

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-13

Study No.: 460

Title: Dynamics of Lake Erie walleye and yellow perch populations and fisheries

Period Covered: April 1, 1996 to March 31, 1997

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

Summary: In 1996, 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 interagency objectives, Michigan's survey data and data analyses were shared with the other Lake Erie fisheries management agencies. The interagency task groups combined their walleye tag data and their walleye and yellow perch survey data to produce estimates of mortality and exploitation rates. The data generated were used to establish harvest quota projections.

Job 1. Title: Carry out trap net sampling.

Findings: In 1996, the Michigan Department of Natural Resources (MDNR) made 45 trap net lifts off the city of Monroe in Michigan waters of Lake Erie. This was the 19th consecutive year the MDNR has conducted this trap net survey. To date, 37,146 walleye have been tagged in those surveys including 2,269 tagged in 1996.

Age and growth data were collected from walleye, and yellow perch. Total number and total weight data were also collected on other Lake Erie species. In 1996, the total combined catch-per-net-lift (CPUE) for all species was the highest since 1991 (Table 1). CPUE values for walleye, smallmouth bass, channel catfish, white sucker, redbhorse spp., common carp, and quillback carpsucker were all above the 19-year means. Smallmouth bass catch rates in 1995 and 1996 were markedly higher than during any previous years. This may be an indication of improving habitat conditions for smallmouth bass in Michigan's waters of Lake Erie. Yellow perch catch per net lift in 1996 was higher than during the previous two years, but remained well below the 19-year mean. For the first time since the early 1990's secchi disc readings did not exceed 2.0 m during the survey period. Mean secchi disc reading in 1996 was 0.88 m.

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

Findings: Scale samples collected from walleye and yellow perch have been processed and aged. Age 3 walleye made up 25% of the trap net walleye catch, reflecting the strength of the 1993 year class (Table 2). The 1991 year class was also well represented, accounting for nearly 20% of the total catch. By contrast, age 4 walleye were quite scarce (1.5%), illustrating the poor recruitment

experienced in 1992. Growth, as reflected by mean length at age remains good for both male and female walleye (Table 3). No trend in growth is apparent for either sex during recent years.

The age composition of yellow perch was rather evenly distributed. Age 3 (15%), age 4 (18%), age 5 (28%), age 6 (18%), and age 7 (14%) combined to account for over 93% of the catch (Table 4). Yellow perch growth, as indicated by mean length at age, has improved since 1990 (Table 5).

In 1996, age 3 walleye (1993 year class) accounted for the largest portion of the walleye harvest, comprising over 51% of the catch (Table 6). The 1994 year class (21%) and 1991 year class (13%) were the only other year classes well represented in the harvest. The weak 1992 year class contributed only 2.9% as age 4 fish. This low contribution is a reflection of the poor recruitment experienced by Lake Erie walleye in 1992. No trend in growth is apparent for angler caught walleye over the past six years (Table 6).

Two year classes dominated the yellow perch harvest in 1996. The 1994 year class (age 2) contributed 53% of the total catch (Table 7). The 1993 year class (age 3) added an additional 41% of the total. In combination, the 1992 and 1993 year classes accounted for 83% of the total catch. Contributions from all other year classes were minor. Growth of age 2-4 yellow perch, as reflected by mean length at age in the sport harvest, has increased dramatically since 1991.

Job 3. Title: Collect tag recovery data.

Findings: A total of 37,146 walleye have been tagged at the Monroe station since the spring of 1978. Of those, 3,006 (8.1%) have been caught and reported by anglers and commercial fishermen through 1996. A total of 2,269 walleye were tagged at Monroe in 1996; of which, 3.0% were subsequently recovered by fishermen. There were 179 reported recoveries from all years of tagging during the 1996 fishing season. The geographical distribution of the 1996 returns is as follows: Lake Huron and Saginaw Bay 2%; St. Clair River 3%; Lake St. Clair 5%; Detroit River 11%; Western Basin-Lake Erie 54%; Central Basin-Lake Erie 23%; and Eastern Basin-Lake Erie 3%. Recoveries were reported from all months except December and January, with over 69% reported during the months of May (22.9%), June (26.8%) and July (19.6%).

