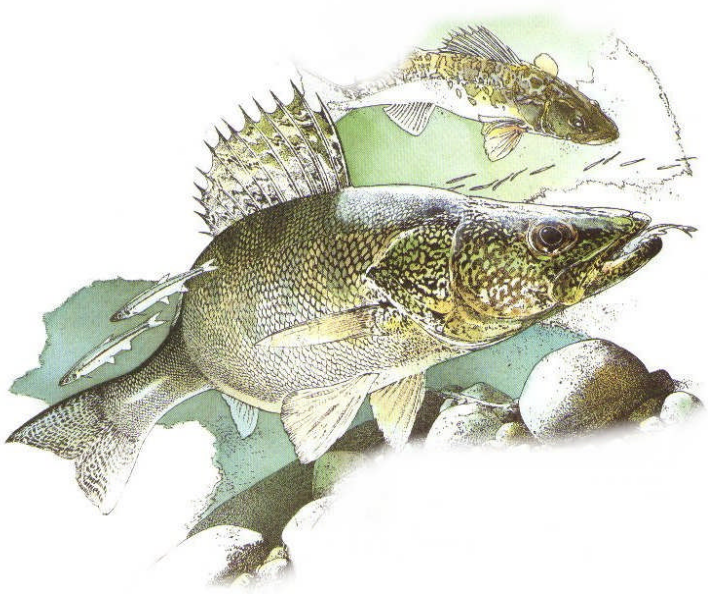
Progress Report for 2002 by the

LAKE ERIE WALLEYE TASK GROUP

March 2003



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Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission

Charges to the WTG from the STC, 2002-2003

The charges from the Standing Technical Committee (STC) to the Walleye Task Group (WTG) for the period from March 2002 to February 2003 were to:

1) Continue analyses supporting development and refinement of the multi-year harvest strategy and evaluate long-term effects of different management strategies on sustainability of walleye as part of the Coordinated Percid Management Strategy (CPMS).
2) Maintain and update centralized time series required for population models including tagging, fishing harvest and effort by grid, growth rate, maturity schedule, and agency or interagency abundance indices.
3) Assemble and analyze various data (harvest and effort, index fishing, tagging, genetic, etc.) for development of a spatially explicit database describing the Lake Erie walleye resource to search for evidence of stock discreteness and contributions to lakewide fisheries.
4) Develop catch-age analysis for Eastern Basin walleye in cooperation with university studies underway (Cornell/U-M).
5) Examine spawning stock biomass trends and develop biological reference points as part of the decision analysis process. Address alternate yield methods other than Fopt, yield-per-recruit that may need to be implemented after the current CPMS.

Review of Walleye Fisheries in 2002

Fishery effort and walleye harvest data were combined for all jurisdictions and Management Units (Figure 1) to produce lakewide estimates. The 2002 total estimated lakewide harvest of walleye was approximately 2.4 million fish, a 17% decline from 2.9 million in 2001, and was the lowest harvest since 1978 (Tables 1 and 2). The total harvest represented about 71% of the total allowable catch (TAC) of 3.4 million walleye and included walleye caught incidentally in commercial fisheries for other species. The sport harvest of 1 million fish was the lowest sport harvest since 1976 and represented a decline of 31% from 2001 (Table 2, Fig. 2). Commercial harvest of walleye declined 5%, to 1.4 million fish in 2002, and was a continuation of a significant drop since 1998 (Table 2, Fig. 2). The commercial harvest was the lowest since 1983 and only 65% of the 1975-2002 mean.

Total sport effort continued the declining trend seen since 1988 dropping 18% to 3.4 million angler hours, the lowest since 1978 (Table 3, Figure 3). Sport effort declined across all Management Units with only the Michigan fishery showing an increase in 2002. Total commercial gill net effort decreased 35% to 13,515 kilometers of net with decreases in all Management Units (Table 3, Figure 4).

Sport catch-per-unit-effort (CUE) showed a slight decrease in the west and east ends of the lake, but a slight increase in the central basin (Management Units 2 and 3). The average sport catch rate of 0.30 fish per angler hour was 30% below the 1975-2002 mean (Table 4, Figure 5). Commercial CUE increased substantially to 104 walleye/kilometer of net in 2002, the second consecutive year of increasing catch rates for the commercial gear, after a trend of declining CUE's since the mid 1980's (Table 4, Figure 5). The increase in 2002 represents a 96% increase over the year 2000 catch rate of 53.2 walleye/kilometer. Commercial CUE increases have been most pronounced in the west and west-central basins.

Age 3 walleye, the 1999 year class, comprised the majority of harvests in both the sport (54%) and commercial (68%) fisheries followed by age 4, the 1998 year-class, which contributed only 13% and 9%, respectively (Tables 5,6). These two year-classes comprised 73% of the harvest in Unit 1 and 74% in Unit 2, but only 43% and 30% of the harvest in Units 3 and 4, respectively. Harvests of older age groups increased from west to east with 28% and 31% of the fish harvested in Unit 3 and 4 being age-7 and older.

Mean age of the catch typically increases from west to east by management unit, and in 2002 it ranged from 3.8 to 7.5 years in the sport fishery and from 3.2 to 5.8 in the commercial fishery, with a mean of 4.6 years for the combined fisheries (Table 7, Figure 6). Mean age in the sport fishery increased slightly (4.0 to 4.3 years), while the commercial mean age remained essentially unchanged. The mean age for both fisheries and the lakewide average were above long-term means.

Coordinated Percid Management Strategy

The Lake Erie Committee (LEC) of the Great Lakes Fishery Commission announced in March, 2000 that it would develop a Coordinated Percid Management Strategy to protect and rebuild the walleye and yellow perch stocks in Lake Erie. In June the LEC, made up of fishery managers from around the lake, met to discuss the status of walleye stocks. The LEC had been increasingly concerned about the declining abundance of Lake Erie walleye since the late 1980s. A number of indicators were reviewed which demonstrated large changes had occurred in the 1990's:

- reduced and more variable fishing success for both sport and commercial fisheries
- declining indices of abundance (fishery and index surveys; population estimates)
- truncated population structure (fewer older fish)
- increased reliance on juvenile fish in the harvest
- reduced survival

- geographic distribution declining in east and central basins to a stronghold in the west
- declining growth rates

The Committee noted that walleye harvest may not have been the sole cause of the problem. Changes in walleye habitat, Lake Erie's food web, nutrient loading, and exotic species introductions may have altered conditions that promoted exceptional recruitment historically. Excessive harvest, however, might restrict or prevent walleye recovery.

To halt these trends and promote recovery of walleye, the LEC proposed substantial changes in the walleye harvest. It was agreed that development of a conservative total allowable catch for 2001 to 2003 would best achieve the CPMS objectives.

Accordingly, a new charge was added to the Walleye Task Group for 2000/2001: " *to derive a recommended multi-year TAC that will reverse declines and rebuild stocks of walleye and achieve a broad distribution of benefits throughout Lake Erie"*. The Walleye Task Group identified the following activities to meet this new charge:

a) develop and refine the essential analytical tools to support accurate estimation of walleye stock size by catch-at-age analysis.
b) update and refine estimates of walleye population parameters (survival, natural mortality, growth, …)
c) review the current yield model and analysis and evaluate the use of alternate yield analysis to derive a Recommended Allowable Harvest (RAH)
d) identify past and current walleye stock status, the relation of stock to recruitment and exploitation, the role of habitat, fish community and other factors that could influence walleye production, and identify potential constraints that could influence realization of the CPMS objective and its timeframe for achievement
e) define movement and exploitation of walleye stocks in L. Erie to support management of the stock concept

The WTG identified tasks a) to c) as priority steps which were the focus of their work in 2000. For the first task, the WTG explored and developed the use of AD Model Builder (ADMB) software (C++ based) to generate catch-at-age analysis as an alternate to the previously used R. Deriso CAGEAN software (Fortran based) that had been used since 1990. The new software alleviated some previous constraints: allowed the use of a longer data series (22 vs. 16 years), the addition of auxiliary sources of effort-catch data (e.g., index fishing survey gear which should add an 'unbiased' input expected to reduce residuals), and removed the terminal F parameter. For the second task, the WTG updated estimates of walleye population parameters (Z, S, M). For the third task, an

alternate yield analysis was derived that should promote rebuilding of walleye stocks (see section: *"Allowable Harvest Recommendations for 2003 and 2004"*).

Relative Abundance and Catch-at-Age Analysis

The current walleye catch at age model was derived from the model of Deriso et al. (1986). The walleye task group has been using this model for several years and started with the application version called CAGEAN (Deriso et al., 1986). In 2000, the WTG rewrote the CAGEAN algorithms into a program in AD Model Builder software compiled in Microsoft Visual C++. During 2001, the WTG re-wrote the model code and included three index gill net surveys representing Michigan (far west end of the west basin of Lake Erie), Ohio (southern half of the west basin of Lake Erie) and Ontario (northern half of western Lake Erie). The catch at age model used natural log (LN) transformed catch and effort data to estimate the abundance at age of fish. The solution of the catch at age equation was obtained using non-linear sums of squares and a penalized likelihood function. The variance ratio technique was employed to estimate the weights assigned to the variances of each of the surveys (Deriso et al., 1986 and Quinn and Deriso, 1999). The 2002 population estimate was about 23.2 million age 2+ walleye (Table 8, Figure 7) and only about 5.5 million age 4+ walleye or spawners (Table 8).

The second model used linear regression to estimate recruitment, while simulating fishing mortality (Tables 9,10 and Figure 8). Simulations were done to forecast the abundance of walleye in 2004, based on varying levels of exploitation of the fishable stock available in 2003 (Table 10). The simulations allowed us to consider varying levels of recruitment and fishing mortality. This was important because the relative abundance of spawners and stochastic factors such as water temperature at hatch, combine to dictate the number of recruits 2 years later. Unfortunately, recruitment in 2000 and 2002 was very poor. The 2001 year class is expected to add only 11.4 million recruits to the walleye population in 2003, approximately 4 million fish less than the mean annual recruitment (Figure 9). The 2003 estimated abundance of age 2+ walleye is 26 million (Figure 10). The abundance of age 4+ walleye (spawners) will increase in 2003 to about 12.7 million walleye as the 1999 year class matures. This will mark the first year since 1995 that walleye spawner abundance exceeds 10 million fish. However, due to poor recruitment in 2000, the abundance of age 4+ walleye will decline in 2004 to 9 million fish (Table 10). For comparison purposes, age 4+ walleye abundance ranged from 14 to 25 million in the late 80s (Table 8) when abundance was at an all time high.

The reproductive success of walleye in Lake Erie has shown considerable variability from year to year. Accurate prediction of recruitment success has challenged fisheries scientists worldwide for over 100 years. In any given year, numerous random factors such as winter and spring weather conditions

(temperatures, warming rates, storms, runoff, etc.) can directly affect egg survival and hatching success. Fry survival is affected by types and densities of zooplankton available, as well as by fry predator abundance. In recent times, invasions by zebra mussels and round gobies have further impacted walleye recruitment by altering spawning habitat, increasing predation on eggs and fry, and indirectly by creating shifts in the zooplankton community. Fisheries agencies can do little to manage the weather or the impact of these exotic species. The only tool available to managers is maximizing the number of spawning fish by implementing restrictive harvest strategies. More spawners produce more eggs and therefore increase the likelihood of a large hatch. However, if climatic or other factors result in poor environmental conditions for survival of eggs and fry, population recovery will be difficult to achieve.

