Report of the Lake Erie Yellow Perch Task Group

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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

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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 2006 through March 2007, 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 2007 for each management unit
    c) Supporting decision/risk analysis strategies for yellow perch management.

3. Prepare a Lake Erie Yellow Perch Management Plan as a companion document to the Walleye Management Plan.

4. Continue to explore the special stock assessment issues for the eastern basin (MU4) yellow perch resource. Maintain assessment approaches capable of detecting discrete stocks. Develop a MU4 harvest policy that recognizes these special considerations.

5. 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: 2006 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) in 2006 was 16.480 million pounds. This allocation represented a 12% increase from a TAC of 14.770 million pounds in 2005. For yellow perch assessment and allocation, Lake Erie is partitioned into four Management Units (Units, or MUs; Figure 1.1). The 2006 allocation by management unit was 3.057, 7.026, 6.045 and 0.352 million pounds for Units 1 through 4, respectively. The lakewide harvest of yellow perch in 2006 was 11.104 million pounds; this was the highest observed since 1990 and a 14.5% increase from the 2005 harvest of 9.700 million pounds. Harvest by management unit was 2.4, 4.5, 3.8 and 0.3 million pounds for Units 1 through 4, respectively (Table 1.1). The portion of TAC

harvested was 80%, 64%, 63% and 95% in MUs 1 through 4, respectively. In 2006, Ontario harvested 8.1 million pounds, followed by Ohio (2.7 million lbs.), Pennsylvania (163 thousand lbs.), Michigan (63 thousand lbs.) and New York (48 thousand lbs.).

Ontario fishers harvested most of their allocation in MU1 (99%) and MU3 (98%) and exceeded their allocations in MU2 (101%) and MU4 (115%). Ontario exceeded the MU4 quota 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 70% of their quota in the western basin (MU1), 35% in the west central basin (MU2) and 14% in the east central basin (MU3). Michigan anglers in MU1 attained one-quarter of their quota (25%). Pennsylvania fisheries achieved a minor fraction of their quota in MU3 (15%), but did attain 94% of their quota in MU4. New York fisheries attained 50% of their quota in MU4.

Ontario's portion of the lakewide yellow perch harvest increased to 73% in 2006 from 63% in 2005 (Table 1.1). This increase was attributed to a strong performance of Ontario fisheries in MU2 and MU3, and to a smaller extent in MU4. Ohio's proportion of lakewide harvest was 24% in 2006, down from 34% in 2005. Severe flooding in MU2 and MU3 in Ohio during the summer affected marinas, ramps and nearshore fishing effort and performance. Harvest in Michigan, Pennsylvania and New York jurisdictions represented 2.5% of the lakewide harvest combined in 2006.

Harvest, fishing effort, and fishery harvest rates are summarized for the time period 1996-2006 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends over a longer time series (1975-2006) 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 2006 of harvest (all gears) and effort by gear type are presented in Figures 1.5 through 1.8.

Ontario's yellow perch harvest from large mesh (3 inches or greater) gill nets in 2006 ranged from 3% to 5% of the gill net harvest in MUs 1-3 but was negligible in MU4 (<1%). 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 10% in MU1, but increased elsewhere: 22% in MU2, two-fold in MU3, and 17% in MU4. Harvest from small mesh gill nets is the highest seen since 1990 in MU2, highest in the YPTG time series in MU3, and highest since 1990 in MU4. Targeted gill net effort was similar to 2005 in MU1 (<0.5%), increased 20% in MU2, increased slightly over two-

fold in MU3, and 29% in MU4. Gill net effort remained lower in 2006 compared to the 1990's and earlier decades (Figure 1.3). Targeted gill net harvest rates increased slightly (1%) in 2006 compared to 2005 in MU2, but decreased 10% in MU1, 8% in MU3, and 9% in MU4.

In 2006, sport harvest in U.S. waters increased in MU1 (34%) and MU4 (9%), and decreased in MU2 (5%) and MU3 (47%) from 2005. U.S. angling effort decreased in 2006 from 2005 across all MUs (MU1 (12%), MU2 (36%), MU3 (54%) and MU4 (28%)). The sport harvest of yellow perch from Ontario waters is assessed periodically and was not assessed in 2006. 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 (Tables 1.2-1.5). Sport harvest rates increased lakewide from 2005 in kg/hr by 25%, 32%, 17% and 33% in MUs 1 through 4, respectively. When sport harvest rates are expressed as fish/hr, harvest rates remained unchanged in Michigan (MU1) and New York (MU4), but increased marginally in Ohio (MU3) and by approximately 1 fish/hr in Units 1 and 2 in Ohio and Units 3 and 4 in Pennsylvania waters.

Harvest from commercial trap nets in 2006 decreased 34% in MU1 and 36% in MU2 but increased 55% and 22% from 2005 in Units 3 and 4, respectively. Trap net effort (lifts) in 2006 decreased in MU1 (10%), MU2 (17%), and MU3 (7%), but increased 16% (second highest effort in the last decade) in MU4 compared to 2005. Ohio trap nets continued fishing in 2006 after re-entering the MU3 fishery in 2005 following three years of absence. Trap net harvest rates decreased in MU1 (27%) and MU2 (23%), but increased in MU3 (66%) and MU4 (5%) from 2005.

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

Age Composition and Growth

The yellow perch harvest in 2006 consisted mostly of the 2003 (age 3) and 2001 (age 5) year classes in MUs 1 to 3 while the 2003 (age 3), 2001 (age 5), and older year classes (1999, 1998 and earlier) were more dominant in the MU4 harvest (Table 1.6). The strong 2003 year class (age 3) was a major contributor to all fisheries across all MUs; however, the 2001 (age 5) year class was a more dominant component of the trap net fishery. Overall, the 2003 (62%) and 2001 (24%) year classes accounted for the majority (86%) of the lakewide harvest. Age-2 and age-4 yellow perch (2000 and 2002 year classes) were not prominent in any fisheries, although the 2002 year class did represent a larger proportion (15%) of harvest in MU4 than in the other MUs.

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 and age 4 (since 2003 in MUs 1, 2, and 3, and since 2004 in MU4). Condition factors (K) of age 1, 2 and 4 yellow perch appears to be declining in MU1 (Figure 1.10). Condition of age 0 fish has declined in 2004 in MU3, however, condition of ages 3 and 4 yellow perch had increased. In MU4, condition of age 1, 2 and 3 fish appears to be declining since 2004, however, condition of age 0 fish has improved. In MU2 there does not appear to be any trends in change of fish condition. In 2006, for the second consecutive year, growth of YOY yellow perch appeared elevated in the western basin, but declined MUs 3 and 4 (Figure 1.9). Reduced length-at-age and weight-at-age trends are also being exhibited across several ages and MUs. Though no long term trends in growth are apparent, growth rates do appear to be declining in the 2000's (Figures 1.9 and 1.10).

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. These weight-at-age declines are not only expressed as a measure of growth, but they also factor in to a decline in the overall

population biomass and subsequent (lower) determinations of recommended allowable harvest (RAH) calculated weight-at-age in the harvest.

ADMB Catch-at-Age Analysis 2007

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 unchanged from the last several years' methodology with 2006 data appended to the time series. Estimates of population size, biomass and parameters such as survival and exploitation rates are presented by management unit for 1990-2006 in Table 1.7 and graphically for 1975-2006 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 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 2006 implies that the time series are continuous. Lack of data continuity 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 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 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; until lambdas remain relatively constant (they don't change within a factor of 0.1). While lambdas within similar parameter groups (*i.e.* effort, catch and surveys) are solved and weighted unequally, the groups themselves are given equal weight.

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 2007 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 2007 was calculated using the mean of values predicted from the indices that correlate well ($F<0.01$, $r^2>0.50$) 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 (geometric means) and Appendix A, Table 4 (arithmetic means), 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 2007 (the 2005 year class) were below average in Management Units 1, 2, and 4, and only slightly above average in MU3 (Table 1.7, Appendix A, Table 2). The 2005 year class is expected to contribute minimally to fisheries in 2007. This marks the third time in the last four years that age-2 yellow perch recruitment is near or below the levels of poor recruitment portrayed in the early 1990's (1990-1994). 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 1993-1994 increases.

2007 Population Size Projection

Stock size estimates for 2007 (ages 3 and older) were projected from catch-at-age analysis estimates of 2006 population size and age-specific survival rates in 2006 (Table 1.8). Projected age-2 yellow perch recruitment from the 2005 year class (method described above) was added to the 2007 population estimate for older fish in each unit, producing the total standing stock in 2007 (Table 1.8). Standard errors and ranges for estimates are provided for each age in 2006, and following estimated survival (from ADMB), for 2007. 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 2007 were lower due primarily to mortality exerted on

the 2003 year class (Table 1.7 and Figure 1.11). Due to the weaker 2005 year class, which was preceded by a weak 2004 year class, estimated abundances of ages 2+ yellow perch in 2007 are at 59%, 74%, and 77% of 2006 abundances across management units 1-3, respectively, while MU4 is projected to be 89% of the 2006 abundance. Abundance projections for 2007 were 23, 57, 66 and 9 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 2007 are sizably lower compared to the 2006 estimates in MUs 1-3: down 49%, 43%, and 42%, respectively. MU4 estimates of age-3-and-older yellow perch are 24% lower for 2007 compared to 2006. Age-3-and-older yellow perch abundance in 2007 is projected to be 18, 41, 45, and 6 million fish in Units 1 through 4, respectively.

As a function of population estimates and mean weight-at-age from surveys, biomass estimates were among the highest in the time series in 2005 (Figure 1.12). Total biomass estimates of age-2-and-older yellow perch for 2007 have declined for the second consecutive year (Figure 1.12). Total biomass in 2007 is estimated to decrease moderately from 2006 values in MU1 (39%), MU2 (19%), MU3 (19%) and MU4 (12%). The biomass estimates for 2007 are well below the historic (1975-2006) mean in MU1 (54% of the mean value), and above historic means in MU2 (13%), MU3 (93%), and MU4 (90%). The strong 2003 year class (at age 4) is expected to represent the largest fraction of total biomass in 2007 in MU1 (58%), MU2 (56%), MU3 (54%), and MU4 (37%; Table 1.8).

Estimates of yellow perch survival for ages 3 and older in 2005 were 38%, 41%, 57% and 59% in MU1, 2, 3 and 4, respectively (Figure 1.13). In 2006, estimated survival rates (ages 3+) were 43%, 52%, 51% and 58% in Units 1 through 4 (Table 1.8). As expected, survival rates were higher for fish ages 2 and older than ages 3 and older, since new recruits are less vulnerable to fishing mortality. Albeit with annual fluctuations, estimated survival has improved gradually in all management units since early to mid 1990s.

Estimated exploitation rates in 2005 were 36%, 32%, 12% and 9% in Management Units 1–4, respectively, for ages 3 and older. Exploitation rates for 2006 were estimated at 30%, 18%, 20% and 12% for yellow perch ages 3 and older across the MUs (Figure 1.14). Exploitation rates of yellow perch ages 2 and older are slightly lower since new recruits are less vulnerable to fishing.

Yellow Perch Genetics

In 2007, the YPTG is supporting 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 genetics analyses and morphometric analyses will complement each other and provide a more holistic assessment of stock structure in Lake Erie.

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). His results from mitochondrial DNA analysis show that most variation is across individual spawning sites rather than generic basinwide differences. The most significant differences were between widely separated spawning sites across basins with the greatest distance between them. The use of microsatellite loci increased the resolution of the analysis; resulting in many significant differences. Strong cluster assignment was found for eastern basin (Dunkirk/Long Point) spawning sites and central basin sites (Vermilion/Lorain), but no cohesive cluster was found for western basin sites (*i.e.* many contributors over a wide area). 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 to continue to provide support for genetic stock discrimination research initiatives, as requested.

Charge 2: Harvest Strategy and RAH

Harvest Strategy Methodology

In 2007, fishing rates applied in 2006 (F_{2006}) 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. Parameters include mean weight-at-age from harvest (recent two-year mean), age-specific selectivities (recent two-year mean) from catch-at-age analysis weighted by sharing formula along with survey maturity data for the spawning stock. The simulation assumes that the targeted fishing rates will be realized for all gear types. Simulation methodology and risk assessment is described below.

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 (1982-2005). 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. The length of time series used this year in the MU3 simulation was 1982-2004 due to the poor model fit with the 2005 data. 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 2007, and are presented for MUs 1, 2, 3 and 4 (Tables 2.1.1 – 2.1.4). Target fishing rates used for TACs in 2006 (F_{2006}) are proposed for 2007 TACs, and are presented for Management Units 1 through 4 (Table 2.2.1). Since Charge 5 (lambda review) is not yet complete, $F_{0.1}$ rates calculated in the same method as last year are presented as biological reference points in Tables 2.1.1– 2.1.4.

Yellow perch allocation based on lake area of each jurisdiction was applied in 2005 and 2006. Allocation shares by management unit and jurisdiction are:

Allocation by Management Unit and Jurisdiction, 2007:

MU 1:	MI	8.10%	OH	49.60%	ONT	42.30%
MU 2:	OH	57.50%	ONT	42.50%		
MU 3:	OH	31.93%	PA	11.93%	ONT	56.14%
MU 4:	NY	27.60%	PA	17.20%	ONT	55.20%

In 2005, an exercise was completed to update the allocation area shares using geographical information systems (GIS) mapping. This process cleaned up MU lines that fell across a grid. In 2008, updated area percentages will be implemented as allocation shares among jurisdictions.

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. Completion of this charge was dependent on resolving Charge 5 (catch-at-age analysis data weighting and definition of lambdas). Establishing population objectives for the YPMP is dependent on final model configurations and risk outcomes using endorsed data weighting approaches. The STC has now prepared a plan outline, and with the YPTG will be addressing these charges. It is expected to be a significant endeavor by the YPTG.

Charge 4: Eastern Basin (MU4) Sub-stock Delineation and Boundaries

Yellow perch in eastern Lake Erie have been treated as a single stock for assessment and allocation purposes since the 1980s. However, MU4 is notable among Lake Erie's yellow perch management units as the area where yellow perch fisheries are more often spatially isolated within the basin, and yellow perch habitat remains more clearly partitioned by lake bathymetry. Also, there has been evidence of differing recruitment patterns within various parts of the basin. Finally, the Myers and Bence (2001) independent review of YPTG stock assessment efforts identified MU4 as a special case where stock definition seemed evident within the basin. Recently, eastern basin yellow perch stock assessment has been examined as part of a thorough technical review being pursued by the Ontario Ministry of Natural Resources, *Status of the Fish Community and Fisheries in Eastern Lake Erie. Results from the 2000-2004 East Basin Rehabilitation Plan – OMNR (2006).* At present, this document supports the YPTG's ongoing practice of treating the east basin yellow perch resource as one unit, *i.e.* "MU4", for stock assessment purposes. Nevertheless, there remains enough evidence for sub-stocks within MU4 that yellow perch assessments in this area should explore approaches capable of detecting, describing and managing discrete stocks.

During 2006, some progress was made in the re-evaluation of MU 4 stock structure. Two long-term fishery-independent surveys conducted in Management Unit 4 are not currently used in the ADMB catch-at-age population model. These two surveys that provide an opportunity to examine separate trends in yellow perch abundance are: 1) an OMNR Long Point Bay gill net survey, and 2) a NYSDEC trawl survey for New York's east basin waters. The survey

areas of these two assessments occur at opposite corners of the management unit where the yellow perch resource in each area could reasonably be considered to be isolated from the other survey. However, results from long- term age-2+ yellow perch abundance indices from these two surveys paralleled each other, and both also closely resembled MU4 yellow perch population trends independently estimated by the ADMB catch-at-age population model (Figure 4.1).

In particular, each of the three yellow perch stock assessments described a period of persistent, low yellow perch abundances from 1993 to 1999, followed by a marked increase from 2000 to 2006. The mean abundance of the 1993-1999 low ebb relative to the subsequent 2000-2006 increase was measured as a five-fold rebound observed for each of the independent surveys, and a similar six-fold increase for the MU4 catch-at-age model. As such, despite concerns for possible separate stocks within MU4, our preliminary examination using some additional yellow perch data sources supports the long standing method of assessing eastern basin yellow perch as a single resource. Nevertheless, inclusion of the OMNR Long Point Bay gill net series and the New York trawl series as possible new elements of the MU4 yellow perch information base allows an opportunity to examine the MU4 yellow perch resource independently of the catch-at-age model, and develop an overall assessment approach capable of detecting the dynamics of discrete stocks. During 2007-2008 the task group expects to formalize any special assessment and harvest policy considerations for MU4 as a component of the Yellow Perch Management Plan (see Charge 3).