The geographical distribution of tag recoveries shifted slightly during the period from 1989 to 1996 (Table 8). The percentage of recoveries reported from Lake Erie waters increased, with the largest portion of that increase occurring in the Central Basin. This increase could reflect changes in fish distribution, but is likely due to expanding fishing effort and access. The percentage of recoveries from the Detroit River in 1992, 1993, and 1994 was much lower than during 1989-91, but rebounded in 1995 and 1996. A pronounced drop in tag recoveries from the St. Clair River in 1996 is not explainable at this time. Tag recovery from central Lake Erie has increased dramatically since 1989, recoveries exceeding 20% in 1994, 1995, and 1996.

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 from 1986 through 1996. 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 1996 fishing year had been received; thus, the recovery rate estimates for 1996 were comparable to those for prior years.

Walleye tag and recovery data from the Ohio and Michigan surveys covered the period from 1986 through 1996 (Table 9). Walleye were not tagged by Ontario in 1989 and 1996; and, May tag recovery data from Ontario might have been biased by heavy commercial fishing effort near tag sites. Michigan and Ohio used a monel metal tag which was placed in the lower jaw. During some years, Ontario 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. Statistical comparisons (z test statistic) showed that average rates of recovery and survival estimated from the 1986-89 Ontario data were not significantly different from Michigan or Ohio rates. For these reasons, historical Ontario data may be the least representative of average conditions for the western basin walleye population. Ontario data was not included in the calculations of population parameters. Standardization of tag studies, begun in 1990, was continued in 1996. This will improve comparability between agencies and provide the maximum benefit from combined data.

Analysis of the combined data produced an estimate for mean annual survival of 62.86% and mean recovery rate of 3.57% (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, \mathbf{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/nonreward ratio of 2.67 (Table 11). A value for \mathbf{u} of 9.56% was generated by expanding mean recovery rate (3.57%) by the nonreporting rate (2.68). The resulting value for M was 0.32. It is important to note that survival rate estimates from program "ESTIMATE" are independent of recovery rates; thus expansion of the tag recovery rate by reward/nonreward ratios will not alter survival rate estimates in any way.

The only statistically significant increase in \mathbf{u} during the study period occurred in 1993. This increase was consistent with higher sport angler catch/effort values documented by creel surveys. The value of \mathbf{u} in 1994 was significantly lower than 1993 and not different from the years prior to 1993. The value of \mathbf{u} in 1995 and 1996 did not vary significantly from 1994.

Job 5. Title: Carry out gill net sampling.

Findings: The MDNR has fished variable mesh multi-filament gill net at two stations in western Lake Erie since the fall of 1978, as part of the interagency assessment program. The 1996 fall gill net survey included two 1300-foot sets of variable mesh multi-filament gill net at each index station, and two sets were made at each of two additional stations. All nets were suspended from the surface. A total of 409 walleye were captured and sampled for age and growth information.

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

Findings: Scale samples taken from walleye captured in fall gill-nets have been processed and aged. Mean length (mm) at age is presented in Table 12. No trends in walleye growth are evident over the last five years. Mean length of yearlings collected in 1996 remained below the 19-year mean

(Table 13). Total walleye catch-per-effort for the index sites (Table 14) was the second lowest recorded during the 19 year time-series. The weak 1992 and 1995 year classes are likely important factors in this low catch rate. Age 2 walleye, 1994 year class, accounted for 67% of the catch.

Historical walleye catch data was used to develop a mean rank for the 1974-95 year classes, some of which were not yet completely represented throughout their life (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, 1977, and 1984. The 1992 year class, which has been recruited to the sport and commercial fisheries for 3 years, is clearly the weakest year class of the period. This analysis will be updated annually and will provide the basis for testing whether the food base for walleye fry at various spawning tributaries was an important determinant of recruitment success (see annual performance report for Study 470).

Job 7. Title: Participate in interagency work groups.

Findings: Data summaries and analyses were completed and presented to the Scientific Technical Committee, the Walleye Task Group, the Forage Task Group, and the Yellow Perch Task Group. Interagency walleye tag data for 1996 was compiled and disseminated to each agency. Extensive walleye and yellow perch population modeling was done utilizing the interagency 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. Computer files containing all 1996 MDNR survey data were presented to the controlling working groups. Ontario trawl data from the interagency random summer series were keypunched, summarized, and presented to all cooperating agencies to fulfill Michigan's responsibility in that cooperative project.

Job 8. Title: Prepare annual reports.

Findings: This progress report was prepared.

