STUDY PERFORMANCE REPORT

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

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, 1997 to March 31, 1998

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 yellow perch and walleyes and similar indices for populations not monitored by sport or commercial fisheries; (3) to determine discreteness of yellow 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 yellow perch and walleye populations.

Summary: This study was amended to extend for another year. Originally, only Job 6 was scheduled for this year. However, all jobs were extended, so this report includes work done on all jobs.

Fish populations in Michigan waters of Green Bay (Big and Little bays de Noc, and open waters south to the Menominee River) were assessed through creel surveys, assessment netting, and a tagging program. Creel surveys have been conducted annually since 1985, assessment netting and tagging since 1988.

Based on 1997 creel survey estimates for the open-water season, sport anglers caught 43,908 yellow perch and 30,016 walleye. Creel surveys were not conducted for the 1997 ice fishing season.

Assessment netting in 1997 captured 1,070 fish representing 27 species. Fish were identified, counted, and 45% were measured and examined to determine sex, maturity, and stomach contents. Yellow perch was the most common species collected (52% of the total number), and walleye ranked sixth (4% of the total). Diet information was summarized from 267 yellow perch, 43 walleye, and 173 other fish.

The 1997 year class of yellow perch was fair to moderate based on trawl sampling in both bays. Overall 1997 trawl and gill net catches of perch (all sizes) were similar to those of 1996.

Over four thousand walleyes were tagged in spring of 1997. Since 1988, 35,583 walleyes and 19,572 yellow perch have been tagged. Tag-return data were used to estimate exploitation and survival rates as well as to document movements. Exploitation rates for walleye, unadjusted for non-reporting, were 4.5% for Little Bay de Noc, 2.9% for Big Bay de Noc, 3.4% for Cedar River, and 6.2% for Menominee River. Walleye survival was 62.4% in Little Bay de Noc,

65.4% in Big Bay de Noc, 43.9% in Cedar River, and 31.5% in Menominee River. Yellow perch exploitation rate in Little Bay de Noc was 3.6% and survival was 41.8%.

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 were summarized under D J 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, 1996, and 1997 have been calculated (G.P. Rakoczy, personal communication, Charlevoix Fisheries Station, Charlevoix, Michigan), but are as yet unpublished. The 1997 walleye catch, estimated from all survey sites combined, was less than half that of 1996, and estimated yellow perch catch was down 86% from 1996. Effort declined by 28% between 1996 and 1997. However, estimates for 1997 catch and effort were not comparable to other years because winter fisheries were not surveyed in 1997.

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

Findings: Marquette Fisheries Station personnel collected monthly samples of adult and juvenile fish from June through September in both Big and Little bays de Noc. Samples were obtained from 37 bottom trawl hauls (22 in Little Bay de Noc and 15 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 60-ft long, with 10-ft panels of experimental monofilament stretch mesh measuring 1.0-, 1.5-, 2.0-, 2.5-, 3.0-, 4.0-in. Two 60-ft gangs were tied together to provide replication of each mesh size for any given set.

Total length, sex, maturity, and diet data were recorded for 267 yellow perch and 43 walleyes (Table 2). An additional 119 yellow perch were measured but not examined internally and 174 were counted only. Scales and/or spines were collected from 40 walleyes and 81 yellow perch. Ages of these fish will be determined and reported in future reports.

Besides walleye and yellow perch, 467 fish, representing 25 other species, were caught. Of these, 173 were measured and examined to determine sex, maturity, and stomach contents.

Yellow perch was the most abundant species present in 1997 assessment netting, and walleye ranked sixth (Table 2). 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. Compared to previous years, 1997 CPUEs were moderate in both bays de Noc for YOYs in trawl hauls and for yellow perch 7 inches and larger in gill nets.

Threespine stickleback is a non-indigenous species that has been collected in Big Bay de Noc assessment nets since 1989. In 1997, five 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. Five white perch were caught during 1997 sampling, 4 in Little Bay de Noc in June and July, and 1 in Big Bay de Noc during September.

Bythotrephes cederstroemi have been observed in fish stomachs collected from both bays de Noc since 1988 (Schneeberger 1989, 1991). As in 1996, *Bythotrephes* were found only in stomachs of yellow perch netted in Little Bay de Noc during 1997.

Zebra mussels (*Dreissena polymorpha*) were abundant in both bays de Noc judging from observations of mussels on submergent plants and in trawl hauls. Zebra mussels were present in stomach samples from three yellow perch (two in Little Bay de Noc during June and July, one in Big Bay de Noc during September), and one white sucker (Little Bay de Noc during June) (see Job 4).

