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

In 2000 / 2001, the Yellow Perch Task Group (YPTG) addressed the following charges:

- produce a lake-wide Recommended Allowable Harvest (RAH) partitioned by Lake Erie management unit
- maintain and update the centralized time-series data set of harvest, effort, growth and maturity
- update interagency abundance and recruitment indices of yellow perch
- investigate further yellow perch stock discrimination through genetic research
- continue examining factors that assist bioenergetic modeling

This year, the task group's assessment process evolved further by employing a more flexible programming tool for catch-age analysis. The yield per recruit model was also revisited, in response to changes in yellow perch growth. Using both new and old methodology, the status of Lake Erie yellow perch stocks is described herein.

2000 Fisheries Review

The reported harvest of yellow perch from Lake Erie in 2000 totaled 6.036 million pounds, which was a 6% increase over the 1999 harvest (Table 1). Yellow perch harvest (pounds) increased from 1999 for Ohio (19%) and considerably for Pennsylvania (291%) while harvest declined in New York (24%), Michigan (34%) and Ontario (2%) relative to the previous year.

For yellow perch assessment and allocation, Lake Erie is partitioned into four Management Units (Units, or MUs; Figure 1).The distribution of harvest among jurisdictions in 2000 remained similar to 1999 (Table 1, Figure 2). Harvest, fishing effort, and catch rates are summarized for the time period 1988-2000 by management unit, year, agency, and gear type in Table 2, parts a through d. Trends over a longer time series (1975-2000) are depicted graphically for harvest (Figure 3), fishing effort (Figure 4), and catch rate (Figure 5) by management unit and gear type. Harvest summed by management unit showed minor increases in Units 1 (1%) and 2 (4%) but more so in MU 3 (21%), with a substantial decrease (25%) seen in Unit 4. Ontario gill nets comprised the largest fraction of the harvest in Unit 4 (73%). The reduction in harvest in Unit 4 is attributed to the implementation of Ontario's five -year plan to rehabilitate percid stocks in eastern Lake Erie. Under this strategy, the annual harvest of yellow perch is limited to 40,000 pounds in waters of the eastern basin . Ontario 2000 harvests experienced declines in Units 1 (6%), 2 (6%), and 4 (40%) but an increase in Unit 3 (16%). Michigan's harvest (Unit 1) decreased by 34% from 1999. Ohio's yellow perch harvest experienced increases in Units 1 (14%),2 (20%) and 3 (26%) respectively. Pennsylvania's fisheries, albeit small, increased dramatically in Unit 3 (265%) and Unit 4 (394%). New York's small fishery (Unit 4) declined 24% from 1999.

Ontario's yellow perch harvest is represented exclusively by the commercial gill net fishery. Relative changes in harvest were discussed in the previous paragraph. The sport harvest of yellow perch in Ontario offshore waters is not routinely assessed. Harvest from commercial trap nets increased in Units 1 (20%), 2 (45%), 3 (49%), but decreased in MU 4 (10%). Lakewide, sport harvest increased in Units 1 (7%), 2 (3%), 3 (24%) and 4 (169%).

Commercial perch gill net effort for 2000 decreased in all Management Units over 1999 levels: down 48% in Unit 1, 52% in Unit 2, 46% in Unit 3, and 64% in Unit 4. In all Units gill net effort was the lowest recorded from 1988-2000. Trap net effort for 2000 also decreased lakewide: Unit 1, down 22%; Unit 2, down 30%; Unit 3, down 29%; and Unit 4, down 63%. Compared to 1999, sport fishing effort for 2000 decreased by 3% in Unit 1, but increased 7% in Unit 2, 28% in Unit 3, and 25% in Unit 4.

Catch rates (catch per unit of effort, or CPE) for the 2000 commercial gill net fishery increased dramatically in all Management Units: up 79% in Unit 1, 99% in Unit 2, 115% in Unit 3 and 65% in Unit 4. Trap net catch rates for 2000 also increased in all units; Unit 1 up 54%, Unit 2, up 106%, Unit 3, up 109%, and 142% in Unit 4. Catch rates for anglers targeting yellow perch (in fish per hour) decreased in Unit 1 for Ohio (9%), but increased slightly for Michigan (2%). In the central basin (MU 2 & 3), rates declined 3% & 14% (Ohio) but increased by 46% in Pennsylvania. In the east basin (MU 4), catch rates declined 55% in New York waters, but increased greatly (325%) in Pennsylvania waters.

The lakewide RAH range recommended by the YPTG for 2000 was 5.2 to 6.8 million pounds lakewide. The Lake Erie Committee supported a total allowable catch (TAC) lakewide allocation of 6.5 million pounds. Partitioned by YPTG Management Unit, TAC values for 2000 were: Unit 1, 2.2 million pounds; Unit 2, 3.0 million pounds; Unit 3, 1.3 million pounds; Unit 4, 0.07 million pounds. The 2000 harvest of Lake Erie yellow perch in each management unit did not exceed total allowable catch set by the Lake Erie Committee. The 2000 harvest in millions of pounds by Management Unit were: Unit 1, 2.086 million pounds; Unit 2, 2.653 million pounds; Unit 3, 1.248 million pounds; Unit 4, 0.049 million pounds. The 2000 Lake Erie yellow perch fisheries attained (calculated from harvest values in Table 1) 95% of TAC in Unit 1, 88% of TAC in Unit 2, 96% of TAC in Unit 3 and 70% of TAC in Unit 4.

Stock Assessment

Trawl and gill net survey data may provide less biased indicators of adult and juvenile abundance compared to fishery data, since the spatial distribution of effort is random compared to fisheries that target a particular species. Fishery and survey gear are both size-selective in some manner, though survey gear are less so. Surveys take place throughout the lake during the summer and fall months. Fisheries operate throughout much of the year, at varying levels of efficiency influenced by the age and size distribution of the population, environmental conditions and associated behavioral responses by fish.

Despite these operational differences, both survey and fishery data exhibit considerable agreement on the overall status of yellow perch stocks in Lake Erie. Both survey and fishery data indicate a lack of synchrony in stock dynamics between Management Unit 1 (west basin) and the rest of the lake. While commercial catch per unit effort (CPUE) has increased in the west basin, the rate of increase was less than observed in the central basin management units (2 and 3). Survey results suggest abundance in MU 1 is similar to recent years. Sport CPUE generally concurs with this, though sport effort continues to exhibit gradual increase in the west basin. Increasing sport effort may reflect anglers' growing interest in catching yellow perch but could also relate to declining stocks and lower catch rates of walleye. The strong 1996 year class was not fully vulnerable to fisheries gear until 2000, due to the slower growth of yellow perch since 1997. Improved fishery performance resulted from four-year-old yellow perch becoming completely vulnerable to commercial gear in 2000.

The spatial distribution of commercial harvest in Ontario waters of MU 2 favored areas adjacent to MU 1 in 2000 (Figure 2). It is conceivable that stock dynamics of MU 1 were influenced by this longitudinal gradient of harvest in MU 2. This pattern of harvest may introduce an additional source of mortality to "MU 1 perch" that is not accounted for by standard task group procedures. The largest increase in abundance occurred in MU 3, driven by increasing survival and strong recruitment in the nineties (Figures 6 and 7). In MU 4, abundance and biomass have increased in response to low exploitation and strong recruitment from the 1996 and 1998 year classes.

Age and Growth

While yellow perch populations recover from the low levels of the early nineties, trends in growth at various life stages appear to differ from west to east, and possibly along a latitudinal cline. Young-of-the-year (YOY) growth has shown a general declining trend in Ontario waters during the nineties, but this trend appears divergent from the Ohio trend since 1998 (Appendix A). Changes in mean length of yearlings in MU 1 exhibit a similar trend to YOY with divergence in growth between the

Ontario and Ohio. While YOY growth paralleled yearling growth in MU 1, the relationship between the size of juveniles (Age 0, 1) and older yellow perch (ages 2 to 3) was poor when comparing the same cohorts (Ontario data). Age 2 yellow perch experienced declining growth in MU 1 since 1993 and this trend was carried forward in subsequent years by age 3 and 4 yellow perch (Appendix A). In the remaining areas of the lake, YOY growth has fluctuated considerably, but appears to be improving in recent years (Appendix A). The size of yearling and older yellow perch also fluctuated greatly during the nineties in the other management units, though growth in recent years seems average or better (Appendix A). The condition of yearlings collected from Ontario waters in MU 1 appeared poor during the past three years, but this trend is less apparent in Ohio waters, and not apparent for older fish in all management units.

Growth differs between areas in Lake Erie, influenced by unique thermal environments, thermal history, changes in yellow perch forage composition and, if food resources are limited, abundance of yellow perch and species with diets that overlap at various life stages. In the latter case, both population dynamics and the spatial distribution of predators could play a role in the differential growth of yellow perch.

In recognition of significant changes in perch growth, forage composition, and fish community structure, the task group has decided to study growth in greater detail in 2001. Similarly, the effect of growth on gear selectivity will be reviewed.

The task group continues to update yellow perch growth 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 important in our calculation of available biomass and for calculating harvest in the next year. The task group reviewed yellow perch von Bertalanffy growth model data and F_{opt} values according to methods previously described (YPTG 1996, 1998), and growth parameters were updated, resulting in changes to last year's F_{opt} values. This is discussed in more detail later in this document.

Catch-Age Analysis Using AD (Auto Differentiation) Model Builder

In January 2000, Yellow Perch Task Group members attended an AD Model Builder (ADMB) workshop at Cornell University conducted by Dr. Pat Sullivan, and a later (October 2000) fish stock assessment workshop coordinated by the GLFC Board of Technical Experts (BOTE). These workshops advanced the task group's ability to use this flexible programming tool. While the former DOS-based CAGEAN (Deriso et al. 1985) used similar catch-age analysis methodology, fewer programming constraints existed with the ADMB C++ application in a Windows environment. Advantages of ADMB over CAGEAN include greater flexibility with data including series length, multiple gear types including survey gear, accommodation of unequal years / ages between series; the absence of a terminal F input requirement, and customized reporting. While more attractive, this Windows programming tool (ADMB) requires greater programming knowledge than it's predecessor CAGEAN.

Parameter Input

A number of programming decisions and data limitations influence population parameter estimation. Assumptions about constant catchability (q) over a time period exerts an influence on model results. We chose to use gear specific q blocks that were partitioned by a non-quota era (coinciding with higher lake productivity), the quota period and gear specific catchability blocks (trapnet and gillnet) associated with spring fishing restrictions. Catch, effort and survey catch per unit effort (CPUE) weighting factors (λ) were calculated by the variance ratio method (Deriso et al, 1985). In the case of MU 1, an alternative weighting method by Quinn and Deriso (1999) was used for survey gear, based on sample size ratios. This method gave the Ohio trawl series more weight since age 2 perch were not fully vulnerable to Ontario index gill nets in recent years. Survey data in the model included Ohio west basin trawl, and Ontario partnership index in MU 1; Ohio District 2 trawl survey and west-central basin Ontario partnership index in MU 2; Ohio District 3 trawl survey and east-central basin Ontario partnership index in MU 3; and a New York gill net index in MU4. The relative weights (λ) between data sources influence minimization of the total residual sums of squares (RSS) and therefore, parameter estimation. While ADMB allows flexible modeling with survey data of various lengths, lack of survey continuity throughout the entire time series compromises the precision of estimates for historical time periods in which survey data are lacking. Gear selectivity was assumed constant for the entire time series in all management units. Natural mortality (M=0.4), determined by a Yellow Perch Task Group review (1997), exerts a small influence on population scaling, but was assumed constant among years and management units.

Catch-Age Analyses

Three-fishery gear (gill net, trap net and sport: harvest-by-age, effort, and weight-at-age) and survey gear (index gillnet and trawl CPUE at age) ADMB catch-age analysis models were used to estimate population size (1975-2000) in numerical abundance and biomass for each management unit. Estimates of population size and parameters such as survival and exploitation rates are presented for 1988-2000 (Tables 4 and 5). Estimates of age 2 recruitment in 2001 were derived using linear regression of previous years' age 2 population estimates and juvenile indices (Appendix B).

Population estimates for 2001 incorporate these recruitment estimates of age 2 perch (Table 5 and Figure 6). Mean weight at age from surveys were applied to abundance estimates to generate biomass estimates (Figure 7). Management Unit 4 estimates of population size and biomass are not presented due to the large error around the estimates, which are related to limitations of sparse data. With rehabilitation strategies and harvest constraints in place for eastern Lake Erie, combined with positive signs of recovery, developing a RAH is not critical at this time. As longer time series data become available, and precision of estimates improve, developing RAH for MU 4 may be reconsidered. Results from the former modeling approach, CAGEAN, are presented as alternative version "b" in Tables 4 to 8 for comparison to ADMB.

Catch-age analysis suggests that former standing biomass levels of the seventies and eighties have been achieved (Figure 7). Recent work indicates that Lake Erie is considered less productive following reduced phosphorus loading and Dreissenid mussel colonization. While signs of recovery are evident, the task group maintains that current production is likely below historically high levels. It is conceivable that standing biomass could be similar during these different eras, though former yellow perch production to biomass ratios would likely have been higher with associated lower survival. There are a number of considerations that limit our confidence in the estimates over the entire time series presented in Figures 6 and 7. Recent modeling (ADMB) incorporated survey gear, to provide less biased estimates of population size. Survey data were limited to the nineties and in some cases the eighties, though survey methodology differed between decades. This lack of survey continuity over the time series for which we've estimated population size, contributes to uncertainty when comparing recent levels to historical levels of abundance. Other assumptions including a constant natural mortality rate from 1975 to 2000, and compatibility of old versus new harvest data, lessen our ability to directly compare abundance levels over three decades.

In order to assess our newer modeling methods, we compared CAGEAN population estimates to those derived using ADMB. It should be recognized that the two methods are not directly comparable, since the ADMB approach is influenced by survey data and lacks the constraint of a terminal F input. In this comparison, CAGEAN results could also differ due to fishery catch and effort weighting, terminal F input, shorter time series, and selectivity blocking. Estimates using ADMB were similar to those of CAGEAN in MU 1 from 1988 to 1994, after which, the series diverge, with higher estimates from ADMB (19% in 2000) (Figure 6). CAGEAN population estimates in MU 2 were higher or equal to ADMB estimates from 1988 until 1997, after which ADMB values were considerably higher (87% in 2000) (Figure 6). The same trend existed in MU 3, in which CAGEAN estimates were equal to or greater than ADMB until 1997, after which ADMB values were higher (105% in 2000)(Figure 6). A similar trend was apparent in MU 4, though 2 standard errors about the 2000 estimate included a population size of zero, so these data are considered too variable to warrant much consideration at this time.

Abundance and biomass trends from ADMB suggested that some yellow perch populations (MUs 2 and 3) have recovered to levels comparable to the seventies and eighties, though CAGEAN estimates do not agree (Figure 6). The discrepancy may stem from the latter model's exclusive reliance on fishery data (without auxiliary survey data) for estimating abundance. The coefficients of variation for the most recent ADMB population estimates (2000) were 31%, 41%, 44% and 67% for MU's 1 to 4 respectively (Table 6). The coefficients of variation for the CAGEAN population estimates (2000) were lower, being 26%, 22%, 42% and 41% for MU's 1 to 4 respectively (Table 6b). Estimates for the historical period using ADMB (70's and 80's), had variance equal to or greater than recent years, likely reflecting the absence of auxiliary survey data, and possible differences in compatibility of fishery data. As stated previously, this earlier time period may not be scaled accurately due to numerous modeling assumptions.

Recruitment Estimator for Incoming Age 2 Yellow Perch

The Yellow Perch Task Group continues to use interagency trawl data series for predicting age 2 recruitment from linear regression against catch-age analysis estimates of two-year-old abundance. Age 2 recruitment in 2001 was calculated using the mean of values predicted from the indices listed in Appendix B, Table B-1. Data from trawl index series for the time period examined are presented in Appendix B, Tables B-2 (geometric means) and B-3 (arithmetic means), while a key summarizing abbreviations used for the trawl series is presented as a Legend in Appendix B.

Estimated recruitment for 2001, the 1999 year class, appears moderate in size, except in MU 4 where it may be weaker. Based on YOY indices in all management units, however, expectations for the 2000 year class are low.

2001 Population Size Projection

Stock size estimates for 2001 (age 3 and older) were projected from the ADMB 2000 population size estimates and age-specific survival rates in 2000 (Tables 5 and 6). Age 2 recruitment values for the 1999 year class in 2001 (methods described above) were then added into the age 3 and older population size estimates in each unit to give a 2001 population of yellow perch ages 2 and older (Table 6). Standard errors and ranges about our mean estimates are provided for each age in 2000 and following estimated survival (ADMB), for 2001.

Stock size estimates (ages 2 and older) for 2001 compared to 2000 were slightly less (3%) in MU 1, but down more in MU 2 (18%), MU 3 (19%), and MU 4 (27%). Abundance of age 3 and older yellow perch in 2001 were estimated to be more abundant than in 2000 (1%, 50%, 61%) in MU's 1 to 3 but more than doubled in MU 4. These changes are influenced by the moderate recruitment of the 1999 year class, coupled with the strong 1998 year class present as age 3 in 2001. The 1996 year class is still expected to contribute significantly to the fisheries in 2001.

Stock size estimates for 2001 using ADMB were 21%, 60%, 67%, and 160% higher than CAGEAN estimated for MU's 1 to 4 respectively (Table 6a vs 6b).

Survival of yellow perch ages 2 and older in 2000 was estimated (ADMB) to be 51%, 55%, 62% and 66% in MU 1,2,3 and 4 respectively. Survival rates for ages 2 and older yellow perch increased in all units, though survival of age 3 and older yellow perch declined from 1999 in units 1,2 and 3 (Figure 7). Survival of yellow perch ages 3 and older in 2000 was estimated to be 39%, 42%, 56% and 65% in MU's 1 to 4 respectively. Generally, survival rates have shown a gradual increase across all management units since 1988 (Figure 8). Using CAGEAN, estimated survival was lower than ADMB values (Table 4b).

Conversely, exploitation decreased gradually, as expected, contributing to the observed increase in survival (Table 4, Figure 9). Observed fishing mortality of yellow perch ages 3 and older has been less than or equal to F_{opt} in recent years.

Yield per Recruit; F_{opt} and F_{age}

The yield per recruit model used to calculate a recommended harvest in 2001 was similar to that used in 2000, though von Bertalanffy growth parameters have been recalculated to reflect current trends in growth, so F_{opt} is lower than in 2000. The optimum harvest rate, F_{opt}, is determined by balancing growth rate with natural mortality rate. For temperate waters, F_{opt} is modified to $F_{0.1}$, which corresponds to 10% of the initial rate of increase in yield per recruit relative to increasing F (fishing mortality) at low levels of fishing. F_{opt} values are presented in Table 7 for projecting 2001 harvest. F_{opt} values are scaled by selectivity values generated by ADMB so that targeted fishing mortality may differ between partially and fully vulnerable age groups. A full description of the model inputs, as well as the steps required to determine a scaled $F_{0.1}$, is given in previous reports (YPTG 1991, 1995).

