STUDY PERFORMANCE REPORT

Project No.: F-53-R-15

State: Michigan

Title: Natural reproduction by walleye in Saginaw Bay.

Study No.: 468

Period Covered: April 1, 1998 to September 30, 1999

Study Objective: To identify the extent of natural reproduction of walleye in Saginaw Bay, relative to stocked and river-produced recruits, and to identify factors affecting reproductive success as well as prospects for improving that success. To identify means of distinguishing walleye of various (hatchery, river, and reef) sources.

Summary: In 1998 and 1999, intensive sampling was again performed at the two study reef sites identified in 1996. Duck and North Island Reefs were the only reefs of any quality located in the inner bay under the reef search portion of this study. Our sampling collected 40 spawners in 1998 and 6 in 1999; including ripe, partially spent, and spent female walleye. Egg pumping from the reef collected eggs believed to be walleye eggs but none could be hatched to confirm their species. Fry trawling collected no walleye larvae in either year and zooplankton densities were documented. This sampling continues to confirm the 1997 results, that there is only minimal reef spawning occurring in Saginaw Bay. Walleye fingerlings stocked in 1998 and 1999 were marked with oxytetracycline (OTC). Extensive sampling for young-of-the-year (YOY) was performed in the summer and fall of each year. In all, over 400 YOY were collected and analyzed for 1998. Analysis indicates that 81% of the 1998 locally-produced year class was a result of stocking (19% wild), identical to the 1997 results. Analysis of the ratio from the 1997 year class (measured as yearlings) indicated the ratio has dropped to 50:50 (hatchery, wild). This difference is attributed to better mixing of the two groups and probably better reflects the true ratio than the YOY results. Sampling for YOY walleye by trawling and electrofishing indicated that the 1997 and 1998 year classes were relatively strong while the 1999 year class was relatively weak. Proportions of yearling walleye in the gill net catch from Study 466 confirm these observations for the 1997- and 1998-year classes. That sampling and biological data from the recreational catch also indicated that both nonstocked year classes (93 and 96) and one stocked year class (92) were weak relative to stocked years. Only about half the number of fingerlings were stocked in 1999 compared to the previous two years. The stocking evaluation will continue in 2000 by again stocking OTC marked fish.

Job 1. Title: Explore and sample potential spawning reefs.

Findings: Variable-mesh gill nets of 198 m length using 15 m panels of 38 mm and 30 m panels of 51 mm - 114 mm stretch measure mesh by 13 mm increments, were used to sample Duck and North Island Reefs in April 1998 and 1999. We collected 40 walleyes of varying maturity levels in 1998 and 6 in 1999 (Table 1). The collections included ripe, partially spent, and spent females. To confirm spawning, an egg pump (Stauffer 1981)

was used to collect eggs from the reef substrate. Eggs were first collected April 7 of each year (Table 2). Most eggs were of morphometry consistent with that of walleye eggs but none were successfully hatched to confirm identity. Larval fish collections were made to search for walleye fry using a neuston net (2 m^2 area, 500-micron mesh). Sampling spanned May and early June (Table 3). No walleye fry were collected anywhere in 1998 or 1999. Reef sampling included zooplankton collections at the same time as larval fish sampling. Sampling was performed with a student plankton net. Densities of total plankters were estimated based on net opening and depth sampled (Table 4). These plankton densities are low for larval walleye survival according to Li and Mathias (1982) but are with in the range reported for successful fry survival in Lake Erie (Roseman 1997).

From this work, it appears that walleye are only minimally using reefs for spawning in Saginaw Bay. Additional substrate egg pumping performed at other locations within the bay in both years found no wider usage than that observed at the two primary study reefs. One final year remains of reef monitoring and emphasis will be on exploring usage of other reef and rocky areas besides Duck and North Island Reefs.

