Report of the Lake Erie Yellow Perch Task Group

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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

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Introduction

From April 2020 through March 2021 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. Evaluate the impact of recruitment indices on ADMB model results.
    b. Evaluate ADMB model parameter sensitivity.

Charge 1: 2020 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) of Yellow Perch in 2020 was 7.805 million pounds. This allocation represented a 9% decrease from a TAC of 8.552 million pounds in 2019. For Yellow Perch assessment and allocation, Lake Erie is partitioned into four management units (MUs; Figure 1.1). The 2020 TAC allocation was 2.110, 2.021, 3.020, and 0.654 million pounds for MUs 1 through 4, respectively. In March 2020 the Lake Erie Committee (LEC) utilized the harvest policy within the new Yellow Perch Management Plan to determine the TAC. For MU1, the LEC set the TAC equal to 2.110 million pounds, which was the mean of the RAH. In MU2, the target fishing mortality rate was reduced to F=0.487, lowering the mean RAH and range. The target fishing mortality rate was reduced to ensure the spawning stock biomass in 2021 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 2.021 million pounds, which was equal to the minimum RAH. For MU3, the LEC set the TAC at 3.020 million pounds, which was equal to the minimum RAH, due to uncertainty in age-2 recruitment and record low survey and harvest catch rates. In MU4, the LEC set the TAC at 0.654 million pounds, which was a 20% increase from the 2019 TAC.

The lakewide harvest of Yellow Perch in 2020 was 3.105 million pounds, or 40% of the total 2020 TAC. This was a 30% decrease from the 2019 harvest of 4.467 million pounds. Harvest from MUs 1 through 4 was 1.333, 0.676, 0.672, and 0.423 million pounds, respectively (Table 1.1). The portion of TAC harvested was 63%, 33%, 22%, and 65%, in MUs 1 through 4, respectively. In 2020, Ontario harvested 2.129 million pounds, followed by Ohio (0.835 million lbs.), Michigan (0.085 million lbs.), New York (0.036 million lbs.), and Pennsylvania (0.021 million lbs.).

Ontario's fraction of allocation harvested was 100% in MU1, 44% in MU2, 30% in MU3, and 102% in MU4 (see paragraph below regarding Ontario's harvest reporting and commercial ice allowance policy). Ohio fishers attained 37% of their TAC in the western basin (MU1), 24% in the west central basin (MU2), and 18% in the east central basin (MU3). Michigan anglers in MU1 attained 44% of their TAC. Pennsylvania fisheries harvested 4% of their TAC in MU3 and 4% of their TAC in MU4. New York fisheries attained 18% of their TAC in MU4. Ontario's portion of the lakewide Yellow Perch harvest in 2020 (69%) slightly decreased from 2019 (73%; Table 1.1). Ohio's proportion of lakewide harvest in 2020 (27%) slightly increased from 2019 (25%), and harvest in Michigan, Pennsylvania, and New York waters combined represented <5% of the lakewide harvest in 2020.

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.

During spring of 2020, fishery agency offices were closed due to COVID-19. As a result, not all fishery assessments were completed as usual. In Ontario, commercial gill net fishery samples were missing from April to June 2020, resulting in a loss of samples to calculate the commercial gill net harvest by age. However, gill net harvest weight and effort were reported as usual and samples were collected through summer and fall. To compensate for a lack of spring samples, samples from fall of 2019 were substituted to estimate spring harvest by cohort and age group. In Michigan, the sport creel survey did not begin until late May and no biological samples were collected. This impacted how the estimates of total sport harvest and effort, and the age composition of the sport fishery were calculated. Yellow Perch total harvest and effort in April and May was assumed to be equal to the measured amount from the late May creel, since the Michigan sport fishery generally does not target or harvest many Yellow Perch during the early spring. Age composition of the Michigan sport fishery was estimated with the assistance of the age composition of the Michigan bottom trawl survey. The Ohio sport creel survey did not begin until July, with reduced area coverage, and no biological samples collected. This impacted how the estimates of total sport harvest and effort, and the age composition of the sport fishery were calculated. Total harvest and effort for 2020 was estimated using proportional expansion matrices based on seasonal-spatial harvest and effort from previous years compared to 2020 measured harvest and effort. Age composition for the Ohio sport fishery was estimated using length data from previous years creel surveys and age composition data from 2020 Ohio bottom trawl surveys. All other fishery assessments and fishery independent surveys used by the Yellow Perch Task Group were completed as usual in 2020.

Harvest, fishing effort, and fishery harvest rates are summarized from 2011 to 2020 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends across a longer time series (1975 to 2020) 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. Spatial distributions of harvest and effort were not available for all gear types in 2020 and are not presented in this report.

Ontario's Yellow Perch harvest from large mesh (3 inches or greater stretched mesh) gill nets in 2020 was 0.5%, 8%, and 16% of the gill net harvest in management units 1, 2 and 3, respectively, and was negligible (0.01%) 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 2020 increased by 4% in MU1 and 18% in MU4, but decreased by 34% in MU2 and 68% in MU3 relative to 2019. Ontario trap net harvest was minimal (2 pounds in 2020) 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 2020, 3 pounds of Yellow Perch were harvested in trawl nets in MU2, 15 pounds were harvested in MU3, and 14 pounds were harvested in MU4.

Targeted (i.e., small mesh) gill net effort in 2020 increased from 2019 in MU1 and MU4 by 44% and 57%, respectively, while decreasing in MU2 and MU3 by 3% and 43% respectively.

Targeted gill net harvest rates in 2020 decreased relative to 2019 rates in all management units, with decreases of 28%, 32%, 44% and 25%, in MU1, MU2, MU3 and MU4 respectively (Figure 1.4).

In 2020, sport harvest in U.S. waters decreased in MU4 by 39%, while increasing by 88%, 41%, and 2% in MU1, MU2 and MU3 respectively compared to the 2019 harvest (Figure 1.2). Angling effort in U.S. waters decreased in 2020 from 2019, in MU3 and MU4 by 17% and 40% respectively, while increasing by 91% in MU1 and 9% in MU2 (Figure 1.3). In 2020, angling effort in U.S. waters was at its lowest in the time series in MU3 and its second lowest in MU2 (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 2019 rates, harvest per angler hour increased in Michigan (+112%) and decreased in Ohio waters of MU1 (-7%), increased in the Ohio waters of MU2 (+168%), and the Ohio waters of MU3 (+1032%), increased in the Pennsylvania waters of MU3 (+18%) and MU4 (+107%), and decreased in the New York waters of MU4 (-13%). 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 2020, the sport harvest rate (in kg/hr) was the same as 2019 values in MU1 (0.24), and MU4 (0.54), and increased in MU2 (0.33; +29%), and MU3 (0.50; +23%) from 2019 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 29% in MU1, 41% in MU2, 47% in MU3, and 21% in MU4. Compared to 2019, trap net effort (lifts) in 2020 decreased by 12% in MU1, 1% in MU2, 37% in MU3, and 39% in MU4. Trap net harvest rates decreased by 19% in MU1, 40% in MU2, 15% in MU3, and increased by 30% in MU4.

Age Composition and Growth

Lakewide, age-2 fish contributed the most to the Yellow Perch harvest (42%), followed by age-4 fish (20%), with age-3 and age-6-and-older fish contributing 19% and 11%, respectively; Table 1.6). In MU1, age-2 fish (2018 year class, 68%), and age-3 fish (2017 year class, 16%) contributed most to the fishery. In MU2, age-3 fish (2017 year class, 32%), and age-2 fish (2018 year class, 28%) contributed most to the fishery. In MU3, age-4 fish (2016 year class, 46%), age-6-and-older fish (2014 and older year class, 25%), and age-3 fish (2017 year class, 20%)

contributed the most to the harvest. In MU4, age-4 fish (2016 year class, 71%), age-2 fish (2018 year class, 17%), and age-3 fish (2017 year class, 6%), contributed the 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 and determination of recommended allowable harvest (RAH). In 2020, weight-at-age values were not available for all fishery harvest gear types, so the three year mean harvest weight-at-age values used to determine the RAH were not updated.

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 2021, 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. 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 combined with 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., 2019 year class in the 2021 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 2001 to 2020, and projections for 2021, are presented in Table 1.7. Abundance, biomass, survival, and exploitation rates are presented by management unit graphically for 1975 to 2020 in Figures 1.5 to 1.8. Mean weights-at-age from assessment surveys were applied to abundance estimates to generate population biomass estimates (Figure 1.6). Projections of abundance and biomass in 2021 are included in Figures 1.5 and 1.6. 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 2020 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 2021 and are presented in Appendix Table 1. The additional recruitment index (generated from the glmulti process) was given a lambda weighting of 1.