Allowable Harvest Recommendations for 2003 and 2004

A major objective of the CPMS is to reverse declines and rebuild stocks of walleye in Lake Erie. To do this, the LEC desired a single TAC to serve as a ceiling for 2001-2003. A ceiling of 3.4 million walleye, based on average recruitment in 2003 and reduced fishing mortality, was recommended. Basically, the WTG abandoned the use of the past target fishing mortality rate ($F_{0.1}$) in favor of a simpler approach balancing mortality with recruitment gains. This approach is similar to a bank account; to rebuild, the number of walleye leaving the fishery has to be less than that entering the fishery. Unfortunately, age-2 recruitment for 2003 is now forecasted to be below average (approx. 11.4 million fish) and for 2004 will be as weak or weaker than the record low recruitment of the 1995 year class (Table 9; Figures 9, 10). Given a natural mortality of 0.32, the WTG modeled different fishing mortality scenarios to 1) maintain the RAH at 3.4 million, 2) maintain F at the 2002 level, 3) maintain the abundance of Age 2+ walleye above the 19 million fish level in 2003 and 2004 (Table 11).

Simulations show that the walleye population in western Lake Erie is still in a precarious state. Since 1990, above average recruitment has occurred only three times in 15 years. The extremely poor recruitment of the 2002 year class will further reduce the number of age 2+ walleye in 2004. This decline will result in RAH well below the CPMS ceiling value of 3.4 million fish. Without above average reproductive success in 2003, stakeholders should expect an even lower RAH in 2005. If the recruitment patterns that have prevailed during the 1990's continue through the next 10 years, RAH levels could fall below 2 million fish annually.

By applying various levels of fishing mortality rates to projected standing stock size estimates, we calculated expected catches, with 95% confidence limits, for 2003 and 2004 (Tables 10a, 10b). If the fishery expanded and harvested the maximum RAH of 3.4 million fish in 2003 (a 48% increase in fishing mortality), the mean expected catch (or RAH) in 2004 would decline to 2.9 million fish and

the abundance age 2+ walleye would decline 35% to 16.8 million fish, painting a bleak picture for the future. If fishing mortality is held unchanged from 2002, the mean RAH would be 2.4 million fish in 2003 and 1.7 million fish in 2004, with an age 2+ walleye population of 17.7 million at the start of fishing in 2004, again suggesting reduced potential for recovery. A drastic 67% reduction in fishing mortality from 2002 would result in RAH of 0.8 million fish in 2003 and 2004, with an age 2+ population of 19 million walleye in 2004, the minimum level required to prevent further declines in the walleye stock (Table 11). **The Walleye Task Group recommends a TAC for 2003 below the 3.4 million ceiling agreed upon by the LEC as part of the CPMS. The WTG encourages the LEC to advise stakeholders that the RAH for 2004 will be considerably below 3.4 million fish.** This rehabilitation harvest strategy will:

1. *Continue to promote survival of the strong 1999 and average 2001 year classes and enhance their contribution as maturing fish to the reproductive population by 2003 and 2005, respectively,*
2. *Increase potential quantity of eggs being deposited by the walleye population each year, and*
3. *Address continued uncertainty about the effects of reduced ecosystem productivity on sustainable fish yields, recruitment and natural mortality.*

Other Walleye Task Group Charges

Centralized Databases

WTG members currently manage several databases. The tagged walleye database, consisting of tag return and tagged population information dating back to 1986, is maintained by MDNR. Fishery characteristics (catch at age and effort) are part of the database used in catch-at-age analysis. A spatially explicit version of these data (e.g., catch and effort by statistical grid) is managed by MDNR. Growth, maturity, catch, and effort data are stored in an interagency gill net database that has been managed by ODNR-Sandusky. This database is in the process of being reformatted and converted into a relational database. Further work is needed to include monofilament data from the OMNR Partnership program at sites used for calculation of the age-1 index for Ontario, as well as data from New York and Ontario for the eastern end of the lake. Growth and relative abundance data from the interagency trawl program in the western basin are stored in databases managed by MDNR. Use of WTG databases by non-members is permitted following protocol established in the 1994 WTG Report (Appendix A).

Analysis of Walleye Distribution Data and Stock Discrimination

To answer the third charge and address issues that are important to the rebuilding of walleye stocks in Lake Erie, several research projects are

underway. Three separate teams of researchers are examining walleye stock structure using different genetic techniques, morphometrics, and analysis of chemical composition and shape of otoliths. These studies are complimentary and will provide different levels of stock discrimination, information about walleye life history in relation to habitat, and an economically feasible and practical method to discriminate stocks. They are occurring at Cleveland State University (Dr. Carol Stepien), Trent University (Dr. Chris Wilson) and the University of Windsor (Dr. Peter Sale and Dr. Tim Johnson OMNR - Wheatley). Two other projects, which are both funded primarily by the Great Lake Fisheries Commission, are focused on modeling walleye distribution. At Cornell University, Dr. Pat Sullivan and a M.Sc. candidate are developing a spatio-temporal model using catch and effort data. At the University of Michigan, Dr. Ed Rutherford and his graduate students have developed a spatial model relating walleye movements, inferred from tag recovery data and fishery catch rates, to Lake Erie water temperature and forage abundance.

Eastern Basin Catch-age Analysis

The Walleye Task Group has been cooperating with three sponsored research projects funded by the Great Lakes Fisheries Commission's Coordination Activities Program (CAP), and the U.S. Fish and Wildlife Restoration Act. These efforts have been assembling and analyzing temporally and spatially explicit fisheries statistics for the Lake Erie walleye resource with the objective of incorporating knowledge of dynamics of individual walleye stocks, and broad seasonal movement patterns into the walleye stock assessment model. The expected completion of these research projects in 2004 should directly support development of a stock assessment model for the eastern basin walleye resource.

Decision Analysis

In 2002, the WTG was charged with investigating the merits of a Decision Analysis (DA) model to enhance the ability of the LEC to understand levels of uncertainty and risk with respect to achieving population targets when setting annual TACs and developing long term management strategies for walleye. In 2002, Dr. Mike Jones (MSU and GLFC PERM) led a CAP funded workshop to educate the LEC and WTG on the DA process, and to take steps toward building a DA model for Lake Erie walleye. Tasks for 2003 flowed out of this workshop that included further investigation into M, evaluating uncertainty around the stock/recruit relationship, and the creation of explicit fishery objectives for use in the DA model. Completion of these charges, and an additional workshop to be held in 2003, will move both the WTG and LEC towards the finalization of a DA model prototype for evaluation and use in the future.

Recommended Charges to the Walleye Task Group in 2003-2004

The WTG recommends that the CPMS charge (Charge 1), should be discontinued. The STC may wish to replace the charge with another that provides additional direction towards achieving walleye recovery or a sustainable walleye fishery.

The WTG recommends that 2002-2003 charges 2 thru 4 remain in effect for 2003-2004**.**

The WTG recommends that the 2002-2003 charge 5 be revised to more directly guide progress on a Decision Analysis tool that incorporates biological reference points, as well as uncertainties regarding stock/recruitment and natural mortality.

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Table 1. Lake Erie walleye total allowable catch (top) and measured harvest (bottom, bold), in numbers of fish, from 1977 to 2002. Allocations based on water area are: Ohio, 51.4%; Ontario, 43.3%; and Michigan, 5.3%. New York and Pennsylvania do not have assigned quotas but are included in the annual catch total.

	TAC Area (MU-1, MU-2, MU-3)				Non TAC Area (MU-4)				All Areas
Year	Michigan	Ohio	Ontario	Total	NY	Penn.	Ontario	Total	Total
1977 TAC	87,600	521,600	386,300	995,500					995,500
Har	**106,530**	**2,167,500**	**371,403**	**2,645,433**					**2,645,433**
1978 TAC	73,000	433,000	321,000	827,000					827,000
Har	**72,195**	**1,586,756**	**446,774**	**2,105,725**					**2,105,725**
1979 TAC	207,000	1,230,000	911,000	2,348,000					2,348,000
Har	**162,375**	**3,314,442**	**734,082**	**4,210,899**					**4,210,899**
1980 TAC	261,700	1,558,600	1,154,100	2,974,400					2,974,400
Har	**183,140**	**2,169,800**	**1,049,269**	**3,402,209**					**3,402,209**
1981 TAC	367,400	2,187,900	1,620,000	4,175,300					4,175,300
Har	**95,147**	**2,942,900**	**1,229,017**	**4,267,064**					**4,267,064**
1982 TAC	504,100	3,001,700	2,222,700	5,728,500					5,728,500
Har	**194,407**	**3,015,400**	**1,260,852**	**4,470,659**					**4,470,659**
1983 TAC	572,000	3,406,000	2,522,000	6,500,000					6,500,000
Har	**145,847**	**1,864,200**	**1,416,101**	**3,426,148**					**3,426,148**
1984 TAC	676,500	4,028,400	2,982,900	7,687,800					7,687,800
Har	**351,169**	**4,055,000**	**2,178,409**	**6,584,578**					**6,584,578**
1985 TAC	430,700	2,564,400	1,898,800	4,893,900					4,893,900
Har	**460,933**	**3,730,100**	**2,435,627**	**6,626,660**					**6,626,660**
1986 TAC	660,000	3,930,000	2,910,000	7,500,000					7,500,000
Har	**605,600**	**4,399,400**	**2,617,507**	**7,622,507**					**7,622,507**
1987 TAC	490,100	2,918,500	2,161,100	5,569,700					5,569,700
Har	**902,500**	**4,433,600**	**2,688,558**	**8,024,658**					**8,024,658**
1988 TAC	397,500	3,855,000	3,247,500	7,500,000					7,500,000
Har	**1,996,788**	**4,890,367**	**3,054,402**	**9,941,557**	**85,282**			**85,282**	**10,026,839**
1989 TAC	383,000	3,710,000	3,125,000	7,218,000					7,218,000
Har	**1,091,641**	**4,191,711**	**2,793,051**	**8,076,403**	**129,226**			**129,226**	**8,205,629**
1990 TAC	616,000	3,475,500	2,908,500	7,000,000					7,000,000
Har	**747,128**	**2,282,520**	**2,517,922**	**5,547,570**	**47,443**			**47,443**	**5,595,013**
1991 TAC	440,000	2,485,000	2,075,000	5,000,000					5,000,000
Har	**132,118**	**1,577,813**	**2,266,380**	**3,976,311**	**34,137**			**34,137**	**4,010,448**
1992 TAC	329,000	3,187,000	2,685,000	6,201,000					6,201,000
Har	**249,518**	**2,081,919**	**2,497,705**	**4,829,142**	**14,384**			**14,384**	**4,843,526**
1993 TAC	556,500	5,397,000	4,546,500	10,500,000					10,500,000
Har	**270,376**	**2,668,684**	**3,821,386**	**6,760,446**	**40,032**			**40,032**	**6,800,478**
1994 TAC	400,000	4,100,000	3,500,000	8,000,000					8,000,000
Har	**216,038**	**1,468,739**	**3,431,119**	**5,115,896**	**59,345**			**59,345**	**5,175,241**
1995 TAC	477,000	4,626,000	3,897,000	9,000,000					9,000,000
Har	**107,909**	**1,435,188**	**3,813,527**	**5,356,624**	**26,964**			**26,964**	**5,383,588**
1996 TAC	583,000	5,654,000	4,763,000	11,000,000					11,000,000
Har	**174,607**	**2,316,425**	**4,524,639**	**7,015,671**	**38,728**	**89,087**		**127,815**	**7,143,486**
1997 TAC	514,000	4,986,000	4,200,000	9,700,000					9,700,000
Har	**122,400**	**1,248,846**	**4,072,779**	**5,444,025**	**29,395**	**88,682**		**118,077**	**5,562,102**
1998 TAC	546,000	5,294,000	4,460,000	10,300,000					10,300,000
Har	**114,606**	**2,303,911**	**4,173,042**	**6,591,559**	**34,090**	**124,814**	**47,000**	**205,904**	**6,797,463**
1999 TAC	477,000	4,626,000	3,897,000	9,000,000					9,000,000
Har	**140,269**	**1,033,733**	**3,454,250**	**4,628,252**	**23,133**	**89,038**	**87,000**	**199,171**	**4,827,423**
2000 TAC	408,100	3,957,800	3,334,100	7,700,000					7,700,000
Har	**252,280**	**932,297**	**2,287,533**	**3,472,110**	**28,599**	**77,512**	**67,000**	**173,111**	**3,645,221**
2001 TAC	180,200	1,747,600	1,472,200	3,400,000					3,400,000
Har	**159,186**	**1,157,914**	**1,498,816**	**2,815,916**	**14,669**	**52,796**	**39,498**	**106,963**	**2,922,879**
2002 TAC	180,200	1,747,600	1,472,200	3,400,000					3,400,000
Har	**193,515**	**703,000**	**1,436,000**	**2,332,515**	**18,377**	**22,000**	**36,000**	**76,377**	**2,408,892**

Table 2. Annual harvest (thousands of fish) of Lake Erie walleye by gear, management unit, and agency.

