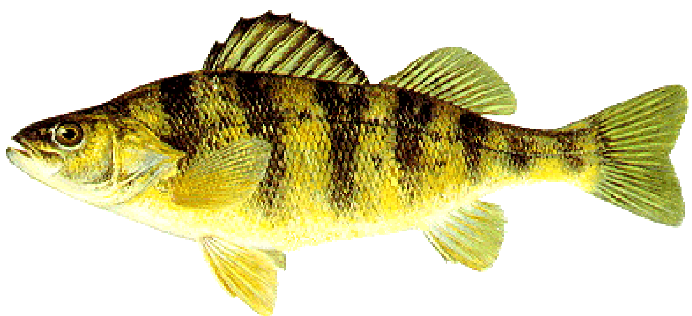
Report of the Lake Erie Yellow Perch Task Group

March 17, 2008



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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

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Note: The data and management summaries contained in this report are provisional. Every effort has been made to insure their correctness. Contact individual agencies for complete state and provincial data. Data reported in pounds for years prior to 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 2007 through March 2008, the Yellow Perch Task Group (YPTG) addressed the following charges:

1. Maintain centralized time series of data required for population models and assessments including:
   a) Fishery harvest, effort, age composition and biological parameters
   b) Survey indices of juvenile and adult abundance, size at age and biological parameters.
   c) Examine methods of expressing juvenile indices; *i.e.* area-based trawl catch rates (catch/ha).
   d) Standardize approaches within YPTG and between YPTG/WTG including q blocks, and selectivity methods.

2. Support a sustainable harvest policy by:
   a) Examining exploitation strategies
   b) Recommending an allowable harvest for 2008 for each management unit
   c) Supporting decision/risk analysis strategies for yellow perch management.

3. Prepare a Lake Erie Yellow Perch Management Plan.

4. Review different methods for calculation of lambdas for use in catch-at-age analyses; implement the most scientifically defensible method for weighting data sources used in analyses.

Charge 1: 2007 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) in 2007 was 11.389 million pounds. This allocation represented a 31% decrease from a TAC of 16.480 million pounds in 2006. For yellow perch assessment and allocation, Lake Erie is partitioned into four Management Units (Units, or MUs; Figure 1.1). The 2007 allocation by management unit was 1.679, 4.206, 5.229 and 0.275 million pounds for Units 1 through 4, respectively. The lakewide harvest of yellow perch in 2007 was 9.684 million pounds. This was a 12.8% decrease from the 2006 harvest of 11.104 million pounds. Harvest by management unit was 1.8, 4.1, 3.6 and 0.2 million pounds for Units 1 through 4, respectively (Table 1.1). The portion of TAC harvested was 106%, 97%, 69% and 87% in MUs 1 through 4, respectively. In 2007, Ontario harvested 5.8 million pounds, followed by Ohio (3.6 million lbs.), Pennsylvania (219 thousand lbs.), Michigan (63 thousand lbs.) and New York (26 thousand lbs.).

Ontario's fraction of allocation harvested was 103% in MU1, 103% in MU2, 102% in MU3, and 122% in MU4. Ontario exceeded the MU4 TAC due to a discrepancy between Ontario quota zone delineation and LEC management unit divisions. Overages in other MUs by Ontario commercial fishers can be explained by adjustments for ice allowance. Ohio fishers attained 118% of their TAC in the western basin (MU1), 93% in the west central basin (MU2) and 23% in the east central basin (MU3). Michigan anglers in MU1 attained almost half of their TAC (46%). Pennsylvania fisheries achieved a fraction of their TAC in MU3 (31%), and just over half of their TAC in MU4 (55%). New York fisheries attained 34% of their TAC in MU4.

Ontario's portion of the lakewide yellow perch harvest decreased to 59% in 2007 from 73% in 2006 (Table 1.1). Ohio's proportion of lakewide harvest was 37% in 2007, up from 24% in 2006. Harvest in Michigan, Pennsylvania and New York combined represented 3.2% of the lakewide harvest in 2007.

Ontario uses 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. 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 landed catch reports. Additional fishery documentation is available in annual agency reports.

Harvest, fishing effort, and fishery harvest rates are summarized for the time period 1997-2007 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends over a longer time series (1975-2007) 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 in 2007 of harvest (all gears) and effort by gear type for 2007 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) gill nets in 2007 ranged from 8% to 10% of the gill net harvest in MUs 1-2 but was negligible in MU3 and MU4 (<2%). Harvest, effort and catch per unit effort from *a*) standard yellow perch effort (<3 inch stretched mesh) and *b*) larger mesh sizes, are distinguished in Tables 1.2 to 1.5. Harvest from targeted small mesh gill nets declined 47% in MU1, 48% in MU2, 12% in MU3 and 22% in MU4. Ontario trap net harvest is minimal and is not included in the total harvest of yellow perch. Incidental catch of yellow perch in Ontario commercial trawls is included in the total harvest of yellow perch in Table 1.1 and is documented by MU at the bottom of Tables 1.2 to 1.5. Targeted gill net effort decreased in all Management Units. Targeted gill net effort decreased 57% in MU1, 75% in MU2, 45% in MU3 and 45% in MU4 from 2006. Gill net effort remained lower in 2007 compared to the 1990's and earlier decades (Figure 1.3). Targeted gill net harvest rates increased in 2007 compared to 2006 in all Management Units (Figure 1.4). Targeted gill net harvest rates increased 24% in MU1, 106% in MU2, 61% in MU3 and 44% in MU4. Harvest rates in MU2 and MU3 in 2007 were the highest in the time series.

In 2007, sport harvest in U.S. waters increased in MU3 (79%), and decreased in MU1 (4%), MU2 (16%) and MU4 (56%) from 2006 (Figure 1.2). The increase in MU3 can be partially attributed to a shift in the dividing line between MU3 and MU4 in Pennsylvania waters, causing an increase in Pennsylvania harvest in MU3 and a decrease in MU4. Angling effort in U.S. waters increased in 2007 from 2006 in MU1 (25%) and MU3 (77%), and decreased in MU4 (34%). Effort remained approximately the same in MU2 in 2007 (Figure 1.3). The sport harvest of yellow perch from Ontario waters is assessed periodically and was not assessed in 2007. Angling harvest rates are expressed as kg harvested per angler hour graphically for pooled jurisdictions (Figure 1.4), while harvest rates for jurisdictions are expressed as number of fish harvested per angler hour for those anglers seeking yellow perch in Tables 1.2-1.5. Sport harvest rates decreased in MU1, MU2, and MU4 from 2006 in kg/hr by 24%, 16%, and 33% respectively. The sport harvest rate remained approximately the same in MU3 from 2006 to 2007. When sport harvest rates are expressed in fish/hr, harvest rates decreased in MU1 (Michigan and Ohio), MU2 (Ohio), and MU4 (Pennsylvania and New York), but remained approximately the same in MU3 (Ohio and Pennsylvania).

Harvest from Ohio, Pennsylvania, and New York commercial trap nets in 2007 decreased 15% in MU1 and 21% in MU3, increased 129% in MU2 and remained approximately the same in MU4 from 2006. Trap net effort (lifts) in 2007 decreased in MU1 (16%), MU3 (20%), and MU4 (30%), but increased 22% in MU2 compared to 2006. Ohio trap nets continued fishing in 2007 after re-entering the MU3 fishery in 2005 following three years of absence. Trap net harvest rates increased in MU2 (88%) and MU4 (46%), but remained approximately the same in MU1 and MU3 from 2006.

Age Composition and Growth

The yellow perch harvest in 2007 consisted mostly of the 2003 (age 4), 2001 (age 6), and 2005 (age 2) year classes in MUs 1 and 2, while the 2003 (age 4), 2001 (age 6), and older year classes (1999, 1998 and earlier) were more dominant in the MU3 and MU4 harvest (Table 1.6). The strong 2003 year class (age 4) was a major contributor to all fisheries across all MUs; however, the 2005 (age 2) year class was a sizable contributor to the sport fishery in MU1. Overall, the 2003 year class accounted for the majority (77%) of the lakewide harvest. Age-3 and age-5 yellow perch (2004 and 2002 year classes) were not prominent in any fisheries, although the 2002 year class did represent a larger proportion (10%) of harvest in MU3 than in the other MUs. This higher percentage of the 2002 year class in MU3 was seen primarily in the gill net fishery.

Yellow perch growth differs among life stages and between basins as illustrated by trends in length-at-age (Figure 1.9). A wealth of yellow perch growth data exists among Lake Erie agencies. For simplicity, Figure 1.9 is comprised of young-of-the-year data from summer and fall interagency trawls, while data for age 1 and successive ages to age 4 are from Ontario Partnership gill net surveys (MUs 1 and 4) and Ohio fall trawls (MUs 2 and 3). Size-at-age time series results describe relatively stable length-at-age for ages 0-4 across management units. However, there are some recent trends in declining growth in age 3 (since 2003 in MU3), age 2 (since 2003 in MU3), and age 0 (since 2004 in MU3 and MU4). Figure 1.10 is comprised of data from Ontario Partnership gill net surveys (MUs 1 and 4) and Ohio fall trawls (MUs 2 and 3). Additional data from Long Point Bay trawl surveys is used to determine condition of Age-0 yellow perch in MU4. Condition factors (K) of age 1 yellow perch appears to be declining in MU1 (Figure 1.10). Condition of age 1 and age 4 yellow perch has increased in MU2 since 2005. Condition of age 0 fish had been declining since 2004 in MU3; however, it increased in 2007. Condition of ages 1, 2, 3 and 4 yellow perch has increased in MU3 since 2005. In MU4 there does not appear to be any trend in fish condition.

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). This year, the YPTG has moved from using a two year average of weight-at-age to using a three year average. This was done 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.

ADMB Catch-at-Age Analysis 2008

Population size for each management unit was estimated by catch-at-age analysis using the Auto Differentiation Model Builder computer program (ADMB), with the Ontario Commercial Selectivity Index (CSI) version that incorporates commercial gill net catchability coefficients based on the seasonal distribution of harvest and relative catch rates. The approach was similar to the last several years' methodology; however, the start year for the last commercial catchability block in the time series was aligned with the start year for the Commercial Selectivity Index (CSI) time series at the direction of Michigan State University's Quantitative Fisheries Center. Estimates of population size, biomass, and parameters such as survival and exploitation rates are presented by management unit for 1990-2007 in Table 1.7 and graphically for 1975-2007 in Figures 1.11–1.14. Mean weight-at-age from surveys was applied to abundance estimates to generate population biomass estimates (Table 1.8 and Figure 1.12). Population abundance and biomass estimates are critical to monitoring the status of stocks and determining allowable harvest.

Abundance estimates should be interpreted with several caveats. Inclusion of abundance estimates from 1975 to 2007 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), while methods of fishery data collection have also varied. Some model parameters are constrained to constants, such as natural mortality, catchability and selectivity blocks. This technique lessens our ability to directly compare abundance levels over three decades. In addition, commercial gill net selectivity (CSI) was estimated independently in the latter part of the time series using gill net selectivity curves derived from index gillnet 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. With catch-at-age analysis, the most recent year's data estimates inherently have the widest error bounds. This is to be expected for cohorts that remain at-large (especially under less than full selectivity) in the population.

Population estimates are derived by minimizing an objective function weighted by data sources including fishery effort, fishery catch, and survey catch rates. The weightings (or lambdas) of effort data are calculated by the ratio of variance of observed log-catch to log-effort (Quinn and Deriso 1999). Weightings of fishery catch and survey catch rates are solved iteratively until convergence occurs; *i.e.* until lambdas remain relatively constant (they do not change within a factor of 0.1). While lambdas within similar parameter groups (effort, catch and surveys) are solved and weighted unequally, the groups themselves are given equal weight (the greatest lambda for catch, effort, and surveys is 1.0). Data weightings are presented in Appendix A, Table 1. In order to address this lambda calculation process fully, a new charge was undertaken in 2006 to derive the most scientifically defensible model lambdas. See section below under "*Charge 5: Lambda Review.*"

Recruitment Estimator for Incoming Age 2 Yellow Perch

Age-2 yellow perch recruitment in 2008 was predicted by linear regression of juvenile yellow perch trawl indices against catch-at-age analysis estimates of two-year-old abundance in each management unit. Age-2 yellow perch recruitment in 2008 was calculated using the mean of values predicted from the indices that correlate well ($p<0.01$, $r^2>0.50$) with age-2 abundance estimates (Appendix A, Table 2). Data from trawl index series for the time period examined are presented in Appendix A, Table 3, while a key that summarizes abbreviations used for the trawl series is presented as a legend in Appendix A.

Estimates of age-2 yellow perch recruitment for 2008 (the 2006 year class) were below average in MUs 1 and 2, slightly above average in MU3 (but it exhibits a high degree of variability), and near average in MU4 (Table 1.7, Appendix A, Table 2). The 2006 year class is expected to contribute minimally to fisheries in 2008. This marks the fourth time in the last five years that age-2 yellow perch recruitment is near or below the levels of poor recruitment portrayed in the early 1990's (1990-1994) in MU1 and MU2. Early 1990's recruitment resulted in minimal stock sizes that were, in many cases, 25% of the magnitude of yellow perch stocks from the late 1990's and early 2000's. In the event of continued poor recruitment, the risk of attaining reference levels of low abundance observed in 1993 and 1994 increases.

2008 Population Size Projection

Stock size estimates for 2008 (ages 3 and older) were projected from catch-at-age analysis estimates of 2007 population size and age-specific survival rates in 2007 (Table 1.8). Projected age-2 yellow perch recruitment from the 2006 year class (method described above) was added to the 2008 population estimate for older fish in each unit, producing the total standing stock in 2008 (Table 1.8). Standard errors and ranges for estimates are provided for each age in 2007, and following estimated survival from ADMB for 2008. Descriptions of *min, mean*, and *max* population estimates refer to the estimates minus or plus one age-specific standard error.

Stock size estimates projected for 2008 were lower primarily due to mortality exerted on the 2003 year class and lower recruitment in MUs 1 and 2 (Table 1.7 and Figure 1.11). Due to the weaker 2006 year class, which was preceded by weak 2004 and 2005 year classes, estimated abundances of ages 2 and older yellow perch in 2008 are 19%, 37%, and 10% lower than the 2007 abundances across Management Units 1-3, respectively. Estimated abundance of ages 2 and older yellow perch in MU4 increased 5% in 2008 from 2007 due to a moderate age-2 year class. Abundance projections for 2008 were 25, 51, 55 and 11 million age-2 and older yellow perch in Management Units 1 through 4, respectively. Estimates of abundance for age-3 and older yellow perch in 2008 are lower compared to the 2007 estimates in MU2 (27%), MU3 (18%), and MU4 (3%); however, estimates of abundance in MU1 are 4% higher in 2008 than in 2007. Age-3 and older yellow perch abundance in 2008 is projected to be 16, 42, 33, and 7 million fish in Units 1 through 4, respectively.

As a function of population estimates and mean weight-at-age from surveys, total biomass estimates of age-2 and older yellow perch for 2008 have declined for the third consecutive year in MU1, MU2 and MU3, and declined slightly from 2007 in MU4 (Figure 1.12). Total biomass in 2008 is estimated to decrease from 2007 values in MU1 (26%), MU2 (32%), MU3 (15%) and MU4 (13%). The biomass estimates for 2008 are below the historic (1975-2007) mean in MU1 (58% of the mean value), and above the historic long-term mean by 11% in MU2, 69% in MU3, and 103% in MU4. The strong 2003 year class at age 5 is expected to represent the largest fraction of total biomass in 2008 in MU2 (55%), MU3 (38%), and MU4 (34%). The 2005 year class (at age 3) is expected to represent the largest fraction of total biomass in MU1 (35%) with the 2003 year class representing 32% of the MU1 biomass.

Estimates of yellow perch survival for ages 3 and older in 2006 were 39%, 54%, 51% and 58% in MUs 1-4, respectively (Figure 1.13). In 2007, estimated survival rates of age-3 and older were 45%, 47%, 52% and 64% in Units 1 through 4 (Table 1.8). As expected, survival rates were higher for fish age-2 and older than age-3 and older, since new recruits are less vulnerable to fishing mortality.

Estimated exploitation rates in 2006 were 35%, 16%, 20% and 11% in Management Units 1–4, respectively, for age-3 and older. Exploitation rates for 2007 were estimated at 28%, 25%, 18% and 4% for yellow perch age-3 and older across the MUs (Figure 1.14). Exploitation rates of yellow perch age-2 and older are slightly lower since new recruits are less vulnerable to fishing.

Yellow Perch Genetics and Stock Discrimination

In 2007, the YPTG supported an examination of morphological measures to assess stock structure with Dr. Patrick M. Kocovsky of the U.S. Geological Survey, Lake Erie Biological Station. Whole-body morphology has been used successfully to identify stock structure of lake herring (*Coregonus artedi*) in Lake Superior (Hoff 2004) and orange roughy (*Hoplostethus atlanticus*) in Australian waters (Elliott et al. 1995), and to discriminate between fall and spring runs of Chinook salmon (*Oncorhynchus tshawytscha;* Tiffan et al. 2000). An advantage of morphological measurements for stock identification is that whole-body morphology is a reflection of both the genetic composition of fishes (*i.e.*, the genes that control morphology) and the conditions in which a species lives; thus, morphology integrates genetics and the environment. Accordingly, the genetic and morphometric analyses will complement each other and provide a more holistic assessment of stock structure in Lake Erie. The YPTG will continue to support this work in 2008.

