Report of the Lake Erie Yellow Perch Task Group

March 2004

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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

Table of Contents

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 2003 through March 2004, 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) recruitment indices and biological parameters of juvenile yellow perch

2) Support a sustainable harvest policy by:
   a) examining exploitation strategies
   b) recommending a range of allowable harvest for 2004 (RAH) for each management unit
   c) contributing to the Coordinated Percid Management Strategy (CPMS)

3) Contribute to lake-wide genetic research on Lake Erie yellow perch stocks.

4) Examine the issues of Eastern Basin (MU4) sub-populations and explore whether there is support for re-defining boundaries within MU4 to manage as separate stocks.

The yellow perch task group continued with the former catch-age analysis model using AD Model Builder (ADMB). In 2003-2004, population simulations incorporating stock recruitment relationships were updated, relating risk to various rates of fishing. This approach, along with presenting several harvest strategies for reference, will provide the necessary support for determination of the total allowable catch (TAC) by the Lake Erie Committee (LEC). For this year the task group addresses Charge 2(b) by providing a series of options within risk tables, instead of generating an RAH, for each management unit. This was done as an interim strategy until a specific risk-level harvest strategy has been adopted by LEC consensus. The 2003 fishing year concluded the Coordinated Percid Management Strategy (CPMS), a three year plan (2001-2003) to facilitate improvement of walleye stocks and to maintain the healthy status of Lake Erie yellow perch populations. While the CPMS has run its' course successfully, the mandate of percid sustainability continues to be supported by the assessment and reporting activities of the YPTG. Although Lake Erie Decision Analysis (DA) continues to focus on walleye into 2004, the process continues to be instructive as common elements apply to yellow perch. The most recent status of Lake Erie yellow perch stocks is described herein.

Charge 1: 2003 Fisheries Review and Population Dynamics

The lake-wide total allowable catch (TAC) in 2003 was 9.906 million pounds. This allocation represented a 6 % increase from a TAC of 9.333 million pounds in 2002. For yellow perch assessment and allocation, Lake Erie is partitioned into four Management Units (Units, or MUs; Figure 1.1). The 2003 allocation by management unit was 2.6, 4.2, 2.9 and 0.206 million pounds for Units 1 to 4, respectively.

The lake-wide harvest of yellow perch in 2003 was 9.359 million pounds, the highest observed since 1990 (9.629 million lbs; Table 1.1). The 2003 harvest was only slightly (1.4 %) above 2002. Harvest by management unit was 2.7, 4.2, 2.3 and 0.141 million pounds for units 1 to 4 respectively. Although the 2003 harvest was within the lake-wide total allowable catch, the TAC was exceeded in management unit 1 by 3%. Jurisdictional TACs defined by sharing formulas were exceeded in MU 1 (Ohio 12% or 148 thousand lbs), in MU 2 (Ontario <1% or 11 thousand lbs) and MU 4 (Pennsylvania 20% or 7 thousand lbs).

The distribution of harvest among jurisdictions in 2003 was similar to 2002 lake-wide, but differed more within management units (Table 1.1, Figure 1.2). Some of the changes may be attributed to the redistribution of quota among jurisdictions according to the yellow perch sharing formula. The transition from historic shares to lake area began in 1992, and by 2005, quota shares for all jurisdictions will conform to lake surface area within each management unit.

Harvest, fishing effort, and catch rates are summarized for the time period 1990-2003 by management unit, year, agency, and gear type in Tables 1.2 to 1.5. Trends over a longer time series (1975-2003) are depicted graphically for harvest (Figure 1.2), fishing effort (Figure 1.4), and catch rates (Figure 1.8) by management unit and gear type. The spatial distributions in 2003 of harvest (all gears), and effort by gear are presented in Figures 1.3 and 1.5 to 1.7 respectively.

Lake-wide, yield increased slightly in 2003 for Ohio (1.5%), Ontario (2.3%), and Pennsylvania (15.8%), but decreased for Michigan (42.3%), and New York (38.6%). Compared to 2002, harvest totals in 2003 increased by 1% in MU 2 and 17.9% in MU 3 but decreased in MU 1 (8.5%) and MU 4 (12.5%). Ontario's 2003 harvest increased in MU 3 (40%), but declined in MU 1 (18.9%), MU 2 (3.8%) and MU 4 (3.2%). Michigan's harvest (Unit 1) decreased 42.3% from 2002. In Ohio waters, harvest increased in Unit 1 (6.8%) and Unit 2 (6.4%), but decreased in Unit 3 (24.8%). Pennsylvania's harvest increased in Unit 3 (26.1%) but decreased in Unit 4 (15.1%). New York's 2003 harvest in MU 4 was down 38.6% from 2002.

Harvest from commercial trap nets decreased in Unit 1 (25.9%) and Unit 4 (47.1%) but increased in Unit 2 (14.1%) and more than doubled (to 5,050 lbs) in Pennsylvania waters of Unit 3. Compared to the total harvest in each management unit, trap nets comprised 9.4%, 29.7%, 0.2% and 0.7% in management units 1 to 4 respectively. Trap net effort for 2003 decreased in Unit 1 (18.5%), Unit 3 (8.4%) and Unit 4 (7.1%), but increased 33.1% in Unit 2.

Among management units, only 0.2% to 4.2% of the yellow perch gill net harvest was taken in large mesh gill nets (3 inch or greater) in 2003. 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. The harvest in larger mesh sizes reflects the composition of larger, older yellow perch among management units. Gill net effort was down in MU 1 (22%) and MU 2 (3.7%), but up 39.2% in MU 3 and 56.4% in MU 4 compared to 2002. Gill net effort remained generally low in 2003 compared to the 1990's and earlier decades (Figure 1.4).

In 2003, sport harvest increased in MU 1 (10.2%) and MU 3 (39.8%) but decreased by 3.2% and 23% in Units 3 and 4 respectively. Angling effort increased only in MU 1 (31.4%) while decreases occurred in MU 2 (3.9%), MU 3 (26.7%) and MU 4 (38%).

In MU 1, catch rates remained generally high and stayed within less than 10% of 2002 values for all gear types (Table 1.2, Figure 1.8). Angling catch rates expressed as kg/angler hour (Figure 1.8) declined more compared to angling catch rates expressed as fish/angler hour (Table 1.2) due to the age composition of the sport harvest. In MU 2, catch rates were comparable to 2002 for both sport and gill net fisheries, but declined 14.3% in the trap net fishery (Table 1.3). In MU 3, catch rates increased considerably for Pennsylvania trap net (174.5%), sport (47.2%) as well as Ohio sport (14.8%) fisheries, but decreased for the gill net fishery by 18.9% (Table 1.4). Catch rates decreased in MU 4 for all gears: trap net (47.5%), gill net (41.5%) and sport according to number per hour (20-27%; Table 1.5). In MU 4 however, sport catch rates increased by weight (kg/hour) due to the large size of yellow perch (Figure 1.8).

In 2002, Ontario implemented an ice allowance policy by which 3.3% was subtracted from commercial landed weight. This step was taken so that ice was not debited from fisher quota. Ontario's landed weights in the YPTG report have not been adjusted to account for ice content. Comparisons between Ontario's harvest and TAC were made after deducting 3.3% from harvest listed in this report. Ontario's reported yellow perch harvest is represented exclusively by the commercial gill net fishery, described above. Reported sport harvests for Michigan, Ohio, Pennsylvania and New York are based on creel survey estimates, however, the sport harvest of yellow perch from Ontario waters is not routinely assessed. Additional fishery documentation is available in annual agency reports.

Age Composition and Growth

The yellow perch harvest in 2003 consisted mostly of the 1999 (age 4), 1998 (age 5) and 2001 (age 2) year classes (Table 1.6). Recruitment of age 2 yellow perch was very strong to the sport fisheries, and most apparent in MU 1 and MU 2. Age 2 fish were more significant in the MU 2 commercial fisheries (gill and trap net) than other management units. Differences between the age composition of the harvest between areas and gear types reflect different growth rates, gear selectivity, and levels of abundance affected by recruitment and survival.

Yellow perch growth trends differ among life stages and between basins (Figure 1.9). An abundance of yellow perch growth data exists among Lake Erie agencies. For simplicity, Figure 1.9 is comprised on 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 describe either improving growth or the absence of any trend in management units 2, 3 and 4. Growth trends in management unit 1 may be showing signs of density dependence at older ages. Size at age comparisons between management units are limited in this report due to differences in collection methods.

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 2002/2003

Population size for each management unit was estimated by catch-at-age analysis using AD Model Builder, with the Commercial Selectivity Index (CSI) version, updated with 2003 data. The approach was unchanged from methodology described in the Yellow Perch Task Group Report (2003). Estimates of population size, biomass and parameters such as survival and exploitation rates are presented for 1990-2003 in Table 1.7 and for 1975-2003 in Figures 1.10 to 1.13. Estimates of age 2 recruitment in 2004 were derived using linear regression of age 2 population estimates and juvenile indices (see section: *Recruitment Estimator of Incoming Age 2 Yellow Perch*). Population estimates for 2004 incorporate recruitment estimates of age 2 yellow perch (see section: *2004 Population Size Projection*). Mean weight-at-age from biological 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 2003 implies that the time series are continuous. Lack of data continuity weakens the validity of this assumption. Survey data are represented in the latter part of the time series while methods of fishery data collection have also varied. Model parameter constants such as natural mortality, catchability and selectivity blocks, lessen 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 gill net data by the method of Helser (1998), involving back calculation of length at age, and weightings based on the monthly distribution of harvest at age. With catch-age analysis, the most recent years' data estimates inherently have wide error bounds. This is to be expected for cohorts that remain at large in the population.

Recruitment Estimator for Incoming Age 2 Yellow Perch

Age 2 recruitment in 2004 was predicted by linear regression of juvenile yellow perch trawl indices against catch-age analysis estimates of two-year-old abundance. Age 2 recruitment in 2004 was calculated using the mean of values predicted from the indices listed in the Appendix Table A-1. Data from trawl index series for the time period examined are presented in Appendix Table A-2 (geometric means) and A-3 (arithmetic means), while a key that summarizes abbreviations used for the trawl series is presented as a Legend in the Appendix.

The estimates of age 2 recruitment for 2004 (the 2002 year class) were weak in all management units (Table 1.7, Appendix Table A-1). Indications from juvenile trawl surveys however, suggest the 2003 year class is strong throughout Lake Erie (Appendix A, Tables A-2 and A-3). The 2003 year class should have a positive effect on fisheries beginning in 2005 and more so in 2006, contingent on survival of juveniles.

2004 Population Size Projection

Stock size estimates for 2004 (ages 3 and older) were projected from catch-age analysis estimates of 2003 population size and age-specific survival rates in 2003 (Table 1.8). Projected age 2 recruitment from the 2002 year class (method described above) was added to the 2004 population estimate for older fish in each unit, producing the total standing stock in 2004 (Table 1.8). Standard errors and ranges for estimates are provided for each age in 2003, and following estimated survival (from ADMB), for 2004. Descriptions of *mean*, *max* and *min population* estimates refer to the estimates plus or minus one standard error. Similarly, yield strategy references (*mean, max, min*) are based on population estimates plus or minus one standard error. In this report, standard errors presented are age specific. Formerly, the coefficient of variation (CV = standard deviation/population estimate) derived from the average CV of all age groups in the most recent fishing year was applied to age specific population estimates to describe standard error (ie: the average CV was assumed for all ages). The newer approach is more representative of the age specific differences in variance around population estimates.

Stock size estimates projected for 2004 remained generally high relative to the time series, but decreased significantly from 2003 due to poor age 2 recruitment from the 2002 year class (Table 1.7 and Figure 1.10). Overall, projected 2004 yellow perch abundance (2+) was 38%, 45%, 41% and 33% less than 2003 in management units 1 to 4 respectively. Estimates of abundance for age 3 and older yellow perch in 2004 however, remained among the highest in the time series in Units 1, 2 and 4, but to a lesser extent in Unit 3. Abundance (3+) doubled in MU 1 and MU 4, increased by 80% in MU 2 and decreased by 5% in MU 3.

Similar to population estimates, biomass estimates in 2004 were high relative to the time series (Figure 1.11). Biomass estimates for 2004 declined less from 2003 than population estimates, compensated for by the greater weights of older fish. Yellow perch biomass (ages 2 and older) declined 25%, 29%, and 34% in MU's 1 to 3 respectively, but increased by 2% in MU 4. Biomass of older yellow perch (3+) increased by 64%, 38% and 62% in Units 1, 2 and 4 respectively, but declined 20% in Unit 3.

Catch-age analysis estimates of survival for yellow perch ages 2 and older in 2002 were 51%, 50%, 57% and 64% in MU 1, 2, 3 and 4, respectively (Figure 1.12). In 2003, estimated survival was 60%, 53%, 56% and 65% in units 1 through 4. Survival rates were lower, as expected, for fish ages 3 and older, since they are more vulnerable to fishing. Survival rates have increased gradually in all management units since early to mid 1990s.

In 2003, exploitation rates for ages 2 and older were highest in MU 2 (18%), followed by MU 3 (18%), MU 1 (9%) and MU 4 (2%). Rates of exploitation on older yellow perch (ages 3+) were 34% in MU 2, 21% in MU 1, 18% in MU 3, and 7% in MU 4 (Figure 1.13). Exploitation rates of yellow perch ages 3+ in 2003 increased moderately from 2002 in Units 2, 3 and 4, but declined slightly in Unit 1.

In recent years, Lake Erie yellow perch populations have been composed of older fish in contrast to the 1970s (Figure 1.10). Strong year classes were produced during earlier periods of high nutrient enrichment and high adult mortality in Lake Erie. If catch-age model assumptions are representative, results imply that conditions were more favorable for reproductive success during the 1970s (Figure 1.10). While yellow perch populations prospered in Lake Erie's past eutrophic state, they continued to thrive following reduced phosphorus loading and colonization of exotics such as *Dreissena, Bythotrephes*, white perch and round gobies.

Charge 2: Harvest Strategy and RAH

Harvest Strategy Methodology

The YPTG examined several harvest strategies since the independent review (Myers and Bence 2001). While the Beverton-Holt yield per recruit F0.1 (Fopt) approach lead to reasonable exploitation rates, the assumption of knife edge recruitment was not considered realistic or consistent with catch-age analysis. Other methods examined included calculating the harvest that would leave a specified percentage of spawner biomass alive compared to the spawner biomass at the beginning of the year. Values of 45%, 40% and 35% of the initial spawning stock biomass were calculated, with the latter being the most aggressive, since fewer spawners would be left alive. The risk simulation described by the YPTG (2003) was repeated this year using the same methodology but was updated to include 2003 data. $F_{0.1}$ values were derived based on the ratio of average yield to average recruitment plotted against fishing rates. $F_{0.1}$ was determined from the fishing rate at which the slope was 10% of the initial slope of the curve. While this approach does not rely on the assumption of knife edge recruitment, it incorporates a gamma stock recruitment relationship. Parameters include mean weight at age from harvest (recent 2 year mean), age specific selectivities (recent 2 year mean) from catch-age analysis weighted by sharing formula, and survey maturity data. The simulation assumes that the targeted fishing rates will be realized for all gear types. With each year of additional data, population estimates and the stock recruitment relationship will change. If a risk simulation-related fishing strategy was adopted, decision rules may be necessary to avoid radical inter-annual changes in targeted fishing rates.

