

## STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-5

Study No.: 230436

Title: Vital Statistics of walleyes in Saginaw Bay

Period Covered: October 1, 2003 to September 30, 2004

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

**Summary:** A total of 2,997 walleyes (*Sander vitreus*) were tagged in 2004 in the Tittabawassee River. The composition of walleyes collected for tagging in 2004 was again skewed towards males. A total of 272 tags were reported by anglers in 2003, representing 11 year classes. The tag recovery software, ESTIMATE was again used to analyze tag returns. The tag recovery rate was 3.00% for 2003, yielding a corresponding corrected exploitation rate of 7.8%. This estimate of exploitation rate represents a statistically significant decrease from 2002 yet total harvest increased. Female walleyes from the large 1998 year class were fully recruited to the 2003 spawning run. This may be one factor contributing to the record level of walleye reproduction that year as measured in Federal Aid Study 466. Total annual survival for 2002 (the most recent year estimated) was 78.2%. The walleye population in Saginaw Bay continues to be only lightly exploited and overall survival is high. This suggests that progress in walleye recovery is probably not being limited by the fishery and further harvest restrictions are not presently necessary. Age and growth analysis of 2004 samples are pending scale aging.

**Findings:** Jobs 1, 2, and 3 were scheduled for 2003-04, and progress is reported below.

**Job 1. Title: Tag walleyes.**—In 2004, a total of 2,997 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 two tagging crews. About 700 walleyes were typically tagged per day. Tagging spanned about five days of work in late March. 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 including Saginaw Bay itself. The 2004 tagging effort brings the study total to 80,084 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), The most up-to-date correction factor is 2.33. This number is used as a multiplier for the exploitation rate estimated by the ESTIMATE output (either the year-specific value or the composite value), and corrects for nonreporting by some anglers.

**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 2004. Sex ratios in the spawning run are considered to be an artifact of sex-specific spawning migration patterns and not necessarily representative of the overall sex ratio in the population (Table 2). Mean total length of both sexes of walleyes from the spawning migration has not changed appreciably in recent years (Table 2).

Analysis of age structure and the corresponding growth rate of walleyes in the spawning migration has not yet been performed for 2004. The age structure of walleyes from the 2003 migration indicates no change for males while mean age for females increased (Table 3). Previously weak year classes such as the years 1992, 1993, and 1996 no longer are prominent in the age structure (Table 3). The strong 1998 year class appears fully recruited to the spawning migration. These mature females from a large year class may be one factor contributing to the record level of walleye natural reproduction in 2003, as detected by Michigan Federal Aid Study 466.

Mean length-at-age exceeds the state average reported by Schneider et al. (2000) (Table 4). 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 become one criterion to gauge walleye recovery progress in the newly adopted Saginaw Bay walleye recovery plan (Fielder and Baker 2004). Growth analysis for the 2004 data awaits completion of scale aging.

In 2003, a total of 272 tags, spanning 11 year-classes, were 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), for tag returns since 1990, the following values were estimated.

2003 recovery rate (percent)	3.00
95% confidence interval	2.39 – 3.61
2002 survival rate (percent)	78.19
95% confidence interval	57.16 – 99.21
Mean adult life span after tagging (years)	2.38
95% confidence interval	2.23 – 2.56

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 1990 was 3.35 (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 non-reporting) of 2.33, determined from Job 2 of this study.

Exploitation of walleyes in Saginaw Bay decreased significantly in 2003 compared to 2002 (z-Test;  $P < 0.05$ ) (Table 6). Harvest, however, increased from 2002. (S. Thayer, Michigan Department of Natural Resources, unpublished data). This implies there was a larger exploitable walleye population in 2003. The walleye of Saginaw Bay continue to be only lightly exploited and overall survival is high. This suggests that progress in walleye recovery is probably not being

limited by the fishery and further harvest restrictions are not presently necessary. Total annual mortality, derived from the ESTIMATE survival estimates, decreased in 2002, the most recent value calculable with ESTIMATE (Table 6).

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 and reporting of the 2004 fishing season tag returns will take place in 2005.

**Literature Cited:**

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**Prepared by:** David Fielder, Robert Haas, and Kathrin Schrouder

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Table 1.—Number of walleyes tagged in the Saginaw Bay system, by site, Saginaw Bay watershed 1986-2004.

Site	Year																			Study total <sup>c</sup>
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 <sup>d</sup>	2001	2002	2003	2004	
Tittabawassee River																				
Dow Dam	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	2,997	68,195
Sanford Dam	608	—	—	497	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,636
Other rivers																				
Kawkawlin River	—	56	—	74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	368
Au Gres River	59	215	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	448
Saginaw River	—	—	115 <sup>a</sup>	—	418	—	—	—	—	—	—	—	—	—	—	—	—	—	—	533
Flint River <sup>b</sup>	—	—	—	—	—	—	—	—	—	—	—	—	2,994	2,997	2,993	—	—	—	—	5,991
Saginaw Bay																				
Consumers Power	0	—	—	207	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	217
Pt. Au Gres	511	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	914
Catfish Hole <sup>c</sup>	529	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	529
Pinconning	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	56
Sand Point	—	1,108	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,197
<b>Total</b>	<b>4,630</b>	<b>7,399</b>	<b>4,151</b>	<b>3,272</b>	<b>2,906</b>	<b>3,079</b>	<b>2,995</b>	<b>2,989</b>	<b>2,999</b>	<b>2,970</b>	<b>2,992</b>	<b>2,993</b>	<b>5,484</b>	<b>5,996</b>	<b>6,292</b>	<b>2,997</b>	<b>2,993</b>	<b>3,000</b>	<b>2,997</b>	<b>80,084</b>

<sup>a</sup>Tagged on May 7, 1988, in Saginaw River at Wickes Park during a walleye tournament.  
<sup>b</sup>Returns analyzed and reported separately and not included in estimate model analysis.  
<sup>c</sup>A 19-foot deep depression about seven miles southwest of Pt. Au Gres in Grid 1507 (includes 98 tagged).  
<sup>d</sup>Includes 300 reward-tagged fish.  
<sup>e</sup>Total number since study inception in 1981.

