

Report of the Lake Erie Yellow Perch Task Group

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Note: The data and management summaries contained in this report are provisional. Every effort has been made to ensure their accuracy. Contact individual agencies for complete state and provincial data. Data reported in pounds for years before 1996 have been converted from metric tonnes. Please contact the Yellow Perch Task Group or individual agencies before using or citing data published herein.

Introduction

From April 2017 through March 2018 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 2018.
3. Participate in the Lake Erie Percid Management Advisory Group (LEPMAG) Yellow Perch harvest strategy evaluation process by assisting the Standing Technical Committee (STC) with the development of new catch-at-age models and exploitation strategies for Yellow Perch, leading to the development of a Yellow Perch Management Plan.
4. Improve existing population models to produce the most scientifically defensible and reliable method for estimating and forecasting abundance, recruitment, and mortality.
 - a. Explore additional recruitment indices for incorporation into catch-at-age model.

Charge 1: 2017 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) of Yellow Perch in 2017 was 10.375 million pounds. This allocation represented a 13% increase from a TAC of 9.208 million pounds in 2016. For Yellow Perch assessment and allocation, Lake Erie is partitioned into four management units (MUs; Figure 1.1). The 2017 TAC allocation was 3.062, 3.237, 3.776, and 0.300 million pounds for MUs 1 through 4, respectively. In March 2017, the process of developing a new assessment model (PR model), management strategy evaluation, and harvest policy for Lake Erie Yellow Perch was underway, but not yet complete. Therefore, the Lake Erie Committee (LEC) set 2017 TACs after considering abundance estimates and RAH ranges from two assessment models that were presented by the YPTG (YPTG and PR models; YPTG 2017), with the TACs remaining close to the previous year's value (decided based on the YPTG model) as possible while remaining within the RAH range estimated using the PR model. For MU1 and MU2, the LEC set the TAC equal to the minimum RAH estimated by the PR model (3.062 and 3.237 million pounds, respectively). For MU3, the LEC set the TAC at 3.776 million pounds, which was equal to the 2016 TAC. For MU4, the LEC set the TAC at 0.300 million pounds, which represented a 22% decrease from the 2016 TAC.

The lake-wide harvest of Yellow Perch in 2017 was 7.789 million pounds, or 75% of the total 2017 TAC. This was a 7.8% increase from the 2016 harvest of 7.223 million pounds. Harvest from MUs 1 through 4 was 2.773, 2.142, 2.639, and 0.235 million pounds, respectively (Table 1.1). The portion of TAC harvested was 91%, 66%, 70%, and 78%, in MUs 1 through 4, respectively. In 2017, Ontario harvested 4.983 million pounds, followed by Ohio (2.387 million lbs.), Michigan (0.256 million lbs.), Pennsylvania (0.123 million lbs.), and New York (0.040 million lbs.).

Ontario's fraction of allocation harvested was 103% in MU1, 102% in MU2, 103% in MU3, and 103% in MU4 (see paragraph below regarding Ontario's harvest reporting and commercial ice allowance policy). Ohio fishers attained 80% of their TAC in the western basin (MU1), 37% in the west central basin (MU2), and 41% in the east central basin (MU3). Michigan anglers in MU1 attained 92% of their TAC. Pennsylvania fisheries harvested 19% of their TAC in MU3 and 49% of their TAC in MU4. New York fisheries attained 43% of their TAC in MU4. Ontario's portion of the lakewide Yellow Perch harvest in 2017 (64%) was comparable to 2016 (62%; Table 1.1). Ohio's proportion of lakewide harvest in 2017 (31%) was also similar to 2016, and harvest in Michigan, Pennsylvania, and New York waters combined represented 5.4% of the lakewide harvest in 2017.

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 2008 to 2017 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends across a longer time series (1975 to 2017) 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 2017 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 2017 was 0.4%, 4.2%, and 3.0% of the gill net harvest in management units 1, 2 and 3, respectively, and was negligible (0.02%) in MU4. Harvest, effort, and catch per unit effort from (1) small mesh Yellow Perch effort (<3 inch stretched mesh) and (2) larger mesh sizes, are distinguished in Tables 1.2 to 1.5. Harvest from targeted small mesh gill nets in 2017 increased by 35% in MU1 and 15.1% in MU2, but declined by 2% in MU3 and 23% in MU4. Ontario trap net harvest was minimal (839 pounds in 2017) 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 2017, 57 pounds of Yellow Perch were harvested in trawl nets in MU2, 1,380 pounds of Yellow Perch were harvested in trawl nets in MU3, and 2,223 pounds were harvested in MU4.

Targeted (i.e., small mesh) gill net effort in 2017 decreased from 2016 across all four MUs (-7%, -5%, -20%, and -57%, respectively). Gill net effort in 2017 was also lower when compared to the 1990s and earlier decades (Figure 1.3). Targeted gill net harvest rates in 2017 increased relative to 2016 rates by 46% in MU1, 21% in MU2, 22% in MU3, and 78% in MU4 (Figure 1.4).

In 2017, sport harvest in U.S. waters decreased by 11% in MU1, 49% in MU2 and MU3, but increased by 85% in MU4 compared to the 2016 harvest (Figure 1.2). Similarly, angling effort in U.S. waters decreased in 2017 from 2016 in MU1 (-9%), MU2 (-42%), MU3 (-35%), and MU4 (-1%; 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 2016 rates, harvest per angler hour decreased in Michigan and Ohio waters of MU1 (-12%), in Ohio waters of MU2 (-19%) and MU3 (-16%), and in Pennsylvania waters of MU4 (-5%). Harvest rates increased in the Pennsylvania waters of MU3 (+8%) and New York waters of MU4 (+42%).

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 2017, the sport harvest rate (in kg/hr) decreased in MU1 (0.48; -3%), MU2 (0.20; -13%), and MU3 (0.34; -23%), but increased in MU4 (0.50; -87%) from 2016 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 14% in MU2, but increased by 333% in MU1, 24% in MU3, and 8% in MU4. Compared to 2016, trap net effort (lifts) in 2017 increased by 57% in MU1,

decreased in MU2 by 43%, decreased by 26% in MU3, and decreased by 16% in MU4. Trap net harvest rate increased in all MUs (176%, 51%, 66%, and 29% increases, respectively).

Age Composition and Growth

Lakewide, age-3 fish contributed the most to the Yellow Perch harvest (57%), followed by age-5 fish (16%), with age-2 and age-4 fish contributing roughly equally (11 and 10%, respectively; Table 1.6). In MU1, age-3 fish (2014 year class, 66%), and age-2 fish (2015 year class, 19%) contributed most to the fishery. In MU2, age-3 fish (2014 year class, 61%) and age-5 fish (2012 year class, 14%) contributed most to the fishery. In MU3, age-3 fish (2014 year class, 41%) and age-5 fish (2012 year class, 35%) contributed the most to the harvest. In MU4, age-3 fish (2014 year class, 49%) and age-2 fish (2015 year class, 28%) 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). The YPTG uses a three-year average of weight-at-age to minimize the impacts of weak year classes on determining the mean weight-at-age of Yellow Perch in the population and in the harvest.

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 2018, the YPTG used two ADMB models in each management unit to estimate abundance. The first was the model the YPTG has used in the past (hereafter referred to as the YPTG model; YPTG 2016), and the second was the model developed by the Quantitative Fisheries Centre (QFC) at Michigan State University (hereafter referred to as the Peterson-Reilly or PR model) as part of the ongoing Lake Erie Percid Management Advisory Group (LEPMAG) review of Yellow Perch management on Lake Erie. Table and figure numbers in this report are designated for each model as YPTG (a) and PR (b).

YPTG model

The YPTG 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. The YPTG model incorporates commercial gill net selectivity estimated independently in the latter part of the time series using gill net selectivity curves derived from index gill net data by the method of Helser (1998), involving back calculation of length-at-age and weightings based on the monthly distribution of harvest-at-age. Commercial gill net catchability coefficients based on the seasonal distribution of harvest and relative catch rates are also used. The model uses catchability blocks for each type of harvest gear, and constant catchability for surveys. The Ontario Partnership gillnet index catch rates are adjusted for selectivity bias associated with mesh size configuration (Helser 1998) with an assumed selectivity of 1 for all age groups. The model is fit to catch at age data.

PR model

The PR model uses the same data sources as the YPTG model, with the addition of age-0 and age-1 recruitment data. The PR model estimates selectivity for all ages in the fishery and surveys. Since survey selectivities are estimated in this model, Ontario Partnership catch rates are not adjusted for selectivity bias. There is a commercial gill net selectivity block beginning in 1998. Catchabilities for all fisheries and surveys vary as a random walk. The model is fit to total catch and proportions-at-age (multinomial age composition) as separate data sets. Running the PR model is a three-step process. In the first step, an ADMB model without recruitment data is run

iteratively until the maximum effective sample size for the multinomial age composition stabilizes (i.e., does not change by more than 1-2 units).

Second, age-2 abundance estimates from the first model are added to age-0 and age-1 recruitment data in a multi-model inference (MMI) R-based model to determine parameters for estimating recruitment (see full explanation below). 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., 2016 year class in the 2018 TAC year) are removed from the analysis. A list of all possible non-redundant models is generated from the survey data and fit using the *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 models; the surveys that are more highly correlated with ADMB age-2 estimates are weighted more heavily, and have greater influence on the recruitment predictions.

In the third step, the age-0 and age-1 recruitment data are added to the ADMB model along with the MMI coefficients from step two. This allows the model to estimate age-2 recruitment for each year class available in the recruitment data, and adds this as a data set in the objective function. This model is then run iteratively until the maximum effective sample size for the multinomial age composition stabilizes.

YPTG Recommendation

The YPTG recommended using the YPTG model in 2017 and 2018. The task group previously discussed the merits of using the PR model relative to the current YPTG model in terms of model fit and performance presented at LEPMAG meetings (e.g., were the models providing similar abundance estimates, how did each model compare in terms of retrospective pattern, sensitivity to various parameters) and while the task group generally felt the PR models provides advantages relative to the YPTG models, a formal harvest policy risk assessment (i.e., management strategy evaluation) has yet to be completed using the PR models (YPTG 2017). The current harvest policy was developed for the existing YPTG assessment models after conducting a stock recruitment simulation to evaluate the risks of various fishing strategies (YPTG 2010). Further, the PR model is sensitive to the recruitment data, and different recruitment surveys may be selected each year during the MMI process leading to instability in the abundance estimates. Additional concerns existed when running the MU3 PR model because the maximum effective

sample size for the multinomial age composition would not converge after several (i.e., >10) model runs, and the task group was use a pin file (containing prior values for parameter estimates). Despite using the pin file, the MU3 PR model would not converge on a whole value for the maximum effective sample size.

YPTG and PR model results

Estimates of population size for both models, from 2000 to 2017, and projections for 2018 based on 2017 fishing mortality rates and recruitment, are presented in Table 1.7. Abundance, biomass, survival, and exploitation rates are presented by management unit graphically for 1975 to 2017 in Figures 1.9 to 1.12. Mean weights-at-age from assessment surveys were applied to abundance estimates to generate population biomass estimates (Table 1.8 and Figure 1.10). Population abundance and biomass estimates are critical to monitoring the status of stocks and determining recommended allowable harvest.

Abundance estimates should be interpreted with several caveats. Inclusion of abundance estimates from 1975 to 2017 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 2018 in both the YPTG and PR models and are presented in Appendix A Table 1. In the PR model, the additional recruitment survey data were given a lambda weighting of 1.

Recruitment Estimator for Incoming Age-2 Yellow Perch

YPTG model

In 2014, the YPTG implemented a multi-model inference based approach, recommended by LEPMAG, for predicting age-2 recruitment. This method provides an objective response by using a multi-model information-theoretic recruitment estimate that is calculated using the *glmulti* package in R (Calcagno 2013). This approach generates a list of all possible (2^n) non-redundant model formulas from a list of n explanatory variables (i.e., surveys) and fits each model with a pre-specified function (i.e., generalized linear model). All models falling within 2 AIC units of the 'best' model comprise the confidence set of models used to generate the model-averaged coefficients. Surveys are not weighted equally in the models; the surveys that are more highly correlated with ADMB age-2 estimates are weighted more, thus having greater influence on the predictions. One caveat with this approach is that years with any missing survey data cannot be used in the model, thereby truncating the time series. Furthermore, any survey required for the current year's age-2 projection that was not performed must be removed from the list of n explanatory variables used by the *glmulti* analysis to generate possible candidate models. Only survey data from within each individual management unit was used to predict age-2 abundance in that management unit.

Estimates of 2018 age-2 Yellow Perch recruitment (the 2016 year class) were 4.923, 10.351, 25.922, and 10.136 million fish in management units 1 through 4, respectively (Table 1.7.a., Appendix A Table 2.a.i). Parameter estimates for the model-averaged coefficients for each MU are detailed in Appendix A Table 2.b.i.

PR model

The PR model also used a MMI approach to project age-2 recruitment in 2018, as described above. However, in this case the MMI parameters were estimated during step two of the PR model process where recruitment data from the last nine years were removed from the model to minimize possible retrospective effects (see section Statistical Catch-at-Age Analysis, PR model).

Estimates of 2018 age-2 Yellow Perch recruitment (the 2016 year class) were 11.550, 11.112, 33.587, and 6.443 million fish in management units 1 through 4, respectively (Table 1.7.b., Appendix A Table 2.a.ii). Parameter estimates for the model-averaged coefficients for each MU are detailed in Appendix A Table 2.b.ii.

Data from trawl and gill net index series for the time period examined are presented in

Appendix A Table 3, and a key that summarizes abbreviations used for the trawl and gill net series is presented as a legend in Appendix A Table 4. A subset of surveys listed in Appendix A Table 3 (in italics) are excluded from the multi-model estimation because they were components of an included composite survey known to better represent the distribution of age-0 and age-1 Yellow Perch abundance.

2018 Population Size Projection

Stock size estimates for age-3-and-older Yellow Perch in 2018 were projected from SCAA estimates of 2017 population size and age-specific survival rates in 2017 for both the YPTG and PR models (Table 1.8). Projected age-2 Yellow Perch recruitment from the 2016 year class (method described above) was added to the 2018 population estimate for older fish in each unit, producing the total standing stock in 2018 (Table 1.8). Standard errors and ranges for estimates are provided for each age in 2017 and following estimated survival from SCAA, for 2018. Descriptions of *min*, *mean*, and *max* population estimates refer to the age-specific mean estimates minus or plus one standard deviation (Table 1.8).

YPTG model

Stock size estimates for 2017 from the YPTG model (Table 1.7.a) were higher than those projected last year in MUs 1 and 2, but lower than projected in MUs 3 and 4 (YPTG 2017). Differences in stock size estimates were due to additional data in the model and differences in age-2 estimates projected in 2017 compared to those estimated by the model in 2018. Current estimates of age-2 fish in 2017 are from first assessment of this cohort and, as such, have the widest error bounds.

In the 2018 YPTG model run, stock size estimates projected for 2018 were lower than 2017 stock size estimates in MUs 1 and 2, and higher in MUs 3 and 4 (Table 1.8.a, Figure 1.9.a). Abundance projections for 2018 were 41.341, 43.279, 49.543, and 17.292 million age-2-and-older Yellow Perch in management units 1 through 4, respectively. Compared to the 2017 abundance estimates, estimates of age-2-and-older Yellow Perch in 2018 are projected to decrease by 40% and 25% in MU1 and MU2, respectively, and to increase by 19% in MU3 and 54% in MU4. Age-3-and-older Yellow Perch abundance in 2018 is projected to be 36.418, 32.929, 23.622, and 7.155 million fish in MUs 1 through 4, respectively. Model estimates of abundance for age-3-and-older Yellow Perch for 2018 are projected to increase from the 2017 estimates by 2%, 7%, and 24% in

MU1, MU2, and MU4, respectively, and decrease by 23% in MU3. Lakewide abundance of age-2-and-older Yellow Perch in 2018 is projected to be 151.5 million fish, a decrease of 16% from 2017.

As a function of population estimates and mean weight-at-age from fishery-independent surveys, total biomass estimates of age-2-and-older Yellow Perch for 2018 are projected to decrease in MU1 (-35%), MU2 (-25%), and in MU3 (-5%), and to increase in MU4 (+30%), compared to 2017 estimates (Table 1.8.a. and Figure 1.10.a).

Estimates of Yellow Perch survival for age-3-and-older in 2017 were 47%, 55%, 54%, and 62% in MUs 1 through 4, respectively (Table 1.8.a and Figure 1.11.a). Estimates of Yellow Perch survival in 2017 for age-2-and-older fish were: 53% in MU1, 57% in MU2 and MU3, and 64% in MU4. Survival estimates are a function of natural mortality and age-specific fishing mortality. Yellow Perch SCAA models used in this report assume that natural mortality is 0.4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2017 were 25%, 15%, 16%, and 6% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2017 were: 18% in MU1, 12% in MU2, 13% in MU3, and 4% in MU4 (Table 1.8a and Figure 1.12a).

PR model

Stock size estimates for 2017 from the PR model (Table 1.7.b) were lower than those projected last year in MUs 1, 2 and 3, but higher than projected in MU 4 (YPTG 2017). Using the PR model, abundance projections for 2018 were 37.901, 53.868, 77.644, and 16.983 million age-2-and-older Yellow Perch in management units 1 through 4, respectively. Abundance estimates of age-2-and-older Yellow Perch in 2018 are projected to decrease by 35% in MU1 and 26% in MU2, and increase by 5% in MU3 and 4% in MU4 compared to the 2017 abundance estimates (Table 1.8.b, Figure 1.9.b). Age-3-and-older Yellow Perch abundance in 2018 is projected to be 26.351, 42.756, 44.056, and 10.540 million fish in MUs 1 through 4, respectively. Model estimates of abundance for age-3-and-older Yellow Perch for 2018 are projected to decrease from the 2017 estimates by 24% and 15% in MUs 1 and 3, respectively, and increase by 2% and 125% in MUs 2 and 4, respectively. Lakewide abundance of age-2-and-older Yellow Perch in 2018 is projected to be 186.4 million fish, a decrease of 16% from 2017.

As a function of population estimates and mean weight-at-age from fishery-independent surveys, total biomass estimates of age-2-and-older Yellow Perch for 2018 are projected to decrease in MU1 (-35%), MU2 (-27%), and MU3 (-9%), and increase in MU4 (+12%), compared

to 2017 estimates (Table 1.8.b. and Figure 1.10.b).

Estimates of Yellow Perch survival for age-3-and-older in 2017 were 36%, 54%, 56%, and 61% in MUs 1 through 4, respectively (Table 1.8.b and Figure 1.11.b). Estimates of Yellow Perch survival in 2017 for age-2-and-older fish were: 45% in MU1, 59% in MU2 and MU3, and 65% in MU4. Estimated exploitation rates of ages-3-and-older Yellow Perch in 2017 were 39%, 16%, 14%, and 7% in management units 1 through 4, respectively. Estimates of Yellow Perch exploitation for ages-2-and-older fish in 2017 were: 27% in MU1, 10% in MU2 and MU3, and 3% in MU4 (Table 1.8b and Figure 1.12b).

Charge 2: Harvest Strategy and Recommended Allowable Harvest

Fishing rates applied in 2018 are presented in Table 2.1, along with associated RAH values for each management unit. The fishing rates applied to abundance estimates from the PR model were the same as those used for the YPTG model since a formal risk assessment and related new harvest policy has not been completed for the PR model. Harvest strategies were developed for a draft Yellow Perch Management Plan (YPMP) and tested using a Yellow Perch simulation with YPTG model results (see YPTG 2010 report). The Yellow Perch simulation determined that fishing rates that were one-half of F_{msy} could support viable sport and commercial fisheries without inviting excessive biological risk. Fishing rates currently applied in calculating RAH in MUs 1, 2, 3, and 4, are 0.67, 0.67, 0.70, and 0.30, respectively. These target fishing rates applied to population estimates and their standard errors, were used to determine *min*, *mean*, and *max* RAH values for 2018 for each management unit (Tables 2.1 and 2.2).

Quota allocation by management unit and jurisdiction for 2018 was determined by the same methods applied in 2009-2017, 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, 2018:

<u>MU1:</u>	ONT	40.6%	OH	50.3%	MI	9.1%
<u>MU2:</u>	ONT	45.6%	OH	54.4%		
<u>MU3:</u>	ONT	52.3%	OH	32.4%	PA	15.3%
<u>MU4:</u>	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 YPMP, the LEC, Standing Technical Committee (STC), QFC, and stakeholder groups from all Lake Erie jurisdictions have formed the Lake Erie Percid Management Advisory Group (LEPMAG) to address stakeholder objectives, modeling concerns, and exploitation policies for Lake Erie percids. The QFC and LEPMAG have been working on developing a new statistical catch at age model (PR model). This model estimates selectivities, uses random walk catchability, has commercial selectivity time blocks, Ontario survey catchability connection to account for the break in the time series in MU3 and MU4, and a multinomial distribution for age composition data. In 2016, the QFC added age-0 and age-1 recruitment survey data to the model (see section Statistical Catch-at-Age Analysis, PR model).

During 2017, LEPMAG discussed stakeholder objectives and began working on a management strategy evaluation to evaluate current and alternative harvest strategies for the PR model. To date, work focused on MUs 1 and 4, although preliminary results are expected for all MUs during 2018.

Charge 4: Improve existing population models

The YPTG explored additional recruitment indices for incorporation into the catch-at-age model. In 2018, the New York gill net age-1 recruitment index was added to the MU4 model. Additional central basin recruitment indices were examined, but not included at this time. Moving forward, the YPTG would like to examine all of the recruitment indices currently used to determine which ones are appropriate moving forward and remove those which may not be appropriate.

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Table 1.1. Lake Erie Yellow Perch harvest in pounds by management unit (Unit) and agency, 2008-2017.

