

## STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-14

Study No.: 465

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

Period Covered: April 1, 1997 to March 31, 1998

**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:** During 1997, an estimated total of 2,729 lake whitefish was harvested by sport anglers in MS-3 and MS-4 combined. The estimated lake whitefish sport harvest was 21,932 in MM-4. In total, 81,588 kg (dressed weight) of lake whitefish were harvested by state-licensed commercial trap-net fishers in Keweenaw Bay, Big Bay, Marquette, and Munising. Smallest values for mean length, mean weight, and mean age were calculated for lake whitefish in the 1997 Keweenaw Bay fishery; values were larger for fish from Big Bay, Marquette, and Munising. Lake whitefish total annual mortality ranged from 32% at Marquette (1995-97 pooled data) to 77% at Upper Entry (1994-95 pooled data). Native American gill-net catch statistics were not available for this report.

### **Job 1. Title: Summarize creel survey data.**

**Findings:** Lake whitefish catch and biological data were collected in 1997 sport fishery creel surveys conducted under Study 427. Sport harvest of lake whitefish was estimated in Lake Superior management zones MS-3 (Keweenaw Bay) and MS-4 (Marquette and Munising). The sport-harvest estimate from Lake Michigan management zone MM-4 (Grand Traverse Bay) was used to put Lake Superior harvests in perspective. No lake whitefish were documented in sport catches in MS-3 and 2,729 were estimated to have been caught in MS-4 (Table 1). Estimated harvest from Lake Superior was not comparable to past years because 1997 creel surveys were not conducted during winter at either Keweenaw Bay or Munising. In past years, ice fisheries produced the greatest numbers of sport-caught lake whitefish. In MM-4, estimated sport harvest during 1997 (21,932 lake whitefish) was more than twice the 1996 estimate and was the highest annual total since 1986 (Table 1).

### **Job 2. Title: Summarize tribal data.**

**Findings:** Commercial gill-net fisheries data will be reported by the Chippewa/Ottawa Treaty Fisheries Management Authority for the Munising area (1836 Treaty Ceded waters) and by 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). Native American commercial gill-net catch statistics for 1997 were not available for this report. Tribal biologists have indicated that their catch summaries will be available in mid April, 1998.

**Job 3. Title: Collect trap-net lake whitefish data.**

**Findings:** All of the state-licensed lake whitefish harvest 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. Lake whitefish data were collected at dock-side in 1997 during June and July (2 days total) at Munising, during June, July, and August (5 days total) at Marquette, during July (3 days total) at Big Bay, and during June and July (4 days total) at Keweenaw Bay. No state-licensed fishing was done at Ontonagon, Upper Entry or Grand Marais during 1997. All sampled whitefish were measured (total length) and scales were taken for age determination. In addition, 100 fish from each sampling area were weighed (round weight) to determine weight-length relationships.

**Job 4. Title: Analyze lake whitefish data.**

**Findings:** Biological data gathered from the 1997 sport fishery have not been analyzed but Schorfhaar and Schneeberger (1997) analyzed and compared size-at-age, age composition, and mortality rates of lake whitefish caught by sport anglers between 1985 and 1996. Biological data from the trap-net fishery were analyzed and used to estimate various population parameters.

The 1997 catch, effort, and CPE statistics for state-licensed trap-net fisheries (Table 2) were compared to those from 1996. Catches declined at Keweenaw Bay (-21%) and Marquette (-34%), and increased at Big Bay (+104%) and Munising (+117%). Effort declined at Marquette (-23%) and increased at Keweenaw Bay (+2%), Big Bay (+196%), and Munising (+19%). CPEs were lower at Keweenaw Bay (-22%), Big Bay (-31%), and Marquette (-14%), and higher at Munising (+83%). No state-licensed fishing occurred at Ontonagon or Upper Entry during 1997.

Lake whitefish total annual mortality rates were derived from estimates of survival using coded age frequencies (Robson and Chapman 1961). The Tripartite Technical Fisheries Review Committee recommended that total annual mortality rate not exceed 55% to adequately protect Lake Superior whitefish stocks. Mortality estimated from pooled data exceeded the target maximum rate at Upper Entry (1994-95 data), Keweenaw Bay (1996-97 data), and Big Bay (1996-97 data), but was well below the target maximum rate at Marquette (1995-97 data) and Munising (1995-97 data) (Table 3).

