

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-13

Study No.: 465

Title: Assessment of lake whitefish populations
in Michigan waters of Lake Superior

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

Study Objective: To specify what areal, and size or age, segments of the whitefish stocks the trap net, gill net, and hook-and-line fisheries harvest. To gather trap net data needed to determine total allowable catches.

Summary: Sport catches of lake whitefish were estimated from 1996 creel surveys conducted at one Lake Michigan location (Grand Traverse Bay), and three Lake Superior sites (Munising, Marquette, and Keweenaw Bay). The largest estimated catch (10,490 fish) and the highest overall catch rate (0.0575 fish/angler hour) were both at Grand Traverse Bay. Lake whitefish were commercially harvested by tribal gill net fishers and by state-licensed trap net fishers in Munising (55,942 lb), Marquette (44,885 lb), Big Bay (25,915 lb), Keweenaw Bay (148,061 lb), Upper Entry (70,158 lb), and Ontonagon (70,882 lb). During 1996 tribal fisheries accounted for 46% of the commercial whitefish harvest at Munising, 0% at both Marquette and Big Bay, 73% in Keweenaw Bay, and 100% at both Upper Entry and Ontonagon. Lake whitefish mean length and mean weight were generally similar at each site in 1996 trap net catches, but mean age was greater at Munising and Marquette compared to Big Bay and Keweenaw Bay. Total annual mortality of lake whitefish ranged from 30% at Marquette (1994-96 pooled data), to 76% at Upper Entry (1994-95 pooled data).

Job 1. Title: Summarize creel survey data.

Findings: Lake whitefish were reported in sport fishery creel surveys conducted under Study 427 at Grand Traverse Bay (Lake Michigan), and Munising, Marquette, and Keweenaw Bay (Lake Superior) during 1996 (Table 1). Catch and effort estimates were combined from three survey sites (East and West Arm of Grand Traverse Bay and Elk Rapids) for the Grand Traverse Bay estimates. Highest monthly catches occurred during June and October at Grand Traverse Bay, but surveys were not conducted during winter when large catches have been documented in the past. Most whitefish catch in the surveyed months was during February and March at Munising, October at Marquette, and January in Keweenaw Bay.

Job 2. Title: Summarize tribal data.

Findings: Tribal commercial catch of lake whitefish was with gill nets (Table 2). Annual summaries of tribal gill net catch and effort were obtained from the Chippewa/Ottawa Treaty Fisheries Management Authority for the Munising area (1836 Treaty Ceded waters) and from the Great Lakes Indian Fish and Wildlife Commission for Lake Superior waters near Marquette, Big Bay, Keweenaw Bay, Upper Entry, and Ontonagon (1842 Treaty Ceded waters).

Job 3. Title: Collect trap net whitefish data.

Findings: All of the state-licensed lake whitefish catch was with trap nets. Lake whitefish commercial catch and effort data (Table 2) for state-licensed trap net operations were reported by the fishers to the Michigan Department of Natural Resources (MIDNR) on forms (Form R8005) provided by the MIDNR. Lake whitefish data were collected at dock-side in 1996 during July at Munising, July and August at Marquette and Keweenaw Bay, and September at Big Bay. Lake whitefish were sampled on 3 days at Munising, Marquette, and Keweenaw Bay, and on 1 day at Big Bay. No state-licensed fishing was done at Upper Entry or Ontonagon in 1996. Total lengths of all whitefish were measured and about 100 fish were also scale sampled for age determination on each sampling day. In addition, about 100 of the scale-sampled fish from one of the sampled days were weighed (round weight) to determine weight-length relationships from each area.

Job 4. Title: Analyze whitefish data.