	Year	Ontario*		Ohio		Michigan		Pennsylvania		New York		Total Harvest
		Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	
Unit 1	2008	580,050	56	409,705	39	47,934	5	--	--	--	--	1,037,689
	2009	853,137	61	463,564	33	87,319	6	--	--	--	--	1,404,020
	2010	879,358	47	889,512	48	83,725	5	--	--	--	--	1,852,595
	2011	870,802	48	796,447	44	145,960	8	--	--	--	--	1,813,209
	2012	752,872	44	883,245	51	93,291	5	--	--	--	--	1,729,408
	2013	648,884	43	789,088	52	76,994	5	--	--	--	--	1,514,966
	2014	620,667	56	391,361	36	87,511	8	--	--	--	--	1,099,539
	2015	541,938	48	485,744	43	94,225	8	--	--	--	--	1,121,907
	2016	947,052	42	886,068	40	397,044	18	--	--	--	--	2,230,164
	2017	1,277,587	46	1,239,575	45	255,605	9					2,772,767
Unit 2	2008	1,990,237	50	2,005,000	50	--	--	--	--	--	--	3,995,237
	2009	2,495,611	58	1,801,978	42	--	--	--	--	--	--	4,297,589
	2010	1,888,876	56	1,457,823	44	--	--	--	--	--	--	3,346,699
	2011	1,665,258	54	1,399,503	46	--	--	--	--	--	--	3,064,761
	2012	1,877,615	50	1,851,846	50	--	--	--	--	--	--	3,729,461
	2013	1,803,684	51	1,721,668	49	--	--	--	--	--	--	3,525,352
	2014	1,679,175	52	1,543,226	48	--	--	--	--	--	--	3,222,401
	2015	1,489,433	57	1,131,993	43	--	--	--	--	--	--	2,621,426
	2016	1,283,379	62	792,869	38	--	--	--	--	--	--	2,076,248
	2017	1,498,437	70	643,554	30							2,141,991
Unit 3	2008	2,200,168	74	629,366	21	--	--	155,014	5	--	--	2,984,548
	2009	2,266,727	74	597,214	20	--	--	190,742	6	--	--	3,054,683
	2010	3,370,099	85	476,808	12	--	--	117,640	3	--	--	3,964,547
	2011	3,366,412	81	636,686	15	--	--	153,233	4	--	--	4,156,331
	2012	3,768,183	81	746,999	16	--	--	161,751	3	--	--	4,676,933
	2013	2,983,539	76	796,307	20	--	--	155,193	4	--	--	3,935,039
	2014	2,668,921	70	979,937	26	--	--	168,690	4	--	--	3,817,548
	2015	2,131,211	77	572,736	21	--	--	77,558	3	--	--	2,781,505
	2016	2,020,470	76	522,549	20	--	--	107,972	4	--	--	2,650,991
	2017	2,027,235	77	504,223	19			107,335	4			2,638,793
Unit 4	2008	240,270	77	--	--	--	--	31,325	10	40,809	13	312,404
	2009	272,579	72	--	--	--	--	37,991	10	70,030	18	380,600
	2010	467,612	89	--	--	--	--	19,989	4	37,730	7	525,331
	2011	468,001	80	--	--	--	--	37,040	6	80,848	14	585,889
	2012	502,778	77	--	--	--	--	41,362	6	106,499	16	650,639
	2013	496,666	72	--	--	--	--	74,277	11	119,869	17	690,812
	2014	485,899	74	--	--	--	--	16,671	3	149,668	23	652,238
	2015	297,716	76	--	--	--	--	10,055	3	85,535	22	393,306
	2016	231,063	87	--	--	--	--	6,791	3	28,078	11	265,932
	2017	179,730	76					16,078	7	39,598	17	235,407
Lakewide Totals	2008	5,010,725	60	3,044,071	37	47,934	<1	186,339	2	40,809	<1	8,329,878
	2009	5,888,054	64	2,862,756	31	87,319	1	228,733	3	70,030	1	9,136,892
	2010	6,605,945	68	2,824,143	29	83,725	1	137,629	1	37,730	<1	9,689,172
	2011	6,370,473	66	2,832,636	29	145,960	2	190,273	2	80,848	1	9,620,190
	2012	6,901,448	64	3,482,090	32	93,291	1	203,113	2	106,499	1	10,786,441
	2013	5,932,773	61	3,307,063	34.2	76,994	1	229,470	2	119,869	1	9,666,169
	2014	5,454,662	62	2,914,524	33.2	87,511	1	185,361	2	149,668	2	8,791,726
	2015	4,460,298	64	2,190,473	31.7	94,225	1	87,613	1	85,535	1	6,918,144
	2016	4,481,964	62	2,201,486	30.5	397,044	5	114,763	2	28,078	0	7,223,335
	2017	4,982,989	64	2,387,352	30.7	255,605	3	123,413	2	39,598	1	7,788,958

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to 2016 (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, 2008-2017.

		Unit 1					
		Michigan	Ohio		Ontario Gill Nets		Ontario
Year		Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trap Nets
Harvest (pounds)	2008	47,934	0	409,705	484,409	49,378	46,263
	2009	87,319	0	463,564	728,012	125,024	70
	2010	83,725	195,674	693,838	815,170	64,188	0
	2011	145,960	156,138	640,309	792,336	78,363	103
	2012	93,291	0	883,245	718,585	34,172	115
	2013	76,994	0	789,088	608,241	40,617	26
	2014	87,511	0	391,361	596,956	23,633	78
	2015	94,225	0	485,744	533,167	8,712	59
	2016	397,044	103,345	782,723	938,558	8,445	49
	2017	255,605	447,263	792,312	1,271,282	5,466	839
Harvest (Metric) (tonnes)	2008	22	0	186	220	22	21.0
	2009	40	0	210	330	57	0.03
	2010	38	89	315	370	29	0.00
	2011	66	71	290	359	36	0.05
	2012	42	0	401	326	15	0.05
	2013	35	0	358	276	18	0.01
	2014	40	0	177	271	11	0.04
	2015	43	0	220	242	4	0.03
	2016	180	47	355	426	4	0.02
	2017	116	203	359	577	2	0.38
Effort (a)	2008	95,925	0	519,050	1,653	899	
	2009	130,556	0	578,303	3,058	1,680	
	2010	132,852	2,607	798,240	3,152	845	
	2011	139,344	3,219	729,369	2,571	682	
	2012	128,013	0	896,083	2,244	438	
	2013	130,809	0	946,138	3,412	547	
	2014	76,996	0	630,989	3,398	362	
	2015	137,246	0	659,460	4,074	508	
	2016	251,426	2,446	824,418	6,091	431	
	2017	204,877	3,830	775,334	5,656	600	
Harvest Rates (b)	2008	1.5	--	2.7	132.9	24.9	
	2009	2.7	--	3.1	108.0	33.8	
	2010	2.3	34.0	3.4	117.3	34.4	
	2011	3.4	22.0	3.5	139.8	52.1	
	2012	2.4	--	3.6	145.3	35.4	
	2013	1.7	--	2.8	80.8	33.7	
	2014	2.2	--	3.0	79.7	29.6	
	2015	2.7	--	3.1	59.4	7.8	
	2016	4.8	19.2	4.1	69.9	8.9	
	2017	4.3	53.0	3.6	101.9	4.1	

(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, 2008-2017.

	Year	Unit 2				
		Ohio		Ontario	Gill Nets	Ontario
		Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest (pounds)	2008	1,376,588	628,412	1,669,682	253,984	66,203
	2009	1,338,616	463,362	1,994,208	482,402	17,315
	2010	935,616	522,207	1,410,051	470,926	7,899
	2011	1,070,817	328,686	1,312,168	339,404	13,686
	2012	1,285,336	566,510	1,550,104	314,440	13,071
	2013	1,230,249	491,419	1,657,811	145,475	398
	2014	1,280,184	263,042	1,550,722	128,453	0
	2015	1,005,061	126,932	1,471,107	18,268	58
	2016	688,033	104,836	1,248,729	34,631	19
	2017	590,447	53,107	1,435,508	62,872	57
Harvest (Metric) (tonnes)	2008	624	285	757	115	30.0
	2009	607	210	904	219	7.9
	2010	424	237	639	214	3.6
	2011	486	149	595	154	6.2
	2012	583	257	703	143	5.9
	2013	558	223	752	66	0.2
	2014	581	119	703	58	0.0
	2015	456	58	667	8	0.0
	2016	312	48	566	16	0.0
	2017	268	24	651	29	0.0
Effort (a)	2008	3,983	450,060	3,124	2,629	
	2009	6,317	417,660	5,545	4,241	
	2010	6,701	502,507	3,783	3,905	
	2011	5,707	395,407	4,214	3,789	
	2012	6,919	456,404	4,616	2,942	
	2013	5,851	428,187	6,821	1,951	
	2014	5,713	280,018	6,653	1,816	
	2015	6,309	217,637	9,459	1,207	
	2016	4,510	204,745	6,424	1,934	
	2017	2,567	119,163	6,094	1,946	
Harvest Rates (b)	2008	156.7	3.5	242.4	43.8	
	2009	96.1	3.0	163.1	51.6	
	2010	63.3	3.2	169.0	54.7	
	2011	85.1	2.6	141.2	40.6	
	2012	84.2	3.1	152.3	48.5	
	2013	95.4	2.6	110.2	33.8	
	2014	101.6	2.7	105.7	32.1	
	2015	72.2	1.5	70.5	6.9	
	2016	69.2	1.2	88.2	8.1	
	2017	104.3	1.0	106.8	14.7	

(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 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, 2008-2017.

	Year	Unit 3						
		Ohio		Pennsylvania		Ontario Gill Nets		Ontario
		Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest (pounds)	2008	139,023	490,343	22,927	132,087	2,160,041	32,673	7,454
	2009	112,030	485,184	35,296	155,446	2,180,834	77,858	8,035
	2010	153,097	323,711	36,026	104,224	3,065,336	302,410	2,353
	2011	327,871	308,815	1,542	151,691	2,911,506	451,628	3,278
	2012	469,401	277,598	15,405	146,346	3,653,296	114,640	247
	2013	300,346	495,961	790	154,403	2,818,241	164,712	586
	2014	265,963	713,974	506	168,184	2,597,079	71,136	706
	2015	266,030	306,706	6,854	70,704	2,084,595	43,072	3,544
	2016	349,844	172,705	51,148	56,824	2,003,842	16,459	169
	2017	449,979	54,244	45,741	61,594	1,964,728	61,127	1,380
Harvest (Metric) (tonnes)	2008	63	222	10.4	60	980	15	3.4
	2009	51	220	16.0	70	989	35	3.6
	2010	69	147	16.3	47	1,390	137	1.1
	2011	149	140	0.7	69	1,320	205	1.5
	2012	213	126	7.0	66	1,657	52	0.1
	2013	136	225	0.4	70	1,278	75	0.3
	2014	121	324	0.2	76	1,178	32	0.3
	2015	121	139	3.1	32	945	20	1.6
	2016	159	78	23.2	26	909	7	0.1
	2017	204	25	20.7	28	891	28	0.6
Effort (a)	2008	1,288	234,179	78	110,403	3,336	417	
	2009	482	289,602	121	139,438	4,050	728	
	2010	972	182,485	128	85,294	5,747	1,125	
	2011	1,108	182,630	37	94,025	6,093	1,481	
	2012	2,074	154,474	87	98,234	7,847	991	
	2013	1,014	232,234	25	83,739	6,037	968	
	2014	581	336,607	186	90,024	5,678	422	
	2015	1,067	212,226	310	70,490	5,000	560	
	2016	2,000	181,622	604	57,545	5,964	798	
	2017	1,679	58,119	262	98,302	4,775	1,206	
Harvest Rates (b)	2008	49.0	4.6	133.3	4.5	293.6	35.5	
	2009	105.4	3.5	132.3	4.8	244.2	48.5	
	2010	71.4	4.0	127.6	4.0	241.9	121.9	
	2011	134.2	4.1	18.9	5.3	216.7	138.3	
	2012	102.6	4.5	80.3	4.7	211.1	52.5	
	2013	134.3	5.0	14.3	5.2	211.7	77.2	
	2014	207.6	4.0	1.2	4.7	207.4	76.4	
	2015	113.1	3.2	10.0	2.8	189.1	34.9	
	2016	79.3	1.9	38.4	2.0	152.4	9.4	
	2017	121.5	1.6	79.2	2.1	186.6	23.0	

(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, 2008-2017.

		Unit 4						
	Year	New York		Pennsylvania		Ontario Gill Nets		Ontario
		Trap Nets	Sport	Trap Nets	Sport	Small Mesh	Large Mesh*	Trawls
Harvest (pounds)	2008	11,136	29,673	0	31,325	234,366	2,689	3,215
	2009	13,476	56,554	0	37,991	266,425	4,738	1,416
	2010	11,772	25,958	0	26,263	465,775	1,517	320
	2011	15,045	65,803	0	37,040	464,331	2,761	909
	2012	17,709	88,790	0	41,362	499,359	833	2,586
	2013	15,814	104,055	0	74,277	492,233	2,778	1,665
	2014	10,355	139,313	0	16,671	482,925	1,160	1,814
	2015	21,503	64,032	0	10,055	295,833	1,083	800
	2016	11,465	16,613	0	6,791	230,333	65	665
	2017	12,366	27,232	0	16,078	177,475	32	2,223
Harvest (Metric) (tonnes)	2008	5.1	13.5	0	14.2	106.3	1.22	1.5
	2009	6.1	25.6	0	17.2	120.8	2.15	0.6
	2010	5.3	11.8	0	11.9	211.2	0.69	0.1
	2011	6.8	29.8	0	16.8	210.6	1.25	0.4
	2012	8.0	40.3	0	18.8	226.5	0.38	1.2
	2013	7.2	47.2	0	33.7	223.2	1.26	0.8
	2014	4.7	63.2	0	7.6	219.0	0.53	0.8
	2015	9.8	29.0	0	4.6	134.2	0.49	0.4
	2016	5.2	7.5	0	3.1	104.5	0.03	0.3
	2017	5.6	12.4	0	7.3	80.5	0.01	1.0
Effort (a)	2008	137	34,511	0	27,041	569	69.2	
	2009	215	58,829	0	58,475	718	50.9	
	2010	287	35,526	0	26,544	1,227	21.7	
	2011	383	50,479	0	48,537	1,564	28.6	
	2012	428	58,621	0	49,577	1,770	12.9	
	2013	364	65,750	0	48,093	1,932	14.5	
	2014	213	76,817	0	13,959	2,016	8.3	
	2015	441	44,029	0	18,638	1,774	44.7	
	2016	248	27,436	0	11,934	1,303	11.2	
	2017	208	26,154	0	12,843	565	6.0	
Harvest Rates (b)	2008	36.9	1.68	--	6.4	186.8	17.6	
	2009	28.4	1.77	--	3.2	168.3	42.2	
	2010	18.6	1.31	--	2.2	172.1	31.7	
	2011	17.8	2.01	--	2.9	134.6	43.8	
	2012	18.8	2.17	--	2.5	127.9	29.3	
	2013	19.7	2.59	--	2.9	115.5	87.1	
	2014	22.0	2.78	--	2.3	108.6	63.4	
	2015	22.1	2.01	--	1.2	75.6	11.0	
	2016	21.0	0.95	--	1.3	80.1	2.6	
	2017	27.0	1.35	--	1.2	142.3	2.4	

(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 2017 Lake Erie Yellow Perch harvest by age and numbers of fish by gear and management unit (Unit).

Gear	Age	Unit 1		Unit 2		Unit 3		Unit 4		Lakewide	
		Number	%	Number	%	Number	%	Number	%	Number	%
Gill Nets	1	0	0.0	0	0.0		0.0		0.0	0	0.0
	2	489,180	11.9	454,978	10.2	56,211	0.9	170,015	32.5	1,170,384	7.8
	3	2,868,936	69.5	2,553,885	57.5	2,452,950	41.2	289,661	55.4	8,165,431	54.2
	4	618,697	15.0	402,758	9.1	476,195	8.0	20,773	4.0	1,518,424	10.1
	5	81,640	2.0	812,830	18.3	2,252,521	37.8	27,702	5.3	3,174,693	21.1
	6+	66,991	1.6	220,126	5.0	722,747	12.1	14,543	2.8	1,024,407	6.8
	Total	4,125,444	<i>45.5</i>	4,444,578	<i>69.8</i>	5,960,624	<i>81.1</i>	522,693	<i>83.9</i>	15,053,339	<i>64.3</i>
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	237,387	18.6	121,346	6.7	101,404	8.5	0	0.0	460,137	10.7
	3	880,779	69.1	1,272,168	70.4	535,787	44.9	2,025	6.7	2,690,759	62.5
	4	113,206	8.9	270,724	15.0	76,260	6.4	405	1.3	460,595	10.7
	5	24,507	1.9	92,058	5.1	262,610	22.0	15,996	52.7	395,171	9.2
	6+	18,913	1.5	51,747	2.9	216,724	18.2	11,946	39.3	299,330	7.0
	Total	1,274,792	<i>14.1</i>	1,808,043	<i>28.4</i>	1,192,785	<i>16.2</i>	30,372	<i>4.9</i>	4,305,992	<i>18.4</i>
Sport	1	34,034	0.9	400	0.4	0	0.0	0	0.0	34,434	0.8
	2	951,397	25.9	25,381	22.4	9,253	4.7	4,762	6.8	990,793	24.5
	3	2,270,763	61.9	50,065	44.1	43,221	21.9	12,966	18.6	2,377,015	58.7
	4	347,573	9.5	10,529	9.3	13,564	6.9	4,917	7.0	376,582	9.3
	5	44,756	1.2	15,500	13.7	61,977	31.5	21,599	30.9	143,832	3.6
	6+	22,459	0.6	11,597	10.2	69,007	35.0	25,576	36.6	128,639	3.2
	Total	3,670,982	<i>40.5</i>	113,472	<i>1.8</i>	197,021	<i>2.7</i>	69,820	<i>11.2</i>	4,051,296	<i>17.3</i>
All Gear	1	34,034	0.4	400	0.0	0	0.0	0	0.0	34,434	0.1
	2	1,677,964	18.5	601,705	9.5	166,868	2.3	174,777	28.1	2,621,314	11.2
	3	6,020,478	66.4	3,876,118	60.9	3,031,958	41.2	304,652	48.9	13,233,205	56.5
	4	1,079,476	11.9	684,011	10.7	566,019	7.7	26,095	4.2	2,355,601	10.1
	5	150,903	1.7	920,388	14.5	2,577,108	35.1	65,296	10.5	3,713,696	15.9
	6+	108,363	1.2	283,470	4.5	1,008,478	13.7	52,065	8.4	1,452,376	6.2
	Total	9,071,218	<i>38.7</i>	6,366,093	<i>27.2</i>	7,350,430	<i>31.4</i>	622,885	<i>2.7</i>	23,410,626	<i>100.0</i>

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.a. Yellow Perch stock size (millions of fish) in each Lake Erie management unit. Abundance in the years 2000 to 2017 are estimated by ADMB catch-age analysis. The 2018 population estimates use age-2 Yellow Perch estimates derived from multi-model averaging of generalized linear models of ADMB age-2 abundance against YOY and yearling survey indices (see Appendix A) in an R program.

ADMB analysis uses the YPTG model

	Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Unit 1	2	33.295	32.760	7.585	39.889	3.146	52.138	1.528	8.993	9.892	23.156	14.521	8.999	12.082	2.185	5.012	16.314	54.780	33.195	4.923
	3	6.446	21.084	21.046	4.835	24.963	1.994	32.182	0.977	5.370	6.064	14.554	9.224	5.733	7.487	1.293	2.674	8.886	31.321	19.558
	4	14.193	3.499	12.356	10.758	2.627	11.472	0.974	12.649	0.521	2.770	3.080	7.547	4.908	2.900	3.267	0.511	1.085	3.620	15.200
	5	3.058	7.114	1.905	5.071	4.810	0.976	4.164	0.396	5.077	0.281	1.337	1.447	3.523	2.266	1.131	1.160	0.193	0.380	1.396
	6+	1.262	1.928	4.699	2.326	3.025	2.293	0.961	1.561	0.750	2.866	1.473	1.268	1.190	2.077	1.637	0.913	0.768	0.297	0.264
	2 and Older	58.254	66.386	47.591	62.878	38.570	68.873	39.810	24.576	21.611	35.137	34.964	28.485	27.436	16.915	12.340	21.572	65.712	68.813	41.341
3 and Older		24.959	33.625	40.006	22.990	35.424	16.735	38.281	15.583	11.719	11.982	20.444	19.485	15.354	14.730	7.328	5.258	10.931	35.618	36.418
Unit 2	2	53.894	47.508	11.131	86.763	4.980	193.308	5.189	23.224	26.536	53.250	44.872	7.689	19.651	11.777	32.182	9.665	39.456	26.535	10.351
	3	9.388	32.452	28.124	7.005	52.368	3.242	124.356	3.416	15.112	17.499	34.484	29.120	5.053	12.300	7.340	18.691	5.245	22.766	15.903
	4	17.980	5.162	18.337	15.028	3.924	27.742	1.877	70.564	2.034	9.170	10.339	20.450	17.830	2.995	6.755	3.624	9.352	2.779	12.978
	5	1.557	8.687	2.538	8.395	6.480	1.889	12.586	1.110	34.618	1.089	4.565	5.515	11.250	9.136	1.340	2.368	1.392	3.996	1.416
	6+	0.415	0.920	4.723	3.310	5.099	5.328	3.301	7.487	4.168	20.872	10.651	7.817	7.159	9.459	8.265	3.140	1.941	1.296	2.632
	2 and Older	83.234	94.730	64.853	120.501	72.851	231.508	147.308	105.801	82.468	101.879	104.910	70.590	60.941	45.666	55.881	37.488	57.386	57.373	43.279
3 and Older		29.340	47.222	53.722	33.738	67.871	38.200	142.119	82.577	55.932	48.630	60.038	62.901	41.291	33.890	23.700	27.823	17.930	30.837	32.929
Unit 3	2	48.418	28.227	7.100	39.804	4.772	163.082	6.506	33.665	50.910	47.340	55.563	6.742	27.850	13.681	22.496	7.555	28.648	11.180	25.922
	3	8.366	31.385	18.129	4.570	25.855	3.133	108.370	4.315	21.258	33.880	31.641	36.848	4.508	17.900	8.814	14.510	4.974	18.123	7.136
	4	18.928	5.312	19.976	11.356	2.842	16.016	1.945	61.130	2.661	13.477	22.199	20.272	24.240	2.723	10.776	5.251	8.349	2.878	10.228
	5	2.694	11.542	3.304	11.999	6.681	1.677	9.288	1.077	35.240	1.616	8.475	13.407	12.905	13.505	1.611	5.999	2.794	4.224	1.528
	6+	2.428	3.088	9.026	7.435	11.438	10.640	7.195	7.522	4.897	24.372	16.295	14.621	17.632	17.053	17.409	10.284	8.234	5.311	4.730
	2 and Older	80.835	79.554	57.534	75.163	51.587	194.548	133.304	107.709	114.965	120.684	134.173	91.889	87.135	64.863	61.106	43.599	53.000	41.715	49.543
3 and Older		32.417	51.327	50.435	35.359	46.815	31.466	126.798	74.044	64.055	73.344	78.610	85.147	59.285	51.182	38.611	36.044	24.352	30.535	23.622
Unit 4	2	11.153	2.362	1.581	6.019	1.094	8.490	0.710	6.454	6.792	5.510	8.730	0.831	9.525	1.956	4.276	1.011	5.411	5.475	10.136
	3	0.895	7.438	1.583	1.058	4.019	0.724	5.605	0.472	4.261	4.506	3.689	5.784	0.550	5.954	1.242	2.675	0.618	3.468	3.565
	4	1.473	0.588	4.967	1.046	0.689	2.574	0.447	3.240	0.304	2.740	2.962	2.303	3.490	0.327	3.189	0.693	1.581	0.376	2.194
	5	0.077	0.950	0.391	3.202	0.657	0.426	1.533	0.247	2.040	0.192	1.743	1.750	1.347	1.843	0.164	1.636	0.407	0.922	0.239
	6+	0.172	0.160	0.734	0.703	2.394	1.830	1.304	1.479	1.086	1.928	1.315	1.764	1.955	1.592	1.595	0.849	1.375	0.990	1.158
	2 and Older	13.770	11.498	9.257	12.028	8.853	14.044	9.599	11.892	14.483	14.875	18.439	12.431	16.867	11.673	10.466	6.864	9.392	11.232	17.292
3 and Older		2.617	9.135	7.676	6.009	7.759	5.554	8.889	5.438	7.691	9.366	9.709	11.600	7.342	9.717	6.189	5.853	3.981	5.757	7.155

Table 1.7.b. Yellow Perch stock size (millions of fish) in each Lake Erie management unit. Abundance in the years 2000 to 2017 are estimated by ADMB catch-age analysis. The 2018 population estimates use age-2 Yellow Perch estimates derived from multi-model averaging of generalized linear models of ADMB age-2 abundance against YOY and yearling survey indices (see Appendix A) in an R program.