Literature cited:

Brownie, C., D. R. Anderson, K. P. Burnham, and D. S. Robson. 1985. Statistical inference from band recovery data - a handbook (2nd edition). U. S. Department of the Interior, Fish and Wildlife Service, Resource Publication No. 156, Washington, D. C.

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

Table 1.—Mean catch per trap net lift for all species commonly taken during spring trap net surveys in Michigan waters of Lake Erie, 1978-96.

Species	Survey year											
	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							78-89 mean	90-96 mean	Overall mean
	1990	1991	1992	1993	1994	1995 ¹	1996			
Walleye	23.8	95.9	37.7	39.2	53.0	26.2	52.0	42.3	46.8	44.0
Smallmouth bass	0.1	0.2	0.1	0.2	0.8	2.2	2.1	0.1	0.8	0.4
Yellow perch	41.7	94.6	35.0	50.2	23.2	10.3	36.6	254.6	41.7	176.1
Rock bass	0.3	0.8	0.5	1.2	1.0	4.1	1.1	1.2	1.3	1.2
White bass	0.9	1.6	0.5	0.1	1.1	2.1	0.6	3.9	1.0	2.8
White perch	40.5	56.8	5.1	0.0	14.7	72.8	5.9	40.0	28.0	35.6
Pumpkinseed	0.0	0.0	0.0	0.0	0.0	0.0	0.1	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
Black crappie	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1
Channel catfish	9.0	6.0	4.6	4.6	5.4	3.7	8.8	5.5	6.0	5.7
Brown bullhead	13.1	4.3	4.0	1.6	1.1	0.2	1.1	2.7	3.6	3.1
White sucker	4.3	13.5	14.6	9.0	5.8	7.4	14.0	10.1	9.8	10.0
Redhorse sp.	0.4	0.6	3.1	3.6	1.8	1.0	5.5	1.3	2.3	1.7
Freshwater drum	5.1	25.6	8.9	20.7	8.8	13.0	15.4	25.8	13.9	21.5
Common carp	2.3	2.3	1.3	1.4	3.7	2.9	8.2	6.7	3.1	5.4
Goldfish	0.1	0.1	0.1	0.0	4.4	0.1	0.5	1.0	0.8	0.9
Gizzard shad	2.3	0.0	0.6	0.3	0.3	1.7	0.3	9.9	0.8	6.5
Longnose gar	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
Quillback	1.9	2.9	4.4	3.2	4.6	6.7	8.9	3.7	4.7	4.0
Stonecat	0.0	0.1	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	409.0	164.6	319.0
% yellow perch	28.6	31.0	29.0	37.1	17.9	6.2	22.7	55.2	25.1	44.0
% white perch	27.8	18.6	4.2	0.0	11.3	46.9	3.6	11.1	18.2	12.9
Net lifts	82	29	55	40	45	39	45	49	48	49

¹Sampling period delayed two weeks.

Table 2.—Age composition (expressed as percentage) of walleye catch in survey trap nets for Lake Erie, near Monroe, 1992-96.

Age	Survey year				
	1992	1993	1994	1995	1996
1	—	—	0.08	0.29	0.04
2	11.00	3.31	0.76	63.60	5.53
3	6.75	32.18	30.86	0.59	25.30
4	11.30	4.61	23.31	13.10	1.54
5	12.20	9.41	4.22	4.81	19.70
6	33.20	11.22	6.45	1.57	15.50
7	10.00	23.49	13.99	4.91	5.36
8	10.20	7.92	11.59	6.58	9.35
9	2.17	4.02	5.27	2.55	8.45
10	2.65	1.69	2.19	1.47	5.83
11	0.14	1.95	0.84	0.10	1.97
12	0.05	0.13	0.38	0.29	0.94
13	—	0.06	0.04	—	0.21
14	—	—	—	—	0.04
Total aged	2,073	1,542	2,387	1,017	2,330

Table 3.—Mean length (mm) and standard error (SE) of walleye caught in trap nets during spring surveys. Sample size in parentheses.

