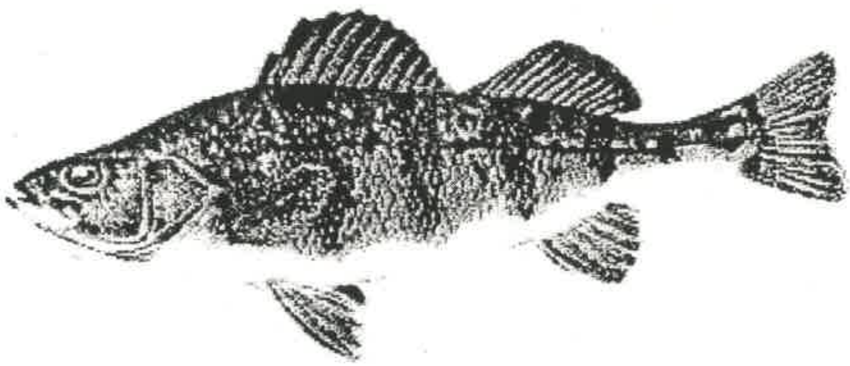
Report of the Lake Erie Yellow Perch Task Group

1998



Members:

Kevin Kayle, (Chairman)	*Ohio Division of Wildlife*
Roger Kenyon,	*Pennsylvania Fish and Boat Commission*
Carey Knight,	*Ohio Division of Wildlife*
Jerry Paine,	*Ontario Ministry of Natural Resources*
Phil Ryan,	*Ontario Ministry of Natural Resources*
Bob Sutherland,	*Ontario Ministry of Natural Resources*
Mike Thomas,	*Michigan Department of Natural Resources*

Presented to:

~~Standing Technical Committee~~
Lake Erie Committee
Great Lakes Fishery Commission

000029

Table of Contents

Note: The data and management summaries contained in this report are provisional. Every effort has been made to insure their correctness. Contact individual agencies for complete state and provincial data. Data reported in pounds for prior years 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 1997, the Yellow Perch Task Group (YPTG) was assigned five charges by the Lake Erie Committee. As in previous years, the task group was charged with producing a lake-wide Recommended Allowable Harvest (RAH) partitioned by Lake Erie management unit, and to maintain and update the centralized time-series data set of harvest, effort, growth and maturity and agency or interagency abundance indices of yellow perch. A recent charge undertaken by the YPTG involves using interagency field data in a regression or other predictive model to estimate the relative strength of the age 2 cohort in each management unit as it recruits into the fishery in the subsequent year. Another charge assigned to the YPTG, a determination of a minimum spawning stock biomass necessary for sustaining fishable yellow perch stocks in Lake Erie, is still being researched by members of the group. More work on that charge will follow concurrently with a new charge exploring the potential for genetic research on Lake Erie yellow perch stocks. Stock delineation and their boundaries need to be defined before we can address the previous charge of minimum spawning stock necessary to sustain yellow perch populations throughout the lake.

Former members of the YPTG were also responsible for the completion of the joint YPTG and Statistics and Modeling Task Group (SAM) report, documenting the procedures used to develop RAH values. This document has been completed and is available from the Great Lakes Fishery Commission office.

1997 Fisheries Review

The reported harvest of yellow perch from Lake Erie in 1997 totaled 6.295 million pounds (2,855 metric tonnes or 2.855 million kgs), which was a 30% increase over the 1996 harvest (Table 1). As in recent years, the YPTG partitioned Lake Erie into four Management Units (Units, or MUs; Figure 1) for harvest, effort, age and population analyses. Yellow perch harvest increased substantially for Ontario (+49%), Ohio (+11%) and Pennsylvania (+135%), but decreased in Michigan (-17%) and New York (-47%).

In comparison with 1996, each agency's proportion of the lakewide harvest changed only slightly. Ontario's proportion increased from 53% to 60% of the lakewide harvest, Ohio's proportion decreased from 44% to 38%, Michigan's proportion decreased from 3% to

2%, while New York's and Pennsylvania's shares remained at less than one percent of the total lakewide harvest.

