STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-53-R-13

Study No.: 453 **Title:** Population dynamics of contemporary yellow perch and walleye stocks in Michigan waters of Green Bay, Lake Michigan

Period Covered: April 1, 1996 to March 31, 1997

Study Objective: (1) To assemble yellow perch and walleye catch and effort data from the sport and/or commercial fisheries; and, where data are available, determine age and size composition, growth, and mortality of fish in those catches; (2) to establish indices of abundance for pre-recruit perch and walleyes and similar indices for populations not monitored by sport or commercial fisheries; (3) to determine discreteness of perch and walleye populations, and movements and range of these populations; (4) to determine interspecific relationships (food habits, predation, and competition for food and space); (5) to determine standing crop and harvestable surplus for perch and walleye populations.

Summary: Creel surveys, assessment netting, and a tagging program produced data for walleye and yellow perch populations in Michigan waters of Green Bay (Big and Little bays de Noc, and open waters south to the Menominee River). Creel surveys have been conducted annually since 1985, assessment netting and tagging since 1988.

According to creel survey estimates, 1996 sport catches were 22% lower for walleyes, and 107% higher for yellow perch, compared to 1995. Fishing effort dropped by 6%.

Approximately 1,000 fish representing 22 species were collected in 1996 assessment nets. Fish were measured or counted, and 38% were examined to determine sex, maturity, and stomach contents. Yellow perch was the most common species collected (47% of the total number), and walleye ranked eighth (1% of the total). Diet information was summarized from 292 yellow perch, 15 walleye, and 142 other fish of various species. Zebra mussels were found in the stomachs of two perch, one in each bay. Two white suckers were the only other fish found with zebra mussels in their stomachs during the assessment period.

Weak yellow perch year classes were produced in 1996 in both bays, according to trawl sampling. Overall catches of perch were down in Little Bay de Noc in both trawl and gill net samples, but catches of yearling and older perch were moderately strong in Big Bay de Noc relative to other sampling years.

Over 3,000walleye were tagged in spring of 1996. Cumulatively, 31,272 walleye and 19,572 yellow perch have been tagged since 1988. Tag-return data were used to estimate exploitation and survival rates. Exploitation rates for walleye, unadjusted for non-reporting, were 4.6% in Little Bay de Noc, 1.6% in Big Bay de Noc, 3.0% in Cedar River, and 5.8% in Menominee River. Walleye survival was 60.0% in Little Bay de Noc, over 95% in Big Bay de Noc, 86.7% in

Cedar River, and 41.2% in Menominee River. The exploitation rate was 3.6% and survival was 41.8% for yellow perch in Little Bay de Noc.

Job 1. Title: Assemble sport and commercial fisheries data from Michigan waters of Green Bay.

Findings: Creel survey data have been collected for the Michigan waters of Green Bay (statistical district MM-1) by Michigan Department of Natural Resources (MDNR) personnel from Districts 2 and 3 since 1985 (Table 1). Creel survey methods and results are summarized under F-53-R, Study 427 by Rakoczy and Rogers (1987, 1988, 1990), Rakoczy and Lockwood (1988), Rakoczy (1992a, 1992b), and Rakoczy and Svoboda (1994). Creel estimates for 1994, 1995, and 1996 have been calculated (G.P. Rakoczy, personal communication, Charlevoix Fisheries Station, Charlevoix, Michigan), but are as yet unpublished. The 1996 walleye catch, estimated from all survey sites combined, was 22% below the 1995 estimate, but was higher than the 1993-95 average. Yellow perch catch was 107% higher in 1996 than in 1995, and was the highest estimated catch since 1992. Effort dropped 6% between 1995 and 1996.

Job 2. Title: Collect additional biological and abundance data.

Findings: Marquette Fishery Station personnel collected monthly samples of adult and juvenile fish from June through September in both Big and Little bays de Noc. Totaled over all months, standardized sampling effort entailed 40 bottom trawl hauls (20 in Little Bay de Noc and 20 in Big Bay de Noc), each of 10-min duration, and 32 overnight gill net sets (16 in each bay). The trawl was a shrimp try net with a 10-ft headrope, 0.75-in square mesh body, and 0.25-in square mesh codend liner. Gill nets were 6-ft deep and 120-ft long, with replicated 10-ft panels of experimental monofilament stretch mesh measuring 1.0-, 1.5-, 2.0-, 2.5-, 3.0-, 4.0-in.

