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 2005 through March 2006, the Yellow Perch Task Group (YPTG) addressed the following charges:

1) Maintain centralized time series of data sets required for population models including:
   a) fishery harvest, effort, age composition and biological parameters
   b) survey indices of adult abundance, size at age, and biological parameters
   c) supporting genetic research focusing on yellow perch stock discrimination

2) Support a sustainable harvest policy by:
   a) examining exploitation strategies
   b) recommending an allowable harvest (RAH) for 2006 in 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 (MU 4) yellow perch resource. Maintain assessment approaches capable of detecting discrete stocks. Develop a MU 4 harvest policy that recognizes these special considerations.

5) Conduct a review of weighting factors provided to various sources input to the catch-at-age model, recommend the most scientifically defensible method to weight data inputs in the model.

Charge 1: 2005 Fisheries Review and Population Dynamics

The lakewide total allowable catch (TAC) in 2005 was 14.770 million pounds. This allocation represented a 34% increase from a TAC of 11.027 million pounds in 2004. For yellow perch assessment and allocation, Lake Erie is partitioned into four Management Units (Units, or MUs; Figure 1.1). The 2005 allocation by management unit was 3.716, 7.405, 3.340 and 0.309 million pounds for Units 1 to 4, respectively. The TAC in Management Unit 2 was originally set at 4.387 million pounds at the March 2005 LEC meeting, but was later adjusted due to a population model program coding error. The lakewide harvest of yellow perch in 2005 of 9.700 million pounds, was almost identical to 2004. Harvest by management unit was 2.5, 4.5, 2.4 and 0.3 million pounds for Units 1 to 4 respectively (Table 1.1). The fraction of TAC harvested was 68%, 61%, 71% and 94% in MUs 1 to 4 respectively. In 2005, Ontario harvested 6.2 million pounds, followed by Ohio (3.3 million lbs), Pennsylvania (184 thousand lbs), New York (53 thousand lbs.) and Michigan (49 thousand lbs.).

In MUs 1 to 3, Ontario fishers harvested most of their allocations (96%, 85% and 95% respectively). Ohio fishers attained 52% of the quota in the western basin (MU1) and 43% in the central basin MUs 2 and 3. Michigan anglers in MU 1 (16%) and Pennsylvania fisheries in MU 3 (36%) did not attain half of their quotas. In MU 4, the proportion of TAC harvested was 69% for New York fisheries, 79% in Pennsylvania and 115% in Ontario (unadjusted for 3.3% ice allowance).

Ontario's fraction of lakewide yellow perch harvest increased to 63% in 2005 from 54% in 2004. (Table 1.1, Figure 1.2). This increase was attributed to strong performance of Ontario fisheries in MU 2 and MU 3 and to a smaller extent, in MU 4. Ohio's proportion of lakewide harvest was 34% in 2005, down from 41% in 2004. Harvest in Michigan, Pennsylvania and New York jurisdictions represented 3% of the lakewide harvest combined in 2005.

Harvest, fishing effort, and fishery harvest rates are summarized for the time period 1995-2005 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends over a longer time series (1975-2005) 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 2005 of harvest (all gears), and effort by gear are presented in Figures 1.5 through 1.8 respectively.

Harvest from commercial trap nets decreased 10% in MU 2 but increased in Units 1,3, and 4 by 24%, 7 times, and 2 times respectively. Trap net effort (lifts) in 2005 decreased in MU 1 (10%) and MU 2 (24%) but increased 15 times (from very low effort the last few years) and 4 times in MU 3 and MU 4 respectively. Ohio trapnets re-entered the MU 3 fishery in 2005 following three years of absence. Trap net harvest rates increased in MU 1 (38%) and MU 2 (19%), but decreased in MU 3 (51%) and MU 4 (51%).

Ontario's yellow perch harvest from large mesh gill nets (3 inch or greater) in 2005 ranged from 6% to 8% of the gill net harvest in MUs 1-3 but was negligible in MU 4 (<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. Targeted gill net effort decreased in MU 1 (15%) but doubled in MU 2 and MU 4 and increased in MU 3 (36%) from 2004. Gill net effort remained lower in 2005 compared to the 1990's and earlier decades (Figure 1.3). Targeted gill net harvest rates remained the same in 2005 compared to 2004 in MU 1, but decreased 34% in MU 2, 16% in MU 3, and 10% in MU 4.

In 2005, sport harvest in U.S. waters decreased in MU 1 (27%), MU 2 (29%), MU 3 (40%) and MU 4 (38%). U.S. angling effort decreased in MU 1 (12%), MU 3 (20%) and MU 4

(5%) but increased by 19% in Unit 2. The sport harvest of yellow perch from Ontario waters is assessed periodically. A western basin access creel survey conducted in Ontario waters from June to September, 2005 estimated 17,266 yellow perch were harvested and a total of 20,088 were caught. This angler harvest represented 0.3% of Ontario's MU 1 yellow perch harvest (5.5 million fish). Angling harvest rates are expressed as kg harvested /angler hour graphically for pooled jurisdictions (Figure 1.8) while harvest rates for jurisdictions are expressed as number of fish harvested /angler hour (Tables 1.2-1.5). Sport harvest rates declined lakewide from 2004 in kg/hr by 17%, 40%, 24% and 35% in MUs 1 to 4 respectively. When sport harvest rates are expressed as fish / hr, harvest rates increased marginally in MU 1 and MU 4 for Michigan, Ohio, Pennsylvania and New York but decreased by approximately 1 fish/hr in Units 2 and 3 in Ohio and Pennsylvania waters.

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 deducted from 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. Additional fishery documentation is available in annual agency reports.

Age Composition and Growth

The yellow perch harvest in 2005 consisted mostly of the 2001 (age 4) year class in MUs 1 to 3 while older year classes (1999, 1998 and earlier) were more dominant in the MU 4 harvest (Table 1.6). The strong 2003 year class (age 2) contributed little to trap net and gill net fisheries in MUs 1 to 3, but was more significant in the MU 4 gill net fishery. This year class was substantial in the MU 1 and MU 2 2005 sport fisheries, but was only marginal in MU 3 and MU 4 sport fisheries. Age 3 and 5 yellow perch (2002 and 2000 year classes) were not prominent in fisheries, although the 2000 year class represented a larger proportion of harvest in MU 4.

Yellow perch growth differs among life stages and between basins, illustrated by trends in length at age (Figure 1.9). An abundance 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 age 1 and older data 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 generally stable or improving length at age for ages 0-4 in management units 2, 3 and

4. Growth in management unit 1 appears to be generally stable or declining slightly among age groups 1 and older. In 2005, growth of YOY yellow perch appeared elevated in the western and eastern basins, but declined from 2004 levels in central basin MUs 2 and 3 (Figure 1.9). Reduced length-at-age trends are also being exhibited by older fish at age in the central basin. No long term trends are apparent in the western basin for older perch, and eastern basin adult yellow perch are sending mixed signals regarding improved growth rates (Figure 1.9).

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.

ADMB Catch-Age Analysis 2006

Population size for each management unit was estimated by catch-at-age analysis using AD Model Builder, with the Commercial Selectivity Index (CSI) version incorporating 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 2005 data appended to the time series. Estimates of population size, biomass and parameters such as survival and exploitation rates are presented for 1990-2005 in Table 1.7 and for 1975-2005 in Figures 1.10–1.13 respectively. Mean weight-at-age from surveys was applied to abundance estimates to generate population biomass estimates (Table 1.8 and Figure 1.11). 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 2005 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, 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-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 Table 1. Plots of fishery and survey data residuals from catch-age analysis are presented in the Appendix Figures 1–4. In order to address this lambda calculation process fully, a new charge was undertaken in 2005-2006 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 recruitment in 2006 was predicted by linear regression of juvenile yellow perch trawl indices against catch-age analysis estimates of two-year-old abundance in each management unit. Age 2 yellow perch recruitment in 2006 was calculated using the mean of values predicted from the indices listed in Appendix Table 2. Data from trawl index series for the time period examined are presented in Appendix Table 3 (geometric means) and Appendix Table 4 (arithmetic means), while a key that summarizes abbreviations used for the trawl series is presented as a legend in the Appendix.

Estimates of age 2 recruitment for 2006 (the 2004 year class) were below average in all management units (Table 1.7, Appendix Table 2). The 2004 year class is expected to contribute minimally to fisheries in 2006.

2006 Population Size Projection

Stock size estimates for 2006 (ages 3 and older) were projected from catch-age analysis estimates of 2005 population size and age-specific survival rates in 2005 (Table 1.8). Projected age 2 recruitment from the 2004 year class (method described above) was added to the 2006 population estimate for older fish in each unit, producing the total standing stock in 2006 (Table 1.8). Standard errors and ranges for estimates are provided for each age in 2005, and following estimated survival (from ADMB), for 2006. 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 2006 were high due primarily to the 2003 year class

(Table 1.7 and Figure 1.10). Due to the weaker 2004 year class, estimated abundance of ages 2+ yellow perch in 2006 ranged from 62% to 68% of 2005 abundance across management units. Abundance projections for 2006 age 2 and older yellow perch were 48, 79, 77 and 7 million perch in management units 1 to 4 respectively. Estimates of abundance for age 3 and older yellow perch in 2006 were close to or more than double 2005 age 3+ estimates in MUs 1-3 while MU 4 estimates of age 3 and older yellow perch were similar for 2005 and 2006. Age 3 and older abundance in 2006 was projected to be 45, 74, 72, and 7 million fish in Units 1 to 4 respectively.

As a function of population estimates and mean weight-at-age from surveys, biomass estimates in 2005 were among the highest in the time series (Figure 1.11). Total biomass estimates of age 2 and older yellow perch for 2006 were generally high for the time series in all MUs and the highest in the series for MU 3 (Figure 1.11). Total biomass decreased slightly from 2005 estimates in MU 1 (24%), MU 2 (11%) and MU 4 (19%) while MU 3 biomass increased 8%. The strong 2003 year class (age 3) is expected to represent the largest fraction of total biomass in 2006 in MU 1 (63%), MU 2 (53%), and MU 3 (60%) but is proportionally lower (26%) in MU 4 (Table 1.8).

Estimates of yellow perch survival for ages 3 and older in 2004 were 47%, 51%, 59% and 63% in MU 1, 2, 3 and 4, respectively (Figure 1.12). In 2005, estimated survival rates (ages 3+) were 44%, 48%, 56% and 60% in Units 1 through 4. 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 fluctuations, estimated survival has improved gradually in all management units since early to mid 1990s**.**

Estimated exploitation rates in 2004 were 26%, 20%, 10% and 5% in Management Units 1–4, respectively, for ages 3 and older. Exploitation rates for 2005 were estimated at 28%, 24%, 14% and 9% for yellow perch ages 3 and older across the MUs (Figure 1.13). Exploitation rates of yellow perch ages 2 and older are lower since new recruits are less vulnerable to fishing.

Yellow Perch Genetics

During 2005 the YPTG supported genetic stock discrimination research by collecting yellow perch tissue samples for Dr. Carol Stepien at the University of Toledo and Dr. Rocky Ward at the United States Geological Survey office in Wellsboro, Pennsylvania. In recent years this support 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. Ongoing tissue collections from spawning concentrations should assemble a database representing a stock library for Lake Erie yellow perch. The YPTG will to continue to provide support to genetic stock discrimination research initiatives, as requested.

Charge 2: Harvest Strategy and RAH

Harvest Strategy Methodology

In 2006, fishing rates applied in 2005 (F_{2005}) are presented for MUs 1-3 in Tables 2.1.1-2.1.3 and in Table 2.2.1 for all management units. These rates are the same as $F_{0.1}$ fishing rates presented in the 2004 YPTG report for Units 1, 2 and 3. 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-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 2004 remains the same with the exception that the time series used for the stock-recruitment relationship is shorter (1982-2004). 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 (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 to 3 in Tables 2.1.1-2.1.3.

Harvest Strategies and RAH Determination

Risk levels associated with fishing rates based on simulations updated in 2006 are presented for MUs 1, 2 and 3 (Tables 2.1.1 – 2.1.3). Target fishing rates used for TACs in 2005 (F_{2005}) are proposed for 2006 TACs and are presented for Management Units 1 to 4 (Table 2.2.1). Since charge 5 (lambda review) is not yet complete, new "$F_{0.1}$" rates are presented as biological reference points in tables 2.1.1– 2.1.3.

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

Allocation by Management Unit and Jurisdiction, 2006:

MU 1 :	MI 8.1%	OH 49.6%	ONT 42.3%
MU 2:	OH 57.5%	ONT 42.5%	
MU 3:	OH 31.9%	PA 11.9%	ONT 56.1%
MU 4:	NY 27.6%	PA 17.2%	ONT 55.2%

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-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 during the 2006-07 work cycle will be addressing these charges. It is expected to be a significant endeavor by the YPTG.

Charge 4: Eastern Basin (MU 4) 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 and New York Department of Environmental Conservation (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 2005, no further progress was made in assessing MU4 sub-stocks. However, MU4 stock assessment and harvest policy considerations are expected in 2006-07 as a planned component of the preparation of the Yellow Perch Management Plan (see Charge 3).

Charge 5: Lambda Review – data weighting factors in catch-age analysis

In 2005, 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-Age Analysis 2006*. The catch-age analysis model assumes that fishery catchability is relatively constant within time periods (blocks). It has been suggested that fishery data conforming to this criterion should be weighted more than fishery data exhibiting either greater density dependence or no relationship between fishery catch rates and abundance. Firstly, the task group focused on fishery effort weighting since these weights are calculated initially and influence derivation of catch and survey lambdas. A spreadsheet template for fishery and survey catch rates was created based on a power model discussed by Harley et al. (2001) where $catch\_rate = qN^{\beta}$ and catchability = q if fishery catch rates are density independent (β=1) or catchability is a function of q and β if fishery catchability is density dependent ($\beta \neq 1$). Regression of log fishery catch rates against log survey catch rates within jurisdictions provided a measure of density dependence of fishery catch rates (β or slope). While a number of possibilities were considered, the slope was proposed as the basis for setting fishery effort weightings and the iterative approach for catch and survey data remained outstanding.

A preliminary assessment of current and proposed percid task group data weighting methodology was undertaken by Dr. James Bence (M.S.U.). The independent review suggested there was a more appropriate, alternative interpretation of the variance ratio method used to generate effort lambdas. Also, weighting the three model data components (fishery effort, fishery catch, and survey catch rates) equally with a maximum of 1.0 for each component may be problematic. Dr. Bence thought the YPTG effort lambda template could be applied in the short term if fishery catchability time blocks did not address density dependent catchability satisfactorily. He added that the issue of density dependent catchability and data weighting are not necessarily synonymous. Options for deriving catch lambdas such as minimizing the difference between fishery sample precision and catch variance from the model were discussed. The YPTG will continue to act on this charge in the coming year, and the suggestion of a lambda workshop in 2006 met with favorable response from the YPTG and LEC.

