STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-1

Study No.: 460 **Title:** Dynamics of Lake Erie walleye and yellow perch populations and fisheries

Period Covered: October 1, 1999 to September 30, 2000

Study Objective: To work with Ohio, New York, Pennsylvania, and Ontario to develop and verify models for inter-agency harvest quotas of walleye and yellow perch in Lake Erie using population samples taken each spring and fall.

Summary: In 1999 and 2000, walleye and yellow perch samples were collected from a spring trap net survey, a fall gill net survey, and an on-site creel survey. To fulfill inter-agency objectives, Michigan's survey data and data analyses were shared with the other Lake Erie fishery management agencies. The inter-agency task groups combined their walleye tag data, and their walleye and yellow perch survey data, to produce estimates of mortality and exploitation rates. These estimates were used to establish harvest quota recommendations for the lakewide recreational and commercial percid fisheries.

Job 1. Title: Carry out trap-net sampling.

Findings: In spring 1999, the Michigan Department of Natural Resources (MDNR) made 45 trap-net lifts off the city of Monroe in Michigan waters of Lake Erie. In spring 2000, another 51 trap net lifts were made at the same site. This was the 23rd consecutive year the MDNR has conducted this trap net survey.

Age and growth data were collected from walleye and yellow perch. Total number and total weight data were collected for all fish species. In 1999, the combined catch-per-net-lift (CPUE) for all species was near the long-term mean and well above the mean for the 1990-99 time period (Table 1). CPUE values for smallmouth bass, yellow perch, rock bass, white bass, white perch, channel catfish, redhorse spp., freshwater drum, common carp, and quillback carpsucker were all above the 22-year means. In fact, the 1999 catch rate for channel catfish was the highest of the time series. Smallmouth bass and rock bass catch rates have been highest since 1995. This is likely an indication of increased abundance since the mid-90s, probably a result of improving habitat conditions for smallmouth bass in Michigan's waters of Lake Erie. Yellow perch catch per net lift in 1999 was the highest since 1991, but remained well below the 22-year mean. Lake whitefish have rarely been seen during the 20-year history of this survey. However, during 1997-99 several whitefish have been captured each spring in the index trap nets. The reason for the unusual presence of lake whitefish was not immediately clear.

To date, 42,576 walleye have been tagged at the Monroe tag site, including 2,082 captured in the trap nets in spring 2000.

Job 2. Title: Analyze growth data from trap nets and angler catches.

Findings: Scale samples collected from walleye and yellow perch in 1999 have been processed and aged. Scales collected during 2000 have not yet been interpreted for ages. Age-3 walleye made up 50% of the 1999 trap net walleye catch, reflecting the strength of the 1996 year class (Table 2). The 1997, 1994, and 1993 year classes were also well represented, accounting for over 35% of the total catch combined. By contrast, age-4 walleye were quite scarce (0.9%), illustrating poor recruitment in 1995. Growth, as reflected by mean length at age, remained good for both male and female walleye (Table 3). No trend in growth was apparent for either sex during recent years.

The age distribution of yellow perch caught in trap nets in 1999 (Table 4) was dominated by age-5 (40%), age-3 (24%), and age-4 (24%) fish. After a period of improved growth rates during the mid-1990s, there has been no apparent trend in yellow perch growth rates (Table 5).

Sport-caught walleye and yellow perch from Michigan's Lake Erie waters were sampled for biological data (length, weight, and age) as part of Michigan's Great Lakes creel survey (Federal Aid Study 427). In 1999, age-2 (25%) and age-3 (50%) fish accounted for the largest portion of the walleye recreational harvest (Table 6). Age-4 fish accounted for an additional 15% of the total catch. No trend in growth was apparent for sport-caught walleye over the past six years (Table 6).

Three strong year classes dominated the yellow perch sport catch in 1999. The 1996 year class (age 3) accounted for 55% of the total catch (Table 7). The 1995 year class (age 4) added an additional 24% to the total. Age-5 fish (1994 year class) accounted for 11% of the total harvest. Contributions from all other year classes were minor. Although yellow perch growth appeared to improve in the interval from 1990 to 1995, growth has declined for most ages during the past 3 years. This is likely a result of increased yellow perch abundance due to good recruitment in 1994, 1995, and 1996.

Job 3. Title: Collect tag recovery data.

Findings: A total of 41,943 walleye have been tagged at the Monroe station since spring 1978. Of those, 3,729 (8.9%) have been reported by anglers and commercial fishermen through 1999. A total of 1,630 walleye were tagged in 1999; of which, 2.1% have been subsequently recovered by fishermen. There were 84 recoveries (from all years of tagging) during the 1999 fishing season. The geographical distribution of the 1999 returns was as follows: St. Clair River-9.9%; Lake St. Clair-4.8%; Detroit River-8.3%; Western Basin-Lake Erie-53.6%; Central Basin-Lake Erie-20.2%; and Eastern Basin-Lake Erie-1.2%. Recoveries were reported from all months except January, February, and March, with over 66% reported during the months of May (29.8%), June (23.8%), and July (13.1%). We tagged 2,082 walleye during spring 2000; however, tag reports have not been compiled for the 2000 fishing season. However, it is clear from the time series of geographical distribution of tag recoveries that large numbers of walleye move northward out of Lake Erie each year and contribute substantially to the walleye fisheries in the Detroit River, Lake St. Clair, the St. Clair River, and even Lake Huron.

The geographical distribution of tag recoveries shifted slightly during the period 1989-99 (Table 8). The percentage of recoveries reported from Lake Erie waters increased, with the largest increase occurring in the Central Basin. This increase could reflect changes in fish distribution, but is likely due to geographical expansion of fishing effort. One interesting point is the heavier relative contribution of tag recaptures from connecting waters north of Lake Erie since 1998. This pattern

was also observed in our walleye tag studies prior to 1990. Unfortunately, interpretation of such change is difficult without information on fishing effort and catch rates.

