perch in 2020 were estimated by the SCAA model (Table 1.7). Standard errors and ranges for 2020 estimates 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 2019 (Table 1.7) were lower than those projected last year in MUs 1, 2, and 3 but similar in MU4 (YPTG 2019). Abundance projections for 2020 are 53.920, 47.247, 62.396, and 9.821 million age-2-and-older Yellow Perch in management units 1 through 4, respectively. Abundance estimates of age-2-and-older Yellow Perch in 2020 are projected to increase by 60% in MU1, 23% in MU2, and to decrease by 15% in MU3, and 30% in MU4, compared to the 2019 abundance estimates (Table 1.7, Figure 1.9).

Estimates of 2020 age-2 Yellow Perch recruitment (the 2018 year class) were 36.994, 25.046, 19.388, and 1.733 million fish in management units 1 through 4, respectively (Table 1.7.).

Age-3-and-older Yellow Perch abundance in 2020 is projected to be 16.926, 22.201, 43.008, and 8.088 million fish in MUs 1 through 4, respectively. Model estimates of abundance for age-3-and-older Yellow Perch for 2020 are projected to increase from the 2019 estimates by 5% in MU1, and decrease by 18%, 4%, and 36%, in Management Units 2, 3, and 4, respectively. Lakewide abundance of age-2-and-older Yellow Perch in 2020 is projected to be 173.4 million fish, an increase of 9% from 2019.

As a function of population estimates and mean weight-at-age from fishery-independent surveys, total biomass estimates of age-2-and-older Yellow Perch for 2020 are projected to increase in MU1 (+36%), while decreasing in MU2 (-6%), MU3 (-11%), and MU4 (-23%), compared to 2019 estimates (Figure 1.10).

Estimates of Yellow Perch survival for age-3-and-older in 2019 were 36%, 54%, 53%, and 57% in MUs 1 through 4, respectively (Figure 1.11). Estimates of Yellow Perch survival in 2019 for age-2-and-older fish were: 50% in MU1, 58% in MU2, 59% in MU3, and 58% in MU4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2019 were 40%, 16%, 17%, and 12% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2019 were: 21% in MU1, 12% in MU2, 10% in MU3, and 11% in MU4 (Figure 1.12).

Charge 2: Harvest Strategy and Recommended Allowable Harvest

In 2020 the LEC and LEPMAG finalized the harvest control rules for Yellow Perch (See Charge 3: Yellow Perch Management Plan). These harvest control rules will form the foundation of the Yellow Perch Management Plan for the next 5 years. 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* < 0.20; see Yellow Perch Management Plan, STC, 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 selectivity at age, are entered into an ADMB model that estimates the parameters of a Ricker stock-recruitment relationship and the abundance of 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 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 $P^* < 0.20$. Due to concerns about poor fishery and survey performance in 2019, recruitment expectations, and ongoing SCAA model assessment, the YPTG recommended minimum RAH levels in MU 2 and MU 3 for 2020 (Tables 2.2, 2.3).

Quota allocation by management unit and jurisdiction for 2020 was determined by the same methods applied in 2009-2020, 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, 2020:

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: Yellow Perch Management Plan and Lake Erie Percid Management Advisory Group Management Strategy Evaluation

Pursuant to the goal of developing a Yellow Perch Management Plan, the LEC, Standing Technical Committee (STC), Michigan State University Quantitative Fisheries Center (QFC), and stakeholder groups from all Lake Erie jurisdictions formed the Lake Erie Percid Management Advisory Group (LEPMAG) to address stakeholder objectives, modeling concerns, and exploitation policies for Lake Erie percids. Previously, the QFC and LEPMAG completed a new statistical catch at age model (PR model; see section Statistical Catch-at-Age Analysis).

Following the completion of a Management Strategy Evaluation and adoption of a new harvest policy for the 2019 TAC setting year, the Lake Erie Percid Management Advisory Group (LEPMAG) completed an additional management strategy evaluation to evaluate four probabilistic risk tolerances (P* = 0.05, 0.1, 0.2, and 0.5), and compared the hierarchy of a 20% TAC constraint overriding the P* rule to scenarios where invoking the P* negates the 20% TAC constraint. The original review of the harvest control rules did not incorporate the 20% TAC constraints; however, a 20% TAC constraint was employed during the 2019 TAC setting year. From this exercise new harvest control rules for Yellow Perch were selected. The probabilistic risk tolerance value was changed from 0.05 to 0.20, and now invoking the P* negates the 20% TAC constraint. These harvest control rules will form the foundation of the Yellow Perch Management Plan for the next 5 years.

Charge 4: Improve existing population models

In 2018-2019, the YPTG examined all age-0 and age-1 recruitment indices used in the MMI model (see Section Statistical Catch at Age Analysis) to improve model stability and transparency. The YPTG determined that some of the indices that had been used in the model should be removed due to potential bias or changes in survey design. Surveys removed from the model include: 1) Management Unit 4, Long Point Bay summer Gill Net age-1 survey. This survey had a change in survey design in 2018 and is no longer a continuous time series; 2) Management Unit 2 and 3, Ohio summer trawl survey age-0 and age-1. These surveys were excluded due to the influence of hypoxia on survey results. Additional surveys had previously been excluded from the model if they were contained within a combined survey dataset or if it had already been decided they had survey biases. A complete list of surveys included and excluded from the model is available in Appendix Table 4

Acknowledgments

The task group members wish to thank the following people for providing support to the task group during the past year:

- Dr. Michael Jones and Alexander Maguffee of Michigan State University's Quantitative Fisheries Center;
- Tim Bader and Ann Marie Gorman of the Ohio Department of Natural Resources, Division of Wildlife;
- Karen Soper and Dr. Yingming Zhao of the Ontario Ministry of Natural Resources and Forestry;
- Dr. Richard Kraus of the U.S. Geological Survey, Biological Resources Division, Sandusky.

The YPTG report could not be completed without the contributions of all Lake Erie staff from the Michigan Department of Natural Resources, Ohio Division of Wildlife, Pennsylvania Fish and Boat Commission, New York Department of Environmental Conservation, US Geological Survey – Biological Resources Division, and the Ontario Ministry of Natural Resources and Forestry. In addition, the YPTG expresses our thanks to the Great Lakes Fishery Commission for their continued support.

Literature Cited

Calcagno, V. 2013. glmulti: Model Selection and Multimodel Inference. R package version 1.0.7. http://CRAN.R-project.org/package=glmulti.

Fournier, D.A., H.J. Skaug, J. Ancheta, J. Ianelli, A. Magnusson, M.N. Maunder, A. Nielsen, and J. Sibert. 2012. AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. Optim. Methods Softw. 27:233-249.

Yellow Perch Task Group (YPTG). 2012. Report of the Yellow Perch Task Group, March 2012. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Yellow Perch Task Group (YPTG). 2019. Report of the Yellow Perch Task Group, March 2018. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Standing Technical Committee (STC), 2020. Yellow Perch Management Plan 2020. Report of the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission.

Table 1.1. Lake Erie Yellow Perch harvest in pounds by management unit (Unit) and agency, 2010-2019

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	**Harvest**
Unit 1	2010	879,358	47	889,512	48	83,725	5	--	--	--	--	1,852,595
	2011	870,802	48	796,447	44	145,960	8	--	--	--	--	1,813,209
	2012	752,872	44	883,245	51	93,291	5	--	--	--	--	1,729,408
	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
Unit 2	2010	1,888,876	56	1,457,823	44	--	--	--	--	--	--	3,346,699
	2011	1,665,258	54	1,399,503	46	--	--	--	--	--	--	3,064,761
	2012	1,877,615	50	1,851,846	50	--	--	--	--	--	--	3,729,461
	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
Unit 3	2010	3,370,099	85	476,808	12	--	--	117,640	3	--	--	3,964,547
	2011	3,366,412	81	636,686	15	--	--	153,233	4	--	--	4,156,331
	2012	3,768,183	81	746,999	16	--	--	161,751	3	--	--	4,676,933
	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
Unit 4	2010	467,612	89	--	--	--	--	19,989	4	37,730	7	525,331
	2011	468,001	80	--	--	--	--	37,040	6	80,848	14	585,889
	2012	502,778	77	--	--	--	--	41,362	6	106,499	16	650,639
	2013	496,666	72	--	--	--	--	74,277	11	119,869	17	690,812
	2014	485,899	74	--	--	--	--	16,671	3	149,668	23	652,238
	2015	297,716	76	--	--	--	--	10,055	3	85,535	22	393,306
	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
Lakewide Totals	2010	6,605,945	68	2,824,143	29	83,725	1	137,629	1	37,730	<1	9,689,172
	2011	6,370,473	66	2,832,636	29	145,960	2	190,273	2	80,848	1	9,620,190
	2012	6,901,448	64	3,482,090	32	93,291	1	203,113	2	106,499	1	10,786,441
	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	149,668	2	8,791,726
	2015	4,460,298	64	2,190,473	32	94,225	1	87,613	1	85,535	1	6,918,144
	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

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to 2019 (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, 2010-2019.

