STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-1

Study No.: 466 **Title:** Fish Community status in Saginaw Bay, Lake Huron

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

Study Objective: To collect growth, abundance and other biological data with which to assess responses of the Saginaw Bay fish community to changing environmental and biological conditions.

Summary: In 1999, 27 trawl tows and 18 gillnet lifts were made on Saginaw Bay. All netting was performed in September and divided between the inner and outer bay areas. This report summarizes the results trawl tows and gillnet lifts and compares them with data from prior surveys. The 1999 trawl catch rates for several species were the highest observed since 1990. In particular, spottail shiner CPUE values were much higher than for any other year. Trawling indicated yellow perch recruitment in 1999 was lowest since 1994. Based on trawl catch rates, the 1999 walleye year class is much less abundant than the record 1998 year class, but about average for the period from 1986 to 1999. Growth rates of yellow perch caught in the trawl have slowed, but remained well above those observed before 1993. While no eurasian ruffe have yet appeared in the trawl catch, round gobies were captured near Linwood, Bay City, Fish Point, and North Island. Gillnet catch rates for walleyes were commensurate with other recent years and the trend basically reflects a static walleye population. Gill netting in 1999 confirmed the record strength of the 1998 walleye year class. That year class, along with the 1997 cohort, comprised more than 70% of the walleye gillnet catch in 1999. These two strong year classes will be crucial to the fishery as they mature, particularly since the 1999 year class appears relatively weak. Despite the very strong 1998 year class, growth rate of walleyes remained very strong and even increased in 1999 for age-1 fish. Yellow perch catch rate in gillnets increased in 1999 but was still well within the range observed for recent years. Yellow perch growth rate based on specimens from gillnet catch remained slightly below the state average. Similar to walleyes, age-1 and age-2 yellow perch made a very strong showing in the 1999 gillnet catch suggesting strong year classes in 1998 and 1997. Round gobies first appeared in the gillnet catch in 1999. Field sampling was conducted as scheduled during 2000, including 36 trawls and 18 gillnet lifts. Data for 2000 have not yet been summarized.

Job 1. Title: Relative abundance and community structure.

Findings: Gill netting was performed in 1999 and 2000, with a total of 18 lifts made each year (Table 1). Sampling effort was divided between the inner and outer bay environments (Table 2). In 1999, 3,116 fish were collected comprising 20 species. Walleye (see Table 3 for a complete list of common and scientific names of fishes mentioned in this report) catch-per-unit-effort (CPUE) dropped to its lowest level since the beginning of the study (Table 4; Fielder et al. 2000). Declines in gillnet CPUE during the early 1990s were attributed partly to changes in gear efficiency (Fielder et al. 2000), however, trends in abundance since 1994 appear to reflect a static walleye population. This was mirrored by trends in the sport fishery as well. Trends in abundance for other notable species included an increase in yellow perch abundance in 1999 compared to 1998 (still within the range observed for recent years). Other species with increased catch rates in 1999 included channel catfish, freshwater drum, and white perch (Table 4).

A record proportion of yearling walleye was collected in 1999 indicating an extremely strong 1998 year class (Table 5). This year class along with the strong 1997 year class comprised more than 70% of the walleye gillnet catch. Given the static gillnet CPUE, it is apparent that the walleye population, and probably the fishery, are now heavily dependent on these two year classes. Gillnet data collected during the 2000 survey has not yet been fully analyzed, but early indications suggested the 1999 year class was weak. Another weak walleye year class was produced in 1993 (Table 5; Fielder et al. 2000).

Walleye growth rate continued to be well above state and Saginaw Bay historical averages (Table 6). Despite the abundance of age-1 and age-2 walleyes in 1999, their growth rates actually increased compared to recent years and remained above the state average. These data suggested that the walleye population in Saginaw Bay is still well below the carrying capacity of the habitat and forage base. Alewives and spottail shiners comprised the majority of prey items found in walleye stomachs in 1999 (Table 7). Walleye condition dropped slightly in 1999 despite the good growth rate (Table 8). The proportional stock density (PSD) of walleye declined in 1999 reflecting the abundance of age-1 and age-2 fish (Table 9).

Yellow perch age structure also indicated strong 1997 and 1998 year classes (Table 10). Mean age of yellow perch declined, as did their PSD, reflecting the abundance of younger fish (Table 9). Yellow perch growth rate remains slightly below the state average (Table 6). Like walleye, their condition declined slightly in 1999 (Table 8). The 1998 year class was also very strong for white perch.

Channel catfish age structure indicated an abundance of age-4 fish in 1999 (Table 11). The 1995 year class also showed strongly in the age structure from 1998 and 1997 surveys. Channel catfish growth rate remained slow in 1999, below the state average (Table 11). A fundamental difference in forage habits or physiology must exist between walleye, which grow very well in Saginaw Bay, and channel catfish, which continually exhibit slow growth. The length/weight relationship for channel catfish and other select species is presented in Table 12.

