STUDY PERFORMANCE REPORT

State: Michigan   **Project No.:** ___F-81-R-6___

Study No.: 230436   **Title:** Vital Statistics of walleyes in Saginaw Bay

Period Covered: ___October 1, 2004 to September 30, 2005___

Study Objective: To monitor trends in exploitation, mortality, and movement of the walleye population in Saginaw Bay. To document age structure and growth rate of walleyes comprising the Tittabawassee River spawning run of walleye.

Summary: In 2005, 3,000 walleyes *Sander vitreus* were tagged in the Tittabawassee River. Unlike most previous years, the composition of walleyes collected was in about equal proportions of males and females. A total of 239 tags were reported by anglers in 2004, representing 11 year classes. The tag recovery software, ESTIMATE was again used to analyze tag returns. The tag recovery rate was 3.07% for 2004, yielding a corresponding corrected exploitation rate of 7.2%. Exploitation was not significantly different from 2003 and harvest of walleyes in the fishery remained similar. The large 1998 year class continued to dominate the age structure of the spawning run in 2004 (age 6). This may be contributing to the increased levels of walleye reproduction since 2003 as measured in Study 230466. Total annual survival for 2003 (most recent year estimated) was 55.6%. The walleye fishery in Saginaw Bay continues to be only lightly exploiting the walleye population and overall survival is high. This suggests that progress in walleye recovery is not being limited by the sport fishery and further harvest restrictions are presently unnecessary. Age and growth analysis of 2005 samples are pending scale aging.

Findings: Jobs 1, 2, and 3 were scheduled for 2004-05, and progress is reported below.

Job 1. Title: <u>Tag walleyes.</u>–In 2005, 3,000 serially-numbered monel tags were applied to the jaws of walleyes below Dow Dam on the Tittabawassee River, a tributary to the Saginaw River and 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 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 including Saginaw Bay itself. The 2005 tagging effort brings the study total to 83,084 walleyes tagged since 1981 (Table 1).

In 2005, one third or 1,000 of the jaw-tagged walleyes were also tagged with a passive integrated transponder (PIT). This is part of a separate interagency study funded by the Great Lakes Restoration Act to assess jaw tag loss rate. Future returns of walleye at the Tittabawassee tagging site under this study will be scanned for the presence of PIT tags but the absence of jaw tags. Part of a larger analysis, a loss rate and ultimately a correction factor will be determined for jaw tagging that will result in further refinement of parameters measured or estimated based on jaw tag return data. PIT tagging is planned for another two years and monitoring for three years. Reporting of results will occur elsewhere, but any correction factors developed will be explained and utilized in this study.

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 sport 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: <u>Process tag returns and analyze data.</u>–Unlike most previous years, the composition of walleyes collected from the spawning migration in the Tittabawassee River was about one male to one female in 2005. In most years, the sex ratio is skewed towards male fish and considered an artifact of sex specific spawning migration patterns and not necessarily representative of the overall sex ratio in the population (Table 2). The 2005 collection may have occurred closer to the peak of the migration compared to other years. Mean total length of both sexes of walleyes from the spawning migration has not changed appreciably in recent years (Table 2). Early in the study, trends in mean lengths were indicative of the building and maturing of the recovering walleye population, but since about 1993, the spawning run has reflected a full complement of cohorts which has provided for a stable mean length pattern.

Analysis of age structure and the corresponding growth rate of walleyes in the spawning migration have not yet been performed for 2005. The age structure of walleyes from the 2004 migration indicates a decline for females and increase for males (Table 3). This is attributed partly to the influence of the strong 1998 year class that is affecting the age distribution (age 6 in 2004). Females of this year class first recruited to the spawning migration in 2003. Other previously weak year classes such as the years 1992, 1993, and 1996 are no longer largely discernable in the age structure (Table 3). The strong 1998 year class may be one factor that is contributing to the strong on-going levels of walleye natural reproduction since 2003 as detected by Michigan Federal Aid Study 466. The large 2003 year class, however will likely not begin to show in this study (spawning migration in the Tittabawassee River) until 2005 or 2006 and perhaps not fully for some years beyond that.

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 Study 230466, 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). There is some evidence that the 2003 through 2005 walleye year classes may be growing slower due to their large size. Those year classes so far, however, are not recruited to this data set. This analysis will be updated with the 2005 data upon completion of the scale aging.

In 2004, 239 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.

2004 recovery rate (percent)	3.07
95% confidence interval	2.45–3.69
2003 survival rate (percent)	55.64
95% confidence interval	39.71–71.56
Mean adult life span after tagging (years)	2.29
95% confidence interval	2.16–2.42

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, previously determined for Saginaw Bay, and was 7.2 for 2004.

