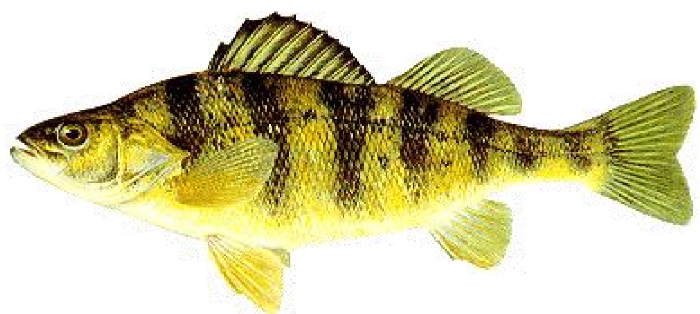
Report of the Lake Erie Yellow Perch Task Group

June 2022



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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

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Update to the 2022 Annual Report

After the 2022 TAC setting process was finalized by the Lake Erie Committee, errors were discovered in sport fishery effort data. Ohio's sport fishery effort estimates were revised in MU1 and MU3, however there were no changes in MU2. The revised estimate for Ohio's sport fishery effort in MU1 was 628,491 angler hours (compared to 628,056 angler hours reported in the March 2022 YPTG report). The revised estimate for Ohio's sport fishery effort in MU3 was 9,688 angler hours (compared to 8,110 angler hours reported in the March 2022 YPTG report). These data are used in the Yellow Perch Task Group's statistical catch-at-age model to estimate the adult Yellow Perch population abundance and ultimately generate a recommended allowable harvest (RAH) for consideration by the Lake Erie Committee. The statistical catch-at-age model was run again using the updated effort data to generate new estimates of population abundance and recommended allowable harvest. Updated RAHs changed minimally from March 2022 values, decreasing by 0.01%, 0%, 1.21% and 0% for MUs 1, 2, 3 and 4 respectively. The information provided in this report is updated to reflect the corrected Ohio effort values.

Introduction

From April 2021 through March 2022 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. Utilize 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: 2021 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) of Yellow Perch in 2021 was 6.238 million pounds. This allocation represented a 20% decrease from a TAC of 7.805 million pounds in 2020. For Yellow Perch assessment and allocation, Lake Erie is partitioned into four management units (MUs; Figure 1.1). The 2021 TAC allocation was 2.532, 0.615, 2.568, and 0.523 million pounds for MUs 1 through 4, respectively. In March 2021 the Lake Erie Committee (LEC) applied the harvest policy within the Yellow Perch Management Plan to set the TAC. For MU1, the LEC set the TAC equal to 2.532 million pounds, which was a 20% increase from 2020. In MU2, the target fishing mortality rate was reduced to F=0.114, lowering the mean RAH and range. The target fishing mortality rate was reduced to ensure the spawning stock biomass in 2022 would not fall below the limit reference point, B_{msy}, with a probabilistic risk tolerance of 0.20 (i.e., P*) For MU2, the LEC set the TAC at 0.615 million pounds, which was equal to the maximum RAH, representing a 70% decrease from 2020. For MU3, the LEC set the TAC at 2.568 million pounds, which was equal to the mean RAH and a 15% decrease from 2020. In MU4, the LEC set the TAC at 0.523 million pounds, which was a 20% decrease from the 2020 TAC.

The lakewide harvest of Yellow Perch in 2021 was 3.296 million pounds, or 53% of the total 2021 TAC. This was a 6% increase from the 2020 harvest of 3.105 million pounds. Harvest from MUs 1 through 4 was 1.655, 0.327, 0.944, and 0.371 million pounds, respectively (Table 1.1). The portion of TAC harvested was 65%, 53%, 37%, and 71%, in MUs 1 through 4, respectively. In 2021, Ontario harvested 2.181 million pounds, followed by Ohio (0.967 million lbs.), Michigan (0.070 million lbs.), New York (0.058 million lbs.), and Pennsylvania (0.021 million lbs.).

Ontario’s fraction of allocation harvested was 93% in MU1, 73% in MU2, 52% in MU3, and 103% in MU4 (see paragraph below regarding Ontario’s harvest reporting and commercial ice allowance policy). Ohio fishers attained 49% of their TAC in the western basin (MU1), 36% in the west central basin (MU2), and 26% in the east central basin (MU3). Michigan anglers in MU1 attained 30% of their TAC. Pennsylvania fisheries harvested 5% of their TAC in MU3 and 3% of their TAC in MU4. New York fisheries attained 36% of their TAC in MU4. Ontario’s portion of the lakewide Yellow Perch harvest in 2021 (66%) slightly decreased from 2020 (69%; Table 1.1). Ohio’s proportion of lakewide harvest in 2021 (29%) slightly increased from 2020 (27%), and harvest in Michigan, Pennsylvania, and New York waters combined represented <5% of the lakewide harvest in 2021.

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 2012 to 2021 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends across a longer time series (1975 to 2021) 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 2021 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 2021 was 2%, 26%, 12%, and 2% of the gill net harvest in management units 1, 2, 3, and 4, respectively. 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 2021 increased by 10% in MU1 and 54% in MU3, but decreased by 60% in MU2 and 21% in MU4 relative to 2020. Ontario trap net harvest was minimal (17 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 2021, 0 pounds of Yellow Perch were harvested in trawl nets in MU2, 8 pounds were harvested in MU3, and 149 pounds were harvested in MU4.

Targeted (i.e., small mesh) gill net effort in 2021 increased from 2020 in MU1, MU3, and MU4 by 14%, 31%, and 40%, respectively, while decreasing in MU2 by 55%. Targeted gill net harvest rates in 2021 decreased relative to 2020 rates in MU1, MU2, and MU4, with decreases of 4%, 11%, and 43% in MU1, MU2, and MU4, respectively, while increasing in MU3 by 18% (Figure 1.4).

In 2021, sport harvest in U.S. waters increased in MU1, MU3, and MU4 by 51%, 107%, and 100%, respectively, while decreasing by 74% in MU2 compared to the 2020 harvest (Figure

1.2). Angling effort in U.S. waters increased in 2021 from 2020, in MU1, MU3, and MU4 by 14%, 93%, and 54%, respectively, while decreasing by 93% in MU2 (Figure 1.3). In 2021, angling effort in U.S. waters was at its lowest in the time series in MU2 and its third lowest in 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 2020 rates, harvest per angler hour decreased in Michigan (-6%) and increased in Ohio waters of MU1 (+23%), decreased in the Ohio waters of MU2 (-93%), decreased in the Ohio (-15%) and Pennsylvania (-29%) waters of MU3, and increased in the New York waters of MU4 (+32%), while decreasing in the Pennsylvania waters of MU4 (-69%).

Trap net harvest increased by 34% in MU1, and 20% in MU3, while decreasing by 53% in MU2, and 23% in MU4 compared to 2020. Trap net effort (lifts) in 2021 increased in MU1, MU3, and MU4 by 12%, 6%, and 1%, respectively, and decreased by 61% in MU2, relative to 2020 trap net effort. Trap net harvest rates increased in MU1, MU2, and MU3 by 19%, 21%, and 14%, respectively, and decreased by 24% in MU4.

Age Composition and Growth

Lakewide, age-3 fish (2018 YC) contributed the most to the Yellow Perch harvest (49%), followed by age-2 fish (2019 YC; 26%), with age-4, age-5, and age-6-and-older fish contributing 12%, 7%, and 5%, respectively; Table 1.6). In MU1, age-3 fish (2018 year class, 60%), and age-2 fish (2019 year class, 28%) contributed most to the fishery. In MU2, age-3 fish (2018 year class, 63%), and age-4 fish (2017 year class, 17%) contributed most to the fishery. In MU3, age-3 fish (2018 year class, 30%), age-4 (2017 year class, 25%), and age-2 (2019 year class, 24%) fish contributed most to the fishery. In MU4, age-2 (2019 year class, 38%), age-5 (2016 year class, 26%), and age-3 (2018 year class, 24%) fish contributed most to the harvest. Yellow Perch size at age was near or above average in all management units.

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 2022, the YPTG continued to use the ADMB model developed by the Quantitative Fisheries Center (QFC) at Michigan State University (referred to as the Peterson-Reilly or PR model) as part of the Lake Erie Percid Management Advisory Group (LEPMAG) review of Yellow Perch management on Lake Erie.

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

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

In the third step, the recruitment index is added to the ADMB model, and this data set is used to inform age-2 abundance estimates within the objective function. This model is then run iteratively until the maximum effective sample size for the multinomial age composition stabilizes. Estimates of population size, from 2003 to 2021, and projections for 2022, are presented in Table 1.7. Abundance, biomass, survival, and exploitation rates are presented by management unit graphically for 1975 to 2021 in Figures 1.9 to 1.12. Mean weights-at-age from assessment surveys were applied to abundance estimates to generate population biomass estimates (Figure 1.10). Projections of abundance and biomass in 2022 are included in Figures 1.9 and 1.10. Population abundance and biomass estimates are critical to monitoring the status of stocks and determining recommended allowable harvest.

Abundance estimates should be interpreted with several caveats. Inclusion of abundance estimates from 1975 to 2021 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 2022 and are presented in Appendix Table 1. The additional recruitment index (generated from the glmulti process) was given a lambda weighting of 1 during the LEPMAG process.

2022 Population Size Projection

The SCAA model was used to project age-2-and-older Yellow Perch stock size in 2022 (Table 1.7). Standard errors and ranges for 2022 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 2021 (Table 1.7) were higher than those projected last year in MU1, MU3, and MU4, and similar in MU2 (YPTG 2021). Abundance projections for 2022 are 65.791, 34.329, 63.260, and 10.204 million age-2-and-older Yellow Perch in MUs 1 through 4, respectively. Abundance of age-2-and-older Yellow Perch in 2022 are projected to decrease in MU1, MU3, and MU4 by 17%, 16%, and 6%, respectively, and to increase by 3% in MU2, relative to the 2021 abundance estimates (Table 1.7, Figure 1.9). Lakewide abundance of age-2-and-older Yellow Perch in 2022 is projected to be 173.584 million fish, a decrease of 12% from 2021.

Projected age-2 Yellow Perch recruitment in 2022 (the 2020 year class) was 25.076, 13.200, 16.417, and 4.092 million fish in management units 1 through 4, respectively (Table 1.7.).

Age-3-and-older Yellow Perch abundance in 2022 is projected to be 40.715, 21.129, 46.843, and 6.111 million fish in MUs 1 through 4, respectively. Abundance for age-3-and-older Yellow Perch for 2022 are projected to increase from the 2021 estimates in MU1 through MU4 by 25%, 15%, 88%, and 77%, respectively.