A total of 27 trawl hauls were performed in 1999 (Table 13). We collected over 46,000 fish. Trawl CPUE is summarized in Table 14. Spottail shiner catch rates were higher in 1999 than for any other year since 1990. Alewife and trout-perch catch rates, which were both high in 1998, declined in 1999. Since nearly all alewives captured with trawls in Saginaw Bay are age-0 fish, the lower catch rate in 1999 is a reflection of a cohort weaker than the record 1998 year class. Trawls effectively sample all ages of trout-perch, so the lower catch rate in 1999 may represent a reduction in the total abundance of trout-perch in the Bay. It is important to note however, that the 1999 trout-perch catch rate (405.8), while much lower than in 1998, remains well above the levels observed in Saginaw Bay in the 1970s and 1980s. While the factors behind this trend are uncertain, we believe it is related to a zebra mussel-driven shift in energy flow from the pelagic portion to the benthic portion of the Saginaw Bay food web. Similar to alewife, rainbow smelt catch rates in the Bay varied greatly between years and consisted mainly of age-0 smelt. In 1999, the rainbow smelt CPUE remained at a level typical of most of the 1990s. Yellow perch CPUE decreased, mainly due to the lowest age-0 CPUE since 1994 (Table 15). Age-0 walleye catch rates declined from the record high in 1998 to a level about average for the period from 1986 to 1999 (Table 16). White perch CPUE decreased to the lowest point observed since 1993 (Table 17). The exotic round goby was collected with trawls during September 1999 at sites near

Linwood, Bay City, Fish Point, and North Island. Impacts of round goby on the fish community of Saginaw Bay will be evaluated with data collected during this study. The exotic eurasian ruffe has been collected from Thunder Bay within the Lake Huron watershed but has not yet been documented from Saginaw Bay.

After a period of improved growth rates in the mid-1990s, mean length at age for yellow perch captured in trawls appeared to decline (Table 18). While mean length at age remained elevated for males and females age-4 and older, the mean length at age for ages 1-3 declined in 1998. Yellow perch growth in Saginaw Bay is believed to be density dependent (Haas and Schaeffer 1992). The stronger yellow perch cohorts produced in 1995, 1997, and 1998 may be the factor behind this apparent decline in growth for young perch. Even with this recent slow down, yellow perch growth rates remain well above those observed in the 1980s and early 1990s. This improvement in growth is likely a density-dependent response to the dramatic decline in yellow perch abundance since 1989. An improvement in food resources may also be involved. Zebra mussels first became abundant throughout Saginaw Bay in 1992. The subsequent redirection of energy into benthic production may be contributing to improved yellow perch growth. Rautio (1995) demonstrated that yellow perch experienced improved growth in the presence of zebra mussels, likely as a result of a more diverse benthic macrovinvertebrate community. In fact, the yellow perch diet in 1997 (Table 19) appeared to be shifting away from planktonic food items toward benthic food items, which in general are larger items. In particular, frequency of occurrence for most zooplankton types declined in 1997, while frequency of occurrence for pelecepods, gastropods, amphipods, tricoptera, and fish were higher than the levels seen for those taxa in the 1980s.

Trawling was conducted as scheduled during 2000. We did 36 trawl tows, including three trawl tows made at two new Outer Bay stations located northeast of the Charity Islands. Lab processing of samples as well as data entry and analysis will be conducted during the winter and spring of 2001.

Job 2. Title: <u>Process and analyze the data.</u>

Findings: Analysis of the study data has been performed by Michigan Department of Natural Resources Fisheries Division personnel from the Alpena Fisheries Research Station, and the Mt. Clemens Fisheries Research Station. Processing of age and diet samples collected in trawls during 1998, 1999, and 2000 are underway but have been delayed due to a shortage of laboratory technical assistance. Analysis of data and samples collected with gillnets in 2000 is also underway.

Job 3. Title: <u>Prepare annual, final and other reports</u>.

Findings: This Performance Report summarizes data from 1999, and those reported previously in performance reports since 1998, under Fielder et al. (2000), and fulfills the requirements of Job 3.

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Prepared by: David Fielder and Mike Thomas
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Table 1.–Number of fall gillnet sets (by location) for Saginaw Bay, Lake Huron, 1990-99.

Station	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Pt. Lookout	---	---	1	1	1	4	3	1	1	1	1
AuGres River	---	2	1	---	1	1	1	1	1	1	1
Pt. AuGres	---	2	2	2	2	6	6	2	2	2	2
Black Hole	3	2	2	2	2	6	5	2	2	2	2
Coreyon Reef	2	2	2	2	2	3	2	2	2	2	2
Fish Pt.	---	---	---	2	2	3	5	2	2	2	2
North Island	---	---	---	---	1	6	5	2	2	2	2
Oak Pt.	---	---	---	1	1	6	5	2	2	2	2
Charity Is.	---	---	---	---	---	3	2	2	2	2	2
Tawas	---	---	---	---	---	2	2	2	2	2	2
Total	5	8	8	9	12	40	36	18	18	18	18

Table 2.–Number of fall gillnet sets in Saginaw Bay, Lake Huron, divided by inner and outer bay environments for 1990-2000.

