STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-53-R-14

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

Period Covered: April 1, 1997 to March 31, 1998

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

Summary: Keller et al. (1987) and Mrozinski et al. (1991) summarized the results through 1988 of this study and related studies on Saginaw Bay. The reintroduction of walleye to Saginaw Bay began with the stocking of 5,500 walleye fry in 1972. Fingerling stocking began in 1974 and replaced fry stocking after 1982 (Table 1). The walleye population response to stocking was evidenced by: a sudden increase in commercial trap netters' incidental catch of small walleyes, beginning in 1979; a dramatic increase in the sport harvest beginning in 1984; and an increase in the Tittabawassee River spawning run, beginning in 1981.

In 1997, 1,006,377 fingerling walleye were stocked in Saginaw Bay. An average of 663,877 walleye fingerlings was stocked annually during the period 1981-97 (Table 1). In 1993 and 1996, however, no walleye were reared for Saginaw Bay. Stocking was interrupted so that the contribution of wild fish to the bay could be evaluated. In years when stocking occurred, the average number of fingerlings planted out was 752,394.

In 1997, 2,993 walleyes were tagged, bringing the total tagged to date in the Bay area to 56,317. All tagging in 1997 was at Dow Dam (Tittabawassee River).

Mean age of male and female walleyes tagged in 1997 was 7.9 and 7.9 years, respectively, the oldest since tagging began. Age 5 and younger walleyes were almost absent from the spawning run in 1996 and 1997, suggesting the 1991, 1992, and 1993 year classes were very weak. From 1983-95, age 5 walleyes made up an average of 28% of the run and never composed less than 16%. For 1996 and 1997, however, age 5 walleyes made up an average of only 4.2% of the spawning run.

The mean survival for walleyes tagged at Dow Dam since 1984 was estimated to be 68% (± 2%). Annual exploitation rate was estimated to be 9.1%.

Job 1. Title: Tag walleyes.

Findings: Since 1981, 56,317 walleyes have been tagged on the jaw with serially-numbered monel tags (Table 2). Most of the tagging was done below Dow Dam on the Tittabawassee River, where a large spawning run has developed since 1981. Some walleyes were tagged at other locations during supplemental surveys.

Walleyes were collected with 230-volt DC electrofishing gear. We used one boat (four people aboard) and one or two tagging crews (two to five people each). Over 1,000 walleye can often be tagged per day.

In 1996, 2,993 walleyes were tagged in the Tittabawassee River below Dow Dam in approximately four days of effort. Fish were measured to 0.1 inch. Samples were externally sexed: mature males were ripe and could be identified easily; fish classified 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 was aged. All tagging information from 1997 has been entered into the database.

Job 2. Title: <u>Determine age and growth.</u>

Findings: Each year, scale samples were collected from subsamples by size group to determine growth and age structure of the walleye population. Scales were taken from a random subsample of tagged walleyes from 1981 through 1984. From 1984 through 1993, scales were subsampled on a stratified-random basis. Ages from the latter were weighted by length-frequency data from the tagged-fish database to estimate the age composition of the entire tagged sample. Beginning in 1994, all scales collected from a single day's tagging effort were aged as a representative sample for age and growth data. The number of fish used in age determinations were 796 fish 1995, 1,099 in 1996, and 814 in 1997. Average lengths of walleyes tagged through 1997 are given by sex and year in Table 3. The estimated age distribution of fish tagged during spring from 1981 through 1996 is given in Table 4.

Over the period of this study, average age and average length of walleyes has generally increased. Initially, the increasing age reflected the recovery and maturing of the spawning population. Mean age of male and female walleyes tagged in 1997 was 7.9 and 7.9 years, respectively, the oldest since tagging began. Age-3 walleye were scarce in 1994, 1995, 1996, and 1997. From 1983-95, age 5 walleyes made up an average of 28% of the run and never composed less than 16%. For 1996 and 1997, however, age 5 walleyes made up an average of only 4.2% of the spawning run. Thus, the 1991, 1992, and 1993 year classes appear to be very weak, and low recruitment in recent years is contributing to the older mean age of the population.