As a function of population abundance and mean weight-at-age from fishery-independent surveys, total biomass of age-2-and-older Yellow Perch for 2022 are projected to increase in MU2 (+19%), MU3 (+3%), and MU4 (+7%), while decreasing in MU1 (-9%) compared to 2021 estimates (Figure 1.10).

Estimates of Yellow Perch survival for age-3-and-older in 2021 were 39%, 61%, 54%, and 44% in MUs 1 through 4, respectively (Figure 1.11). Estimates of Yellow Perch survival in 2021 for age-2-and-older fish were: 52% in MU1, 63% in MU2, 62% in MU3, and 57% in MU4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2021 were 35%, 8%, 16%, and 29% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2021 were: 19% in MU1, 5% in MU2, 6% in MU3, and 13% in MU4 (Figure 1.12). Exploitation rate for ages-2-and-older fish in MU2 were the lowest in the 47 year time series.

Charge 2: Harvest Strategy and Recommended Allowable Harvest

In 2022 the YPTG applied the harvest control rules finalized by the LEC and LEPMAG in 2020. The harvest control rules are comprised of:

- Target fishing mortality as a percent of the fishing mortality at maximum sustainable yield (F_{msy})
- Limit reference point of the biomass at maximum sustainable yield (B_{msy})
- Probabilistic risk tolerance, P-star, P*=0.20
- A limit on the annual change in TAC of ± 20% (when $P(SSB<B_{msy})<P^*$); see Yellow Perch Management Plan, Lake Erie Committee, 2020.

Target fishing rates and limit reference points are estimated annually using SCAA model results. Estimating reference points and recommended allowable harvest is a three-step process. First, estimated recruitment and spawning stock biomass from the SCAA model, along with maturity, weight, and average selectivity at age, are entered into an ADMB model that: 1) estimates the parameters of a Ricker stock-recruitment model and 2) calculates the theoretical spawning stock biomass without fishing (SSB_0). The stock-recruitment relationships for management units 1, 2, and 3, are fit using a hierarchical framework, while management unit 4 is fit independently. In the second step, maturity, weight, and average selectivity at age, along with the parameters of the stock-recruitment relationship are entered in an R-based model. This model estimates F_{msy} and B_{msy} for the harvest control rule. Finally, F_{msy}, F_{target} (as a percent of F_{msy}), and B_{msy} (as a percent of SSB_0), are entered into the PR ADMB model to estimate RAH in each management unit. If the model estimates that fishing at F_{target} meets or exceeds a 0.20 probability (P*) that the projected spawning stock biomass will be less than the limit reference point (B_{msy}), then the fishing rate is reduced until the probability is less than 0.20. Values of SSB_0, B_{msy}, F_{msy}, and F_{target} for each management unit can be found in table 2.1. Target fishing rates are applied to population estimates and their standard errors to determine minimum, mean, and maximum RAH values for each management unit (Tables 2.2 and 2.3). In addition, RAH values may be subject to a ±20% limit on the annual change in TAC when $P(SSB<B_{msy}) < 0.20$.

Quota allocation by management unit and jurisdiction for 2022 was determined by the same methods applied in 2009-2021, 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, 2022:

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

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

The YPTG evaluated the impact of missing one year of the Ohio trawl survey in the MU1 model. In 2021 the Ohio fall trawl survey was not conducted due to a boat malfunction, this resulted in the loss of one year of age 2 and older data from this data set in the ADMB model. In order to evaluate the impacts of this missing year of data, the February 2021 model was run assuming that the Ohio fall trawl survey did not occur during 2020. This resulted in minor changes to model results including: a 14% increase in abundance in the final year of the ADMB model, and an average of 18% difference in the final 5 years of Ohio trawl survey catchability estimates. There were virtually no changes to estimates of selectivity for the Ohio trawl data set. These differences were negligible and the MU1 model was run in 2022 with Ohio trawl survey data available up to 2020.

The YPTG has been using the current configuration of the ADMB model for 4 years. It has been found that abundance estimates in the last year of the ADMB model often decrease between the first estimate in the model and subsequent years estimates in the model. On average age 2 estimates decrease between 5% and 33% from the first time they are estimated by the model to the second time they are estimated by the model. Further, age 2 estimates decrease an average of 23% to 52% between the first time they are estimated by the model to the third time they are estimated by the model. Changes in random walk catchability estimates between model runs can contribute to changes in abundance estimates, with increases in catchability leading to reduced abundance estimates. Constant selectivity in the model may contribute to different abundance estimates, as changes in selectivity will not be recognized by the model when they occur. Additional work is required to evaluate retrospective patterns in model results and their causes.

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Table 1.1. Lake Erie Yellow Perch harvest in pounds by management unit (Unit) and agency, 2012-2021

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	**Harvest**
Unit 1	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
	2021	959,259	58	625,787	38	69,575	4	--	--	--	--	1,654,621
Unit 2	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
	2021	205,377	63	121,200	37	--	--	--	--	--	--	326,577
Unit 3	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
	2021	704,636	75	220,127	23	--	--	18,938	2	--	--	943,701
Unit 4	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	149,669	23	652,239
	2015	297,716	77	--	--	--	--	10,055	3	76,597	20	384,368
	2016	231,063	87	--	--	--	--	6,791	3	28,078	11	265,932
	2017	179,730	76	--	--	--	--	16,078	7	39,598	17	235,407
	2018	272,733	90	--	--	--	--	1,452	0	29,159	10	303,344
	2019	326,179	85	--	--	--	--	1,485	0	56,219	15	383,883
	2020	384,737	91	--	--	--	--	2,664	1	36,083	9	423,484
	2021	311,866	84	--	--	--	--	1,677	0	57,567	16	371,110
Lakewide Totals	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	149,669	2	8,791,727
	2015	4,460,298	65	2,190,473	32	94,225	1	87,613	1	76,597	1	6,909,206
	2016	4,481,964	62	2,201,486	30	397,044	5	114,763	2	28,078	0	7,223,335
	2017	4,982,989	64	2,387,352	31	255,605	3	123,413	2	39,598	1	7,788,958
	2018	4,613,972	68	1,975,935	29	107,789	2	55,537	1	29,159	0	6,782,393
	2019	3,243,111	73	1,111,766	25	15,745	0	40,437	1	56,219	1	4,467,278
	2020	2,128,688	69	834,994	27	84,613	3	20,685	1	36,083	1	3,105,063
	2021	2,181,138	66	967,114	29	69,575	2	20,615	1	57,567	2	3,296,009

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to 2021 (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, 2012-2021.

		Unit 1					
		Michigan	Ohio		Ontario Gill Nets		Ontario
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trap Nets
Harvest	2012	93,291	0	883,245	718,585	34,172	115
(pounds)	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
	2021	69,575	182,521	443,266	939,063	20,179	17
Harvest	2012	42	0	401	326	15	0.05
(Metric)	2013	35	0	358	276	18	0.01
(tonnes)	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
	2021	32	83	201	426	9	0.01
Effort	2012	128,013	0	896,083	2,244	438	--
(a)	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	--
	2021	113,935	3,741	628,491	10,489	1,124	--
Harvest Rates	2012	2.4	--	3.6	145.3	35.4	--
(b)	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	--
	2021	1.7	22.1	2.0	40.6	8.1	--

(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 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, 2012-2021.

		Unit 2				
		Ohio		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2012	1,285,336	566,510	1,550,104	314,440	13,071
(pounds)	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
	2021	116,109	5,091	151,859	53,518	0
Harvest	2012	583	257	703	143	5.9
(Metric)	2013	558	223	752	66	0.2
(tonnes)	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
	2021	53	2	69	24	0.0
Effort	2012	6,919	456,404	4,616	2,942	--
(a)	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	--
	2021	839	1,898	1,951	2,999	--
Harvest Rates	2012	84.2	3.1	152.3	48.5	--
(b)	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	--
	2021	62.8	0.1	35.3	8.1	--

(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, 2012-2021.

		Unit 3						
		Ohio		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2012	469,401	277,598	15,405	146,346	3,653,296	114,640	247
(pounds)	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
	2021	206,384	13,743	17,303	1,635	622,917	81,711	8
Harvest	2012	213	126	7.0	66	1,657	52	0.1
(Metric)	2013	136	225	0.4	70	1,278	75	0.3
(tonnes)	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
	2021	94	6	7.8	1	283	37	0.0
Effort	2012	2,074	154,474	87	98,234	7,847	991	--
(a)	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	--
	2021	2,075	9,688	92	3,301	5,191	1,519	--
Harvest Rates	2012	102.6	4.5	80.3	4.7	211.1	52.5	--
(b)	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	--
	2021	45.1	1.2	85.3	0.5	54.4	24.4	--

(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, 2012-2021.

		Unit 4						
		New York		Pennsylvania		Ontario Gill Nets		Ontario
	Year	Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest	2012	17,709	88,790	0	41,362	499,359	833	2,586
(pounds)	2013	15,814	104,055	0	74,277	492,233	2,778	1,665
	2014	10,356	139,313	0	16,671	482,925	1,160	1,814
	2015	12,565	64,032	0	10,055	295,833	1,083	800
	2016	11,465	16,613	0	6,791	230,333	65	665
	2017	12,366	27,232	0	16,078	177,475	32	2,223
	2018	10,657	18,502	0	1,452	271,795	583	355
	2019	18,750	37,469	0	1,485	326,075	58	46
	2020	14,837	21,246	0	2,664	384,684	39	14
	2021	11,354	46,213	0	1,677	305,463	6,254	149
Harvest	2012	8.0	40.3	0	18.8	226.5	0.38	1.2
(Metric)	2013	7.2	47.2	0	33.7	223.2	1.26	0.8
(tonnes)	2014	4.7	63.2	0	7.6	219.0	0.53	0.8
	2015	5.7	29.0	0	4.6	134.2	0.49	0.4
	2016	5.2	7.5	0	3.1	104.5	0.03	0.3
	2017	5.6	12.4	0	7.3	80.5	0.01	1.0
	2018	4.8	8.4	0	0.7	123.3	0.26	0.2
	2019	8.5	17.0	0	0.7	147.9	0.03	0.0
	2020	6.7	9.6	0	1.2	174.5	0.02	0.0
	2021	5.1	21.0	0	0.8	138.5	2.84	0.1
Effort	2012	428	58,621	0	49,577	1,770	12.9	--
(a)	2013	364	65,743	0	48,093	1,932	14.5	--
	2014	213	76,817	0	13,959	2,016	8.3	--
	2015	357	44,029	0	18,638	1,774	44.7	--
	2016	248	27,436	0	11,934	1,303	11.2	--
	2017	208	26,154	0	12,843	565	6.0	--
	2018	135	19,035	0	3,940	887	58.7	--
	2019	224	30,166	0	2,730	947	29.7	--
	2020	136	18,677	0	1,294	1,492	34.4	--
	2021	137	29,237	0	1,598	2,081	67.1	--
Harvest Rates	2012	18.8	2.17	--	2.5	127.9	29.3	--
(b)	2013	19.7	2.59	--	2.9	115.5	87.1	--
	2014	22.0	2.78	--	2.3	108.6	63.4	--
	2015	16.0	2.01	--	1.2	75.6	11.0	--
	2016	21.0	0.95	--	1.3	80.1	2.6	--
	2017	27.0	1.35	--	1.2	142.3	2.4	--
	2018	35.8	1.53	--	0.4	139.0	4.5	--
	2019	38.0	1.81	--	0.6	156.1	0.9	--
	2020	49.5	1.55	--	1.2	117.0	0.5	--
	2021	37.6	2.04		0.4	66.6	42.3	--

