STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-14

Study No.: 460

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

Period Covered: April 1, 1997 to March 31, 1998

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 1997, 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 1997, the Michigan Department of Natural Resources (MDNR) made 57 trap net lifts off the city of Monroe in Michigan waters of Lake Erie. This was the 20th consecutive year the MDNR has conducted this trap net survey. To date, 38,864 walleye have been tagged in those surveys including 1,718 tagged in 1997.

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 1997, the total combined catch-per-net-lift (CPUE) for all species was the lowest for the time series (Table 1). CPUE values for all species except white bass, white perch, and lake whitefish were below the 20-year means. Smallmouth bass catch rates in 1997 remained above 1.0 for the third straight year. 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 1997 remained well below the 20-year mean. Lake whitefish have rarely been seen during the 20 year history of this survey. In 1997, a total of 14 lake whitefish were captured for a CPUE value of 0.2. The reason for the unusually high lake whitefish catch during this survey is not clear. As has been common during the 1990’s, secchi disc depths exceeding 2.0 m were not unusual during the survey period. Mean secchi disc reading in 1996 was 1.24 m. We suspect that increased water clarity, as indicated by secchi disc depth, has been a factor in lower CPUE’s for most species during the 1990’s.

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 32% of the trap net walleye catch, reflecting the strength of the 1994 year class (Table 2). The 1993 and 1991 year classes were also well represented, accounting for over

37% of the total catch combined. By contrast, age 5 walleye were quite scarce (1.9%), 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 (26%), age 4 (32%), age 5 (15%), age 6 (14%), and age 7 (9%) combined to account for over 96% of the catch (Table 4). A trend of improving growth for yellow perch since 1990 appears to have reversed in 1996 and 1997 (Table 5).

In 1997, age 3 (38%) and age 4 (36%) fish accounted for the largest portion of the walleye harvest, combining for over 74% of the catch (Table 6). The 1990 year class (6%) and 1991 year class (9%) were the only other year classes well represented in the harvest. The combined contribution of the weak 1992 and 1995 year classes was only 5%. This low contribution is a reflection of the poor recruitment experienced by Lake Erie walleye in 1992 and 1995. No trend in growth is apparent for angler caught walleye over the past six years (Table 6). Mean length of walleye harvested by Michigan anglers in 1997 was the highest in the last 5 years, likely a result of the low contribution to the harvest from age 2 fish (1995 year class).

Three year classes dominated the yellow perch harvest in 1997. The 1994 year class (age 3) contributed 52% of the total catch (Table 7). The 1993 year class (age 4) added an additional 25% of the total. Age 2 fish (1995 year class) accounted for 17% of the total harvest. In combination, these three year classes accounted for over 95% of the total catch. 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 in 1996 and 1997.

Job 3. Title: <u>Collect tag recovery data.</u>

Findings: A total of 38,876 walleye have been tagged at the Monroe station since the spring of 1978. Of those, 3,207 (8.3%) have been caught and reported by anglers and commercial fishermen through 1997. A total of 1,724 walleye were tagged at Monroe in 1997; of which, 3.4% were subsequently recovered by fishermen. There were 189 reported recoveries from all years of tagging during the 1997 fishing season. The geographical distribution of the 1997 returns is as follows: St. Clair River 4.2%; Lake St. Clair 4.7%; Detroit River 12.2%; Western Basin-Lake Erie 57.1%; Central Basin-Lake Erie 20.1%; and Eastern Basin-Lake Erie 1.6%. Recoveries were reported from all months except December, with over 71% reported during the months of May (23.3%), June (23.3%) and July (24.9%).

The geographical distribution of tag recoveries shifted slightly during the period from 1989 to 1997 (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. Other interesting or unusual points in the time series include no returns from Saginaw Bay or Lake Huron during 1997, two years of higher returns from Lake St. Clair (1996 and 1997), and a three year period of lower returns from the Detroit River from 1992 to 1994.. Unfortunately, interpretation of such changes is difficult without information on fishing effort and catch rates. 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.

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 1997. 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 1997 fishing year had been received; thus, the recovery rate estimates for 1997 were comparable to those for prior years.