Other factors updated for yield derivation include calculating mean weight-at-age in the population (Table 6) and mean weight-at-age in harvest (Table 7). In both cases, the recent two-year average was used in each management unit. These values are based on intensive sampling from interagency surveys, creel surveys and commercial fishery sampling.

Projected harvests (2001) for age 2 and older fish are summarized by management unit in Table 7. The harvest in weight is calculated by multiplying the age specific catch (millions of fish) by mean weight in the harvest (2 year average, 1999-2000). The CAGEAN version of projected 2001 harvest is presented in Table 7b.

The 2001 projected harvest estimates were influenced by new F_{opt} values, estimated selectivity, ADMB estimates of 2000 population size and fishing mortality, and recruitment of the 1999 year class. The 2001 harvest is expected to be influenced strongly by the 1998 (age 3) and 1996 (age 5) year classes.

Recommended Allowable Harvest

The Recommended Allowable Harvest (RAH) and accepted Total Allowable Catch (TAC) for 2000 were presented under *2000 Fisheries Review*. For 2001, there were a number of considerations for recommending allowable harvest. In accordance with the new Lake Erie Percid Management Strategy, continued conservative exploitation contributes to the goal of stock sustainability. New methodology was adopted this year in two forms. Catch-age analysis using ADMB with auxiliary survey data was used to estimate population size in each management unit. In the past, CAGEAN was used for catch-age analysis, with a number of constraints described earlier under *Catch-Age Analysis*. Additionally, the targeted fishing mortality rate, F_{opt}, was reduced in each management unit in response to recent changes in growth reflected by von Bertalanffy parameters which are variables in the yield per recruit model. Growth of yellow perch has declined during recent years in MU 1. The mechanism of this change will continue to be investigated as a charge over the next year. If growth remains depressed, the MU 1 stock may be sustainable only at lower levels of exploitation.

While more positive signs in abundance are apparent in management units 2, 3 and 4 , new methodology and variance about the population / biomass estimates lead to uncertainty. Uncertainty is proportional to risk in fisheries management. For these reasons, and for reference, we have included two RAH scenarios in Table 8, based on the most recent ADMB (and new Fopt) and former CAGEAN methodology (with old F_{opt}). Tables 8 a and b refer to the mean, minimum and maximum recommended harvest using the newer (8a) and older (8b) methodology. Minimum and maximum RAH values reflect the F_{opt} strategy applied to population estimates plus or minus one standard error.

Unit 4 has been excluded from RAH derivation. The Lake Erie Committee chose this course based on signs of yellow perch recovery due to existing rehabilitation efforts (ie: Ontario Five-Year East Basin Rehabilitation Strategy). Limitations of existing data reflected by wide variance about population estimates supports this course of action. The Total Allowable Catch for Unit 4 is expected to remain the same as last year, but is presented in tables for reference only.

The task group maintains that conservative allocations are appropriate. However, the perception of *conservative* varies between the two methods. The lake-wide mean RAH varies from 4.9 to 6.8 million pounds with the different approaches. The lake-wide 2000 TAC was 6.5 million pounds, and 6 million pounds were harvested. According to survey gear, abundance in 2000 was comparable to and in some cases above, 1999 levels. While indictors such as increasing sport effort and declining commercial effort signaled good abundance, other indicators were mixed. Catch-per-unit-effort results were more ambiguous, depending on the management unit. Compared to 1999, sport CPUE in 2000 was similar or less in MU 1, similar in MU 2, while angling success varied more between jurisdictions in MU 3 and MU4. Commercial CPUE values in 2000 (trap nets and gill nets) were consistently higher in all management units.

These data, combined with recruitment, growth, and age structure information, describe the status of Lake Erie yellow perch stocks. These data, while incorporated into the catch-age analysis models, should also be considered independently when determining total allowable catch for each management unit.

Additional Task Group Charges

Yellow Perch Stock Genetics

The task group has agreed to continue collection of samples in support of genetic research in 2001. Stock discrimination is necessary for assessment and research purposes and also represents the basis for management units.

Yellow Perch Bioenergetics

This year, the task group continued to examine parameters and input data that will assist in bioenergetic modeling. In this coming year, the Yellow Perch Task Group, in cooperation with the forage task group, will examine the role of biotic and abiotic factors affecting growth of yellow perch.

Conclusions

Task group methodology continues to improve, while maintaining proven techniques of the past. In the upcoming year, the group seeks explanations for changes in growth and related effects on gear selectivity. While advances using AD Model Builder were implemented in 2000, the task group is committed to advancing this methodology further. In 2001, the performance of new and older modeling tools will be compared, based on survey and fishery information as it becomes available.

Task group members are grateful to Dr. Pat Sullivan, Dr. Jim Bence and Cliff Kraft for their continued instruction using AD Model Builder for fisheries applications. We are pleased that Dr. Carol Stepien has agreed to continue with yellow perch genetic research. We look forward to working and communicating with other researchers on our charges in the coming year.

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Table 1. Lake Erie yellow perch harvest in pounds by management unit (Unit) and agency, 1988-2000.

		Ontario*		Ohio		Michigan		Pennsylvania		New York		Total
	Year	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch
Unit 1	1988	3,186,225	61	1,865,430	36	167,580	3	--	--	--	--	5,219,235
	1989	3,157,560	59	1,900,710	35	332,955	6	--	--	--	--	5,391,225
	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
Unit 2	1988	5,596,290	93	421,155	7	--	--	--	--	--	--	6,017,445
	1989	5,578,650	84	1,071,630	16	--	--	--	--	--	--	6,650,280
	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
Unit 3	1988	2,487,240	78	526,995	17	--	--	178,605	6	--	--	3,192,840
	1989	2,414,475	63	1,199,520	31	--	--	211,680	6	--	--	3,825,675
	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
Unit 4	1988	568,890	98	--	--	--	--	2,205	<1	8,820	2	579,915
	1989	438,795	78	--	--	--	--	0	0	121,275	22	560,070
	1990	282,240	88	--	--	--	--	0	0	37,485	12	319,725
	1991	160,965	87	--	--	--	--	0	0	24,255	13	185,220
	1992	114,660	85	--	--	--	--	0	0	19,845	15	134,505
	1993	72,765	85	--	--	--	--	0	0	13,230	15	85,995
	1994	52,920	83	--	--	--	--	0	0	11,025	17	63,945
	1995	33,075	83	--	--	--	--	0	0	6,615	17	39,690
	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
Lakewide Totals	1988	11,838,645	79	2,813,580	19	167,580	1	180,810	1	8,820	<1	15,009,435
	1989	11,589,480	71	4,171,860	25	332,955	2	211,680	1	121,275	1	16,427,250
	1990	7,064,820	73	2,110,185	22	231,525	2	185,220	2	37,485	<1	9,629,235
	1991	4,193,910	69	1,618,470	27	94,815	2	152,145	3	24,255	<1	6,083,595
	1992	4,515,840	78	1,091,475	19	66,150	1	77,175	1	19,845	<1	5,770,485
	1993	3,752,910	73	1,217,160	24	123,480	2	24,255	<1	13,230	<1	5,131,035
	1994	2,443,140	55	1,838,970	42	66,150	1	55,125	1	11,025	<1	4,414,410
	1995	2,096,955	54	1,673,595	43	77,175	2	30,870	1	6,615	<1	3,885,210
	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

* processor weight

Table 2a. 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, 1988-2000.

		Unit 1			
		Ohio		Michigan	Ontario
	Year	Trap Nets	Sport	Sport	Gill Nets
	1988	626,220	1,239,210	167,580	3,186,225
	1989	864,360	1,036,350	332,955	3,157,560
	1990	463,050	189,630	231,525	1,781,640
	1991	196,245	485,100	94,815	648,270
	1992	123,480	282,240	66,150	687,960
Catch	1993	158,760	418,950	123,480	1,139,985
(pounds)	1994	165,375	269,010	66,150	710,010
	1995	108,045	676,935	77,175	524,790
	1996	200,313	925,403	134,810	704,167
	1997	211,876	859,149	111,819	1,091,844
	1998	184,142	784,700	132,051	1,170,533
	1999	200,939	707,609	101,549	1,048,100
	2000	240,541	798,109	67,010	980,323
	1988	284	562	76	1,445
	1989	392	470	151	1,432
	1990	210	86	105	808
	1991	89	220	43	294
Catch	1992	56	128	30	312
(Metric)	1993	72	190	56	517
(tonnes)	1994	75	122	30	322
	1995	49	307	35	238
	1996	91	420	61	319
	1997	96	390	51	495
	1998	84	356	60	531
	1999	91	321	46	475
	2000	109	362	30	445
	1988	6,900	1,153,182	494,158	9,616
	1989	8,418	1,028,551	696,973	12,716
	1990	6,299	350,000	634,255	18,305
	1991	7,259	700,719	164,517	13,629
	1992	6,795	350,433	120,979	9,221
Effort	1993	7,092	530,012	244,455	12,006
(a)	1994	5,937	469,959	224,744	11,734
	1995	5,103	598,977	123,616	11,136
	1996	4,869	772,078	193,733	8,614
	1997	5,580	834,934	192,605	13,704
	1998	5,446	863,336	183,882	19,095
	1999	5,185	941,350	184,710	12,846
	2000	4,026	965,628	122,447	6,741
	1988	41.2	4.2	0.5	150.3
	1989	46.6	2.8	1.7	112.6
	1990	33.3	1.4	1.3	44.1
	1991	12.3	2.4	1.9	21.6
	1992	8.2	2.8	2.1	33.8
Catch Rates	1993	10.2	2.6	1.9	43.1
(b)	1994	12.6	2.2	1.1	27.4
	1995	9.6	4.3	2.8	21.4
	1996	18.7	4.9	3.3	37.0
	1997	17.2	3.7	2.8	36.1
	1998	15.4	3.8	3.2	27.8
	1999	17.6	3.3	2.1	37.0
	2000	27.1	3.0	2.2	66.0

(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 2b. 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, 1988-2000.

		Unit 2		
		Ohio		Ontario
	Year	Trap Nets	Sport	Gill Nets
	1988	46,305	374,850	5,596,290
	1989	200,655	870,975	5,578,650
	1990	650,475	302,085	2,873,115
	1991	302,085	381,465	2,171,925
	1992	145,530	355,005	2,522,520
Catch	1993	114,660	379,260	1,933,785
(pounds)	1994	304,290	740,880	1,300,950
	1995	257,985	546,840	1,073,835
	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
	1988	21	170	2,538
	1989	91	395	2,530
	1990	295	137	1,303
	1991	137	173	985
Catch	1992	66	161	1,144
(Metric)	1993	52	172	877
(tonnes)	1994	138	336	590
	1995	117	248	487
	1996	147	227	585
	1997	226	263	828
	1998	138	147	815
	1999	177	265	713
	2000	256	274	673
	1988	448	402,180	17,315
	1989	1,403	572,612	25,679
	1990	6,238	400,676	31,613
	1991	6,480	452,277	34,739
	1992	4,753	340,917	35,348
Effort	1993	2,558	320,891	25,569
(a)	1994	7,139	538,977	23,441
	1995	6,467	388,238	18,337
	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
	1988	46.9	2.4	146.6
	1989	64.9	3.4	98.5
	1990	47.3	1.5	41.2
	1991	21.1	2.2	28.4
	1992	13.9	3.0	32.4
Catch Rates	1993	20.3	3.1	34.3
(b)	1994	19.3	3.3	25.2
	1995	18.1	3.5	26.6
	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

(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 2c. 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, 1988-2000.

		Unit 3					
		Ohio		Ontario	Pennsylvania		
	Year	Trap Nets	Sport	Gill Nets	Gill Nets	Trap Nets	Sport
	1988	330,750	196,245	2,487,240	178,605		
	1989	635,040	564,480	2,414,475	211,680		
	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		
Catch	1993	68,355	77,175	606,375	24,255		
(pounds)	1994	141,120	218,295	379,260	55,125		
	1995	63,945	19,845	465,255	30,870		
	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
	1988	150	89	1,128	81		
	1989	288	256	1,095	96		
	1990	203	26	965	84		
Catch	1991	84	31	550	69		
(Metric)	1992	46	38	540	35		
(tonnes)	1993	31	35	275	11		
	1994	64	99	172	25		
	1995	29	9	211	14		
	1996	47	38	232	0	2.4	1.7
	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
	1988	4,781	172,490	6,203	1,418		
	1989	7,281	248,530	7,098	1,037		
	1990	7,376	31,881	12,472	1,978		
Effort	1991	4,516	54,607	12,247	2,018		
(a)	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		
	1995	3,258	42,234	6,843	1,465		
	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
	1988	31.4	2.7	181.8	57.1		
	1989	39.6	4.1	154.3	92.6		
	1990	27.5	1.9	77.4	42.5		
Catch Rates	1991	18.6	2.0	44.9	34.2		
(b)	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		
	1995	8.9	1.3	30.8	9.6		
	1996	17.2	2.8	37.5		13.0	0.8
	1997	10.2	3.1	39.9		7.6	0.9
	1998	16.3	3.6	34.0		7.9	1.4
	1999	20.1	3.5	69.6		5.4	1.3
	2000	43.3	3.0	149.4		11.6	1.9

(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 2d. 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, 1988-2000.

		Unit 4					
		New York		Ontario	Pennsylvania		
	Year	Trap Nets	Sport	Gill Nets	Gill Nets	Trap Nets	Sport
Catch (pounds)	1988	8,820		568,890	2,205		
	1989	17,640	103,635	438,795	0		
	1990	19,845	17,640	282,240	0		
	1991	15,435	8,820	160,965	0		
	1992	11,025	8,820	114,660	0		
	1993	6,615	6,615	72,765	0		
	1994	4,410	6,615	52,920	0		
	1995	3,122	6,615	33,075	0		
	1996	2,822	1,650	30,495	0	0	2,205
	1997	1,241	1,146	36,171	0	0	3,049
	1998	1,345	1,830	48,457	0	0	538
	1999	694	2,540	59,842	0	0	2,216
	2000	625	1,833	35,686	0	0	10,950
Catch (Metric) (tonnes)	1988	4.0		258	1		
	1989	8.0	47.0	199	0		
	1990	9.0	8.0	128	0		
	1991	7.0	4.0	73	0		
	1992	5.0	4.0	52	0		
	1993	3.0	3.0	33	0		
	1994	2.0	3.0	24	0		
	1995	1.4	3.0	15	0		
	1996	1.3	0.7	14	0	0	1.0
	1997	0.6	0.5	16	0	0	1.4
	1998	0.6	0.8	22	0	0	0.2
	1999	0.3	1.2	27	0	0	1.0
	2000	0.3	0.8	16	0	0	5.0
Effort *(a)*	1988	2,132		2,719	8		
	1989	1,136	65,370	2,628	0		
	1990	981	24,463	3,924	0		
	1991	918	22,090	3,859	0		
	1992	632	52,398	3,351	0		
	1993	761	26,297	2,008	0		
	1994	555	14,800	1,642	0		
	1995	532	12,115	1,375	0		
	1996	533	6,535	1,063	0	0	7,292
	1997	292	8,905	1,073	0	0	13,747
	1998	178	7,073	1,081	0	0	3,784
	1999	118	5,410	872	0	0	13,623
	2000	44	2,606	314	0	0	21,146
Catch Rates *(b)*	1988	1.9		94.9	125.0		
	1989	7.0	2.0	75.7			
	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			
	1995	2.7	0.5	10.9			
	1996	2.4	0.3	13.1			0.6
	1997	1.9	0.3	14.9			1.0
	1998	3.4	0.5	20.4			0.3
	1999	2.7	0.4	31.0			0.4
	2000	6.4	0.2	51.0			1.7

(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 3. Lake Erie 2000 yellow perch harvest in numbers of fish by gear, age and management unit (Unit).

Gear	Age	Unit 1 Number	Unit 1 %	Unit 2 Number	Unit 2 %	Unit 3 Number	Unit 3 %	Unit 4 Number	Unit 4 %	Lakewide Number	Lakewide %
Gill Nets	1	0	0.0	1,490	0.0	0	0.0	0	0.0	1,490	0.0
	2	94,153	2.5	611,193	11.0	98,897	4.2	15,076	13.3	819,319	6.9
	3	238,673	6.4	545,892	9.8	177,356	7.5	22,987	20.3	984,908	8.3
	4	2,058,267	54.9	3,779,189	67.8	1,478,310	62.1	66,344	58.6	7,382,110	62.5
	5	1,111,488	29.7	520,360	9.3	529,311	22.2	6,916	6.1	2,168,075	18.3
	6+	245,681	6.6	117,362	2.1	96,379	4.0	1,829	1.6	461,251	3.9
	Total	3,748,262		5,575,486		2,380,253		113,152		11,817,153	
Trap Nets	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	0	0.0	11,773	0.7	13,595	2.9	53	5.9	25,421	0.9
	3	44,638	5.9	180,414	10.4	69,219	14.7	0	0.0	294,271	10.0
	4	315,578	42.0	1,418,561	82.0	364,904	77.7	370	41.2	2,099,413	71.1
	5	377,859	50.2	95,926	5.5	11,761	2.5	53	5.9	485,599	16.4
	6+	14,027	1.9	23,576	1.4	10,082	2.1	423	47.1	48,108	1.6
	Total	752,102		1,730,250		469,561		899		2,952,812	
Sport	1	14,208	0.4	24,687	1.4	0	0.0	0	0.0	38,895	0.7
	2	815,469	24.5	623,976	35.2	154,606	20.7	1,550	7.9	1,595,601	27.2
	3	637,948	19.2	416,923	23.5	134,924	18.1	330	1.7	1,190,125	20.3
	4	1,322,892	39.8	614,962	34.7	318,045	42.6	8,535	43.2	2,264,434	38.6
	5	393,957	11.8	40,596	2.3	46,638	6.2	1,219	6.2	482,410	8.2
	6+	140,409	4.2	49,546	2.8	92,222	12.4	8,103	41.1	290,280	5.0
	Total	3,324,884		1,770,690		746,435		19,737		5,861,746	
All Gear	1	14,208	0.2	26,177	0.3	0	0.0	0	0.0	40,385	0.2
	2	909,622	11.6	1,246,942	13.7	267,098	7.4	16,679	12.5	2,440,341	11.8
	3	921,259	11.8	1,143,229	12.6	381,499	10.6	23,317	17.4	2,469,304	12.0
	4	3,696,737	47.3	5,812,712	64.0	2,161,259	60.1	75,249	56.2	11,745,957	56.9
	5	1,883,304	24.1	656,882	7.2	587,710	16.3	8,188	6.1	3,136,084	15.2
	6+	400,117	5.1	190,484	2.1	198,683	5.5	10,355	7.7	799,639	3.9
	Total	7,811,040		9,076,426		3,596,249		133,788		20,631,711	

Table 4. Estimates of Lake Erie yellow perch population size, biomass, exploitation and survival rates from the AD Model Catch-Age analysis. S is the annual survival rate and u is the annual exploitation rate. Results are presented for ages 2+ and ages 3+ for 1988-2000 by management unit (Unit).