(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 2021 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	12,822	0.4	10,360	1.7	0	0.0	0	0.0	23,182	0.4
	2	874,249	29.3	93,149	15.6	561,424	27.7	370,426	41.5	1,899,249	29.2
	3	1,823,687	61.2	343,142	57.5	554,418	27.4	229,336	25.7	2,950,583	45.4
	4	173,238	5.8	122,379	20.5	525,091	25.9	69,860	7.8	890,568	13.7
	5	28,739	1.0	21,629	3.6	265,668	13.1	196,624	22.0	512,660	7.9
	6+	68,184	2.3	6,553	1.1	117,441	5.8	26,286	2.9	218,465	3.4
	Total	2,980,919	*60.0*	597,212	*66.7*	2,024,041	*81.9*	892,533	*91.2*	6,494,706	*69.7*
Trap Nets	1	0	0.0		0.0	0	0.0	0	0.0	0	0.0
	2	138,084	27.9	13,237	4.6	36,984	8.6	631	2.7	188,935	15.3
	3	303,530	61.4	217,959	75.2	189,884	44.3	2,997	12.8	714,371	57.8
	4	31,598	6.4	26,085	9.0	90,233	21.0	2,839	12.2	150,756	12.2
	5	5,827	1.2	6,630	2.3	41,242	9.6	13,092	56.1	66,791	5.4
	6+	15,023	3.0	26,074	9.0	70,680	16.5	3,786	16.2	115,563	9.3
	Total	494,062	*9.9*	289,985	*32.4*	429,024	*17.4*	23,345	*2.4*	1,236,416	*13.3*
Sport	1	27,092	1.8	0	0.0	0	0.0	0	0.0	27,092	1.7
	2	371,476	24.9	0	0.0	0	0.0	655	1.0	372,131	23.5
	3	865,442	58.0	3,932	46.2	1,908	10.7	2,293	3.7	873,575	55.3
	4	106,132	7.1	1,796	21.1	7,120	39.9	3,260	5.2	118,308	7.5
	5	33,181	2.2	1,693	19.9	7,296	40.9	49,565	79.0	91,735	5.8
	6+	88,156	5.9	1,088	12.8	1,533	8.6	6,983	11.1	97,760	6.2
	Total	1,491,480	*30.0*	8,509	*0.9*	17,856	*0.7*	62,756	*6.4*	1,580,601	*17.0*
All Gear	1	39,915	0.8	10,360	1.2	0	0.0	0	0.0	50,274	0.5
	2	1,383,808	27.9	106,386	11.9	598,408	24.2	371,713	38.0	2,460,314	26.4
	3	2,992,659	60.3	565,034	63.1	746,210	30.2	234,626	24.0	4,538,529	48.7
	4	310,968	6.3	150,260	16.8	622,444	25.2	75,960	7.8	1,159,632	12.5
	5	67,747	1.4	29,952	3.3	314,206	12.7	259,281	26.5	671,186	7.2
	6+	171,364	3.5	33,715	3.8	189,654	7.7	37,054	3.8	431,787	4.6
	Total	4,966,461	53.3	895,707	9.6	2,470,922	26.5	978,634	10.5	9,311,723	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 2003 to 2021 and projected abundance in 2022 from the ADMB catch-age analysis.

	Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Unit 1	2	33.098	3.407	39.678	2.008	10.118	13.049	28.737	22.584	8.840	10.950	2.423	5.974	16.896	39.235	11.909	4.369	7.506	49.786	46.383	25.076
	3	4.230	20.824	2.138	25.020	1.269	6.405	8.420	18.255	14.076	5.500	6.693	1.435	3.605	10.048	22.496	7.028	2.675	4.661	30.066	28.035
	4	9.321	2.244	10.574	1.109	13.079	0.692	3.744	4.593	9.324	7.160	2.696	2.899	0.652	1.548	3.705	9.167	3.208	1.220	1.881	12.171
	5	4.766	4.116	0.857	4.224	0.449	6.082	0.368	1.732	1.882	3.797	2.920	0.878	0.985	0.200	0.348	0.971	2.830	0.901	0.269	0.417
	6+	2.565	2.989	2.393	1.222	1.907	1.085	3.619	1.840	1.367	1.213	1.886	1.434	0.747	0.479	0.142	0.104	0.258	0.634	0.261	0.093
	2 and Older	53.981	33.580	55.640	33.583	26.822	27.313	44.888	49.003	35.489	28.620	16.619	12.620	22.885	51.510	38.600	21.638	16.477	57.203	78.859	65.791
	3 and Older	20.883	30.174	15.962	31.575	16.704	14.264	16.151	26.419	26.649	17.670	14.195	6.646	5.989	12.275	26.691	17.269	8.971	7.417	32.476	40.715
Unit 2	2	99.390	6.468	174.363	7.109	23.480	24.746	56.377	42.607	7.390	18.399	11.192	27.008	8.251	27.442	12.008	5.897	6.679	21.231	15.058	13.200
	3	7.263	64.701	4.224	113.055	4.625	15.498	16.345	36.942	28.005	4.858	12.042	7.266	17.507	5.281	17.686	7.748	3.811	4.323	13.867	9.991
	4	17.390	4.090	37.032	2.334	63.395	2.817	9.549	9.535	22.013	16.656	2.810	6.617	3.903	8.606	2.716	9.220	4.099	2.008	2.410	8.654
	5	8.453	7.919	1.925	16.274	1.056	34.187	1.571	4.695	4.917	11.294	8.011	1.205	2.667	1.280	3.128	1.026	3.619	1.573	0.873	1.368
	6+	2.232	4.300	5.116	2.796	7.878	4.504	20.430	10.056	7.055	5.705	7.366	5.838	2.489	1.403	0.829	1.301	0.821	1.473	1.176	1.116
	2 and Older	134.727	87.478	222.658	141.568	100.433	81.752	104.273	103.836	69.381	56.912	41.420	47.934	34.817	44.012	36.368	25.192	19.029	30.609	33.384	34.329
	3 and Older	35.337	81.010	48.295	134.459	76.954	57.006	47.895	61.228	61.991	38.514	30.229	20.926	26.567	16.570	24.360	19.295	12.350	9.377	18.326	21.129
Unit 3	2	52.544	6.277	130.185	8.951	35.347	44.379	60.333	51.154	12.040	27.918	21.375	40.130	7.796	35.544	12.796	19.328	14.712	21.094	50.204	16.417
	3	6.115	34.953	4.178	86.689	5.952	23.559	29.618	40.226	34.083	8.018	18.571	14.215	26.616	5.170	23.535	8.494	12.801	9.672	14.006	33.342
	4	13.975	3.844	22.230	2.649	53.693	3.795	15.215	18.995	25.479	21.503	4.985	11.574	8.658	16.078	3.054	14.233	4.988	6.926	5.839	8.471
	5	11.653	7.769	2.224	12.699	1.397	31.100	2.291	8.993	10.779	14.301	11.573	2.702	5.859	4.265	7.423	1.508	6.409	1.745	3.385	2.873
	6+	5.720	8.814	8.852	5.783	8.722	5.412	20.971	12.767	11.348	11.359	12.379	11.656	6.254	5.125	3.599	4.709	2.298	2.259	1.682	2.158
	2 and Older	90.006	61.656	167.669	116.771	105.112	108.246	128.426	132.135	93.730	83.099	68.882	80.276	55.182	66.181	50.408	48.270	41.208	41.694	75.116	63.260
	3 and Older	37.462	55.379	37.484	107.820	69.765	63.866	68.094	80.982	81.690	55.181	47.507	40.146	47.386	30.637	37.612	28.943	26.496	20.601	24.912	46.843
Unit 4	2	4.127	0.876	6.133	0.664	6.405	4.252	4.777	6.048	0.618	6.523	1.356	2.564	0.397	2.458	3.260	9.743	1.107	2.356	7.347	4.092
	3	1.079	2.739	0.580	4.020	0.433	4.215	2.794	3.120	3.912	0.396	4.152	0.852	1.591	0.247	1.541	2.100	6.115	0.700	1.486	4.588
	4	1.372	0.692	1.742	0.352	2.384	0.268	2.589	1.668	1.787	2.156	0.211	2.095	0.407	0.772	0.124	0.867	1.057	3.173	0.360	0.732
	5	2.314	0.843	0.415	0.956	0.186	1.363	0.151	1.373	0.824	0.815	0.920	0.081	0.731	0.146	0.295	0.059	0.337	0.433	1.288	0.134
	6+	0.725	1.870	1.631	1.188	1.202	0.846	1.280	0.815	1.148	0.997	0.866	0.782	0.421	0.472	0.308	0.313	0.196	0.245	0.316	0.658
	2 and Older	9.617	7.021	10.502	7.179	10.610	10.943	11.591	13.024	8.288	10.887	7.505	6.374	3.547	4.095	5.528	13.082	8.814	6.907	10.798	10.204
	3 and Older	5.490	6.145	4.369	6.515	4.205	6.691	6.814	6.976	7.670	4.364	6.149	3.810	3.150	1.637	2.268	3.339	7.706	4.551	3.451	6.111

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($logSSB_0$)**	**2022**	**2023[a]**	**B_{msy}**	**%SSB_0**	**P**	**F_{msy}**	**% F_{msy}**	**F_{target}**	**F_{actual} [b]**
MU1	2.71	3.60E-07	0.98	5,972,010	0.22	5,650,690	5,882,750	1,706,173	29%	0.00	2.53	28%	0.708	0.708
MU2	2.22	1.44E-07	0.98	13,433,400	0.21	4,088,550	3,680,850	3,755,618	28%	0.54	1.90	35%	0.665	0.120
MU3	2.26	1.43E-07	0.98	13,046,100	0.20	6,564,430	6,054,890	3,653,532	28%	0.02	2.14	32%	0.685	0.685
MU4	2.10	1.18E-06	1.00	1,698,720	0.18	1,264,080	1,262,840	483,998	28%	0.00	1.62	34%	0.551	0.551