Job 4. Title: Analyze tag recovery data.

Findings: Walleye tag data were analyzed to estimate annual rates for tag recovery and survival during the period 1986-99 (Table 9). The computer program known as ESTIMATE (Brownie et al. 1985) was used, and all parameter estimates were taken from Model 1 under the assumption that survival and reporting rates were year-specific. Model 1 was more compatible with all data sets than three alternative models and probably produced the least-biased estimates. Another assumption made was that all tag recoveries attributable to the 1999 fishing year had been received; thus, recovery rate estimates for 1999 were comparable to those for prior years.

Walleye were captured, tagged, and recaptured consistently during this study with minor exceptions. Fish were not tagged by Ontario in 1989 and 1996, nor by Ohio in 1999; and, May tag-recovery data from Ontario might have been biased by heavy commercial fishing effort near tag sites. Michigan, Ontario, and Ohio used a monel metal tag, which was placed in the lower jaw. During some years, Ontario also used a plastic streamer tag, which was sewn into the dorsal musculature with monofilament nylon. Based on a literature review of studies comparing different tag types, tag loss was considered to be a potential problem only with the plastic streamer tag.

Analysis of the combined data produced an estimate for mean annual survival of 65.01% and for mean recovery rate of 3.47% (Table 10). These values were used to estimate instantaneous natural mortality (M) according to the relationship $M = Z - \mathbf{u}Z/A$ where ($\mathbf{u}Z/A = F$) for type II fisheries; where Z is instantaneous total mortality rate, **u** is the exploitation rate, A is the total mortality rate, and F is the instantaneous fishing rate (Ricker 1975). A walleye reward-tag study, funded by the Ontario Ministry of Natural Resources, was conducted during 1990 by Ontario, Ohio, and Michigan. This study, based on random application of $100.00 (US) tags to 10% of the walleye, produced a reward/non-reward ratio of 2.69 (Table 11). A value for **u** of 9.46% was generated by expanding mean recovery rate (3.47%) by the non-reporting rate (2.69). The resulting value for M was 0.31. It is important to note that survival rate estimates from the program "ESTIMATE" are independent of recovery rates; thus, expansion of the tag recovery rate by reward/non-reward ratios did not alter survival rate estimates in any way.

Fishery management agencies recognize that Lake Erie its walleye fisheries have changed considerably since 1990. Therefore, the reward-tag program was replicated in 2000, to provide an updated non-reporting rate. Approximately 10% of the tags used by the agencies tagging Lake Erie walleye in 2000 were reward tags. Funding for the $100.00 (US) tags was provided by the U. S. agencies (NY, PA, OH, and MI). A new version of the tag reporting software, utilizing MS Access© and Arcview© GIS software, was developed by R. Haas and distributed to all inter-agency fishery management offices.

Job 5. Title: Carry out gill net sampling.

Findings: The MDNR has fished experimental gill nets at two stations in western Lake Erie since the fall of 1978, as part of the inter-agency assessment program. The 1999 fall gill-net survey included two 1300-foot sets of variable-mesh multi-filament gill net at each index station, as well as two sets made at each of two additional stations. All nets were suspended from the surface. A total of 795 walleye were captured, and sampled for age and growth information.

Job 6. Title: Analyze growth and abundance data from gill net sampling.

Findings: Scale samples taken from walleye captured in 1999 fall gillnets have been processed and aged. Mean length (mm) at age is presented in Table 12. No trends in walleye growth were evident over the last five years. Mean length of yearlings collected in 1999 recovered from the 21-year survey low observed in 1997 (Table 13). Total walleye catch-per-effort for the index sites (Table 14) declined from 1998, but remained well above the levels observed in 1996 and 1997. Age-1 fish, representing the 1998 year class, accounted for a modest 26% of the total catch rate, suggesting it was probably an average strength year class. The extremely poor recruitment for Lake Erie walleye in 1995 has been well illustrated in the low catch rates for this cohort over the past 4 years.

Historical walleye catch data were used to develop a mean rank for the 1974-97 year classes, some of which were not yet completely represented (Table 15). Total harvest included the sport and commercial catches from the Western and Central basins of Lake Erie. Trap and gill net catch-per-effort data came from Michigan's spring and fall surveys. Year classes were ranked for each capture method and then averaged. There was very good agreement between the three gear types and a nonparametric statistical comparison showed no significant differences. The top five year classes were 1982, 1986, 1985, 1991, and 1984. The worst five year classes were 1995, 1976, 1974, 1992, and 1997. There have not been any strong year classes in the six years examined since 1991, and three of those (1991, 1995, and 1997) produced very weak year classes. The adult walleye stock is declining because it was dominated through the 1980s and early 1990s by strong year classes, like 1982 and 1986.

Job 7. Title: Participate in inter-agency work groups.

Findings: Data summaries and analyses for 1999 MDNR surveys were completed and presented (as computer files and hard copies) to the (Great Lakes Fishery Commission, Lake Erie) Scientific Technical Committee, Walleye Task Group, Forage Task Group, and Yellow Perch Task Group. Inter-agency walleye tag data for 1999 were compiled and disseminated to each agency. Extensive walleye and yellow perch population modeling was done utilizing the inter-agency tag and fishery data sets. Estimates of walleye size selectivity by the commercial and sport fisheries were determined from tag recovery data and submitted to the Walleye Task Group to assist with development of a walleye management model.

Job 8. Title: Prepare annual reports.

Findings: This progress report was prepared. A final report presenting the results of this study for the period from 1994-98 was completed (Thomas and Haas 2000). Additionally, some of the data collected during this study were presented in the annual "Status of the fisheries in Michigan waters of Lake St. Clair and Lake Erie" report prepared each winter by the Mt. Clemens Fisheries Research Station for the Great Lakes Fisheries Commission's Lake Erie Committee Annual Meeting.