		Unit 1					
		Michigan	Ohio		Ontario Gill Nets		Ontario
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trap Nets
Harvest	2010	83,725	195,674	693,838	815,170	64,188	0
(pounds)	2011	145,960	156,138	640,309	792,336	78,363	103
	2012	93,291	0	883,245	718,585	34,172	115
	2013	76,994	0	789,088	608,241	40,617	26
	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
Harvest	2010	38	89	315	370	29	0.00
(Metric)	2011	66	71	290	359	36	0.05
(tonnes)	2012	42	0	401	326	15	0.05
	2013	35	0	358	276	18	0.01
	2014	40	0	177	271	11	0.04
	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
Effort	2010	132,852	2,607	798,240	3,152	845	
(a)	2011	139,344	3,219	729,369	2,571	682	
	2012	128,013	0	896,083	2,244	438	
	2013	130,809	0	946,138	3,412	547	
	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	
Harvest Rates	2010	2.3	34.0	3.4	117.3	34.4	
(b)	2011	3.4	22.0	3.5	139.8	52.1	
	2012	2.4	--	3.6	145.3	35.4	
	2013	1.7	--	2.8	80.8	33.7	
	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	

(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, 2010-2019.

		Unit 2				
		Ohio		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2010	935,616	522,207	1,410,051	470,926	7,899
(pounds)	2011	1,070,817	328,686	1,312,168	339,404	13,686
	2012	1,285,336	566,510	1,550,104	314,440	13,071
	2013	1,230,249	491,419	1,657,811	145,475	398
	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
Harvest	2010	424	237	639	214	3.6
(Metric)	2011	486	149	595	154	6.2
(tonnes)	2012	583	257	703	143	5.9
	2013	558	223	752	66	0.2
	2014	581	119	703	58	0.0
	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
Effort	2010	6,701	502,507	3,783	3,905	
(a)	2011	5,707	395,407	4,214	3,789	
	2012	6,919	456,404	4,616	2,942	
	2013	5,851	428,187	6,821	1,951	
	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	
Harvest Rates	2010	63.3	3.2	169.0	54.7	
(b)	2011	85.1	2.6	141.2	40.6	
	2012	84.2	3.1	152.3	48.5	
	2013	95.4	2.6	110.2	33.8	
	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	

(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, 2010-2019.

		Unit 3						
		Ohio		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2010	153,097	323,711	36,026	104,224	3,065,336	302,410	2,353
(pounds)	2011	327,871	308,815	1,542	151,691	2,911,506	451,628	3,278
	2012	469,401	277,598	15,405	146,346	3,653,296	114,640	247
	2013	300,346	495,961	790	154,403	2,818,241	164,712	586
	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
Harvest	2010	69	147	16.3	47	1,390	137	1.1
(Metric)	2011	149	140	0.7	69	1,320	205	1.5
(tonnes)	2012	213	126	7.0	66	1,657	52	0.1
	2013	136	225	0.4	70	1,278	75	0.3
	2014	121	324	0.2	76	1,178	32	0.3
	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
Effort	2010	972	182,485	128	85,294	5,747	1,125	
(a)	2011	1,108	182,630	37	94,025	6,093	1,481	
	2012	2,074	154,474	87	98,234	7,847	991	
	2013	1,014	232,234	25	83,739	6,037	968	
	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	
Harvest Rates	2010	71.4	4.0	127.6	4.0	241.9	121.9	
(b)	2011	134.2	4.1	18.9	5.3	216.7	138.3	
	2012	102.6	4.5	80.3	4.7	211.1	52.5	
	2013	134.3	5.0	14.3	5.2	211.7	77.2	
	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	

(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, 2010-2019.

		Unit 4						
		New York		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2010	11,772	25,958	0	26,263	465,775	1,517	320
(pounds)	2011	15,045	65,803	0	37,040	464,331	2,761	909
	2012	17,709	88,790	0	41,362	499,359	833	2,586
	2013	15,814	104,055	0	74,277	492,233	2,778	1,665
	2014	10,355	139,313	0	16,671	482,925	1,160	1,814
	2015	21,503	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
Harvest	2010	5.3	11.8	0	11.9	211.2	0.69	0.1
(Metric)	2011	6.8	29.8	0	16.8	210.6	1.25	0.4
(tonnes)	2012	8.0	40.3	0	18.8	226.5	0.38	1.2
	2013	7.2	47.2	0	33.7	223.2	1.26	0.8
	2014	4.7	63.2	0	7.6	219.0	0.53	0.8
	2015	9.8	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
Effort	2010	287	35,526	0	26,544	1,227	21.7	
(a)	2011	383	50,479	0	48,537	1,564	28.6	
	2012	428	58,621	0	49,577	1,770	12.9	
	2013	364	65,750	0	48,093	1,932	14.5	
	2014	213	76,817	0	13,959	2,016	8.3	
	2015	441	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	30,285	0	2,730	947	29.7	
Harvest Rates	2010	18.6	1.31	--	2.2	172.1	31.7	
(b)	2011	17.8	2.01	--	2.9	134.6	43.8	
	2012	18.8	2.17	--	2.5	127.9	29.3	
	2013	19.7	2.59	--	2.9	115.5	87.1	
	2014	22.0	2.78	--	2.3	108.6	63.4	
	2015	22.1	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	

(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 2019 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	6,133	0.3	0	0.0	0	0.0	0	0.0	6,133	0.1
	2	411,063	16.9	160,563	8.4	58,399	1.6	2,431	0.3	632,456	7.1
	3	418,766	17.2	308,543	16.2	1,174,331	32.1	855,237	88.2	2,756,877	30.7
	4	543,263	22.3	428,949	22.5	419,675	11.5	43,456	4.5	1,435,344	16.0
	5	884,195	36.3	841,158	44.2	1,347,916	36.8	54,371	5.6	3,127,640	34.9
	6+	169,417	7.0	163,160	8.6	660,778	18.0	14,155	1.5	1,007,510	11.2
	Total	2,432,837	*69.4*	1,902,374	*65.6*	3,661,098	*83.1*	969,650	*89.5*	8,965,960	*75.3*
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	76,808	15.6	5,313	0.5	57,762	7.9	0	0.0	139,883	6.2
	3	73,525	14.9	149,816	15.3	112,887	15.4	21,242	43.3	357,470	15.9
	4	158,648	32.2	389,946	39.9	111,409	15.2	12,745	26.0	672,748	29.9
	5	164,837	33.4	376,133	38.5	297,146	40.5	8,497	17.3	846,613	37.6
	6+	19,491	4.0	55,251	5.7	154,606	21.1	6,536	13.3	235,884	10.5
	Total	493,310	*14.1*	976,459	*33.7*	733,809	*16.6*	49,021	*4.5*	2,252,598	*18.9*
Sport	1	74,667	12.9	0	0.0	0	0.0	0	0.0	74,667	11.0
	2	180,393	31.1	281	1.2	1,169	8.9	1,000	1.5	182,843	26.9
	3	62,573	10.8	1,842	8.1	2,536	19.3	30,574	47.2	97,525	14.3
	4	103,600	17.9	7,052	30.9	3,847	29.3	18,975	29.3	133,474	19.6
	5	140,302	24.2	8,034	35.2	2,394	18.2	6,661	10.3	157,391	23.1
	6+	18,384	3.2	5,642	24.7	3,185	24.3	7,571	11.7	34,782	5.1
	Total	579,920	*16.5*	22,851	*0.8*	13,131	*0.3*	64,780	*6.0*	680,683	*5.7*
All Gear	1	80,800	2.3	0	0.0	0	0.0	0	0.0	80,800	0.7
	2	668,265	19.1	166,157	5.7	117,329	2.7	3,431	0.3	955,182	8.0
	3	554,864	15.8	460,201	15.9	1,289,753	29.3	907,053	83.7	3,211,872	27.0
	4	805,512	23.0	825,947	28.5	534,931	12.1	75,177	6.9	2,241,566	18.8
	5	1,189,335	33.9	1,225,325	42.2	1,647,456	37.4	69,528	6.4	4,131,645	34.7
	6+	207,291	5.9	224,053	7.7	818,569	18.6	28,262	2.6	1,278,176	10.7
	Total	3,506,067	29.5	2,901,683	24.4	4,408,039	37.0	1,083,451	9.1	11,899,240	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. Abundance in the years 2000 to 2020 are estimated by ADMB catch-age analysis.

	Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Unit 1	2	28.353	26.644	6.698	32.762	3.405	39.232	1.999	10.150	13.180	29.219	23.376	9.258	11.576	2.627	6.620	19.857	51.661	18.540	8.429	17.625	36.994
	3	6.667	18.002	17.219	4.249	20.608	2.143	24.790	1.266	6.417	8.503	18.593	14.599	5.773	7.089	1.566	4.041	12.018	30.555	11.275	5.293	11.218
	4	13.732	3.560	10.524	9.204	2.233	10.363	1.101	12.830	0.683	3.731	4.624	9.471	7.419	2.832	3.109	0.728	1.809	4.805	13.549	5.558	2.616
	5	2.758	5.912	1.872	4.578	3.979	0.830	4.034	0.434	5.833	0.359	1.709	1.877	3.834	3.011	0.932	1.087	0.236	0.458	1.440	4.789	1.844
	6+	0.992	1.378	3.539	2.112	2.536	1.963	0.932	1.585	0.859	3.265	1.558	1.161	1.062	1.758	1.336	0.689	0.475	0.143	0.135	0.424	1.249
	2 and Older	52.502	55.496	39.852	52.906	32.761	54.530	32.856	26.264	26.972	45.077	49.859	36.367	29.664	17.318	13.563	26.402	66.198	54.501	34.828	33.689	53.920
	3 and Older	24.149	28.852	33.153	20.143	29.356	15.299	30.857	16.114	13.792	15.857	26.483	27.109	18.088	14.691	6.943	6.546	14.538	35.961	26.399	16.063	16.926
Unit 2	2	51.256	48.256	11.426	99.419	6.600	175.632	7.268	24.230	25.964	59.393	45.673	8.158	20.679	12.953	32.846	10.952	43.016	22.472	11.026	11.476	25.046
	3	8.651	33.192	31.508	7.433	64.860	4.318	114.257	4.747	16.012	17.176	39.049	30.097	5.379	13.590	8.468	21.477	7.117	28.182	14.792	7.289	7.603
	4	16.232	4.721	19.108	17.554	4.189	37.159	2.387	64.138	2.899	9.893	10.084	23.429	18.056	3.154	7.648	4.712	11.304	3.993	16.402	8.907	4.449
	5	1.095	6.916	2.264	8.435	7.883	1.946	16.106	1.068	34.465	1.617	4.874	5.226	12.124	8.828	1.401	3.267	1.756	4.915	1.910	8.539	4.760
	6+	0.408	0.553	3.188	2.089	4.092	4.849	2.575	7.444	4.207	20.265	9.804	6.952	5.776	7.811	6.455	2.901	1.907	1.385	2.726	2.258	5.389
	2 and Older	77.641	93.638	67.493	134.929	87.625	223.904	142.592	101.626	83.546	108.345	109.484	73.861	62.013	46.336	56.816	43.309	65.100	60.946	46.856	38.469	47.247
	3 and Older	26.386	45.382	56.067	35.510	81.025	48.272	135.324	77.396	57.582	48.952	63.811	65.703	41.335	33.383	23.971	32.357	22.084	38.474	35.830	26.993	22.201
Unit 3	2	46.522	32.861	9.221	53.015	6.398	132.805	9.197	37.032	46.884	64.581	55.636	13.291	31.537	24.767	48.517	9.952	50.023	20.562	32.172	28.627	19.388
	3	9.481	31.011	21.903	6.140	35.316	4.262	88.537	6.130	24.712	31.314	43.104	37.128	8.867	21.023	16.509	32.285	6.626	33.282	13.710	21.457	19.079
	4	18.039	6.024	19.754	13.914	3.851	22.427	2.699	54.751	3.905	15.966	20.100	27.336	23.466	5.532	13.169	10.142	19.759	3.995	20.628	8.479	13.108
	5	2.315	10.446	3.514	11.483	7.722	2.230	12.815	1.424	31.753	2.365	9.489	11.481	15.466	12.795	3.053	6.869	5.213	9.724	2.128	10.900	4.321
	6+	1.393	1.960	6.679	5.340	8.333	8.427	5.452	8.380	5.154	21.109	12.782	11.513	11.721	13.087	12.667	6.952	6.048	4.594	6.673	4.015	6.501
	2 and Older	77.750	82.301	61.072	89.893	61.619	170.151	118.699	107.715	112.409	135.335	141.111	100.748	91.056	77.203	93.915	66.200	87.669	72.157	75.310	73.478	62.396
	3 and Older	31.228	49.440	51.851	36.878	55.221	37.346	109.502	70.684	65.525	70.755	85.475	87.457	59.519	52.436	45.398	56.248	37.646	51.595	43.138	44.851	43.008
Unit 4	2	8.322	3.185	1.691	4.272	0.921	6.447	0.756	6.828	4.593	5.235	6.760	0.737	7.624	1.647	3.244	0.576	3.636	5.137	14.624	1.371	1.733
	3	0.724	5.543	2.127	1.125	2.836	0.610	4.229	0.493	4.498	3.022	3.425	4.384	0.474	4.875	1.043	2.040	0.364	2.326	3.365	9.502	0.893
	4	1.277	0.472	3.656	1.378	0.722	1.805	0.371	2.515	0.306	2.774	1.817	1.979	2.446	0.257	2.535	0.525	1.056	0.198	1.404	1.960	5.584
	5	0.126	0.810	0.306	2.277	0.847	0.433	0.994	0.197	1.445	0.174	1.493	0.913	0.925	1.081	0.105	0.977	0.214	0.473	0.108	0.720	1.019
	6+	0.518	0.417	0.794	0.681	1.816	1.595	1.171	1.209	0.855	1.335	0.860	1.241	1.099	0.982	0.933	0.524	0.666	0.471	0.536	0.377	0.593
	2 and Older	10.967	10.426	8.573	9.733	7.141	10.890	7.520	11.242	11.696	12.541	14.356	9.253	12.569	8.843	7.861	4.641	5.937	8.605	20.036	13.931	9.821
	3 and Older	2.644	7.241	6.883	5.461	6.220	4.443	6.764	4.414	7.103	7.306	7.596	8.516	4.945	7.196	4.617	4.066	2.301	3.468	5.412	12.560	8.088

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*>0.20.

	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($logSSB_0$)**	**2020**	**2021(a)**	**B_{msy}**	**%SSB_0**	**P***	**F_{msy}**	**% F_{msy}**	**F_{target}**	**F_{actual} (b)**
MU1	2.75	3.72E-07	0.96	5,711,580	0.22	2,714,810	3,994,330	1,585,842	28%	0.00	2.40	28%	0.672	0.672
MU2	2.38	1.54E-07	0.96	12,708,800	0.19	4,686,180	3,890,990	3,522,489	28%	0.35	2.11	35%	0.739	0.487
MU3	2.26	1.30E-07	0.96	13,424,200	0.21	6,843,120	5,507,670	3,682,414	27%	0.05	2.04	32%	0.653	0.653
MU4	2.11	1.11E-06	1.01	1,762,980	0.19	1,954,820	1,288,580	498,137	28%	0.00	1.51	34%	0.513	0.513

(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 2020 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

		2020 Stock Size (millions of fish)			2020 Mean Biomass	Exploitation Rate				2020 Catch (millions of fish)			3-yr Mean Weight in	2020 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	24.086	36.994	49.902	8.917	0.672	0.110	0.074	0.059	1.421	2.183	2.945	0.129	0.404	0.621	0.837
	3	9.334	11.218	13.101	3.718	0.672	0.407	0.274	0.199	1.859	2.235	2.610	0.146	0.598	0.719	0.840
	4	2.163	2.616	3.069	0.938	0.672	0.721	0.485	0.322	0.696	0.841	0.987	0.163	0.250	0.302	0.355
	5	1.455	1.844	2.234	0.736	0.672	1.000	0.672	0.412	0.600	0.760	0.921	0.172	0.227	0.288	0.349
	6+	0.894	1.249	1.604	0.633	0.672	0.798	0.536	0.348	0.311	0.435	0.558	0.187	0.128	0.179	0.230
	Total	37.931	53.920	69.909	14.942				0.120	4.887	6.454	8.020	0.148	1.605	2.110	2.611
	(3+)	13.846	16.926	20.007	6.025				0.252	3.466	4.271	5.076	0.158	1.204	1.489	1.774
Unit 2	2	18.904	25.046	31.189	6.755	0.487	0.070	0.034	0.028	0.522	0.691	0.861	0.145	0.167	0.221	0.275
	3	6.408	7.603	8.798	3.112	0.487	0.357	0.174	0.132	0.848	1.006	1.164	0.156	0.292	0.346	0.400
	4	3.812	4.449	5.086	2.308	0.487	0.738	0.360	0.252	0.961	1.121	1.282	0.178	0.377	0.440	0.503
	5	4.070	4.760	5.450	2.697	0.487	0.987	0.481	0.320	1.302	1.523	1.743	0.190	0.545	0.638	0.730
	6+	4.478	5.389	6.300	3.766	0.487	1.000	0.487	0.323	1.447	1.741	2.036	0.202	0.644	0.775	0.907
	Total	37.671	47.247	56.823	18.638				0.129	5.079	6.083	7.086	0.180	2.021	2.420	2.815
	(3+)	18.767	22.201	25.634	11.883				0.243	4.557	5.391	6.225	0.185	1.858	2.199	2.540
Unit 3	2	12.954	19.388	25.822	3.975	0.653	0.022	0.014	0.012	0.153	0.229	0.305	0.128	0.043	0.065	0.086
	3	15.801	19.079	22.357	6.113	0.653	0.205	0.134	0.104	1.638	1.977	2.317	0.150	0.542	0.654	0.766
	4	11.006	13.108	15.210	5.587	0.653	0.547	0.357	0.250	2.757	3.283	3.810	0.171	1.039	1.238	1.436
	5	3.556	4.321	5.085	2.194	0.653	0.829	0.541	0.351	1.247	1.515	1.784	0.177	0.487	0.591	0.696
	6+	5.114	6.501	7.887	4.424	0.653	1.000	0.653	0.404	2.064	2.624	3.184	0.201	0.915	1.163	1.411
	Total	48.431	62.396	76.362	22.293				0.154	7.859	9.630	11.400	0.175	3.020	3.711	4.396
	(3+)	35.476	43.008	50.540	18.318				0.219	7.706	9.400	11.095	0.176	2.982	3.646	4.309
Unit 4	2	1.172	1.733	2.293	0.434	0.513	0.095	0.049	0.039	0.046	0.068	0.090	0.149	0.015	0.022	0.030
	3	0.670	0.893	1.115	0.413	0.513	0.432	0.222	0.165	0.111	0.147	0.184	0.164	0.040	0.053	0.067
	4	4.548	5.584	6.620	3.131	0.513	0.883	0.453	0.305	1.386	1.702	2.018	0.176	0.538	0.661	0.783
	5	0.802	1.019	1.235	0.707	0.513	1.000	0.513	0.337	0.270	0.343	0.416	0.182	0.108	0.138	0.167
	6+	0.463	0.593	0.724	0.504	0.513	0.666	0.342	0.241	0.112	0.143	0.175	0.215	0.053	0.068	0.083
	Total	7.654	9.821	11.987	5.190				0.245	1.925	2.404	2.883	0.178	0.753	0.942	1.129
	(3+)	6.483	8.088	9.694	4.756				0.289	1.879	2.336	2.793	0.179	0.739	0.919	1.099

(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 2020 by Management Unit (Unit). RAH values may be subject to a limit on the annual change in TAC (±20%).