Charge 5: 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 model. The current weighting methodology is described in *Charge 1, ADMB Catch-at-Age Analysis 2007*. 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) to resolve the lambda weighting in the ADMB catch-at-age models. Task group members and QFC personnel held a workshop at the University of Windsor on June 28-29, 2006, to discuss new λ weighting processes. It was decided that λ values for fishery catch and survey catch rates should be based upon how well harvest, effort, and abundance are measured. The data sources were weighted based upon the observed variability in the data sources themselves. As such, all λ values would be pre-specified prior to population model runs based on model fitting criteria.

This process was first applied to the walleye ADMB catch-at-age model. It is still being evaluated in this model, and has not yet been applied to the yellow perch models. However, task group members have completed preliminary work necessary to address the yellow perch lambda charge, including calculating coefficients of variation and standard errors for annual fishery and survey data. Preliminary ADMB program coding has been completed, including coding for new lambdas, survey selectivity, and full negative log likelihood objective functions. It is expected that the new λ weighting process will be evaluated within the yellow perch models during 2007, for use in 2008.

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Table 1.1. Lake Erie yellow perch harvest in pounds by management unit (Unit) and agency, 1996-2006.

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest
Unit 1	1996	704,167	36	1,125,716	57	134,810	7	--	--	--	--	1,964,693
	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
Unit 2	1996	1,290,998	61	823,425	39	--	--	--	--	--	--	2,114,423
	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
Unit 3	1996	512,293	72	186,695	26	--	--	9,041	1	--	--	708,029
	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
Unit 4	1996	30,495	82	--	--	--	--	2,205	6	4,472	12	37,172
	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
Lakewide Totals	1996	2,537,953	53	2,135,836	44	134,810	3	11,246	<1	4,472	<1	4,824,317
	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

*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, 1996-2006.

		Unit 1				
		Michigan	Ohio		Ontario Gill Nets	
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh
Harvest (pounds)	1996	134,810	200,313	925,403	704,167	--
	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
Harvest (Metric) (tonnes)	1996	61	91	420	319	--
	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
Effort *(a)*	1996	193,733	4,869	754,277	8,614	--
	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
Harvest Rates *(b)*	1996	3.3	18.7	4.9	37.0	--
	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

(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, 1996-2006.

		Unit 2			
		Ohio		Ontario Gill Nets	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh
Harvest (pounds)	1996	323,334	500,091	1,290,998	--
	1997	498,945	580,937	1,826,180	--
	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
Harvest (Metric) (tonnes)	1996	147	227	585	--
	1997	226	263	828	--
	1998	138	147	815	--
	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
Effort *(a)*	1996	5,834	316,736	14,572	--
	1997	8,721	575,365	24,974	--
	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
Harvest Rates *(b)*	1996	25.1	4.2	40.1	--
	1997	25.9	2.8	33.2	--
	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

(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 1.4. 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, 1996-2006.

		Unit 3					
		Ohio		Ontario Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
Harvest (pounds)	1996	103,414	83,281	512,293	--	5,292	3,749
	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
Harvest (Metric) (tonnes)	1996	47	38	232	--	2.4	1.7
	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
Effort *(a)*	1996	2,730	69,887	6,184	--	185	12,850
	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
Harvest Rates *(b)*	1996	17.2	2.8	37.5	--	13.0	0.8
	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

(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 1.5. 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, 1996-2006.

		Unit 4					
		New York		Ontario Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
Harvest (pounds)	1996	2,822	1,650	30,495	--	0	2,205
	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
Harvest (Metric) (tonnes)	1996	1.3	0.7	13.8	--	0	1.0
	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
Effort *(a)*	1996	533	6,535	1,063	--	0	7,292
	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	12,451
	2002	89	44,270	224	28	9	61,734
	2003	91	33,162	373	21	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	32	0	47,274
Harvest Rates *(b)*	1996	2.4	0.5	13.0	--	--	0.6
	1997	1.9	0.4	15.3	--	--	1.0
	1998	3.4	0.7	20.3	--	--	0.3
	1999	2.7	0.8	31.1	--	--	0.4
	2000	6.4	0.2	51.5	--	--	1.7
	2001	0.3	1.8	121.5	26.0	--	1.5
	2002	9.9	1.3	174.0	25.0	1.5	2.4
	2003	5.2	0.9	102.9	2.9	--	1.9
	2004	40.3	1.4	126.1	2.4	--	1.7
	2005	19.6	1.5	113.2	3.0	--	1.8
	2006	20.5	1.5	103.2	16.6	--	2.9

(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

Table 1.6. Estimated Lake Erie 2006 yellow perch harvest in numbers of fish by gear, age and management unit (Unit).

		Unit 1		Unit 2		Unit 3		Unit 4		Lakewide	
Gear	Age	Number	%	Number	%	Number	%	Number	%	Number	%
Gill Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	27,550	0.6	83,795	0.8	114,544	1.1	37,951	6.4	263,840	1.0
	3	3,050,355	65.4	8,716,361	79.1	5,445,572	51.9	330,886	55.4	17,543,174	65.5
	4	56,435	1.2	183,565	1.7	1,337,648	12.7	100,987	16.9	1,678,634	6.3
	5	999,039	21.4	1,749,615	15.9	2,547,867	24.3	82,410	13.8	5,378,931	20.1
	6+	533,680	11.4	288,193	2.6	1,054,921	10.0	44,888	7.5	1,921,682	7.2
	Total	4,667,060		11,021,529		10,500,552		597,121		26,786,261	
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	3	246,776	30.0	809,190	36.4	100,857	39.8	1,036	4.7	1,157,859	34.8
	4	49,323	6.0	88,015	4.0	10,777	4.3	444	2.0	148,559	4.5
	5	498,051	60.6	1,130,496	50.8	101,417	40.0	9,620	43.3	1,739,584	52.3
	6+	28,242	3.4	198,101	8.9	40,511	16.0	11,100	50.0	277,954	8.4
	Total	822,392		2,225,802		253,562		22,201		3,323,957	
Sport	1	32,174	1.0	6,073	0.3	272	0.0	179	0.8	38,698	0.6
	2	62,215	1.8	35,569	1.8	5,669	0.9	536	0.3	103,989	1.7
	3	2,311,836	68.5	1,301,489	65.8	231,881	35.8	24,010	13.7	3,869,216	62.7
	4	148,765	4.4	48,667	2.5	28,056	4.3	18,175	10.4	243,663	3.9
	5	684,237	20.3	473,559	24.0	186,975	28.8	48,488	27.7	1,393,259	22.6
	6+	134,458	4.0	111,152	5.6	195,506	30.2	83,846	47.8	524,962	8.5
	Total	3,373,685		1,976,509		648,359		175,234		6,173,787	
All Gear	1	32,174	0.4	6,073	0.0	272	0.0	179	0.0	38,698	0.1
	2	89,765	1.0	119,364	0.8	120,213	1.1	38,487	4.8	367,829	1.0
	3	5,608,967	63.5	10,827,040	71.1	5,778,310	50.7	355,932	44.8	22,570,249	62.2
	4	254,523	2.9	320,247	2.1	1,376,481	12.1	119,606	15.1	2,070,856	5.7
	5	2,181,327	24.7	3,353,670	22.0	2,836,259	24.9	140,518	17.7	8,511,774	23.5
	6+	696,380	7.9	597,446	3.9	1,290,938	11.3	139,834	17.6	2,724,598	7.5
	Total	8,830,963		15,223,840		11,402,473		794,555		36,284,004	

Table 1.7. Yellow perch stock size (millions of fish) in each Lake Erie management unit. The years 1990 to 2006 are estimated by ADMB catch-age analysis. The 2007 population estimates use age-2 yellow perch 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
Unit 1	2	3.654	10.806	13.861	4.661	10.164	22.968	26.246	21.773	41.361	10.824	32.766	32.147	8.611	39.794	3.770	45.361	4.149	5.110
	3	1.374	1.941	5.731	7.722	1.909	6.224	14.125	15.756	13.641	25.704	6.962	20.992	20.825	5.562	25.262	2.421	28.429	2.707
	4	5.419	0.528	0.606	2.040	2.055	0.859	2.840	6.262	7.576	7.012	14.398	3.898	12.583	11.147	3.148	12.282	1.243	12.800
	5	2.036	1.531	0.120	0.138	0.302	0.513	0.237	0.760	1.950	2.739	3.206	7.114	2.125	5.271	5.113	1.225	4.622	0.551
	6+	1.436	0.636	0.305	0.069	0.023	0.078	0.174	0.105	0.186	0.491	1.239	1.978	4.747	2.514	3.290	2.604	1.190	2.038
	2 and Older	13.920	15.443	20.624	14.630	14.453	30.642	43.622	44.656	64.714	46.770	58.570	66.128	48.891	64.287	40.583	63.893	39.633	23.206
	3 and Older	10.266	4.636	6.763	9.970	4.289	7.674	17.376	22.883	23.353	35.946	25.804	33.982	40.280	24.494	36.813	18.532	35.484	18.096
Unit 2	2	5.518	14.097	18.796	6.826	12.225	12.521	27.154	17.001	61.318	15.320	53.191	42.524	9.895	81.388	6.327	90.006	5.250	16.007
	3	1.549	2.178	5.792	9.080	3.175	6.969	7.008	13.145	8.740	32.071	9.460	32.061	25.108	6.209	48.582	4.106	57.402	3.439
	4	7.783	0.535	0.727	2.099	3.359	1.125	2.652	2.784	4.180	3.712	17.772	5.194	18.041	13.264	3.417	25.043	2.291	31.189
	5	2.237	1.850	0.115	0.195	0.550	0.682	0.237	0.567	0.465	0.864	1.778	8.299	2.483	7.864	5.286	1.521	9.811	1.274
	6+	1.427	0.701	0.412	0.143	0.078	0.127	0.172	0.087	0.069	0.077	0.378	0.975	4.432	3.001	4.378	4.092	2.219	5.073
	2 and Older	18.513	19.361	25.841	18.343	19.386	21.424	37.223	33.585	74.772	52.044	82.578	89.053	59.959	111.726	67.991	124.767	76.972	56.982
	3 and Older	12.995	5.264	7.045	11.516	7.161	8.903	10.069	16.584	13.454	36.724	29.387	46.529	50.064	30.337	61.663	34.761	71.722	40.975
Unit 3	2	4.116	8.463	5.385	3.085	6.241	6.935	12.986	9.632	37.530	12.010	44.401	26.353	6.887	39.152	3.839	92.144	7.918	20.707
	3	1.852	2.500	3.690	2.410	1.522	3.637	4.290	8.245	5.991	24.267	7.782	28.640	16.846	4.421	25.392	2.516	61.098	5.234
	4	4.230	0.871	0.834	1.323	1.019	0.819	2.143	2.519	4.339	3.589	15.488	4.905	18.110	10.491	2.738	15.627	1.539	32.900
	5	1.457	1.475	0.328	0.250	0.446	0.358	0.421	1.096	1.207	2.397	2.238	9.333	3.024	10.798	6.139	1.602	8.835	0.806
	6+	4.078	1.677	0.759	0.343	0.205	0.251	0.319	0.373	0.637	0.935	2.024	2.535	7.255	6.153	9.923	9.349	6.241	6.201
	2 and Older	15.732	14.986	10.996	7.410	9.434	12.001	20.160	21.865	49.704	43.198	71.934	71.766	52.122	71.015	48.032	121.238	85.631	65.848
	3 and Older	11.617	6.523	5.611	4.326	3.192	5.066	7.174	12.233	12.174	31.188	27.533	45.414	45.235	31.863	44.193	29.094	77.714	45.141
Unit 4	2	0.579	0.420	0.100	0.269	0.126	1.061	0.712	0.313	3.759	1.351	11.583	2.353	1.959	7.426	1.112	6.612	2.182	3.013
	3	0.681	0.375	0.269	0.067	0.170	0.080	0.698	0.468	0.205	2.517	0.894	7.726	1.577	1.312	4.961	0.737	4.370	1.454
	4	0.939	0.342	0.171	0.173	0.028	0.077	0.046	0.398	0.262	0.135	1.586	0.588	5.155	1.041	0.856	3.190	0.457	2.617
	5	0.396	0.353	0.105	0.098	0.046	0.009	0.037	0.022	0.189	0.164	0.083	1.024	0.391	3.323	0.659	0.534	1.919	0.265
	6+	0.904	0.486	0.252	0.203	0.077	0.036	0.020	0.026	0.022	0.124	0.170	0.161	0.782	0.722	2.482	1.872	1.387	1.809
	2 and Older	3.499	1.976	0.898	0.809	0.447	1.263	1.513	1.228	4.437	4.291	14.316	11.852	9.863	13.824	10.069	12.944	10.316	9.157
	3 and Older	2.920	1.556	0.798	0.540	0.321	0.202	0.801	0.915	0.679	2.940	2.733	9.499	7.904	6.398	8.958	6.333	8.134	6.145

Table 1.8. Projection of the 2007 Lake Erie yellow perch population. Stock size estimates are derived from ADMB and age 2 estimates for 2007 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.

	2006 Parameters					Rate Functions					2007 Parameters				Stock Biomass		
	Stock Size (numbers)					Mortality Rates				Survival Rate	Stock Size (numbers)			Mean Weight in	millions kg		millions lbs.
	Age	**Mean**	**Std. Err.**	**Min.**	**Max.**	**(F)**	**(Z)**	**(A)**	**(u)**	**(S)**	**Age**	**Mean**	**Min.**	**Max.**	Pop. (kg)	**2006**	**2007**	**2007**
Unit 1	2	4.149	2.630	1.519	6.779	0.027	0.427	0.348	0.022	0.652	2	5.110	3.807	6.414	0.054	0.191	0.276	0.608
	3	28.429	12.917	15.512	41.346	0.398	0.798	0.550	0.274	0.450	3	2.707	0.991	4.423	0.091	2.843	0.246	0.543
	4	1.243	0.495	0.748	1.738	0.414	0.814	0.557	0.283	0.443	4	12.800	6.984	18.615	0.114	0.114	1.459	3.217
	5	4.622	1.942	2.680	6.564	0.620	1.020	0.639	0.389	0.361	5	0.551	0.332	0.770	0.152	0.707	0.084	0.185
	6+	1.190	0.584	0.606	1.774	0.764	1.164	0.688	0.451	0.312	6+	2.038	1.156	2.921	0.224	0.287	0.457	1.007
	Total	39.633		21.065	58.201	0.384	0.784	0.543	0.266	0.457	Total	23.206	13.269	33.143	0.109	4.142	2.522	5.560
	(3+)	35.484		19.546	51.422	0.435	0.835	0.566	0.295	0.434	(3+)	18.096	9.462	26.729	0.124	3.951	2.246	4.952
Unit 2	2	5.250	2.815	2.435	8.065	0.023	0.423	0.345	0.019	0.655	2	16.007	11.435	20.580	0.061	0.299	0.976	2.153
	3	57.402	22.417	34.985	79.819	0.210	0.610	0.457	0.157	0.543	3	3.439	1.595	5.283	0.099	6.085	0.340	0.751
	4	2.291	0.775	1.516	3.066	0.187	0.587	0.444	0.141	0.556	4	31.189	19.009	43.370	0.135	0.241	4.211	9.284
	5	9.811	3.562	6.249	13.373	0.458	0.858	0.576	0.307	0.424	5	1.274	0.843	1.705	0.227	1.943	0.289	0.638
	6+	2.219	0.856	1.363	3.075	0.488	0.888	0.589	0.323	0.411	6+	5.073	3.210	6.935	0.337	0.721	1.710	3.770
	Total	76.972		46.547	107.397	0.230	0.630	0.468	0.171	0.532	Total	56.982	36.092	77.873	0.132	9.288	7.526	16.595
	(3+)	71.722		44.112	99.332	0.248	0.648	0.477	0.182	0.523	(3+)	40.975	24.657	57.293	0.160	8.989	6.550	14.442
Unit 3	2	7.918	4.422	3.496	12.340	0.014	0.414	0.339	0.011	0.661	2	20.707	15.054	26.361	0.044	0.293	0.911	2.009
	3	61.098	25.359	35.739	86.457	0.219	0.619	0.462	0.163	0.538	3	5.234	2.311	8.157	0.100	5.621	0.523	1.154
	4	1.539	0.564	0.975	2.103	0.247	0.647	0.476	0.182	0.524	4	32.900	19.245	46.556	0.134	0.145	4.409	9.721
	5	8.835	3.084	5.751	11.919	0.512	0.912	0.598	0.336	0.402	5	0.806	0.511	1.101	0.219	1.864	0.176	0.389
	6+	6.241	2.040	4.201	8.281	0.456	0.856	0.575	0.306	0.425	6+	6.201	4.095	8.307	0.345	2.191	2.139	4.717
	Total	85.631		50.162	121.100	0.240	0.640	0.473	0.177	0.527	Total	65.848	41.215	90.481	0.124	10.114	8.159	17.990
	(3+)	77.714		46.667	108.761	0.266	0.666	0.486	0.195	0.514	(3+)	45.141	26.161	64.120	0.161	9.821	7.248	15.981
Unit 4	2	2.182	1.667	0.515	3.849	0.006	0.406	0.334	0.005	0.666	2	3.013	2.165	3.860	0.056	0.109	0.169	0.372
	3	4.370	2.715	1.655	7.085	0.113	0.513	0.401	0.088	0.599	3	1.454	0.343	2.564	0.159	0.717	0.231	0.510
	4	0.457	0.265	0.192	0.722	0.146	0.546	0.421	0.113	0.579	4	2.617	0.991	4.242	0.240	0.123	0.628	1.385
	5	1.919	1.085	0.834	3.004	0.202	0.602	0.452	0.152	0.548	5	0.265	0.111	0.418	0.276	0.535	0.073	0.161
	6+	1.387	0.808	0.579	2.195	0.204	0.604	0.453	0.153	0.547	6+	1.809	0.773	2.845	0.332	0.447	0.601	1.325
	Total	10.316		3.776	16.856	0.118	0.518	0.404	0.092	0.596	Total	9.157	4.384	13.931	0.186	1.931	1.702	3.752
	(3+)	8.134		3.261	13.007	0.150	0.550	0.423	0.116	0.577	(3+)	6.145	2.219	10.070	0.249	1.822	1.533	3.380