Walleye tag and recovery data from the Ohio and Michigan surveys covered the period from 1986 through 1997 (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 63.28% and mean recovery rate of 3.60% (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, **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 2.68 (Table 11). A value for **u** of 9.64% was generated by expanding mean recovery rate (3.60%) by the nonreporting rate (2.68). The resulting value for M was 0.34. 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 **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 **u** in 1994 was significantly lower than 1993 and not different from the years prior to 1993. The value of **u** in 1995, 1996, and 1997 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 1997 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 349 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 1997 was the lowest observed during the 20 year survey period (Table 13). Total walleye catch-per-effort for the index sites (Table 14) remained low for the second consecutive year. The weak 1992 and 1995 year classes are likely important factors in the low catch rate. Age 1 walleye, 1996 year class, accounted for 54% of the catch.

Historical walleye catch data was used to develop a mean rank for the 1974-96 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. While the 1992 and 1995 year classes have not been completely recruited to all the gear types, it is clear that both are extremely poor. Fortunately, the 1990, 1991, 1993, and 1994 year classes are at least average strength or better. In addition, early indications suggest that the 1996 year class, which contributed a surprising half-million fish to the lakewide harvest in 1997 as yearlings, may be quite robust. 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 DJ 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 1997 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 1997 MDNR survey data were presented to the controlling working groups.

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.

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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, 1978-96.

	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	78-89 mean	90-97 mean	Overall mean
Walleye	23.8	95.9	37.7	39.2	53.0	26.2	52.0	30.2	42.3	44.8	43.3
Smallmouth bass	0.1	0.2	0.1	0.2	0.8	2.2	2.1	1.2	0.1	0.9	0.4
Yellow perch	41.7	94.6	35.0	50.2	23.2	10.3	36.6	30.7	254.6	40.1	168.8
Rock bass	0.3	0.8	0.5	1.2	1.0	4.1	1.1	0.9	1.2	1.2	1.2
White bass	0.9	1.6	0.5	0.1	1.1	2.1	0.6	2.6	3.9	1.2	2.8
White perch	40.5	56.8	5.1	0.0	14.7	72.8	5.9	10.2	40.0	25.7	34.3
Pumpkinseed	0.0	0.0	0.0	0.0	0.0	0.0	0.1	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
Black crappie	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1
Channel catfish	9.0	6.0	4.6	4.6	5.4	3.7	8.8	4.4	5.5	5.8	5.6
Brown bullhead	13.1	4.3	4.0	1.6	1.1	0.2	1.1	0.4	2.7	3.2	2.9
White sucker	4.3	13.5	14.6	9.0	5.8	7.4	14.0	4.7	10.1	9.2	9.7
Redhorse sp.	0.4	0.6	3.1	3.6	1.8	1.0	5.5	1.9	1.3	2.2	1.7
Freshwater drum	5.1	25.6	8.9	20.7	8.8	13.0	15.4	6.8	25.8	13.0	20.7
Common carp	2.3	2.3	1.3	1.4	3.7	2.9	8.2	0.6	6.7	2.8	5.2
Goldfish	0.1	0.1	0.1	0.0	4.4	0.1	0.5	0.1	1.0	0.7	0.9
Gizzard shad	2.3	0.0	0.6	0.3	0.3	1.7	0.3	0.0	9.9	0.7	6.2
Longnose gar	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
Quillback	1.9	2.9	4.4	3.2	4.6	6.7	8.9	2.2	3.7	4.3	3.9
Stonecat	0.0	0.1	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	409.0	156.0	307.8
% yellow perch	28.6	31.0	29.0	37.1	17.9	6.2	22.7	31.7	55.2	25.5	43.3
% white perch	27.8	18.6	4.2	0.0	11.3	46.9	3.6	10.5	11.1	15.4	12.8
Net lifts	82	29	55	40	45	39	45	57	49	49	49

[1]Sampling period delayed two weeks.

Table 2.–Age composition (expressed as percentage) of walleye catch in survey trap nets for Lake Erie, near Monroe, 1990-97.