Exploitation of walleyes in Saginaw Bay remained unchanged in 2004 compared to 2003 (P>0.05) (Table 6). Harvest also did not change appreciably from 2003 (S. Thayer, Michigan Department of Natural Resources, unpublished data). This implies some relative stability to the fishery and population. The walleye fishery in Saginaw Bay continues to be only lightly exploiting the walleye population and overall survival is high. This suggests that progress in walleye recovery is probably not being limited by the sport fishery and further harvest restrictions are not presently necessary. Total annual mortality derived from the ESTIMATE survival estimates increased in 2003, the most recent value calculable with ESTIMATE (Table 6), but is still within the range reported for recent years.

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 2005 fishing season tag returns will take place in 2006.

Job 3. Title: <u>Prepare annual, final, and other reports.</u>–The performance report was prepared. A seven year summary report spanning the findings from 1998–2004 is in preparation and will couple with the findings of Study 466 for the same period. Although these studies were renewed in 2005, the in-depth summary report will take the place of a final report. A full draft is expected by late 2005.

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Table 1.–Number of walleyes tagged in the Saginaw Bay system, by site, Saginaw Bay watershed 1987–2005.

Site	Year																			Study total[e]
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[d]	2001	2002	2003	2004	2005	
Tittabawassee River																				
Dow Dam	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	3,000	71,195
Sanford Dam	–	–	497	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,636
Other rivers																				
Kawkawlin River	56	–	74	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	368
Au Gres River	215	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	448
Saginaw River	–	115[a]	–	418	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	533
Flint River[b]	–	–	–	–	–	–	–	–	–	–	–	2,994	2,997	2,993	–	–	–	–	–	5,991
Saginaw Bay																				
Consumers Power	–	–	207	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	217
Pt. Au Gres	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	914
Black Hole[c]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	529
Pinconning	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	56
Sand Point	1,108	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1,197
Total	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	2,997	3,000	83,084

[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. Au Gres in Grid 1507 (includes 98 tagged).
[d] Includes 300 reward-tagged fish.
[e] Total number since study inception in 1981.

Table 2.–Mean total length (mm) of walleyes collected by electrofishing below Dow Dam, Tittabawassee River, March–April 1981–2005.

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
2005	604	1,586	531	1,413	570	2,998

Table 3.–Age composition (percent) of walleyes sampled from Tittabawassee River (Dow Dam) during spring electrofishing, 1991–2004.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	Mean age
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
2004															
Female	–	–	0.3	10.5	28.0	28.6	11.0	3.7	5.1	5.4	3.7	2.5	0.8	0.4	6.5
Male	–	–	9.7	6.3	16.2	25.2	13.3	11.7	4.5	6.5	3.8	1.8	0.7	0.4	6.6

Table 4.–Mean length (mm) at age by sex and two standard errors of the mean (in parentheses) for walleyes from the tagging operation, Tittabawassee River (Dow Dam), spring 1998–2004, compared with Michigan average lengths from April catches. No means included for sample sizes less than 5 specimens.

Age	1998 Male	1998 Female	1999 Male	1999 Female	2000 Male	2000 Female	2001 Male	2001 Female	2002 Male	2002 Female	2003 Male	2003 Female	2004 Male	2004 Female	Michigan average[a]
0															–
1															180
2					390 (6)										264
3	430(13)		430(13)		446 (6)		447 (4)	480(26)			451(14)		447(4)		353
4	481 (6)	525 (9)	481 (6)	525 (9)	477(16)		478(10)	538(14)	481 (6)	544(12)	490 (6)	533(12)	496(12)	529(8)	401
5	515(10)	559(10)	515(10)	559(10)	510 (6)	553(10)	507(14)	542(14)	502 (4)	545 (6)	514 (6)	568 (6)	518(6)	573(6)	447
6	530(11)	585(33)	530(11)	585(33)	529 (6)	580(12)	530(10)	606(14)	535 (8)	547 (8)	533 (6)	588 (6)	542(4)	599(6)	488
7	543 (8)	643(27)	543 (8)	643(27)	540 (6)	600(12)	550 (8)	610(16)	542 (8)	608(20)	542(10)	607(18)	557(6)	619(10)	523
8	562 (6)	643(14)	562 (6)	643(14)	552 (8)	633(14)	565 (8)	641(20)	555(10)	643(30)	554(12)	656(16)	569(8)	644(24)	549
9	582 (7)	663 (9)	582 (6)	663 (9)	569 (4)	632(14)	582 (6)	646(20)	582(14)	663(18)	582(22)	678(16)	585(10)	681(12)	569
10	597 (7)	678(11)	597 (7)	678(11)	589 (6)	672(14)	582(10)	688(16)	578(12)	646(48)	575(12)	703(14)	607(8)	684(16)	586
11	604(12)	699(13)	604(12)	699(13)	599 (8)	677(20)	600(12)	702(12)	596(20)	698(26)	600(30)	710(14)		715(12)	–
12	608(31)	708(17)	608(31)	708(17)	614(20)	702(18)	613(18)	705(14)				725(24)		735(22)	–
13								741(26)							

[a] Sexes combined, from Schneider et al. (2000).