Literature cited:

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Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 191.

Thomas, M. V. and R. C. Haas. 2000. Status of yellow perch and walleye populations in Michigan waters of Lake Erie, 1994-98. Michigan Department of Natural Resources, Fisheries Research Report 2054, Ann Arbor.

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Table 1.–Mean catch per trap-net lift for all species commonly taken during spring trap net surveys in Michigan waters of Lake Erie, 1978-98.

	Survey year											
Species	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Walleye	28.1	49.0	18.1	20.6	38.8	26.1	36.6	75.5	61.7	33.9	83.1	35.9
Smallmouth bass	0.1	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.3
Yellow perch	377.0	320.0	669.0	512.0	146.0	257.0	129.0	156.0	40.3	174.0	22.9	251.5
Rock bass	1.2	0.8	1.9	0.9	1.5	1.3	1.0	1.5	0.7	1.5	0.9	0.8
White bass	1.5	1.5	3.7	1.4	10.5	4.9	2.5	2.8	7.6	0.4	5.3	4.7
White perch	0.0	0.1	0.3	0.5	24.6	35.0	10.9	38.9	30.3	43.5	63.1	233.0
Pumpkinseed	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1
Bluegill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Black crappie	0.2	0.0	0.2	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.4	0.2
Channel catfish	3.5	9.7	5.4	5.8	4.9	10.6	4.6	5.5	5.4	2.7	3.5	4.1
Brown bullhead	0.2	1.1	1.6	1.9	1.7	4.2	2.5	1.5	4.1	0.9	9.2	3.9
White sucker	7.8	8.3	7.9	12.2	8.7	6.7	10.2	33.0	10.2	7.0	6.7	2.8
Redhorse sp.	2.4	1.2	0.6	1.0	0.8	1.5	1.7	1.4	1.3	1.7	1.8	0.6
Freshwater drum	37.4	66.8	14.0	42.9	13.4	23.5	25.1	30.6	25.3	9.1	15.6	6.4
Common carp	5.1	26.1	4.7	8.2	6.9	14.9	3.5	2.0	1.9	0.6	6.0	0.6
Goldfish	4.8	2.4	0.3	0.4	0.4	2.5	0.6	0.2	0.1	0.0	0.2	0.1
Gizzard shad	4.4	4.7	2.3	3.9	17.8	28.4	18.1	17.4	2.7	2.3	15.9	0.3
Longnose gar	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Bowfin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Quillback	4.0	18.6	1.8	2.0	2.4	5.6	2.0	1.9	1.7	1.8	1.5	0.7
Stonecat	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Total	477.9	510.3	731.8	613.9	278.8	422.4	248.7	368.5	193.6	279.7	236.4	546.2
% yellow perch	78.9	62.7	91.4	83.4	52.4	60.8	51.9	42.3	20.8	62.2	9.7	46.0
% white perch	0.0	0.0	0.0	0.1	8.8	8.3	4.4	10.6	15.7	15.6	26.7	42.7
Net lifts	50	46	48	36	37	53	57	51	49	55	51	55

Table 1.–Continued.

Species	Survey year 1990	1991	1992	1993	1994	1995[1]	1996	1997	1998	1999	78-89 Mean	90-99 Mean	78-99 Mean
Walleye	23.8	95.9	37.7	39.2	53.0	26.2	52.0	30.2	34.8	38.0	42.3	43.1	42.6
Smallmouth bass	0.1	0.2	0.1	0.2	0.8	2.2	2.1	1.2	1.9	1.9	0.1	1.1	0.5
Yellow perch	41.7	94.6	35.0	50.2	23.2	10.3	36.6	30.7	33.3	61.0	254.6	41.5	157.7
Rock bass	0.3	0.8	0.5	1.2	1.0	4.1	1.1	0.9	1.0	2.8	1.2	1.4	1.3
White bass	0.9	1.6	0.5	0.1	1.1	2.1	0.6	2.6	1.3	4.6	3.9	1.5	2.8
White perch	40.5	56.8	5.1	0.0	14.7	72.8	5.9	10.2	8.7	79.4	40.0	29.4	35.2
Pumpkinseed	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Bluegill	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Black crappie	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1
Channel catfish	9.0	6.0	4.6	4.6	5.4	3.7	8.8	4.4	11.4	16.0	5.5	7.4	6.3
Brown bullhead	13.1	4.3	4.0	1.6	1.1	0.2	1.1	0.4	0.0	1.0	2.7	2.7	2.7
White sucker	4.3	13.5	14.6	9.0	5.8	7.4	14.0	4.7	15.0	6.0	10.1	9.4	9.8
Redhorse sp.	0.4	0.6	3.1	3.6	1.8	1.0	5.5	1.9	3.3	2.2	1.3	2.3	1.8
Freshwater drum	5.1	25.6	8.9	20.7	8.8	13.0	15.4	6.8	28.3	50.4	25.8	18.3	22.4
Common carp	2.3	2.3	1.3	1.4	3.7	2.9	8.2	0.6	3.1	8.0	6.7	3.4	5.2
Goldfish	0.1	0.1	0.1	0.0	4.4	0.1	0.5	0.1	0.0	0.1	1.0	0.5	0.8
Gizzard shad	2.3	0.0	0.6	0.3	0.3	1.7	0.3	0.0	0.0	0.2	9.9	0.6	5.6
Longnose gar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bowfin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Quillback	1.9	2.9	4.4	3.2	4.6	6.7	8.9	2.2	7.9	8.5	3.7	5.1	4.3
Stonecat	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	145.8	305.5	120.5	135.2	129.6	155.2	161.2	96.9	150.0	280.3	409.0	167.8	299.4
% yellow perch	28.6	31.0	29.0	37.1	17.9	6.2	22.7	31.7	22.2	21.8	55.2	24.8	41.4
% white perch	27.8	18.6	4.2	0.0	11.3	46.9	3.6	10.5	5.8	28.3	11.1	15.7	13.2
Net lifts	82	29	55	40	45	39	45	57	44	45	49	48	49

[1]Sampling period delayed two weeks.