Table 2.1.1. Management Unit 1 yellow perch biological references from simulations and projected population size in 2008 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+ (14.6 million) and 1994 for ages 3+ (4.3 million). The "Harvest 2007" column is based on fishing rates in the "F" column and 2007 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2005 and were used to determine $F_{0.1}$. F_{2006} was the fishing rate used for setting TAC in 2004, 2005, and 2006.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2007 (lbs x 10^6)	Population 2+ in 2008 (millions)	Population 3+ in 2008 (millions)	Harvest Strategy Reference
100	67%	67%	5.5	0.0	0.000	0.000	23.435	15.555	
98	67%	67%	5.5	0.0	0.010	0.029	23.353	15.474	
92	66%	65%	5.9	0.0	0.050	0.142	23.032	15.153	
85	64%	63%	6.9	0.1	0.100	0.280	22.642	14.763	
78	63%	61%	11.3	0.1	0.150	0.414	22.265	14.385	
73	62%	60%	15.7	0.1	0.200	0.544	21.900	14.020	
68	61%	58%	16.5	0.2	0.250	0.669	21.546	13.667	
64	60%	56%	17.4	0.2	0.300	0.791	21.204	13.325	
60	59%	55%	19.4	0.2	0.350	0.909	20.873	12.994	
57	58%	53%	20.4	0.3	0.400	1.024	20.553	12.674	
54	57%	52%	22.3	0.5	0.450	1.135	20.243	12.363	
51	57%	51%	24.4	1.0	0.500	1.242	19.942	12.063	
49	56%	49%	25.9	1.7	0.550	1.347	19.652	11.772	
46	55%	48%	27.5	2.1	0.600	1.448	19.370	11.491	
46	55%	48%	27.9	2.1	0.606	1.460	19.337	11.458	**$F_{0.1}$**
44	54%	47%	30.1	2.9	0.650	1.546	19.097	11.218	
43	54%	46%	31.9	3.7	0.700	1.642	18.833	10.954	
42	54%	45%	32.6	4.0	**0.720**	1.679	18.730	10.851	**F_{2006}**
41	53%	45%	33.8	4.9	0.750	1.734	18.578	10.698	
39	53%	44%	35.8	6.1	0.800	1.824	18.330	10.451	
38	52%	43%	38.0	6.8	0.850	1.911	18.090	10.211	
37	51%	42%	39.3	9.2	0.900	1.995	17.858	9.979	
35	51%	41%	41.3	10.9	0.950	2.077	17.633	9.754	
34	50%	40%	43.4	12.7	1.000	2.157	17.415	9.536	
32	49%	38%	47.4	20.0	1.100	2.309	16.999	9.120	
30	49%	36%	51.0	23.6	1.200	2.453	16.609	8.729	
29	48%	35%	55.5	27.3	1.300	2.588	16.242	8.363	
27	47%	33%	59.1	36.0	1.400	2.716	15.897	8.018	
26	46%	32%	61.4	42.2	1.500	2.836	15.574	7.694	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.074	0.083
3	0.384	0.112
4	0.683	0.128
5	0.749	0.144
6	0.810	0.161

2007 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	5.110	3.807	6.414
3	2.707	0.991	4.423
4	12.800	6.984	18.615
5	0.551	0.332	0.770
6+	2.038	1.156	2.921
(2+)	23.206	13.269	33.143
(3+)	18.096	9.462	26.729

2008 Recruitment

Millions Age 2s
7.879

Table 2.1.2. Management Unit 2 yellow perch biological references from simulations and projected population size in 2008 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+ (18.3 million) and 1994 for ages 3+ (7.2 million). The "Harvest 2007" column is based on fishing rates in the "F" column and 2007 abundance estimates at the bottom of the page. Simulations based on a gamma curve of ADMB abundance estimates from 1982-2005 were used to determine $F_{0.1}$. F_{2006} was the fishing rate used for setting TAC in 2004, 2005, and 2006.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2007 (lbs x 10^6)	Population 2+ in 2008 (millions)	Population 3+ in 2008 (millions)	Harvest Strategy Reference
100	67%	67%	0.1	0.0	0.000	0.000	52.633	38.196	
99	67%	67%	0.2	0.0	0.010	0.078	52.433	37.997	
94	65%	65%	0.7	0.0	0.050	0.386	51.648	37.212	
88	64%	63%	1.2	0.0	0.100	0.759	50.697	36.261	
83	63%	61%	2.1	0.0	0.150	1.119	49.778	35.342	
78	62%	59%	3.5	0.0	0.200	1.469	48.890	34.454	
74	60%	58%	5.6	0.0	0.250	1.807	48.032	33.596	
70	59%	56%	8.4	0.1	0.300	2.134	47.203	32.766	
67	58%	54%	11.5	0.6	0.350	2.451	46.401	31.965	
64	57%	53%	14.1	0.9	0.400	2.757	45.627	31.191	
61	57%	52%	18.9	1.4	0.450	3.054	44.878	30.442	
58	56%	50%	22.2	2.7	0.500	3.341	44.155	29.719	
56	55%	49%	24.7	5.1	0.550	3.620	43.455	29.019	
54	54%	48%	27.9	7.5	0.600	3.889	42.779	28.343	
52	54%	47%	29.8	10.7	0.650	4.150	42.126	27.689	
51	54%	47%	30.0	11.1	**0.661**	4.206	41.985	27.549	**F_{2006}**
50	53%	46%	31.5	12.8	0.700	4.403	41.493	27.057	
48	53%	45%	33.2	14.7	0.734	4.570	41.076	26.639	**$F_{0.1}$**
48	52%	45%	33.7	15.9	0.750	4.648	40.882	26.446	
46	52%	44%	35.5	18.6	0.800	4.885	40.291	25.855	
45	51%	43%	38.1	21.1	0.850	5.115	39.719	25.283	
43	51%	42%	39.4	23.6	0.900	5.337	39.166	24.730	
42	50%	41%	41.4	26.1	0.950	5.553	38.632	24.195	
41	50%	40%	42.5	29.4	1.000	5.762	38.114	23.678	
38	49%	38%	44.6	35.7	1.100	6.161	37.129	22.693	
36	48%	37%	47.4	40.7	1.200	6.537	36.207	21.771	
34	47%	35%	49.3	48.1	1.300	6.890	35.343	20.907	
33	46%	34%	51.6	52.2	1.400	7.222	34.533	20.097	
31	46%	33%	56.4	55.4	1.500	7.534	33.774	19.338	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.078	0.096
3	0.335	0.123
4	0.716	0.134
5	0.851	0.167
6	0.801	0.216

2007 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	16.007	11.435	20.580
3	3.439	1.595	5.283
4	31.189	19.009	43.370
5	1.274	0.843	1.705
6+	5.073	3.210	6.935
(2+)	56.982	36.092	77.873
(3+)	40.975	24.657	57.293

2008 Recruitment

Millions Age 2s
14.436

Table 2.1.3. Management Unit 3 yellow perch biological references from simulations and projected population size in 2008 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+ (7.4 million) and 1994 for ages 3+ (3.2 million). The "Harvest 2007" column is based on fishing rates in the "F" column and 2007 abundance estimates at the bottom of the page. Simulations based on a gamma curve of ADMB abundance estimates from 1982-2004 were used to determine $F_{0.1}$. F_{2006} was the fishing rate used for setting TAC in 2004, 2005, and 2006.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2007 (lbs x 10^6)	Population 2+ in 2008 (millions)	Population 3+ in 2008 (millions)	Harvest Strategy Reference
100	67%	67%	0.0	0.0	0.000	0.000	64.489	44.139	
98	67%	67%	0.0	0.0	0.010	0.091	64.292	43.942	
92	66%	65%	0.0	0.0	0.050	0.450	63.514	43.164	
85	64%	63%	0.0	0.0	0.100	0.887	62.570	42.220	
79	63%	61%	0.0	0.0	0.150	1.310	61.656	41.306	
73	62%	60%	0.0	0.0	0.200	1.721	60.771	40.421	
69	61%	58%	0.1	0.0	0.250	2.119	59.913	39.563	
64	60%	57%	0.1	0.0	0.300	2.506	59.082	38.732	
60	59%	55%	0.6	0.0	0.350	2.880	58.278	37.928	
57	58%	54%	0.9	0.0	0.400	3.244	57.498	37.148	
54	57%	52%	1.0	0.0	0.450	3.597	56.743	36.393	
51	57%	51%	1.2	0.1	0.500	3.940	56.012	35.662	
48	56%	50%	1.4	0.1	0.550	4.272	55.303	34.953	
46	55%	49%	1.6	0.5	0.600	4.595	54.617	34.266	
44	55%	48%	1.8	0.7	0.650	4.908	53.951	33.601	
43	54%	47%	1.9	0.7	0.665	5.000	53.756	33.406	**$F_{0.1}$**
42	54%	47%	2.0	0.8	0.700	5.211	53.307	32.956	
42	54%	47%	2.0	0.8	**0.703**	5.229	53.268	32.918	**F_{2006}**
40	53%	46%	2.4	1.2	0.750	5.506	52.682	32.332	
38	53%	45%	2.7	1.4	0.800	5.793	52.076	31.726	
36	52%	44%	3.2	1.6	0.850	6.071	51.490	31.139	
35	52%	43%	4.3	2.0	0.900	6.341	50.921	30.571	
34	51%	42%	4.9	2.4	0.950	6.603	50.370	30.019	
32	51%	41%	5.7	3.3	1.000	6.857	49.835	29.485	
30	50%	39%	7.7	4.9	1.100	7.345	48.815	28.465	
28	49%	38%	9.3	6.5	1.200	7.804	47.856	27.506	
26	48%	36%	11.2	9.1	1.300	8.238	46.954	26.604	
25	48%	35%	12.7	12.5	1.400	8.648	46.106	25.756	
23	47%	34%	14.6	16.4	1.500	9.035	45.308	24.958	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.037	0.110
3	0.320	0.127
4	0.669	0.159
5	0.794	0.186
6	0.717	0.250

2007 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	20.707	15.054	26.361
3	5.234	2.311	8.157
4	32.900	19.245	46.556
5	0.806	0.511	1.101
6+	6.201	4.095	8.307
(2+)	65.848	41.215	90.481
(3+)	45.141	26.161	64.120

2008 Recruitment

Millions Age 2s
20.350

Table 2.1.4. Management Unit 4 yellow perch biological references from simulations and projected population size in 2008 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+ (0.81 million) and 1994 for ages 3+ (0.32 million). The "Harvest 2007" column is based on fishing rates in the "F" column and 2007 abundance estimates at the bottom of the page. Simulations are based on ADMB abundance estimates from 1982-2005 and were used to determine $F_{0.1}$. F_{2006} was the fishing rate used for setting TAC in 2004, 2005, and 2006.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob. % 1993 2+	Prob. % 1994 3+	F	Harvest 2007 (lbs x 10^6)	Population 2+ in 2008 (millions)	Population 3+ in 2008 (millions)	Harvest Strategy Reference
100	67%	67%	0.0	0.0	0.000	0.000	6.143	6.138	
99	67%	67%	0.0	0.0	0.010	0.013	6.121	6.116	
94	66%	65%	0.0	0.0	0.050	0.063	6.032	6.027	
89	64%	63%	0.0	0.0	0.100	0.124	5.923	5.918	
85	63%	62%	0.1	0.0	0.150	0.184	5.818	5.813	
80	62%	60%	0.1	0.0	0.200	0.241	5.716	5.711	
78	62%	59%	0.1	0.0	**0.230**	0.275	5.656	5.651	**F_{2006}**
77	61%	59%	0.1	0.0	0.250	0.298	5.616	5.611	
73	60%	57%	0.1	0.1	0.300	0.352	5.520	5.515	
70	59%	56%	0.3	0.1	0.350	0.405	5.426	5.421	
67	58%	54%	0.4	0.1	0.400	0.457	5.334	5.329	
64	58%	53%	0.7	0.1	0.450	0.507	5.245	5.240	
62	57%	52%	0.8	0.1	0.500	0.556	5.159	5.154	
60	56%	51%	1.1	0.1	0.550	0.604	5.075	5.070	
57	56%	50%	1.1	0.5	0.600	0.650	4.993	4.988	
55	55%	49%	1.4	0.5	0.650	0.695	4.913	4.908	
54	54%	48%	1.7	0.7	0.700	0.739	4.836	4.831	
52	54%	47%	2.2	1.0	0.750	0.782	4.761	4.756	
50	53%	46%	2.9	1.2	0.800	0.823	4.687	4.682	
49	53%	45%	3.2	1.4	0.836	0.852	4.636	4.631	**$F_{0.1}$**
48	53%	45%	3.3	1.5	0.850	0.863	4.616	4.611	
47	52%	44%	3.4	2.0	0.900	0.903	4.547	4.542	
46	52%	43%	4.0	2.5	0.950	0.941	4.479	4.474	
44	51%	42%	4.6	3.2	1.000	0.979	4.413	4.408	
42	50%	41%	5.9	4.0	1.100	1.050	4.287	4.282	
39	50%	39%	7.4	5.6	1.200	1.119	4.167	4.162	
37	49%	38%	8.4	7.0	1.300	1.183	4.053	4.048	

Parameters in Computations

Age	sel (age)	Weight (kg)
2	0.035	0.143
3	0.314	0.158
4	0.463	0.179
5	0.820	0.202
6	0.766	0.256

2007 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	3.013	2.165	3.860
3	1.454	0.343	2.564
4	2.617	0.991	4.242
5	0.265	0.111	0.418
6+	1.809	0.773	2.845
(2+)	9.157	4.384	13.931
(3+)	6.145	2.219	10.070

2008 Recruitment Millions Age 2s
0.005

Table 2.2.1. Lake Erie yellow perch fishing rates and the Recommended Allowable Harvest (RAH; in millions of pounds) for 2007 by management unit according to the harvest strategies presented. The F_{2006} strategy is based on the stock-recruitment simulation model applied in 2006. The proposed RAH for MU4 is based on the fishing rate (F=0.230) associated with the TAC in 2005 and 2006.