Simulation methodology and risk assessment is described below. Multiple harvest strategies under consideration are addressed in the Harvest Strategies - RAH section.

Stock-Recruitment Simulation

In 2001-2002, the YPTG examined the relationships between spawning stock, environmental variables, and recruitment. Spawner recruit (S/R) 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)

Using current and forecasted abundance (2004-2005) 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 3) 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. Results are presented for each management unit in Tables 2.2.1-2.2.3. MU 4 was excluded from simulations until east basin stock delineation is resolved. Preliminary work with MU 4 simulations demonstrated extreme sensitivity to adding an additional year of assessment data to the model. This may be attributed to issues discussed in “Charge 4: Eastern Basin (MU 4) Sub-stock Delineation and Boundaries”.

Harvest Strategies For RAH Determination

Since the independent review, the YPTG has examined alternative harvest strategies with the intent of improving the process. While several have been considered, a single strategy has not been adopted. The best strategy may represent a composite of strategies unique to Lake Erie yellow perch populations and its fisheries. Consensus among the LEC, STC, YPTG and stakeholders is desirable.

As there is no consensus on a single harvest strategy at this time, the YPTG lacks the basis for recommending an allowable harvest. Further work with the task group, the LEC and stakeholders needs to be completed to understand risk-appropriate harvest strategies. However, multiple harvest strategies are presented, along with indicators of risk to facilitate the LEC decision on total allowable catch (TAC) for 2004.

The Beverton-Holt F_{opt} strategy used in the past is presented in Table 2.1, with broad ranges of possible harvest and mean weight at age in the harvest for each management unit. Additional harvest strategies presented include spawner biomass fishing strategies (Fx%SSB), presented for 45%, 40% and 35%, and the stock-recruitment simulation $F_{0.1}$ approach (SR $F_{0.1}$). All of the harvest strategies are referred to in Tables 2.2.1 – 2.2.3 and in Tables 2.3.1 to 2.3.3.

Risk indicators and population parameters from simulations are presented in Tables 2.2.1 to 2.2.3 for management units 1 to 3 respectively. Adjacent to simulation results in these tables are projected harvests for 2004 and 2005 that correspond to various rates of fishing. Also, population estimates for 2005 and 2006 presented were derived from the number of yellow perch that survive at the specified fishing rates, combined with projected age 2 recruitment listed below the main tables from the recruitment regression module. In the rightmost column of Tables 2.2.1 – 2.2.3, harvest strategies are listed as they approximately correspond to the projected harvest in 2004. Exact harvest projections for 2004 are described for each strategy in Tables 2.3.1 – 2.3.2. Management unit 4 was not considered in the harvest strategies due to the ongoing special management/rehabilitation work completed there (see Charge 4).

Charge 3: Yellow Perch Genetics

The YPTG collected yellow perch samples for stock discrimination in the spring of 2003. The task group plans to collect additional samples in 2004 for Dr. Carol Stepien at Cleveland State University. Dr. Stepien's analysis of mitochondrial control region sequences for yellow perch will be finished in 2004 to be followed by work on microsatellite loci. Results could be incorporated into a proposed (Ohio Sea Grant) web-based interactive data base used for stock structure applications by fisheries management and research. Progress to date has revealed population genetic structure among basins and some sites within basins of Lake Erie. The YPTG thanks Dr. Carol Stepien and Alexander Ford for their continued efforts.

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. While it may be convenient to pool perch harvest and assessment information together in management unit 4, there are several reasons to recognize sub-stocks within the east basin:

- Spatial isolation of sub-stocks evident from
  - Yellow perch habitat partitioned by lake bathymetry
  - Patchy spatial distribution of harvest in east basin
  - Tagging of yellow perch indicates limited range (MacGregor et al. 1987)
- Lack of synchrony in recruitment indices around the east basin
- Pooling sub-stocks leads to reduced precision with catch-age analysis when small isolated fisheries data are used
- Stock recruitment analysis was very sensitive with pooled MU 4 data
- Recommendations by Myers and Bence (2001)

These points, along with a multi-year strategy currently in place (Ontario), dictate that MU 4 be excluded from reported harvest strategies and simulations that apply to other management units, for the time being.

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Table 1.1. Lake Erie yellow perch harvest in pounds by management unit (Unit) and agency, 1990-2003.

		Ontario*		**Ohio**		**Michigan**		**Pennsylvania**		**New York**		Total
	Year	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch
Unit 1	1990	1,781,640	67	652,680	24	231,525	9	--	--	--	--	2,665,845
	1991	648,270	46	681,345	48	94,815	7	--	--	--	--	1,424,430
	1992	687,960	59	405,720	35	66,150	6	--	--	--	--	1,159,830
	1993	1,139,985	62	577,710	31	123,480	7	--	--	--	--	1,841,175
	1994	710,010	59	434,385	36	66,150	5	--	--	--	--	1,210,545
	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	84,879	3	--	--	--	--	2,670,931
Unit 2	1990	2,873,115	75	952,560	25	--	--	--	--	--	--	3,825,675
	1991	2,171,925	76	683,550	24	--	--	--	--	--	--	2,855,475
	1992	2,522,520	83	500,535	17	--	--	--	--	--	--	3,023,055
	1993	1,933,785	80	493,920	20	--	--	--	--	--	--	2,427,705
	1994	1,300,950	55	1,045,170	45	--	--	--	--	--	--	2,346,120
	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
Unit 3	1990	2,127,825	76	504,945	18	--	--	185,220	7	--	--	2,817,990
	1991	1,212,750	75	253,575	16	--	--	152,145	9	--	--	1,618,470
	1992	1,190,700	82	185,220	13	--	--	77,175	5	--	--	1,453,095
	1993	606,375	78	145,530	19	--	--	24,255	3	--	--	776,160
	1994	379,260	48	359,415	45	--	--	55,125	7	--	--	793,800
	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	481,559	21	--	--	177,517	8	--	--	2,326,209
Unit 4	1990	282,240	88	--	--	--	--	0	0	37,485	12	319,725
	1991	160,965	87	--	--	--	--	0	0	23,047	13	184,012
	1992	114,660	85	--	--	--	--	0	0	20,476	15	135,136
	1993	72,765	86	--	--	--	--	0	0	12,331	14	85,096
	1994	52,920	84	--	--	--	--	0	0	10,214	16	63,134
	1995	33,075	80	--	--	--	--	0	0	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	--	--	--	--	39,822	28	16,512	12	141,106
Lakewide	1990	7,064,820	73	2,110,185	22	231,525	2	185,220	2	37,485	<1	9,629,235
Totals	1991	4,193,910	69	1,618,470	27	94,815	2	152,145	3	23,047	<1	6,082,387
	1992	4,515,840	78	1,091,475	19	66,150	1	77,175	1	20,476	<1	5,771,116
	1993	3,752,910	73	1,217,160	24	123,480	2	24,255	<1	12,331	<1	5,130,136
	1994	2,443,140	55	1,838,970	42	66,150	1	55,125	1	10,214	<1	4,413,599
	1995	2,096,955	54	1,673,595	43	77,175	2	30,870	1	8,012	<1	3,886,607
	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	4,001,229	43	84,879	1	217,339	2	16,512	<1	9,359,170

* 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, 1990-2003.

		Unit 1			
		Michigan	Ohio		Ontario
	Year	Sport	Trap Nets	Sport	Gill Nets
	1990	231,525	463,050	189,630	1,781,640
	1991	94,815	196,245	485,100	648,270
	1992	66,150	123,480	282,240	687,960
	1993	123,480	158,760	418,950	1,139,985
	1994	66,150	165,375	269,010	710,010
Catch	1995	77,175	108,045	676,935	524,790
(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 *(a)*
					101,321 *(b)*
	2002	147,065	337,829	978,724	1,359,637 *(a)*
					94,468 *(b)*
	2003	84,879	250,456	1,155,929	1,151,358 *(a)*
					28,309 *(b)*
	1990	105	210	86	808
	1991	43	89	220	294
	1992	30	56	128	312
	1993	56	72	190	517
	1994	30	75	122	322
Catch	1995	35	49	307	238
(Metric)	1996	61	91	420	319
(tonnes)	1997	51	96	390	495
	1998	60	84	356	531
	1999	46	91	321	475
	2000	30	109	362	445
	2001	32	81	334	323 *(a)*
					46 *(b)*
	2002	67	153	444	617 *(a)*
					43 *(b)*
	2003	38	114	524	522 *(a)*
					12.8 *(b)*
	1990	634,255	6,299	350,000	18,305
	1991	164,517	7,259	700,719	13,629
	1992	120,979	6,795	350,433	9,221
	1993	244,455	7,092	530,012	12,006
	1994	224,744	5,937	469,959	11,734
Effort	1995	123,616	5,103	598,977	11,136
(c)	1996	193,733	4,869	772,078	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	686,937	2,167 *(a)*
					2,142 *(b)*
	2002	190,573	2,715	900,289	4,546 *(a)*
					739 *(b)*
	2003	121,638	2,213	1,182,694	3,725 *(a)*
					395 *(b)*
	1990	1.3	33.3	1.4	44.1
	1991	1.9	12.3	2.4	21.6
	1992	2.1	8.2	2.8	33.8
	1993	1.9	10.2	2.6	43.1
	1994	1.1	12.6	2.2	27.4
Catch Rates	1995	2.8	9.6	4.3	21.4
(d)	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 *(a)*
					21.5 *(b)*
	2002	2.5	56.4	3.4	135.7 *(a)*
					58.2 *(b)*
	2003	2.4	51.3	3.5	140.1 *(a)*
					32.4 *(b)*

(a) small mesh gill net effort
(b) large mesh gill net effort
(c) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(d) 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, 1990-2003.

		Unit 2			
		Ohio		Ontario	
	Year	Trap Nets	Sport	Gill Nets	
	1990	650,475	302,085	2,873,115	
	1991	302,085	381,465	2,171,925	
	1992	145,530	355,005	2,522,520	
	1993	114,660	379,260	1,933,785	
	1994	304,290	740,880	1,300,950	
Catch	1995	257,985	546,840	1,073,835	
(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	*(a)*
				200,571	*(b)*
	2002	1,099,971	886,759	1,892,070	*(a)*
				298,551	*(b)*
	2003	1,255,205	858,080	2,019,617	*(a)*
				88,022	*(b)*
	1990	295	137	1,303	
	1991	137	173	985	
	1992	66	161	1,144	
	1993	52	172	877	
	1994	138	336	590	
Catch	1995	117	248	487	
(Metric)	1996	147	227	585	
(tonnes)	1997	226	263	828	
	1998	138	147	815	
	1999	177	265	713	
	2000	256	274	673	
	2001	410	382	723	*(a)*
				91	*(b)*
	2002	499	402	858	*(a)*
				135	*(b)*
	2003	569	389	916	*(a)*
				40	*(b)*
	1990	6,238	400,676	31,613	
	1991	6,480	452,277	34,739	
	1992	4,753	340,917	35,348	
	1993	2,558	320,891	25,569	
	1994	7,139	538,977	23,441	
Effort	1995	6,467	388,238	18,337	
(c)	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	581,118	3,445	*(a)*
				4,975	*(b)*
	2002	7,675	658,799	4,786	*(a)*
				3,209	*(b)*
	2003	10,214	632,813	5,311	*(a)*
				1,555	*(b)*
	1990	47.3	1.5	41.2	
	1991	21.1	2.2	28.4	
	1992	13.9	3.0	32.4	
	1993	20.3	3.1	34.3	
	1994	19.3	3.3	25.2	
Catch Rates	1995	18.1	3.5	26.6	
(d)	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	*(a)*
				18.3	*(b)*
	2002	65.0	3.1	179.3	*(a)*
				42.1	*(b)*
	2003	55.7	3.3	172.5	*(a)*
				25.7	*(b)*

(a) small mesh gill net effort
(b) large mesh gill net effort
(c) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(d) 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, 1990-2003.

		Unit 3					
		Ohio		Ontario	Pennsylvania		
	Year	Trap Nets	Sport	Gill Nets	Gill Nets	Trap Nets	Sport
	1990	447,615	57,330	2,127,825	185,220		
	1991	185,220	68,355	1,212,750	152,145		
	1992	101,430	83,790	1,190,700	77,175		
	1993	68,355	77,175	606,375	24,255		
	1994	141,120	218,295	379,260	55,125		
Catch	1995	63,945	19,845	465,255	30,870		
(pounds)	1996	103,414	83,281	512,293	0	5,292	3,749
	1997	54,776	164,888	829,353	0	7,398	15,962
	1998	90,082	184,911	811,903	0	5,291	23,236
	1999	106,258	246,377	665,703	0	2,905	6,020
	2000	156,510	286,740	771,646	0	5,930	26,683
	2001	4,472	460,339	948,622 *(a)*	0	2,602	96,946
				50,828 *(b)*			
	2002	0	640,104	1,094,894 *(a)*	0	2,009	138,812
				97,797 *(b)*			
	2003	0	481,559	1,647,047 *(a)*		5,050	172,467
				20,086 *(b)*			
	1990	203	26	965	84		
	1991	84	31	550	69		
	1992	46	38	540	35		
	1993	31	35	275	11		
	1994	64	99	172	25		
Catch	1995	29	9	211	14		
(Metric)	1996	47	38	232	0	2.4	1.7
(tonnes)	1997	25	75	376	0	3.4	7.2
	1998	41	84	368	0	2.4	10.5
	1999	48	112	302	0	1.3	2.7
	2000	71	130	350	0	2.7	12.1
	2001	2.0	209	430 *(a)*	0	1.2	44.0
				23 *(b)*			
	2002	0	290	497 *(a)*	0	0.9	63.0
				44 *(b)*			
	2003	0	218	747 *(a)*		2.3	78.2
				9.1 *(b)*			
	1990	7,376	31,881	12,472	1,978		
	1991	4,516	54,607	12,247	2,018		
	1992	3,361	84,445	14,540	1,321		
	1993	2,610	96,619	10,017	620		
	1994	3,053	173,706	8,169	1,442		
Effort	1995	3,258	42,234	6,843	1,465		
(c)	1996	2,730	69,887	6,184	0	185	12,850
	1997	2,455	126,530	9,423	0	441	43,377
	1998	2,512	111,425	10,809	0	305	30,612
	1999	2,388	176,603	4,338	0	243	28,485
	2000	1,640	214,825	2,342	0	231	48,561
	2001	32	257,217	2,451 *(a)*	0	175	90,214
				1,047 *(b)*			
	2002	0	416,543	2,490 *(a)*	0	95	123,287
				1,055 *(b)*			
	2003	0	256,890	4617 *(a)*		87	138,720
				316 *(b)*			
	1990	27.5	1.9	77.4	42.5		
	1991	18.6	2.0	44.9	34.2		
	1992	13.7	1.8	37.1	26.5		
	1993	11.9	1.7	27.5	17.7		
	1994	21.0	2.3	21.1	17.3		
Catch Rates	1995	8.9	1.3	30.8	9.6		
(d)	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 *(a)*		6.7	2.6
				22.0 *(b)*			
	2002	--	2.7	199.6 *(a)*		9.6	3.6
				41.7 *(b)*			
	2003	--	3.1	161.8 *(a)*		26.3	5.3
				28.8 *(b)*			

(a) small mesh gill net effort
(b) large mesh gill net effort
(c) sport effort in angler-hours; gill net effort in km; trap net effort in lifts
(d) 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, 1990-2003.