In recent years, tissue collection has become an annual endeavor by the YPTG with the expectation that genetic research will expand our understanding of yellow perch stock structure and assist in defining management unit delineation. The latest genetic analyses completed with YPTG samples have been summarized by the University of Toledo's Osvaldo J. Sepulveda Villet in a progress report to the Yellow Perch Task Group (Sepulveda Villet 2007). Ongoing tissue collections from spawning concentrations should continue to assemble a diverse database representing a thorough stock library for Lake Erie yellow perch. The YPTG will continue to provide support for genetic stock discrimination research initiatives, as requested.

Charge 2: Harvest Strategy and RAH

Harvest Strategy Methodology

In 2008, fishing rates applied in 2007 (F_{2007}) are presented for MUs 1-4 in Tables 2.1.1-2.1.4 and in Table 2.2.1 summarized for all management units. These rates are the same as $F_{0.1}$ fishing rates presented in the 2005 YPTG report for Units 1, 2, 3 and 4. In 2004, $F_{0.1}$ values were derived based on the ratio of average yield to average recruitment plotted against fishing rates in simulations that assumed gamma stock-recruitment functions based on 1975-2003 stock and recruitment estimates. $F_{0.1}$ was determined from the fishing rate at which the slope was 10% of the initial slope of the curve. This approach does not assume knife-edge recruitment. The simulation assumes that the targeted fishing rates will be realized for all gear types.

Stock-Recruitment Simulation

This simulation approach, documented in YPTG 2004, remains the same with the exception that the time series used for the stock-recruitment relationship is shorter (1982-2006). The time series was shortened as the task group believes that conditions during the 1970s were more favorable for supporting recruitment compared to the period after in which municipal phosphorus loading targets were achieved (Dolan 1993). The length of the spawner-recruit (S/R) time series is relevant for assessing the risk associated with fishing rates. Spawner-recruit relationships were described by gamma functions (Reish et al. 1985 in Quinn et al. 1999) with the recognition that environmental factors exert major influence on recruitment. The YPTG created population simulations based on gamma stock-recruitment functions, influenced by environmental factors. Environment Factors (EF) were derived from residuals of the S/R relationship as:

EF = (observed recruitment)/(predicted recruitment)

Two years of recent abundance estimates were used to initiate simulations. Recruitment for each year was estimated from the S/R function, and then multiplied by an EF selected randomly from the observed distribution of residuals (EFs). This process extended over 20 years and 100 replicates under a broad range of fishing mortality rates (F=0 to 2) to produce measures of risk. Other model parameters included were consistent with ADMB catch-at-age analysis. This process, applied to populations in each management unit, allowed the YPTG to quantify risk associated with various fishing rates, while giving consideration to stock-recruitment patterns and environmental influences experienced by yellow perch during recent decades in Lake Erie. Biological reference points including spawner biomass (as a fraction of an unfished population), survival rates, and the probability of attaining low levels of abundance comparable to 1993-94 were included as outputs. A further refinement since the 2005 YPTG report included averaging the results of simulations over ten multiple runs. Updated $F_{0.1}$ reference points were derived based on the fishing rate at which the slope equaled 10% of the initial slope when average yield was plotted against instantaneous fishing mortality rate. Results are presented for Management Units 1 through 4 in Tables 2.1.1-2.1.4

Harvest Strategies and RAH Determination

Risk levels associated with fishing rates are based on simulations updated in 2008, and are presented for MUs 1-4 (Tables 2.1.1 – 2.1.4). Target fishing rates used for TACs in 2007 (F_{2007}) are proposed for 2008 TACs, and are presented for Management Units 1 through 4 (Table 2.2.1).

$F_{0.1}$ rates calculated in the same method as last year are presented as biological reference points in Tables 2.1.1– 2.1.4.

In 2005, an exercise was completed to update the allocation area shares using geographical information systems (GIS) mapping. In 2008, updated area percentages will be implemented as allocation shares among jurisdictions (Figure 2.1). Allocation shares by management unit and jurisdiction are:

Allocation by Management Unit and Jurisdiction, 2008:

MU 1:	MI 9.10%	OH 50.31%	ONT 40.58%
MU 2:	OH 54.42%	ONT 45.58%	
MU 3:	OH 32.85%	PA 15.46%	ONT 51.69%
MU 4:	NY 30.27%	PA 10.76%	ONT 58.97%

Charge 3: Lake Erie Yellow Perch Management Plan

With oversight by the Standing Technical Committee (STC), the YPTG was charged with preparation of a Lake Erie Yellow Perch Management Plan (YPMP) as a companion document to the recently completed Walleye Management Plan. The YPTG has completed a draft of the YPMP, including strategies for the exploitation of yellow perch in Lake Erie. The YPTG recommendations in the YPMP include benchmarks for population abundance and a sliding fishing rate harvest strategy in each MU, similar to what has been implemented by the Lake Erie Walleye Task Group. The YPTG and LEC are currently examining these exploitation strategies further. Implementation of the YPMP and its exploitation policies is expected after stakeholder review of the management plan and final approval by the LEC.

Charge 4: Lambda Review – Data Weighting Factors in Catch-at-age Analysis

In 2005-06, the YPTG was charged with reviewing the methodology of assigning weighting factors to data sources in the catch-at-age models. The current weighting methodology is described in Charge 1 of this report. The Lake Erie Walleye and Yellow Perch Task Groups have been working with Dr. James Bence and Travis Brenden of Michigan State University's Quantitative Fisheries Center (QFC) and Dr. Yingming Zhao of the Ontario Ministry of Natural Resources to resolve the lambda weighting issues in the ADMB catch-at-age models. Previous external reviews by QFC modelers have shown the current methods, while adequate, could be improved. Task group members and QFC personnel held a workshop at the Great Lakes Fishery Commission office in Ann Arbor, Michigan, on June 14, 2007, to discuss new lambda weighting processes. At this meeting, a Bayesian approach to determining dataset weightings was presented and discussed. A Bayesian approach is able to approximate uncertainty by providing a posterior distribution of parameters using lengthy runs of Markov Chain Monte Carlo (MCMC) simulations. Since the meeting, the modeling group developed Bayesian models for Lake Erie walleye and yellow perch which weighted datasets based on their relative coefficients of variance. Evaluation of these models using total sums of square, degree of retrospectivity, and deviance information criteria, revealed that further model refinements and testing is still required. The QFC has now appointed a Ph.D. student to investigate the structure of the yellow perch and walleye models including an investigation of dataset weightings. Final results of this investigation are not expected for approximately three years; however, the task groups' modelers can incorporate valuable, substantial model improvements as they become available upon presentation and discussion with the STC and LEC. At this time, the YPTG is continuing to utilize the population abundance estimation models which weight data sets by the ratio of variance of observed log-catch to log-effort.

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- Dr. James Bence, Dr. Michael Jones and Travis Brenden of Michigan State University's Quantitative Fishery Center;
- Dr. Carol Stepien and Osvaldo J. Sepulveda Villet of the University of Toledo;
- Mike Bur of the U.S. Geological Survey, Biological Resources Division, Sandusky.

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Table 1.1. Lake Erie yellow perch harvest in pounds by management unit (Unit) and agency, 1997-2007.

		Ontario*		**Ohio**		**Michigan**		**Pennsylvania**		**New York**		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest
Unit 1	1997	1,091,844	48	1,071,025	47	111,819	5	--	--	--	--	2,274,688
	1998	1,170,533	52	968,842	43	132,051	6	--	--	--	--	2,271,426
	1999	1,048,100	51	908,548	44	101,549	5	--	--	--	--	2,058,197
	2000	980,323	47	1,038,650	50	67,010	3	--	--	--	--	2,085,983
	2001	813,066	45	915,641	51	70,910	4	--	--	--	--	1,799,617
	2002	1,454,105	50	1,316,553	45	147,065	5	--	--	--	--	2,917,723
	2003	1,179,667	44	1,406,385	53	84,878	3	--	--	--	--	2,670,930
	2004	1,698,761	59	1,090,669	38	94,732	3	--	--	--	--	2,884,162
	2005	1,513,890	60	965,231	38	49,485	2	--	--	--	--	2,528,606
	2006	1,325,464	54	1,055,378	43	62,854	3	--	--	--	--	2,443,696
	2007	727,678	41	982,677	55	62,815	4	--	--	--	--	1,773,170
Unit 2	1997	1,826,180	63	1,079,882	37	--	--	--	--	--	--	2,906,062
	1998	1,797,458	74	627,944	26	--	--	--	--	--	--	2,425,402
	1999	1,572,829	62	974,123	38	--	--	--	--	--	--	2,546,952
	2000	1,484,125	56	1,169,234	44	--	--	--	--	--	--	2,653,359
	2001	1,794,275	51	1,747,069	49	--	--	--	--	--	--	3,541,344
	2002	2,190,621	52	1,986,730	48	--	--	--	--	--	--	4,177,351
	2003	2,107,639	50	2,113,285	50	--	--	--	--	--	--	4,220,924
	2004	2,051,473	48	2,246,264	52	--	--	--	--	--	--	4,297,737
	2005	2,666,231	59	1,843,190	41	--	--	--	--	--	--	4,509,421
	2006	3,102,269	69	1,393,732	31	--	--	--	--	--	--	4,496,001
	2007	1,847,139	45	2,244,656	55	--	--	--	--	--	--	4,091,795
Unit 3	1997	829,353	77	219,664	20	--	--	23,360	2	--	--	1,072,377
	1998	811,903	73	274,993	25	--	--	28,527	3	--	--	1,115,423
	1999	665,703	65	352,635	34	--	--	8,925	1	--	--	1,027,263
	2000	771,646	62	443,250	36	--	--	32,613	3	--	--	1,247,509
	2001	999,450	64	464,811	30	--	--	91,211	6	--	--	1,555,472
	2002	1,192,691	60	640,104	32	--	--	140,821	7	--	--	1,973,616
	2003	1,667,133	72	481,558	21	--	--	177,516	8	--	--	2,326,207
	2004	1,453,419	62	659,447	28	--	--	244,063	10	--	--	2,356,929
	2005	1,771,800	75	457,593	19	--	--	142,028	6	--	--	2,371,421
	2006	3,451,499	90	271,144	7	--	--	106,260	3	--	--	3,828,903
	2007	2,997,101	84	391,285	11	--	--	193,065	5	--	--	3,581,451
Unit 4	1997	36,171	87	--	--	--	--	3,049	7	2,387	6	41,607
	1998	48,457	93	--	--	--	--	538	1	3,175	6	52,170
	1999	59,842	92	--	--	--	--	2,216	3	3,234	5	65,292
	2000	35,686	73	--	--	--	--	10,950	22	2,458	5	49,094
	2001	35,893	60	--	--	--	--	8,337	14	15,319	26	59,549
	2002	87,541	54	--	--	--	--	46,903	29	26,903	17	161,347
	2003	84,772	60	--	--	--	--	39,821	28	16,511	12	141,104
	2004	98,733	49	--	--	--	--	46,344	23	54,862	27	199,939
	2005	195,347	67	--	--	--	--	42,226	15	53,468	18	291,041
	2006	230,226	69	--	--	--	--	57,005	17	48,107	14	335,338
	2007	185,954	78	--	--	--	--	25,859	11	25,935	11	237,748
Lakewide Totals	1997	3,783,548	60	2,370,571	38	111,819	2	26,409	<1	2,387	<1	6,294,734
	1998	3,828,351	65	1,871,779	32	132,051	2	29,065	<1	3,175	<1	5,864,421
	1999	3,346,474	59	2,235,306	39	101,549	2	11,141	<1	3,234	<1	5,697,704
	2000	3,271,780	54	2,651,134	44	67,010	1	43,563	1	2,458	<1	6,035,945
	2001	3,642,684	52	3,127,521	45	70,910	1	99,548	1	15,319	<1	6,955,982
	2002	4,924,958	53	3,943,387	43	147,065	2	187,724	2	26,903	<1	9,230,037
	2003	5,039,211	54	4,001,228	43	84,878	<1	217,337	2	16,511	<1	9,359,165
	2004	5,302,386	54	3,996,380	41	94,732	1	290,407	3	54,862	<1	9,738,767
	2005	6,147,268	63	3,266,014	34	49,485	<1	184,254	2	53,468	<1	9,700,489
	2006	8,109,458	73	2,720,254	24	62,854	<1	163,265	1	48,107	<1	11,103,938
	2007	5,757,872	59	3,618,618	37	62,815	<1	218,924	2	25,935	<1	9,684,164

*processor weight (quota debit weight) to 2001; fisher/observer weight from 2002 to present (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, 1997-2007.

		Unit 1				
		Michigan	Ohio		Ontario Gill Nets	
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh
Harvest (pounds)	1997	111,819	211,876	859,149	1,091,844	--
	1998	132,051	184,142	784,700	1,170,533	--
	1999	101,549	200,939	707,609	1,048,100	--
	2000	67,010	240,541	798,109	980,323	--
	2001	70,910	179,234	736,407	711,745	101,321
	2002	147,065	337,829	978,724	1,359,637	94,468
	2003	84,879	250,456	1,155,929	1,151,358	28,309
	2004	94,732	289,136	801,533	1,637,488	61,273
	2005	49,485	357,182	608,049	1,402,523	111,082
	2006	62,854	235,852	819,526	1,264,370	61,094
	2007	62,815	200,818	781,859	671,536	56,142
Harvest (Metric) (tonnes)	1997	51	96	390	495	--
	1998	60	84	356	531	--
	1999	46	91	321	475	--
	2000	30	109	362	445	--
	2001	32	81	334	323	46
	2002	67	153	444	617	43
	2003	38	114	524	522	13
	2004	43	131	364	743	28
	2005	22	162	276	636	50
	2006	29	107	372	573	28
	2007	28	91	355	305	25
Effort *(a)*	1997	192,605	5,580	834,934	13,704	--
	1998	183,882	5,446	863,336	19,095	--
	1999	184,710	5,185	941,350	12,846	--
	2000	122,447	4,026	965,628	6,741	--
	2001	97,761	1,518	720,923	2,167	2,142
	2002	190,573	2,715	900,289	4,546	739
	2003	121,638	2,213	1,182,694	3,725	395
	2004	206,902	4,351	833,690	6,052	901
	2005	98,429	3,903	816,959	5,170	1,182
	2006	118,628	3,517	683,994	5,194	787
	2007	181,698	2,951	823,624	2,230	1,125
Harvest Rates *(b)*	1997	2.8	17.2	3.7	36.1	--
	1998	3.2	15.3	3.8	27.8	--
	1999	2.1	17.6	3.3	37.0	--
	2000	2.2	27.1	3.0	66.0	--
	2001	2.9	53.5	3.4	149.1	21.5
	2002	2.5	56.4	3.4	135.7	58.2
	2003	2.4	51.3	3.5	140.1	32.4
	2004	1.6	30.1	3.0	122.7	30.8
	2005	1.7	41.5	3.1	123.0	42.6
	2006	1.7	30.4	4.2	110.4	35.2
	2007	1.0	30.9	3.4	136.6	22.6

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift

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, 1997-2007.

		Unit 2			
		Ohio		Ontario* Gill Nets	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh
Harvest	1997	498,945	580,937	1,826,180	--
(pounds)	1998	304,661	323,283	1,797,458	--
	1999	389,973	584,150	1,572,829	--
	2000	565,009	604,225	1,484,125	--
	2001	905,088	841,891	1,593,704	200,571
	2002	1,099,971	886,759	1,892,070	298,551
	2003	1,255,205	858,080	2,019,617	88,022
	2004	1,287,747	958,517	1,893,871	157,602
	2005	1,162,746	680,444	2,446,007	219,723
	2006	744,452	649,280	2,981,793	120,476
	2007	1,701,552	543,104	1,561,287	173,699
Harvest	1997	226	263	828	--
(Metric)	1998	138	147	815	--
(tonnes)	1999	177	265	713	--
	2000	256	274	673	--
	2001	410	382	723	91
	2002	499	402	858	135
	2003	569	389	916	40
	2004	584	435	859	71
	2005	527	309	1,109	100
	2006	338	294	1,352	55
	2007	772	246	708	79
Effort	1997	8,721	575,365	24,974	--
(a)	1998	7,943	422,176	23,823	--
	1999	7,502	563,819	13,179	--
	2000	5,272	601,712	6,266	--
	2001	4,747	594,741	3,445	4,975
	2002	7,675	658,799	4,786	3,209
	2003	10,214	632,813	5,311	1,555
	2004	12,023	659,454	4,929	2,787
	2005	9,103	784,942	9,716	2,173
	2006	7,544	499,412	11,692	1,925
	2007	9,158	498,843	2,966	2,826
Harvest Rates	1997	25.9	2.8	33.2	--
(b)	1998	17.4	2.6	34.2	--
	1999	23.6	3.0	54.1	--
	2000	48.6	2.9	107.4	--
	2001	86.5	3.2	209.9	18.3
	2002	65.0	3.1	179.3	42.1
	2003	55.7	3.3	172.5	25.7
	2004	48.6	3.7	174.3	25.6
	2005	57.9	2.8	114.2	45.9
	2006	44.8	3.7	115.7	28.4
	2007	84.3	2.8	238.7	27.9

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(*) Ontario commercial trawlers harvested 112,153 pounds of yellow perch in MU2 in 2007

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, 1997-2007.