MU	Fishing Rate	Recommended Allowable Harvest (millions lbs.)	Yield Methods
1	0.720	1.679	F_{2006}
2	0.661	4.206	F_{2006}
3	0.703	5.229	F_{2006}
4	0.230	0.275	F_{2006}
Total		11.389	

Lake Erie Yellow Perch Management Units (MUs)

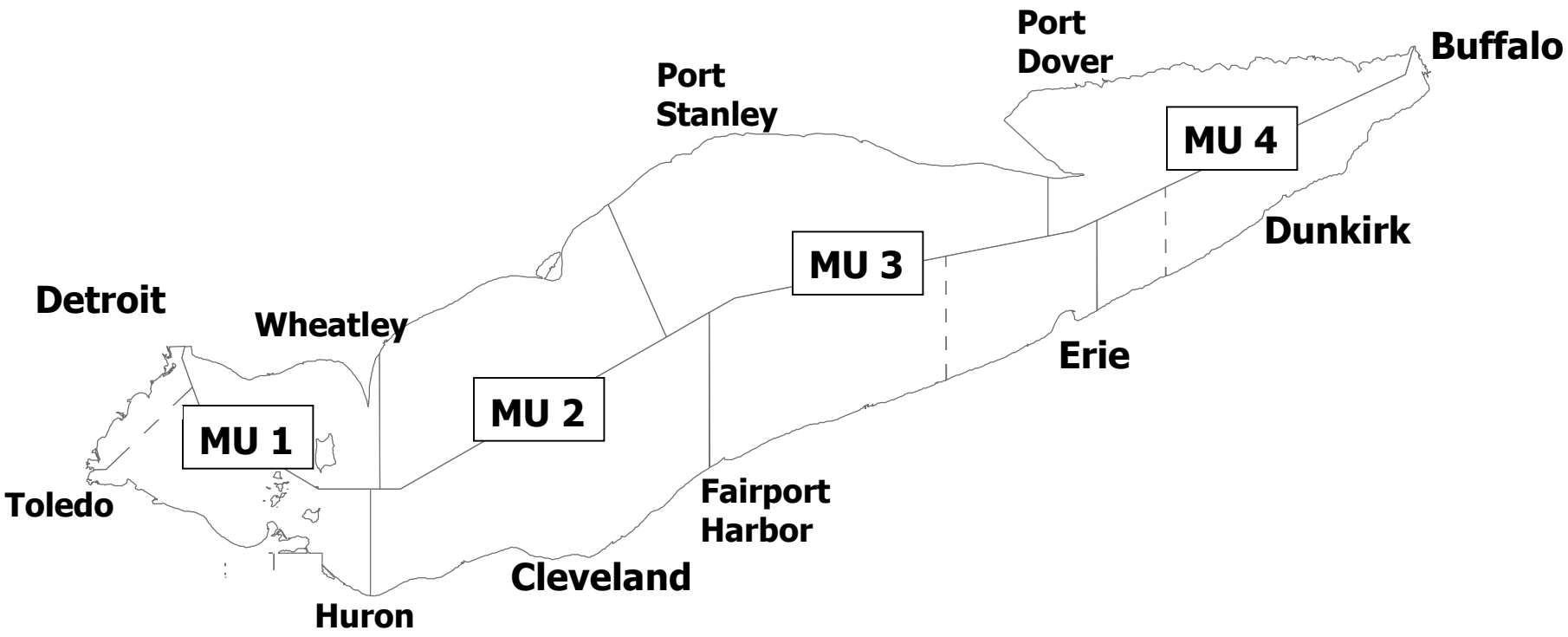


Figure 1.1. Yellow Perch management units (MUs) of Lake Erie. For illustrative purposes only, this map should not be used for quota determination or border delineation.

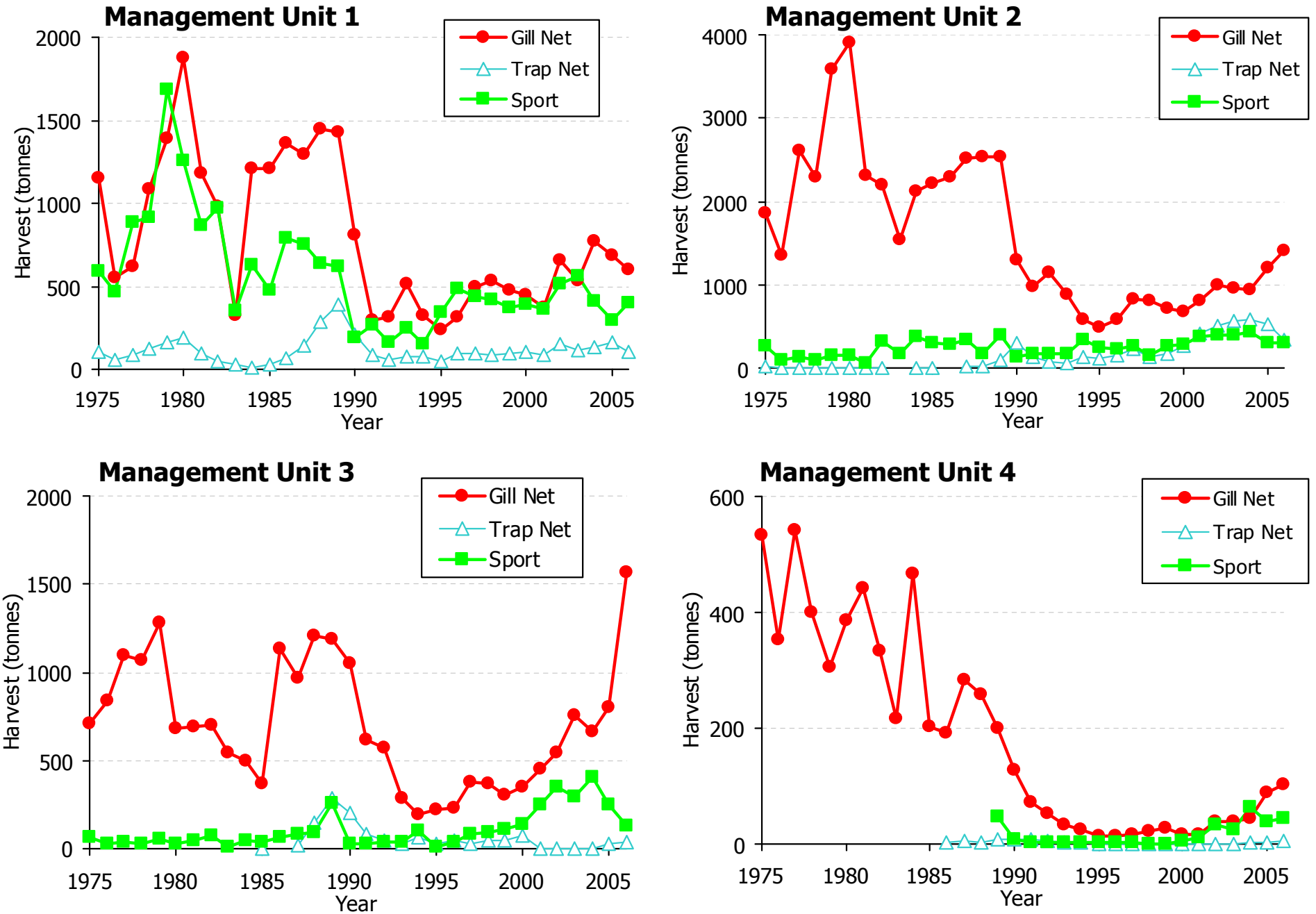


Figure 1.2. Lake Erie yellow perch harvest by management unit and gear type.

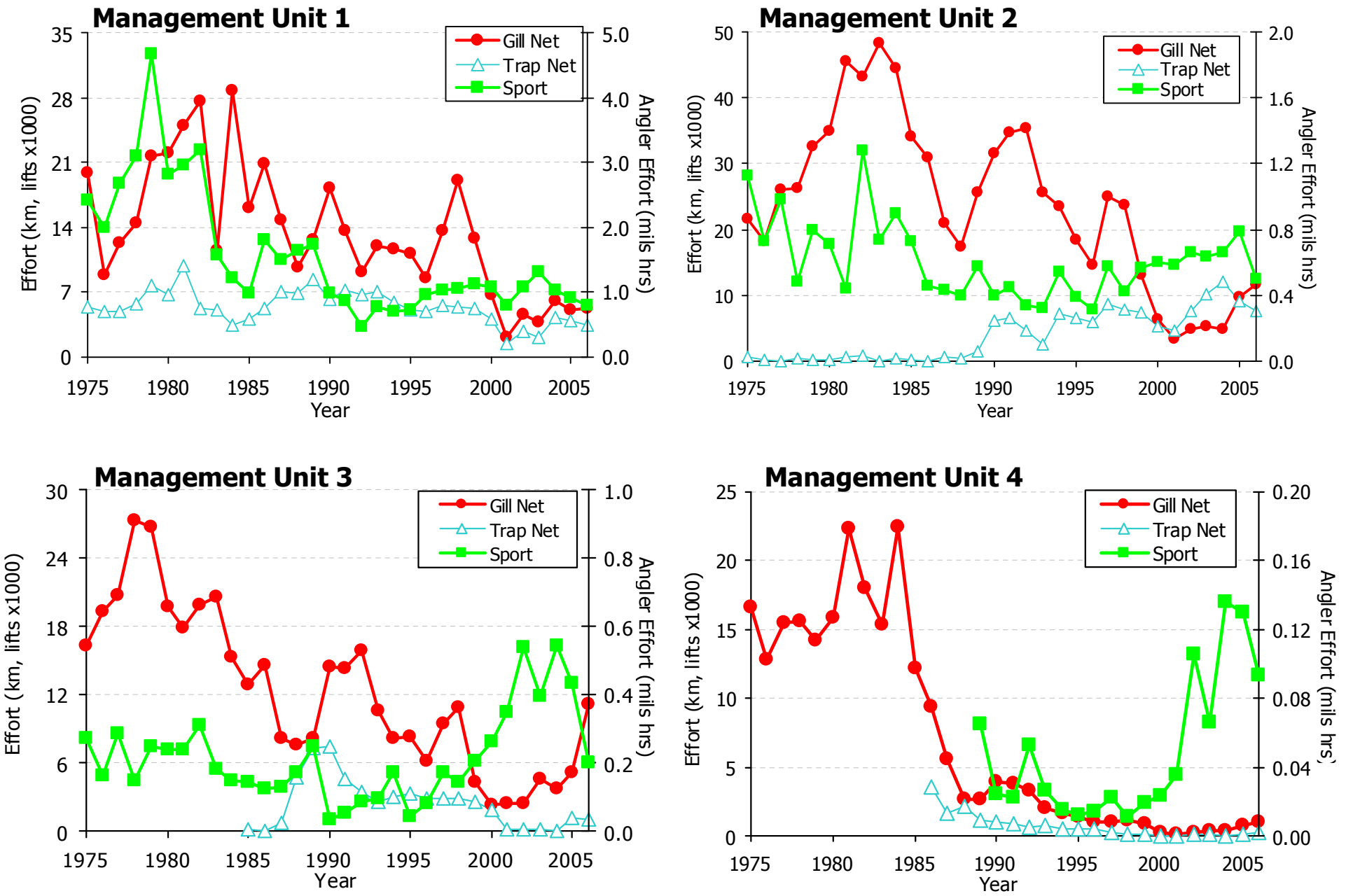


Figure 1.3. Lake Erie yellow perch effort by management unit and gear type. Note: gill net effort is targeted (mesh size <3").

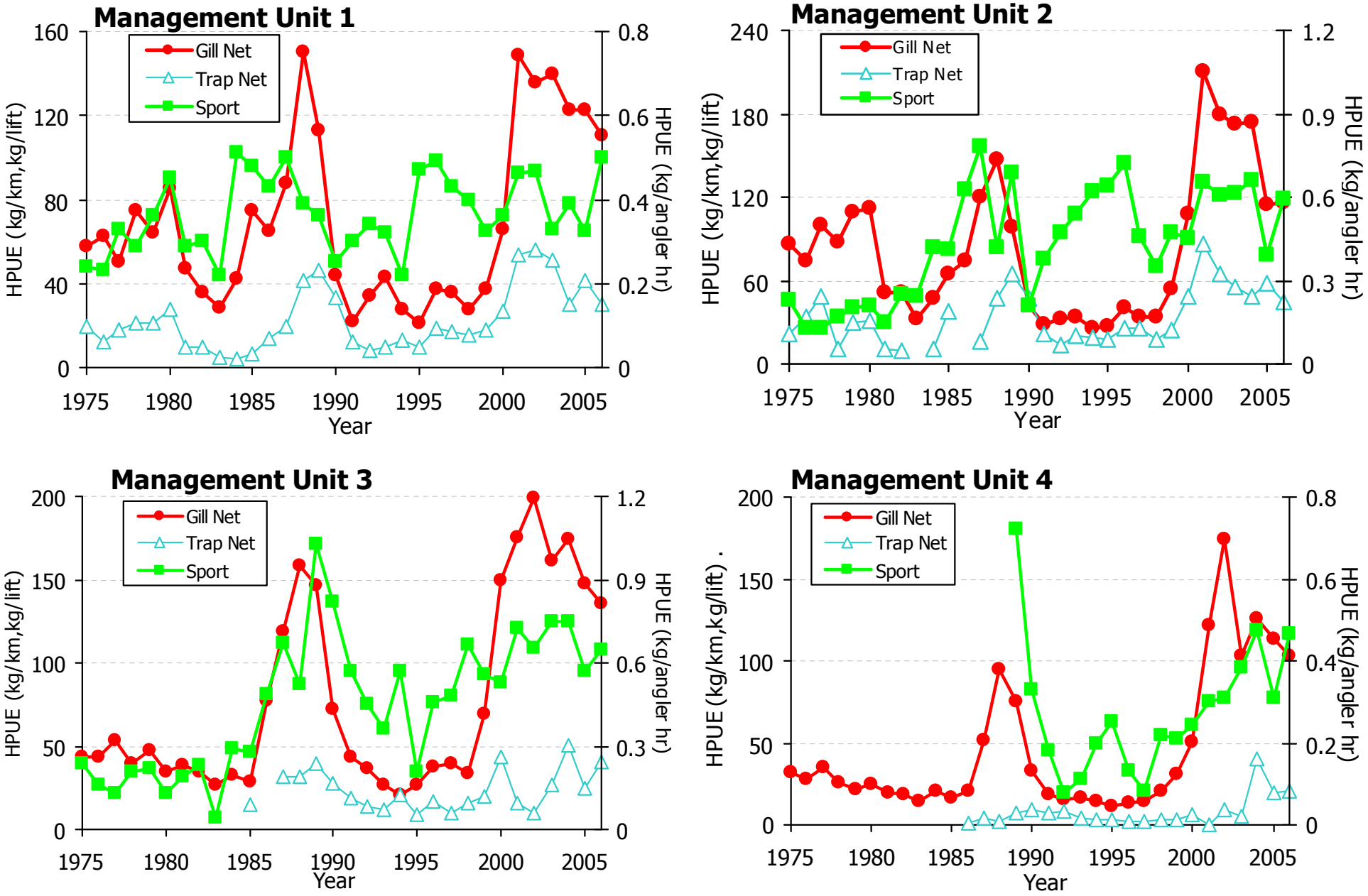


Figure 1.4. Lake Erie yellow perch harvest per unit effort (HPUE) by management unit and gear type. Note: 2001 to 2006 gill net CPUE is for small mesh only.

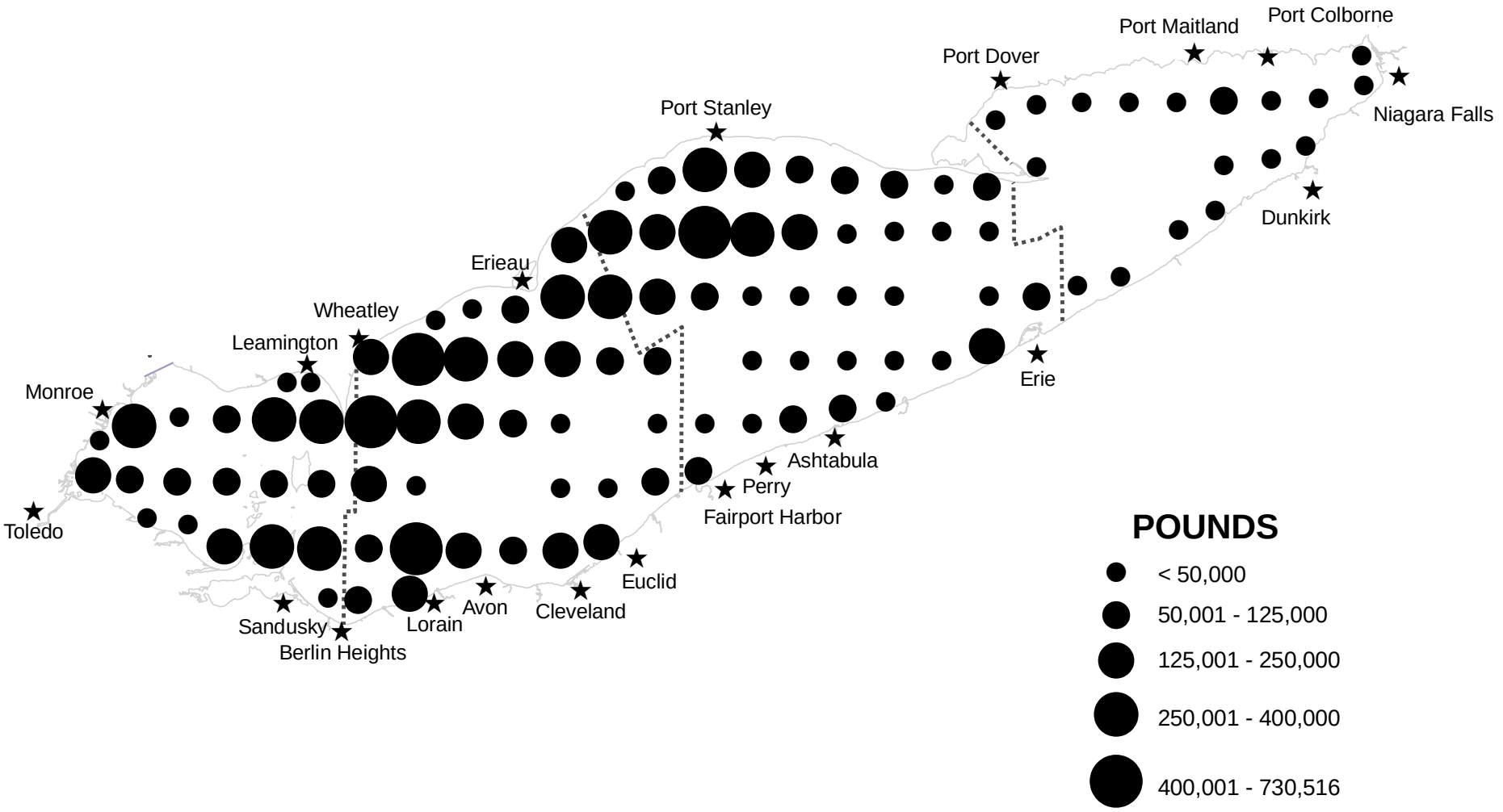


Figure 1.5. Spatial distribution of yellow perch total harvest (lbs.) in 2006 by 10-minute grid.