		Unit 4				
		New York		Ontario	Pennsylvania	
	Year	Trap Nets	Sport	Gill Nets	Trap Nets	Sport
	1990	19,845	17,640	282,240		
	1991	15,435	7,612	160,965		
	1992	11,025	9,451	114,660		
	1993	6,615	5,716	72,765		
	1994	4,410	5,804	52,920		
Catch	1995	3,122	4,890	33,075		
(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 *(a)*	0	8,337
				1,608 *(b)*		
	2002	1,951	24,952	85,935 *(a)*	29	46,874
				1,606 *(b)*		
	2003	1,048	15,464	84,648 *(a)*	0	39,822
				124 *(b)*		
	1990	9.0	8.0	128		
	1991	7.0	3.5	73		
	1992	5.0	4.3	52		
	1993	3.0	2.6	33		
	1994	2.0	2.6	24		
Catch	1995	1.4	2.2	15		
(Metric)	1996	1.3	0.7	14	0	1.0
(tonnes)	1997	0.6	0.5	16	0	1.4
	1998	0.6	0.8	22	0	0.2
	1999	0.3	1.2	27	0	1.0
	2000	0.3	0.8	16	0	5.0
	2001	0.01	6.9	16 *(a)*	0	3.8
				0.7 *(b)*		
	2002	0.9	11.3	39 *(a)*	0.01	21.3
				0.7 *(b)*		
	2003	0.5	7.0	38 *(a)*	0.00	18.1
				0.06 *(b)*		
	1990	981	24,463	3,924		
	1991	918	22,090	3,859		
	1992	632	52,398	3,351		
	1993	761	26,297	2,008		
	1994	555	14,800	1,642		
Effort	1995	532	12,115	1,375		
(c)	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 *(a)*	0	12,451
				28 *(b)*		
	2002	89	44,270	224 *(a)*	9	61,734
				28 *(b)*		
	2003	91	33,162	373 *(a)*	0	32,525
				21 *(b)*		
	1990	9.2	0.3	32.6		
	1991	7.6	0.6	18.9		
	1992	7.9	0.3	15.5		
	1993	3.9	0.3	16.4		
	1994	3.6	0.3	14.6		
Catch Rates	1995	2.7	0.5	10.9		
(d)	1996	2.4	0.3	13.0		0.6
	1997	1.9	0.3	15.3		1.0
	1998	3.4	0.5	20.3		0.3
	1999	2.7	0.4	31.1		0.4
	2000	6.4	0.2	51.5		1.7
	2001	0.3	1.7	121.5 *(a)*		1.5
				26.0 *(b)*		
	2002	9.9	1.1	174.1 *(a)*	1.5	2.4
				25.0 *(b)*		
	2003	5.2	0.8	101.9 *(a)*		1.9
				2.9 *(b)*		

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

Table 1.6. Lake Erie 2003 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	237,123	6.4	1,243,766	21.1	242,206	5.9	12,628	5.3	1,735,723	12.5
	3	363,612	9.8	624,185	10.6	254,366	6.2	13,466	5.6	1,255,628	9.0
	4	1,355,693	36.7	2,225,460	37.8	2,046,382	49.8	84,519	35.2	5,712,054	41.0
	5	1,117,580	30.2	1,329,245	22.6	1,046,649	25.5	114,911	47.9	3,608,384	25.9
	6+	622,345	16.8	466,102	7.9	516,444	12.6	14,391	6.0	1,619,282	11.6
	Total	3,696,354		5,888,756		4,106,047		239,914		13,931,071	
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	114,475	15.6	797,809	22.5	0	0.0	720	7.1	913,004	21.2
	3	14,771	2.0	164,594	4.6	0	0.0	1,546	15.3	180,911	4.2
	4	276,975	37.7	1,331,105	37.5	744	8.7	2,515	24.9	1,611,339	37.4
	5	243,669	33.2	1,089,418	30.7	3,100	36.2	3,904	38.7	1,340,091	31.1
	6+	84,373	11.5	166,888	4.7	4,712	55.1	1,402	13.9	257,375	6.0
	Total	734,263		3,549,814		8,556		10,087		4,302,720	
Sport	1	1,053	0.0	0	0.0	0	0.0	0	0.0	1,053	0.0
	2	2,092,161	46.8	913,887	41.7	158,432	13.4	5,033	5.7	3,169,513	39.9
	3	433,303	9.7	222,047	10.1	157,949	13.3	12,126	13.7	825,425	10.4
	4	1,607,879	36.0	673,690	30.7	374,271	31.6	20,225	22.8	2,676,065	33.7
	5	281,036	6.3	246,326	11.2	368,480	31.1	36,567	41.2	932,409	11.8
	6+	57,061	1.3	134,918	6.2	124,024	10.5	14,773	16.7	330,776	4.2
	Total	4,472,493		2,190,868		1,183,156		88,724		7,935,241	
All Gear	1	1,053	0.0	0	0.0	0	0.0	0	0.0	1,053	0.0
	2	2,443,759	27.5	2,955,462	25.4	400,638	7.6	18,380	5.4	5,818,240	22.2
	3	811,686	9.1	1,010,826	8.7	412,315	7.8	27,138	8.0	2,261,964	8.6
	4	3,240,547	36.4	4,230,255	36.4	2,421,397	45.7	107,259	31.7	9,999,458	38.2
	5	1,642,285	18.4	2,664,989	22.9	1,418,229	26.8	155,382	45.9	5,880,884	22.5
	6+	763,779	8.6	767,908	6.6	645,180	12.2	30,566	9.0	2,207,433	8.4
	Total	8,902,057		11,629,438		5,297,759		338,724		26,169,031	

Table 1.7. Yellow perch stock size (millions of fish) in each Lake Erie management unit. The years 1990 to 2003 are estimated by ADMB catch-age analysis in a commercial selectivity input (CSI) model. The 2004 population estimates use age 2 values derived from regressions of ADMB age 2 abundance against YOY and yearling trawl indices

	Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Unit 1	2	3.778	9.080	11.953	4.249	8.856	21.648	24.946	20.721	40.413	11.064	34.722	35.300	8.486	61.517	1.409
	3	1.341	2.005	4.891	6.702	1.830	5.431	13.351	15.018	13.027	25.123	7.116	22.267	22.908	5.505	39.501
	4	5.330	0.510	0.645	1.768	1.937	0.825	2.483	5.942	7.270	6.653	13.996	3.979	13.395	12.518	3.214
	5	2.945	1.469	0.118	0.153	0.292	0.504	0.229	0.674	1.870	2.561	2.982	6.846	2.179	5.818	6.124
	6+	0.997	0.732	0.322	0.076	0.029	0.080	0.173	0.104	0.172	0.451	1.128	1.813	4.549	2.591	3.858
	2 and Older	14.391	13.796	17.929	12.949	12.943	28.489	41.182	42.458	62.752	45.852	59.944	70.205	51.516	87.949	54.106
	3 and Older	10.613	4.716	5.976	8.699	4.087	6.841	16.236	21.737	22.339	34.788	25.222	34.905	43.031	26.432	52.697
Unit 2	2	5.899	14.424	18.630	6.416	13.436	12.847	27.129	16.322	61.385	14.738	49.589	42.370	9.806	68.725	1.667
	3	1.524	2.255	5.890	8.900	2.991	7.702	7.231	13.069	8.199	32.108	9.054	29.572	24.792	6.108	40.129
	4	8.659	0.515	0.754	2.112	3.313	1.088	2.994	2.869	3.946	3.476	17.604	4.880	16.419	12.810	3.240
	5	2.711	2.088	0.118	0.212	0.591	0.729	0.250	0.645	0.456	0.814	1.662	8.148	2.291	6.955	4.633
	6+	1.956	0.874	0.480	0.160	0.086	0.133	0.182	0.088	0.067	0.072	0.342	0.868	4.139	2.635	3.404
	2 and Older	20.748	20.156	25.871	17.800	20.417	22.499	37.787	32.992	74.053	51.207	78.251	85.839	57.446	97.232	53.073
	3 and Older	14.849	5.732	7.242	11.384	6.981	9.652	10.658	16.670	12.668	36.470	28.663	43.469	47.640	28.507	51.406
Unit 3	2	3.410	6.772	5.337	2.848	5.814	6.245	11.324	8.047	30.327	8.731	31.623	16.470	2.698	13.015	0.909
	3	1.990	2.056	3.906	2.267	1.369	3.242	3.909	6.990	4.978	19.467	5.605	20.131	10.324	1.679	7.926
	4	4.377	0.839	0.819	1.257	0.895	0.669	1.954	2.259	3.612	2.916	12.248	3.456	12.421	6.103	0.960
	5	1.687	1.608	0.239	0.320	0.426	0.366	0.320	0.970	1.056	1.927	1.787	7.163	2.064	6.867	3.157
	6+	3.785	1.705	0.756	0.248	0.193	0.252	0.313	0.321	0.543	0.771	1.600	1.947	5.376	4.141	5.716
	2 and Older	15.249	12.980	11.056	6.940	8.697	10.775	17.820	18.588	40.516	33.813	52.863	49.168	32.884	31.804	18.668
	3 and Older	11.840	6.208	5.720	4.092	2.883	4.529	6.496	10.540	10.189	25.082	21.240	32.698	30.185	18.789	17.759
Unit 4	2	0.604	0.411	0.097	0.262	0.121	1.000	0.622	0.268	3.240	1.114	10.182	1.686	1.297	11.222	0.187
	3	0.647	0.390	0.263	0.064	0.166	0.077	0.657	0.409	0.175	2.170	0.736	6.785	1.130	0.868	7.493
	4	0.910	0.323	0.177	0.169	0.027	0.076	0.044	0.373	0.227	0.114	1.355	0.482	4.522	0.742	0.564
	5	0.410	0.341	0.100	0.103	0.045	0.009	0.036	0.021	0.174	0.141	0.069	0.870	0.320	2.891	0.467
	6+	0.975	0.515	0.257	0.204	0.080	0.038	0.021	0.026	0.021	0.113	0.148	0.137	0.662	0.591	2.107
	2 and Older	3.547	1.981	0.893	0.803	0.440	1.198	1.381	1.097	3.837	3.652	12.490	9.961	7.931	16.315	10.817
	3 and Older	2.942	1.569	0.797	0.540	0.319	0.199	0.758	0.829	0.597	2.538	2.308	8.275	6.634	5.092	10.630

Table 1.8. Projection of the 2004 Lake Erie yellow perch population. Stock size estimates are derived from ADMB CSI catch-age analysis. Age 2 estimates in 2004 are derived from regressions of ADMB age 2 abundance against YOY and yearling trawl indices. Standard errors are produced in ADMB catch-age analysis report.

		2003 Parameters				Rate Functions					2004 Parameters				Stock Biomass			
		Stock Size (numbers)				Mortality Rates				Survival Rate		Stock Size (numbers)			Mean Weight in Pop. (kg)	millions kg		millions lbs.
	Age	**Mean**	**Std. Err.**	**Min.**	**Max.**	**(F)**	**(Z)**	**(A)**	**(u)**	**(S)**	**Age**	**Mean**	**Min.**	**Max.**		**2003**	**2004**	**2004**
Unit 1	2	61.517	36.536	24.981	98.053	0.043	0.443	0.358	0.035	0.642	2	1.409	0.956	1.862	0.062	4.306	0.087	0.193
	3	5.505	2.410	3.095	7.915	0.138	0.538	0.416	0.107	0.584	3	39.501	16.041	62.961	0.087	0.479	3.437	7.578
	4	12.518	4.807	7.711	17.325	0.315	0.715	0.511	0.225	0.489	4	3.214	1.807	4.622	0.126	1.527	0.405	0.893
	5	5.818	2.298	3.520	8.116	0.359	0.759	0.532	0.252	0.468	5	6.124	3.772	8.475	0.162	0.913	0.992	2.187
	6+	2.591	1.079	1.512	3.670	0.426	0.826	0.562	0.290	0.438	6+	3.858	2.310	5.406	0.242	0.591	0.934	2.059
	Total	87.949		40.819	135.079	0.112	0.512	0.401	0.088	0.599	Total	54.106	24.886	83.326	0.108	7.817	5.855	12.909
	(3+)	26.432		15.838	37.026	0.295	0.695	0.501	0.212	0.499	(3+)	52.697	23.930	81.464	0.109	3.510	5.767	12.717
Unit 2	2	68.725	37.165	31.560	105.890	0.138	0.538	0.416	0.107	0.584	2	1.667	1.173	2.161	0.096	6.735	0.160	0.353
	3	6.108	2.412	3.696	8.520	0.234	0.634	0.470	0.173	0.530	3	40.129	18.428	61.831	0.156	0.825	6.260	13.804
	4	12.810	4.441	8.369	17.251	0.617	1.017	0.638	0.387	0.362	4	3.240	1.961	4.519	0.240	3.151	0.778	1.715
	5	6.955	2.379	4.576	9.334	0.651	1.051	0.650	0.403	0.350	5	4.633	3.027	6.239	0.289	2.093	1.339	2.952
	6+	2.635	0.921	1.714	3.556	0.597	0.997	0.631	0.378	0.369	6+	3.404	2.232	4.575	0.343	0.835	1.167	2.574
	Total	97.232		49.914	144.550	0.237	0.637	0.471	0.176	0.529	Total	53.073	26.820	79.325	0.183	13.639	9.704	21.398
	(3+)	28.507		18.354	38.660	0.527	0.927	0.604	0.344	0.396	(3+)	51.406	25.647	77.164	0.186	6.904	9.544	21.045
Unit 3	2	13.015	7.685	5.330	20.700	0.096	0.496	0.391	0.076	0.609	2	0.909	0.573	1.245	0.082	1.028	0.075	0.164
	3	1.679	0.752	0.927	2.431	0.159	0.559	0.428	0.122	0.572	3	7.926	3.246	12.606	0.150	0.243	1.189	2.621
	4	6.103	2.408	3.695	8.511	0.259	0.659	0.483	0.190	0.517	4	0.960	0.530	1.390	0.210	1.349	0.202	0.444
	5	6.867	2.610	4.257	9.477	0.261	0.661	0.484	0.191	0.516	5	3.157	1.911	4.403	0.255	1.936	0.805	1.775
	6+	4.141	1.497	2.644	5.638	0.246	0.646	0.476	0.181	0.524	6+	5.716	3.584	7.848	0.292	1.313	1.669	3.680
	Total	31.804		16.852	46.756	0.183	0.583	0.442	0.138	0.558	Total	18.668	9.844	27.492	0.211	5.869	3.939	8.686
	(3+)	18.789		11.522	26.056	0.248	0.648	0.477	0.182	0.523	(3+)	17.759	9.271	26.247	0.218	4.841	3.865	8.522
Unit 4	2	11.222	8.961	2.261	20.183	0.004	0.404	0.332	0.003	0.668	2	0.187	0.112	0.262	0.072	0.774	0.013	0.030
	3	0.868	0.571	0.297	1.439	0.032	0.432	0.351	0.026	0.649	3	7.493	1.510	13.475	0.161	0.142	1.206	2.660
	4	0.742	0.450	0.292	1.192	0.064	0.464	0.371	0.051	0.629	4	0.564	0.193	0.934	0.222	0.164	0.125	0.276
	5	2.891	1.675	1.216	4.566	0.103	0.503	0.395	0.081	0.605	5	0.467	0.184	0.749	0.261	0.792	0.122	0.268
	6+	0.591	0.334	0.257	0.925	0.098	0.498	0.392	0.077	0.608	6+	2.107	0.891	3.323	0.307	0.195	0.647	1.426
	Total	16.315		4.324	28.306	0.028	0.428	0.348	0.023	0.652	Total	10.817	2.889	18.745	0.195	2.068	2.114	4.661
	(3+)	5.092		2.062	8.122	0.084	0.484	0.384	0.067	0.616	(3+)	10.630	2.778	18.482	0.198	1.293	2.100	4.631

Table 2.1. Estimated harvest of Lake Erie yellow perch for 2004. The exploitation rate is derived from the optimal yield policy, and the stock size estimate are from ADMB-CSI catch-age analysis and trawl regressions. Stock size and catch in numbers are millions of fish. Catch weight is presented in millions of kilograms and pounds. This is one of several harvest strategies presented. See text for MU 4 strategy.