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

Findings: In Michigan waters of Green Bay, individually numbered monel bird leg bands have been used to jaw tag 35,523 walleye between 1988 and 1997, 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 4,251 walleye tagged in 1997, 700 were tagged in Little Bay de Noc, 868 were tagged in Big Bay de Noc, 925 were tagged in or near the Cedar River, and 1,758 were tagged in the Menominee River (Table 4). Tagging operations were conducted by personnel from the Marquette Fisheries Station and from Districts 1, 2, and 3. 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 at all other locations, and 191 were obtained from commercial pound nets set near the mouth of the Cedar River. Numbers tagged exceeded targets at Little Bay de Noc and Menominee River, but were below targets at Big Bay de Noc and Cedar River.

Advertisements for the return of tags have appeared in local newspapers, sport-club information bulletins, and notices at launch sites. In addition, the creel clerk surveying Cedar and Menominee river fisheries solicited tag-return data on his personal fishing information web page. Anglers catching tagged fish were asked to contact a creel clerk or an MDNR office 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. These data were entered into a computer and a program calculated and stored 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 generated a letter that passed most of this information on to the angler and provided 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 240 walleye tag returns were reported between May 1997 and April 1998 (Table 4). Returns from fish tagged in Little Bay de Noc included fish that had been tagged in 1988, 1989, and 1991-97. Big Bay de Noc returns came from fish tagged in 1990, 1993 and 1995-97. Fish tagged during 1994-97 contributed to reported catches in Cedar and Menominee rivers.

No tagged yellow perch were caught in 1997. Yellow perch have not been tagged in bays de Noc since 1993, but additional perch tagging is planned for 1998 in conjunction with a lakewide tagging effort coordinated among various agencies around Lake Michigan.

Use of drop boxes, placed at 10 access sites throughout the study area, continued for the second year in 1997. Signs were posted asking walleye anglers to fill out brief catch summary forms that were available from a compartment in the drop boxes. During 1997, 57 forms were voluntarily completed and deposited in a separate slotted portion of the drop boxes. Drop boxes provide an additional way for anglers to report tagged fish and it is hoped that useful information will be obtained relating to the ratio of tagged to untagged fish in catches.

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 1996, incidence of the disease on 1997 spawning populations decreased slightly in each area: from 10% to 8% in Little Bay de Noc, from 14% to 11% in Big Bay de Noc, from 19% to 17% in Cedar River, and from 16% to 15% in Menominee River. Lymphocystis was not seen on any of the 43 walleye caught in assessment nets.

Job 4. Title: **Determine forage utilization of yellow perch and walleye in Michigan waters of Green Bay.**

Findings: Fish stomach contents were examined in the field and food items were 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 145 yellow perch and 33 walleye. Aquatic insects (especially Ephemeroptera), fish (mostly trout-perch), amphipods, and *Bythotrephes* were prominent in yellow perch stomachs, and two yellow perch stomachs contained 1-7 zebra mussels (Table 5). Nineteen walleye stomachs were empty, but 8 contained fish (mostly alewife) and 6 contained Ephemeroptera nymphs (Table 6).

Stomachs were examined from 122 yellow perch and 10 walleyes in Big Bay de Noc. Yellow perch ate amphipods, fish (including alewife, sticklebacks, darters, and shiners), insects, crustaceans, zooplankton, and various other food items including one zebra mussel (Table 7). The three walleye stomachs that were not empty contained alewife or other unidentified fish (Table 8).

In an attempt to obtain additional walleye diet data, a cooperative arrangement was made with the proprietors of a resort located at the head of Little Bay de Noc. Anglers that used the resort's cleaning station had the opportunity to label and save walleye stomachs in containers provided by the Marquette Fisheries Station. The resort owners kept the collected stomachs frozen until the containers could be picked up by MDNR personnel. Subsequently, a student from Northern Michigan University identified, counted, and weighed stomach contents for each of the 49 walleye in the collection. A summary of his findings will be prepared for course credits. Because of the success of this initiative, it will be expanded in 1998 to include additional cooperative resorts and sport clubs. This will enable collection of a greater number of stomachs from different areas and during different times of the year.

Job 5. Title: Develop population models.

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 1997, walleye exploitation rates were 4.5% in Little Bay de Noc, 2.9% in Big Bay de Noc, 3.4% in Cedar River, and 6.2% in Menominee River. Estimated exploitation rate of yellow perch in Little Bay de Noc was 3.6%. Walleye survival was 65.4% in Big Bay de Noc, 62.4% in Little Bay de Noc, 43.9% in Cedar River, and 31.5% in Menominee River. Survival of yellow perch in Little Bay de Noc was estimated to be 41.8%.

Thomas and Haas (1994) examined reward versus non-reward walleye tag returns in Lake Erie to determine an adjustment factor of 2.84 for non-reporting. Using this factor to adjust for non-reporting in Michigan waters of Green Bay, estimated exploitation for walleye was 12.8% in Little Bay de Noc, 8.2% in Big Bay de Noc, 9.6% in Cedar River, and 17.6% in Menominee River. An adjusted estimate of yellow perch exploitation in Little Bay de Noc was 10.2%.