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inner	5	8	7	7	10	28	24	11	11	11	11
Outer	0	0	1	2	2	12	12	7	7	7	7
Total	5	8	8	9	12	40	36	18	18	18	18

Table 3.–Common and scientific names of fishes and other aquatic organisms mentioned in this report.

Common name	Scientific name
Alewife	*Alosa pseudoharengus*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Bowfin	*Amia calva*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Common carp	*Cyprinus carpio*
Emerald shiner	*Notropis atherinoides*
Eurasian ruffe	*Gymnouphalus cernuus*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Goldfish	*Carassius auratus*
Johnny darter	*Etheostoma nigrum*
Lake trout	*Salvelinus namaycusn*
Lake whitefish	*Coregonus clupeaformis*
Longnose gar	*Lepisosteus osseus*
Longnose sucker	*Catostomus catostomus*
Ninespine stickleback	*Pungitius pungitius*
Northern pike	*Esox lucius*
Northern redhorse	*Moxostoma macrolepidotum*
Pumpkinseed	*Lepomis gibbosus*
Quillback	*Carpiodes cyprinus*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhyhus mykiss*
Rockbass	*Ambloplites rupestris*
Round goby	*Neogobius melanostomus*
Round whitefish	*Prosopium cylindraceum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Smallmouth bass	*Micropterus dolomievi*
Spottail shiner	*Notropis hudsonius*
Stone cat	*Noturus flavus*
Tiger musky	*Esox masquinongy*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Stizostedion vitreum*
White bass	*Morone chrysops*
White perch	*Morone americana*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*
Zebra mussel	*Dreissena polymorpha*

Table 4.–Mean catch per unit of effort (CPUE; number per 305 m gillnet) by species for Saginaw Bay, 1991-1999, at traditional netting locations. This table omits four net lifts from Charity Islands and Tawas Bay added in 1995.

	1991 (2,440m) 8 sets		1992 (2,440m) 8 sets		1993 (3,050m) 11 sets		1994 (3,355m) 11 sets		1995 (3,660m) 12 sets		1996 (4,270m) 14 sets		1997 (4,270m) 14 sets		1998 (4,270m) 14 sets		1999 (4,270m) 14 sets	
	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE	Total catch	CPUE
Alewife	0	0	0	0	0	0	8	0.7	0	0	1	0.1	0	0	0	0	1	0.7
Bigmouth buffalo	0	0	3	0.4	7	0.7	1	0.1	0	0	0	0	0	0	0	0	0	0
Black crappie	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.7
Bowfin	0	0	0	0	0	0	0	0	0	0	1	0.1	1	0.1	0	0	0	0
Brown trout	1	0.1	2	0.2	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	3	0.3	1	0.1	2	0.2	1	0.1	2	0.1	1	0.1	0	0
Carp	1	0.1	17	2.1	5	0.5	13	1.2	3	0.2	9	0.6	1	0.1	1	0.1	23	1.6
Channel catfish	122	15.2	26	3.2	58	5.8	40	3.6	17	1.4	123	8.8	68	4.9	94	6.7	214	15.3
Chinook salmon	0	0	6	0.8	5	0.5	1	0.1	3	0.2	1	0.1	0	0	1	0.1	0	0
Freshwater drum	27	3.4	89	11.1	53	5.3	86	7.8	105	8.8	398	28.4	266	19.0	67	4.8	244	17.4
Gizzard shad	357	44.6	21	2.6	92	9.2	45	4.1	47	3.9	207	14.8	31	2.2	560	40.0	167	11.9
Goldfish	0	0	0	0	0	0	0	0	0	0	3	0.2	1	0.1	0	0	0	0
Lake trout	0	0	1	0.1	0	0	0	0	0	0	0	0	1	0.1	0	0	2	0.1
Lake whitefish	0	0	4	0.5	1	0.1	0	0	1	0.1	0	0	2	0.1	0	0	0	0
Longnose gar	0	0	0	0	0	0	0	0	0	0	2	0.1	0	0	3	0.2	1	0.7
Longnose sucker	0	0	0	0	1	0.1	3	0.3	0	0	2	0.1	2	0.1	0	0	0	0
Northern pike	4	0.5	6	0.8	0	0	5	0.4	4	0.3	1	0.1	1	0.1	3	0.2	2	0.1
Northern redhorse	7	0.9	0	0	0	0	0	0	2	0.2	11	0.8	2	0.1	5	0.4	3	0.2
Quillback	8	1.0	3	0.4	3	0.3	4	0.4	10	0.8	16	1.1	10	0.7	0	0	42	3.0
Rainbow smelt	0	0	6	0.8	5	0.5	2	0.2	0	0	0	0	21	1.5	0	0	2	0.1
Rainbow trout	0	0	1	0.1	3	0.3	0	0	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	1	0.1	0	0	0	0	0	0	4	0.3	0	0	2	0.1	7	0.5
Round whitefish	0	0	0	0	3	0.3	0	0	1	0.1	0	0	0	0	0	0	0	0
Smallmouth bass	1	0.1	0	0	1	0.1	0	0	3	0.2	2	0.1	0	0	2	0.1	0	0
Stone cat	3	0.4	2	0.2	4	0.4	3	0.3	3	0.2	14	1.0	5	0.4	3	0.2	0	0
Tiger musky	5	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	689	86.1	171	21.4	380	38.0	163	14.8	161	13.4	180	12.9	158	11.3	176	12.6	154	11.0
White bass	21	2.3	14	1.8	10	1.0	1	0.1	13	1.1	7	0.5	9	0.6	11	0.8	8	0.6
White perch	229	28.6	15	1.9	28	2.8	318	28.9	105	8.8	398	28.4	266	19.0	47	3.36	285	20.4
White sucker	499	62.4	975	121.9	358	35.8	443	40.3	218	18.2	464	33.1	263	18.8	258	18.4	284	20.3
Yellow perch	427	5.4	267	33.4	621	62.1	343	31.2	313	26.4	832	59.4	430	30.7	173	12.4	313	22.4

