STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-1

Study No.: 468 **Title:** Natural reproduction by walleye in Saginaw Bay

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

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

Summary: In 2000, we again sampled at two study reef sites identified in 1996, Duck and North Island Reefs. We also sampled several other Outer-Bay locations. Few spawners were found at any location. No walleye larvae were collected by fry trawling except in the Tittabawassee River, which was sampled for comparison purposes. Results of this sampling confirmed earlier findings of only minimal reef spawning still occurring in Saginaw Bay. Walleye fingerlings stocked in 1999 and 2000 were again marked with oxytetracycline (OTC). Extensive sampling for age-0 walleye was performed in summer and fall. Sampling included collections of older walleye to reexamine contributions of hatchery fish from past year classes. In all, 356 walleye were collected and analyzed in 1999. Analysis indicated that 85% of the 1999 year class was a result of stocking (15% wild). However, this cohort is thought to be weak. Analysis of the ratio from the 1998 year class (measured as yearlings; 83% hatchery: 17% wild) indicated the ratio has not changed appreciably from that measured as age-0. The proportion of hatchery fish in the 1997 year class (measured in 1999 as age-2 fish) was 73%. That contribution level was consistent with the measurement of the 1997 year class based on age-0 fish, although the age-1 measurement was 50%. These findings collectively indicate that hatchery fish are making a substantial contribution to local recruitment. Work has begun on a Final Report and will include analysis of samples collected in 2000.

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

Findings: Sampling with gillnets for reef spawners was again conducted in 2000. Duck and North Island Reefs were sampled in April with variable-mesh gillnets of 198-m length (we used 15-m panels of 38-mm stretch measure mesh and 30-m panels of 51-mm to 114-mm stretch-measure mesh by 13-mm increments). Sampling was also expanded to include the area around Charity Islands and Oak Point. No walleye were collected from Duck Reef, North Island Reef, or reefs around Charity Island (Table 1). Eleven walleye, mostly spent females, were collected from Oak Point Reef. These low catches of walleye and lack of ripe females are consistent with observations from the past three years. It is now apparent from gillnet sampling that there is not an abundance of walleye attempting to spawn on reefs in Saginaw Bay.

Egg pumping, using equipment described by Stauffer (1981), was again performed in 2000 (Table 2). Eggs were only collected from Duck Reef on one date. For purpose of comparison, egg pumping was performed below Dow Dam on the Tittabawassee River, which is known to host a substantial annual migration of spawning walleye from the bay (Fielder et al. 2000). That

egg collection rate was more than a hundred times greater than the rate measured for Duck Reef the same year, illustrating the difference of magnitude between the two sources of walleye reproduction (Table 2).

Larval walleye were collected using a neuston net (2-m^2 area, 500-micron mesh). Sampling spanned mid-April through mid-May (Table 3). No walleye fry were collected anywhere in the open water of Saginaw Bay in 2000, but fry were collected at the mouth of the Tittabawassee River. Reef sampling included zooplankton collections at the same time as larval fish sampling. Sampling was performed with a student-type plankton net. Densities of total plankters were estimated based on net opening area and depth sampled (Table 4). Plankton densities were low for optimal larval walleye survival according to Li and Mathias (1982) but were within the range reported for successful fry survival in Lake Erie (Roseman 1997).

Reef spawning is no longer a significant source of walleye production in Saginaw Bay. Previous Performance Reports under this Job documented the degraded condition of most inner bay reefs in Saginaw Bay. Sampling performed in 2000 was the final field season of this study. From sampling on remaining reefs, it is now apparent that walleye are only minimally using reefs for spawning in Saginaw Bay. Outer bay reefs were not thought to be widely utilized by spawning walleye historically (Schneider 1977; Organ et al. 1979). A Final Report is in development and will fully review findings and implications of this job.

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

Findings: Sampling was again performed in 2000 to collect juvenile walleye for analysis of hatchery contribution. Trawling was performed in seven locations around the bay for a total of more than 40 tows. Electrofishing in similar locations, later in summer, was also performed for a total of 14 hours of generator time (Figure 1). Together, the two sampling efforts and their corresponding catch-per-unit-effort (CPUE) suggested the 2000 year class was weak relative to some previous years. Collections of juveniles for OTC mark examination was supplemented with specimens collected by the annual Saginaw Bay Fish Population Survey (Michigan Federal Aid Study 466).