Job 2. Title: <u>Collect walleye recruits.</u>

Findings: In addition to the usual collection efforts of bottom trawling and electrofishing performed by DNR Southern Lake Huron Management Unit, collection of YOY walleye in 1998 and 1999 was again expanded to include other collection efforts that were occurring in the bay area. These included bottom trawling by the USFWS during their annual exotic species survey, bottom trawling performed by the DNR research vessel Channel Cat during summer and fall (under Study 466), and YOY collected by the gill net portion of Study 466. In all, just over 400 YOY walleye were collected in 1998. The 1999 results are not yet available. These specimens served as the source of OTC detection analysis described in Job 3. In addition, recruitment was also measured based on collections of yearling walleye in Study 466. While not sampled consistently among years, the catch rate of the YOY walleye using electrofishing and trawling did provide an early measure of year-class strength. Based on this work, 1998 recruitment appeared to be strong, while 1999 recruitment appeared relatively weak (Figure 1). Only about half as many walleye were stocked in 1999, compared with recent years.

Job 3. Title: <u>Determine source of walleye recruits.</u>

Findings: All walleye fingerlings stocked in Saginaw Bay and northward along Michigan's Lake Huron coast as far as Thunder Bay were immersion marked with OTC. Marking occurred according to the methods of Brooks et al. (1994). Using the recruits collected under Job 2, otoliths were examined using fluorescence microscopy. Figure 2 depicts the contribution of hatchery fish to the 1998 YOY catch by location. Overall, 81% of the YOY were of hatchery origin and 19% of wild. These results were identical to those for 1997.

Examination of otolith percentages for yearling walleye from the gill net collections of Study 466 also provided a measure of recruitment to the population. Samples from 1997 indicated a weak 1996-year class. No fingerling walleye were stocked in 1996. A non-stocked year also occurred in 1993 and was found to be weak. At present, the Saginaw

Bay walleye population contains three weak locally-produced year classes, two based on natural reproduction alone (nonstocked years) and one from a stocked year (1992).

To date, five year classes are subject for stocking evaluation: two by comparing nonstocked years to stocked years and three by OTC differentiation. While the 1999 results are not yet available, the other four year classes indicate substantial contribution by stocked fish. Further evaluation is still planned under Study 468 based on the OTC marking technique. Alternate-year stocking may again be employed in the future. Evaluation based on OTC marking has several advantages including maintaining the benefit of stocked fish contribution to the fishery.

Job 4. Title: Analyze data and write progress report.

Findings: Field data have been analyzed. This annual report was prepared.

Literature Cited:

Brooks, R. C., R. C. Heidinger, and C. C. Kohler. 1994. Mass-marking otoliths of larval and juvenile walleye by immersion in oxytetracycline, calcein or calcein blue. North American Journal of Fisheries Management 14:143-150.

Li, S., and J. A. Mathias. 1982. Causes of high mortality among cultured larval walleyes. Transactions of the American Fisheries Society 111:710-721.

Roseman, E. F. 1997. Factors influencing the year-class strength of reef spawned walleye in Western Lake Erie. Michigan Department of Natural Resources, Fisheries Research Report 2043, Ann Arbor.

Stauffer, T. M. 1981. Collecting gear for lake trout eggs and fry. The Progressive Fish Culturist 43:186-193.