	Survey year							
Age	1990	1991	1992	1993	1994	1995	1996	1997
1	0.36	0.04	–	–	0.08	0.29	0.04	–
2	4.23	5.77	11.00	3.31	0.76	63.60	5.53	0.98
3	7.53	15.15	6.75	32.18	30.86	0.59	25.30	32.30
4	42.00	12.08	11.30	4.61	23.31	13.10	1.54	22.30
5	12.60	41.32	12.20	9.41	4.22	4.81	19.70	1.95
6	15.00	7.80	33.20	11.22	6.45	1.57	15.50	15.10
7	2.63	11.11	10.00	23.49	13.99	4.91	5.36	8.23
8	13.60	3.68	10.20	7.92	11.59	6.58	9.35	5.75
9	0.93	2.74	2.17	4.02	5.27	2.55	8.45	5.23
10	0.57	0.14	2.65	1.69	2.19	1.47	5.83	4.89
11	0.15	0.07	0.14	1.95	0.84	0.10	1.97	2.13
12	0.21	0.07	0.05	0.13	0.38	0.29	0.94	0.52
13	0.05	–	–	0.06	0.04	–	0.21	0.29
14	–	–	–	–	–	–	0.04	0.06
15	–	–	–	–	–	–	–	0.06
Total aged	1,938	2,782	2,073	1,542	2,387	1,017	2,330	1,737

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

	1992		1993		1994		1995		1996		1997	
Age	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
						Males						
2	365 (207)	1.2	334 (31)	4.5	353 (6)	6.7	342 (57)	2.0	346 (75)	2.5	354 (13)	6.0
3	433 (135)	2.0	418 (460)	1.0	409 (621)	0.9	420 (2)	1.5	410 (500)	1.0	411 (513)	0.9
4	462 (200)	1.7	468 (57)	3.4	464 (365)	1.5	450 (81)	2.6	459 (26)	5.4	456 (307)	1.4
5	493 (215)	1.9	495 (127)	2.8	494 (80)	3.1	488 (35)	3.6	482 (408)	1.4	491 (30)	5.8
6	514 (614)	1.2	517 (151)	2.5	520 (127)	2.5	518 (13)	7.4	510 (304)	1.6	508 (241)	1.8
7	546 (184)	2.2	532 (270)	2.0	536 (291)	1.8	537 (40)	5.3	534 (113)	3.0	533 (127)	2.6
8	563 (190)	2.3	564 (89)	3.5	551 (212)	2.3	560 (51)	5.1	551 (194)	2.3	558 (94)	3.4
9	579 (37)	4.8	578 (34)	5.5	569 (85)	3.9	560 (18)	5.4	568 (165)	2.8	579 (86)	3.7
10	588 (35)	5.1	586 (13)	7.5	584 (27)	6.4	5804 (9)	8.5	577 (107)	3.7	580 (71)	4.8
11	–	–	579 (16)	6.6	597 (14)	8.2	600 (2)		609 (31)	6.2	581 (29)	7.8
						Females						
2	–	–	317 (3)	5.3	349 (6)	9.8	–	–	–	–	–	–
3	–	–	430 (3)	30.2	416 (66)	3.6	–	–	453 (5)	17.5	443 (14)	3.7
4	501 (23)	5.6	515 (4)	11.6	511 (172)	2.2	501 (17)	6.2	517 (8)	14.0	497 (41)	3.7
5	536 (21)	6.5	550 (12)	11.2	537 (19)	7.8	509 (4)	25.3	539 (37)	4.6	511 (3)	20.4
6	577 (57)	4.7	569 (14)	9.6	578 (24)	7.4	–	–	572 (55)	4.8	517 (16)	11.0
7	607 (17)	6.3	598 (67)	3.9	613 (34)	7.1	–	–	593 (12)	12.7	586 (13)	11.6
8	654 (19)	8.5	639 (25)	10.4	611 (56)	6.8	636 (7)	21.1	637 (22)	10.4	614 (2)	9.0
9	671 (7)	12.3	660 (23)	6.7	646 (35)	7.5	663 (3)	30.0	652 (29)	9.6	645 (3)	25.9
10	681 (16)	8.5	667 (12)	10.7	672 (24)	9.3	682 (3)	13.4	662 (29)	6.5	667 (12)	16.6
11	–	–	702 (14)	7.7	644 (6)	21.6	690 (1)		685 (15)	8.3	687 (7)	17.3
12	–	–	–	–	683 (8)	14.1	685 (1)		720 (9)	15.4	709 (3)	25.9

Table 4.–Yellow perch catch per unit effort (CPUE) by age for trap net surveys from 1989-97 (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

[1]Sampling 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.