Findings: Sport catches of lake whitefish were very low in 1996 at all Lake Superior sites, but the estimated catch in Grand Traverse Bay, Lake Michigan (10,490 fish) was more than twice the 1995 estimate (4,428 fish) (Table 1). The highest overall 1996 catch rate was also in Grand Traverse Bay (0.0575 fish/angler hour). At Grand Traverse Bay, lake whitefish were caught in five of the seven survey months, with the highest monthly catches and catch rates in June (4,996 fish; 0.2233 fish/angler hour) and October (3,764 fish; 0.2553 fish/angler hour). Both total annual catch (10,490 fish) and catch rate (0.0575 fish/angler hour) were more than double the 1995 figures for Grand Traverse Bay. At Munising, lake whitefish were caught in five of the eight survey months with the highest catches in February (379 fish) and March (324 fish), and highest catch rate in April (0.1445 fish/angler hour). The total annual catch estimate at Munising (914 fish) and overall catch rate (0.0221 fish/angler hour) were similar to 1994 figures, but were 3.5-4.4 times lower than in 1995. At Marquette, lake whitefish were caught in five of the eight survey months. Highest catch (213 fish) and catch rate (0.0382 fish/angler hour) occurred in October. The total annual Marquette catch estimate (290 fish) was about one fifth that of 1995, and the overall catch rate (0.0049) was about one sixth the 1995 figure. At Keweenaw Bay, 97 fish in January were the only lake whitefish estimated to have been caught throughout the ten survey months. Both the catch estimate and the 1996 catch rate (0.0011 fish/angler hour) surpassed 1995 figures for Keweenaw Bay. The sport catch represents a minor portion of the total catch (sport and commercial) in each area. Biological data gathered from the sport fishery have not been analyzed but will include size-at-age, age composition in the catch, and mortality rates. These parameters will be compared with similar data from the commercial fishery to determine if the two fisheries are in direct competition.

During 1996, tribal fisheries accounted for 46% of the commercial whitefish harvest at Munising (13% in 1995), 0% at Marquette (4% in 1995), 0% at Big Bay (30% in 1995), 73% in Keweenaw Bay (100% in 1995), 100% at Upper Entry (48% in 1995), and 100% at Ontonagon (72% in 1995) (Table 2). At Munising tribal lake whitefish catch was 3.2 times higher, effort was 1.9 times higher, and catch-per-effort (CPE) was 1.7 times higher than in 1995. Tribal catch and effort have been low at Marquette for several years (none in 1996). At Big Bay, tribal catches averaged about 9,000 pounds in 1994-95, but no tribal fishing was done in 1996. In Keweenaw Bay, the 1996 catch and effort were both 1.3 times higher than in 1995, and 1996 CPE was the same as in 1995. At Upper Entry, the 1996 catch was 15% lower, effort was 35% lower, and

CPE was 32% higher compared to 1995. At Ontonagon, the 1996 catch was 3.4 times higher, effort was 2.2 times higher, and CPE was 1.5 times higher than in 1995.

At Munising, the 1996 state-licensed trap net catch declined 43%, effort declined 45%, and CPE increased by 5% from 1995 (Table 2). At Marquette, catch was 1.3 times greater, effort was 12% lower, and CPE was 1.5 times greater in 1996 than 1995. At Big Bay, the 1996 trap net catch was 1.4 times higher, effort declined 8%, and CPE was 1.5 times higher than in 1995. No state-licensed fishing occurred in Keweenaw Bay during 1995, but 1996 catch, effort, and CPE were 2% greater, 30% less, and 45% greater compared with 1994. No state-licensed fishing occurred at Upper Entry or Ontonagon during 1996.

Compared to 1995, the 1996 combined state and tribal commercial lake whitefish catch (Table 2) declined 8% at Munising, increased 27% at Marquette, declined 4% at Big Bay, increased 75% in Keweenaw Bay, and declined 59% at Upper Entry. The catch at Ontonagon was 2.4 times higher in 1996 than in 1995, as tribal catches increased 236% and state-licensed fishing dropped out of the picture.

Mean lengths were similar for lake whitefish in 1996 commercial trap net catches, with the exception that mean length was significantly (non-overlapping confidence intervals) less for fish from Keweenaw Bay compared to those from Marquette (Table 3). Mean weights were similar for lake whitefish at all fishing locations. Mean age of fish in catches was significantly greater at Munising and Marquette compared to Big Bay and Keweenaw Bay. Modal ages were 7 at Munising, 6 at Marquette, Big Bay, and Keweenaw Bay (Table 4). Mean length-at-age was generally greater at Marquette and Big Bay, and smaller at Munising and Keweenaw Bay.