2021 Population Size Projection

The SCAA model was used to project age-2-and-older Yellow Perch stock size in 2021 (Table 1.7). Standard errors and ranges for 2021 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 2020 (Table 1.7) were lower than those projected last year in MUs 3 and 4, higher in MU1, and similar in MU2 (YPTG 2020). Abundance projections for 2021 are 72.711, 34.935, 58.554, and 9.258 million age-2-and-older Yellow Perch in management units 1 through 4, respectively. Abundance of age-2-and-older Yellow Perch in 2021 are projected to decrease by 19% in MU1, and 27% in MU2, and to increase by 17% in MU3, and 35% in MU4, relative to the 2020 abundance estimates (Table 1.7, Figure 1.5). Lakewide abundance of age-2-and-older Yellow Perch in 2021 is projected to be 175.5 million fish, a decrease of 10% from 2020.

Projected age-2 Yellow Perch recruitment in 2021 (the 2019 year class) were 21.224, 5.504, 27.775, and 6.069 million fish in management units 1 through 4, respectively (Table 1.7.).

Age-3-and-older Yellow Perch abundance in 2021 is projected to be 51.487, 29.431, 30.779, and 3.189 million fish in MUs 1 through 4, respectively. Abundance for age-3-and-older Yellow Perch for 2021 are projected to increase from the 2020 estimates by 429% in MU1, 107% in MU2, and 19% in MU3, and decrease by 23%, in Management Unit 4.

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 2021 are projected to decrease in MU1 (-4%), MU2 (-16%), and MU4 (-2%), while increasing in MU3 (+13%) compared to 2020 estimates (Figure 1.6).

Estimates of Yellow Perch survival for age-3-and-older in 2020 were 30%, 52%, 56%, and 36% in MUs 1 through 4, respectively (Figure 1.7). Estimates of Yellow Perch survival in 2020 for age-2-and-older fish were: 57% in MU1, 62% in MU2, 61% in MU3, and 46% in MU4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2020 were 47%, 19%, 14%, and 38% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2020 were: 12% in MU1, 7% in MU2, 7% in MU3, and 26% in MU4 (Figure 1.8).

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 duration of the 5-year plan. 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, Drouin et al., 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 $P(SSB<B_{msy}) < 0.20$.

Quota allocation by management unit and jurisdiction for 2021 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, 2021:

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 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 (P*) was changed from 0.05 to 0.20, and now invoking the P* negates the 20% TAC constraint. During 2020 the Yellow Perch Management Plan was completed and will inform Yellow Perch management for the next 5 years (Drouin et al, 2020).

Charge 4: Improve existing population models

Charge 4a asks the task group to evaluate the impact of recruitment indices on ADMB model results. During 2020, the task group performed a retrospective analysis to determine if the recruitment data adds stability to the model. The retrospective looked at model results from data ending in 2014 to data ending in 2019, with a recruitment data lambda of 1.0. There was a focus on MU2 and MU3 since these MU's had the largest differences in model results, between the first run of the model without recruitment data and the second run of the model when recruitment data was added. Mohn's rho of selected parameters was estimated during the first run and second run of the model. The task group found that adding the recruitment data to the model did lower the Mohn's rho value, and therefore increased the stability of the model. Results were more evident in MU2 compared to MU3.

The task group also evaluated the impact of reducing the weighting (lambda) of the recruitment data, which is currently weighted 1.0. The recruitment lambda of 1.0 does not take into account the potential increased mortality of juvenile Yellow Perch, and the nine-year lag in data used for multi model inference of recruitment data excludes potential recent changes in recruitment patterns. The model was run with 5 different lambda values (1.0, 0.75, 0.50, 0.25, 0.05), with a focus on MU2 and MU3. Reducing the weight of the recruitment data does decrease the difference between model results of the first model run (PR model, without recruitment data) and the second model run (HCR model, with recruitment data). Reducing the weight of the recruitment data also lowers the total sums of squares. A retrospective was also performed with different recruitment lambda values. The model was run with data ending in 2014 to data ending in 2019, using a recruitment lambda of 1.0, 0.5, and 0.05, with a focus on MU2 and MU3. Mohn's rho of selected parameters was calculated. Reducing the weight of the recruitment data lowers the total sums of squares and value of the objective function, which indicates an improved model fit. However, reducing the weight of the recruitment data increases the retrospective pattern of the model. Therefore, there is a tradeoff between improved model fit and increased retrospective pattern. The YPTG will continue to evaluate the potential to change the recruitment data lambda.

In pursuit of charge 4b, the YPTG performed analyses to evaluate the sensitivity of catchability in the model looking at: catchability trends over time, an evaluation of constant catchability for surveys, and an evaluation of constraining catchability for all data sets. To evaluate the use of a constant catchability for surveys, the MU2 model was evaluated with constant catchability for Ontario partnership and Ohio trawl surveys, which was found to increase the total sums of squares in the model. In addition, catchability was constrained for all data sets by using a bounded deviation vector in the model, instead of the bounded vector. When using a bounded vector, the effort deviations do not sum to zero, and catchability is allowed to vary more. When using a bounded deviation vector, the effort deviations sum to zero, and catchability is constrained to vary less. The YPTG performed at a retrospective of model results from data ending in 2014 to data ending in 2019 using this approach, with a focus on MU3. Mohn's rho values were calculated for selected parameters. Average Mohn's rho values were lower when using the bounded vector to estimate catchability. This work is ongoing and the YPTG will continue to evaluate ADMB model parameter sensitivity.

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Table 1.1. Lake Erie Yellow Perch harvest in pounds by management unit (Unit) and agency, 2011-2020

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	**Harvest**
Unit 1	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
	2020	857,561	64	391,231	29	84,613	6	--	--	--	--	1,333,405
Unit 2	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
	2020	407,553	60	268,213	40	--	--	--	--	--	--	675,766
Unit 3	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
	2020	478,837	71	175,550	26	--	--	18,022	3	--	--	672,408
Unit 4	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
	2020	384,737	91	--	--	--	--	2,664	1	36,083	9	423,484
Lakewide Totals	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
	2020	2,128,688	69	834,994	27	84,613	3	20,685	1	36,083	1	3,105,063

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to 2020 (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, 2011-2020.

		Unit 1					
		Michigan	Ohio		Ontario Gill Nets		Ontario
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trap Nets
Harvest	2011	145,960	156,138	640,309	792,336	78,363	103
(pounds)	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
	2020	84,613	136,555	254,676	853,096	4,463	2
Harvest	2011	66	71	290	359	36	0.05
(Metric)	2012	42	0	401	326	15	0.05
(tonnes)	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
	2020	38	62	115	387	2	0.00
Effort	2011	139,344	3,219	729,369	2,571	682	
(a)	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	
	2020	151,528	3,341	500,595	9,183	393	
Harvest Rates	2011	3.4	22.0	3.5	139.8	52.1	
(b)	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	
	2020	1.8	18.5	1.6	42.1	5.2	

(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, 2011-2020.

		Unit 2				
		Ohio		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2011	1,070,817	328,686	1,312,168	339,404	13,686
(pounds)	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
	2020	248,721	19,492	376,946	30,604	3
Harvest	2011	486	149	595	154	6.2
(Metric)	2012	583	257	703	143	5.9
(tonnes)	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
	2020	113	9	171	14	0.0
Effort	2011	5,707	395,407	4,214	3,789	
(a)	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	
	2020	2,177	27,006	4,294	1,920	
Harvest Rates	2011	85.1	2.6	141.2	40.6	
(b)	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	
	2020	51.8	1.1	39.8	7.2	

(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 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, 2011-2020.

		Unit 3						
		Ohio		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2011	327,871	308,815	1,542	151,691	2,911,506	451,628	3,278
(pounds)	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
	2020	171,180	4,370	14,961	3,061	403,720	75,102	15
Harvest	2011	149	140	0.7	69	1,320	205	1.5
(Metric)	2012	213	126	7.0	66	1,657	52	0.1
(tonnes)	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
	2020	78	2	6.8	1	183	34	0.0
Effort	2011	1,108	182,630	37	94,025	6,093	1,481	
(a)	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	
	2020	1,811	5,022	241	1,697	3,968	1,275	
Harvest Rates	2011	134.2	4.1	18.9	5.3	216.7	138.3	
(b)	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	
	2020	42.9	1.4	28.2	0.7	46.1	26.7	

(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, 2011-2020.