Weight-length relationships and von Bertalanffy growth coefficients (Table 4) were calculated using 3-yr pooled data as available. Parameters generally varied without trend.

Values for mean lengths and mean ages were smallest in 1997 for lake whitefish in Keweenaw Bay, larger for Big Bay whitefish, and largest for Marquette and Munising whitefish (Table 5). Mean weights were similar for lake whitefish at Big Bay and Munising, less at Keweenaw Bay, and more at Marquette. During 1993-97, mean length, mean weight, and mean age have fluctuated without trend in all fishing areas except that mean weight and mean age have shown trends in opposite directions for Big Bay whitefish. Compared to 1996 values, 1997 mean lengths were smaller at Keweenaw Bay, the same at Big Bay and Marquette, and larger at Munising.

No total allowable catch (TAC) estimates were calculated for 1997 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. In past years, there has been little

correspondence between TAC and actual catch because commercial fishing effort has varied unpredictably (Schorfhaar and Schneeberger 1997).

**Job 5. Title: Prepare performance report.**

**Findings:** The 1997-98 Study Performance Report (F-53-R-14) and Research Report (Commercial and sport fisheries for lake whitefish in Michigan waters of Lake Superior, 1983-96, Research Report No. 2034) were prepared during this study segment.

**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.

Schorfhaar, R.G. and P.J. Schneeberger. 1997. Commercial and sport fisheries for lake whitefish in Michigan waters of Lake Superior, 1983-96. Michigan Department of Natural Resources, Fisheries Division Report No. 2034, Ann Arbor.

Table 1.—Creel survey estimate data for lake whitefish in Lake Michigan and Lake Superior. Estimated harvest in numbers of fish, round weight in kg, and effort in non-targeted angler hours.

Year	MM-4 Grand Traverse Bay			MS-3 Keweenaw Bay			MS-4 Marquette and Munising		
	Harvest	Weight	Effort	Harvest	Weight	Effort	Harvest	Weight	Effort
1985	89,866	126,365	466,505						
1986	53,875	75,757	335,002						
1987	20,011	21,784	284,478	1,184	1,558	29,365	9,587	3,479	157,697
1988	13,636	11,752	262,402	5,160	6,085	102,597	8,023	4,003	138,865
1989	13,806	13,151	251,561	5,421	4,180	107,951			
1990	12,102	10,430	191,901	121	137	32,551	698	380	69,777
1991 <sup>a</sup>	10,746	11,698	233,139	212	240	57,647	4,082	1,481	168,410
1992	4,978	5,419	191,459	364	479	67,137	1,192	433	150,663
1993	2,480	3,375	179,805	471	620	94,709	2,536	805	152,316
1994	4,152	4,897	184,550	408	518	125,975	1,102	550	116,497
1995	4,428	4,619	196,525	10	12	69,297	4,225	1,533	94,848
1996	10,490	11,420	191,401	97	119	86,569	2,515	1,141	118,204
1997 <sup>b</sup>	21,932	pending	278,426	0	0	48,386	2,729	pending	134,001

<sup>a</sup> Only month of May was surveyed at Keweenaw Bay.

<sup>b</sup> Winter ice fishery was not surveyed at Keweenaw Bay and Munising.

Table 2.—Lake whitefish catch (dressed kg), effort (trap-net lifts, 305 m of gill net), and catch per unit effort (CPE - kg per trap-net lift, kg per 305 m of gill net) in Lake Superior commercial fisheries, 1993-97.