Suggested New Charges for 2006-2007

1) Examine methods of expressing recruitment indices including area based trawl catch rates (number / ha) and harmonization of approaches used by the walleye and forage task groups
2) Reassess approaches to model parameterization (selectivity, catchability, blocking) with the intention of standardizing approaches with the Walleye Task Group.
These new charges would be completed in time to support development of the YPMP.

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Table 1.1. Lake Erie yellow perch harvest in pounds by management unit (Unit) and agency, 1995-2005.

		Ontario*		**Ohio**		**Michigan**		**Pennsylvania**		**New York**		Total
	Year	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch
Unit 1	1995	524,790	38	784,980	57	77,175	6	--	--	--	--	1,386,945
	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
Unit 2	1995	1,073,835	57	804,825	43	--	--	--	--	--	--	1,878,660
	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
Unit 3	1995	465,255	80	83,790	14	--	--	30,870	5	--	--	579,915
	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
Unit 4	1995	33,075	80	--	--	--	--	--	--	8,012	20	41,087
	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
Lakewide	1995	2,096,955	54	1,673,595	43	77,175	2	30,870	1	8,012	<1	3,886,607
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	6,147,267	63	3,266,014	34	49,485	<1	184,254	2	53,468	<1	9,700,489

* processor weight

Table 1.2. Catch, effort and catch per unit effort summaries for Lake Erie yellow perch fisheries in Management Unit 1 (Western Basin) by agency and gear type, 1995-2005.

		Unit 1				
		Michigan	Ohio		Ontario Gill Nets	
	Year	Sport	Trap Nets	Sport	Small Mesh	Large Mesh
	1995	77,175	108,045	676,935	524,790	--
Catch	1996	134,810	200,313	925,403	704,167	--
(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
	1995	35	49	307	238	--
Catch	1996	61	91	420	319	--
(Metric)	1997	51	96	390	495	--
(tonnes)	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
	1995	123,616	5,103	598,977	11,136	--
Effort	1996	193,733	4,869	754,277	8,614	--
(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
	1995	2.8	9.6	4.3	21.4	--
Catch Rates	1996	3.3	18.7	4.9	37.0	--
(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

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

Table 1.3. Catch, effort and catch per unit effort summaries for Lake Erie yellow perch fisheries in Management Unit 2 (western Central Basin) by agency and gear type, 1995-2005.

		Unit 2			
		Ohio		Ontario Gill Nets	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh
	1995	257,985	546,840	1,073,835	--
Catch	1996	323,334	500,091	1,290,998	--
(pounds)	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
	1995	117	248	487	--
Catch	1996	147	227	585	--
(Metric)	1997	226	263	828	--
(tonnes)	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
	1995	6,467	388,238	18,337	--
Effort	1996	5,834	316,736	14,572	--
(a)	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
	1995	18.1	3.5	26.6	--
Catch Rates	1996	25.1	4.2	40.1	--
(b)	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

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

Table 1.4. Catch, effort and catch per unit effort summaries for Lake Erie yellow perch fisheries in Management Unit 3 (eastern Central Basin) by agency and gear type, 1995-2005.

		Unit 3					
		Ohio		Ontario Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
	1995	63,945	19,845	465,255	--	0	--
Catch	1996	103,414	83,281	512,293	--	5,292	3,749
(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
	1995	29	9.0	211	--	0	--
Catch	1996	47	38	232	--	2.4	1.7
(Metric)	1997	25	75	376	--	3.4	7.2
(tonnes)	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
	1995	3,258	42,234	6,843	--	0	--
Effort	1996	2,730	69,887	6,184	--	185	12,850
(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
	1995	8.9	1.3	30.8	--	--	--
Catch Rates	1996	17.2	2.8	37.5	--	13.0	0.8
(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

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

Table 1.5. Catch, effort and catch per unit effort summaries for Lake Erie yellow perch fisheries in Management Unit 4 (Eastern Basin) by agency and gear type, 1995-2005.

		Unit 4					
		New York		Ontario Gill Nets		Pennsylvania	
	Year	Trap Nets	Sport	Small Mesh	Large Mesh	Trap Nets	Sport
	1995	3,122	4,890	33,075	--	0	--
Catch	1996	2,822	1,650	30,495	--	0	2,205
(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
	1995	1.4	2.2	15.0	--	0	--
Catch	1996	1.3	0.7	13.8	--	0	1.0
(Metric)	1997	0.6	0.5	16.4	--	0	1.4
(tonnes)	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
	1995	532	12,115	1,375	--	0	--
Effort	1996	533	6,535	1,063	--	0	7,292
(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	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
	1995	2.7	0.8	10.9	--	--	--
Catch Rates	1996	2.4	0.5	13.0	--	--	0.6
(b)	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

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

Table 1.6. Lake Erie 2005 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	342,031	6.3	463,483	5.7	98,677	2.3	110,973	23.2	1,015,163	5.5
	3	407,607	7.5	260,891	3.2	239,687	5.7	32,449	6.8	940,633	5.1
	4	3,243,943	59.6	6,829,441	83.8	2,772,452	65.7	192,518	40.3	13,038,354	71.3
	5	546,937	10.1	263,036	3.2	351,078	8.3	39,842	8.3	1,200,892	6.6
	6+	900,053	16.5	334,911	4.1	760,010	18.0	102,454	21.4	2,097,427	11.5
	Total	5,440,570		8,151,762		4,221,903		478,236		18,292,470	
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	42,069	3.6	327,471	8.4	12,182	7.0	0	0.0	381,721	7.3
	3	31,699	2.7	31,838	0.8	1,866	1.1	153	0.9	65,556	1.3
	4	961,183	82.0	2,644,199	68.2	101,769	58.3	4,283	24.1	3,711,434	70.8
	5	44,670	3.8	171,313	4.4	7,736	4.4	2,294	12.9	226,014	4.3
	6+	92,583	7.9	703,170	18.1	51,035	29.2	11,013	62.1	857,801	16.4
	Total	1,172,204		3,877,990		174,588		17,743		5,242,526	
Sport	1	1,083	0.0	206	0.0	501	0.0	0	0.0	1,790	0.0
	2	1,393,906	50.4	765,051	34.1	119,255	9.3	2,580	1.6	2,280,792	35.4
	3	125,911	4.6	95,676	4.3	29,379	2.3	7,344	4.4	258,310	4.0
	4	924,733	33.5	986,617	44.0	526,937	41.2	59,536	35.9	2,497,823	38.7
	5	81,513	2.9	77,595	3.5	70,670	5.5	25,419	15.3	255,197	4.0
	6+	236,842	8.6	316,489	14.1	531,042	41.6	70,860	42.8	1,155,233	17.9
	Total	2,763,988		2,241,634		1,277,784		165,739		6,449,145	
All Gear	1	1,083	0.0	206	0.0	501	0.0	0	0.0	1,790	0.0
	2	1,778,006	19.0	1,556,005	10.9	230,113	4.1	113,553	17.2	3,677,677	12.3
	3	565,216	6.0	388,404	2.7	270,931	4.8	39,946	6.0	1,264,498	4.2
	4	5,129,859	54.7	10,460,256	73.3	3,401,159	59.9	256,337	38.7	19,247,611	64.2
	5	673,120	7.2	511,944	3.6	429,484	7.6	67,555	10.2	1,682,103	5.6
	6+	1,229,478	13.1	1,354,570	9.5	1,342,087	23.7	184,327	27.9	4,110,462	13.7
	Total	9,375,679		14,271,386		5,674,275		661,718		29,984,141	

Table 1.7. Yellow perch stock size (millions of fish) in each Lake Erie management unit. The years 1990 to 2005 are estimated by ADMB catch-age analysis. The 2006 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
Unit 1	2	3.654	10.748	14.085	4.427	10.196	22.870	26.356	21.640	41.911	10.424	33.344	32.512	8.647	45.193	5.494	55.085	3.318
	3	1.350	1.944	5.699	7.858	1.818	6.243	14.050	15.792	13.534	26.025	6.699	21.349	21.056	5.582	28.740	3.546	35.124
	4	5.356	0.520	0.607	2.042	2.085	0.819	2.843	6.192	7.560	6.951	14.545	3.747	12.792	11.268	3.177	14.575	1.929
	5	2.061	1.546	0.121	0.143	0.312	0.527	0.228	0.765	1.953	2.793	3.200	7.253	2.053	5.415	5.275	1.331	6.413
	6+	1.532	0.673	0.319	0.074	0.025	0.082	0.180	0.105	0.190	0.507	1.273	2.008	4.861	2.555	3.452	3.002	1.619
	2 and Older	13.954	15.432	20.831	14.544	14.436	30.541	43.658	44.493	65.148	46.699	59.061	66.868	49.408	70.013	46.138	77.539	48.402
	3 and Older	10.299	4.684	6.746	10.117	4.240	7.671	17.302	22.854	23.238	36.275	25.717	34.356	40.761	24.820	40.644	22.454	45.084
Unit 2	2	5.582	14.227	17.132	6.716	12.838	13.276	28.259	17.897	62.695	15.580	55.204	45.768	11.010	93.709	5.726	86.000	4.848
	3	1.484	2.235	5.938	8.323	3.110	7.293	7.444	13.725	9.141	33.110	9.652	33.364	27.155	6.939	56.738	3.730	55.221
	4	7.294	0.475	0.673	1.953	2.993	0.936	2.209	2.325	3.554	3.330	17.295	5.062	17.748	13.549	3.483	29.320	1.932
	5	2.282	1.918	0.112	0.193	0.519	0.727	0.215	0.559	0.439	0.873	1.688	8.584	2.578	8.401	6.233	1.697	13.767
	6+	1.591	0.826	0.494	0.176	0.087	0.147	0.203	0.106	0.078	0.090	0.413	1.010	4.884	3.518	5.541	5.499	3.430
	2 and Older	18.233	19.681	24.350	17.361	19.548	22.379	38.330	34.612	75.906	52.983	84.253	93.787	63.376	126.116	77.720	126.247	79.198
	3 and Older	12.651	5.454	7.218	10.645	6.710	9.103	10.072	16.715	13.211	37.403	29.049	48.020	52.366	32.407	71.995	40.247	74.350
Unit 3	2	3.962	8.242	5.224	3.004	6.200	6.766	12.776	9.446	37.165	11.753	42.963	25.494	6.569	35.866	2.661	86.683	5.173
	3	1.786	2.404	3.610	2.336	1.494	3.609	4.190	8.111	5.882	24.028	7.611	27.689	16.276	4.210	23.221	1.738	57.355
	4	4.063	0.838	0.808	1.291	0.997	0.801	2.130	2.459	4.281	3.521	15.316	4.788	17.469	10.099	2.595	14.127	1.047
	5	1.421	1.423	0.320	0.243	0.444	0.352	0.415	1.094	1.185	2.367	2.196	9.227	2.948	10.386	5.877	1.496	7.753
	6+	4.165	1.697	0.767	0.345	0.207	0.252	0.318	0.371	0.640	0.927	2.000	2.495	7.153	6.030	9.557	8.841	5.732
	2 and Older	15.397	14.604	10.727	7.219	9.342	11.781	19.828	21.480	49.153	42.596	70.087	69.693	50.415	66.590	43.911	112.885	77.060
	3 and Older	11.434	6.362	5.503	4.215	3.142	5.015	7.052	12.034	11.988	30.843	27.124	44.200	43.846	30.724	41.250	26.202	71.887
Unit 4	2	0.592	0.423	0.102	0.279	0.132	1.102	0.728	0.323	4.022	1.420	12.624	2.588	2.182	9.172	1.046	4.318	0.085
	3	0.664	0.383	0.270	0.068	0.177	0.084	0.726	0.480	0.212	2.694	0.941	8.422	1.735	1.462	6.129	0.694	2.857
	4	0.923	0.335	0.176	0.174	0.029	0.082	0.049	0.419	0.273	0.139	1.704	0.619	5.621	1.146	0.956	3.956	0.431
	5	0.409	0.351	0.105	0.101	0.048	0.009	0.040	0.024	0.206	0.172	0.086	1.103	0.412	3.641	0.731	0.602	2.380
	6+	0.957	0.517	0.265	0.212	0.085	0.041	0.023	0.030	0.026	0.138	0.185	0.173	0.843	0.779	2.742	2.096	1.560
	2 and Older	3.546	2.008	0.918	0.835	0.471	1.319	1.566	1.275	4.739	4.563	15.539	12.906	10.793	16.199	11.604	11.666	7.313
	3 and Older	2.953	1.586	0.816	0.556	0.339	0.216	0.838	0.953	0.718	3.142	2.915	10.318	8.611	7.027	10.558	7.348	7.228

Table 1.8. Projection of the 2006 Lake Erie yellow perch population. Stock size estimates are derived from ADMB and age 2 estimates for 2006 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.