Table 5.–Catch and percent contribution of year classes of walleye from fall gillnet surveys, Saginaw Bay, Lake Huron, 1994-99. Catch-per-unit-effort (CPUE) is catch per 305m.

Year class	Age	Percent	CPUE	Age	Percent	CPUE	Age	Percent	CPUE
	1994			1995[a]			1996[a]		
1995	---	---	---	0	3.3	0.4	1	17.6	1.9
1994	0	3.0	0.2	1	23.5	2.7	2	28.0	3.0
1993	1	4.2	0.7	2	0.7	0.1	3	4.6	0.5
1992	2	7.9	1.2	3	8.6	1.0	4	3.1	0.3
1991	3	19.4	2.7	4	16.9	2.0	5	11.9	1.3
1990	4	21.8	3.2	5	18.5	2.1	6	12.3	1.3
1989	5	15.8	2.5	6	12.9	1.5	7	11.1	1.2
1988	6	15.8	2.4	7	8.3	0.9	8	5.4	0.6
1987	7	9.1	1.4	8	5.6	0.6	9	4.6	0.5
1986	8	3.0	0.5	9	0.7	0.1	10	1.5	0.2
1985	9	---	---	10	0.3	<0.1	11	---	---
1984	10	---	---	11	0.7	0.1	12	---	---
1983	11	---	---	12	---	---	13	---	---
1982	12	---	---	13	---	---	14	---	---
1981	13	---	---	14	---	---	15	---	---
Mean	4.3			4.1			4.1		
Total		100	14.8		100	11.5		100	10.6
	1997[a]			1998[a]			1999[a]		
1999	---	---	---	---	---	---	0	0.4	0.1
1998	---	---	---	0	5.2	0.7	1	52.8	6.8
1997	0	1.0	0.1	1	33.2	4.2	2	17.3	2.2
1996	1	2.5	0.2	2	1.3	0.2	3	1.3	0.2
1995	2	16.9	1.7	3	10.5	1.3	4	4.3	0.6
1994	3	28.9	2.9	4	18.8	2.4	5	6.1	0.8
1993	4	4.0	0.4	5	5.7	0.7	6	2.6	0.3
1992	5	5.0	0.5	6	4.4	0.6	7	6.1	0.8
1991	6	10.9	1.1	7	7.4	0.9	8	3.9	0.5
1990	7	8.5	0.8	8	6.1	0.8	9	2.6	0.3
1989	8	10.9	1.1	9	3.1	0.4	10	1.7	0.2
1988	9	8.5	0.8	10	3.5	0.4	11	0.9	0.1
1987	10	2.0	0.2	11	0.4	0.1	12	---	---
1986	11	0.5	0.1	12	0.4	0.1	13	---	---
1985	12	0.5	0.1	13	---	---	14	---	---
Mean	4.8			3.7			2.8		
Total		100	10.1		100	13.0		100	12.8

[a] Data based on expanded netting effort catch to provide a larger sample size. Total catch per 305m therefore differs slightly from value reported in Table 4, which is based solely on catch from traditional netting locations.

Table 6.–Mean length (mm) at age of walleye and yellow perch from Saginaw Bay, Lake Huron, from fall gillnet data for 1992-99, compared with Michigan average lengths from August-September catches. Saginaw Bay historic average for 1926-38 is also included for walleye[b]. Standard error of the mean in parentheses. No means included for sample sizes less than 5 specimens. Growth Index is calculated with methodology from Schneider et al. (2000).