ADMB analysis uses the PR model

	Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Unit 1	2	29.208	27.874	7.049	34.331	3.628	41.056	1.931	10.273	13.382	29.219	23.399	9.399	11.521	2.671	6.455	18.922	51.897	23.555	11.550
	3	6.678	18.606	18.050	4.488	21.670	2.291	26.028	1.226	6.505	8.645	18.647	14.694	5.898	7.111	1.607	3.960	11.429	30.206	13.962
	4	13.670	3.594	10.918	9.726	2.374	10.970	1.181	13.475	0.660	3.774	4.698	9.563	7.543	2.932	3.159	0.747	1.710	4.086	11.508
	5	2.643	5.847	1.884	4.722	4.173	0.863	4.151	0.449	5.982	0.340	1.677	1.867	3.817	3.046	0.943	1.049	0.213	0.316	0.827
	6+	0.962	1.331	3.496	2.111	2.598	2.018	0.943	1.575	0.842	3.277	1.515	1.114	1.029	1.752	1.331	0.661	0.398	0.085	0.054
	2 and Older	53.160	57.251	41.397	55.378	34.443	57.198	34.233	26.999	27.372	45.254	49.936	36.636	29.809	17.513	13.495	25.338	65.646	58.248	37.901
	3 and Older	23.952	29.377	34.348	21.047	30.815	16.142	32.302	16.726	13.990	16.036	26.537	27.236	18.288	14.842	7.040	6.417	13.749	34.693	26.351
Unit 2	2	51.606	48.175	11.175	99.420	6.496	176.857	7.537	24.504	26.162	59.532	45.885	8.444	19.910	12.970	32.850	11.045	48.572	30.353	11.112
	3	8.803	33.474	31.488	7.279	64.940	4.254	115.262	4.933	16.203	17.319	39.189	30.260	5.572	13.097	8.492	21.518	7.195	31.856	19.983
	4	16.344	4.818	19.311	17.594	4.116	37.330	2.362	64.996	3.021	10.032	10.204	23.573	18.200	3.279	7.409	4.755	11.398	4.035	18.342
	5	1.087	6.914	2.299	8.474	7.864	1.905	16.121	1.053	34.920	1.684	4.935	5.279	12.173	8.885	1.455	3.165	1.763	4.879	1.861
	6+	0.399	0.543	3.163	2.087	4.078	4.813	2.549	7.413	4.198	20.481	9.950	7.053	5.843	7.843	6.490	2.940	1.874	1.347	2.569
	2 and Older	78.240	93.924	67.435	134.853	87.494	225.159	143.831	102.900	84.504	109.048	110.163	74.608	61.699	46.073	56.696	43.423	70.802	72.470	53.868
	3 and Older	26.633	45.749	56.260	35.434	80.998	48.302	136.294	78.396	58.342	49.516	64.278	66.165	41.788	33.104	23.846	32.378	22.230	42.117	42.756
Unit 3	2	44.853	31.834	8.866	50.908	6.143	126.247	8.603	34.803	43.898	60.455	52.173	12.040	29.420	23.199	45.718	9.872	52.211	22.441	33.587
	3	9.082	29.910	21.226	5.906	33.930	4.094	84.199	5.739	23.234	29.327	40.363	34.836	8.037	19.626	15.475	30.450	6.579	34.771	14.968
	4	17.281	5.767	19.053	13.483	3.701	21.530	2.591	52.052	3.656	15.012	18.831	25.620	22.041	5.026	12.330	9.545	18.707	3.966	21.387
	5	2.181	9.932	3.347	11.021	7.398	2.126	12.190	1.347	29.976	2.205	8.885	10.698	14.422	11.979	2.773	6.435	4.898	9.045	2.035
	6+	1.225	1.763	6.187	4.899	7.649	7.714	4.903	7.554	4.580	19.524	11.641	10.414	10.564	11.825	11.506	6.211	5.435	4.024	5.666
	2 and Older	74.623	79.206	58.679	86.218	58.820	161.710	112.485	101.494	105.345	126.523	131.892	93.609	84.484	71.654	87.801	62.513	87.830	74.247	77.644
	3 and Older	29.769	47.372	49.813	35.310	52.677	35.463	103.882	66.691	61.446	66.068	79.719	81.568	55.063	48.455	42.083	52.641	35.619	51.806	44.056
Unit 4	2	11.797	3.796	1.806	5.417	1.172	8.577	0.910	8.114	4.959	7.673	7.018	0.883	7.802	1.866	3.364	0.784	4.669	11.644	6.443
	3	0.975	7.870	2.538	1.203	3.604	0.778	5.651	0.597	5.367	3.277	5.050	4.592	0.574	5.056	1.199	2.147	0.504	3.026	7.674
	4	1.599	0.639	5.210	1.657	0.779	2.316	0.482	3.442	0.376	3.369	2.020	3.027	2.681	0.329	2.786	0.641	1.183	0.289	1.876
	5	0.175	1.026	0.417	3.296	1.035	0.477	1.321	0.267	2.040	0.221	1.902	1.086	1.540	1.315	0.150	1.199	0.292	0.585	0.166
	6+	0.697	0.570	1.043	0.925	2.646	2.274	1.657	1.744	1.258	1.987	1.323	1.830	1.623	1.684	1.538	0.927	1.077	0.789	0.824
	2 and Older	15.243	13.902	11.014	12.497	9.237	14.424	10.021	14.164	13.999	16.527	17.313	11.417	14.221	10.250	9.037	5.698	7.724	16.333	16.983
	3 and Older	3.446	10.106	9.208	7.081	8.065	5.847	9.111	6.050	9.040	8.854	10.295	10.535	6.419	8.384	5.673	4.914	3.056	4.689	10.540

Table 1.8.a. Projection of the 2018 Lake Erie Yellow Perch population. Stock size estimates are derived from ADMB 2017 abundance and survival, and incoming age-2 estimates for 2018 are derived from multi-model averaging of generalized linear models of ADMB age-2 abundance against YOY and yearling survey indices (see Appendix A) in an R program. Standard errors are produced from ADMB catch-age and MMI analyses.

ADMB analysis uses the YPTG model																		
2017 Parameters					Rate Functions					2018 Parameters				Stock Biomass				
Age	Stock Size (millions of fish)				Mortality Rates				Survival Rate	Stock Size (millions of fish)				3-yr Mean Weight in Pop'n. (kg)	millions kg		millions lbs.	
	Mean	Std. Error	Min.	Max.	(F)	(Z)	(A)	(u)	(S)	Age	Min.	Mean	Max.		2017	2018	2018	
Unit 1	2	33.195	18.639	14.556	51.834	0.129	0.529	0.411	0.100	0.589	2	3.523	4.923	0.879	0.091	3.552	0.448	0.988
	3	31.321	12.905	18.416	44.226	0.323	0.723	0.515	0.230	0.485	3	8.576	19.558	30.540	0.121	4.040	2.360	5.204
	4	3.620	1.396	2.224	5.016	0.553	0.953	0.614	0.357	0.386	4	8.937	15.200	21.463	0.146	0.496	2.219	4.893
	5	0.380	0.156	0.224	0.537	0.589	0.989	0.628	0.374	0.372	5	0.858	1.396	1.934	0.167	0.065	0.234	0.515
	6+	0.297	0.135	0.161	0.432	0.486	0.886	0.588	0.322	0.412	6+	0.150	0.264	0.378	0.221	0.080	0.058	0.128
	Total (3+)	68.813		35.582	102.045	0.236	0.636	0.471	0.175	0.529	Total (3+)	22.044	41.341	55.194	0.129	8.234	5.319	11.728
		35.618		21.026	50.211	0.348	0.748	0.527	0.245	0.473		18.521	36.418	54.315	0.134	4.682	4.871	10.741
Unit 2	2	26.535	13.755	12.780	40.290	0.112	0.512	0.401	0.088	0.599	2	7.975	10.351	13.434	0.108	3.264	1.121	2.473
	3	22.766	8.788	13.978	31.555	0.162	0.562	0.430	0.124	0.570	3	7.659	15.903	24.146	0.140	3.597	2.226	4.909
	4	2.779	0.933	1.846	3.711	0.274	0.674	0.490	0.199	0.510	4	7.968	12.978	17.988	0.164	0.509	2.124	4.684
	5	3.996	1.353	2.644	5.349	0.295	0.695	0.501	0.213	0.499	5	0.941	1.416	1.892	0.197	0.907	0.279	0.615
	6+	1.296	0.491	0.805	1.788	0.310	0.710	0.508	0.222	0.492	6+	1.715	2.632	3.548	0.276	0.380	0.725	1.600
	Total (3+)	57.373		32.053	82.692	0.155	0.555	0.426	0.119	0.574	Total (3+)	26.258	43.279	61.008	0.150	8.656	6.476	14.280
		30.837		19.272	42.402	0.194	0.594	0.448	0.146	0.552		18.283	32.929	47.574	0.163	5.392	5.355	11.808
Unit 3	2	11.180	6.977	4.203	18.157	0.049	0.449	0.362	0.039	0.638	2	20.660	25.922	32.523	0.082	1.152	2.126	4.687
	3	18.123	8.395	9.728	26.517	0.172	0.572	0.436	0.131	0.564	3	2.683	7.136	11.589	0.121	2.519	0.861	1.899
	4	2.878	1.164	1.714	4.041	0.233	0.633	0.469	0.173	0.531	4	5.491	10.228	14.966	0.158	0.481	1.620	3.571
	5	4.224	1.679	2.545	5.903	0.305	0.705	0.506	0.219	0.494	5	0.910	1.528	2.146	0.188	0.904	0.287	0.632
	6+	5.311	2.139	3.171	7.450	0.298	0.698	0.502	0.215	0.498	6+	2.836	4.730	6.623	0.262	1.386	1.241	2.736
	Total (3+)	41.715		21.361	62.068	0.169	0.569	0.434	0.129	0.566	Total (3+)	32.579	49.543	67.847	0.124	6.441	6.134	13.525
		30.535		17.159	43.911	0.216	0.616	0.460	0.162	0.540		11.919	23.622	35.325	0.170	5.290	4.008	8.838
Unit 4	2	5.475	3.385	2.090	8.860	0.029	0.429	0.349	0.024	0.651	2	7.216	10.136	14.238	0.111	0.690	1.125	2.481
	3	3.468	1.632	1.837	5.100	0.058	0.458	0.367	0.047	0.633	3	1.361	3.565	5.769	0.190	0.739	0.679	1.496
	4	0.376	0.158	0.218	0.533	0.054	0.454	0.365	0.043	0.635	4	1.162	2.194	3.226	0.231	0.091	0.507	1.118
	5	0.922	0.368	0.554	1.290	0.103	0.503	0.395	0.081	0.605	5	0.139	0.239	0.339	0.283	0.285	0.068	0.149
	6+	0.990	0.409	0.581	1.400	0.101	0.501	0.394	0.079	0.606	6+	0.687	1.158	1.628	0.346	0.342	0.401	0.884
	Total (3+)	11.232		5.280	17.183	0.051	0.451	0.363	0.041	0.637	Total (3+)	10.564	17.292	25.201	0.161	2.146	2.779	6.128
		5.757		3.190	8.323	0.072	0.472	0.376	0.057	0.624		3.348	7.155	10.962	0.231	1.456	1.654	3.647

Table 1.8.b. Projection of the 2018 Lake Erie Yellow Perch population. Stock size estimates are derived from ADMB 2017 abundance and survival, and incoming age-2 estimates for 2018 are derived from multi-model averaging of generalized linear models of ADMB age-2 abundance against YOY and yearling survey indices (see Appendix A) in an R program. Standard errors are produced from ADMB catch-age and MMI analyses.

ADMB analysis uses the PR model																		
2017 Parameters					Rate Functions					2018 Parameters				Stock Biomass				
Age	Stock Size (millions of fish)				Mortality Rates				Survival Rate	Stock Size (millions of fish)				3-yr Mean Weight in Pop'n. (kg)	millions kg		millions lbs.	
	Mean	Std. Error	Min.	Max.	(F)	(Z)	(A)	(u)	(S)	Age	Min.	Mean	Max.		2017	2018	2018	
Unit 1	2	23.555	4.184	19.372	27.739	0.123	0.523	0.407	0.096	0.593	2	6.558	11.550	20.341	0.091	2.520	1.051	2.318
	3	30.206	4.493	25.713	34.699	0.565	0.965	0.619	0.362	0.381	3	11.482	13.962	16.442	0.121	3.897	1.685	3.715
	4	4.086	0.691	3.395	4.777	1.198	1.598	0.798	0.598	0.202	4	9.796	11.508	13.220	0.146	0.560	1.680	3.705
	5	0.316	0.080	0.236	0.396	1.661	2.061	0.873	0.703	0.127	5	0.687	0.827	0.966	0.167	0.054	0.138	0.305
	6+	0.085	0.036	0.049	0.121	1.408	1.808	0.836	0.651	0.164	6+	0.038	0.054	0.070	0.221	0.023	0.012	0.026
	Total (3+)	58.248		48.765	67.731	0.393	0.793	0.548	0.271	0.452	Total (3+)	28.562	37.901	51.039	0.120	7.054	4.566	10.069
	34.693		29.393	39.992	0.630	1.030	0.643	0.393	0.357		22.004	26.351	30.698	0.133	4.534	3.515	7.751	
Unit 2	2	30.353	5.267	25.086	35.621	0.018	0.418	0.342	0.015	0.658	2	7.283	11.112	16.956	0.108	3.733	1.204	2.654
	3	31.856	3.976	27.880	35.832	0.152	0.552	0.424	0.117	0.576	3	16.516	19.983	23.451	0.140	5.033	2.798	6.169
	4	4.035	0.507	3.528	4.543	0.374	0.774	0.539	0.260	0.461	4	16.053	18.342	20.632	0.164	0.738	3.002	6.620
	5	4.879	0.662	4.217	5.540	0.488	0.888	0.589	0.323	0.411	5	1.627	1.861	2.095	0.197	1.107	0.367	0.808
	6+	1.347	0.266	1.082	1.613	0.475	0.875	0.583	0.317	0.417	6+	2.186	2.569	2.952	0.276	0.395	0.708	1.562
	Total (3+)	72.470		61.792	83.148	0.128	0.528	0.410	0.099	0.590	Total (3+)	43.664	53.868	66.086	0.150	11.007	8.078	17.813
	42.117		36.706	47.528	0.215	0.615	0.459	0.161	0.541		36.382	42.756	49.130	0.161	7.274	6.875	15.158	
Unit 3	2	22.441	3.911	18.530	26.352	0.005	0.405	0.333	0.004	0.667	2	26.919	33.587	41.907	0.082	2.311	2.754	6.073
	3	34.771	5.348	29.423	40.119	0.086	0.486	0.385	0.068	0.615	3	12.359	14.968	17.576	0.121	4.833	1.806	3.982
	4	3.966	0.617	3.349	4.583	0.267	0.667	0.487	0.195	0.513	4	18.097	21.387	24.677	0.158	0.662	3.386	7.467
	5	9.045	1.270	7.775	10.316	0.426	0.826	0.562	0.290	0.438	5	1.719	2.035	2.352	0.188	1.936	0.382	0.842
	6+	4.024	0.680	3.344	4.704	0.458	0.858	0.576	0.307	0.424	6+	4.822	5.666	6.511	0.262	1.050	1.486	3.278
	Total (3+)	74.247		62.420	86.074	0.122	0.522	0.407	0.095	0.593	Total (3+)	63.916	77.644	93.022	0.126	10.793	9.815	21.642
	51.806		43.891	59.722	0.177	0.577	0.439	0.135	0.561		36.997	44.056	51.116	0.160	8.481	7.061	15.569	
Unit 4	2	11.644	1.856	9.788	13.500	0.017	0.417	0.341	0.014	0.659	2	3.508	6.443	11.833	0.111	1.467	0.715	1.577
	3	3.026	0.428	2.598	3.454	0.078	0.478	0.380	0.062	0.620	3	6.451	7.674	8.897	0.190	0.645	1.461	3.221
	4	0.289	0.047	0.242	0.336	0.155	0.555	0.426	0.119	0.574	4	1.611	1.876	2.142	0.231	0.070	0.433	0.956
	5	0.585	0.091	0.493	0.676	0.158	0.558	0.428	0.121	0.572	5	0.139	0.166	0.193	0.283	0.181	0.047	0.103
	6+	0.789	0.128	0.660	0.917	0.077	0.477	0.379	0.061	0.621	6+	0.692	0.824	0.956	0.346	0.272	0.285	0.629
	Total (3+)	16.333		13.782	18.884	0.038	0.438	0.355	0.031	0.645	Total (3+)	12.401	16.983	24.020	0.173	2.634	2.942	6.486
	4.689		3.994	5.384	0.092	0.492	0.389	0.073	0.611		8.893	10.540	12.188	0.211	1.167	2.226	4.909	

Table 2.1.a. Estimated harvest of Lake Erie Yellow Perch for 2018 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

ADMB analysis uses the YPTG model

	Age	2018 Stock Size (millions of fish)			Exploitation Rate				2018 Catch (millions of fish)			3-yr Mean Weight in Harvest (kg)	2018 Harvest Range					
		Min.	Mean	Max.	F	s(age)	F(age)	(u)	Min.	Mean	Max.		Catch (millions of kg)			Catch (millions of lbs)		
													Min.	Mean	Max.	Min.	Mean	Max.
Unit 1	2	3.523	4.923	0.879	0.670	0.170	0.114	0.089	0.314	0.438	0.078	0.115	0.036	0.050	0.009	0.080	0.111	0.020
	3	8.576	19.558	30.540	0.670	0.539	0.361	0.253	2.168	4.945	7.721	0.138	0.299	0.682	1.066	0.660	1.505	2.350
	4	8.937	15.200	21.463	0.670	0.740	0.496	0.327	2.927	4.978	7.029	0.155	0.454	0.772	1.090	1.000	1.701	2.402
	5	0.858	1.396	1.934	0.670	0.763	0.511	0.335	0.288	0.468	0.649	0.174	0.050	0.081	0.113	0.110	0.180	0.249
	6+	0.150	0.264	0.378	0.670	0.760	0.509	0.334	0.050	0.088	0.126	0.186	0.009	0.016	0.023	0.021	0.036	0.052
	Total	22.044	41.341	55.194				0.264	5.747	10.918	15.604	0.147	0.848	1.602	2.300	1.871	3.533	5.072
	(3+)	18.521	36.418	54.315				0.288	5.433	10.479	15.526	0.148	0.812	1.552	2.291	1.791	3.422	5.053
Unit 2	2	7.975	10.351	13.434	0.670	0.204	0.137	0.106	0.844	1.095	1.421	0.139	0.117	0.152	0.198	0.259	0.336	0.436
	3	7.659	15.903	24.146	0.670	0.358	0.240	0.177	1.357	2.818	4.278	0.146	0.198	0.411	0.625	0.437	0.907	1.377
	4	7.968	12.978	17.988	0.670	0.718	0.481	0.320	2.548	4.150	5.752	0.149	0.380	0.618	0.857	0.837	1.363	1.890
	5	0.941	1.416	1.892	0.670	0.764	0.512	0.336	0.316	0.476	0.635	0.154	0.049	0.073	0.098	0.107	0.161	0.216
	6+	1.715	2.632	3.548	0.670	0.824	0.552	0.356	0.611	0.937	1.263	0.185	0.113	0.173	0.234	0.249	0.382	0.515
	Total	26.258	43.279	61.008				0.219	5.675	9.475	13.350	0.151	0.857	1.428	2.011	1.889	3.150	4.434
	(3+)	18.283	32.929	47.574				0.254	4.832	8.380	11.929	0.152	0.739	1.276	1.813	1.630	2.814	3.998
Unit 3	2	20.660	25.922	32.523	0.700	0.078	0.055	0.044	0.906	1.137	1.427	0.125	0.113	0.142	0.178	0.250	0.313	0.393
	3	2.683	7.136	11.589	0.700	0.338	0.237	0.175	0.470	1.249	2.028	0.136	0.064	0.170	0.276	0.141	0.375	0.608
	4	5.491	10.228	14.966	0.700	0.658	0.461	0.309	1.696	3.159	4.623	0.150	0.254	0.474	0.693	0.561	1.045	1.529
	5	0.910	1.528	2.146	0.700	0.701	0.491	0.325	0.296	0.496	0.697	0.165	0.049	0.082	0.115	0.108	0.181	0.254
	6+	2.836	4.730	6.623	0.700	0.755	0.529	0.344	0.976	1.628	2.280	0.185	0.181	0.301	0.422	0.398	0.664	0.930
	Total	32.579	49.543	67.847				0.155	4.344	7.670	11.055	0.152	0.661	1.169	1.684	1.457	2.578	3.714
	(3+)	11.919	23.622	35.325				0.277	3.437	6.533	9.628	0.157	0.548	1.027	1.506	1.207	2.264	3.321
Unit 4	2	7.216	10.136	14.238	0.300	0.167	0.050	0.040	0.291	0.409	0.574	0.154	0.045	0.063	0.088	0.099	0.139	0.195
	3	1.361	3.565	5.769	0.300	0.336	0.101	0.079	0.108	0.283	0.457	0.158	0.017	0.045	0.072	0.038	0.098	0.159
	4	1.162	2.194	3.226	0.300	0.442	0.133	0.103	0.119	0.226	0.332	0.168	0.020	0.038	0.056	0.044	0.084	0.123
	5	0.139	0.239	0.339	0.300	0.780	0.234	0.173	0.024	0.041	0.059	0.194	0.005	0.008	0.011	0.010	0.018	0.025
	6+	0.687	1.158	1.628	0.300	0.766	0.230	0.171	0.117	0.197	0.278	0.212	0.025	0.042	0.059	0.055	0.092	0.130
	Total	10.564	17.292	25.201				0.067	0.660	1.156	1.700	0.169	0.111	0.195	0.287	0.246	0.431	0.632
	(3+)	3.348	7.155	10.962				0.104	0.369	0.747	1.125	0.177	0.067	0.132	0.198	0.147	0.292	0.437

Table 2.1.b. Estimated harvest of Lake Erie Yellow Perch for 2018 using the proposed fishing policy and selectivity-at-age from combined fishing gears.