	Sport Fishery															Commercial Fishery				
	Unit 1				Unit 2			Unit 3			Unit 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4	
Year	OH	MI	ON	Total	OH	ON	Total	OH	ON	Total	ON	PA	NY	Total	Total	ON	ON	ON	ON	Total
75	77	4	7	88	10	--	10	--	--	--	--	--	--	--	98	--	--	--	--	0
76	605	30	50	685	35	--	35	--	--	--	--	--	--	--	720	113	44	--	--	157
77	2,131	107	69	2,307	37	--	37	--	--	--	--	--	--	--	2,344	235	67	--	--	302
78	1,550	72	112	1,734	37	--	37	--	--	--	--	--	--	--	1,771	274	60	--	--	334
79	3,254	162	79	3,495	60	--	60	--	--	--	--	--	--	--	3,555	625	30	--	--	655
80	2,096	183	57	2,336	49	--	49	24	--	24	--	--	--	--	2,409	953	40	--	--	993
81	2,857	95	70	3,022	38	--	38	48	--	48	--	--	--	--	3,108	1,037	119	3	--	1,159
82	2,959	194	49	3,202	49	--	49	8	--	8	--	--	--	--	3,259	1,077	134	2	--	1,213
83	1,626	146	41	1,813	212	--	212	26	--	26	--	--	--	--	2,051	1,129	167	80	--	1,376
84	3,089	351	39	3,479	787	--	787	179	--	179	--	--	--	--	4,445	1,639	392	108	--	2,139
85	3,347	461	57	3,865	294	--	294	89	--	89	--	--	--	--	4,248	1,721	432	225	--	2,378
86	3,743	606	52	4,401	480	--	480	176	--	176	--	--	--	--	5,057	1,651	558	356	--	2,565
87	3,751	902	51	4,704	550	--	550	132	--	132	--	--	--	--	5,386	1,611	622	405	--	2,638
88	3,744	1,997	18	5,759	584	--	584	562	--	562	--	--	85	85	6,990	1,866	762	409	--	3,037
89	2,891	1,092	14	3,997	867	35	902	434	80	514	--	--	129	129	5,542	1,656	621	386	--	2,663
90	1,467	747	35	2,249	389	14	403	426	23	449	--	--	47	47	3,148	1,615	529	302	--	2,446
91	1,104	132	39	1,275	216	24	240	258	44	302	--	--	34	34	1,851	1,446	440	274	--	2,160
92	1,479	250	20	1,749	338	56	394	265	25	290	--	--	14	14	2,447	1,547	534	316	--	2,397
93	1,846	270	37	2,153	450	26	476	372	12	384	--	--	40	40	3,053	2,488	762	496	--	3,746
94	992	216	21	1,229	291	20	311	186	21	207	--	--	59	59	1,806	2,307	630	432	--	3,369
95	1,161	108	32	1,301	159	7	166	115	27	141	--	--	27	27	1,635	2,578	681	489	--	3,748
96	1,442	175	17	1,634	645	8	653	229	27	256	--	89	39	128	2,671	2,777	1,107	589	--	4,473
97	929	122	8	1,059	188	2	190	132	5	138	--	89	29	118	1,505	2,585	928	544	--	4,057
98	1,790	115	34	1,939	215	5	220	299	5	304	19	125	34	178	2,641	2,497	1,166	462	28	4,153
99	812	140	34	986	139	5	144	83	5	88	19	89	23	131	1,349	2,461	631	317	68	3,477
00	674	252	34	961	165	5	170	93	5	98	19	78	29	125	1,354	1,603	444	196	48	2,291
01	941	160	34	1,135	171	5	176	46	5	51	19	53	15	87	1,449	1,004	310	141	20	1,475
02	516	194	34	744	141	5	146	46	5	51	19	22	18	59	1,000	937	309	146	17	1,409
Mean	1,888	332	41	2,261	271	15	279	184	21	196	19	78	41	84	2,746	1,535	464	304	36	2,172

Table 3. Annual fishing effort for Lake Erie walleye by gear, management unit, and agency.

	Sport Fishery [a]														Commercial Fishery [b]				
	Unit 1				Unit 2			Unit 3			Unit 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4	
Year	OH	MI	ON	Total	OH	ON	Total	OH	ON	Total	ON	PA	NY	Total	Total	ON	ON	ON	ON	Total
1975	486	30	46	562	61	--	61	--	--	--	--	--	--	--	623	--	--	--	--	--
1976	1,356	84	98	1,538	163	--	163	--	--	--	--	--	--	--	1,701	1,796	1,933	--	--	3,729
1977	2,768	171	130	3,069	151	--	151	--	--	--	--	--	--	--	3,220	4,282	1,572	--	--	5,854
1978	2,880	176	148	3,204	154	--	154	--	--	--	--	--	--	--	3,358	5,253	436	--	--	5,689
1979	4,179	257	97	4,533	169	--	169	--	--	--	--	--	--	--	4,702	5,798	1,798	--	--	7,596
1980	3,938	624	92	4,654	237	--	237	187	--	187	--	--	--	--	5,078	6,229	1,565	--	--	7,794
1981	5,766	447	138	6,351	264	--	264	382	--	382	--	--	--	--	6,997	6,881	2,144	622	--	9,647
1982	5,928	449	108	6,484	223	--	223	114	--	114	--	--	--	--	6,821	10,531	2,913	689	--	14,133
1983	4,168	451	118	4,737	568	--	568	128	--	128	--	--	--	--	5,433	11,205	5,352	5,814	--	22,371
1984	4,077	557	82	4,716	1,322	--	1,322	392	--	392	--	--	--	--	6,430	11,550	6,008	2,438	--	19,996
1985	4,606	926	84	5,616	1,078	--	1,078	464	--	464	--	--	--	--	7,158	7,496	2,800	2,983	--	13,279
1986	6,437	1,840	107	8,384	1,086	--	1,086	538	--	538	--	--	--	--	10,008	7,824	5,637	3,804	--	17,265
1987	6,631	2,193	84	8,908	1,431	--	1,431	472	--	472	--	--	--	--	10,811	6,595	4,243	3,045	--	13,883
1988	7,547	4,362	87	11,996	1,677	--	1,677	1,081	--	1,081	--	--	462	462	15,216	7,495	5,794	3,778	--	17,067
1989	5,246	3,794	81	9,121	1,532	77	1,609	883	205	1,088	--	--	556	556	12,374	7,846	5,514	3,473	--	16,833
1990	4,116	1,803	121	6,040	1,675	33	1,708	869	83	952	--	--	432	432	9,132	9,016	5,829	5,544	--	20,389
1991	3,616	440	144	4,200	1,241	79	1,320	724	155	880	--	--	440	440	6,840	10,418	5,055	3,146	--	18,619
1992	3,955	715	105	4,775	1,169	81	1,249	640	145	786	--	--	299	299	7,109	9,486	6,906	6,043	--	22,435
1993	3,943	691	125	4,759	1,349	70	1,418	1,062	125	1,187	--	--	305	305	7,669	16,283	11,656	7,420	--	35,359
1994	2,808	788	125	3,721	1,025	65	1,090	599	130	729	--	--	355	355	5,894	16,698	9,968	6,459	--	33,125
1995	3,188	277	125	3,589	803	65	868	355	130	485	--	--	259	259	5,201	20,521	12,113	7,850	--	40,484
1996	3,060	521	125	3,706	1,132	65	1,197	495	130	625	--	316	256	572	6,101	19,976	15,685	10,990	--	46,651
1997	2,748	374	88	3,210	864	45	909	492	91	583	--	388	273	661	5,363	15,708	11,588	9,094	--	36,390
1998	3,010	374	103	3,487	635	51	686	409	55	464	217	390	280	887	5,524	19,027	19,397	13,253	818	52,495
1999	2,368	411	103	2,882	603	51	654	323	55	379	217	397	171	785	4,699	21,432	10,955	7,630	1,444	41,461
2000	1,975	540	103	2,618	540	51	591	281	55	336	217	244	177	638	4,183	22,238	11,049	7,896	1,781	43,054
2001	1,952	362	103	2,417	697	51	748	261	55	316	217	241	163	621	4,102	9,372	5,746	5,021	639	20,778
2002	1,393	606	103	2,102	444	51	495	246	55	301	217	130	132	479	3,377	4,431	4,212	4,427	445	13,515
Mean	3,806	876	106	4788	809	60	838	507	109	571	217	329	316	519	6361	11,191	6,679	5,571	1,171	22,553

[a]Sport units of effort are thousands of angler hours.
[b]Estimated Standard (Total) Effort in kilometers of gill net = (walleye targeted effort x walleye total harvest) / walleye targeted harvest.

Table 4. Annual catch per unit effort for Lake Erie walleye by gear, management unit, and agency.