Age	1991		1992		1993		1994		1995		1996	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Males												
2	358 (145)	1.5	365 (207)	1.2	334 (31)	4.5	353 (6)	6.7	342 (57)	2.0	346 (75)	2.5
3	413 (379)	1.0	433 (135)	2.0	418 (460)	1.0	409 (621)	0.9	420 (2)	1.5	410 (500)	1.0
4	448 (280)	1.6	462 (200)	1.7	468 (57)	3.4	464 (365)	1.5	450 (81)	2.6	459 (26)	5.4
5	480 (933)	0.9	493 (215)	1.9	495 (127)	2.8	494 (80)	3.1	488 (35)	3.6	482 (408)	1.4
6	520 (183)	2.4	514 (614)	1.2	517 (151)	2.5	520 (127)	2.5	518 (13)	7.4	510 (304)	1.6
7	541 (254)	1.8	546 (184)	2.2	532 (270)	2.0	536 (291)	1.8	537 (40)	5.3	534 (113)	3.0
8	566 (84)	3.2	563 (190)	2.3	564 (89)	3.5	551 (212)	2.3	560 (51)	5.1	551 (194)	2.3
9	561 (43)	5.2	579 (37)	4.8	578 (34)	5.5	569 (85)	3.9	560 (18)	5.4	568 (165)	2.8
10	—	—	588 (35)	5.1	586 (13)	7.5	584 (27)	6.4	5804 (9)	8.5	577 (107)	3.7
11	—	—	—	—	579 (16)	6.6	597 (14)	8.2	600 (2)	—	609 (31)	6.2
Females												
2	—	—	—	—	317 (3)	5.3	349 (6)	9.8	—	—	—	—
3	421 (6)	7.8	—	—	430 (3)	30.2	416 (66)	3.6	—	—	453 (5)	17.5
4	496 (32)	4.4	501 (23)	5.6	515 (4)	11.6	511 (172)	2.2	501 (17)	6.2	517 (8)	14.0
5	534 (160)	1.9	536 (21)	6.5	550 (12)	11.2	537 (19)	7.8	509 (4)	25.3	539 (37)	4.6
6	584 (28)	4.9	577 (57)	4.7	569 (14)	9.6	578 (24)	7.4	—	—	572 (55)	4.8
7	600 (36)	6.1	607 (17)	6.3	598 (67)	3.9	613 (34)	7.1	—	—	593 (12)	12.7
8	647 (12)	13.4	654 (19)	8.5	639 (25)	10.4	611 (56)	6.8	636 (7)	21.1	637 (22)	10.4
9	654 (28)	5.8	671 (7)	12.3	660 (23)	6.7	646 (35)	7.5	663 (3)	30.0	652 (29)	9.6
10	672 (3)	40.2	681 (16)	8.5	667 (12)	10.7	672 (24)	9.3	682 (3)	13.4	662 (29)	6.5
11	—	—	—	—	702 (14)	7.7	644 (6)	21.6	690 (1)	—	685 (15)	8.3
12	—	—	—	—	—	—	683 (8)	14.1	685 (1)	—	720 (9)	15.4

Table 4.—Yellow perch catch per unit effort (CPUE) by age for trap net surveys from 1989-96 (expressed as number caught per net per 24 h).

Year	Days	Age						Age 8+	Total CPUE
		2	3	4	5	6	7		
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	100.67	0.20	2.42	2.87	4.38	2.82	2.24	0.67	15.60

¹Sampling period delayed two weeks.

Table 5.—Mean length (mm) and standard error (SE) of yellow perch caught in trap nets during spring surveys. Sample size in parentheses.