Total annual mortality rate not exceeding 55% is recommended by the Tripartite Technical Fisheries Review Committee to adequately protect Lake Superior whitefish stocks. Mortality estimated from pooled data (1994-96 for Munising and Marquette, 1994 and 1996 for Big Bay and Keweenaw Bay, and 1994-95 for Upper Entry) exceeded the target maximum rate at Keweenaw Bay and Upper Entry (Table 5). Using only 1996 data, the target maximum rate was exceeded at Big Bay.

Weight-length relationships (Table 6) and von Bertalanffy growth coefficients (Table 7) were calculated from 1996 data and from 3-yr pooled data as available. Parameters calculated for 1996 were similar to previous years.

No total allowable catch estimates were calculated for 1996 because the Stock Assessment Package One (Clark and Smith 1985) computer program is still being recoded to run under DOS system computers in Microsoft Excel. Personnel changes have affected the schedule, but assignment of a new biologist should facilitate completion of the Excel version in the near future.

Job 5. Title: Prepare performance report.

Findings: I prepared the 1996-97 Study Performance Report (F-53-R-13). A Research Report (Population dynamics and interactions of commercial and sport fisheries for lake whitefish in Lake Superior waters between Keweenaw Point and Munising, 1983-96, Research Report 2034) is being prepared.

Literature Cited:

Clark, R. D., Jr., and K. D. Smith. 1985. Methods for determining catch quotas for Great Lakes fish. Michigan Department of Natural Resources, Fisheries Division Dingell-Johnson Report Study No. 524, Ann Arbor.

Robson, D. S., and D. G. Chapman. 1961. Catch curves and mortality rates. Transactions of the American Fisheries Society 90:181-189.

Table 1.—Lake whitefish catch (number) and effort (angler hours) in sport fisheries of Lake Michigan (Grand Traverse Bay), and Lake Superior (Munising, Marquette, and Keweenaw Bay), during 1996, with two standard errors in parentheses (from Rakoczy Study 427, F-53-R).

Month	Parameter	Gd Traverse Bay	Munising	Marquette	Keweenaw Bay
January	Catch				97 (137)
	Effort				12,533 (4,150)
February	Catch		379 (291)		0
	Effort		5,789 (577)		20,466 (5,310)
March	Catch		324 (249)	2 (4)	0
	Effort		13,935 (1,745)	2,921 (353)	29,299 (6,376)
April	Catch	13 (27)	25 (28)	27 (30)	0
	Effort	15,120 (1,450)	173 (84)	3,761 (569)	381 (341)
May	Catch	474 (427)	54 (77)	22 (38)	0
	Effort	20,139 (2,020)	3,207 (520)	3,807 (487)	2,576 (522)
June	Catch	4,996 (3,559)	132 (265)	0	0
	Effort	22,377 (2,785)	5,968 (995)	9,015 (1,119)	1,956 (953)
July	Catch	1,243 (1,548)	0	26 (56)	0
	Effort	35,863 (6,149)	3,606 (1,092)	12,463 (1,615)	1,545 (530)
August	Catch	0	0	0	0
	Effort	42,712 (6,696)	4,207 (753)	13,427 (1,467)	1,669 (488)
September	Catch	0	0	0	0
	Effort	31,388 (4,921)	4,450 (600)	8,178 (1,062)	213 (123)
October	Catch	3,764 (1,517)		213 (123)	0
	Effort	14,743 (2,054)		5,576 (718)	690 (299)
Total	Catch	10,490 (4,189)	914 (473)	290 (144)	97 (137)
	Effort	182,342 (11,181)	41,335 (2,601)	59,148 (2,888)	86,227 (9,380)

Table 2.—Lake whitefish catch (dressed lb), effort (1,000 ft of gill net, trap net lifts), and catch per unit of effort (lb per 1,000 ft of large mesh gill net, lb per trap net lift) in Lake Superior commercial fisheries, 1994-96.