		Number - Ages 2+	Biomass - Ages 2+				Number - Ages 3+	Biomass - Ages 3+			
	Year	(millions)	(millions kg)	(millions lbs)	S	u	(millions)	(millions kg)	(millions lbs)	S	u
Unit 1	1988	72.559	5.729	12.632	0.433	0.296	51.656	4.997	11.019	0.352	0.399
	1989	34.279	3.186	7.025	0.283	0.490	31.442	3.078	6.787	0.253	0.530
	1990	14.435	1.469	3.239	0.378	0.366	9.707	1.223	2.697	0.261	0.519
	1991	17.456	1.666	3.674	0.532	0.171	5.457	0.838	1.848	0.337	0.419
	1992	24.245	2.268	5.002	0.502	0.209	9.290	1.162	2.561	0.308	0.458
	1993	17.047	1.951	4.301	0.347	0.406	12.176	1.517	3.345	0.244	0.541
	1994	17.481	1.731	3.816	0.515	0.193	5.918	0.898	1.980	0.296	0.473
	1995	40.521	3.017	6.652	0.578	0.115	8.997	0.968	2.134	0.387	0.355
	1996	54.387	4.412	9.729	0.471	0.248	23.403	2.429	5.356	0.289	0.482
	1997	54.641	3.832	8.450	0.486	0.229	25.601	2.322	5.120	0.328	0.431
	1998	73.819	4.731	10.432	0.550	0.149	26.544	2.320	5.115	0.396	0.344
	1999	50.614	4.280	9.436	0.504	0.207	40.587	3.718	8.198	0.468	0.251
	2000	50.293	4.222	9.310	0.511	0.198	25.497	2.709	5.974	0.386	0.356
Unit 2	1988	65.870	5.501	12.130	0.514	0.194	35.611	4.170	9.194	0.434	0.295
	1989	36.492	3.845	8.477	0.407	0.329	33.840	3.693	8.144	0.393	0.347
	1990	19.978	3.500	7.717	0.316	0.446	14.853	3.084	6.801	0.236	0.552
	1991	20.304	2.719	5.996	0.459	0.263	6.314	1.530	3.374	0.277	0.498
	1992	26.377	3.097	6.828	0.474	0.244	9.321	1.698	3.744	0.322	0.439
	1993	18.976	2.506	5.525	0.398	0.341	12.506	1.911	4.213	0.321	0.440
	1994	24.451	2.867	6.321	0.494	0.219	7.547	1.700	3.749	0.299	0.469
	1995	27.363	2.098	4.627	0.462	0.259	12.084	1.212	2.673	0.312	0.451
	1996	35.065	3.882	8.560	0.478	0.239	12.654	1.820	4.013	0.298	0.470
	1997	35.340	3.427	7.556	0.423	0.309	16.760	2.256	4.975	0.281	0.493
	1998	85.350	7.144	15.752	0.533	0.170	14.949	1.934	4.264	0.322	0.439
	1999	55.355	6.519	14.375	0.514	0.194	45.476	5.729	12.632	0.490	0.224
	2000	78.462	10.051	22.163	0.545	0.155	28.468	5.052	11.140	0.417	0.316
Unit 3	1988	41.516	5.092	11.228	0.575	0.118	25.727	3.813	8.408	0.525	0.180
	1989	27.806	4.717	10.401	0.510	0.199	23.856	4.464	9.844	0.487	0.228
	1990	18.151	3.554	7.836	0.430	0.300	14.174	3.263	7.196	0.377	0.368
	1991	14.049	2.470	5.447	0.451	0.273	7.810	1.902	4.195	0.334	0.423
	1992	11.829	1.705	3.759	0.505	0.206	6.339	1.233	2.718	0.413	0.321
	1993	8.321	1.259	2.777	0.427	0.304	5.968	1.048	2.310	0.359	0.391
	1994	7.906	0.911	2.008	0.529	0.175	3.554	0.632	1.394	0.412	0.323
	1995	11.251	0.732	1.615	0.607	0.079	4.186	0.471	1.039	0.536	0.166
	1996	17.204	1.464	3.229	0.604	0.082	6.825	0.790	1.741	0.533	0.171
	1997	17.936	1.912	4.217	0.554	0.144	10.385	1.467	3.234	0.495	0.218
	1998	36.900	3.131	6.905	0.610	0.075	9.930	1.324	2.920	0.519	0.188
	1999	29.211	3.788	8.352	0.615	0.069	22.499	3.237	7.138	0.602	0.085
	2000	46.994	6.394	14.100	0.617	0.066	17.957	3.433	7.569	0.555	0.143
Unit 4	1988	14.900	1.253	2.764	0.581	0.111	11.892	1.127	2.485	0.561	0.136
	1989	9.691	1.187	2.617	0.536	0.166	8.654	1.135	2.503	0.522	0.184
	1990	5.855	1.245	2.745	0.564	0.132	5.197	1.212	2.673	0.553	0.146
	1991	3.776	1.019	2.247	0.563	0.133	3.301	0.994	2.192	0.550	0.149
	1992	2.216	0.611	1.348	0.636	0.043	2.124	0.606	1.337	0.634	0.044
	1993	1.939	0.653	1.440	0.602	0.084	1.409	0.608	1.341	0.583	0.108
	1994	1.625	0.308	0.679	0.617	0.066	1.167	0.288	0.635	0.601	0.086
	1995	3.818	0.366	0.807	0.653	0.021	1.002	0.225	0.496	0.622	0.059
	1996	3.973	0.436	0.961	0.639	0.039	2.493	0.342	0.755	0.623	0.058
	1997	3.123	0.375	0.826	0.624	0.057	2.537	0.345	0.760	0.614	0.069
	1998	7.600	0.677	1.493	0.665	0.007	1.949	0.434	0.958	0.652	0.023
	1999	6.217	1.007	2.221	0.639	0.039	5.050	0.913	2.013	0.632	0.047
	2000	14.876	1.891	4.171	0.663	0.009	3.970	0.855	1.886	0.648	0.027

Table 4b. Estimates of Lake Erie yellow perch population size, biomass, exploitation and survival rates from the three-gear CAGEAN model. S is the annual survival rate and u is the annual exploitation rate. Results are presented for ages 2+ and ages 3+ from 1988 (1990 in MU 4) through 2000 by management unit (Unit).

	Year	Number - Ages 2+ (millions)	Biomass - Ages 2+ (millions kg)	Biomass - Ages 2+ (millions lbs)	S	u	Number - Ages 3+ (millions)	Biomass - Ages 3+ (millions kg)	Biomass - Ages 3+ (millions lbs)	S	u
Unit 1	1988	78.426	9.440	20.815	0.451	0.273	55.272	7.294	16.083	0.379	0.365
	1989	37.625	4.821	10.631	0.346	0.408	35.402	4.636	10.223	0.329	0.430
	1990	17.324	2.807	6.190	0.371	0.375	13.009	2.241	4.941	0.296	0.472
	1991	16.677	2.043	4.505	0.464	0.257	6.435	1.019	2.247	0.274	0.502
	1992	20.492	2.381	5.251	0.497	0.215	7.732	1.042	2.297	0.317	0.445
	1993	16.375	1.923	4.240	0.401	0.337	10.183	1.500	3.307	0.281	0.493
	1994	19.739	2.258	4.979	0.507	0.203	6.565	0.928	2.045	0.302	0.465
	1995	34.934	3.681	8.116	0.545	0.156	10.004	1.288	2.839	0.367	0.381
	1996	47.833	5.092	11.227	0.512	0.196	19.028	2.278	5.024	0.353	0.398
	1997	44.970	4.705	10.374	0.502	0.208	24.493	2.869	6.326	0.388	0.353
	1998	49.118	4.987	10.997	0.508	0.201	22.594	2.547	5.616	0.358	0.392
	1999	31.882	3.384	7.461	0.453	0.271	24.969	2.946	6.496	0.400	0.338
	2000	42.328	3.309	7.297			14.430	2.287	5.042		
Unit 2	1988	93.209	13.358	29.454	0.507	0.202	62.599	9.858	21.737	0.463	0.258
	1989	50.116	8.374	18.464	0.387	0.355	47.292	8.161	17.995	0.377	0.368
	1990	25.533	4.527	9.982	0.403	0.334	19.376	3.801	8.380	0.368	0.379
	1991	29.809	4.455	9.823	0.430	0.300	10.297	2.146	4.732	0.362	0.387
	1992	35.914	4.752	10.479	0.450	0.274	12.808	2.226	4.909	0.349	0.404
	1993	25.404	3.249	7.165	0.402	0.336	16.177	2.582	5.693	0.335	0.422
	1994	29.354	3.823	8.430	0.496	0.216	10.208	1.749	3.857	0.392	0.348
	1995	29.515	3.999	8.818	0.494	0.219	14.563	2.250	4.961	0.403	0.334
	1996	50.382	6.242	13.765	0.565	0.130	14.579	2.340	5.160	0.437	0.291
	1997	44.227	5.547	12.230	0.438	0.290	28.463	4.044	8.916	0.353	0.398
	1998	81.866	9.640	21.255	0.556	0.142	19.359	3.014	6.646	0.395	0.344
	1999	50.860	7.258	16.003	0.504	0.206	45.505	6.665	14.696	0.490	0.224
	2000	42.048	5.996	13.222			25.655	3.964	8.741		
Unit 3	1988	58.535	10.913	24.064	0.542	0.159	50.789	9.710	21.411	0.524	0.181
	1989	35.082	6.601	14.556	0.457	0.265	31.733	6.263	13.810	0.437	0.292
	1990	20.539	4.368	9.632	0.480	0.236	16.040	3.849	8.488	0.437	0.291
	1991	19.427	3.341	7.367	0.496	0.217	9.865	2.270	5.006	0.382	0.361
	1992	14.460	2.456	5.415	0.428	0.303	9.627	1.930	4.257	0.333	0.425
	1993	8.483	1.476	3.255	0.419	0.313	6.183	1.203	2.652	0.342	0.413
	1994	15.812	1.671	3.684	0.586	0.104	3.557	0.825	1.820	0.398	0.341
	1995	16.205	2.160	4.763	0.587	0.103	9.273	1.361	3.001	0.533	0.170
	1996	23.274	3.074	6.779	0.592	0.097	9.509	1.496	3.299	0.498	0.214
	1997	23.438	2.792	6.156	0.527	0.177	13.781	2.103	4.637	0.440	0.287
	1998	31.992	4.141	9.132	0.581	0.110	12.355	2.014	4.441	0.466	0.254
	1999	20.421	3.165	6.978	0.543	0.157	18.590	2.988	6.588	0.532	0.171
	2000	22.899	3.289	7.253			11.096	2.382	5.252		
Unit 4	1990	12.041	1.977	4.359	0.532	0.171	11.028	1.910	4.212	0.520	0.186
	1991	7.127	1.377	3.036	0.546	0.154	6.405	1.305	2.878	0.534	0.169
	1992	4.380	0.937	2.066	0.552	0.147	3.889	0.877	1.933	0.540	0.162
	1993	2.746	0.547	1.205	0.626	0.055	2.416	0.537	1.183	0.621	0.061
	1994	2.438	0.452	0.997	0.610	0.074	1.719	0.376	0.828	0.591	0.097
	1995	2.473	0.342	0.755	0.634	0.045	1.488	0.274	0.604	0.615	0.068
	1996	4.260	0.582	1.284	0.653	0.021	1.567	0.342	0.753	0.633	0.046
	1997	4.915	0.515	1.136	0.643	0.034	2.784	0.380	0.839	0.626	0.055
	1998	3.856	0.555	1.223	0.629	0.050	3.160	0.510	1.125	0.622	0.060
	1999	4.420	0.686	1.512	0.636	0.042	2.427	0.496	1.093	0.613	0.071
	2000	3.355	0.733	1.617			2.810	0.621	1.369		

Table 5. Yellow perch stock size (millions of fish) at the start of the year, estimated by ADMB catch-age analysis for the years 1988 to 2000. The 2001 population estimates use age 2 values derived from regressions of ADMB catch-age analysis age 2 abundance against YOY and yearling trawl indices.

	Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Unit 1	2	20.902	2.837	4.728	11.999	14.955	4.871	11.563	31.525	30.984	29.040	47.275	10.027	24.796	23.244
	3	25.361	13.235	1.758	2.921	7.451	9.319	2.943	7.246	19.923	18.833	18.148	30.086	6.483	15.842
	4	20.759	10.058	4.076	0.526	0.992	2.369	2.478	1.128	2.991	6.193	6.887	7.936	14.821	3.032
	5	0.755	5.437	1.709	0.686	0.099	0.166	0.319	0.489	0.294	0.445	1.348	2.071	3.089	5.089
	6+	4.781	2.712	2.164	1.324	0.747	0.323	0.179	0.133	0.195	0.130	0.162	0.494	1.104	1.714
	2 and Older	72.559	34.279	14.435	17.456	24.245	17.047	17.481	40.521	54.387	54.641	73.819	50.614	50.293	48.922
	3 and Older	51.656	31.442	9.707	5.457	9.290	12.176	5.918	8.997	23.403	25.601	26.544	40.587	25.497	25.677
Unit 2	2	30.259	2.651	5.125	13.990	17.056	6.470	16.905	15.279	22.411	18.581	70.401	9.879	49.994	21.889
	3	14.498	18.403	1.563	2.808	7.573	9.508	3.533	9.826	8.881	12.986	10.248	40.669	6.181	30.874
	4	20.358	7.295	8.256	0.552	0.864	2.481	3.316	1.193	3.171	2.832	3.945	3.655	20.218	2.928
	5	0.154	7.758	2.344	1.507	0.094	0.179	0.513	0.853	0.300	0.750	0.539	0.936	1.554	8.049
	6+	0.602	0.385	2.690	1.447	0.789	0.338	0.184	0.211	0.303	0.192	0.217	0.216	0.516	0.894
	2 and Older	65.870	36.492	19.978	20.304	26.377	18.976	24.451	27.363	35.065	35.340	85.350	55.355	78.462	64.635
	3 and Older	35.611	33.840	14.853	6.314	9.321	12.506	7.547	12.084	12.654	16.760	14.949	45.476	28.468	42.745
Unit 3	2	15.789	3.950	3.977	6.239	5.490	2.353	4.352	7.065	10.379	7.552	26.969	6.712	29.037	9.041
	3	7.535	10.356	2.559	2.468	3.732	3.350	1.411	2.721	4.582	6.749	4.793	17.345	4.421	19.040
	4	17.062	4.405	5.619	1.229	1.030	1.692	1.410	0.665	1.545	2.567	3.576	2.692	10.574	2.615
	5	0.360	8.497	1.944	1.733	0.279	0.291	0.410	0.504	0.308	0.720	1.076	1.684	1.532	5.688
	6+	0.769	0.599	4.052	2.380	1.298	0.636	0.322	0.295	0.391	0.349	0.485	0.778	1.430	1.654
	2 and Older	41.516	27.806	18.151	14.049	11.829	8.321	7.906	11.251	17.204	17.936	36.900	29.211	46.994	38.039
	3 and Older	25.727	23.856	14.174	7.810	6.339	5.968	3.554	4.186	6.825	10.385	9.930	22.499	17.957	28.998
Unit 4	2	3.008	1.037	0.658	0.475	0.092	0.530	0.457	2.817	1.480	0.586	5.651	1.167	10.907	1.047
	3	2.536	1.987	0.681	0.429	0.308	0.062	0.347	0.300	1.870	0.984	0.390	3.780	0.777	7.289
	4	8.279	1.499	1.098	0.360	0.216	0.197	0.033	0.194	0.184	1.163	0.614	0.256	2.386	0.506
	5	0.552	4.522	0.749	0.493	0.149	0.131	0.090	0.016	0.112	0.109	0.694	0.398	0.156	1.534
	6+	0.525	0.646	2.667	2.019	1.451	1.019	0.698	0.491	0.328	0.281	0.251	0.617	0.650	0.532
	2 and Older	14.900	9.691	5.855	3.776	2.216	1.939	1.625	3.818	3.973	3.123	7.600	6.217	14.876	10.908
	3 and Older	11.892	8.654	5.197	3.301	2.124	1.409	1.167	1.002	2.493	2.537	1.949	5.050	3.970	9.862

Table 5b. Yellow perch stock size (millions of fish) at the start of the year, estimated by CAGEAN for the years 1988 to 2000. The 2001 population estimates use age 2 values derived from regressions of CAGEAN age 2 abundance against YOY and yearling trawl indices.

	Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Unit 1	2	23.154	2.223	4.315	10.242	12.760	6.192	13.174	24.930	28.804	20.477	26.524	6.913	27.899	17.497
	3	24.562	14.452	1.367	2.579	5.971	7.734	3.707	8.020	15.361	17.775	13.079	16.882	4.438	17.736
	4	24.884	9.579	4.934	0.357	0.609	1.809	2.169	1.143	2.966	5.398	7.565	5.453	7.482	1.935
	5	2.187	8.893	2.922	1.187	0.076	0.166	0.457	0.611	0.392	1.042	1.550	2.070	1.663	2.412
	6+	3.639	2.478	3.786	2.312	1.076	0.474	0.231	0.231	0.311	0.278	0.400	0.564	0.846	0.861
	2 and Older	78.426	37.625	17.324	16.677	20.492	16.375	19.739	34.934	47.833	44.970	49.118	31.882	42.328	40.442
	3 and Older	55.272	35.402	13.009	6.435	7.732	10.183	6.565	10.004	19.028	24.493	22.594	24.969	14.430	22.944
Unit 2	2	30.611	2.824	6.157	19.512	23.106	9.227	19.146	14.952	35.803	15.764	62.507	5.356	16.392	22.628
	3	14.955	18.287	1.565	3.167	9.080	11.707	4.793	10.557	8.713	22.096	9.312	37.854	3.368	10.083
	4	45.530	7.418	7.443	0.453	0.698	2.642	3.735	1.903	4.103	3.691	7.527	3.523	18.306	1.538
	5	0.876	20.404	2.572	1.629	0.070	0.156	0.659	1.316	0.740	1.724	1.248	2.825	1.695	7.332
	6+	1.237	1.184	7.797	5.048	2.960	1.672	1.020	0.787	1.023	0.952	1.272	1.303	2.286	2.154
	2 and Older	93.209	50.116	25.533	29.809	35.914	25.404	29.354	29.515	50.382	44.227	81.866	50.860	42.048	43.734
	3 and Older	62.599	47.292	19.376	10.297	12.808	16.177	10.208	14.563	14.579	28.463	19.359	45.505	25.655	21.107
Unit 3	2	7.747	3.349	4.499	9.562	4.834	2.300	12.254	6.932	13.765	9.657	19.637	1.831	11.803	9.855
	3	6.652	5.123	2.189	2.853	5.856	2.983	1.445	7.859	4.563	9.048	6.294	12.829	1.207	7.701
	4	42.292	3.743	2.511	0.750	0.665	1.509	0.946	0.577	4.205	2.246	3.937	2.856	6.787	0.551
	5	1.244	21.857	1.574	0.524	0.076	0.081	0.273	0.279	0.267	2.070	0.977	1.770	1.490	3.019
	6+	0.601	1.010	9.767	5.738	3.029	1.611	0.893	0.559	0.473	0.416	1.148	1.135	1.611	1.586
	2 and Older	58.535	35.082	20.539	19.427	14.460	8.483	15.812	16.205	23.274	23.438	31.992	20.421	22.899	22.712
	3 and Older	50.789	31.733	16.040	9.865	9.627	6.183	3.557	9.273	9.509	13.781	12.355	18.590	11.096	12.858
Unit 4	2		1.013	0.722	0.491	0.330	0.719	0.985	2.693	2.131	0.696	1.993	0.545	3.430	1.329
	3		2.552	0.667	0.470	0.317	0.218	0.472	0.651	1.791	1.418	0.463	1.322	0.362	1.328
	4		0.949	1.489	0.346	0.231	0.190	0.122	0.282	0.402	1.110	0.873	0.277	0.788	0.291
	5		6.190	0.451	0.505	0.101	0.116	0.078	0.060	0.174	0.248	0.682	0.522	0.165	0.549
	6+		1.337	3.797	2.568	1.767	1.195	0.817	0.573	0.416	0.384	0.409	0.689	0.774	0.706
	2 and Older		12.041	7.127	4.380	2.746	2.438	2.473	4.260	4.915	3.856	4.420	3.355	5.519	4.203
	3 and Older		11.028	6.405	3.889	2.416	1.719	1.488	1.567	2.784	3.160	2.427	2.810	2.089	2.874

Table 6. Projection of the 2001 Lake Erie yellow perch population. Stock size estimates are derived from ADMB catch-age analysis. Age 2 estimates in 2001 are derived from regressions of ADMB catch-age analysis age 2 abundance against YOY and yearling trawl indices. CV is coefficient of variation in stock size for the last year of ADMB catch-age analysis runs.

			2000 Parameters				Rate Functions					2001 Parameters				Stock Biomass			
			Stock Size (numbers)				Mortality Rates				Survival Rate		Stock Size (numbers)			Mean Weight in	millions kg		millions lbs.
	CV	Age	Mean	Std. Err.	Min.	Max.	(F)	(Z)	(A)	(u)	(S)	Age	Mean	Min.	Max.	Pop. (kg)	2000	2001	2001
Unit 1		2	24.796	7.765	17.031	32.561	0.048	0.448	0.361	0.039	0.639	2	23.244	9.744	36.744	0.058	1.513	1.359	2.996
	0.313	3	6.483	2.030	4.453	8.513	0.360	0.760	0.532	0.252	0.468	3	15.842	10.881	20.803	0.085	0.577	1.342	2.958
		4	14.821	4.641	10.180	19.463	0.669	1.069	0.657	0.411	0.343	4	3.032	2.082	3.981	0.101	1.482	0.307	0.678
		5	3.089	0.967	2.122	4.056	0.669	1.069	0.657	0.411	0.343	5	5.089	3.495	6.683	0.148	0.426	0.755	1.664
		6+	1.104	0.346	0.758	1.449	0.124	0.524	0.408	0.097	0.592	6+	1.714	1.177	2.251	0.268	0.224	0.459	1.012
		Total	50.293	12.304	37.988	62.597	0.272	0.672	0.489	0.198	0.511	Total	48.922	27.381	70.463		4.222	4.221	9.308
		(3+)	25.497	6.238	17.512	33.482	0.553	0.953	0.614	0.356	0.386	(3+)	25.677	17.636	33.718		2.709	2.863	6.312
Unit 2		2	49.994	20.445	29.549	70.439	0.082	0.482	0.382	0.065	0.618	2	21.889	14.771	29.008	0.090	4.999	1.966	4.334
	0.409	3	6.181	2.528	3.653	8.709	0.347	0.747	0.526	0.244	0.474	3	30.874	18.248	43.500	0.127	0.828	3.931	8.668
		4	20.218	8.268	11.950	28.486	0.521	0.921	0.602	0.340	0.398	4	2.928	1.731	4.126	0.168	3.700	0.491	1.083
		5	1.554	0.635	0.918	2.189	0.521	0.921	0.602	0.340	0.398	5	8.049	4.757	11.341	0.212	0.340	1.710	3.770
		6+	0.516	0.211	0.305	0.727	0.227	0.627	0.466	0.169	0.534	6+	0.894	0.528	1.260	0.402	0.184	0.359	0.792
		Total	78.462	32.087	46.375	110.549	0.207	0.607	0.455	0.155	0.545	Total	64.635	40.036	89.234		10.051	8.457	18.648
		(3+)	28.468	11.642	16.826	40.110	0.475	0.875	0.583	0.316	0.417	(3+)	42.745	25.265	60.226		5.052	6.491	14.313
Unit 3		2	29.037	12.856	16.180	41.893	0.022	0.422	0.344	0.018	0.656	2	9.041	5.219	12.863	0.092	2.962	0.832	1.835
	0.443	3	4.421	1.957	2.463	6.378	0.125	0.525	0.408	0.097	0.592	3	19.040	10.610	27.471	0.134	0.637	2.560	5.645
		4	10.574	4.682	5.892	15.256	0.220	0.620	0.462	0.164	0.538	4	2.615	1.457	3.773	0.167	1.946	0.438	0.965
		5	1.532	0.679	0.854	2.211	0.220	0.620	0.462	0.164	0.538	5	5.688	3.170	8.207	0.232	0.357	1.321	2.913
		6+	1.430	0.633	0.797	2.063	0.144	0.544	0.420	0.111	0.580	6+	1.654	0.922	2.387	0.349	0.493	0.577	1.272
		Total	46.994	20.807	26.187	67.801	0.083	0.483	0.383	0.066	0.617	Total	38.039	21.378	54.701		6.394	5.728	12.631
		(3+)	17.957	7.951	10.007	25.908	0.190	0.590	0.445	0.143	0.555	(3+)	28.998	16.159	41.837		3.433	4.896	10.795
Unit 4		2	10.907	7.266	3.641	18.172	0.003	0.403	0.332	0.002	0.668	2	1.047	0.160	1.970	0.085	1.036	0.089	0.195
	0.666	3	0.777	0.518	0.259	1.295	0.028	0.428	0.348	0.023	0.652	3	7.289	2.433	12.145	0.137	0.116	1.001	2.207
		4	2.386	1.590	0.797	3.976	0.042	0.442	0.357	0.034	0.643	4	0.506	0.169	0.844	0.193	0.477	0.098	0.215
		5	0.156	0.104	0.052	0.260	0.042	0.442	0.357	0.034	0.643	5	1.534	0.512	2.556	0.256	0.035	0.392	0.865
		6+	0.650	0.433	0.217	1.083	0.009	0.409	0.336	0.007	0.664	6+	0.532	0.178	0.887	0.343	0.227	0.182	0.402
		Total	14.876	9.910	4.966	24.787	0.011	0.411	0.337	0.009	0.663	Total	10.908	3.452	18.402		1.891	1.762	3.885
		(3+)	3.970	2.645	1.325	6.614	0.034	0.434	0.352	0.027	0.648	(3+)	9.862	3.292	16.431		0.855	1.673	3.690

Table 6b. Projection of the 2001 Lake Erie yellow perch population. Stock size estimates are derived from CAGEAN. Age 2 estimates in 2001 are derived from regressions of CAGEAN age 2 abundance against YOY and yearling trawl indices. CV is coefficient of variation in stock size for the last year of CAGEAN runs.

			2000 Parameters				Rate Functions					2001 Parameters				Stock Biomass			
			Stock Size (numbers)				Mortality Rates				Survival Rate		Stock Size (numbers)			Mean Weight in Pop. (kg)	millions kg		millions lbs.
	CV	**Age**	**Mean**	**Std. Err.**	**Min.**	**Max.**	**(F)**	**(Z)**	**(A)**	**(u)**	**(S)**	**Age**	**Mean**	**Min.**	**Max.**		**2000**	**2001**	**2001**
Unit 1		2	27.899	7.186	20.713	35.084	0.053	0.453	0.364	0.043	0.636	2	17.497	7.850	27.145	0.058	0.438	1.023	2.255
	0.258	3	4.438	1.143	3.295	5.581	0.430	0.830	0.564	0.292	0.436	3	17.736	13.167	22.304	0.085	1.857	1.502	3.312
		4	7.482	1.927	5.555	9.410	0.732	1.132	0.678	0.438	0.322	4	1.935	1.437	2.434	0.101	0.658	0.196	0.433
		5	1.663	0.428	1.235	2.092	0.732	1.132	0.678	0.438	0.322	5	2.412	1.791	3.034	0.148	0.306	0.358	0.789
		6+	0.846	0.218	0.628	1.063	0.556	0.956	0.616	0.358	0.384	6+	0.861	0.639	1.083	0.268	0.125	0.231	0.509
		Total	42.328	10.356	31.972	52.684	0.212	0.612	0.458	0.159	0.542	Total	40.442	24.884	55.999		3.384	3.309	7.297
		(3+)	14.430	3.530	10.713	18.146	0.619	1.019	0.639	0.388	0.361	(3+)	22.944	17.034	28.854		2.946	2.287	5.042
Unit 2		2	16.392	3.524	12.868	19.917	0.086	0.486	0.385	0.068	0.615	2	22.628	14.038	31.217	0.090	0.593	2.032	4.480
	0.215	3	3.368	0.724	2.644	4.093	0.384	0.784	0.543	0.266	0.457	3	10.083	7.915	12.250	0.127	5.135	1.284	2.831
		4	18.306	3.936	14.370	22.242	0.515	0.915	0.599	0.337	0.401	4	1.538	1.207	1.869	0.168	0.568	0.258	0.569
		5	1.695	0.364	1.331	2.060	0.330	0.730	0.518	0.234	0.482	5	7.332	5.756	8.908	0.212	0.594	1.557	3.434
		6+	2.286	0.491	1.794	2.777	0.136	0.536	0.415	0.105	0.585	6+	2.154	1.691	2.617	0.402	0.367	0.865	1.908
		Total	42.048	9.040	33.008	51.088	0.289	0.689	0.498	0.209	0.502	Total	43.734	30.607	56.862		7.258	5.996	13.222
		(3+)	25.655	5.516	20.139	31.171	0.445	0.845	0.570	0.300	0.430	(3+)	21.107	16.569	25.645		6.665	3.964	8.741
Unit 3		2	11.803	4.958	6.845	16.762	0.027	0.427	0.348	0.022	0.652	2	9.855	4.224	15.485	0.092	0.177	0.907	2.000
	0.420	3	1.207	0.507	0.700	1.714	0.384	0.784	0.543	0.266	0.457	3	7.701	4.466	10.936	0.134	1.813	1.036	2.283
		4	6.787	2.851	3.936	9.639	0.410	0.810	0.555	0.281	0.445	4	0.551	0.320	0.782	0.167	0.460	0.092	0.203
		5	1.490	0.626	0.864	2.116	0.410	0.810	0.555	0.281	0.445	5	3.019	1.751	4.288	0.232	0.405	0.701	1.546
		6+	1.611	0.677	0.934	2.288	0.157	0.557	0.427	0.120	0.573	6+	1.586	0.920	2.252	0.349	0.310	0.553	1.220
		Total	22.899	9.619	13.280	32.519	0.177	0.577	0.439	0.135	0.561	Total	22.712	11.680	33.744		3.165	3.289	7.253
		(3+)	11.096	4.661	6.435	15.757	0.366	0.766	0.535	0.256	0.465	(3+)	12.858	7.457	18.259		2.988	2.382	5.252
Unit 4		2	1.993	0.822	1.171	2.815	0.006	0.406	0.334	0.005	0.666	2	1.329	0.495	2.163	0.085	0.190	0.112	0.248
	0.413	3	0.463	0.191	0.272	0.654	0.064	0.464	0.371	0.051	0.629	3	1.328	0.780	1.876	0.137	0.066	0.182	0.402
		4	0.873	0.360	0.513	1.233	0.064	0.464	0.371	0.051	0.629	4	0.291	0.171	0.411	0.193	0.155	0.056	0.124
		5	0.682	0.281	0.401	0.964	0.050	0.450	0.362	0.040	0.638	5	0.549	0.322	0.775	0.256	0.161	0.140	0.310
		6+	0.409	0.169	0.240	0.578	0.012	0.412	0.338	0.010	0.662	6+	0.706	0.415	0.997	0.343	0.114	0.242	0.533
		Total	4.420	1.824	2.596	6.244	0.031	0.431	0.350	0.025	0.650	Total	4.203	2.183	6.223		0.686	0.733	1.617
		(3+)	2.427	1.002	1.425	3.428	0.051	0.451	0.363	0.041	0.637	(3+)	2.874	1.688	4.060		0.496	0.621	1.369

Table 7. Estimated harvest of Lake Erie yellow perch for 2001. The exploitation rate is derived from optimal yield policy, and the stock size estimate are from ADMB catch-age analysis and trawl regressions. Stock size and catch in numbers are in millions of fish. Catch weight is presented in millions of kilograms and poun

		Stock Size (numbers)			Exploitation Rate				Catch (millions of fish)			Mean Wt. in Harvest	RAH Catch (millions of kg)			RAH Catch (millions of lbs)		
	Age	**Mean**	**Min.**	**Max.**	**F(opt)**	**s(age)**	**(F)**	**(u)**	**Mean**	**Min.**	**Max.**	(kg)	**Mean**	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**
Unit 1	2	23.244	9.744	36.744	0.429	0.072	0.031	0.025	0.581	0.244	0.919	0.095	0.055	0.023	0.088	0.122	0.051	0.193
	3	15.842	10.881	20.803	0.429	0.538	0.231	0.171	2.712	1.863	3.562	0.109	0.296	0.203	0.389	0.653	0.448	0.857
	4	3.032	2.082	3.981	0.429	1.000	0.429	0.292	0.884	0.607	1.161	0.119	0.105	0.072	0.138	0.232	0.159	0.304
	5	5.089	3.495	6.683	0.429	1.000	0.429	0.292	1.484	1.019	1.949	0.130	0.193	0.133	0.254	0.426	0.293	0.560
	6+	1.714	1.177	2.251	0.429	0.185	0.080	0.063	0.108	0.074	0.142	0.176	0.019	0.013	0.025	0.042	0.029	0.055
	Total	48.922	27.381	70.463				0.118	5.770	3.808	7.733	0.116	0.669	0.444	0.893	1.474	0.980	1.969
	(3+)	25.677	17.636	33.718				0.202	5.189	3.564	6.814	0.118	0.613	0.421	0.805	1.352	0.929	1.776
Unit 2	2	21.889	14.771	29.008	0.390	0.157	0.061	0.049	1.076	0.726	1.426	0.119	0.128	0.086	0.169	0.282	0.190	0.373
	3	30.874	18.248	43.500	0.390	0.666	0.260	0.190	5.871	3.470	8.272	0.128	0.753	0.445	1.060	1.660	0.981	2.338
	4	2.928	1.731	4.126	0.390	1.000	0.390	0.270	0.790	0.467	1.112	0.142	0.112	0.066	0.158	0.247	0.146	0.349
	5	8.049	4.757	11.341	0.390	1.000	0.390	0.270	2.170	1.283	3.058	0.171	0.371	0.219	0.523	0.818	0.484	1.153
	6+	0.894	0.528	1.260	0.390	0.436	0.170	0.130	0.116	0.068	0.163	0.241	0.028	0.017	0.039	0.062	0.036	0.087
	Total	64.635	40.036	89.234				0.155	10.023	6.014	14.032	0.139	1.392	0.833	1.950	3.068	1.837	4.300
	(3+)	42.745	25.265	60.226				0.209	8.947	5.288	12.606	0.141	1.264	0.747	1.781	2.787	1.647	3.927
Unit 3	2	9.041	5.219	12.863	0.405	0.100	0.041	0.033	0.296	0.171	0.421	0.114	0.034	0.019	0.048	0.074	0.043	0.106
	3	19.040	10.610	27.471	0.405	0.568	0.230	0.171	3.250	1.811	4.690	0.147	0.479	0.267	0.691	1.056	0.588	1.523
	4	2.615	1.457	3.773	0.405	1.000	0.405	0.278	0.727	0.405	1.050	0.157	0.114	0.064	0.165	0.252	0.140	0.363
	5	5.688	3.170	8.207	0.405	1.000	0.405	0.278	1.582	0.882	2.283	0.190	0.301	0.168	0.434	0.664	0.370	0.957
	6+	1.654	0.922	2.387	0.405	0.655	0.265	0.194	0.320	0.178	0.462	0.231	0.074	0.041	0.107	0.163	0.091	0.235
	Total	38.039	21.378	54.701				0.162	6.177	3.448	8.906	0.162	1.002	0.559	1.444	2.209	1.232	3.185
	(3+)	28.998	16.159	41.837				0.203	5.881	3.277	8.484	0.165	0.968	0.539	1.396	2.134	1.189	3.079
Unit 4	2	1.047	0.160	1.970	0.428	0.071	0.031	0.025	0.026	0.004	0.049	0.117	0.003	0.000	0.006	0.007	0.001	0.013
	3	7.289	2.433	12.145	0.428	0.667	0.285	0.207	1.505	0.503	2.508	0.138	0.208	0.069	0.347	0.459	0.153	0.764
	4	0.506	0.169	0.844	0.428	1.000	0.428	0.291	0.147	0.049	0.246	0.159	0.023	0.008	0.039	0.052	0.017	0.086
	5	1.534	0.512	2.556	0.428	1.000	0.428	0.291	0.446	0.149	0.744	0.176	0.079	0.026	0.131	0.173	0.058	0.289
	6+	0.532	0.178	0.887	0.428	0.214	0.092	0.072	0.039	0.013	0.064	0.251	0.010	0.003	0.016	0.021	0.007	0.036
	Total	10.908	3.452	18.402				0.198	2.164	0.718	3.611	0.149	0.323	0.107	0.538	0.712	0.236	1.187
	(3+)	9.862	3.292	16.431				0.217	2.138	0.714	3.562	0.150	0.320	0.107	0.533	0.705	0.235	1.175

Table 7b. Estimated harvest of Lake Erie yellow perch for 2001. The exploitation rate is derived from optimal yield policy, and the stock size estimate are from CAGEAN and trawl regressions. Stock size and catch in numbers are in millions of fish. Catch weight is presented in millions of kilograms and pounds.

