STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-4

Study No.: 436 **Title:** Vital Statistics of walleyes in Saginaw Bay

Period Covered: October 1, 2002 to September 30, 2003

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

Summary: A total of 3,000 walleyes *Sander vitreus* (formerly known as *Stizostedion vitreum*) were tagged in 2003 in the Tittabawassee River. The composition of walleyes collected for tagging in 2003 was again skewed towards males. A total of 349 tags were reported by anglers in 2002, representing 12 year classes. The tag recovery software, ESTIMATE was again used to analyze tag returns. The tag recovery rate was 5.01 percent for 2002, yielding a corresponding corrected exploitation rate of 11.7%. This estimate of exploitation rate represents a statistically significant increase from 2001 yet total harvest remained unchanged. The 2002 walleye fishery was again largely dependent on the strong 1997 and 1998 year classes. Female walleyes from the 1998 year class still were not fully recruited to the 2002 spawning run. Consequently, the population of tagged fish at large in 2002 didn't fully represent the fishable population and exploitation was possibly underestimated for that year (2002). Total annual survival for 2001 (the most recent year estimated) was 53.5%. A slightly revised correction factor of non-reporting based on reward tag returns has been derived updating previous values with additional years of tag return data. The new value, which should be more accurate, is 2.33. Age and growth analysis of 2003 samples are pending scale aging.

Findings: Jobs 1, 2, and 3 were scheduled for 2002-03, and progress is reported below.

Job 1. Title: **Tag walleyes.**–In 2003, a total of 3,000 serially-numbered monel tags were applied to the jaws of walleyes below Dow Dam on the Tittabawassee River, a tributary to Saginaw Bay (Table 1). Walleyes were collected with 230-volt DC electrofishing gear. We used a single boat and one or two tagging crews. About 600 walleyes were typically tagged per day. Tagging spanned about five days of work in early April. The collection effort also doubled as a spawn collection opportunity for the Michigan state hatchery system. Fingerlings and fry reared from spawn collected from Tittabawassee River walleyes are used for stocking in the Lake Huron watershed. The 2003 tagging effort brings the study total to 77,087 walleyes tagged since 1981 (Table 1).

Biological data were collected from all walleyes 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 recreational 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 walleyes tagged. A subsample of these scales from the height of the run is being aged. A single day of scale collection was selected for aging when the sex ratio most closely approximated 1:1.

Job 2. Title: **Determine tag correction factor.**–This job is complete (see 2001 Performance Report for details), however, the correction factor can be continually refined based on ongoing returns of

both reward and non-reward tags from the year 2000 (Table 2). This provides a slightly different correction factor compared to those previously reported and should be more accurate. As before, this analysis assumes that both groups have equal vulnerability to the fishery. The updated tag reporting correction factor is 2.33 (Table 2).

Job 3. Title: Analyze data and prepare performance and final reports.–The composition of walleyes collected from the spawning migration in the Tittabawassee River was again skewed towards male fish in 2002, which is considered to be an artifact of sex specific spawning migration patterns and not necessarily representative of the overall sex ratio in the population (Table 3). Mean total length of both sexes of walleyes from the spawning migration has not changed appreciably in recent years (Table 3).

Analysis of age structure and the corresponding growth rate of walleyes in the spawning migration has not yet been performed for 2003. Mean age of walleyes from the 2002 migration declined, for both sexes, as stronger year classes (1997 & 1998) become sexually mature (Table 4). The relatively weak year classes (1992, 1993, and 1996) are no longer discernable in the age structure with the possible exception of the 1993 year class (age-9) for male walleyes in 2002 (Table 4). The strong 1997 year class is fully recruited to the spawning migration, but females of the even stronger 1998 year class appeared only partially recruited in 2002. These trends account for the decrease in mean ages of both sexes. Female walleye mean age will likely also decrease in the 2003 migration. Female maturation usually begins around age 4.

Mean length-at-age exceeds the state average reported by Schneider et al. (2000) (Table 5). The fast growth rate of Saginaw Bay walleyes, 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 prey 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). This analysis will be updated with the 2003 data upon completion of the scale aging.

In 2002 a total of 349 tags, spanning 12 year classes, were reported by anglers (Table 6). 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.

2002 recovery rate (percent)	5.01
95% confidence interval	4.23-5.79
2001 survival rate (percent)	53.19
95% confidence interval	40.58-65.80
Mean adult life span after tagging (years)	2.20
95% confidence interval	2.11-2.30

Recovery rates reported here and in Table 6 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 1986 was 3.41 (Table 6). Similarly, survival estimates used to determine total annual mortality rate (Table 7) 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 non-reporting) of 2.33, determined from Job 2 of this study.