Growth of walleye continues to be rapid (Table 5). It can be expected that if the walleye population approaches the Bay's carrying capacity growth rates will decline.

Job 3. Title: <u>Collect tag returns.</u>

Findings: As of April 1, 1997, 289 tag returns from fish caught in tagging year 1996-97 had been processed and entered in the database. A total of 56,317 walleye have been tagged, of which 45,861 were tagged from 1984 to 1997 during spring below Dow Dam. The tag return matrix for just the fish tagged at Dow Dam is given in Table 6.

Using the tag-recovery program ESTIMATE, Model 1 (for year-specific survival, fishing, and reporting rates) (Brownie et al. 1985), the following parameters were estimated:

Mean recovery rate (percent)	3.41
95% confidence interval	3.27-3.54
Mean survival rate (percent)	68.0
95% confidence interval	65.9-70.0
Mean adult life span after tagging (years)	2.59
95% confidence interval	2.40-2.81

Recovery rates peaked in 1992 at 5.5% and declined to 2.0% in 1995. The recovery rate for 1997 is conservative because not all tags for the 1996-97 tagging year had been received at the time the model was run. These trends in recovery rate suggest vulnerability to angling may have changed, which could explain some of the variation in harvest measured by Study 427. Harvest peaked in 1988 and remained below the 1988 level through 1992. In 1993, walleye harvest rose to a new peak level. Walleye harvest in 1995 and 1996 fell below the 10-year average and recovered to near average in 1997. Tag recovery rates have roughly paralleled trends in harvest and effort.

Haas et al. (1988), in a comparable study at Lake St. Clair using $2.00, $4.00, $6.00, and $8.00 reward tags, estimated actual recoveries were about 1.5 times those reported by anglers. Using this correction factor, the annual harvest rate of walleye in Saginaw Bay is probably close to 5.1%. More recently, Haas used $100.00 reward tags on Lake Erie walleyes and estimated the correction factor for nonresponse was 2.68 (R. Haas, Michigan Department of Natural Resources, Study 460). This latter correction factor gives an annual exploitation rate of 9.1%.

Although over 60% of tag returns have been from Saginaw Bay or the Saginaw River system, walleye tagged at Sand Point, near the outer reaches of the bay, often were caught outside the bay, usually from southern Lake Huron, and sometimes as far as Lake Erie. The recapture locations of all tag returns from the Dow Dam data set were digitized during 1994-97. Mapping of movement and digitizing of recapture locations will continue during 1998.

Job 4. Title: <u>Prepare annual reports.</u>

Findings: This job was completed as scheduled.

Literature Cited:

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Haas, R. C., M. E. Fabrizio, and T. N. Todd. 1988. Identification, movement, growth, mortality, and exploitation of walleye stocks in Lake St. Clair and the eastern basin of Lake Erie. Michigan Department of Natural Resources, Research Report 1954, Ann Arbor.

Keller, M., J. C. Schneider, L. E. Mrozinski, R. C. Haas, and J. R. Weber. 1987. History, status, and management of fishes in Saginaw Bay, Lake Huron, 1891-1986. Michigan Department of Natural Resources, Fisheries Technical Report 87-2, Ann Arbor.

Mrozinski, L. E., J. C. Schneider, R. C. Haas, and R. E. Shepherd. 1991. Rehabilitation of walleye in Saginaw Bay, Lake Huron. Pages 63-84 in P. J. Colby, C. A. Lewis, and R. L. Eshenroder [ed]. Status of walleye in the Great Lakes: case studies prepared for the 1989 workshop. Great Lakes Fishery Commission, Special Publication 91-1.

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Table 1.–Number of walleye stocked in Saginaw Bay and tributaries, 1972-97.

Year	Fry	Fingerlings
1972	50,000,000	0
1973	50,000,000	0
1974	0	5,500
1975	300,000	0
1976	300,000	0
1977	400,000	4,070
1978	0	25,000
1979	300,000	334,427
1980	0	9,989
1981	800,000	294,656
1982	0	269,540
1983	0	869,000
1984	0	947,796
1985	0	954,218
1986	0	871,263
1987	0	632,204
1988	0	345,537
1989	0	834,375
1990	0	850,085
1991	0	622,687
1992	0	787,675
1993	0	0
1994	1,100,000	1,282,992
1995	0	717,519
1996	0	0
1997	0	1,006,377
Totals	**103,200,000**	**11,664,910**

Table 2.–Number of walleye tagged, by site, 1981-97.