		Unit 4						
		New York		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2011	15,045	65,803	0	37,040	464,331	2,761	909
(pounds)	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
	2020	14,837	21,246	0	2,664	384,684	39	14
Harvest	2011	6.8	29.8	0	16.8	210.6	1.25	0.4
(Metric)	2012	8.0	40.3	0	18.8	226.5	0.38	1.2
(tonnes)	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
	2020	6.7	9.6	0	1.2	174.5	0.02	0.0
Effort	2011	383	50,479	0	48,537	1,564	28.6	
(a)	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	
	2020	136	18,677	0	1,294	1,492	34.4	
Harvest Rates	2011	17.8	2.01	--	2.9	134.6	43.8	
(b)	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	
	2020	49.5	1.57	--	1.2	117.0	0.5	

(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 2020 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	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	2,044,604	72.6	440,904	46.3	37,370	3.1	182,017	18.3	2,704,895	45.3
	3	478,621	17.0	271,008	28.5	229,454	19.1	57,386	5.8	1,036,469	17.4
	4	82,861	2.9	59,679	6.3	607,112	50.4	716,947	71.9	1,466,598	24.6
	5	78,448	2.8	68,078	7.2	42,540	3.5	28,557	2.9	217,623	3.6
	6+	129,807	4.6	112,458	11.8	286,999	23.8	12,175	1.2	541,439	9.1
	Total	2,814,341	*66.8*	952,127	*51.5*	1,203,474	*81.5*	997,081	*93.4*	5,967,024	*69.3*
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	245,161	74.4	81,607	9.4	0	0.0	437	1.4	327,204	21.9
	3	31,849	9.7	306,026	35.3	60,825	23.1	5,021	15.6	403,721	27.1
	4	11,110	3.4	60,072	6.9	65,145	24.8	21,611	67.3	157,937	10.6
	5	23,701	7.2	199,484	23.0	55,426	21.1	3,056	9.5	281,668	18.9
	6+	17,776	5.4	218,752	25.3	81,700	31.1	1,965	6.1	320,193	21.5
	Total	329,597	*7.8*	865,941	*46.9*	263,096	*17.8*	32,089	*3.0*	1,490,723	*17.3*
Sport	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	596,532	55.8	3,469	11.7	1,180	11.0	420	1.1	601,601	52.4
	3	159,446	14.9	6,310	21.3	1,636	15.2	6,294	16.6	173,686	15.1
	4	85,974	8.0	13,422	45.3	5,593	52.1	23,441	62.0	128,430	11.2
	5	104,721	9.8	6,187	20.9	1,437	13.4	5,716	15.1	118,060	10.3
	6+	123,149	11.5	247	0.8	887	8.3	1,939	5.1	126,222	11.0
	Total	1,069,821	*25.4*	29,635	*1.6*	10,733	*0.7*	37,810	*3.5*	1,147,999	*13.3*
All Gear	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	2,886,297	68.5	525,980	28.5	38,550	2.6	182,873	17.1	3,633,700	42.2
	3	669,916	15.9	583,345	31.6	291,914	19.8	68,700	6.4	1,613,875	18.8
	4	179,944	4.3	133,173	7.2	677,850	45.9	761,999	71.4	1,752,966	20.4
	5	206,870	4.9	273,748	14.8	99,404	6.7	37,329	3.5	617,351	7.2
	6+	270,731	6.4	331,458	17.9	369,586	25.0	16,079	1.5	987,854	11.5
	Total	4,213,759	49.0	1,847,703	21.5	1,477,304	17.2	1,066,980	12.4	8,605,746	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 2001 to 2020 and projected abundance in 2021 from the ADMB catch-age analysis.

	Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Unit 1	2	26.403	6.598	32.393	3.353	38.783	1.986	10.002	12.993	28.849	22.883	8.995	11.192	2.493	6.224	17.990	43.835	14.058	5.490	10.206	80.408	21.224
	3	17.954	17.061	4.182	20.374	2.107	24.476	1.256	6.329	8.386	18.350	14.281	5.603	6.849	1.481	3.776	10.790	25.519	8.423	3.401	6.382	48.549
	4	3.581	10.504	9.126	2.202	10.267	1.085	12.709	0.681	3.691	4.570	9.354	7.247	2.742	2.976	0.678	1.647	4.111	10.775	3.945	1.548	2.425
	5	6.049	1.888	4.587	3.967	0.825	4.034	0.432	5.839	0.360	1.703	1.863	3.786	2.939	0.894	1.019	0.212	0.387	1.132	3.445	1.088	0.291
	6+	1.475	3.690	2.226	2.638	2.065	1.003	1.666	0.916	3.347	1.633	1.213	1.093	1.771	1.331	0.678	0.447	0.127	0.107	0.298	0.715	0.221
	2 and Older	55.463	39.741	52.515	32.534	54.046	32.583	26.066	26.758	44.632	49.139	35.706	28.922	16.794	12.906	24.140	56.931	44.201	25.927	21.295	90.140	72.711
	3 and Older	29.060	33.144	20.122	29.181	15.263	30.598	16.064	13.765	15.783	26.256	26.711	17.729	14.301	6.683	6.151	13.096	30.143	20.437	11.090	9.732	51.486
Unit 2	2	48.862	11.482	101.326	6.644	178.296	7.275	24.066	25.492	58.120	44.092	7.683	19.234	11.847	29.084	9.154	32.332	15.213	7.815	9.585	33.556	5.504
	3	33.480	31.864	7.457	66.013	4.342	115.734	4.739	15.892	16.846	38.123	29.004	5.054	12.604	7.706	18.902	5.887	20.956	9.890	5.100	6.272	22.080
	4	4.782	19.307	17.801	4.215	37.916	2.408	65.133	2.895	9.815	9.869	22.806	17.323	2.941	6.990	4.194	9.521	3.128	11.410	5.534	2.885	3.676
	5	7.183	2.318	8.666	8.137	1.990	16.759	1.096	35.246	1.621	4.858	5.119	11.777	8.407	1.281	2.882	1.442	3.701	1.298	5.069	2.494	1.406
	6+	0.612	3.430	2.322	4.463	5.324	2.938	8.201	4.733	21.245	10.574	7.465	6.065	7.852	6.318	2.780	1.640	1.041	1.752	1.248	2.570	2.270
	2 and Older	94.919	68.401	137.572	89.471	227.867	145.114	103.235	84.259	107.647	107.515	72.076	59.454	43.651	51.379	37.912	50.822	44.039	32.165	26.535	47.778	34.935
	3 and Older	46.057	56.919	36.246	82.827	49.571	137.839	79.170	58.767	49.528	63.423	64.394	40.220	31.804	22.294	28.758	18.490	28.826	24.349	16.950	14.221	29.431
Unit 3	2	32.663	9.011	51.816	6.341	127.965	8.539	34.509	43.297	59.501	50.920	12.056	28.194	21.582	41.309	8.405	38.180	14.024	22.889	17.692	24.478	27.775
	3	30.778	21.770	6.000	34.512	4.224	85.293	5.690	23.023	28.912	39.702	33.972	8.041	18.787	14.378	27.464	5.590	25.369	9.336	15.227	11.736	16.329
	4	5.991	19.622	13.839	3.765	21.917	2.673	52.720	3.623	14.860	18.537	25.163	21.456	5.007	11.732	8.784	16.672	3.324	15.440	5.562	8.659	7.294
	5	10.571	3.492	11.389	7.660	2.172	12.466	1.400	30.426	2.184	8.781	10.536	14.165	11.598	2.729	5.994	4.386	7.829	1.669	7.237	2.258	4.617
	6+	2.035	6.849	5.480	8.454	8.524	5.513	8.323	5.141	20.336	12.289	10.950	11.012	12.138	11.567	6.250	5.232	3.736	5.016	2.591	3.109	2.539
	2 and Older	82.038	60.744	88.525	60.732	164.801	114.485	102.642	105.510	125.792	130.230	92.677	82.868	69.112	81.713	56.896	70.061	54.282	54.351	48.308	50.239	58.554
	3 and Older	49.375	51.733	36.709	54.392	36.836	105.945	68.133	62.213	66.291	79.310	80.621	54.674	47.530	40.405	48.491	31.881	40.258	31.462	30.617	25.761	30.779
Unit 4	2	3.105	1.589	4.054	0.867	6.015	0.645	6.267	4.159	4.676	5.909	0.602	6.343	1.319	2.470	0.378	2.426	3.241	9.064	1.109	2.734	6.069
	3	5.483	2.074	1.057	2.690	0.574	3.941	0.421	4.124	2.733	3.054	3.822	0.386	4.041	0.830	1.537	0.236	1.524	2.089	5.678	0.695	1.686
	4	0.485	3.617	1.343	0.678	1.709	0.348	2.333	0.260	2.530	1.629	1.746	2.105	0.206	2.046	0.399	0.749	0.118	0.856	1.038	2.826	0.322
	5	0.830	0.315	2.250	0.823	0.405	0.932	0.182	1.328	0.146	1.334	0.800	0.792	0.897	0.079	0.718	0.144	0.286	0.056	0.323	0.391	0.935
	6+	0.432	0.817	0.702	1.811	1.576	1.142	1.154	0.810	1.232	0.778	1.098	0.950	0.824	0.745	0.399	0.452	0.294	0.298	0.184	0.218	0.245
	2 and Older	10.336	8.410	9.405	6.868	10.279	7.008	10.356	10.681	11.316	12.704	8.067	10.576	7.286	6.171	3.431	4.007	5.464	12.362	8.333	6.864	9.258
	3 and Older	7.231	6.822	5.351	6.002	4.264	6.363	4.090	6.522	6.640	6.795	7.465	4.233	5.967	3.700	3.053	1.581	2.222	3.298	7.223	4.129	3.189