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Date: September 30, 1999

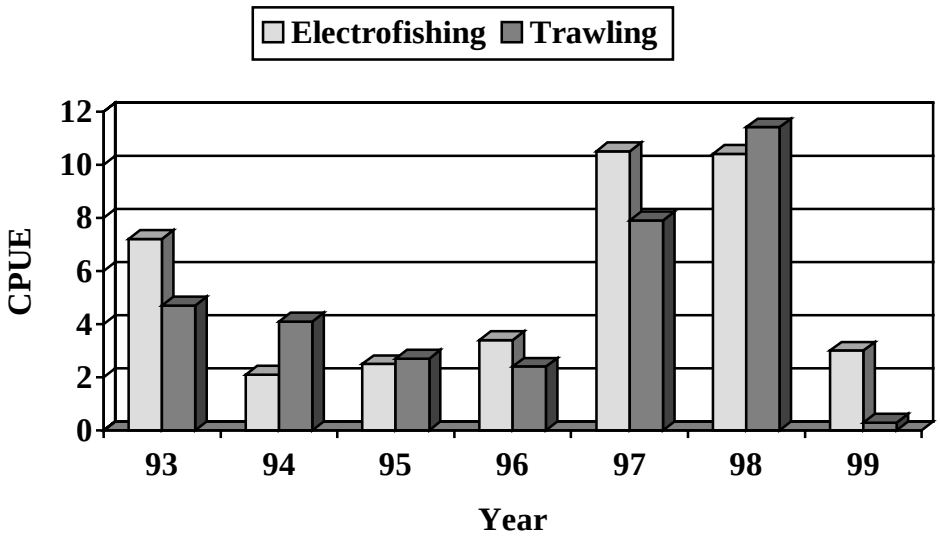

Figure 1.–Trends in average walleye YOY catch per unit effort (CPUE) in Saginaw Bay. Sample efforts are hours of shocking time and number of 10 minute trawl hauls.

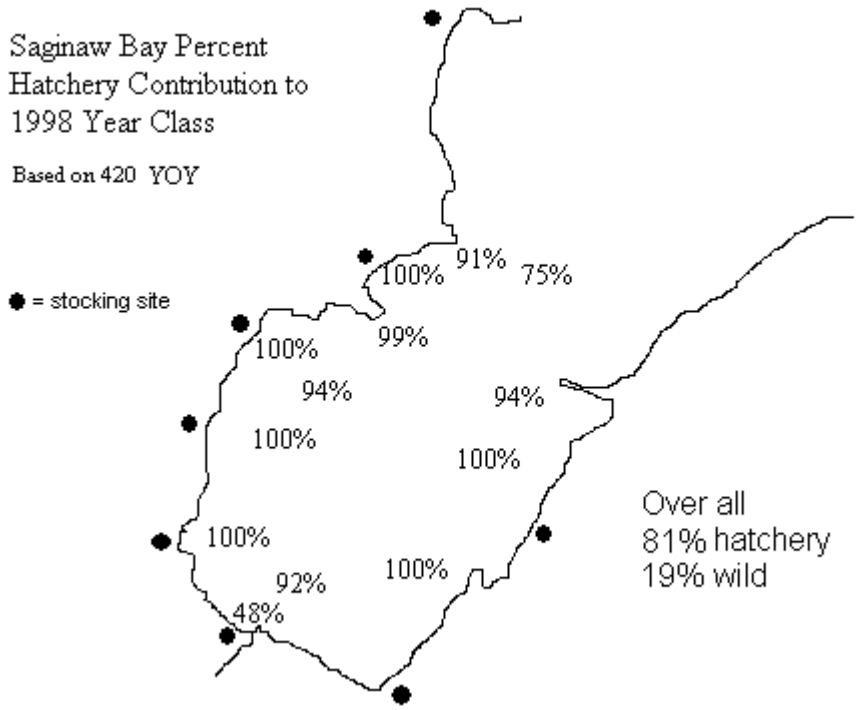

Figure 2.–Percent hatchery contribution to the 1998 walleye year class as based on YOY collected at sampling sites in Saginaw Bay summer and fall 1998. Overall hatchery contribution was 81% (N = 420).