Unit	Fishing Rate	Recommended Allowable Harvest (millions lbs.)			±20% of previous year TAC	
		MIN	MEAN	MAX	MIN (-20%)	MAX (+20%)
1	0.672	1.605	2.110	2.611	1.940	2.910
2	0.487	2.021	2.420	2.815	1.766	2.650
3	0.653	3.020	3.711	4.396	2.699	4.049
4	0.513	0.753	0.942	1.129	0.436	0.654
Total		7.399	9.182	10.951	6.842	10.262

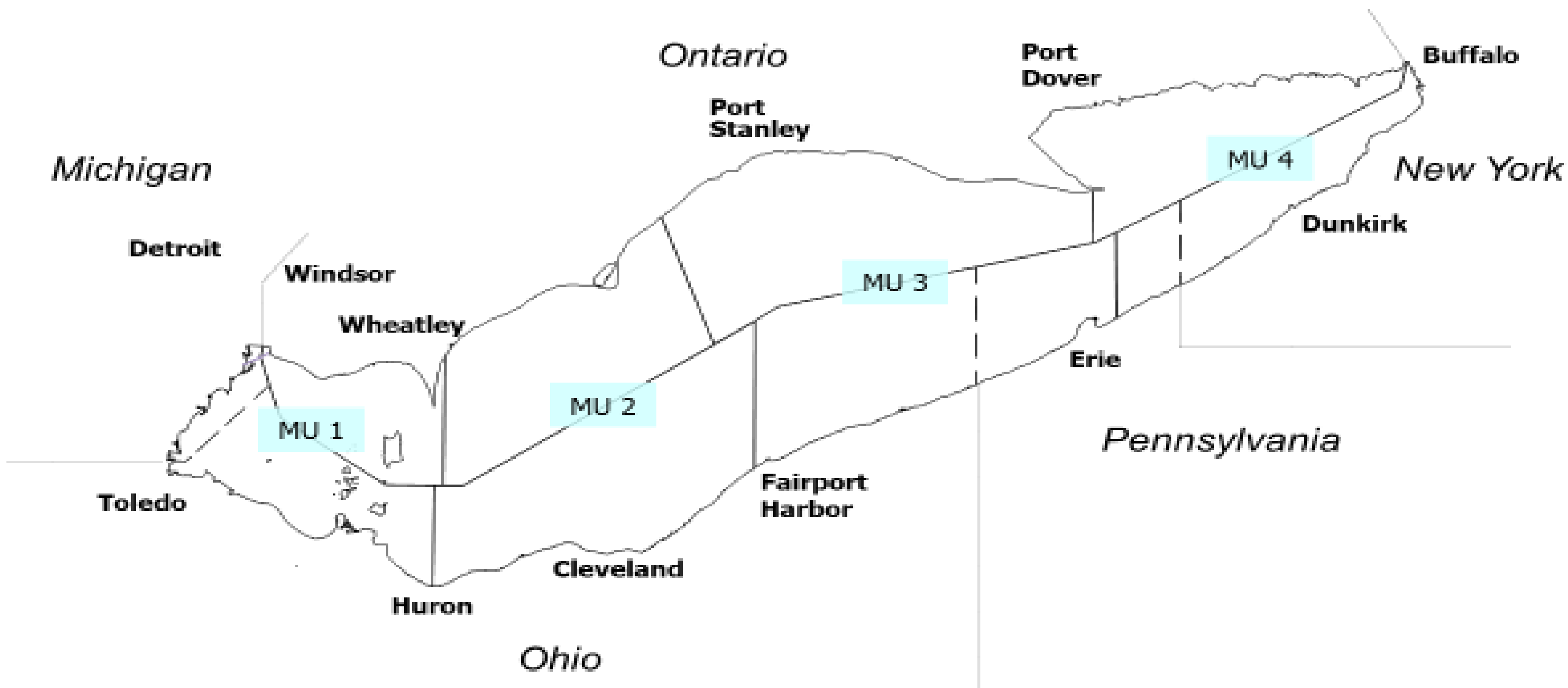

Figure 1.1. The Yellow Perch Management Units (MUs) of Lake Erie defined by the YPTG and LEC, for illustrative purposes.

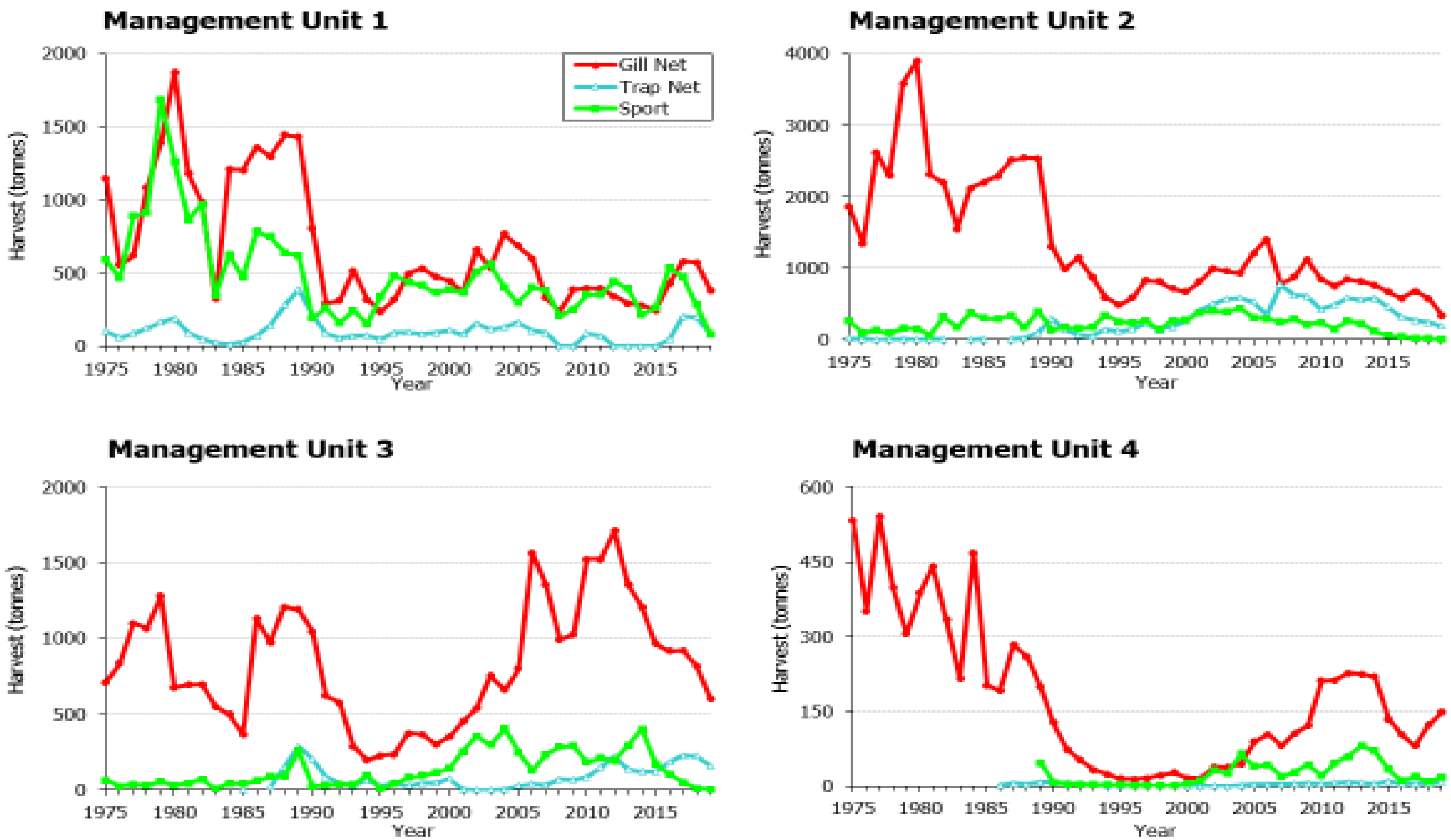

Figure 1.2. Historic Lake Erie Yellow Perch harvest (metric tonnes) by management unit and gear type.