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($logSSB_0$)**	**2021**	**2022[(a)]**	**B_{msy}**	**%SSB_0**	**P**	**F_{msy}**	**% F_{msy}**	**F_{target}**	**F_{actual}[(b)]**
MU1	2.69	3.52E-07	0.97	5,934,540	0.23	5,808,720	5,738,570	1,661,670	28%	0.00	2.34	28%	0.655	0.655
MU2	2.30	1.46E-07	0.97	13,311,200	0.20	4,592,480	3,565,750	3,727,140	28%	0.57	1.92	35%	0.672	0.114
MU3	2.26	1.44E-07	0.97	12,475,900	0.20	4,952,570	5,047,750	3,493,250	28%	0.07	2.11	32%	0.675	0.675
MU4	2.18	1.34E-06	0.99	1,526,230	0.16	818,537	1,065,060	442,607	29%	0.00	1.76	34%	0.598	0.598

(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 2021 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

		2021 Stock Size (millions of fish)			2021 Mean Biomass	Exploitation Rate				2021 Catch (millions of fish)			3-yr Mean Weight in	2021 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	13.512	21.224	28.937	5.241	0.655	0.113	0.074	0.059	0.797	1.251	1.706	0.129	0.227	0.356	0.485
	3	39.767	48.549	57.332	16.554	0.655	0.416	0.272	0.198	7.882	9.623	11.364	0.146	2.537	3.098	3.658
	4	1.955	2.425	2.894	0.973	0.655	0.733	0.480	0.319	0.625	0.774	0.924	0.163	0.224	0.278	0.332
	5	0.208	0.291	0.373	0.122	0.655	1.000	0.655	0.405	0.084	0.118	0.151	0.172	0.032	0.045	0.057
	6+	0.132	0.221	0.311	0.104	0.655	0.787	0.516	0.338	0.045	0.075	0.105	0.187	0.018	0.031	0.043
	Total	55.574	72.711	89.847	22.994				0.163	9.433	11.842	14.251	0.146	3.033	3.807	4.576
	(3+)	42.062	51.486	60.910	17.753				0.206	8.636	10.590	12.545	0.148	2.812	3.451	4.091
Unit 2	2	4.122	5.504	6.885	1.565	0.114	0.081	0.009	0.008	0.031	0.042	0.052	0.145	0.010	0.013	0.017
	3	18.742	22.080	25.417	10.320	0.114	0.388	0.044	0.036	0.670	0.789	0.909	0.156	0.230	0.271	0.313
	4	3.113	3.676	4.240	2.267	0.114	0.779	0.089	0.070	0.219	0.259	0.298	0.178	0.086	0.102	0.117
	5	1.157	1.406	1.655	0.946	0.114	1.000	0.114	0.089	0.103	0.126	0.148	0.190	0.043	0.053	0.062
	6+	1.740	2.270	2.800	1.720	0.114	0.961	0.110	0.086	0.150	0.195	0.241	0.202	0.067	0.087	0.107
	Total	28.874	34.935	40.996	16.817				0.040	1.174	1.411	1.648	0.169	0.436	0.526	0.615
	(3+)	24.752	29.431	34.111	15.252				0.047	1.142	1.369	1.596	0.170	0.426	0.513	0.599
Unit 3	2	18.293	27.775	37.257	5.205	0.675	0.024	0.016	0.013	0.239	0.363	0.487	0.128	0.067	0.102	0.137
	3	13.576	16.329	19.082	5.352	0.675	0.213	0.144	0.111	1.507	1.813	2.119	0.150	0.498	0.600	0.701
	4	6.173	7.294	8.415	3.329	0.675	0.579	0.391	0.270	1.667	1.970	2.273	0.171	0.629	0.743	0.857
	5	3.860	4.617	5.374	2.616	0.675	0.845	0.571	0.365	1.410	1.686	1.963	0.177	0.550	0.658	0.766
	6+	1.990	2.539	3.088	2.034	0.675	1.000	0.675	0.414	0.823	1.050	1.277	0.201	0.365	0.465	0.566
	Total	43.891	58.554	73.216	18.535				0.118	5.647	6.883	8.119	0.169	2.105	2.568	3.027
	(3+)	25.598	30.779	35.959	13.330				0.212	5.408	6.520	7.632	0.172	2.042	2.466	2.890
Unit 4	2	4.019	6.069	8.119	1.530	0.598	0.095	0.057	0.046	0.184	0.278	0.372	0.149	0.060	0.091	0.122
	3	1.296	1.686	2.075	0.846	0.598	0.431	0.258	0.189	0.245	0.318	0.392	0.164	0.089	0.115	0.142
	4	0.232	0.322	0.412	0.195	0.598	0.890	0.533	0.346	0.080	0.112	0.143	0.176	0.031	0.043	0.055
	5	0.582	0.935	1.289	0.690	0.598	1.000	0.598	0.379	0.220	0.354	0.488	0.182	0.088	0.142	0.196
	6+	0.148	0.245	0.342	0.217	0.598	0.656	0.393	0.271	0.040	0.067	0.093	0.215	0.019	0.032	0.044
	Total	6.278	9.258	12.238	3.478				0.122	0.770	1.128	1.487	0.170	0.287	0.423	0.559
	(3+)	2.259	3.189	4.119	1.948				0.267	0.586	0.851	1.115	0.177	0.227	0.332	0.437

(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 2021 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	0.655	3.033	3.807	4.576	1.688	2.532
2	0.114	0.436	0.526	0.615	1.617	2.425
3	0.675	2.105	2.568	3.027	2.416	3.624
4	0.598	0.287	0.423	0.559	0.523	0.785
Total		5.861	7.325	8.777	6.244	9.366