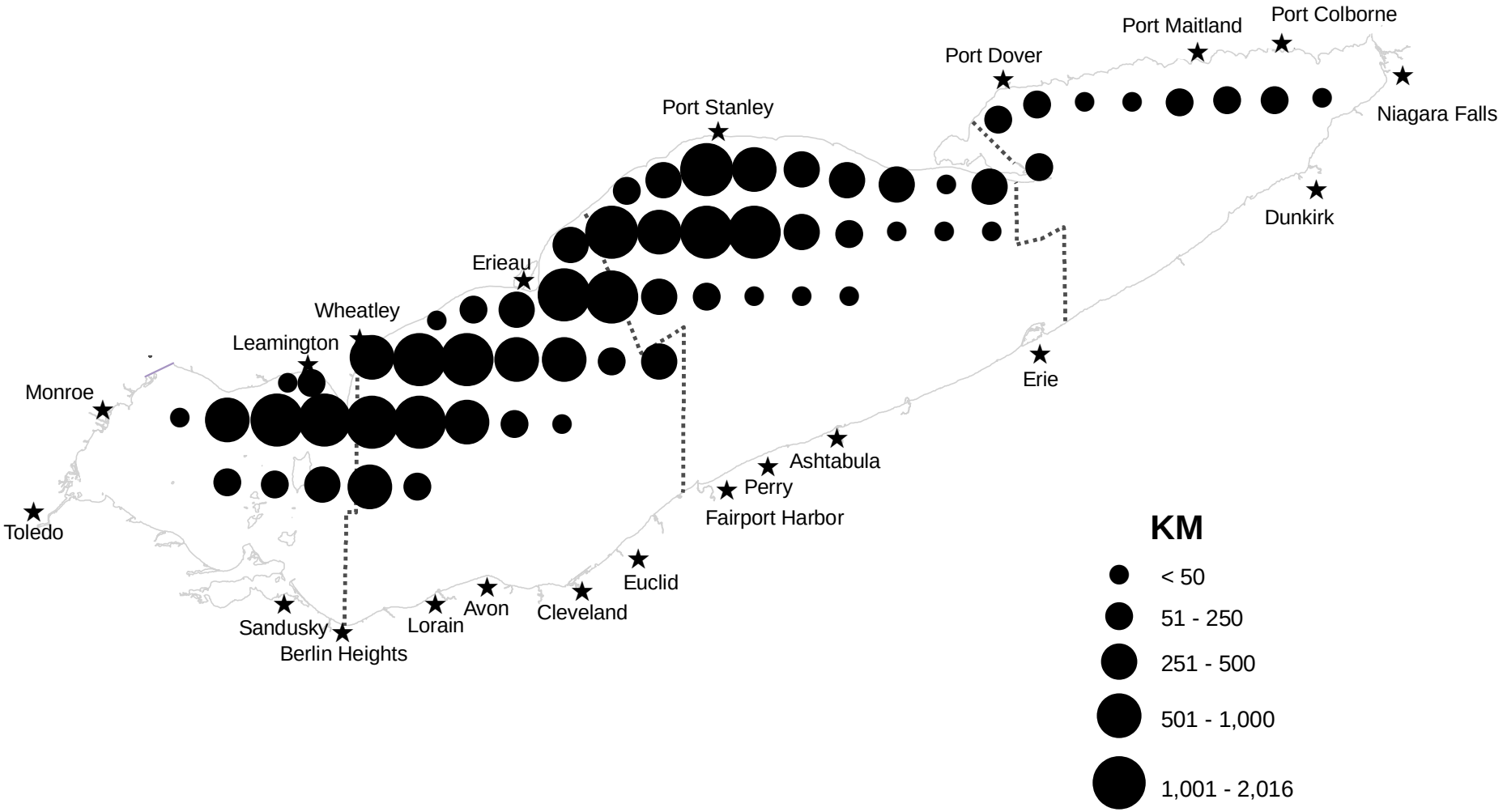


Figure 1.6. Spatial distribution of yellow perch gill net effort (km) in 2006 by 10-minute grid.

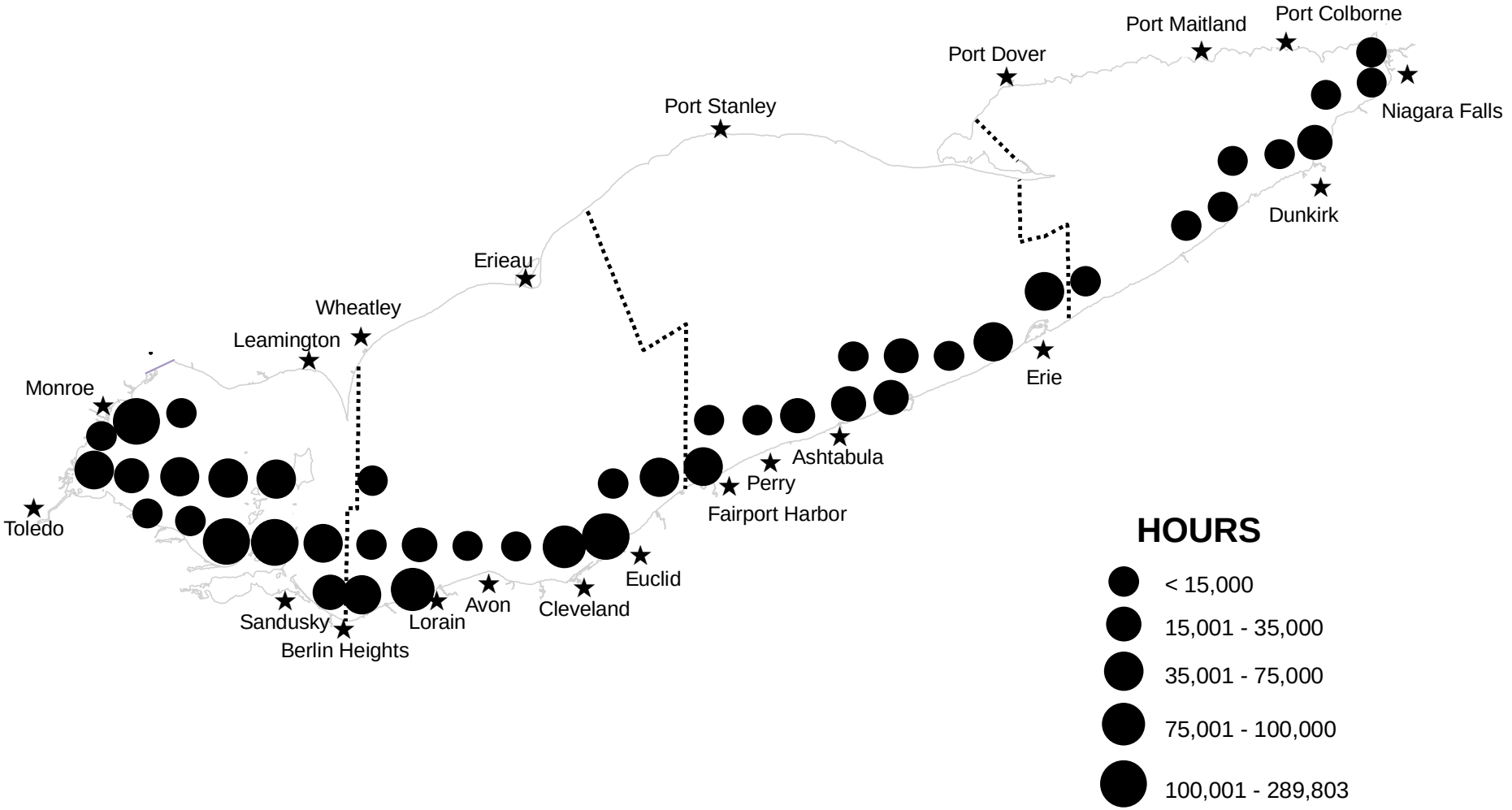


Figure 1.7. Spatial distribution of yellow perch sport angling effort (angler hours) in 2006 by 10-minute grid.

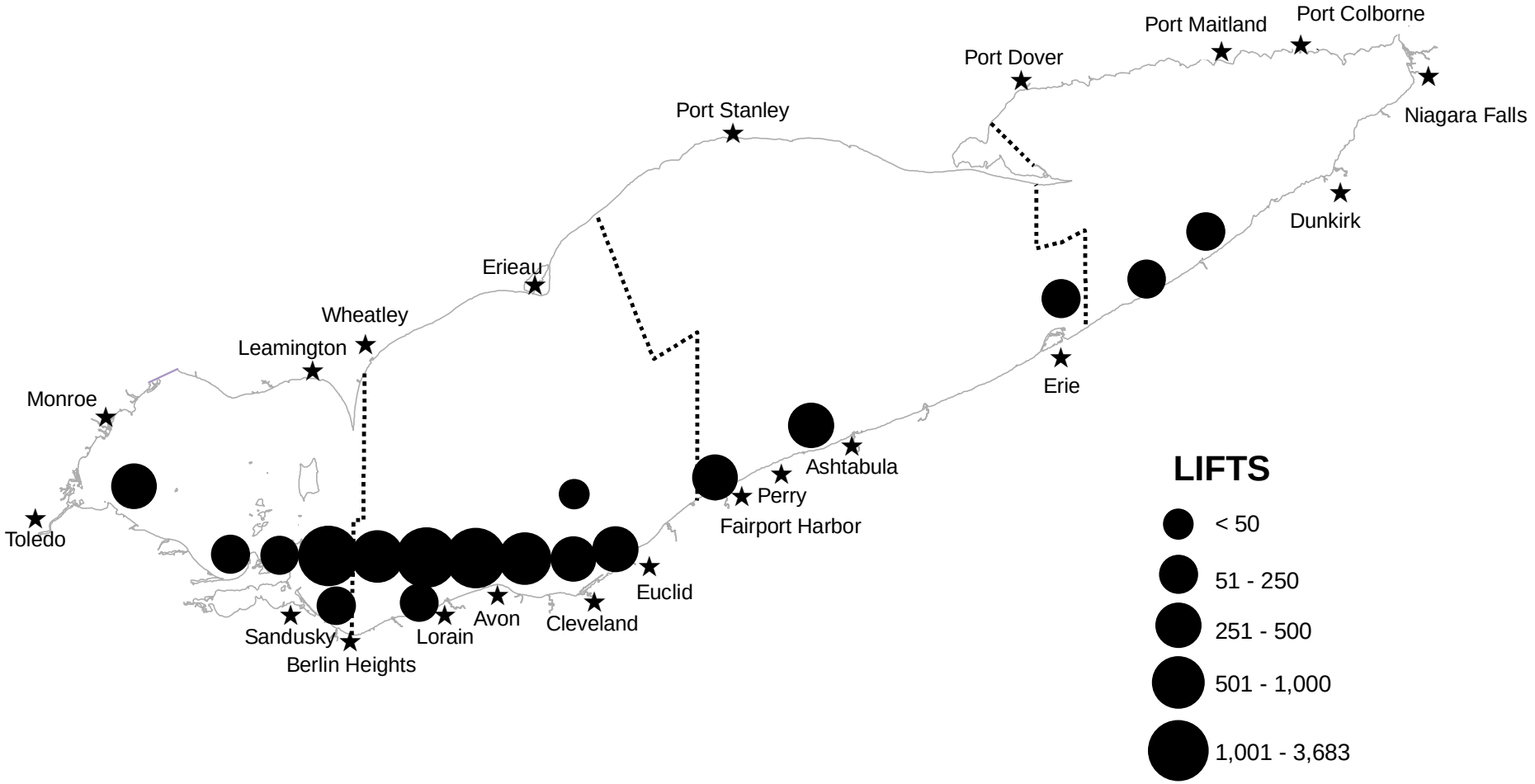


Figure 1.8. Spatial distribution of yellow perch trap net effort (lifts) in 2006 by 10-minute grid.

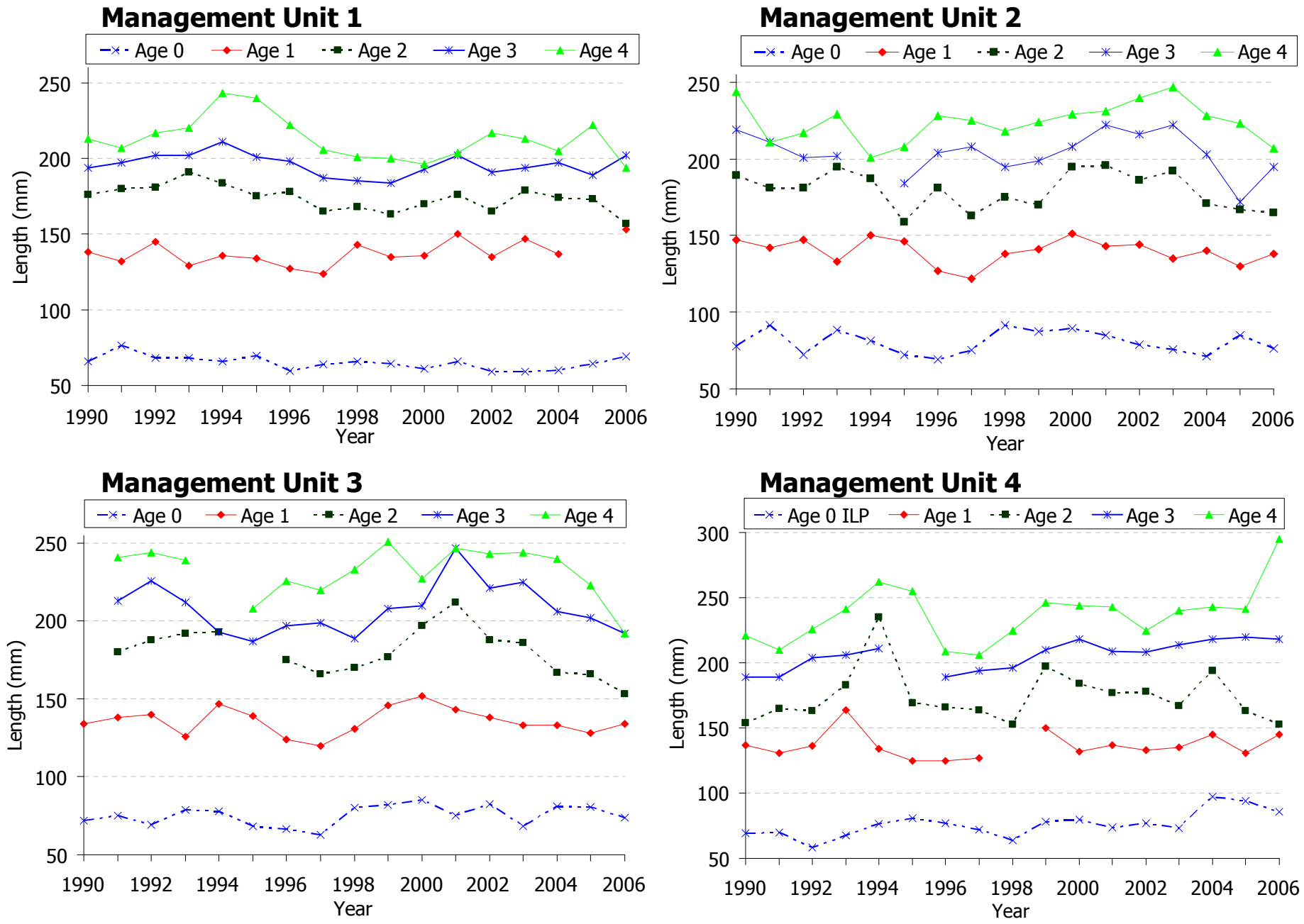


Figure 1.9. Yellow perch length-at-age from 1990-2006 fall interagency experimental samples for ages 0-4 by management unit.