	Sport Fishery [a]															Commercial Fishery [b]				
	Unit 1				Unit 2			Unit 3			Unit 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4	
Year	OH	MI	ON	Total	OH	ON	Total	OH	ON	Total	ON	PA	NY	Total	Total	ON	ON	ON	ON	Total
1975	.16	.13	.16	.16	.17	--	.17	--	--	--	--	--	--	--	.16	--	--	--	--	--
1976	.45	.36	.50	.45	.22	--	.22	--	--	--	--	--	--	--	.42	63.0	22.9	--	--	42.2
1977	.77	.62	.53	.75	.24	--	.24	--	--	--	--	--	--	--	.73	54.9	42.6	--	--	51.6
1978	.54	.41	.76	.54	.24	--	.24	--	--	--	--	--	--	--	.53	52.2	138.2	--	--	58.8
1979	.78	.63	.81	.77	.36	--	.36	--	--	--	--	--	--	--	.76	107.9	16.7	--	--	86.3
1980	.53	.29	.62	.50	.21	--	.21	.13	--	.13	--	--	--	--	.47	153.0	25.3	--	--	127.3
1981	.50	.21	.51	.48	.14	--	.14	.12	--	.12	--	--	--	--	.44	150.7	55.4	4.9	--	120.1
1982	.50	.43	.45	.49	.22	--	.22	.07	--	.07	--	--	--	--	.48	102.2	45.9	2.8	--	85.8
1983	.39	.32	.34	.38	.37	--	.37	.20	--	.20	--	--	--	--	.38	100.7	31.2	13.7	--	61.5
1984	.76	.63	.48	.74	.60	--	.60	.46	--	.46	--	--	--	--	.69	141.9	65.3	44.4	--	107.0
1985	.73	.50	.68	.69	.27	--	.27	.19	--	.19	--	--	--	--	.59	229.6	154.5	75.6	--	179.1
1986	.58	.33	.49	.52	.44	--	.44	.33	--	.33	--	--	--	--	.51	211.0	99.0	93.7	--	148.6
1987	.57	.41	.61	.53	.38	--	.38	.28	--	.28	--	--	--	--	.50	244.2	146.5	133.1	--	190.0
1988	.50	.46	.21	.48	.35	--	.35	.52	--	.52	--	--	.18	.18	.46	249.0	131.4	108.2	--	177.9
1989	.55	.29	.17	.44	.57	.45	.56	.49	.39	.47	--	--	.23	.23	.45	211.1	112.7	111.2	--	158.3
1990	.36	.41	.29	.37	.23	.42	.24	.49	.28	.47	--	--	.11	.11	.34	179.1	90.7	54.5	--	120.0
1991	.31	.30	.27	.30	.17	.30	.18	.36	.28	.34	--	--	.08	.08	.27	138.8	87.0	87.1	--	116.0
1992	.37	.35	.19	.37	.29	.69	.32	.41	.18	.37	--	--	.05	.05	.34	163.1	77.3	52.3	--	106.8
1993	.47	.39	.30	.45	.33	.37	.34	.35	.09	.32	--	--	.13	.13	.40	152.8	65.4	66.8	--	106.0
1994	.35	.27	.17	.33	.28	.31	.28	.31	.16	.28	--	--	.17	.17	.31	138.2	63.2	66.9	--	101.7
1995	.36	.39	.25	.36	.20	.12	.19	.32	.21	.29	--	--	.10	.10	.31	125.7	56.2	62.2	--	92.6
1996	.47	.34	.13	.44	.57	.13	.55	.46	.21	.41	--	.28	.15	.22	.44	139.0	70.6	53.6	--	95.9
1997	.34	.33	.10	.33	.22	.04	.21	.27	.06	.24	--	.23	.11	.17	.28	164.6	80.1	59.8	--	111.5
1998	.59	.31	.33	.56	.34	.10	.32	.73	.08	.65	.09	.32	.12	.18	.48	131.3	60.1	34.8	34.2	79.1
1999	.34	.34	.33	.34	.23	.10	.22	.26	.08	.23	.09	.22	.14	.15	.29	114.8	57.6	41.6	47.4	83.9
2000	.34	.47	.33	.37	.31	.10	.29	.33	.08	.29	.09	.32	.16	.19	.32	72.1	40.2	24.8	27.1	53.2
2001	.48	.44	.33	.47	.25	.10	.24	.18	.08	.16	.09	.22	.09	.13	.35	107.1	54.0	28.1	32.1	71.0
2002	.37	.32	.33	.35	.32	.10	.29	.19	.08	.17	.09	.17	.12	.13	.30	211.5	73.4	33.0	37.4	104.3
Mean	.48	.38	.38	.46	.30	.24	.30	.32	.16	.30	.09	.25	.13	.15	.43	144.8	72.7	57.0	35.6	105.0

[a] Sport CPE = Number/angler hour

[b] Commercial CPE = Number/kilometer of gill net

Table 5. Catch at age of walleye harvest by management unit, gear, and agency in Lake Erie during 2002. Units 4 and 5 are combined in Unit 4.

		Comm'l	Sport						All Gears	
Unit	Age	OMNR	OMNR	ODNR	MDNR	NYDEC	PA	Total	OMNR	Total
1	1	45,226		434	0	--	--	434	45,226	45,660
	2	30,907		29,241	7,006	--	--	36,247	30,907	67,154
	3	717,736		308,253	127,721	--	--	435,974	717,736	1,153,710
	4	57,122		70,376	23,946	--	--	94,322	57,122	151,444
	5	36,223		22,974	13,614	--	--	36,588	36,223	72,811
	6	22,448		51,930	10,989	--	--	62,919	22,448	85,367
	7+	27,618		32,723	10,239	--	--	42,962	27,618	70,580
	Total	937,280	34,000	515,931	193,515	--	--	743,446	971,280	1,680,726
2	1	13,187		317	--	--	--	317	13,187	13,504
	2	8,139		2,793	--	--	--	2,793	8,139	10,932
	3	190,697		72,564	--	--	--	72,564	190,697	263,261
	4	50,503		22,611	--	--	--	22,611	50,503	73,114
	5	21,399		5,113	--	--	--	5,113	21,399	26,512
	6	16,780		14,527	--	--	--	14,527	16,780	31,307
	7+	8,456		22,926	--	--	--	22,926	8,456	31,382
	Total	309,161	5,000	140,851	--	--	--	145,851	314,161	455,012
3	1	3,076		0	--	--	--	0	3,076	3,076
	2	1,992		1,542	--	--	--	1,542	1,992	3,534
	3	49,740		16,716	--	--	--	16,716	49,740	66,456
	4	14,579		4,228	--	--	--	4,228	14,579	18,807
	5	14,234		4,055	--	--	--	4,055	14,234	18,289
	6	19,416		6,540	--	--	--	6,540	19,416	25,956
	7+	43,259		12,603	--	--	--	12,603	43,259	55,862
	Total	146,296	5,000	45,684	--	--	--	50,684	151,296	196,980
4	1	44		--	--	0	0	0	44	44
	2	157		--	--	97	0	97	157	254
	3	3,261		--	--	2,487	7,360	9,847	3,261	13,108
	4	2,038		--	--	3,521	4,089	7,610	2,038	9,648
	5	1,787		--	--	645	0	645	1,787	2,432
	6	2,929		--	--	3,650	1,636	5,286	2,929	8,215
	7+	6,422		--	--	7,977	8,996	16,973	6,422	23,395
	Total	16,638	19,000	--	--	18,377	22,081	59,458	35,638	76,096
All	1	61,533		751	0	0	0	751	61,533	62,284
	2	41,195		33,576	7,006	97	0	40,679	41,195	81,874
	3	961,434		397,533	127,721	2,487	7,360	535,101	961,434	1,496,535
	4	124,242		97,215	23,946	3,521	4,089	128,771	124,242	253,013
	5	73,643		32,142	13,614	645	0	46,401	73,643	120,044
	6	61,573		72,997	10,989	3,650	1,636	89,271	61,573	150,844
	7+	85,755		68,252	10,239	7,977	8,996	95,464	85,755	181,219
	Total	1,409,375	98,000	702,466	193,515	18,377	22,081	999,439	1,409,375	2,408,814

Table 6. Percent age composition of walleye harvested by management unit, gear, and agency in Lake Erie during 2002. Units 4 and 5 are combined in Unit 4.

		Comm'l	Sport						All Gears	
Unit	Age	OMNR	OMNR	ODNR	MDNR	NYDEC	PA	Total	OMNR	Total
1	1	4.8	--	0.1	0.0	--	--	0.1	4.7	2.7
	2	3.3	--	5.7	3.6	--	--	4.9	3.2	4.0
	3	76.6	--	59.7	66.0	--	--	58.6	73.9	68.6
	4	6.1	--	13.6	12.4	--	--	12.7	5.9	9.0
	5	3.9	--	4.5	7.0	--	--	4.9	3.7	4.3
	6	2.4	--	10.1	5.7	--	--	8.5	2.3	5.1
	7+	2.9	--	6.3	5.3	--	--	5.8	2.8	4.2
	Total	100	100	100	100	--	--	100	100	100
2	1	4.3	--	0.2	--	--	--	0.2	4.2	3.0
	2	2.6	--	2.0	--	--	--	1.9	2.6	2.4
	3	61.7	--	51.5	--	--	--	49.8	60.7	57.9
	4	16.3	--	16.1	--	--	--	15.5	16.1	16.1
	5	6.9	--	3.6	--	--	--	3.5	6.8	5.8
	6	5.4	--	10.3	--	--	--	10.0	5.3	6.9
	7+	2.7	--	16.3	--	--	--	15.7	2.7	6.9
	Total	100	100	100	--	--		100	100	100
3	1	2.1	--	0.0	--	--	--	0.0	2.0	1.6
	2	1.4	--	3.4	--	--	--	3.0	1.3	1.8
	3	34.0	--	36.6	--	--	--	33.0	32.9	33.7
	4	10.0	--	9.3	--	--	--	8.3	9.6	9.5
	5	9.7	--	8.9	--	--	--	8.0	9.4	9.3
	6	13.3	--	14.3	--	--	--	12.9	12.8	13.2
	7+	29.6	--	27.6	--	--	--	24.9	28.6	28.4
	Total	100	100	100	--	--		100	100	100
4	1	0.3	--	--	--	--	--	--	0.1	0.1
	2	0.9	--	--	--	0.5	0.0	0.2	0.4	0.3
	3	19.6	--	--	--	13.5	33.3	16.6	9.2	17.2
	4	12.2	--	--	--	19.2	18.5	12.8	5.7	12.7
	5	10.7	--	--	--	3.5	0.0	1.1	5.0	3.2
	6	17.6	--	--	--	19.9	7.4	8.9	8.2	10.8
	7+	38.6	--	--	--	43.4	40.7	28.5	18.0	30.7
	Total	100	100	--	--	100	100	100	100	100
All	1	4.4	--	0.1	0.0	--	--	0.1	4.4	2.6
	2	2.9	--	4.8	3.6	0.5	0.0	4.1	2.9	3.4
	3	68.2	--	56.6	66.0	13.5	33.3	53.5	68.2	62.1
	4	8.8	--	13.8	12.4	19.2	18.5	12.9	8.8	10.5
	5	5.2	--	4.6	7.0	3.5	0.0	4.6	5.2	5.0
	6	4.4	--	10.4	5.7	19.9	7.4	8.9	4.4	6.3
	7+	6.1	--	9.7	5.3	43.4	40.7	9.6	6.1	7.5
	Total	100	100	100	100	100	100	100	100	100

Table 7. Annual mean age (years) of Lake Erie walleye by gear, management unit, and agency.