Age	1992	1993	1994	1995	1996	1997	1998	1999	Michigan average[a]	Bay historic average[b]
Walleye										
0	--- ---	--- ---	207 (10.4)	224 (4.6)	--- ---	--- ---	227 (4.0)	--- ---	180	---
1	320 (2.6)	306 (7.7)	348 (8.8)	346 (3.0)	352 (4.9)	330 (13.5)	341 (2.1)	360 (1.4)	250	254
2	438 (4.3)	410 (3.4)	426 (13.9)	--- ---	437 (3.7)	419 (4.2)	--- ---	438 (4.0)	338	320
3	500 (5.0)	465 (4.9)	473 (6.0)	470 (3.8)	478 (11.6)	468 (3.8)	482 (12.7)	--- ---	386	371
4	535 (6.1)	516 (4.3)	521 (5.3)	501 (7.2)	537 (16.4)	504 (5.6)	508 (11.0)	505 (10.0)	437	411
5	548 (6.8)	537 (4.8)	537 (5.1)	543 (4.3)	517 (9.0)	536 (11.6)	496 (21.0)	544 (6.6)	472	457
6	588 (12.2)	552 (5.7)	564 (6.0)	555 (5.3)	582 (8.6)	547 (6.2)	565 (8.2)	570 (14.0)	516	483
7	611 (11.6)	580 (9.5)	613 (15.7)	572 (8.3)	568 (6.5)	576 (11.9)	551 (7.0)	560 (13.0)	541	505
8	638 (9.8)	601 (10.4)	612 (17.0)	590 (12.2)	579 (14.2)	586 (12.9)	570 (9.2)	563 (17.7)	561	533
9	--- ---	--- ---	--- ---	--- ---	619 (27.4)	579 (11.5)	612 (23.0)	588 (8.0)	582	582
10	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	624 (22.5)	--- ---	---	---
Growth Index	+3.30	+1.68	+2.60	+2.23	+2.54	+2.00	+2.08	+2.45		-0.60
Yellow Perch										
0	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	84	---
1	--- ---	153 (11.0)	--- ---	148 (0.9)	150 (2.2)	141 (1.2)	153 (1.9)	149 (1.2)	127	---
2	176 (3.6)	185 (8.2)	148 (1.6)	161 (2.3)	151 (1.0)	155 (1.1)	154 (1.0)	159 (0.9)	160	---
3	196 (2.6)	189 (2.3)	176 (3.3)	187 (3.5)	184 (1.8)	189 (2.2)	172 (1.9)	184 (2.5)	183	---
4	211 (3.2)	195 (2.8)	198 (1.8)	205 (2.3)	196 (1.6)	202 (1.9)	198 (4.6)	199 (2.2)	208	---
5	235 (5.6)	208 (3.4)	214 (2.1)	220 (4.6)	211 (1.9)	227 (3.3)	217 (2.4)	212 (2.2)	234	---
6	237 (9.4)	213 (5.2)	243 (8.1)	248 (9.2)	232 (4.4)	239 (4.4)	235 (5.2)	226 (2.4)	257	---
7	--- ---	216 (8.1)	--- ---	--- ---	244 (7.2)	247 (6.4)	251 (6.5)	252 (4.9)	277	---
8	--- ---	--- ---	--- ---	--- ---	--- ---	256 (16.5)	--- ---	269 (6.5)	292	---
9	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	284 (6.6)	302	---
Growth Index	+0.10	-0.48	-0.49	0.00	-0.31	-0.46	-0.37	-0.46		---

[a] From Schneider et al. (2000).

[b] From Hile (1954).

Table 7.–Incidence of void stomachs and percent-abundance of food items found in stomachs of walleye from fall gillnets in Saginaw Bay, 1989-97.

				Percent-Abundance								
Year	Stomachs examined	% void	Unidentified fish remains	Gizzard shad	Yellow perch	Spottail shiner	Rainbow smelt	Alewife	Ninespine stickleback	White sucker	White perch	Channel catfish
1989	257	26	27	63	0	0	<1	8	1	0	<1	0
1990	508	37	22	76	0	0	<1	1	<1	0	<1	0
1991	669	36	34	63	<1	<1	0	2	0	<1	0	0
1992	171	56	62	2	2	2	14	17	0	2	0	0
1993	371	52	39	59	0	0	<1	2	0	0	0	0
1994	84	45	24	70	3	3	0	0	0	0	0	0
1995	291	45	31	28	1	<1	0	37	0	<1	1	0
1996	148	61	72	23	4	0	0	1	0	0	0	0
1997	204	35	59	12	3	7	0	17	0	0	2	0
1998	234	47	40	2	1	2	0	54	0	0	0	1
1999	231	49	36	<1	8	13	<1	41	0	0	<1	0

Table 8.–Mean relative weight by length class[a] and all sizes combined for walleye and yellow perch collected in gillnets during fall 1989-98 from Saginaw Bay, Lake Huron. N=sample size for that year.

Year	Stock-quality	Quality-preferred	Preferred-memorable	All sizes combined	N
			Walleye		
1989	100	95	95	96	259
1990	98	102	97	98	508
1991	95	96	95	96	689
1992	87	88	90	89	171
1993	91	91	88	90	382
1994	88	88	90	88	155
1995	92	93	92	95	302
1996	90	92	90	90	267
1997	95	90	92	91	204
1998	91	89	88	90	231
1999	88	90	86	88	231
			Yellow perch		
1989	NA	NA	NA	NA	NA
1990	98	97	92	97	101
1991	82	80	83	81	231
1992	82	86	86	84	202
1993	96	95	94	96	218
1994	99	96	92	96	203
1995	91	87	90	89	501
1996	96	93	90	95	1658
1997	94	95	93	94	962
1998	87	85	86	86	348
1999	79	90	87	82	528

[a]See Table 9 for explanation of size classes.