		2005 Parameters				Rate Functions					2006 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)	2005	2006	2006
Unit 1	2	55.085	35.589	19.496	90.674	0.050	0.450	0.362	0.040	0.638	2	3.318	2.347	4.289	0.063	3.379	0.209	0.461
	3	3.546	1.675	1.871	5.221	0.209	0.609	0.456	0.157	0.544	3	35.124	12.431	57.816	0.088	0.287	3.091	6.815
	4	14.575	6.149	8.426	20.724	0.421	0.821	0.560	0.287	0.440	4	1.929	1.018	2.840	0.121	1.933	0.233	0.515
	5	1.331	0.565	0.766	1.896	0.553	0.953	0.614	0.357	0.386	5	6.413	3.707	9.118	0.155	0.196	0.994	2.192
	6+	3.002	1.456	1.546	4.458	0.599	0.999	0.632	0.379	0.368	6+	1.619	0.865	2.373	0.212	0.601	0.343	0.757
	Total	77.539		32.105	122.973	0.142	0.542	0.419	0.110	0.581	Total	48.402	20.368	76.436	0.101	6.396	4.870	10.739
	(3+)	22.454		12.609	32.299	0.413	0.813	0.556	0.283	0.444	(3+)	45.084	18.021	72.147	0.103	3.017	4.661	10.278
Unit 2	2	86.000	46.677	39.323	132.677	0.043	0.443	0.358	0.035	0.642	2	4.848	3.370	6.327	0.070	5.590	0.339	0.748
	3	3.730	1.543	2.187	5.273	0.258	0.658	0.482	0.189	0.518	3	55.221	25.250	85.193	0.112	0.343	6.185	13.637
	4	29.320	10.687	18.633	40.007	0.356	0.756	0.530	0.250	0.470	4	1.932	1.133	2.731	0.177	4.838	0.342	0.754
	5	1.697	0.587	1.110	2.284	0.402	0.802	0.552	0.276	0.448	5	13.767	8.749	18.785	0.268	0.434	3.690	8.136
	6+	5.499	1.773	3.726	7.272	0.323	0.723	0.515	0.230	0.485	6+	3.430	2.306	4.553	0.329	1.914	1.128	2.488
	Total	126.247		64.980	187.514	0.129	0.529	0.411	0.101	0.589	Total	79.198	40.807	117.589	0.148	13.119	11.684	25.763
	(3+)	40.247		25.657	54.837	0.344	0.744	0.525	0.243	0.475	(3+)	74.350	37.437	111.262	0.153	7.529	11.345	25.015
Unit 3	2	86.683	49.109	37.574	135.792	0.013	0.413	0.338	0.011	0.662	2	5.173	3.230	7.115	0.062	4.334	0.321	0.707
	3	1.738	0.741	0.997	2.479	0.107	0.507	0.398	0.084	0.602	3	57.355	24.862	89.849	0.116	0.186	6.653	14.670
	4	14.127	5.278	8.849	19.405	0.200	0.600	0.451	0.150	0.549	4	1.047	0.601	1.493	0.177	2.444	0.185	0.409
	5	1.496	0.532	0.964	2.028	0.236	0.636	0.471	0.175	0.529	5	7.753	4.857	10.650	0.253	0.339	1.962	4.325
	6+	8.841	2.902	5.939	11.743	0.182	0.582	0.441	0.138	0.559	6+	5.732	3.829	7.635	0.349	2.988	2.000	4.411
	Total	112.885		54.323	171.447	0.051	0.451	0.363	0.041	0.637	Total	77.060	37.377	116.742	0.144	10.292	11.121	24.522
	(3+)	26.202		16.749	35.655	0.189	0.589	0.445	0.143	0.555	(3+)	71.887	34.147	109.627	0.150	5.958	10.800	23.815
Unit 4	2	4.318	3.332	0.986	7.650	0.013	0.413	0.338	0.011	0.662	2	0.085	0.060	0.110	0.080	0.268	0.007	0.015
	3	0.694	0.440	0.254	1.134	0.075	0.475	0.378	0.060	0.622	3	2.857	0.652	5.062	0.153	0.106	0.437	0.964
	4	3.956	2.306	1.650	6.262	0.108	0.508	0.398	0.085	0.602	4	0.431	0.158	0.705	0.214	0.827	0.092	0.204
	5	0.602	0.339	0.263	0.941	0.177	0.577	0.438	0.134	0.562	5	2.380	0.993	3.768	0.262	0.164	0.624	1.375
	6+	2.096	1.176	0.920	3.272	0.140	0.540	0.417	0.108	0.583	6+	1.560	0.684	2.435	0.335	0.717	0.523	1.152
	Total	11.666		4.073	19.259	0.079	0.479	0.380	0.063	0.620	Total	7.313	2.546	12.080	0.230	2.081	1.682	3.710
	(3+)	7.348		3.087	11.609	0.119	0.519	0.405	0.093	0.595	(3+)	7.228	2.487	11.970	0.232	1.814	1.676	3.695

Table 2.1.1. Management Unit 1 yellow perch biological references from simulations and projected population size in 2007 for a range of fishing rates "F". Biological reference points include mean spawner biomass as a fraction of an unfished population, mean survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993-4 for ages 2+ (14.5 million) and 3+ (4.2 million). The harvest in the "Harvest 2006" column, is based on fishing rates in the "F" column and 2006 abundance estimates at the bottom of the page. S/R simulations based on ADMB abundance estimates from 1982-2004 were used to determine $F_{0.1}$. F_{2005} was the fishing rate used for TAC in 2004 and 2005. Refer to Table 2.2.1 for summary of F_{2005} fishing rates and 2006 recommended harvest by management unit.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob %. 1993 2+	Prob. % 1994 3+	F	Harvest (lbs x 10^6) 2006	Population 2+ (millions) 2007	Population 3+ (millions) 2007	Harvest Strategy Reference
100	67%	67%	0	0	0.000	0.000	47.385	32.445	
98	67%	67%	0	0	0.010	0.050	47.239	32.299	
93	66%	65%	0	0	0.050	0.250	46.663	31.723	
87	64%	63%	0.2	0	0.100	0.493	45.960	31.020	
81	63%	61%	0.5	0	0.150	0.731	45.275	30.335	
76	62%	59%	1.0	0	0.200	0.962	44.607	29.667	
72	61%	58%	1.3	0	0.250	1.188	43.956	29.017	
68	60%	56%	2.4	0	0.300	1.408	43.322	28.382	
65	59%	54%	3.7	0.0	0.350	1.623	42.704	27.764	
62	58%	53%	5.0	0.1	0.400	1.832	42.101	27.161	
59	57%	51%	6.1	0.3	0.450	2.037	41.514	26.574	
57	56%	50%	8.3	0.4	0.500	2.236	40.941	26.001	
54	55%	49%	10.2	0.7	0.550	2.430	40.382	25.442	
52	54%	48%	11.7	0.8	0.600	2.620	39.837	24.898	
50	54%	46%	14.1	1.1	0.646	2.790	39.348	24.408	$F_{0.1}$
50	54%	46%	14.7	1.1	0.650	2.805	39.306	24.366	
48	53%	45%	16.9	1.8	0.700	2.986	38.788	23.848	
48	53%	45%	17.8	2.0	**0.720**	3.057	38.584	23.645	$\mathbf{F_{2005}}$
47	52%	44%	19.7	2.2	0.750	3.162	38.283	23.343	
45	52%	43%	21.6	3.1	0.800	3.334	37.790	22.850	
44	51%	42%	24.0	4.2	0.850	3.502	37.309	22.369	
42	51%	41%	26.6	5.8	0.900	3.666	36.839	21.900	
41	50%	40%	28.2	7.6	0.950	3.826	36.382	21.442	
40	50%	39%	30.5	8.3	1.000	3.983	35.935	20.995	
38	48%	37%	35.1	11.5	1.100	4.285	35.073	20.134	
36	48%	36%	38.7	15.9	1.200	4.573	34.253	19.313	
34	47%	34%	42.1	20.1	1.300	4.848	33.471	18.532	
33	46%	33%	44.6	23.9	1.400	5.110	32.726	17.786	
32	45%	31%	47.4	29.5	1.500	5.361	32.016	17.076	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.084	0.093
3	0.397	0.114
4	0.693	0.131
5	0.768	0.152
6	0.827	0.185

2006 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	3.318	2.347	4.289
3	35.124	12.431	57.816
4	1.929	1.018	2.840
5	6.413	3.707	9.118
6+	1.619	0.865	2.373
(2+)	48.402	20.368	76.436
(3+)	45.084	18.021	72.147

2007 Recruitment

Millions Age 2s
14.940

Table 2.1.2. Management Unit 2 yellow perch biological references from simulations and projected population size in 2007 for a range of fishing rates "F". Biological reference points include mean spawner biomass as a fraction of an unfished population, mean survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993-4 for ages 2+ (17.4 million) and 3+ (6.7 million). The harvest in the "Harvest 2006" column, is based on fishing rates in the "F" column and 2006 abundance estimates at the bottom of the page. S/R simulations based on ADMB abundance estimates from 1982-2004 were used to determine $F_{0.1}$. F_{2005} was the fishing rate used for TAC in 2004 and 2005. Refer to Table 2.2.1 for summary of F_{2005} fishing rates and 2006 recommended harvest by management unit.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob %. 1993 2+	Prob. % 1994 3+	F	Harvest (lbs x 10^6) 2006	Population 2+ (millions) 2007	Population 3+ (millions) 2007	Harvest Strategy Reference
100	67%	67%	0	0	0.000	0.000	81.808	53.1	
99	67%	67%	0.1	0	0.010	0.130	81.477	52.8	
93	65%	65%	0.1	0	0.050	0.642	80.173	51.5	
87	64%	62%	0.4	0	0.100	1.263	78.592	49.9	
82	62%	60%	0.7	0	0.150	1.864	77.064	48.3	
77	61%	58%	1.5	0	0.200	2.447	75.586	46.9	
73	59%	56%	2.8	0	0.250	3.011	74.158	45.4	
69	58%	54%	4.1	0	0.300	3.557	72.776	44.1	
65	57%	52%	6.7	0.5	0.350	4.086	71.440	42.7	
62	56%	50%	9.4	0.9	0.400	4.599	70.149	41.4	
59	55%	48%	11.5	1.7	0.450	5.095	68.900	40.2	
56	54%	47%	14.4	2.7	0.500	5.576	67.692	39.0	
53	53%	45%	17.6	4.1	0.550	6.042	66.523	37.8	
51	52%	44%	20.5	6.1	0.600	6.494	65.393	36.7	
49	51%	42%	22.7	8.9	0.650	6.931	64.300	35.6	
48	51%	42%	23.2	9.5	**0.661**	7.026	64.065	35.3	**F_{2005}**
47	51%	41%	24.4	10.7	0.686	7.238	63.535	34.8	$F_{0.1}$
47	51%	41%	25.7	11.2	0.700	7.355	63.243	34.5	
45	50%	40%	28.0	15.1	0.750	7.766	62.220	33.5	
43	49%	38%	31.2	19.2	0.800	8.165	61.231	32.5	
42	49%	37%	34.1	23.5	0.850	8.551	60.274	31.6	
40	48%	36%	37.2	27.4	0.900	8.925	59.348	30.6	
39	47%	35%	40.2	32.5	0.950	9.288	58.452	29.7	
37	47%	34%	42.4	36.2	1.000	9.640	57.585	28.9	
35	46%	32%	46.2	44.4	1.100	10.312	55.935	27.2	
33	45%	30%	51.4	52.1	1.200	10.945	54.389	25.7	
31	44%	28%	55.1	59.0	1.300	11.540	52.941	24.2	
29	43%	26%	58.5	64.8	1.400	12.100	51.585	22.9	
27	42%	25%	62.0	71.1	1.500	12.628	50.314	21.6	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.088	0.114
3	0.593	0.131
4	0.812	0.145
5	0.882	0.168
6	0.805	0.208

2006 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	4.848	3.370	6.327
3	55.221	25.250	85.193
4	1.932	1.133	2.731
5	13.767	8.749	18.785
6+	3.430	2.306	4.553
(2+)	79.198	40.807	117.589
(3+)	74.350	37.437	111.262

2007 Recruitment Millions Age 2s
28.720

Table 2.1.3. Management Unit 3 yellow perch biological references from simulations and projected population size in 2007 for a range of fishing rates "F". Biological reference points include mean spawner biomass as a fraction of an unfished population, mean survival of age 2+ and 3+ fish, and the probability of attaining low population levels observed in 1993-4 for ages 2+ (7.2 million) and 3+ (3.1 million). The harvest in the "Harvest 2006" column, is based on fishing rates in the "F" column and 2006 abundance estimates at the bottom of the page. S/R simulations based on ADMB abundance estimates from 1982-2004 were used to determine $F_{0.1}$. F_{2005} was the fishing rate used for TAC in 2004 and 2005. Refer to Table 2.1 for summary of F_{2005} fishing rates and 2006 recommended harvest by management unit.

Simulation					Projections at Different Fishing Rates				
% Spawner Biomass (of Unfished)	Survival 2+	Survival 3+	Prob %. 1993 2+	Prob. % 1994 3+	F	Harvest (lbs x 10^6) 2006	Population 2+ (millions) 2007	Population 3+ (millions) 2007	Harvest Strategy Reference
100	67%	67%	0	0	0.000	0.000	64.063	51.655	
98	67%	67%	0	0	0.010	0.102	63.834	51.426	
92	65%	65%	0	0	0.050	0.506	62.930	50.522	
84	64%	63%	0	0	0.100	1.000	61.827	49.418	
78	63%	61%	0	0	0.150	1.480	60.751	48.342	
73	61%	59%	0	0	0.200	1.948	59.703	47.294	
68	60%	57%	0	0	0.250	2.404	58.681	46.272	
63	59%	56%	0.5	0	0.300	2.849	57.685	45.277	
60	58%	54%	0.7	0	0.350	3.282	56.714	44.306	
56	57%	52%	1.1	0	0.400	3.704	55.768	43.359	
53	56%	51%	1.8	0	0.450	4.115	54.845	42.436	
50	55%	49%	2.5	0.5	0.500	4.516	53.945	41.536	
48	54%	48%	3.2	0.8	0.550	4.907	53.067	40.659	
45	54%	47%	4.0	1.1	0.600	5.289	52.211	39.803	
43	53%	46%	4.6	1.9	0.648	5.646	51.410	39.001	$F_{0.1}$
43	53%	46%	4.6	1.9	0.650	5.660	51.377	38.968	
41	52%	44%	6.1	2.7	0.700	6.023	50.562	38.154	
41	52%	44%	6.3	2.7	**0.703**	6.045	50.514	38.105	$\mathbf{F_{2005}}$
39	51%	43%	7.7	3.3	0.750	6.377	49.768	37.359	
38	51%	42%	9.3	4.9	0.800	6.722	48.993	36.584	
36	50%	41%	11.3	6.5	0.850	7.059	48.237	35.828	
35	50%	40%	12.6	7.8	0.900	7.387	47.499	35.090	
34	49%	39%	14.2	10.0	0.950	7.708	46.779	34.370	
32	49%	38%	15.6	11.6	1.000	8.021	46.076	33.667	
30	48%	36%	18.5	16.8	1.100	8.624	44.720	32.312	
28	47%	35%	21.6	22.7	1.200	9.200	43.428	31.020	
27	46%	33%	24.8	28.5	1.300	9.749	42.197	29.788	
25	45%	32%	28.6	35.5	1.400	10.272	41.023	28.614	
24	44%	30%	33.6	42.3	1.500	10.772	39.903	27.494	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.075	0.111
3	0.390	0.136
4	0.760	0.168
5	0.826	0.205
6	0.744	0.261

2006 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	5.173	3.230	7.115
3	57.355	24.862	89.849
4	1.047	0.601	1.493
5	7.753	4.857	10.650
6+	5.732	3.829	7.635
(2+)	77.060	37.377	116.742
(3+)	71.887	34.147	109.627

2007 Recruitment Millions Age 2s
12.409

Table 2.2.1. Lake Erie yellow perch fishing rate and proposed Total Allowable Catch (TAC; in millions of pounds) in 2006 according to harvest strategies presented. The F_{2005} strategy is based on the stock recruitment simulation model produced in 2004 (using ADMB abundance estimates from 1975-2003) applied in 2005. The proposed TAC for MU 4 is based on the target fishing rate associated with the TAC in 2005.

