

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-3

Study No.: 465

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

Period Covered: October 1, 2001 to September 30, 2002

Study Objectives: (1) To specify what areal, and size or age, segments of the lake whitefish stocks are harvested by trap-net, gill-net, and hook-and-line fisheries. (2) To gather trap-net data needed to determine total allowable catches.

Summary: Samples were collected as scheduled during 2002. Data from these samples will be processed, analyzed, and then summarized in future reports. Data from samples collected in 2001 were analyzed and summarized for this performance report. During 2001 in Lake Superior, an estimated 67 lake whitefish were harvested by sport anglers in MS-3, and 4,921 were harvested in MS-4. Estimated lake whitefish sport harvest was 21,847 in Lake Michigan management zone MM-4. In Michigan waters of Lake Superior between Ontonagon and Munising, state-licensed commercial trap-net fishers harvested 128,547 kg and tribal commercial gill-net fishers harvested 195,715 kg of lake whitefish during 2001. Trap-net effort totaled 1,311 lifts and gill-net effort was 1,652,000 m of net. Lake whitefish total annual mortality, calculated using pooled commercial trap-net data from 1999 through 2001, was at or below the target maximum in all management units, ranging from 42% at Upper Entry to 55% at Marquette. Mean lengths, weights, and ages were calculated for lake whitefish harvested during 2001 by state-licensed commercial trap nets in Upper Entry, Keweenaw Bay, Big Bay, Marquette, and Munising. Mean lengths per fish ranged from 475 mm at Keweenaw Bay to 544 mm at Marquette. Mean weights per fish ranged from 951 g at Keweenaw Bay to 1,448 g at Marquette. Mean age was lowest at Keweenaw Bay (6.2) and highest at Upper Entry (7.9).

Findings: Jobs 1, 2, 3, 4, and 5 were scheduled for 2001-02, and progress is reported below.

Job 1. Title: Summarize creel survey data.—Lake whitefish creel survey data were collected in 2002 under F-81-R Study 427. Estimated lake whitefish sport harvest in 2001 was 67 fish from MS-3 (Keweenaw Bay, Lake Superior), 4,921 fish from MS-4 (Marquette and Munising, Lake Superior), and 21,847 fish from MM-4 (Grand Traverse Bay, Lake Michigan) (Table 1). The MS-3 sport harvest has been less than 500 fish since 1990. Sport harvest was down 24% in MS-4 and up 65% in MM-4 compared to 2000.

Job 2. Title: Summarize tribal data.—Commercial gill-net fisheries data are reported by the Chippewa Ottawa Resource Authority (CORA) for the Munising area (1836 Treaty Ceded waters) and by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) for Lake Superior waters near Marquette, Big Bay, Keweenaw Bay, Upper Entry, and Ontonagon (1842 Treaty Ceded waters). Overall, tribal yield in 2001 (195,715 kg) was down 27% from 2000, and effort (1,652,000 m) was down 7% (Table 2).

Job 3. Title: Collect trap-net lake whitefish data.—State-licensed commercial fishers harvest lake whitefish with trap nets and submit yield and effort data to Michigan Department of Natural Resources in Lansing, Michigan. Marquette Fisheries Research Station personnel collected lake

whitefish data dock-side at Upper Entry, Bete Grise, Big Bay, Marquette, and Munising during 2002. Summary statistics generated from fishery and biological samples collected in 2001 included data from 2,661 commercially caught lake whitefish. All sampled lake whitefish were measured (total length to the nearest mm) and weighed (round weight to the nearest g). Scales were taken from each fish for age determination. Kidney swabs were taken from 116 Lake Superior lake whitefish during 2001. Swabs were sent to Wolf Lake State Fish Hatchery, Mattawan, Mich., to test for *Renibacterium salmoninarum*, the bacterium that causes bacterial kidney disease in trout and salmon.

Job 4. Title: Analyze lake whitefish data.—Sport-fishery biological data gathered during 2002 will be examined during the upcoming winter. Biological data from 2001 sport fisheries were processed on schedule during 2002.

Catch, effort, and CPE statistics for state-licensed trap-net fisheries (Table 2) showed that in 2001, overall yield decreased 34%, effort decreased 24%, and CPE decreased 13% compared to 2000 values. Yield was lowest at Keweenaw Bay (10,333 kg) and highest at Upper Entry (56,283 kg) during 2001. Effort ranged from 85 lifts at Keweenaw/Bete Grise to 535 lifts at Munising. CPE varied from 67 kg/lift at Munising to 155 kg/lift at Upper Entry.