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												Mean Wt.	RAH					
		Stock Size (numbers)			Exploitation Rate				Catch (millions of fish)			in Harvest	Catch (millions of kg)			Catch (millions of lbs)		
	Age	**Mean**	**Min.**	**Max.**	**F(opt)**	**s(age)**	**(F)**	**(u)**	**Mean**	**Min.**	**Max.**	(kg)	**Mean**	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**
Unit 1	2	17.497	7.850	27.145	0.519	0.072	0.038	0.030	0.533	0.239	0.826	0.095	0.051	0.023	0.079	0.112	0.050	0.174
	3	17.736	13.167	22.304	0.519	0.587	0.305	0.219	3.880	2.881	4.880	0.109	0.423	0.314	0.532	0.934	0.693	1.174
	4	1.935	1.437	2.434	0.519	1.000	0.519	0.339	0.657	0.488	0.826	0.119	0.078	0.058	0.098	0.172	0.128	0.216
	5	2.412	1.791	3.034	0.519	1.000	0.519	0.339	0.819	0.608	1.030	0.130	0.107	0.079	0.134	0.235	0.175	0.296
	6+	0.861	0.639	1.083	0.519	0.760	0.394	0.272	0.234	0.174	0.295	0.176	0.041	0.031	0.052	0.091	0.068	0.114
	Total	40.442	24.884	55.999				0.151	6.123	4.389	7.856	0.114	0.700	0.505	0.895	1.544	1.113	1.974
	(3+)	22.944	17.034	28.854				0.244	5.590	4.150	7.030	0.116	0.649	0.482	0.817	1.432	1.063	1.801
Unit 2	2	22.628	14.038	31.217	0.477	0.167	0.080	0.063	1.432	0.888	1.975	0.119	0.170	0.105	0.234	0.375	0.232	0.517
	3	10.083	7.915	12.250	0.477	0.746	0.356	0.250	2.517	1.976	3.058	0.128	0.323	0.253	0.392	0.711	0.558	0.864
	4	1.538	1.207	1.869	0.477	1.000	0.477	0.318	0.488	0.383	0.594	0.142	0.069	0.054	0.084	0.153	0.120	0.186
	5	7.332	5.756	8.908	0.477	0.641	0.306	0.219	1.608	1.262	1.953	0.171	0.275	0.216	0.334	0.606	0.476	0.737
	6+	2.154	1.691	2.617	0.477	0.264	0.126	0.098	0.211	0.166	0.256	0.241	0.051	0.040	0.062	0.112	0.088	0.136
	Total	43.734	30.607	56.862				0.143	6.255	4.675	7.836	0.142	0.888	0.669	1.107	1.957	1.475	2.440
	(3+)	21.107	16.569	25.645				0.229	4.824	3.787	5.861	0.149	0.718	0.564	0.872	1.583	1.243	1.923
Unit 3	2	9.855	4.224	15.485	0.466	0.066	0.031	0.025	0.246	0.105	0.386	0.114	0.028	0.012	0.044	0.062	0.026	0.097
	3	7.701	4.466	10.936	0.466	0.937	0.436	0.296	2.277	1.321	3.234	0.147	0.335	0.195	0.476	0.740	0.429	1.050
	4	0.551	0.320	0.782	0.466	1.000	0.466	0.312	0.172	0.100	0.244	0.157	0.027	0.016	0.038	0.059	0.034	0.084
	5	3.019	1.751	4.288	0.466	1.000	0.466	0.312	0.941	0.546	1.337	0.190	0.179	0.104	0.254	0.395	0.229	0.561
	6+	1.586	0.920	2.252	0.466	0.383	0.178	0.135	0.215	0.125	0.305	0.231	0.050	0.029	0.070	0.109	0.063	0.155
	Total	22.712	11.680	33.744				0.170	3.851	2.196	5.506	0.161	0.619	0.355	0.883	1.365	0.782	1.948
	(3+)	12.858	7.457	18.259				0.280	3.605	2.091	5.120	0.164	0.591	0.343	0.839	1.303	0.756	1.851
Unit 4	2	1.329	0.495	2.163	0.391	0.094	0.037	0.030	0.039	0.015	0.064	0.117	0.005	0.002	0.008	0.010	0.004	0.017
	3	1.328	0.780	1.876	0.391	1.000	0.391	0.270	0.359	0.211	0.507	0.138	0.050	0.029	0.070	0.109	0.064	0.154
	4	0.291	0.171	0.411	0.391	1.000	0.391	0.270	0.079	0.046	0.111	0.159	0.012	0.007	0.018	0.028	0.016	0.039
	5	0.549	0.322	0.775	0.391	0.781	0.305	0.219	0.120	0.071	0.170	0.176	0.021	0.012	0.030	0.047	0.027	0.066
	6+	0.706	0.415	0.997	0.391	0.188	0.073	0.058	0.041	0.024	0.058	0.251	0.010	0.006	0.015	0.023	0.013	0.032
	Total	4.203	2.183	6.223				0.152	0.638	0.366	0.910	0.154	0.098	0.057	0.140	0.217	0.125	0.308
	(3+)	2.874	1.688	4.060				0.208	0.599	0.352	0.846	0.156	0.094	0.055	0.132	0.206	0.121	0.292

Table 8. Lake Erie yellow perch recommended allowable harvest (RAH) estimates for 2001. Estimates are based on the F(opt) fishing strategy. Table (a) refers to ADMB, new F(opt) method; table (b) refers to CAGEAN with old F(opt). Unit 4 will remain fixed at 70,000 pounds and is not part of the RAH process.

a ADMB, new Fopt

Yield (Millions of Pounds)

	RAH		
	Min.	**Mean**	**Max.**
Unit 1	0.980	1.474	1.969
Unit 2	1.837	3.068	4.300
Unit 3	1.232	2.209	3.185
Unit 4	0.070	0.070	0.070
Total	**4.119**	**6.821**	**9.524**

Yield (Millions of Kilograms)

	RAH		
	Min.	**Mean**	**Max.**
Unit 1	0.444	0.669	0.893
Unit 2	0.833	1.392	1.950
Unit 3	0.559	1.002	1.444
Unit 4	0.032	0.032	0.032
Total	1.868	3.094	4.319

b CAGEAN old Fopt

Yield (Millions of Pounds)

	RAH		
	Min.	**Mean**	**Max.**
Unit 1	1.113	1.544	1.974
Unit 2	1.475	1.957	2.440
Unit 3	0.782	1.365	1.948
Unit 4	0.070	0.070	0.070
Total	**3.440**	**4.936**	**6.432**

Yield (Millions of Kilograms)

	RAH		
	Min.	**Mean**	**Max.**
Unit 1	0.505	0.700	0.895
Unit 2	0.669	0.888	1.107
Unit 3	0.355	0.619	0.883
Unit 4	0.032	0.032	0.032
Total	1.560	2.239	2.917

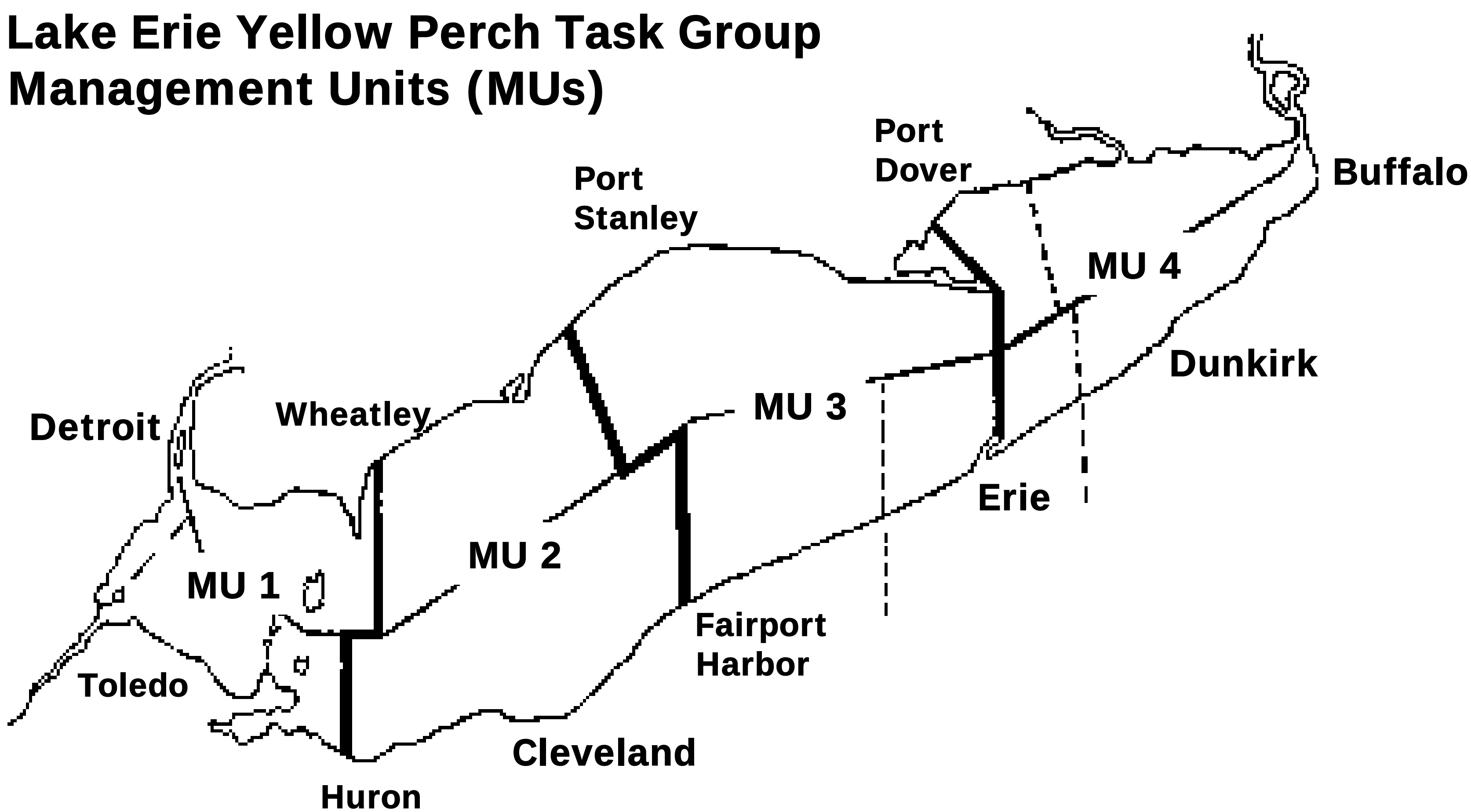


Figure 1. The Yellow Perch Task Group management units (MUs) of Lake Erie.

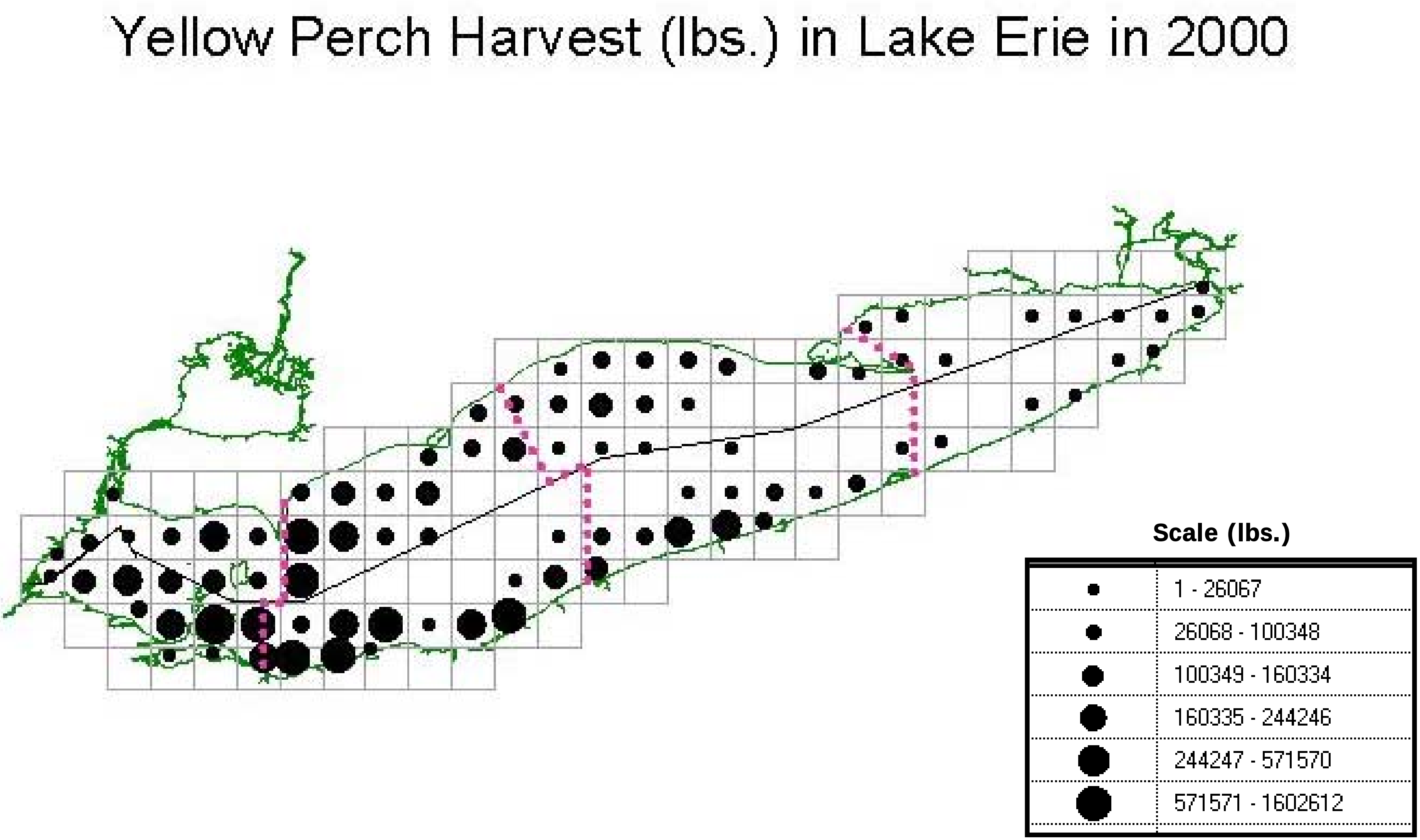


Figure 2. Spatial distribution of yellow perch harvest in 2000 by 10 minute grid.

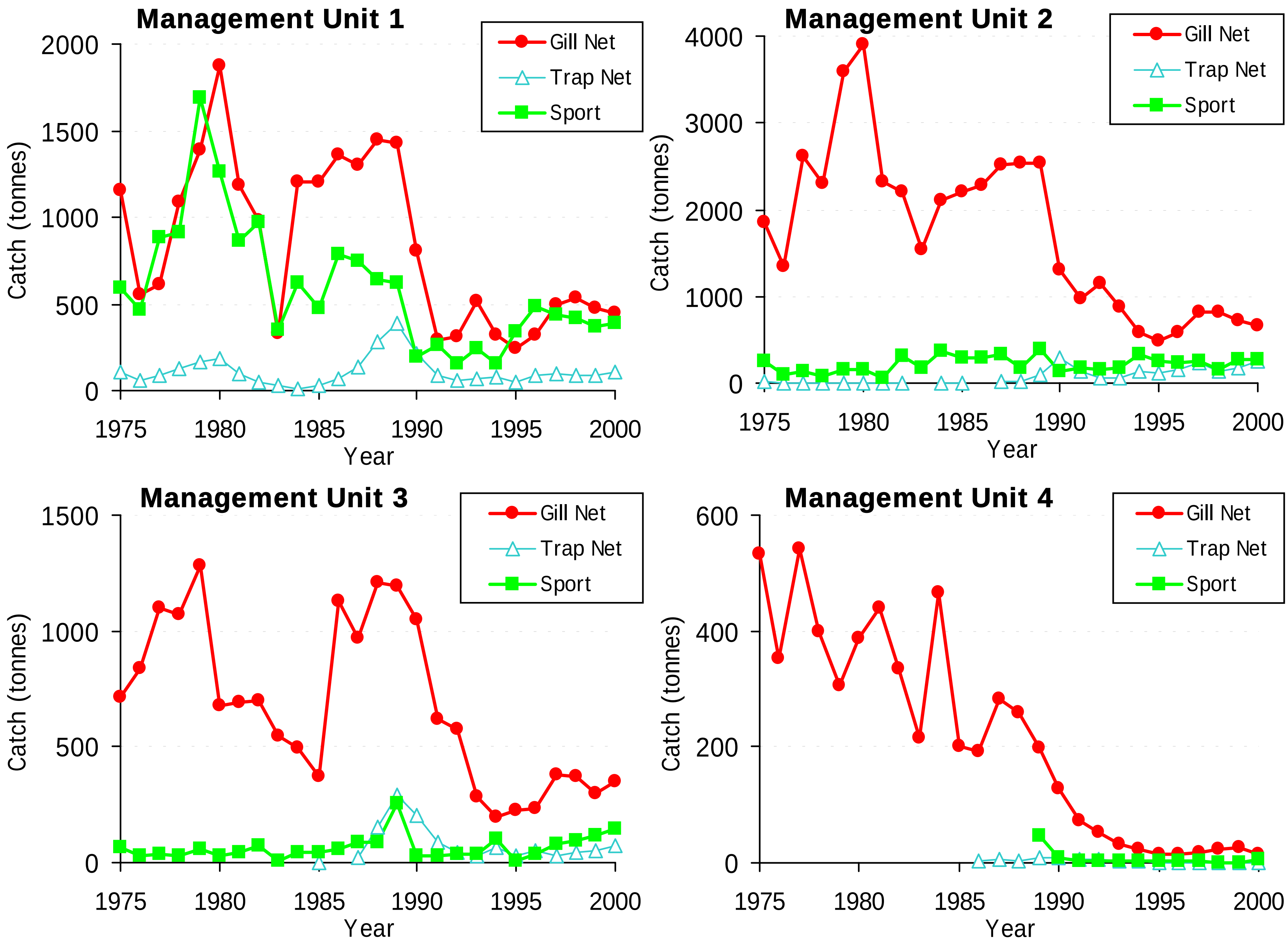


Figure 3. Lake Erie yellow perch harvest by management unit and gear type.