Harvest, fishing effort, and catch rates are summarized for the time period 1987-1997 by management unit, year, agency, and gear type in Table 2, parts a through d. Trends over longer time series (1975-1997) are depicted for harvest (Figure 2), fishing effort (Figure 3), and catch rate (Figure 4) by management unit and gear type. Harvest summed by management unit showed strong increases in Units 1 through 3. Unit 4 (the eastern basin) exhibited a minor increase for the first time since 1987. Ontario experienced sizable harvest increases in all Units. Ontario's harvest increased by 55% in Unit 1, 41% in Unit 2, 62% in Unit 3, and 19% in Unit 4. Michigan's harvest (Unit 1) decreased by 17% over 1996. Ohio's yellow perch harvest experienced modest increases in Units 2 and 3, up 31% and 18%, respectively. Ohio's Unit 1 harvest was down 5% compared to 1996. Pennsylvania's fisheries, albeit small, showed sizable increases: up 158% in Unit 3 and up 38% in Unit 4. New York's harvest declined for the eighth consecutive year to 53% of their 1996 harvest.

Commercial gill net harvest for 1997 increased in all management units over 1996 levels. Ontario has the only gill net fishery remaining on Lake Erie for yellow perch. Harvest from commercial trap nets increased in Units 1 and 2, up 6% and 54%, respectively, but declined in Units 3 and 4, down 43% and 56%, respectively. Sport harvest increased in Units 2 through 4: up 16% in Unit 2, 108% in Unit 3, and 9% in Unit 4, but declined by 8% in Unit 1. *Note: Ontario's Lake Erie sport, trap net and large mesh gill net catches and effort are not calculated in Yellow Perch Task Group reporting procedures and analyses. The task group uses Ontario commercial small mesh gill net fishery data obtained in OMNR fish processor reports (known as processor weight) instead of landed estimates because they are more precise.*

Commercial small mesh gill net effort for 1997 increased sizably in Management Units 1-3 and slightly in Unit 4: up 59% in Unit 1, 71% in Unit 2, 52% in Unit 3 and 1% in Unit 4. Trap net effort for 1997 increased in Unit 1 (up 15%) and Unit 2 (up 49%), remained nearly unchanged (-0.6%) in Unit 3, and decreased by 45% in the small trap net fishery in Unit 4. Compared to 1996, sport fishing effort for 1997 increased by 7% in Unit 1, 82% in Unit 2, 105% in Unit 3, and 64% in Unit 4.

Catch rates (catch per unit of effort, or CPE) for the 1997 commercial gill net fishery decreased in Units 1 and 2: down 3% in Unit 1 and 17% in Unit 2. Small to moderate increases in CPE were realized in Units 3 and 4: up 6% in Unit 3 and 15% in Unit 4. Trap net catch rates declined in Unit 1, down 8%, and Unit 3, down 41%; but increased slightly in Unit 2, up 3%. Trap net catch rates for the small Unit 4 fishery declined for the fifth consecutive year, down 15% compared to 1996. Catch rates for anglers targeting yellow perch declined in Unit 1 (-24%) and Unit 2 (-33%), but increased in Unit 3 (+11%) and Unit 4 (+21%).

The lakewide RAH range recommended by the YPTG for 1997 was 4.2 to 7.9 million pounds lakewide, with a mean RAH of 6.0 million pounds. The Lake Erie Committee supported a total allowable catch (TAC) lakewide allocation of 7.4 million pounds. Partitioned by YPTG Management Unit, TAC values for 1997 were: Unit 1, 2.4 million pounds; Unit 2, 3.6 million pounds; Unit 3, 1.2 million pounds; Unit 4, 0.2 million pounds. The YPTG RAH mean values by Unit from west to east were: 1.9, 2.9, 1.1 and 0.2 million pounds respectively. The harvest of Lake Erie yellow perch in 1997 by management unit did not exceed total allowable catch set by the Lake Erie Committee. The 1997 Lake Erie yellow perch fisheries attained 94.8% of TAC in Unit 1, 80.7% of TAC in Unit 2, 89.3% of TAC in Unit 3 and 20.8% of TAC in Unit 4.

Stock Assessment

Age and Growth

Recruitment of yellow perch year classes to the fishery was generally low and inconsistent from 1990 through 1994. During this time period no large, dominant year classes, as large as those seen in 1982 or 1984, recruited into the fishery. The failure to produce large year classes resulted in yellow perch stock size, harvest and catch rates reaching historic lows from 1991 through 1995. Moderate-sized year classes were produced in 1993 and 1994 which helped reverse the downward trend and have brought on the appreciable increases in harvest realized in 1996 and 1997. Older fish (age 6+) continue to be a component of the trap net and sport fishing harvest from Unit 4 (Table 3), but stronger age 3 and 4 cohorts are starting to make an impact in the fishery. All management units and fisheries should be affected by the incoming recruitment of a potentially very large 1996 year class that should enter the fisheries late in 1998, and fully recruit to all fisheries gear during 1999.

