

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-8

Study No.: 230460

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

Period Covered: October 1, 2006 to September 30, 2007

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 2006 and 2007, walleye *Sander vitreus* and yellow perch *Perca flavescens* samples were collected from a spring trap-net survey, a fall gill-net survey, and an on-site creel survey. Spawning walleye were also captured by electrofishing in the Huron River, tagged, and released. 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.

Findings: Jobs 1 through 8 were scheduled for 2006-07, and progress is reported below.

Job 1. Title: Carry out trap-net sampling.—In spring 2006, a total of 29 net lifts were made between April 19 and May 1. Age and growth data were collected from walleye and yellow perch. Total number and total weight data were collected for all fish species. In 2006, the catch-per-net-lift (CPUE) for walleye was the highest since 1991. White perch and white bass CPUE were both the highest ever recorded for the spring trap-net survey (Table 1). The yellow perch CPUE increased slightly, but was still the second lowest observed during the history of this survey.

Due to vessel repairs and resulting time constraints, trap nets were not fished during spring 2007, but walleye were collected from the Huron River with electrofishing gear. This allowed continuation of the long-term walleye tagging study on Lake Erie.

Job 2. Title: Analyze growth data from trap nets and angler catches.—Scale samples collected from walleye and yellow perch caught in trap nets in 2006 were processed and interpreted for ages. Age-3 walleye (2003 year class) accounted for about 84% of the 2006 trap-net walleye catch (Table 2). Contributions from all other cohorts were minor in comparison. The age distribution of yellow perch caught in the trap nets in 2005 was dominated by age-4 (51%), age-7 (18%), and age-5 (15%) fish. No trend in growth was apparent for either sex during recent years.

Sport-caught walleye and yellow perch from Michigan's Lake Erie waters have been sampled for biological data (length, weight, and age) as part of Michigan's Great Lakes creel survey (Federal Aid Study 427). In 2006, a total of 795 walleye were sampled for length and weight. Ages were assigned to individual fish using the Ohio DNR length-age key based on otoliths from the western basin sport fishery. Age-3 walleye accounted for the largest portion (88%) of the walleye recreational harvest, reflecting the strength of the 2003 year class. No trend in growth was apparent for sport-caught walleye over the past six years. A total of 391 yellow perch from the

sport harvest were sampled for length, weight, and age. The 2003 year class was dominant in 2006, accounting for 65% of the total harvest. The average length of yellow perch harvested by Michigan sport anglers was 224 mm, reflecting the importance of the age-3 cohort which averaged 220 mm in total length. No obvious trend in growth was apparent for sport-caught yellow perch over the past six years.

Job 3. Title: Collect tag recovery data.—A total of 52,934 walleye have been tagged at Monroe (site 61) between 1978 and 2006. An additional 1,493 walleye were tagged on the spawning run in the lower Huron River (site 64) in 2006 to boost total number tagged. Of the fish tagged at Monroe, 5,730 (10.8%) have been reported caught by anglers and commercial fishermen through 2006. A total of 2,384 walleye were tagged in 2006; of which 61 were later recovered by fishermen in 2006. There were 49 reported recoveries from all years of tagging, at Monroe, and 79 recoveries from Huron River tagging during the 2006 fishing season. The geographical distribution of the 2006 returns (Table 3) is as follows: St. Clair River 4.3%; Lake St. Clair 2.9%; Detroit River 15.6%; Western Basin-Lake Erie 64.3%; Central Basin-Lake Erie 10.0%; and Eastern Basin-Lake Erie 2.9%. Recoveries were reported for all months except January, February, and December with 91.6% reported during the months of April (20.0%), May (7.1%), June (27.1%), July (20.0%), and August (8.6%).

Job 4. Title: Analyze tag recovery data.—Walleye tag data were analyzed to estimate annual rates for tag recovery and survival during the period from 1990 through 2006. 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 2006 fishing year had been received. Thus, the recovery rate estimates for 2006 were comparable to those for prior years.

Walleye tag and recovery data from the Ohio, Ontario, and Michigan surveys covered the period from 1990 through 2006 (Table 4). Walleye were not tagged by Ontario in 1996 and Ohio in 1999 and Michigan tagged very few (94) in 2001. 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 that 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 63.2% and mean recovery rate of 3.29% (Table 5). These values were used to estimate instantaneous natural mortality (M) according to the relationship $M = Z - uZ/A$ where ($uZ/A = F$) 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/non-reward ratio of 2.73 (Thomas and Haas 1999). A value for u of 9.0% was generated by expanding mean recovery rate (3.29%) by the non-reporting rate (2.73). The resulting value for M was 0.35. 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/non-reward ratios will not alter survival rate estimates in any way.