Lake whitefish total annual mortality rates were derived from estimates of survival using coded age frequencies (Robson and Chapman 1961) pooled from data for 1999-2001. Total annual mortality rate is targeted to be below 50-55% (depending on area) to adequately protect Lake Superior lake whitefish stocks. Estimated mortality rates for 1999-2001 were at or below target maximums in all areas, ranging from 42% at Upper Entry to 55% at Marquette (Table 3).

Weight-length relationships and von Bertalanffy growth coefficients were calculated using 3-yr pooled data. Parameter values for 1999-2001 were similar to those from other pooled data sets (Table 4).

Mean length and mean weight of lake whitefish in commercial trap-net catches were greatest for Marquette and least for Keweenaw Bay in 2001; mean age was highest at Upper Entry and lowest at Keweenaw Bay (Table 5). Mean length and weight of fish ranged from 475 mm and 951 g in Keweenaw Bay to 544 mm and 1,428 g in Marquette; mean age ranged from 6.2 years at Keweenaw Bay to 7.9 years at Upper Entry.

Using 1986-2000 data, age-structured stock-assessment models were employed to calculate allowable yields of lake whitefish in management zones MFS-4 and MFS-5 for the 2002 fishing season, as mandated by the 2000 Consent Decree that governs sport and commercial fishing in 1836 treaty waters. Data from 2001 fisheries and assessments will be appended to models to generate harvest quotas for 2003.

Job 5. Title: Prepare reports.—The 2001-02 Study Performance Report (F-81-R-1) was prepared during this study segment.

Reference:

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

Prepared by: P. J. Schneeberger

Date: September 30, 2002

Table 1.—Creel survey estimate data for lake whitefish in Lake Michigan and Lake Superior, 1985-2001. Estimated harvest in numbers of fish, round weight in kg, and effort in non-targeted angler hours. Blanks correspond to years and areas when surveys were not conducted. Except where otherwise indicated, estimated values were calculated from surveys conducted only during the open water season at Grand Traverse Bay and during both open water and ice fishing seasons at Keweenaw Bay, Marquette, and Munising.

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 ^a	89,866	126,365	466,505						
1986 ^a	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 ^b	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 ^c	21,932	~23,029	278,426	0	0	48,386	2,729	990	134,001
1998	5,259	~5,522	304,638	0	0	40,553	5,773	2,357	103,097
1999	4,430	4,913	227,978	267	317	39,144	6,744	2,781	103,165
2000	13,233	~14,676	185,571	159	~189	28,887	6,500	~2,681	96,370
2001	21,847	~24,229	176,729	67	~80	41,563	4,921	~2,029	100,590

^a Winter ice fishery survey included in estimates for Grand Traverse Bay.

^b Only month of May was surveyed at Keweenaw Bay.

^c Winter ice fishery was not surveyed at Keweenaw Bay and Munising.

Table 2.—Lake whitefish yield (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, 1998-2001.

Fishing area (stat. district)	Year	Trap net ^a			Gill net ^b			Total yield
		Yield	Effort	CPE	Yield	Effort	CPE	
Ontonagon (WFS-01)	1998				5,440	85	64	5,440
	1999				16,700	170	98	16,700
	2000				51,435	382	135	51,435
	2001				8,992	95	95	8,992
Upper Entry (WFS-02)	1998	27,202	200	136	141,917	2,566	55	169,119
	1999	69,935	269	260	95,785	1,722	56	165,720
	2000	64,083	295	217	92,563	1,609	58	156,646
	2001	56,283	362	155	81,811	1,712	48	138,094
Keweenaw Bay/Bete Grise (WFS-03)	1998				66,121	2,253	29	66,121
	1999	24,342	133	183	68,353	2,172	31	92,695
	2000	16,408	151	109	58,645	2,020	29	75,053
	2001	10,333	85	122	63,124	2,336	27	73,457
Big Bay (WFS-04)	1998	20,370	144	141	15,264	482	32	35,634
	1999	18,366	182	101	9,913	258	38	28,279
	2000	26,612	149	179	13,431	235	57	40,043
	2001	11,882	140	85	2,655	75	35	14,537
Marquette (WFS-04)	1998	13,957	204	68	12,977	280	46	26,934
	1999	17,765	230	77	6,482	178	36	24,247
	2000	17,178	194	89	23,294	484	48	40,472
	2001	14,449	189	76	9,524	248	38	23,973
Munising (WFS-05)	1998	49,090	791	62	23,054	942	24	72,144
	1999	48,812	718	68	18,410	650	28	67,222
	2000	69,422	930	75	27,599	1,107	25	97,021
	2001	35,600	535	67	29,609	949	31	65,209
All the above	1998	110,619	1,339	83	264,773	6,608	40	375,392
	1999	179,220	1,532	117	215,643	5,150	42	394,863
	2000	193,703	1,719	113	266,967	5,837	46	460,670
	2001	128,547	1,311	98	195,715	5,415	36	324,262

^a Large-mesh trap nets used by state-licensed fishers.