The 1993 and 1994 year classes dominated the fisheries in Management Units 1 through 3 during 1997. In Units 1, 2, and 4 the 1995 year class entered the fishery weaker than expected (Table 3). In Unit 3 it was slightly stronger than expected, but still not comparable to other strong year classes seen in that management unit.

In examination of the growth of 1995 year class, it was observed that length and weight across ages was substantially below the mean value or recent trend since about 1990 (Appendix A). In concern that overall lake productivity might be affecting yellow perch growth, condition, maturity and ultimately recruitment into the fishery, we investigated this issue further. We calculated condition factors for agency fall trawl series for ages 1, 2, and 4 yellow perch in each management unit. Although there was a high degree of variation in yellow perch length, weight and condition factors (K values), there was no apparent decreasing trend in condition for Lake Erie yellow perch. This variation may be attributed to abiotic or biotic factors associated with lake and their effects on the food web. Appendix A also presents some long term trends showing decreasing annual growth in the western and central basins. This issue warrants serious concern and investigation by the Yellow Perch Task Group because of its ability to affect all cohorts, but particularly the magnitude of the incoming age 2 year class as it first enters the fishery. This is especially a concern for those fisheries like gill nets that experience a more knife-edge recruitment on the ascending limb of the selectivity curve (Figure 5), or trap nets that are governed by a minimum size limit, and also display a similar ascending limb in their selectivity curve. If growth is slowed across all ages, effects on selectivity (increases or decreases) across ages may also occur, having concomitant effects on harvest, exploitation and survival of the affected cohorts. The task group analyzed age 2 yellow perch growth differences (by mean length in harvest) observed in the gill net fishery, and when weighted by when the fish were caught, little difference was calculated for an annual estimate of mean length at harvest (Appendix A).

The task group continues to update yellow perch growth in: (1) weight-at-age values recorded annually in the harvest and (2) 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 and updated yellow perch von Bertalanffy growth model data and F_{opt} values according to methods previously described (YPTG 1996). The YPTG uses this information to provide model predictors that reflect recent conditions and changes in the Lake Erie environment and yellow perch population response to those conditions.

Catch-at-Age Analysis (CAGEAN) and the 1998 Population Estimate

CAGEAN 1997

As discussed in a previous report (YPTG 1996), only data from 1988 to present were incorporated in the CAGEAN model. The accuracy and credibility of the model was improved by reducing the number of parameters used by the model (e.g. selectivity or catchability groups, gear types, age groups), according to the pattern of residual variables, which decreased variability in the shortened data series (T. Quinn - personal communication). Lack of sufficient biological data from Unit 4 has caused analyses for that management unit to be less precise. However, given the current reduced state of the yellow perch population and the small size of the fishery (and low exploitation rates), our CAGEAN results and conservative recommendations for low harvest in Unit 4 are still valid.

The effort lambda, λ_E was adjusted for each gear type as the ratio of the variances of catch observations to effort observations. The 1997-98 CAGEAN model ran efficiently as model iterations were low (usually 3 to 6), no apparent trends were depicted in the residuals, and 50 bootstraps were easily completed. The 1997 CAGEAN estimates of Lake Erie yellow perch populations ages 3 and older are supported by abundance indices from all agencies.

A three-gear (gill net, trap net and sport: harvest, effort, and weight-at-age) version of the CAGEAN model was used to estimate the 1997 population size in numerical abundance and biomass in each management unit. The three-gear version allows factors such as catchabilities and selectivities to be gear specific. Population size estimates were based on a natural mortality rate of 0.4 (M=0.4).

Population size and population parameters such as survival and exploitation rates are presented for a stock size estimate that consists of 1998 age 2 abundance estimates derived from a refined recruitment-regression model (Table 4 and Appendix B). Last year's non-parametric methods were not repeated this year because comparable estimates for 1998 age 2 yellow perch would be expected based on trawl series information. Numbers and biomass by management unit are presented for age 2 and older. Population estimates using the regression model are depicted in Figure 6, and biomass estimates are presented in

Figure 7.