Total length, sex, maturity, and diet data were recorded for 292 yellow perch and 15 walleye (Table 2). An additional 262 yellow perch were measured or counted only. Besides walleye and yellow perch, 613 fish, representing 20 other species, were caught. Of these, 142 were measured and examined to determine sex, maturity, and stomach contents.

Yellow perch was the most abundant species present in 1996 assessment netting, and walleye ranked eighth. Similar rankings have occurred in other years. Yellow perch were less abundant in Little Bay de Noc than in Big Bay de Noc, but the opposite was true for walleye.

Catch per unit effort (CPUE) was calculated for yellow perch caught in standard monthly trawl hauls and gill net sets (Table 3). Trawl catches of YOY yellow perch (<3.5 inches) were used as an index of year-class strength, and gill-net catches of perch 7-inches and larger (generally ≥ 3-years old) were used as an index of abundance for sizes large enough to interest sport anglers. The 1996 YOY CPUE in trawl hauls was relatively weak in both bays de Noc. Gill net CPUEs for yellow perch 7 inches and larger were also relatively low in both bays, but the overall CPUE of perch in gill nets was relatively high in Big Bay de Noc.

Lymphocystis, an endemic viral skin disease common to walleye, especially during spawning (Scott and Crossman 1973), was noted on fish at each tagging location. Compared to 1995, incidence of the disease on 1996 spawning populations increased in Little Bay de Noc from 8% to 10%, increased in Big Bay de Noc from 6% to 14%, decreased in Cedar River from 25% to

19%, and decreased in Menominee River from 20% to 16%. Lymphocystis was not seen on any of the 15 walleye caught in assessment nets.

Threespine stickleback is a non-indigenous species that has been collected in Big Bay de Noc assessment nets since 1989. In 1996, 14 threespine sticklebacks were caught in Big Bay de Noc during June and July sampling. White perch is another non-indigenous species whose presence in Little Bay de Noc was first noted in 1990. Fifteen white perch were caught during 1996 sampling, 5 in Little Bay de Noc in June and July, and 10 in Big Bay de Noc (first documentation of white perch in this bay) during August and September.

Bythotrephes cederstroemi have been observed in fish stomachs collected from both bays de Noc since 1988 (Schneeberger 1989, 1991). In 1996, *Bythotrephes* were found only in stomachs of yellow perch netted in Little Bay de Noc.

Judging from non-quantified observations, abundance of zebra mussels (*Dreissena polymorpha*) has increased in Little Bay de Noc since they were first seen in 1993. Again during 1996, zebra mussels of various sizes were very abundant on overnight gill net anchors and ropes, in trawl hauls, and on submergent plants (e.g., Chara) in Little Bay de Noc. Only a few zebra mussels were caught or observed during 1995 in Big Bay de Noc, but in 1996, zebra mussels were extremely abundant on vegetation collected via routine trawl sampling. Zebra mussels were present in stomach samples from two yellow perch (one from each bay) and two white suckers (see Job 4).

Job 3. Title: <u>Determine discreteness of perch and walleye populations.</u>

Findings: In Michigan waters of Green Bay, individually numbered monel bird leg bands have been used to jaw tag 31,332 walleye between 1988 and 1996, and 19,572 yellow perch between 1989 and 1993. Virtually all tagged walleye were of legal size, and 99.8% of the tagged yellow perch were 7 inches or larger. Of 3,013 walleye tagged in 1996, 700 were tagged in Little Bay de Noc, 1,324 were tagged in Big Bay de Noc, 445 were tagged in or near the Cedar River, and 544 were tagged in the Menominee River (Table 4). Tagging operations were conducted by personnel from the Marquette Fishery Station and from Districts 1, 2, 3, and 4. Additional help for the Menominee River walleye population was provided by personnel from the Wisconsin DNR. Walleyes were tagged coincident with egg-take operations in Little Bay de Noc where fish were collected in fyke nets. Boomshocking boats were used to catch walleyes for tagging in all other locations, though a few were also obtained from commercial pound nets set near the mouth of the Cedar River. Numbers tagged were well below targets except at Little Bay de Noc. Record snowfall and persistent cold temperatures combined to spread spawning over an extended period of time so fish did not congregate in concentrated numbers. Also, melting of record snow accumulations made collections difficult due to high river flows and turbidity.