(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 2022 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

		2022 Stock Size (millions of fish)			2022 Mean Biomass	Exploitation Rate				2022 Catch (millions of fish)			3-yr Mean Weight in Harvest (kg)	2022 Harvest Range Catch (millions of lbs)		
	Age	**Min.**	**Mean**	**Max.**	**mil. lbs**	**F [(a)]**	**s(age)**	**F(age)**	**(u)**	**Min.**	**Mean**	**Max.**		**Min.**	**Mean**	**Max.**
Unit 1	2	15.829	25.076	34.323	6.210	0.708	0.120	0.085	0.067	1.067	1.691	2.314	0.128	0.301	0.477	0.653
	3	22.515	28.035	33.555	10.074	0.708	0.431	0.305	0.219	4.933	6.142	7.352	0.152	1.653	2.058	2.464
	4	9.544	12.171	14.797	6.001	0.708	0.754	0.534	0.347	3.314	4.226	5.138	0.175	1.279	1.630	1.982
	5	0.288	0.417	0.546	0.211	0.708	1.000	0.708	0.428	0.124	0.179	0.234	0.193	0.053	0.076	0.099
	6+	0.051	0.093	0.135	0.047	0.708	0.720	0.510	0.335	0.017	0.031	0.045	0.212	0.008	0.015	0.021
	Total	48.228	65.791	83.355	22.545				0.186	9.455	12.269	15.082	0.157	3.287	4.256	5.219
	(3+)	32.399	40.715	49.032	16.335				0.260	8.388	10.578	12.768	0.162	2.992	3.779	4.566
Unit 2	2	9.740	13.200	16.660	3.628	0.120	0.079	0.010	0.008	0.076	0.103	0.130	0.141	0.024	0.032	0.040
	3	8.439	9.991	11.542	4.743	0.120	0.383	0.046	0.037	0.312	0.369	0.426	0.161	0.111	0.131	0.151
	4	7.432	8.654	9.875	5.634	0.120	0.772	0.092	0.073	0.542	0.632	0.721	0.188	0.225	0.262	0.299
	5	1.153	1.368	1.582	1.076	0.120	1.000	0.120	0.093	0.108	0.128	0.148	0.204	0.048	0.057	0.066
	6+	0.871	1.116	1.362	0.972	0.120	0.967	0.116	0.090	0.079	0.101	0.123	0.245	0.043	0.055	0.066
	Total	27.636	34.329	41.021	16.054				0.039	1.117	1.332	1.548	0.183	0.449	0.537	0.623
	(3+)	17.896	21.129	24.361	12.426				0.058	1.041	1.229	1.418	0.186	0.426	0.505	0.583
Unit 3	2	10.817	16.417	22.017	2.895	0.685	0.024	0.016	0.013	0.145	0.221	0.296	0.131	0.042	0.064	0.085
	3	26.917	33.342	39.766	10.364	0.685	0.218	0.149	0.115	3.089	3.826	4.563	0.155	1.055	1.307	1.559
	4	7.021	8.471	9.922	4.202	0.685	0.598	0.409	0.281	1.970	2.378	2.785	0.182	0.791	0.954	1.117
	5	2.325	2.873	3.420	1.856	0.685	0.861	0.589	0.374	0.870	1.075	1.280	0.191	0.366	0.453	0.539
	6+	1.643	2.158	2.672	2.012	0.685	1.000	0.685	0.418	0.687	0.902	1.117	0.236	0.357	0.469	0.581
	Total	48.722	63.260	77.798	21.330				0.133	6.761	8.401	10.041	0.175	2.607	3.247	3.882
	(3+)	37.906	46.843	55.781	18.434				0.175	6.616	8.180	9.745	0.177	2.570	3.183	3.797
Unit 4	2	2.727	4.092	5.458	1.047	0.551	0.097	0.053	0.043	0.117	0.176	0.234	0.133	0.034	0.051	0.069
	3	3.642	4.588	5.534	2.303	0.551	0.434	0.239	0.177	0.643	0.811	0.978	0.158	0.224	0.282	0.341
	4	0.565	0.732	0.898	0.466	0.551	0.891	0.491	0.325	0.184	0.238	0.292	0.172	0.070	0.090	0.111
	5	0.095	0.134	0.174	0.106	0.551	1.000	0.551	0.355	0.034	0.048	0.062	0.187	0.014	0.020	0.025
	6+	0.454	0.658	0.862	0.602	0.551	0.644	0.355	0.249	0.113	0.164	0.215	0.233	0.058	0.084	0.110
	Total	7.482	10.204	12.925	4.523				0.141	1.091	1.436	1.780	0.167	0.399	0.528	0.656
	(3+)	4.755	6.111	7.468	3.476				0.206	0.974	1.260	1.546	0.171	0.366	0.476	0.587

(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 2022 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	0.708	3.287	4.256	5.219	2.026	3.038
2	0.120	0.449	0.537	0.623	0.492	0.738
3	0.685	2.607	3.247	3.882	2.054	3.082
4	0.551	0.399	0.528	0.656	0.418	0.628
Total		6.742	8.568	10.381	4.990	7.486

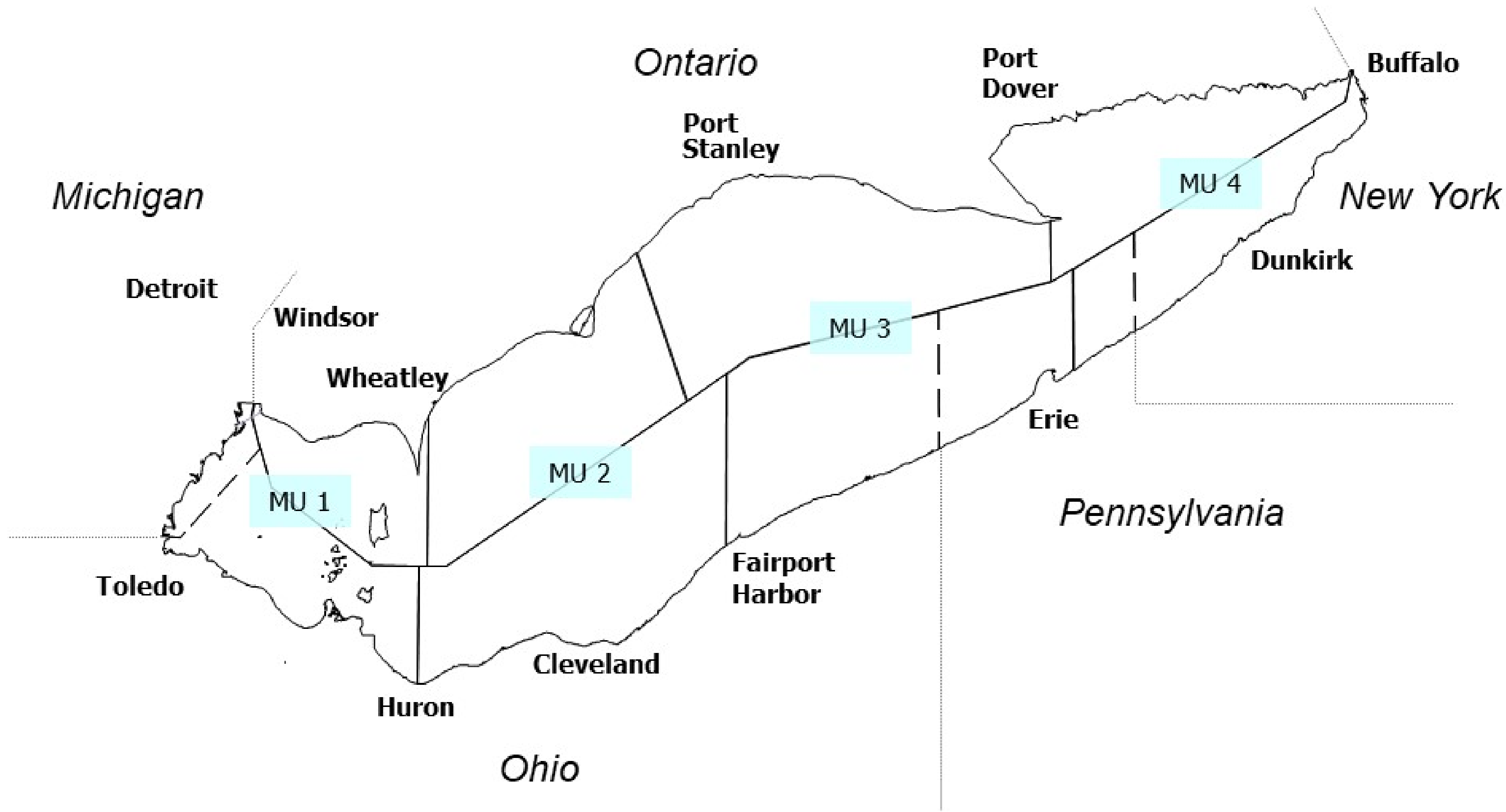


Figure 1.1. The Yellow Perch Management Units (MUs) of Lake Erie defined by the YPTG and LEC, for illustrative purposes.