Table 9.–Walleye and yellow perch proportional stock density (PSD)[a] and relative stock density (RSD-P and RSD-M)[b] in parentheses from fall gill-net data, 1992-99 from Saginaw Bay, Lake Huron.

Species	1992	1993	1994	1995	1996	1997	1998	1999
Walleye	81(46,8)	93(40,3)	96(58,5)	76(55,3)	83(46,6)	96(51,8)	63(47,3)	55(25,3)
Yellow perch	62(18,4)	45(3,0)	73(9,1)	38 (6,1)	22(2,0)	33(5,1)	26(3,0)	23(4,1)

[a] Stock and quality size for walleye is 250mm and 380mm, respectively, yellow perch: 130mm and 200mm. Range of PSD values suggested as indicative of balance when the population supports a substantial fishery is 30-60 for walleye and 30-50 for yellow perch (Anderson and Weithman 1978).

[b] Preferred size for walleye is 510mm, memorable size is 630mm. For yellow perch, it is 250mm and 300mm, respectively (Anderson and Gutreuter 1983).

Table 10.–Age composition of white perch and yellow perch from the gillnet catch, Saginaw Bay, Lake Huron, 1993-99.

	White perch							Yellow perch						
Age	1993	1994	1995	1996	1997	1998	1999	1993	1994	1995	1996	1997	1998	1999
0	---	27	3	---	2	8	8	---	---	---	---	1	1	2
1	5	151	57	102	43	5	209	5	---	93	34	32	8	198
2	15	15	1	31	55	2	4	11	6	44	193	135	83	138
3	4	11	---	3	21	3	1	80	29	47	91	164	51	45
4	3	4	---	2	4	---	1	71	98	101	85	66	29	49
5	1	6	---	---	1	---	1	28	82	32	82	43	42	56
6	---	---	---	---	1	3	---	16	21	10	31	25	17	44
7	---	---	---	---	2	---	---	5	1	---	12	14	5	19
8	---	---	---	---	---	---	---	2	23	1	2	8	4	10
9	---	---	---	---	---	---	---	1	---	1	---	---	---	5
10	---	---	---	---	---	---	---	---	---	---	---	1	---	2
11	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Number aged	28	214	61	138	129	21	224	218	241	328	531	488	240	569
Mean age	2.29	1.67	0.97	1.31	1.99	1.71	1.02	3.84	4.73	3.20	3.26	3.25	3.43	2.88

Table 11.–Age composition (percent) and mean length (mm) at age for channel catfish 1997-99, Saginaw Bay. Sample size in parenthesis. Means limited to sample sizes of at least five fish. State average is a mid-growing season average[a]. Growth index is calculated with the methodology from Schneider et al. (2000).

	1997		1998		1999		
Age	Percent	Mean Length	Percent	Mean Length	Percent	Mean Length	[a]State average
0	0.0 (0)	---	1.8 (1)	---	0.0 (0)	---	---
1	0.0 (0)	---	3.6 (2)	---	6.3 (5)	174	165
2	27.8 (15)	236	14.3 (8)	279	0.0 (0)	---	284
3	24.1 (13)	328	46.4 (26)	310	6.3 (5)	310	345
4	7.4 (4)	---	14.3 (8)	340	66.3 (53)	343	401
5	11.1 (6)	404	3.6 (2)	403	5.0 (4)	---	450
6	13.0 (7)	411	0.0 (0)	---	7.5 (6)	432	490
7	5.6 (3)	---	5.4 (3)	---	1.3 (1)	---	523
8	1.9 (1)	---	0.0 (0)	---	3.8 (3)	---	559
9	0.0 (0)	---	3.6 (2)	---	1.3 (1)	---	589
10	0.0 (0)	---	3.6 (2)	---	0.0 (0)	---	605
11	1.9 (1)	---	0.0 (0)	---	1.3 (1)	---	---
12	3.7 (2)	---	0.0 (0)	---	0.0 (0)	---	---
13	3.7 (2)	---	0.0 (0)	---	0.0 (0)	---	---
14	0.0 (0)	---	0.0 (0)	---	0.0 (0)	---	---
15	0.0 (0)	---	0.0 (0)	---	1.3 (1)	---	---
16	0.0 (0)	---	0.0 (0)	---	0.0 (0)	---	---
17	0.0 (0)	---	0.0 (0)	---	0.0 (0)	---	---
18	0.0 (0)	---	1.8 (1)	---	0.0 (0)	---	---
19	0.0 (0)	---	1.8 (1)	---	0.0 (0)	---	---
Total	100 (54)	348	100 (56)	327	100 (80)	329	
Average age	4.57		4.18		4.43		
Growth index		-1.85		-1.44		-1.38	

[a]State average from Schneider et al. (2000)

Table 12.–Length-weight regression equations for select species based on 1999 fall gillnet collections in Saginaw Bay, Lake Huron. Logs are base 10, weight (wt) is in grams, and 1ength (len) is in mm.