Advertisements for the return of tags have appeared in local newspapers, sport-club information bulletins, and notices at launch sites. An angler who catches a tagged fish is asked to report the species, tag number, fish length, date of capture, location of capture, whether they kept or released the fish, and their name, address, and phone number to a proximate MDNR office. These data are entered into a computer and a program calculates and stores the number of days between the tag and capture dates, the distance between the tag and capture sites, and the growth of the fish; the program also generates a letter that passes most of this information on to the angler and provides some basic facts about the tagging program. Changes are made annually to

the text of the letter in an attempt to provide new information and retain the interest of participating anglers.

A total of 152 walleye tag returns were reported between May 1996 and April 1997. Returns from fish tagged in Little Bay de Noc included fish that had been tagged in 1988, 1989, and 1991-96. Big Bay de Noc returns came from fish tagged in 1990-93 and 1995-96. Fish from each tagging year 1993-96 contributed to reported catches in Cedar and Menominee rivers. Only one tagged yellow perch (tagged in 1993) was caught in 1996.

A new effort was initiated in 1996 in an attempt to gain further information about tagged fish and walleye fisheries in general. Drop boxes were constructed and placed at 10 access sites throughout the study area. Signs were posted asking walleye anglers to fill out brief catch summary forms that were available from a compartment in the drop boxes. Completed forms could be deposited in a separate slotted portion of drop boxes. Periodic checking by creel clerks and other MDNR personnel resulted in the collection of 89 responses. Forms have only been examined cursorily to date, but interesting information has been obtained including catch data (date, time of day, location, fish length) for tagged, untagged, and undersize walleye. Anglers also provided interesting comments and observations about fishing techniques (e.g., lure selection, fishing depth), the weather, and catches of other species.

Job 4. Title: <u>Determine forage utilization of perch and walleye in Michigan waters of Green Bay.</u>

Findings: Fish stomach contents were examined in the field and food items were grossly identified and counted. Fish prey were measured and identified to species when possible, insects were identified to order, or family, and zooplankton was considered a broad, inclusive category except that *Bythotrephes cederstroemi* was differentiated from other zooplankton.

In Little Bay de Noc, diet data were taken from 131 yellow perch and 12 walleye. Fish, zooplankton, (mostly *Bythotrephes*), aquatic insects, and amphipods were prominent food items in yellow perch stomachs, and one perch stomach contained 20 zebra mussels (Table 5). Most walleye had eaten fish (alewife, yellow perch, and unidentified), and one had eaten a burrowing mayfly nymph (Table 6).

Stomachs were examined from 161 yellow perch and 3 walleye in Big Bay de Noc. Yellow perch ate fish (mostly sticklebacks and darters), aquatic insects, amphipods, zooplankton, and various other food items including one zebra mussel (Table 7). The one walleye stomach that was not empty contained an unidentified fish (Table 8).

Job 5. Title: <u>Develop population models.</u>

Findings: Exploitation rates (unadjusted for non-reporting) and survival were estimated from tag-return data using formulae provided by Brownie et al. (1985). Based on cumulative tag returns through 1996, walleye exploitation rates were 4.6% in Little Bay de Noc, 1.6% in Big Bay de Noc, 3.0% in Cedar River, and 5.8% in Menominee River. Estimated exploitation rate of yellow perch in Little Bay de Noc was 3.6%. Walleye survival was over 95% in Big Bay de Noc, 87% in Cedar River, 60% in Little Bay de Noc, and 41% in Menominee River. Survival of yellow perch in Little Bay de Noc was estimated to be 42%.

Using the same factor (2.7) as in past years to adjust for non-reporting, estimated exploitation for walleye was 12.4% in Little Bay de Noc, 4.3% in Big Bay de Noc, 8.1% in Cedar River, and 15.7% in Menominee River. An adjusted estimate of yellow perch exploitation in Little Bay de Noc was 10%.