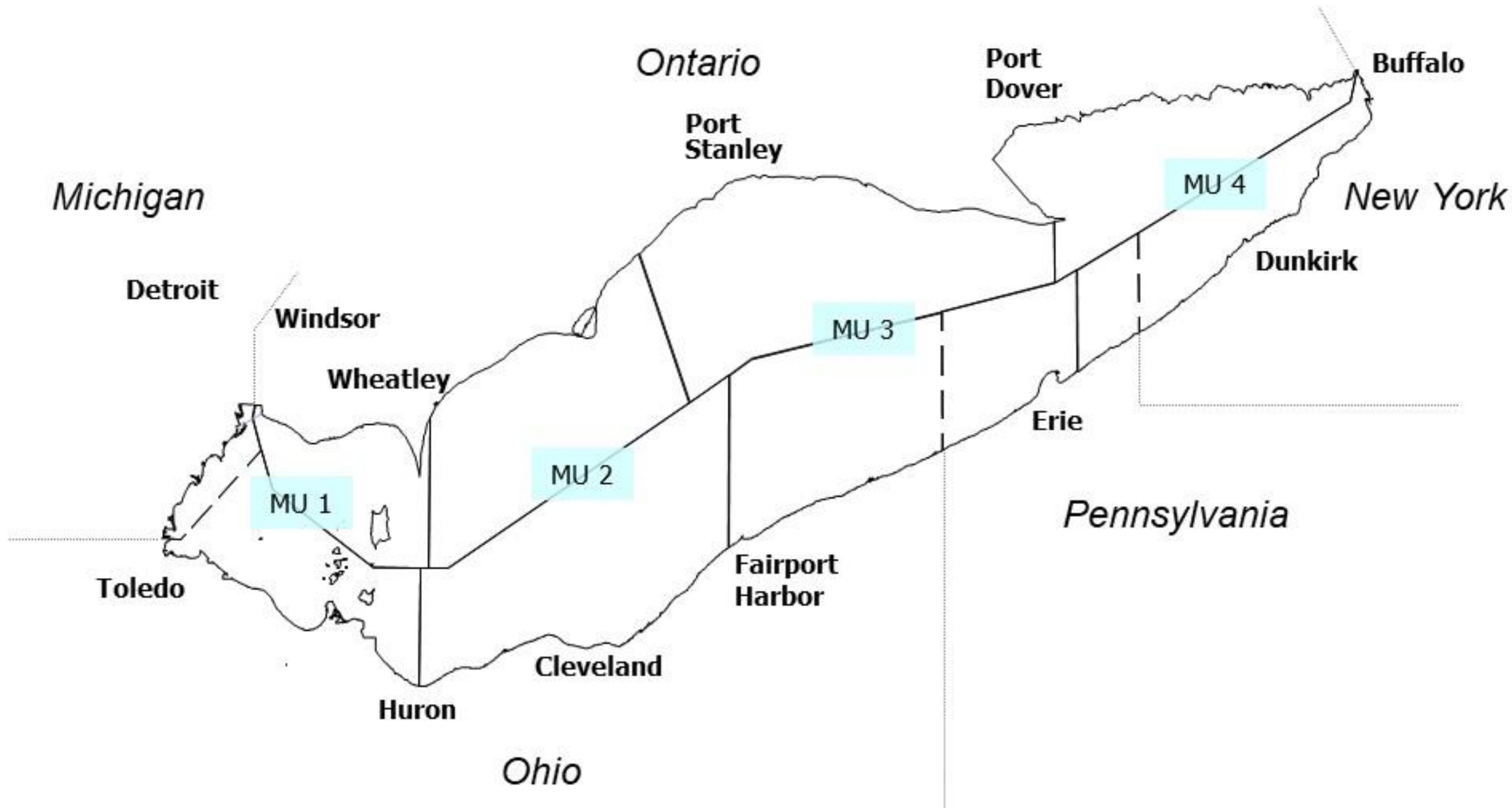


Figure 1.1. The Yellow Perch Management Units (MUs) of Lake Erie defined by the YPTG and LEC, for illustrative purposes.

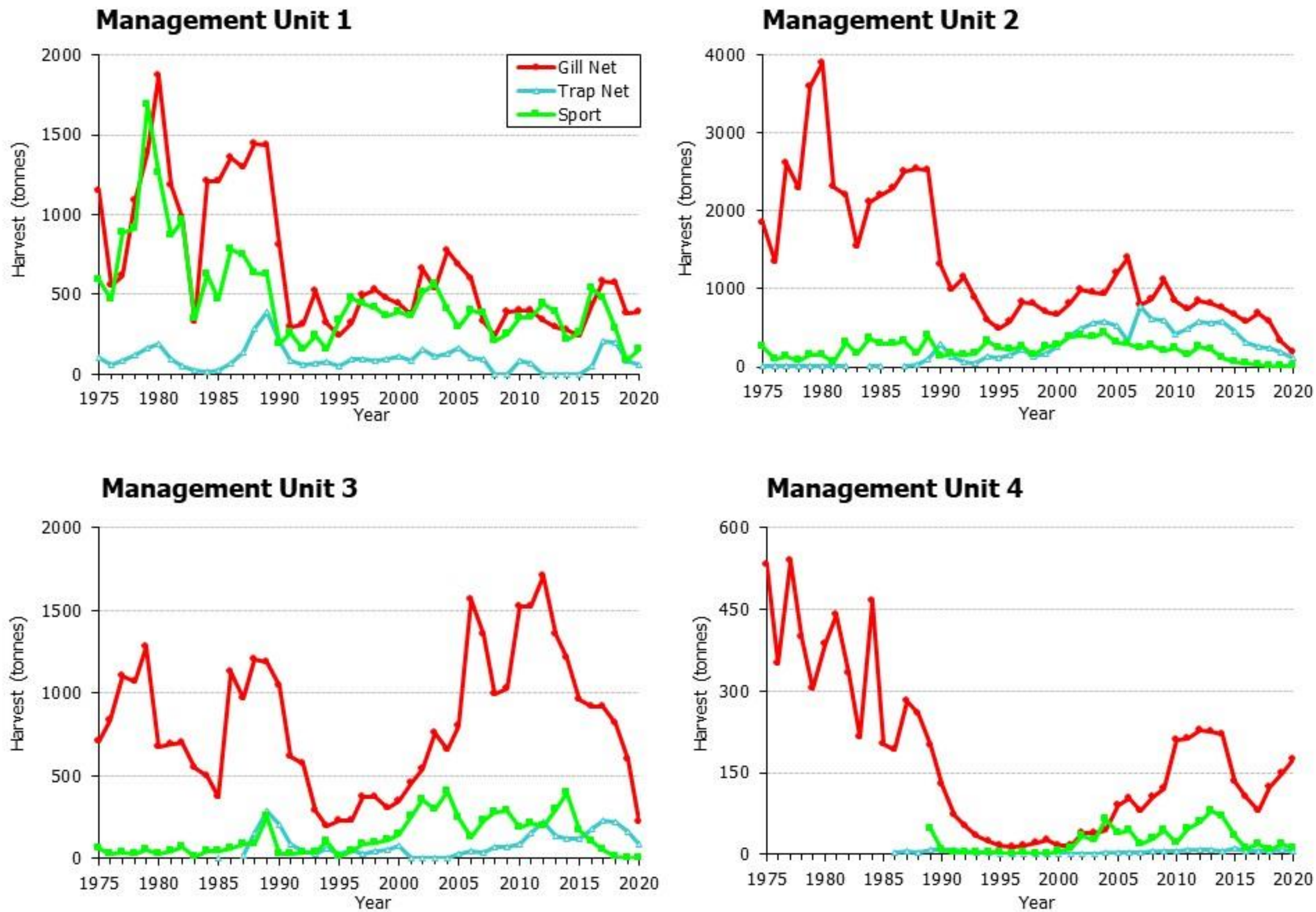


Figure 1.2. Historic Lake Erie Yellow Perch harvest (metric tonnes) by management unit and gear type.