		Stock Size (numbers)			Exploitation Rate				Catch (millions of fish)			Mean Wt. in Harvest	2004 Harvest Range Catch (millions of kg)			2004 Harvest Range Catch (millions of lbs)		
	Age	**Mean**	**Min.**	**Max.**	**Fopt**	**s(age)**	**(F)**	**(u)**	**Mean**	**Min.**	**Max.**	(kg)	**Mean**	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**
Unit 1	2	1.409	0.956	1.862	0.516	0.101	0.052	0.042	0.059	0.040	0.078	0.106	0.006	0.004	0.008	0.014	0.009	0.018
	3	39.501	16.041	62.961	0.516	0.324	0.167	0.128	5.039	2.046	8.032	0.125	0.630	0.256	1.004	1.389	0.564	2.214
	4	3.214	1.807	4.622	0.516	0.739	0.382	0.265	0.851	0.478	1.224	0.148	0.126	0.071	0.181	0.278	0.156	0.399
	5	6.124	3.772	8.475	0.516	0.843	0.435	0.295	1.805	1.112	2.499	0.168	0.303	0.187	0.420	0.669	0.412	0.926
	6+	3.858	2.310	5.406	0.516	1.000	0.516	0.338	1.304	0.781	1.827	0.197	0.257	0.154	0.360	0.566	0.339	0.794
	Total	54.106	24.886	83.326				0.167	9.059	4.458	13.660	0.146	1.322	0.671	1.973	2.916	1.481	4.351
	(3+)	52.697	23.930	81.464				0.171	9.000	4.418	13.582	0.146	1.316	0.667	1.965	2.902	1.471	4.332
Unit 2	2	1.667	1.173	2.161	0.508	0.212	0.108	0.084	0.141	0.099	0.182	0.121	0.017	0.012	0.022	0.038	0.026	0.049
	3	40.129	18.428	61.831	0.508	0.359	0.183	0.138	5.554	2.550	8.557	0.148	0.822	0.377	1.266	1.812	0.832	2.792
	4	3.240	1.961	4.519	0.508	0.948	0.481	0.320	1.037	0.627	1.446	0.169	0.175	0.106	0.244	0.386	0.234	0.539
	5	4.633	3.027	6.239	0.508	1.000	0.508	0.334	1.547	1.010	2.083	0.191	0.295	0.193	0.398	0.651	0.426	0.877
	6+	3.404	2.232	4.575	0.508	0.917	0.466	0.312	1.061	0.696	1.426	0.219	0.232	0.152	0.312	0.512	0.336	0.689
	Total	53.073	26.820	79.325				0.176	9.339	4.983	13.694	0.165	1.542	0.841	2.243	3.400	1.854	4.946
	(3+)	51.406	25.647	77.164				0.179	9.198	4.884	13.512	0.166	1.525	0.829	2.221	3.362	1.828	4.897
Unit 3	2	0.909	0.573	1.245	0.500	0.368	0.184	0.139	0.127	0.080	0.173	0.119	0.015	0.010	0.021	0.033	0.021	0.046
	3	7.926	3.246	12.606	0.500	0.609	0.305	0.219	1.733	0.710	2.756	0.155	0.269	0.110	0.427	0.592	0.243	0.942
	4	0.960	0.530	1.390	0.500	0.992	0.496	0.328	0.315	0.174	0.455	0.192	0.060	0.033	0.087	0.133	0.073	0.193
	5	3.157	1.911	4.403	0.500	1.000	0.500	0.330	1.041	0.630	1.452	0.219	0.228	0.138	0.318	0.503	0.304	0.701
	6+	5.716	3.584	7.848	0.500	0.943	0.471	0.315	1.798	1.127	2.469	0.250	0.450	0.282	0.617	0.991	0.621	1.361
	Total	18.668	9.844	27.492				0.269	5.013	2.721	7.305	0.204	1.022	0.573	1.470	2.252	1.263	3.242
	(3+)	17.759	9.271	26.247				0.275	4.886	2.641	7.132	0.206	1.006	0.563	1.450	2.219	1.242	3.197

Table 2.2.1. Management Unit 1 yellow perch biological references from simulations and projected population size in 2004 and 2005 at fishing rates F= 0.0 to 2.0. 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+ and 3+. Several harvest strategies are referred to in the table that correspond **approximately** to the "Harvest 2004" column, including Fopt (min, mean and max), S/R $F_{0.1}$ based on stock recruitment simulation, and an SSB $Fx_{\%}$ approach that results in x% of the spawner biomass surviving compared to the beginning of the year (45-35% shown). Please refer to Tables 2.3.1 to 2.3.3 for exact 2004 harvest projections by strategy.

Simulation					Future 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) 2004	Harvest (lbs x 10^6) 2005	Population 2+ (millions) 2005	Population 3+ (millions) 2005	Population 3+ (millions) 2006	Harvest Strategy Reference **(Approximate)**
100	67%	67%	0	0	0.00	0.0	0.0	106.5	36.3	71.4	
85	64%	63%	0	0	0.10	0.6	0.8	104.9	34.7	68.3	
74	62%	59%	0	0	0.20	1.2	1.5	103.4	33.1	65.5	$F_{opt\ min}$
66	60%	56%	0	0	0.30	1.8	2.1	102.0	31.7	63.0	
59	58%	53%	0	0	0.40	2.3	2.6	100.6	30.3	60.8	
53	56%	50%	0	0	0.50	2.8	3.1	99.3	29.0	58.8	$F_{opt\ mean}$, $F_{45\%SSB}$
48	55%	48%	1	0	0.60	3.3	3.5	98.1	27.8	56.9	$F_{40\%SSB}$
45	53%	46%	1	0	0.70	3.8	3.8	96.9	26.6	55.2	SR $F_{0.1}$, $F_{35\%SSB}$
41	52%	43%	2	0	0.80	4.2	4.1	95.8	25.5	53.7	$F_{opt\ max}$
38	51%	41%	4	0	0.90	4.7	4.3	94.7	24.4	52.3	
36	50%	40%	4	1	1.00	5.1	4.5	93.7	23.4	51.1	
33	49%	38%	5	3	1.10	5.4	4.7	92.7	22.4	49.9	
31	48%	36%	6	3	1.20	5.8	4.9	91.8	21.5	48.8	
30	47%	35%	7	4	1.30	6.1	5.0	90.9	20.6	47.8	
28	46%	33%	8	7	1.40	6.5	5.1	90.1	19.8	46.9	
27	46%	32%	9	7	1.50	6.8	5.2	89.3	19.0	46.1	
25	45%	31%	11	9	1.60	7.1	5.2	88.5	18.3	45.3	
24	44%	30%	14	10	1.70	7.4	5.3	87.8	17.5	44.6	
23	44%	28%	14	14	1.80	7.7	5.4	87.1	16.8	43.9	
22	43%	27%	16	17	1.90	7.9	5.4	86.5	16.2	43.2	
21	42%	26%	19	20	2.00	8.2	5.4	85.8	15.6	42.6	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.081	0.106
3	0.360	0.125
4	0.717	0.148
5	0.772	0.168
6	0.837	0.197

2004 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	1.409	0.956	1.862
3	39.501	16.041	62.961
4	3.214	1.807	4.622
5	6.124	3.772	8.475
6+	3.858	2.310	5.406
(2+)	54.106	24.886	83.326
(3+)	52.697	23.930	81.464

2005 Age 2

Estimate	Recruits (x 10^6)
Predicted	70.272
Lower 95 CL	42.133
Upper 95 CL	98.411

Table 2.2.2. Management Unit 2 yellow perch biological references from simulations and projected population size in 2004 and 2005 at fishing rates F= 0.0 to 2.0. 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+ and 3+. Several harvest strategies are referred to in the table that correspond **approximately** to the "Harvest 2004" column, including Fopt (min, mean and max), S/R $F_{0.1}$ based on stock recruitment simulation, and an SSB $Fx_{\%}$ approach that results in x% of the spawner biomass surviving compared to the beginning of the year (45-35% shown). Please refer to Tables 2.3.1 to 2.3.3 for exact 2004 harvest projections by strategy.

Simulation					Future 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) 2004	Harvest (lbs x 10^6) 2005	Population 2+ (millions) 2005	Population 3+ (millions) 2005	Population 3+ (millions) 2006	Harvest Strategy Reference **(Approximate)**
100	67%	67%	0	0	0.00	0.0	0.0	116.0	35.6	77.8	
90	64%	63%	0	0	0.10	0.8	1.1	114.3	33.8	73.9	
82	61%	59%	0	0	0.20	1.5	2.1	112.6	32.2	70.5	
75	58%	55%	0	0	0.30	2.2	3.0	111.0	30.6	67.3	$F_{opt\ min}$
69	56%	52%	1	0	0.40	2.9	3.8	109.6	29.1	64.4	
64	54%	49%	3	0	0.50	3.5	4.4	108.2	27.7	61.8	$F_{opt\ mean}$, $F_{45\%SSB}$
60	52%	46%	3	1	0.60	4.1	5.0	106.8	26.4	59.4	
57	51%	44%	6	2	0.70	4.7	5.5	105.6	25.1	57.2	$F_{opt\ max,}$ SR $F_{0.1,}$ $F_{40\%SSB}$
53	49%	42%	11	3	0.80	5.2	6.0	104.4	23.9	55.2	
50	48%	40%	12	10	0.90	5.7	6.4	103.2	22.8	53.3	$F_{35\%SSB}$
48	47%	38%	12	11	1.00	6.2	6.8	102.2	21.7	51.5	
45	45%	36%	12	15	1.10	6.6	7.1	101.1	20.7	49.9	
43	44%	34%	14	19	1.20	7.1	7.4	100.2	19.7	48.4	
41	43%	32%	20	23	1.30	7.5	7.7	99.3	18.8	47.0	
39	42%	31%	24	32	1.40	7.9	7.9	98.4	17.9	45.7	
37	41%	29%	29	41	1.50	8.3	8.2	97.6	17.1	44.4	
36	40%	28%	31	45	1.60	8.6	8.4	96.8	16.3	43.2	
34	39%	27%	33	53	1.70	9.0	8.6	96.0	15.6	42.1	
33	38%	26%	36	61	1.80	9.3	8.7	95.3	14.9	41.0	
31	37%	24%	43	70	1.90	9.6	8.9	94.6	14.2	40.0	
30	36%	23%	48	74	2.00	9.9	9.1	94.0	13.6	39.1	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.189	0.121
3	0.434	0.148
4	0.755	0.169
5	0.851	0.191
6	0.815	0.219

2004 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	1.667	1.173	2.161
3	40.129	18.428	61.831
4	3.240	1.961	4.519
5	4.633	3.027	6.239
6+	3.404	2.232	4.575
(2+)	53.073	26.820	79.325
(3+)	51.406	25.647	77.164

2005 Age 2

Estimate	Recruits (x 10^6)
Predicted	80.447
Lower 95 CL	52.815
Upper 95 CL	108.078

Table 2.2.3. Management Unit 3 yellow perch biological references from simulations and projected population size in 2004 and 2005 at fishing rates F= 0.0 to 2.0. 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+ and 3+. Several harvest strategies are referred to in the table that correspond **approximately** to the "Harvest 2004" column, including Fopt (min, mean and max), S/R $F_{0.1}$ based on stock recruitment simulation, and an SSB $Fx_{\%}$ approach that results in x% of the spawner biomass surviving compared to the beginning of the year (45-35% shown). Please refer to Tables 2.3.1 to 2.3.3 for exact 2004 harvest projections by strategy.

Simulation					Future 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) 2004	Harvest (lbs x 10^6) 2005	Population 2+ (millions) 2005	Population 3+ (millions) 2005	Population 3+ (millions) 2006	Harvest Strategy Reference **(Approximate)**
100	67%	67%	0	0	0.00	0.0	0.0	50.3	12.5	33.7	
89	64%	63%	0	0	0.10	0.4	0.5	49.5	11.7	32.0	
79	61%	59%	0	0	0.20	0.8	1.0	48.8	11.0	30.5	
72	58%	55%	0	0	0.30	1.2	1.4	48.1	10.4	29.1	$F_{opt\ min}$
66	55%	52%	0	0	0.40	1.6	1.8	47.5	9.7	27.8	$F_{45\%SSB}$
60	53%	48%	1	0	0.50	1.9	2.1	46.9	9.2	26.7	$F_{40\%SSB}$
56	51%	46%	3	0	0.60	2.2	2.4	46.4	8.6	25.6	$F_{35\%SSB,}$ $F_{opt\ mean}$
52	49%	43%	4	3	0.70	2.5	2.6	45.9	8.1	24.6	SR $F_{0.1}$
49	48%	41%	4	4	0.80	2.8	2.8	45.4	7.6	23.7	
45	46%	38%	9	6	0.90	3.0	3.0	45.0	7.2	22.9	
43	45%	36%	10	9	1.00	3.3	3.2	44.5	6.8	22.1	$F_{opt\ max}$
40	43%	34%	14	22	1.10	3.5	3.4	44.2	6.4	21.3	
38	42%	33%	23	33	1.20	3.7	3.5	43.8	6.0	20.6	
36	41%	31%	29	43	1.30	3.9	3.6	43.4	5.7	20.0	
34	40%	29%	36	53	1.40	4.1	3.7	43.1	5.3	19.4	
32	39%	28%	47	60	1.50	4.2	3.9	42.8	5.0	18.8	
31	38%	27%	51	65	1.60	4.4	4.0	42.5	4.8	18.3	
29	37%	25%	54	77	1.70	4.6	4.1	42.3	4.5	17.7	
28	36%	24%	57	83	1.80	4.7	4.1	42.0	4.2	17.2	
27	35%	23%	61	86	1.90	4.9	4.2	41.8	4.0	16.8	
26	34%	22%	68	93	2.00	5.0	4.3	41.6	3.8	16.3	

Parameters in Computations

Age	s(age)	Weight (kg)
2	0.237	0.119
3	0.474	0.155
4	0.811	0.192
5	0.819	0.219
6	0.779	0.250

2004 Stock Size (numbers x 10^6)

Age	Mean	Min.	Max.
2	0.909	0.573	1.245
3	7.926	3.246	12.606
4	0.960	0.530	1.390
5	3.157	1.911	4.403
6+	5.716	3.584	7.848
(2+)	18.668	9.844	27.492
(3+)	17.759	9.271	26.247

2005 Age 2

Estimate	Recruits (x 10^6)
Predicted	37.776
Lower 95 CL	21.965
Upper 95 CL	53.588

Table 2.3.1. Lake Erie yellow perch harvest (millions of pounds) in 2004 according to harvest strategies examined. Strategies include Beverton-Holt yield per recruit Fopt (min, mean, max), $F_{0.1}$ based on yield per recruit from simulations with a gamma stock recruitment function, and Fx% SSB which results in a spawner biomass that is a percentage of spawner biomass at the beginning of the year (35%, 40% and 45% shown). Management unit 4 examples are excluded due to the special multi-year strategy.