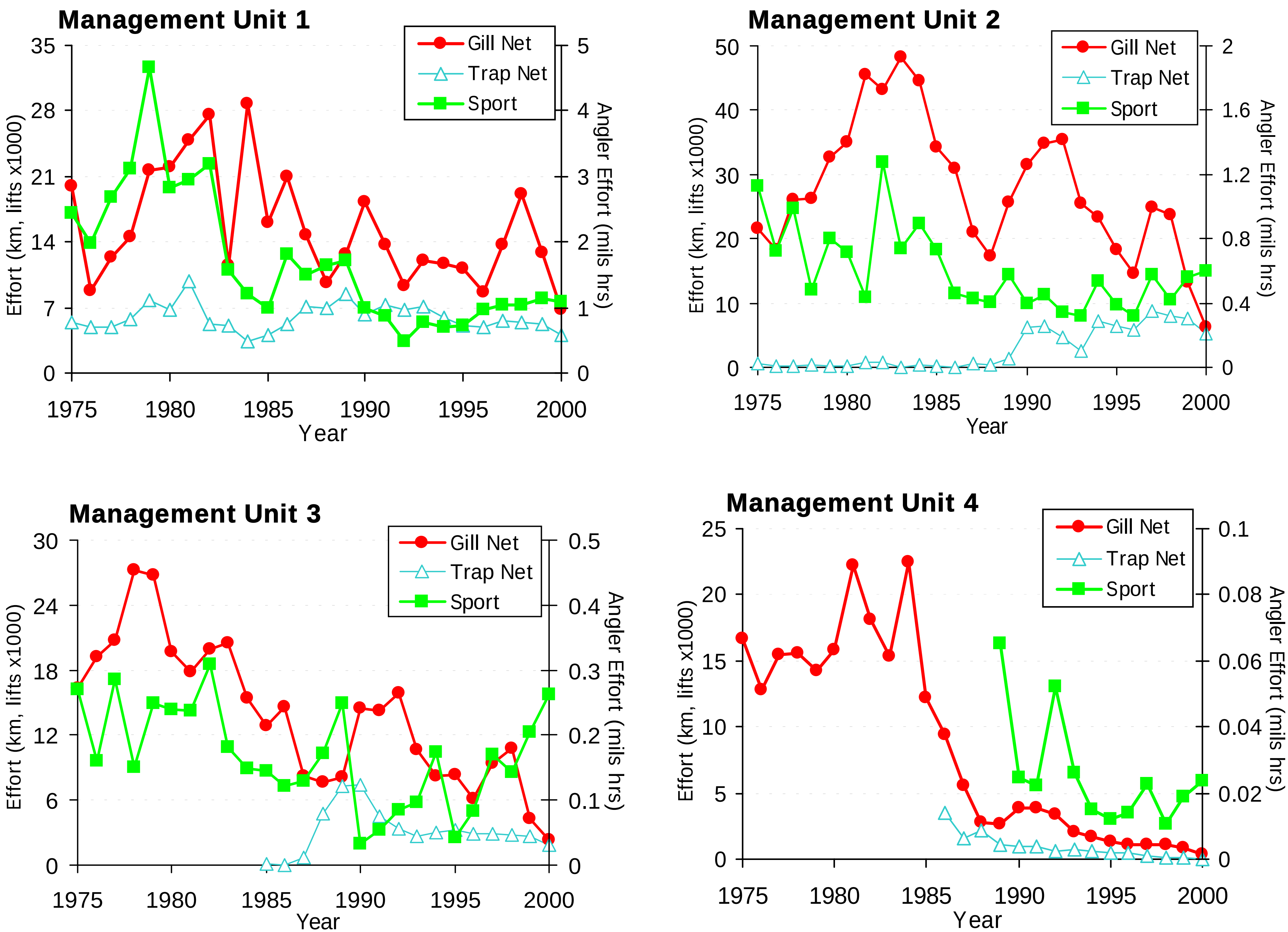


Figure 4. Lake Erie yellow perch effort by management unit and gear type.

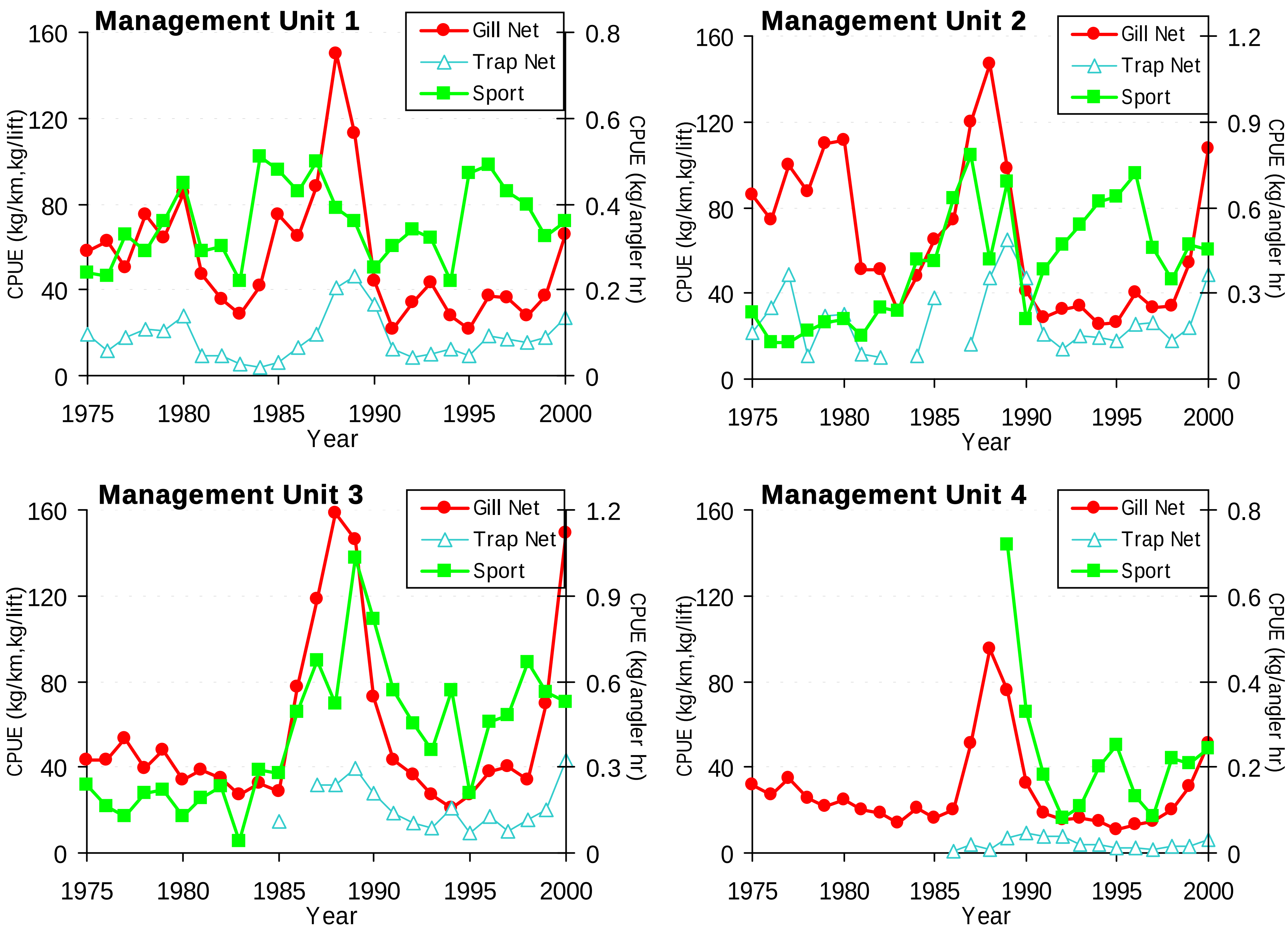


Figure 5. Lake Erie yellow perch catch per unit effort by management unit and gear type.

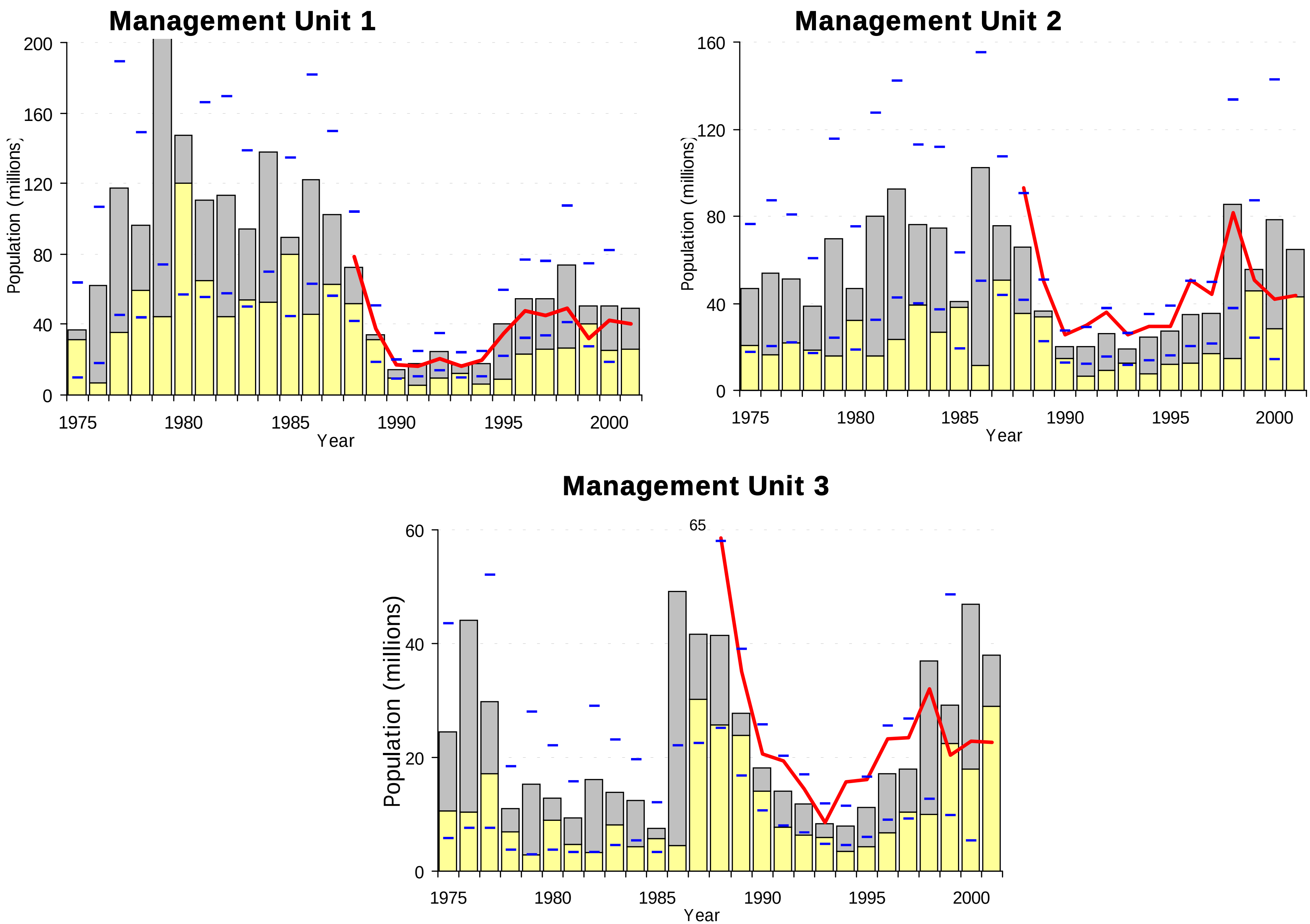


Figure 6. Lake Erie yellow perch population estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2001 are from AD Model Catch-Age and parametric regressions for age 2. Dashes represent 2 standard errors about the population estimates for ages 2 and older. Line series represents CAGEAN population estimates including the recruitment projection for 2001.

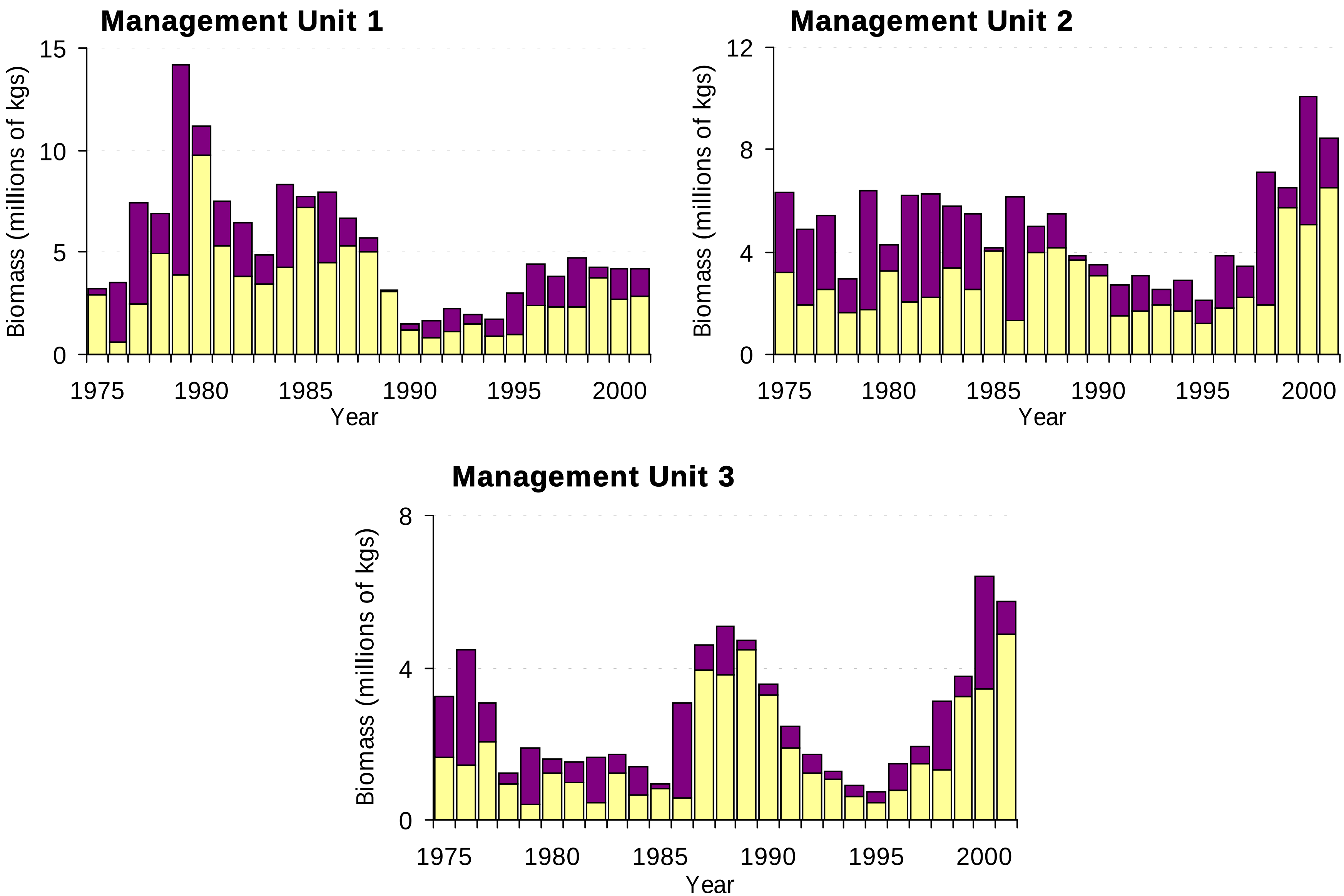


Figure 7. Lake Erie yellow perch biomass estimates by management unit for age 2 (dark bars) and ages 3+ (light bars). Estimates for 2001 are from AD Model Catch-Age and parametric regressions for age 2.

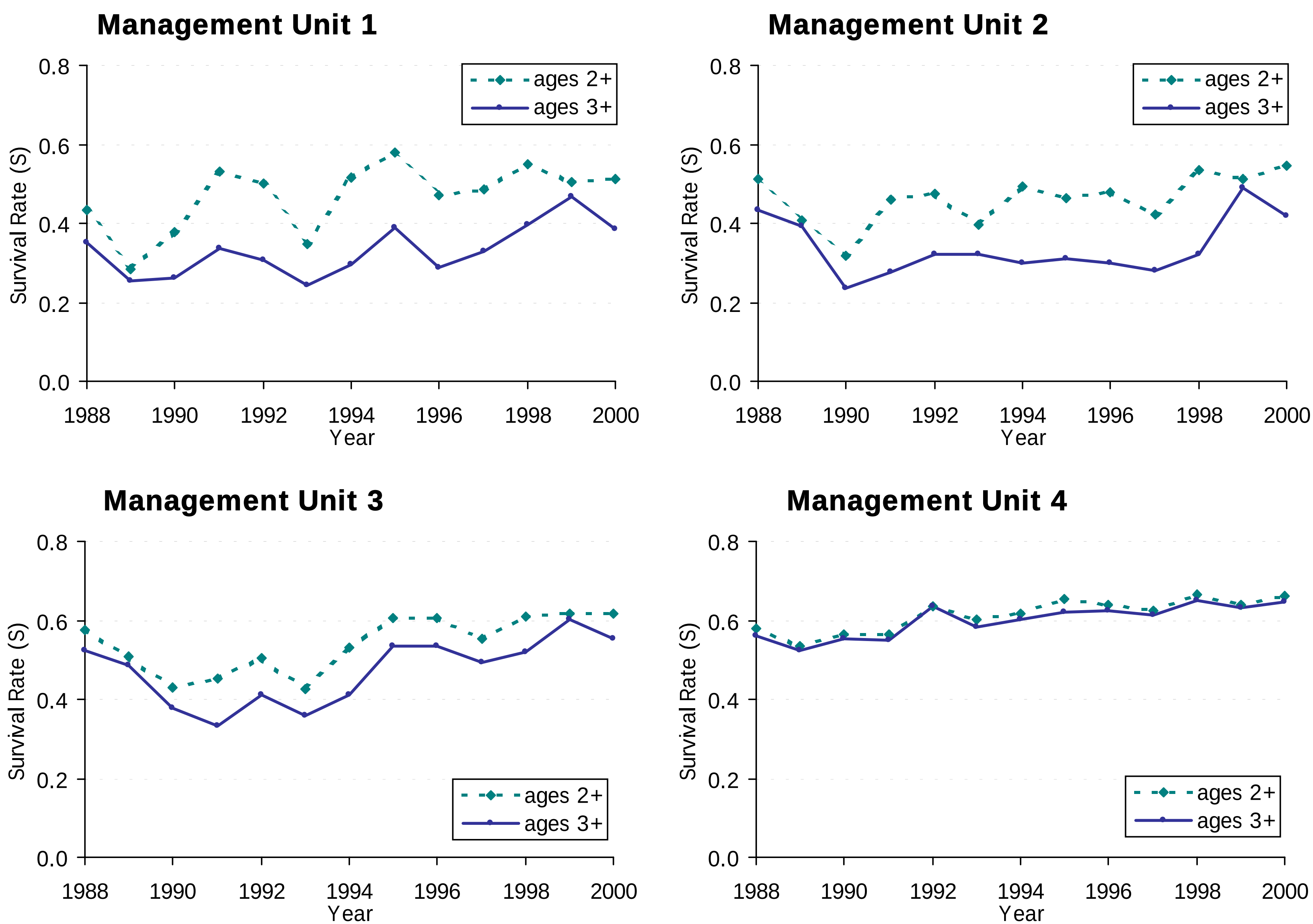


Figure 8. Lake Erie yellow perch survival rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from AD Model Catch-Age.

