STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-53-R-15

Study No.: 484 **Title**: Population dynamics of yellow perch stocks in Michigan waters of Lake Michigan.

Period Covered: April 1, 1998 to September 30, 1999

Study Objectives: (1) To summarize pertinent existing data from state, federal, commercial, sport, university, and private sources; (2) to conduct assessment netting to establish baseline data and determine whether lack of recruitment and declining yellow perch numbers are problems in Michigan waters; (3) to determine whether factors of fish health might be affecting abundance or recruitment of yellow perch; (4) to reestablish a program of biological data collection for sport-caught yellow perch; (5) to investigate discreteness of yellow perch populations in Lake Michigan; and (6) to develop information and mathematical models from these data that will allow managers to predict, with some predetermined level of certainty, the outcome of various yellow perch management strategies.

Summary: Gill-net assessments were conducted at four southern Lake Michigan ports (Grand Haven, Saugatuck, South Haven, and St. Joseph) in April, 1996-99. Catch-per-unit-effort at the four southern Lake Michigan ports ranged from <20 to >300 yellow perch per 1,000 feet of gill net per 24 h, and averaged 41-177 fish per net night for the four ports combined. Yellow perch catch rates were highest at Grand Haven and South Haven, and were typically higher in deep (60-70 feet) net sets when compared with shallow (30-40 feet) sets at the four southern Lake Michigan ports we sampled. Additional species collected in yellow perch assessment nets included alewife, rainbow smelt, spottail shiner, salmonines, whitefish (lake and round), sucker (white and longnose), and round goby.

Trawling was conducted in July and August/September at Muskegon, Grand Haven, South Haven, and St. Joseph. The collection of significant numbers of age 1 and older yellow perch in 1996 indicates that some measurable level of reproduction occurred in 1995. Additionally, a relatively strong year class of yellow perch (163 fish per trawl hour) was produced in 1998.

Overall recreational catch of Lake Michigan yellow perch has declined in recent years, from 3.2 million fish in 1988 to 0.4 million fish in 1998. In southern Lake Michigan, yellow perch catch varied significantly across ports, and a continuous decline over this time period has not been observed at every port. Average total length of yellow perch in the recreational catch was approximately 9.5 inches, and did not vary significantly by mode of angling, although yellow perch caught in the Grand Traverse Bay area were significantly shorter than those from other locations.

Tagging of yellow perch (approximately 3,000 per year) was conducted during spring 1997-99, in coordination with other Lake Michigan management agencies through the Great Lakes Fishery Commission Yellow Perch Task Group. Analysis of tag return data from throughout Lake

Michigan will provide much needed information on fish movements, growth, exploitation rates, and mixing of stocks.

Job 1. Title: <u>Review literature and summarize existing data.</u>

Findings: *Michigan Dept. of Natural Resources Assessment Netting*–Yellow perch were collected in MDNR assessment netting throughout Lake Michigan between 1968-86. From 300-3,000 yellow perch were collected and aged per year. These data are currently being summarized, along with information on alewife abundance in these same assessments (see Job 2). Results of these analyses will be presented in future reports.

Literature Review–A review of yellow perch literature has been conducted, focusing on the following subjects; yellow perch disease, sampling techniques, interactions with alewife, reproduction and early life history, population fluctuations, age and growth, regulations, stock assessment, foraging, and energetics. This review is ongoing and will be used in planning and completing other jobs within this study.

Job 2. Title: <u>Conduct standardized assessment sampling.</u>

Findings: *Spring Assessment Netting***–**Gill-net assessments were conducted at four southern Lake Michigan ports (Grand Haven, Saugatuck, South Haven, and St. Joseph) in April, 1996-99. Four nets (1,000 feet long, 1.5 to 3.5" stretched nylon mesh, 0.5" intervals) were fished overnight at each port. In addition, yellow perch were collected near Ludington, Michigan by Barnes-Williams Environmental Consultants, Inc. and Tim Robbins (Independent Observer) of The Wyatt Group, Inc., as part of the Ludington Pumped Storage Project Barrier Net Study. Subsamples of fish from MDNR assessments and from the Ludington study were returned to the Charlevoix Great Lakes Station (MDNR) for analysis of age and growth, fecundity, body composition (percent water, gonadosomatic index), and diet.