MU	F45%SSB	F40%SSB	F35%SSB	Fopt MIN	Fopt MEAN	Fopt MAX	SR F0.1
1	2.689	3.300	3.912	1.481	2.916	4.351	3.890
2	3.791	4.652	5.514	1.854	3.400	4.946	4.437
3	1.451	1.781	2.111	1.263	2.252	3.242	2.494
4				Special Strategy			
Total 1-3	7.931	9.733	11.537	4.598	8.568	12.539	10.820

Table 2.3.2. Lake Erie yellow perch harvest (millions pounds) in 2004 associated with harvest strategies described in Table 2.3.1, sorted in order of increasing harvest from left to right. Management unit 4 remains under the special multi-year strategy.

MU	Lowest Yield (millions lbs)					Highest Yield (millions lbs)	
1	F_{opt} MIN 1.481	$F_{45\%}$SSB 2.689	F_{opt} MEAN 2.916	$F_{40\%}$SSB 3.300	SR $F_{0.1}$ 3.890	$F_{35\%}$SSB 3.912	F_{opt} MAX 4.351
2	F_{opt} MIN 1.854	F_{opt} MEAN 3.400	$F_{45\%}$SSB 3.791	SR $F_{0.1}$ 4.437	$F_{40\%}$SSB 4.652	F_{opt} MAX 4.946	$F_{35\%}$SSB 5.514
3	F_{opt} MIN 1.263	$F_{45\%}$SSB 1.451	$F_{40\%}$SSB 1.781	$F_{35\%}$SSB 2.111	F_{opt} MEAN 2.252	SR $F_{0.1}$ 2.494	F_{opt} MAX 3.242
4				Special Strategy			

Table 2.3.3. Instantaneous fishing mortality F, associated with harvest strategies presented.

MU	F45%SSB[1]	F40%SSB[1]	F35%SSB[1]	Fopt MEAN[2]	SR F0.1[3]
1	0.468	0.593	0.725	0.516	0.720
2	0.549	0.700	0.864	0.508	0.661
3	0.369	0.467	0.572	0.500	0.703
4			Special Strategy		

Note: These are fully selected fishing rates multiplied by selectivity and applied to population estimates.

1 These fishing rates would vary annually depending on spawner biomass. Harvest is amount that leaves X% spawner biomass alive. F was derived for reference only.

2 F is the same for Fopt MIN and Fopt MAX (the fishing rate is applied to the population estimate ± 1 standard error). Fopt is the Beverton-Holt Yield Per Recruit $F_{0.1}$ approach. decimal place. Selectivities are calculated from F_{age}/F_{full} in catch-at-age analysis (Table 2.1).

3 These fishing rates could change as population estimates and S/R relationship changes. Selectivities based on recent 2-year means for each gear from catch-age analysis; weighted by sharing formula. Mean weight of harvest based on recent 2 years (Table 2.1).

Lake Erie Yellow Perch Management Units (MUs)

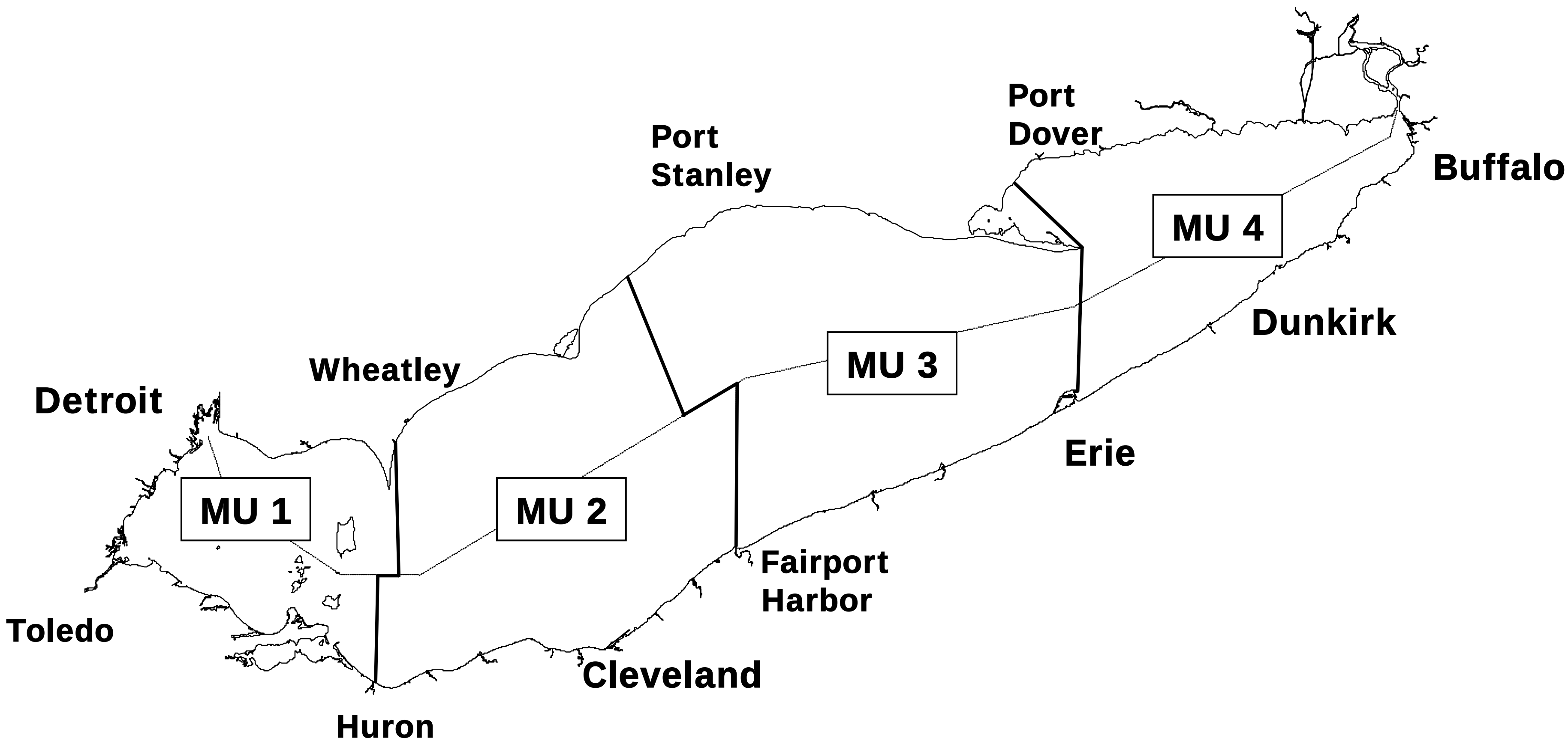

Figure 1.1. Yellow Perch management units (MUs) of Lake Erie.

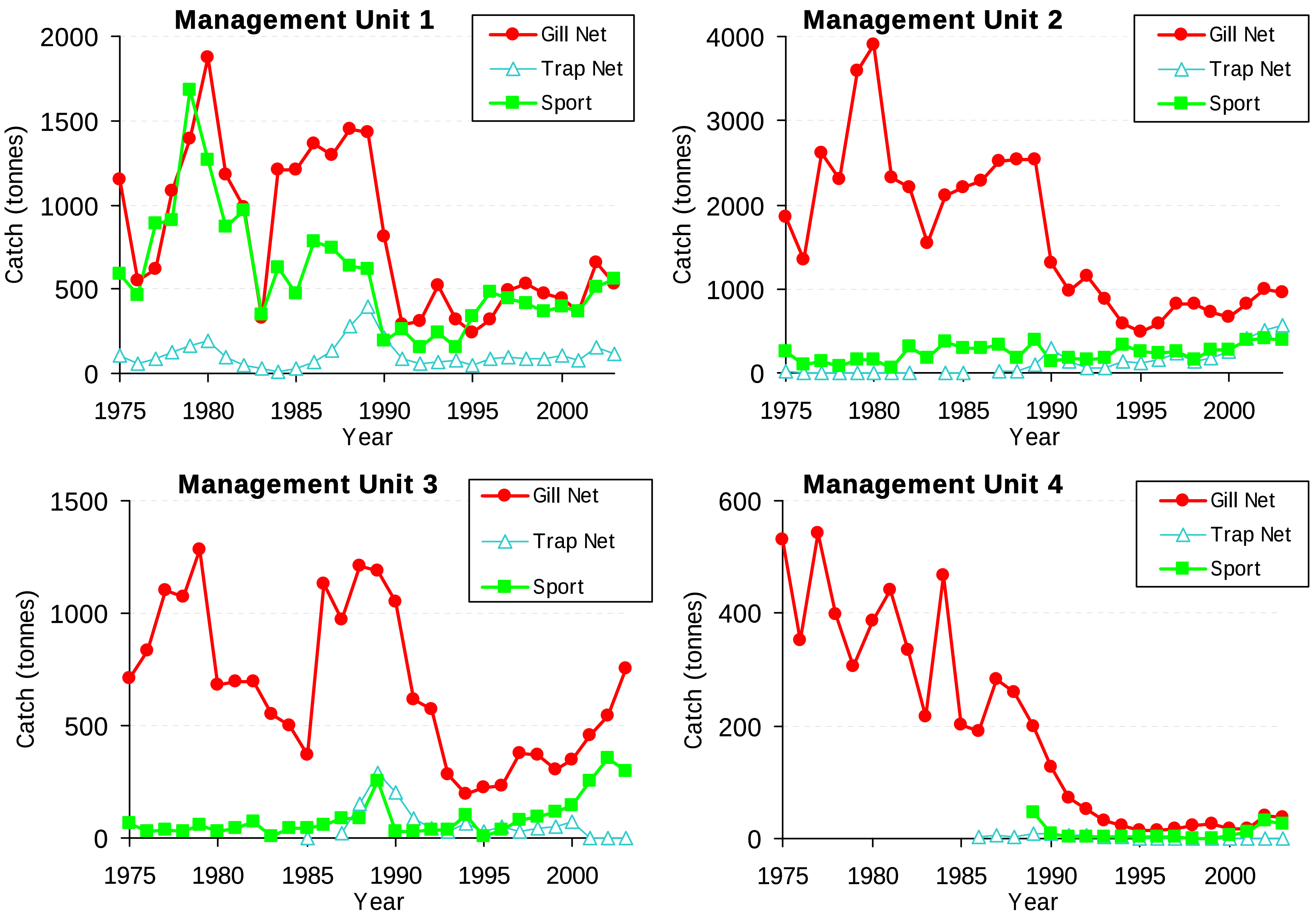

Figure 1.2. Lake Erie yellow perch harvest by management unit and gear type.

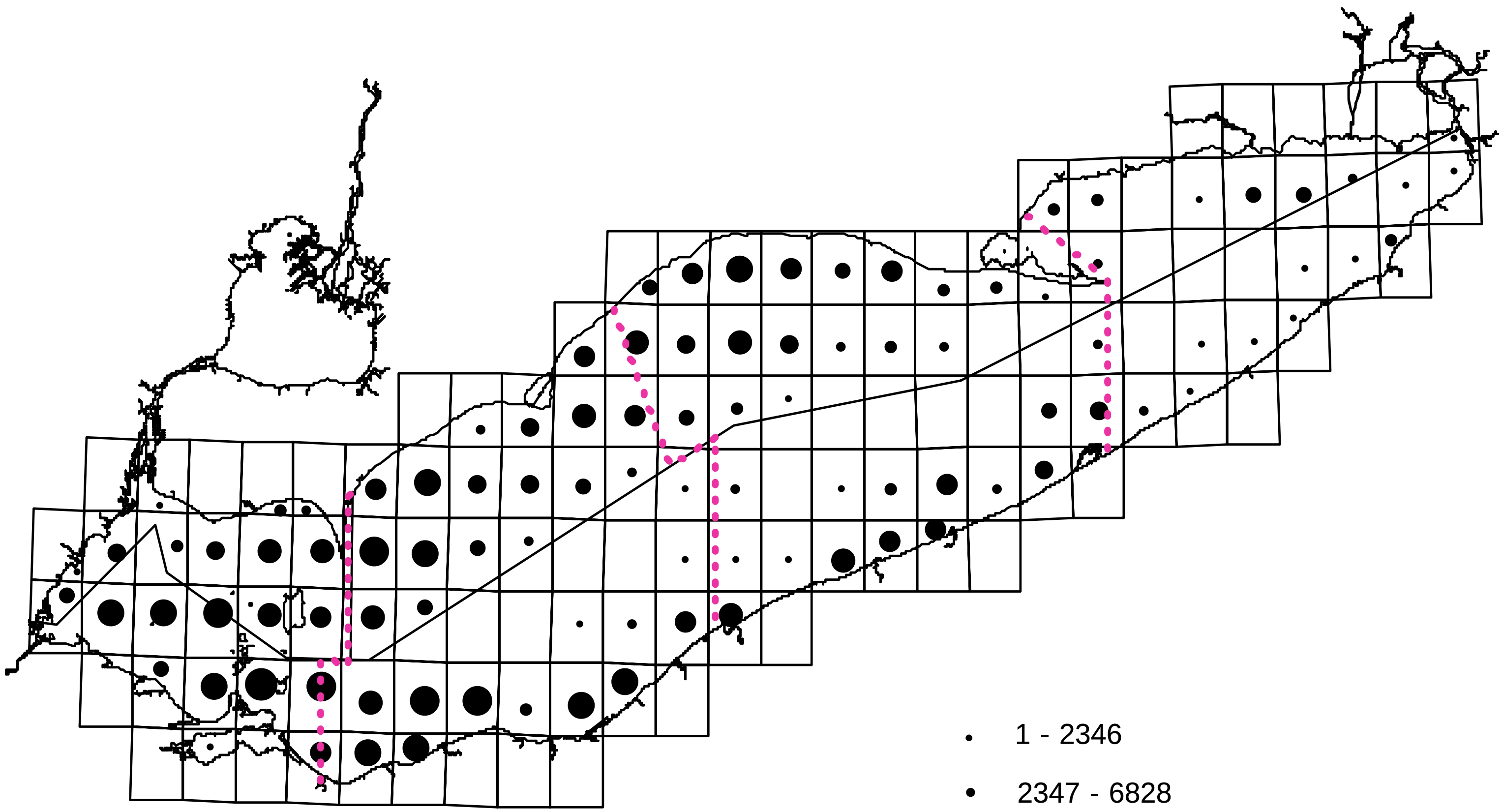

Figure 1.3. Spatial distribution of yellow perch harvest (lbs) in 2003 by 10-minute grid.