		Unit 3					
		Ohio		Ontario* Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
Harvest (pounds)	1997	54,776	164,888	829,353	--	7,398	15,962
	1998	90,082	184,911	811,903	--	5,291	23,236
	1999	106,258	246,377	665,703	--	2,905	6,020
	2000	156,510	286,740	771,646	--	5,930	26,683
	2001	4,472	460,339	948,622	50,828	2,602	96,946
	2002	0	640,104	1,094,894	97,797	2,009	138,812
	2003	0	481,559	1,647,047	20,086	5,050	172,467
	2004	0	659,447	1,443,314	10,105	7,753	236,310
	2005	43,253	414,340	1,657,498	113,969	15,228	126,800
	2006	70,310	200,834	3,332,037	119,461	20,467	85,793
	2007	48,286	342,999	2,941,451	42,570	23,471	169,594
Harvest (Metric) (tonnes)	1997	25	75	376	--	3.4	7.2
	1998	41	84	368	--	2.4	11
	1999	48	112	302	--	1.3	2.7
	2000	71	130	350	--	2.7	12
	2001	2.0	209	430	23	1.2	44
	2002	0	290	497	44	0.9	63
	2003	0	218	747	9.1	2.3	78
	2004	0	299	655	4.6	3.5	107
	2005	20	188	752	52	6.9	58
	2006	32	91	1,511	54	9.3	39
	2007	22	156	1,334	19	10.6	77
Effort *(a)*	1997	2,455	126,530	9,423	--	441	43,377
	1998	2,512	111,425	10,809	--	305	30,612
	1999	2,388	176,603	4,338	--	243	28,485
	2000	1,640	214,825	2,342	--	231	48,561
	2001	32	269,062	2,451	1,047	175	90,214
	2002	0	416,543	2,490	1,055	95	123,287
	2003	0	256,890	4,617	316	87	138,720
	2004	0	368,537	3,750	268	70	175,596
	2005	947	305,885	5,098	743	129	127,462
	2006	881	139,536	11,130	1,030	124	60,612
	2007	713	218,683	6,115	614	88	135,611
Harvest Rates *(b)*	1997	10.1	3.1	39.9	--	7.6	0.9
	1998	16.3	3.6	34.0	--	7.9	1.4
	1999	20.2	3.5	69.6	--	5.4	1.3
	2000	43.3	3.0	149.4	--	11.6	1.9
	2001	63.4	2.9	175.4	22.0	6.7	2.6
	2002	--	2.7	199.6	41.7	9.6	3.6
	2003	--	3.1	161.8	28.8	26.3	5.3
	2004	--	4.3	174.6	17.1	50.2	3.9
	2005	20.7	3.1	147.4	69.6	53.5	2.9
	2006	36.2	3.3	135.8	52.6	74.9	3.7
	2007	30.7	3.4	218.2	31.4	121.0	3.8

(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
(*) Ontario commercial trawlers harvested 13,080 pounds of yellow perch in MU3 in 2007.

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, 1997-2007.

		Unit 4					
		New York		Ontario* Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
Harvest (pounds)	1997	1,241	1,146	36,171	--	0	3,049
	1998	1,345	1,830	48,457	--	0	538
	1999	694	2,540	59,842	--	0	2,216
	2000	625	1,833	35,686	--	0	10,950
	2001	27	15,292	34,284	1,608	0	8,337
	2002	1,951	24,952	85,935	1,606	29	46,874
	2003	1,048	15,464	84,648	124	0	39,822
	2004	3,907	50,955	98,716	17	0	90,514
	2005	7,726	45,742	195,258	52	0	42,226
	2006	9,423	38,684	229,063	1,163	0	57,005
	2007	9,511	16,424	179,595	3,076	0	25,859
Harvest (Metric) (tonnes)	1997	0.6	0.5	16.4	--	0	1.4
	1998	0.6	0.8	22.0	--	0	0.2
	1999	0.3	1.2	27.1	--	0	1.0
	2000	0.3	0.8	16.2	--	0	5.0
	2001	0.01	6.9	15.5	0.7	0	3.8
	2002	0.9	11.3	39.0	0.7	0.01	21.3
	2003	0.5	7.0	38.4	0.06	0	18.1
	2004	1.8	23.1	44.8	0.01	0	41.0
	2005	3.5	20.7	88.6	0.02	0	19.2
	2006	4.3	17.5	103.9	0.53	0	25.9
	2007	4.3	7.4	81.4	1.40	0	11.7
Effort *(a)*	1997	292	8,905	1,073	--	0	13,747
	1998	178	7,073	1,081	--	0	3,784
	1999	118	5,410	872	--	0	13,623
	2000	44	2,606	314	--	0	21,146
	2001	39	22,950	128	28.0	0	12,451
	2002	89	44,270	224	28.0	9	61,734
	2003	91	33,162	373	21.0	0	32,525
	2004	44	73,056	355	3.2	0	62,639
	2005	179	58,667	782	7.8	0	70,921
	2006	208	46,174	1,007	31.8	0	47,274
	2007	144	29,999	550	62.1	0	31,545
Harvest Rates *(b)*	1997	1.9	0.27	15.3	--	--	1.0
	1998	3.4	0.46	20.3	--	--	0.3
	1999	2.7	0.44	31.1	--	--	0.4
	2000	6.4	0.20	51.5	--	--	1.7
	2001	0.3	1.65	121.5	26.0	--	1.5
	2002	9.9	1.13	174.0	25.0	1.5	2.4
	2003	5.2	0.76	102.9	2.9	--	1.9
	2004	40.3	1.14	126.1	2.4	--	1.7
	2005	19.6	1.23	113.2	3.0	--	1.8
	2006	20.5	1.36	103.2	16.6	--	2.9
	2007	30.0	0.97	148.1	22.5	--	1.5

(a) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(b) harvest rates for sport in fish/hr, gill net in kg/km, trap net in kg/lift
(*) Ontario commercial trawlers harvested 3,283 pounds of yellow perch in MU4 in 2007.

Table 1.6. Estimated Lake Erie 2007 yellow perch harvest by age in 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	%
	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	106,643	4.2	83,058	1.4	76,759	0.8	1,351	0.3	267,812	1.4
	3	164,099	6.5	21,925	0.4	497,187	4.9	45,449	8.8	728,660	3.8
Gill Nets	4	2,057,414	81.9	5,098,551	87.9	7,502,528	73.4	383,384	74.4	15,041,877	79.0
	5	27,164	1.1	51,747	0.9	1,153,583	11.3	32,113	6.2	1,264,607	6.6
	6+	155,505	6.2	546,894	9.4	989,717	9.7	52,786	10.2	1,744,903	9.2
	Total	2,510,825		5,802,176		10,219,775		515,083		19,047,859	
	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	25,170	3.7	201,794	3.6	16,725	7.8	0	0.0	243,689	3.7
	3	23,297	3.4	148,341	2.7	7,387	3.5	0	0.0	179,025	2.8
Trap Nets	4	482,169	70.6	4,583,415	82.1	168,792	78.9	3,890	18.1	5,238,266	80.6
	5	26,783	3.9	120,334	2.2	3,102	1.5	864	4.0	151,083	2.3
	6+	125,415	18.4	530,194	9.5	17,814	8.3	16,714	77.9	690,137	10.6
	Total	682,834		5,584,078		213,820		21,468		6,502,200	
	1	34,304	1.1	5,525	0.4	0	0.0	0	0.0	39,829	0.7
	2	680,879	22.7	66,893	4.6	45,641	3.9	3,348	3.9	796,761	13.9
	3	122,289	4.1	90,378	6.2	20,998	1.8	1,583	1.8	235,248	4.1
Sport	4	1,851,062	61.8	1,086,916	74.2	727,080	62.3	49,399	57.3	3,714,457	65.0
	5	20,478	0.7	20,062	1.4	17,297	1.5	3,132	3.6	60,969	1.1
	6+	287,352	9.6	194,933	13.3	356,618	30.5	28,781	33.4	867,684	15.2
	Total	2,996,364		1,464,707		1,167,634		86,243		5,714,948	
	1	34,304	0.6	5,525	0.0	0	0.0	0	0.0	39,829	0.1
	2	812,692	13.2	351,745	2.7	139,125	1.2	4,699	0.8	1,308,262	4.2
	3	309,685	5.0	260,644	2.0	525,572	4.5	47,032	7.6	1,142,933	3.7
All Gear	4	4,390,645	71.3	10,768,882	83.8	8,398,400	72.4	436,673	70.1	23,994,600	76.7
	5	74,425	1.2	192,143	1.5	1,173,982	10.1	36,109	5.8	1,476,659	4.7
	6+	568,272	9.2	1,272,021	9.9	1,364,149	11.8	98,281	15.8	3,302,724	10.6
	Total	6,155,719		12,850,961		11,601,229		622,794		31,265,007	

Table 1.7. Yellow perch stock size (millions of fish) in each Lake Erie management unit. The years 1990 to 2007 are estimated by ADMB catch-age analysis. The 2008 population estimates use age-2 yellow pe estimates derived from regressions of ADMB age-2 abundance values against YOY and yearling trawl index values.

	Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Unit 1	2	3.645	10.739	14.049	4.427	10.184	22.836	26.248	21.449	41.407	10.239	32.693	31.810	8.284	40.068	3.222	47.979	2.510	15.411	8.927
	3	1.347	1.933	5.677	7.820	1.808	6.224	14.002	15.681	13.385	25.642	6.567	20.890	20.567	5.336	25.358	2.060	29.844	1.623	9.460
	4	5.353	0.517	0.602	2.027	2.071	0.811	2.826	6.138	7.469	6.837	14.258	3.653	12.466	10.897	2.997	12.052	1.031	12.153	0.920
	5	2.071	1.536	0.120	0.141	0.308	0.520	0.225	0.753	1.915	2.727	3.115	7.049	1.988	5.174	4.963	1.136	4.352	0.416	5.262
	6+	1.531	0.668	0.316	0.073	0.024	0.080	0.177	0.102	0.184	0.486	1.220	1.924	4.672	2.399	3.171	2.421	1.042	1.633	0.855
	2 and Older	13.947	15.394	20.764	14.488	14.396	30.471	43.478	44.123	64.360	45.931	57.853	65.326	47.978	63.872	39.711	65.648	38.778	31.235	25.423
	3 and Older	10.302	4.655	6.715	10.061	4.212	7.635	17.229	22.674	22.953	35.692	25.161	33.517	39.693	23.805	36.489	17.669	36.268	15.825	16.496
Unit 2	2	5.465	14.111	18.787	6.567	12.120	12.582	27.314	16.416	61.664	15.100	53.536	43.561	10.059	85.404	5.504	133.012	4.441	22.905	8.584
	3	1.473	2.183	5.861	9.124	3.064	6.928	7.057	13.226	8.423	32.297	9.325	32.245	25.718	6.316	51.151	3.574	85.242	2.918	14.855
	4	7.852	0.516	0.735	2.133	3.385	1.087	2.632	2.811	4.184	3.574	17.872	5.113	18.129	13.599	3.488	26.475	2.031	47.556	1.719
	5	2.297	1.909	0.112	0.199	0.567	0.698	0.231	0.583	0.478	0.874	1.718	8.406	2.455	7.972	5.524	1.580	11.125	1.157	22.218
	6+	1.501	0.748	0.440	0.151	0.082	0.133	0.179	0.091	0.072	0.080	0.385	0.957	4.496	3.043	4.523	4.332	2.506	6.117	3.357
	2 and Older	18.589	19.465	25.935	18.174	19.217	21.428	37.413	33.126	74.822	51.925	82.835	90.282	60.857	116.334	70.190	168.973	105.345	80.652	50.733
	3 and Older	13.124	5.355	7.148	11.607	7.097	8.846	10.100	16.711	13.158	36.825	29.299	46.721	50.799	30.930	64.686	35.961	100.904	57.748	42.149
Unit 3	2	4.489	9.772	5.669	2.976	6.267	6.710	12.359	8.896	35.048	10.887	41.688	24.764	6.190	35.254	3.525	88.188	4.994	20.039	21.310
	3	1.797	2.736	4.251	2.464	1.430	3.588	4.136	7.821	5.497	22.600	7.033	26.799	15.772	3.958	22.797	2.305	58.423	3.297	12.118
	4	4.180	0.856	0.912	1.465	1.006	0.755	2.103	2.412	4.033	3.267	14.370	4.411	16.877	9.767	2.436	13.932	1.401	30.979	1.919
	5	1.380	1.498	0.326	0.264	0.473	0.331	0.384	1.062	1.123	2.196	2.025	8.583	2.701	9.956	5.644	1.407	7.768	0.720	16.124
	6+	4.092	1.712	0.782	0.340	0.200	0.245	0.299	0.340	0.585	0.848	1.833	2.272	6.585	5.502	8.935	8.371	5.499	5.265	3.052
	2 and Older	15.937	16.574	11.940	7.509	9.375	11.628	19.281	20.530	46.286	39.798	66.948	66.830	48.126	64.436	43.338	114.202	78.084	60.300	54.523
	3 and Older	11.448	6.802	6.271	4.533	3.108	4.918	6.922	11.635	11.238	28.911	25.260	42.065	41.936	29.183	39.812	26.014	73.091	40.261	33.213
Unit 4	2	0.574	0.422	0.100	0.269	0.132	1.134	0.764	0.336	3.997	1.494	12.433	2.611	2.166	7.638	1.333	9.390	1.139	3.489	4.174
	3	0.718	0.372	0.270	0.067	0.171	0.085	0.747	0.503	0.221	2.677	0.990	8.296	1.750	1.451	5.104	0.884	6.219	0.759	2.308
	4	0.995	0.362	0.171	0.174	0.029	0.080	0.049	0.433	0.287	0.145	1.697	0.652	5.537	1.157	0.949	3.296	0.555	3.736	0.491
	5	0.407	0.374	0.111	0.097	0.047	0.009	0.039	0.024	0.212	0.180	0.090	1.099	0.434	3.581	0.735	0.596	2.012	0.322	2.373
	6+	0.912	0.493	0.261	0.209	0.080	0.039	0.022	0.029	0.026	0.141	0.193	0.181	0.846	0.796	2.708	2.081	1.579	1.979	1.453
	2 and Older	3.607	2.024	0.913	0.816	0.458	1.347	1.621	1.325	4.743	4.638	15.402	12.839	10.733	14.623	10.828	16.247	11.503	10.285	10.798
	3 and Older	3.032	1.601	0.813	0.547	0.326	0.213	0.857	0.989	0.746	3.144	2.970	10.228	8.567	6.985	9.495	6.856	10.364	6.796	6.625

Table 1.8. Projection of the 2008 Lake Erie yellow perch population. Stock size estimates are derived from ADMB and age 2 estimates for 2008 are derived from regressions of ADMB age-2 abundance against YOY and yearling trawl indices. Standard errors are produced from the ADMB catch-age analysis report.

		2007 Parameters				Rate Functions						2008 Parameters			Stock Biomass			
		Stock Size (numbers)				Mortality Rates				Survival Rate		Stock Size (numbers)			3-yr Mean Weight in	millions kg		millions lbs.
	Age	**Mean**	**Std. Err.**	**Min.**	**Max.**	**(F)**	**(Z)**	**(A)**	**(u)**	**(S)**	**Age**	**Mean**	**Min.**	**Max.**	Pop'n. (kg)	**2007**	**2008**	**2008**
Unit 1	2	15.411	9.754	5.656	25.165	0.088	0.488	0.386	0.070	0.614	2	8.927	6.442	11.411	0.065	1.356	0.580	1.279
	3	1.623	0.754	0.870	2.377	0.168	0.568	0.433	0.128	0.567	3	9.460	3.472	15.447	0.099	0.183	0.937	2.065
	4	12.153	5.269	6.884	17.421	0.437	0.837	0.567	0.296	0.433	4	0.920	0.493	1.347	0.122	1.665	0.112	0.247
	5	0.416	0.173	0.243	0.589	0.445	0.845	0.570	0.300	0.430	5	5.262	2.981	7.544	0.161	0.074	0.847	1.868
	6+	1.633	0.813	0.820	2.446	0.482	0.882	0.586	0.320	0.414	6+	0.855	0.444	1.265	0.217	0.328	0.185	0.409
	Total	31.235		14.473	47.998	0.238	0.638	0.472	0.176	0.528	Total	25.423	13.832	37.015	0.105	3.607	2.662	5.869
	(3+)	15.825		8.816	22.833	0.410	0.810	0.555	0.281	0.445	(3+)	16.496	7.389	25.603	0.126	2.251	2.081	4.589
Unit 2	2	22.905	12.293	10.612	35.198	0.033	0.433	0.351	0.027	0.649	2	8.584	6.427	10.742	0.070	1.993	0.601	1.325
	3	2.918	1.139	1.779	4.057	0.129	0.529	0.411	0.100	0.589	3	14.855	6.882	22.828	0.106	0.350	1.575	3.472
	4	47.556	16.153	31.403	63.709	0.361	0.761	0.533	0.253	0.467	4	1.719	1.048	2.390	0.141	7.276	0.242	0.534
	5	1.157	0.356	0.801	1.513	0.365	0.765	0.535	0.255	0.465	5	22.218	14.671	29.765	0.193	0.146	4.288	9.455
	6+	6.117	2.241	3.877	8.358	0.375	0.775	0.539	0.261	0.461	6+	3.357	2.159	4.554	0.316	1.682	1.061	2.339
	Total	80.652		48.471	112.834	0.249	0.649	0.477	0.183	0.523	Total	50.733	31.187	70.279	0.153	11.447	7.767	17.126
	(3+)	57.748		37.859	77.636	0.349	0.749	0.527	0.246	0.473	(3+)	42.149	24.760	59.537	0.170	9.454	7.166	15.801
Unit 3	2	20.039	11.435	8.604	31.474	0.103	0.503	0.395	0.081	0.605	2	21.310	15.678	26.942	0.056	1.603	1.193	2.631
	3	3.297	1.401	1.896	4.698	0.141	0.541	0.418	0.109	0.582	3	12.118	5.203	19.033	0.099	0.326	1.200	2.645
	4	30.979	11.871	19.108	42.850	0.253	0.653	0.480	0.186	0.520	4	1.919	1.104	2.735	0.139	4.647	0.267	0.588
	5	0.720	0.261	0.458	0.981	0.285	0.685	0.496	0.206	0.504	5	16.124	9.945	22.303	0.207	0.131	3.338	7.360
	6+	5.265	2.190	3.075	7.455	0.272	0.672	0.489	0.198	0.511	6+	3.052	1.802	4.302	0.327	1.537	0.998	2.200
	Total	60.300		33.141	87.458	0.196	0.596	0.449	0.148	0.551	Total	54.523	33.732	75.314	0.128	8.245	6.995	15.425
	(3+)	40.261		24.538	55.984	0.246	0.646	0.476	0.181	0.524	(3+)	33.213	18.054	48.372	0.175	6.642	5.802	12.793
Unit 4	2	3.489	2.573	0.916	6.062	0.013	0.413	0.338	0.011	0.662	2	4.174	2.239	6.108	0.077	0.412	0.321	0.709
	3	0.759	0.458	0.301	1.217	0.036	0.436	0.353	0.029	0.647	3	2.308	0.606	4.011	0.169	0.143	0.390	0.860
	4	3.736	2.136	1.601	5.872	0.054	0.454	0.365	0.043	0.635	4	0.491	0.195	0.787	0.247	0.975	0.121	0.267
	5	0.322	0.182	0.140	0.505	0.065	0.465	0.372	0.052	0.628	5	2.373	1.017	3.729	0.286	0.099	0.679	1.496
	6+	1.979	1.155	0.824	3.133	0.059	0.459	0.368	0.047	0.632	6+	1.453	0.609	2.297	0.336	0.679	0.488	1.076
	Total	10.285		3.782	16.788	0.040	0.440	0.356	0.032	0.644	Total	10.798	4.665	16.931	0.185	2.308	1.999	4.409
	(3+)	6.796		2.866	10.726	0.054	0.454	0.365	0.043	0.635	(3+)	6.625	2.426	10.823	0.253	1.897	1.678	3.700