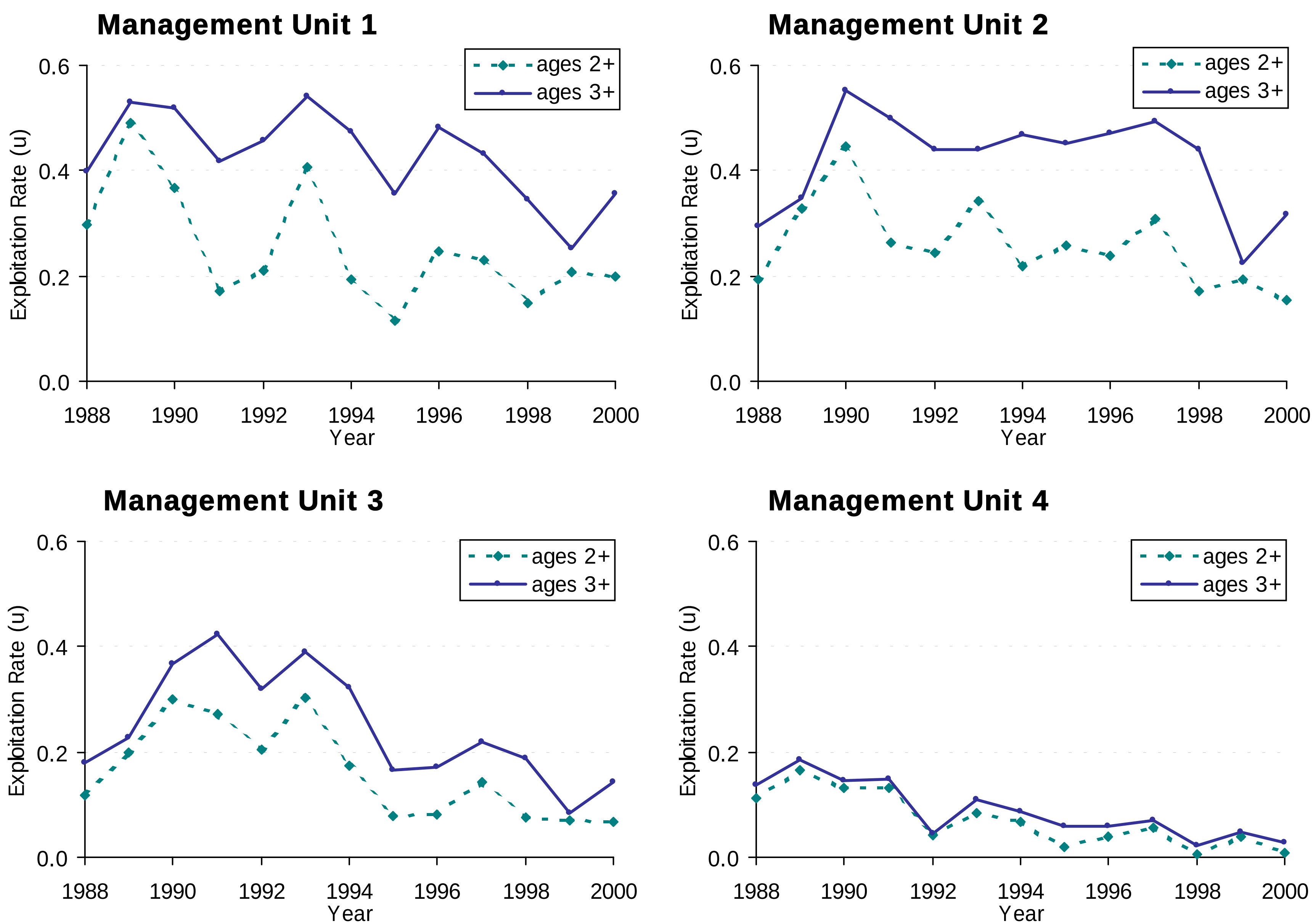


Figure 9. Lake Erie yellow perch exploitation rates by management unit for ages 2+ (dashed line) and ages 3+ (solid line). Estimates are derived from AD Model Catch-Age.

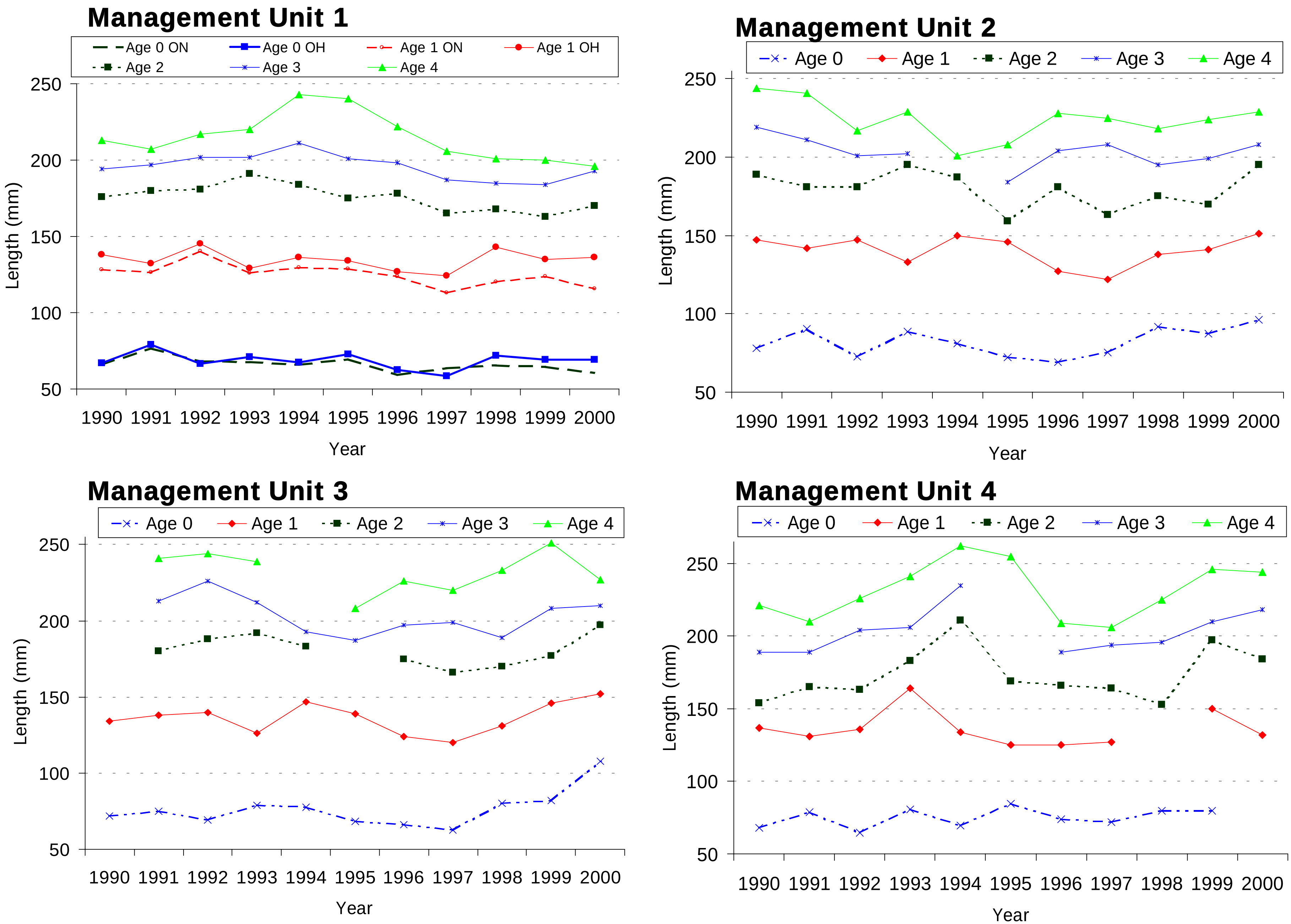
Appendix A. Review of Lake Erie Yellow Perch Growth Rates, Trends and Factors Affecting Growth

In this appendix, we present growth data (in length) for ages 0, 1, 2 and 4 by management unit. These ages are presented because:

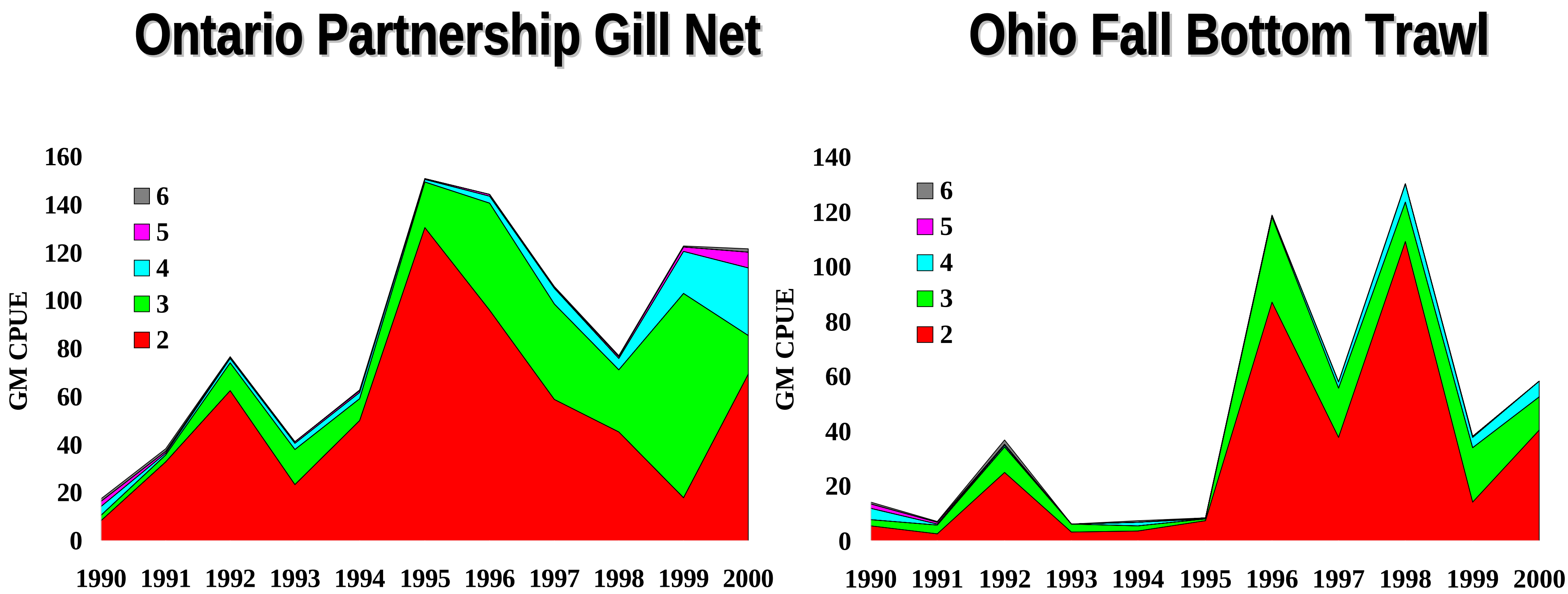
- Age 0 lengths give us a good first look at year class performance and may set trends for cohorts in future.
- Age 1 length in the fall is a determining factor of size of fish as they recruit into fishery gear the next spring at age 2. Smaller fish will not recruit highly, and will not be selected for by gear such as gill nets and trap nets.
- Age 2 length is also important for the same reason, a determinant in timing of entry and higher recruitment and selectivity by the fishery.
- Age 4 length is important as showing size of fish being taken at full recruitment by all gears.

The general short-term trend shows smaller lengths-at-age achieved for these ages during 1996 and 1997, but since 1998 the trend reverses itself (Figure A-1). There are some long-term trends, though, that may be cautionary. These include the decline in length of Age 2 and Age 4 yellow perch in Unit 1. There were also variations in weight-at-age, as described in YPTG 1998, but our analyses again determined no trends or significant differences in yellow perch condition factor across any Unit or age group. We cannot directly attribute these trends in length to trophic changes or exotic expansion in Lake Erie, and certainly more analyses will be valuable in these regards.

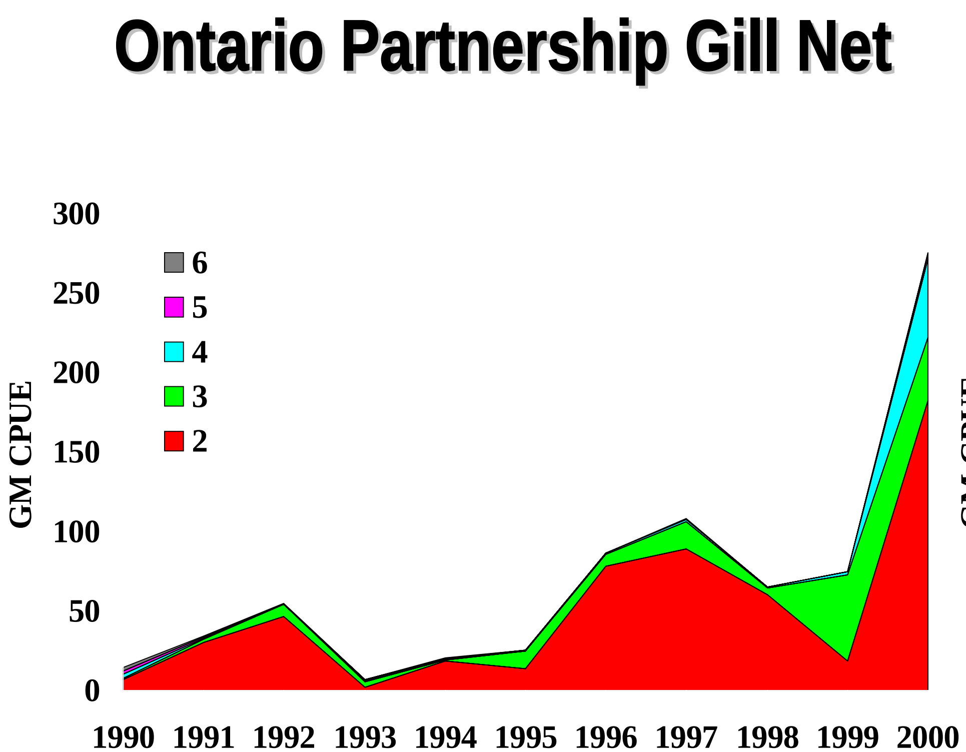
The YPTG has also performed some analyses on abiotic and biotic factors that can affect growth of yellow perch to the end of age 0 and age 1 (YPTG 1999). Cooling degree days (CDD), a daily mean temperature calculation, is a factor in describing the thermal energy input into Lake Erie during the growing season. In general, there was an increasing trend in growth rates with increasing heat input, as evident from a higher sum of CDD index values during the growing season. We will continue this analysis to determine factors that may be affecting yellow perch growth.

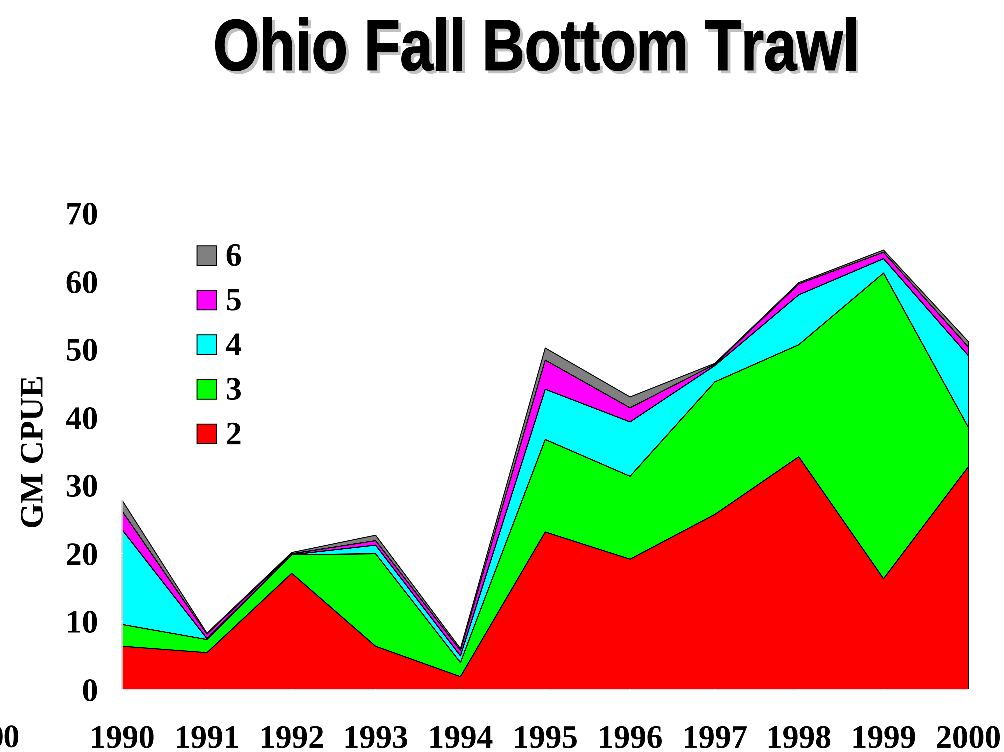


Appendix A: Figure A-1. Yellow perch length-at-age from October interagency experimental samples for ages 0, 1, 2, and 4 in Management Units 1 through 4.