The reward tag program was replicated in 2000, to provide an updated non-reporting rate. Funding for the \$100.00 US tags was provided by the US agencies (NY, PA, OH, and MI). Reward tags were applied to 10% of the tagged walleye population at the Chicken and Hen Island

site in Ontario, the Lackawanna and Van Buren Bay sites in New York, the Grand River and Sandusky Bay sites in Ohio, and the Raisin River site in Michigan. Anglers reported catching 320 non-reward and 157 reward tags from the 2000 tagged population during the 2000, 2001, 2002, 2003, 2004, and 2005 fishing seasons. The non-reporting ratio for anglers was 2.79 which was almost identical to the 2.73 value calculated from the long-term recovery data from the 1990 reward study. However, commercial operators reported 70 reward tags and only 40 non-reward tags resulting in a non-reporting ratio of 15.70. This was much higher than any non-reporting ratios encountered during the 1990-99 period suggesting that the commercial operators dramatically altered how frequently they reported non-reward tags after 1999. These data were used to calculate a different non-reporting ratio to adjust for this change in reporting behavior. The new non-reporting ratio was 4.4 which produced an exploitation estimate of 14.47% and M of 0.28.

Job 5. Title: Carry out gill-net sampling.—The 2006 fall gill-net survey included two 396-meter sets of variable-mesh multi-filament gill net at each index station. A total of 280 walleye were captured, and sampled for age and growth information.

Job 6. Title: Analyze growth and abundance data from gill-net sampling.—Scale samples taken from walleye captured in 2006 fall gill nets have been processed and aged. The total walleye catch-per-effort for the index sites of 70.0 was a 63% decrease from the previous year (Table 6). The 2003 year-class remained dominant, accounting for 68% of the total CPUE. The total CPUE for the 2003 year-class across all years, 287.0, ranks third behind the 1982 and 1986 year-classes. Unfortunately, based on yearling catch rates in the index gill-net survey, the 2004 and 2005 cohorts appear rather weak.

Job 7. Title: Participate in inter-agency work groups.—Data summaries and analyses for 2006 MDNR surveys were completed and presented (as computer files and hard copies) to the Scientific Technical Committee, the Walleye Task Group (WTG), and the Yellow Perch Task Group. Inter-agency walleye tag data for 2006 were compiled and disseminated to each agency. Extensive walleye and yellow perch population modeling was done using the inter-agency tag and fishery data sets.

Job 8. Title: Prepare annual reports.—This progress report was prepared. Additionally, some of the data collected during this study were presented in the following annual status report prepared each winter by the Lake St. Clair Fisheries Research Station for the Great Lakes Fisheries Commission's Lake Erie Committee Annual Meeting:

Thomas, M. V., and R. C. Haas. 2007. Status of the fisheries in Michigan waters of Lake Erie and Lake St. Clair 2006. Report to the Lake Erie Committee of the Great Lakes Fisheries Commission. Michigan Department of Natural Resources, Mt. Clemens.

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 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.

Thomas, M. V., and R. C. Haas. 1999. Dynamics of Lake Erie walleye and yellow perch populations and fisheries. Michigan Department of Natural Resources, Federal Aid in Sport Fish Restoration, Annual Report for Project F-81-R-1, Ann Arbor.

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

Table 1.—Mean catch per trap-net lift for all species taken during spring trap-net surveys in Michigan waters of Lake Erie, 1999 to 2006.

Species	Survey year						Mean		
	1999	2000	2002	2004	2005	2006	1978–89	1990–99	1978–2006
Walleye	38.0	41.4	35.7	38.7	11.6	73.5	42.3	43.1	42.2
Smallmouth bass	1.9	2.2	1.2	3.3	2.2	2.4	0.1	1.1	0.9
Yellow perch	61.0	50.1	74.5	11.2	2.0	6.0	254.6	41.5	133.8
Rock bass	2.8	0.7	1.1	0.9	0.6	1.3	1.2	1.4	1.2
White bass	4.6	4.0	3.0	7.7	6.8	30.3	3.9	1.5	4.2
White perch	79.4	54.7	36.3	62.2	84.1	403.0	40.0	29.4	52.4
Pumpkinseed	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0
Bluegill	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black crappie	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Channel catfish	16.0	5.2	8.0	7.6	1.4	2.2	5.5	7.4	6.1
Brown bullhead	1.0	2.9	0.8	0.7	0.2	0.7	2.7	2.7	2.4
White sucker	6.0	5.8	6.3	4.3	1.6	0.0	10.1	9.4	8.7
Redhorse sp.	2.2	3.8	4.8	4.3	1.8	2.6	1.3	2.3	2.1
Freshwater drum	50.4	11.3	42.7	21.5	4.2	3.9	25.8	18.3	21.4
Common carp	8.0	12.2	1.6	7.6	1.6	6.2	6.7	3.4	5.1
Goldfish	0.1	0.0	0.0	0.1	0.2	1.8	1.0	0.5	0.7
Gizzard shad	0.2	2.4	0.1	0.0	0.2	0.1	9.9	0.6	4.7
Longnose gar	0.0	0.0	0.0	0.0	0.0	0.1	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
Quillback	8.5	3.7	20.8	14.2	3.3	14.5	3.7	5.1	5.6
Stonecat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	280.3	200.4	237.0	184.4	121.7	549.5	409.0	167.8	291.8
% yellow perch	21.8	25.0	31.4	6.1	1.7	1.1	55.2	24.8	36.1
% white perch	28.3	27.3	15.3	33.7	69.1	73.3	11.1	15.7	18.8
Net lifts	45	51	81	38	42	29	49	48	48.5