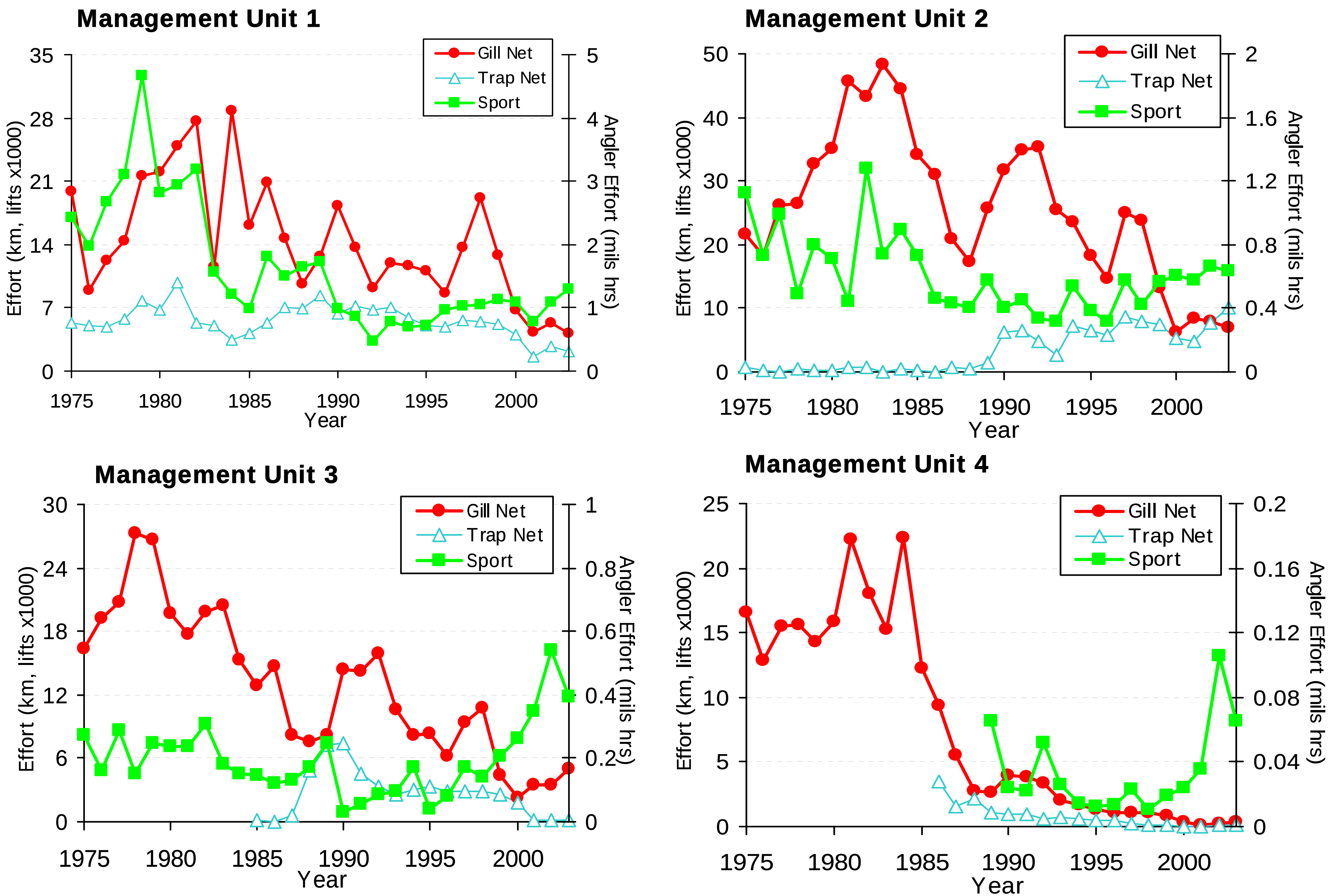

Figure 1.4. Lake Erie yellow perch effort by management unit and gear type. Note: 2001 - 2003 gill net effort presented contains both small and large mesh.

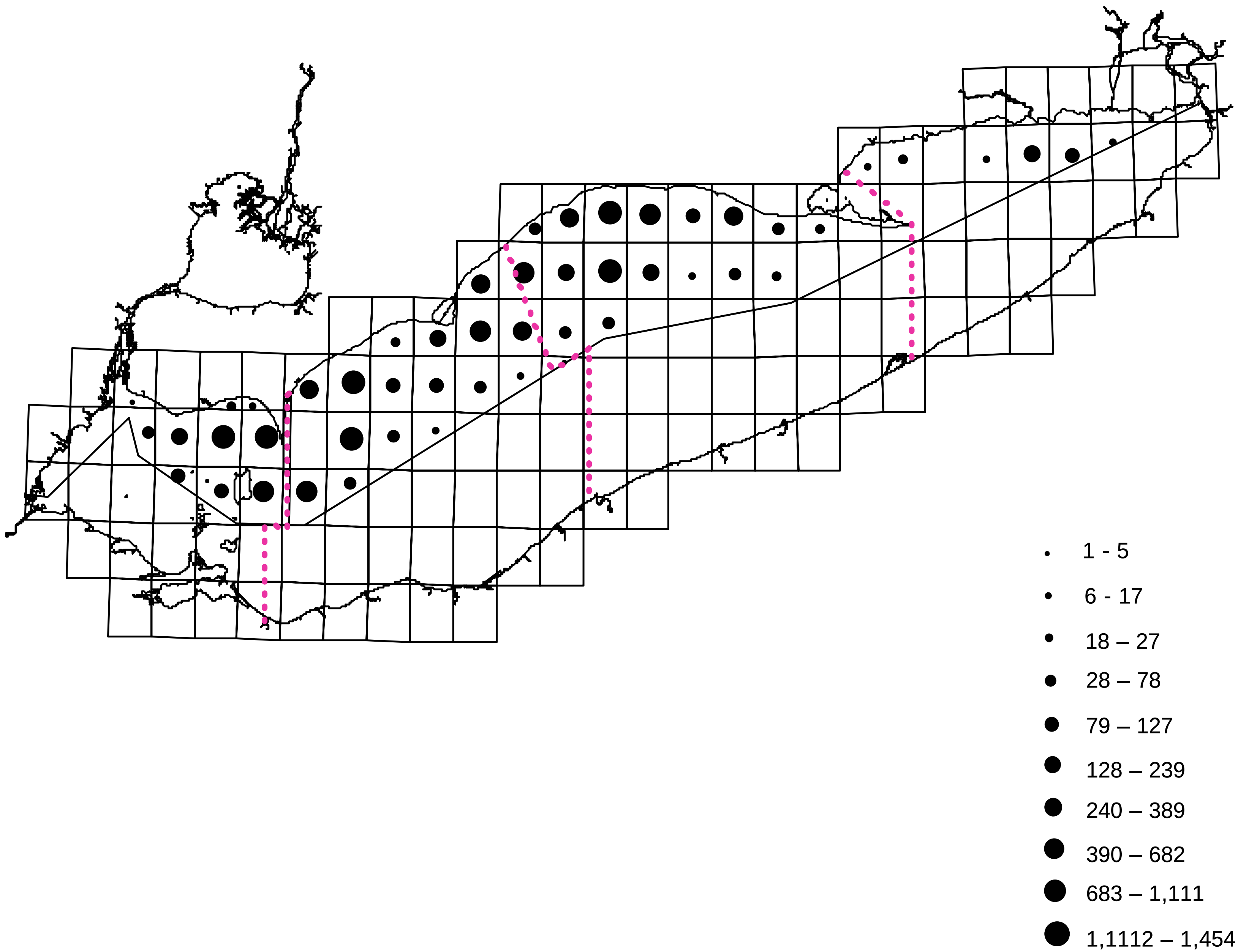

Figure 1.5. Spatial distribution of yellow perch gill net effort (km) in 2003 by 10-minute grid.

Figure 1.6. Spatial distribution of yellow perch sport angling effort (angler hours) in 2003 by 10-minute grid.

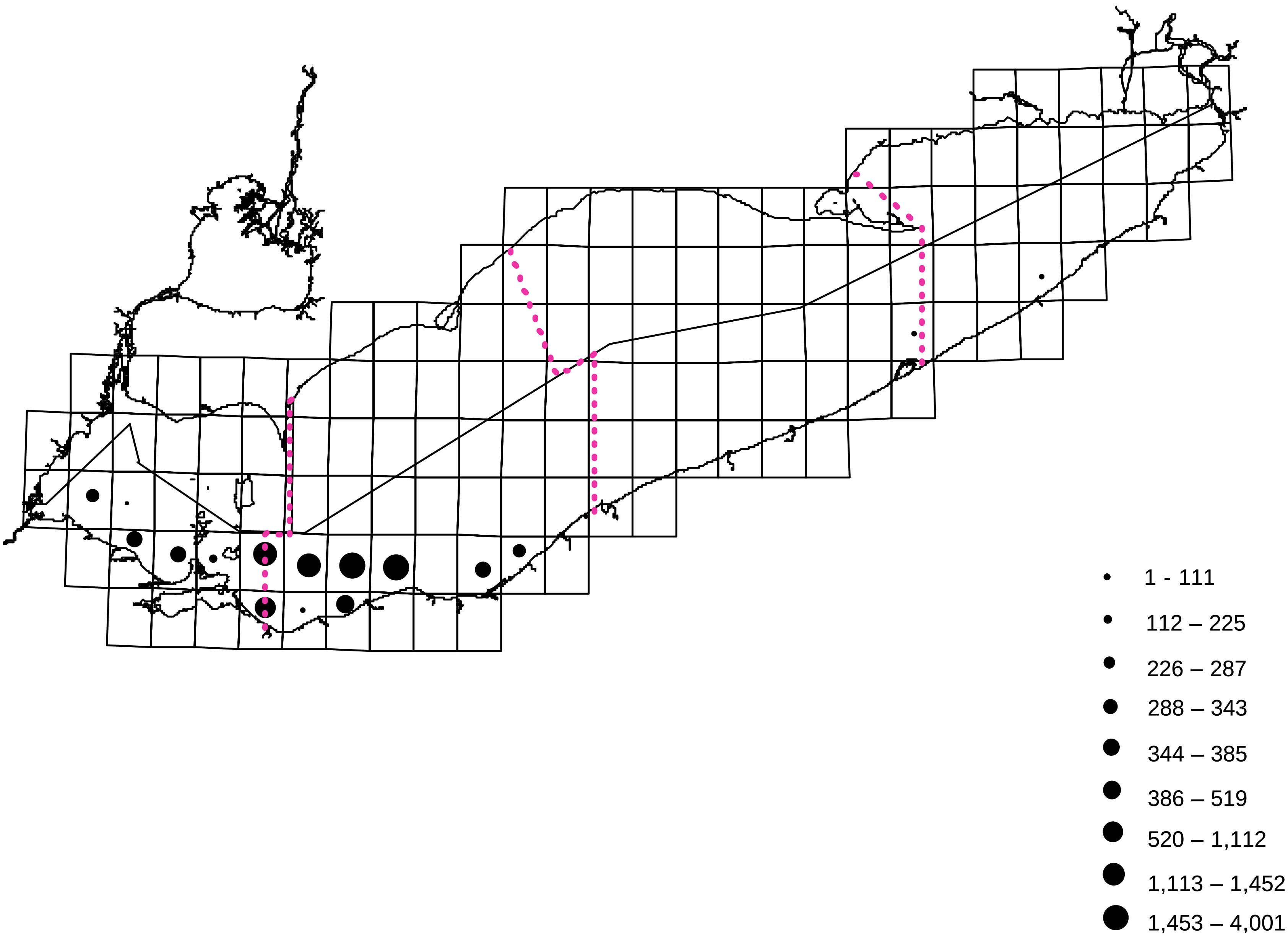

Figure 1.7. Spatial distribution of yellow perch trap net effort (lifts) in 2003 by 10-minute grid.

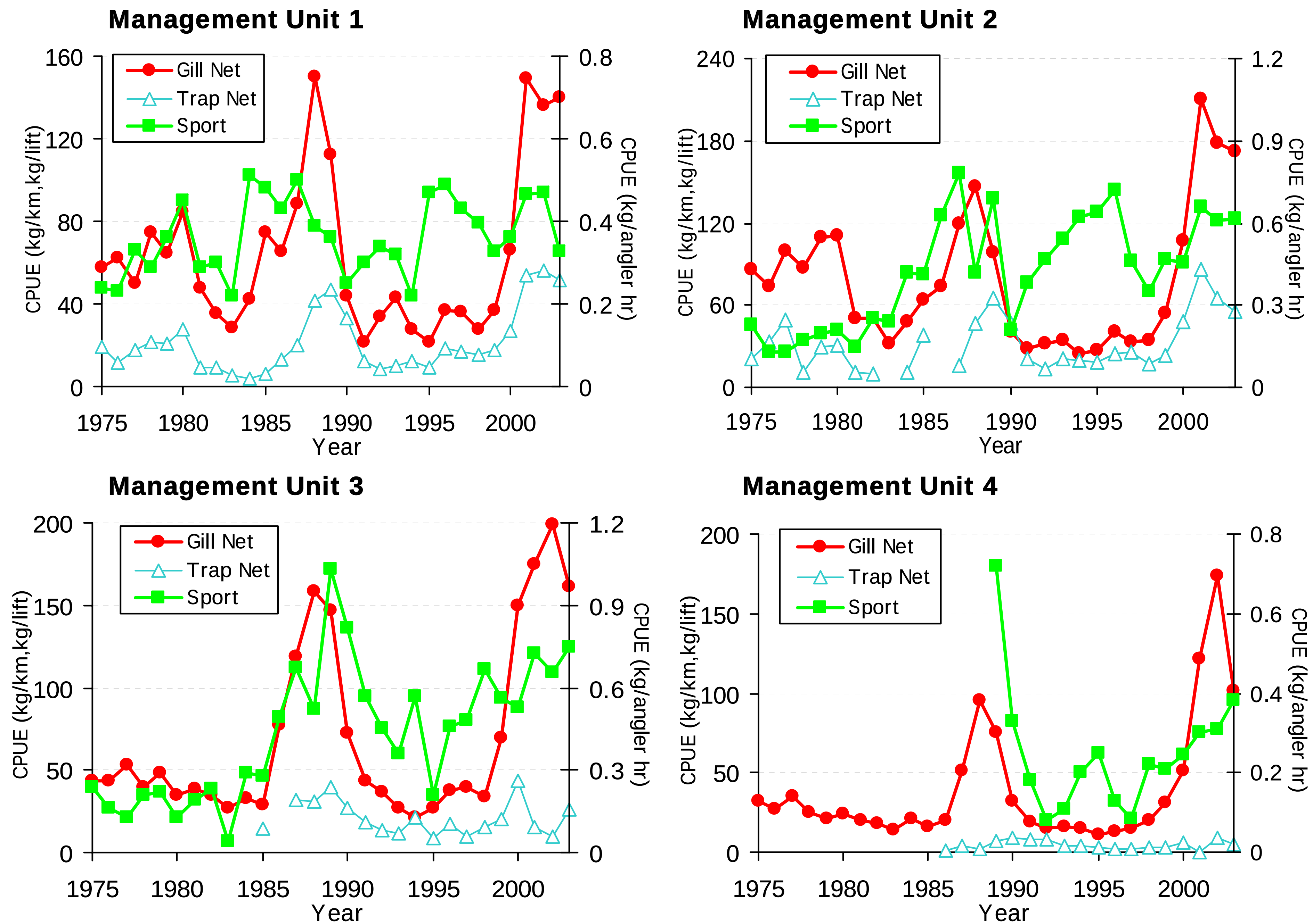

Figure 1.8. Lake Erie yellow perch catch per unit effort (CPUE) by management unit and gear type. Note: 2001 to 2003 gill net CPUE is for small mesh only.