Catch-per-unit-effort at the four southern Lake Michigan ports ranged from <20 to >300 yellow perch per 1,000 feet of gill net per 24 h, and averaged 41-177 fish per net night for the four ports combined (Table 1). Yellow perch catch rates were highest at Grand Haven and South Haven, and were typically higher in deep (60-70 feet) net sets when compared with shallow (30-40 feet) sets at the four southern Lake Michigan ports we sampled.

Overall sex ratio (F:M, all ports combined, 1996-97) was 1.1:1. A higher percentage of fish collected in Grand Haven were females (1.8:1); sex ratio was lowest at Saugatuck (0.9:1) and at St. Joseph (0.3:1). Sex ratio for yellow perch collected in 1998-99 has not yet been determined. In addition, aging of yellow perch collected in April 1997-99 has not yet been completed. Estimates of mortality rate and relative year-class strength will be completed when ages of yellow perch collected in 1997-99 have been determined.

Additional species collected in yellow perch assessment nets include alewife, rainbow smelt, spottail shiner, salmonines, whitefish (lake and round), sucker (white and longnose), and round goby. Of these, alewife probably have the greatest potential to influence yellow perch populations (GLFC 1996, Brandt et al. 1987). In 1996-97, alewife ranged from 30-90% of the catch, by number; catch increased from north to south. In 1996, a higher percentage of young alewife (<150 mm) were collected at South Haven (1%) and St. Joseph (36%) than at Grand Haven and Saugatuck (0% at each port). Analysis of forage fish data from 1998-99 assessments is ongoing.

Summer Trawl Assessments–Trawling was conducted in July and August/September at Muskegon, Grand Haven, South Haven, and St. Joseph. Samples consisted of 12, 10-minute trawls at each port during each month. Six trawls were conducted prior to sunset and six were conducted after dark. The collection of significant numbers of age 1 and older fish in 1996 (Table 2) indicates that some measurable level of reproduction occurred in 1995. Additionally, a relatively strong year class of yellow perch was produced in 1998 (age 0, 1998; age 1 and older, 1999; Table 2).

Several species have the potential to predate or compete with just-hatched yellow perch. Other species collected in trawl samples included spottail shiner, alewife, rainbow smelt, and johnny darter. Spottail shiner were the most abundant fish in trawl samples at southern Lake Michigan ports in all years (Table 3). There were no distinct patterns in abundance of predators or competitors across ports in southern Lake Michigan. Preliminary sampling was conducted at Empire and Onekema in northern Lake Michigan in 1997; at these ports the most abundant species was johnny darter (Table 3; "other").

Through our trawl assessments, we have been able to document the range extension and establishment of round gobies in eastern Lake Michigan at Grand Haven. Round gobies were first collected in survey samples at Grand Haven in 1997 (0.5 fish per trawl hour); catch rates increased in 1998 (3.0 fish/h) and again in 1999 (data analysis ongoing). Individuals collected by trawling ranged in length from 20 to 51 mm.

Job 3. Title: <u>Investigate the potential impacts of disease on yellow perch populations.</u>

Findings: Early Mortality Syndrome (EMS) has been found to be detrimental to fry survival in coho salmon, rainbow trout, lake trout, and other species. Survival has increased dramatically when these fry were treated with thiamin. EMS (or other facets of fish health) could potentially influence recruitment of yellow perch as well. To investigate these possibilities, Fish Quality Laboratory personnel collected mature male and female yellow perch from Lake Michigan. Experiments were conducted in 1996 to compare survival of Lake Michigan yellow perch fry to those from Lake Huron (Saginaw Bay). Additional tests were attempted in hopes of directly investigating the possibility that thiamin deficiency may be influencing yellow perch survival. Due to personnel changes at Wolf Lake Hatchery, continuation of these tests has been postponed for the foreseeable future.

Parasites may also influence yellow perch populations in Lake Michigan; a complete parasite survey of Lake Michigan yellow perch has not been conducted. Samples from several years of summer trawling were provided to Dr. Pat Muzzall at Michigan State University to assess parasite load in yearling yellow perch. These data are currently being analyzed; results will be presented in future reports.

