STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-1

Study No.: 436

Title: Vital Statistics of walleye in Saginaw Bay

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

Study Objective: To determine exploitation, abundance, growth, mortality, movement, and recruitment for the walleye population in Saginaw Bay.

Summary: A total of 3,299 walleye was tagged in 2000 in the Tittabawassee River. These included 300 reward tags. Returns of reward tags will be used to calculate a correction factor in the coming year for non-reporting. The sex composition of walleye collected for tagging in 2000 was skewed towards males. The age and size structures of male walleye in the spawning migration have plateaued, although mean age of females has continued to increase. Growth rate of walleye in the spawning migration continues to be very fast, indicating the bay's population is still below carrying capacity. A total of 395 tags was reported by anglers in 1999, representing 14 year classes. The tag recovery software, ESTIMATE, was again used to analyze tag returns. The tag recovery rate was 4.20% for 1999, yielding a corresponding corrected exploitation rate of 11.5%. Total annual survival for 1998 (the most recent year estimated) was 71.1%. Age structure of the bay's open-water fishery reflected three weak year classes: 1992, 1993, and 1996.

Job 1. Title: <u>Tag walleye.</u>

Findings: In 2000, a total of 3,299 serially-numbered monel tags was applied to the jaws of walleye below Dow Dam on the Tittabawassee River, a tributary to Saginaw Bay (Table 1). Walleye were collected with 230-volt DC electrofishing gear. We used a single boat and one or two tagging crews. Over 1,000 walleye were typically tagged per day. Tagging spanned about four days of work in late March. The collection effort also doubled as a spawn collection opportunity for the Michigan Department of Natural Resources Hatchery system. Fingerlings and fry reared from spawn collected annually from Tittabawassee River walleye are used for stocking in the Lake Huron watershed. The 2000 tagging effort brought the study total to 68,097 walleye tagged since 1981.

Biological data were collected from all walleye handled as part of the tagging program. Fish were measured for total length to the nearest mm. Tagging was limited to fish meeting or exceeding the 381-mm minimum length limit in the fishery. Fish were externally sexed: mature males were ripe and easily identified; fish identified as females could have included some immature individuals of both sexes. Scales were taken from all walleye tagged. A subsample of these scales from the height of the run was aged. A single day of scale collection was selected for aging when the sex ratio most closely approximated 1:1.

Job 2. Title: <u>Determine tag correction factor.</u>

Findings: The tagging effort in 2000 included 300 monel tags (included in the 3,299 tagged total) that indicated a $100 reward for their return. The return rate of these tags with the added monetary incentive, will be compared to normal tags with no reward. The difference will constitute a correction factor for non-reporting by anglers. The correction factor will then be applied to future tag recovery rate estimates. The correction factor can not be calculated until after all tag reporting is complete for the 2000 tagging year (March 2000 through March 2001; this factor will be calculated and reported in 2001).

All anglers returning or reporting a tag were sent a letter of explanation and appreciation. This practice has been in place since the inception of the study. Anglers producing a reward tag will have a check included with their letter. A similar study is underway in Lake Erie and the Great Lakes Fishery Commission is coordinating dispensing of Michigan Department of Natural Resources reward funds for both projects.

Job 3. Title: <u>Analyze data and prepare performance and final reports.</u>

Findings: The sex composition of walleye collected from the spawning migration in the Tittabawassee River was strongly skewed towards male fish in 2000 (Table 2). Mean total length of fish from the spawning migration has not changed appreciably in recent years (Table 2). The spawning migration of walleye in the Tittabawassee River has been maturing since its resurgence in the early 1980s and these mean lengths reflected that trend.

The age structure of walleye from the migration also reflected the maturing of the population. Mean age increased in 2000 for female fish but plateaued for males (Table 3). The 1992, 1993, and 1996 year classes continued to make a weaker showing in the age structure in 2000 relative to those ages in previous years. The strong 1997 and 1998 year classes detected in the open water population under Michigan Federal Aid Study 466 have not yet recruited to the spawning migration in the Tittabawassee River (Table 3; Table 4).