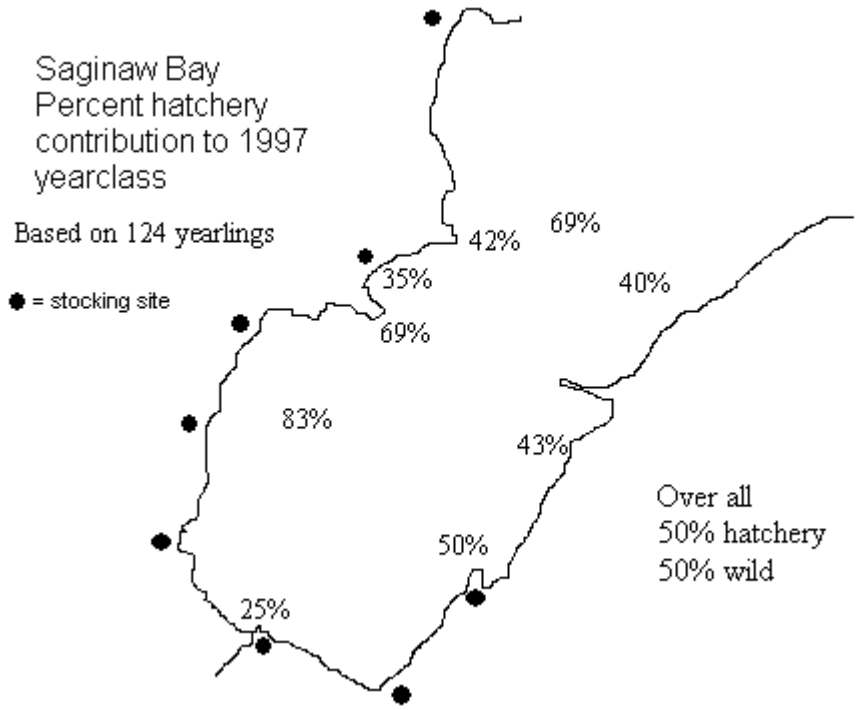

Figure 3.–Percent hatchery contribution of the 1997 walleye year class based on age-1 fish specimens collected at sampling sites in Saginaw Bay the summer and fall 1998. Previous ratio measured as YOY was 81% hatchery: 19% wild. Overall hatchery contribution was 50% (N = 124).

Table 1.–Gill net collection of walleye from Duck and North Island Reefs, Saginaw Bay; April 1998 and 1999. A unit of effort is one 198 m length experimental net.

	Duck Reef		North Island Reef	
	Avg. CPUE	Sex/maturity	Avg. CPUE	Sex/maturity
		1998		
April 14	2	1 male ripe 1 female spent	7	2 male ripe 5 spent female 1 gravid female
April 20	8	2 male ripe 5 female immature 1 female gravid	13	3 male ripe 7 female immature 3 female spent
April 28	9	4 male 5 female	12	5 male 7 female
		1999[1]		
April 7	3	2 gravid females 1 female spent	1	1 immature female
April 13	1	1 spent female	2	2 spent females

[1] Other locations sampled in 1999 (average CPUE; two net sets each date/location for these additional areas not listed above): April 13, Oak Pt. Bar; no walleye caught. April 20, Gravelly Shoal; 1 immature male caught. April 26, Charity Island; 6 walleye caught, 4 spent female, 2 mature males.

Table 2.–Mean egg catch per unit effort and temperature (°C) from Saginaw Bay reefs, 1997 through 1999. Each unit of effort is one 10-minute tow with substrate egg pump.

Date	Location	Temperature	Mean egg CPUE
		1997	
4/14	Duck	4.0	0.00
	North Island	5.5	0.00
4/21	Duck	7.2	16.00
	North Island	6.1	4.33
4/28	Duck	9.4	1.50
	North Island	10.8	1.25
5/7	Duck	10.6	0.00
	North Island	10.6	1.33
5/13	Duck	10.2	3.33
	North Island	10.9	2.00
5/21	Duck	10.4	16.33
	North Island	10.4	5.00
5/27	North Island	11.2	3.33
		1998	
4/7	Duck	8.6	0.67
	North Island	9.2	0.33
4/14	Duck	10.0	4.00
	North Island	12.3	1.33
4/16	Tawas Artificial	7.6	3.33
4/20	Duck	9.4	13.00
	North Island	10.5	0.00
4/28	Duck	9.7	70.00
	North Island	10.5	0.33
4/30	Tawas Artificial	11.0	2.00
5/5	Duck	12.3	51.67
	North Island	12.3	16.00
5/12	Duck	13.7	36.33
	North Island	13.7	5.00
		1999	
4/7	Duck	9.1	0.67
	North Island	9.7	0.33
4/13	Duck	8.2	0.00
	North	8.5	3.33
	Oak Point	7.3	0.33
4/20	Gravelly Shoal	7.9	0.60
4/26	Charity Island	9.3	0.00