	1991		1992		1993		1994		1995		1996		1997	
Age	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	189 (12)	4.7	181 (31)	2.3	185 (48)	2.1	189 (24)	3.9	194 (4)	0.7	191 (33)	1.9	191 (30)	1.9
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	212 (25)	3.1
5	210 (31)	4.7	221 (8)	6.7	233 (10)	7.2	217 (26)	5.7	250 (12)	2.4	244 (26)	4.0	231 (16)	5.6
6	229 (21)	4.8	243 (34)	4.1	238 (8)	3.9	239 (8)	6.2	256 (7)	5.0	258 (22)	3.8	257 (17)	4.8
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	255 (18)	1.8
8	258 (8)	5.5	247 (13)	7.2	258 (6)	7.5	277 (1)	–	273 (1)	–	277 (4)	12.8	266 (2)	2.0
9	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	215 (14)	3.7
4	255 (3)	10.2	243 (22)	6.7	239 (32)	3.8	239 (47)	3.4	278 (31)	4.2	243 (21)	3.3	238 (48)	3.0
5	250 (21)	5.8	254 (14)	6.8	267 (24)	5.7	248 (19)	5.6	287 (39)	3.0	282 (33)	4.2	261 (23)	5.8
6	253 (18)	5.5	276 (23)	4.3	281 (14)	5.0	286 (16)	5.8	288 (20)	5.6	287 (17)	4.2	295 (27)	3.7
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	305 (10)	6.2
8	279 (7)	13.4	296 (21)	6.0	311 (13)	6.6	306 (4)	8.0	–	–	351 (1)	–	317 (10)	6.3
9	300 (6)	8.8	294 (3)	8.1	307 (10)	5.8	308 (3)	20.0	–	–	316 (2)	30.0	–	–
10	–	–	–	–	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.

	Survey year											
Age	1992		1993		1994		1995		1996		1997	
1	–	–	–	–	–	–	–	–	–	–	–	–
2	364	(224)	345	(83)	364	(14)	352	(330)	348	(132)	339	(5)
3	436	(57)	419	(137)	403	(199)	418	(34)	414	(322)	415	(192)
4	469	(59)	454	(15)	475	(70)	451	(250)	454	(18)	465	(182)
5	486	(48)	509	(24)	504	(9)	488	(62)	489	(83)	518	(21)
6	533	(60)	514	(28)	520	(16)	513	(14)	547	(27)	519	(44)
7	568	(26)	550	(54)	544	(27)	544	(20)	528	(10)	558	(30)
8	575	(21)	584	(18)	584	(22)	556	(22)	566	(14)	565	(16)
9	651	(3)	591	(18)	565	(10)	614	(24)	631	(11)	623	(12)
10	641	(12)	709	(5)	639	(10)	658	(7)	662	(5)	625	(4)
11	–	–	669	(3)	667	(3)	684	(6)	671	(4)	680	(3)
12	686	(2)	–	–	668	(1)	664	(2)	560	(2)	625	(1)
13	–	–	610	(1)	–	–	–	–	–	–	–	–
Mean	444	(512)	457	(386)	456	(381)	426	(771)	430	(628)	467	(510)

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

Age	Survey Year											
	1992		1993		1994		1995		1996		1997	
1	181	(3)	166	(7)	159	(21)	173	(21)	154	(11)	–	–
2	190	(310)	194	(120)	200	(202)	193	(414)	190	(355)	182	(101)
3	199	(246)	205	(369)	224	(88)	212	(121)	206	(273)	197	(356)
4	209	(74)	214	(113)	231	(125)	240	(41)	223	(18)	217	(178)
5	225	(29)	226	(32)	242	(40)	252	(40)	255	(8)	233	(24)
6	232	(47)	230	(3)	251	(7)	276	(6)	288	(4)	263	(3)
7	255	(17)	244	(5)	248	(9)	282	(2)	229	(1)	292	(1)
8	250	(15)	267	(2)	269	(5)	–	–	–	–	–	–
9	281	(3)	246	(1)	302	(1)	315	(1)	–	–	–	–
10	318	(1)	323	(1)	287	(1)	–	–	–	–	–	–
Mean	202	(745)	206	(653)	216	(499)	204	(646)	198	(670)	202	(663)