The growth rate of walleye in the spawning migration, as determined by mean length at age, was very fast compared to the state average reported by Schneider et al. (2000) (Table 4). The fast growth rate of Saginaw Bay walleye, which has long been documented under Michigan Federal Aid Study 466, indicates the population is well below carrying capacity of the bay's habitat and forage base (Fielder et al. 2000). Walleye growth rate has been a primary means of evaluating the status of recovery of the Saginaw Bay walleye population (Fielder et al. 2000).

In 1999, a total of 395 tags, spanning 14 year classes, was reported by anglers (Table 5). Using the tag-recovery program, ESTIMATE–Model 1 (for year-specific survival, fishing, and reporting rates) (Brownie et al. 1985), the following values were estimated.

1999 recovery rate (percent)	4.20
95% confidence interval	3.48-4.92
1998 survival rate (percent)	71.1
95% confidence interval	53.8-88.4
Mean adult life span after tagging (years)	2.44
95% confidence interval	2.32-2.57

Recovery rates reported here and in Table 5 represent year-specific rates from the ESTIMATE analysis and are the most up-to-date values. These may differ slightly from values previously reported for this study. The mean recovery rate for all years since 1984 was 3.36% (Table 5). Similarly, survival estimates used to determine total annual mortality rate (Table 6) are year specific and improve with reporting over time. Exploitation rate was estimated by expanding the year-specific recovery rate by a correction factor (for nonreporting) of 2.73, determined for Lake

Erie (R. Haas, Michigan Department of Natural Resources, personal communication). This correction factor is dated and not specific to Saginaw Bay. Beginning in 2001, tag return rates for Saginaw Bay will be expanded by the correction factor being determined under Job 2 of this study.

Exploitation of walleye in Saginaw Bay increased to its highest rate in six years in 1999 (Table 6). The increase, however, came in a year when open water walleye harvest and catch rate declined (G. Rakoczy, Michigan Department of Natural Resources, personal communication). Total annual mortality derived from the ESTIMATE survival estimates declined slightly in 1998, the most recent value calculable with ESTIMATE (Table 6). Age structure of the walleye harvest in Saginaw Bay was available from biological data collected as part of Michigan's Great Lakes Creel Survey program (Michigan Federal Aid Study 427; G. Rakoczy, Michigan Department of Natural Resources, unpublished data; Table 6). The weak 1992, 1993, and 1996 year classes were fully recruited to the fishery. The strong 1997 year class recruited to the fishery in 1999 but the even stronger 1998 year class did not.

More background and the history of this study can be found in Keller et al. (1987) and Mrozinski et al. (1991) who summarized results through 1988. Fielder et al. (2000) summarized results from 1989 through 1997 and related the findings to other work on Saginaw Bay including movement based on tag returns.

Analysis of the 2000 fishing season tag returns will take place early in 2001 and will include the calculation of the correction factor.

Literature Cited:

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Date: September 30, 2000

Table 1.–Number of walleye tagged in the Saginaw Bay system, by site, 1981-2000.

	Year																				
Site	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[d]	**Total**
Tittabawassee River																					
Dow Dam	400	722	3,436	3,548	3,335	2,923	6,020	4,036	2,494	2,488	3,079	2,995	2,989	2,999	2,970	2,992	2,993	2,490	2,999	3,299	56,208
Sanford Dam	–	–	–	–	531	608	–	–	497	–	–	–	–	–	–	–	–	–	–	–	1,636
Other rivers																					
Kawkawlin River	–	–	126	112	–	–	56	–	74	–	–	–	–	–	–	–	–	–	–	–	368
AuGres River	–	–	–	–	174	59	215	–	–	–	–	–	–	–	–	–	–	–	–	–	448
Saginaw River	–	–	–	–	–	–	–	115[a]	–	418	–	–	–	–	–	–	–	–	–	–	533
Flint River[b]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2,994	2,997	2,993	5,991
Saginaw Bay																					
Consumers Power	–	–	10	–	–	0	–	–	207	–	–	–	–	–	–	–	–	–	–	–	217
Pt. AuGres	–	–	–	343	60	511	–	–	–	–	–	–	–	–	–	–	–	–	–	–	914
Catfish Hole[c]	–	–	–	–	–	529	–	–	–	–	–	–	–	–	–	–	–	–	–	–	529
Pinconning	–	–	–	56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56
Sand Point	–	–	–	89	–	–	1,108	–	–	–	–	–	–	–	–	–	–	–	–	–	1,197
Total	400	722	3,572	4,148	4,100	4,630	7,399	4,151	3,272	2,906	3,079	2,995	2,989	2,999	2,970	2,992	2,993	5,987	5,996	6,292	68,097