Table 2.1.1. Management Unit 1 yellow perch biological references from simulations and projected population size in 2009 for a range of fishing rates (F). Biological reference points include mean spawner biomass as a fraction of an unfished population, survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993 for ages 2+ (14.5 million) and 1994 for ages 3+ (4.2 million). The "Harvest 2008" column is based on fishing rates in the "F" column and 2008 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2006 and were used to determine $F_{0.1}$. F_{2007} was the fishing rate used for setting TAC in 2004, 2005, 2006, and 2007.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob %. 1993 2+	Prob. % 1994 3+	F	Harvest 2008 (lbs x 10^6)	Population 2+ in 2009 (millions)	Population 3+ in 2009 (millions)	Harvest Strategy Reference
100	67%	67%	0.0	0.0	0.000	0.000	47.129	17.042	
99	67%	67%	0.1	0.0	0.010	0.024	47.062	16.975	
93	66%	65%	0.4	0.0	0.050	0.117	46.800	16.713	
87	64%	63%	0.5	0.0	0.100	0.230	46.480	16.393	
82	63%	61%	1.5	0.0	0.150	0.341	46.169	16.082	
77	62%	59%	2.2	0.0	0.200	0.448	45.866	15.779	
73	61%	58%	3.4	0.0	0.250	0.552	45.572	15.485	
69	60%	56%	4.7	0.1	0.300	0.654	45.285	15.198	
65	59%	55%	6.1	0.2	0.350	0.753	45.007	14.919	
62	58%	53%	8.4	0.4	0.400	0.849	44.735	14.648	
59	57%	52%	10.5	0.5	0.450	0.943	44.471	14.384	
57	56%	50%	13.4	1.1	0.500	1.034	44.214	14.127	
54	55%	49%	15.5	1.7	0.550	1.123	43.964	13.877	
52	54%	48%	18.3	2.1	0.600	1.210	43.720	13.633	
50	54%	47%	21.7	3.1	0.650	1.294	43.483	13.396	
48	53%	45%	23.9	4.2	0.700	1.376	43.252	13.164	
48	53%	45%	24.7	4.3	0.710	1.392	43.206	13.119	**$F_{0.1}$**
48	53%	45%	25.3	4.8	**0.720**	1.408	43.162	13.075	**F_{2007}**
47	52%	44%	26.6	5.6	0.750	1.456	43.026	12.939	
45	52%	43%	29.2	6.9	0.800	1.534	42.807	12.720	
44	51%	42%	32.2	8.1	0.850	1.610	42.593	12.506	
42	50%	41%	35.2	10.2	0.900	1.684	42.385	12.298	
41	50%	40%	36.5	12.5	0.950	1.757	42.182	12.095	
40	49%	39%	37.4	14.9	1.000	1.827	41.984	11.897	
37	48%	38%	42.7	20.3	1.100	1.963	41.602	11.515	
35	47%	36%	46.9	26.8	1.200	2.092	41.240	11.153	
34	46%	34%	51.5	31.1	1.300	2.215	40.895	10.807	
32	45%	33%	56.2	35.3	1.400	2.332	40.566	10.479	
30	45%	31%	59.6	40.7	1.500	2.443	40.253	10.165	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.105	0.089
3	0.387	0.115
4	0.713	0.129
5	0.760	0.150
6	0.816	0.162

2008 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	8.927	6.442	11.411
3	9.460	3.472	15.447
4	0.920	0.493	1.347
5	5.262	2.981	7.544
6+	0.855	0.444	1.265
(2+)	25.423	13.832	37.015
(3+)	16.496	7.389	25.603

2009 Recruitment

Millions Age 2s
30.087

Table 2.1.2. Management Unit 2 yellow perch biological references from simulations and projected population size in 2009 for a range of fishing rates (F). Biological reference points include mean spawner biomass as a fraction of an unfished population, survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993 for ages 2+ (18.2 million) and 1994 for ages 3+ (7.1 million). The "Harvest 2008" column is based on fishing rates in the "F" column and 2008 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2006 and were used to determine $F_{0.1}$. F_{2007} was the fishing rate used for setting TAC in 2004, 2005, 2006, and 2007.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2008 (lbs x 10^6)	Population 2+ in 2009 (millions)	Population 3+ in 2009 (millions)	Harvest Strategy Reference
100	67%	67%	0.1	0.0	0.000	0.000	93.653	34.007	
99	67%	67%	0.1	0.0	0.010	0.079	93.462	33.816	
94	65%	65%	0.3	0.0	0.050	0.388	92.710	33.065	
88	64%	63%	1.2	0.0	0.100	0.764	91.799	32.154	
84	63%	61%	2.4	0.0	0.150	1.127	90.920	31.274	
79	61%	59%	4.3	0.0	0.200	1.478	90.070	30.424	
75	60%	57%	7.4	0.2	0.250	1.818	89.248	29.603	
71	59%	56%	10.1	0.5	0.300	2.147	88.455	28.810	
68	58%	54%	13.3	0.7	0.350	2.465	87.688	28.043	
65	57%	53%	16.7	1.6	0.400	2.773	86.947	27.301	
62	56%	51%	20.8	2.7	0.450	3.071	86.230	26.585	
59	55%	50%	23.7	4.2	0.500	3.359	85.538	25.892	
57	54%	49%	26.9	7.5	0.550	3.638	84.868	25.223	
55	54%	47%	30.4	10.3	0.600	3.909	84.220	24.575	
55	54%	47%	30.4	10.3	0.650	4.171	83.594	23.949	
53	53%	46%	33.1	14.3	**0.661**	4.227	83.459	23.814	$\mathbf{F_{2007}}$
51	52%	45%	34.9	18.0	0.700	4.424	82.988	23.343	
49	51%	44%	36.9	20.4	0.750	4.670	82.402	22.757	
48	51%	43%	39.8	23.8	0.800	4.908	81.836	22.190	
48	51%	43%	39.8	23.8	0.823	5.014	81.581	21.936	$\mathbf{F_{0.1}}$
46	50%	42%	41.6	28.1	0.850	5.138	81.287	21.642	
45	49%	41%	44.0	31.7	0.900	5.361	80.756	21.111	
43	49%	40%	45.6	35.3	0.950	5.578	80.243	20.597	
42	48%	39%	47.5	39.1	1.000	5.788	79.746	20.100	
40	47%	37%	50.8	44.5	1.100	6.188	78.798	19.153	
37	46%	35%	53.3	50.2	1.200	6.565	77.910	18.265	
35	45%	34%	54.7	55.6	1.300	6.919	77.077	17.432	
34	44%	32%	57.2	59.8	1.400	7.252	76.295	16.650	
32	44%	31%	59.3	63.1	1.500	7.566	75.560	15.915	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.116	0.088
3	0.385	0.126
4	0.708	0.136
5	0.811	0.156
6	0.796	0.210

2008 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	8.584	6.427	10.742
3	14.855	6.882	22.828
4	1.719	1.048	2.390
5	22.218	14.671	29.765
6+	3.357	2.159	4.554
(2+)	50.733	31.187	70.279
(3+)	42.149	24.760	59.537

2009 Recruitment Millions Age 2s
59.645

Table 2.1.3. Management Unit 3 yellow perch biological references from simulations and projected population size in 2009 for a range of fishing rates (F). Biological reference points include mean spawner biomass as a fraction of an unfished population, survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993 for ages 2+ (7.5 million) and 1994 for ages 3+ (0.31 million). The "Harvest 2008" column is based on fishing rates in the "F" column and 2008 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2006 and were used to determine $F_{0.1}$. F_{2007} was the fishing rate used for setting TAC in 2004, 2005, 2006, and 2007.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2008 (lbs x 10^6)	Population 2+ in 2009 (millions)	Population 3+ in 2009 (millions)	Harvest Strategy Reference
100	67%	67%	0.0	0.0	0.000	0.000	79.902	36.548	
98	67%	67%	0.0	0.0	0.010	0.065	79.758	36.403	
93	66%	65%	0.0	0.0	0.050	0.320	79.189	35.835	
86	64%	63%	0.0	0.0	0.100	0.631	78.499	35.144	
80	63%	61%	0.0	0.0	0.150	0.932	77.830	34.476	
75	62%	60%	0.0	0.0	0.200	1.223	77.182	33.828	
70	61%	58%	0.0	0.0	0.250	1.506	76.554	33.200	
66	60%	57%	0.0	0.0	0.300	1.780	75.946	32.591	
62	59%	55%	0.1	0.0	0.350	2.046	75.356	32.002	
58	58%	54%	0.3	0.0	0.400	2.304	74.784	31.430	
55	57%	52%	0.3	0.0	0.450	2.554	74.230	30.876	
52	56%	51%	0.5	0.1	0.500	2.796	73.692	30.338	
49	56%	50%	0.5	0.2	0.550	3.032	73.171	29.817	
47	55%	49%	0.6	0.3	0.600	3.260	72.665	29.311	
45	54%	48%	1.1	0.4	0.650	3.482	72.175	28.820	
45	54%	48%	1.1	0.4	0.658	3.517	72.097	28.743	**$F_{0.1}$**
43	53%	46%	1.3	0.5	0.700	3.697	71.698	28.344	
43	53%	46%	1.3	0.5	**0.703**	3.710	71.671	28.317	**F_{2007}**
41	53%	45%	1.9	0.6	0.750	3.906	71.236	27.882	
39	52%	44%	3.1	0.6	0.800	4.109	70.788	27.433	
37	52%	43%	4.3	1.0	0.850	4.306	70.352	26.998	
36	51%	43%	5.1	1.5	0.900	4.498	69.930	26.575	
34	51%	42%	5.6	2.2	0.950	4.684	69.519	26.165	
33	50%	41%	6.7	3.6	1.000	4.864	69.120	25.766	
30	49%	39%	8.2	5.6	1.100	5.211	68.356	25.002	
28	48%	38%	10.8	8.0	1.200	5.538	67.634	24.280	
26	47%	36%	13.7	11.1	1.300	5.848	66.952	23.598	
25	47%	35%	16.9	14.4	1.400	6.141	66.307	22.952	
23	46%	33%	19.3	18.5	1.500	6.418	65.696	22.341	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.072	0.114
3	0.314	0.125
4	0.698	0.152
5	0.787	0.175
6	0.735	0.226

2008 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	21.310	15.678	26.942
3	12.118	5.203	19.033
4	1.919	1.104	2.735
5	16.124	9.945	22.303
6+	3.052	1.802	4.302
(2+)	54.523	33.732	75.314
(3+)	33.213	18.054	48.372

2009 Recruitment Millions Age 2s
43.354

Table 2.1.4. Management Unit 4 yellow perch biological references from simulations and projected population size in 2009 for a range of fishing rates (F). Biological reference points include mean spawner biomass as a fraction of an unfished population, survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993 for ages 2+ (0.82 million) and 1994 for ages 3+ (0.33 million). The "Harvest 2008" column is based on fishing rates in the "F" column and 2008 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2006 and were used to determine $F_{0.1}$. F_{2007} was the fishing rate used for setting TAC in 2004, 2005, 2006, and 2007.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2008 (lbs x 10^6)	Population 2+ in 2009 (millions)	Population 3+ in 2009 (millions)	Harvest Strategy Reference
100	67%	67%	0.0	0.0	0.000	0.000	17.404	7.238	
99	67%	67%	0.0	0.0	0.010	0.015	17.376	7.211	
94	66%	65%	0.0	0.0	0.050	0.075	17.269	7.104	
89	64%	63%	0.1	0.0	0.100	0.147	17.138	6.973	
84	63%	62%	0.2	0.0	0.150	0.217	17.012	6.846	
79	62%	60%	0.2	0.0	0.200	0.285	16.889	6.723	
77	62%	59%	0.2	0.0	**0.230**	0.325	16.817	6.652	**F_{2007}**
76	61%	59%	0.2	0.0	0.250	0.351	16.769	6.604	
72	60%	57%	0.2	0.0	0.300	0.415	16.654	6.488	
69	59%	56%	0.2	0.1	0.350	0.478	16.541	6.376	
66	58%	55%	0.2	0.2	0.400	0.538	16.432	6.267	
63	58%	53%	0.3	0.2	0.450	0.597	16.326	6.161	
61	57%	52%	0.5	0.2	0.500	0.654	16.223	6.058	
58	56%	51%	0.7	0.2	0.550	0.709	16.124	5.958	
56	55%	50%	1.2	0.2	0.600	0.763	16.027	5.861	
54	55%	49%	1.4	0.3	0.650	0.816	15.933	5.767	
52	54%	48%	1.8	0.6	0.700	0.866	15.841	5.676	
51	54%	47%	2.1	0.9	0.750	0.916	15.752	5.587	
49	53%	46%	2.6	1.1	0.800	0.964	15.666	5.500	
47	52%	45%	3.1	1.3	0.850	1.011	15.582	5.417	
47	52%	45%	3.3	1.4	0.865	1.024	15.557	5.392	**$F_{0.1}$**
46	52%	44%	3.6	2.0	0.900	1.056	15.500	5.335	
45	51%	43%	4.1	2.7	0.950	1.100	15.421	5.256	
43	51%	42%	4.6	2.8	1.000	1.143	15.344	5.178	
41	50%	41%	5.7	4.2	1.100	1.226	15.196	5.030	
39	49%	39%	6.5	5.3	1.200	1.304	15.056	4.890	
37	48%	38%	7.6	6.5	1.300	1.378	14.923	4.758	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.059	0.138
3	0.320	0.148
4	0.483	0.179
5	0.766	0.207
6	0.715	0.260

2008 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	4.174	2.239	6.108
3	2.308	0.606	4.011
4	0.491	0.195	0.787
5	2.373	1.017	3.729
6+	1.453	0.609	2.297
(2+)	10.798	4.665	16.931
(3+)	6.625	2.426	10.823

2009 Recruitment Millions Age 2s
10.165

Table 2.2.1. Lake Erie yellow perch fishing rates and the Recommended Allowable Harvest (RAH; in millions of pounds) for 2008 by management unit according to the harvest strategies presented. The F_{2007} strategy is based on the stock-recruitment simulation model applied in 2005. The proposed RAH for MU4 is based on the fishing rate (F=0.230) associated with the TAC in 2005-2007.