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	1997
Lake Huron - Saginaw Bay	0.5	0.5	0.4	0.5	1.6	2.0	0.8	1.7	0.0
St. Clair River	7.2	4.9	7.1	2.7	6.1	6.2	8.3	2.8	4.2
Lake St. Clair	3.8	8.3	3.1	4.1	2.6	3.1	2.3	4.5	4.9
Detroit River	13.0	14.7	17.3	9.5	8.1	8.8	12.1	11.2	12.2
Western Basin-Lake Erie	55.3	54.2	56.9	64.5	58.7	54.1	43.9	54.1	57.1
Central Basin-Lake Erie	10.6	12.8	11.6	13.1	17.7	21.6	28.8	22.9	20.1
Eastern Basin-Lake Erie	3.8	3.0	1.8	2.7	3.5	4.1	3.8	2.8	1.6
Lake Erie-total	69.7	70.0	70.3	80.3	79.9	79.8	76.5	79.8	78.8

Table 9.–Tag recovery data (non-reward) for walleye tagged by Ohio and Michigan at Lake Erie sites, 1986-97.

	Number	Year												Percent
Year	tagged	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	recovered
							Michigan							
1986	2,959	94	56	53	31	20	27	5	9	4	2	2	2	10.3
1987	1,842	–	65	72	21	13	12	12	7	3	6	0	0	11.5
1988	3,918	–	–	126	58	30	25	25	13	6	2	3	5	7.5
1989	1,866	–	–	–	64	33	33	18	10	9	4	1	4	9.4
1990	1,674	–	–	–	–	75	58	39	29	10	8	8	2	13.7
1991	2,730	–	–	–	–	–	103	85	57	21	16	15	13	11.4
1992	2,507	–	–	–	–	–	–	95	85	34	12	23	12	10.4
1993	1,946	–	–	–	–	–	–	–	90	28	22	18	8	8.5
1994	2,518	–	–	–	–	–	–	–	–	63	46	28	17	6.1
1995	957	–	–	–	–	–	–	–	–	–	21	11	8	4.2
1996	2,269	–	–	–	–	–	–	–	–	–	–	72	59	5.8
1997	1,724	–	–	–	–	–	–	–	–	–	–	–	59	3.4
							Ohio							
1986	2,686	64	32	40	20	15	8	5	6	6	2	3	0	7.5
1987	2,466	–	98	75	35	15	10	6	4	3	4	0	3	10.3
1988	2,953	–	–	108	62	39	15	15	8	9	2	2	7	9.0
1989	2,193	–	–	–	68	31	27	19	13	11	8	5	1	8.3
1990	2,696	–	–	–	–	77	56	33	29	20	10	7	8	8.9
1991	3,838	–	–	–	–	–	139	95	59	31	23	19	4	9.6
1992	4,357	–	–	–	–	–	–	142	99	43	24	11	7	7.5
1993	4,150	–	–	–	–	–	–	–	216	66	42	33	12	8.9
1994	2,539	–	–	–	–	–	–	–	–	89	58	36	20	8.0
1995	3,718	–	–	–	–	–	–	–	–	–	136	68	39	6.5
1996	3,449	–	–	–	–	–	–	–	–	–	–	154	83	6.9
1997	1,736	–	–	–	–	–	–	–	–	–	–	–	56	3.2

Table 10.–Annual survival and recovery rate (percent) during 1986-97 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	56.29	3.88
1987	3.35	0.23	91.56	5.96
1988	3.45	0.19	52.54	3.75
1989	3.20	0.21	48.67	3.52
1990	3.44	0.22	70.13	4.26
1991	3.59	0.19	64.94	3.69
1992	4.03	0.21	62.62	3.77
1993	5.10	0.25	63.72	4.48
1994	3.33	0.21	75.35	6.11
1995	2.94	0.20	47.65	3.96
1996	4.34	0.24	62.62	7.26
1997	3.32	0.31	–	–
Mean	3.60	0.07	63.28	0.83

Table 11.–Recovery rates for reward and non-reward walleye tags from four tag sites in Lake Erie, 1990 through 1997.