[a]Tagged on May 7, 1988, in Saginaw River at Wickes Park during a walleye tournament.
[b]Returns analyzed and reported separately and not included in estimate model analysis.
[c]A 19-foot deep depression about seven miles southwest of Pt. AuGres in Grid 1507 (includes 98 tagged).
[d]Includes 300 reward-tagged fish.

Table 2.–Average total length (mm) of walleye collected by electrofishing below Dow Dam, Tittabawassee River, March-April 1981-2000.

	Female		Male		Total	
Year	Length	Number	Length	Number	Length	Number
1981	528	87	350	272	394	399
1982	516	179	452	513	467	697
1983	549	2,082	498	1,300	528	3,413
1984	584	1,052	472	2,421	505	3,540
1985	531	1,322	457	1,662	490	2,984
1986	536	1,370	465	2,023	493	3,574
1987	546	1,736	472	3,829	485	5,976
1988	582	549	477	3,338	490	4,033
1989	561	1,774	485	1,244	528	3,064
1990	582	972	493	1,481	528	2,467
1991	584	2,232	488	843	559	3,079
1992	610	1,491	483	1,497	556	2,995
1993	582	1,323	488	1,666	531	2,989
1994	599	1,452	531	1,534	564	2,999
1995	589	962	538	2,003	556	2,970
1996	627	1,376	556	1,614	589	2,992
1997	630	1,905	554	1,088	604	2,993
1998	589	1,170	544	1,311	564	2,489
1999	620	957	549	2,031	569	2,995
2000	630	531	540	2,756	555	3,299

Table 3.–Age composition (percent) of walleye sampled from Saginaw Bay tributaries during spring electrofishing, 1988-2000.

	Age														Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	age
1988															
Female	–	–	4.0	18.5	32.8	25.7	10.5	5.7	3.0	–	–	–	–	–	5.5
Male	–	0.5	29.5	22.8	25.5	14.5	3.8	2.3	1.1	–	–	–	–	–	4.5
1989															
Female	–	–	1.5	41.4	27.3	23.1	5.7	1.1	–	–	–	–	–	–	4.9
Male	–	0.8	5.8	58.5	20.4	8.2	4.4	1.2	0.6	–	–	–	–	–	4.5
1990															
Female	–	0.1	0.1	1.2	37.1	34.7	22.9	3.6	0.4	–	–	–	–	–	5.9
Male	–	3.1	5.0	14.0	49.2	21.1	7.1	0.5	0.1	–	–	–	–	–	5.0
1991															
Female	–	–	0.1	18.8	19.2	45.7	11.5	2.6	1.5	0.6	–	–	–	–	5.7
Male	–	0.1	43.8	9.6	19.6	20.5	3.6	2.6	0.2	–	–	–	–	–	4.4
1992															
Female	–	0.1	0.0	9.4	14.5	12.1	17.9	13.7	10.2	12.9	4.6	3.0	1.7	0.2	7.5
Male	–	0.6	19.5	30.8	17.4	17.6	11.4	1.0	1.0	0.3	0.4	–	–	–	4.8
1993															
Female	–	–	1.6	13.7	31.8	11.7	18.6	14.6	6.5	1.2	0.3	–	–	–	6.1
Male	–	–	33.3	25.6	14.2	12.6	9.0	2.9	1.1	1.3	–	–	–	–	4.6
1994															
Female	–	–	1.3	17.3	32.7	16.0	7.7	12.2	7.7	1.9	1.3	0.6	–	–	6.0
Male	–	–	4.9	18.9	12.8	10.4	13.4	17.1	12.8	4.9	1.2	–	–	–	6.5
1995															
Female	–	–	–	9.4	53.1	13.4	9.1	7.1	3.9	2.4	1.2	0.4	–	–	5.8
Male	–	–	1.3	9.0	20.5	21.0	12.7	14.0	12.5	7.6	0.7	0.4	0.2	–	6.7
1996															
Female	–	–	–	0.2	9.1	18.4	22.6	13.1	12.6	15.9	6.9	1.3	–	–	7.8
Male	–	–	0.6	0.8	6.3	16.1	18.9	21.9	18.4	13.0	3.1	0.9	–	–	7.8
1997															
Female	–	–	0.4	4.1	1.3	11.8	26.8	22.9	12.4	8.4	7.1	4.9	–	–	7.9
Male	–	–	–	1.5	0.3	15.2	23.6	27.3	16.1	9.2	4.0	2.0	–	0.6	7.9
1998															
Female	–	–	1.7	22.8	11.0	6.6	11.3	19.6	12.8	7.3	4.0	2.7	0.3	–	7.0
Male	–	–	6.8	9.3	3.4	4.8	16.4	22.7	17.7	10.3	6.2	1.5	0.9	–	7.6
1999															
Female	–	–	0.4	8.0	13.3	4.9	4.5	11.4	21.2	18.6	9.8	6.8	0.4	0.4	8.3
Male	–	0.6	1.7	13.2	8.5	5.2	7.4	23.5	19.8	12.4	4.5	1.2	0.8	–	7.6
2000															
Female	–	–	–	0.6	11.2	14.9	10.6	4.3	13.0	20.5	13.7	8.1	2.5	–	8.7
Male	–	4.4	11.7	2.2	9.0	11.4	5.8	8.2	21.8	14.1	8.3	2.5	0.6	–	7.4