Fishing area	Year	Trap net <sup>a</sup>			Gill net <sup>b</sup>			Total catch
		Catch	Effort	CPE	Catch	Effort	CPE	
Ontonagon	1994				9,954	294	34	9,954
	1995	3,708	72	52	9,552	302	32	13,260
	1996				32,152	658	49	32,152
	1997				<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>
Upper Entry	1993	39,189	378	104	50,979	1,370	37	90,168
	1994	51,966	434	120	20,302	1,316	15	72,268
	1995	40,610	352	115	25,930	1,059	24	66,540
	1996				31,823	797	40	31,823
	1997				<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>
Keweenaw Bay	1993	19,277	154	125	68,222	5,529	12	87,499
	1994	17,799	190	94	39,990	3,581	11	57,789
	1995				38,412	1,994	19	38,412
	1996	18,072	133	136	49,088	2,587	19	67,160
	1997	14,292	135	106	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>
Big Bay	1993	14,902	129	116	15,657	759	21	30,559
	1994	11,712	95	123	4,558	294	16	16,270
	1995	8,584	50	172	3,648	101	36	12,232
	1996	11,755	46	256				11,755
	1997	24,043	136	177				
Marquette	1993	16,134	272	59	738	61	12	16,872
	1994	18,212	260	70	524	36	15	18,736
	1995	15,407	222	69	565	12	47	15,972
	1996	20,360	196	104				20,360
	1997	13,414	151	89	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>
Munising	1993	38,215	935	41	4,177	464	9	42,392
	1994	29,897	695	43	12,254	1,184	10	42,151
	1995	23,976	520	46	3,646	360	10	27,622
	1996	13,740	284	48	11,635	675	17	25,375
	1997	29,839	337	88	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>
All	1993	127,717	1,868	68	139,773	8,183	17	267,490
	1994	129,586	1,674	77	87,582	6,705	13	217,168
	1995	92,285	1,216	76	81,753	3,828	21	174,038
	1996	63,927	659	97	124,698	4,717	26	188,625
	1997	81,588	759	108	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>

<sup>a</sup> Large-mesh trap nets used by state-licensed fishers.

<sup>b</sup> Large-mesh gill nets used by tribal fishers. Gill-net catch statistics are from Great Lakes Indian Fish and Wildlife Commission for Upper Entry, Keweenaw Bay, Big Bay, and Marquette. Statistics from Chippewa-Ottawa Treaty Fishery Management Authority for Munising.

<sup>c</sup> 1997 tribal harvest data not available for this report.

Table 3.—Total annual mortality rates of lake whitefish in commercial trap-net catches, with 2 SE and ages included in calculations. When possible, data from each Lake Superior fishing area were pooled over 3-year intervals.

Fishing area	Years pooled	Mortality	2 SE	Ages included
Ontonagon	1995	0.47	0.04	6-14
Upper Entry	1992-93	0.59	0.04	7-12
	1992-94	0.63	0.03	7-12
	1993-95	0.78	0.03	7-11
	1994-95	0.77	0.04	7-11
Keweenaw Bay	1993-94	0.71	0.04	7-12
	1994 & 1996	0.62	0.03	6-14
	1996-97	0.65	0.04	7-14
Big Bay	1991-93	0.38	0.02	7-16
	1992-94	0.37	0.02	6-16
	1993-94	0.53	0.03	6-16
	1994 & 1996	0.58	0.05	7-12
	1996-97	0.64	0.05	7-12
Marquette	1991-93	0.42	0.03	8-17
	1992-94	0.41	0.03	9-17
	1993-95	0.49	0.06	13-17
	1994-96	0.30	0.02	8-17
	1995-97	0.32	0.02	7-17
Munising	1991-93	0.54	0.07	12-17
	1992-94	0.55	0.06	12-17
	1993-95	0.51	0.05	12-17
	1994-96	0.40	0.03	10-17
	1995-97	0.35	0.02	7-20

Table 4.–Vital statistics from commercial trap-net data sets (pooled over 3 yr when possible) used to generate lake whitefish total allowable catches.