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

Findings: All walleye fingerlings stocked in Saginaw Bay were again immersion marked with OTC. Marking occurred at the fry stage according to the methods of Fielder (in press). Using recruits collected under Job 2, analysis was performed with fluorescence microscopy. Fielder (in press) documented OTC detection methodology used in Michigan as originally developed under this study.

Hatchery fish continued to make substantial contributions to local recruitment in Saginaw Bay. Although the 1999 year class was weak, it was comprised of 85% hatchery fish as determined by OTC marking (Figure 2). This is very similar to contribution to local recruitment measured from other year classes. Percentage of hatchery fish in the 1998 year class held steady in 1999 as age-1 fish at 83% (Figure 3). Contribution of hatchery fish in the 1997 year class measured close to its original age-0 proportions (81%) in 1999 with 73% hatchery fish (Figure 4). Table 5 summarizes collective contributions of all marked year classes to date. Juvenile walleye collected in 2000 have not yet been analyzed.

The annual contribution of hatchery fish has been remarkably consistent. Hatchery fish contributed 79% to the composition of all year classes combined (Table 5). It is not fully clear

why the 1997 age-1 measurement of contribution deviated from values determined in 1997 (age-0) and 1999 (age-2), but this may be due to uneven distribution of hatchery and wild fish over time. The Final Report is in development and will compare contribution of hatchery fish to local recruitment based on OTC marking and the alternate-year stocking strategy.

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

Findings: 1999 Field data have been analyzed. Analysis of 2000 data continues. The annual report was prepared and a Final Report is in development.

Literature Cited:

Fielder, D. G. In Press. Methodology for immersion marking walleye fry and fingerlings in oxytetracycline hydrochloride and its detection with fluorescence microscopy. Michigan Department of Natural Resources, Fisheries Technical Report, Ann Arbor.

Fielder, D. G., J. E. Johnson, J. R. Weber, M. V. Thomas, and R. C. Haas. 2000. Fish Population Survey of Saginaw Bay, Lake Huron, 1989-97. Michigan Department of Natural Resources, Fisheries Research Report 2052, Ann Arbor.

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

Organ, W. L., G. L. Towns, M. O. Walter, R. B. Pelletier, and D. A. Riege. 1979. Past and presently known spawning grounds of fishes in the Michigan coastal waters of the Great Lakes. Michigan Department of Natural Resources, Fisheries Technical Report 79-1, Ann Arbor.

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 No. 2043, Ann Arbor.

Schneider, J. C. 1977. History of the walleye fisheries of Saginaw Bay, Lake Huron. Michigan Department of Natural Resources, Fisheries Research Report 1850, 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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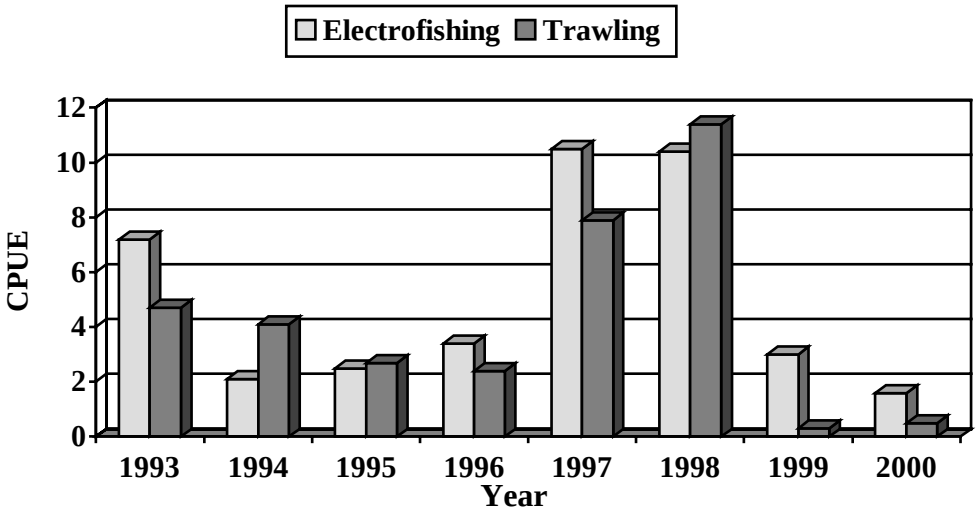
Date: September 30, 2000



Electrofish hrs.	**12.1**	**12.7**	**20.5**	**22.0**	**21.1**	**15.2**	**13.0**	**14.0**
Trawl tows	**78.3**	**58.5**	**69.8**	**59.5**	**75.6**	**65.5**	**30.8**	**40.8**

Figure 1.–Trends in average walleye age-0 catch-per-unit-effort (CPUE) in Saginaw Bay, 1993-2000. Sample effort is hours of shocking time and number of 10-minute trawl tows. Amount of annual effort appears below each year.