Table 4.–Mean total length (mm) at age of walleye from tagging operation, Tittabawassee River, spring 1997-2000.

Year		Male		Female			Male		Female	
class	Age	Length	Number	Length	Number	Age	Length	Number	Length	Number
		1997					1998			
1995	2	–	0	–	0	3	432	44	495	10
1994	3	–	0	521	2	4	478	60	523	137
1993	4	508	5	528	19	5	505	22	559	66
1992	5	513	1	556	6	6	526	31	584	40
1991	6	521	53	584	55	7	544	106	612	68
1990	7	536	82	615	125	8	561	147	635	118
1989	8	554	95	632	107	9	584	115	655	77
1988	9	577	56	668	58	10	594	67	671	44
1987	10	594	32	681	39	11	610	40	701	24
1986	11	597	14	688	33	12	610	10	686	16
1985	12	630	7	714	23	13	632	6	–	0
1984	13	–	0	–	0	14	–	0	–	0
1983	14	681	1	–	0	15	–	0	–	0
1982	15	–	0	–	0	16	–	0	–	0
1981	16	546	1	–	0	17	–	0	–	0
Total			347		467			648		600
		1999					2000			
1998	1	–	0	–	0	2	390	32	–	–
1997	2	394	3	–	0	3	446	84	–	–
1996	3	430	9	500	1	4	477	16	533	1
1995	4	481	68	525	21	5	510	65	553	18
1994	5	515	44	559	35	6	529	82	580	24
1993	6	530	27	585	13	7	540	42	600	17
1992	7	543	38	643	12	8	552	59	633	7
1991	8	562	121	643	30	9	569	157	632	21
1990	9	582	102	663	56	10	589	102	672	33
1989	10	597	64	678	49	11	599	60	677	22
1988	11	604	23	699	26	12	614	18	702	13
1987	12	608	6	708	18	13	608	4	705	4
1986	13	610	4	–	0	14	–	–	–	–
1985	14	–	0	–	0	15	–	–	730	1
1984	15	–	0	–	0	16	–	–	–	–
1983	16	–	0	–	0	17	–	–	–	–
Total			509		261			721		161

Table 5.–Tag return matrix for walleye tagged at Dow Dam, Tittabawassee River, during spring, 1984-99.