Age	1990		1991		1992		1993		1994		1995		1996	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Males														
2	—	—	—	—	159 (7)	9.7	177 (4)	2.5	168 (11)	3.5	187 (1)	—	173 (8)	2.2
3	175 (3)	6.7	189 (12)	4.7	181 (31)	2.3	185 (48)	2.1	189 (24)	3.9	194 (4)	0.7	191 (33)	1.9
4	185 (38)	3.4	196 (11)	6.6	208 (16)	7.0	212 (25)	3.6	207 (45)	2.8	243 (11)	4.6	216 (21)	4.5
5	205 (29)	3.3	210 (31)	4.7	221 (8)	6.7	233 (10)	7.2	217 (26)	5.7	250 (12)	2.4	244 (26)	4.0
6	230 (25)	4.9	229 (21)	4.8	243 (34)	4.1	238 (8)	3.9	239 (8)	6.2	256 (7)	5.0	258 (22)	3.8
7	233 (10)	5.7	244 (21)	5.0	238 (25)	4.2	250 (23)	5.4	252 (8)	3.4	265 (2)	13.5	258 (10)	6.4
8	252 (22)	2.7	258 (8)	5.5	247 (13)	7.2	258 (6)	7.5	277 (1)	—	273 (1)	—	277 (4)	12.8
9	266 (4)	9.8	255 (6)	4.4	278 (4)	12.9	260 (10)	4.2	257 (3)	4.1	286 (2)	7.0	284 (3)	12.4
10	—	—	—	—	—	—	248 (3)	14.4	250 (1)	—	—	—	—	—
Females														
3	—	—	237 (4)	13.0	233 (13)	6.8	224 (31)	4.4	216 (25)	3.7	251 (1)	—	223 (8)	6.7
4	213 (17)	7.1	255 (3)	10.2	243 (22)	6.7	239 (32)	3.8	239 (47)	3.4	278 (31)	4.2	243 (21)	3.3
5	233 (36)	3.3	250 (21)	5.8	254 (14)	6.8	267 (24)	5.7	248 (19)	5.6	287 (39)	3.0	282 (33)	4.2
6	252 (28)	5.5	253 (18)	5.5	276 (23)	4.3	281 (14)	5.0	286 (16)	5.8	288 (20)	5.6	287 (17)	4.2
7	278 (22)	6.7	272 (24)	4.4	283 (23)	5.8	290 (12)	6.8	297 (3)	8.0	290 (3)	4.2	302 (23)	3.5
8	290 (17)	3.9	279 (7)	13.4	296 (21)	6.0	311 (13)	6.6	306 (4)	8.0	—	—	351 (1)	—
9	292 (15)	6.2	300 (6)	8.8	294 (3)	8.1	307 (10)	5.8	308 (3)	20.0	—	—	316 (2)	30.0
10	279 (3)	28.1	—	—	—	—	305 (5)	4.8	—	—	—	—	344 (1)	—

Table 6.—Mean length (mm) of walleye sampled from Michigan's Lake Erie sport fishery. Sample size in parentheses.

Age	Survey year											
	1991		1992		1993		1994		1995		1996	
1	363	(2)	—	—	—	—	—	—	—	—	—	—
2	376	(79)	364	(224)	345	(83)	364	(14)	352	(330)	348	(132)
3	432	(106)	436	(57)	419	(137)	403	(199)	418	(34)	414	(322)
4	467	(88)	469	(59)	454	(15)	475	(70)	451	(250)	454	(18)
5	493	(146)	486	(48)	509	(24)	504	(9)	488	(62)	489	(83)
6	541	(44)	533	(60)	514	(28)	520	(16)	513	(14)	547	(27)
7	561	(54)	568	(26)	550	(54)	544	(27)	544	(20)	528	(10)
8	632	(18)	575	(21)	584	(18)	584	(22)	556	(22)	566	(14)
9	671	(28)	651	(3)	591	(18)	565	(10)	614	(24)	631	(11)
10	655	(4)	641	(12)	709	(5)	639	(10)	658	(7)	662	(5)
11	693	(2)	—	—	669	(3)	667	(3)	684	(6)	671	(4)
12	660	(1)	686	(2)	—	—	668	(1)	664	(2)	560	(2)
13	—	—	—	—	610	(1)	—	—	—	—	—	—
Mean	486	(572)	444	(512)	457	(386)	456	(381)	426	(771)	430	(628)

Table 7.—Mean length (mm) of yellow perch sampled from Michigan's Lake Erie sport fishery. Sample size in parentheses.

Age	Survey Year											
	1991		1992		1993		1994		1995		1996	
1	157	(2)	181	(3)	166	(7)	159	(21)	173	(21)	154	(11)
2	180	(74)	190	(310)	194	(120)	200	(202)	193	(414)	190	(355)
3	185	(285)	199	(246)	205	(369)	224	(88)	212	(121)	206	(273)
4	198	(223)	209	(74)	214	(113)	231	(125)	240	(41)	223	(18)
5	216	(189)	225	(29)	226	(32)	242	(40)	252	(40)	255	(8)
6	229	(162)	232	(47)	230	(3)	251	(7)	276	(6)	288	(4)
7	241	(67)	255	(17)	244	(5)	248	(9)	282	(2)	229	(1)
8	264	(22)	250	(15)	267	(2)	269	(5)	—	—	—	—
9	300	(6)	281	(3)	246	(1)	302	(1)	315	(1)	—	—
10	—	—	318	(1)	323	(1)	287	(1)	—	—	—	—
Mean	206	(1,030)	202	(745)	206	(653)	216	(499)	204	(646)	198	(670)