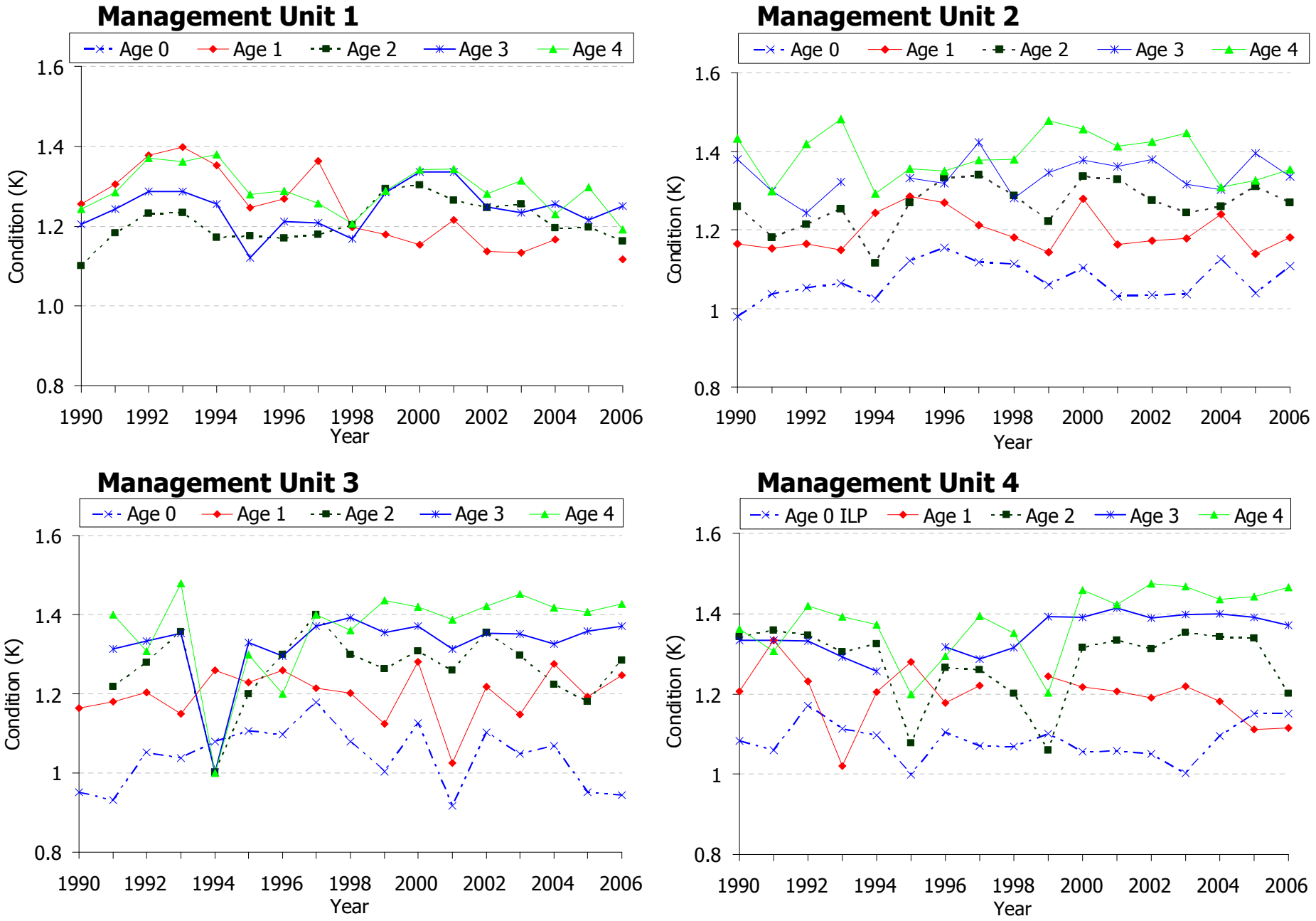


Figure 1.10. Yellow perch condition (K) at age from 1990-2006 fall interagency experimental samples for ages 0-4 by management unit.

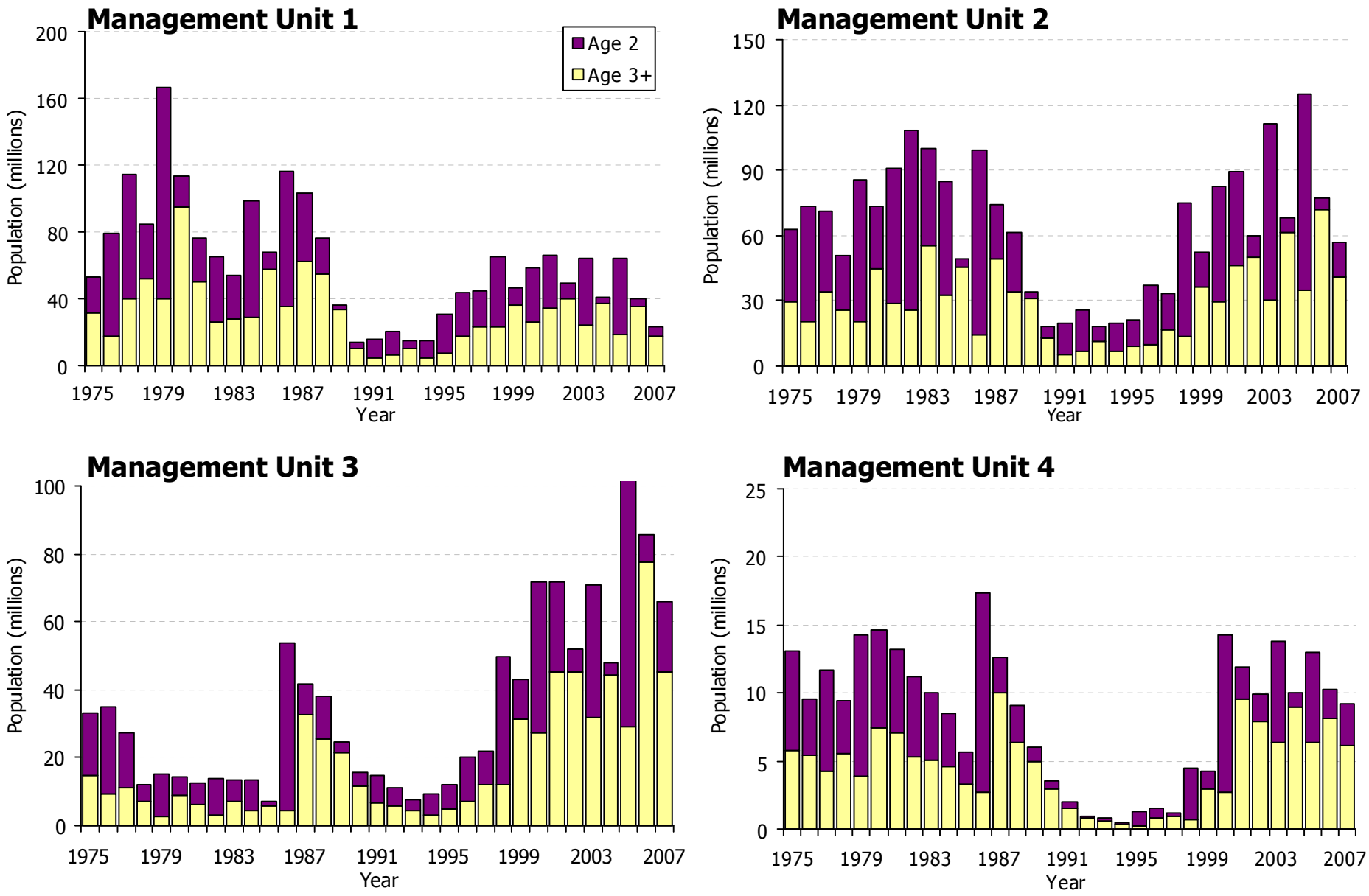


Figure 1.11. Lake Erie yellow perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2007 are from ADMB and parametric regressions for age 2 from survey gears.

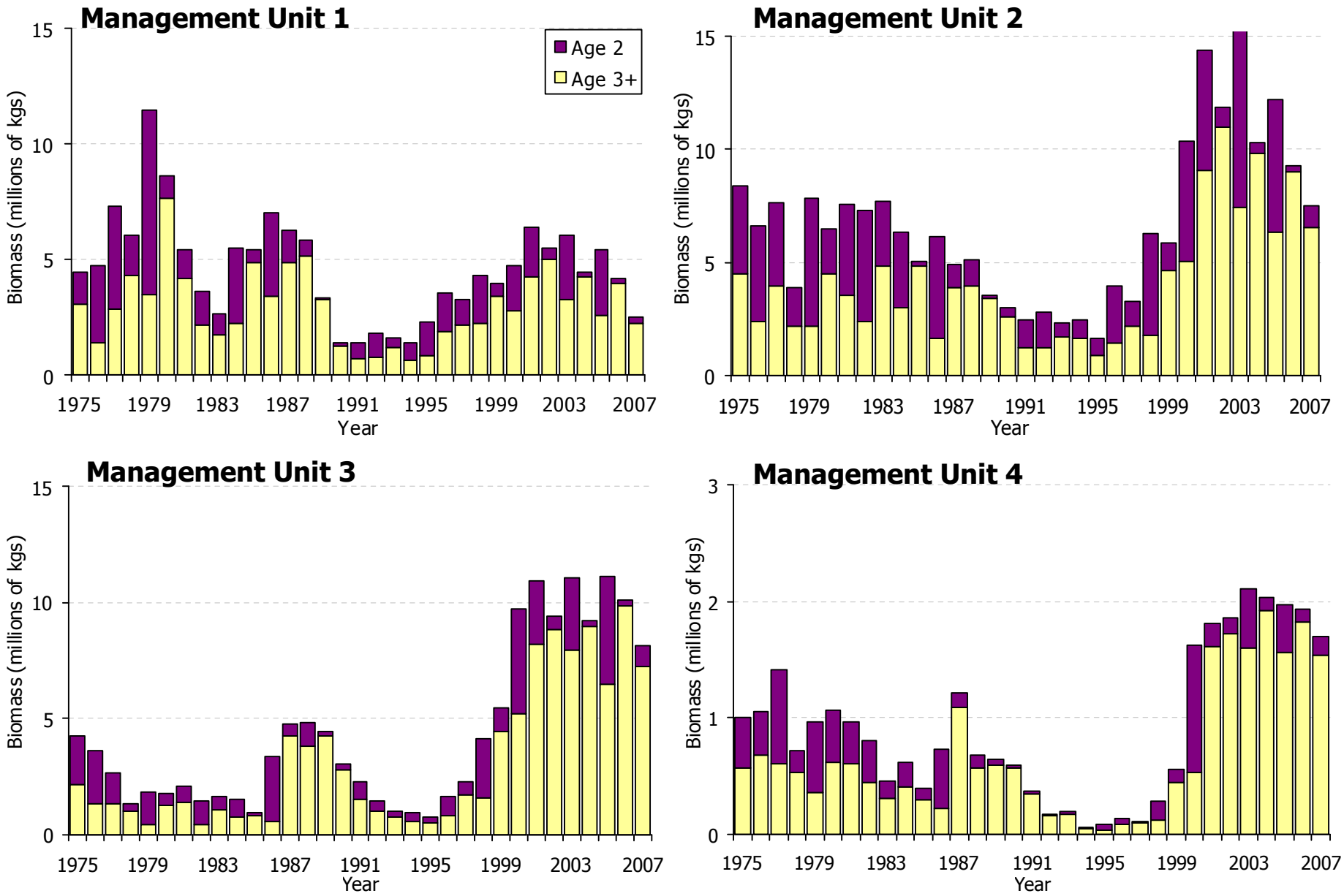


Figure 1.12. Lake Erie yellow perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2007 are from ADMB and parametric regressions for age 2 from survey gears.

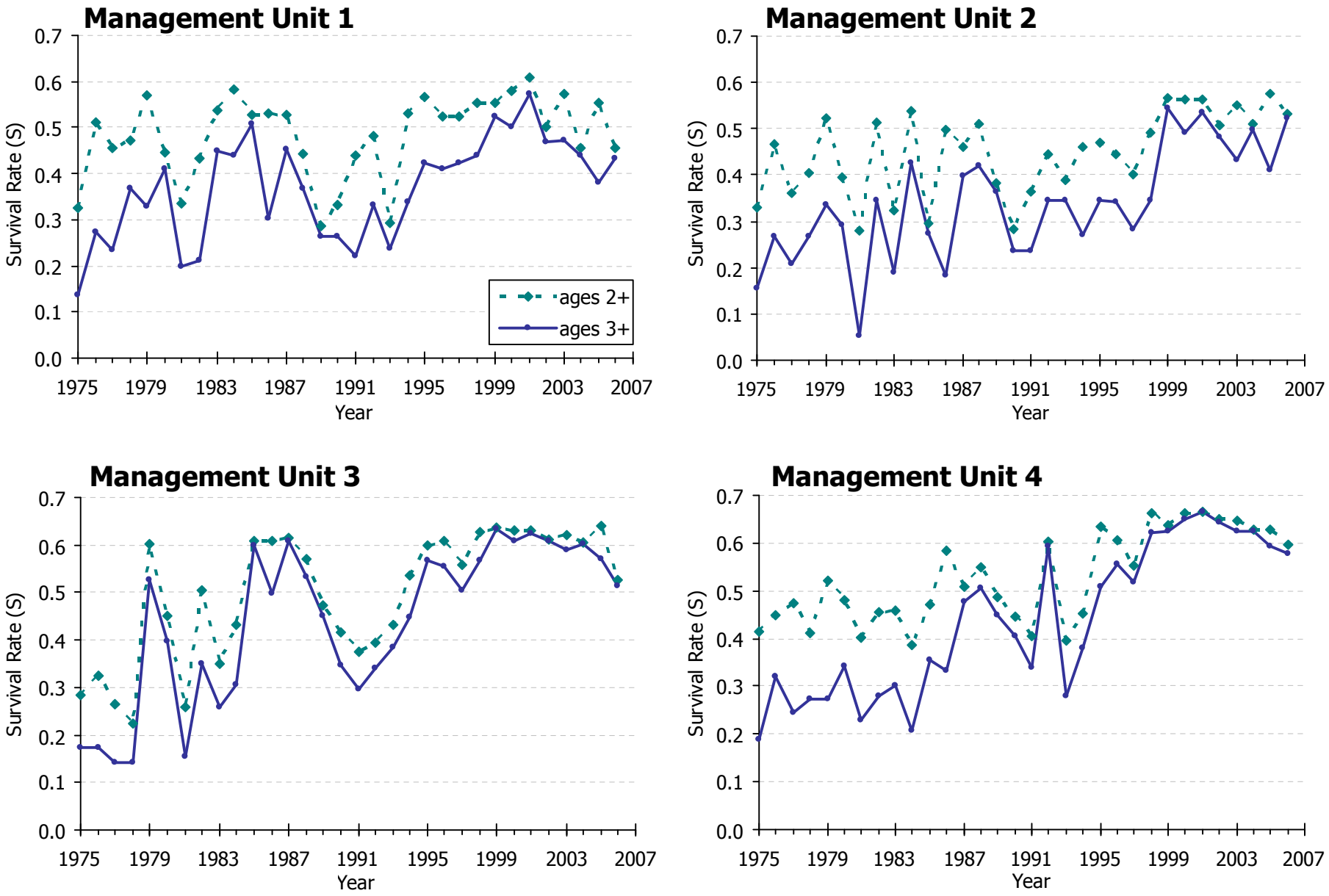


Figure 1.13. Lake Erie yellow perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.