Fishing area	Years pooled	Instantaneous fishing mortality <sup>a</sup> (F)	Weight-length coefficients <sup>b</sup>		Von Bertalanffy coefficients			Mean dressed weight of fish in catch (kg)	Catch (dressed kg) <sup>c</sup>
			Intercept	Slope	K	L <sub>∞</sub> (mm)	t <sub>0</sub>		
Ontonagon	1995	0.38	-13.00	3.22	0.115	894	-0.108	1.5	13,260
Upper Entry	1992-93	0.65	-12.67	3.17	0.314	552	-0.004	1.0	102,911
	1992-94	0.75	-12.05	3.07	0.314	551	-0.005	1.0	92,697
	1993-95	1.26	-12.02	3.07	0.362	531	-0.002	0.9	76,325
	1994-95	1.21	-10.74	2.86	0.496	507	-0.001	0.9	56,877
Keweenaw Bay	1993-94	1.00	-13.26	3.27	0.020	800	-0.500	1.0	72,644
	1994 & 96	0.73	-12.69	3.18	0.1286	809	-0.164	1.1	62,474
	1996-97	0.80	-12.98	3.22	0.1489	746	-0.2758	1.0	
Big Bay	1991-93	0.23	-12.92	3.20	0.358	596	-0.007	1.4	33,479
	1992-94	0.22	-12.25	3.09	0.365	590	-0.006	1.4	26,477
	1993-94	0.50	-12.70	3.17	0.272	662	-0.018	1.5	23,414
	1994 & 96	0.61	-12.52	3.14	0.225	680	-0.008	1.4	14,012
	1996-97	0.78	-13.72	3.34	0.279	627	0.015	1.3	
Marquette	1991-93	0.30	-14.67	3.48	0.176	790	-0.040	1.9	30,739
	1992-94	0.28	-14.44	3.45	0.178	792	-0.026	1.9	22,048
	1993-95	0.43	-13.59	3.31	0.183	786	-0.020	2.1	17,193
	1994-96	0.11	-13.51	3.30	0.168	801	-0.022	2.0	18,356
	1995-97	0.14	-13.84	3.35	0.159	805	-0.036	1.9	
Munising	1991-93	0.52	-11.94	3.05	0.202	731	-0.111	1.8	68,981
	1992-94	0.56	-13.03	3.23	0.212	727	-0.080	2.0	48,691
	1993-95	0.46	-12.23	3.11	0.219	733	-0.016	2.5	37,388
	1994-96	0.27	-14.50	3.46	0.201	740	-0.035	2.2	31,716
	1995-97	0.18	-13.66	3.33	0.196	734	-0.085	1.8	

<sup>a</sup> Instantaneous rate of natural mortality (M) was assumed to be 0.25 year<sup>-1</sup> (Rakoczy 1983) in all fishing areas.

<sup>b</sup>  $\log_e(\text{Weight})=a + b(\log_e[\text{Length}])$

<sup>c</sup> Computed from catch data in Table 1.

Table 5.—Mean length, weight, and age (with  $\pm$  factor for 95% confidence intervals) of Lake Superior lake whitefish in commercial trap nets, 1993-97. Total length in millimeters, round weight in grams, age in years.

Fishing area	Year	Length		Weight		Age	
		Mean	$\pm$ factor	Mean	$\pm$ factor	Mean	$\pm$ factor
Ontonagon	1995	496.4	6.5	1,536.4	209.9	7.0	0.2
Upper Entry	1993	473.6	2.5	987.4	44.1	6.4	0.1
	1994	465.2	2.3	919.1	29.7	6.5	0.1
	1995	470.8	3.5	910.9	29.5	6.7	0.1
Keweenaw Bay	1993	478.8	3.3	977.7	56.6	6.9	0.1
	1994	473.6	3.0	990.4	39.8	6.2	0.1
	1996	487.5	5.0	1,188.4	85.6	6.6	0.2
	1997	456.8	2.3	845.9	23.9	6.4	0.1
Big Bay	1993	542.6	6.5	1,472.6	128.4	6.3	0.2
	1994	519.6	5.4	1,464.5	65.0	6.5	0.1
	1996	515.9	5.7	1,298.9	72.1	6.6	0.2
	1997	522.3	4.9	1,258.2	51.8	6.8	0.1
Marquette	1993	587.7	7.2	1,771.8	158.1	8.0	0.2
	1994	585.0	7.9	1,695.0	163.3	7.8	0.2
	1995	639.7	5.8	2,841.7	168.1	9.9	0.2
	1996	524.3	6.6	1,474.8	136.8	7.2	0.2
	1997	532.1	4.9	1,453.5	139.6	7.1	0.1
Munising	1993	581.8	7.0	2,225.9	178.5	8.3	0.3
	1994	609.7	6.1	2,475.7	155.3	8.7	0.2
	1995	624.6	5.7	2,790.7	142.9	9.1	0.3
	1996	509.7	5.6	1,191.2	109.2	7.5	0.2
	1997	527.6	6.2	1,214.2	85.5	7.2	0.2

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Date: March 31, 1998