	Sport Fishery															Commercial Fishery				
	Unit 1				Unit 2			Unit 3			Unit 4 & 5					Unit 1	Unit 2	Unit 3	Unit 4	
Year	OH	MI	ON	Total	OH	ON	Total	OH	ON	Total	ON	PA	NY	Total	Total	ON	ON	ON	ON	Total
75	2.53	2.53	3.26	2.59	1.53	--	1.53	--	--	--	--	--	--	--	2.48	--	--	--	--	--
76	2.49	2.49	2.35	2.48	2.05	--	2.05	--	--	--	--	--	--	--	2.46	1.51	1.51	--	--	1.51
77	3.29	3.29	2.64	3.27	2.44	--	2.44	--	--	--	--	--	--	--	3.26	2.74	2.74	--	--	2.74
78	3.50	3.62	3.07	3.48	3.33	--	3.33	--	--	--	--	--	--	--	3.48	2.69	2.69	--	--	2.69
79	2.71	2.71	2.67	2.71	2.29	--	2.29	--	--	--	--	--	--	--	2.70	2.83	2.83	--	--	2.83
80	3.00	3.00	2.84	3.00	2.92	--	2.92	2.65	--	2.65	--	--	--	--	2.99	2.96	2.96	--	--	2.96
81	3.61	2.97	3.47	3.59	2.62	--	2.62	2.72	--	2.72	--	--	--	--	3.56	3	3.00	2.99	--	3.00
82	3.25	3.25	2.76	3.24	2.58	--	2.58	2.51	--	2.51	--	--	--	--	3.23	2.81	2.81	2.81	--	2.81
83	3.03	3.03	3.17	3.03	2.25	--	2.25	2.07	--	2.07	--	--	--	--	2.94	3.47	3.47	3.47	--	3.47
84	2.64	2.64	2.90	2.64	2.61	--	2.61	2.68	--	2.68	--	--	--	--	2.64	2.89	2.89	2.89	--	2.89
85	3.36	3.36	3.17	3.36	3.24	--	3.24	3.58	--	3.58	--	--	--	--	3.35	3.04	3.04	3.04	--	3.04
86	3.73	3.61	3.54	3.71	3.69	--	3.69	4.08	--	4.08	--	--	--	--	3.72	3.61	3.70	4.22	--	3.71
87	3.83	3.32	3.78	3.73	3.68	--	3.68	4.10	--	4.10	--	--	--	--	3.73	3.71	3.47	3.40	--	3.61
88	3.97	3.43	4.58	3.78	3.81	--	3.81	5.37	--	5.37	--	--	4.87	4.87	3.93	3.27	3.15	3.89	--	3.32
89	4.48	3.75	4.29	4.28	4.65	4.29	4.64	5.13	4.29	5.00	--	--	5.59	5.59	4.44	3.49	3.51	4.22	--	3.60
90	4.44	4.64	5.00	4.52	5.31	5.41	5.31	6.41	5.41	6.36	--	--	5.70	5.70	4.90	3.91	3.90	4.60	--	3.99
91	4.91	5.29	5.01	4.95	6.22	6.03	6.20	6.70	5.91	6.58	--	--	6.36	6.36	5.41	4.21	4.63	5.14	--	4.41
92	4.60	3.49	3.45	4.43	4.89	6.72	5.15	5.67	6.42	5.73	--	--	6.35	6.35	4.71	4.03	4.23	5.49	--	4.27
93	4.60	4.41	4.09	4.57	5.79	6.45	5.83	5.98	6.17	5.99	--	--	6.15	6.15	4.96	3.64	4.38	5.21	--	4.00
94	4.53	4.19	5.84	4.49	5.38	6.41	5.45	6.22	6.85	6.28	--	--	6.49	6.49	4.93	3.65	4.36	5.60	--	4.03
95	4.04	3.55	4.74	4.02	6.07	7.29	6.12	6.08	7.17	6.33	--	--	6.80	6.80	4.48	3.38	4.63	5.92	--	3.94
96	3.98	3.46	4.31	3.93	4.22	7.22	4.26	6.06	7.57	6.22	--	--	6.47	6.47	4.35	3.57	3.36	5.21	--	3.73
97	4.21	3.99	4.21	4.18	5.30	5.30	5.30	6.27	6.27	6.22	--	--	6.25	6.25	4.67	3.87	3.68	4.83	--	3.96
98	3.74	3.13	3.15	3.69	4.66	8.09	4.74	4.64	7.81	4.69	9.55	--	10.13	9.92	4.32	3.26	4.00	5.26	7.00	3.72
99	3.72	3.16	3.43	3.63	5.35	9.17	5.48	5.95	10.00	6.18	8.15	--	10.29	9.32	4.55	3.41	4.29	5.28	6.76	3.81
00	3.94	3.27	3.43	3.75	4.12	9.17	4.27	6.36	10.00	6.53	8.15	--	9.75	9.11	4.51	3.69	4.67	5.65	6.46	4.11
01	3.66	3.02	3.43	3.56	4.09	9.17	4.23	6.14	10.00	6.52	8.15	7.70	9.09	8.04	4.02	3.19	3.77	5.52	6.00	3.57
02	3.80	3.83	3.43	3.79	4.57	9.17	4.73	5.46	10.00	5.91	8.15	6.59	8.05	7.54	4.26	3.22	3.50	5.37	5.80	3.54
Mean	3.70	3.44	3.64	3.66	3.92	7.14	3.96	4.91	7.42	4.97	8.43	7.15	7.22	7.00	3.88	3.30	3.53	4.51	6.56	3.45

Table 8. Estimated abundance at age, mean survival (S) and mean exploitation (U) for Lake Erie walleye, 1978 – 2002 from the 2003 catch-at-age analysis model in ADMB, M=.32. WTG 2003.

Year	Age						Total	S	U
	2	3	4	5	6	7+			
1978	2,734,500	10,185,200	781,515	32,617	335,234	3,745	14,072,811	0.530	0.233
1979	18,154,400	1,790,060	5,233,280	393,343	16,417	170,611	25,758,111	0.267	0.558
1980	21,946,100	9,328,580	398,402	1,129,380	84,887	40,362	32,927,711	0.555	0.204
1981	11,159,900	14,584,300	5,086,110	210,879	597,796	66,296	31,705,281	0.302	0.513
1982	17,435,900	6,003,890	3,829,730	1,286,090	53,324	167,924	28,776,858	0.453	0.326
1983	8,847,450	10,821,000	2,594,140	1,594,020	535,300	92,088	24,483,998	0.323	0.487
1984	49,931,100	4,875,770	3,150,380	709,147	435,751	171,506	59,273,654	0.542	0.218
1985	4,461,520	32,943,100	2,637,230	1,617,450	364,085	311,774	42,335,159	0.598	0.152
1986	19,037,400	3,040,090	19,580,900	1,523,800	934,565	390,513	44,507,268	0.577	0.177
1987	16,542,300	12,818,700	1,749,900	10,822,600	842,220	732,385	43,508,105	0.578	0.175
1988	49,691,700	11,149,500	7,344,360	972,877	6,016,960	875,423	76,050,820	0.571	0.184
1989	14,104,000	33,352,700	6,305,010	4,022,380	532,828	3,774,840	62,091,758	0.542	0.219
1990	10,391,900	9,302,910	17,741,700	3,249,880	2,073,310	2,220,360	44,980,060	0.552	0.207
1991	6,426,170	6,896,400	5,060,600	9,338,340	1,710,570	2,259,970	31,692,050	0.608	0.140
1992	13,162,900	4,402,850	4,205,300	2,974,390	5,488,650	2,333,700	32,567,790	0.577	0.177
1993	21,266,000	8,864,070	2,543,740	2,322,710	1,642,840	4,320,510	40,959,870	0.546	0.214
1994	3,852,110	14,061,900	4,876,250	1,312,370	1,198,330	3,076,620	28,377,580	0.546	0.214
1995	13,342,400	2,547,630	7,765,390	2,514,900	676,848	2,204,790	29,051,958	0.521	0.244
1996	15,094,200	8,688,870	1,351,190	3,779,090	1,223,900	1,402,370	31,539,620	0.481	0.292
1997	1,683,790	9,566,510	4,235,400	596,271	1,667,680	1,158,950	18,908,601	0.513	0.253
1998	16,175,000	1,090,830	4,998,280	2,022,120	284,679	1,349,530	25,920,439	0.491	0.281
1999	8,070,080	10,320,900	545,894	2,256,270	912,802	737,694	22,843,640	0.492	0.279
2000	6,823,710	5,153,580	5,167,710	247,313	1,022,180	747,743	19,162,236	0.497	0.273
2001	23,090,100	4,371,850	2,593,310	2,372,610	113,547	812,612	33,354,029	0.525	0.239
2002	2,950,200	15,071,600	2,281,280	1,281,930	1,172,830	457,820	23,215,660	0.629	0.115

Table 9. Data used to estimate the abundance of age 2 walleye by simple linear regression where Y=ADMB AGE2 and X=Pooled ONT-OH YOY Trawl. Values in bold are regression estimates and used for RAH projections 2003-2004, respectively. Regression statistics are given at the bottom of the page.

Year of Recruitment to fisheries	Year Class	Pooled ONT and OH YOY Trawl Catch	LN Pooled ONT and OH YOY Trawl	LN Estimated Age 2 walleye (millions)	Estimated Age 2 walleye (millions)
1989	1987	9.1473	2.21346	2.646458	14.104000
1990	1988	19.3721	2.96383	2.341027	10.391900
1991	1989	5.6000	1.72277	1.860379	6.426170
1992	1990	47.0270	3.85072	2.577402	13.162900
1993	1991	68.0220	4.21983	3.057110	21.266000
1994	1992	4.6400	1.53471	1.348621	3.852110
1995	1993	97.7813	4.58273	2.590947	13.342400
1996	1994	62.1538	4.12961	2.714311	15.094200
1997	1995	2.6667	0.98083	0.521047	1.683790
1998	1996	93.1268	4.53396	2.783467	16.175000
1999	1997	24.7500	3.20883	2.088163	8.070080
2000	1998	13.6690	2.61513	1.920403	6.823710
2001	1999	58.1364	4.06279	3.139404	23.090100
2002	2000	3.1935	1.16113	1.081873	2.950200
2003	2001	31.1642	3.43927	2.429927	**11.358054**[1]
2004	2002	0.1739	-1.7492	-0.297620	**0.742585**[2]

[1]This regression estimate was used for 2003 age 2 projection (see Table 10a, 10b).
[2]This regression estimate was used for 2004 age 2 projection (see Table 10a, 10b).

Note: The regression equation, with standard errors in parentheses, was,

$$Y = 0.5257\ (0.083)\ X + 0.6219\ (0.269)$$

with n=14, F=39.9, $p<0.0001$ and an $r^2=0.77$. Both parameters were transformed by natural logarithm (LN) and were significant at $p<0.04$.

Table 10a. Projection of Lake Erie walleye stock size estimates (M=.32) to 2003, 2004, and 2005 with expected harvest based on a constant fishing mortality from 2003 – 2005. Age-2 estimates for 2003 and 2004 from Ontario and Ohio pooled trawl data, 1987-2002 (x) and Age 2 from ADMB (y) regression. The projected harvest for 2003 is set at the 3.4 million fish CPMS ceiling value.

2002 Parameters from ADMB catch-at-age analysis

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	2.950	1.113	0.724	5.176	0.047	0.367	0.307	0.039	0.693	0.115	0.028	0.202	0.046
3	15.072	4.234	6.603	23.541	0.141	0.461	0.369	0.113	0.631	1.700	0.745	2.655	0.677
4	2.281	0.596	1.089	3.474	0.169	0.489	0.387	0.134	0.613	0.306	0.146	0.465	0.122
5	1.282	0.325	0.632	1.932	0.169	0.489	0.387	0.134	0.613	0.172	0.085	0.259	0.068
6	1.173	0.294	0.585	1.761	0.169	0.489	0.387	0.134	0.613	0.157	0.078	0.236	0.063
7+	0.458	0.115	0.227	0.689	0.169	0.489	0.387	0.134	0.613	0.061	0.030	0.092	0.024
Total	23.216		9.860	36.572	0.144	0.464	0.371	0.115	0.629	2.510	1.112	3.909	

PROJECTED 2003 PARAMETERS

	Stock Size (millions)				Mortality Rates				Survival Rate	Expected 2003 Harvest			
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	11.358	1.110	9.138	13.578	0.069	0.389	0.322	0.057	0.678	0.648	0.522	0.775	0.191
3	2.045	0.429	1.186	2.903	0.208	0.528	0.410	0.162	0.590	0.330	0.192	0.469	0.097
4	9.508	1.996	5.516	13.499	0.250	0.570	0.435	0.191	0.565	1.814	1.052	2.575	0.533
5	1.398	0.294	0.811	1.986	0.250	0.570	0.435	0.191	0.565	0.267	0.155	0.379	0.078
6	0.786	0.165	0.456	1.116	0.250	0.570	0.435	0.191	0.565	0.150	0.087	0.213	0.044
7+	1.000	0.210	0.580	1.419	0.250	0.570	0.435	0.191	0.565	0.191	0.111	0.271	0.056
Total	26.094		17.689	34.500	0.213	0.533	0.412	0.164	0.588	3.400	2.118	4.682	