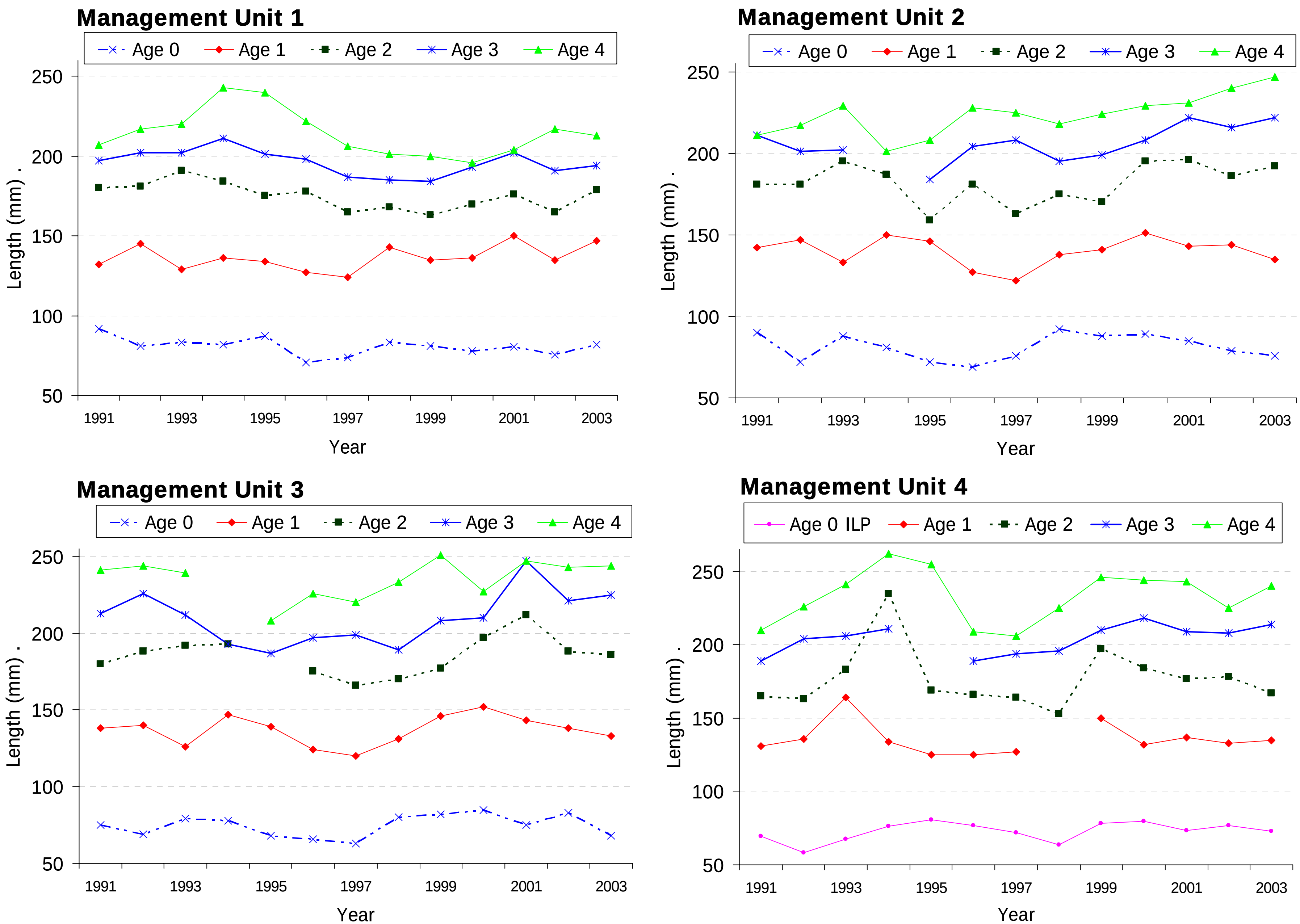

Figure 1.9. Yellow perch length-at-age from 1991-2003 fall interagency experimental samples for ages 0-4 by management unit.

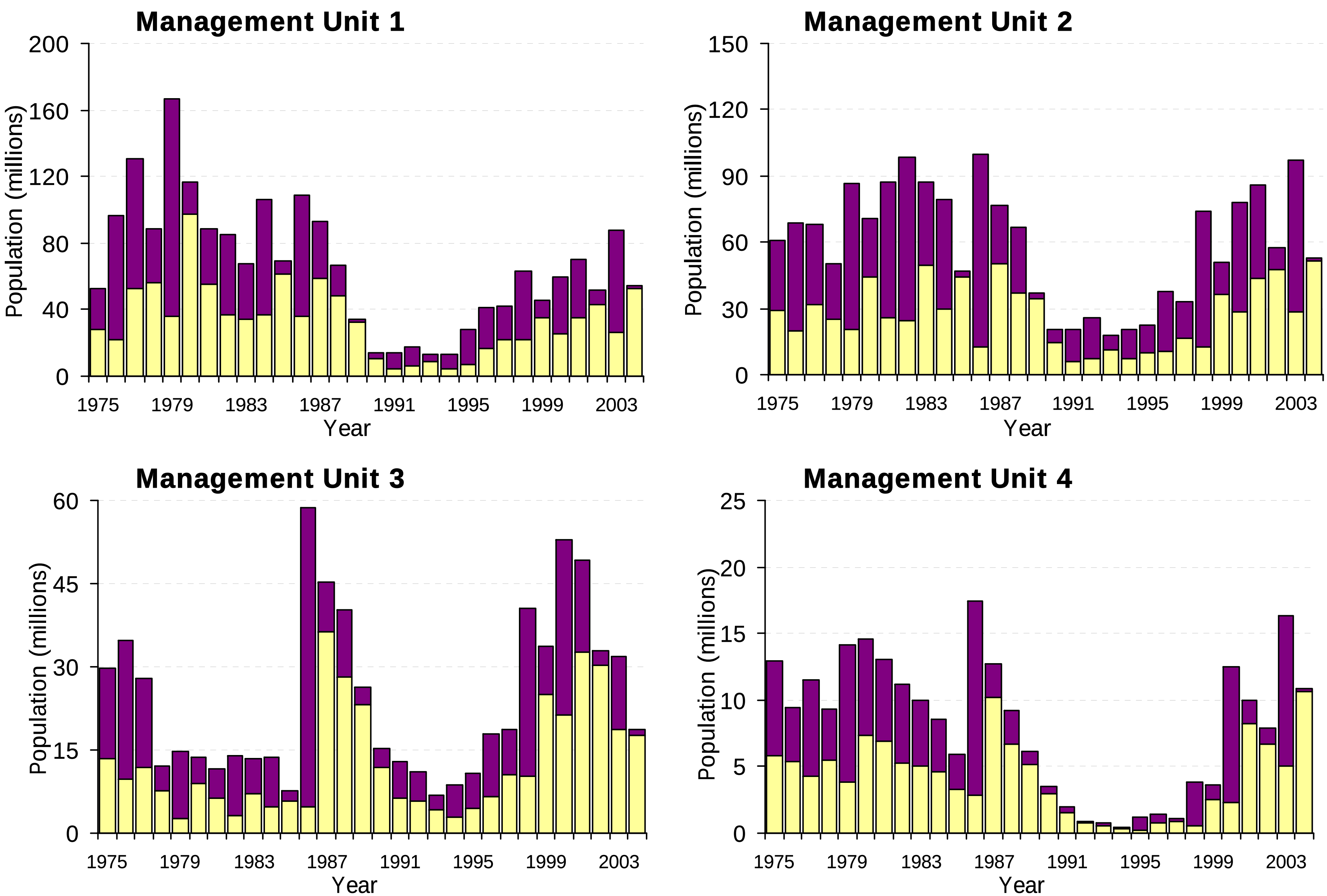

Figure 1.10. Lake Erie yellow perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2004 are from ADMB CSI Catch-Age and parametric regressions for age 2.

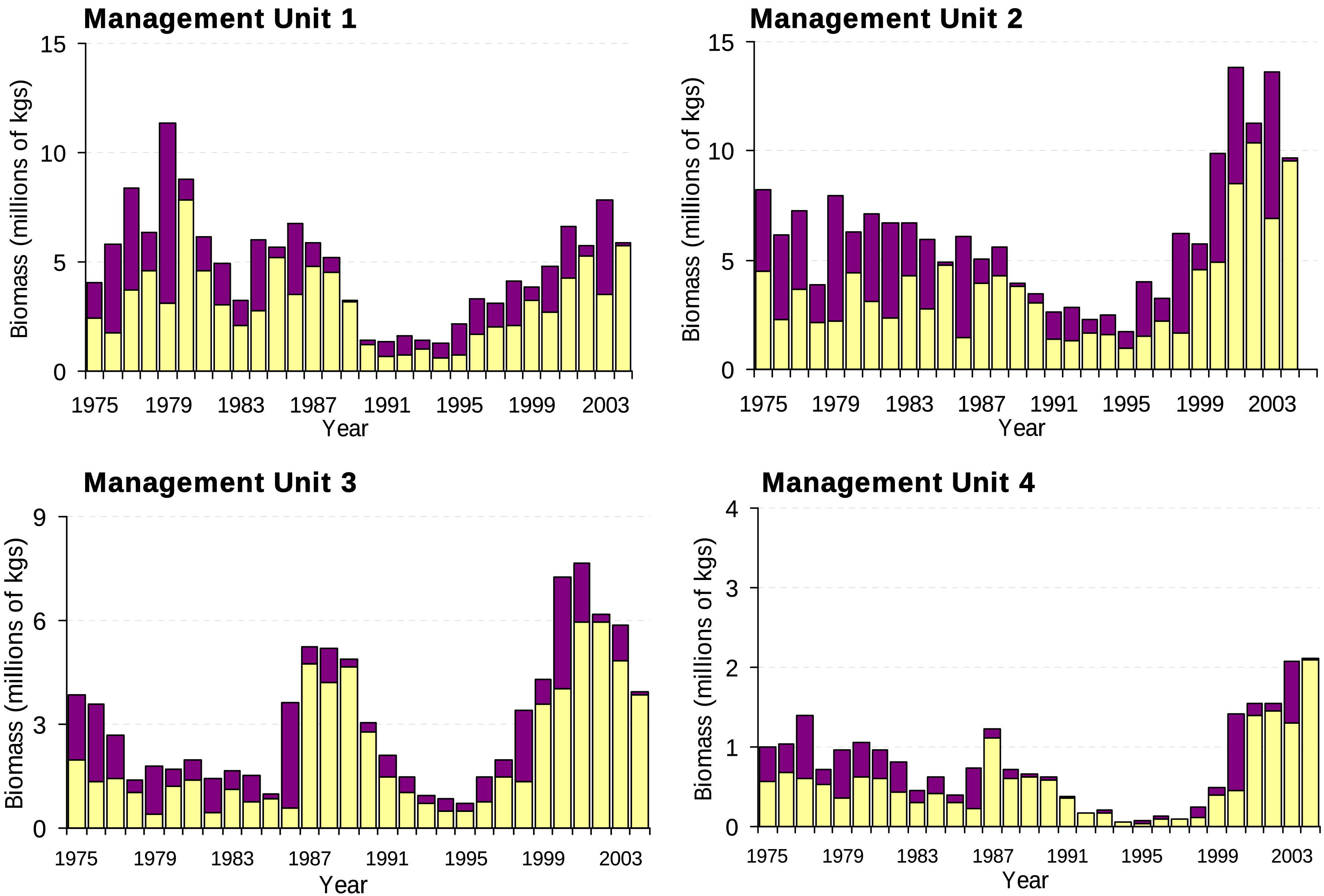

Figure 1.11. Lake Erie yellow perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2004 are from ADMB CSI Catch-Age and parametric regressions for age 2.

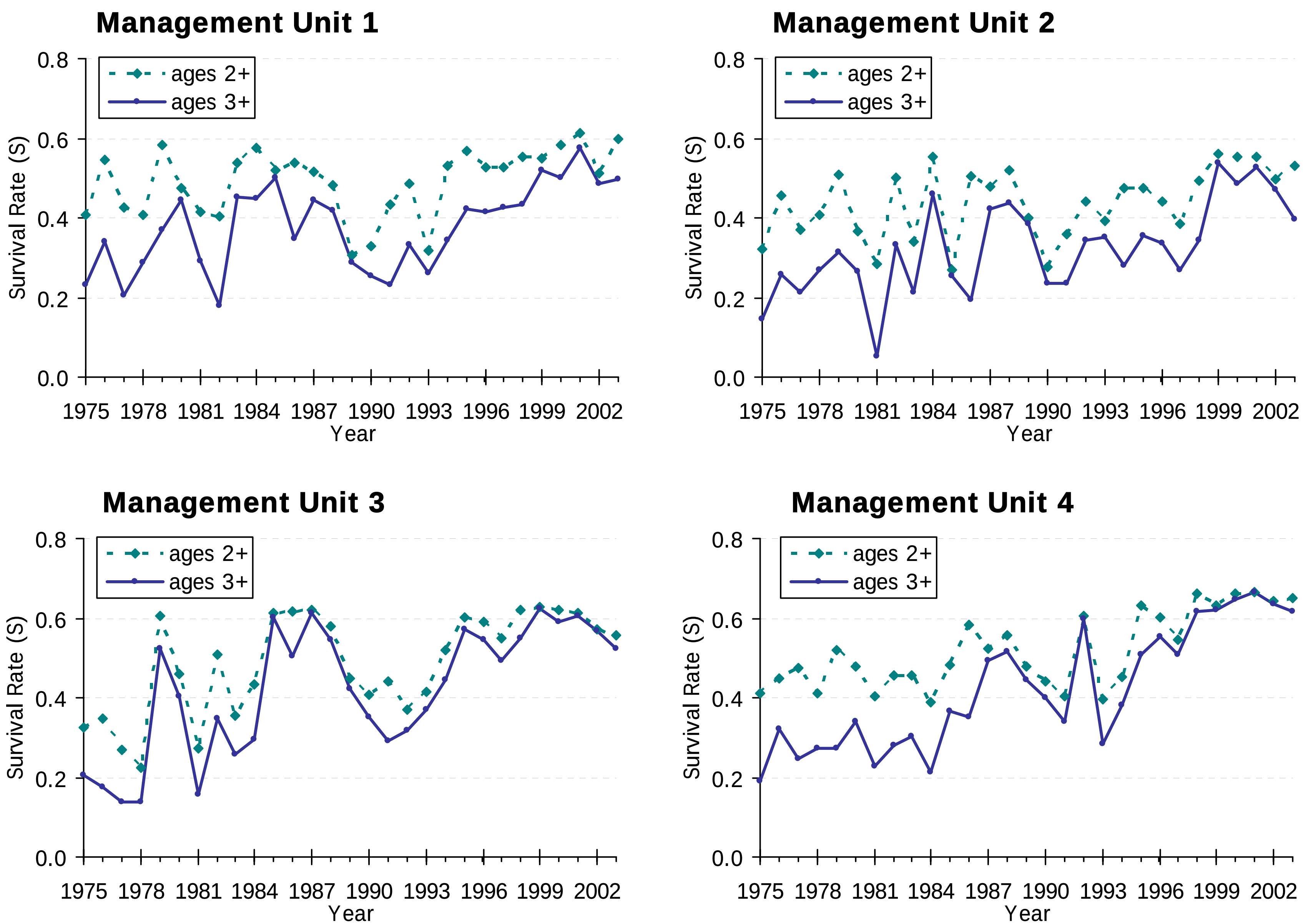

Figure 1.12. Lake Erie yellow perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB CSI Catch-Age model.