Table 2.—Average total length (mm) of walleyes collected by electrofishing below Dow Dam, Tittabawassee River, March-April 1981-2004.

Year	Female		Male		Total	
	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
2004	602	1,095	529	1,902	556	2,997

Table 3.—Age composition (percent) of walleyes sampled from Tittabawassee River (Dow Dam) during spring electrofishing, 1990-2003.

	Age														Mean age
	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	
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
2003															
Female	—	—	—	4.5	25.9	17.7	9.1	10.7	9.1	6.6	8.2	5.8	1.6	0.8	7.4
Male	—	1.2	5.5	13.1	26.2	17.7	12.8	11.9	4.9	4.0	2.0	0.6	—	—	6.1

Table 4.—Mean total length (mm) at age of walleyes from tagging operation, Tittabawassee River, spring 2000-2003.

Year class	Age	Male		Female		Age	Male		Female		
		Length	Number	Length	Number		Length	Number	Length	Number	
2000						2001					
1998	2	390	32	—	—	3	447	145	480	6	
1997	3	446	84	—	—	4	478	54	538	17	
1996	4	477	16	533	1	5	507	17	542	13	
1995	5	510	65	553	18	6	530	52	606	19	
1994	6	529	82	580	24	7	550	60	610	30	
1993	7	540	42	600	17	8	565	63	641	18	
1992	8	552	59	633	7	9	582	81	646	22	
1991	9	569	157	632	21	10	582	54	688	35	
1990	10	589	102	672	33	11	600	31	702	33	
1989	11	599	60	677	22	12	613	11	705	26	
1988	12	614	18	702	13	13	616	3	741	5	
1987	13	608	4	705	4	14	—	—	754	2	
1986	14	—	—	—	—	15	—	—	—	—	
1985	15	—	—	730	1	16	—	—	—	—	
1984	16	—	—	—	—	17	—	—	—	—	
1983	17	—	—	—	—	18	—	—	—	—	
<b>Total</b>			721		161			571		226	
2002						2003					
2000	2	—	—	—	—	3	451	18	—	—	
1999	3	432	2	—	—	4	490	43	533	11	
1998	4	481	75	544	26	5	514	86	568	63	
1997	5	502	69	545	60	6	533	58	588	43	
1996	6	535	17	547	24	7	542	42	607	22	
1995	7	542	19	608	15	8	554	39	656	26	
1994	8	555	18	643	6	9	582	16	678	22	
1993	9	582	7	663	7	10	575	13	703	16	
1992	10	578	17	646	6	11	600	7	710	20	
1991	11	596	10	698	6	12	—	—	725	14	
1990	12	636	2	687	4	13	—	—	—	—	
1989	13	610	3	732	3	14	—	—	—	—	
1988	14	—	—	696	1	15	—	—	—	—	
1987	15	—	—	—	—	16	—	—	—	—	
1986	16	—	—	—	—	17	—	—	—	—	
1985	17	—	—	—	—	18	—	—	—	—	
<b>Total</b>			239		158			322		237	

Table 5.—Tag return matrix for walleyes tagged at Dow Dam, Tittabawassee River, during spring, 1990-2003.

Tag year	Recovery Year														Total returns	Estimated recovery rate
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003		
1990	59	52	51	33	9	6	4	5	1	1	3	0	0	0	224	2.37
1991		71	109	49	16	9	11	11	4	7	2	1	3	1	294	2.56
1992			165	83	30	21	14	11	12	11	6	2	1	0	356	5.58
1993				150	52	31	24	17	13	15	9	5	3	0	319	4.90
1994					76	52	44	36	18	16	12	2	0	1	257	2.50
1995						55	50	45	30	32	9	3	2	3	229	1.99
1996							73	74	54	47	20	10	9	3	290	2.70
1997								84	82	58	19	11	12	11	277	3.09
1998									95	69	24	19	13	10	230	3.40
1999										127	38	28	25	15	233	4.15
2000											86	45	49	44	224	2.77
2001												80	88	37	205	2.63
2002													154	57	211	4.68
2003														90	90	3.00
Mean																3.35
Total	59	123	325	315	183	174	220	283	309	383	228	206	359	272	3,439	

Table 6.—Walleye year class percent composition of Saginaw Bay sport fishery harvest, April – October harvest (2 SE of the mean), adjusted annual exploitation rate, and total annual mortality rate, 1991 through 2003.

Year class	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 <sup>c</sup>	2003 <sup>c</sup>
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 <sup>a</sup>	61,028 (10,817)	64,447 (8,702)	125,160 (18,357)	68,170 (11,907)	47,887 (9,208)	47,566 (9,990)	78,128 (15,109)	80,801 (11,614)	43,747 (16,893)	58,018 (28,002)	44,178 (17,832)	45,244 (21,452)	66,734 (25,587)
Exploitation	7.0	14.9	13.1	7.0	5.7	7.2	8.8	9.5	11.5	8.5	4.9	11.7	7.0
Total mortality <sup>b</sup>	42.0	39.8	34.6	22.9	39.5	24.6	32.7	28.8	52.5	44.8	46.8	21.8	—

<sup>a</sup> From previous MDNR creel survey reports. <sup>b</sup> Annual rate for last year cannot yet be calculated. <sup>c</sup> Age data not yet available.