MU	Fishing Rate	Harvest (millions lbs)	Yield Methods
1	0.720	3.057	F_{2005}
2	0.661	7.026	F_{2005}
3	0.703	6.045	F_{2005}
4	0.230	0.352	F_{2005}
Total		16.480	

* Note: F=0.230 is the targeted fishing rate that produced the TAC of 309,000 lbs in 2005.

Lake Erie Yellow Perch Management Units (MUs)

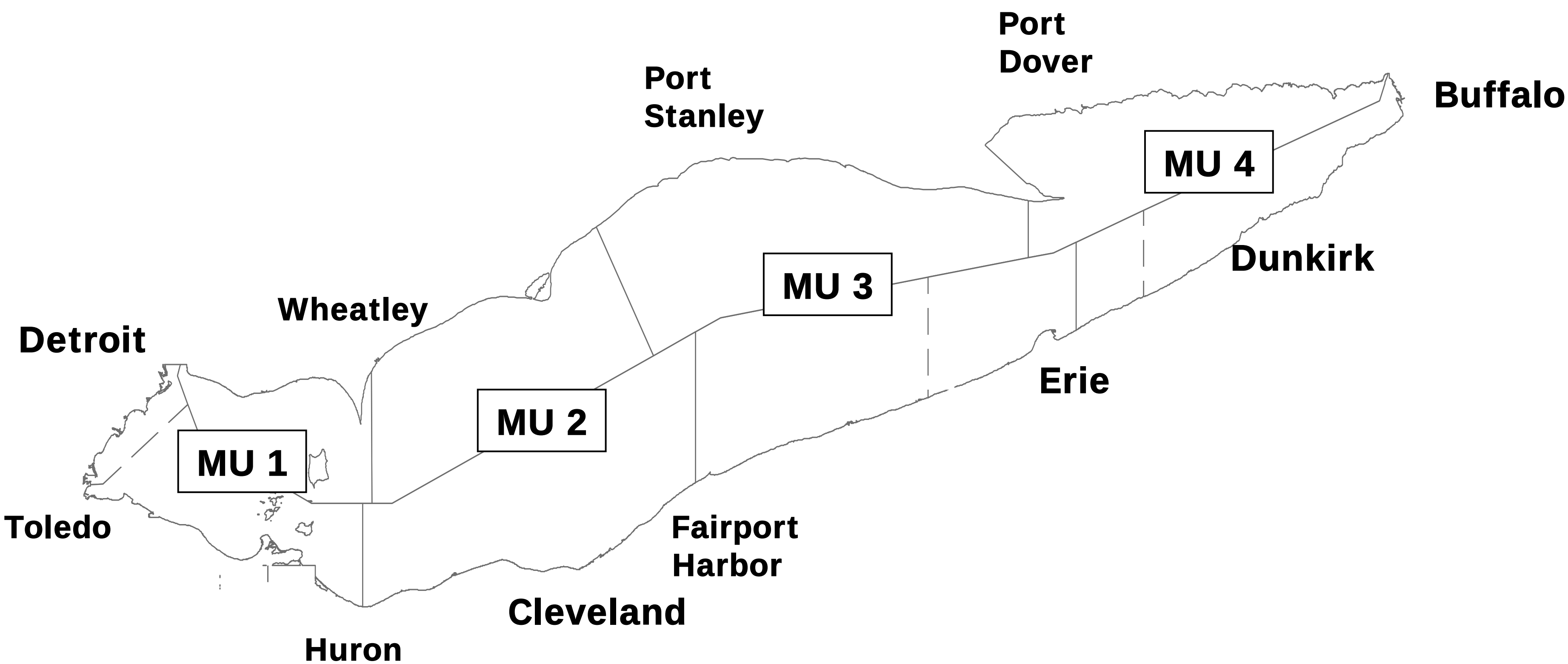


Figure 1.1. Yellow Perch management units (MUs) of Lake Erie; for illustrative purposes only; not to be used for quota determination or border delineation.

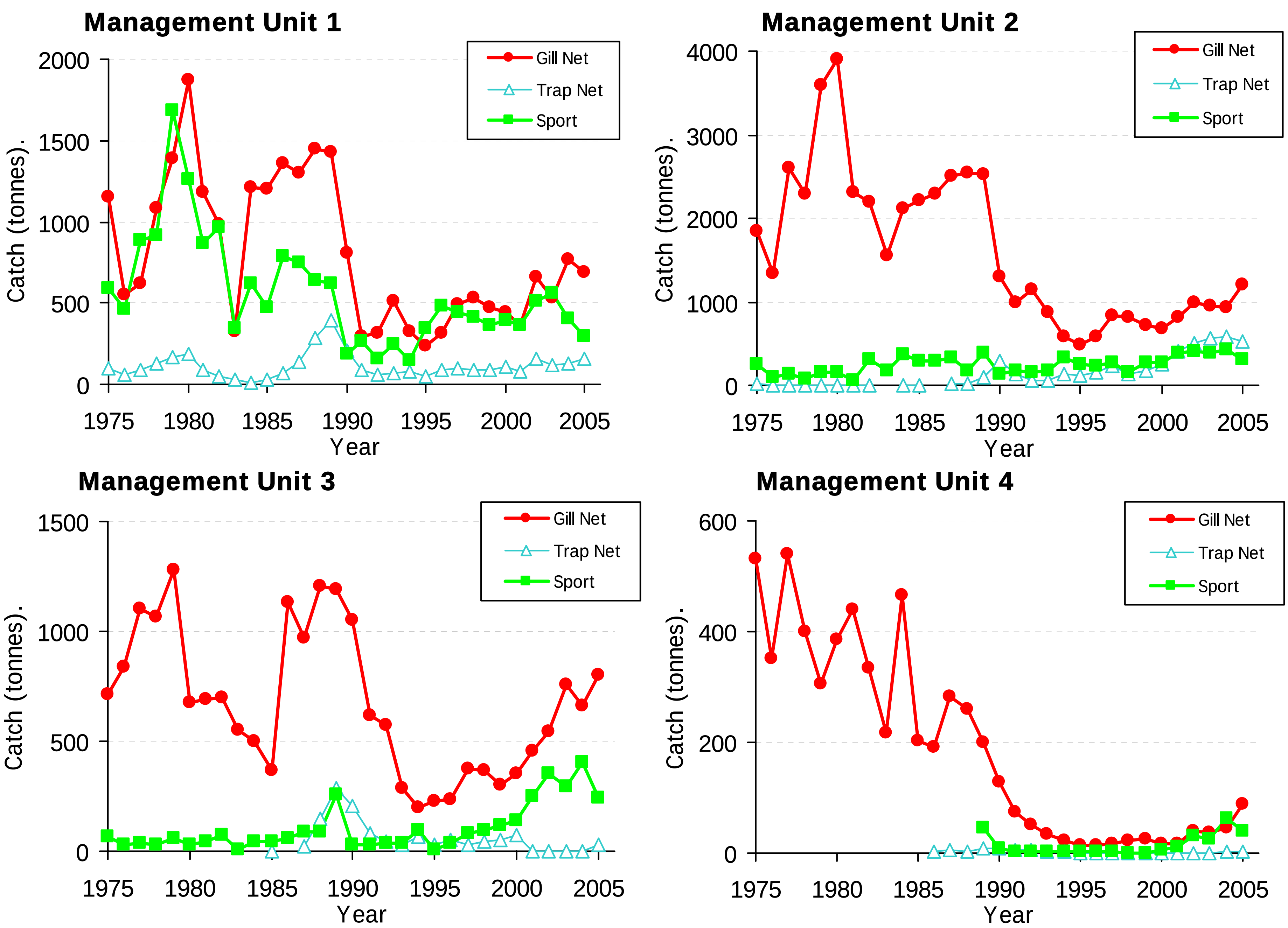


Figure 1.2. Lake Erie yellow perch harvest by management unit and gear type.

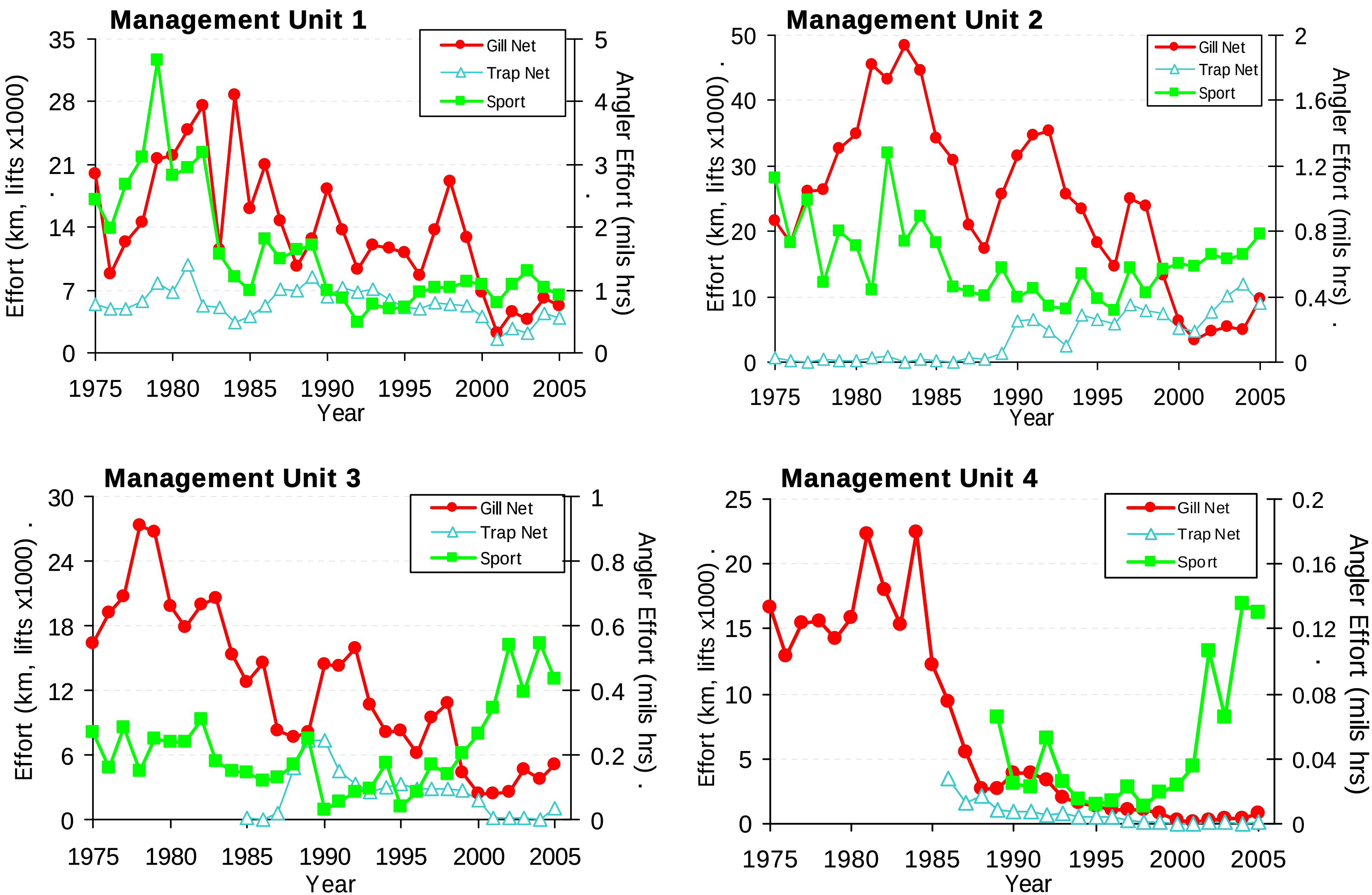


Figure 1.3. Lake Erie yellow perch effort by management unit and gear type. Note: gill net effort is targeted (mesh sizes < 3”).

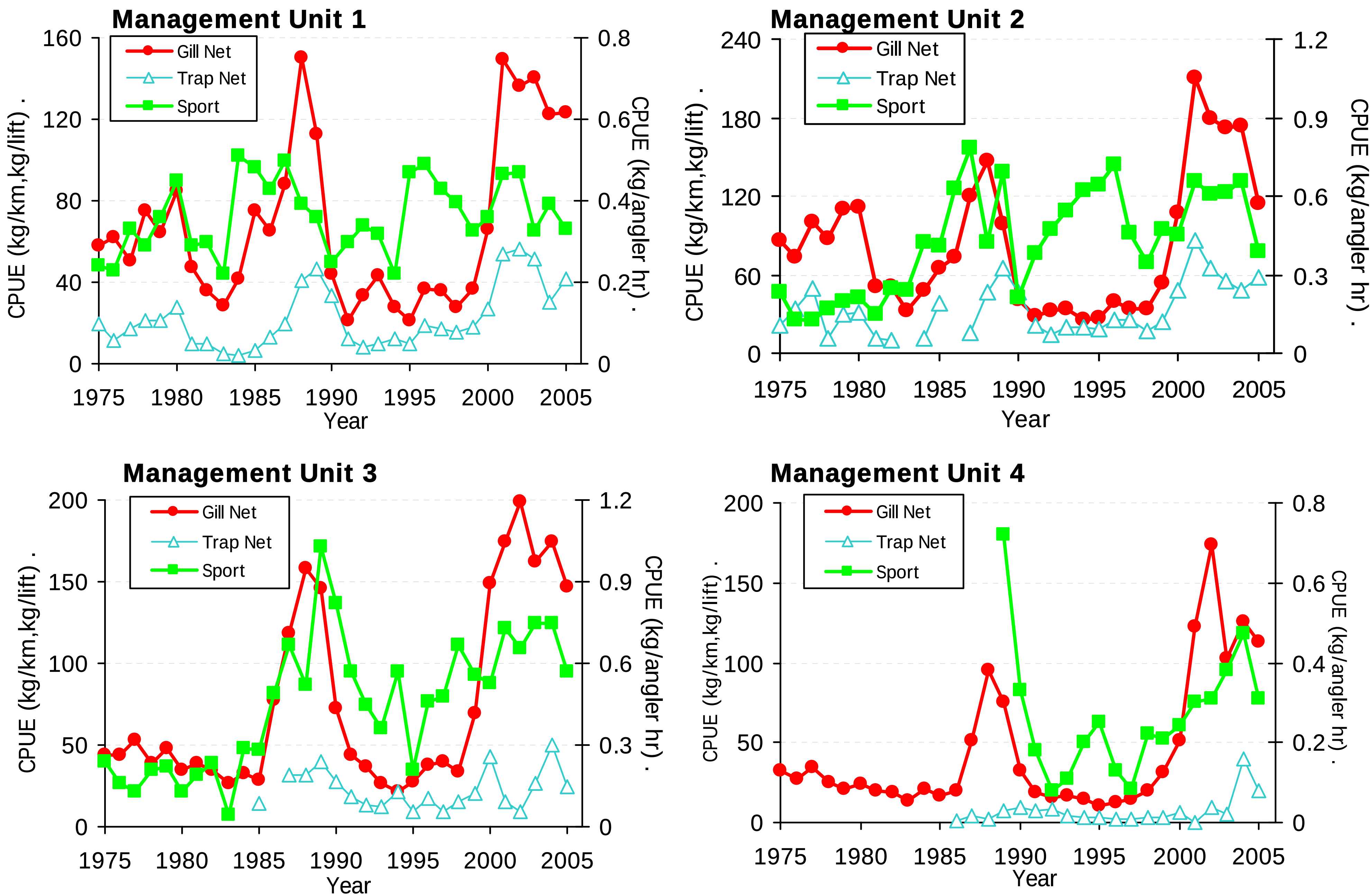


Figure 1.4. Lake Erie yellow perch catch per unit effort (CPUE) by management unit and gear type. Note: gill net effort is targeted (mesh sizes < 3”).