Yellow perch were also provided to Candy Shrank (Wisconsin Department of Natural Resources) for a study investigating reproductive anomalies in yellow perch. In addition, Lake Michigan forage fish (alewife, rainbow smelt, bloater chubs) from yellow perch gillnet and trawl assessment samples were provided to the U. S. Fish and Wildlife Service laboratory in LaCrosse, Wisconsin for the National Wild Fish Health Survey, and to the Great Lakes Fishery Trust-funded study on EMS and thiamin in Great Lakes fish.

Job 4. Title: Collect and analyze biological data from sport-caught yellow perch.

Findings: *Yellow Perch Catch*–Yellow perch recreational catch information for the period 1985-98 were summarized in coordination with Studies 427 and 462. Overall Lake Michigan yellow perch catch has declined in recent years, from 3.2 million fish in 1988 to 0.4 million fish in 1998. In southern Lake Michigan, yellow perch catch varies significantly across ports, and a continuous decline over this time period has not been observed at every port. Catch was highest at St. Joseph (greater than 600,000 yellow perch) and Grand Haven (greater than 200,000 fish) in the mid- to late-1980s, whereas catch peaked at South Haven in 1994 (approximately 1.5 million yellow perch; Table 4). Recreational catch statistics generally parallel fishery independent assessments of adult yellow perch in southern Lake Michigan (see Table 1 and Table 4).

Biological data collection–Yellow perch length and age data were collected in 1985-92 as part of the Lake Michigan creel survey program (Study 427). Beginning in 1996, data were again collected from the recreational creel at four sites for which fisheries-independent assessment data are available. In 1997, this data collection program was expanded to include all standard creel sites between New Buffalo and Grand Traverse Bay. At a given site, data are collected from up to 100 angler-caught yellow perch per month. Length and sex are determined for each fish. Similar data are solicited from yellow perch charter captains, with assistance from District 9 and 12 personnel.

Average total length of yellow perch in the recreational catch was approximately 9.5 inches, and did not vary significantly by mode of angling (Table 5). Yellow perch caught by anglers from the Grand Traverse Bay / Elk Rapids area were significantly shorter than those from other locations (Table 5). Age composition of the recreational catch will be determined in the future, using a length-age key based on gillnet assessment samples.

Job 5. Title: Investigate discreteness of yellow perch populations in Lake Michigan.

Findings: *Tagging study*–Tagging of yellow perch was conducted during spring 1997-99, in coordination with other Lake Michigan management agencies through the Great Lakes Fishery Commission Yellow Perch Task Group. Yellow perch tagged by MDNR personnel (approximately 3,000 per year) were released near Bridgman, St. Joseph, and Onekama (Table 6). Analysis of tag return data from throughout Lake Michigan will provide much needed information on fish movements, growth, exploitation rates, and mixing of stocks.

Physiological parameters–Physiological parameters have often been used as measures of discreteness of fish populations (Ihssen et al. 1981). As part of our spring assessment sampling, we examined various physiological and biological parameters (percent water, gonadosomatic index, growth rate, and diet) for differences among populations (ports). This initial examination showed no apparent differences in these parameters among perch populations at southern Lake Michigan ports. Analyses of fecundity and diet of yellow perch collected in spring assessment netting are still being conducted. In the future, we will examine correlations between yellow perch reproductive success and these various physiological parameters using data collected over a number of years.

Job 6. Title: Develop information and mathematical models related to yellow perch management strategies.

Findings: Successful modeling of Lake Michigan yellow perch populations will require collection of information on length, weight, age, sex, maturity, egg production, diet, movement, harvest rates, and predation. These data are currently being collected in Jobs 1-5 (see above). Initial modeling efforts will be aimed at investigating predictability of yellow perch population fluctuations (see Job 1), and the influence of commercial and recreational harvest on yellow perch populations. Results of these efforts will be presented in future reports.

Job 7. Title: Evaluate results, write reports, and develop future study plans for Michigan waters of Lake Michigan south of the 45th parallel.