PROJECTED 2004 PARAMETERS

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	0.743	1.201	0.000	3.144	0.069	0.389	0.322	0.057	0.678	0.042	0.000	0.179	0.015
3	7.699	1.616	4.467	10.930	0.208	0.528	0.410	0.162	0.590	1.244	0.722	1.766	0.431
4	1.206	0.253	0.700	1.712	0.250	0.570	0.435	0.191	0.565	0.230	0.133	0.327	0.080
5	5.375	1.128	3.119	7.632	0.250	0.570	0.435	0.191	0.565	1.025	0.595	1.456	0.355
6	0.791	0.166	0.459	1.122	0.250	0.570	0.435	0.191	0.565	0.151	0.088	0.214	0.052
7+	1.009	0.212	0.586	1.433	0.250	0.570	0.435	0.191	0.565	0.193	0.112	0.273	0.067
Total	16.822		7.671	25.974	0.213	0.533	0.412	0.164	0.588	2.885	1.555	4.216	

PROJECTED 2005 PARAMETERS*

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	5.500	1.154	3.191	7.809	0.069	0.389	0.322	0.057	0.678	0.314	0.182	0.446	0.145
3	0.503	0.106	0.292	0.715	0.208	0.528	0.410	0.162	0.590	0.081	0.047	0.115	0.038
4	4.541	0.953	2.634	6.447	0.250	0.570	0.435	0.191	0.565	0.866	0.503	1.230	0.400
5	0.682	0.143	0.396	0.968	0.250	0.570	0.435	0.191	0.565	0.130	0.075	0.185	0.060
6	3.039	0.638	1.763	4.315	0.250	0.570	0.435	0.191	0.565	0.580	0.336	0.823	0.268
7+	1.018	0.214	0.590	1.445	0.250	0.570	0.435	0.191	0.565	0.194	0.113	0.276	0.090
Total	15.282		8.867	21.698	0.213	0.533	0.412	0.164	0.588	2.165	1.256	3.074	

PROJECTED 2005 PARAMETERS**

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	16.500	3.463	9.573	23.427	0.069	0.389	0.322	0.057	0.678	0.942	0.546	1.337	0.337
3	0.503	0.106	0.292	0.715	0.208	0.528	0.410	0.162	0.590	0.081	0.047	0.115	0.029
4	4.541	0.953	2.634	6.447	0.250	0.570	0.435	0.191	0.565	0.866	0.503	1.230	0.310
5	0.682	0.143	0.396	0.968	0.250	0.570	0.435	0.191	0.565	0.130	0.075	0.185	0.047
6	3.039	0.638	1.763	4.315	0.250	0.570	0.435	0.191	0.565	0.580	0.336	0.823	0.208
7+	1.018	0.214	0.590	1.445	0.250	0.570	0.435	0.191	0.565	0.194	0.113	0.276	0.069
Total	26.282		15.249	37.315	0.213	0.533	0.412	0.164	0.588	2.793	1.621	3.966	

* Projected 2005 parameters if 2005 recruitment is 50% of average recruitment since 1990.

** Projected 2005 parameters if 2005 recruitment is 150% of average recruitment since 1990.

Table 10b. Projection of Lake Erie walleye stock size estimates (M=.32) to 2003, 2004, and 2005 with expected harvest based on a constant fishing mortality from 2003 – 2005. Age-2 estimates for 2003 and 2004 from Ontario and Ohio pooled trawl data, 1987-2002 (x) and Age 2 from ADMB (y) regression. The projected harvest for 2003 was calculated to achieve a 2004 population of 19 million fish (year 2000 population level).

2002 Parameters from ADMB catch-at-age analysis

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	2.950	1.113	0.724	5.176	0.047	0.367	0.307	0.039	0.693	0.115	0.028	0.202	0.046
3	15.072	4.234	6.603	23.541	0.141	0.461	0.369	0.113	0.631	1.700	0.745	2.655	0.677
4	2.281	0.596	1.089	3.474	0.169	0.489	0.387	0.134	0.613	0.306	0.146	0.465	0.122
5	1.282	0.325	0.632	1.932	0.169	0.489	0.387	0.134	0.613	0.172	0.085	0.259	0.068
6	1.173	0.294	0.585	1.761	0.169	0.489	0.387	0.134	0.613	0.157	0.078	0.236	0.063
7+	0.458	0.115	0.227	0.689	0.169	0.489	0.387	0.134	0.613	0.061	0.030	0.092	0.024
Total	23.216		9.860	36.572	0.144	0.464	0.371	0.115	0.629	2.510	1.112	3.909	

PROJECTED 2003 PARAMETERS

	Stock Size (millions)				Mortality Rates				Survival Rate	Expected 2003 Harvest			
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	11.358	1.110	9.138	13.578	0.015	0.335	0.285	0.013	0.715	0.148	0.119	0.177	0.181
3	2.045	0.429	1.186	2.903	0.046	0.366	0.307	0.039	0.693	0.079	0.046	0.112	0.097
4	9.508	1.996	5.516	13.499	0.056	0.376	0.313	0.046	0.687	0.441	0.256	0.626	0.541
5	1.398	0.294	0.811	1.986	0.056	0.376	0.313	0.046	0.687	0.065	0.038	0.092	0.080
6	0.786	0.165	0.456	1.116	0.056	0.376	0.313	0.046	0.687	0.036	0.021	0.052	0.045
7+	1.000	0.210	0.580	1.419	0.056	0.376	0.313	0.046	0.687	0.046	0.027	0.066	0.057
Total	26.094		17.689	34.500	0.047	0.367	0.307	0.040	0.693	0.815	0.506	1.125	

PROJECTED 2004 PARAMETERS

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	0.743	1.201	0.000	3.144	0.015	0.335	0.285	0.013	0.715	0.010	0.000	0.041	0.012
3	8.122	1.705	4.713	11.532	0.046	0.366	0.307	0.039	0.693	0.314	0.182	0.446	0.396
4	1.418	0.298	0.823	2.013	0.056	0.376	0.313	0.046	0.687	0.066	0.038	0.093	0.083
5	6.531	1.371	3.789	9.272	0.056	0.376	0.313	0.046	0.687	0.303	0.176	0.430	0.381
6	0.961	0.202	0.557	1.364	0.056	0.376	0.313	0.046	0.687	0.045	0.026	0.063	0.056
7+	1.226	0.257	0.712	1.741	0.056	0.376	0.313	0.046	0.687	0.057	0.033	0.081	0.072
Total	19.000		8.934	29.066	0.047	0.367	0.307	0.040	0.693	0.794	0.433	1.154	

PROJECTED 2005 PARAMETERS*

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	5.500	1.154	3.191	7.809	0.015	0.335	0.285	0.013	0.715	0.072	0.042	0.102	0.106
3	0.531	0.111	0.308	0.754	0.046	0.366	0.307	0.039	0.693	0.021	0.012	0.029	0.030
4	5.632	1.182	3.268	7.996	0.056	0.376	0.313	0.046	0.687	0.261	0.152	0.371	0.386
5	0.974	0.204	0.565	1.383	0.056	0.376	0.313	0.046	0.687	0.045	0.026	0.064	0.067
6	4.486	0.941	2.603	6.368	0.056	0.376	0.313	0.046	0.687	0.208	0.121	0.295	0.308
7+	1.502	0.315	0.871	2.133	0.056	0.376	0.313	0.046	0.687	0.070	0.040	0.099	0.103
Total	18.624		10.806	26.442	0.047	0.367	0.307	0.040	0.693	0.676	0.392	0.960	

PROJECTED 2005 PARAMETERS**

	Stock Size (millions)				Mortality Rates				Survival Rate				
Age	Mean	SE	Min	Max	(F)	(Z)	(A)	(u)	(S)	E(C)	Hvmin	Hvmax	% of Harv
2	16.500	3.463	9.573	23.427	0.015	0.335	0.285	0.013	0.715	0.215	0.125	0.305	0.262
3	0.531	0.111	0.308	0.754	0.046	0.366	0.307	0.039	0.693	0.021	0.012	0.029	0.025
4	5.632	1.182	3.268	7.996	0.056	0.376	0.313	0.046	0.687	0.261	0.152	0.371	0.319
5	0.974	0.204	0.565	1.383	0.056	0.376	0.313	0.046	0.687	0.045	0.026	0.064	0.055
6	4.486	0.941	2.603	6.368	0.056	0.376	0.313	0.046	0.687	0.208	0.121	0.295	0.254
7+	1.502	0.315	0.871	2.133	0.056	0.376	0.313	0.046	0.687	0.070	0.040	0.099	0.085
Total	29.624		17.188	42.060	0.047	0.367	0.307	0.040	0.693	0.819	0.475	1.163	

* Projected 2005 parameters if 2005 recruitment is 50% of average recruitment since 1990.

** Projected 2005 parameters if 2005 recruitment is 150% of average recruitment since 1990.

Table 11. Recommended Allowable Harvests (RAHs in millions of fish) for Lake Erie walleye using fishery and survey data through 2002, and recruitment projections for 2003 and 2004 from recruitment regression. The RAH 2003 values presented are the CPMS ceiling value, an RAH representing fishing mortality rate (F) equal to that in 2002, and an RAH level consistent with maintaining a minimum population size of 19 million walleye in 2004.

2003 RAH	F (% of 2002)	N2004	N2005*	N2005**
3.400	148	16.8	15.3	26.3
2.374	100	17.7	16.5	27.5
0.815	33	19.0	18.6	29.6

*Projected 2005 parameters if 2005 recruitment is 50% of average recruitment since 1990 (5.5 million age 2 walleye).

**Projected 2005 parameters if 2005 recruitment is 150% of average recruitment since 1990 (16.5 million age 2 walleye).

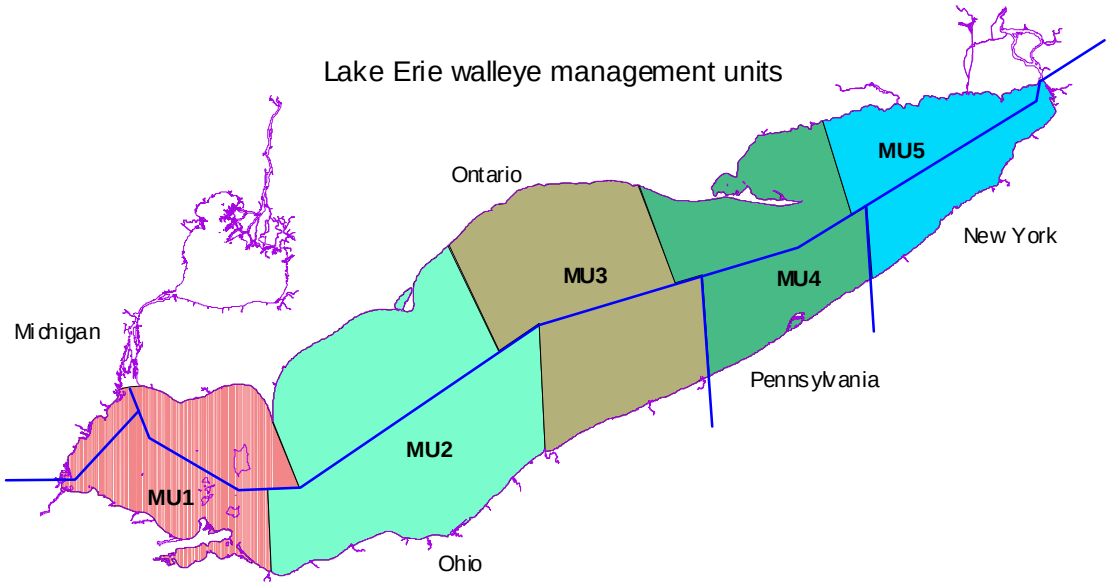

Figure 1. Map of Lake Erie with management units recognized by the Walleye Task Group for interagency management of walleye.