		Returns								Reporting rate								
Tag Site	Tagged	1990	1991	1992	1993	1994	1995	1996	1997	1990	1991	1992	1993	1994	1995	1996	1997	Total
Chicken/Hen Islands[1]																		
Reward	400	37	18	18	11	7	5	3	2	9.25	4.50	4.50	2.75	1.75	1.25	0.75	0.50	25.25
Nonreward	1,972	65	32	23	25	10	6	6	1	3.30	1.62	1.17	1.27	0.51	0.30	0.30	0.05	8.52
Nonreporting rate	–	–	–	–	–	–	–	–	–	2.81	2.77	3.86	2.17	3.45	4.11	2.47	9.86	2.96
Sandusky Bay[2]																		
Reward	149	5	2	3	1	2	0	0	1	3.36	1.34	2.01	0.67	1.34	0.00	0.00	0.67	9.40
Nonreward	1,344	31	15	12	13	6	4	3	1	2.31	1.12	0.89	0.97	0.45	0.30	0.22	0.07	6.32
Nonreporting rate	–	–	–	–	–	–	–	–	–	1.45	1.20	2.26	0.69	3.01	0.00	0.00	9.02	1.49
Sugar Rock[2]																		
Reward	178	19	10	6	9	1	1	2	1	10.67	5.62	3.37	5.06	0.56	0.56	1.12	0.56	27.53
Nonreward	1,333	40	36	17	19	14	8	4	5	3.00	2.70	1.28	1.43	1.05	0.60	0.30	0.38	10.73
Nonreporting rate	–	–	–	–	–	–	–	–	–	3.56	2.08	2.64	3.55	0.53	0.94	3.74	1.50	2.57
Monroe[3]																		
Reward	218	26	13	10	16	6	2	4	0	11.93	5.96	4.59	7.34	2.75	0.92	1.83	0.00	35.32
Nonreward	1,675	71	46	28	32	10	9	7	2	4.24	2.75	1.67	1.91	0.60	0.54	0.42	0.12	12.24
Nonreporting rate	–	–	–	–	–	–	–	–	–	2.81	2.17	2.74	3.84	4.61	1.71	4.39	0.00	2.89
All tag sites																		
Reward	945	87	43	37	37	16	8	9	4	9.21	4.55	3.92	3.92	1.69	0.85	0.95	0.42	25.50
Nonreward	6,324	207	129	80	89	40	27	20	9	3.27	2.04	1.27	1.41	0.63	0.43	0.32	0.14	9.50
Nonreporting rate	–	–	–	–	–	–	–	–	–	2.81	2.23	3.10	2.78	2.68	1.98	3.01	2.97	2.68

[1] Ontario tag site
[2] Ohio tag sites
[3] 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).

	Survey year									
Age	1993		1994		1995		1996		1997	
Sexes combined										
1	331	(13)	328	(415)	318	(444)	326	(18)	306	(210)
2	389	(246)	407	(32)	401	(480)	404	(273)	380	(7)
3	445	(62)	440	(340)	443	(19)	452	(62)	443	(63)
4	462	(11)	476	(83)	478	(96)	504	(2)	475	(35)
5	501	(23)	505	(17)	513	(21)	488	(39)	523	(7)
6	510	(13)	523	(31)	536	(7)	533	(7)	521	(13)
7	548	(22)	545	(20)	563	(7)	568	(3)	556	(5)
8	539	(3)	556	(15)	566	(4)	550	(3)	572	(3)
9	541	(2)	548	(4)	550	(2)	640	(2)	581	(3
10	–	–	578	(2)	–	–	–	–	604	(3)
Mean	418	(399)	402	(959)	380	(1080)	422	(409)	372	(349)
Males										
1	337	(5)	324	(220)	314	(213)	325	(8)	302	(94)
2	385	(161)	402	(24)	394	(292)	397	(138)	372	(4)
3	429	(39)	434	(277)	436	(15)	435	(39)	429	(37
4	447	(9)	469	(72)	463	(67)	456	(1)	462	(27)
5	487	(18)	498	(15)	494	(14)	484	(35)	475	(4)
6	510	(13)	523	(31)	513	(5)	500	(4)	499	(9)
7	529	(16)	536	(18)	534	(5)	533	(1)	542	(4)
8	539	(3)	553	(14)	548	(2)	523	(2)	572	(3)
9	541	(2)	548	(4)	550	(2)	578	(1)	537	(2)
10	–	–	–	–	–	–	–	–	554	(2)
Mean	416	(268)	413	(677)	380	(615)	419	(229)	380	(186)
Females										
1	328	(8)	333	(194)	322	(230)	327	(10)	310	(115)
2	398	(85)	421	(8)	412	(188)	410	(135)	392	(3)
3	472	(23)	468	(63)	472	(4)	480	(23)	463	(25)
4	532	(2)	517	(11)	515	(28)	553	(1)	519	(8)
5	550	(5)	564	(2)	551	(7)	522	(4)	586	(3)
6	–	–	–	–	595	(2)	577	(3)	571	(4)
7	599	(6)	629	(2)	637	(2)	586	(2)	612	(1)
8	–	–	610	(1)	584	(2)	604	(1)	670	(1)
9	–	–	–	–	–	–	701	(1)	704	(1)
Mean	422	(129)	378	(281)	379	(463)	425	(180)	364	(161)