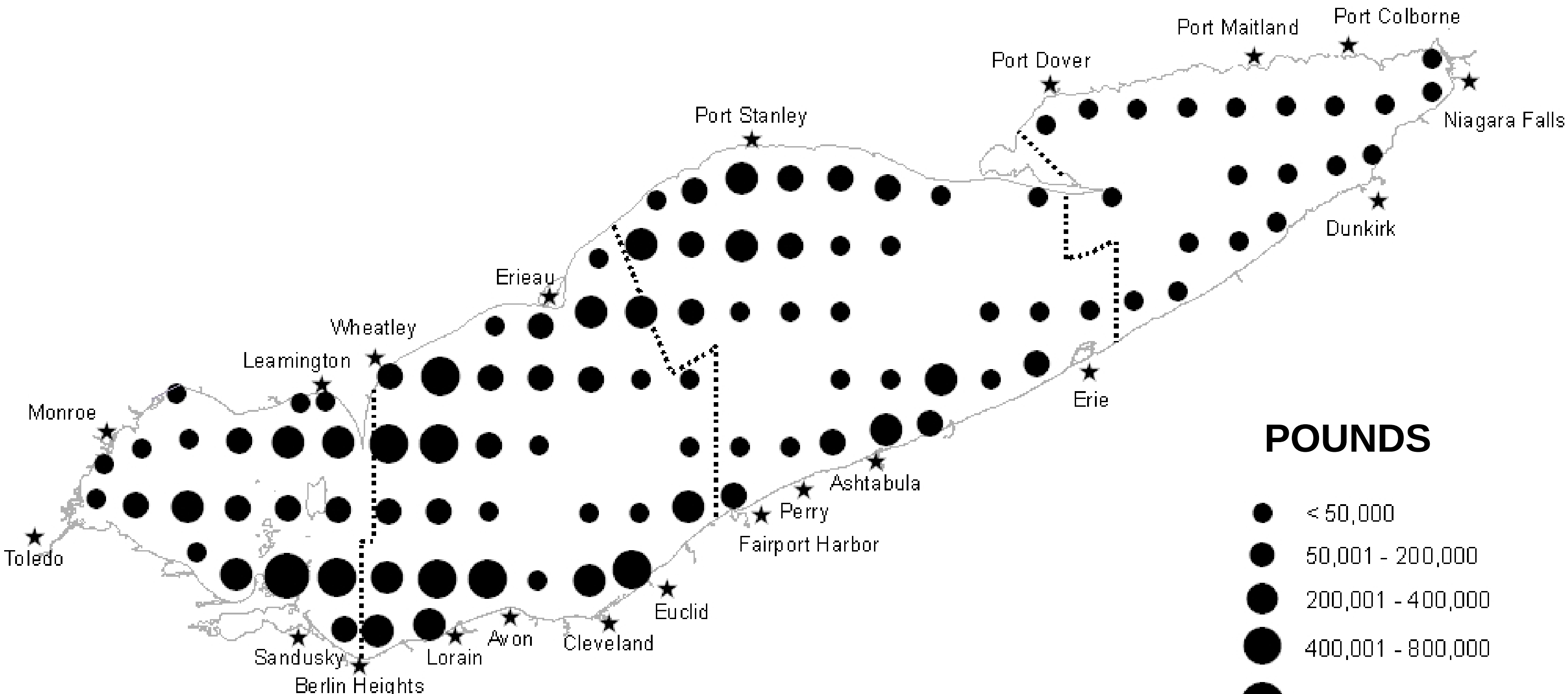


Figure 1.5. Spatial distribution of yellow perch total harvest (lbs.) in 2005 by 10-minute grid.

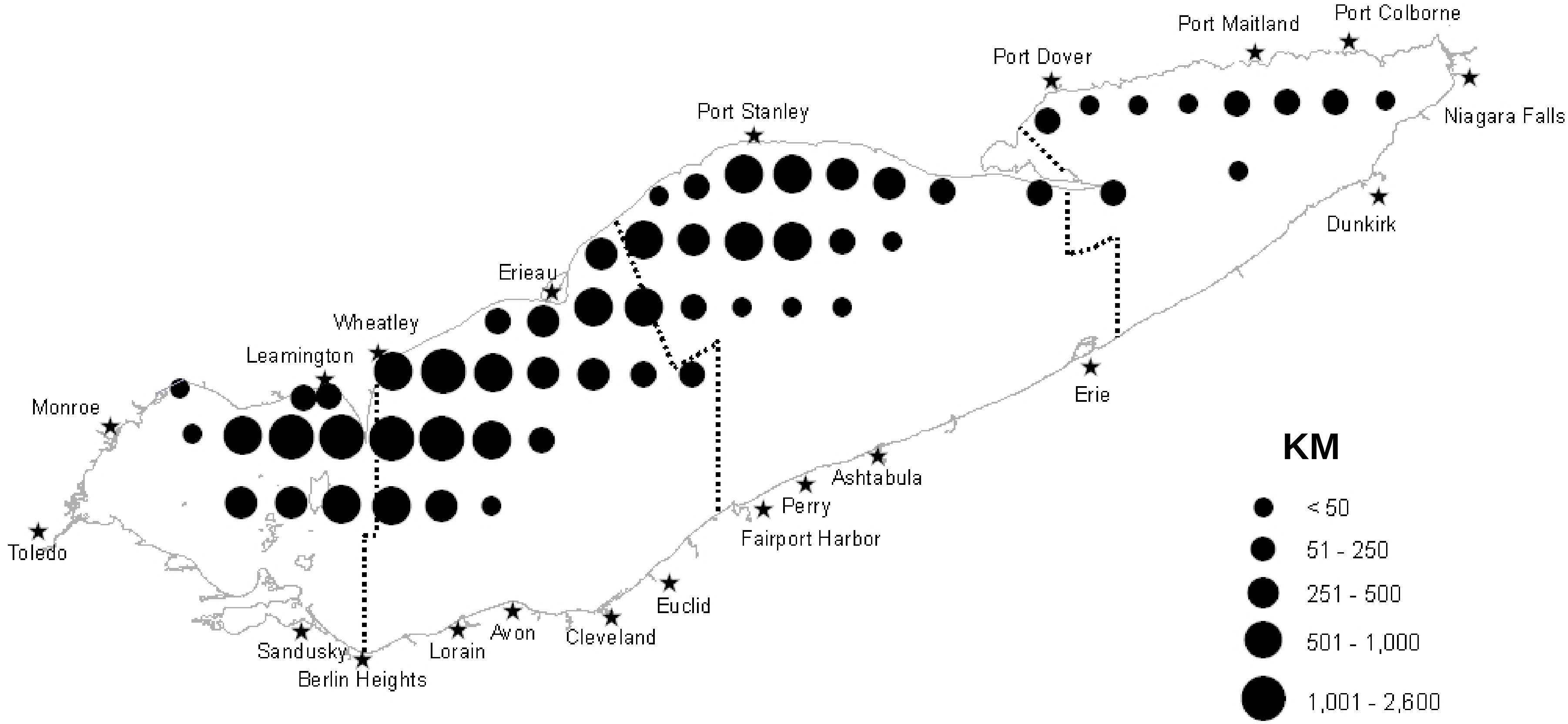


Figure 1.6. Spatial distribution of yellow perch gill net effort (km) in 2005 by 10-minute grid.

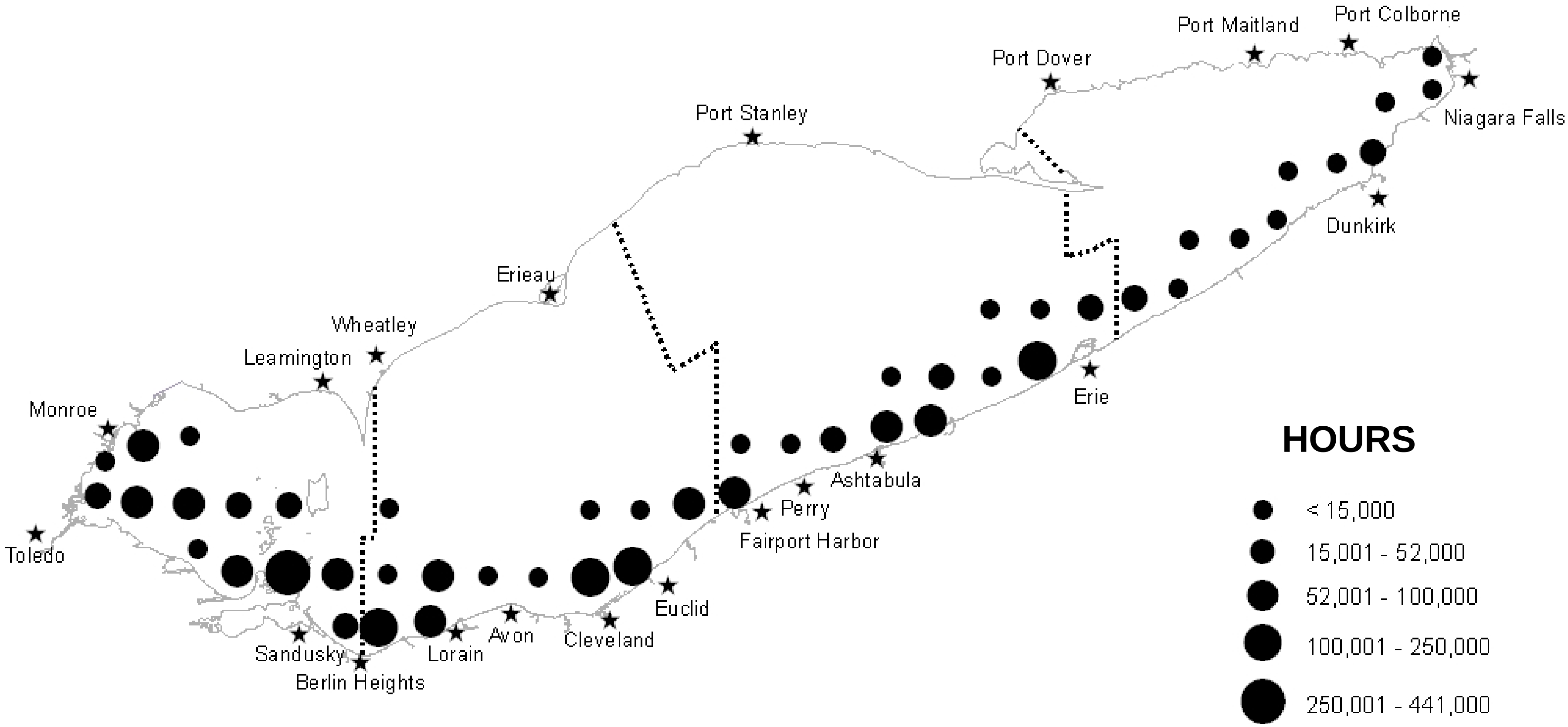


Figure 1.7. Spatial distribution of yellow perch sport angling effort (angler hours) in 2005 by 10-minute grid.

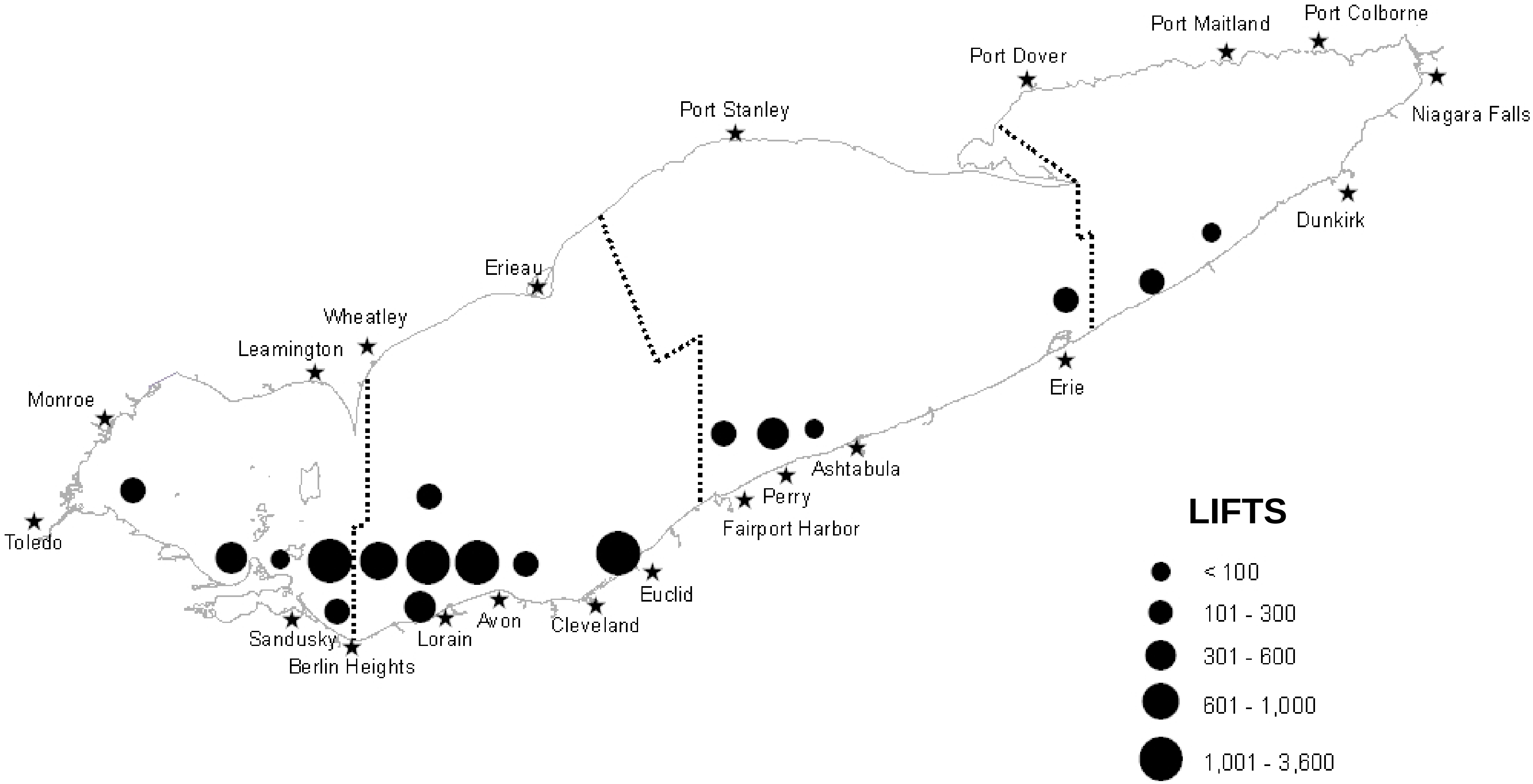


Figure 1.8. Spatial distribution of yellow perch trap net effort (lifts) in 2005 by 10-minute grid.