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Table 1.–Estimated sport catch (number and pounds) and effort (angling hours) of walleye and yellow perch in Michigan waters of Green Bay (Statistical District MM-1). Data from G. Rakoczy, Michigan DNR, Charlevoix.

	Effort	Walleye		Yellow perch	
Year	(hours)	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	163,155	323,789	64,758
1997[b,d,e,f]	452,044	30,016	pending	43,908	pending

[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] Little Bay de Noc open water season

Table 2.–Species of fish captured in assessment nets in Little Bay de Noc (LBDN) and Big Bay de Noc (BBDN), Jun-Sep, 1997.

	Measured and examined[a]		Measured or counted only		Totals			
Common name	LBDN	BBDN	LBDN	BBDN	LBDN	BBDN	All	%
Yellow perch	145	122	110	183	255	305	560	52.34
Alewife	24	29	1	55	25	84	109	10.19
Johnny darter	3	0	40	47	43	47	90	8.41
Smallmouth bass	1	27	1	60	2	87	89	8.32
Spottail shiner	3	5	38	17	41	22	63	5.89
Walleye	33	10	0	0	33	10	43	4.02
Northern pike	27	3	0	0	27	3	30	2.80
White sucker	9	10	3	1	12	11	23	2.15
Brook trout	0	0	0	9	0	9	9	0.84
Rock bass	5	0	2	1	7	1	8	0.75
Trout-perch	6	2	0	0	6	2	8	0.75
Threespine stickleback	0	0	0	5	0	5	5	0.47
White perch	4	1	0	0	4	1	5	0.47
Logperch	0	0	4	0	4	0	4	0.37
Bluntnose minnow	0	0	2	1	2	1	3	0.28
Brook stickleback	0	0	0	3	0	3	3	0.28
Gizzard shad	2	0	0	1	2	1	3	0.28
Redhorse	1	2	0	0	1	2	3	0.28
Bluegill	2	0	0	0	2	0	2	0.19
Brown bullhead	0	0	0	2	0	2	2	0.19
Splake	2	0	0	0	2	0	2	0.19
Burbot	1	0	0	0	1	0	1	0.09
Carp	0	0	0	1	0	1	1	0.09
Chinook salmon	0	1	0	0	0	1	1	0.09
Largemouth bass	1	0	0	0	1	0	1	0.09
Ninespine stickleback	0	1	0	0	0	1	1	0.09
Sauger	1	0	0	0	1	0	1	0.09
Total	270	213	201	386	471	599	1,070	100.00

[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		
Bay	Year	<3.5”	≥3.5”	All	<7”	≥7”	All
Little Bay	1988	35.3	43.1	71.8	15.1	4.8	16.8
de Noc	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	5.4	0.9	4.2	7.9	0.7	8.6
	1997	20.0	1.8	15.9	9.3	2.3	10.7
Big Bay	1988	34.7	34.0	51.5	3.0	3.0	5.0
de Noc	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	22.8	27.8	35.2	15.2	2.0	17.2
	1997	20.8	1.0	7.0	12.5	2.1	13.8

Table 4.–Number of fish tagged and tag returns by year from Michigan waters of Green Bay, 1988-97. (Recovery year = May-Apr for walleye; Apr-Mar for yellow perch).

Tag year	Number tagged	Recovery year										
		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total
Walleye in Little Bay de Noc												
1988	2,496	167	141	72	42	12	21	14	5	2	1	477
1989	2,486	-	150	58	25	20	7	7	8	1	1	277
1990	1,744	-	-	94	33	13	15	3	0	0		159
1991	1,886	-	-	-	79	30	10	5	2	1	1	128
1992	1,690	-	-	-	-	50	18	11	5	4	1	89
1993	1,563	-	-	-	-	-	69	22	10	5	1	107
1994	1,246	-	-	-	-	-	-	69	23	7	5	104
1995	711	-	-	-	-	-	-	-	33	18	4	55
1996	700	-	-	-	-	-	-	-	-	25	17	42
1997	700	-	-	-	-	-	-	-	-	-	14	14
Walleye in Big Bay de Noc												
1990	867	-	-	22	19	1	2	1	0	1	1	47
1991	354	-	-	-	6	3	3	1	2	1	0	16
1993	617	-	-	-	-	-	20	13	11	1	1	46
1994	1,458	-	-	-	-	-	-	37	15	3	0	60
1995	1,993	-	-	-	-	-	-	-	67	28	18	113
1996	1,324	-	-	-	-	-	-	-	-	32	25	57
1997	868	-	-	-	-	-	-	-	-	-	18	18
Walleye in Cedar River												
1993	1,312	-	-	-	-	-	50	27	9	1	0	87
1994	1,500	-	-	-	-	-	-	73	17	6	2	98
1995	1,677	-	-	-	-	-	-	-	36	23	7	66
1996	445	-	-	-	-	-	-	-	-	7	9	16
1997	925	-	-	-	-	-	-	-	-	-	22	22
Walleye in Menominee River												
1993	1,280	-	-	-	-	-	100	24	6	4	0	134
1994	1,500	-	-	-	-	-	-	127	16	4	2	149
1995	1,879	-	-	-	-	-	-	-	103	25	13	141
1996	544	-	-	-	-	-	-	-	-	20	7	27
1997	1,758	-	-	-	-	-	-	-	-	-	70	70
Yellow perch in Little Bay de Noc												
1989	2,523	-	102	51	17	2	5	0	0	0	0	177
1990	2,127	-	-	73	30	12	1	1	0	0	0	117
1991	2,418	-	-	-	71	32	13	0	1	0	0	117
1992	3,683	-	-	-	-	137	49	3	2		0	191
1993	5,278	-	-	-	-	-	153	28	13	2	0	196
Yellow perch in Big Bay de Noc												
1990	1,059	-	-	19	3	0	0	0	0	0	0	22
1991	2,484	-	-	-	14	2	2	0	0	0	0	18