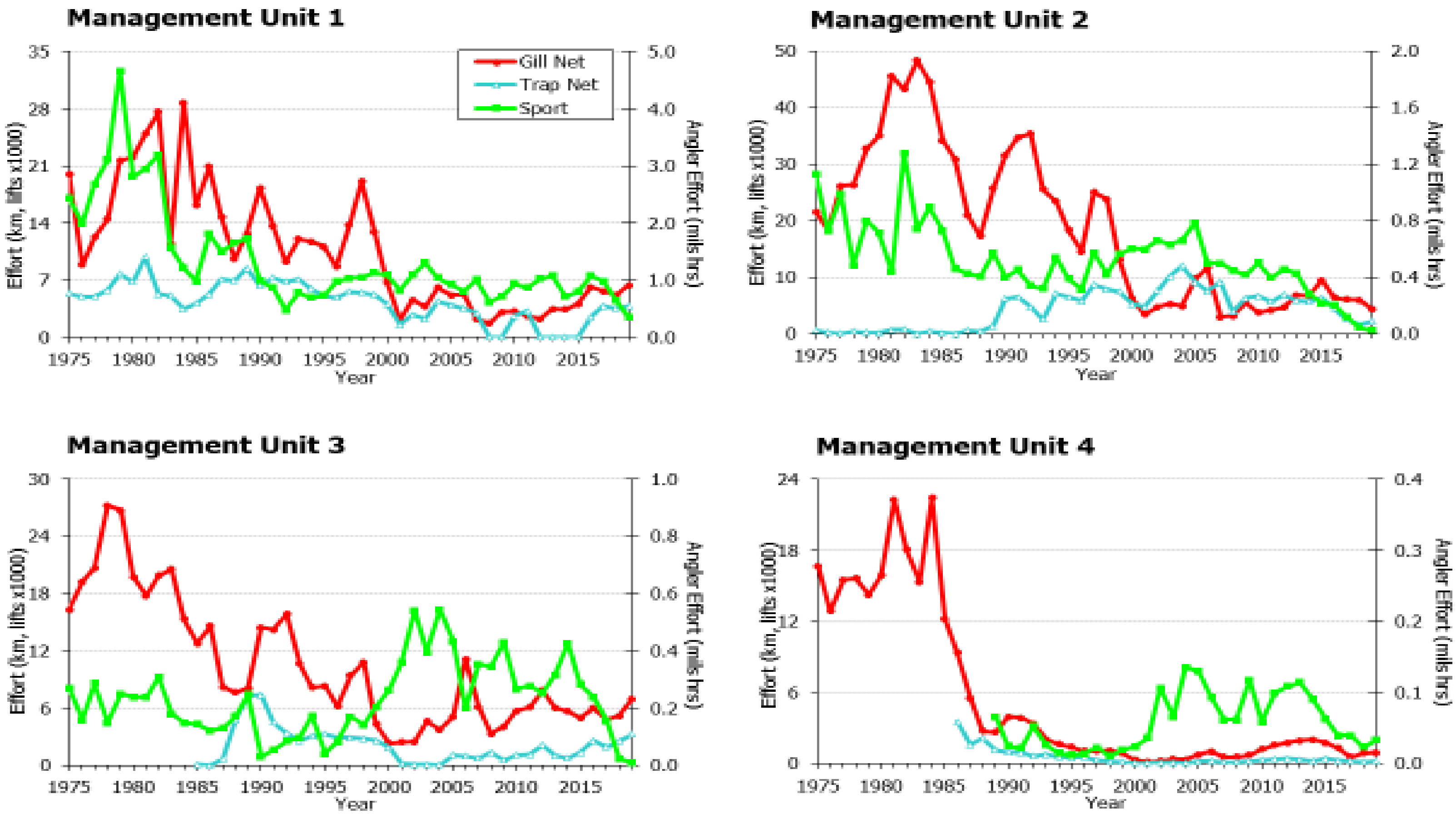

Figure 1.3. Historic Lake Erie Yellow Perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh (< 3").

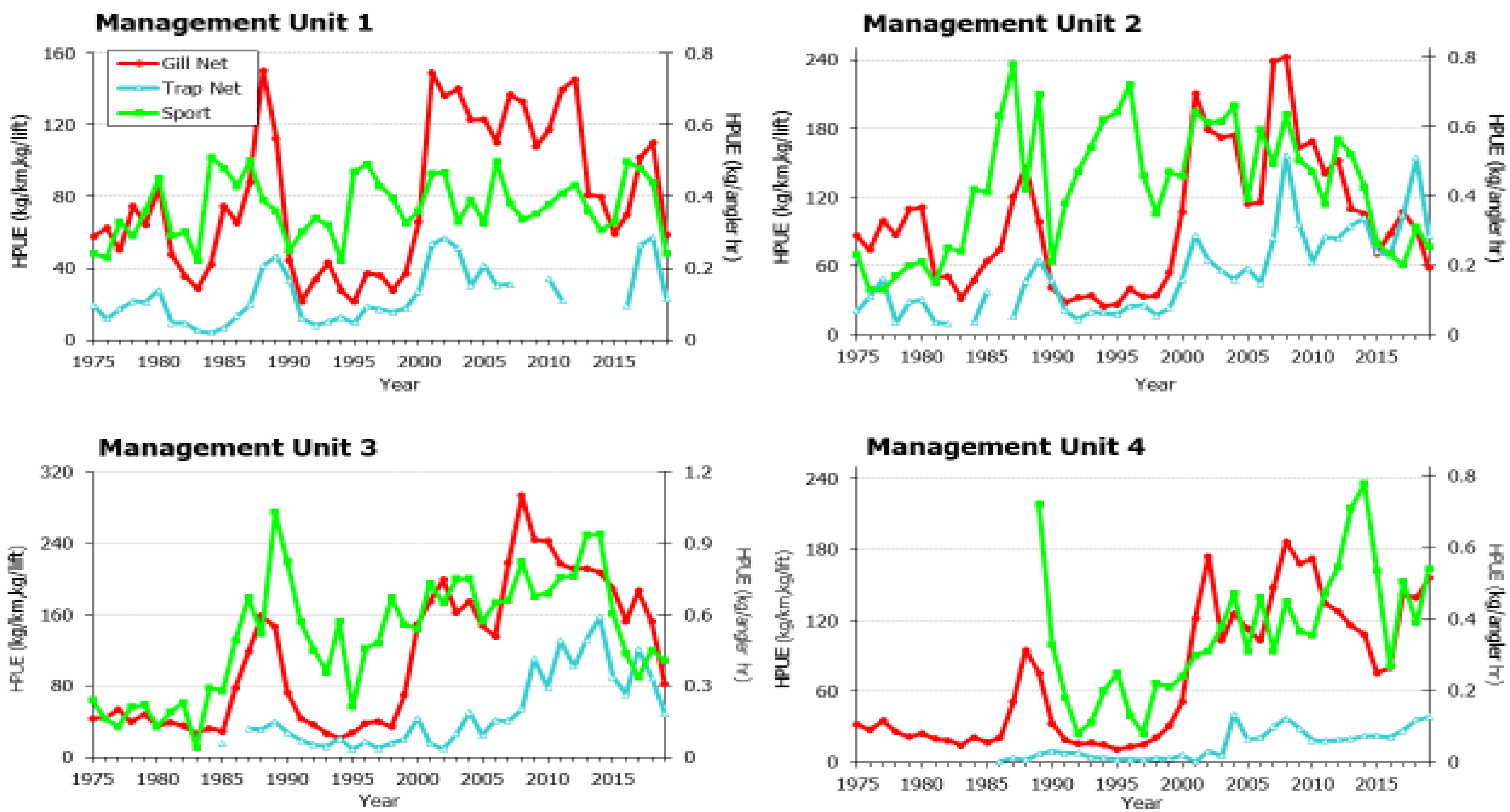

Figure 1.4. Historic Lake Erie Yellow Perch harvest per unit effort (HPUE) by management unit and gear type. Note: gill net CPUE for 2001 to 2019 is for small mesh (< 3") only.

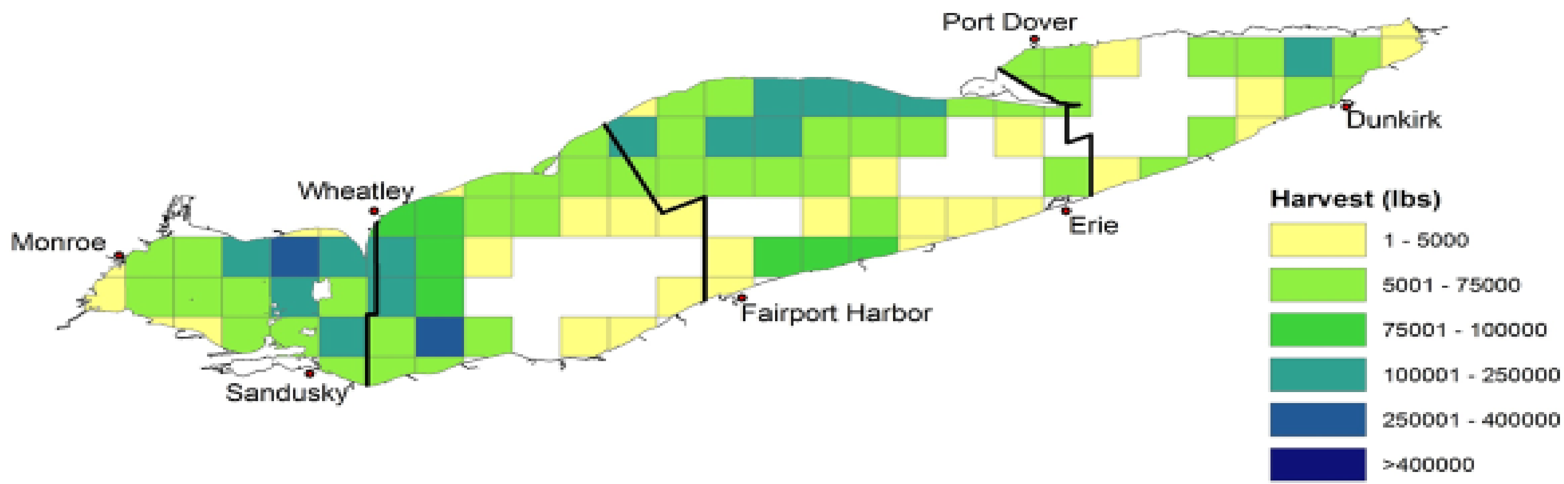

Figure 1.5. Spatial distribution of Yellow Perch total harvest (lbs.) in 2019 by 10-minute grid.