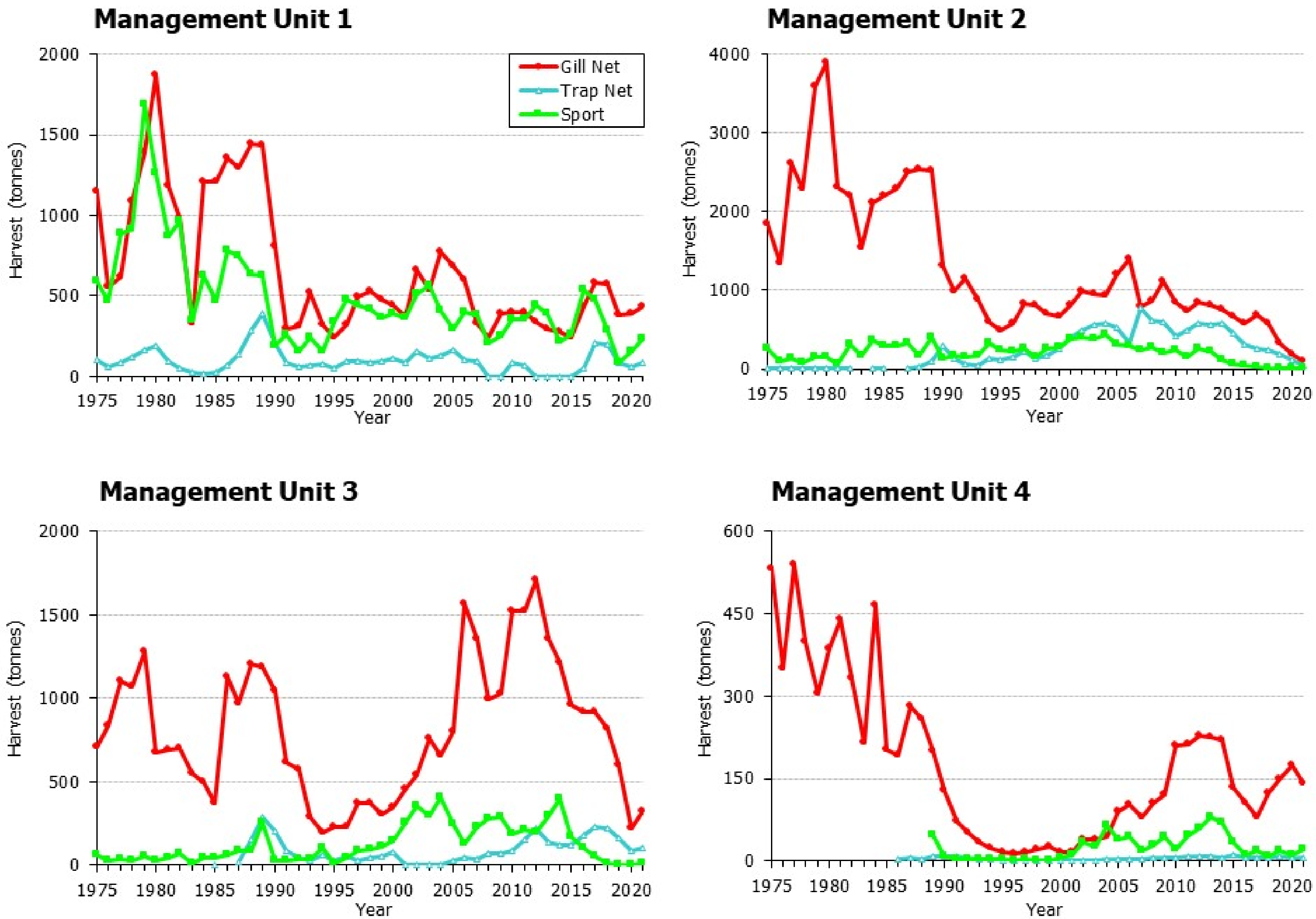


Figure 1.2. Historic Lake Erie Yellow Perch harvest (metric tonnes) by management unit and gear type.

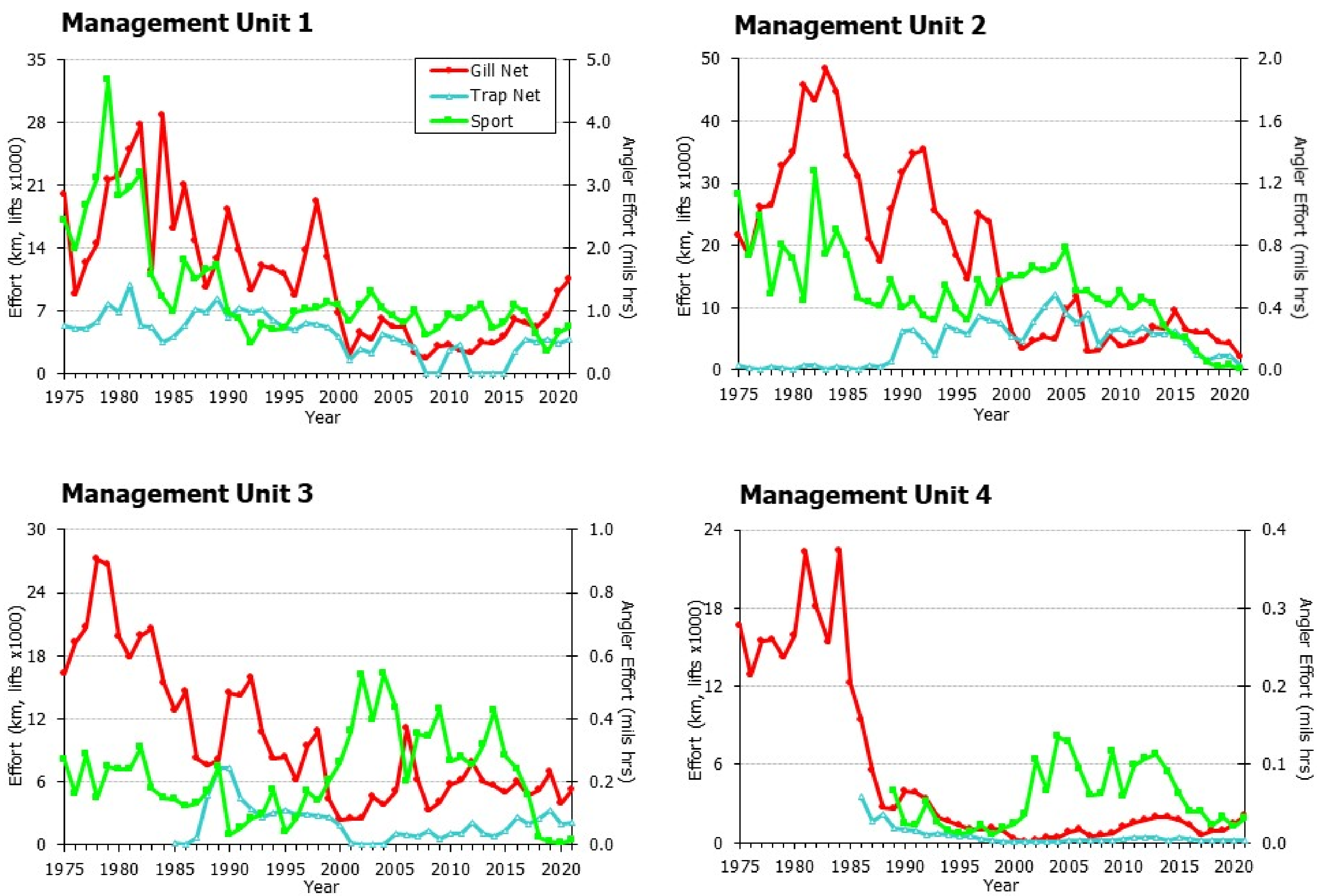


Figure 1.3. Historic Lake Erie Yellow Perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh (< 3").

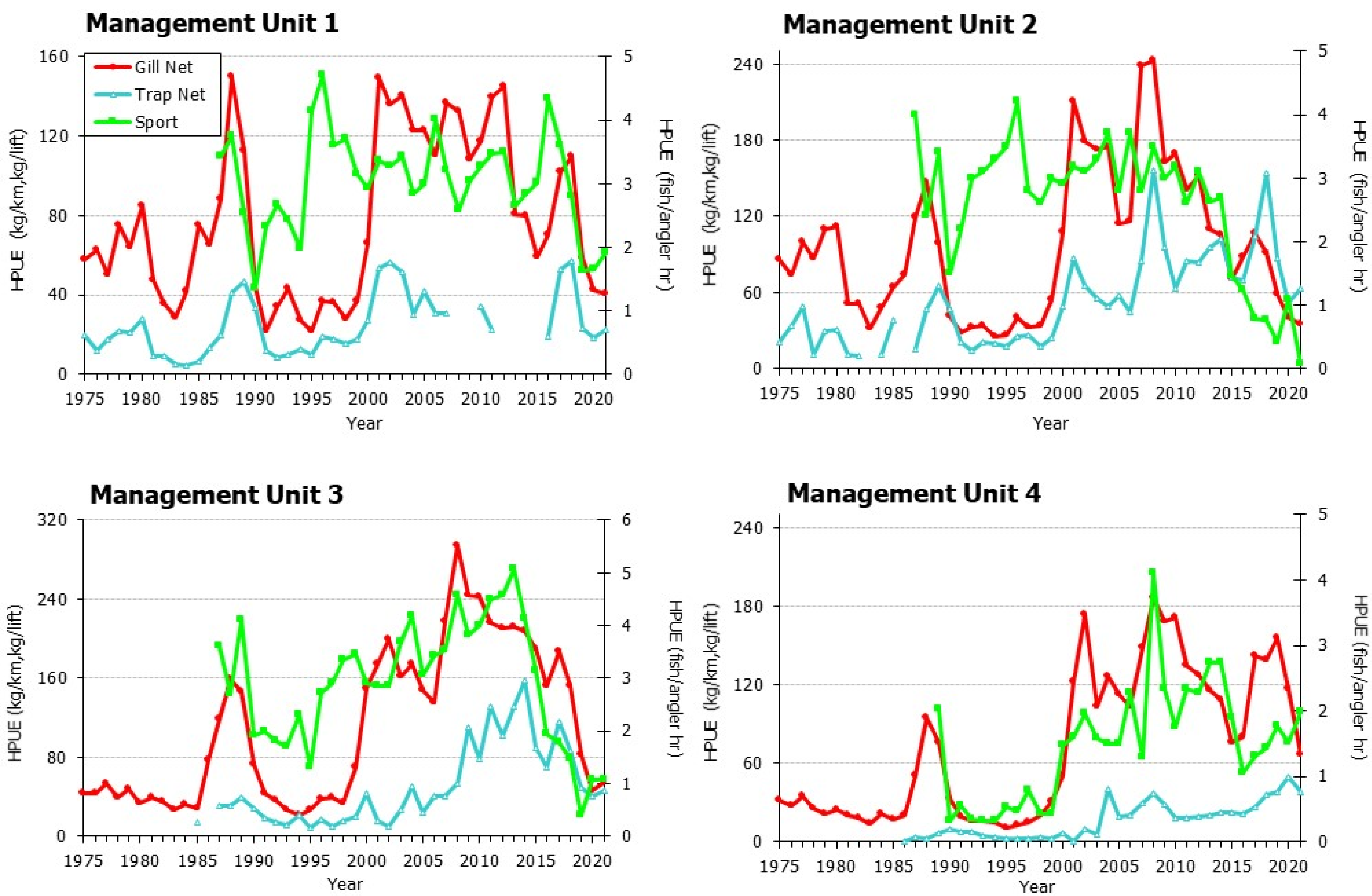


Figure 1.4. Historic Lake Erie Yellow Perch harvest per unit effort (HPUE) by management unit and gear type.
Note: gill net CPUE for 2001 to 2021 is for small mesh (< 3″) only.