MU	Fishing Rate	Recommended Allowable Harvest (millions lbs.)	Yield Methods
1	0.720	1.408	F_{2007}
2	0.661	4.227	F_{2007}
3	0.703	3.710	F_{2007}
4	0.230	0.325	F_{2007}
Total		9.670	

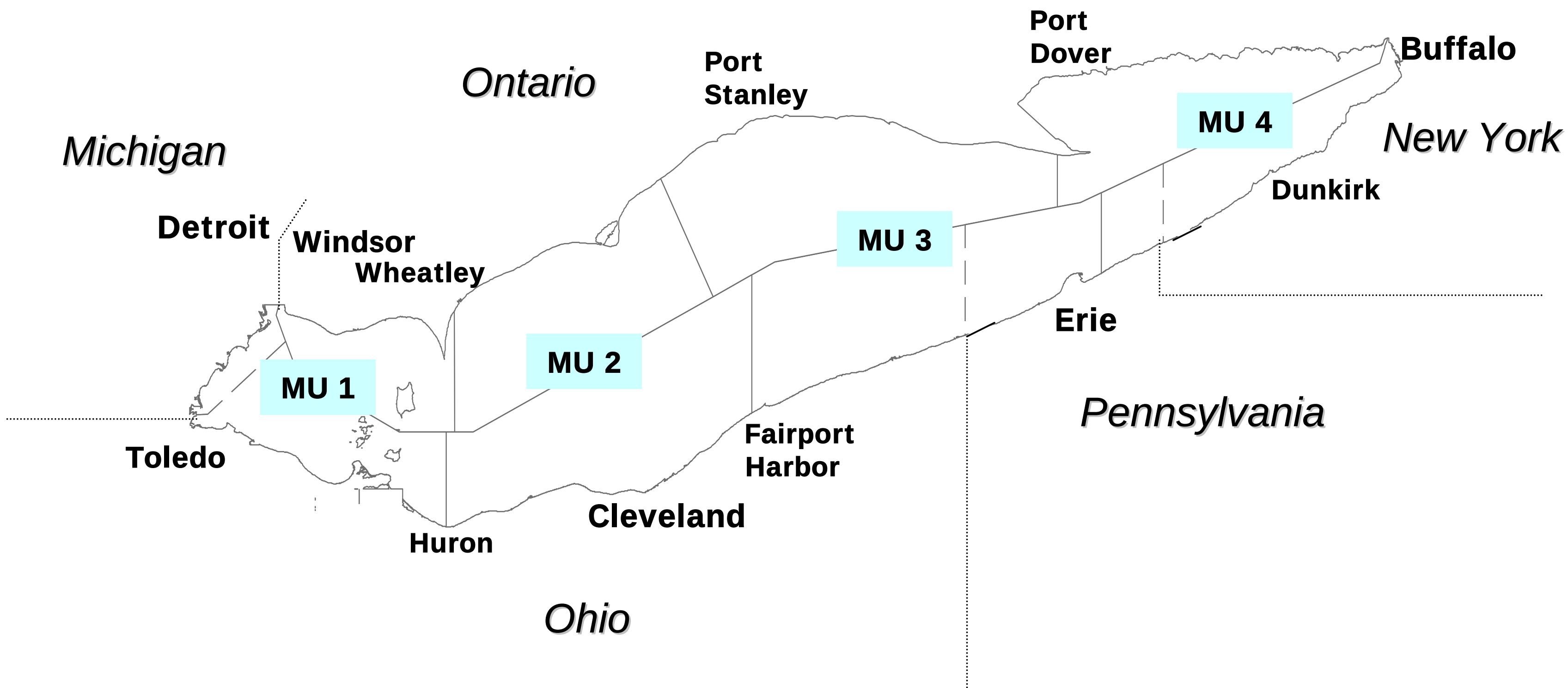


Figure 1.1. Yellow Perch management units (MUs) of Lake Erie. For illustrative purposes only, this map should not be used for quota determination or border delineation.

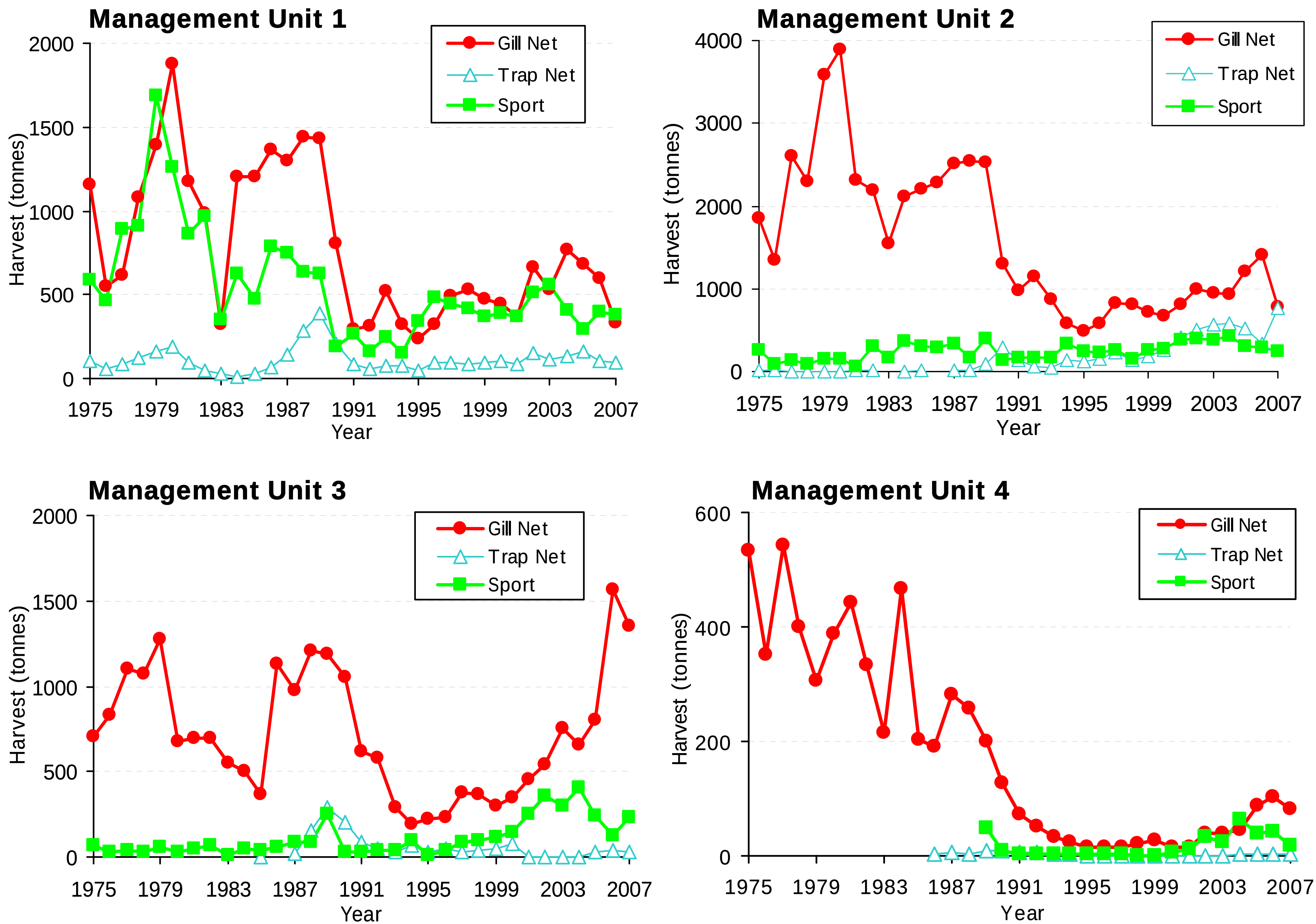


Figure 1.2. Historic Lake Erie yellow perch harvest by management unit and gear type.

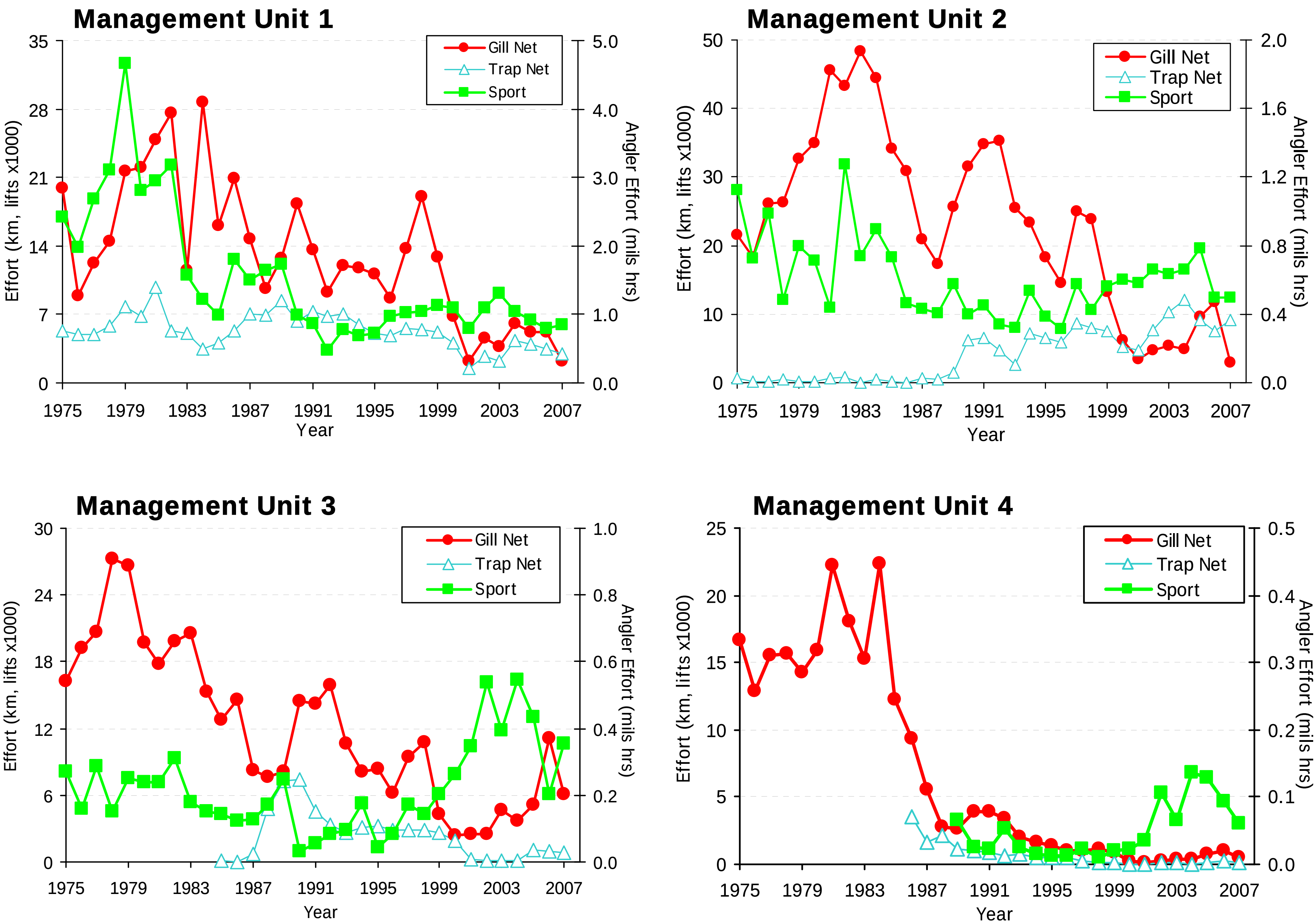


Figure 1.3. Historic Lake Erie yellow perch effort by management unit and gear type. Note: gill net effort presented is targeted effort with small mesh (<3”) only.

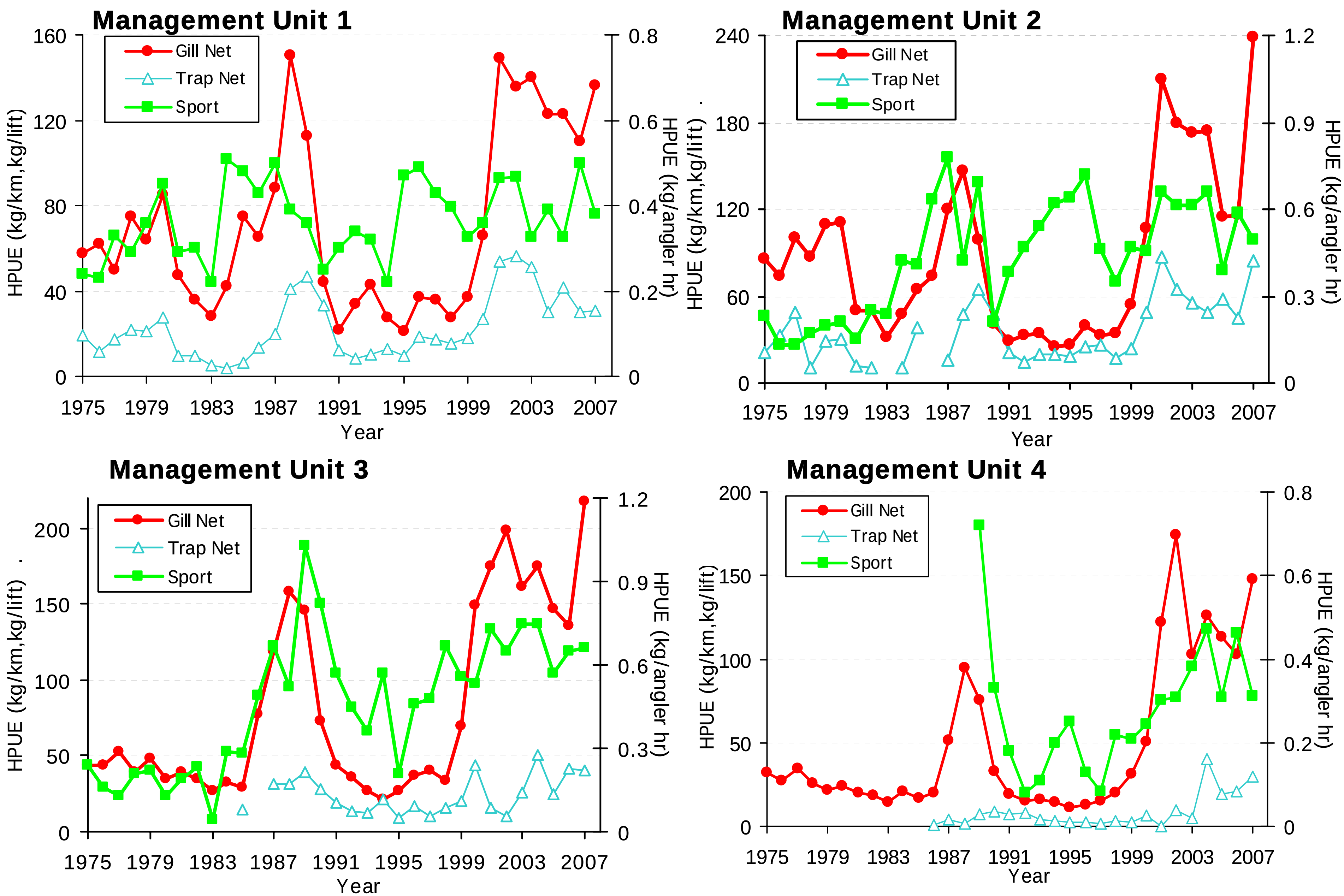


Figure 1.4. Historic Lake Erie yellow perch harvest per unit effort (HPUE) by management unit and gear type. Note: 2001 to 2007 gill net CPUE is for small mesh (< 3") only.

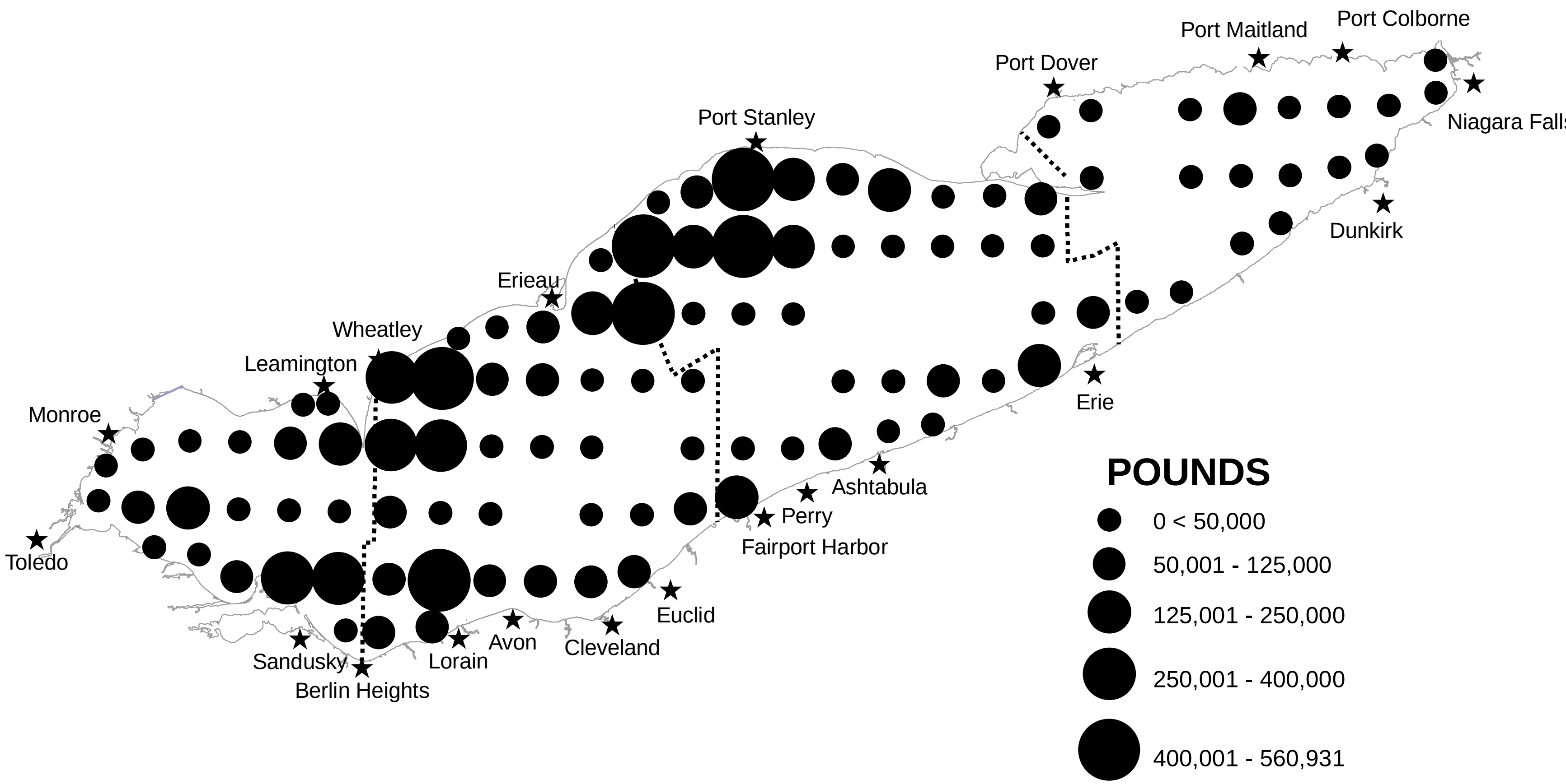


Figure 1.5. Spatial distribution of yellow perch total harvest (lbs.) in 2007 by 10-minute grid.