Site	Year																	**Total**
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
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	50,419
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[1]	---	418	---	---	---	---	---	---	---	533
Saginaw Bay																		
Consumers Power	---	---	10	---	---	0	---	---	207	---	---	---	---	---	---	---	---	217
Pt. AuGres	---	---	---	343	60	511	---	---	---	---	---	---	---	---	---	---	---	914
Catfish Hole[2]	---	---	---	---	---	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	56,317

[1]Tagged on May 7, 1988, in Saginaw River at Wickes Park during a walleye tournament.
[2]A 19-foot deep depression about seven miles southwest of Pt. AuGres in Grid 1507 (includes 98 tagged).

Table 3.–Average total length (inches) of walleye collected by electrofishing below Dow Dam, Tittabawassee River, March-April 1981-97.

	Female		Male		Total	
Year	Length	Number	Length	Number	Length	Number
1981	20.8	87	13.8	272	---	399
1982	20.3	179	17.8	513	---	697
1983	21.6	2,082	19.6	1,300	---	3,413
1984	23.0	1,052	18.6	2,421	---	3,540
1985	20.9	1,322	18.0	1,662	---	2,984
1986	21.1	1,370	18.3	2,023	---	3,574
1987	21.5	1,736	18.6	3,829	19.1	5,976
1988	22.9	549	18.8	3,338	19.3	4,033
1989	22.1	1,774	19.1	1,244	20.8	3,064
1990	22.9	972	19.4	1,481	20.8	2,467
1991	23.0	2,232	19.2	843	22.0	3,079
1992	24.0	1,491	19.8	1,497	21.9	2,995
1993	22.9	1,323	19.2	1,666	20.9	2,989
1994	23.6	1,452	20.9	1,534	22.2	2,999
1995	23.2	962	21.2	2,003	21.9	2,970
1996	24.7	1,376	21.9	1,614	23.2	2,992
1997	24.8	1,905	21.8	1,088	23.8	2,993

Table 4.–Age composition (percent) of walleye sampled from Saginaw Bay tributaries during spring electrofishing, 1981-97.

	Age														Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	Age
1981	0.3	56.0	22.6	20.0	1.1	---	---	---	---	---	---	---	---	---	2.7
1982	---	---	79.2	13.6	7.2	---	---	---	---	---	---	---	---	---	3.3
1983	---	---	0.7	85.3	4.4	3.7	3.7	1.5	0.0	0.7	---	---	---	---	4.3
1984	---	14.7	18.2	22.1	33.8	8.2	3.0	---	---	---	---	---	---	---	4.1
1985	0.1	8.6	48.3	20.3	19.2	3.3	0.2	---	---	---	---	---	---	---	3.6
1986	---	3.1	28.4	39.1	17.3	5.9	5.2	1.0	0.1	---	---	---	---	---	4.2
1987	---	10.4	1.9	46.9	29.9	5.0	3.7	1.9	0.3	---	---	---	---	---	4.4
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															7.9
Female	---	---	0.4	4.1	1.3	11.8	26.8	22.9	12.4	8.4	7.1	4.9	---	---	
Male	---	---	---	1.5	0.3	15.2	23.6	27.3	16.1	9.2	4.0	2.0	---	0.6	7.9

Table 5.–Mean total length (inches) at age of walleye from tagging operation, Tittabawassee River, spring 1992-97.