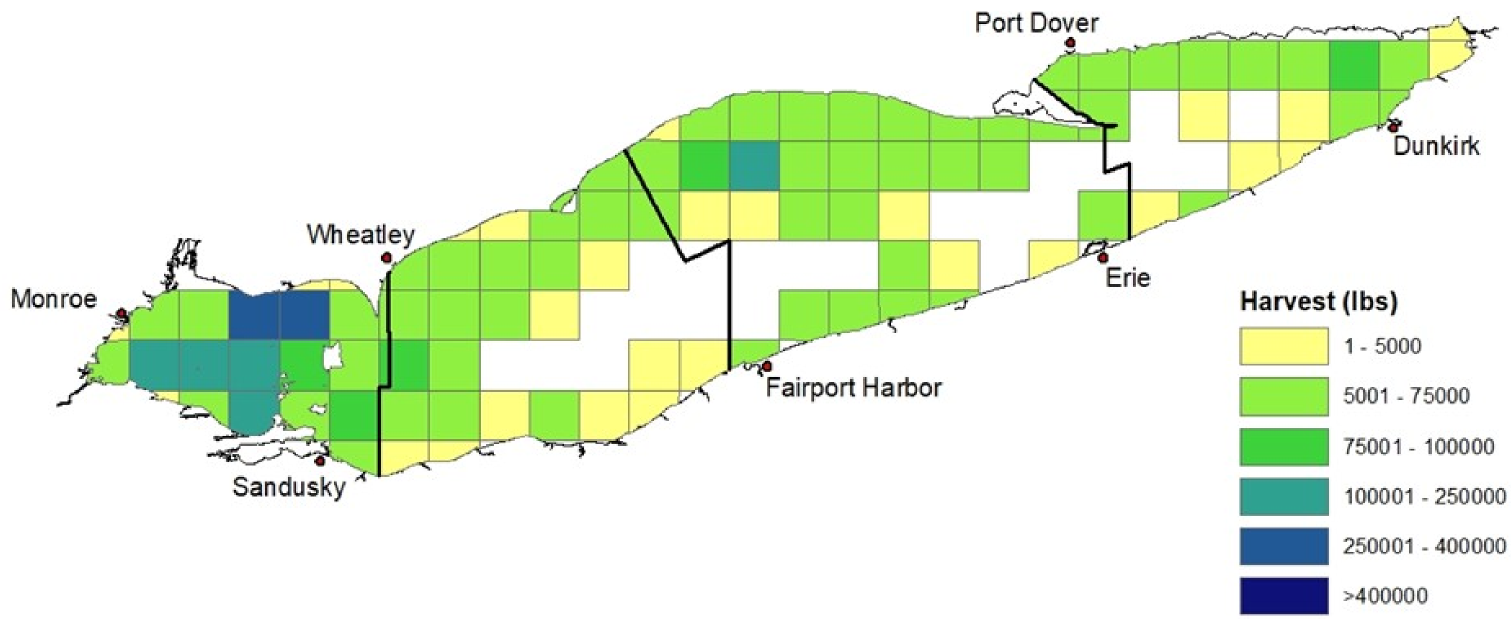


Figure 1.5. Spatial distribution of Yellow Perch total harvest (lbs.) in 2021 by 10-minute grid.

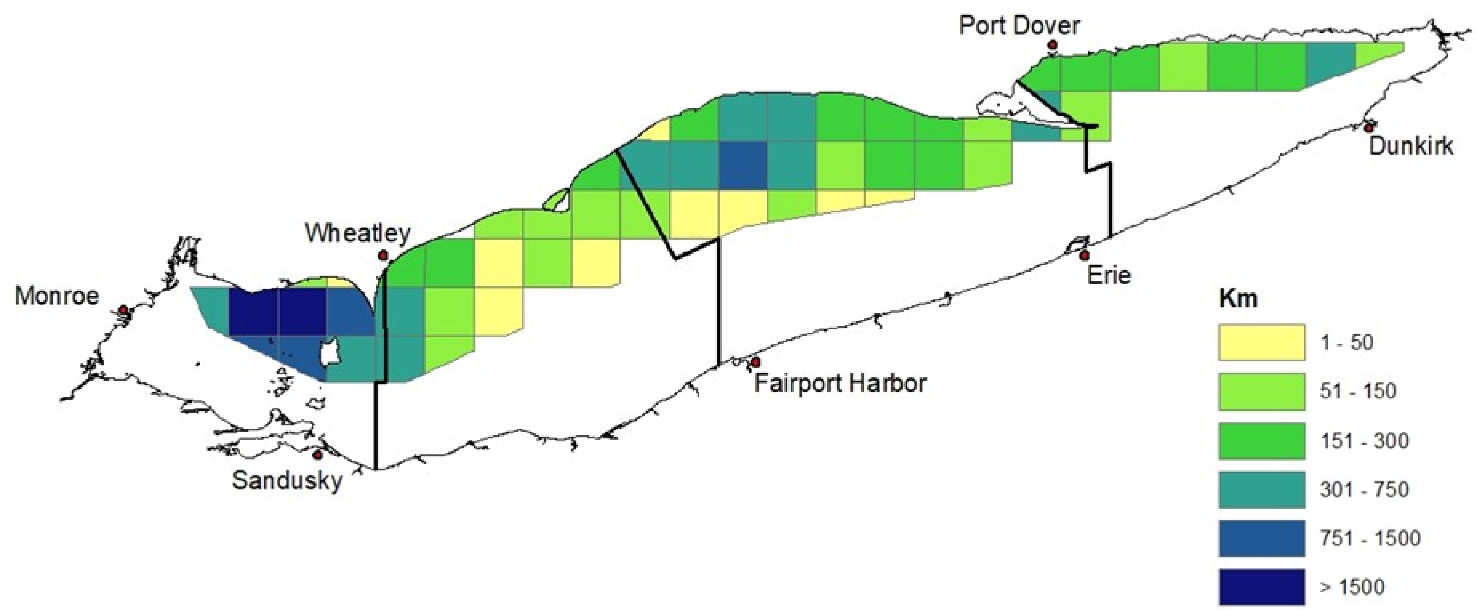


Figure 1.6. Spatial distribution of Yellow Perch small mesh gill net effort (km) in 2021 by 10-minute grid.

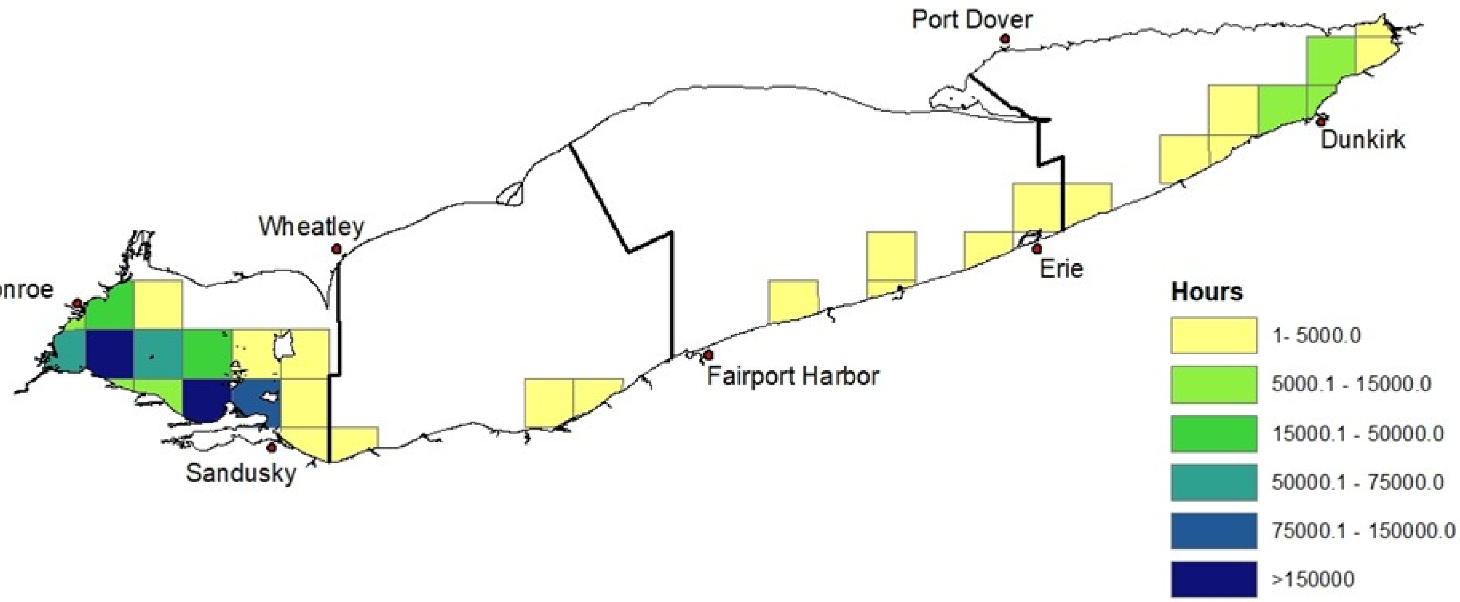


Figure 1.7. Spatial distribution of Yellow Perch sport effort (angler hours) in 2021 by 10-minute grid.

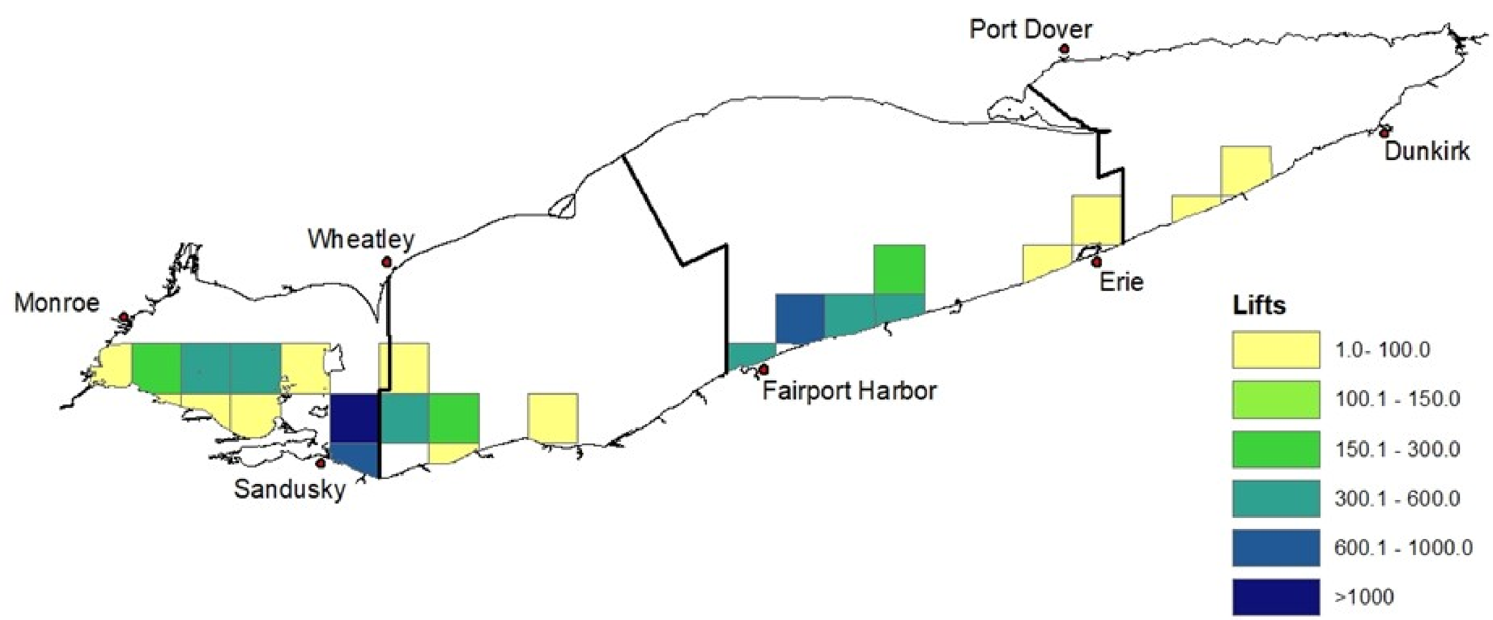


Figure 1.8. Spatial distribution of Yellow Perch trap net effort (lifts) in 2021 by 10-minute grid.