Table 2.–Age composition (expressed as percentage) of annual walleye catch in survey trap nets for Lake Erie, near Monroe, 1990-99.

	Survey year								
Age	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.04	–	–	0.08	0.29	0.04	–	–	0.06
2	5.77	11.00	3.31	0.76	63.60	5.53	0.98	31.50	23.70
3	15.15	6.75	32.18	30.86	0.59	25.30	32.30	3.39	49.70
4	12.08	11.30	4.61	23.31	13.10	1.54	22.30	23.1	0.93
5	41.32	12.20	9.41	4.22	4.81	19.70	1.95	13.7	6.47
6	7.80	33.20	11.22	6.45	1.57	15.50	15.10	2.67	5.60
7	11.11	10.00	23.49	13.99	4.91	5.36	8.23	10.3	2.33
8	3.68	10.20	7.92	11.59	6.58	9.35	5.75	4.37	4.02
9	2.74	2.17	4.02	5.27	2.55	8.45	5.23	3.52	1.92
10	0.14	2.65	1.69	2.19	1.47	5.83	4.89	4.17	2.45
11	0.07	0.14	1.95	0.84	0.10	1.97	2.13	1.24	1.05
12	0.07	0.05	0.13	0.38	0.29	0.94	0.52	1.43	1.16
13	–	–	0.06	0.04	–	0.21	0.29	0.39	0.35
14	–	–	–	–	–	0.04	0.06	–	0.06
15	–	–	–	–	–	–	0.06	0.06	0.06
Total aged	2,782	2,073	1,542	2,387	1,017	2,330	1,737	1,532	1,714

Table 3.–Mean length-at-age (mm) and standard error (SE) of walleye caught in trap nets during spring surveys in Michigan waters of Lake Erie, 1994-99. Sample size in parentheses.

	1994		1995		1996		1997		1998		1999	
Age	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
						Males						
2	353	6.7	342	2.0	346	2.5	354	6.0	337	0.9	343	1.8
	(6)		(57)		(75)		(13)		(301)		(171)	
3	409	0.9	420	1.5	410	1.0	411	0.9	408	3.5	407	0.8
	(621)		(2)		(500)		(513)		(49)		(711)	
4	464	1.5	450	2.6	459	5.4	456	1.4	446	1.4	466	7.3
	(365)		(81)		(26)		(307)		(323)		(11)	
5	494	3.1	488	3.6	482	1.4	491	5.8	478	2.1	483	2.5
	(80)		(35)		(408)		(30)		(198)		(95)	
6	520	2.5	518	7.4	510	1.6	508	1.8	512	5.3	498	3.1
	(127)		(13)		(304)		(241)		(37)		(78)	
7	536	1.8	537	5.3	534	3.0	533	2.6	521	2.3	508	5.9
	(291)		(40)		(113)		(127)		(147)		(33)	
8	551	2.3	560	5.1	551	2.3	558	3.4	549	4.3	544	5.2
	(212)		(51)		(194)		(94)		(58)		(60)	
9	569	3.9	560	5.4	568	2.8	579	3.7	575	5.6	572	7.3
	(85)		(18)		(165)		(86)		(46)		(24)	
10	584	6.4	580	8.5	577	3.7	580	4.8	585	5.4	594	5.7
	(27)		(9)		(107)		(71)		(45)		(33)	
11	597	8.2	600		609	6.2	581	7.8	593	9.0	594	8.7
	(14)		(2)		(31)		(29)		(13)		(15)	
						Females						
2	349	9.8	–	–	–	–	–	–	332	–	–	–
	(6)								(1)			
3	416	3.6	–	–	453	17.5	443	3.7	518	–	451	–
	(66)				(5)		(14)		(1)		(1)	
4	511	2.2	501	6.2	517	14.0	497	3.7	488	4.8	528	37.5
	(172)		(17)		(8)		(41)		(29)		(2)	
5	537	7.8	509	25.3	539	4.6	511	20.4	532	12.3	549	12.1
	(19)		(4)		(37)		(3)		(7)		(7)	
6	578	7.4	–	–	572	4.8	517	11.0	588	16.2	579	4.6
	(24)				(55)		(16)		(4)		(5)	
7	613	7.1	–	–	593	12.7	586	11.6	605	10.1	615	5.0
	(34)				(12)		(13)		(11)		(2)	
8	611	6.8	636	21.1	637	10.4	614	9.0	636	11.7	641	12.0
	(56)		(7)		(22)		(2)		(9)		(7)	
9	646	7.5	663	30.0	652	9.6	645	25.9	648	7.8	634	10.4
	(35)		(3)		(29)		(3)		(8)		(3)	
10	672	9.3	682	13.4	662	6.5	667	16.6	677	8.2	658	19.5
	(24)		(3)		(29)		(12)		(18)		(7)	
11	644	21.6	690	–	685	8.3	687	17.3	688	17.3	646	85.0
	(6)		(1)		(15)		(7)		(6)		(2)	
12	683	14.1	685	–	720	15.4	709	25.9	726	10.4	722	14.3
	(8)		(1)		(9)		(3)		(8)		(3)	

Table 4.–Yellow perch catch per unit effort (CPUE) by age for trap net surveys in Michigan waters of Lake Erie, 1989-99 (expressed as number caught per net per 24 h).