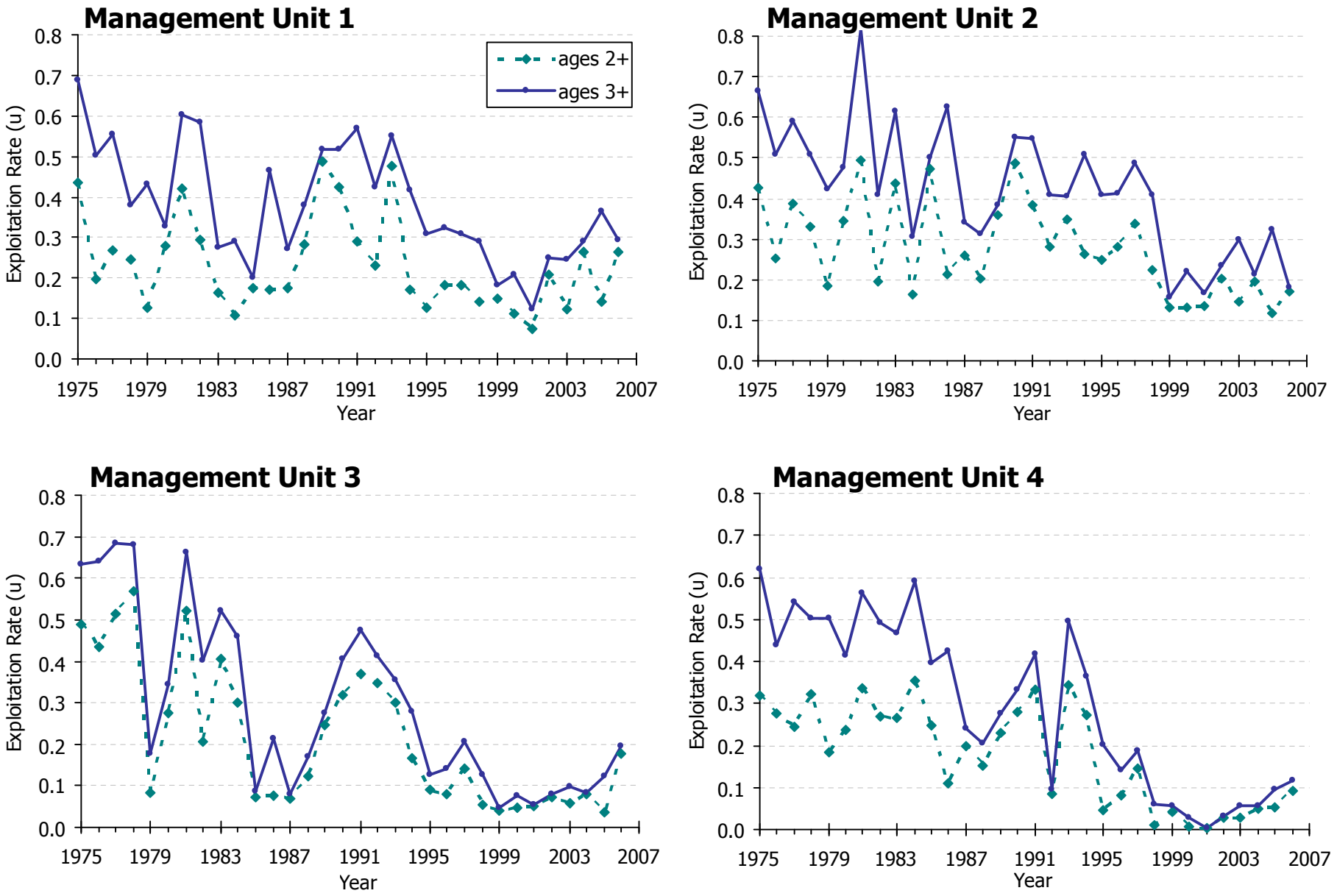
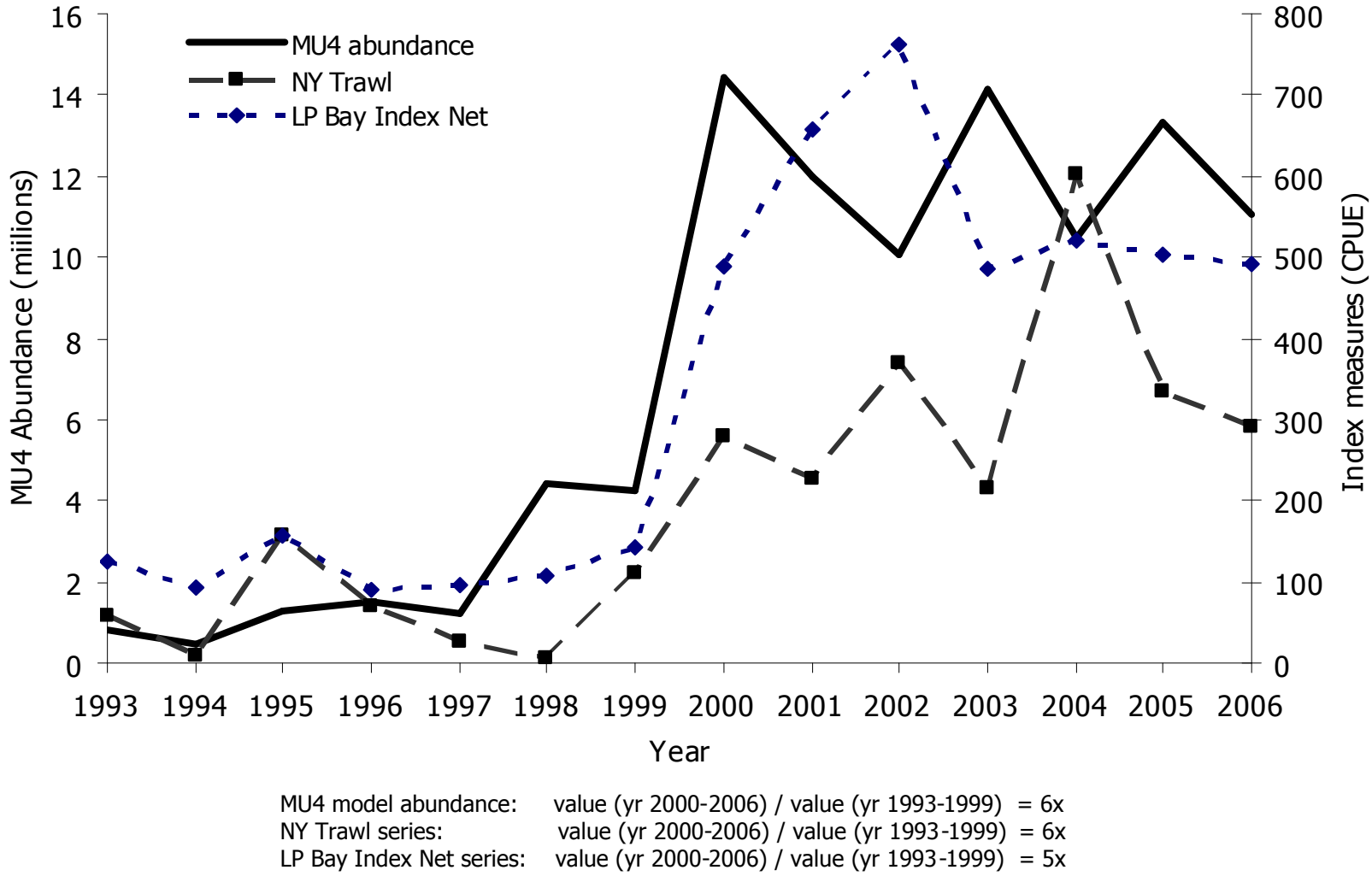


Figure 1.14. Lake Erie yellow perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.



MU4 model abundance: value (yr 2000-2006) / value (yr 1993-1999) = 6x
NY Trawl series: value (yr 2000-2006) / value (yr 1993-1999) = 6x
LP Bay Index Net series: value (yr 2000-2006) / value (yr 1993-1999) = 5x

Figure 4.1. Eastern basin (MU4) yellow perch abundance from ADMB and two independent measures from outside the model.

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	0.4	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	0.8	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	0.6	5
	Commercial Trap Net Harvest	0.3	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	1.0	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	0.6	1
	Commercial Gill Net Harvest	1.0	5
	Sport Harvest	1.0	5
	Commercial Trap Net Harvest	0.7	5
	NY Gill Net Survey Catch Rates	0.5	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 2007 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	0.8887	0.13641	119.8	16.342	0.01339	13.134	19.550
OHF11A	0.8201	0.27919	12.5	3.490	0.03626	2.583	4.396
OHF21A	0.7434	0.11074	11.6	1.285	0.01739	0.881	1.688
ONOHF10G	0.7289	0.08748	64.0	5.599	0.01334	3.891	7.306
ONS10A	0.7252	0.01885	181.5	3.421	0.00253	2.503	4.340
USF11A	0.6766	0.72416	0.2	0.145	0.10925	0.101	0.189
ONS11G	0.6544	0.30675	17.9	5.491	0.05407	3.555	7.427
			mean	**5.110**		**3.807**	**6.414**

Management Unit 2

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
BOHF20A	0.9632	0.22227	103.1	22.916	0.01205	20.431	25.401
BOHF31A	0.9348	0.63295	34.2	21.647	0.04468	18.591	24.703
OHF11G	0.8472	1.39911	4.7	6.576	0.16477	5.027	8.125
ONS10G	0.8134	0.13757	78.6	10.813	0.01438	8.552	13.074
BOHF21A	0.7898	0.18612	11.3	2.103	0.02566	1.523	2.683
BOHS30G	0.7694	1.26480	15.8	19.984	0.19988	13.668	26.300
ONOHF10G	0.7556	0.14353	64.0	9.186	0.02040	6.575	11.797
BOHS20A	0.7152	0.03444	324.0	11.159	0.00603	7.251	15.066
OHS31G	0.7041	1.34707	7.7	10.372	0.24221	6.642	14.102
ONS11G	0.6732	0.49738	17.9	8.903	0.08405	5.894	11.912
OHF30G	0.6616	1.35112	38.8	52.423	0.26801	31.626	73.221
			mean	**16.007**		**11.435**	**20.580**

Management Unit 3

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
BOHF20A	0.8761	0.16176	103.1	16.677	0.01688	13.197	20.158
BOHF21A	0.8663	0.14853	11.3	1.678	0.01559	1.326	2.031
OHS20G	0.8626	0.67763	30.0	20.329	0.07501	15.828	24.830
OHS30G	0.8605	0.90960	15.8	14.372	0.10574	11.030	17.713
BOHF31A	0.8421	0.45776	34.2	15.655	0.05297	12.032	19.279
NYF41A	0.7805	1.03276	81.9	84.583	0.15809	58.688	110.478
NYF40A	0.7732	0.10371	117.1	12.144	0.01693	8.179	16.109
PAF30G	0.6300	0.04748	4.6	0.218	0.00776	0.147	0.290
			mean	**20.707**		**15.054**	**26.361**

Management Unit 4

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
NYF41A	0.8309	0.14228	81.9	11.653	0.01853	8.618	14.688
BOHF31A	0.7601	0.05789	34.2	1.980	0.00869	1.385	2.574
ILP41G	0.7030	0.35252	1.1	0.388	0.04885	0.280	0.495
ILP40G	0.6221	0.02152	2.4	0.052	0.00350	0.035	0.068
OHS31G	0.5639	0.12884	7.7	0.992	0.03142	0.508	1.476
			mean	**3.013**		**2.165**	**3.860**

Appendix A Table 3. Geometric catch per trawl hour index values from lakewide trawl surveys.

Year	ONTS10G	ONTS11G	OHS10G	OHS11G	OHF10G	OHF11G	USS10G	USS11G	USF10G	USF11G	ONOHF10G	OHS20G	OHS21G	OHF20G	OHF21G	BOHS20G	BOHS21G	BOHF20G	BOHF21G
1980	-	-	10.5	0.0	69.0	10.4	-	-	-	-	-	-	-	-	-	-	-	-	-
1981	-	-	3.0	7.9	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1982	320.4	-	30.0	13.8	31.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	2.4	-	2.0	0.0	2.2	-	4.0	16.0	2.8	17.5	-	-	-	-	-	-	-	-	-
1984	428.3	-	16.3	0.3	5.3	-	7.1	1.9	10.9	2.9	-	-	-	-	-	-	-	-	-
1985	132.0	-	7.0	0.0	3.9	-	6.5	8.4	28.8	12.8	-	-	-	-	-	-	-	-	-
1986	127.2	-	155.8	0.0	7.6	-	141.7	34.1	8.8	22.7	-	-	-	-	-	-	-	-	-
1987	0.6	3.6	3.6	23.0	4.1	-	1.4	17.3	4.3	12.3	4.0	-	-	-	-	-	-	-	-
1988	88.6	7.6	17.8	2.1	3.6	-	43.3	3.6	1.0	0.1	45.4	-	-	-	-	-	-	-	-
1989	127.0	5.4	20.5	2.5	18.8	-	32.6	8.1	20.0	1.0	61.9	-	-	-	-	-	-	-	-
1990	109.4	32.4	43.8	8.0	54.1	-	29.2	6.7	59.2	2.0	80.2	1.2	40.3	19.2	55.2	1.2	40.3	32.5	52.7
1991	38.2	43.0	21.1	9.2	14.4	0.2	16.9	17.1	63.4	4.9	32.5	1.9	28.5	4.3	57.2	1.9	28.5	3.3	54.1
1992	23.8	20.7	11.8	1.7	10.2	0.2	4.3	0.1	17.3	0.3	21.6	15.0	6.7	8.7	11.7	15.0	6.7	6.7	9.5
1993	80.2	29.0	83.7	5.3	21.2	0.2	28.8	0.9	17.3	0.2	107.5	4.0	24.3	9.4	28.7	4.0	24.3	9.1	34.1
1994	289.0	42.7	62.9	14.5	34.9	18.0	419.9	8.0	78.7	36.1	161.7	6.5	2.8	20.0	6.8	6.5	2.8	21.4	8.4
1995	51.9	28.3	26.7	37.9	30.8	0.1	475.2	23.1	9.3	4.4	51.1	0.8	20.0	2.9	45.8	0.7	26.1	2.4	66.1
1996	679.0	72.7	569.9	25.6	233.9	23.5	10633.1	5.3	228.7	3.9	649.2	61.0	2.7	95.0	5.4	55.9	2.9	91.7	5.7
1997	11.4	23.4	29.2	33.5	5.4	30.3	18.3	27.1	5.6	9.0	15.0	3.5	855.1	2.1	42.2	3.5	855.1	2.5	33.9
1998	112.4	10.3	64.6	2.2	94.6	5.2	74.4	3.8	100.9	5.4	100.5	16.9	2.1	70.4	5.7	13.8	1.9	56.0	5.6
1999	171.0	72.0	93.7	20.5	69.2	21.4	943.4	12.7	50.2	14.7	148.3	10.6	14.1	47.6	48.3	10.3	13.9	51.3	50.8
2000	16.5	74.8	44.7	36.7	13.9	16.1	11.1	5.4	4.9	9.0	32.4	0.3	27.8	5.0	39.2	0.3	27.8	7.5	45.9
2001	243.5	5.8	129.2	5.8	120.7	4.5	22.2	1.1	16.8	0.6	202.4	40.7	2.6	52.1	4.9	40.7	2.6	54.1	5.4
2002	10.3	36.5	5.4	37.9	7.0	44.9	1.4	20.1	3.5	10.5	12.1	0.3	181.4	1.2	20.8	0.3	181.4	2.0	30.5
2003	751.5	6.5	333.4	1.0	381.9	2.8	708.0	0.8	57.4	0.2	619.6	146.7	1.5	59.4	1.1	208.5	1.9	79.9	1.3
2004	29.1	215.3	11.5	105.5	3.1	79.6	14.2	110.8	0.5	34.2	25.7	3.5	67.7	8.5	159.3	4.2	75.4	8.9	179.6
2005	78.6	4.0	30.5	1.4	24.9	0.6	10.6	0.04	2.2	0.6	64.0	30.0	8.7	12.4	11.1	27.0	10.3	10.5	10.6
2006	162.0	17.9	28.4	1.7	49.2	4.7	0.3	4.6	0.6	0.1	100.5	2.5	1.2	14.5	3.9	2.5	1.2	12.7	3.9

Year	OHS30G	OHS31G	OHF30G	OHF31G	BOHS30G	BOHS31G	BOHF30G	BOHF31G	PAF30G	PAF31G	ILP40G	ILP41G	OLP40G	OLP41G	NYF40G	NYF41G
1980	-	-	-	-	-	-	-	-	-	-	77.5	69.0	11.8	25.7	-	-
1981	-	-	-	-	-	-	-	-	23.0	-	357.4	29.9	21.6	1.7	-	-
1982	-	-	-	-	-	-	-	-	26.0	-	229.5	16.0	7.9	4.1	-	-
1983	-	-	-	-	-	-	-	-	0.5	-	25.6	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	385.0	-	414.8	16.0	57.0	1.4	-	-
1985	-	-	-	-	-	-	-	-	4.0	-	6.0	32.7	0.7	5.6	-	-
1986	-	-	-	-	-	-	-	-	125.0	-	465.4	3.8	38.5	0.3	-	-
1987	-	-	-	-	-	-	-	-	25.0	-	0.7	2.6	1.1	10.8	-	-
1988	-	-	-	-	-	-	-	-	40.0	-	73.4	0.8	47.3	0.4	-	-
1989	-	-	-	-	-	-	-	-	0.5	-	70.0	6.4	18.0	6.8	-	-
1990	0.3	5.3	5.9	15.8	0.2	3.4	5.5	18.5	3.0	-	27.2	8.9	8.2	3.4	-	-
1991	2.0	6.3	1.0	23.0	2.4	13.6	1.0	17.0	5.0	-	8.0	2.8	2.0	0.5	-	-
1992	11.4	2.5	20.4	3.6	21.3	1.4	26.9	4.1	50.0	-	46.5	3.3	6.1	1.4	4.4	1.8
1993	5.6	4.7	13.8	12.6	6.6	4.7	22.0	15.0	38.0	-	19.2	5.8	6.2	1.2	54.9	2.1
1994	3.0	1.6	9.5	1.5	3.0	1.6	12.2	2.0	172.0	-	13.2	3.8	26.4	3.3	12.8	2.6
1995	4.5	9.2	11.6	35.1	3.5	7.3	13.1	22.9	20.0	-	1.2	5.4	2.4	10.4	4.9	9.6
1996	53.4	1.2	76.7	3.2	66.6	1.1	96.7	3.3	214.8	-	12.6	1.5	36.8	1.2	24.1	0.2
1997	-	-	2.0	7.5	-	-	1.7	6.4	0.0	-	3.1	1.6	2.6	4.5	0.1	1.5
1998	7.9	1.3	21.8	2.2	7.4	1.0	24.9	2.2	0.2	-	383.3	3.6	14.3	0.7	0.6	0.1
1999	11.0	22.2	12.0	22.2	11.0	22.2	12.6	21.6	15.0	9.0	5.1	17.6	0.6	8.8	5.6	3.9
2000	0.0	22.3	0.8	6.9	0.0	22.3	1.0	6.5	14.4	1.8	0.7	0.8	2.6	1.1	5.3	1.9
2001	38.5	5.3	35.0	0.5	38.5	5.3	36.1	0.4	35.8	1.5	169.7	1.6	26.1	0.5	112.3	13.8
2002	0.9	82.3	1.4	9.7	0.9	82.3	1.4	9.1	20.8	28.3	1.5	9.6	0.2	5.1	3.3	10.0
2003	102.0	0.6	23.0	0.9	73.5	0.3	18.3	0.9	2160.0	42.0	13.9	0.37	7.9	0.15	417.1	1.4
2004	2.6	20.7	1.6	24.8	2.6	20.4	1.4	28.4	1.3	2.2	0.04	1.27	0.09	1.2	1.3	17.5
2005	15.8	26.1	38.8	39.9	15.8	26.1	50.9	47.3	4.6	0.9	2.4	0.12	1.6	0.08	31.0	1.6
2006	16.9	7.7	16.3	7.6	16.9	7.7	16.8	6.3	-	-	0.23	1.07	0.8	0.35	321.4	55.8

Appendix Table 4. Arithmetic catch per trawl hour index values from lakewide trawl surveys.