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

Geographical area	Percent of tags recovered by location							
	1989	1990	1991	1992	1993	1994	1995	1996
Lake Huron - Saginaw Bay	0.5	0.5	0.4	0.5	1.6	2.0	0.8	1.7
St. Clair River	7.2	4.9	7.1	2.7	6.1	6.2	8.3	2.8
Lake St. Clair	3.8	8.3	3.1	4.1	2.6	3.1	2.3	4.5
Detroit River	13.0	14.7	17.3	9.5	8.1	8.8	12.1	11.2
Western Basin-Lake Erie	55.3	54.2	56.9	64.5	58.7	54.1	43.9	54.1
Central Basin-Lake Erie	10.6	12.8	11.6	13.1	17.7	21.6	28.8	22.9
Eastern Basin-Lake Erie	3.8	3.0	1.8	2.7	3.5	4.1	3.8	2.8
Lake Erie-total	69.7	70.0	70.3	80.3	79.9	79.8	76.5	79.8

Table 9.—Tag recovery data (non-reward) for walleye tagged by Ohio and Michigan at Lake Erie sites, 1986-96.

Year	Number tagged	Year											Percent recovered
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	
Michigan													
1986	2,959	94	56	53	31	20	27	5	9	4	2	2	10.2
1987	1,842	—	65	72	21	13	12	12	7	3	6	0	11.5
1988	3,918	—	—	126	58	30	25	25	13	6	2	1	7.3
1989	1,866	—	—	—	64	33	33	18	10	9	4	1	9.2
1990	1,674	—	—	—	—	75	58	39	29	10	8	7	13.5
1991	2,730	—	—	—	—	—	103	85	57	21	16	14	10.8
1992	2,507	—	—	—	—	—	—	95	85	34	12	21	9.9
1993	1,946	—	—	—	—	—	—	—	90	28	22	18	8.1
1994	2,518	—	—	—	—	—	—	—	—	63	45	28	5.4
1995	957	—	—	—	—	—	—	—	—	—	21	10	3.2
1996	2,269	—	—	—	—	—	—	—	—	—	—	68	3.0
Ohio													
1986	2,686	64	32	40	20	15	8	5	6	6	2	3	7.5
1987	2,466	—	98	75	35	15	10	6	4	3	4	0	10.1
1988	2,953	—	—	108	62	39	15	15	8	9	2	2	8.8
1989	2,193	—	—	—	68	31	27	19	13	11	8	4	8.3
1990	2,696	—	—	—	—	77	56	33	29	20	10	5	8.5
1991	3,838	—	—	—	—	—	139	95	59	31	23	17	9.5
1992	4,357	—	—	—	—	—	—	142	99	43	24	11	7.3
1993	4,150	—	—	—	—	—	—	—	216	66	42	26	8.4
1994	2,539	—	—	—	—	—	—	—	—	89	58	33	7.1
1995	3,718	—	—	—	—	—	—	—	—	—	136	64	5.4
1996	3,449	—	—	—	—	—	—	—	—	—	—	144	4.2

Table 10.—Annual survival and recovery rate (percent) during 1986-96 for Lake Erie walleye from Ohio and Michigan nonreward tags produced by program "ESTIMATE" (combined data).

Fishing year	Tag recovery rate	Standard error	Walleye survival rate	Standard error
1986	2.80	0.22	56.33	3.90
1987	3.35	0.23	93.09	6.12
1988	3.42	0.18	51.53	3.73
1989	3.23	0.22	47.88	3.52
1990	3.48	0.22	69.52	4.29
1991	3.63	0.19	63.92	3.71
1992	4.10	0.21	61.40	3.81
1993	5.22	0.26	63.17	4.73
1994	3.40	0.22	72.09	6.48
1995	3.06	0.22	49.72	5.21
1996	3.71	0.25	—	—
Mean	3.57	0.07	64.32	0.91

Table 11.—Recovery rates for reward and non-reward walleye tags from four tag sites in Lake Erie, 1990 through 1996.