^b Large-mesh gill nets used by tribal fishers. Gill-net catch statistics are from Great Lakes Indian Fish & Wildlife Commission (GLIFWC) for Upper Entry, Keweenaw Bay, Big Bay, and Marquette. Statistics from Chippewa-Ottawa Resource Authority (formerly Chippewa-Ottawa Treaty Fishery Management Authority) for Munising.

Table 3.—Total annual mortality rates of lake whitefish in state-licensed commercial trap-net catches, 1993-2001, 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	1993-1995	0.78	0.03	7-11
	1994-1995	0.77	0.04	7-11
	1998	0.76	0.10	9-11
	1998-1999	0.63	0.04	8-12
	1998-2000	0.56	0.04	9-13
	1999-2001	0.42	0.02	7-13
Keweenaw Bay	1994 & 1996	0.62	0.03	6-14
	1996-1997	0.65	0.04	7-14
	1997-1999	0.76	0.04	7-14
	1998-2000	0.70	0.04	7-14
	1999-2001	0.50	0.06	8-14
Big Bay	1993-1994	0.53	0.03	6-16
	1994 & 1996	0.58	0.05	7-12
	1996-1997	0.64	0.05	7-12
	1996-1998	0.69	0.06	8-14
	1997-1999	0.66	0.05	8-14
	1998-2000	0.61	0.04	8-16
	1999-2001	0.53	0.06	9-16
Marquette	1993-1995	0.49	0.06	13-17
	1994-1996	0.30	0.02	8-17
	1995-1997	0.32	0.02	7-17
	1996-1998	0.44	0.02	7-19
	1997-1999	0.34	0.05	10-19
	1998-2000	0.33	0.05	10-21
	1999-2001	0.55	0.03	8-21
Munising	1993-1995	0.51	0.05	12-17
	1994-1996	0.40	0.03	10-17
	1995-1997	0.35	0.02	7-20
	1996-1998	0.47	0.02	7-18
	1997-1999	0.36	0.03	10-19
	1998-2000	0.32	0.03	11-19
1999-2001	0.44	0.02	8-19	
Grand Marais	1997	0.35	0.06	8-17

Table 4.—Vital statistics from state-licensed commercial trap-net data sets (pooled over 3 yr period when possible) used to generate lake whitefish total allowable catches for Lake Superior stocks.

Fishing area	Years pooled	Instantaneous fishing mortality ^a (F)	Weight-length coefficients ^b		Von Bertalanffy coefficients		Mean dressed weight of fish in catch (kg)	Yield (round kg) ^c	
			Intercept	Slope	K	L _∞ (mm)			t ₀
Ontonagon	1995	0.38	-13.00	3.22	0.115	894	-0.108	1.5	13,260
Upper Entry	1993-1995	1.26	-12.02	3.07	0.362	531	-0.002	0.9	76,325
	1994-1995	1.21	-10.74	2.86	0.496	507	-0.001	0.9	69,404
	1998	1.18	-11.88	3.04	0.429	515	-0.000	1.1	70,393
	1998-1999	0.75	-11.88	3.04	0.325	551	-0.001	1.1	48,568
	1998-2000	0.56	-11.20	2.93	0.360	532	-0.000	0.9	45,932
	1999-2001	0.29	-11.82	3.03	0.345	551	-0.014	1.1	63,434
Keweenaw Bay	1993-1994	1.00	-13.26	3.27	0.020	800	-0.500	1.0	72,644
	1994 & 1996	0.73	-12.69	3.18	0.129	809	-0.164	1.1	62,474
	1996-1997	0.80	-12.98	3.22	0.149	746	-0.276	1.0	74,984
	1997 & 1999	1.19	-11.54	2.98	0.460	507	-0.005	1.0	19,317
	1998-2000	0.95	-10.82	2.87	0.383	537	-0.009	0.8	16,510
	1999-2001	0.44	-12.92	3.21	0.341	557	-0.018	1.0	17,027
		1993-1994	0.50	-12.70	3.17	0.272	662	-0.018	1.5
Big Bay	1994 & 1996	0.61	-12.52	3.14	0.225	680	-0.008	1.4	14,012
	1996-1997	0.78	-13.72	3.34	0.279	627	0.015	1.3	17,899
	1996-1998	0.92	-9.12	2.60	0.252	656	-0.057	1.3	18,723
	1997-1999	0.82	-10.40	2.80	0.212	678	-0.035	1.2	21,380
	1998-2000	0.68	-13.51	3.35	0.199	697	-0.036	1.2	18,618
	1999-2001	0.50	-13.61	3.32	0.243	654	-0.056	1.3	18,953

Table 4.—Continued.