Table 2.—Age composition (expressed as percentage) of annual walleye catch in spring survey trap nets for Lake Erie, near Monroe, 1994 to 2006.

Age	Survey year											
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2004	2005	2006
1	0.08	0.29	0.04	—	—	0.06	0.19	—	—	—	—	—
2	0.76	63.60	5.53	0.98	31.50	23.70	9.08	69.8	4.8	—	35.6	1.0
3	30.86	0.59	25.30	32.30	3.39	49.70	26.70	7.5	55.6	34.8	0.6	83.7
4	23.31	13.10	1.54	22.30	23.1	0.93	35.00	3.8	8.9	3.2	21.5	1.1
5	4.22	4.81	19.70	1.95	13.7	6.47	1.71	3.8	9.7	31.1	4.1	5.2
6	6.45	1.57	15.50	15.10	2.67	5.60	8.51	1.9	9.5	6.5	15.7	0.5
7	13.99	4.91	5.36	8.23	10.3	2.33	5.18	4.7	1.9	8.5	9.0	3.6
8	11.59	6.58	9.35	5.75	4.37	4.02	4.04	0.9	4.4	8.5	5.3	1.0
9	5.27	2.55	8.45	5.23	3.52	1.92	3.80	1.9	1.6	2.2	4.5	1.1
10	2.19	1.47	5.83	4.89	4.17	2.45	2.66	0.9	1.8	2.4	1.8	0.9
11	0.84	0.10	1.97	2.13	1.24	1.05	1.28	2.8	1.0	0.7	1.4	0.6
12	0.38	0.29	0.94	0.52	1.43	1.16	1.23	1.9	0.5	1.1	0.4	0.6
13	0.04	—	0.21	0.29	0.39	0.35	0.24	—	0.1	0.5	—	0.3
14	—	—	0.04	0.06	—	0.06	0.19	—	—	0.3	—	0.1
15	—	—	—	0.06	0.06	0.06	—	—	—	0.1	—	0.1
Total aged	2,387	1,017	2,330	1,737	1,532	1,714	2,112	106	2,872	1,472	489	2,126

Table 3.–Geographical distribution of tag recoveries, 1994 to 2006, from walleye tagged at Monroe, Michigan, Lake Erie (expressed as a percentage of the total number recovered each year).

Geographical area	1994	1995	1996	1997	1998	1999	2000	2001 ^a	2002	2003	2004	2005	2006
Lake Huron – Saginaw Bay	2.0	0.8	1.7	0.0	2.4	1.2	0.8	0.0	1.0	0.8	1.0	0.0	0.0
St. Clair River	6.2	8.3	2.8	4.2	7.9	9.5	4.6	0.0	6.9	7.4	8.1	7.4	4.3
Lake St. Clair	3.1	2.3	4.5	4.9	7.1	4.8	6.1	0.0	7.4	4.9	2.0	1.1	2.9
Detroit River	8.8	12.1	11.2	12.2	6.3	8.3	15.3	4.3	27.5	18.9	10.1	18.9	15.6
Lake Erie – Western Basin	54.1	43.9	54.1	57.1	56.7	53.6	65.6	76.6	48.5	55.7	70.7	65.3	64.3
Lake Erie – Central Basin	21.6	28.8	22.9	20.1	16.5	20.2	5.3	13.8	6.7	8.2	6.1	6.3	10.0
Lake Erie – Eastern Basin	4.1	3.8	2.8	1.6	3.1	1.2	2.3	4.3	2.0	2.5	2.0	1.1	2.9
Lake Erie – total	79.8	76.5	79.8	78.8	73.2	75.0	73.2	93.6	57.2	66.4	78.8	72.6	77.2

^a Only 94 tags applied in 2001.

Table 4.—Nonreward tag recovery data for walleye tagged by Ohio, Ontario, and Michigan at Lake Erie sites, 1990 to 2006.