Year class	Age	Male Length	Male Number	Female Length	Female Number	Age	Male Length	Male Number	Female Length	Female Number
		1992					1993			
1992	---	---	---	---	---	---	---	---	---	---
1991	---	---	---	---	---	---	---	---	---	---
1990	2	14.6	9	---	0	3	16.4	29	21.6	1
1989	3	17.2	21	---	0	4	18.4	20	18.4	17
1988	4	18.9	18	20.4	20	5	20.6	11	21.5	24
1987	5	20.1	10	21.6	16	6	21.8	13	23.5	9
1986	6	21.7	14	23.3	8	7	22.3	13	25.1	18
1985	7	22.8	16	23.4	11	8	24.2	13	25.8	18
1984	8	24.0	8	25.0	7	9	24.0	5	26.8	11
1983	9	24.2	3	26.0	8	10	22.8	2	28.2	6
1982	10	24.6	3	26.8	15	11	---	0	29.1	3
1981	11	25.7	4	27.2	8	12	19.7	1	---	0
1980	12	---	0	28.5	8	---	---	---	---	---
1979	13	---	0	28.6	6	---	---	---	---	---
1978	14	---	0	28.6	1	---	---	---	---	---
Total number			106		108			107		107
		1994					1995			
1992						3	16.8	7	---	0
1991	3	16.3	8	17.1	2	4	18.4	49	20.0	24
1990	4	18.2	31	20.2	27	5	19.9	111	22.1	135
1989	5	19.6	21	21.7	51	6	20.7	114	22.9	34
1988	6	20.8	17	23.2	25	7	21.4	69	24.0	23
1987	7	21.7	22	24.6	12	8	22.2	76	24.7	18
1986	8	22.2	28	25.3	19	9	22.7	68	27.3	10
1985	9	22.6	21	25.3	12	10	23.7	41	25.5	6
1984	10	23.6	8	25.2	3	11	23.6	4	28.3	3
1983	11	24.8	2	27.5	2	12	23.9	2	28.2	1
1982	12	---	0	29.7	1	13	25.6	1	---	0
1981	---	---	---	---	---	14				
1980	---	---	---	---	---					
1979	---	---	---	---	---					
1978	---	---	---	---	---					
Total number			158		154			542		254

Table 5.–Contunued.

Year class	Age	Male Length	Male Number	Female Length	Female Number	Age	Male Length	Male Number	Female Length	Female Number
	1996					1997				
1994						3	---	0	20.5	2
1993	3	17.5	4	---	0	4	20.0	5	20.8	19
1992	4	17.8	5	21.1	1	5	20.2	1	21.9	6
1991	5	19.6	41	21.7	41	6	20.5	53	23.0	55
1990	6	20.5	104	23.3	83	7	21.1	82	24.2	125
1989	7	21.3	122	24.1	102	8	21.8	95	24.9	107
1988	8	22.2	142	25.0	59	9	22.7	56	26.3	58
1987	9	23.0	119	26.5	57	10	23.4	32	26.8	39
1986	10	23.2	84	27.1	72	11	23.6	14	27.1	33
1985	11	24.3	20	28.1	31	12	24.8	7	28.1	23
1984	12	24.9	6	28.3	6	13	---	0	---	0
1983	---	---	---	---	---	14	26.8	1	---	0
1982	---	---	---	---	---	15	---	0	---	0
1981	---	---	---	---	---	16	21.5	1	---	0
Total number			647		452			347		467

Table 6.–Tag return matrix for walleye tagged at Dow Dam during spring, 1984-97.

		Recovery year															
Tag year	Number tagged	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total returns	Estimated recovery rate
1984	3,548	77	98	69	56	33	21	9	7	5	5	1	1	1	2	383	2.17
1985	3,335		100	95	59	31	12	5	4	7	3	0	1	0	0	317	3.01
1986	2,923			120	100	42	18	19	12	10	9	3	2	0	2	337	4.29
1987	6,020				307	121	64	22	19	24	14	10	4	1	2	588	4.77
1988	4,036					163	86	34	28	20	17	12	6	1	4	371	3.91
1989	2,494						71	47	37	51	18	15	6	3	4	252	3.53
1990	2,488							60	55	53	34	9	8	4	5	228	2.44
1991	3,079								75	113	51	16	9	11	11	286	2.67
1992	2,995									170	83	30	19	14	10	326	5.40
1993	2,989										154	52	31	24	17	278	4.88
1994	2,999											76	49	44	36	205	2.75
1995	2,970												54	54	45	150	1.99
1996	2,992													71	71	142	2.46
1997	2,993														80	80	2.67
Mean	**3,276**																**3.35**
Total	**45,861**															**3,945**	