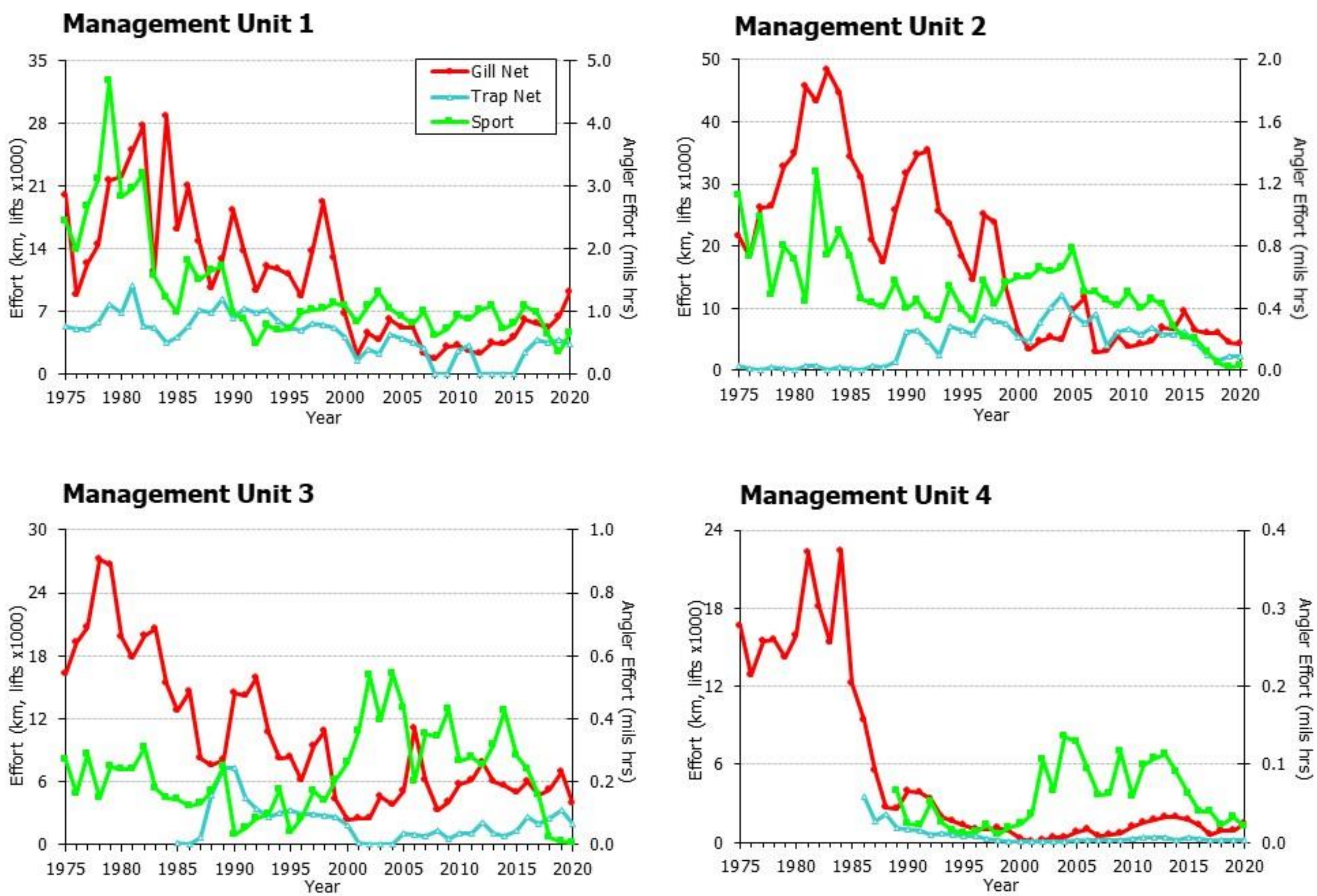


Figure 1.3. Historic Lake Erie Yellow Perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh (< 3").

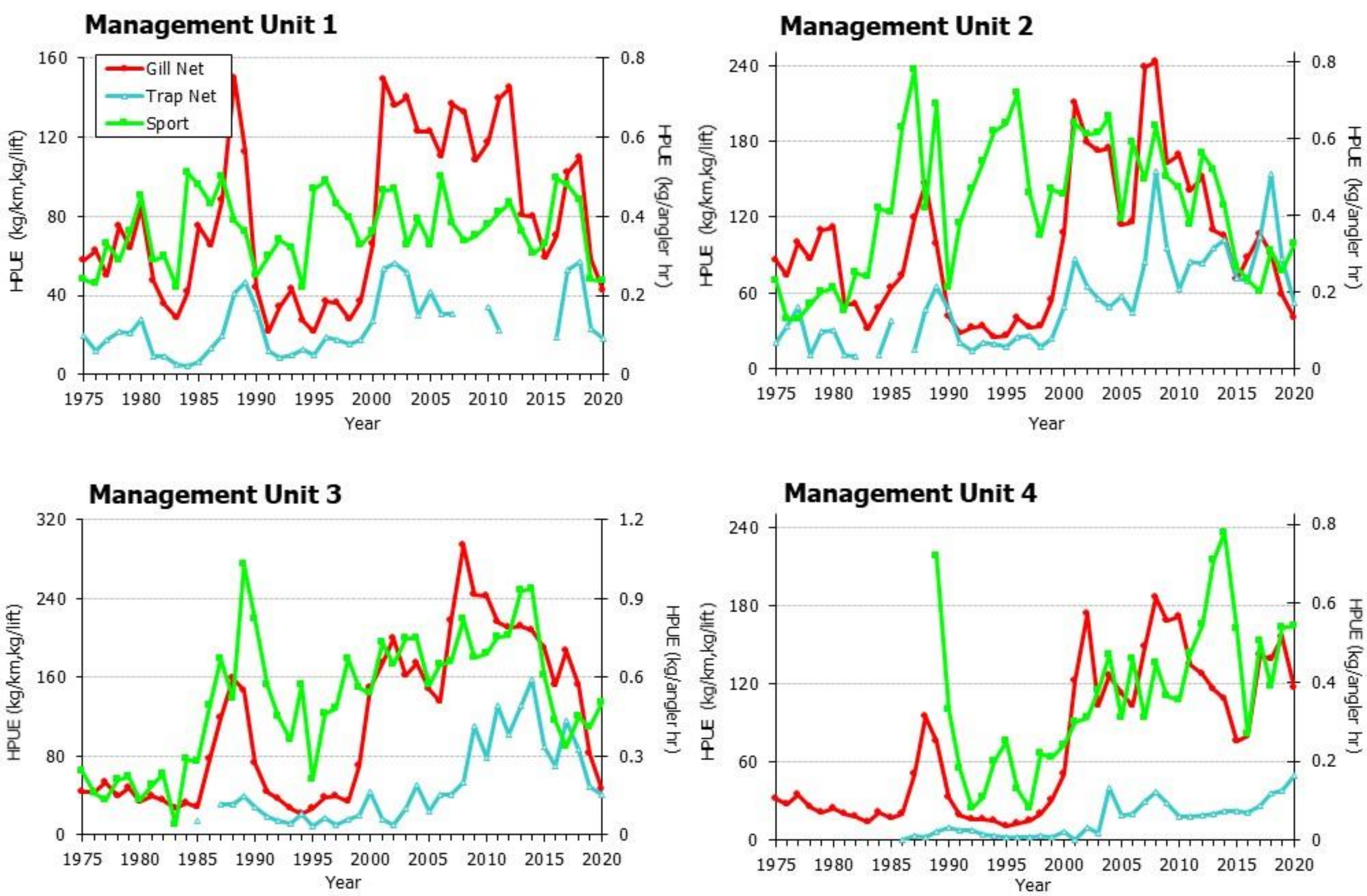


Figure 1.4. Historic Lake Erie Yellow Perch harvest per unit effort (HPUE) by management unit and gear type. Note: gill net CPUE for 2001 to 2019 is for small mesh (< 3") only.