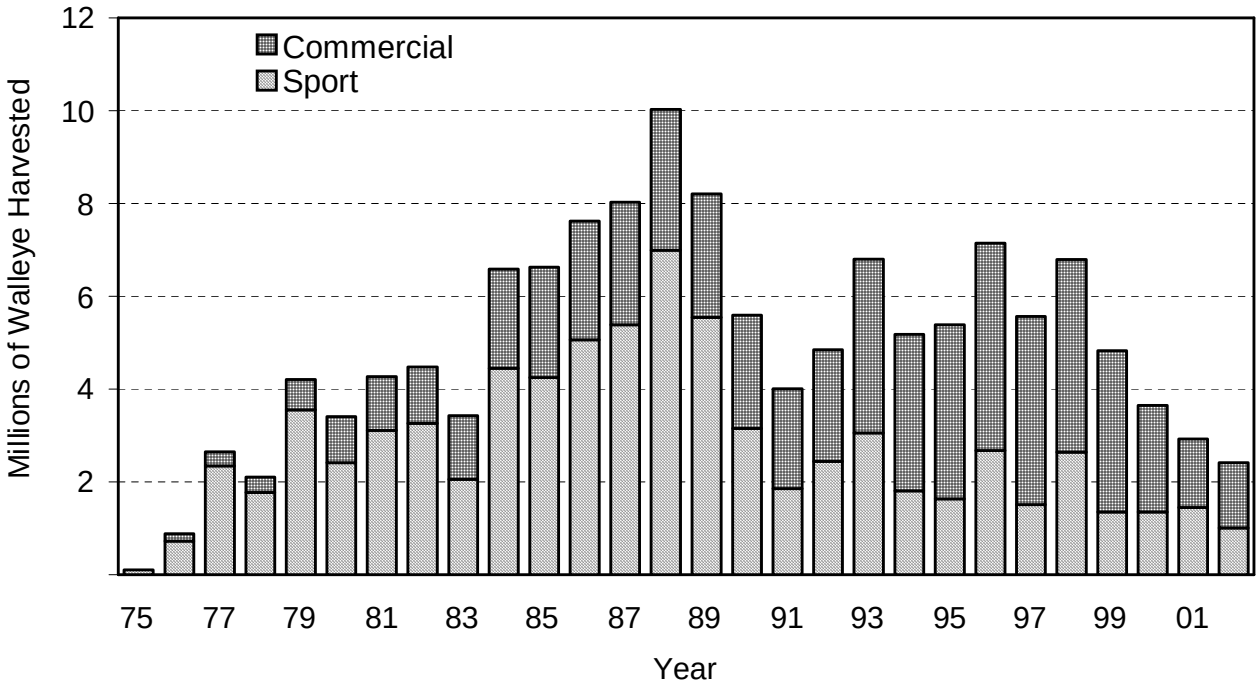

Figure 2. Lakewide harvest of Lake Erie walleye by sport and commercial fisheries, 1975 - 2002.

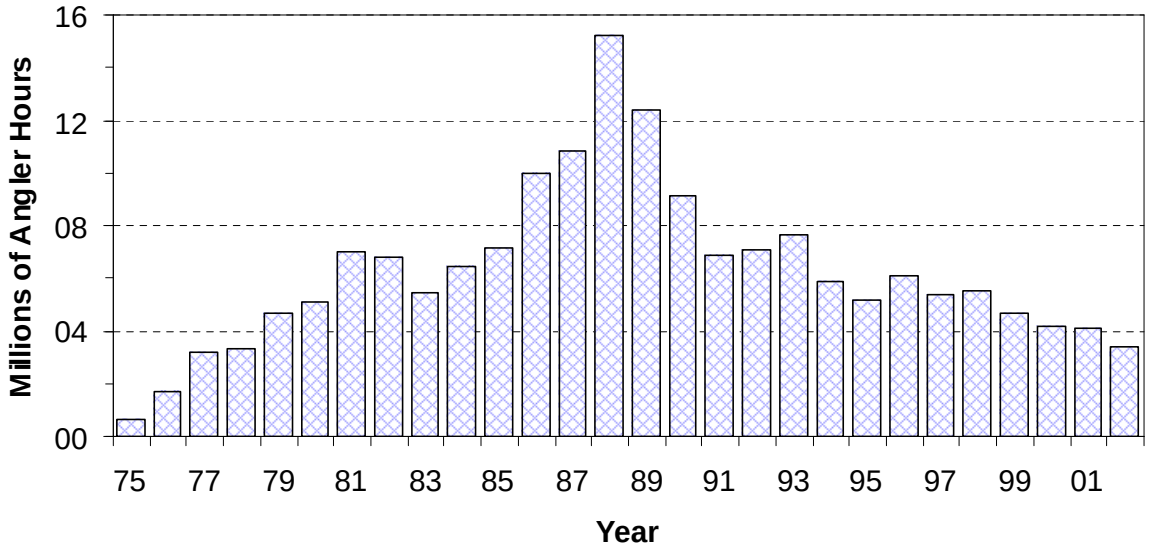

Figure 3. Lakewide total effort (angler hours) by sport fisheries for Lake Erie walleye, 1975 - 2002.

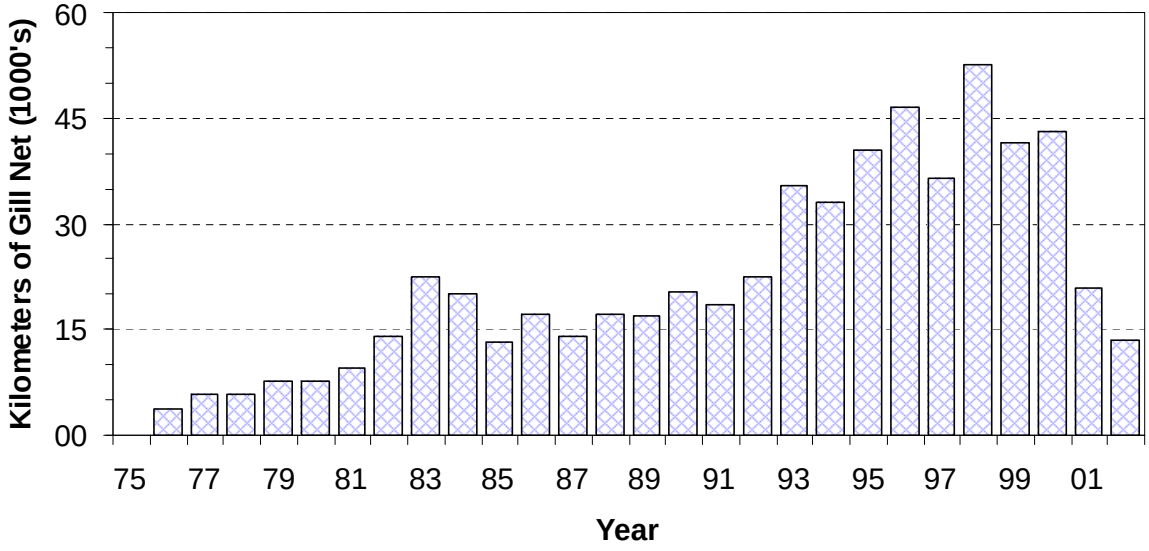

Figure 4. Lakewide total effort (kilometers of gill net) by commercial fisheries for Lake Erie walleye, 1975-2002.

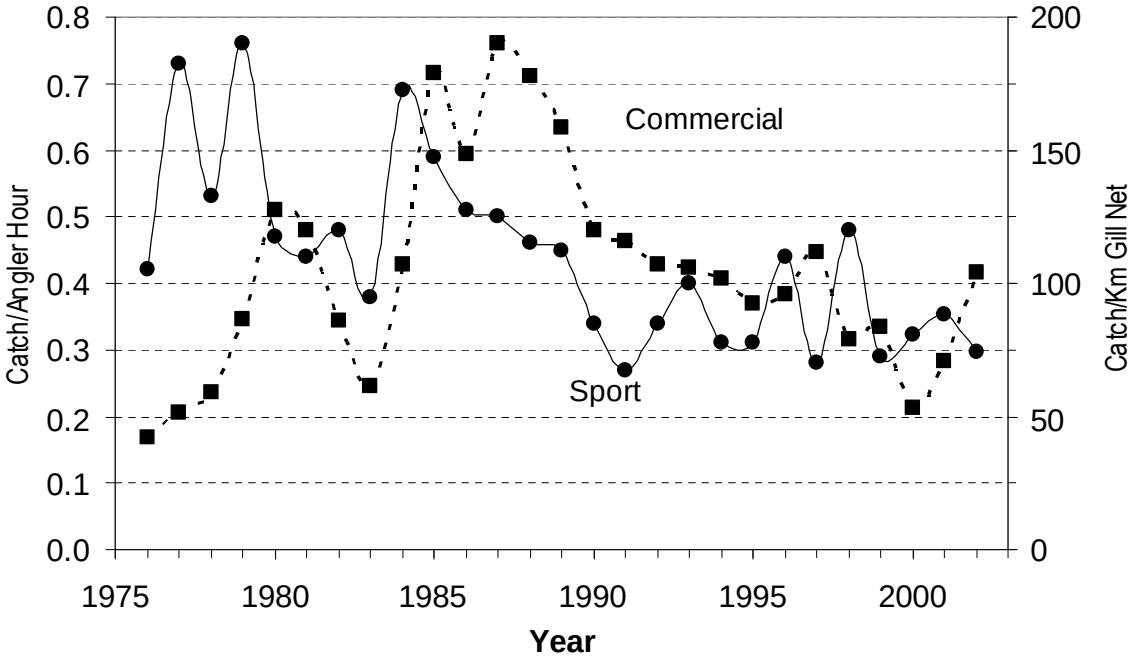

Figure 5. Lakewide CUE for Lake Erie sport and commercial walleye fisheries, 1975-2002.

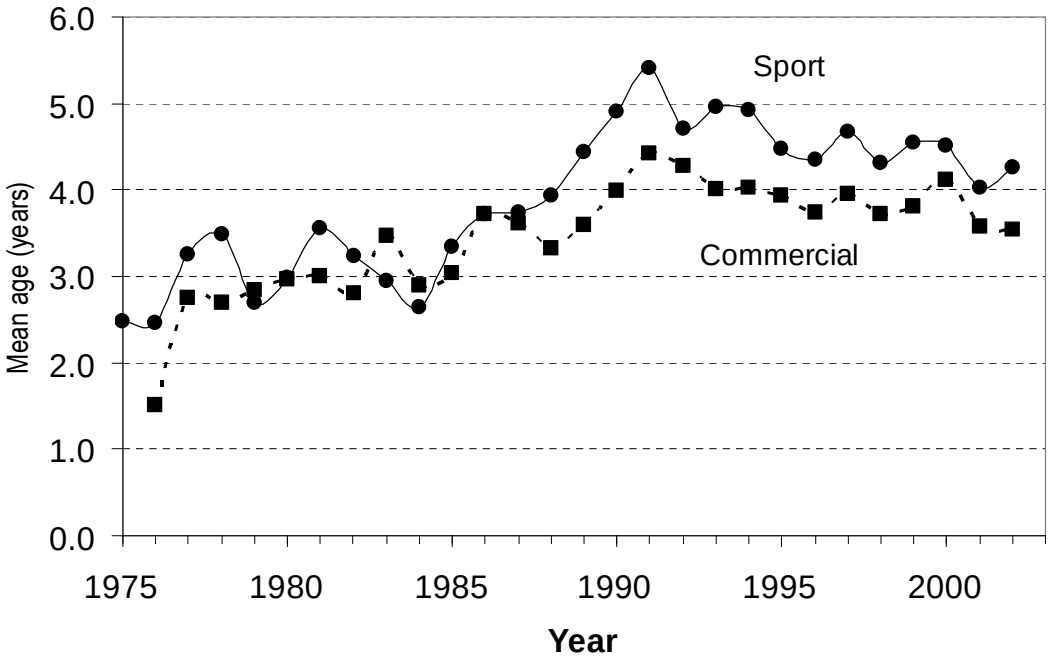

Figure 6. Lakewide mean age of Lake Erie walleye in sport and commercial harvests, 1975-2002.