Findings: Results of research were summarized for this report, as well as for summaries to various MDNR and external committees. Presentations were given at the Michigan State University Fisheries Extension Workshop in Bridgman, a yellow perch conference in Racine, Wisconsin, and at the 1999 International Joint Commission meeting in Milwaukee, Wisconsin. A poster describing the expansion of round gobies in Lake Michigan (see Job 2) was presented at the 1999 International Association of Great Lakes Research meeting in Cleveland, Ohio.

Literature Cited:

Brandt, S.B., et al. 1987. Predation by alewives on larvae of yellow perch in Lake Ontario. Transactions of the American Fisheries Society 116:641-645.

Great Lakes Fishery Commission. 1996. Multi-agency yellow perch research initiative. Yellow Perch Task Group, Lake Michigan Technical Committee.

Great Lakes Fishery Commission. 1997. Status of yellow perch in Lake Michigan. Yellow Perch Task Group Progress Report, Lake Michigan Technical Committee.

Ihssen, P.E., and five coauthors. 1981. Stock identification: materials and methods. Canadian Journal of Fisheries and Aquatic Sciences 38:1838-1855.

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Table 1.–Average assessment gillnet catch (fish / 1,000' of gillnet / 24 hours) of yellow perch at four southern Lake Michigan ports, 1996-97. Four nets were set at each port in each year, except three nets were set at Grand Haven in 1997. Two standard errors are shown in parentheses.

Sample year	Port				
	Grand Haven	Saugatuck	South Haven	St. Joseph	Combined
1996	315(326)	20(4)	338(584)	33(14)	177(168)
1997	155(104)	59(62)	153(200)	25(10)	94(61)
1998	158(238)	35(50)	86(74)	17(15)	74(64)
1999	20(15)	19(19)	58(36)	84(42)	41(18)

Table 2.–Yellow perch catch-per-unit-effort (number per trawl hour) at four Lake Michigan ports (Muskegon, Grand Haven, South Haven, and St. Joseph); values are for samples from the four ports combined. Percent of catch composed of age 0 and age 1+ yellow perch for each month is shown in parentheses. Age class determinations are based on length frequency analysis. Samples were not collected at St. Joseph in September 1996, at Muskegon in July 1997, or at Muskegon after 1997.

	Age 0			Age 1 and older		
Year	July	August / September	Combined	July	August / September	Combined
1996	0	2	1	138	17	84
	(--)	(9)	(1)	(100)	(91)	(99)
1997	2	2	2	31	3	15
	(6)	(40)	(12)	(94)	(60)	(88)
1998	7	218	163	4	9	8
	(64)	(96)	(95)	(36)	(4)	(5)
1999	7	5	6	95	339	190
	(7)	(1)	(3)	(93)	(99)	(97)

Table 3.–Composition of summer (July-September) trawl catch at six Lake Michigan ports, 1996-97. Data are percent (by number) of trawl catch made up of each species. Other species include (primarily) Johnny darter, 3-spine stickleback, 9-spine stickleback, rainbow smelt, trout perch, slimy sculpin, longnose sucker, and gizzard shad. Empire and Onekema were not sampled in 1996.

	Port					
Species	Empire	Onekema	Muskegon	Grand Haven	South Haven	St. Joseph
			1996			
Alewife	---	---	14	7	3	21
Spottail shiner	---	---	51	79	91	47
Yellow perch	---	---	18	12	1	8
Other	---	---	17	2	5	24
			1997			
Alewife	0	1	1	1	7	21
Spottail shiner	30	1	93	77	87	76
Yellow perch	0	0	0	1	3	1
Other	70	98	6	21	3	2

Table 4.–Yellow perch recreational catch at four southern Lake Michigan ports, 1985-1998. Estimates of charter catch were not obtained prior to 1990. Creel estimates were not obtained at Holland and South Haven in 1989-1991.