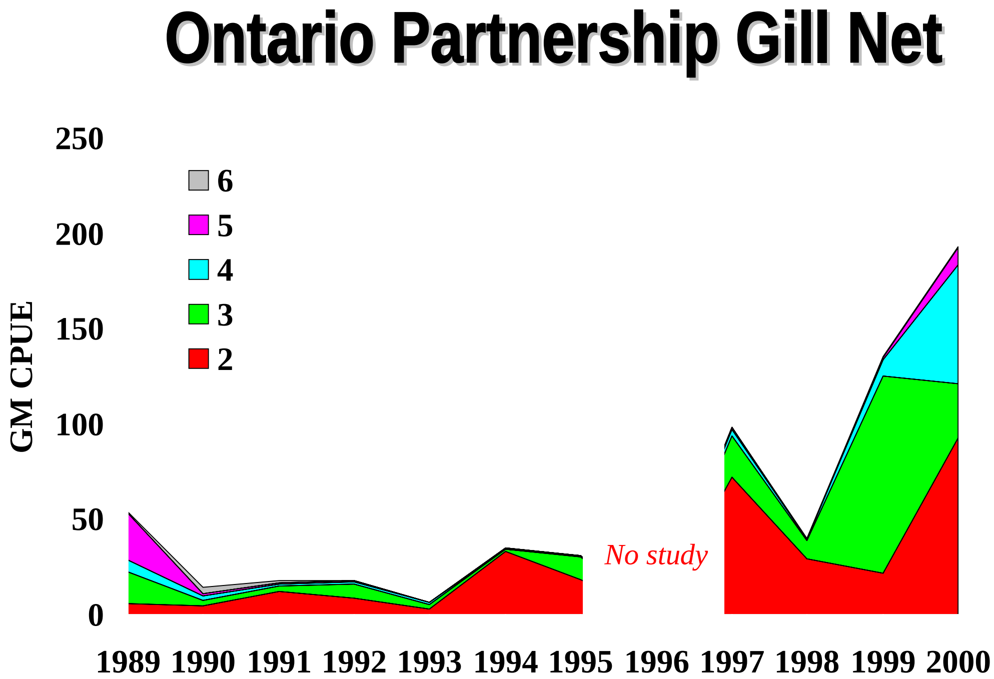


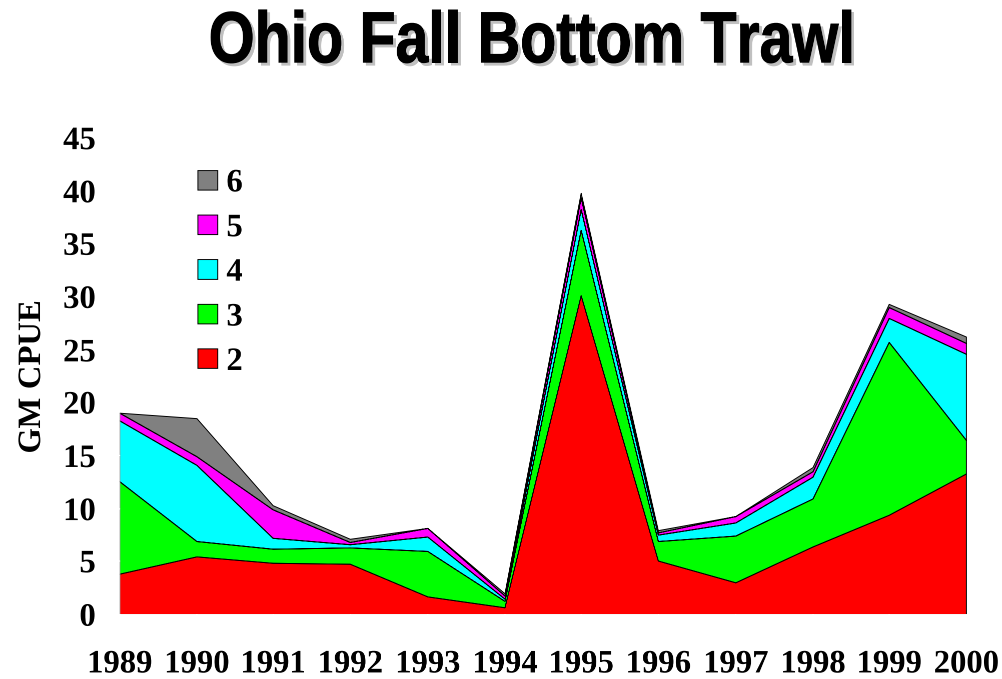
Appendix A: Figure A-2. Ontario and Ohio yellow perch indices, expressed as geometric mean catch per unit effort (GM CPUE). Management Unit 1 (west basin).



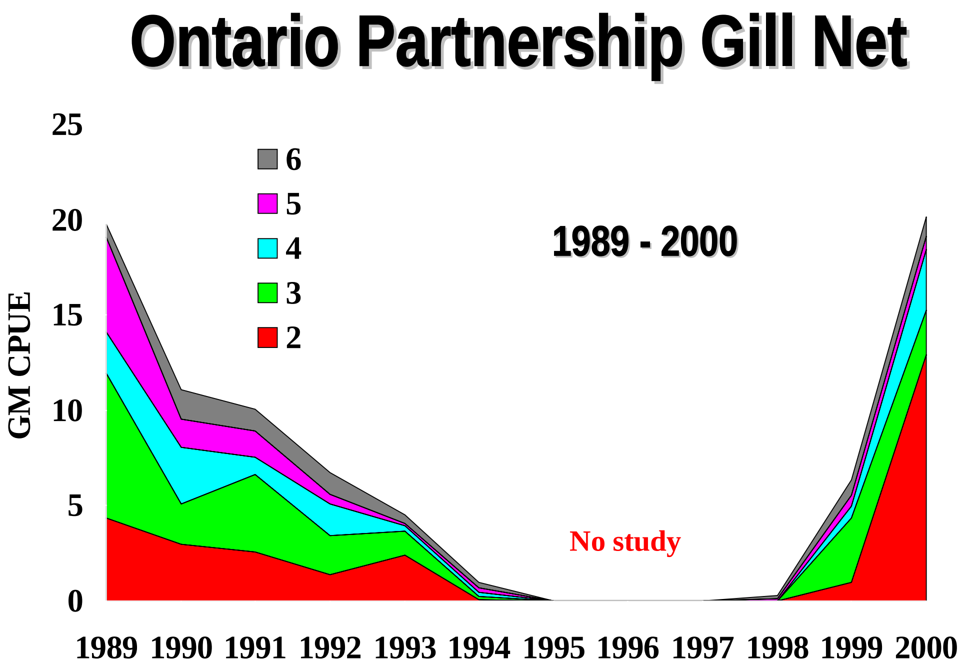


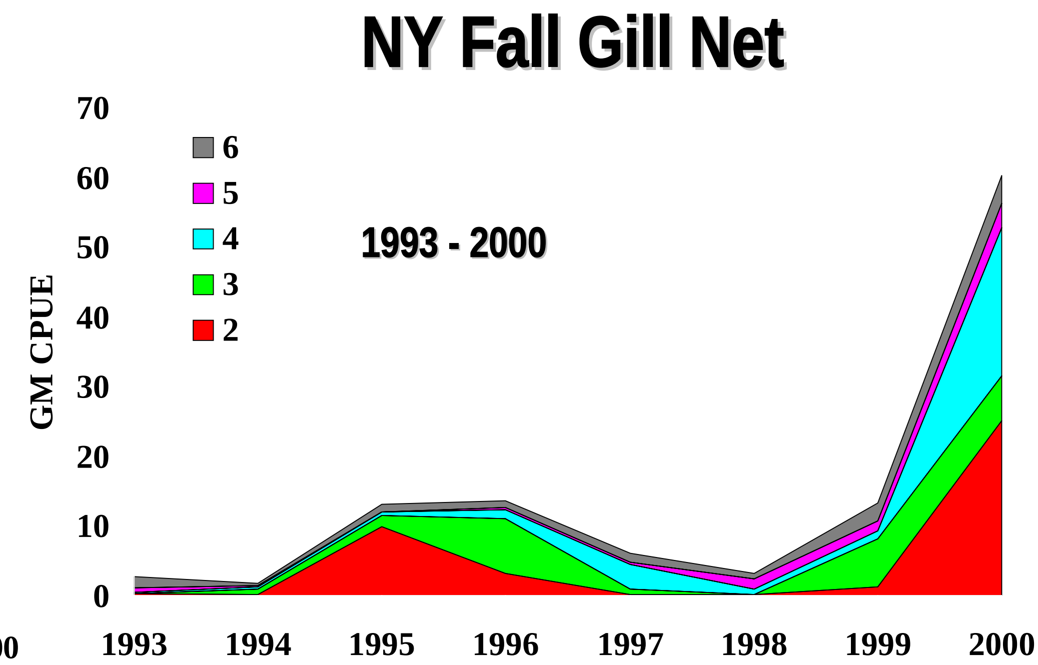
Appendix A: Figure A-3. Ontario and Ohio yellow perch indices, expressed as geometric mean catch per unit effort (GM CPUE). Management Unit 2 (west-central basin).

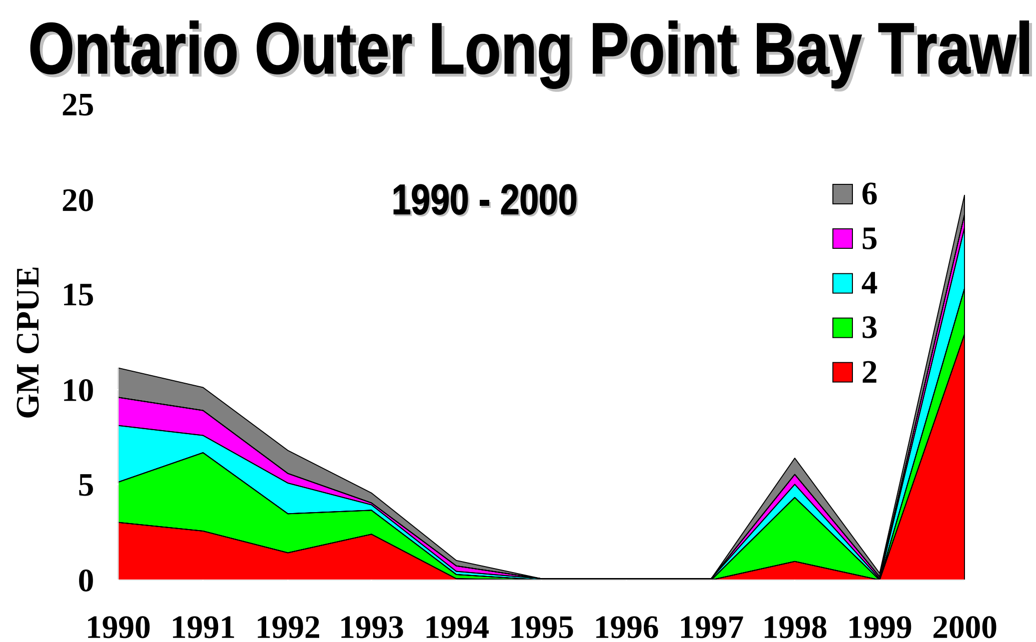




Appendix A: Figure A-4. Ontario and Ohio yellow perch indices, expressed as geometric mean catch per unit effort (GM CPUE). Management Unit 3 (east-central basin).







Appendix A: Figure A-5. Ontario and New York yellow perch indices, expressed as geometric mean catch per unit effort (GM CPUE). Management Unit 4 (east basin).

Appendix B. Age 2 Recruitment Regressions and Index Trawl Data Series

In this appendix, the YPTG presents significant regressions that result in the estimation of the number of age 2 yellow perch available to the fishery in 2001. The YPTG continues to use parametric regression analysis to predict age 2 yellow perch abundance by management unit from interagency trawl surveys. Age 2 mean value estimates and their standard error estimates are then incorporated into Tables 6 and 7 in the main body of this report to complete abundance estimates, yield per recruit, and RAH projections for 2001.

Trawl series data was updated again this year with interagency data. The 1999 cohort was a low to moderate one in all management units compared to the strong year class produced in 1996 and the weak year class of 1997. These estimates are substantiated from many trawl series giving significant relationships in each management unit. The Unit 4 estimate is considered less robust due to the low number of significant regression models contributing to the estimate.

Table B-1 presents by management unit those regressions found significant for predicting age 2 yellow perch. Table B-2 contains trawl data series in geometric mean catch per trawl hour. Table B-3 contains trawl data series in arithmetic mean catch per trawl hour. Definitions of the trawl series abbreviations used in Tables B-2 and B-3 can be found in the Legend that follows these tables.

Appendix B: Table B-1. Agency trawl regression indices found statistically significant for projecting estimates of age 2 yellow perch by management unit.

Management Unit 1

Index	Slope	Intercept	R-SQUARE	Index Value	Age-2 estimate	Upper Age 2 CI.	Lower Age 2 CI.	Std Error of Est.
OHS11G	0.723	5.659	0.8019	46.1	38.989	55.046	22.933	8.028
ONOHP10A	0.013	9.127	0.7658	534.2	16.072	23.738	8.405	3.833
USS10A	0.003	12.425	0.6800	1234.8	16.129	23.959	8.300	3.915
OHF11G	0.675	13.563	0.6427	19.5	26.726	43.233	10.219	8.254
OHF20G	0.339	15.680	0.5322	47.6	31.816	53.364	10.268	10.774
USS11G	1.118	7.109	0.5255	5.4	13.146	25.643	0.649	6.248
BOHS21A	0.020	16.402	0.5223	271.4	21.830	33.370	10.290	5.770
OHS20A	0.011	18.321	0.5115	85.7	19.264	28.341	10.186	4.539
OHF21A	0.080	12.780	0.5081	155.6	25.228	44.006	6.450	9.389
				mean	**23.244**	**36.744**	**9.744**	6.750

Management Unit 2

Index	Slope	Intercept	R-SQUARE	Index Value	Age-2 estimate	Upper Age 2 CI.	Lower Age 2 CI.	Std Error of Est.
BOHS21A	0.037	12.018	0.9635	271.4	22.060	26.612	17.507	2.276
OHF30A	0.184	9.172	0.9629	60.1	20.230	25.649	14.811	2.710
OHF20G	0.637	9.260	0.9607	47.6	39.581	48.343	30.820	4.381
BOHS30A	0.011	15.262	0.9574	122.3	16.607	20.804	12.411	2.098
OHS20A	0.021	14.131	0.9443	85.7	15.931	20.234	11.628	2.151
ONOHP10G	0.097	7.253	0.9436	148.3	21.638	27.303	15.973	2.832
OHS10G	0.107	9.794	0.9223	102.8	20.794	26.320	15.268	2.763
BOHF21A	0.151	5.569	0.9036	162.0	30.031	41.901	18.161	5.935
USS10A	0.005	10.390	0.8453	1234.8	16.564	23.904	9.224	3.670
USF10A	0.078	8.120	0.7656	176.5	21.887	33.331	10.443	5.722
PAF30G	0.194	12.551	0.6850	15.0	15.461	24.685	6.237	4.612
				mean	**21.889**	**29.008**	**14.771**	3.559

Management Unit 3

Index	Slope	Intercept	R-SQUARE	Index Value	Age-2 estimate	Upper Age 2 CI.	Lower Age 2 CI.	Std Error of Est.
BOHS20A	0.009	5.736	0.9302	93.8	6.580	8.470	4.691	0.945
BOHS21A	0.014	5.110	0.9387	271.4	8.910	10.894	6.925	0.992
BOHS30A	0.004	5.857	0.9230	122.3	6.346	8.549	4.144	1.101
OHF20G	0.237	4.071	0.9129	47.6	15.352	20.320	10.384	2.484
OHF21A	0.053	2.861	0.8305	155.6	11.108	16.793	5.423	2.842
OHF30A	0.067	4.136	0.8785	60.1	8.163	11.865	4.461	1.851
OHF31A	0.144	2.846	0.7223	54.4	10.680	18.199	3.160	3.760
PAF30G	0.096	3.751	0.8688	15.0	5.191	7.817	2.565	1.313
				mean	**9.041**	**12.863**	**5.219**	1.911

Management Unit 4

Index	Slope	Intercept	R-SQUARE	Index Value	Age-2 estimate	Upper Age 2 CI.	Lower Age 2 CI.	Std Error of Est.
BOHS30A	0.001	0.917	0.8017	122.3	1.039	1.890	0.188	0.425
OHF30G	0.066	0.433	0.7698	12.0	1.225	2.437	0.013	0.606
NYF40A	0.016	0.000	0.7596	73.3	1.173	1.906	0.440	0.367
PAF30G	0.017	0.495	0.6179	15.0	0.750	1.648	0.000	0.449
				mean	**1.047**	**1.970**	**0.160**	**0.462**

Appendix B. Table B-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	49.4	30.0	13.8	31.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	1.4	2.0	0.0	2.2	-	4.0	16.0	2.8	17.5	-	-	-	-	-	-	-	-	-
1984	118.5	16.3	0.3	5.3	-	7.1	1.9	10.9	2.9	-	-	-	-	-	-	-	-	-
1985	36.0	7.0	0.0	3.9	-	6.5	8.4	28.8	12.8	-	-	-	-	-	-	-	-	-
1986	56.5	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	111.5	42.8	9.6	54.1	-	29.2	6.7	59.2	2.0	81.0	1.0	28.4	19.2	55.2	0.4	24.0	24.6	55.1
1991	41.3	20.1	10.8	14.4	0.2	16.9	17.1	63.4	4.9	33.6	1.9	28.5	4.3	57.2	1.4	28.1	4.9	66.6
1992	27.4	12.2	2.0	10.2	0.2	4.3	0.1	17.3	0.3	23.1	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	243.2	64.6	18.2	35.6	22.7	499.2	8.0	78.7	36.1	148.5	6.5	2.8	20.0	6.8	6.5	2.8	21.1	6.7
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	9.9	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	6.7	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	16.3	44.0	46.1	13.3	19.5	11.1	5.4	4.9	9.0	32.3	0.3	27.8	5.6	39.2	0.3	34.2	5.5	45.7

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

Appendix B. Table B-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	965.6	359.1	124.3	854.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	3.3	30.5	0.0	5.8	-	19.8	59.2	15.0	43.3	-	-	-	-	-	-	-	-	-
1984	3020.8	138.3	0.8	110.0	-	28.5	5.8	46.4	11.8	-	-	-	-	-	-	-	-	-
1985	521.7	26.1	0.0	39.0	-	42.0	34.0	71.4	27.2	-	-	-	-	-	-	-	-	-
1986	1754.5	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	788.4	107.2	15.7	113.5	-	149.8	15.7	34.2	3.3	447.9	-	-	-	-	-	-	-	-
1990	739.9	145.5	26.4	330.0	-	81.0	22.2	176.2	6.3	458.8	3.7	152.5	108.8	59.9	1.7	158.5	121.5	59.5
1991	111.4	139.3	34.1	61.8	0.6	185.2	35.0	210.8	18.0	126.1	10.7	95.7	27.0	120.8	8.4	91.9	29.5	128.3
1992	271.7	65.4	12.9	91.5	1.0	21.0	0.5	75.3	2.5	164.4	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	887.7	526.5	78.2	289.4	97.4	4404.2	40.3	162.0	57.8	702.5	144.2	12.3	155.7	26.9	144.2	12.3	165.6	26.1
1995	1337.8	348.0	167.8	81.6	0.2	2867.0	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	51.5	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	75.4	180.8	112.0	39.7	46.8	115.8	23.8	42.2	30.8	126.4	1.7	236.1	50.5	155.6	2.0	271.4	49.9	162.0

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

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

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 B. 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