

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-13

Study No.: 464

Title: Marking of chinook salmon in Lakes Michigan and Huron

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

Study Objective: To determine (1) movement, (2) growth, (3) exploitation/survival, (4) survival from holding pens versus direct stream plants, (5) survival from upstream versus downstream plants, (6) incidence of bacterial kidney disease (BKD) in hatchery versus naturally produced stocks, and (7) contribution of natural reproduction to the catchable stocks of chinook salmon in lakes Michigan and Huron.

Summary: Nearly six million chinook salmon were marked with coded wire tags and adipose fin clips and planted into lakes Michigan and Huron during 1990-94, making up about 20% of all chinook salmon stocked by MDNR (Table 1). Coded wire tag (CWT) marking of chinook salmon for Lake Huron during 1995 and 1996 was done under Study 482. During 1990-95 all chinook salmon planted by MDNR were also marked with oxytetracycline.

CWT chinook salmon were recovered from several sources including voluntary returns by sport anglers, from sampling of tribal harvest, sampling at harvest weirs, research surveys in the open lakes, and sampling of the sport fisheries. A total of 2,812 CWT chinook salmon, 56 steelhead trout, 52 Atlantic salmon, and 2,777 lake trout were recovered and reported to MDNR through March 31, 1997.

Return rates of CWT fish per 100,000 fish were determined for fish stocked at 5 Lake Michigan and 3 Lake Huron planting sites. CWT returns per 100,000 fish planted were highest for the northern most planting site in both Lake Michigan and Lake Huron (Medusa Creek and Swan River). Return rates of fish reared at Wolf Lake Hatchery were higher for 4 of five year classes. Net pen cultured fish provided higher return rates for all year classes at the Grand River and for 3 of 4 year classes at the Au Sable River. At the Grand River net pen cultured fish provided the best returns followed by downstream and upstream planted fish. The highest percentage of CWT fish recovered at harvest weirs were fish planted at or near the location of the weir.

Job 2. Title: Sample fishery for chinook salmon.

Findings: CWT chinook salmon were recovered from several sources including voluntary returns by sport anglers, from sampling of tribal harvest, sampling at harvest weirs, research surveys in the open lakes, and sampling of the sport fisheries.

Voluntary returns by sport anglers in Michigan has been promoted by posting signs at many fishing ports, distributing forms and zip-lock bags in many important fishing areas, and establishing over 100 drop-off stations. Other fisheries agencies bordering the Great Lakes have also been alerted to the program and signs, forms, and bags have been provided to them. Anglers

were asked to provide length, weight, and capture location along with the head of adipose fin (Ad) clipped chinook salmon.

Tribal commercial fishers target on chinook salmon in the northern areas of Lakes Michigan and Huron. The entire harvest of chinook salmon was sampled during 1996 in Grand Traverse Bay under orders of the Federal Court. Other tribal fisheries were sampled at wholesale fish houses in St. Ignace and Mackinac City. Chinook salmon were sampled for length, weight, sex, fin clips, and lamprey wounding. Heads or snouts were removed from Ad clipped fish.

Sampling of weir harvested chinook salmon from Little Manistee River, Platte River, Boardman River, Medusa Creek, and Swan River was done either at the weir as fish were harvested or at processing plants in St. Ignace or Mackinac City. Fifteen percent of harvested chinook salmon were sampled for length, weight, sex, fin clips, and lamprey wounding. Heads or snouts were removed from Ad clipped fish.

CWT fish taken in research surveys come from netting in the open lake by MDNR, electrofishing surveys in tributary rivers, and from contract netting at the Ludington Pumped Storage facility. Chinook salmon were sampled for length, weight, sex, fin clips, BKD, lamprey wounding, and vertebrae were recovered on the MDNR surveys. Heads or snouts were removed from Ad clipped fish.

Sampling of the sport fishery was done through the state wide creel survey and by five roving "head-hunters". Chinook salmon were sampled for length, weight, sex, fin clips, and lamprey wounding. Heads or snouts were removed from Ad clipped fish if anglers would allow it.