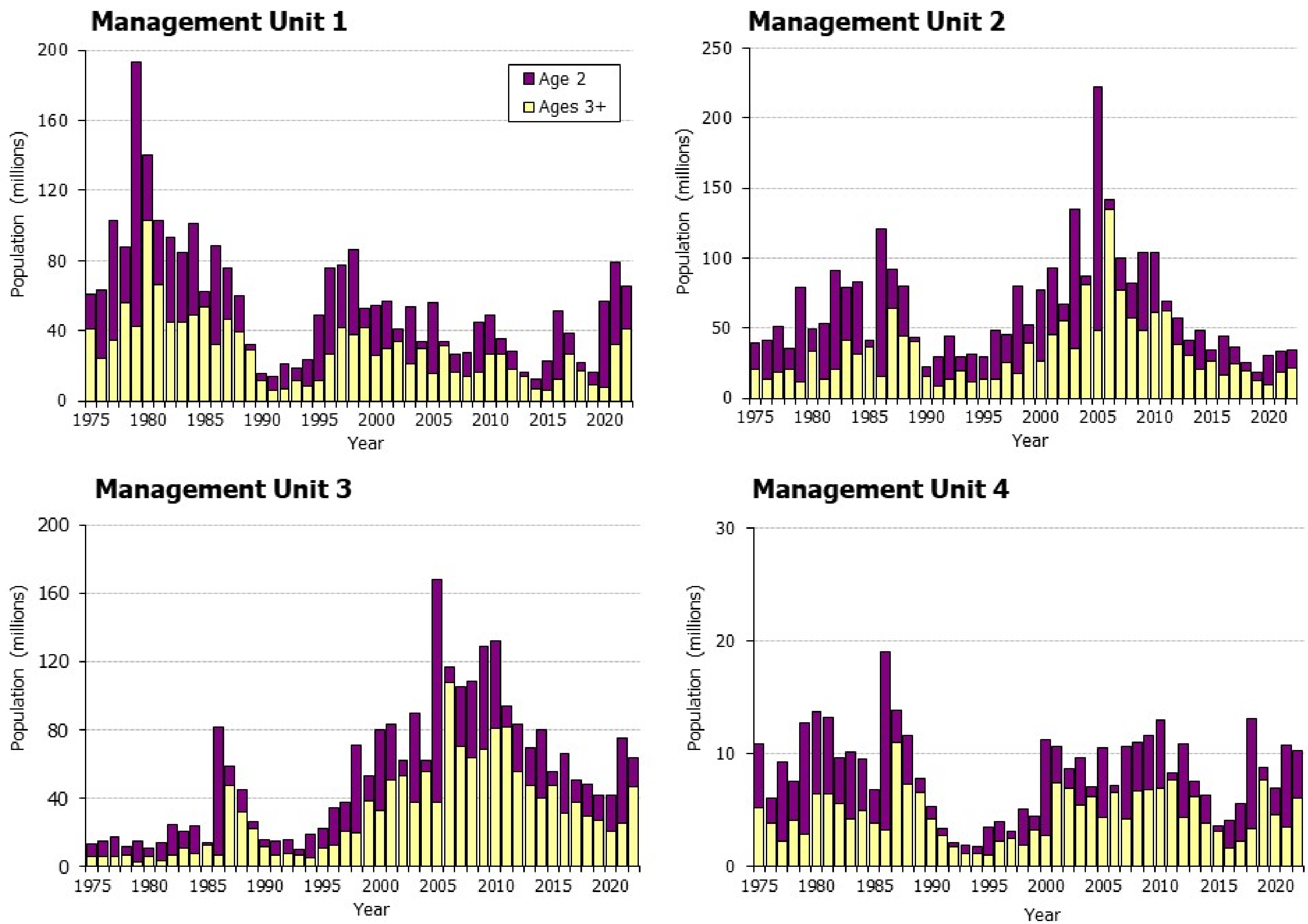


Figure 1.9. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2022, from the ADMB model.

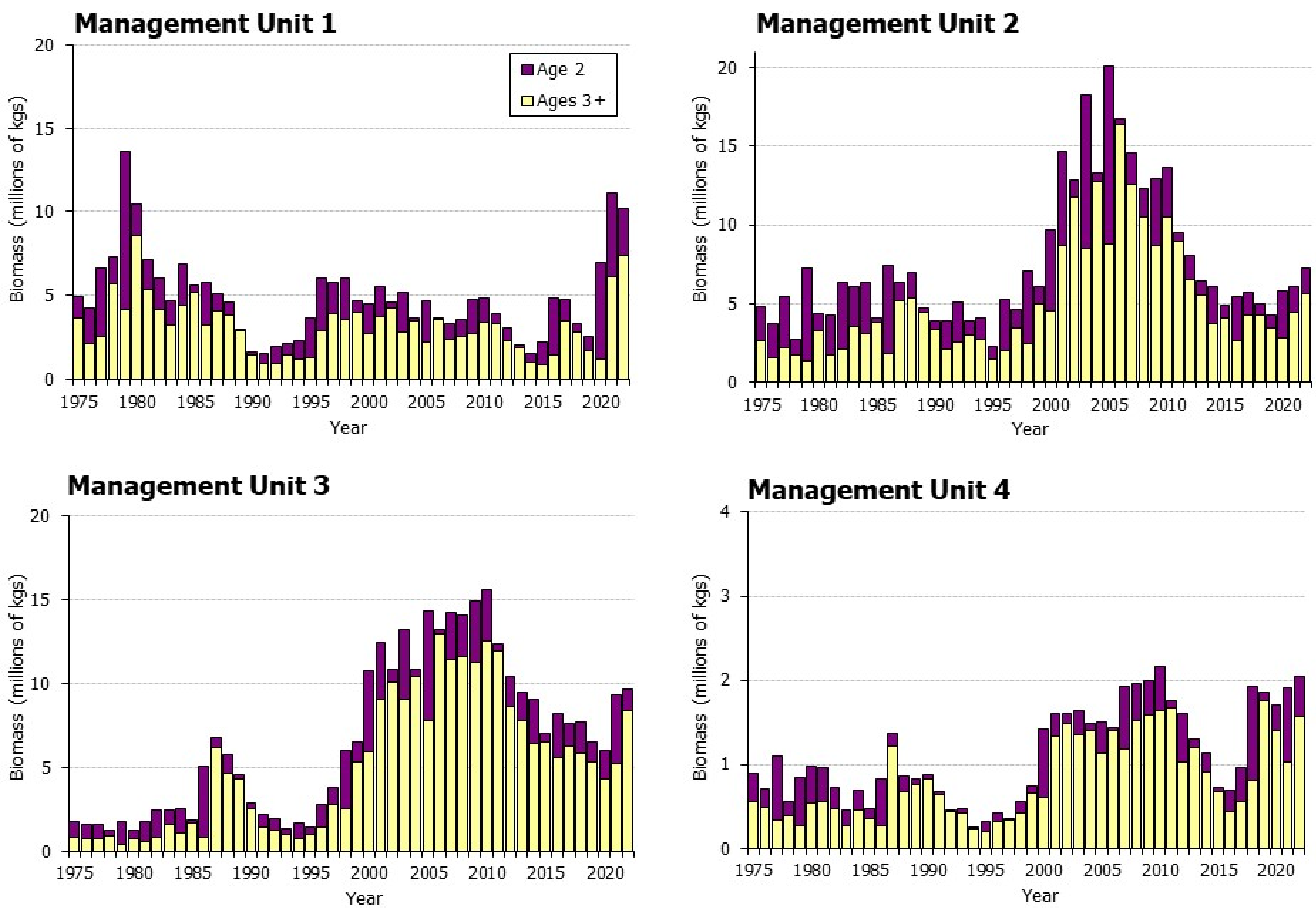


Figure 1.10. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars), 1975 to 2022, from the ADMB model.