Tag year	Number tagged	Recovery Year 1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total returns	Estimated recovery rate
1984	3,548	69	88	66	56	32	21	9	7	5	5	1	1	1	1	0	0	363	1.94
1985	3,335		112	97	62	34	12	5	4	7	3	0	1	0	0	0	0	337	3.21
1986	2,923			118	89	36	18	16	10	9	7	1	2	0	2	0	1	309	4.02
1987	6,020				308	117	64	23	19	23	12	6	5	0	2	4	2	585	4.80
1988	4,036					161	85	32	26	20	15	11	7	1	4	0	4	366	3.86
1989	2,494						68	44	34	49	18	8	5	3	4	1	4	238	3.40
1990	2,488							59	52	51	33	9	6	4	5	1	1	221	2.37
1991	3,079								71	109	49	16	9	11	12	4	6	287	2.58
1992	2,995									165	83	30	21	14	10	12	11	347	5.47
1993	2,989										150	52	31	24	18	13	15	302	4.79
1994	2,999											76	52	45	37	18	16	241	2.58
1995	2,970												53	51	47	31	31	216	2.08
1996	2,992													72	76	53	50	251	2.62
1997	2,993														87	83	58	228	3.21
1998	2,490															92	70	162	3.49
1999	2,998																126	126	4.20
Mean	**3,209**																		**3.36**
Total	**51,349**	69	200	281	515	380	268	188	223	438	375	210	162	226	306	311	395	**4,579**	

Table 6.–Walleye year class percent composition in Saginaw Bay sport fishery, harvest (2 SE of the mean), adjusted annual exploitation rate, and total annual mortality rate, 1989 through 1999.

	Creel Survey Year											
Year class	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Mean
1981	–	–	0.8	1.3	0.6	0.2	–	–	–	–	–	
1982	5.1	–	2.4	3.1	2.1	–	0.7	0.2	–	–	–	
1983	5.1	–	6.5	4.5	4.1	1.8	1.4	2.2	0.6	–	–	
1984	13.6	–	8.4	4.9	4.8	4.4	4.2	2.7	2.4	0.2	–	
1985	28.8	–	14.5	10.7	12.7	8.4	8.7	7.7	3.6	1.2	–	
1986	45.7	–	16.1	18.3	10.6	11.6	9.7	10.2	6.7	2.5	–	
1987	1.7	–	12.0	11.6	7.6	9.2	8.3	6.2	6.1	3.5	0.5	
1988	–	–	20.2	16.5	14.1	13.8	11.1	7.0	6.7	3.7	0.5	
1989	–	–	19.1	24.6	23.0	17.6	16.3	11.7	5.2	9.6	5.8	
1990	–	–	–	4.5	15.5	14.8	12.7	9.2	9.7	11.3	9.7	
1991	–	–	–	–	4.9	17.8	20.3	19.0	18.2	12.5	12.3	
1992	–	–	–	–	–	0.4	6.4	6.7	11.5	8.0	8.9	
1993	–	–	–	–	–	–	0.2	1.2	1.2	3.3	5.8	
1994	–	–	–	–	–	–	–	15.7	25.2	28.1	24.9	
1995	–	–	–	–	–	–	–	–	3.0	15.4	15.0	
1996	–	–	–	–	–	–	–	–	–	0.6	4.7	
1997	–	–	–	–	–	–	–	–	–	–	11.8	
1998	–	–	–	–	–	–	–	–	–	–	–	
1999	–	–	–	–	–	–	–	–	–	–	–	
No. aged	59	–	491	224	631	500	424	401	330	512	990	
Harvest[a]	56,337	–	61,028	64,447	125,160	68,170	47,887	47,566	78,128	80,366	42,276	61,040
	(10,580)	–	(10,817)	(8,702)	(18,357)	(11,907)	(9,208)	(9,990)	(15,109)	(11,614)	(16,918)	
Exploitation	9.3	7.2	7.0	14.9	13.1	7.0	5.7	7.2	8.8	9.5	11.5	9.2
Total mortality[b]	31.1	30.3	42.0	39.8	34.6	22.9	39.5	24.6	32.7	28.8	–	32.6

[a]From previous MDNR creel survey reports.
[b]Annual rate for last year cannot yet be calculated.