Area and gear	Statistic	Year				Mean total catch ^a
		1994	1995	1996	1994-96	
Munising						69,922
LMGN ^b	Catch	27,016	8,038	25,651	60,705	
	Effort	1,184	360	675	2,219	
	CPE	23	22	38	27	
LMTN ^c	Catch	65,911	52,858	30,291	149,060	
	Effort	695	520	284	1499	
	CPE	95	102	107	99	
Marquette						40,467
LMGN	Catch	1,155	1,245		2,400	
	Effort	36	12		48	
	CPE	32	100		50	
LMTN	Catch	40,151	33,966	44,885	119,002	
	Effort	260	222	196	678	
	CPE	254	153	229	176	
Big Bay						29,584
LMGN	Catch	10,049	8,043		18,092	
	Effort	294	101		395	
	CPE	34	80		46	
LMTN	Catch	25,820	18,925	25,915	70,660	
	Effort	95	50	46	191	
	CPE	272	379	563	370	
Keweenaw Bay						106,968
LMGN	Catch	88,161	84,682	108,219	281,062	
	Effort	3,581	1,994	2,587	8,162	
	CPE	25	42	42	34	
LMTN	Catch	39,240		39,842	39,842	
	Effort	190		133	133	
	CPE	207		300	300	
Upper Entry						142,342
LMGN	Catch	70,316	82,459	70,158	222,933	
	Effort	1,629	1,305	848	3,782	
	CPE	43	63	83	59	
LMTN	Catch	114,565	89,528		204,093	
	Effort	434	352		786	
	CPE	264	254		260	
Ontonagon						40,687
LMGN	Catch	21,945	21,059	70,882	113,886	
	Effort	294	302	658	1254	
	CPE	75	70	108	91	
LMTN	Catch		8,175		8,175	
	Effort		72		72	
	CPE		114		114	

^aMean annual catch for combined gill net and trap net fisheries.

^bLMGN = large mesh gill nets used by tribal fishers.

^cLMTN = large mesh trap nets used by state-licensed fishers.

Table 3.—Means, ± 2 SE, of total lengths, round weights, and ages of lake whitefish caught in Lake Superior commercial trap nets, 1996 and 1994-96 (pooled as available).

Fishing area	Year(s)	Length (in)	Weight (lb)	Age (yr)
Munising	1996	20.1 \pm 0.5	2.62 \pm 0.32	7.5 \pm 0.2
	1994-96	23.1 \pm 0.3	4.78 \pm 0.24	8.5 \pm 0.1
Marquette	1996	20.6 \pm 0.5	3.24 \pm 0.36	7.2 \pm 0.2
	1994-96	23.3 \pm 0.3	4.41 \pm 0.24	8.6 \pm 0.2
Big Bay	1996	20.3 \pm 0.6	2.86 \pm 0.34	6.6 \pm 0.2
	1994 & 1996	20.4 \pm 0.4	3.06 \pm 0.23	6.5 \pm 0.1
Keweenaw Bay	1996	19.2 \pm 0.5	2.61 \pm 0.32	6.6 \pm 0.2
	1994 & 1996	18.9 \pm 0.3	2.40 \pm 0.22	6.4 \pm 0.1
Upper Entry	1994-95	18.4 \pm 0.3	2.01 \pm 0.20	6.6 \pm 0.1
Ontonagon	1995	19.5 \pm 0.4	3.38 \pm 0.37	7.0 \pm 0.2

Table 4.—Age frequencies, mean total lengths-at-age, and overall mean total lengths for aged samples of lake whitefish caught in Lake Superior commercial trap nets, 1996. Total lengths (± 2 SE) in inches.