Backcasting population estimates for 1997, and comparing to YPTG (1997) model projections, stock size estimates of age 3 and older fish increased slightly (i.e., they were underestimated last year) in all management units (YPTG 1997 and this report: Tables 4 and 5). Our estimates were within the stated coefficients of variation stated in last year's report that calculate variation around the estimate. Comparing this year's CAGEAN to last year's total population estimates for ages 3+: Unit 1 increased 21%, Unit 2 increased 3%, Unit 3 increased 13%, and Unit 4 decreased 6%. When incorporating all (2-6+) ages, our models from last year overestimated populations in Management Units 1, 2, and 4 largely based on the reduction in the entry of the age 2 fish to the fishery. In Unit 3, our estimate of recruitment for age 2 yellow perch was just above the predicted range. Our recruitment estimation last year overestimated age 2 population by 82% in Unit 1, by 55% in Unit 2, and by 72% in Unit 4. The recruitment regression underestimated the age 2 cohort by 44% in Unit 3. As previously discussed, growth declines for Age 2 fish and specific gear selectivity (Figure 5, Appendix A) may have lead to their reduced recruitment, which in turn could give an underestimate to CAGEAN's first estimate of the 1995 year class as it entered the fishery in each management unit. These estimates have generally followed a pattern of increasing abundance of the year class represented by the age 2 cohort for the first few years after successive annual CAGEAN runs. This process improves precision of the cohort estimate with time.

Backcast estimates of biomass for ages 2+ at the start of 1997 were lower than projected in the YPTG 1997 report, in part due to reduction in growth and weight-at-age values. Age 2+ backcast values were lower than YPTG 1997 projections by 10% in Unit 1, 8% in Unit 2, 2% in Unit 3 and 23% in Unit 4. Backcast estimates slightly increased the biomass of ages 3+ yellow perch in Unit 1 and 2, up 17% and 8% respectively. Backcast estimates reduced biomass in Unit 3 by 10% and by 17% in Unit 4.

A problem in the moderate to severe underestimation of the age 2 cohort occurs when this smaller numerical estimate is not corroborated with similar tendencies in interagency trawl and partnership gill net index series. These potentially erroneous values are then projected forward into the next year as age 3 in the yield per recruit scenario, ultimately giving rise to a lower projected harvest range and RAH. The YPTG investigated methods to calculate an alternate estimate for age 2 cohort in 1997. Conversely, if the age 2 estimate is adjusted upward too far, then the age 3 estimate would be high, leading to an RAH value that could be potentially too high, causing overharvest, increased exploitation and reduced survival. Certainly the opposite scenario could occur if growth was significantly higher than average, leading to an overestimate of abundance.

We have adjusted age 2 cohort estimates for 1997 for Units 1-3 by incorporating a regression of partnership gill net catches of age 2 against the age 2 cohort in that season produced by this year's CAGEAN long data series output. No partnership gill net information was available for Unit 4. These calculations increased the numbers in the age 2 cohorts in 1997 for Management Units 1-3. The methodology and projected population abundance, biomass and projected RAH information for this second scenario are presented in Appendix C.

Recruitment Estimator for Incoming Age 2 Yellow Perch

In recent years, age 2 yellow perch recruits have been projected using regressions of annual index trawling values for each year class as young-of-the-year and yearlings against CAGEAN estimates of abundance for those year classes as age 2 fish. By using CAGEAN as a method of backcasting age 2 population size and recruitment, it has been shown that our prior methods of calculating age 2 yellow perch entering the fishery using either the old regressions or the three-year, age 2 averaging method (YPTG 1995, 1996) were not robust and did not predict actual magnitude of age 2 entry very well. Typically in most cases, the old regression model overestimated age 2 severely (YPTG 1995, 1996) and the averaging method underestimated age 2 recruits. Further investigations into the effect of changes in growth at early ages and selectivity of the fisheries is warranted to improve the precision of this estimator.