A total of 2,812 CWT chinook salmon, 56 steelhead trout, 52 Atlantic salmon, and 2,777 lake trout were recovered and reported to MDNR through March 31, 1997. Not all CWT data have been reported by all agencies. Heads or snouts were collected monthly or more frequently from drop-off locations and CWTs were extracted, read, and data entered into a computer program.

Job 3. Title: Analyze tag return and bio-data.

Findings: We determined return rates of CWT fish per 100,000 fish stocked at 5 Lake Michigan and 3 Lake Huron planting sites. CWT returns per 100,000 fish planted were highest for the northern most planting site in both Lake Michigan and Lake Huron (Medusa Creek and Swan River), however the return rates have not been adjusted for differences in efficiency of tag recovery or fishing effort among areas (Table 2).

Paired plants of Platte River and Wolf Lake Hatchery fish were made in the Little Manistee River (Table 3). To date the contribution of Wolf Lake Hatchery to lake sport harvest was higher than for the Platte River Hatchery fish of the 1991 through 1994 year classes but not for the 1990 year class.

Net-pen culture appears to be a more effective method of stocking chinook salmon in the Grand and Au Sable Rivers. Comparison of CWT chinook salmon that were direct planted at downstream and upstream sites with net-pen cultured fish was done in the Grand River, Lake Michigan (Table 4). Comparison of net-pen cultured with direct planted fish was done in the Au Sable River, Lake Huron (Table 5). Net-pen cultured fish provided higher returns per 100,000 fish planted for all year classes at the Grand River and for 3 of 4 year classes at the Au Sable

River. Most of the 1992 year-class fish cultured in the net pen may have been lost due to a collapse of the net pen which may have resulted in the low return of those fish. At the Grand River net-pen cultured fish provided the best returns followed by downstream and upstream planted fish, respectively.

Chinook salmon returns to harvest weirs and their contribution from various planting sites are presented in Table 6. The highest percentage of CWT fish recovered at harvest weirs were fish planted at or near the location of the weir.

Job 4. Title: Prepare annual, final, and published reports.

Findings: The annual performance report was prepared and submitted to Federal Aid. A summary report of findings in this study were provided in a report to the Great Lakes Fishery Commission Lake Michigan Committee Meeting on March 20-21, 1997. Results of this study were presented to several sportsmen's, charter fisher's, and civic groups.

I prepared an amendment extending this study through the year 2001-02. Objectives of the amended study will be: To coded-wire tag and adipose fin clip or mark with oxytetracycline experimental lots of fish at state fish hatcheries. To design, develop, and manage data bases for research studies which utilize coded-wire tags or oxytetracycline, harvest and weir data, and survey data from Charlevoix Fisheries Station research studies. To convert all past Charlevoix Fisheries Station main frame and personal computer data files into a common personal computer based format. Data analysis and reporting on biological data from tagging or oxytetracycline marking will be included in Studies 471, 485, 486, and 487.

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Date: March 31, 1997

Table 1.—Number of recoverable coded wire tagged (CWT) chinook salmon planted (adjusted for tag loss and missed fin clips) in Lakes Huron and Michigan during 1990-94.