ADMB analysis uses the PR model

	Age	2018 Stock Size (millions of fish)			Exploitation Rate				2018 Catch (millions of fish)			3-yr Mean Weight in Harvest (kg)	2018 Harvest Range					
		Min.	Mean	Max.	F	s(age)	F(age)	(u)	Min.	Mean	Max.		Catch (millions of kg)			Catch (millions of lbs)		
													Min.	Mean	Max.	Min.	Mean	Max.
Unit 1	2	6.558	11.550	20.341	0.670	0.117	0.078	0.062	0.409	0.720	1.267	0.115	0.047	0.083	0.146	0.104	0.182	0.321
	3	11.482	13.962	16.442	0.670	0.430	0.288	0.208	2.392	2.908	3.425	0.138	0.330	0.401	0.473	0.728	0.885	1.042
	4	9.796	11.508	13.220	0.670	0.756	0.507	0.333	3.263	3.833	4.403	0.155	0.506	0.594	0.682	1.115	1.310	1.505
	5	0.687	0.827	0.966	0.670	1.000	0.670	0.411	0.283	0.340	0.398	0.174	0.049	0.059	0.069	0.108	0.130	0.153
	6+	0.038	0.054	0.070	0.670	0.797	0.534	0.347	0.013	0.019	0.024	0.186	0.002	0.003	0.005	0.005	0.008	0.010
	Total	28.562	37.901	51.039				0.206	6.359	7.819	9.517	0.146	0.934	1.141	1.374	2.060	2.516	3.031
	(3+)	22.004	26.351	30.698				0.269	5.950	7.100	8.249	0.149	0.887	1.058	1.229	1.957	2.333	2.709
Unit 2	2	7.283	11.112	16.956	0.670	0.045	0.030	0.025	0.178	0.272	0.415	0.139	0.025	0.038	0.058	0.055	0.083	0.127
	3	16.516	19.983	23.451	0.670	0.304	0.204	0.153	2.525	3.056	3.586	0.146	0.369	0.446	0.524	0.813	0.984	1.154
	4	16.053	18.342	20.632	0.670	0.729	0.488	0.324	5.196	5.936	6.677	0.149	0.774	0.885	0.995	1.707	1.950	2.194
	5	1.627	1.861	2.095	0.670	1.000	0.670	0.411	0.669	0.766	0.862	0.154	0.103	0.118	0.133	0.227	0.260	0.293
	6+	2.186	2.569	2.952	0.670	0.965	0.647	0.401	0.876	1.030	1.183	0.185	0.162	0.191	0.219	0.357	0.420	0.483
	Total	43.664	53.868	66.086				0.205	9.445	11.060	12.724	0.152	1.433	1.677	1.928	3.159	3.698	4.251
	(3+)	36.382	42.756	49.130				0.252	9.267	10.788	12.309	0.152	1.408	1.639	1.870	3.105	3.614	4.124
Unit 3	2	26.919	33.587	41.907	0.700	0.019	0.013	0.011	0.293	0.366	0.457	0.125	0.037	0.046	0.057	0.081	0.101	0.126
	3	12.359	14.968	17.576	0.700	0.189	0.132	0.103	1.268	1.535	1.803	0.136	0.172	0.209	0.245	0.380	0.460	0.541
	4	18.097	21.387	24.677	0.700	0.526	0.368	0.257	4.651	5.496	6.341	0.150	0.698	0.824	0.951	1.538	1.818	2.097
	5	1.719	2.035	2.352	0.700	0.825	0.578	0.369	0.633	0.750	0.867	0.165	0.105	0.124	0.143	0.230	0.273	0.315
	6+	4.822	5.666	6.511	0.700	1.000	0.700	0.425	2.047	2.406	2.764	0.185	0.379	0.445	0.511	0.835	0.981	1.128
	Total	63.916	77.644	93.022				0.136	8.892	10.553	12.232	0.156	1.390	1.648	1.908	3.065	3.633	4.207
	(3+)	36.997	44.056	51.116				0.231	8.599	10.187	11.775	0.157	1.353	1.602	1.851	2.984	3.532	4.081
Unit 4	2	3.508	6.443	11.833	0.300	0.086	0.026	0.021	0.074	0.135	0.249	0.154	0.011	0.021	0.038	0.025	0.046	0.084
	3	6.451	7.674	8.897	0.300	0.389	0.117	0.091	0.588	0.699	0.811	0.158	0.093	0.110	0.128	0.205	0.244	0.282
	4	1.611	1.876	2.142	0.300	0.812	0.244	0.180	0.289	0.337	0.385	0.168	0.049	0.057	0.065	0.107	0.125	0.143
	5	0.139	0.166	0.193	0.300	0.876	0.263	0.192	0.027	0.032	0.037	0.194	0.005	0.006	0.007	0.011	0.014	0.016
	6+	0.692	0.824	0.956	0.300	0.563	0.169	0.129	0.089	0.106	0.123	0.212	0.019	0.023	0.026	0.042	0.050	0.058
	Total	12.401	16.983	24.020				0.077	1.067	1.310	1.604	0.165	0.177	0.217	0.264	0.390	0.478	0.583
	(3+)	8.893	10.540	12.188				0.111	0.993	1.174	1.356	0.167	0.166	0.196	0.226	0.365	0.432	0.498

Table 2.2.a. Lake Erie Yellow Perch fishing rates and the Recommended Allowable Harvest (RAH; in millions of pounds) for 2018 by Management Unit (Unit).

ADMB analysis uses the YPTG model

Unit	Fishing Rate	Recommended Allowable Harvest (millions lbs.)		
		MIN	MEAN	MAX
1	0.670	1.871	3.533	5.072
2	0.670	1.889	3.150	4.434
3	0.700	1.457	2.578	3.714
4	0.300	0.246	0.431	0.632
Total		5.463	9.691	13.853

Table 2.2.b. Lake Erie Yellow Perch fishing rates and the Recommended Allowable Harvest (RAH; in millions of pounds) for 2018 by Management Unit (Unit).

ADMB analysis uses the PR model

Unit	Fishing Rate	Recommended Allowable Harvest (millions lbs.)		
		MIN	MEAN	MAX
1	0.670	2.060	2.516	3.031
2	0.670	3.159	3.698	4.251
3	0.700	3.065	3.633	4.207
4	0.300	0.390	0.478	0.583
Total		8.675	10.324	12.071

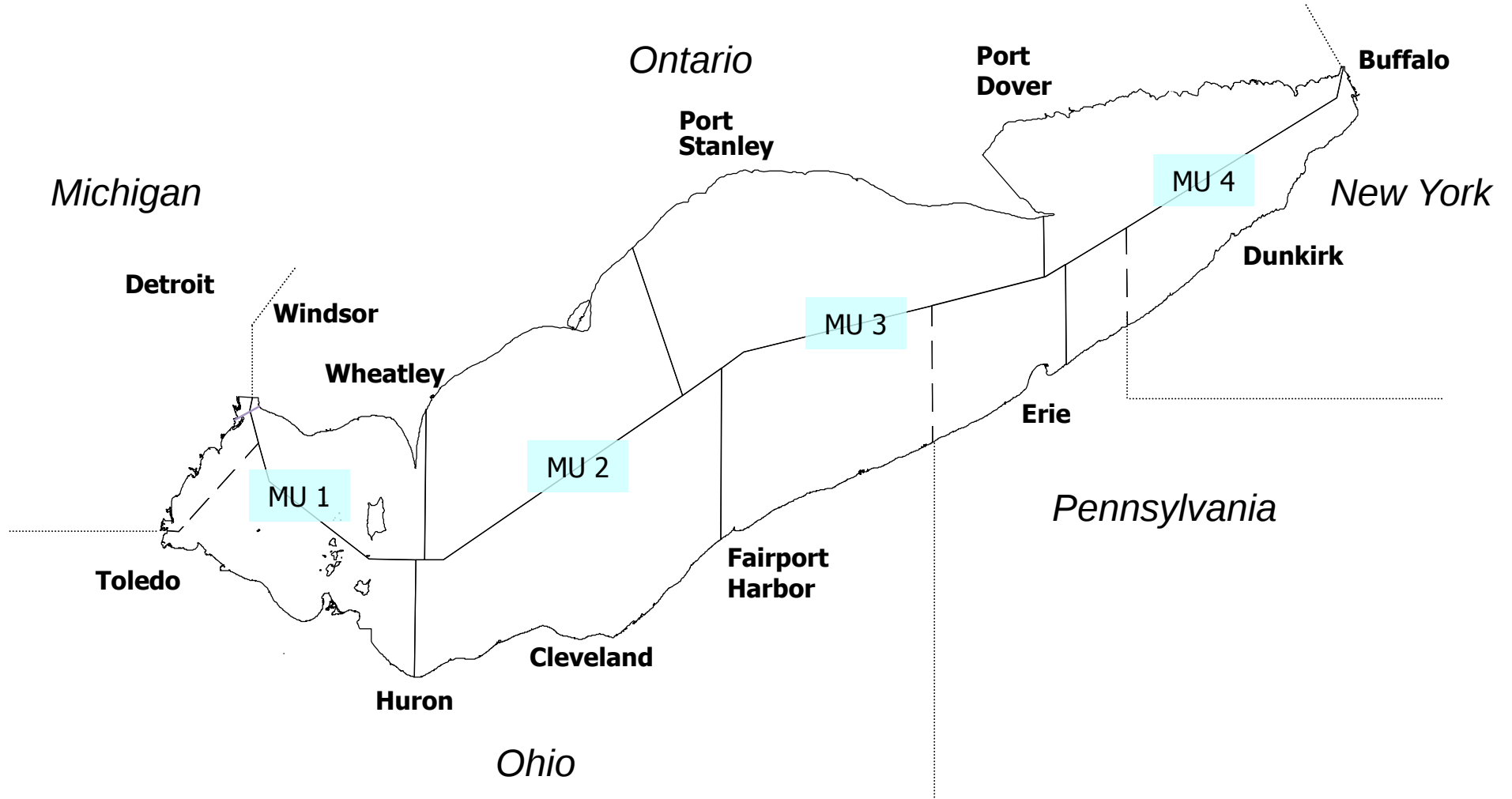


Figure 1.1. The Yellow Perch Management Units (MUs) of Lake Erie defined by the YPTG and LEC, for illustrative purposes.

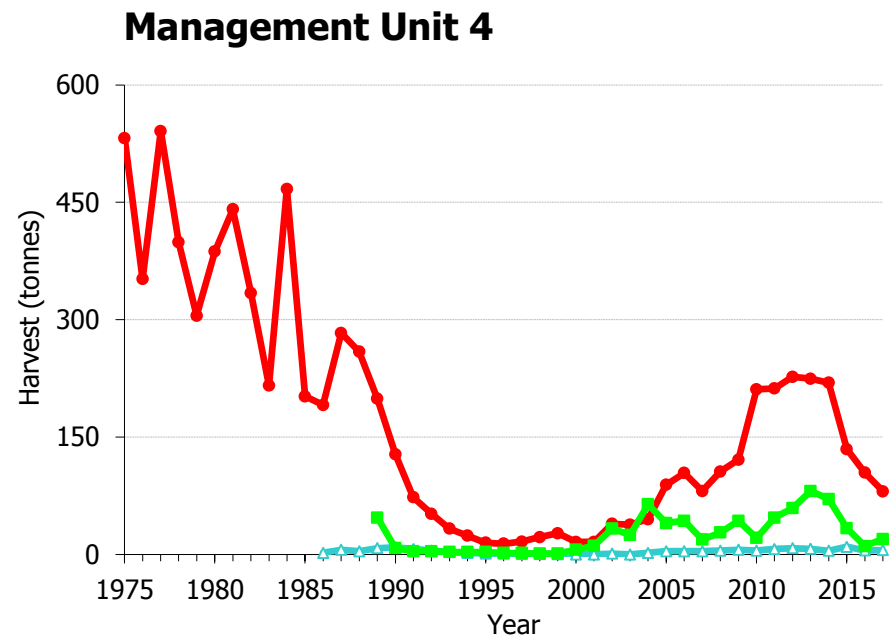
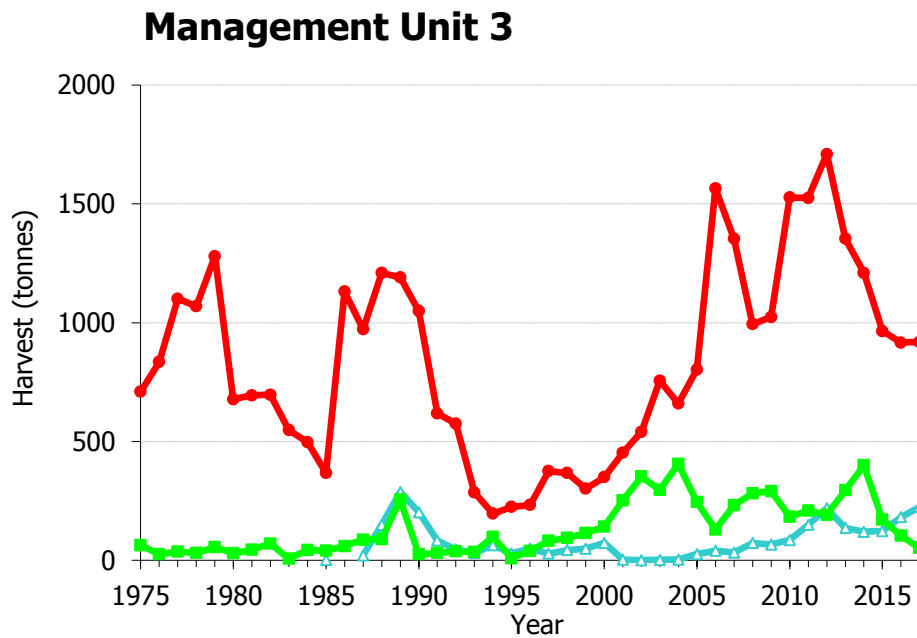
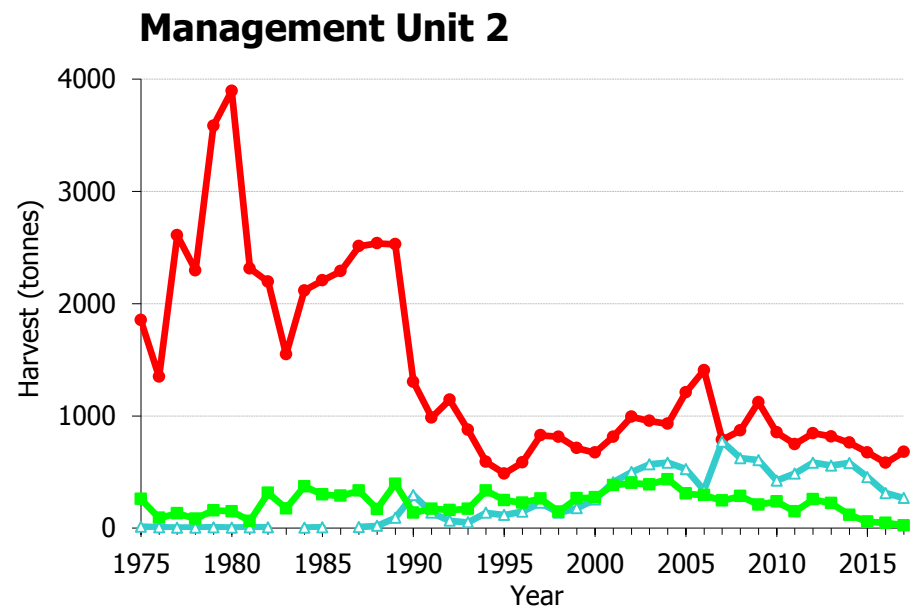
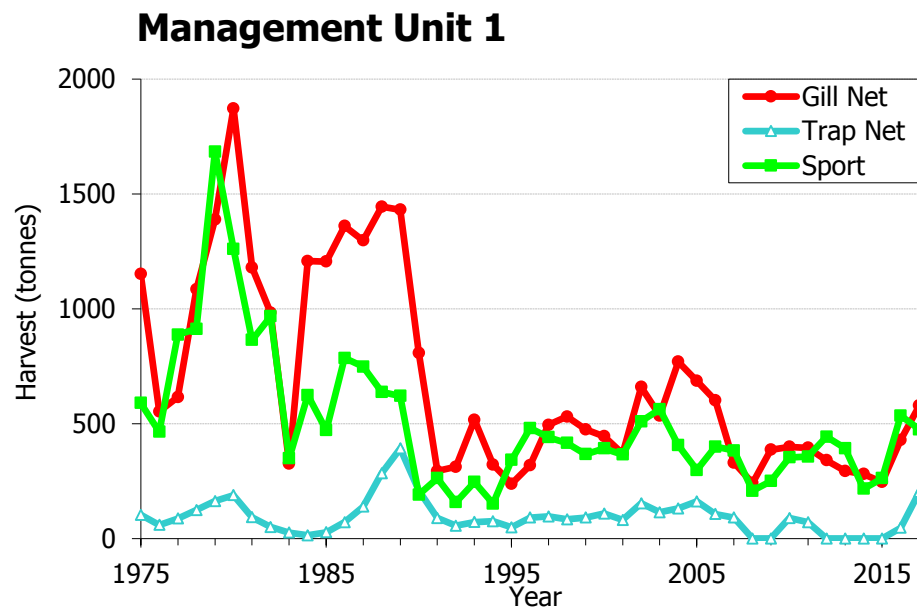


Figure 1.2. Historic Lake Erie Yellow Perch harvest (metric tonnes) by management unit and gear type.

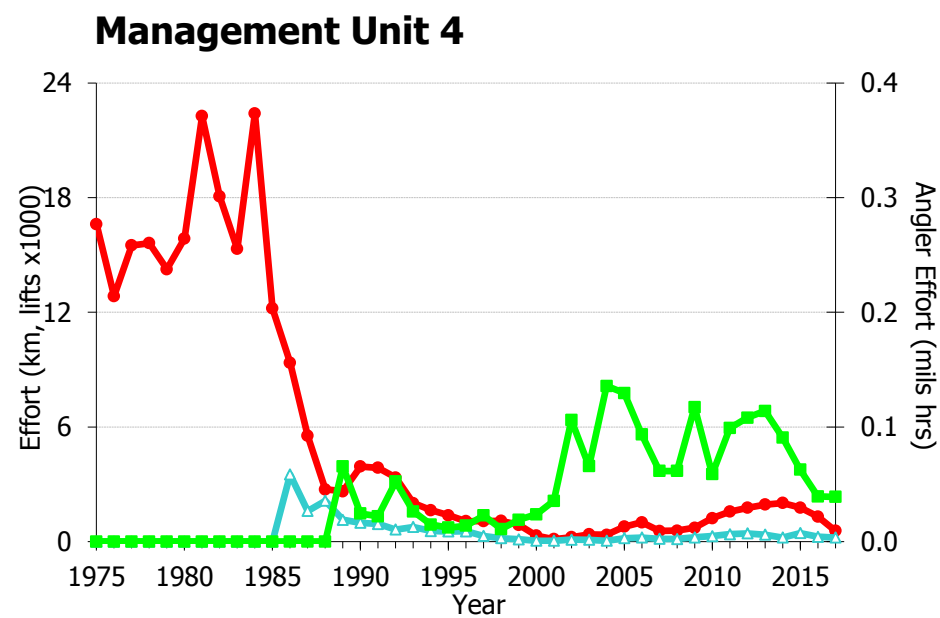
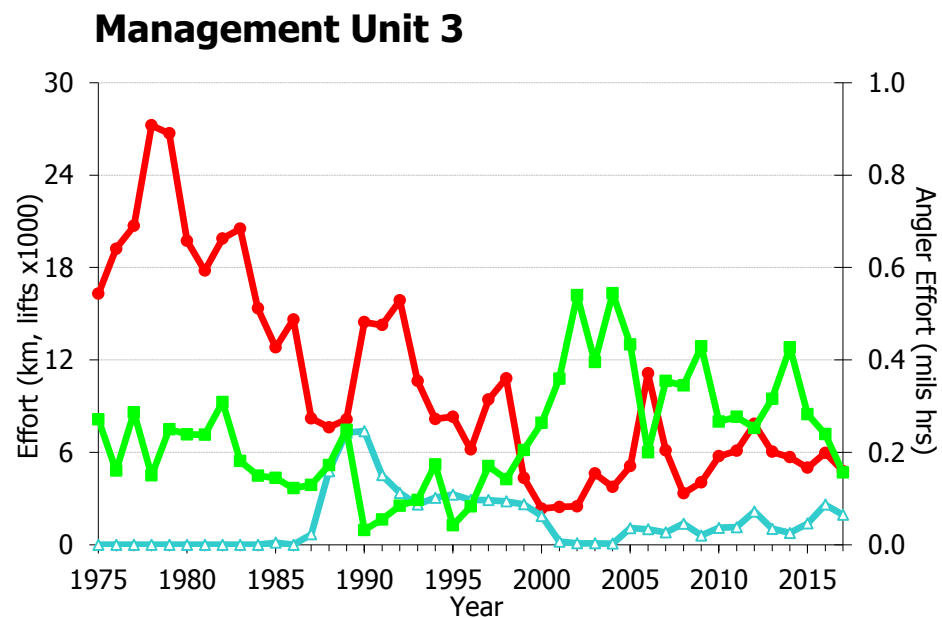
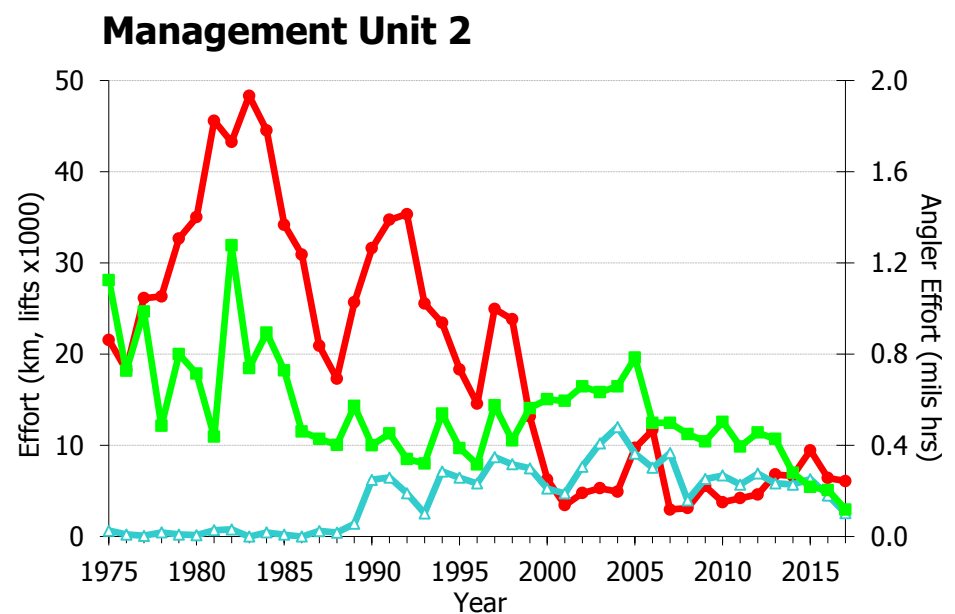
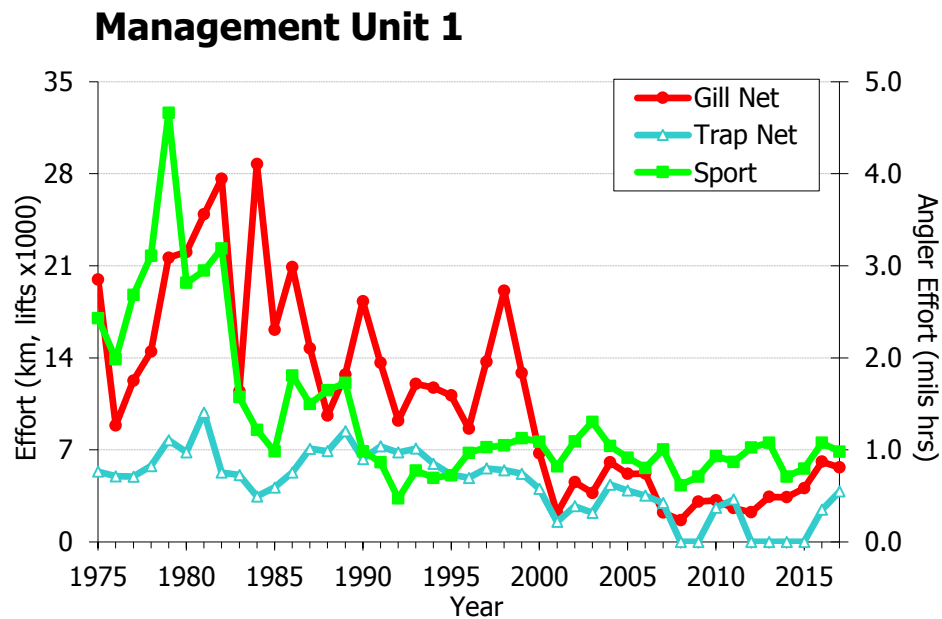


Figure 1.3. Historic Lake Erie Yellow Perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh ($< 3''$).