Age	Munising		Marquette		Big Bay		Keweenaw Bay	
	N	Length	N	Length	N	Length	N	Length
4					1	17.2	1	17.6
5	20	19.0 \pm 0.5	22	18.2 \pm 0.4	30	18.9 \pm 0.4	45	18.2 \pm 0.2
6	58	19.4 \pm 0.4	95	19.5 \pm 0.2	79	19.8 \pm 0.3	132	18.8 \pm 0.2
7	86	19.6 \pm 0.3	91	20.4 \pm 0.3	48	20.9 \pm 0.4	62	19.4 \pm 0.4
8	72	20.0 \pm 0.4	53	21.5 \pm 0.3	31	21.4 \pm 0.5	40	20.2 \pm 0.5
9	31	21.4 \pm 0.8	21	22.2 \pm 0.8	8	22.6 \pm 0.7	5	19.5 \pm 0.4
10	22	21.1 \pm 1.0	3	22.7 \pm 2.7	1	24.8	8	20.3 \pm 1.5
11	2	19.7 \pm 18.3	2	25.8 \pm 6.5	1	22.8	2	23.2 \pm 0.8
12	6	23.0 \pm 3.6	5	27.5 \pm 1.6			3	24.6 \pm 4.2
13	2	26.7 \pm 1.5	1	28.4				
14			2	28.6 \pm 13.8			1	30.2
15	1	29.4	1	25.9				
16			3	29.7 \pm 1.9				
Total	300	20.1 \pm 0.5	299	20.6 \pm 0.5	199	20.3 \pm 0.6	299	19.2 \pm 0.5

Table 5.—Total annual mortality (A), calculated using the maximum likelihood estimate (Robson and Chapman 1961), for lake whitefish caught in Lake Superior commercial trap nets, 1996 and 1994-96 (pooled as available).

Fishing area	Year(s)	A (± 2 SE)	Chi-square	Ages
Munising	1996	0.47 \pm 0.06	0.02	8-15
	1994-96	0.40 \pm 0.03	1.97	10-17
Marquette	1996	0.48 \pm 0.05	0.31	7-16
	1994-96	0.30 \pm 0.02	1.32	8-17
Big Bay	1996	0.75 \pm 0.12	0.00	8-11
	1994 & 1996	0.54 \pm 0.03	3.14	6-15
Keweenaw Bay	1996	0.53 \pm 0.04	0.09	6-14
	1994 & 1996	0.63 \pm 0.03	2.27	6-14
Upper Entry	1994-95	0.76 \pm 0.04	0.20	7-13
Ontonagon	1995	0.46 \pm 0.03	0.12	6-16

Table 6.—Weight-length relationships ($\text{Log}_e \text{ weight (lb)} = a + b \text{ Log}_e \text{ total length (in)}$) and 95% confidence intervals for lake whitefish caught in Lake Superior commercial trap nets, 1996 and 1994-96 (pooled as available).

Fishing area	Year(s)	N	Intercept (a)	Slope (b)	R^2
Munising	1996	100	-8.91±0.53	3.28±0.18	0.93
	1994-96	310	-9.43±0.23	3.46±0.07	0.97
Marquette	1996	100	-8.76±0.40	3.22±0.13	0.96
	1994-96	301	-8.96±0.32	3.29±0.10	0.93
Big Bay	1996	97	-9.00±0.52	3.32±0.17	0.94
	1994 & 1996	221	-8.46±0.41	3.14±0.13	0.91
Keweenaw Bay	1996	100	-8.58±0.58	3.19±0.19	0.92
	1994 & 1996	200	-8.53±0.47	3.17±0.16	0.89
Upper Entry	1994-95	199	-7.60±0.79	2.87±0.27	0.69
Ontonagon	1995	99	-8.70±0.39	3.22±0.13	0.96

Table 7.—Von Bertalanffy growth coefficients for lake whitefish caught in Lake Superior commercial trap nets, 1996 and 1994-96 (pooled as available).

Fishing area	Year(s)	K	L_{∞}^a	T_0
Munising	1996	0.169	28.0	-0.133
	1994-96	0.201	29.1	-0.035
Marquette	1996	0.152	31.4	-0.052
	1994-96	0.167	31.6	-0.022
Big Bay	1996	0.238	26.1	-0.008
	1994 & 1996	0.222	26.9	-0.008
Keweenaw Bay	1996	0.129	31.7	-0.176
	1994 & 1996	0.128	32.0	-0.166
Upper Entry	1994-5	0.305	21.8	-0.010
Ontonagon	1995	0.113	35.4	-0.110

^aTotal length in inches

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