Mean length at age was calculated for 157 walleye and 150 yellow perch caught in 1996. Walleye ages were determined from spines collected during tagging near Cedar River (Table 9). Length-at-age was significantly larger for Cedar River female walleyes than for males at ages 4 through 7. Walleye spines were also collected from other tagging locations, but samples have not yet been processed. Yellow perch ages were found by examining scales of fish collected in assessment nets (Table 10). Big Bay de Noc yellow perch were generally larger than those from Little Bay de Noc after age 1. Differences were significant for ages 2 and 3.

Job 6. Title: <u>Evaluate results and write report.</u>

Findings: This report was prepared on schedule.

Literature Cited:

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Table 1.–Estimated sport catch for walleye and yellow perch in Statistical District MM-1 (footnotes indicate sites and seasons included in estimates). Data from G. Rakoczy, Michigan DNR, Charlevoix.

Year	Effort (hours)	Walleye		Yellow perch	
		Number	Pounds	Number	Pounds
1985[a,b]	523,167	18,738	41,224	459,089	114,772
1986[a,b]	486,339	21,682	45,532	432,646	90,856
1987[a,b]	303,077	12,005	38,416	210,872	59,044
1988[a,c]	551,750	25,535	79,159	323,294	74,358
1989[a,c]	656,462	42,029	88,261	291,003	78,571
1990[a,b]	736,599	43,144	94,917	372,402	85,652
1991[a,b]	948,456	50,009	125,023	564,597	169,379
1992[a,b]	692,284	23,374	63,110	399,671	79,934
1993[a,b,d,e]	734,400	25,425	66,105	104,902	20,980
1994[a,b,d,e]	609,360	32,508	87,772	139,409	27,882
1995[a,b,d,e]	666,976	80,508	192,775	156,720	31,344
1996[a,b,d,e]	627,900	62,752	150,605[f]	323,789	64,758[f]

[a] Little Bay de Noc open water and ice seasons
[b] Big Bay de Noc open water season
[c] Big Bay de Noc open water and ice seasons
[d] Cedar River open water season
[e] Menominee River open water season
[f] Estimated from 1995 mean weight data - subject to revision

Table 2.–Species of fish sampled in Little Bay de Noc (LBDN) and Big Bay de Noc (BBDN), Jun-Sep, 1996.

Common name	Measured and examined[a]		Measured or counted only		Totals		
	LBDN	BBDN	LBDN	BBDN	LBDN	BBDN	All
Yellow perch	131	161	23	239	154	400	554
Spottail shiner	8	5	4	220	12	225	237
Alewife	12	39	2	33	14	72	86
Brook stickleback	0	2	0	78	0	80	80
Johnny darter	2	1	24	24	26	25	51
Trout-perch	5	10	3	33	8	43	51
White sucker	2	10	21	7	23	17	40
Walleye	12	3	0	0	12	3	15
White perch	5	10	0	0	5	10	15
Threespine stickleback	0	0	0	14	0	14	14
Northern pike	11	0	0	0	11	0	11
Rock bass	9	1	0	0	9	1	10
Bluegill	0	1	0	3	0	4	4
Brown bullhead	0	4	0	0	0	4	4
Smallmouth bass	0	0	0	2	0	2	2
Splake	1	1	0	0	1	1	2
Brown trout	1	0	0	0	1	0	1
Burbot	0	1	0	0	0	1	1
Carp	0	0	0	1	0	1	1
Gizzard shad	0	0	1	0	1	0	1
Rainbow smelt	0	0	1	0	1	0	1
White bass	1	0	0	0	1	0	1
Totals	200	249	79	654	279	903	1,182

[a] Stomach contents, sex, and maturity.

Table 3.–Catch-per-unit-effort for yellow perch in 10-min trawl hauls and 24-hr, 60-ft experimental gill net sets.