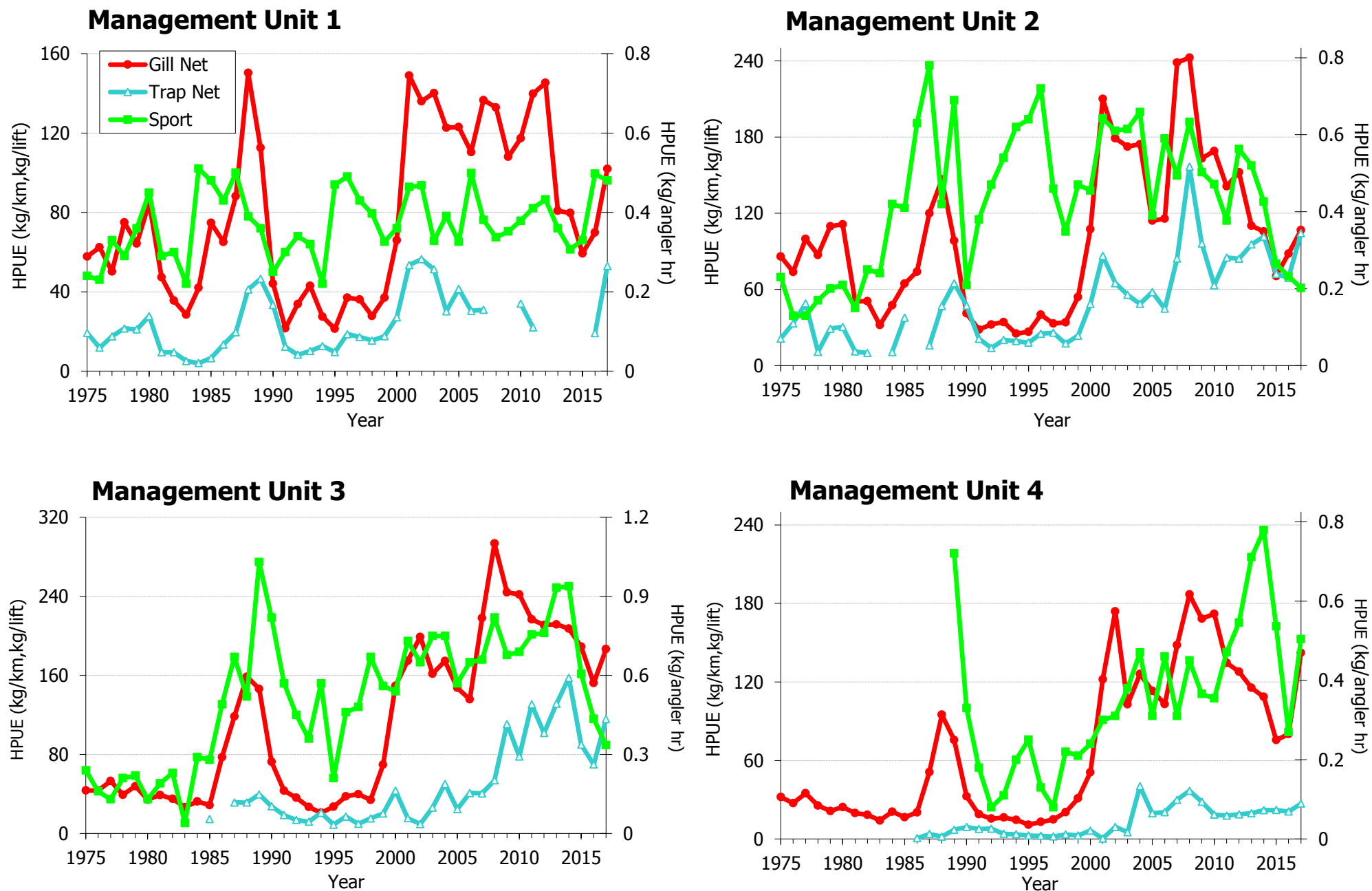


Figure 1.4. Historic Lake Erie Yellow Perch harvest per unit effort (HPUE) by management unit and gear type.
Note: gill net CPUE for 2001 to 2017 is for small mesh (< 3") only.

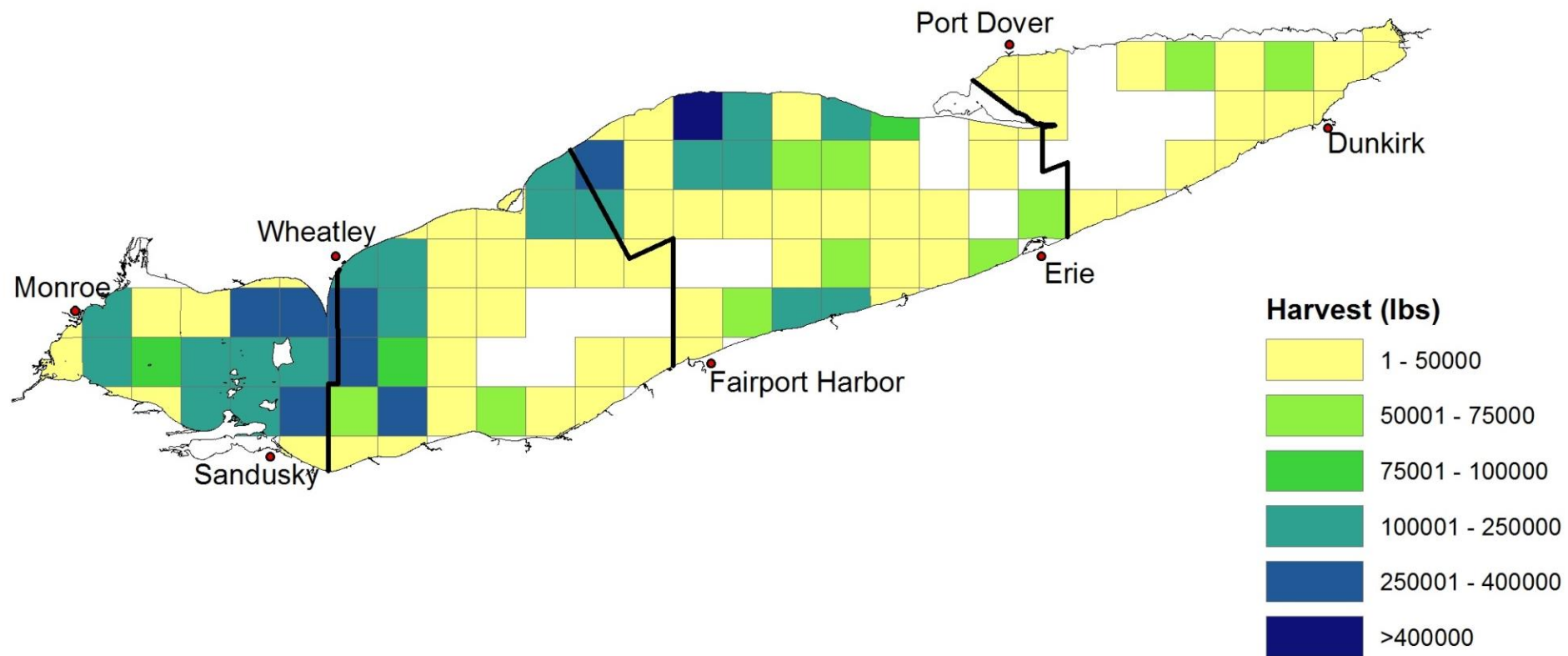


Figure 1.5. Spatial distribution of Yellow Perch total harvest (lbs.) in 2017 by 10-minute grid.

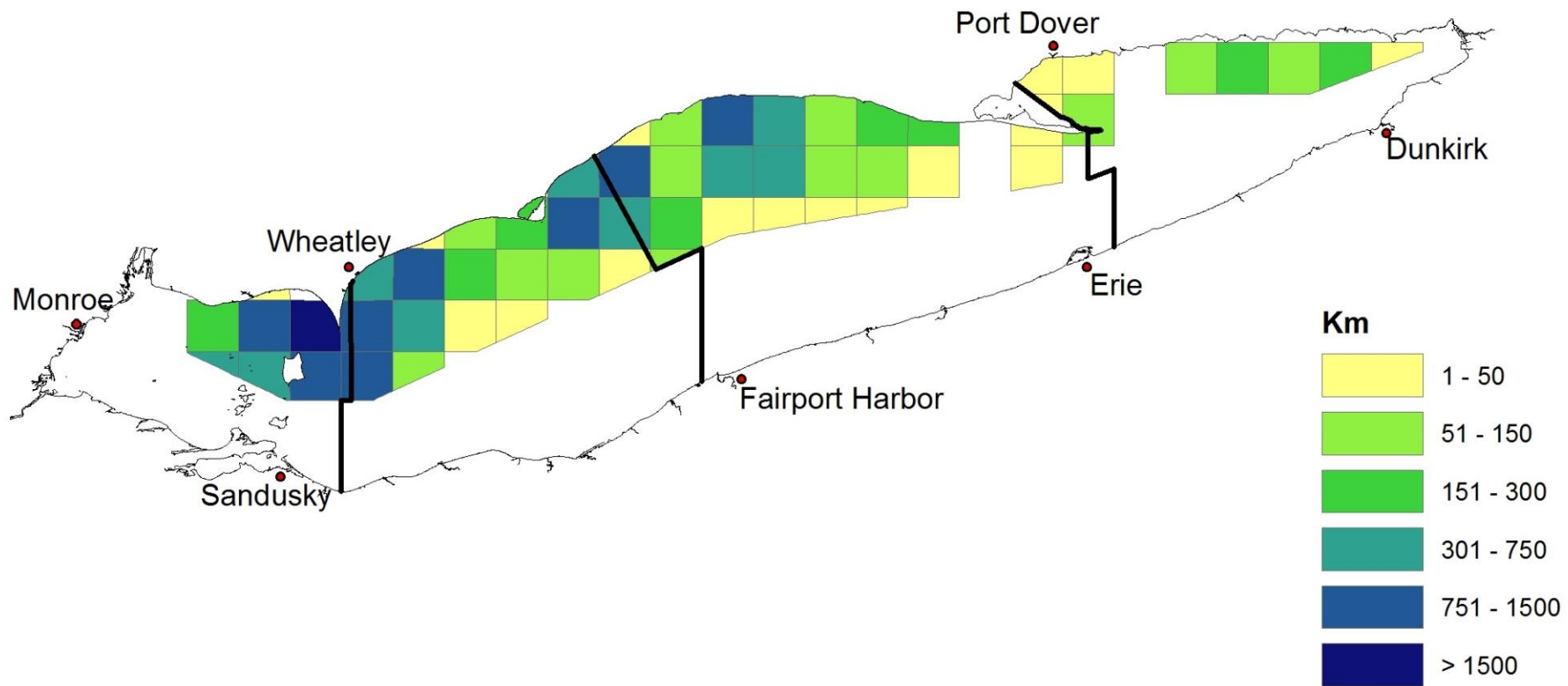


Figure 1.6. Spatial distribution of Yellow Perch small mesh gill net effort (km) in 2017 by 10-minute grid.

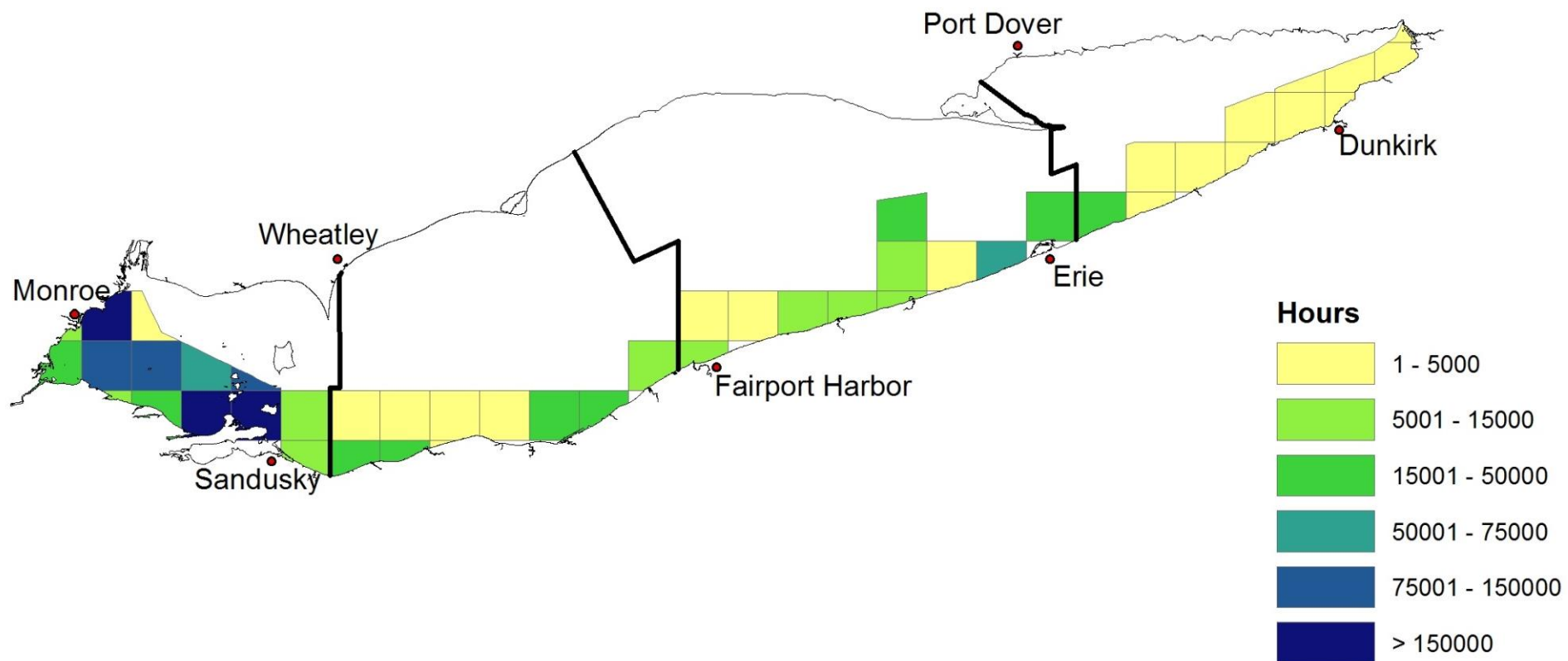


Figure 1.7. Spatial distribution of Yellow Perch sport effort (angler hours) in 2017 by 10-minute grid.

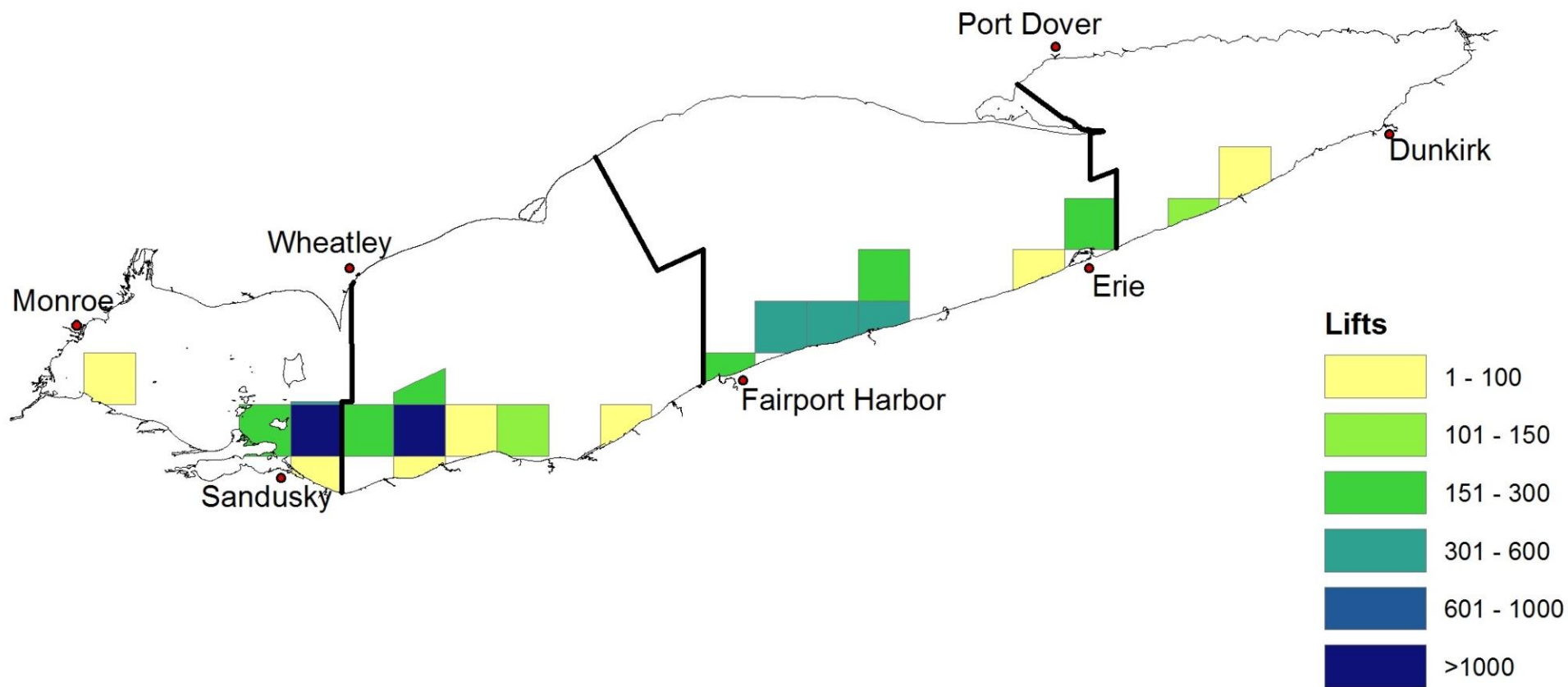


Figure 1.8. Spatial distribution of Yellow Perch trap net effort (lifts) in 2017 by 10-minute grid.

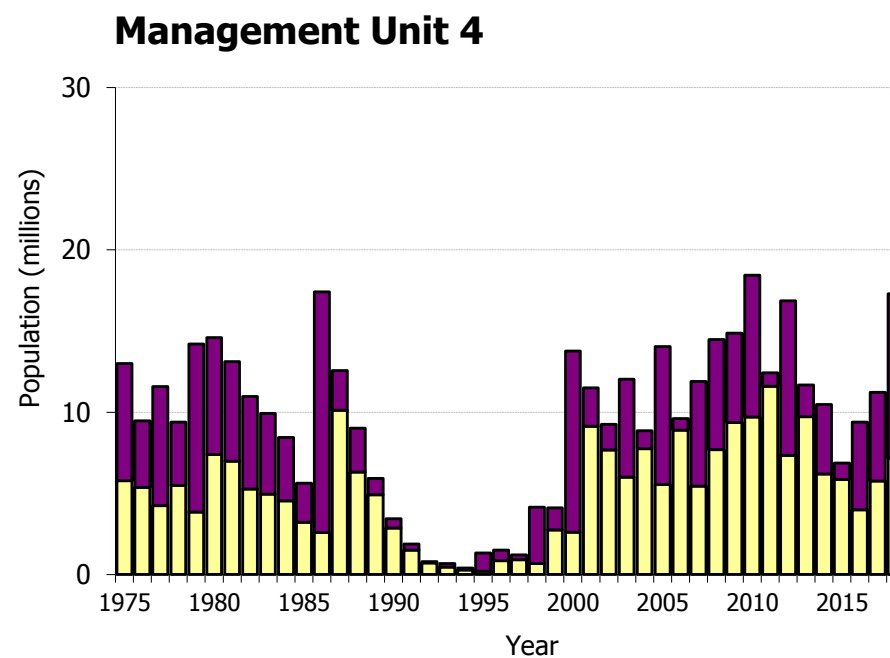
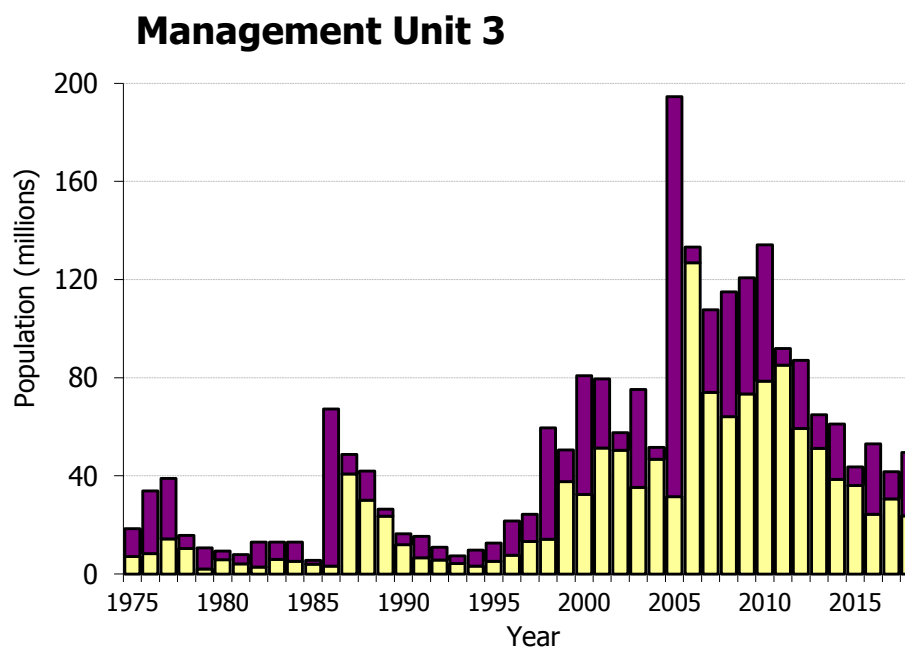
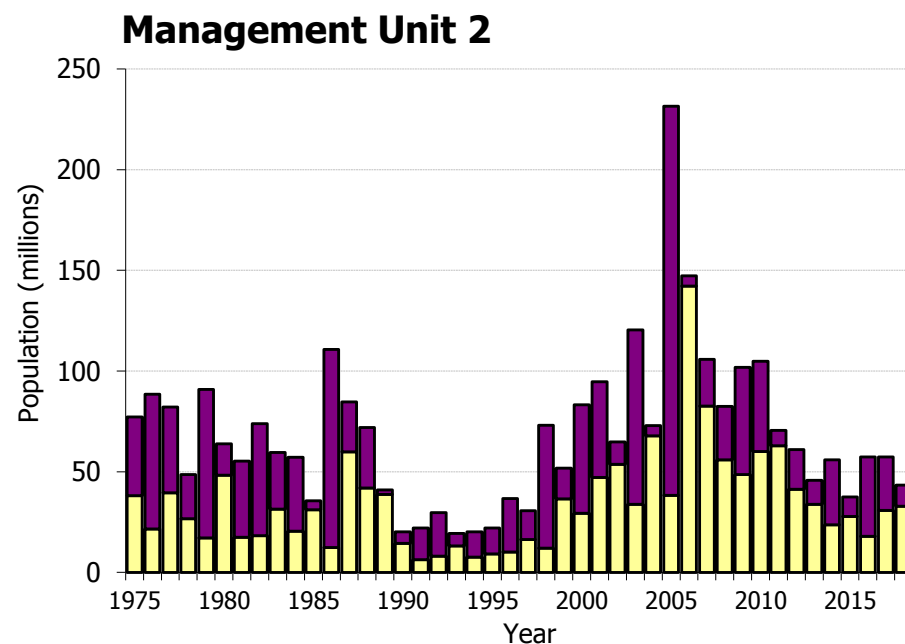
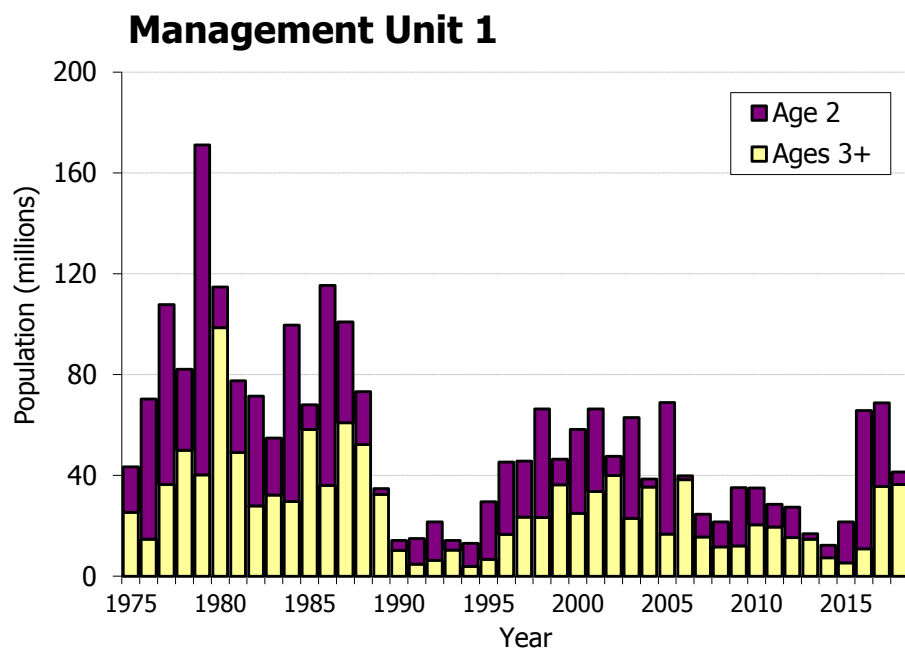


Figure 1.9.a. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 1975 to 2017 are from the **YPTG ADMB model**. Estimates for 2018 are projected from the YPTG model and regressions for age 2 from survey gears.