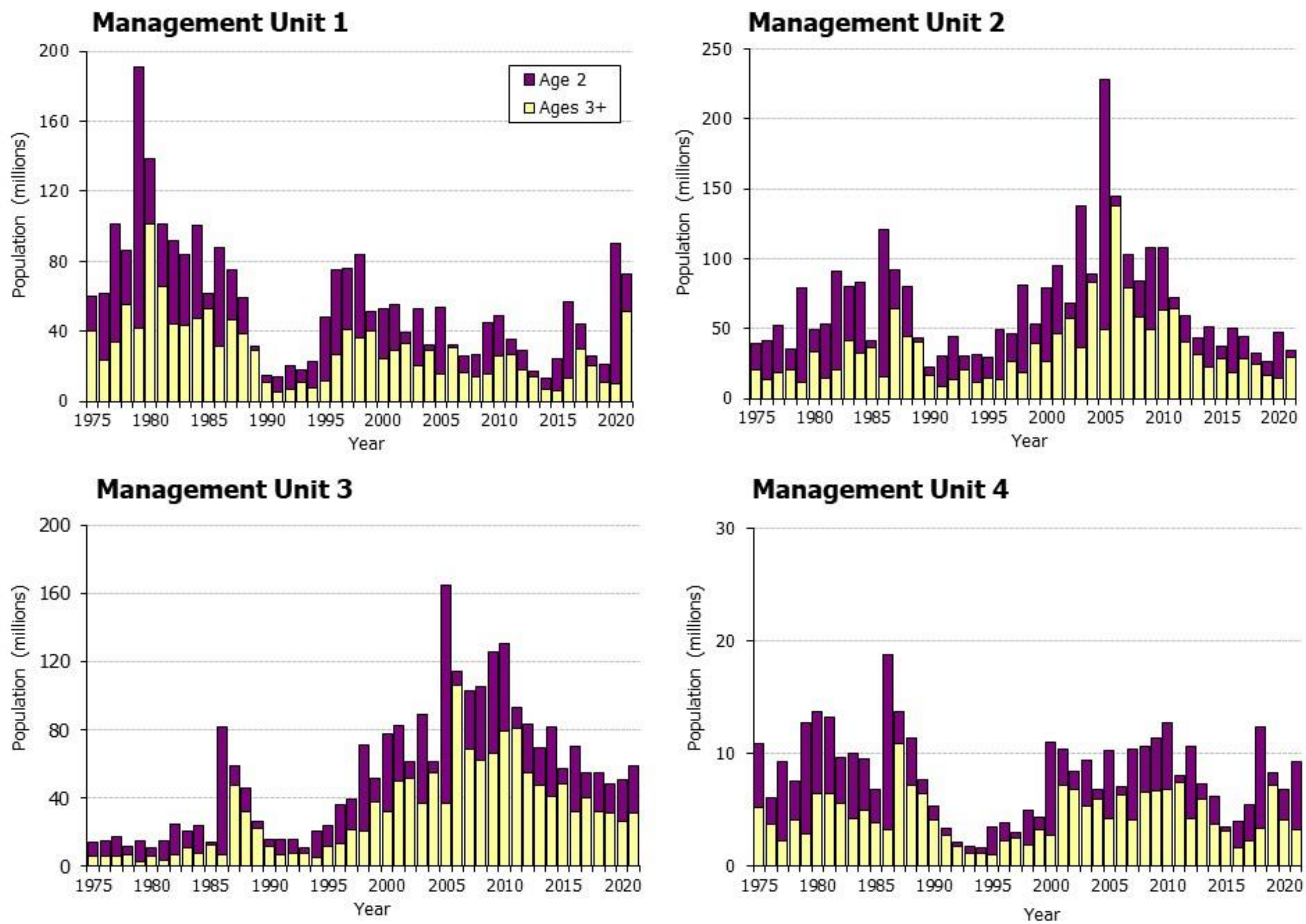


Figure 1.5. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2021, from the PR ADMB model.

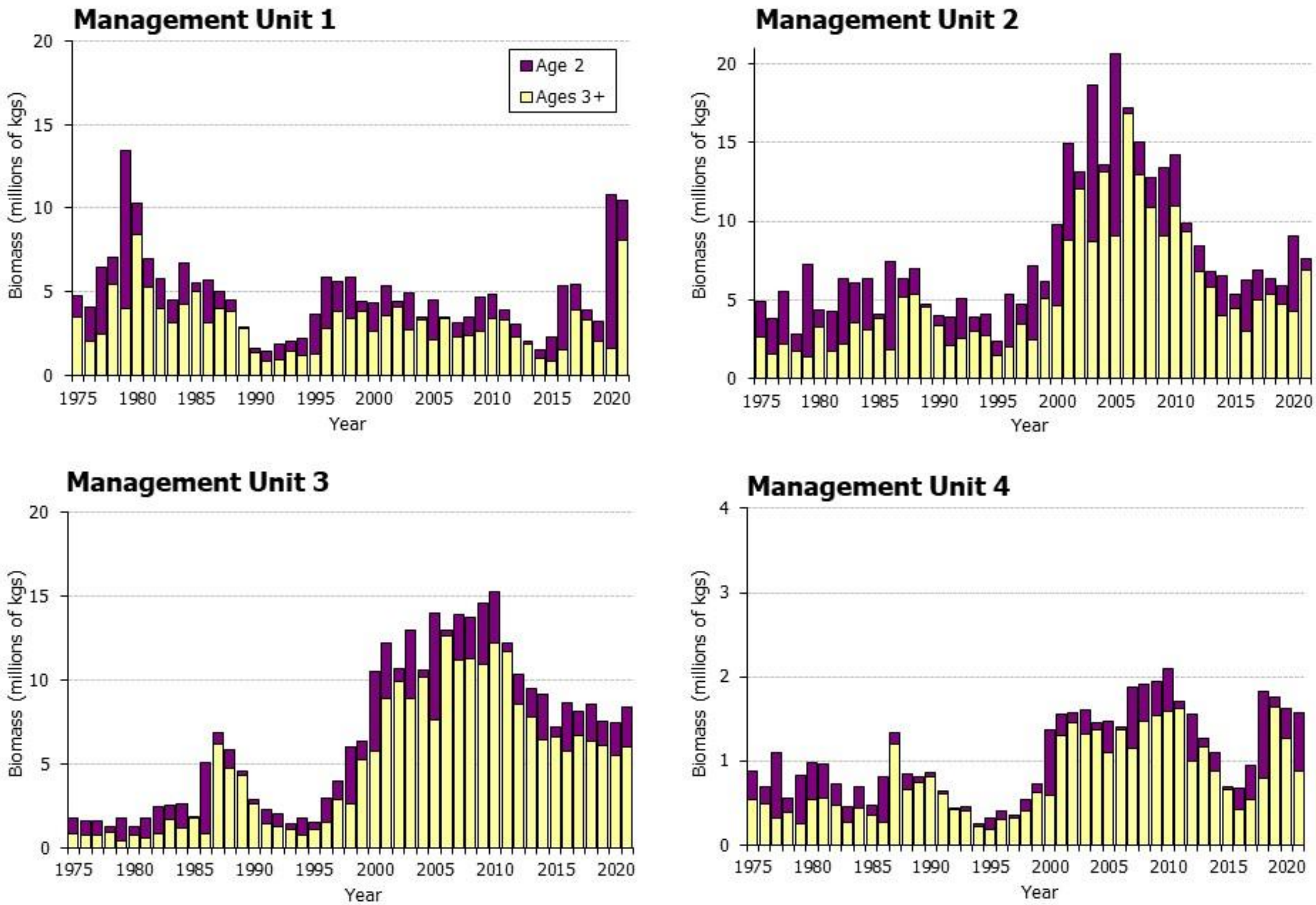


Figure 1.6. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2021, from the PR ADMB model.

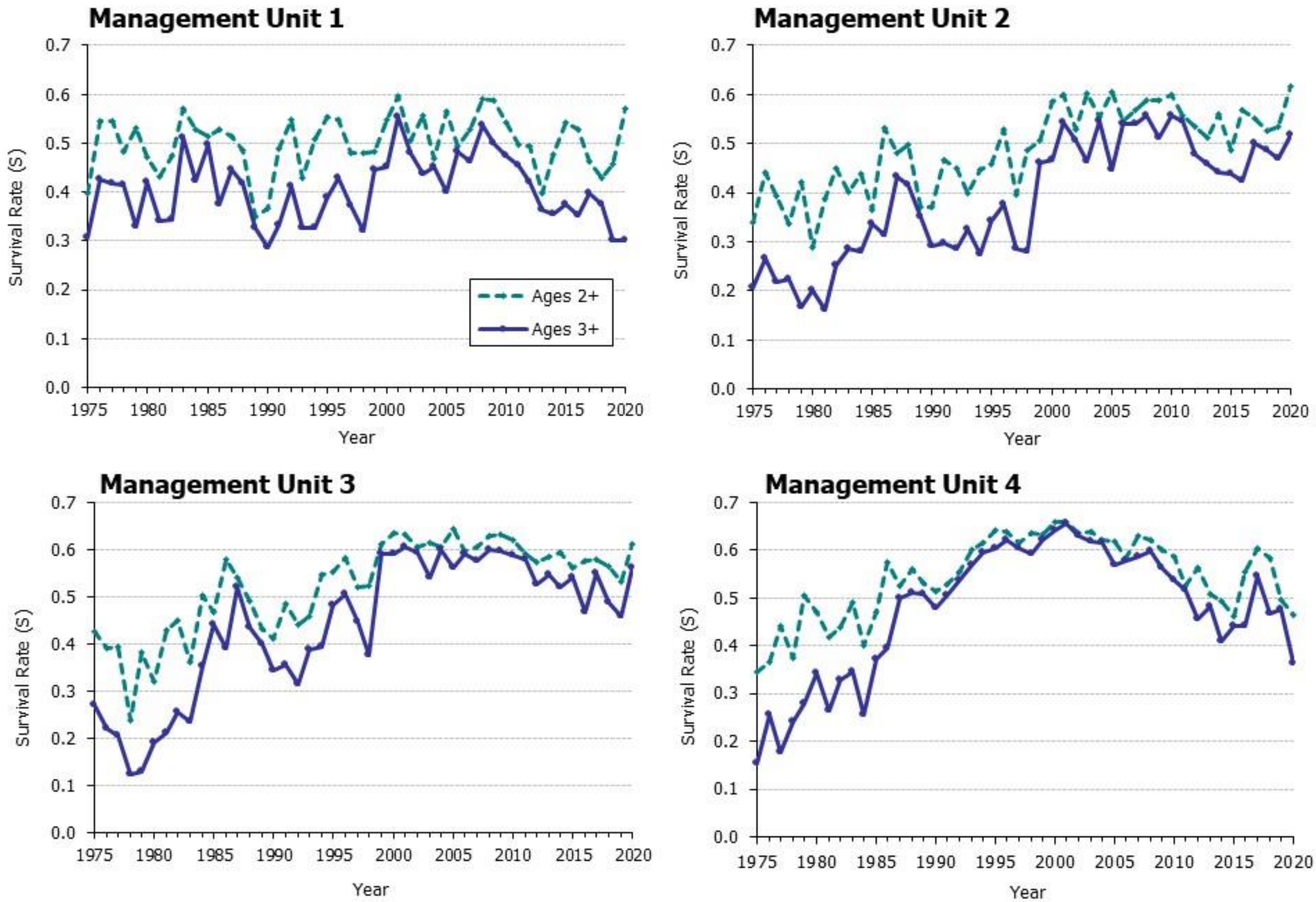


Figure 1.7. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).