Year	Days	Age 2	3	4	5	6	7	Age 8+	Total CPUE
1989	95.5	0.02	26.64	50.02	39.27	24.63	2.89	1.28	144.83
1990	139.2	0.04	0.35	4.20	8.72	5.82	2.90	1.73	24.58
1991	86.0	0.03	2.74	2.41	9.29	7.99	6.29	1.79	31.91
1992	98.6	0.22	2.31	2.47	1.68	5.04	4.47	2.41	19.50
1993	99.1	0.25	6.28	5.34	2.31	1.58	2.51	0.81	20.24
1994	95.0	0.20	1.70	4.39	2.20	1.29	0.52	0.65	10.95
1995[1]	88.9	0.01	0.09	1.39	1.60	0.84	0.15	0.09	4.16
1996	100.7	0.20	2.42	2.87	4.38	2.82	2.24	0.67	15.60
1997	93.0	0.00	4.87	6.11	2.82	2.67	1.66	0.68	18.82
1998	88.0	0.42	6.30	4.70	2.39	1.68	0.65	0.38	16.51
1999	105.4	0.39	6.57	6.38	10.69	2.42	0.26	0.17	26.88

[1]Sampling period delayed two weeks.

Table 5.–Mean length-at-age (mm) and standard error (SE) of yellow perch caught in trap nets during spring surveys in Michigan waters of Lake Erie, 1993-99. Sample size in parentheses.

	1993		1994		1995		1996		1997		1998		1999	
Age	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
							Males							
2	177	2.5	168	3.5	187	–	173	2.2	–	–	–	–	175	4.5
	(4)		(11)		(1)		(8)						(5)	
3	185	2.1	189	3.9	194	0.7	191	1.9	191	1.9	206	12.6	185	3.4
	(48)		(24)		(4)		(33)		(30)		(7)		(32)	
4	212	3.6	207	2.8	243	4.6	216	4.5	212	3.1	207	2.3	212	4.8
	(25)		(45)		(11)		(21)		(25)		(72)		(26)	
5	233	7.2	217	5.7	250	2.4	244	4.0	231	5.6	226	3.9	230	3.6
	(10)		(26)		(12)		(26)		(16)		(26)		(42)	
6	238	3.9	239	6.2	256	5.0	258	3.8	257	4.8	250	7.8	248	5.5
	(8)		(8)		(7)		(22)		(17)		(8)		(10)	
7	250	5.4	252	3.4	265	13.5	258	6.4	255	1.8	268	5.0	–	–
	(23)		(8)		(2)		(10)		(18)		(12)			
8	258	7.5	277	–	273	–	277	12.8	266	2.0	290	–	–	–
	(6)		(1)		(1)		(4)		(2)		(1)			
9	260	4.2	257	4.1	286	7.0	284	12.4	–	–	–	–	–	–
	(10)		(3)		(2)		(3)							
10	248	14.4	250	–	–	–	–	–	–	–	–	–	–	–
	(3)		(1)											
							Females							
3	224	4.4	216	3.7	251	–	223	6.7	215	3.7	199	14.4	224	4.8
	(31)		(25)		(1)		(8)		(14)		(5)		(22)	
4	239	3.8	239	3.4	278	4.2	243	3.3	238	3.0	240	3.8	249	5.8
	(32)		(47)		(31)		(21)		(48)		(53)		(23)	
5	267	5.7	248	5.6	287	3.0	282	4.2	261	5.8	254	4.9	275	3.9
	(24)		(19)		(39)		(33)		(23)		(38)		(58)	
6	281	5.0	286	5.8	288	5.6	287	4.2	295	3.7	279	5.6	278	6.7
	(14)		(16)		(20)		(17)		(27)		(15)		(16)	
7	290	6.8	297	8.0	290	4.2	302	3.5	305	6.2	308	5.8	308	7.4
	(12)		(3)		(3)		(23)		(10)		(9)		(4)	
8	311	6.6	306	8.0	–	–	351	–	317	6.3	305	10.2	327	7.9
	(13)		(4)				(1)		(10)		(4)		(4)	
9	307	5.8	308	20.0	–	–	316	30.0	–	–	320	–	334	–
	(10)		(3)				(2)				(1)		(1)	
10	305	4.8	–	–	–	–	344	–	–	–	–	–	–	–
	(5)						(1)							

Table 6.–Mean length-at-age (mm) of walleye sampled from Michigan's Lake Erie sport fishery, 1994-99. Sample size in parentheses.

	Survey year											
Age	1994		1995		1996		1997		1998		1999	
1	–	–	–	–	–	–	–	–	–	–	–	–
2	364	(14)	352	(330)	348	(132)	339	(5)	341	(196)	357	(105)
3	403	(199)	418	(34)	414	(322)	415	(192)	431	(72)	411	(211)
4	475	(70)	451	(250)	454	(18)	465	(182)	473	(147)	446	(66)
5	504	(9)	488	(62)	489	(83)	518	(21)	513	(25)	496	(21)
6	520	(16)	513	(14)	547	(27)	519	(44)	548	(14)	561	(4)
7	544	(27)	544	(20)	528	(10)	558	(30)	576	(8)	567	(4)
8	584	(22)	556	(22)	566	(14)	565	(16)	583	(8)	569	(3)
9	565	(10)	614	(24)	631	(11)	623	(12)	655	(3)	628	(6)
10	639	(10)	658	(7)	662	(5)	625	(4)	651	(5)	546	(2)
11	667	(3)	684	(6)	671	(4)	680	(3)	–	–	–	–
12	668	(1)	664	(2)	560	(2)	625	(1)	–	–	655	(2)
13	–	–	–	–	–	–	–	–	–	–	572	(1)
Mean	456	(381)	426	(771)	430	(628)	467	(510)	424	(478)	416	(425)

Table 7.–Mean length-at-age (mm) of yellow perch sampled from Michigan's Lake Erie sport fishery, 1994-99. Sample size in parentheses.