Species	Equation	r^2
Walleye	log(wt)=3.153 log(len)-5.440	0.98
Yellow perch	log(wt)=3.530 log(1en)-6.152	0.94
White perch	log(wt)=2.298 log(1en)-4.658	0.56
Channel catfish	log(wt)=3.111 log(1en)-5.381	0.99

Table 13.–Location of trawl stations and number of tows performed in Saginaw Bay, 1990-2000. All sampling was conducted in fall except where indicated otherwise.

Quadrant Location	Site description	1990	1991	1992	1993	1994	1995[a]	1996	1997	1998	1999	2000[b]
Northeast	North Island & Wildfowl Bay	5	4	16	5	6	6	6	13	13	9	9
Southeast	Fish Point	4	4	6	5	3	9	6	16	12	15	6
Southwest	Pinconning	4	4	3	13	13	9	12	15	17	20	6
Northwest	AuGres	3	4	11	15	10	15	6	23	22	20	6
Total		16	16	36	38	32	39	30	31	27	27	33
Study total												580[c]

[a] Total for northwest quadrant includes six experimental trawls near Charity Islands
[b]Total number of tows includes 6 tows made at Outer Bay sites.
[c] Total for study includes 15 tows from 1989.

Table 14.–Mean catch-per-unit-effort of fish collected from trawling in Saginaw Bay, Lake Huron, 1990-99 based on fall data only. Total number of tows is in parentheses. See Table 3 for complete listing of scientific names for each species.

Species	1991 (16)	1992 (37)	1993 (38)	1994 (32)	1995 (39)	1996 (30)	1997 (31)	1998 (27)	1999 (27)
Alewife	80	302	191	48	307	99	301	1,590	82
Bluegill	0	0	0	<1	0	<1	0	0	0
Burbot	0	0	0	0	0	0	0	0	0
Channel catfish	<1	<1	1	6	3	6	2	3	4
Common carp	3	3	3	9	7	4	4	7	6
Emerald shiner	15	9	1	0	0	1	13	1	1
Freshwater drum	25	3	9	28	28	16	5	26	9
Gizzard shad	50	<1	19	8	6	23	18	23	3
Johnny darter	<1	12	10	11	29	21	20	5	6
Lake whitefish	0	<1	0	0	1	<1	1	0	<1
Pumpkinseed	<1	0	0	0	0	<1	0	0	2
Quillback	<1	<1	1	1	1	1	<1	0	4
Rainbow smelt	44	280	468	58	22	15	1,585	70	32
Rock bass	0	0	0	0	0	<1	0	<1	5
Round goby	0	0	0	0	0	0	0	0	4
Shorthead redhorse	0	0	0	<1	0	0	0	0	<1
Spottail shiner	124	182	97	204	373	209	809	665	1,935
Trout perch	166	200	416	513	514	474	733	1,730	406
Walleye	6	1	1	1	1	1	3	10	7
White bass	6	<1	2	6	1	<1	4	2	<1
White perch	404	92	28	183	528	277	416	346	141
White sucker	12	8	10	10	7	8	28	12	10
Yellow perch	177	70	38	24	126	85	122	170	90

Table 15.–Number of young-of-the-year yellow perch caught per ten-minute tow (CPUE) from Saginaw Bay, Lake Huron and their mean total length, fall 1970-99[a].

Year	CPUE	Mean total length (mm)
1970	29.5	96.5
1971	20.2	91.4
1972	13.9	83.8
1973	30.6	91.4
1974	27.9	88.9
1975	247.9	88.9
1976	11.1	91.4
1977	52.9	91.4
1978	99.8	86.4
1979	166.7	78.7
1980	39.0	86.4
1981	71.3	83.8
1982	686.7	76.2
1983	251.9	76.2
1984	171.0	78.7
1985	147.8	78.7
1986	71.4	73.7
1987	131.5	81.3
1988	56.6	76.2
1989	252.8	71.1
1990	39.0	79.5
1991	110.8	70.2
1992	7.1	76.2
1993	0.5	90.7
1994	3.9	85.0
1995	98.9	72.8
1996	37.3	81.9
1997	83.3	73.8
1998	112.5	76.1
1999	19.8	92.4

[a] Data prior to 1990 from Haas and Schaeffer (1992).

Table 16.–Number of age-0 walleye caught, number of trawl tows, and age-0 walleye catch rate (expressed as mean catch per 10-minute tow) for fall trawls on Saginaw Bay from 1986 to 1999.

Year	Number of age-0 walleye captured	Number of trawl tows	Age-0 walleye catch rate
1986	20	53	0.43
1987	34	86	0.46
1988	39	80	0.59
1989	19	15	1.27
1990	0	16	0.00
1991	28	16	1.89
1992	6	37	0.16
1993	1	38	0.02
1994	22	35	0.64
1995	14	39	0.36
1996	0	30	0.00
1997	83	34	2.18
1998	149	27	8.55
1999	20	27	0.74

Table 17.–White perch catch from trawling effort, fall 1985-99, Saginaw Bay, Lake Huron[a].