In 1997-98 the Yellow Perch Task Group continued to refine the recruitment module and has improved the trawl data series that goes into calculating the least-squares regression values against calculated CAGEAN age 2 values. Trawl values were also pooled across season and agency where available to gather additional index series. Greater precision was gained by compiling data in arithmetic and/or geometric mean catch per hour tow. The YPTG presents the most significant regression equations used in calculating age 2 yellow perch from the 1996 year class entering the fishery in 1998 in Appendix B, Table B-1. Raw data from trawl index series for the time period examined are presented in Appendix

B, Table B-2, while a key summarizing abbreviations used for the trawl series is presented as a Legend in Appendix B. The YPTG chose a mean estimator from the significant regression lines to describe age 2 yellow perch available to the fishery beginning in 1998. Area discrepancies across management units were taken into consideration (i.e. Unit 4 data was not applicable in Units 1 and 2), and also omitted were regressions that produced negative slopes or did not have index values for 1997.

1998 Population Size Projection

Stock size estimates for 1998 (age 3 and older) were projected from the CAGEAN 1997 population size estimates and age-specific survival rates in 1997 (Tables 5 and 6). Recruitment of the 1996 year class in 1998 (age 2 fish) was estimated from the revised recruitment-regression module (Table 6, Appendix B). Stock size estimates for 1998 (age 3 and older) were projected from the CAGEAN 1997 population size estimates and age-specific survival rates in 1996 (Tables 5 and 6).

At the request of the Lake Erie Committee (LEC) and the Standing Technical Committee (STC) last year, the YPTG changed the way it calculates and reports standard errors and ranges about our mean estimates for each age (YPTG 1997). At the request of LEC and STC, the YPTG adopted the Lake Erie Walleye Task Group (WTG) calculation method in 1997. This method calculates the coefficient of variation (CV, Table 6), using the mean and standard deviation from the last year in the time series of CAGEAN in each management unit, instead of the bootstrap mean of means that was used in the past. This new method has been adopted as a standard procedure from last year (Table 6). The net effect will be wider ranges for the 1998 population estimates and RAH's for each management unit.

For 1998, stock size estimates of age 2 and older yellow perch show a sizable increase of 230% in Unit 1, 142 % in Unit 2, 165% in Unit 3, and 5% in Unit 4 (Tables 4 and 5, Figure 6). Stock size estimates of age 3 and older fish show a sizable decrease in all management units in 1998: down 56% in Unit 1, down 46% in Unit 2, down 19% in Unit 3 and down 34% in Unit 4, due to the weak recruitment, possible underestimate of abundance, and poor growth of the 1995 year class and the higher exploitation and lower survival of the older age groups.

Biomass estimates for age 2 and older fish for 1998 increase greatly over 1997 levels in all Units except Unit 4 (Table 4, Figure 7) due, again, to the entrance of the strong 1996 year class. Ages 2+ biomass estimates are +97% in Unit 1, +74% in Unit 2, +69% in Unit 3 and -9% in Unit 4. Biomass estimates of age 3 and older yellow perch available at the start of 1998 are substantially lower than 1997 in all management units: Unit 1, -44%; Unit 2, -36%; Units 3 and 4, each -23%. Yellow perch populations in all units will be dominated by fish from the 1996 year class, but the 1993 and especially the 1994 year class are persisting in all management units. Yellow perch ages 6 and older will continue to persist in the Eastern Basin fishery.

Survival rates for ages 2 and older perch in 1997 declined markedly in all management units (Figure 8). This trend was also exhibited for survival of ages 3 and older yellow perch in all units (Figure 9). Overall survival trends since 1988 show a general (slow) increase in survival across all management units until this past year. Exploitation rates for ages 2 and older fish in 1997 increased substantially in all management units (Figure 10). The same trend for exploitation of age 3 and older yellow perch is evident in all units (Figure 11). Overall trends for exploitation showed a slight decreasing trend up until last year, but are influenced in each management unit independently by periodic spikes that coincide with the entry of strong year classes into the fishery. The 1997 rebound in exploitation both for ages 2+ and 3+ was most likely due to the large increase in the TAC for each management unit compared to 1996, which was not backed up by a sizable gain in the population abundance or biomass estimates, and the overestimate of potential age 2 yellow perch entering the fishery.

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

The yield per recruit model used to calculate a recommended harvest in 1998 is modified from that used in 1997 by several different factors. The first of which is how we calculate F_{opt}. The basic assumption of the yield per recruit model is that the desired harvest strategy is to optimize the return in weight per recruit. The optimum harvest rate, F_{opt}, is determined by growth rate versus natural mortality rate. For temperate waters, F_{opt} is modified to $F_{0.1}$, which corresponds to 10% of the rate of increase in yield per recruit, which can be obtained by increasing F (fishing mortality) at low levels of fishing. A full