Fishing area	Years pooled	Instantaneous fishing mortality ^a (F)	Weight-length coefficients ^b		Von Bertalanffy coefficients		Mean dressed weight of fish in catch (kg)	Yield (round kg) ^c
			Intercept	Slope	K	L _∞ (mm)		
Marquette	1993-1995	0.43	-13.59	3.31	0.183	786	-0.020	17,193
	1994-1996	0.11	-13.51	3.30	0.168	801	-0.022	18,356
	1995-1997	0.14	-13.84	3.35	0.159	805	-0.036	19,917
	1996-1998	0.34	-11.25	2.94	0.202	718	0.015	22,942
	1997-1999	0.16	-11.18	2.92	0.155	800	-0.072	15,045
	1998-2000	0.15	-12.48	3.14	0.152	803	-0.081	16,300
	1999-2001	0.55	-12.67	3.16	0.182	754	-0.119	16,464
	1993-1995	0.46	-12.23	3.11	0.219	733	-0.016	37,388
	1994-1996	0.27	-14.50	3.46	0.201	740	-0.035	31,716
Munising	1995-1997	0.18	-13.66	3.33	0.196	734	-0.085	30,913
	1996-1998	0.39	-13.92	3.36	0.182	753	-0.178	38,069
	1997-1999	0.20	-13.56	3.30	0.163	767	-0.292	42,757
	1998-2000	0.14	-12.70	3.17	0.169	757	-0.256	55,775
	1999-2001	0.34	-13.11	3.23	0.151	771	-0.342	51,278

^a Instantaneous rate of natural mortality (M) was assumed to be 0.25 year⁻¹ (Rakoczy 1983) in all fishing areas.

^b $\log_e(\text{Weight})=a + b(\log_e[\text{Length}])$

^c Computed from yield data in Table 2.

Table 5.—Mean length, weight, and age (with \pm factor for 95% confidence intervals) of Lake Superior lake whitefish in state-licensed commercial trap nets, 1994-2001. Total length is in millimeters, round weight is in grams, and age is in years.

Fishing area	Year	Length		Weight		Age	
		Mean	\pm factor	Mean	\pm factor	Mean	\pm factor
Ontonagon	1995	496	6	1,536	210	7.0	0.2
Upper Entry	1994	465	2	919	30	6.5	0.1
	1995	471	4	911	30	6.7	0.1
	1998	494	4	1,066	29	7.5	0.1
	1999	500	3	1,048	23	7.5	0.1
	2000	493	3	1,092	26	8.3	0.2
	2001	506	4	1,216	34	7.9	0.2
Keweenaw Bay	1994	474	3	990	40	6.2	0.1
	1996	488	5	1,188	86	6.6	0.2
	1997	457	2	846	24	6.4	0.1
	1999	485	3	1,024	25	6.3	0.1
	2000	471	3	934	20	6.3	0.1
	2001	475	4	951	34	6.2	0.2
Big Bay	1994	520	5	1,464	65	6.5	0.1
	1996	516	6	1,299	72	6.6	0.2
	1997	522	5	1,258	52	6.8	0.1
	1998	524	5	1,263	40	6.8	0.1
	1999	514	5	1,242	40	7.0	0.1
	2000	533	5	1,416	44	7.5	0.1
	2001	528	5	1,338	50	7.4	0.2
Marquette	1994	585	8	1,695	163	7.8	0.2
	1995	640	6	2,842	168	9.9	0.2
	1996	524	7	1,475	137	7.2	0.2
	1997	532	5	1,454	140	7.1	0.1
	1998	552	7	1,578	81	7.9	0.2
	1999	549	4	1,462	40	7.5	0.1
	2000	540	6	1,451	54	7.5	0.2
	2001	544	6	1,428	57	7.3	0.2
Munising	1994	610	6	2,476	155	8.7	0.2
	1995	625	6	2,791	143	9.1	0.3
	1996	510	6	1,191	109	7.5	0.2
	1997	528	6	1,214	86	7.2	0.2
	1998	547	4	1,544	44	7.5	0.1
	1999	521	4	1,298	41	8.1	0.1
	2000	533	5	1,448	48	8.1	0.1
	2001	508	4	1,209	35	7.8	0.1