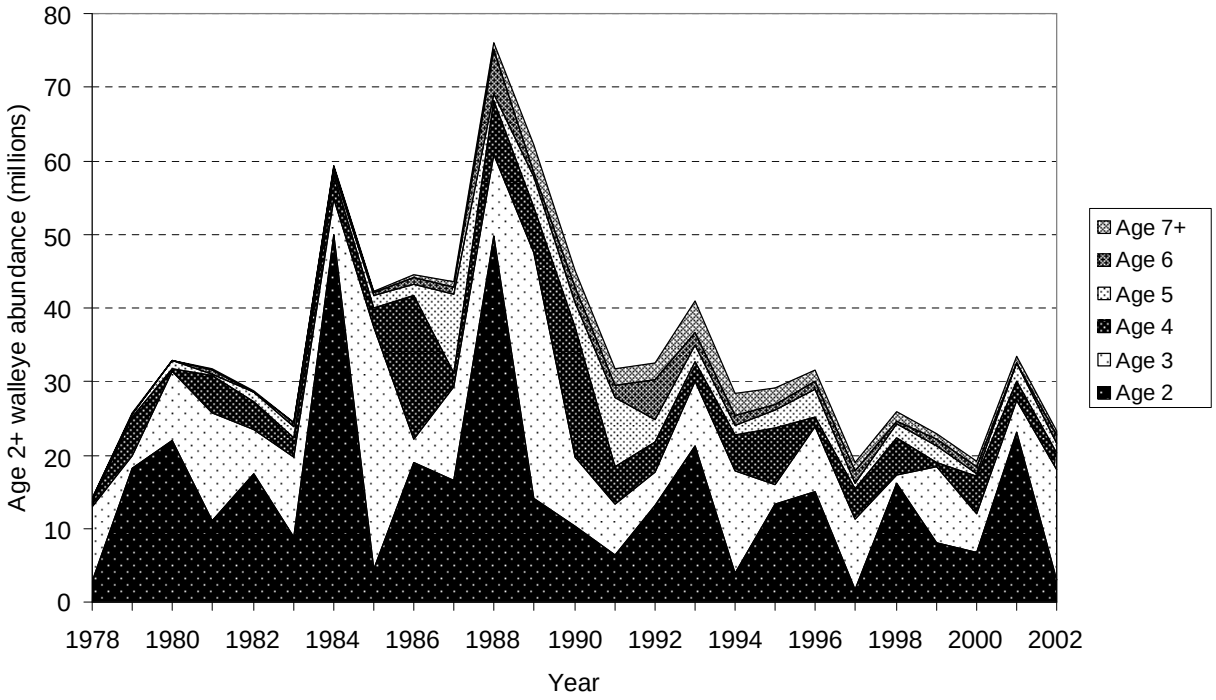

Figure 7. Age class composition of Lake Erie walleye 1978-2002. Data are from Table 8 in this document.

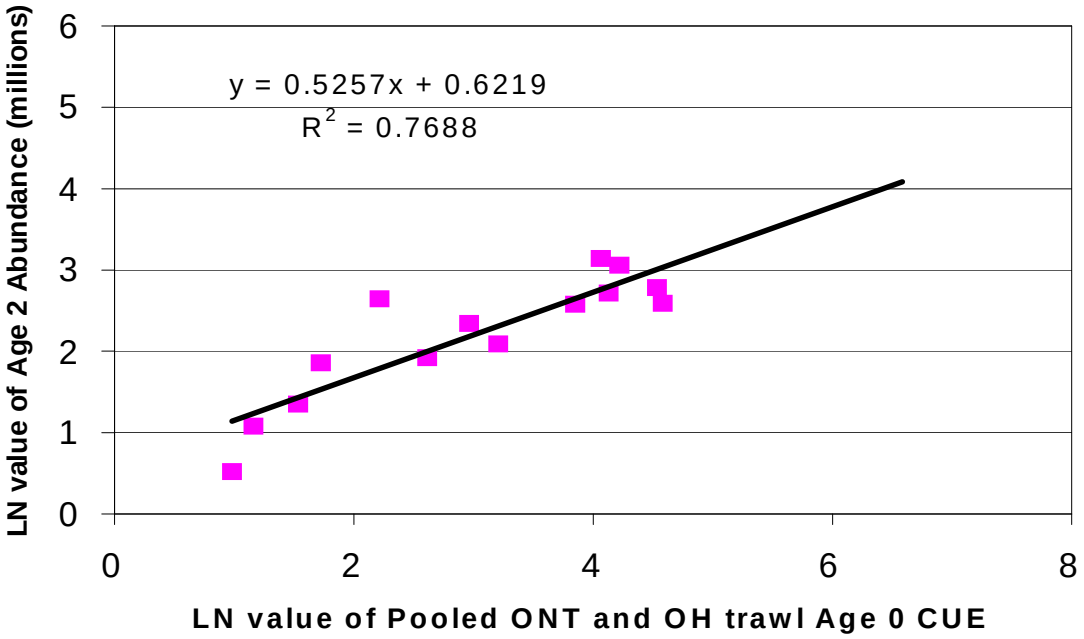

Figure 8. Regression estimates of abundance for age-2 Lake Erie walleye using natural logarithm transformed ADMB 2002 model catch-at-age estimates (y) and pooled Ontario and Ohio young-of-the-year trawl indices (x).

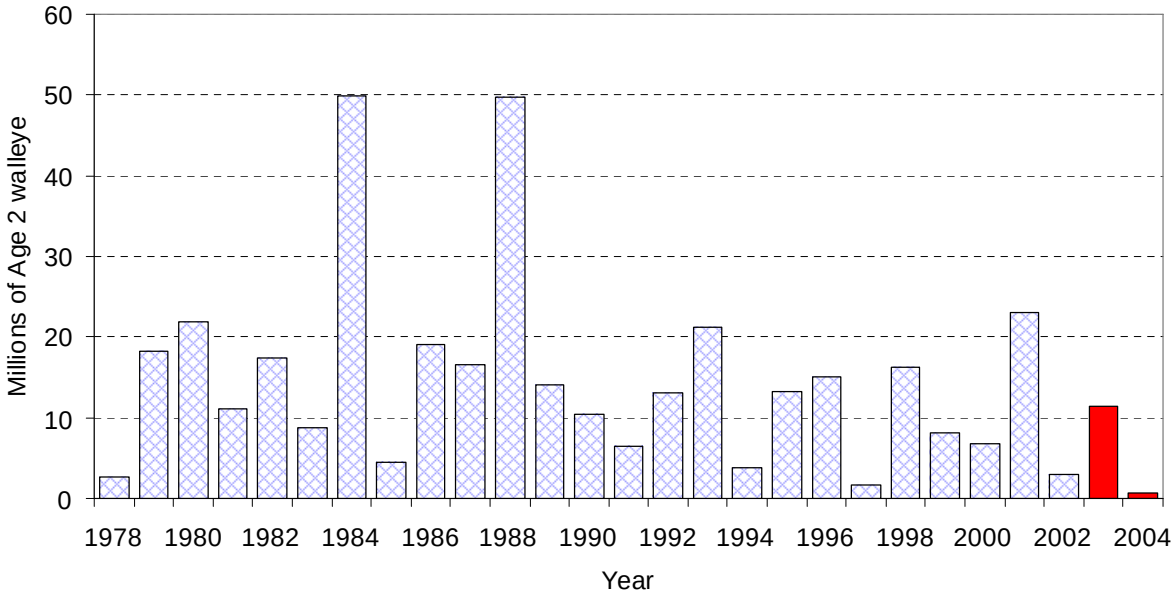

Figure 9. Catch-at-age estimates of age-2 Lake Erie walleye for 1978 to 2002. Estimates for 2003-2004 are from the regression of YOY index and numbers of age-2 from catch-at-age analysis. (see Table 9)

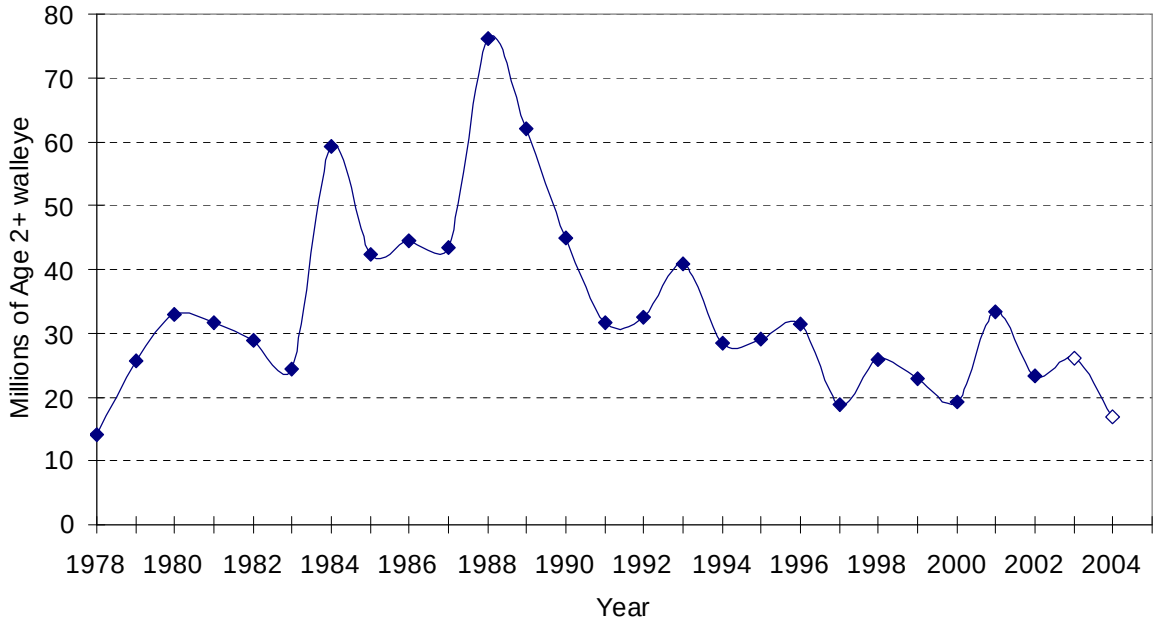

Figure 10. Abundance of Lake Erie walleye from 1978-2002, forecasting two additional years and a harvest of 3.4 million walleye in 2003.

Appendix A

PROTOCOL FOR USE OF CENTRALIZED WALLEYE DATABASES

- Management of Great Lakes fisheries would benefit from broad accessibility to data. Agencies and individuals involved in data collection programs have a substantial investment in the information collected.

- Well-intentioned researchers who are not familiar with a particular data set may be misled by special characteristics of the information.

- Broad accessibility to data SHOULD NOT be regarded as automatic permission to publish results of the analysis.

- The release of data for publication should be contingent on written permission from the agency or individual to participate in the research and publication.

- It is important to identify properly all data and the source of that data which becomes part of the centralized data base.

- An accurate and updated log needs to be maintained by the "keeper" of the data base. This log should include a proper documentation of the data, specifically noting if the data are real or extrapolated, and/or derived from other sources.

- Involvement of agency personnel in research and publication is the best way to avoid the problem of lack of familiarity with the data.

- The benefits to be gained from combining the expertise of agency and external personnel would be shared by all parties.

- The Walleye Task Group recommends having an outside agent contact the appropriate agency for the use of any specific data from that agency, but that we still need to establish a procedure for accessing interagency databases. The Walleye Task Group agreed that access may be granted only after unanimous approval among agencies.

This Appendix A originally appeared in the 1994 Walleye Task Group report.