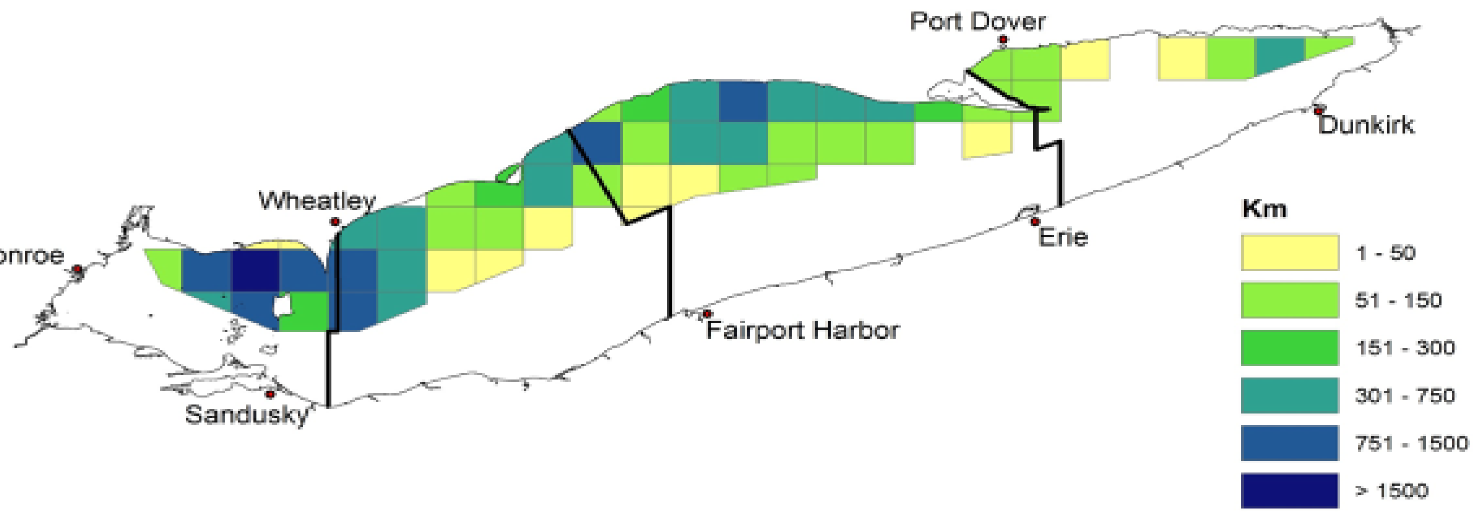

Figure 1.6. Spatial distribution of Yellow Perch small mesh gill net effort (km) in 2019 by 10-minute grid.

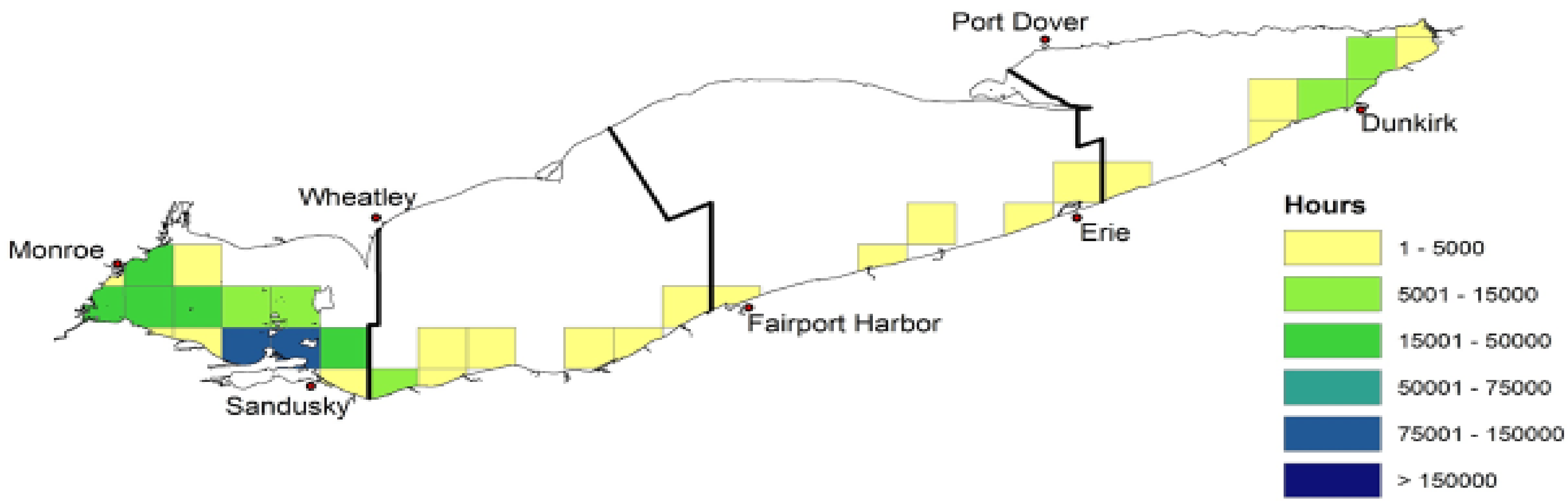

Figure 1.7. Spatial distribution of Yellow Perch sport effort (angler hours) in 2019 by 10-minute grid.

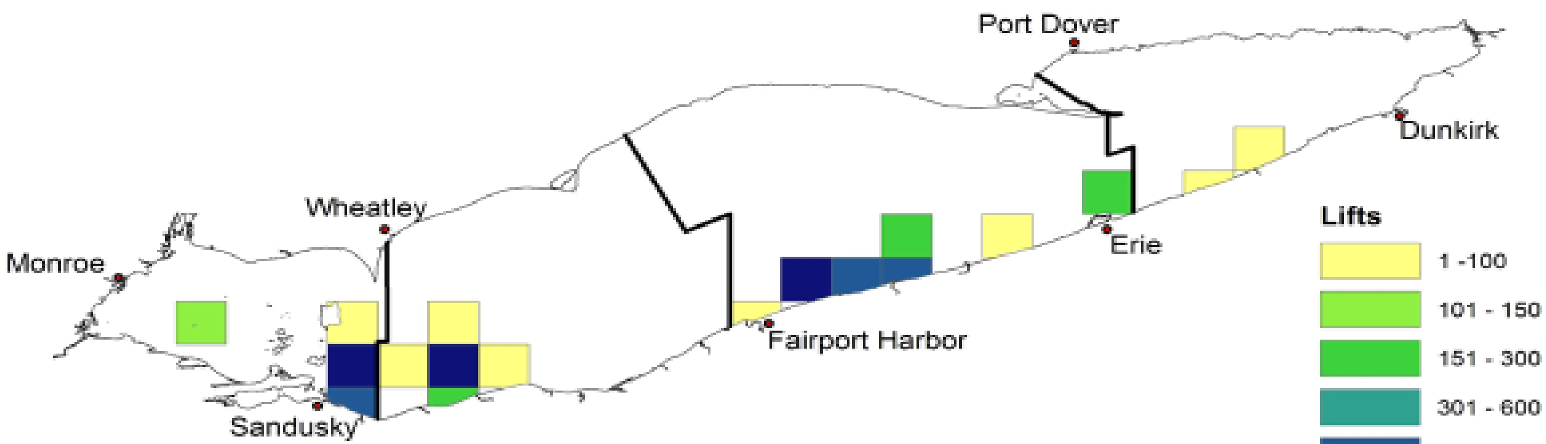

Figure 1.8. Spatial distribution of Yellow Perch trap net effort (lifts) in 2019 by 10-minute grid.