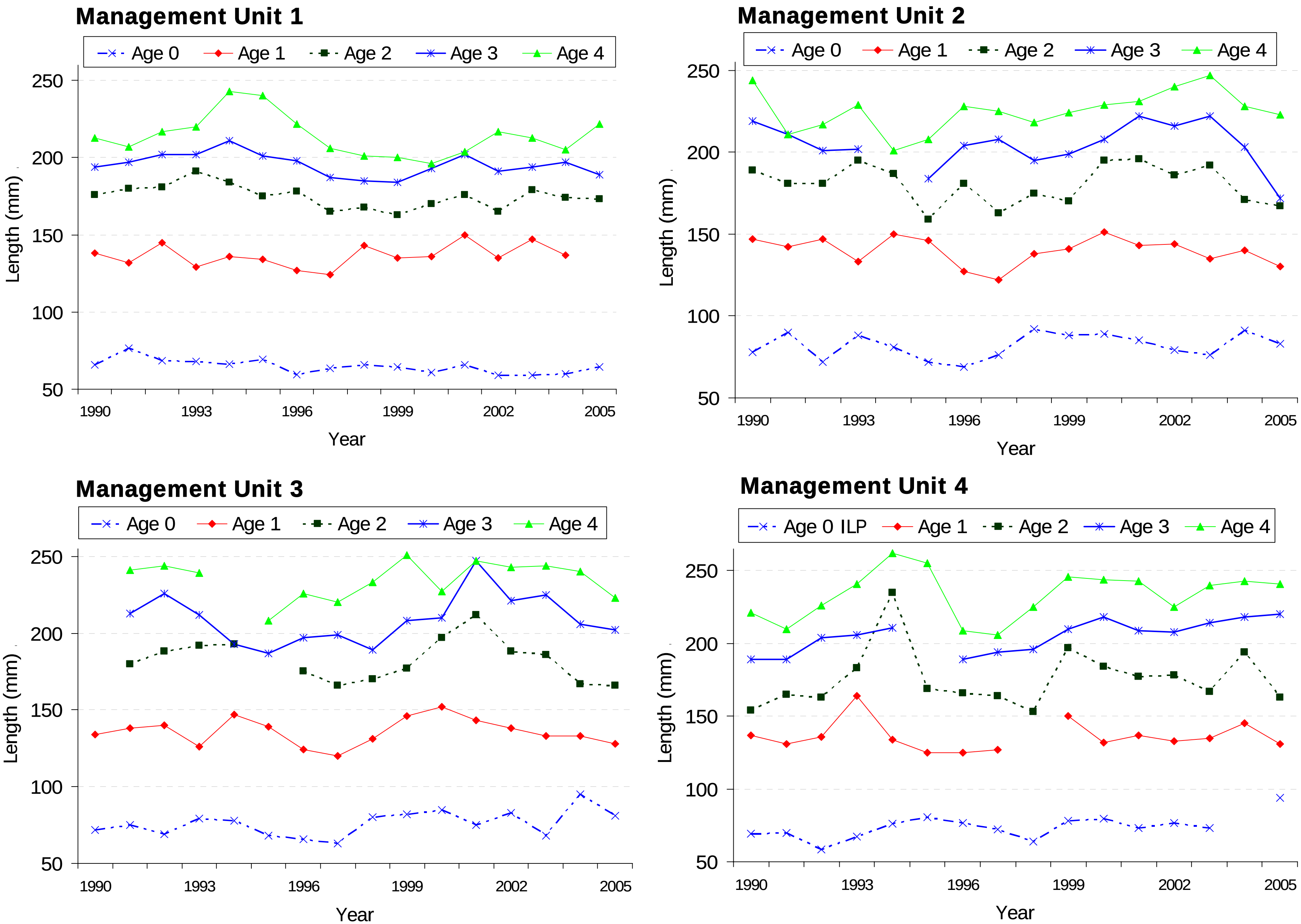


Figure 1.9. Yellow perch length-at-age from 1990-2005 fall interagency experimental samples for ages 0-4 by management unit.

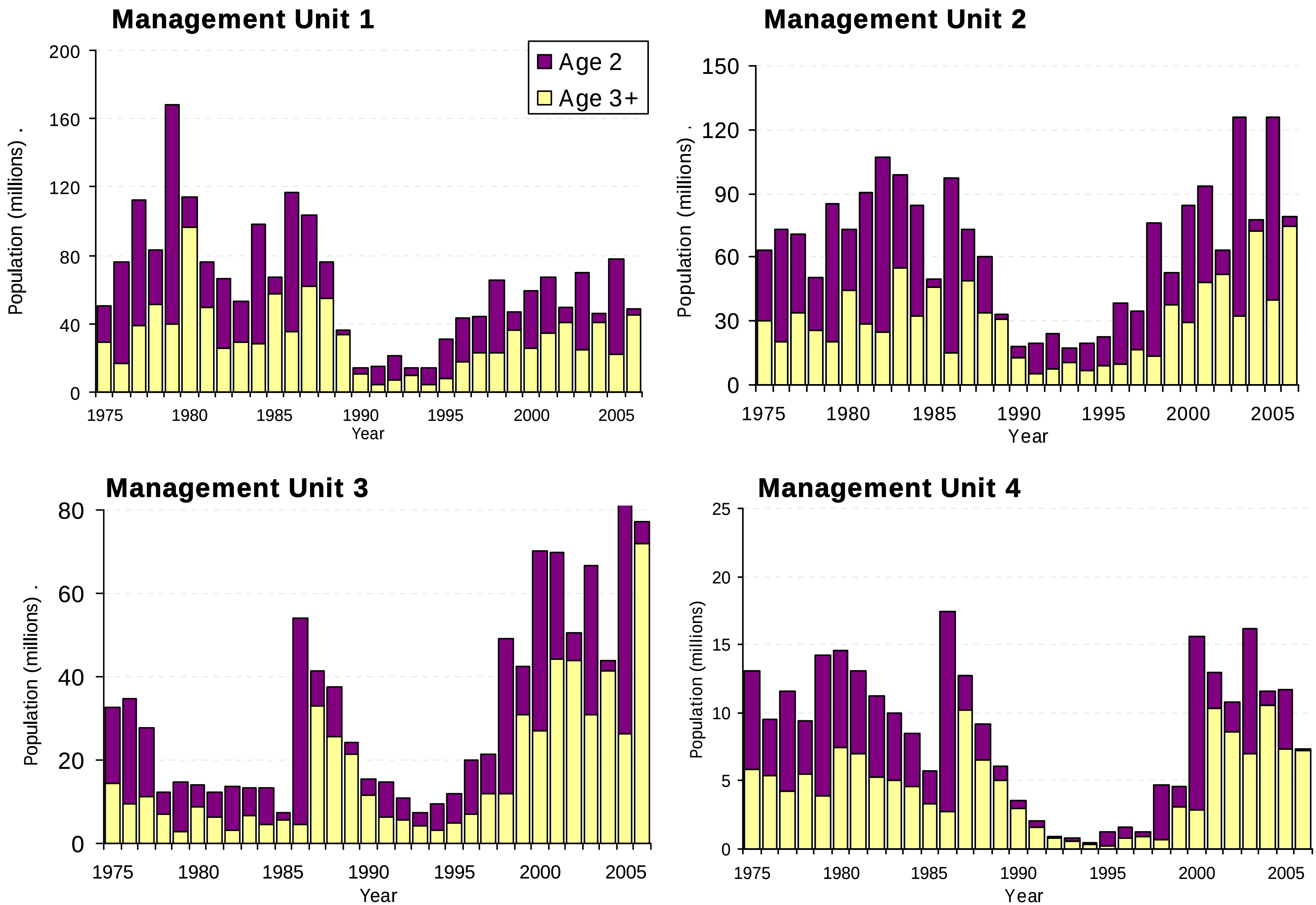


Figure 1.10. Lake Erie yellow perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2006 are from ADMB and parametric regressions for age 2 from survey gears.

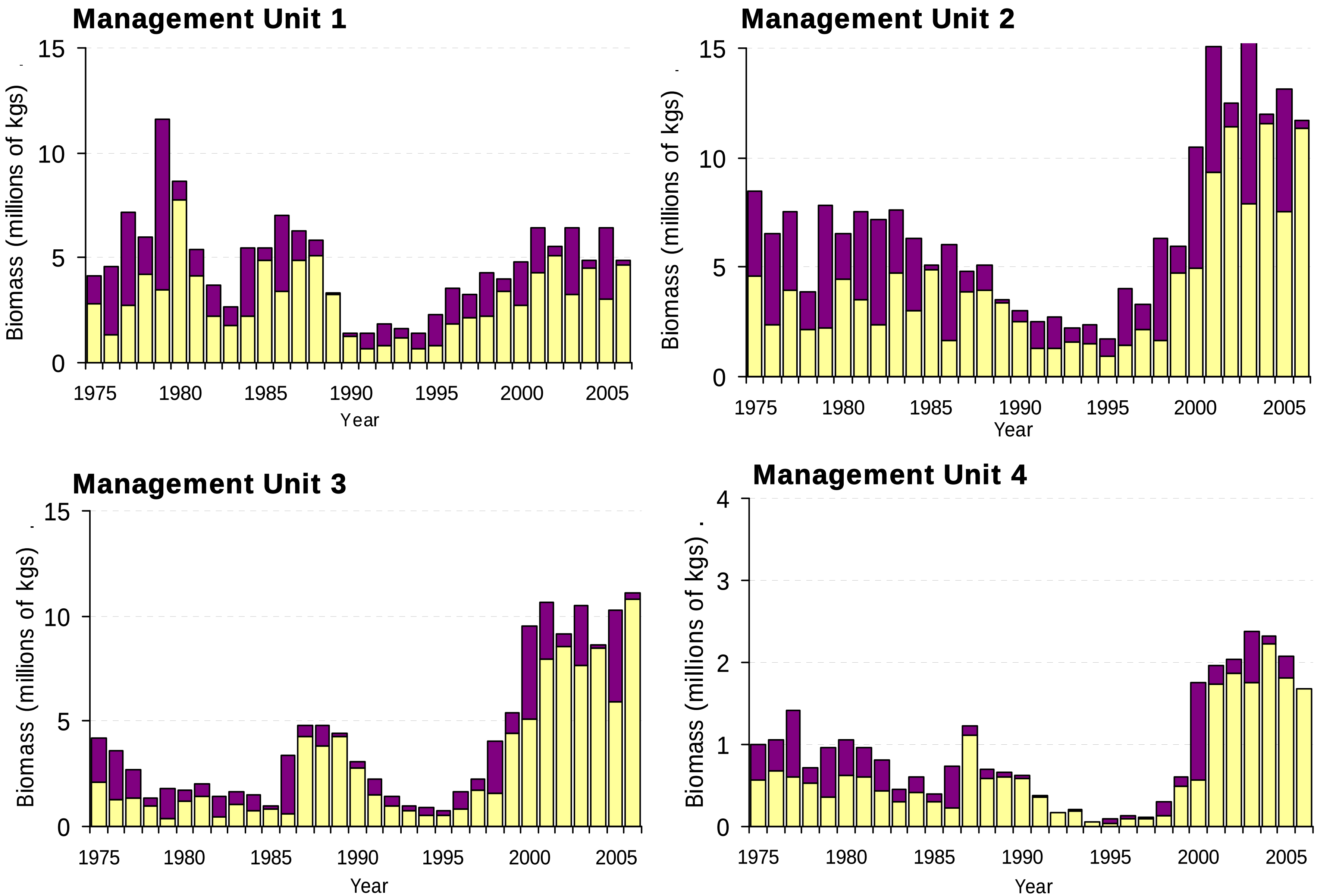


Figure 1.11. Lake Erie yellow perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2006 are from ADMB and parametric regressions for age 2 from survey gears.