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
1997	1996	306	(210)	1.3

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 1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1972	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1973	1.0	0.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1974	13.6	0.3	1.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1975	42.8	3.5	2.0	0.5	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1976	18.4	2.8	1.0	1.5	0.3	0.0	0.5	–	–	–	–	–	–	–	–	–	–	–	–
1977	171.0	22.7	9.0	5.0	2.5	3.0	0.5	0.3	–	–	–	–	–	–	–	–	–	–	–
1978	61.6	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	127.5	–	–	–	–	–	–	–	–	4.5	53.8	26.8	20.0	13.8	2.5	3.8	1.0	0.5	0.8
1988	125.0	–	–	–	–	–	–	–	–	–	61.5	35.8	9.3	7.3	4.5	4.5	0.5	0.8	0.8
1989	52.0	–	–	–	–	–	–	–	–	–	–	16.0	17.0	10.0	2.8	3.3	1.3	0.8	0.8
1990	136.1	–	–	–	–	–	–	–	–	–	–	–	54.5	48.0	13.0	16.5	1.5	1.3	1.3
1991	192.7	–	–	–	–	–	–	–	–	–	–	–	–	63.0	47.3	61.5	11.3	6.8	2.8
1992	13.1	–	–	–	–	–	–	–	–	–	–	–	–	–	2.0	7.3	2.0	0.3	1.5
1993	164.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	73.3	71.0	11.8	8.1
1994	120.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	63.3	43.0	14.0
1995	4.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.3	1.3
1996	37.5																		37.5
	Total	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	68.8
	Net lifts	6	2	2	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	2,728,109	16	4.59	19	13.6	21	18.67
1975	3,487,115	14	12.01	13	42.8	17	14.63
1976	888,628	21	1.77	20	18.3	20	20.33
1977	7,045,673	4	36.44	3	170.9	5	4.00
1978	3,596,299	13	8.93	16	61.5	15	14.67
1979	2,683,348	17	8.99	15	72.3	13	15.00
1980	5,704,888	7	21.86	6	92.5	12	8.33
1981	3,091,794	15	17.85	8	72.0	14	12.33
1982	21,925,955	1	112.03	1	306.0	1	1.00
1983	2,234,666	18	9.24	14	34.5	19	17.00
1984	6,987,746	5	34.07	4	147.6	7	5.33
1985	7,559,794	3	31.93	5	177.1	4	4.00
1986	13,852,246	2	55.05	2	297.4	2	2.00
1987	4,098,022	11	17.82	9	127.4	9	9.67
1988	3,844,448	12	14.80	12	124.9	10	11.33
1989	2,055,511	19	7.66	17	52.0	16	17.33
1990	5,475,255	8	19.34	7	136.1	8	7.67
1991	6,314,496	6	17.81	10	192.7	3	6.33
1992	903,329	20	0.94	21	13.1	22	21.00
1993	5,106,511	9	17.40	11	164.1	6	8.67
1994	4,935,441	10	7.33	18	120.3	11	13.00
1995	73,128	23	0.18	22	4.6	23	22.67
1996	566,847	22	0.00	23	37.5	18	21.00
Mean	5,006,924		16.68		116.4		

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