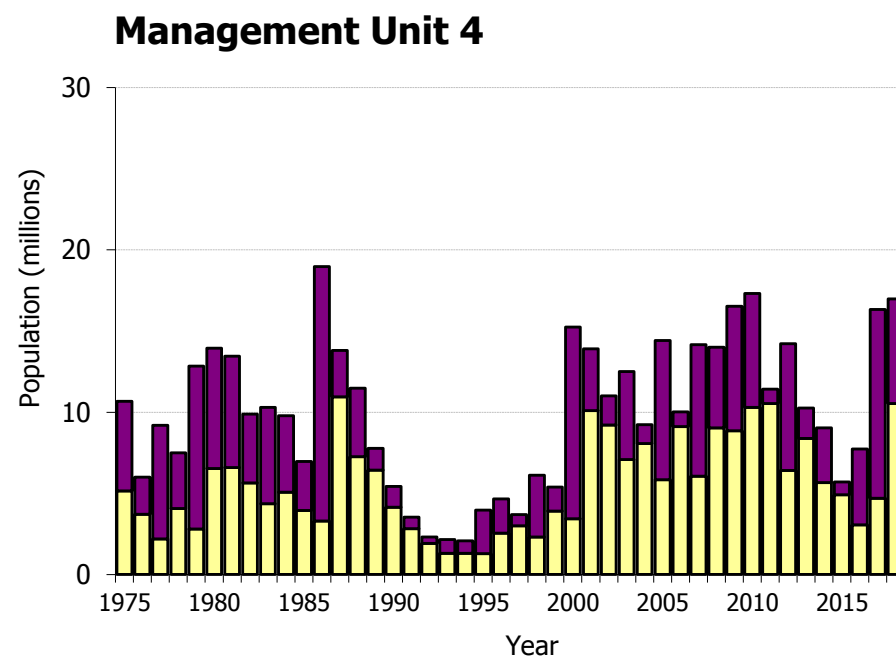
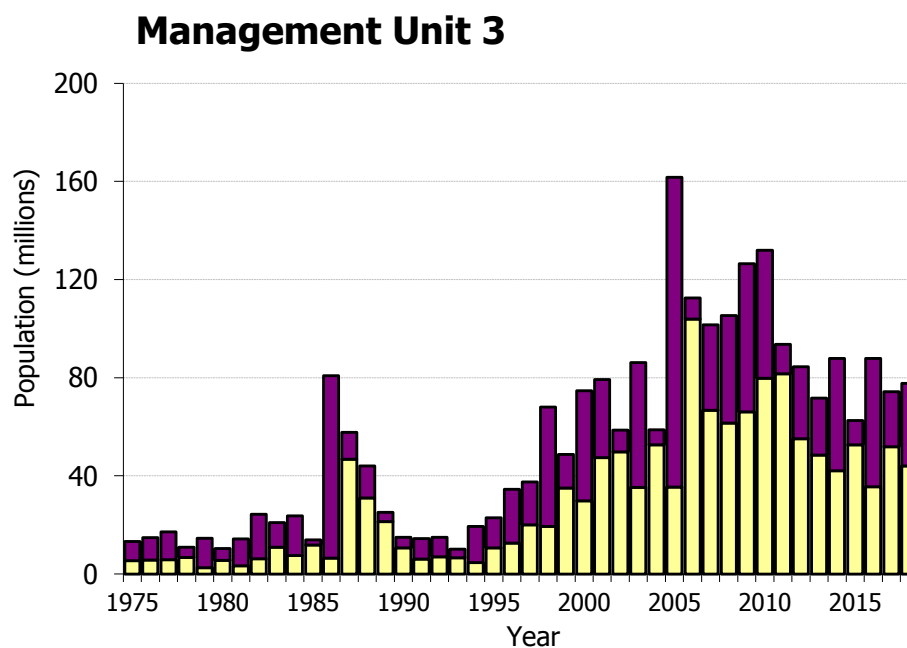
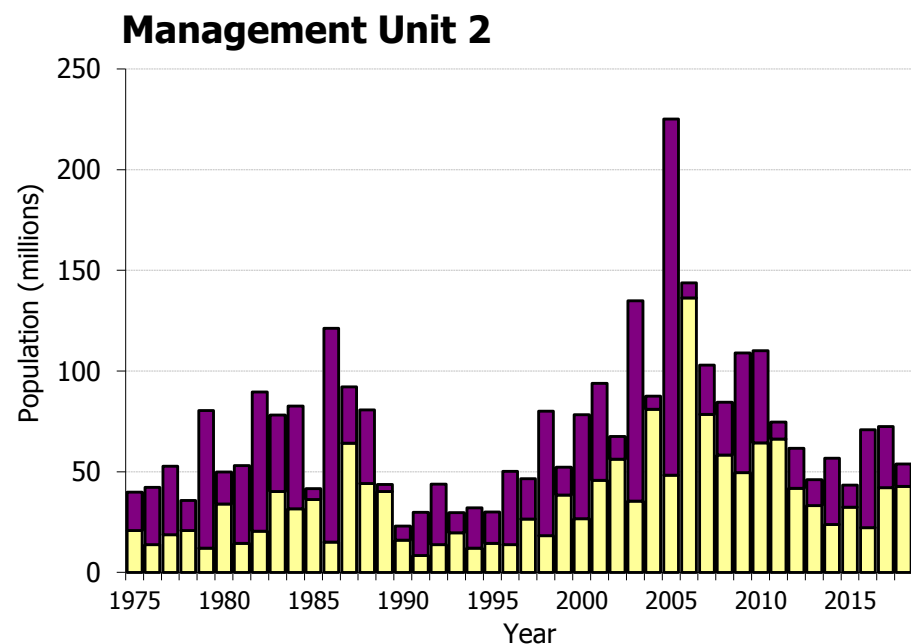
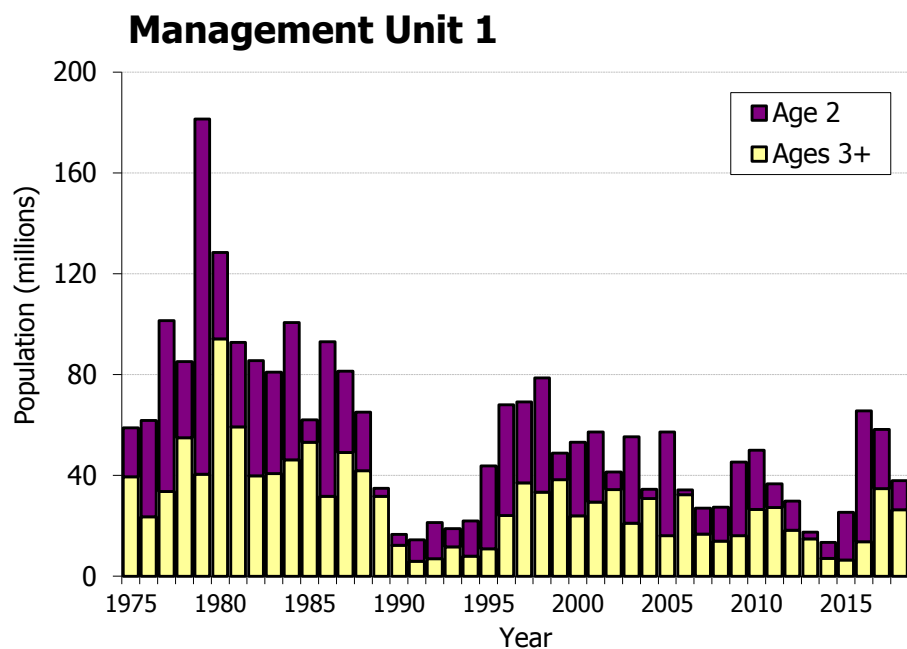


Figure 1.9.b. Lake Erie Yellow Perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 1975 to 2017 are from the **PR ADMB model**. Estimates for 2018 are projected from the PR model and regressions for age 2 from survey gears.

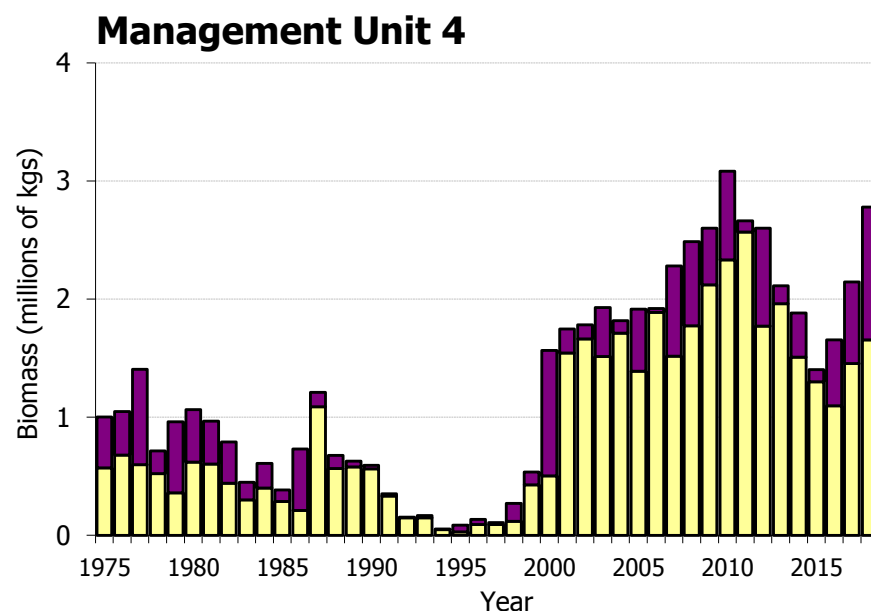
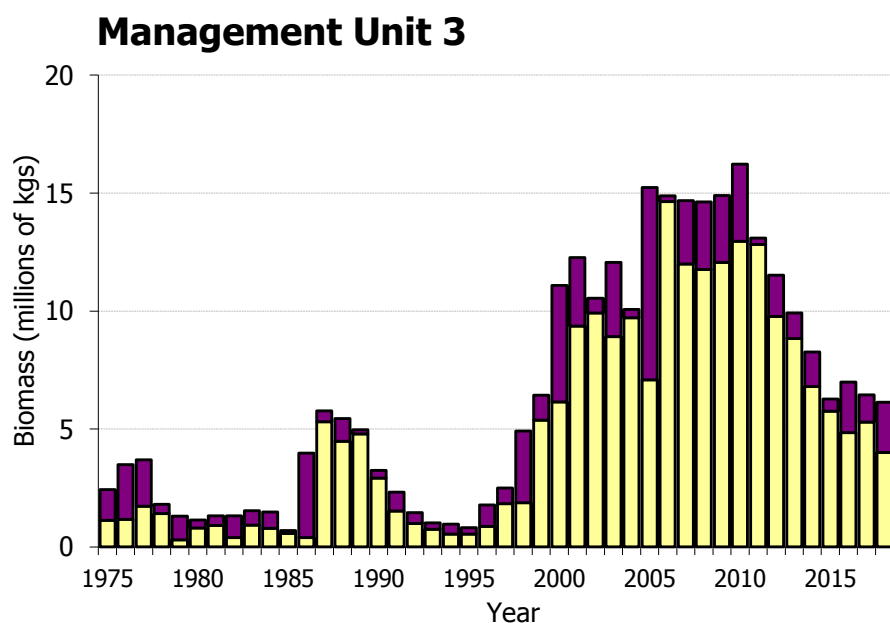
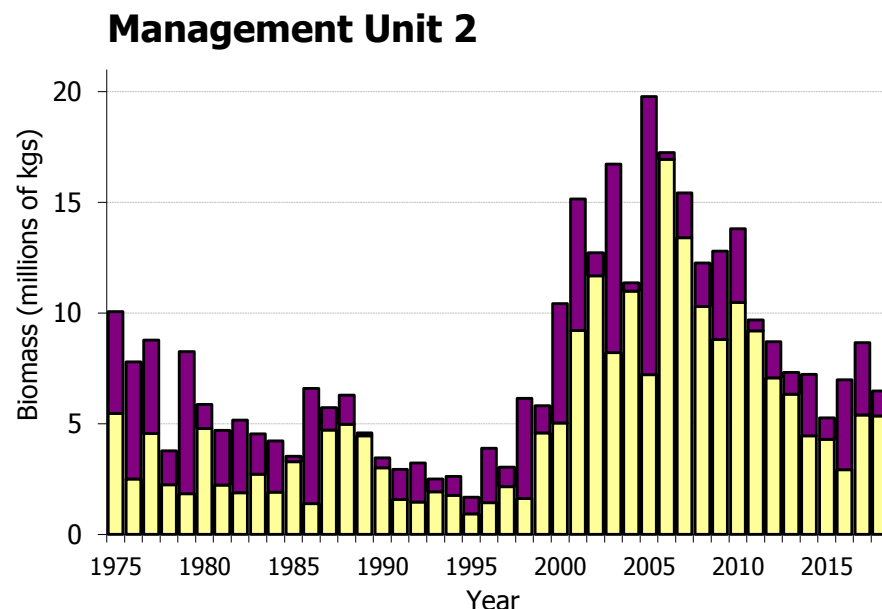
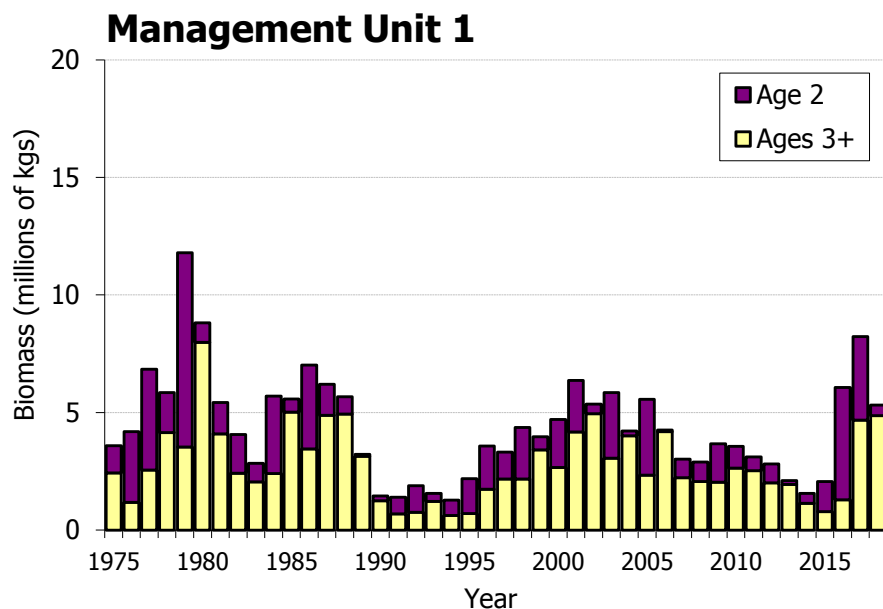


Figure 1.10.a. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 1975 to 2016 are from the **YPTG ADMB model**. Estimates for 2017 are projected from the YPTG model and regressions for age 2⁸ from survey gears.

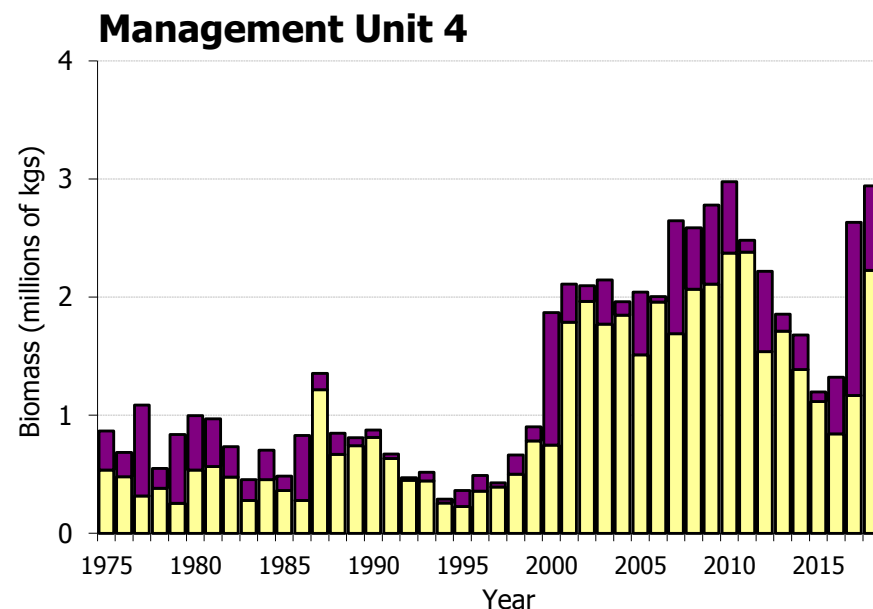
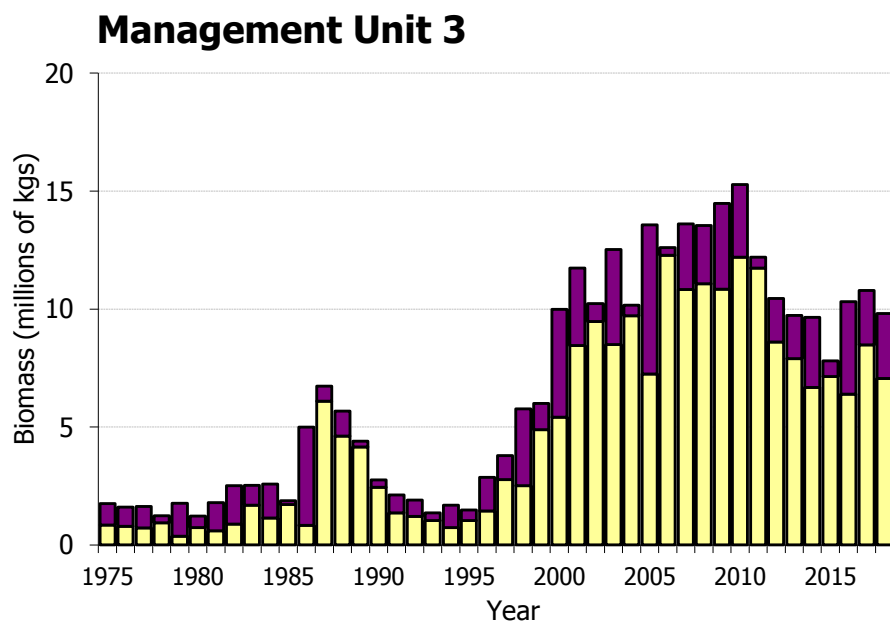
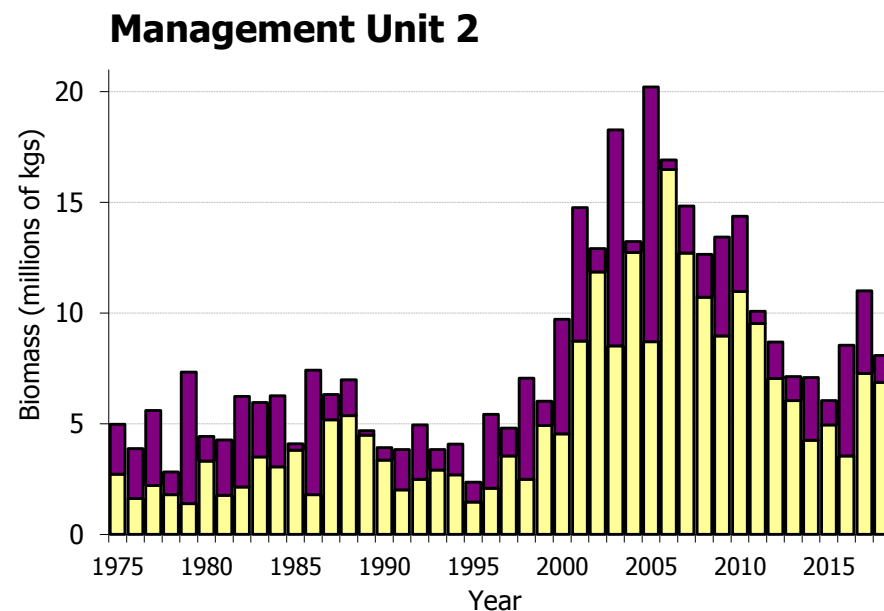
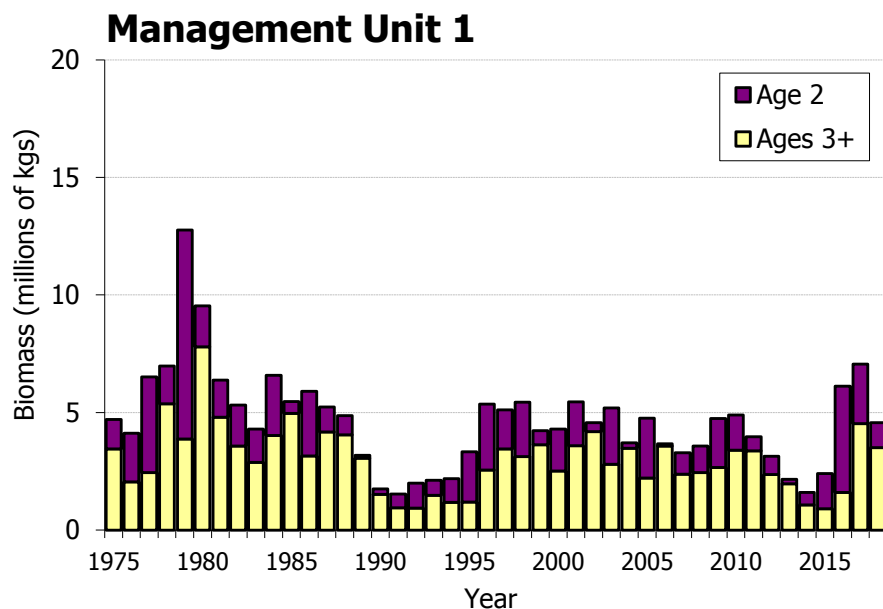


Figure 1.10.b. Lake Erie Yellow Perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 1975 to 2017 are from the **PR ADMB model**. Estimates for 2018 are projected from the PR model and regressions for age 2 from survey gears.