Year	ONTS10A	ONTS11A	OHS10A	OHS11A	OHF10A	OHF11A	USS10A	USS11A	USF10A	USF11A	ONOHF10A	OHS20A	OHS21A	OHF20A	OHF21A	BOHS20A	BOHS21A	BOHF20A	BOHF21A
1980	-	-	122.0	0.0	663.7	191.0	-	-	-	-	-	-	-	-	-	-	-	-	-
1981	-	-	29.5	56.0	110.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1982	1952.4	-	359.1	124.3	854.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	5.4	-	30.5	0.0	5.8	-	19.8	59.2	15.0	43.3	-	-	-	-	-	-	-	-	-
1984	2493.5	-	138.3	0.8	110.0	-	28.5	5.8	46.4	11.8	-	-	-	-	-	-	-	-	-
1985	885.0	-	26.1	0.0	39.0	-	42.0	34.0	71.4	27.2	-	-	-	-	-	-	-	-	-
1986	2503.6	-	1143.7	0.0	61.5	-	1295.0	162.3	63.7	76.3	-	-	-	-	-	-	-	-	-
1987	0.9	21.2	20.0	104.4	18.0	-	5.0	41.0	12.8	61.2	10.9	-	-	-	-	-	-	-	-
1988	328.9	15.7	145.9	12.6	35.0	-	129.0	10.3	5.8	0.3	224.6	-	-	-	-	-	-	-	-
1989	788.7	11.6	107.2	15.7	113.5	-	149.8	15.7	34.2	3.3	448.0	-	-	-	-	-	-	-	-
1990	739.7	68.9	145.5	26.4	330.0	-	81.0	22.2	176.2	5.3	458.7	4.1	167.8	108.8	59.9	4.1	167.8	130.3	57.4
1991	109.3	93.0	139.3	34.1	61.8	0.6	185.2	35.0	210.8	18.0	124.3	10.7	95.7	27.0	120.8	10.7	95.7	23.3	115.6
1992	262.0	44.5	65.4	12.9	91.5	1.0	21.0	0.5	75.3	2.5	159.8	16.4	19.2	92.1	34.7	16.4	19.2	82.0	31.8
1993	766.9	126.0	1261.0	19.6	274.5	4.8	321.7	6.0	137.7	0.5	1052.5	104.0	72.5	23.9	92.7	104.0	72.5	24.9	116.8
1994	953.7	105.6	526.5	78.2	289.4	97.4	4281.8	40.3	162.0	57.8	734.6	144.2	12.3	155.7	26.9	144.2	12.3	146.4	29.3
1995	1337.8	162.5	348.0	167.8	81.6	0.2	2866.6	223.4	27.5	20.0	815.4	8.7	278.7	8.0	180.4	6.0	412.0	5.7	218.4
1996	3310.1	352.1	3284.9	105.5	644.2	121.5	11444.0	13.2	737.2	9.2	3296.3	2721.8	31.6	347.0	35.0	2299.8	42.9	320.6	30.2
1997	109.9	65.3	58.2	175.4	37.2	156.9	293.7	85.3	39.3	51.0	81.2	79.0	1848.0	24.2	402.1	79.0	1848.0	31.7	299.1
1998	285.4	20.5	195.4	7.4	281.7	23.3	138.7	11.0	246.2	19.4	236.0	641.1	9.5	199.7	17.2	610.3	8.0	186.9	17.1
1999	816.0	133.0	299.3	96.8	180.2	70.6	1234.8	29.2	176.5	28.8	534.2	85.7	52.9	172.1	113.8	73.2	52.8	200.8	111.1
2000	75.6	266.0	180.8	112.0	39.7	46.8	115.8	23.8	42.2	30.8	126.5	1.7	236.1	49.1	155.6	1.7	236.1	59.6	168.1
2001	998.0	11.1	361.6	18.8	262.9	14.3	63.5	3.3	57.3	2.8	703.5	854.0	21.0	321.8	14.3	932.3	17.4	312.5	15.6
2002	23.6	68.1	51.4	90.0	43.4	127.1	8.7	37.7	25.2	38.2	36.5	0.8	520.9	10.3	125.2	0.8	520.9	16.3	140.9
2003	3677.8	50.2	2059.6	4.2	1540.8	9.8	1238.5	5.0	298.4	0.8	2846.3	3204.1	10.3	345.6	6.9	2938.4	11.4	406.2	8.6
2004	89.9	509.9	53.1	293.5	11.8	169.4	62.8	232.8	0.4	87.0	72.1	95.8	853.5	22.3	562.0	108.4	882.6	23.7	590.3
2005	181.5	7.4	164.3	5.7	82.8	2.5	27.7	0.06	6.2	1.9	173.1	296.7	63.1	119.8	52.3	324.0	68.1	103.1	50.0
2006	564.0	38.6	180.2	6.4	121.9	12.5	1.2	26.7	1.7	0.2	425.3	13.4	6.0	30.9	11.6	13.4	6.0	27.2	11.3

Year	OHS30A	OHS31A	OHF30A	OHF31A	BOHS30A	BOHS31A	BOHF30A	BOHF31A	PAF30A	PAF31A	ILP40A	ILP41A	OLP40A	OLP41A	NYF40A	NYF41A
1980	-	-	-	-	-	-	-	-	-	-	191.0	207.5	38.1	59.7	-	-
1981	-	-	-	-	-	-	-	-	-	-	607.2	98.9	109.8	5.3	-	-
1982	-	-	-	-	-	-	-	-	-	-	840.2	142.3	54.4	18.7	-	-
1983	-	-	-	-	-	-	-	-	-	-	142.6	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	1167.9	73.7	275.7	7.6	-	-
1985	-	-	-	-	-	-	-	-	-	-	24.6	138.7	3.6	71.3	-	-
1986	-	-	-	-	-	-	-	-	-	-	1324.5	41.2	122.8	0.9	-	-
1987	-	-	-	-	-	-	-	-	-	-	2.8	30.0	2.6	206.4	-	-
1988	-	-	-	-	-	-	-	-	-	-	269.5	3.6	476.1	0.7	-	-
1989	-	-	-	-	-	-	-	-	-	-	359.4	66.9	201.7	37.8	-	-
1990	1.9	22.7	52.5	33.6	1.3	17.8	51.2	35.7	-	-	181.6	31.6	36.4	12.6	-	-
1991	11.3	166.2	3.5	51.2	16.1	258.1	3.3	46.8	-	-	106.2	25.7	10.5	1.1	-	-
1992	45.5	10.4	68.2	7.8	57.2	6.0	79.2	8.5	-	-	428.4	24.3	39.6	7.9	23.0	5.0
1993	96.9	34.7	38.3	29.4	96.9	34.7	67.0	29.9	-	-	180.7	15.4	24.5	3.8	222.4	6.2
1994	176.7	33.5	35.0	9.8	176.7	33.5	39.0	8.4	-	-	67.0	22.9	114.6	12.7	102.9	18.7
1995	69.1	61.2	26.7	87.5	83.2	51.0	32.5	72.7	-	-	3.5	42.6	5.6	27.9	12.0	30.9
1996	5214.4	8.8	330.1	9.9	4870.1	7.4	346.3	10.4	-	-	48.6	5.5	167.0	2.7	232.1	0.7
1997	-	-	7.9	129.4	-	-	7.0	92.4	-	-	18.8	6.5	14.1	38.2	0.4	12.4
1998	751.3	10.1	105.6	10.8	815.0	9.5	103.0	10.1	32.5	-	1054.3	17.2	130.8	1.4	2.7	0.4
1999	122.3	173.3	60.1	110.7	122.3	173.3	57.2	109.1	30.6	47.4	23.8	104.4	1.9	41.9	73.3	62.3
2000	0.0	231.3	2.7	54.4	0.0	231.3	3.5	52.5	31.2	4.2	2.1	3.1	9.8	3.1	46.8	14.1
2001	3500.8	27.8	36.0	1.2	3500.8	27.8	37.0	1.0	177.0	4.3	483.2	5.3	54.1	1.1	207.5	24.4
2002	4.5	2044.1	8.4	134.9	4.5	2044.1	6.7	104.5	26.5	48.8	5.8	36.5	0.4	11.8	19.2	32.0
2003	3191.3	6.2	154.0	3.1	2303.3	4.1	129.6	3.2	2196.0	87.0	118.8	0.95	56.3	0.38	942.2	3.9
2004	9.9	168.3	5.5	121.2	9.9	168.9	5.1	123.3	8.3	26.6	0.08	17.9	0.33	3.8	3.0	59.1
2005	758.8	224.5	345.8	358.8	758.8	224.5	426.0	360.7	18.0	3.0	10.3	0.25	11.5	0.17	117.1	11.1
2006	165.7	29.3	53.6	37.0	165.7	29.3	51.4	34.2	-	-	0.66	4.5	2.2	1.0	577.9	81.9

Appendix A Legend. Lakewide trawl index series names and codes used in Appendix A.

Geometric Means

Abbreviation	Series
ONTS10G	Ontario Management Unit 1 summer age 0 geometric
ONTS11G	Ontario Management Unit 1 summer age 1 geometric
OHS10G	Ohio Management Unit 1 summer age 0 geometric
OHS11G	Ohio Management Unit 1 summer age 1 geometric
OHF10G	Ohio Management Unit 1 fall age 0 geometric
OHF11G	Ohio Management Unit 1 fall age 1 geometric
USS10G	USGS Management Unit 1 summer age 0 geometric
USS11G	USGS Management Unit 1 summer age 1 geometric
USF10G	USGS Management Unit 1 fall age 0 geometric
USF11G	USGS Management Unit 1 fall age 1 geometric
ONOHP10G	Ontario/Ohio Management Unit 1 summer age 0 geometric
OHS20G	Ohio Management Unit 2 summer age 0 geometric
OHS21G	Ohio Management Unit 2 summer age 1 geometric
OHF20G	Ohio Management Unit 2 fall age 0 geometric
OHF21G	Ohio Management Unit 2 fall age 1 geometric
BOHS20G	Ohio Management Unit 2 summer age 0 geometric (blocked by depth strata)
BOHS21G	Ohio Management Unit 2 summer age 1 geometric (blocked by depth strata)
BOHF20G	Ohio Management Unit 2 fall age 0 geometric (blocked by depth strata)
BOHF21G	Ohio Management Unit 2 fall age 1 geometric (blocked by depth strata)
OHS30G	Ohio Management Unit 3 summer age 0 geometric
OHS31G	Ohio Management Unit 3 summer age 1 geometric
OHF30G	Ohio Management Unit 3 fall age 0 geometric
OHF31G	Ohio Management Unit 3 fall age 1 geometric
BOHS30G	Ohio Management Unit 3 summer age 0 geometric (blocked by depth strata)
BOHS31G	Ohio Management Unit 3 summer age 1 geometric (blocked by depth strata)
BOHF30G	Ohio Management Unit 3 fall age 0 geometric (blocked by depth strata)
BOHF31G	Ohio Management Unit 3 fall age 1 geometric (blocked by depth strata)
PAF30G	Pennsylvania Management Unit 3 fall age 0 geometric
PAF31G	Pennsylvania Management Unit 3 fall age 1 geometric
ILP40G	Inner Long Point Bay Management Unit 4 age 0 geometric
ILP41G	Inner Long Point Bay Management Unit 4 age 1 geometric
OLP40G	Outer Long Point Bay Management Unit 4 age 0 geometric
OLP41G	Outer Long Point Bay Management Unit 4 age 1 geometric
NYF40G	New York Management Unit 4 fall age 0 geometric
NYF41G	New York Management Unit 4 fall age 1 geometric

(continued)

Appendix A Legend (continued)

Arithmetic Means

Abbreviation	Series
ONTS10A	Ontario Management Unit 1 summer age 0 arithmetic
ONTS11A	Ontario Management Unit 1 summer age 1 arithmetic
OHS10A	Ohio Management Unit 1 summer age 0 arithmetic
OHS11A	Ohio Management Unit 1 summer age 1 arithmetic
OHF10A	Ohio Management Unit 1 fall age 0 arithmetic
OHF11A	Ohio Management Unit 1 fall age 1 arithmetic
USS10A	USGS Management Unit 1 summer age 0 arithmetic
USS11A	USGS Management Unit 1 summer age 1 arithmetic
USF10A	USGS Management Unit 1 fall age 0 arithmetic
USF11A	USGS Management Unit 1 fall age 1 arithmetic
ONOHP10A	Ontario/Ohio Management Unit 1 summer age 0 arithmetic
OHS20A	Ohio Management Unit 2 summer age 0 arithmetic
OHS21A	Ohio Management Unit 2 summer age 1 arithmetic
OHF20A	Ohio Management Unit 2 fall age 0 arithmetic
OHF21A	Ohio Management Unit 2 fall age 1 arithmetic
BOHS20A	Ohio Management Unit 2 summer age 0 arithmetic (blocked by depth strata)
BOHS21A	Ohio Management Unit 2 summer age 1 arithmetic (blocked by depth strata)
BOHF20A	Ohio Management Unit 2 fall age 0 arithmetic (blocked by depth strata)
BOHF21A	Ohio Management Unit 2 fall age 1 arithmetic (blocked by depth strata)
OHS30A	Ohio Management Unit 3 summer age 0 arithmetic
OHS31A	Ohio Management Unit 3 summer age 1 arithmetic
OHF30A	Ohio Management Unit 3 fall age 0 arithmetic
OHF31A	Ohio Management Unit 3 fall age 1 arithmetic
BOHS30A	Ohio Management Unit 3 summer age 0 arithmetic (blocked by depth strata)
BOHS31A	Ohio Management Unit 3 summer age 1 arithmetic (blocked by depth strata)
BOHF30A	Ohio Management Unit 3 fall age 0 arithmetic (blocked by depth strata)
BOHF31A	Ohio Management Unit 3 fall age 1 arithmetic (blocked by depth strata)
PAF30A	Pennsylvania Management Unit 3 fall age 0 arithmetic
PAF31A	Pennsylvania Management Unit 3 fall age 1 arithmetic
ILP40A	Inner Long Point Bay Management Unit 4 age 0 arithmetic
ILP41A	Inner Long Point Bay Management Unit 4 age 1 arithmetic
OLP40A	Outer Long Point Bay Management Unit 4 age 0 arithmetic
OLP41A	Outer Long Point Bay Management Unit 4 age 1 arithmetic
NYF40A	New York Management Unit 4 fall age 0 arithmetic
NYF41A	New York Management Unit 4 fall age 1 arithmetic