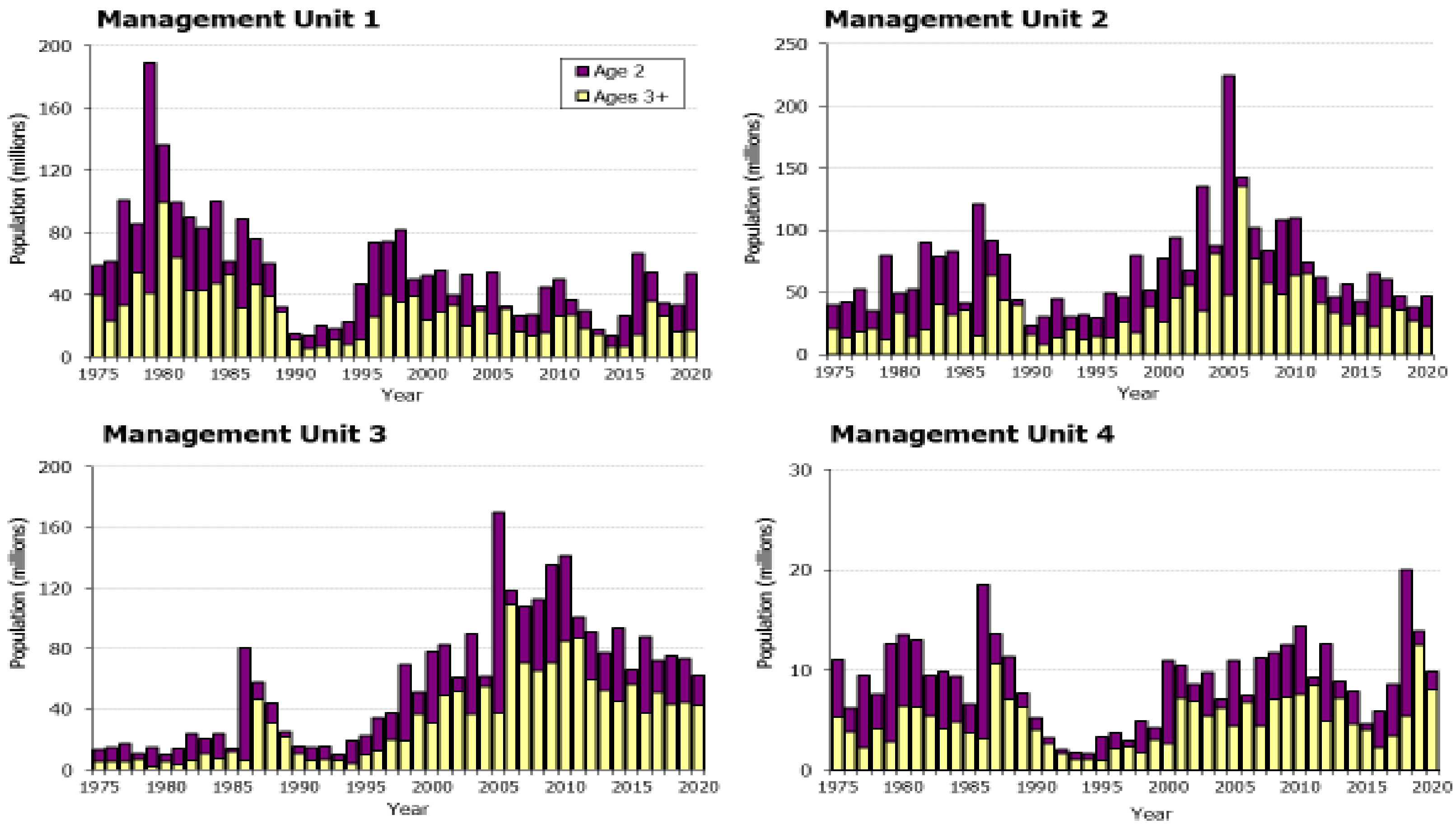

Figure 1.9. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2020, from the PR ADMB model.

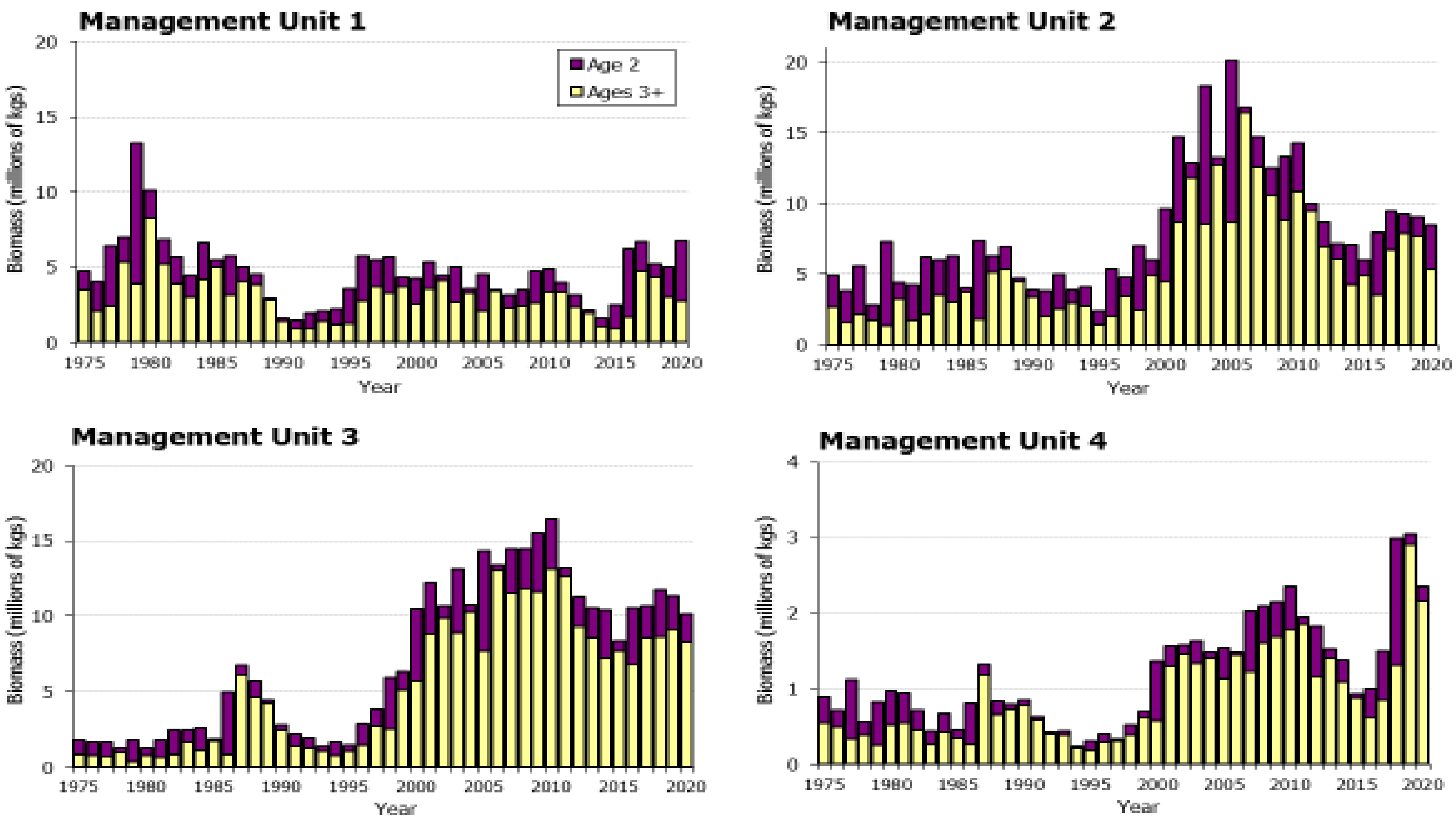

Figure 1.10. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2020, from the PR ADMB model.

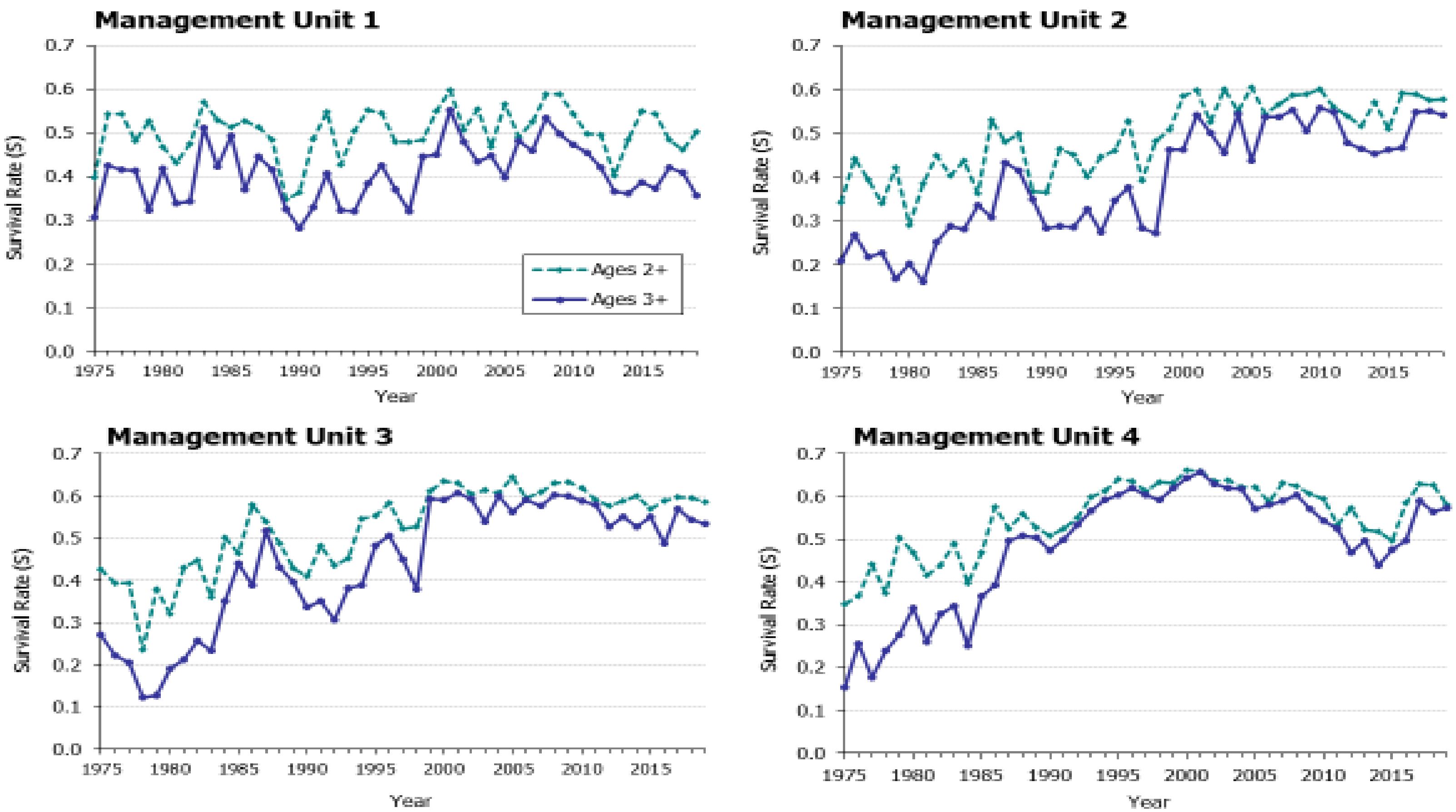

Figure 1.11. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).