Tag Site	Tagged	Returns							Reporting rate							Total	
		1990	1991	1992	1993	1994	1995	1996	1990	1991	1992	1993	1994	1995	1996		
Chicken/Hen Islands¹																	
Reward	400	37	18	18	11	7	5	3	9.25	4.50	4.50	2.75	1.75	1.25	0.75	24.00	
Nonreward	1,972	65	32	23	25	10	6	5	3.30	1.62	1.17	1.27	0.51	0.30	0.25	8.16	
Nonreporting rate	—	—	—	—	—	—	—	—	2.81	2.77	3.86	2.17	3.45	4.11	2.96	2.94	
Sandusky Bay²																	
Reward	149	5	2	3	1	2	0	0	3.36	1.34	2.01	0.67	1.34	0.00	0.00	8.72	
Nonreward	1,344	31	15	12	13	6	4	2	2.31	1.12	0.89	0.97	0.45	0.30	0.15	6.03	
Nonreporting rate	—	—	—	—	—	—	—	—	1.45	1.20	2.26	0.69	3.01	0.00	0.00	1.45	
Sugar Rock²																	
Reward	178	19	10	6	9	1	1	2	10.67	5.62	3.37	5.06	0.56	0.56	1.12	25.84	
Nonreward	1,333	40	36	17	19	14	8	3	3.00	2.70	1.28	1.43	1.05	0.60	0.23	10.05	
Nonreporting rate	—	—	—	—	—	—	—	—	3.56	2.08	2.64	3.55	0.53	0.94	4.99	2.57	
Monroe³																	
Reward	218	26	13	10	16	6	2	3	11.93	5.96	4.59	7.34	2.75	0.92	1.38	33.49	
Nonreward	1,675	71	46	28	32	10	9	7	4.24	2.75	1.67	1.91	0.60	0.54	0.42	11.70	
Nonreporting rate	—	—	—	—	—	—	—	—	2.81	2.17	2.74	3.84	4.61	1.71	3.29	2.86	
All tag sites																	
Reward	945	87	43	37	37	16	8	8	9.21	4.55	3.92	3.92	1.69	0.85	0.85	24.13	
Nonreward	6,324	207	129	80	89	40	27	17	3.27	2.04	1.27	1.41	0.63	0.43	0.27	9.04	
Nonreporting rate	—	—	—	—	—	—	—	—	2.81	2.23	3.10	2.78	2.68	1.98	3.15	2.67	

¹ Ontario tag site² Ohio tag sites³ Michigan tag site

Table 12.—Mean total length (mm) at age for walleye caught during fall in survey index multi-filament gill nets (sample size in parentheses).

Age	Survey year				
	1992	1993	1994	1995	1996
Sexes combined					
1	309 (252)	331 (13)	328 (415)	318 (444)	326 (18)
2	414 (192)	389 (246)	407 (32)	401 (480)	404 (273)
3	459 (40)	445 (62)	440 (340)	443 (19)	452 (62)
4	487 (29)	462 (11)	476 (83)	478 (96)	504 (2)
5	504 (55)	501 (23)	505 (17)	513 (21)	488 (39)
6	530 (44)	510 (13)	523 (31)	536 (7)	533 (7)
7	542 (5)	548 (22)	545 (20)	563 (7)	568 (3)
8	627 (2)	539 (3)	556 (15)	566 (4)	550 (3)
9	— —	541 (2)	548 (4)	550 (2)	640 (2)
10	— —	— —	578 (2)	— —	— —
Mean	395 (619)	418 (399)	402 (959)	380 (1080)	422 (409)
Males					
1	305 (153)	337 (5)	324 (220)	314 (213)	325 (8)
2	408 (139)	385 (161)	402 (24)	394 (292)	397 (138)
3	449 (27)	429 (39)	434 (277)	436 (15)	435 (39)
4	477 (22)	447 (9)	469 (72)	463 (67)	456 (1)
5	492 (46)	487 (18)	498 (15)	494 (14)	484 (35)
6	511 (26)	510 (13)	523 (31)	513 (5)	500 (4)
7	542 (5)	529 (16)	536 (18)	534 (5)	533 (1)
8	556 (1)	539 (3)	553 (14)	548 (2)	523 (2)
9	— —	541 (2)	548 (4)	550 (2)	578 (1)
Mean	394 (419)	416 (268)	413 (677)	380 (615)	419 (229)
Females					
1	316 (98)	328 (8)	333 (194)	322 (230)	327 (10)
2	430 (52)	398 (85)	421 (8)	412 (188)	410 (135)
3	478 (12)	472 (23)	468 (63)	472 (4)	480 (23)
4	518 (5)	532 (2)	517 (11)	515 (28)	553 (1)
5	577 (7)	550 (5)	564 (2)	551 (7)	522 (4)
6	558 (18)	— —	— —	595 (2)	577 (3)
7	— —	599 (6)	629 (2)	637 (2)	586 (2)
8	698 (1)	— —	610 (1)	584 (2)	604 (1)
9	— —	— —	— —	— —	701 (1)
Mean	396 (193)	422 (129)	378 (281)	379 (463)	425 (180)