Exploitation of walleyes in Saginaw Bay increased significantly in 2002 compared to 2001 (z-Test; $P<0.05$) (Table 7). Harvest, however, remained largely unchanged from 2001 (D. Clapp,

Michigan Department of Natural Resources, unpublished data). This might imply a smaller exploitable walleye population in 2002, however, the fishery is fully exploiting the strong 1998 year class which was not fully available for tagging in 2002. Consequently, the tagged population at large may not fully have reflected the true fishable population. Conversely, the 1997 year class which was tagged in 2002 may have been more vulnerable or more largely reflected in the harvest in 2002 whereby affecting possible disparities between the fishery and estimated exploitation rates. Beginning in 2003, the two should reconcile as the age structure of the spawning migration again better approximates those fish in the fishery. Total annual mortality, derived from the ESTIMATE survival estimates, increased slightly in 2001, the most recent value calculable with ESTIMATE (Table 7).

Analysis of the 2003 fishing season tag returns will take place in 2004.

Literature Cited:

Brownie, C., D. R. Anderson, K. P. Burnham, and D. S. Robson. 1985. Statistical inference from band recovery data: a handbook. U. S. Fish and Wildlife Service, Resource Publication No. 156, Washington, D.C.

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 - 1997. Michigan Department of Natural Resources, Fisheries Research Report 2052, Ann Arbor.

Schneider, J. C., P. W. Laarman, and H. Gowing. 2000. Age and growth methods and state averages. Chapter 9 *in* J. Schneider, editor. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

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Table 1.–Number of walleyes tagged in the Saginaw Bay system, by site, Saginaw Bay watershed 1985-2003.

Site	Year																			Study total[5]
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[4]	2001	2002	2003	
Tittabawassee River																				
Dow Dam	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	2,997	2,993	3,000	65,198
Sanford Dam	531	608	–	–	497	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,636
Other rivers																				
Kawkawlin River	–	–	56	–	74	–	–	–	–	–	–	–	–	–	–	–	–	–	–	368
Au Gres River	174	59	215	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	448
Saginaw River	–	–	–	115[1]	–	418	–	–	–	–	–	–	–	–	–	–	–	–	–	533
Flint River[2]	–	–	–	–	–	–	–	–	–	–	–	–	–	2,994	2,997	2,993	–	–	–	5,991
Saginaw Bay																				
Consumers Power	–	0	–	–	207	–	–	–	–	–	–	–	–	–	–	–	–	–	–	217
Pt. Au Gres	60	511	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	914
Catfish Hole[3]	–	529	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	529
Pinconning	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56
Sand Point	–	–	1,108	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,197
Total	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	5,484	5,996	6,292	2,997	2,993	3,000	77,087

[1]Tagged on May 7, 1988, in Saginaw River at Wickes Park during a walleye tournament.
[2]Returns analyzed and reported separately and not included in estimate model analysis.
[3]A 19-foot deep depression about seven miles southwest of Pt. Au Gres in Grid 1507 (includes 98 tagged).
[4]Includes 300 reward-tagged fish.
[5] Total number since study inception in 1981.

Table 2.–Correction Factor from non-reporting as determined from comparison of rewarded tag returns vs. unrewarded tag returns as derived from 2000–2002.

Year	Number	Reward	Percent	Non-reward	Percent	Non-reporting Rate (Correction factor)
2000	Tagged	300		2997		
2000	Recovered	20	6.67	99	3.30	2.02
2001	Recovered	9	3.00	29	0.97	3.10
2002	Recovered	12	4.00	48	1.60	2.50
	Running total	41	13.67	176	5.87	2.33

Table 3.–Average total length (mm) of walleyes collected by electrofishing below Dow Dam, Tittabawassee River, March-April 1981-2003.

	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
2001	635	576	518	2,421	540	2,997
2002	594	809	536	2,178	551	2,993
2003	615	967	525	2,028	554	2,994

Table 4.–Age composition (percent) of walleyes sampled from Tittabawassee River (Dow Dam) during spring electrofishing, 1989-2002.

	Age														Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	age
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
2001															
Female	–	–	2.7	7.5	5.8	8.4	13.3	8.0	9.7	15.5	14.6	11.5	2.2	0.9	8.6
Male	–	–	25.4	9.5	3.0	9.1	10.5	11.0	14.2	9.5	5.4	1.9	0.5	–	6.6
2002															
Female	–	–	–	16.5	38.0	15.2	9.5	3.8	4.4	3.8	3.8	2.5	1.9	0.6	6.3
Male	–	–	0.8	31.4	28.9	7.1	7.9	7.5	2.9	7.1	4.2	0.8	1.3	–	6.0

Table 5.–Mean total length (mm) at age of walleyes from tagging operation, Tittabawassee River, spring 1999-2002.

Year class	Age	Male Length	Male Number	Female Length	Female Number	Age	Male Length	Male Number	Female Length	Female Number
		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
		2001					2002			
1999	2	–	–	–	–	3	432	2	–	–
1998	3	447	145	480	6	4	481	75	544	26
1997	4	478	54	538	17	5	502	69	545	60
1996	5	507	17	542	13	6	535	17	547	24
1995	6	530	52	606	19	7	542	19	608	15
1994	7	550	60	610	30	8	555	18	643	6
1993	8	565	63	641	18	9	582	7	663	7
1992	9	582	81	646	22	10	578	17	646	6
1991	10	582	54	688	35	11	596	10	698	6
1990	11	600	31	702	33	12	636	2	687	4
1989	12	613	11	705	26	13	610	3	732	3
1988	13	616	3	741	5	14	–	–	696	1
1987	14	–	–	754	2	15	–	–	–	–
1986	15	–	–	–	–	16	–	–	–	–
1985	16	–	–	–	–	17	–	–	–	–
Total			571		226			239		158

Table 6.–Tag return matrix for walleyes tagged at Dow Dam, Tittabawassee River, during spring, 1986-2002.