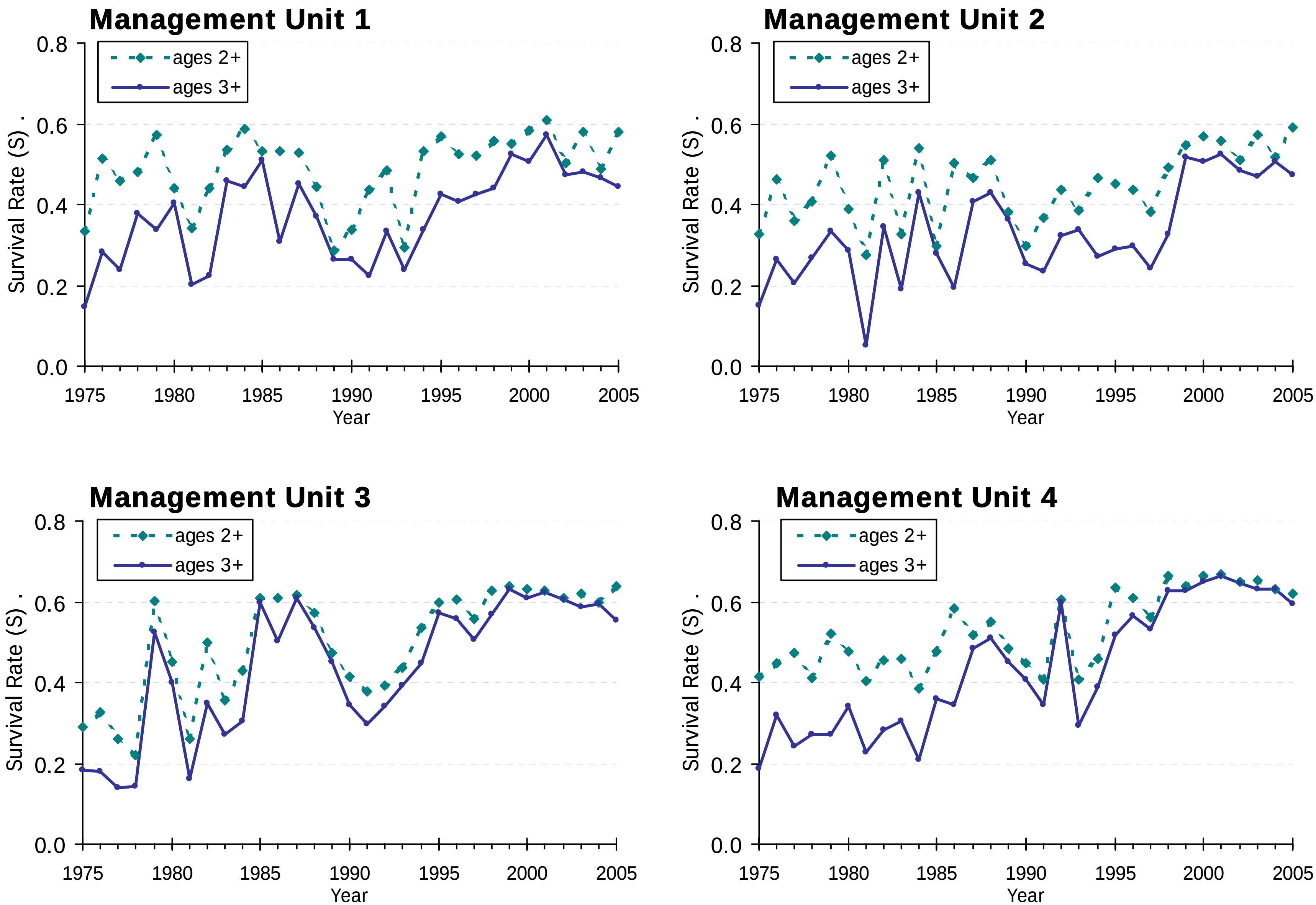


Figure 1.12. Lake Erie yellow perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.

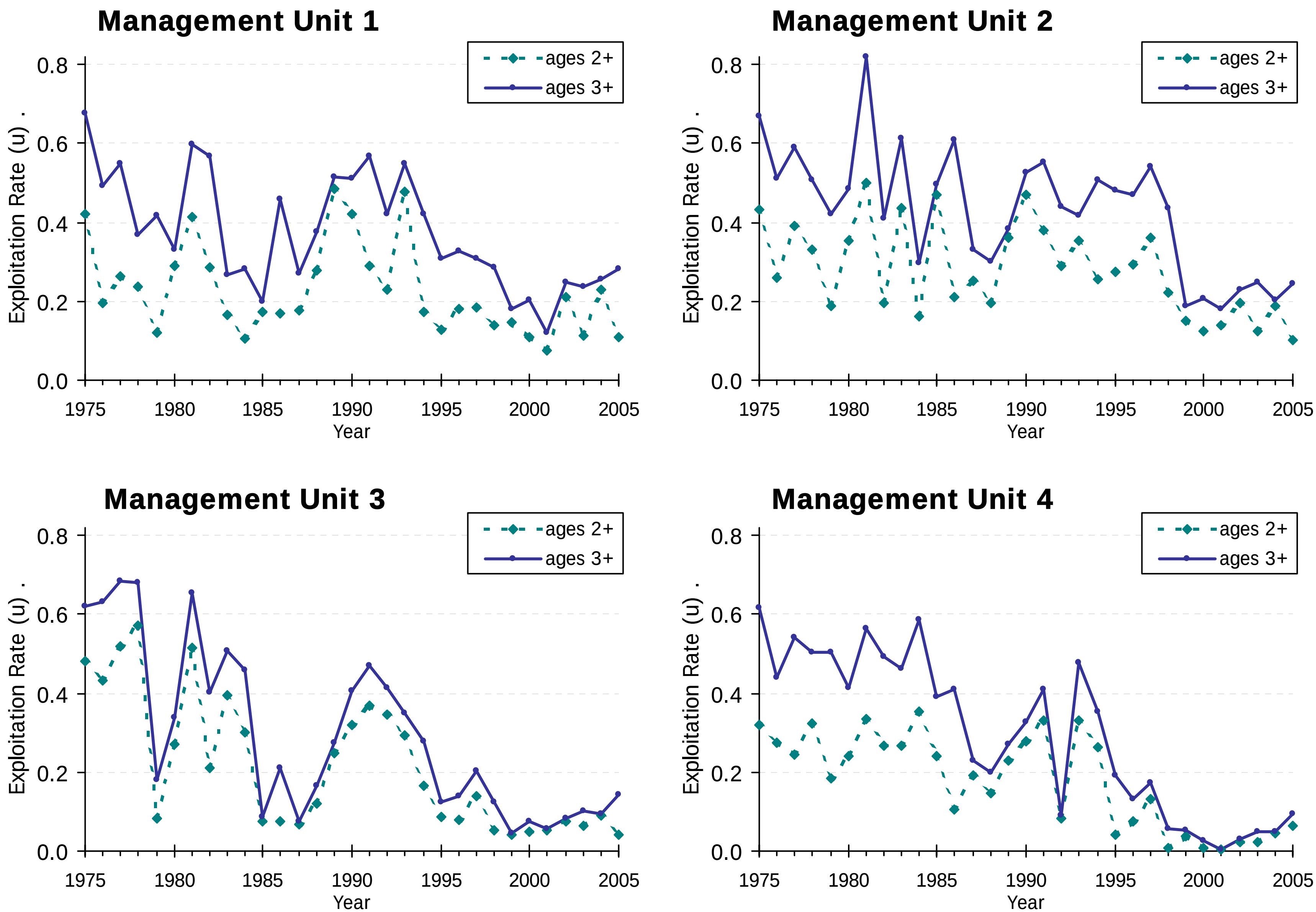


Figure 1.13. Lake Erie yellow perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB.

Appendix Table 1. Lambda (λ) values and relative number of terms associated with catch-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	0.8	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	1.0	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	0.9	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	0.8	5
	NY Gill Net Survey Catch Rates	0.5	5
	ONT Partnership Gill Net Index Catch Rates	1.0	5

Appendix Table 2. Agency trawl regression indices found statistically significant for projecting estimates of age-2 yellow perch recruiting in 2006 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.
BOHF20A	0.8825	0.14870	23.7	3.524	0.01566	2.782	4.266
BOHF21A	0.7955	0.16900	50.2	8.484	0.02377	6.097	10.870
BOHS20G	0.6803	1.01767	4.2	4.274	0.20141	2.582	5.966
OHF10A	0.6280	0.08489	11.8	1.002	0.01393	0.673	1.330
OHF11G	0.8276	1.21610	0.6	0.730	0.16022	0.537	0.922
ONTS10G	0.7418	0.12680	29.1	3.690	0.01673	2.716	4.664
USF11A	0.6672	0.80176	1.9	1.523	0.12662	1.042	2.005
			mean	**3.318**		**2.347**	**4.289**

Management Unit 2

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
BOHF20A	0.9323	0.23914	23.7	5.668	0.01860	4.786	6.549
BOHF21A	0.7152	0.25024	50.2	12.562	0.04380	8.165	16.960
BOHS20G	0.7656	1.68925	4.2	7.095	0.26984	4.828	9.362
OHF10A	0.6230	0.10869	11.8	1.283	0.01827	0.851	1.714
OHF11G	0.8508	1.92934	0.6	1.158	0.23321	0.878	1.437
OHF30G	0.6923	1.26946	1.6	2.031	0.24429	1.249	2.813
OHS30G	0.7394	1.76052	2.6	4.577	0.31516	2.939	6.216
ONTS10G	0.7468	0.15167	29.1	4.414	0.01975	3.264	5.563
			mean	**4.848**		**3.370**	**6.327**

Management Unit 3

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
BOHF21A	0.7046	0.13283	50.2	6.668	0.02386	4.273	9.064
OHF30G	0.6989	0.68153	1.6	1.090	0.12914	0.677	1.504
OHS20G	0.7154	0.82098	3.5	2.873	0.14947	1.827	3.920
OHS31G	0.6485	0.59883	26.1	15.629	0.12726	8.986	22.272
NYF41A	0.7076	0.74635	11.1	8.284	0.14467	5.073	11.496
OHF20G	0.9134	0.51186	8.5	4.351	0.04550	3.577	5.124
OHS30G	0.6656	0.88709	2.6	2.306	0.18960	1.321	3.292
PAF30G	0.5395	0.13652	1.3	0.177	0.02752	0.106	0.249
			mean	**5.173**		**3.230**	**7.115**

Management Unit 4

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
NYF41A	0.8067	0.17545	1.60	0.281	0.02590	0.198	0.364
ILP41G	0.7227	0.36272	0.12	0.044	0.04903	0.032	0.055
OLP40G	0.4932	0.16163	0.09	0.015	0.03492	0.008	0.021
ILP40G	0.6486	0.02228	0.04	0.001	0.00350	0.001	0.001
			mean	**0.085**		**0.060**	**0.110**

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

Year	ONTS10G	OHS10G	OHS11G	OHF10G	OHF11G	USS10G	USS11G	USF10G	USF11G	ONOHP10G	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	0.5	3.6	23.0	4.1	-	1.4	17.3	4.3	12.3	3.9	-	-	-	-	-	-	-	-
1988	88.6	17.8	2.1	3.6	-	43.3	3.6	1.0	0.1	45.4	-	-	-	-	-	-	-	-
1989	127.0	20.5	2.5	18.8	-	32.6	8.1	20.0	1.0	61.9	-	-	-	-	-	-	-	-
1990	109.4	43.8	8.0	54.1	-	29.2	6.7	59.2	2.0	80.2	1.0	28.4	19.2	55.2	1.2	40.3	32.5	52.7
1991	38.2	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	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	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	285.8	62.9	14.5	34.9	18.0	419.9	8.0	78.7	36.1	160.8	6.5	2.8	20.0	6.8	6.5	2.8	21.4	8.4
1995	51.9	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	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	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	64.6	2.2	94.6	5.2	74.4	3.8	100.9	6.4	100.5	16.9	1.8	70.4	3.1	13.8	1.9	56.0	5.6
1999	171.0	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	44.7	36.7	13.9	16.1	11.1	5.4	4.9	9.0	32.4	0.3	27.8	5.6	39.2	0.3	27.8	7.5	45.9
2001	243.5	129.2	6.8	120.7	4.5	22.2	1.1	16.8	0.6	202.4	40.7	2.6	52.1	5.2	40.7	2.6	54.1	5.4
2002	10.3	6.4	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	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	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	30.5	1.4	24.9	0.6	10.6	0.04	2.2	0.6	64.0	30.0	8.7	11.4	12.1	27.0	10.3	9.8	11.3

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	6.9	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	0.9	18.7	2.4	13.6	0.8	14.9	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	6.6	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	1.2	21.8	1.1	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	0.4	7.9	0.1	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	1.3	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	0.1	31.0	1.6

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

Year	ONTS10A	OHS10A	OHS11A	OHF10A	OHF11A	USS10A	USS11A	USF10A	USF11A	ONOHP10A	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	0.7	20.0	104.4	18.0	-	5.0	41.0	12.8	61.2	10.8	-	-	-	-	-	-	-	-
1988	328.7	145.9	12.6	35.0	-	129.0	10.3	5.8	0.3	224.5	-	-	-	-	-	-	-	-
1989	788.7	107.2	15.7	113.5	-	149.8	15.7	34.2	3.3	448.0	-	-	-	-	-	-	-	-
1990	739.7	145.5	26.4	330.0	-	81.0	22.2	176.2	6.3	458.7	4.1	167.8	108.8	59.9	4.1	167.8	130.3	57.4
1991	109.3	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	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	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	950.4	526.5	78.2	289.4	97.4	4281.8	40.3	162.0	57.8	733.0	144.2	12.3	155.7	26.9	144.2	12.3	146.4	29.3
1995	1337.8	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	6.7	218.4
1996	3309.9	3284.9	105.5	644.2	121.5	11444.0	13.2	737.2	9.2	3296.2	2721.8	31.6	347.0	35.0	2299.8	42.9	320.6	30.2
1997	109.9	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	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	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	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	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	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	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	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	164.3	6.7	82.8	2.5	27.7	0.06	6.2	1.9	173.1	296.7	63.1	119.5	52.7	324.0	68.1	102.8	50.2

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	3.2	48.0	16.1	258.1	3.0	45.4	-	-	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	6.8	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	1.0	56.3	0.4	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	0.3	3.8	3.0	59.1
2005	757.8	224.5	345.8	358.8	758.8	224.5	426.0	360.7	18.0	3.0	10.3	0.2	11.5	0.2	117.1	11.1