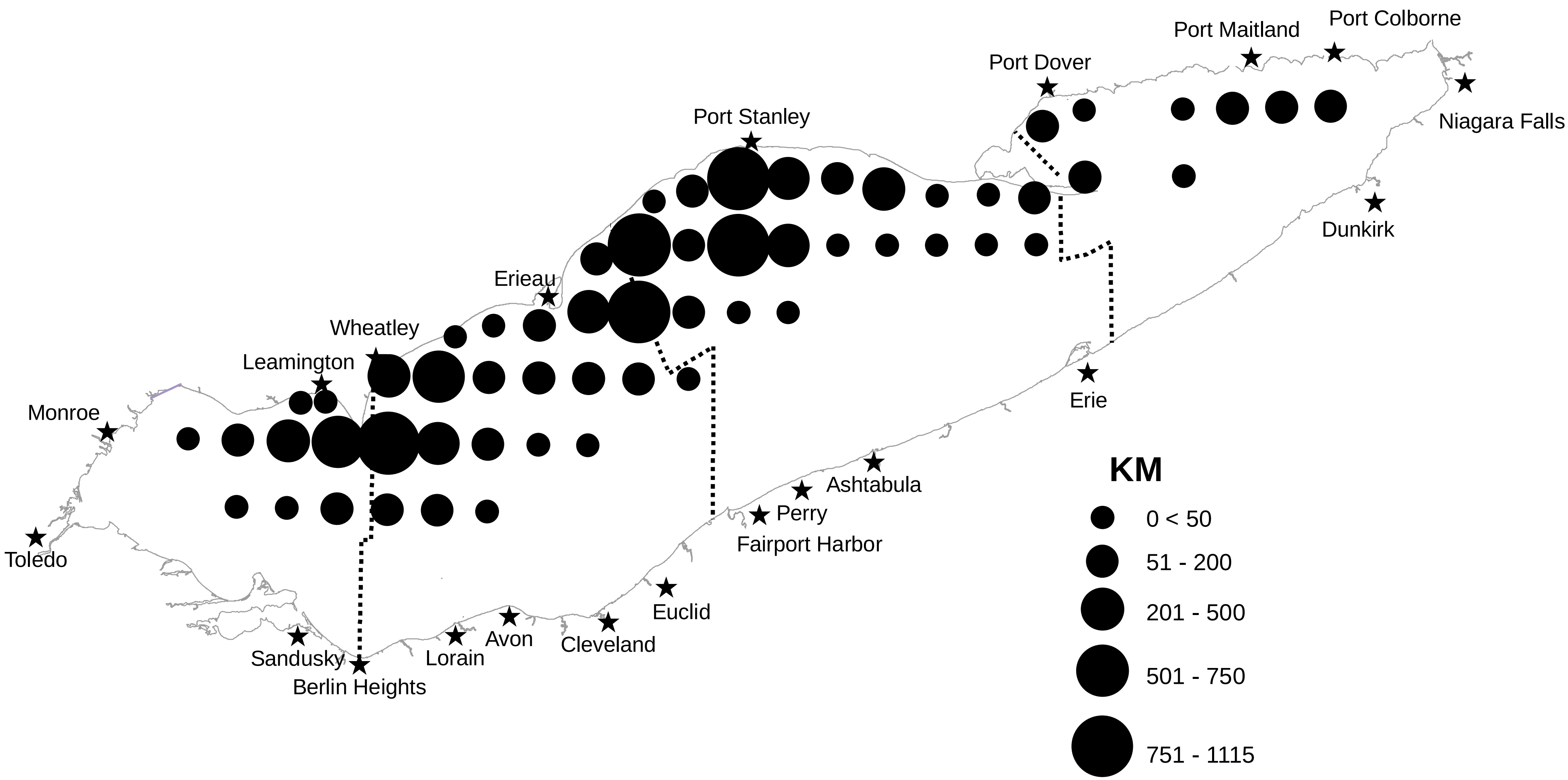


Figure 1.6. Spatial distribution of yellow perch gill net effort (km) in 2007 by 10-minute grid.

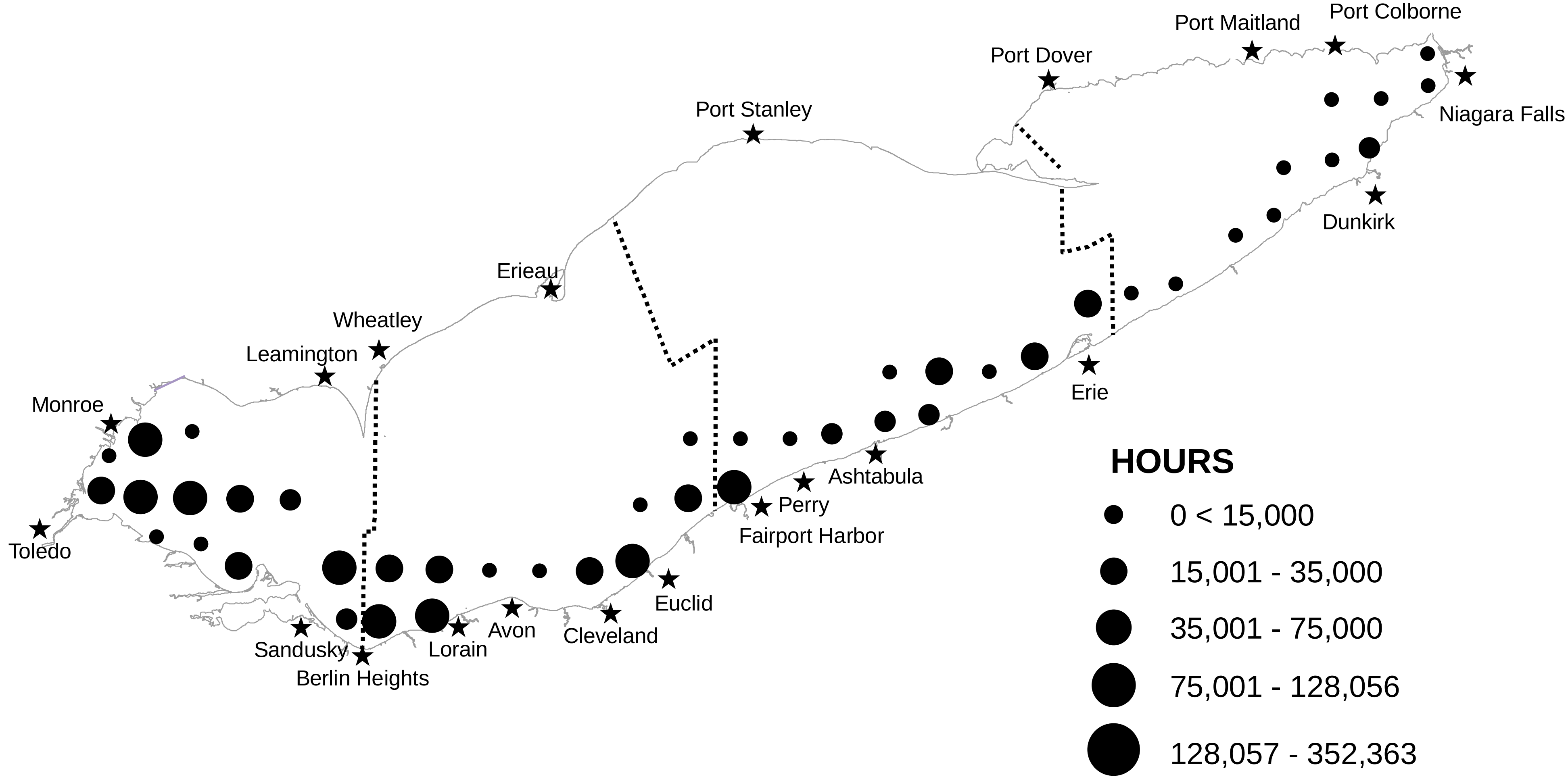


Figure 1.7. Spatial distribution of yellow perch sport angling effort (angler hours) in 2007 by 10-minute grid.

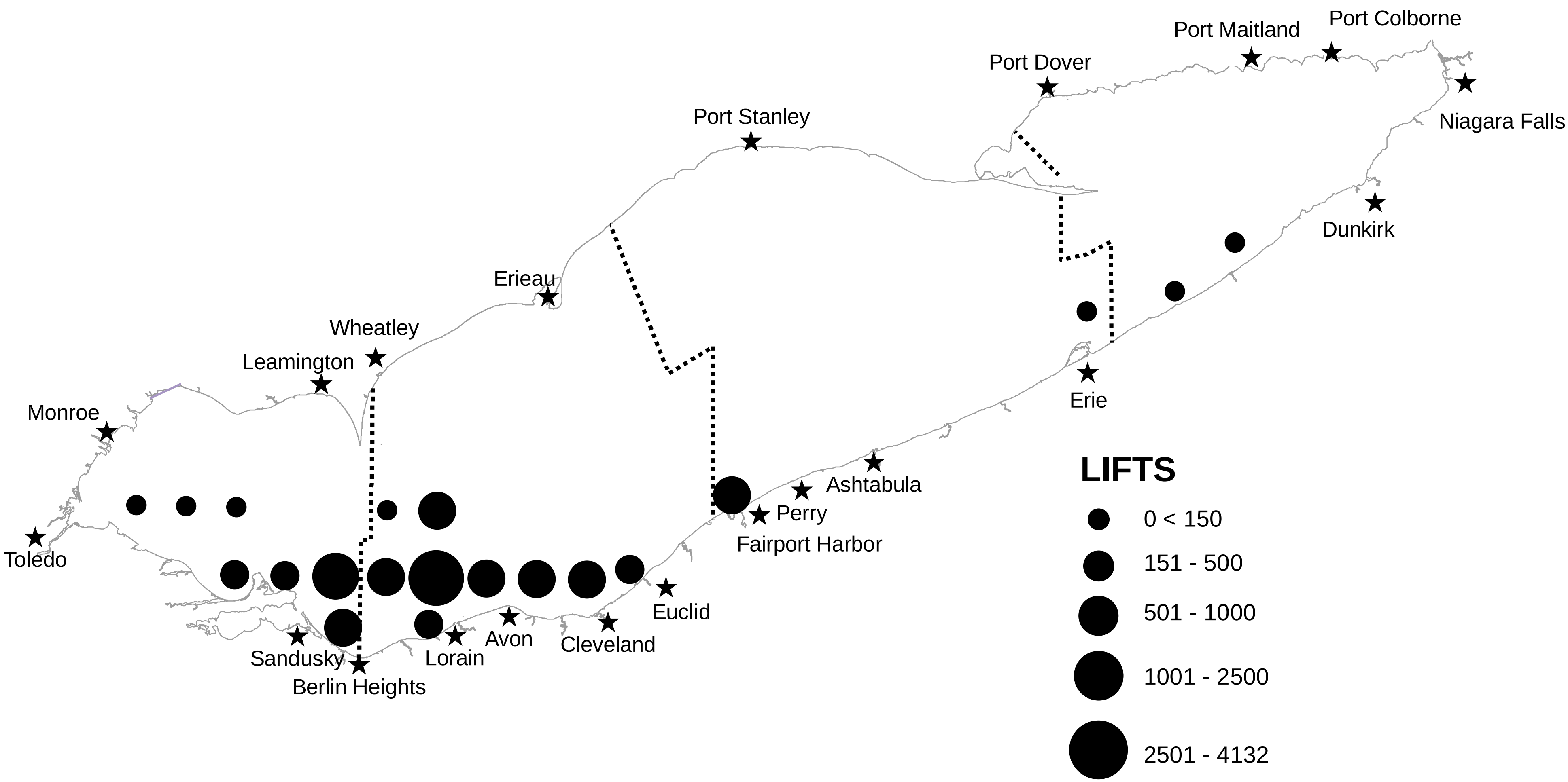


Figure 1.8. Spatial distribution of yellow perch trap net effort (lifts) in 2007 by 10-minute grid.

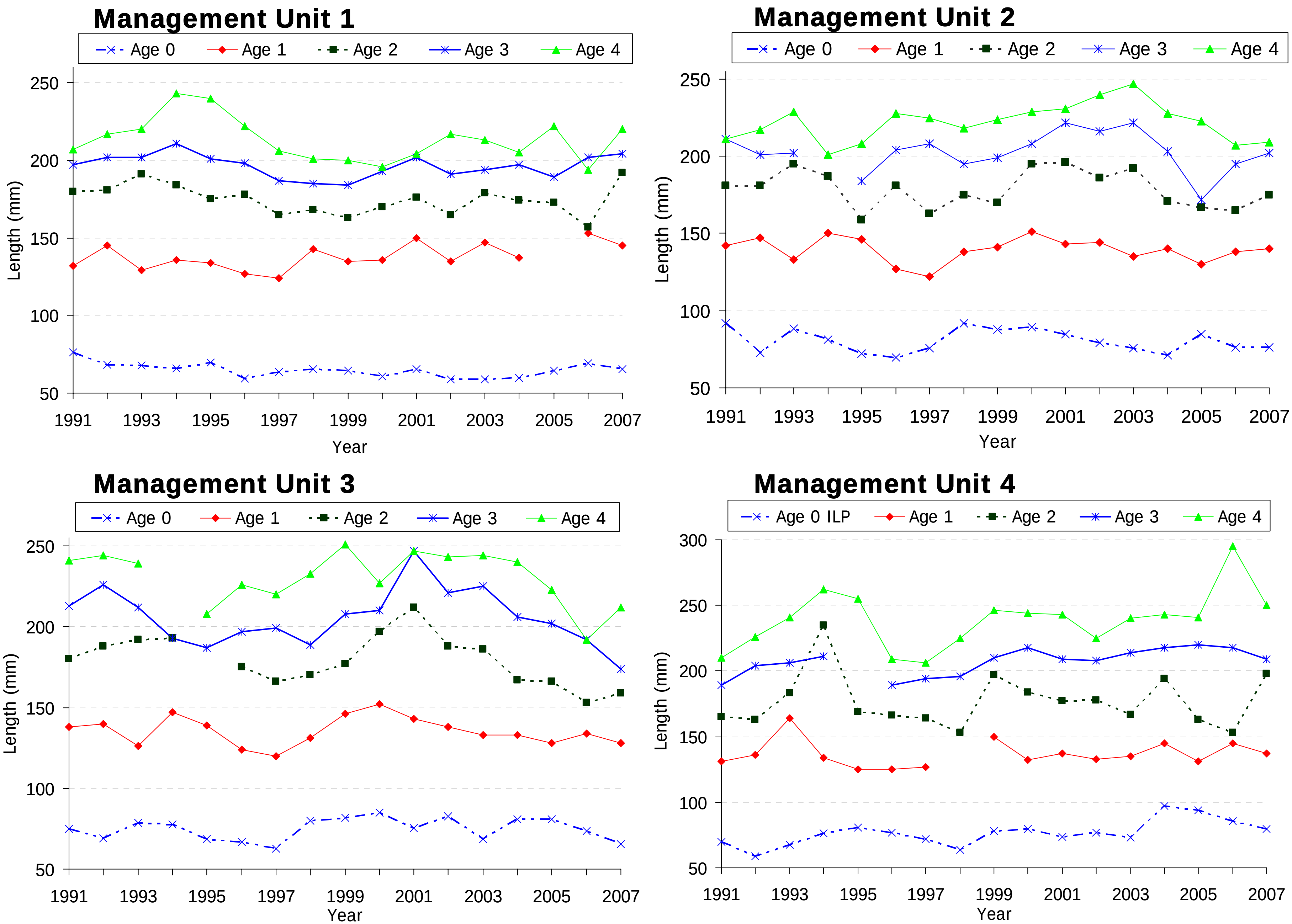


Figure 1.9. Yellow perch length-at-age from 1991-2007 fall interagency experimental samples for ages 0-4 by management unit.

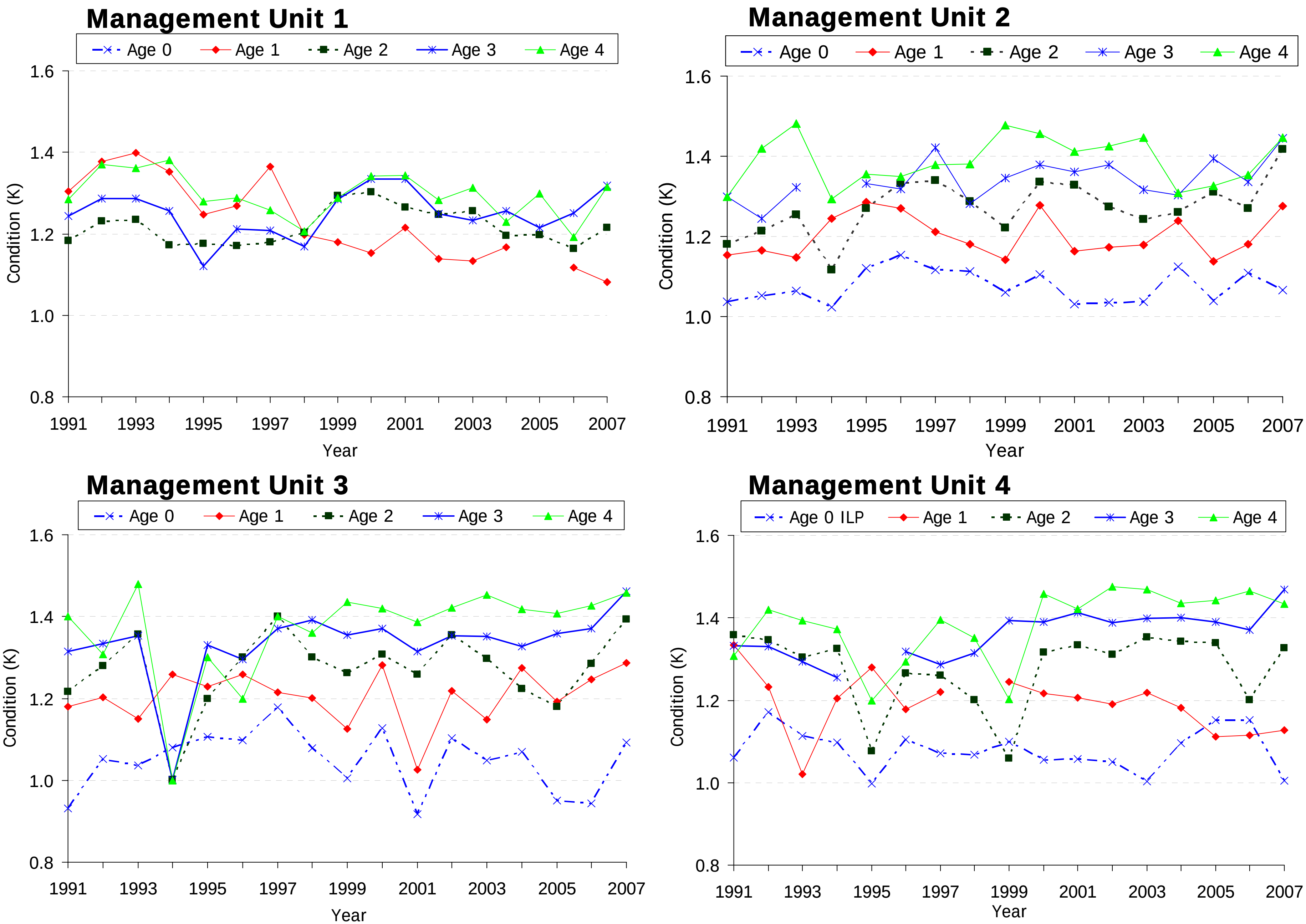


Figure 1.10. Yellow perch condition (K) at age from 1991-2007 fall interagency experimental samples for ages 0 through 4 by management unit.