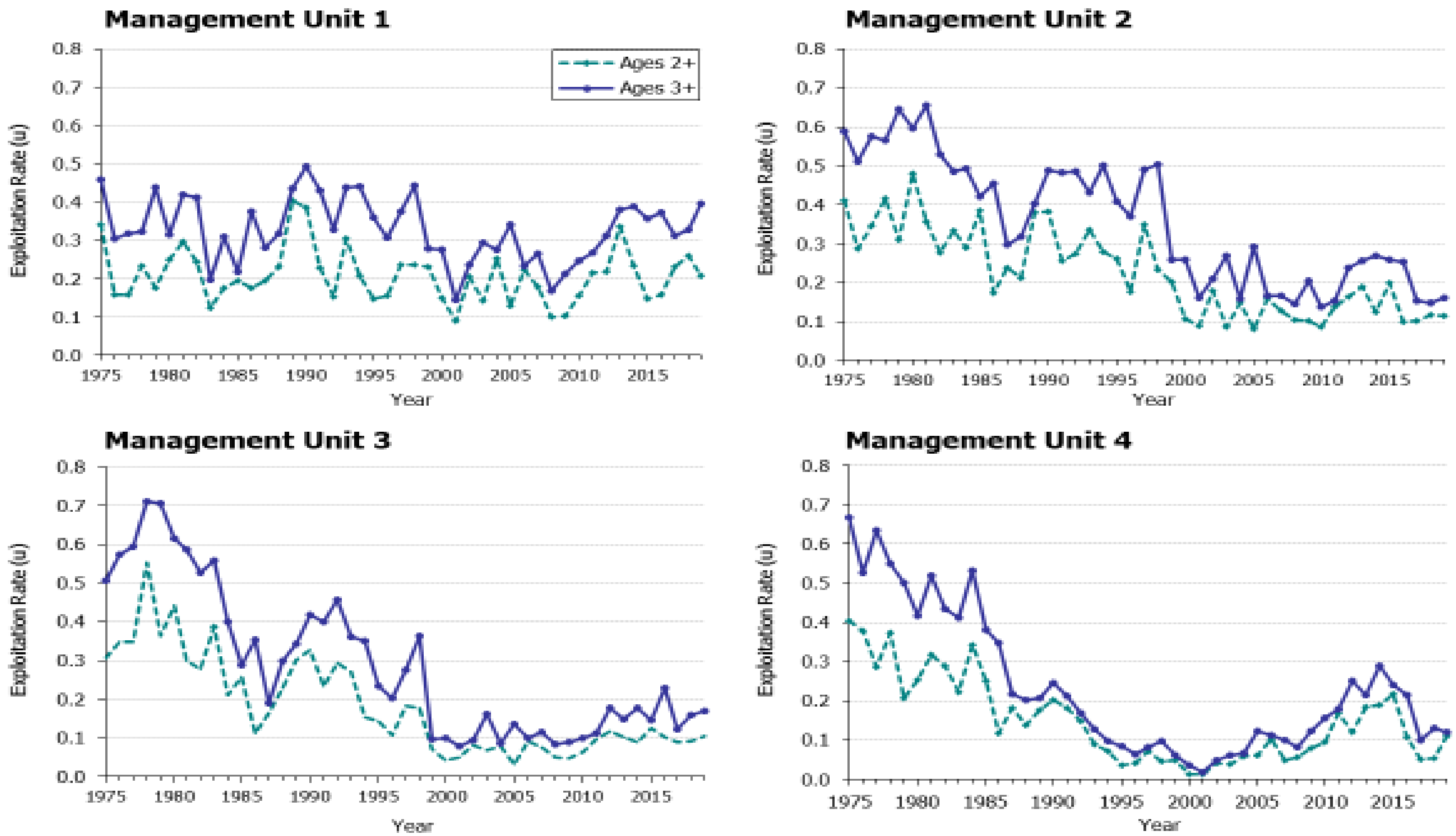

Figure 1.12. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).

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	3
	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	4
	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	4
	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
	Long Point Bay Gill Net Index Catch Rates	1.0	5

Appendix Table 2. Surveys selected by multi-model inference (MMI) age-2 recruitment models run for each management unit.

MU	Number of Years in Model	Survey	Parameter Estimate	Number of Models
MU1	19	OOS11	0.134	1
		OOS10	0.364	2
		OPSF11	0.105	2
		(Intercept)	13.716	2
MU2	18	OHF20	0.260	1
		OPSF21	0.326	1
		(Intercept)	14.947	1
MU3	17	OHJ31	0.277	1
		OPSF31	0.336	1
		(Intercept)	14.862	1
MU4	15	LPC41	0.191	1
		NYF41	0.421	2
		(Intercept)	13.416	2

Appendix Table 3. 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	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

Appendix Table 3 continued

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*	.	.	.	.
1989	*106.1*	*11.8*	*296.9*	*53.2*	*457.7*	*84.6*	*0.4*	*1.9*					*6.3*	.	.	.	.
1990	*144.4*	*20.7*	*43.3*	*12.0*	*202.6*	*21.0*	*0.0*	*2.6*	*1.5*	*18.6*	*0.9*	*42.6*	*0.0*	*1.7*	*67.4*	*1.2*	*7.5*
1991	*146.9*	*27.6*	*15.5*	*1.0*	*144.0*	*24.5*	*0.7*	*0.6*			*0.0*	*0.0*	*1.7*	*5.4*	*43.5*	*5.2*	*77.7*
1992	*60.7*	*9.5*	*54.3*	*9.0*	*594.0*	*32.8*	*0.0*	*0.1*	*0.0*	*10.9*	*0.0*	*0.7*	*5.6*	*7.2*	*8.0*	*24.3*	*2.7*
1993	*1164.2*	*14.4*	*21.6*	*4.5*	*239.8*	*17.9*	*2.9*	*0.2*	*0.0*	*13.2*	*0.0*	*19.1*	*7.9*	*41.7*	*29.1*	*39.7*	*16.0*
1994	*508.5*	*57.7*	*159.8*	*15.3*	*84.0*	*29.8*	*10.6*	*1.7*	*518.8*	*5.3*	*265.8*	*13.0*	*2.7*	*73.3*	*5.0*	*77.2*	*16.7*
1995	*348.9*	*128.8*	*6.0*	*33.7*	*5.3*	*54.3*	*4.0*	*1.7*	*28.9*	*8.5*	*28.5*	*1.0*	*15.2*	*2.8*	*120.5*	*27.3*	*21.0*
1996	*3290.8*	*79.9*	*199.1*	*2.6*	*53.6*	*6.1*	*7.9*	*0.1*	*1464.4*	*2.9*	*558.3*	*1.2*	*0.4*	*1059.9*	*12.1*	*2006.8*	*3.6*
1997	*52.2*	*121.8*	*18.9*	*59.8*	*21.5*	*5.4*	*0.0*	*0.1*	*0.0*	*68.1*	*0.7*	*225.2*	*4.4*	*29.0*	*677.7*		
1998	*174.5*	*4.8*	*114.9*	*1.2*	*1005.9*	*14.9*	*8.1*	*0.0*					*8.4*	*225.4*	*3.4*	*275.5*	*3.7*
1999	*270.1*	*68.5*	*2.5*	*69.5*	*34.0*	*155.7*	*15.5*	*109.3*	*0.3*	*32.5*	*68.9*	*58.3*	*23.0*	*29.5*	*19.4*	*44.8*	*63.5*
2000	*186.4*	*85.3*	*10.2*	*2.1*	*1.2*	*4.8*	*3.0*	*13.4*	*0.0*	*129.3*	*1.1*	*28.7*	*0.7*	*0.6*	*86.6*	*0.0*	*84.8*
2001	*322.1*	*12.8*	*76.7*	*2.0*	*463.8*	*2.7*	*13.8*	*1.9*	*54.3*	*11.3*	*263.5*	*20.8*	*4.8*	*341.9*	*6.4*	*1283.7*	*10.2*
2002	*33.1*	*77.1*	*0.6*	*13.9*	*8.3*	*42.6*	*0.0*	*0.7*	*0.0*	*192.4*	.	.	*6.8*	*0.3*	*191.0*	*1.7*	*749.6*
2003	*1509.9*	*3.0*	*93.3*	*0.8*	*224.0*	*1.5*	*240.6*	*2.6*	*607.9*	*20.9*	*193.6*	*6.9*	*1.3*	*1180.4*	*3.8*	*1170.2*	*2.3*
2004	*40.9*	*210.7*	*0.5*	*4.3*	*0.1*	*21.4*	*0.1*	*12.2*	*0.0*	*60.5*	*0.2*	*55.9*	*6.5*	*32.8*	*316.2*	*3.6*	*61.9*
2005	*124.2*	*5.2*	*10.3*	*0.1*	*8.8*	*0.2*	*156.2*	*0.0*	*0.0*	*47.3*	*44.9*	*10.3*	*0.4*	*105.2*	*22.3*	*278.2*	*82.3*
2006	*180.2*	*6.4*	*2.8*	*1.4*	*0.3*	*4.8*	*38.0*	*14.6*	*13.4*	*78.0*	*250.8*	*14.3*	*19.5*	*4.9*	*2.2*	*60.7*	*10.8*
2007	*592.9*	*14.5*	*6.3*	*0.9*	*73.9*	*3.0*	*70.0*	*9.6*	*47.1*	*7.5*	*540.5*	*21.5*	*9.1*	*245.8*	*21.3*	*237.0*	*40.9*
2008	*267.0*	*23.5*	*4.9*	*6.6*	*0.3*	*4.1*	*356.0*	*25.1*	*2129.1*	*358.0*	*320.9*	*101.8*	*5.7*	*210.5*	*62.6*	*558.3*	*150.2*
2009	*186.0*	*85.3*	*1.5*	*4.2*	*0.0*	*0.0*	*0.3*	*13.1*	*0.0*	*24.2*	*0.0*	*109.9*	*0.7*	*14.2*	*62.7*	*0.1*	*104.3*
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*

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 2019 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 2019 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