Year	Number tagged	Year																	Percent recovered
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
1990	6,323	313	166	133	114	57	26	29	16	7	2	3	0	4	0	2	0	0	13.8
1991	8,602		248	220	157	68	48	42	21	14	4	2	3	0	3	1	0	0	9.7
1992	7,260			283	225	92	48	34	22	10	4	4	3	4	1	0	3	1	10.1
1993	7,359				396	140	82	67	28	14	9	4	3	4	2	0	0	1	10.2
1994	5,539					183	117	80	40	35	11	10	1	5	2	2	1	1	8.8
1995	5,540						168	91	46	22	4	6	5	4	4	2	1	0	6.4
1996	5,718							251	123	57	31	12	14	13	5	3	1	0	8.9
1997	6,261								191	82	34	18	7	17	4	4	5	4	5.8
1998	1,668									28	20	4	0	8	5	0	1	1	4.0
1999	1,630										35	29	13	13	4	4	1	0	6.1
2000	4,469											166	98	51	29	23	16	6	8.7
2001	2,719												79	32	34	14	23	11	7.1
2002	5,291													148	143	54	52	18	7.8
2003	3,461														168	62	30	9	7.8
2004	3,855															151	79	30	6.7
2005	7,447																198	69	3.6
2006	4,402																	149	3.4

Table 5.—Annual survival and recovery rate (percent) during 1990 to 2006 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
1990	4.95	0.27	91.41	4.77
1991	2.88	0.15	67.01	3.43
1992	3.76	0.18	62.23	3.27
1993	4.98	0.21	59.00	3.54
1994	3.35	0.18	85.46	6.01
1995	2.53	0.16	43.03	3.03
1996	4.23	0.22	80.10	5.71
1997	2.78	0.17	75.37	0.05
1998	1.78	0.23	36.43	5.78
1999	2.15	0.25	45.02	5.15
2000	3.35	0.23	75.12	6.76
2001	2.65	0.23	56.62	5.07
2002	2.99	0.20	62.24	4.99
2003	4.13	0.28	53.87	4.97
2004	3.52	0.25	89.62	8.49
2005	2.62	0.17	28.28	3.46
2006	3.39	0.27		
Mean	3.29	0.21	63.18	4.66

Table 6.—Walleye CPUE (number per net lift), by cohort, in multi-filament gill nets during fall surveys on Michigan waters of Lake Erie, 1988 to 2006.

Year class	Total CPUE	Survey year																	
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1976	18.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1977	171.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1978	61.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1979	72.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1980	92.7	0.0	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1981	72.3	0.3	0.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1982	306.2	7.5	3.5	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1983	34.6	1.8	1.8	2.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1984	147.7	8.0	8.3	2.0	0.5	0.3	0.5	—	—	—	—	—	—	—	—	—	—	—	—
1985	177.2	14.3	8.5	1.5	1.3	0.8	1.0	—	—	—	—	—	—	—	—	—	—	—	—
1986	297.5	90.3	43.5	19.5	11.0	3.8	2.0	0.3	—	—	—	—	—	—	—	—	—	—	—
1987	127.8	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	17.0	—	—	—	—	2.0	7.3	2.0	0.3	1.5	2.3	1.0	0.3	—	—	—	0.3	—	—
1993	170.3	—	—	—	—	—	73.3	71.0	11.8	8.08	3.3	1.5	0.3	0.5	—	—	0.3	0.3	—
1994	131.8	—	—	—	—	—	—	63.3	43.0	14.0	4.8	2.8	1.8	0.8	—	—	0.8	0.5	—
1995	10.4	—	—	—	—	—	—	—	3.3	1.3	0.8	1.0	0.8	0.8	0.3	—	0.8	0.8	0.5
1996	180.0	—	—	—	—	—	—	—	—	37.5	84.3	30.5	13.3	9.8	1.8	1.0	1.5	0.3	0.0
1997	133.3	—	—	—	—	—	—	—	—	—	54.3	34.3	20.3	15.3	3.0	1.0	3.8	1.0	0.3
1998	82.7	—	—	—	—	—	—	—	—	—	—	26.0	29.5	14.8	6.3	1.0	3.8	1.0	0.3
1999	178.9	—	—	—	—	—	—	—	—	—	—	—	57.0	73.3	21.5	5.8	13.0	6.8	1.5
2000	20.4	—	—	—	—	—	—	—	—	—	—	—	—	6.5	6.3	0.8	4.0	2.0	0.8
2001	130.9	—	—	—	—	—	—	—	—	—	—	—	—	—	42.8	32.5	43.8	10.0	1.8
2002	13.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.8	4.0	6.5	2.3
2003	287.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	81.2	157.5	48.3
2004	6.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.8	2.3
2005	12.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12.3
Total		237.5	144.5	126.3	154.9	77.0	173.7	152.2	68.6	68.8	151.4	98.3	123.3	121.8	82.0	42.1	157.3	190.5	70.0
Net lifts		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4