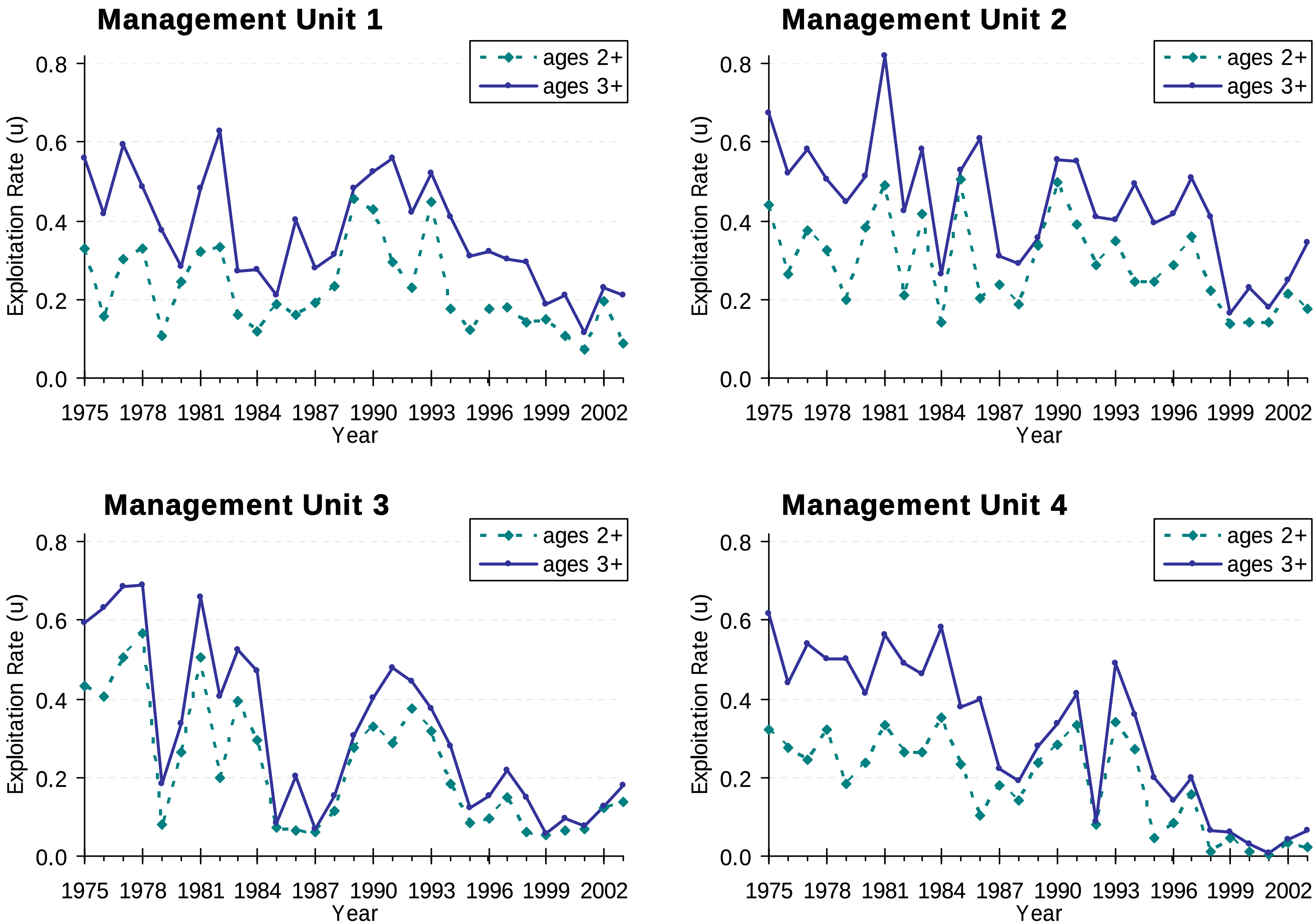

Figure 1.13. Lake Erie yellow perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from ADMB CSI Catch-Age model.

Appendix Table A-1. Agency trawl regression indices found statistically significant for projecting estimates of age 2 yellow perch recruiting in 2004 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.
OHS11G	0.9152	0.77644	1.2	0.932	0.06316	0.780	1.083
OHF20A	0.8260	0.14448	10.3	1.488	0.02097	1.056	1.920
OHF11G	0.7895	0.99469	3.5	3.481	0.16243	2.344	4.618
OHF10A	0.7824	0.07806	43.4	3.388	0.01100	2.433	4.343
BOHF21A	0.7634	0.13566	9.2	1.248	0.02277	0.829	1.667
USF11A	0.7352	0.61187	0.8	0.489	0.09815	0.332	0.647
USS11G	0.7243	1.43641	0.8	1.149	0.23688	0.770	1.528
ONTS10A	0.6891	0.01523	23.7	0.361	0.00273	0.232	0.490
USF10A	0.6755	0.07547	25.2	1.902	0.01398	1.197	2.606
OHS10G	0.5664	0.09737	8.2	0.798	0.02277	0.425	1.172
OHS20G	0.5657	0.87914	0.3	0.264	0.24361	0.118	0.410
			mean	**1.409**		**0.956**	**1.862**

Management Unit 2

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
OHF20A	0.9353	0.19855	10.3	2.045	0.01651	1.705	2.385
OHS31G	0.9145	2.22357	0.6	1.334	0.21503	1.076	1.592
OHF31A	0.9053	0.45900	3.0	1.377	0.04475	1.109	1.646
OHF21A	0.8413	0.18183	6.9	1.255	0.02381	0.926	1.583
OHS11A	0.8391	0.28970	4.2	1.217	0.03390	0.932	1.502
BOHF30G	0.8376	1.75276	1.3	2.279	0.24407	1.644	2.913
OHF10A	0.7950	0.10338	43.4	4.487	0.01403	3.269	5.704
USF10G	0.7603	0.32667	3.5	1.143	0.04902	0.800	1.486
USS11G	0.7590	1.93197	0.8	1.546	0.29024	1.081	2.010
OHF11G	0.7390	1.24280	3.5	4.350	0.23356	2.715	5.985
BOHS20G	0.7246	1.58700	0.3	0.476	0.30943	0.290	0.662
ONTS10A	0.7163	0.02039	23.7	0.483	0.00343	0.321	0.646
USF11A	0.6910	0.77938	0.8	0.624	0.13929	0.401	0.846
OHS10G	0.6514	0.13719	8.2	1.125	0.02682	0.685	1.565
OHS30G	0.6472	1.40260	0.9	1.262	0.34522	0.641	1.884
			mean	**1.667**		**1.173**	**2.161**

Management Unit 3

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
OHF20G	0.9215	0.37110	1.2	0.445	0.03426	0.363	0.528
OHF31A	0.8906	0.22995	3.0	0.690	0.02430	0.544	0.836
OHS31G	0.8519	1.09752	0.6	0.659	0.14472	0.485	0.832
BOHF30G	0.8121	0.87295	1.3	1.135	0.13281	0.790	1.480
BOHF21A	0.7669	0.08900	9.2	0.819	0.01479	0.547	1.091
NYF41A	0.6364	0.51152	3.9	1.995	0.12889	0.990	3.000
OHS30G	0.6164	0.68956	0.9	0.621	0.18132	0.294	0.947
			mean	**0.909**		**0.573**	**1.245**

Management Unit 4

Index	R-SQUARE	Slope	Index Value	Age-2 estimate	SE of slope	Lower Age 2 CI.	Upper Age 2 CI.
NYF41A	0.7886	0.12433	3.9	0.485	0.02146	0.317	0.652
ILP41G	0.6506	0.39018	0.4	0.156	0.07642	0.095	0.217
OHS31G	0.6003	0.23539	0.6	0.141	0.06073	0.068	0.214
BOHF31A	0.5932	0.04256	3.1	0.132	0.01063	0.066	0.198
ILP40G	0.5678	0.01397	1.5	0.021	0.00326	0.011	0.031
			mean	**0.187**		**0.112**	**0.262**

Appendix Table A-2. Geometric 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	4.3	31.6	4.1	-	1.4	17.3	4.3	12.3	3.9	-	-	-	-	-	-	-	-
1988	88.6	17.1	2.3	3.6	-	43.3	3.6	1.0	0.1	45.4	-	-	-	-	-	-	-	-
1989	127.0	20.4	2.9	18.8	-	32.6	8.1	20.0	1.0	61.9	-	-	-	-	-	-	-	-
1990	109.4	42.8	9.6	54.1	-	29.2	6.7	59.2	2.0	80.2	1.0	28.4	19.2	55.2	0.4	24.0	24.6	55.1
1991	38.2	20.1	10.8	14.4	0.2	16.9	17.1	63.4	4.9	32.5	1.9	28.5	4.3	57.2	1.4	28.1	4.9	66.6
1992	23.8	12.2	2.0	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	9.1	12.4
1993	80.2	86.8	6.6	24.0	0.2	28.8	0.9	17.3	0.2	107.5	4.0	24.3	9.4	28.7	4.0	24.3	9.9	25.2
1994	285.8	64.6	18.2	35.6	22.7	419.9	8.0	78.7	36.1	160.8	6.5	2.8	20.0	6.8	6.5	2.8	20.7	5.6
1995	51.9	26.3	46.4	30.6	0.1	475.2	23.1	9.3	4.4	51.1	0.8	20.0	2.9	45.8	0.8	20.0	2.7	35.8
1996	679.0	575.2	32.7	262.1	32.1	10633.1	5.3	228.7	3.9	649.2	61.0	2.7	95.0	5.4	47.8	2.7	94.5	4.9
1997	11.4	10.8	45.3	5.9	42.9	18.3	27.1	5.6	9.0	15.0	3.5	855.1	2.1	42.2	5.7	762.4	2.1	40.1
1998	112.4	71.8	2.8	104.4	6.8	74.4	3.8	100.9	6.4	100.5	16.9	1.8	70.4	3.1	12.9	2.0	70.4	3.1
1999	171.0	102.8	27.8	79.4	31.2	943.4	12.7	50.2	14.7	148.3	10.6	14.1	47.6	48.3	11.3	11.6	44.1	56.8
2000	16.5	44.0	46.1	13.3	19.5	11.1	5.4	4.9	9.0	32.4	0.3	27.8	5.6	39.2	0.3	34.2	5.5	45.7
2001	230.9	144.0	9.5	128.5	5.7	22.2	1.1	16.8	0.6	202.4	40.7	2.6	52.1	5.2	40.7	2.6	69.9	6.2
2002	10.3	8.2	52.7	9.0	63.8	1.4	20.1	3.5	10.5	12.1	0.3	181.4	1.2	20.8	0.3	181.4	0.9	21.4
2003	751.5	451.1	1.2	529.0	3.5	708.0	0.8	57.4	0.2	619.6	146.7	1.5	59.4	1.1	47.2	1.2	80.4	1.5

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	-	0.0	0.0	-	-
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	0.4	4.6	6.8	13.7	3.0	-	27.2	8.9	8.2	3.4	-	-
1991	2.0	6.3	0.9	18.7	1.6	12.6	0.9	13.3	5.0	-	8.0	2.8	2.0	0.5	-	-
1992	11.4	2.5	20.4	3.6	23.5	1.5	17.1	3.1	50.0	-	46.5	3.3	6.1	1.4	4.4	1.8
1993	6.6	4.7	13.8	12.6	6.1	4.1	12.2	10.6	38.0	-	19.2	5.8	6.2	1.2	54.9	2.1
1994	3.0	1.6	9.5	1.5	4.0	1.6	8.3	1.4	172.0	-	13.2	3.8	26.4	3.3	12.8	2.6
1995	4.5	9.2	11.6	35.1	4.5	9.2	10.9	36.3	20.0	-	1.2	5.4	2.4	10.4	4.9	9.6
1996	53.4	1.2	76.7	3.2	50.0	1.1	39.9	2.4	214.8	-	12.6	1.5	36.8	1.2	24.1	0.2
1997	-	-	2.0	7.5	-	-	1.8	5.5	0.0	-	3.1	1.6	2.6	4.5	0.1	1.5
1998	7.9	1.2	21.8	1.1	7.9	1.2	18.3	1.1	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	11.8	21.9	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	21.5	0.8	5.8	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	34.8	0.4	35.8	1.5	169.7	1.6	26.1	0.5	112.3	13.8
2002	0.9	82.2	1.4	9.7	0.8	113.3	1.3	9.2	20.8	28.3	1.5	9.6	0.2	5.1	3.3	10.0
2003	102.0	0.6	22.5	0.9	102.0	0.6	24.0	0.9	2160.0	42.0	13.9	0.4	7.9	0.1	417.1	1.4

Appendix Table A-3. Arithmetic 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	3.7	152.5	108.8	59.9	1.7	158.5	121.5	59.5
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	8.4	91.9	29.5	128.3
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	99.0	36.7
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	25.3	86.9
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	164.6	23.8
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	8.7	278.7	7.5	161.6
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	2411.0	28.6	343.7	33.7
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	116.3	1590.0	25.4	394.0
1998	285.4	195.4	7.4	281.7	23.3	138.7	11.0	246.2	19.4	236.0	641.1	7.2	199.7	7.4	561.6	8.1	199.7	7.4
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	93.8	47.8	157.5	123.8
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	50.5	155.6	2.0	271.4	49.9	162.0
2001	982.6	361.6	18.8	262.9	14.3	63.5	3.3	57.3	2.8	703.5	854.0	21.0	321.8	14.6	854.0	21.0	365.1	15.5
2002	23.7	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	8.1	134.4
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	2424.0	8.9	411.4	9.2

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	2.7	20.9	55.2	29.9	-	-	181.6	31.6	36.4	12.6	-	-
1991	11.3	166.2	3.2	48.0	10.8	306.8	3.2	39.7	-	-	106.2	25.7	10.5	1.1	-	-
1992	45.5	10.4	68.2	7.8	60.1	7.0	58.6	7.8	-	-	428.4	24.3	39.6	7.9	23.0	5.0
1993	96.9	34.7	38.3	29.4	91.1	32.6	34.3	26.8	-	-	180.7	15.4	24.5	3.8	222.4	6.2
1994	176.7	33.5	35.0	9.8	224.1	33.2	33.2	9.3	-	-	67.0	22.9	114.6	12.7	102.9	18.7
1995	69.1	61.2	26.7	87.5	69.1	61.2	25.4	89.4	-	-	3.5	42.6	5.6	27.9	12.0	30.9
1996	5214.4	8.8	330.1	9.9	5160.4	8.5	265.8	8.6	-	-	48.6	5.5	167.0	2.7	232.1	0.7
1997	-	-	7.9	129.4	-	-	7.1	115.2	-	-	18.8	6.5	14.1	38.2	0.4	12.4
1998	751.3	8.5	105.6	3.0	751.3	8.5	100.5	3.0	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	60.3	112.4	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	248.4	2.5	50.2	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	36.0	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	3.8	2139.6	7.8	132.6	26.5	48.8	6.8	36.5	0.4	11.8	19.2	32.0
2003	3191.3	6.2	148.9	3.0	3191.3	6.2	153.3	3.1	2196.0	87.0	118.8	1.0	56.3	0.4	942.2	3.9

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

Geometric Means	
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	
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