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

Geometric Means

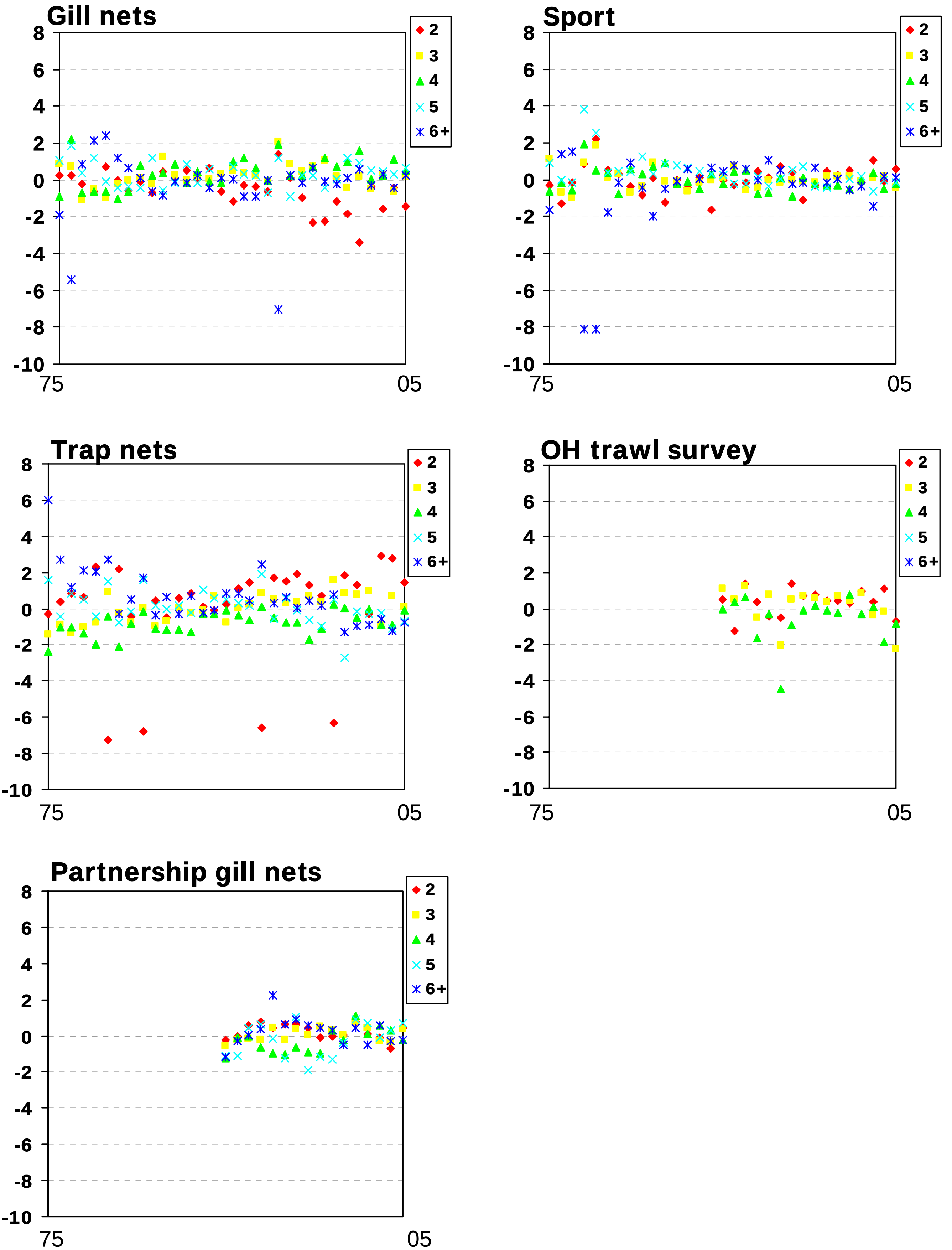
Abbreviation	Series
ONTS10G	Ontario Management Unit 1 summer age 0 geometric
OHS10G	Ohio Management Unit 1 summer age 0 geometric
OHS11G	Ohio Management Unit 1 summer age 1 geometric
OHF10G	Ohio Management Unit 1 fall age 0 geometric
OHF11G	Ohio Management Unit 1 fall age 1 geometric
USS10G	USGS Management 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)

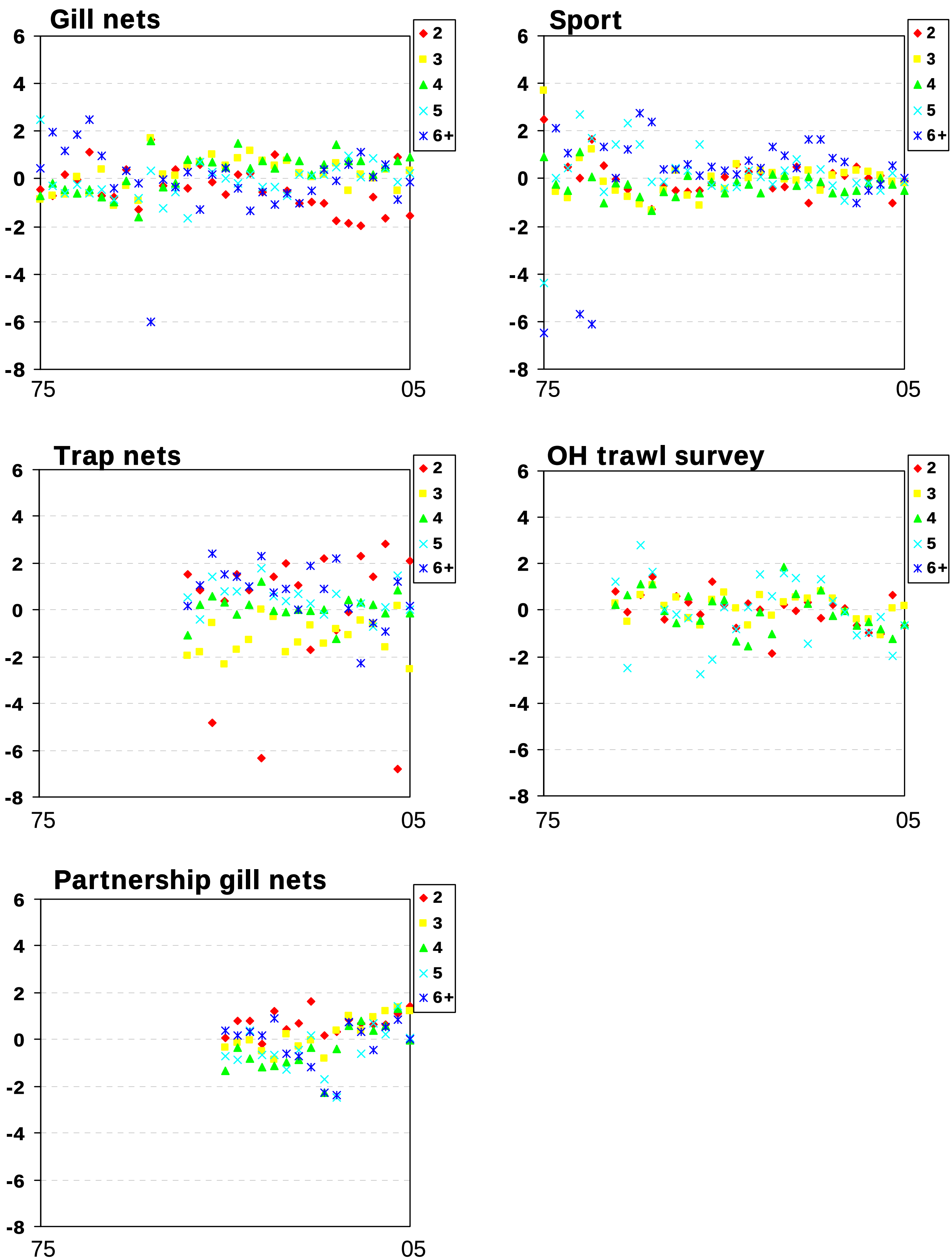
Appendix Legend (continued)

Arithmetic Means

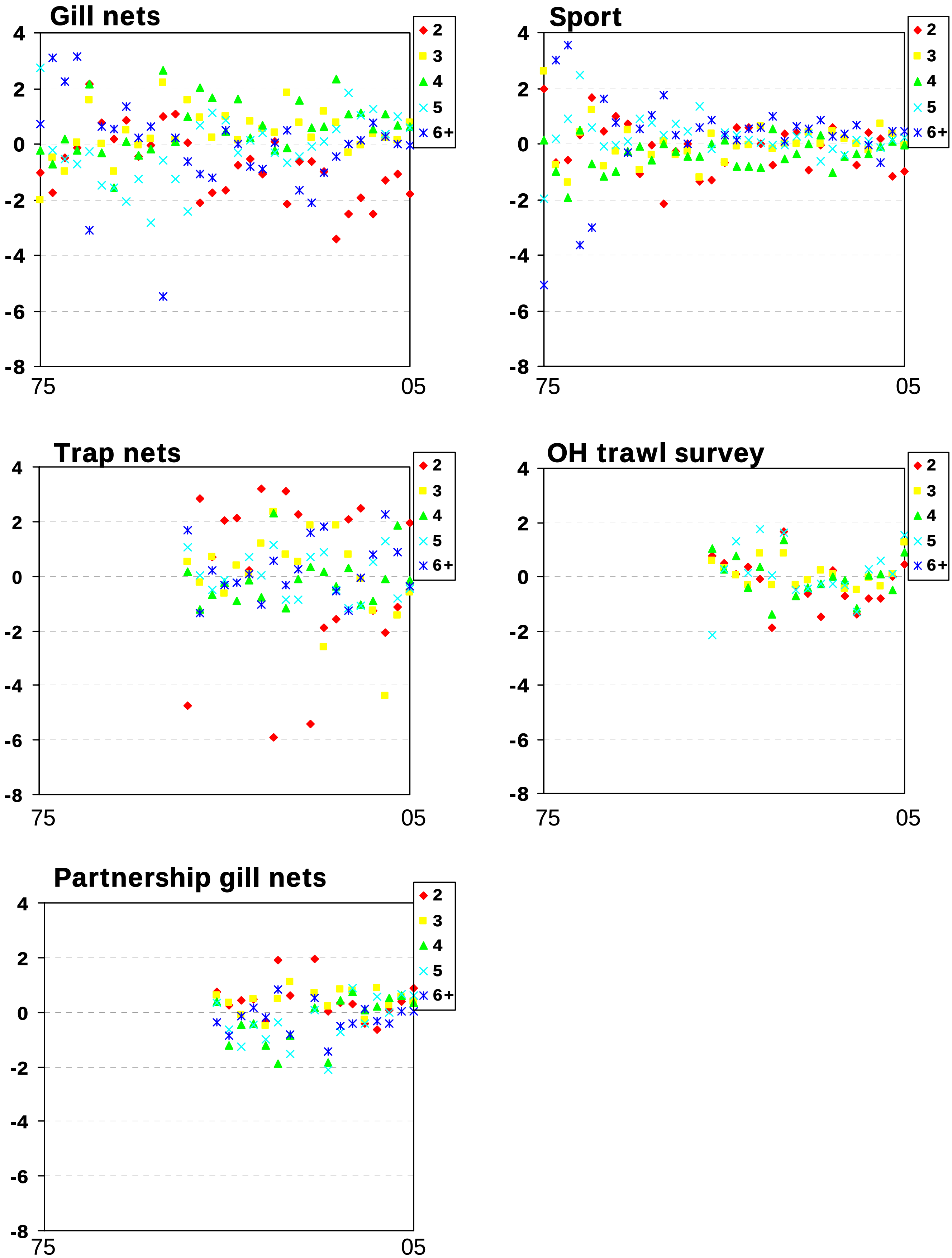
Abbreviation	Series
ONTS10A	Ontario Management Unit 1 summer age 0 arithmetic
OHS10A	Ohio Management Unit 1 summer age 0 arithmetic
OHS11A	Ohio Management Unit 1 summer age 1 arithmetic
OHF10A	Ohio Management Unit 1 fall age 0 arithmetic
OHF11A	Ohio Management Unit 1 fall age 1 arithmetic
USS10A	USGS 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



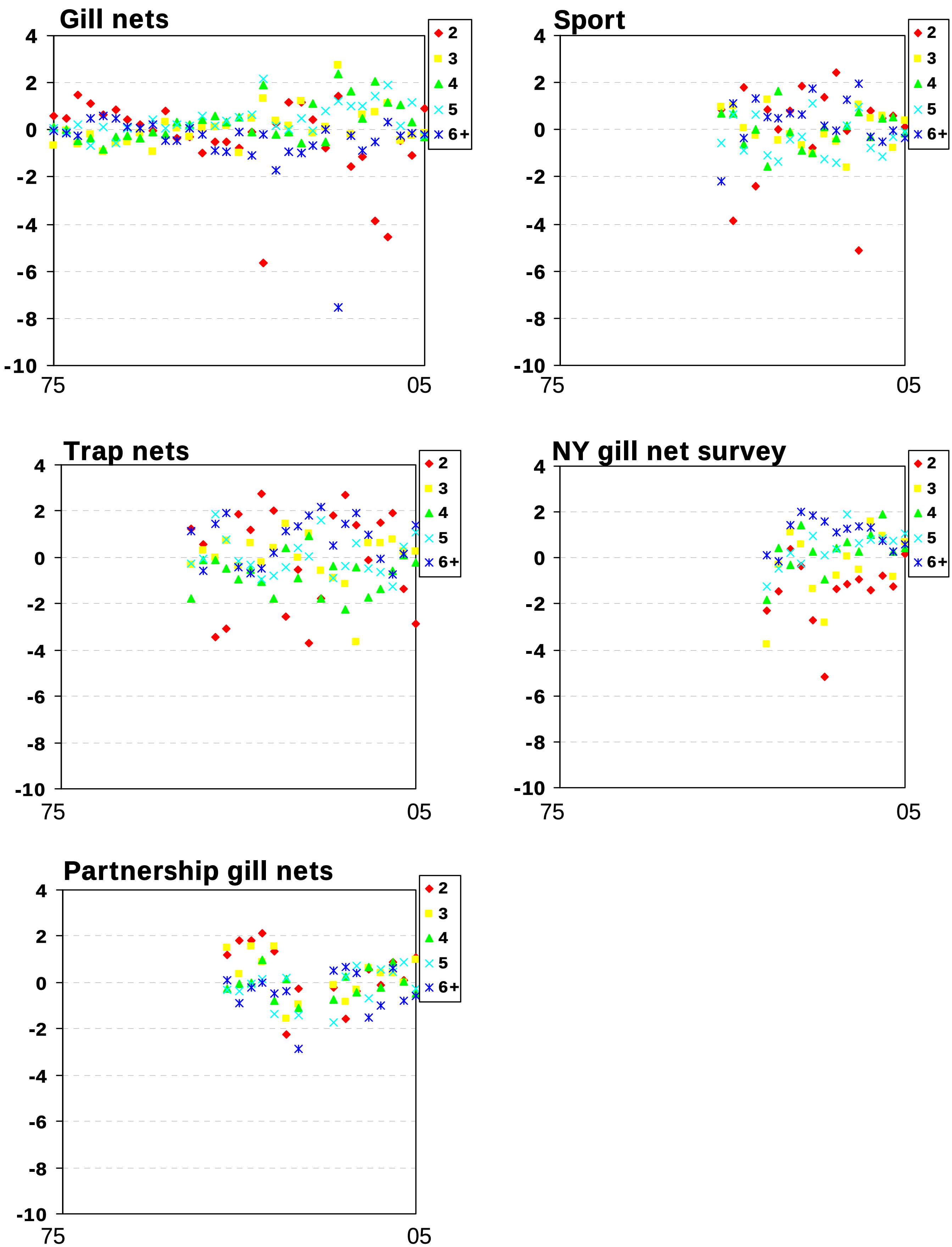
Appendix Figure 1. Patterns of residuals by gear and age from ADMB for Management Unit 1.



Appendix Figure 2. Patterns of residuals by gear and age from ADMB for Management Unit 2.



Appendix Figure 3. Patterns of residuals by gear and age from ADMB for Management Unit 3.



Appendix Figure 4. Patterns of residuals by gear and age from ADMB for Management Unit 4.