Year	Total catch	Number of tows	Number of minutes	Number per tow	Number per minute
1985	0	NA	NA	---	---
1986	606	167	1,457	3.6	0.42
1987	7,514	252	2,321	29.8	3.24
1988	41,427	248	2,181	167.0	18.99
1989	34,817	15	150	2,321.1	232.11
1990	10,739	16	158	671.2	68.97
1991	6,463	16	149	403.9	43.52
1992	3,295	36	360	91.5	9.15
1993	1,076	38	419	27.9	2.57
1994	6,062	32	320	183.0	18.94
1995	19,002	36	360	528.2	52.78
1996	8,130	30	306	277.2	26.6
1997	12,873	31	320	416.4	40.2
1998	7,415	27	245	345.8	30.3
1999	2,400	27	170	141.2	14.1

[a] Data prior to 1990 from Haas and Schaeffer (1992).

Table 18.–Mean length (mm) at age for yellow perch from fall Saginaw Bay trawls, 1986-98[a].

Age	Survey year												
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Males												
Age-1	118	120	119	120	124	124	124	131	145	135	132	131	123
Age-2	137	137	137	141	146	146	149	155	159	169	166	166	156
Age-3	154	152	150	157	165	167	164	178	176	179	189	195	180
Age-4	184	168	164	170	175	184	181	194	191	192	200	202	205
Age-5	199	190	177	185	186	201	187	202	200	203	211	219	211
Age-6	209	189	201	194	195	212	209	213	200	211	219	219	-----
Age-7	249	223	211	210	210	242	224	262	222	236	247	234	245
	Females												
Age-1	121	122	123	123	126	127	127	132	148	142	137	136	129
Age-2	145	143	143	149	157	155	159	169	172	179	183	179	159
Age-3	173	166	160	169	176	179	173	188	195	193	203	210	200
Age-4	197	190	183	184	201	202	204	210	214	211	220	232	210
Age-5	233	214	207	208	215	221	236	242	235	225	233	230	234
Age-6	265	226	217	222	235	246	249	245	246	247	260	286	294
Age-7	222	256	245	246	246	273	244	283	296	276		279	

[a] Data prior to 1990 from Haas and Schaeffer (1992).

Table 19.–Frequency of occurrence for food items in yellow perch from Saginaw Bay fall trawl surveys, 1986-97.

	Survey year									Grand
Taxa	1986	1987	1988	1991	1992	1994	1995	1996	1997	total
Bosmina	5.50	1.59	3.37	2.73	17.65	5.81	0.80	1.72	1.16	3.61
Daphnia	1.26	0.32	0.59	0.00	1.96	0.00	0.00	0.00	0.00	0.61
Chydorid	67.14	25.50	27.16	19.09	61.76	41.86	8.00	18.97	13.87	34.96
Macrothricid	13.99	4.44	13.48	16.36	27.45	18.60	12.80	5.17	2.89	11.22
Leptadora	0.16	2.01	0.10	0.00	0.00	0.00	0.00	0.00	4.62	0.67
Copepod	37.58	51.32	45.49	57.27	46.08	39.53	41.60	53.45	30.64	46.05
Ostracod	27.36	25.61	34.39	39.09	63.73	45.35	48.80	50.86	45.66	32.92
Sida	23.27	16.51	3.17	1.82	38.24	24.42	3.20	8.62	6.36	13.17
BC	0.00	0.00	0.00	0.00	21.57	13.95	20.80	0.00	1.16	1.92
All plankton	73.27	62.54	59.66	65.45	78.43	68.60	78.40	63.79	47.98	65.26
Pelecepod	7.39	3.60	3.77	9.09	3.92	0.00	5.60	11.21	14.45	4.89
Gastropod	3.30	0.74	0.50	0.00	0.00	0.00	0.80	0.86	2.31	1.12
Zebra mussel	0.00	0.00	0.00	0.91	16.67	20.93	1.60	12.93	4.62	1.69
Isopod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	1.16	0.03
Hydracarina	8.49	2.54	9.42	0.91	2.94	1.16	0.80	0.00	1.16	5.72
Amphipod	4.40	1.90	1.29	0.00	28.43	15.12	0.00	4.31	36.42	3.39
Total "Others"	19.18	8.57	13.97	10.91	41.18	33.72	8.80	21.55	49.71	14.80
Ephemerida	3.46	0.21	0.69	0.00	0.00	0.00	0.00	1.72	0.00	1.05
Tricoptera	5.82	1.38	0.10	0.00	4.90	6.98	8.00	29.31	10.98	3.39
Chironomid pupae	28.30	30.16	33.89	3.64	25.49	3.49	12.80	26.72	11.56	28.35
Chironomid larvae	66.67	78.41	77.40	71.82	69.61	47.67	60.00	68.10	46.82	73.22
All insects	71.07	82.33	81.27	72.73	80.39	54.65	67.20	75.00	56.07	77.66
All fish	18.08	7.41	7.33	10.00	10.78	9.30	12.00	16.38	21.97	10.32
Non-empty stomachs	636	945	1009	110	102	86	125	116	173	3129