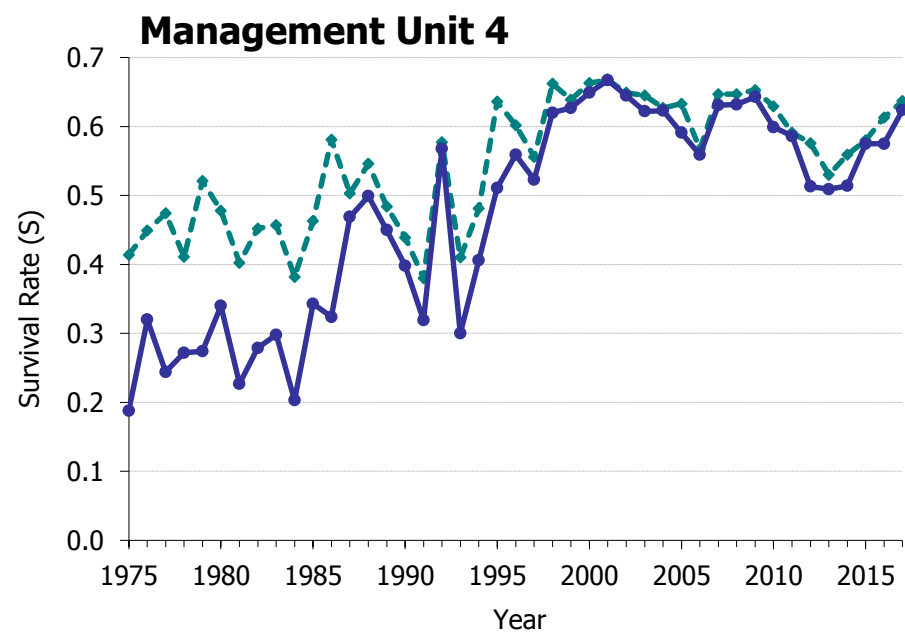
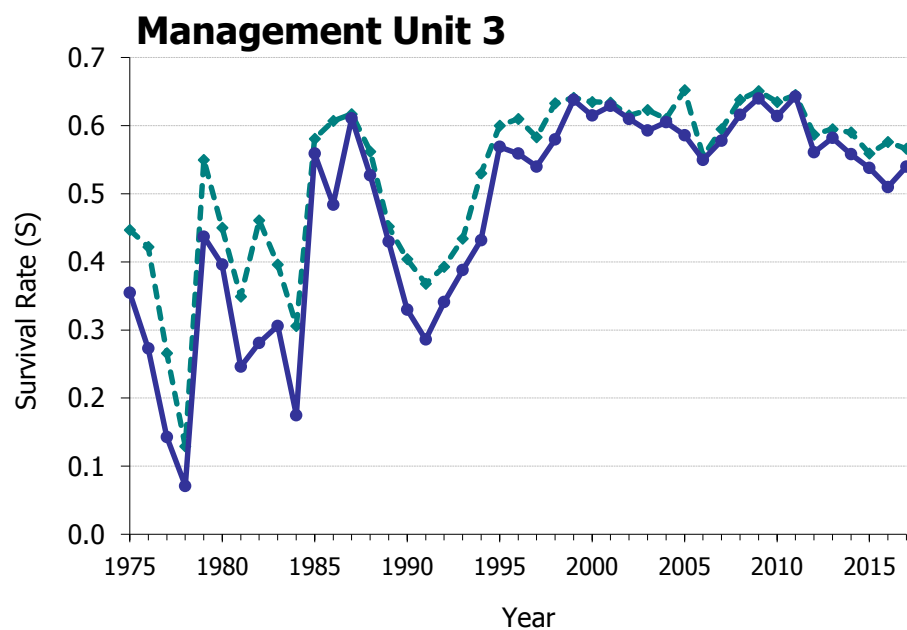
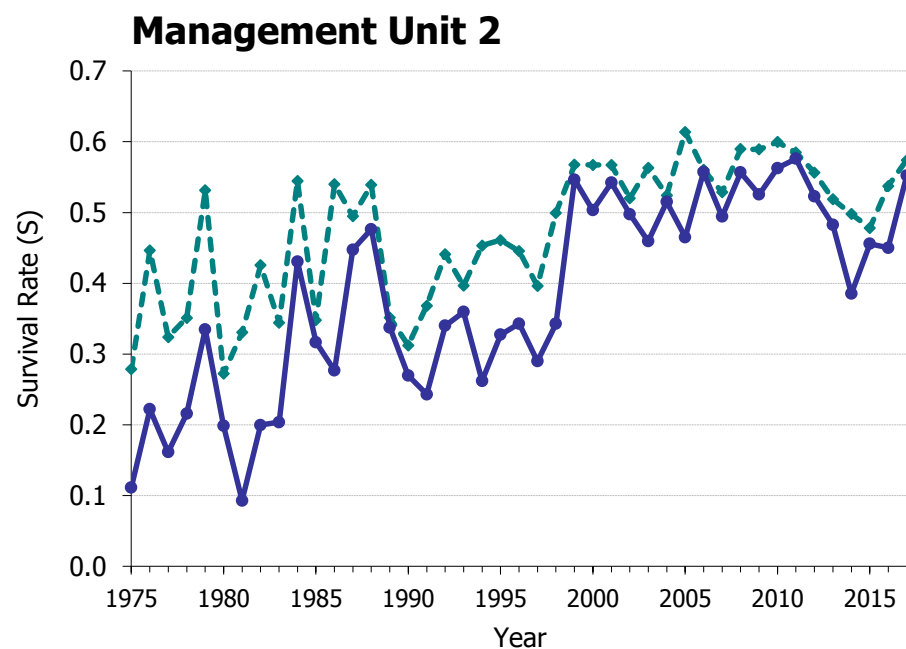
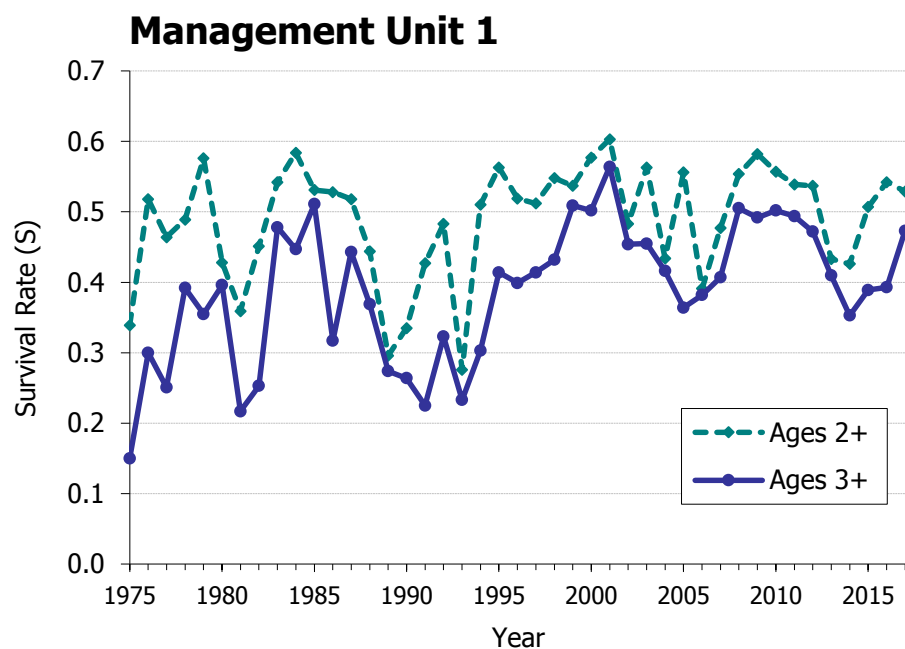


Figure 1.11.a. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from the **YPTG ADMB model**.

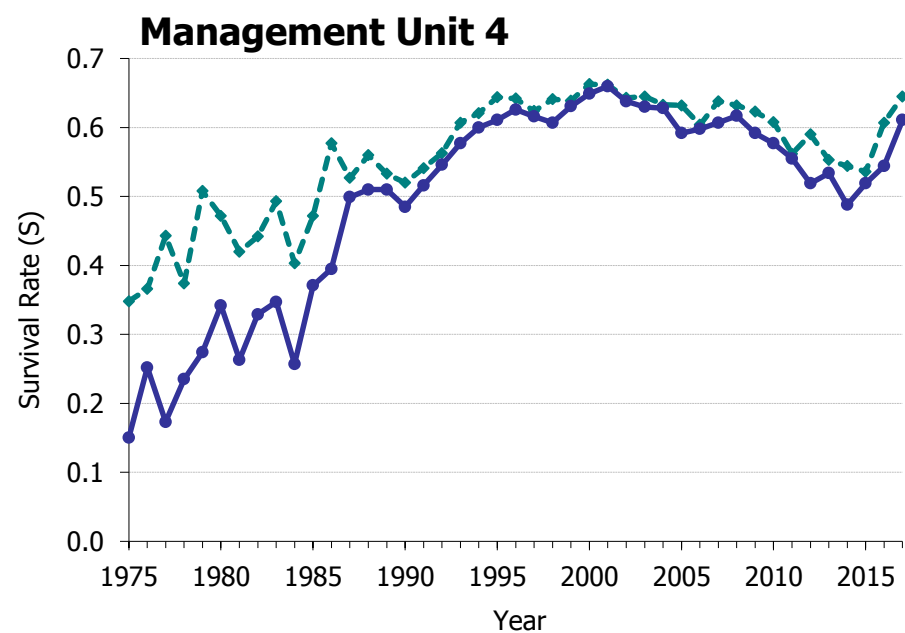
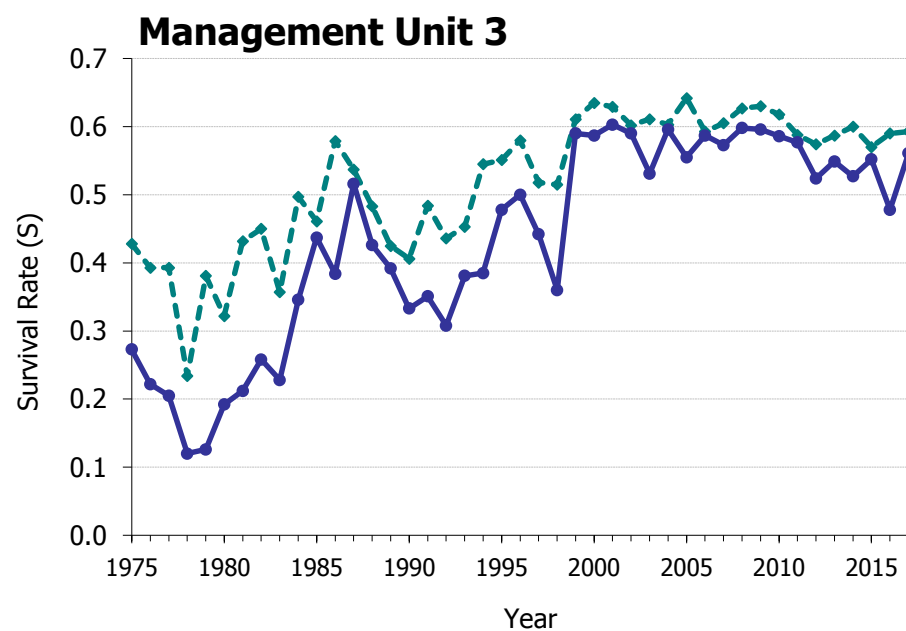
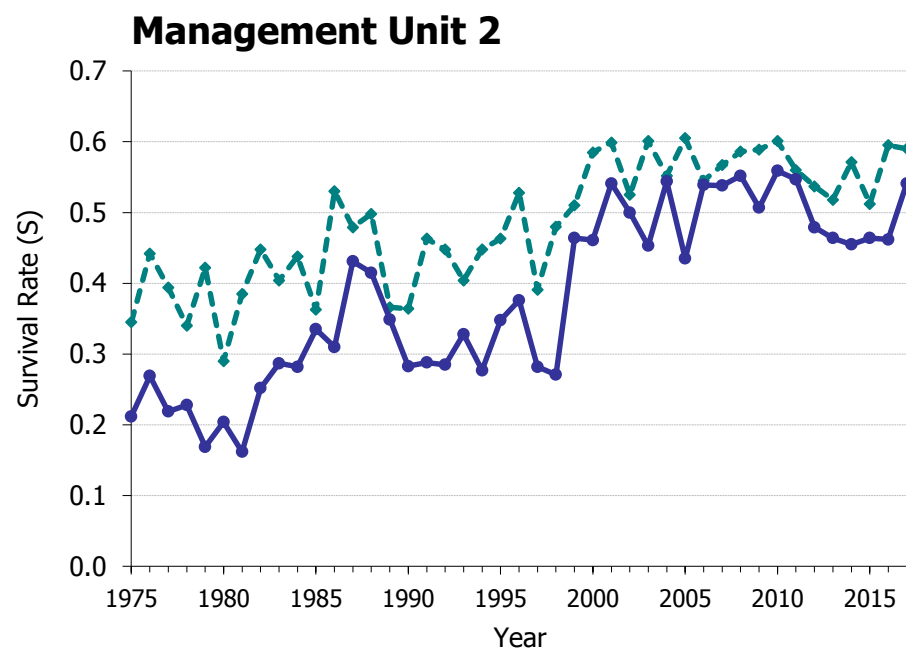
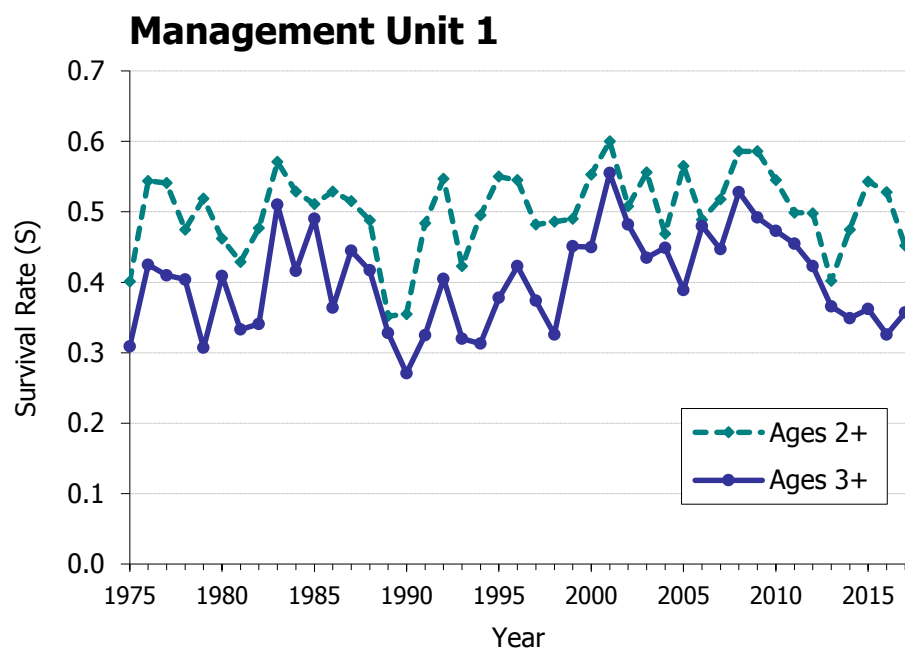


Figure 1.11.b. Lake Erie Yellow Perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from the **PR ADMB model**.

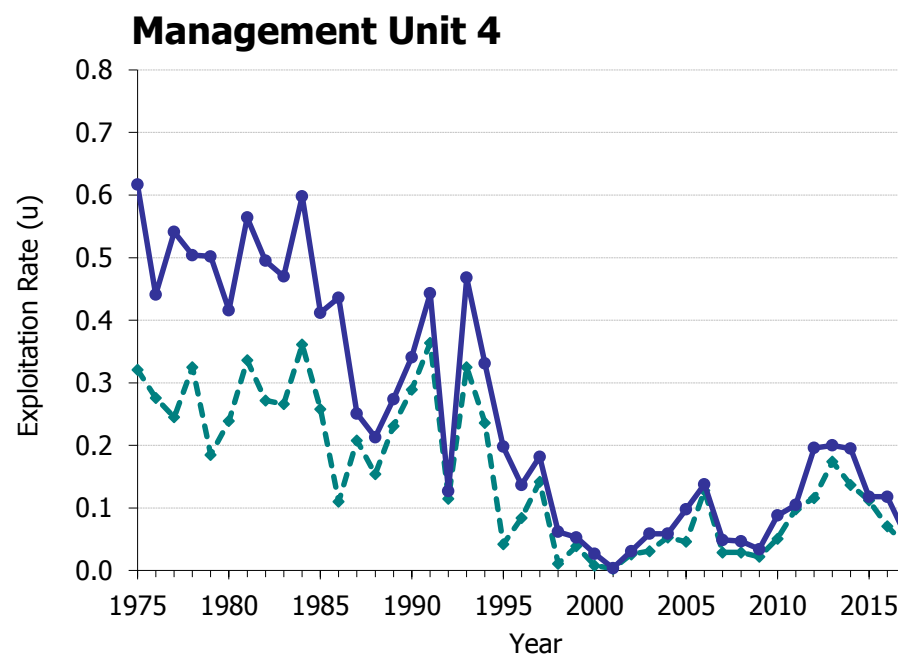
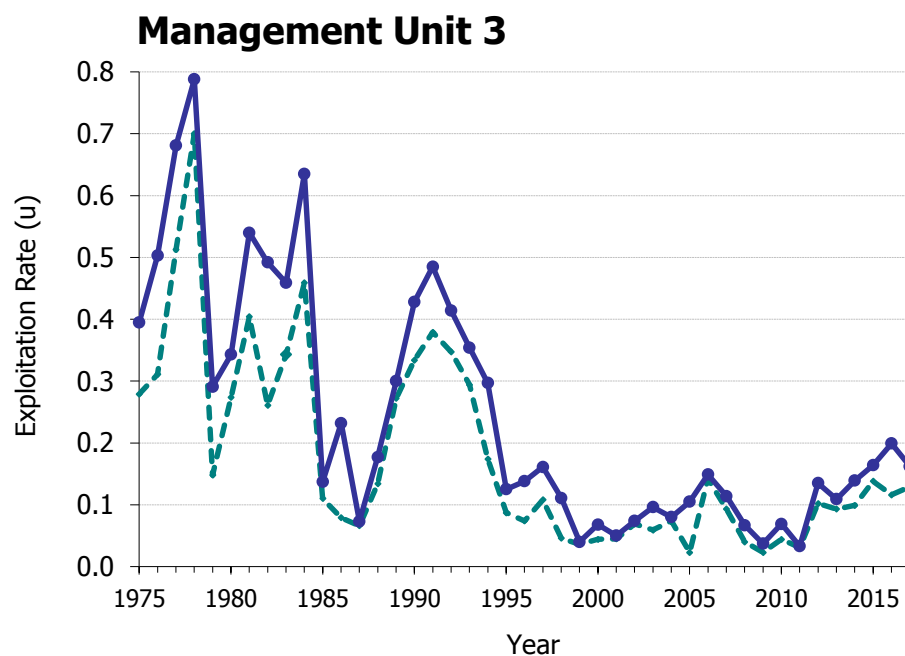
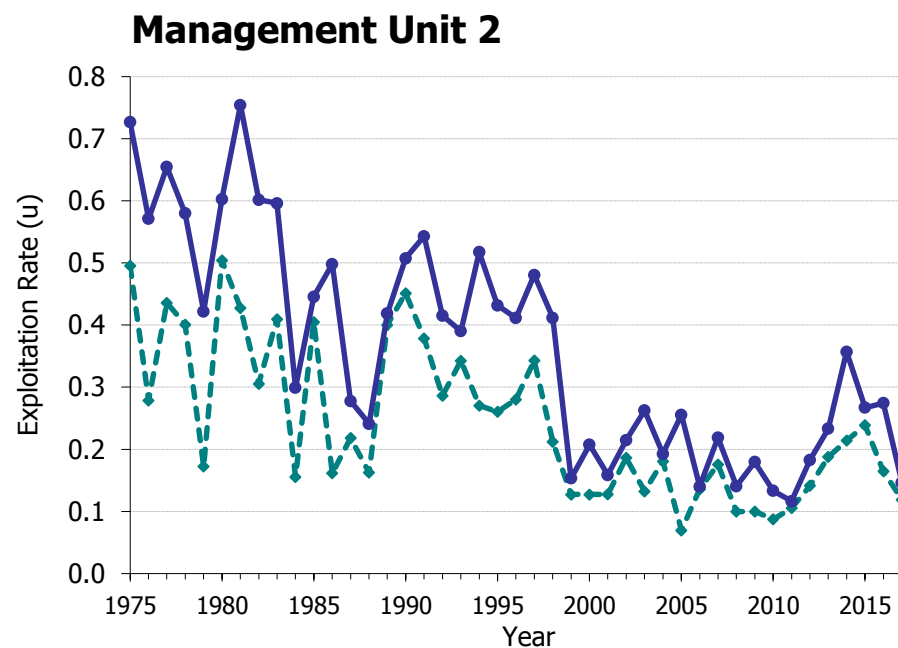
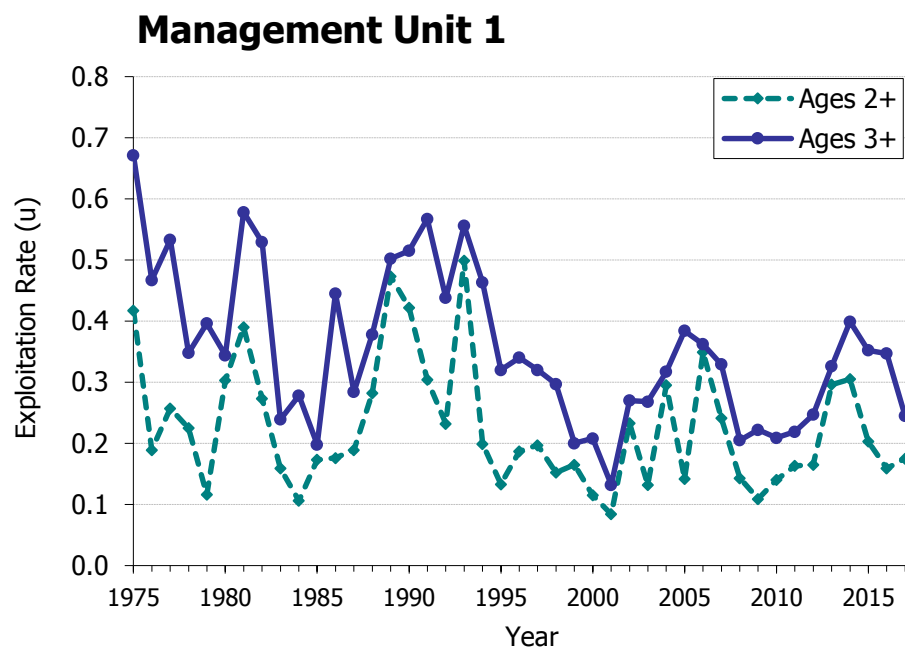


Figure 1.12.a. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from the **YPTG ADMB model**.