Table 3.–Larval fish densities from Duck Island Reef, North Island Reef, and the Tittabawassee River, Saginaw Bay; 1998 and 1999. All densities are number per m^3.

Date	Walleye	Yellow perch	Whitefish	White sucker	Rainbow smelt	Unidentified	Cyprinidae sp.	Northern pike	Brook silverside	Rock bass	Gizzard shad	Longnose gar	Lake chub	Emerald shiner
1998														
Duck Island Reef														
5-5-98		0.0133	0.0010											
5-12-98		0.0097	0.0057	0.0027	0.0027	0.0007		0.0007						
5-19-98		0.0021			0.0052	0.0028	0.0229							
5-26-98		0.0022				0.0214	0.5909			0.0032		0.0006	0.0028	
6-5-98		0.0017				0.0141	1.0028					0.0018		
6-9-98						0.0226	1.6732				0.0135			
North Island Reef														
5-5-98		0.4750	0.0017	0.0047		0.0163								
5-12-98		0.1070		0.0007	0.0087	0.0007								
5-19-98		0.0118			0.0043	0.0123	0.5937		0.0016					
5-26-98		0.0082			0.0007	0.0222	2.4385				0.0377			
6-5-98						0.19997	1.2207				0.0218			
6-9-98		0.0012				0.0135	0.8349				0.0930			
1999														
Duck Island Reef														
5-5-99		0.1273		0.0019		0.0012								
5-10-99		0.0044			0.0009									
5-20-99		0.0185		0.0019		0.0006								
5-28-99		0.0037		0.0005	0.0064	0.0038	0.5875							
6-2-99				0.1384	0.0830	0.0113	0.4283							
6-8-99				0.0013	0.1948	0.0070	0.1098							
North Island Reef														
5-5-99		1.4533	0.0017	0.0047		0.0304		0.0006						
5-10-99		0.0415		0.0305		0.0021								
5-20-99		0.2625			0.0006	0.0022	0.2245							
5-28-99		0.0106			0.0026	0.0147	2.1546							
Tittabawassee River														
5-6-99		0.0118			0.0360	0.0037	0.0074				0.0030			0.0015

Table 4.– Zooplankton densities (taxonomic groups combined) from Duck Island Reef, North Island Reef, and the Tittabawassee River mouth, Saginaw Bay, 1998 and 1999.

Date	No./m^3	No./l
	1998	
	Duck Island Reef	
5/5/98	738.77	0.74
5/12/98	813.19	0.81
5/19/98	4,337.77	4.34
5/26/98	5,111.64	5.11
6/5/98	57,149.08	57.15
6/9/98	83,535.63	83.54
	North Island Reef	
5/5/98	1,818.59	1.82
5/12/98	5,153.02	5.15
5/19/98	4,262.39	4.26
5/26/98	na	na
6/5/98	14,168.84	14.17
6/9/98	25,120.25	25.12
	1999	
	Duck Island Reef	
5/5/99	2,570.58	2.57
5/10/99	5,685.78	5.68
5/20/99	10,984.36	10.98
5/28/99	1,206.22	1.21
6/2/99	40,687.30	40.69
6/8/99	17,2355.30	17.23
	North Island Reef	
5/5/99	7,900.50	7.90
5/10/99	7,625.37	7.62
5/20/99	6,999.55	7.00
5/28/99	1,618.20	1.62
6/2/99	12,712.55	12.71
6/8/99	54,480.21	54.48
	Tittabawasee River mouth	
5/10/99	4,348.54	4.35