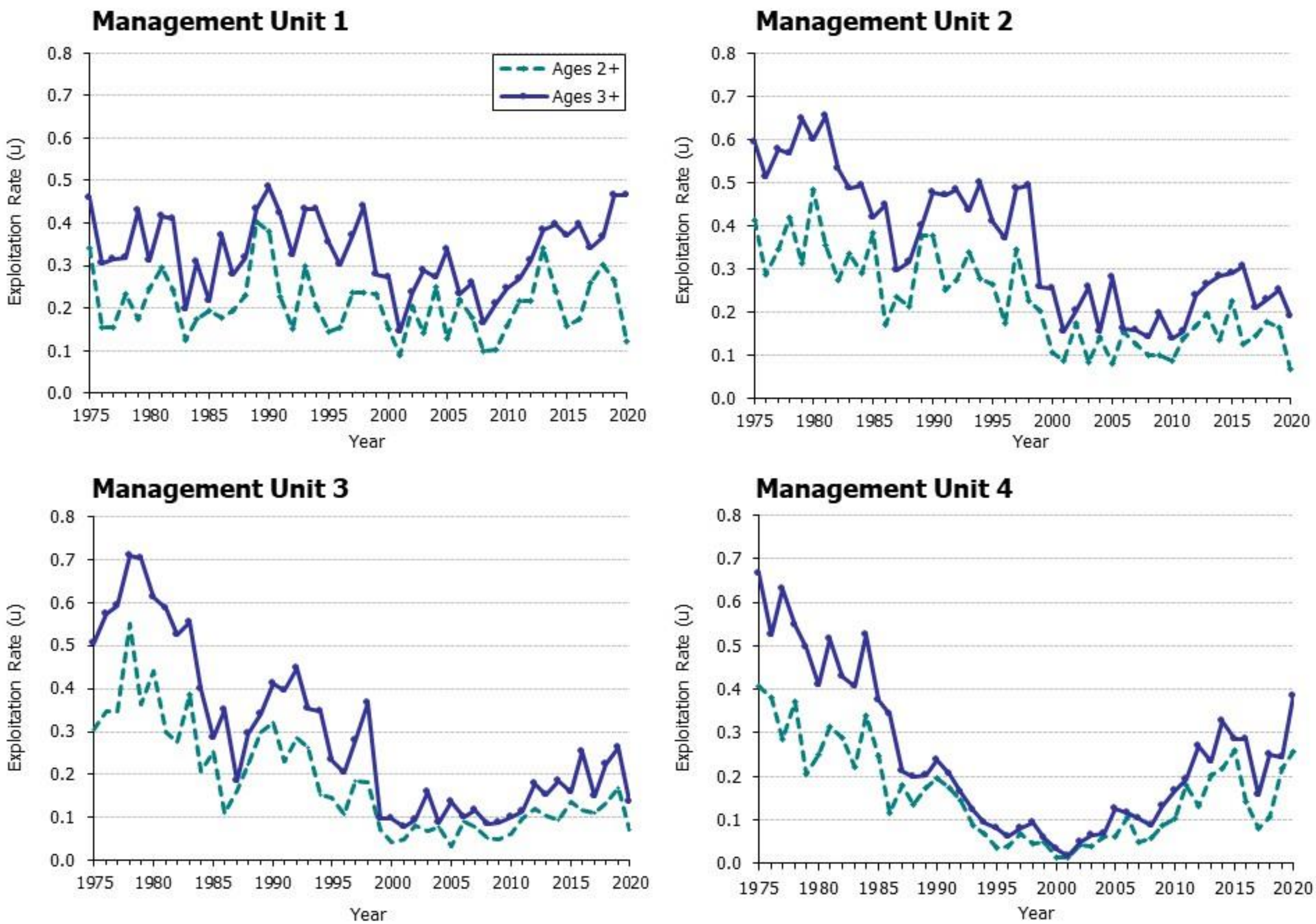
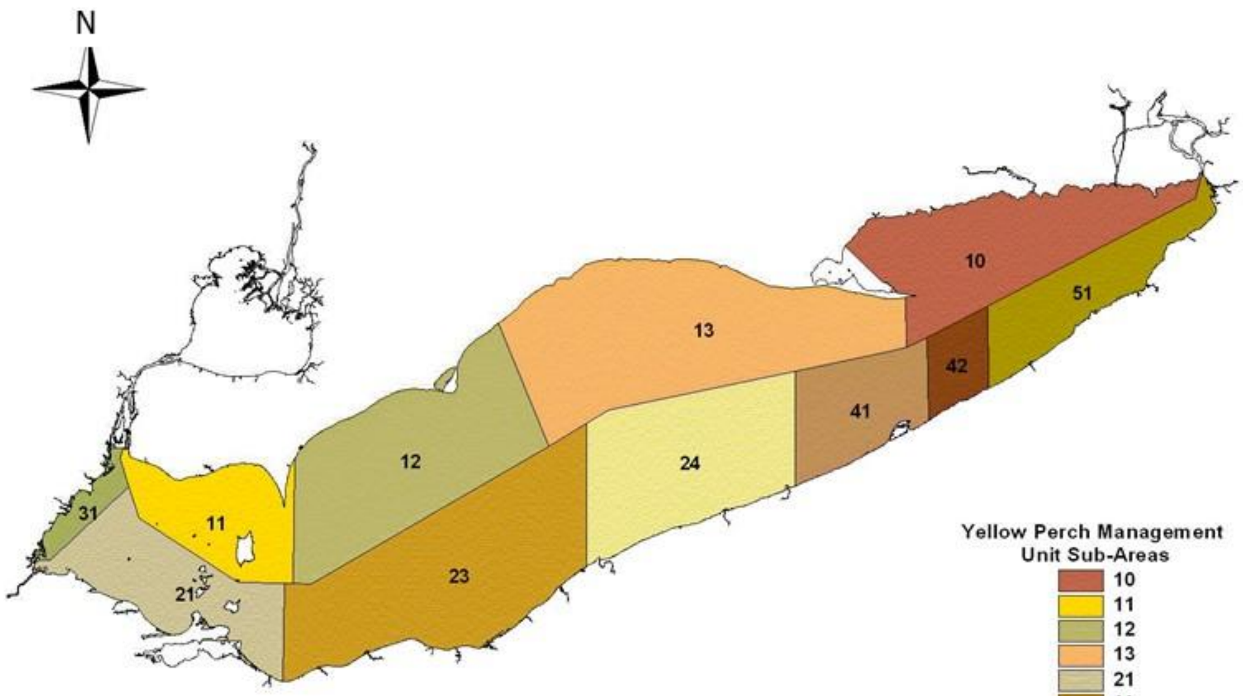


Figure 1.8. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).



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	20	OOS11	0.135	1
		OOS10	0.375	2
		OPSF11	0.103	2
		(Intercept)	13.639	2
MU2	20	OHF20	0.288	1
		OPSF21	0.313	1
		(Intercept)	14.889	1
MU3	19	OHF31A	0.025	1
		OHF30A	0.037	1
		OPSF31	0.445	3
		(Intercept)	15.099	3
MU4	16	LPC41	0.281	1
		NYF41	0.349	1
		(Intercept)	13.365	1

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	73.3	21.1	93.5	31.7	87.5	314.3

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	.	.	.	.
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
2020	535.8	14.9	53.3	3.4	232.2	35.2	54.1	21.6	79.0	0.7	15.2	1.1		2.8	8.0	2.8	2.5

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 2021 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