Table 13.—Mean total length (mm) for yearling walleye caught in Michigan fall gill net surveys (sample size in parentheses).

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

Table 14.—Walleye CPUE (number per net lift) in multi-filament gill nets during fall surveys on Michigan waters of Lake Erie.

Year class	Total CPUE	Survey year																	
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1972	1.0	0.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1973	1.0	0.3	0.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1974	13.6	3.5	0.3	1.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1975	42.8	10.5	3.5	2.0	0.5	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—
1976	18.4	5.3	2.8	1.0	1.5	0.3	0.0	0.5	—	—	—	—	—	—	—	—	—	—	—
1977	171.0	37.0	22.7	9.0	5.0	2.5	3.0	0.5	0.3	—	—	—	—	—	—	—	—	—	—
1978	61.6	19.0	25.0	6.0	5.5	2.5	1.8	0.5	1.3	—	—	—	—	—	—	—	—	—	—
1979	72.4	—	44.0	13.5	5.0	4.3	2.3	2.0	0.5	0.5	0.3	—	—	—	—	—	—	—	—
1980	92.7	—	—	43.0	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	126.7	—	—	—	—	—	—	—	—	—	4.5	53.8	26.8	20.0	13.8	2.5	3.8	1.0	0.5
1988	124.2	—	—	—	—	—	—	—	—	—	—	61.5	35.8	9.3	7.3	4.5	4.5	0.5	0.8
1989	51.2	—	—	—	—	—	—	—	—	—	—	—	16.0	17.0	10.0	2.8	3.3	1.3	0.8
1990	134.8	—	—	—	—	—	—	—	—	—	—	—	—	54.5	48.0	13.0	16.5	1.5	1.3
1991	189.9	—	—	—	—	—	—	—	—	—	—	—	—	—	63.0	47.3	61.5	11.3	6.8
1992	11.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.0	7.3	2.0	0.3
1993	156.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	73.3	71.0	11.8
1994	106.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	63.3	43.0
1995	3.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.3
Total		75.5	98.7	76.0	72.5	74.3	116.5	190.0	187.5	196.5	57.0	237.5	144.3	126.3	91.8	76.8	173.8	152.0	68.6
Net lifts		4	6	2	2	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 net rank	Gill CPUE	Gill net rank	Mean rank
1974	2,728,065	13	4.59	18	13.6	20	17.00
1975	3,486,656	10	12.01	10	42.8	17	12.33
1976	887,337	20	1.77	19	18.3	19	19.33
1977	7,039,127	4	36.44	3	170.9	5	4.00
1978	3,583,839	10	8.93	16	61.5	15	13.67
1979	2,666,167	16	8.99	15	72.3	13	14.67
1980	5,658,052	7	21.86	6	92.5	12	8.33
1981	3,112,162	13	17.85	7	72.0	14	11.33
1982	21,938,782	1	112.03	1	306.0	1	1.00
1983	2,230,181	18	9.24	14	34.5	18	16.67
1984	6,953,480	5	34.06	4	147.6	7	5.33
1985	8,088,500	3	31.92	5	177.1	4	4.00
1986	12,501,171	2	54.65	2	297.4	2	2.00
1987	3,576,882	11	16.90	9	126.1	9	9.67
1988	2,844,284	14	13.83	11	123.3	10	11.67
1989	1,685,072	19	6.59	17	50.4	16	17.33
1990	4,507,593	8	17.80	8	133.5	8	8.00
1991	5,844,983	6	14.97	10	183.1	3	6.33
1992	738,207	21	0.57	21	11.3	21	21.00
1993	4,032,866	9	13.23	12	144.3	6	9.00
1994	2,563,868	17	1.29	20	63.3	11	16.00
1995	7,628	22	0.00	22	0.0	22	22.00
Mean	5,079,394		20.55		131.9		

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