Sample year	Port							
	Grand Haven		Holland/Saugatuck		South Haven		St. Joseph	
	Creel	Charter	Creel	Charter	Creel	Charter	Creel	Charter
1985	110,084	---	105,398	---	292,225	---	664,671	---
1986	79,972	---	27,382	---	307,847	---	590,044	---
1987	213,199	---	126,910	---	313,800	---	448,285	---
1988	156,496	---	119,128	---	618,933	---	575,937	---
1989	121,713	---	---	---	---	---	313,084	---
1990	74,151	1,755	---	74	---	2,107	348,313	16,099
1991	133,783	154	---	2	---	39,870	253,873	6,076
1992	58,126	791	47,610	12	348,138	19,906	430,828	8,293
1993	78,364	1,532	62,585	176	732,128	40,452	384,416	17,822
1994	119,106	1,344	63,588	504	1,414,005	48,756	152,108	11,232
1995	11,490	363	68,882	85	981,999	92,074	74,063	3,528
1996	75,553	608	40,704	0	148,115	35,372	64,113	2,327
1997	84,774	304	16,899	0	209,663	41,771	11,891	800
1998	23,554	79	8,249	39	121,798	25,503	13,369	383

Table 5.–Average total length (inches) of yellow perch in recreational catch, 1996-98. Data are presented for boat and shore angling modes; fish caught by charter anglers at South Haven are presented separately. Values in parentheses are two standard errors.

	Year					
	1996		1997		1998	
Port	Boat	Shore	Boat	Shore	Boat	Shore
Arcadia – Onekema	-----	-----	10.2 (0.4)	-----	11.9 (1.0)	-----
Elk Rapids	-----	-----	-----	9.3 (0.4)	-----	7.2 (0.3)
Grand Traverse Bay	-----	-----	8.2 (0.2)	7.0 (0.2)	7.8 (0.4)	7.3 (0.7)
Grand Haven – Muskegon	10.1 (0.2)	9.4 (0.2)	10.4 (0.2)	9.5 (0.2)	9.8 (0.2)	8.4 (0.2)
Holland - Saugatuck	9.4 (0.4)	9.6 (0.2)	10.3 (0.2)	9.4 (0.4)	11.0 (0.7)	-----
South Haven	9.3 (0.2)	10.2 (0.4)	9.3 (0.2)	10.4 (1.4)	9.8 (0.4)	-----
South Haven (Charter)	9.3 (0.2)	-----	8.7 (0.2)	-----	-----	-----
St. Joseph - New Buffalo	9.8 (0.2)	9.8 (0.2)	10.2 (0.2)	10.2 (0.4)	9.3 (0.2)	8.9 (0.2)
Combined	9.7 (0.2)	9.7 (0.2)	9.9 (0.2)	9.2 (0.2)	9.5 (0.1)	8.4 (0.2)

Table 6.–Number of perch tagged, and number and percent of participant (>24-h at liberty), sport, and commercial recaptures from Lake Michigan tagging locations. Data are for fish tagged in 1997 and 1998 (from GLFC 1997 and Steve Robillard, INHS, personal communication – 10/12/98).

		recaptures		
Tagging location	Perch tagged N	Participant N (%)	Sport N (%)	Commercial N (%)
		1997		
Illinois	8,482	530 (6.2)	67 (0.8)	0 (---)
Indiana	2,950	85 (2.9)	41 (1.4)	0 (---)
Michigan (Grand Traverse Bay)	32	0 (---)	0 (---)	0 (---)
Wisconsin (Green Bay)	1,844	40 (2.2)	12 (0.6)	39 (2.1)
Michigan (St. Joseph)	3,292	92 (2.8)	62 (1.9)	0 (---)
Wisconsin (Milwaukee)	5,563	319 (5.7)	20 (0.4)	0 (---)
All sites	21,753	1,066 (4.9)	202 (0.9)	39 (0.2)
		1998		
Illinois	4,902	83 (1.7)	8 (0.2)	0 (---)
Indiana	620	7 (1.1)	6 (1.0)	0 (---)
Wisconsin (Green Bay)	2,314	27 (1.2)	6 (0.2)	55 (2.4)
Michigan (St. Joseph and Onekama)	3,369	105 (3.1)	20 (0.6)	0 (---)
Wisconsin (Milwaukee)	1,318	12 (0.9)	9 (0.7)	0 (---)
All sites	12,523	234 (1.9)	49 (0.4)	55 (0.4)