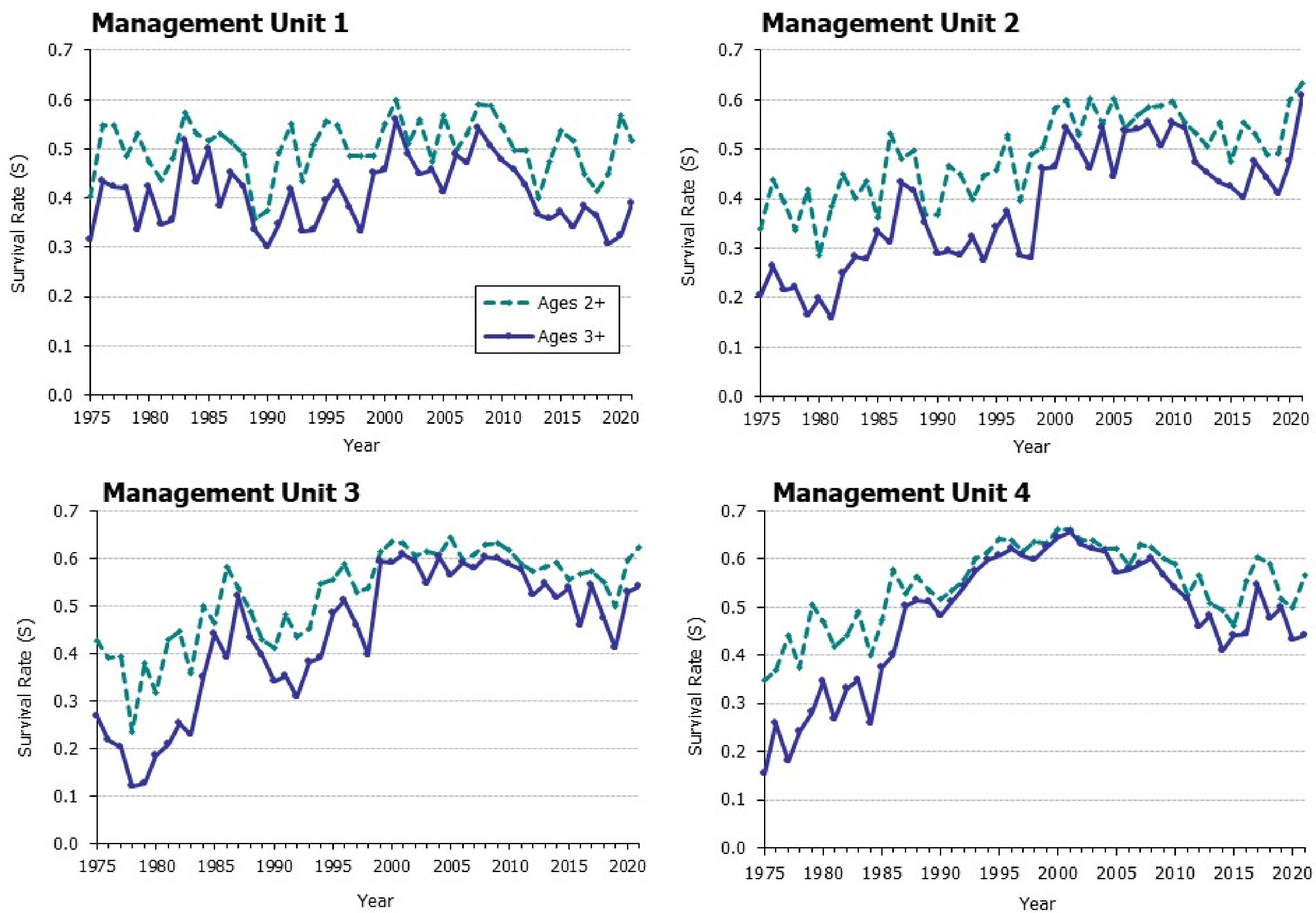


Figure 1.11. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).

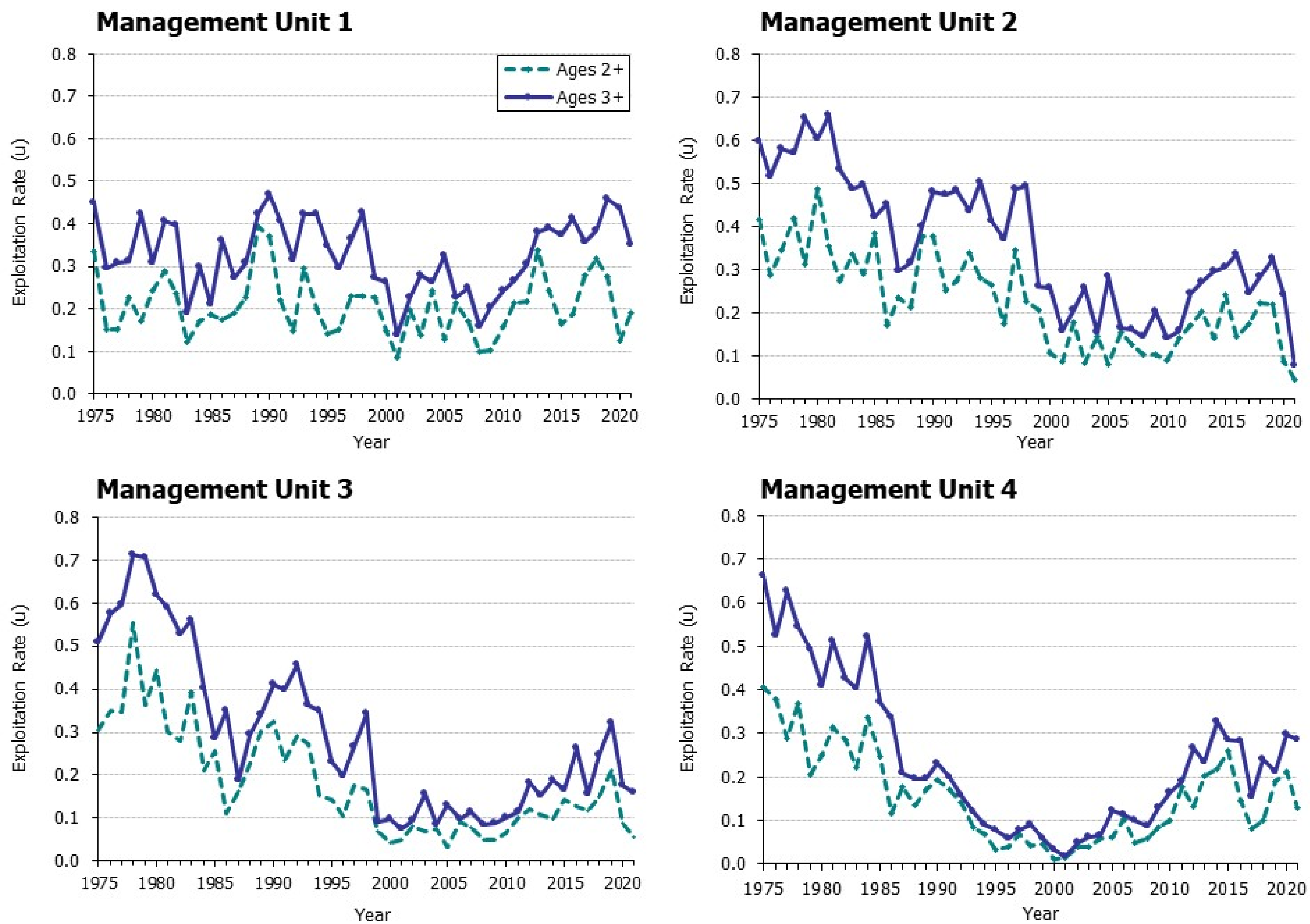
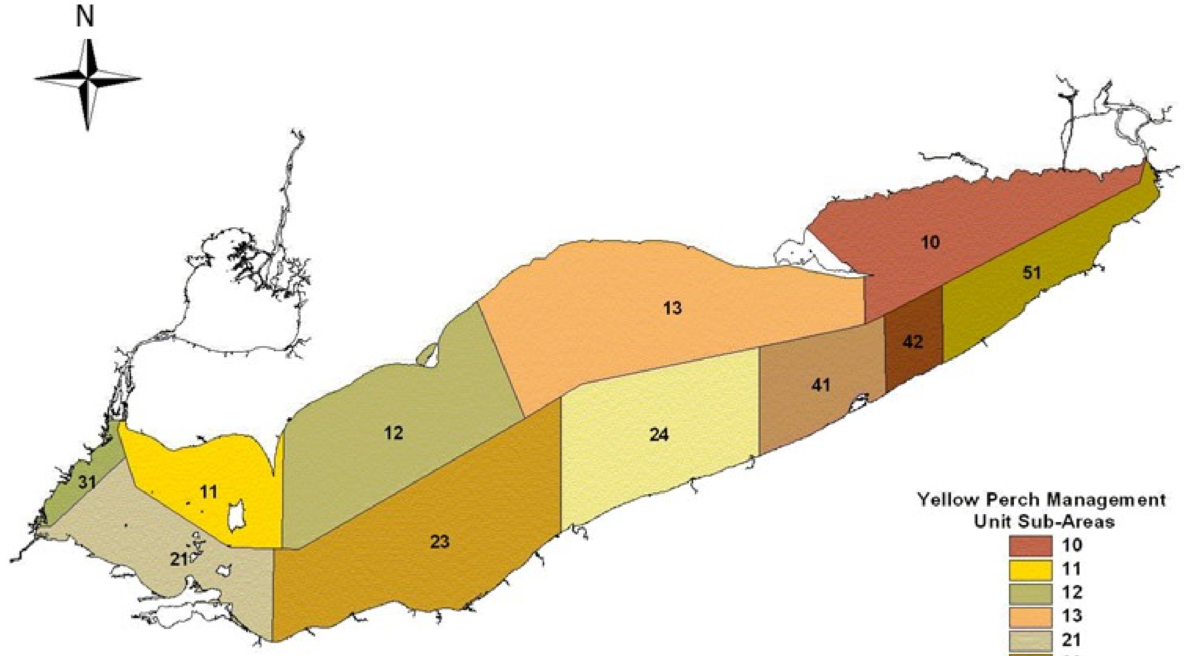


Figure 1.12. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line).



Management Unit	Sub-Area	Jurisdiction	Area Estimate (km2)	New Relative Surface Area
MU1	11	Ontario	1537.1	**40.6%**
	31	Michigan	344.8	**9.1%**
	21	Ohio	1905.6	**50.3%**
		MU 1 Total	**3787.5**	
MU2	12	Ontario	3497.4	**45.6%**
	23	Ohio	4175.3	**54.4%**
		MU 2 Total	**7672.7**	
MU3	13	Ontario	4749.9	**52.3%**
	24	Ohio	2943.7	**32.4%**
	41	Pennsylvania	1385.8	**15.3%**
		MU 3 Total	**9079.4**	
MU4	10	Ontario	2818.7	**58.0%**
	42	Pennsylvania	535.6	**11.0%**
	51	New York	1507.2	**31.0%**
		MU 4 Total	**4861.4**	

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

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

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

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

MU	Number of Years in Model	Survey	Parameter Estimate	Number of Models
MU1	21	OOS11	0.135	1
		OOS10	0.396	2
		OPSF11	0.097	2
		(Intercept)	13.551	2
MU2	20	OHF20	0.289	1
		OPSF21	0.305	1
		(Intercept)	14.879	1
MU3	19	OHJ31A	0.304	1
		OPSF31	0.297	2
		(Intercept)	14.862	2
MU4	17	NYF41	0.378	1
		LPC41	0.267	1
		(Intercept)	13.346	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	73.7	21.1	93.5	31.7	87.5	314.3
2021	.	.	1358.0	39.6	13.0	13.0	2.2	4.8	13.9	3.7	284.2	33.5	15.3	14.0	8.1	145.9	27.7	96.3	252.2

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*	*56.4*	*3.6*	*231.8*	*35.2*	*54.2*	*21.6*	*79.0*	*0.7*	*15.2*	*1.1*	.	*2.8*	*8.0*	*2.8*	*2.5*
2021	.	.	*65.9*	*8.2*	*45.7*	*42.3*	*2.4*	*3.4*	*61.4*	*0.6*	*15.8*	*5.7*	.	*1.1*	*1.7*	*379.7*	*28.8*

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