Age	Survey Year											
	1994		1995		1996		1997		1998		1999	
1	159	(21)	173	(21)	154	(11)	–	–	162	(2)	164	(3)
2	200	(202)	193	(414)	190	(355)	182	(101)	182	(224)	179	(26)
3	224	(88)	212	(121)	206	(273)	197	(356)	202	(268)	202	(419)
4	231	(125)	240	(41)	223	(18)	217	(178)	218	(187)	215	(183)
5	242	(40)	252	(40)	255	(8)	233	(24)	242	(45)	233	(86)
6	251	(7)	276	(6)	288	(4)	263	(3)	253	(3)	243	(31)
7	248	(9)	282	(2)	229	(1)	292	(1)	273	(2)	266	(12)
8	269	(5)	–	–	–	–	–	–	–	–	263	(5)
9	302	(1)	315	(1)	–	–	–	–	–	–	–	–
10	287	(1)	–	–	–	–	–	–	–	–	–	–
Mean	216	(499)	204	(646)	198	(670)	202	(663)	203	(731)	211	(765)

Table 8.–Geographical distribution of tag recoveries 1991-99 from walleye tagged at Monroe, Michigan, Lake Erie (expressed as a percentage of the total number recovered each year).

	Percent of tags recovered by location								
Geographical area	1991	1992	1993	1994	1995	1996	1997	1998	1999
Lake Huron - Saginaw Bay	0.4	0.5	1.6	2.0	0.8	1.7	0.0	2.4	1.2
St. Clair River	7.1	2.7	6.1	6.2	8.3	2.8	4.2	7.9	9.5
Lake St. Clair	3.1	4.1	2.6	3.1	2.3	4.5	4.9	7.1	4.8
Detroit River	17.3	9.5	8.1	8.8	12.1	11.2	12.2	6.3	8.3
Western Basin-Lake Erie	56.9	64.5	58.7	54.1	43.9	54.1	57.1	56.7	53.6
Central Basin-Lake Erie	11.6	13.1	17.7	21.6	28.8	22.9	20.1	16.5	20.2
Eastern Basin-Lake Erie	1.8	2.7	3.5	4.1	3.8	2.8	1.6	3.1	1.2
Lake Erie-total	70.3	80.3	79.9	79.8	76.5	79.8	78.8	73.2	75.0

Table 9.–Tag recovery data for walleye tagged by Ohio, Ontario, and Michigan at Lake Erie sites, 1986-99.

Year	Number tagged	Year														Percent recovered
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
1986	5,645	158	88	93	51	33	28	10	15	9	3	5	2	3	0	8.8
1987	4,308	–	163	147	57	28	18	16	10	5	9	0	3	3	0	10.7
1988	6,871	–	–	234	120	64	35	33	21	15	3	5	12	2	2	7.9
1989	4,059	–	–	–	134	62	48	34	21	22	10	6	5	2	1	8.5
1990	4,352	–	–	–	–	152	114	72	58	30	18	14	11	7	2	11.0
1991	6,568	–	–	–	–	–	242	180	116	52	39	34	17	15	4	10.6
1992	5,649	–	–	–	–	–	–	237	184	77	36	34	19	11	6	10.7
1993	5,279	–	–	–	–	–	–	–	306	94	64	52	21	15	7	10.6
1994	4,545	–	–	–	–	–	–	–	–	152	104	71	36	33	10	8.9
1995	4,704	–	–	–	–	–	–	–	–	–	157	86	43	22	4	6.6
1996	5,718	–	–	–	–	–	–	–	–	–	–	253	123	57	28	8.1
1997	3,460	–	–	–	–	–	–	–	–	–	–	–	132	84	31	7.1
1998	1,668	–	–	–	–	–	–	–	–	–	–	–	–	28	20	2.9
1999	1,630	–	–	–	–	–	–	–	–	–	–	–	–	–	35	2.1

Table 10.–Annual survival and recovery rate (percent) during 1986-99 for Lake Erie walleye from Ohio, Ontario, and Michigan non-reward tags produced by program "ESTIMATE" (combined data).

Fishing year	Tag recovery rate	Standard error	Walleye survival rate	Standard error
1986	2.80	0.22	58.42	3.87
1987	3.35	0.23	91.81	5.95
1988	3.44	0.19	52.84	3.75
1989	3.19	0.21	48.27	3.46
1990	3.44	0.22	70.75	4.22
1991	3.58	0.18	65.94	3.68
1992	3.99	0.20	63.20	3.72
1993	5.04	0.24	62.02	4.13
1994	3.36	0.20	83.76	6.34
1995	2.75	0.18	48.05	3.61
1996	4.16	0.22	54.50	4.47
1997	3.92	0.27	109.78	7.55
1998	2.04	0.30	37.77	8.81
1999	2.15	0.36	–	–
Mean	3.47	0.06	65.01	1.16

Table 11.–Reporting rates for reward and non-reward (Nreward=non-reward) walleye tags and estimated non-reporting rate (NrepRate) from four tag sites in Lake Erie, 1990-99.