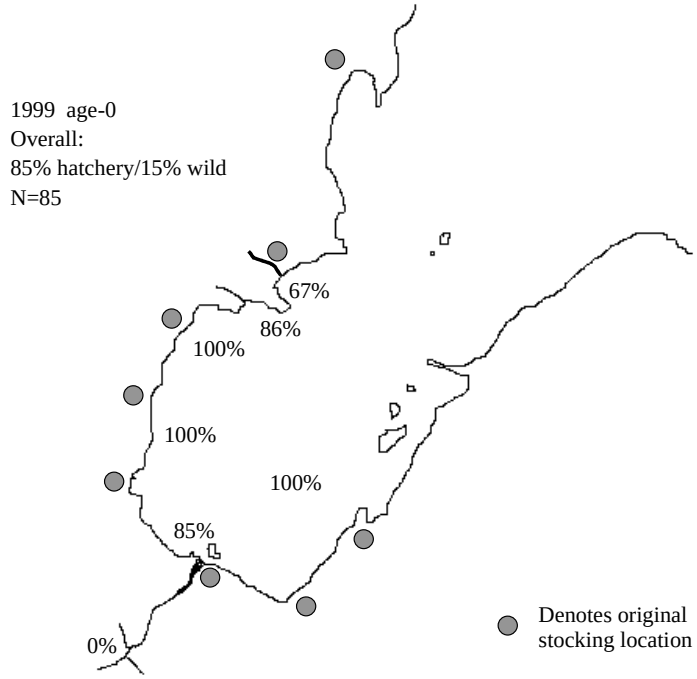


Figure 2.–Percent hatchery contribution to the 1999 walleye year class as based on age-0 specimens collected in summer and fall, 1999.

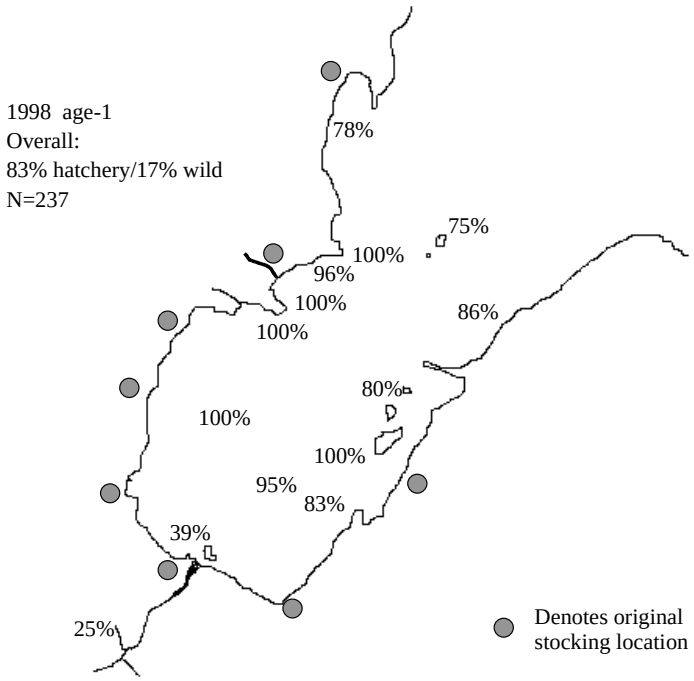


Figure 3.–Percent hatchery contribution of the 1998 walleye year class based on age-1 specimens collected in summer and fall 1999. Previous ratio measured as age-0 was 81% hatchery: 19% wild.