	Number of perch per trawl haul			Number of perch per gill-net lift		
Year	<3.5”	≥3.5”	All	<7”	≥7”	All
			Little Bay de Noc			
1988	35.3	43.1	71.8	15.1	4.8	16.8
1989	17.7	10.7	21.3	11.0	2.7	12.5
1990	10.3	18.0	24.0	9.4	1.8	9.8
1991	33.1	11.3	36.7	6.4	4.3	9.6
1992	4.3	11.0	13.2	12.6	5.9	16.1
1993	64.1	17.6	67.1	9.9	1.8	10.5
1994	9.7	3.2	12.9	14.4	3.2	17.5
1995	34.3	3.8	28.6	10.8	4.0	12.7
1996	3.4	0.9	4.2	7.9	0.7	8.6
			Big Bay de Noc			
1988	34.7	34.0	51.5	3.0	3.0	5.0
1989	3.5	3.7	3.6	14.9	7.1	20.2
1990	70.3	12.0	70.4	6.6	4.2	9.7
1991	205.0	1.5	205.2	8.4	3.8	9.4
1992	2.9	2.8	3.8	11.6	3.6	13.6
1993	23.4	1.7	24.0	9.4	2.0	9.5
1994	141.7	8.5	150.2	3.9	1.9	5.8
1995	44.1	60.0	52.6	5.2	1.4	5.9
1996	7.6	27.8	35.2	15.2	2.0	17.2

Table 4.–Number of fish tagged and tag returns by year from Michigan waters of Green Bay, 1988-96. Recovery year considered May of the year in the heading through April of the following year for walleye, and April through March for yellow perch.

Tag year	Number tagged	Recovery year									Total
		1988	1989	1990	1991	1992	1993	1994	1995	1996	
Walleye in Little Bay de Noc											
1988	2,496	167	141	72	42	12	21	14	5	1	475
1989	2,486	–	150	58	25	20	7	6	9	1	276
1990	1,744	–	–	95	33	13	15	3	0	0	159
1991	1,886	–	–	–	79	30	10	5	2	1	127
1992	1,690	–	–	–	–	50	18	11	5	3	87
1993	1,563	–	–	–	–	–	69	22	10	3	104
1994	1,246	–	–	–	–	–	–	69	23	7	99
1995	711	–	–	–	–	–	–	–	33	18	51
1996	700	–	–	–	–	–	–	–	–	21	21
Walleye in Big Bay de Noc											
1990	867	–	–	22	19	1	2	1	0	1	46
1991	354	–	–	–	6	3	3	1	2	1	16
1993	617	–	–	–	–	–	8	7	9	1	25
1994	1,458	–	–	–	–	–	–	11	5	0	16
1995	1,993	–	–	–	–	–	–	–	54	22	76
1996	1,324	–	–	–	–	–	–	–	–	26	26
Walleye in Cedar River											
1993	1,312	–	–	–	–	–	49	28	9	1	87
1994	1,500	–	–	–	–	–	–	72	18	4	94
1995	1,677	–	–	–	–	–	–	–	7	5	12
1996	445	–	–	–	–	–	–	–	–	3	3
Walleye in Menominee River											
1993	1,280	–	–	–	–	–	100	24	6	4	134
1994	1,500	–	–	–	–	–	–	127	16	4	147
1995	1,879	–	–	–	–	–	–	–	28	8	36
1996	544	–	–	–	–	–	–	–	–	17	17
Yellow perch in Little Bay de Noc											
1989	2,523	–	102	51	17	2	5	0	0	0	177
1990	2,127	–	–	73	30	12	1	1	0	0	117
1991	2,418	–	–	–	71	32	13	0	1	0	117
1992	3,683	–	–	–	–	137	49	3	1		191
1993	5,278	–	–	–	–	–	153	28	13	1	195
Yellow perch in Big Bay de Noc											
1990	1,059	–	–	19	3	0	0	0	0	0	22
1991	2,484	–	–	–	14	2	2	0	0	0	18

Table 5.–Diet data from 131 yellow perch collected in Little Bay de Noc, Jun-Sep, 1996.