Table 5.–Diet data from 145 yellow perch collected in Little Bay de Noc, Jun-Sep, 1997.

	Observed occurrence in yellow perch stomachs			Length of yellow perch	
Food category	Frequency	Mean number per fish	Months	Minimum	Maximum
Ephemeroptera	53	3.2	6, 7, 8, 9	2.9	8.4
Fish[a]	24	1.4	6, 7, 8, 9	5.2	12.4
Amphipods	18	3.9	6, 7, 8, 9	2.2	6.5
Diptera	14	3.3	6, 7, 8, 9	2.3	7.2
Bythotrephes	10	66.6	6, 7, 8, 9	2.5	8.4
Tricoptera	8	3.0	6, 7, 8	4.1	6.4
Isopoda	3	1.3	6, 8, 9	4.5	7.1
Annelids	3	1.3	8, 9	2.2	6.3
Zebra mussels	2	4.0	6, 7	5.6	5.8
Gastropoda	1	1.0	8	5.6	5.6
Zooplankton	1	12.0	9	2.5	2.5
Miscellaneous	4	1.0	7, 8	3.8	6.2
Empty	30	-	6, 7, 8, 9	3.2	7.3

[a] Trout-perch (19), yellow perch (2), alewife (1), johnny darter (1), unidentified (10)

Table 6.–Diet data from 33 walleye collected in Little Bay de Noc, Jun-Sep, 1997.

	Observed occurrence in walleye stomachs			Length of walleye	
Food category	Frequency	Mean number per fish	Months	Minimum	Maximum
Fish[a]	8	2.0	6, 7, 8, 9	13.2	22.0
Ephemeroptera	6	1.5	6, 7, 8	10.5	19.9
Empty	19	-	6, 7, 8, 9	6.9	21.1

[a] Alewife (6), johnny darter (1), spottail shiner (1), white sucker (1), unidentified (7)

Table 7.–Diet data from 122 yellow perch collected in Big Bay de Noc, Jun-Sep, 1997.

	Observed occurrence in yellow perch stomachs			Length of yellow perch	
Food category	Frequency	Mean number per fish	Months	Minimum	Maximum
Amphipods	45	10.1	6, 7, 9	1.8	6.7
Fish[a]	13	1.3	6, 7, 8, 9	5.5	8.0
Ephemeroptera	11	1.4	6, 7, 8, 9	2.0	7.5
Crayfish	9	1.2	7, 8, 9	6.3	8.2
Diptera	8	3.0	7	1.7	6.1
Zooplankton	7	10.3	7, 9	1.7	2.7
Tricoptera	2	1.5	7	6.0	6.6
Isopoda	1	1.0	6	6.2	6.2
Terrestrial insects	1	1.0	7	2.0	2.0
Zebra mussels	1	1.0	9	3.0	3.0
Miscellaneous	4	1.0	7, 8	6.3	7.0
Empty	38	-	6, 7, 8, 9	1.5	9.4

[a] Alewife (4), threespine stickleback (3), johnny darter (2), spottail shiner (1), unidentified (11)

Table 8.–Diet data from 10 walleye collected in Big Bay de Noc, Jun-Sep, 1997.

	Observed occurrence in walleye stomachs			Length of walleye	
Food category	Frequency	Mean number per fish	Months	Minimum	Maximum
Fish[a]	3	2.0	7, 8	10.1	21.2
Empty	7	-	8	5.5	20.6

[a] Alewife (2), unidentified (4)