Table 5.–Tag return matrix for walleyes tagged at Dow Dam, Tittabawassee River, during spring, 1990–2004.

Tag year	Recovery year															Total returns	Recovery rate
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
1990	59	52	51	33	9	6	4	5	1	1	3	0	0	0	1	225	2.37
1991		71	109	49	16	9	11	11	4	7	2	1	3	2	0	295	2.56
1992			165	83	30	21	14	11	12	11	6	2	1	0	0	358	5.56
1993				150	52	31	24	17	13	15	9	5	3	0	1	320	4.90
1994					76	52	44	36	18	16	12	2	1	1	1	259	2.50
1995						55	50	45	30	32	9	3	2	3	0	229	2.00
1996							73	74	54	47	20	10	9	3	0	290	2.68
1997								84	82	58	19	11	12	11	1	273	3.08
1998									95	69	24	19	13	10	7	237	3.64
1999										127	38	28	25	15	8	241	4.17
2000											86	45	49	45	13	238	2.77
2001												80	88	38	22	228	2.66
2002													156	58	36	250	4.74
2003														93	57	150	3.28
2004															92	92	3.07
Mean																	**3.35**
Total	59	123	325	315	183	174	220	283	309	383	228	206	362	279	239	**3,688**	

Table 6.–Walleye year class percent composition in Saginaw Bay sport fishery, April–October harvest (2 SE of the mean), corrected annual exploitation rate, and total annual mortality rate, 1992 through 2004.

Year class	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1981	1.3	0.6	0.2	–	–	–	–	–	–	–	–	–	–
1982	3.1	2.1	–	0.7	0.2	–	–	–	–	–	–	–	–
1983	4.5	4.1	1.8	1.4	2.2	0.6	–	–	–	–	–	–	–
1984	4.9	4.8	4.4	4.2	2.7	2.4	0.2	–	–	–	–	–	–
1985	10.7	12.7	8.4	8.7	7.7	3.6	1.2	–	–	–	–	–	–
1986	18.3	10.6	11.6	9.7	10.2	6.7	2.5	–	0.9	–	–	–	–
1987	11.6	7.6	9.2	8.3	6.2	6.1	3.5	0.5	0.5	0.3	–	–	–
1988	16.5	14.1	13.8	11.1	7.0	6.7	3.7	0.5	1.1	0.8	0.7	–	–
1989	24.6	23.0	17.6	16.3	11.7	5.2	9.6	5.8	3.4	2.0	1.1	–	–
1990	4.5	15.5	14.8	12.7	9.2	9.7	11.3	9.7	3.9	2.9	2.0	0.4	0.3
1991	–	4.9	17.8	20.3	19.0	18.2	12.5	12.3	4.6	7.1	2.9	1.6	0.3
1992	–	–	0.4	6.4	6.7	11.5	8.0	8.9	8.7	6.6	4.0	1.4	0.6
1993	–	–	–	0.2	1.2	1.2	3.3	5.8	6.2	5.6	4.7	2.1	0.8
1994	–	–	–	–	15.7	25.2	28.1	24.9	13.5	7.8	6.7	5.4	2.5
1995	–	–	–	–	–	3.0	15.4	15.0	11.6	7.6	4.7	7.2	4.2
1996	–	–	–	–	–	–	0.6	4.7	3.2	3.0	5.1	7.9	6.4
1997	–	–	–	–	–	–	–	11.8	16.4	12.8	13.3	13.0	5.8
1998	–	–	–	–	–	–	–	–	26.0	40.8	37.8	21.9	10.0
1999	–	–	–	–	–	–	–	–	–	2.7	11.8	18.2	17.8
2000	–	–	–	–	–	–	–	–	–	–	5.3	10.3	10.8
2001	–	–	–	–	–	–	–	–	–	–	–	10.7	33.3
2002	–	–	–	–	–	–	–	–	–	–	–	–	6.9
No. aged	224	631	500	424	401	330	512	990	438	593	450	516	360
Harvest[a]	64,447	125,160	68,170	47,887	47,566	78,128	80,801	43,747	58,018	44,178	45,244	66,734	60,188
2 SE mean	(8,702)	(18,357)	(11,907)	(9,208)	(9,990)	(15,109)	(11,614)	(16,893)	(28,002)	(17,832)	(21,452)	(25,587)	(21,845)
Exploitation	12.8	11.7	5.9	4.3	5.7	6.5	8.9	9.9	6.1	6.2	12.0	7.0	7.2
Total mortality[b]	39.8	34.6	22.9	39.5	24.6	32.7	28.8	52.5	44.8	46.8	21.8	44.4	–

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