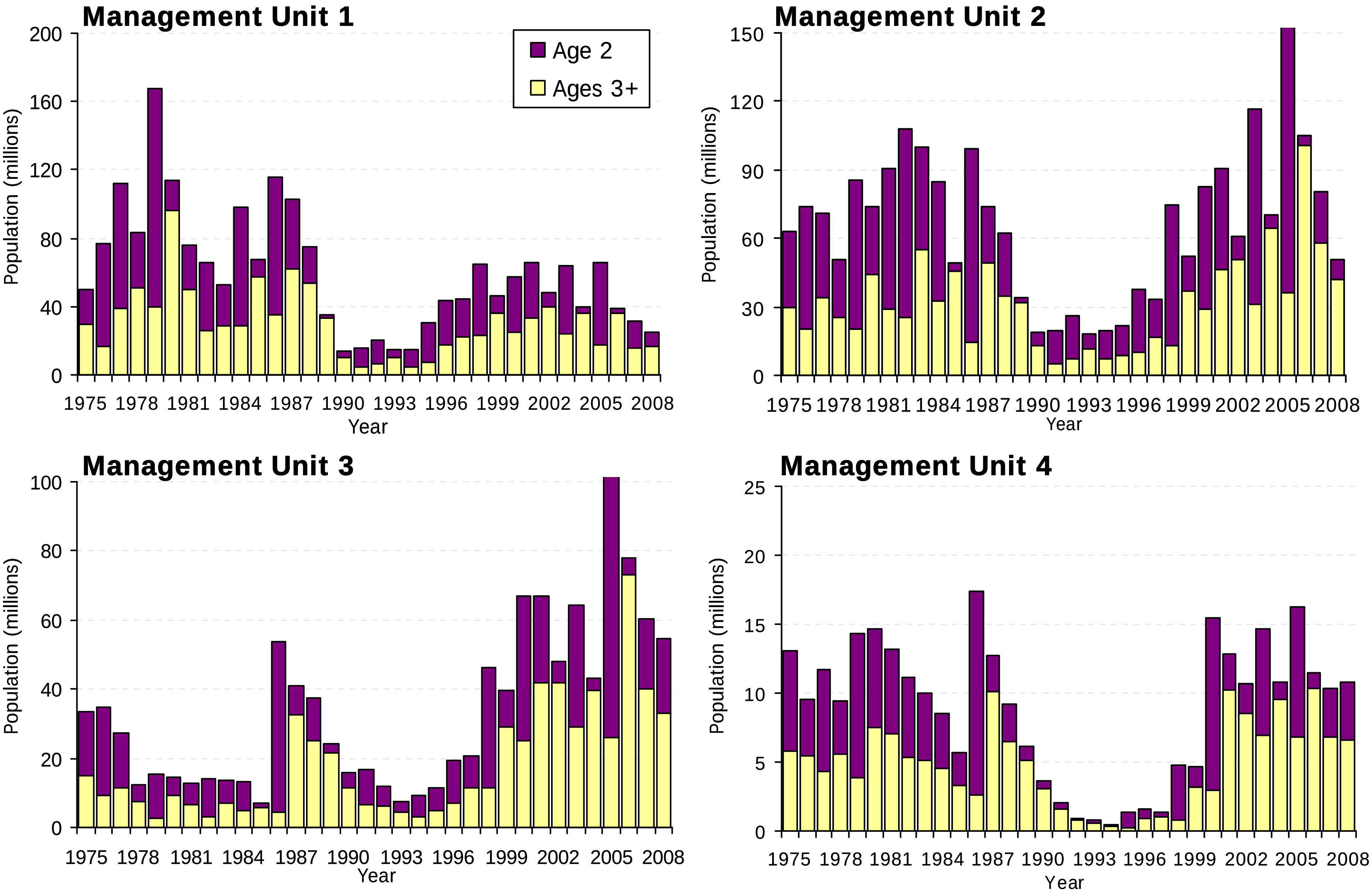


Figure 1.11. Lake Erie yellow perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2008 are from ADMB and parametric regressions for age 2 from survey gears.

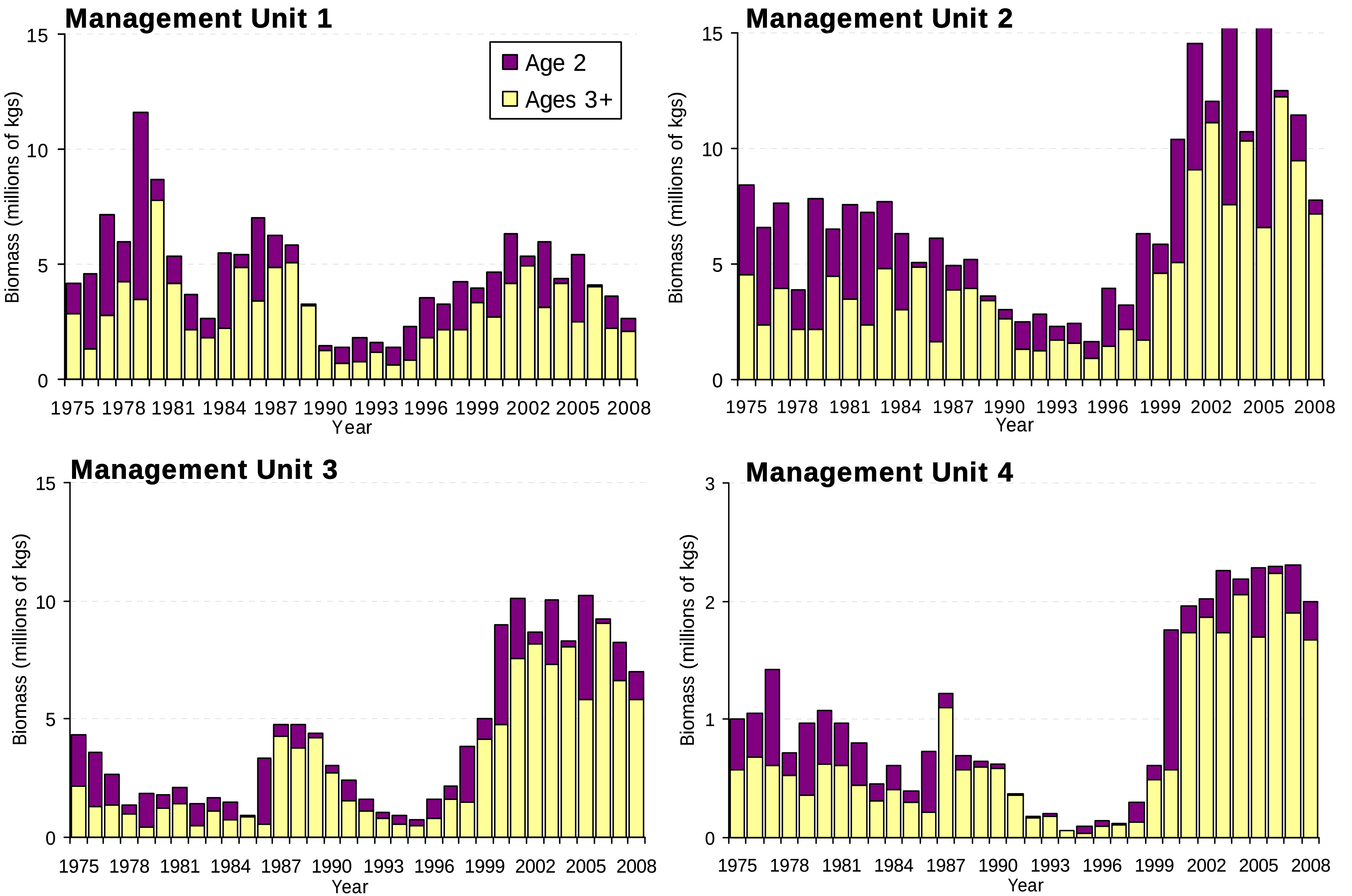


Figure 1.12. Lake Erie yellow perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2008 are from ADMB and parametric regressions for age 2 from survey gears.

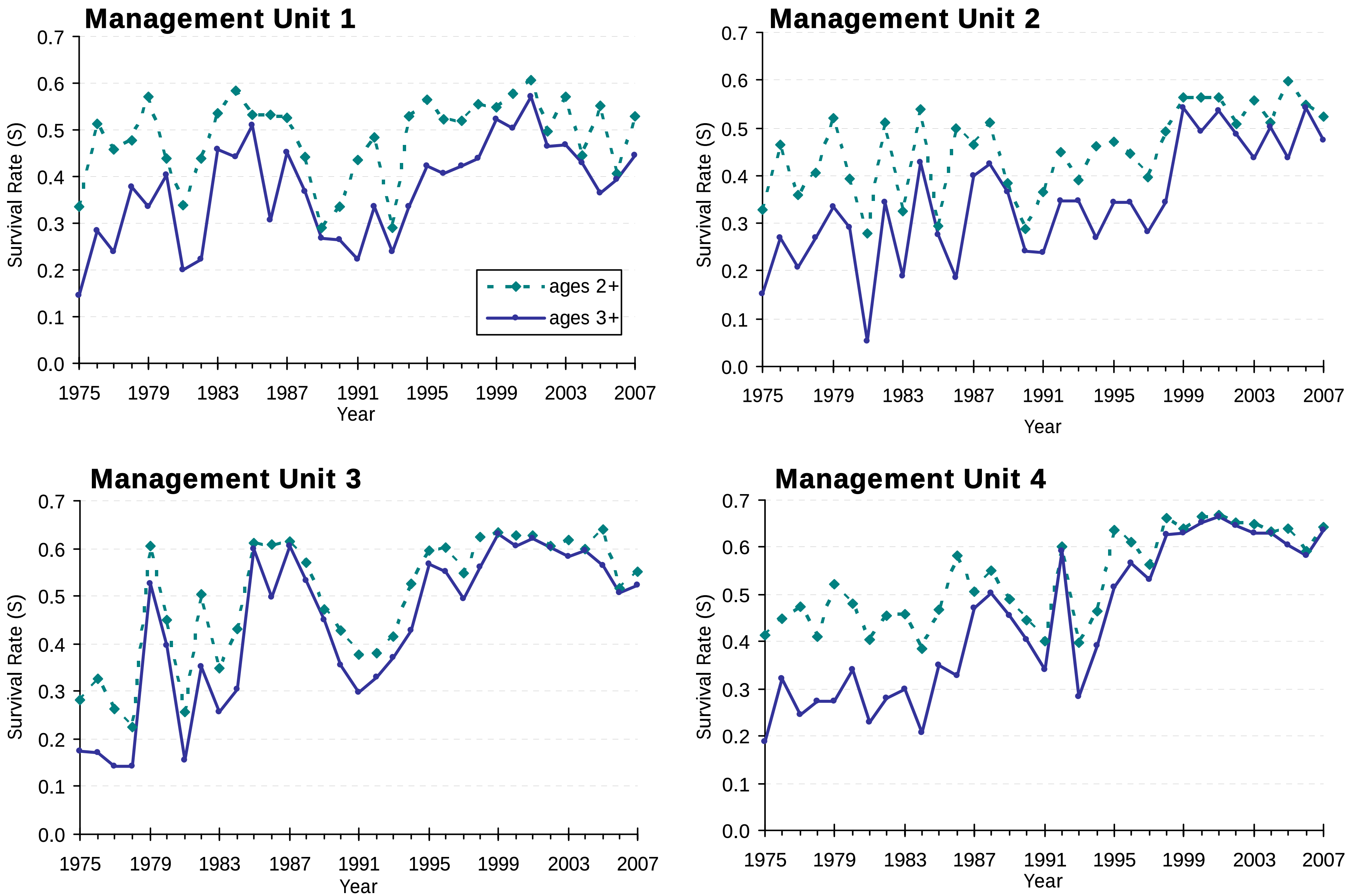


Figure 1.13. Lake Erie yellow perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.

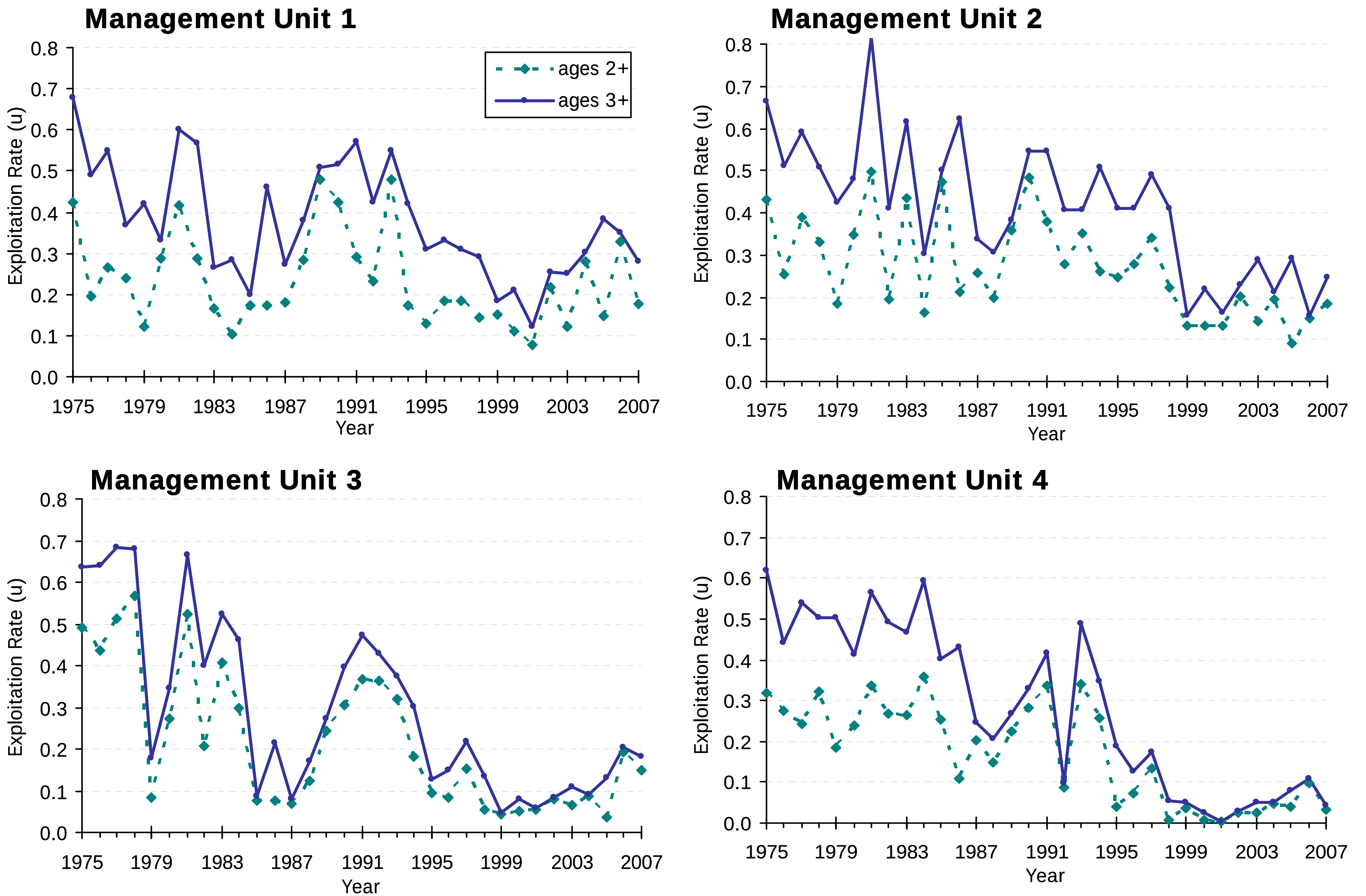
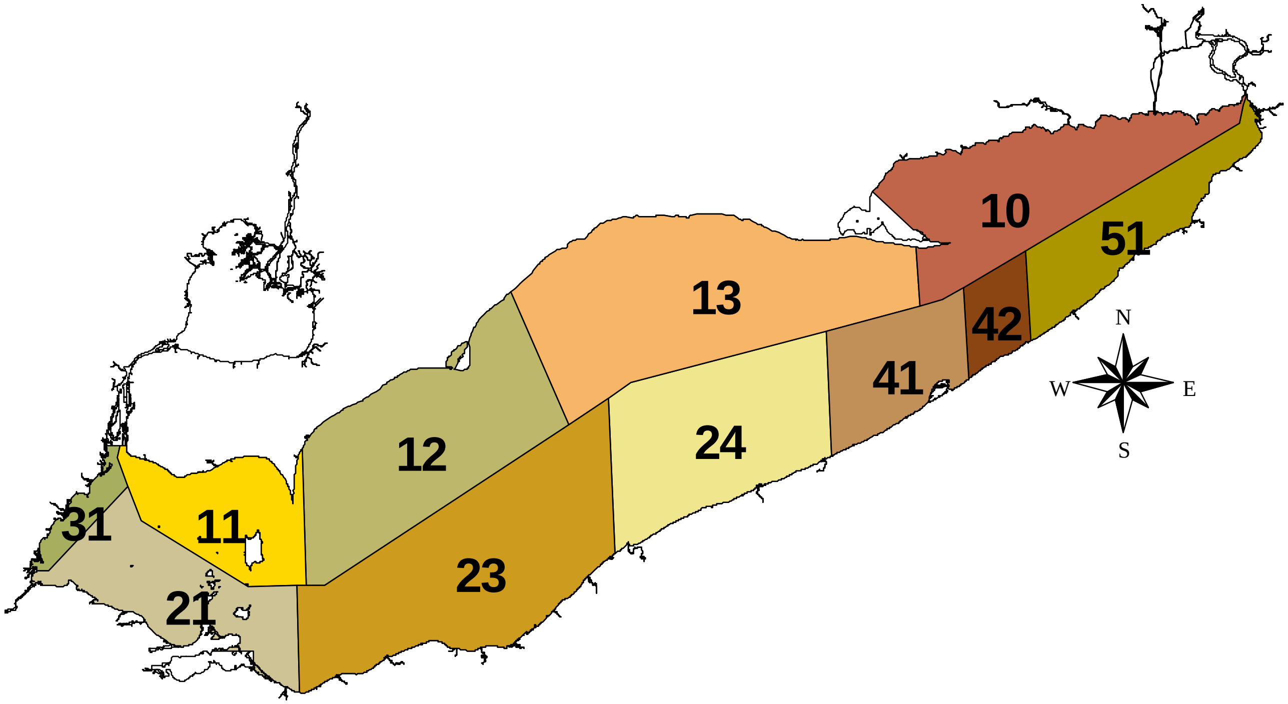