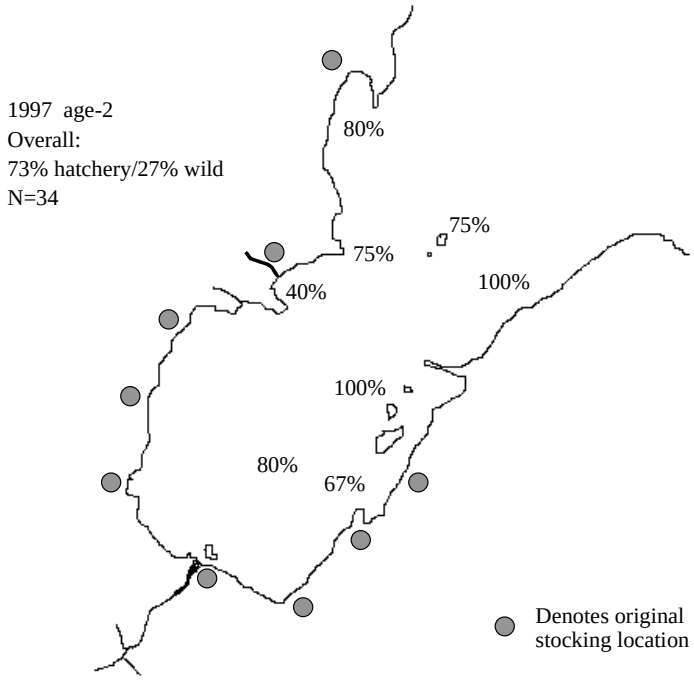


Figure 4.–Percent hatchery contribution of the 1997 walleye year class based on age-2 specimens collected in summer and fall 1999. Previous ratio measured as age-1; 50% hatchery : 50% wild, as age-0; 81% hatchery: 19% wild.

Table 1.–Gillnet collection of walleye from Duck and North island reefs, Saginaw Bay, April 1998 through April 2000.

	Duck Reef		North Island Reef	
	CPUE	Sex/maturity	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[a]				
April 7	3	2 gravid females 1 female spent	1	1 immature female
April 13	1	1 spent female	2	2 spent females
2000[b]				
April 10	0	---	0	---

[a]Other locations sampled in 1999 (average CPUE; two net sets each date/location): April 13, Oak Pt. Bar; no walleye caught. April 20, Gravelly Shoal; one immature male caught. April 26, Charity Island; six walleye caught, four spent female, two mature males.

[b]Other locations sampled in 2000: April 18, Charity Island; no walleye caught. April 18, Oak Point; eight spent females, one immature female, and two ripe males.

Table 2.–Mean egg collection per unit effort and temperature (°C) from Saginaw Bay reefs, 1997 through 2000. Each unit of effort is one 10-minute tow with an 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
2000			
4/3	Duck	9.3	8.67
	North Island	9.5	0.00
4/4	Tittabawassee River		886.00
4/18	Charity Island	5.5	0.00
	Oak Point	6.9	0.00

Table 3.–Larval fish densities from various locations in Saginaw Bay, 2000. All densities are number per m^3.

	Walleye	Yellow perch	Whitefish	White sucker	Rainbow smelt	Unidentified	Cyprinidae sp.	Northern pike	Brook silverside	Gizzard shad	Emerald shiner	Burbot
Duck Reef												
5/3/00			0.0105									.0006
5/16/00		0.160				0.0406	0.1128			0.2200	0.1078	
North Island Reef												
5/3/00		0.0221		0.0139		0.0096						
5/16/00		0.2447		0.0139		0.0984	0.1186			0.0310	0.1522	.0011
Charity Island												
4/18/00			0.0004									.0044
Oak Point												
4/18/00			0.0017									
Tittabawassee River												
4/17/00	0.0537	0.0145				0.0044						
4/25/00		0.0028										

Table 4.–Zooplankton density (taxonomic groups combined) from Duck and North island reefs, Saginaw Bay, 1999 and 2000.

Date	No./m^3	No./L
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
2000		
Duck Island Reef		
5-3-00	1,313.74	1.31
5-16-00	8,442.19	8.44
North Island Reef		
5-3-00	222.29	0.22
5-16-00	8,299.61	8.29
Charity Island		
4-18-00	4,094.41	4.09
Oak Point		
4-18-00	5,086.62	5.09
Saginaw River		
4-25-00	5,570.99	5.57
Tittabawassee River		
4-17-00	174.25	0.17
4-25-00	6,677.56	6.68

Table 5.–Percent hatchery contribution of fingerling-stocked walleye as determined by oxytetracycline marking over three year classes in Saginaw Bay.

Year class	Age-0	Age-1	Age-2	Composite for year class
1997	81%	50%	73%	74%
1998	81%	83%		82%
1999	85%			85%
Composite for all groups				79%