	Observed occurrence in yellow perch stomachs			Length of yellow perch	
Food category	Frequency	Mean number per fish	Months	Min.	Max.
Bythotrephes	25	22.7	6,7,8,9	2.2	6.9
Ephemeroptera	23	1.3	6,7,8	3.8	8.0
Diptera	22	4.8	6,7,8,9	2.8	5.6
Fish[a]	17	1.7	6,7,8,9	3.0	7.9
Zooplankton	14	14.0	6,7,8	1.8	3.3
Amphipoda	13	3.9	6,8	3.1	5.1
Corixids	4	1.0	6,9	3.3	4.8
Isopoda	4	2.0	6	3.1	4.6
Mollusks[b]	3	9.3	6	4.6	8.0
Tricoptera	3	6.3	8	5.1	5.7
Crayfish	2	1.0	7	5.2	5.8
Eggs	1	30.0	6	3.0	3.0
Miscellaneous	7	–	6,7,9	2.9	8.0
Empty	33	–	6,7,8,9	2.1	9.9

[a] Johnny darter (8), trout-perch (4), unidentified (7 larvae and 10 juvenile/adults)
[b] Includes one 4.6-in yellow perch that had eaten 20 zebra mussels

Table 6.–Diet data from 12 walleye collected in Little Bay de Noc, Jun-Sep, 1996.

	Observed occurrence in walleye stomachs			Length of walleye	
Food category	Frequency	Mean number per fish	Months	Min.	Max.
Fish[a]	8	2.0	6,7,8,9	4.1	20.8
Ephemeroptera	1	1.0	7	17.5	17.5
Empty	3	–	6,8	12.1	20.6

[a] Alewife (5), yellow perch (2), unidentified (9)

Table 7.–Diet data from 161 yellow perch collected in Big Bay de Noc, Jun-Sep, 1996.

	Observed occurrence in yellow perch stomachs			Length of yellow perch	
Food category	Frequency	Mean number per fish	Months	Min.	Max.
Fish[a]	39	2.2	6,7,8,9	4.2	9.9
Ephemeroptera	34	2.6	6,7,8,9	2.4	8.4
Amphipoda	28	5.4	6,7,9	3.0	6.2
Zooplankton	19	16.1	7,8,9	2.0	5.5
Crayfish	10	1.1	6	6.3	9.1
Diptera	8	1.8	6,7,8,9	2.1	6.4
Eggs	4	61.8	6,7	4.5	6.3
Mollusks[b]	2	1.0	6,7	4.2	6.3
Tricoptera	2	4.5	8	4.2	4.3
Corixids	1	1.0	8	4.6	4.6
Isopoda	1	1.0	6	6.5	6.5
Miscellaneous	2	-	6	6.6	7.4
Empty	44	-	6,7,8,9	2.2	8.1

[a] Sticklebacks (26), johnny darter (21), alewife (5), sculpin (1), trout-perch (1), unidentified (32)
[b] Includes one 6.3-in yellow perch that had eaten 1 zebra mussel

Table 8.–Diet data from 3 walleye collected in Big Bay de Noc, Jun-Sep, 1996.

	Observed occurrence in walleye stomachs			Length of walleye	
Food category	Frequency	Mean number per fish	Months	Min.	Max.
Fish[a]	1	1.0	6	8.7	8.7
Empty	2	-	7	16.6	21.2

[a] Unidentified (1)

Table 9.–Mean length at age for Cedar River walleye, 1996. Total length in inches.

Sex	Parameter	Age 3	4	5	6	7	8	9
Male	N	10	14	33	10	14	2	
	Mean length	16.4	16.7	19.6	20.5	22.6	23.6	
	95% C.L.	0.5	0.6	0.5	1.0	0.5	18.4	
Female	N		2	36	18	12	5	1
	Mean length		18.0	21.0	22.6	25.0	26.0	24.8
	95% C.L.		0.6	0.5	0.6	0.4	2.5	–

Table 10.–Mean length at age for yellow perch caught in assessment nets in Little Bay de Noc (LBDN) and Big Bay de Noc (BBDN), Jun-Sep, 1996. Total length in inches.

Bay	Parameter	Age 1	2	3	4	5
LBDN	N	20	24	20	7	2
	Mean length	4.1	5.4	6.4	7.7	8.2
	95% C.L.	0.1	0.3	0.3	1.0	3.8
BBDN	N	20	25	24	7	1
	Mean length	4.2	6.2	7.1	8.2	9.9
	95% C.L.	0.2	0.3	0.2	0.9	–

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