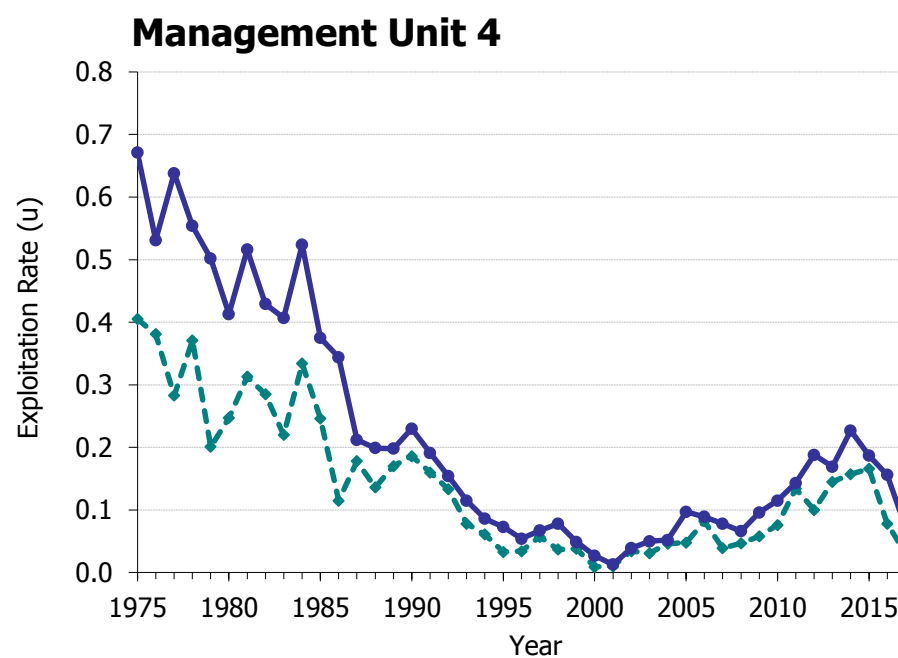
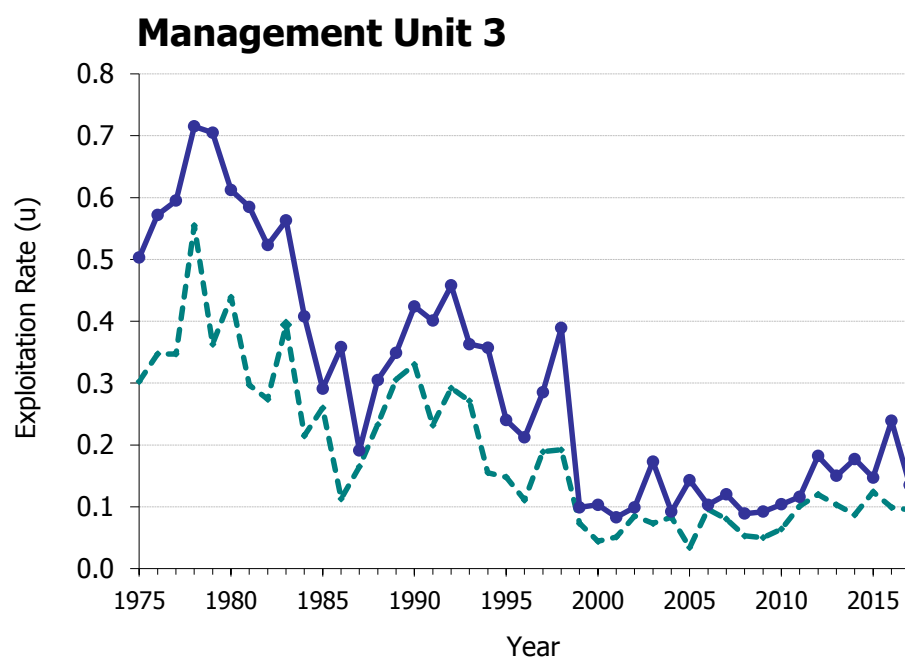
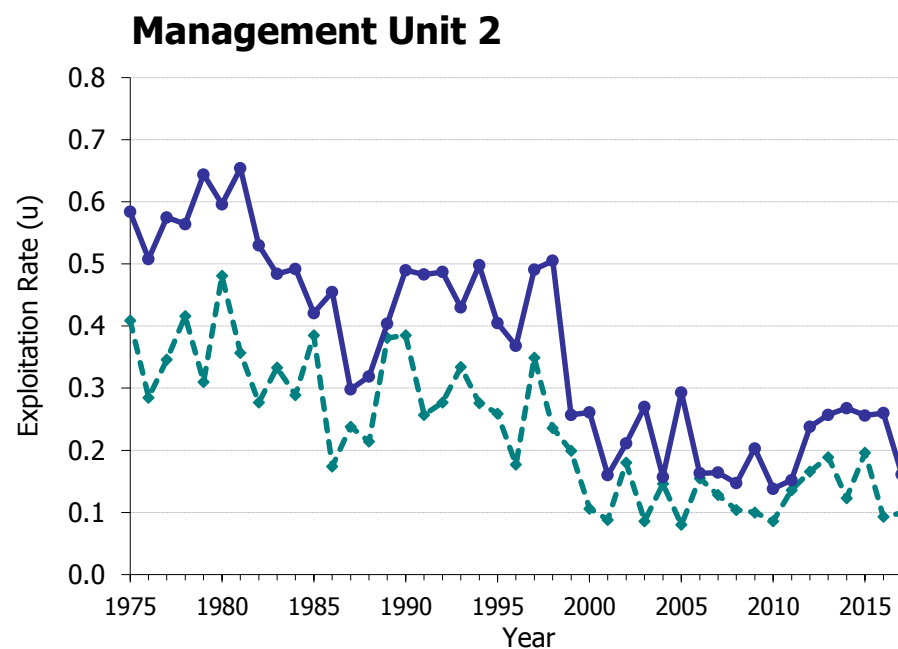
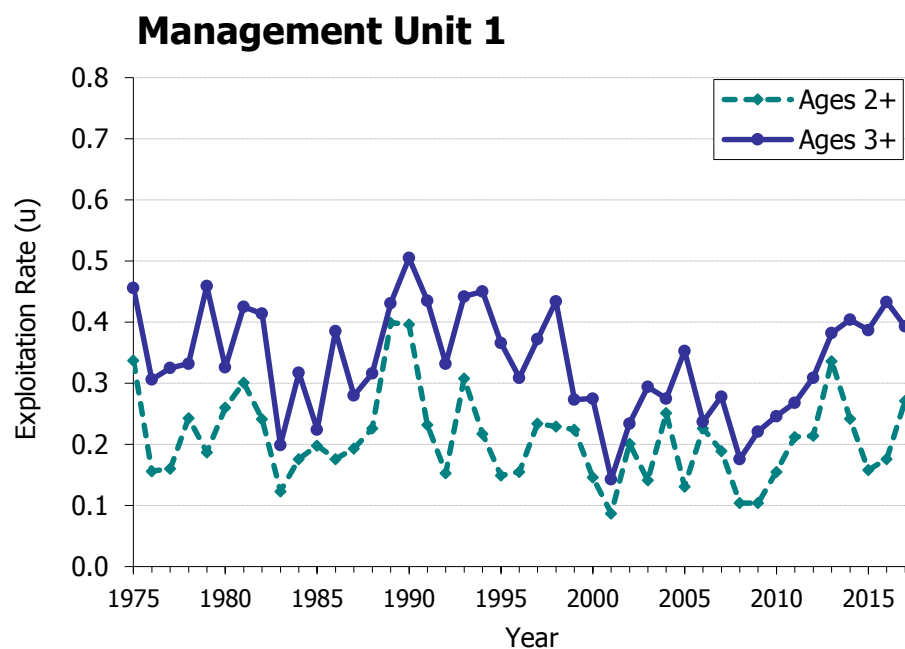
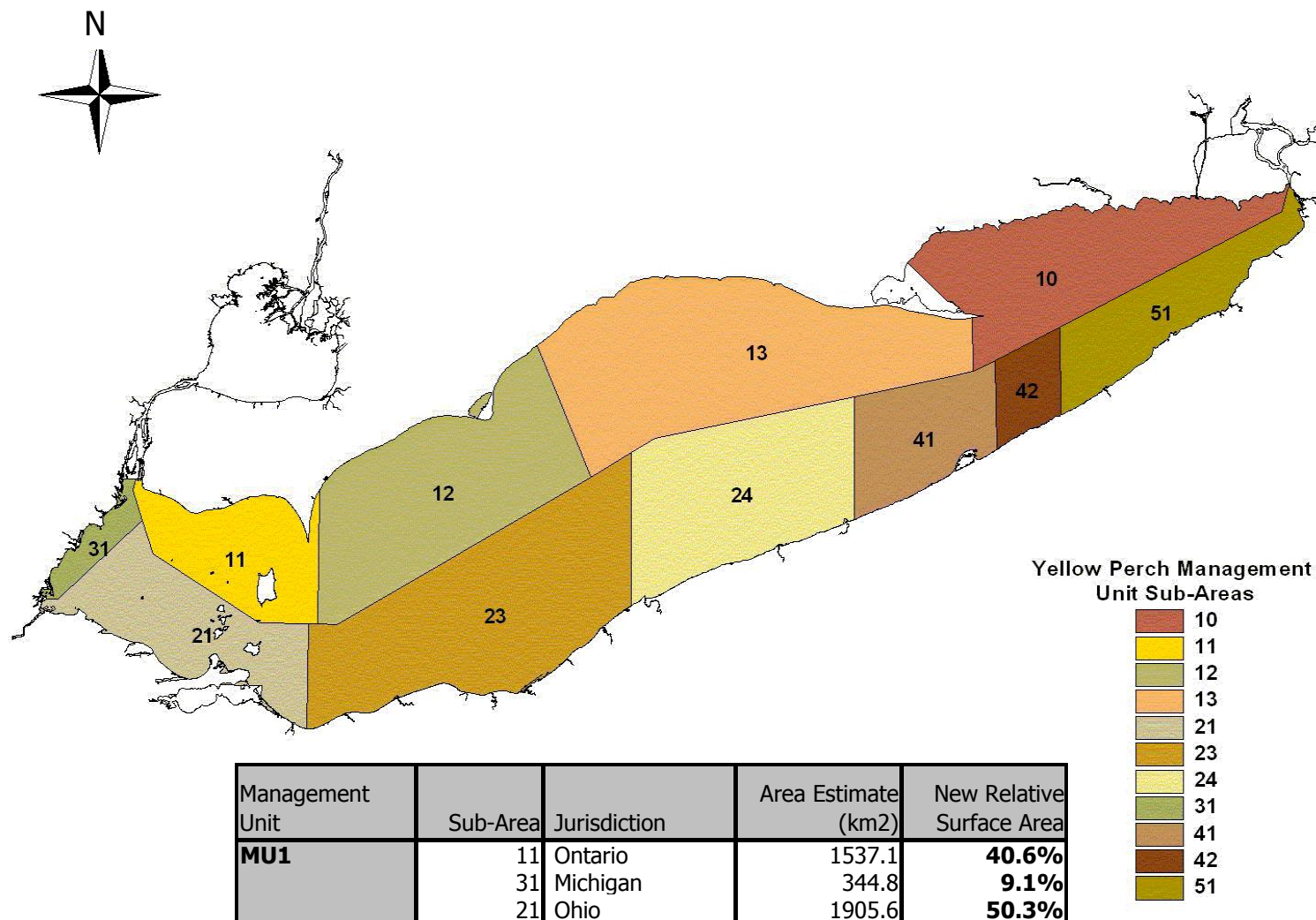


Figure 1.12.b. Lake Erie Yellow Perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from the **PR ADMB model**.



Management Unit	Sub-Area	Jurisdiction	Area Estimate (km ²)	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 A 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 A Table 2.a.i. Projected Lake Erie Yellow Perch age-2 estimates (in millions of fish) from multi-model inference recruitment models run for each management unit.

MMI parameters estimates use age-2 values from the YPTG model

2018 Age-2 Projections

MU	Age-2 Recruitment Estimates			Number of years in model	Number of models averaged
	2018				
	Min.	Mean	Max.		
1	3.523	4.923	0.879	17	2
2	7.975	10.351	13.434	16	2
3	20.660	25.922	32.523	13	2
4	7.216	10.136	14.238	13	1

Appendix A Table 2.b.i. Parameters from multi-model inference age-2 recruitment models run for each management unit.

2018 Age-2 Projections

MU1

Age_2 ~ Intercept + OPSF11 + OHF10 + OHF11 + OOS11					
Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OPSF11	0.013	0.001	1	0.276	0.049
(Intercept)	13.178	0.092	2	1	0.630
OHF10	0.321	0.015	2	1	0.252
OHF11	0.101	0.002	2	1	0.095
OOS11	0.385	0.020	2	1	0.292

MU2

Age_2 ~ Intercept + OHJ21 + + OHF20 + OHS20 + OPSF21					
Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OHJ21	0.105	0.007	1	0.722	0.178
(Intercept)	14.685	0.076	2	1	0.583
OHS20	0.131	0.002	2	1	0.087
OPSF21	0.352	0.004	2	1	0.133

MU3

Age_2 ~ Intercept + OHJ31 + OPSF31					
Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OHJ31	0.163	0.026	1	0.629	0.343
(Intercept)	14.524	0.160	2	1	0.856
OPSF31	0.447	0.018	2	1	0.288

MU4

Age_2 ~ Intercept + NYF41

Survey	Estimate
NYF41	0.622768
(Intercept)	13.10268

Appendix A Table 2.a.ii. Projected Lake Erie Yellow Perch age-2 estimates (in millions of fish) from multi-model inference recruitment models run for each management unit.

MMI parameters estimates use age-2 values from the PR model

2018 Age-2 Projections

MU	Age-2 Recruitment Estimates			Number of years in model	Number of models averaged
	2018				
	Min.	Mean	Max.		
1	6.558	11.550	20.341	17	3
2	7.283	11.112	16.956	16	3
3	26.919	33.587	41.907	13	3
4	3.508	6.443	11.833	13	3

Appendix A Table 2.b.ii. Parameters from multi-model inference age-2 recruitment models run for each management unit.

2018 Age-2 Projections

MU1

Age_2 ~ Intercept + OOS11 + OOS10 + OPSF11

Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OOS11	0.256	0.047	2	0.684	0.465
OOS10	0.259	0.029	2	0.786	0.367
(Intercept)	13.870	0.197	3	1.000	0.956
OPSF11	0.101	0.001	3	1.000	0.074

MU2

Age_2 ~ Intercept + OHS20 + OHF20 + OPSF21

Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OHS20	0.055	0.003	2	0.566	0.128
OHF20	0.174	0.020	2	0.704	0.304
(Intercept)	15.046	0.066	3	1.000	0.558
OPSF21	0.332	0.004	3	1.000	0.143

MU3

Age_2 ~ Intercept + OHS31 + OHJ31 + OPSF31

Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
OHS31	0.069	0.011	1	0.315	0.233
OHJ31	0.114	0.021	1	0.442	0.320
(Intercept)	14.802	0.155	3	1.000	0.873
OPSF31	0.411	0.012	3	1.000	0.247

MU4

Age_2 ~ Intercept + LPC41 + NYF41

Survey	Estimate	Uncond. variance	Number of models	Importance	+/- (alpha = 0.05)
LPC41	0.241	0.033	2	0.734	0.400
NYF41	0.321	0.046	2	0.779	0.474
(Intercept)	13.761	0.142	3	1.000	0.834

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

Trawl series in *italics* are not used to estimate age-2 recruitment.

Year	OHF10	OHF11	OOS10	OOS11	OHF20B	OHF21B	OHF30B	OHF31B	OHS20B	OHS21B	OHS30B	OHS31B	OHJ21B	OHJ31B	NYF40	NYF41	NYGN41	LPS41	LPC40	LPC41	OPSF11	OPSF21	OPSF31	OPSF41
1990	310.1	0.0	259.2	35.2	52.2	23.0	21.2	12.4	1.7	67.4	1.2	7.5	.	.	.	.	.	0.0	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	5.4	43.5	5.2	77.7	216.5	19.7	.	.	.	1.7	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	7.2	8.0	24.3	2.7	18.5	0.8	10.7	2.4	.	5.6	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	41.7	29.1	39.7	16.0	9.7	5.8	113.0	3.1	0.2	7.9	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	73.3	5.0	77.2	16.7	23.3	10.2	49.0	8.6	0.6	2.7	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	2.8	120.5	27.3	21.0	.	.	5.9	13.6	0.6	15.2	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	1059.9	12.1	2006.8	3.6	8.9	0.9	105.8	0.3	0.1	0.4	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	29.0	677.7	.	.	493.9	64.0	0.2	5.7	0.0	4.4	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	225.4	3.4	275.5	3.7	21.5	16.2	1.3	0.4	0.0	8.4	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	29.5	19.4	44.8	63.5	402.8	97.3	35.9	33.3	13.1	23.0	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	0.6	86.6	0.0	84.8	51.4	10.2	23.9	7.0	3.3	0.7	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	341.9	6.4	1283.7	10.2	279.8	4.3	100.4	11.7	2.2	4.8	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	0.3	191.0	1.7	749.6	239.6	37.7	9.5	16.0	0.9	6.8	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	1180.4	3.8	1170.2	2.3	9.5	2.5	484.8	2.0	2.0	1.3	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	32.8	316.2	3.6	61.9	410.3	42.7	1.5	29.4	2.9	6.5	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	105.2	22.3	278.2	82.3	51.2	19.3	59.3	5.6	0.4	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	4.9	2.2	60.7	10.8	29.7	113.6	290.6	40.9	32.6	19.5	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	245.8	21.3	237.0	40.9	287.6	281.8	412.0	42.3	16.1	9.1	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	210.5	62.6	558.3	150.2	303.5	97.2	1116.7	45.5	16.4	5.7	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	14.2	62.7	0.1	104.3	125.9	48.2	11.9	64.1	42.4	0.7	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	1.7	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	7.1	34.5	14.1	41.3	70.8	41.7	89.5	141.8	105.9	5.0	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	65.9	9.2	154.3	23.5	42.5	76.5	280.0	16.7	8.0	13.7	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	2.6	52.2	3.5	272.9	84.2	116.2	4.4	24.4	16.0	2.2	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	33.6	2.8	45.8	15.4	.	.	274.2	2.9	0.9	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	4.0	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	0.2	91.3	156.9	184.0	46.5	149.4	2178.2	53.0	10.4	31.7	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	191.8	3.3	1399.9	65.1	7.2	17.6	247.0	129.5	77.4	37.6	65.5	4.4	90.3	65.3	104.8	414.1

Year	<i>OHS10</i>	<i>OHS11</i>	<i>OLPN40</i>	<i>OLPN41</i>	<i>ILP40</i>	<i>ILP41</i>	<i>OLPO40</i>	<i>OLPO41</i>	<i>OHJY20B</i>	<i>OHJY21B</i>	<i>OHJY30B</i>	<i>OHJY31B</i>
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
1991	146.9	27.6	15.5	1.0	144.0	24.5	0.7	0.6	.	.	0.0	0.0
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
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
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
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
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
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
1998	174.5	4.8	114.9	1.2	1005.9	14.9	8.1	0.0	.	.	.	.
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
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
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
2002	33.1	77.1	0.6	13.9	8.3	42.6	0.0	0.7	0.0	192.4	.	.
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
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
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
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
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
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
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
2010	58.2	22.2	13.2	0.6	5.7	0.6	63.5	0.0	33.6	5.0	.	.
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
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
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
2014	668.9	17.4	80.1	0.2	4.7	0.0	24.6	0.0	.	.	.	.
2015	264.9	61.7	78.5	0.3	326.0	3.0	18.7	1.6	.	.	.	.
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
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

Appendix A Table 4. Legend. Lakewide trawl index codes and series names used in Appendix A Tables 2 and 3. All series are reported in arithmetic mean catch per hectare, except LPS41 and OPSF11-41, gill net indices which are reported in mean catch per lift. Abbreviations in Appendix T3 ending with a 'B' represent survey indices blocked by depth strata.

Abbreviation	Series
OHS10	Ohio Management Unit 1 summer age 0
OHS11	Ohio Management Unit 1 summer age 1
OHF10	Ohio Management Unit 1 fall age 0
OHF11	Ohio Management Unit 1 fall age 1
OOS10	Ontario/Ohio Management Unit 1 summer age 0
OOS11	Ontario/Ohio Management Unit 1 summer age 1
OHS20	Ohio Management Unit 2 summer age 0
OHF20	Ohio Management Unit 2 fall age 0
OHS21	Ohio Management Unit 2 summer age 1
OHF21	Ohio Management Unit 2 fall age 1
OHS30	Ohio Management Unit 3 summer age 0
OHF30	Ohio Management Unit 3 fall age 0
OHS31	Ohio Management Unit 3 summer age 1
OHF31	Ohio Management Unit 3 fall age 1
OHJ21	Ohio Management Unit 2 June age 1
OHJ31	Ohio Management Unit 3 June age 1
OHJY20	Ohio Management Unit 2 July age 0
OHJY30	Ohio Management Unit 3 July age 0
OHJY21	Ohio Management Unit 2 July age 1
OHJY31	Ohio Management Unit 3 July age 1
OLPN40	Outer Long Point Bay Nearshore Management Unit 4 age 0
OLPN41	Outer Long Point Bay Nearshore Management Unit 4 age 1
OLPO40	Outer Long Point Bay Offshore Management Unit 4 age 0
OLPO41	Outer Long Point Bay Offshore Management Unit 4 age 1
ILPF40	Inner Long Point Bay Management Unit 4 age 0
ILPF41	Inner Long Point Bay Management Unit 4 age 1
LPC40	Long Point Composite Management Unit 4 age 0
LPC41	Long Point Composite Unit 4 age 1
LPS41	Long Point Bay Management Unit 4 summer Gill Net age 1
NYF40	New York Management Unit 4 fall trawl age 0
NYF41	New York Management Unit 4 fall trawl age 1
NYGN41	New York Management Unit 4 gill net age 1
OPSF11	Ontario Partnership Gill Net Management Unit 1 fall age 1
OPSF21	Ontario Partnership Gill Net Management Unit 2 fall age 1
OPSF31	Ontario Partnership Gill Net Management Unit 3 fall age 1
OPSF41	Ontario Partnership Gill Net Management Unit 4 fall age 1