Tag year	Recovery Year																	Total returns	Estimated recovery rate
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002		
1986	118	89	36	18	16	10	9	7	1	2	0	2	0	1	0	0	0	309	4.04
1987		309	116	64	23	19	23	12	6	5	0	2	4	3	1	1	2	590	4.99
1988			161	85	32	26	20	15	11	7	1	4	0	4	1	2	0	369	3.80
1989				68	44	34	49	18	8	5	3	4	1	4	1	1	0	240	3.33
1990					59	52	51	33	9	6	4	5	1	1	3	0	0	224	2.34
1991						71	109	49	16	9	11	11	4	7	2	1	3	293	2.56
1992							165	83	30	21	14	11	12	11	6	2	1	356	5.44
1993								150	52	31	24	17	13	15	9	5	3	319	4.75
1994									76	52	44	36	18	16	12	2	0	256	2.50
1995										55	50	45	30	32	9	3	2	226	2.01
1996											73	74	54	47	20	9	8	285	2.60
1997												84	82	58	19	11	9	263	3.01
1998													95	69	24	19	13	220	3.53
1999														127	38	28	25	218	4.16
2000															86	45	48	179	2.65
2001																80	85	165	2.82
2002																	150	150	5.01
Mean																			3.41
Total	118	398	313	235	174	212	426	367	209	193	224	295	314	395	231	209	349	4,662	

Table 7.–Walleye year class percent composition in the Saginaw Bay sport fishery, April – October harvest (2 SE of the mean), adjusted annual exploitation rate, and total annual mortality rate, 1990 through 2002.

	Harvest year													
Year class	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 [3]	Mean
1981	–	0.8	1.3	0.6	0.2	–	–	–	–	–	–	–		
1982	–	2.4	3.1	2.1	–	0.7	0.2	–	–	–	–	–		
1983	–	6.5	4.5	4.1	1.8	1.4	2.2	0.6	–	–	–	–		
1984	–	8.4	4.9	4.8	4.4	4.2	2.7	2.4	0.2	–	–	–		
1985	–	14.5	10.7	12.7	8.4	8.7	7.7	3.6	1.2	–	–	–		
1986	–	16.1	18.3	10.6	11.6	9.7	10.2	6.7	2.5	–	0.9	–		
1987	–	12.0	11.6	7.6	9.2	8.3	6.2	6.1	3.5	0.5	0.5	0.3		
1988	–	20.2	16.5	14.1	13.8	11.1	7.0	6.7	3.7	0.5	1.1	0.8		
1989	–	19.1	24.6	23.0	17.6	16.3	11.7	5.2	9.6	5.8	3.4	2.0		
1990	–	–	4.5	15.5	14.8	12.7	9.2	9.7	11.3	9.7	3.9	2.9		
1991	–	–	–	4.9	17.8	20.3	19.0	18.2	12.5	12.3	4.6	7.1		
1992	–	–	–	–	0.4	6.4	6.7	11.5	8.0	8.9	8.7	6.6		
1993	–	–	–	–	–	0.2	1.2	1.2	3.3	5.8	6.2	5.6		
1994	–	–	–	–	–	–	15.7	25.2	28.1	24.9	13.5	7.8		
1995	–	–	–	–	–	–	–	3.0	15.4	15.0	11.6	7.6		
1996	–	–	–	–	–	–	–	–	0.6	4.7	3.2	3.0		
1997	–	–	–	–	–	–	–	–	–	11.8	16.4	12.8		
1998	–	–	–	–	–	–	–	–	–	–	26.0	40.8		
1999	–	–	–	–	–	–	–	–	–	–	–	2.7		
2000	–	–	–	–	–	–	–	–	–	–	–	–		
2001	–	–	–	–	–	–	–	–	–	–	–	–		
No. aged	–	491	224	631	500	424	401	330	512	990	438	593		
Harvest[1]	–	61,028	64,447	125,160	68,170	47,887	47,566	78,128	80,801	43,747	58,018	44,178	45,244	63,698
	–	(10,817)	(8,702)	(18,357)	(11,907)	(9,208)	(9,990)	(15,109)	(11,614)	(16,893)	(28,002)	(17,832)	(21,452)	
Exploitation	7.2	7.0	14.9	13.1	7.0	5.7	7.2	8.8	9.5	11.5	8.5	4.9	11.7	9.0
Total mortality[2]	30.3	42.0	39.8	34.6	22.9	39.5	24.6	32.7	28.8	52.5	44.8	46.8	---	36.6

[1] From previous MDNR creel survey reports.
[2] Annual rate for last year cannot yet be calculated.
[3] 2002 age data not yet available.