Figure 1.14. Lake Erie yellow perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.



MU	Subunit Area	JURISDICTION	UPDATED AREA (km^2)	ORIGINAL AREA (km^2)	ABSOLUTE CHANGE (km^2)	% by MU	% CHANGE FROM ORIGINAL
1	11	**ONT**	1537.13	1532.09	5.04	**40.58**	-1.72
	21	**OH**	1905.60	1795.79	109.81	**50.31**	0.71
	31	**MI**	344.78	290.35	54.43	**9.10**	1.00
2	12	**ONT**	3497.41	3333.33	164.08	**45.58**	3.08
	23	**OH**	4175.26	4501.66	-326.40	**54.42**	-3.08
3	13	**ONT**	4635.29	4769.86	-134.57	**51.69**	-4.41
	24	**OH**	2946.24	2714.22	232.02	**32.85**	0.95
	41	**PA**	1386.77	1013.95	372.82	**15.46**	3.56
4	10	**ONT**	2937.85	2935.70	2.15	**58.97**	3.77
	42	**PA**	535.90	915.01	-379.11	**10.76**	-6.44
	51	**NY**	1507.98	1471.14	36.84	**30.27**	2.67
All		**Total**	**25410.21**	**25273.10**	**137.11**		

Figure 2.1 Areal calculations by subunit area for Yellow Perch Task Group Management Units

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

MU	Data Source	λ	Relative Number of Terms
1	Commercial Gill Net Effort	0.3	1
	Sport Effort	0.4	1
	Commercial Trap Net Effort	1.0	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.9	5
	Commercial Trap Net Harvest	0.5	5
	Trawl Survey Catch Rates	0.4	3
	Partnership Gill Net Index Catch Rates	1.0	5
2	Commercial Gill Net Effort	0.3	1
	Sport Effort	1.0	1
	Commercial Trap Net Effort	0.9	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.6	5
	Commercial Trap Net Harvest	0.4	5
	Trawl Survey Catch Rates	1.0	4
	Partnership Gill Net Index Catch Rates	0.9	5
3	Commercial Gill Net Effort	0.3	1
	Sport Effort	1.0	1
	Commercial Trap Net Effort	0.6	1
	Commercial Gill Net Harvest	0.6	5
	Sport Harvest	1.0	5
	Commercial Trap Net Harvest	0.4	5
	Trawl Survey Catch Rates	0.8	4
	Partnership Gill Net Index Catch Rates	1.0	5
4	Commercial Gill Net Effort	0.3	1
	Sport Effort	1.0	1
	Commercial Trap Net Effort	0.5	1
	Commercial Gill Net Harvest	0.9	5
	Sport Harvest	1.0	5
	Commercial Trap Net Harvest	0.6	5
	NY Gill Net Survey Catch Rates	0.6	5
	ONT Partnership Gill Net Index Catch Rates	1.0	5

Appendix A Table 2. Trawl regression indices used for projecting estimates of age-2 yellow perch recruiting in 2008 by management unit.

Management Unit 1

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
OHF20A	0.904	0.35802	10.0	3.580	0.03017	2.977	4.184
OHS11A	0.880	0.29114	14.5	4.222	0.02472	3.505	4.938
OHF11A	0.838	0.40330	23.6	9.518	0.04731	7.285	11.751
OHF10A	0.746	0.06254	121.9	7.624	0.01012	5.156	10.091
OHF21A	0.744	0.30817	19.8	6.102	0.04513	4.315	7.889
ONS10A*	0.731	0.01903	564.0	10.733	0.00240	8.026	13.440
USF11A*	0.677	0.72858	41.1	29.945	0.10490	21.322	38.567
ONS11A	0.648	0.11171	46.1	5.150	0.01890	3.407	6.892
OHS10A	0.550	0.01925	180.2	3.469	0.00411	1.988	4.950
			mean	**8.927**		**6.442**	**11.411**

Management Unit 2

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
OHF10A	0.858	0.12746	121.9	15.537	0.01437	12.034	19.041
OHF11A	0.789	0.74318	23.6	17.539	0.10276	12.689	22.389
OHF20A	0.924	0.68456	10.0	6.846	0.05052	5.835	7.856
OHF21A	0.848	0.61995	19.8	12.275	0.06562	9.676	14.874
OHS11A	0.833	0.52821	14.5	7.659	0.05416	6.088	9.230
OHS20A	0.796	0.11811	4.9	0.579	0.01545	0.427	0.730
OHS21A	0.548	0.17639	25.1	4.427	0.04006	2.416	6.438
OHS30A	0.629	0.06283	60.7	3.814	0.01289	2.249	5.379
			mean	**8.584**		**6.427**	**10.742**

Management Unit 3

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
NYF40A	0.776	0.19925	283.2	56.428	0.02687	41.208	71.647
NYF41A	0.618	1.39346	41.2	57.411	0.18605	42.080	72.741
OHF20A	0.852	0.40230	10.0	4.023	0.03630	3.297	4.749
OHF21A	0.841	0.37813	19.8	7.487	0.03956	5.920	9.054
OHS20A	0.813	0.07308	4.9	0.358	0.00836	0.276	0.440
OHS30A	0.536	0.03547	60.7	2.153	0.00714	1.286	3.020
			mean	**21.310**		**15.678**	**26.942**

Management Unit 4

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
NYF41A	0.558	0.00897	0.6	0.005	0.00160	0.003	0.007
NYF40A	0.412	0.02331	283.2	6.601	0.00772	2.229	10.974
ILP41A	0.641	0.08236	1.8	0.148	0.01258	0.103	0.194
ILP40A	0.719	0.24124	41.2	9.939	0.04026	6.622	13.257
			mean	**4.174**		**2.239**	**6.108**

Appendix A Table 3. Arithmetic mean index values from interagency trawl surveys. All series are reported in catch per hectare except those with an asterisk (*) which are catch per trawl-hour

year	OHS10A	OHF10A	OHS11A	OHF11A	ONTS10A*	ONTS11A*	ONOHS10A*	USS10A*	USS11A*	USF10A*	USF11A*	OHS20A	OHF20A	OHS21A	OHF21A
1980	.	.	.	.	-	-	-	-	-	-	-	.	.	.	.
1981	.	.	.	.	-	-	-	-	-	-	-	.	.	.	.
1982	.	.	.	.	1952.4	-	-	-	-	-	-	.	.	.	.
1983	.	.	.	.	5.4	-	-	19.8	59.2	15.0	43.3	.	.	.	.
1984	.	.	.	.	2493.5	-	-	28.5	5.8	46.4	11.8	.	.	.	.
1985	.	.	.	.	885.0	-	-	42.0	34.0	71.4	27.2	.	.	.	.
1986	.	.	.	.	2503.6	-	-	1295.0	162.3	63.7	76.3	.	.	.	.
1987	16.3	.	74.9	.	0.9	21.2	10.9	5.0	41.0	12.8	61.2	.	.	.	.
1988	188.6	.	11.2	.	328.9	15.7	224.6	129.0	10.3	5.8	0.3	.	.	.	.
1989	106.1	.	11.8	.	788.7	11.6	448.0	149.8	15.7	34.2	3.3	.	.	.	.
1990	144.4	.	20.7	.	739.7	68.9	458.7	81.0	22.2	176.2	6.3	1.9	52.2	74.1	23.0
1991	146.9	.	27.6	.	109.3	93.0	124.3	185.2	35.0	210.8	18.0	5.4	9.3	43.5	50.0
1992	60.7	90.9	9.5	0.7	262.0	44.5	159.8	21.0	0.5	75.3	2.5	7.2	35.8	8.0	14.3
1993	1164.2	256.4	14.4	3.7	766.9	126.0	1052.5	321.7	6.0	137.7	0.5	41.7	10.6	29.1	49.0
1994	508.5	287.1	57.7	73.1	953.7	105.6	734.6	4281.8	40.3	162.0	57.8	73.3	71.9	5.0	12.0
1995	348.9	82.4	128.8	0.1	1337.8	162.5	815.4	2866.6	223.4	27.5	20.0	2.2	2.5	151.1	82.3
1996	3290.8	579.3	79.9	82.3	3310.1	352.1	3296.3	11444.0	13.2	737.2	9.2	843.3	119.1	15.7	11.2
1997	52.2	33.7	121.8	104.9	109.9	65.3	81.2	293.7	85.3	39.3	51.0	29.0	12.3	677.7	110.2
1998	174.5	250.9	4.8	16.0	285.4	20.5	236.0	138.7	11.0	246.2	19.4	223.8	69.8	2.9	6.3
1999	270.1	155.3	68.5	47.1	816.0	133.0	534.2	1234.8	29.2	176.5	28.8	26.8	73.6	19.4	40.7
2000	186.4	41.5	85.3	38.0	75.6	266.0	126.5	115.8	23.8	42.2	30.8	0.6	21.9	86.6	61.6
2001	322.1	246.3	12.8	10.3	998.0	11.1	703.5	63.5	3.3	57.3	2.8	341.9	114.6	6.4	5.7
2002	33.1	30.4	77.1	86.5	23.6	68.1	36.5	8.7	37.7	25.2	38.2	0.3	6.0	191.0	51.7
2003	1509.9	1111.6	3.0	7.1	3677.8	50.2	2846.3	1238.5	5.0	298.4	0.8	1077.5	149.0	4.2	3.2
2004	40.9	9.3	210.7	127.7	89.9	509.9	72.1	62.8	232.8	0.4	87.0	39.7	8.7	323.7	216.5
2005	124.2	62.3	5.2	2.0	181.5	7.4	173.1	27.7	0.1	6.2	1.9	118.8	37.8	25.0	18.3
2006	180.2	121.9	6.4	12.5	564.0	38.6	425.3	1.2	26.7	1.7	0.2	4.9	10.0	2.2	4.2
2007	592.9	631.5	14.5	23.6	507.2	46.1	663.5	75.8	8.6	111.9	41.1	244.5	167.0	25.1	19.8

year	OHS30A	OHF30A	OHS31A	OHF31A	OLP40A	OLP41A	ILP40A	ILP41A	NYF40A	NYF41A
1980	.	.	.	.	27.5	50.0	125.7	144.9	.	.
1981	.	.	.	.	75.4	4.0	486.6	59.2	.	.
1982	.	.	.	.	46.9	16.1	741.9	125.6	.	.
1983	.	.	.	.	.	.	125.9	.	.	.
1984	.	.	.	.	237.8	6.6	1031.3	65.1	.	.
1985	.	.	.	.	3.1	61.5	21.8	122.5	.	.
1986	.	.	.	.	105.9	0.7	1169.5	36.4	.	.
1987	.	.	.	.	2.3	178.0	2.5	26.5	.	.
1988	.	.	.	.	410.6	0.6	238.0	3.1	.	.
1989	.	.	.	.	174.0	32.6	317.4	59.1	.	.
1990	0.6	20.5	7.2	14.3	31.4	10.0	160.3	27.9	.	.
1991	6.4	1.3	103.4	19.1	9.0	0.9	93.7	22.7	.	.
1992	24.3	31.8	2.7	3.4	34.1	6.9	378.3	21.5	10.4	2.3
1993	39.7	27.3	16.0	12.1	21.1	3.3	159.5	13.6	110.1	3.0
1994	77.2	16.1	16.7	3.4	98.8	10.9	59.2	20.3	47.7	8.4
1995	30.5	12.4	18.7	27.3	5.0	24.0	3.5	41.2	5.7	14.2
1996	1785.8	128.4	2.7	3.9	130.0	2.2	37.5	4.2	106.3	0.3
1997	.	2.6	.	34.0	12.6	34.1	18.1	6.3	0.2	5.5
1998	298.9	38.1	3.5	3.7	84.1	1.2	854.2	14.3	1.5	0.2
1999	44.8	21.0	63.5	40.0	1.7	41.3	23.2	105.5	36.1	33.5
2000	0.0	1.3	84.8	19.3	8.7	2.8	1.9	3.0	23.1	6.6
2001	1283.7	13.6	10.2	0.4	55.9	1.2	479.3	5.0	97.9	11.5
2002	1.7	2.5	749.6	38.3	0.3	10.8	6.5	36.7	9.3	15.5
2003	844.6	47.5	1.5	1.2	48.8	0.4	117.0	0.9	472.5	1.9
2004	3.6	1.9	61.9	45.2	0.3	3.5	0.1	15.5	1.5	28.7
2005	278.2	156.2	82.3	132.3	10.3	0.1	8.8	0.2	57.8	5.4
2006	60.7	18.9	10.8	12.5	2.0	1.0	0.6	3.9	283.2	39.9
2007	237.0	177.8	40.9	37.1	4.0	0.5	45.5	1.8	401.3	41.2

Appendix A Table 4. Legend. Lakewide trawl index series codes, names and arithmetic mean type used in Appendix A Table 2 and Appendix A Table 3.
(CPTH = catch per trawl hour; CPHa = catch per hectare)

Abbreviation	Series	Type
ONTS10A	Ontario Management Unit 1 summer age 0 arithmetic	CPTH
ONTS11A	Ontario Management Unit 1 summer age 1 arithmetic	CPTH
OHS10A	Ohio Management Unit 1 summer age 0 arithmetic	CPHa
OHS11A	Ohio Management Unit 1 summer age 1 arithmetic	CPHa
OHF10A	Ohio Management Unit 1 fall age 0 arithmetic	CPHa
OHF11A	Ohio Management Unit 1 fall age 1 arithmetic	CPHa
USS10A	USGS Management Unit 1 summer age 0 arithmetic	CPTH
USS11A	USGS Management Unit 1 summer age 1 arithmetic	CPTH
USF10A	USGS Management Unit 1 fall age 0 arithmetic	CPTH
USF11A	USGS Management Unit 1 fall age 1 arithmetic	CPTH
ONOHS10A	Ontario/Ohio Management Unit 1 summer age 0 arithmetic	CPTH
OHS20A	Ohio Management Unit 2 summer age 0 arithmetic	CPHa
OHS21A	Ohio Management Unit 2 summer age 1 arithmetic	CPHa
OHF20A	Ohio Management Unit 2 fall age 0 arithmetic	CPHa
OHF21A	Ohio Management Unit 2 fall age 1 arithmetic	CPHa
OHS30A	Ohio Management Unit 3 summer age 0 arithmetic	CPHa
OHS31A	Ohio Management Unit 3 summer age 1 arithmetic	CPHa
OHF30A	Ohio Management Unit 3 fall age 0 arithmetic	CPHa
OHF31A	Ohio Management Unit 3 fall age 1 arithmetic	CPHa
ILP40A	Inner Long Point Bay Management Unit 4 age 0 arithmetic	CPHa
ILP41A	Inner Long Point Bay Management Unit 4 age 1 arithmetic	CPHa
OLP40A	Outer Long Point Bay Management Unit 4 age 0 arithmetic	CPHa
OLP41A	Outer Long Point Bay Management Unit 4 age 1 arithmetic	CPHa
NYF40A	New York Management Unit 4 fall age 0 arithmetic	CPHa
NYF41A	New York Management Unit 4 fall age 1 arithmetic	CPHa