		Returns										Reporting rate										
Tag Site	Tagged	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
C/HI[1]																						
Reward	400	37	18	18	11	7	5	3	2	0	0	9.25	4.50	4.50	2.75	1.75	1.25	0.75	0.50	0.00	0.00	25.25
Nreward	1,972	65	32	23	25	10	6	6	1	1	0	3.30	1.62	1.17	1.27	0.51	0.30	0.30	0.05	0.05	0.00	8.57
NrepRate	–	–	–	–	–	–	–	–	–			2.81	2.77	3.86	2.17	3.45	4.11	2.47	9.86	0.00	0.00	2.95
SB[2]																						
Reward	149	5	2	3	1	2	0	0	1	0	0	3.36	1.34	2.01	0.67	1.34	0.00	0.00	0.67	0.00	0.00	9.40
Nreward	1,344	31	15	12	13	6	4	3	1	0	0	2.31	1.12	0.89	0.97	0.45	0.30	0.22	0.07	0.00	0.00	6.32
NrepRate	–	–	–	–	–	–	–	–	–			1.45	1.20	2.26	0.69	3.01	0.00	0.00	9.02	0.00	0.00	1.49
SR[2]																						
Reward	178	19	10	6	9	1	1	2	1	2	0	10.67	5.62	3.37	5.06	0.56	0.56	1.12	0.56	1.12	0.00	28.65
Nreward	1,333	40	36	17	19	14	8	4	5	4	2	3.00	2.70	1.28	1.43	1.05	0.60	0.30	0.38	0.30	0.15	11.18
NrepRate	–	–	–	–	–	–	–	–	–			3.56	2.08	2.64	3.55	0.53	0.94	3.74	1.50	3.74	0.00	2.56
MO[3]																						
Reward	218	26	13	10	16	6	2	4	0	2	0	11.93	5.96	4.59	7.34	2.75	0.92	1.83	0.00	0.92	0.00	36.24
Nreward	1,675	71	46	28	32	10	9	7	2	1	0	4.24	2.75	1.67	1.91	0.60	0.54	0.42	0.12	0.06	0.00	12.30
NrepRate	–	–	–	–	–	–	–	–	–			2.81	2.17	2.74	3.84	4.61	1.71	4.39	0.00	15.4.	0.00	2.95
All sites																						
Reward	945	87	43	37	37	16	8	9	4	4	0	9.21	4.55	3.92	3.92	1.69	0.85	0.95	0.42	0.42	0.00	25.93
Nreward	6,324	207	129	80	89	40	27	20	9	6	2	3.27	2.04	1.27	1.41	0.63	0.43	0.32	0.14	0.09	0.03	9.63
NrepRate	–	–	–	–	–	–	–	–	–			2.81	2.23	3.10	2.78	2.68	1.98	3.01	2.97	4.46	0.00	2.69

[1] Ontario tag site (C/HI=Chicken/Hen Islands)
[2] Ohio tag sites (SB=Sandusky Bay; SR=Sugar Rock)
[3] Michigan tag site (MO=Monroe)

Table 12.–Mean total length-at-age (mm) for walleye caught in Michigan waters of Lake Erie during fall in survey index multi-filament gill nets (sample size in parentheses) 1995-99.

	Survey year									
Age	1995		1996		1997		1998		1999	
Sexes combined										
1	318	(444)	326	(18)	306	(210)	319	(357)	339	(233)
2	401	(480)	404	(273)	380	(7)	404	(593)	416	(301)
3	443	(19)	452	(62)	443	(63)	439	(7)	462	(218)
4	478	(96)	504	(2)	475	(35)	487	(38)	514	(5)
5	513	(21)	488	(39)	523	(7)	514	(20)	515	(16)
6	536	(7)	533	(7)	521	(13)	525	(12)	535	(10)
7	563	(7)	568	(3)	556	(5)	517	(6)	554	(6)
8	566	(4)	550	(3)	572	(3)	525	(1)	562	(2)
9	550	(2)	640	(2)	581	(3	525	(1)	569	(1)
10	–	–	–	–	604	(3)	586	(1)	648	(2)
Mean	380	(1080)	422	(409)	372	(349)	382	(1036)	412	(795)
Males										
1	314	(213)	325	(8)	302	(94)	317	(133)	337	(87)
2	394	(292)	397	(138)	372	(4)	396	(328)	406	(154)
3	436	(15)	435	(39)	429	(37	428	(3)	444	(133)
4	463	(67)	456	(1)	462	(27)	473	(27)	480	(3)
5	494	(14)	484	(35)	475	(4)	502	(15)	492	(10)
6	513	(5)	500	(4)	499	(9)	525	(12)	511	(7)
7	534	(5)	533	(1)	542	(4)	517	(6)	544	(4)
8	548	(2)	523	(2)	572	(3)	525	(1)	562	(2)
9	550	(2)	578	(1)	537	(2)	525	(1)	569	(1)
10	–	–	–	–	554	(2)	586	(1)	–	–
Mean	380	(615)	419	(229)	380	(186)	388	(527)	411	(402)
Females										
1	322	(230)	327	(10)	310	(115)	321	(223)	340	(146)
2	412	(188)	410	(135)	392	(3)	413	(265)	426	(147)
3	472	(4)	480	(23)	463	(25)	447	(4)	489	(85)
4	515	(28)	553	(1)	519	(8)	522	(11)	564	(2)
5	551	(7)	522	(4)	586	(3)	550	(5)	553	(6)
6	595	(2)	577	(3)	571	(4)	–	–	592	(3)
7	637	(2)	586	(2)	612	(1)	–	–	572	(2)
8	584	(2)	604	(1)	670	(1)	–	–	–	–
9	–	–	701	(1)	704	(1)	–	–	–	–
Mean	379	(463)	425	(180)	364	(161)	376	(508)	414	(393)

Table 13.–Mean total length (mm) for yearling walleye caught in Michigan waters of Lake Erie, in fall gill-net surveys (sample size in parentheses) 1978-99.

Survey year	Year class	Mean length		Standard error
1978	1977	343	(410)	1.0
1979	1978	330	(115)	1.9
1980	1979	344	(222)	1.3
1981	1980	336	(86)	2.0
1982	1981	333	(143)	1.9
1983	1982	308	(116)	1.7
1984	1983	311	(18)	4.7
1985	1984	329	(279)	1.2
1986	1985	339	(392)	1.0
1987	1986	332	(387)	1.1
1988	1987	347	(18)	4.2
1989	1988	336	(246)	1.2
1990	1989	352	(64)	2.4
1991	1990	345	(218)	1.3
1992	1991	309	(252)	1.4
1993	1992	331	(13)	6.5
1994	1993	328	(415)	1.0
1995	1994	318	(444)	1.1
1996	1995	326	(18)	4.0
1997	1996	306	(210)	1.3
1998	1997	319	(357)	1.0
1999	1998	339	(233)	1.1

Table 14.–Walleye CPUE (number per net lift), by cohort, in multi-filament gill nets during fall surveys on Michigan waters of Lake Erie, 1982-99.

Year class	Total CPUE	Survey year																	
		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1973	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1974	13.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1975	42.8	0.5	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1976	18.4	1.5	0.3	0.0	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1977	171.0	5.0	2.5	3.0	0.5	0.3	–	–	–	–	–	–	–	–	–	–	–	–	–
1978	61.6	5.5	2.5	1.8	0.5	1.3	–	–	–	–	–	–	–	–	–	–	–	–	–
1979	72.4	5.0	4.3	2.3	2.0	0.5	0.5	0.3	–	–	–	–	–	–	–	–	–	–	–
1980	92.7	21.5	14.5	5.0	5.3	2.3	0.5	0.3	0.0	0.3	–	–	–	–	–	–	–	–	–
1981	72.3	33.5	21.3	7.8	3.8	2.8	2.3	0.5	0.3	0.0	–	–	–	–	–	–	–	–	–
1982	306.2	–	29.0	91.8	95.8	44.3	28.5	5.3	7.5	3.5	0.5	–	–	–	–	–	–	–	–
1983	34.6	–	–	4.5	12.0	4.0	5.0	3.5	1.8	1.8	2.0	–	–	–	–	–	–	–	–
1984	147.7	–	–	–	69.8	34.3	20.5	3.5	8.0	8.3	2.0	0.5	0.3	0.5	–	–	–	–	–
1985	177.2	–	–	–	–	98.0	42.5	9.3	14.3	8.5	1.5	1.3	0.8	1.0	–	–	–	–	–
1986	297.5	–	–	–	–	–	96.8	30.3	90.3	43.5	19.5	11.0	3.8	2.0	0.3	–	–	–	–
1987	127.8	–	–	–	–	–	–	4.5	53.8	26.8	20.0	13.8	2.5	3.8	1.0	0.5	0.8	–	0.3
1988	125.0	–	–	–	–	–	–	–	61.5	35.8	9.3	7.3	4.5	4.5	0.5	0.8	0.8	–	–
1989	52.6	–	–	–	–	–	–	–	–	16.0	17.0	10.0	2.8	3.3	1.3	0.8	0.8	0.3	0.3
1990	136.4	–	–	–	–	–	–	–	–	–	54.5	48.0	13.0	16.5	1.5	1.3	1.3	0.0	0.3
1991	194.3	–	–	–	–	–	–	–	–	–	–	63.0	47.3	61.5	11.3	6.8	2.8	1.3	0.3
1992	16.4	–	–	–	–	–	–	–	–	–	–	–	2.0	7.3	2.0	0.3	1.5	2.3	1.0
1993	168.9	–	–	–	–	–	–	–	–	–	–	–	–	73.3	71.0	11.8	8.08	3.3	1.5
1994	127.9	–	–	–	–	–	–	–	–	–	–	–	–	–	63.3	43.0	14.0	4.8	2.8
1995	6.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.3	1.3	0.8	1.0
1996	152.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	37.5	84.3	30.5
1997	88.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	54.3	34.3
1998	26.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	26.0
Total		72.5	74.9	116.2	190.2	187.8	196.6	57.5	237.5	144.5	126.3	154.9	77.0	173.7	152.2	68.6	68.8	151.4	98.3
Net lifts		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Table 15.–Mean rank of Lake Erie walleye year classes based on measured harvest and survey catch per effort.

Year class	Total harvest[1]	Harvest rank	Trap CPUE	Trap rank	Gill CPUE	Gill-net rank	Mean rank
1974	2,727,989	17	0.4	24	13.6	23	21.3
1975	3,356,110	15	1.3	21	42.8	19	18.3
1976	812,855	22	0.8	23	18.4	21	22.0
1977	6,837,878	6	10.2	15	171.0	5	8.7
1978	3,578,926	14	8.9	16	61.6	17	15.7
1979	2,535,057	20	8.7	18	72.4	15	17.7
1980	5,426,616	10	21.5	6	92.7	13	9.7
1981	3,093,746	16	16.9	11	72.3	16	14.3
1982	21,305,596	1	98.6	1	306.2	1	1.0
1983	2,572,846	19	21.4	7	34.6	20	15.3
1984	6,639,741	7	28.1	3	147.7	8	6.0
1985	7,518,595	3	27.0	5	177.2	4	4.0
1986	13,469,004	2	56.6	2	297.5	2	2.0
1987	4,081,685	12	27.5	4	127.8	11	9.0
1988	3,941,361	13	15.7	12	125.0	12	12.3
1989	2,688,970	18	8.7	17	52.6	18	17.7
1990	6,106,960	8	20.5	9	136.4	9	8.7
1991	7,163,771	4	20.3	10	194.3	3	5.7
1992	1,579,416	21	1.8	20	16.4	22	21.0
1993	5,837,762	9	20.7	8	168.9	6	7.7
1994	7,110,788	5	12.4	14	127.9	10	9.7
1995	472,806	24	0.9	22	6.4	24	23.3
1996	5,125,107	11	13.6	13	152.3	7	10.3
1997	780,840	23	3.9	19	88.6	14	18.7
Mean	5,198,518		18.6		112.7		

[1]Total harvest determined by summing each agencies sport and commercial age specific harvest estimates.