Plant Site	1990		1991		1992		1993		1994	
	Hatchery/ Egg origin	CWTs Planted	Hatchery/ Egg origin	CWTs Planted	Hatchery/ Egg origin	CWTs Planted	Hatchery/ Egg origin	CWTs Planted	Hatchery/ Egg origin	CWTs Planted
Medusa Creek ¹	Platte R Michigan	98,381	Platte R Michigan	105,648	Platte R Ontario	100,302	Platte R Ontario	86,102	Platte R Michigan	84,578
Kids Creek	—	—	Wolf Lake Ontario	95,488	Platte R Ontario	97,459	Platte R Ontario	83,689	Platte R Michigan	90,757
Little Manistee River	Platte R Michigan	194,538	Platte R Michigan	190,010	Platte R Ontario	196,227	Platte R Ontario	188,911	Platte R Ontario	175,854
Little Manistee River	Wolf Lake Ontario	103,317	Wolf Lake Ontario	98,098	Wolf Lake Ontario	92,750	Wolf Lake Ontario	93,524	Wolf Lake Ontario	86,459
Grand R Grand Haven	Wolf Lake Michigan	97,761	Wolf Lake Ontario	97,149	Wolf Lake Ontario	94,904	Wolf Lake Ontario	95,480	Wolf Lake Ontario	87,996
Grand R Grand Haven net pen	Wolf Lake Michigan	89,617	Wolf Lake Ontario	97,077	Wolf Lake Ontario	83,986	Wolf Lake Ontario	92,385	Wolf Lake Ontario	95,302
Grand R Grand Rapids	—	—	Wolf Lake Ontario	99,299	Wolf Lake Ontario	99,091	Wolf Lake Ontario	96,009	Wolf Lake Ontario	90,735
St. Joseph River net pen ²	—	—	Wolf Lake Ontario	99,555	Wolf Lake Ontario	97,266	Wolf Lake Ontario	82,392	Wolf Lake Ontario	98,282
Swan River	—	—	Platte R Michigan	202,744	Platte R Ontario	186,814	Platte R Ontario	189,853	Platte R Ontario	185,558
Au Sable River	—	—	Platte R Michigan	105,220	Wolf Lake Ontario	96,288	Wolf Lake Ontario	97,641	Wolf Lake Ontario	85,648
Au Sable River net pen ^{3,4}	—	—	Platte R Michigan	107,542	Wolf Lake Ontario	47,627	Wolf Lake Ontario	99,233	Wolf Lake Ontario	92,594
Harbor Beach	—	—	—	—	—	—	Platte R Ontario	88,271	Platte R Michigan	90,983

¹ 1992, 1993, and 1994 Medusa Creek plants were held in an imprint pond at the planting site for a few weeks prior to release.

² 1991 St. Joseph River plants were not held in a net pen prior to release and were stocked upstream near Berrien Springs.

³ 1993 and 1994 net pens were located in Van Etten Creek.

⁴ 1994 Au Sable River net pen fish were transported to 3 Mile Park (approximately 3 miles north of river mouth) when they were released.

Table 2.—Chinook salmon sport catch per 100,000 fish planted in Michigan's waters of Lakes Huron and Michigan and tributary rivers.

Year planted	Ages	Lake Michigan					Lake Huron		
		Medusa Creek	Boardman River	Little Manistee River ¹	Grand River ²	St. Joseph River	Swan River	Au Sable River ³	Harbor Beach
1990	0.0	0.00	-	0.00	0.00	-	-	-	-
	0.1	7.12	-	8.76	6.14	-	-	-	-
	0.2	18.30	-	10.92	10.94	-	-	-	-
	0.3	9.15	-	5.02	10.18	-	-	-	-
	0.4	1.02	-	0.52	0.00	-	-	-	-
	Total	35.59	-	25.21	27.26	-	-	-	-
1991	0.0	0.00	0.00	0.27	0.00	0.00	0.00	0.00	-
	0.1	78.56	29.32	27.83	9.86	6.03	41.92	10.34	-
	0.2	26.50	8.38	9.11	8.53	1.00	65.60	43.20	-
	0.3	10.41	3.14	7.31	2.73	2.01	97.66	74.21	-
	0.4	0.00	0.00	1.32	0.00	0.00	28.61	10.32	-
	Total	115.47	40.84	45.82	21.12	9.04	233.79	138.07	-
1992	0.0	2.99	5.13	1.08	0.75	1.03	0.00	0.00	-
	0.1	33.90	33.86	21.58	24.99	25.70	22.48	12.98	-
	0.2	23.93	21.55	20.38	16.24	16.45	88.32	50.94	-
	0.3	7.98	18.47	11.03	11.71	10.28	169.69	44.19	-
	0.4	1.00	0.00	0.26	1.04	1.03	34.26	2.08	-
	Total	69.80	79.01	53.23	54.72	54.49	314.75	110.18	-
1993	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.1	36.00	26.29	9.87	19.49	8.50	38.45	42.06	10.20
	0.2	36.00	29.87	10.40	30.87	18.21	76.37	90.20	26.06
	0.3	36.00	17.92	1.87	25.82	0.00	54.25	60.83	31.72
	0.4								
	Total	108.00	74.08	22.13	76.19	26.71	169.07	193.08	67.98
1994	0.0	1.18	3.31	0.00	0.00	0.00	0.00	0.59	0.00
	0.1	18.92	24.24	9.76	20.85	28.49	38.80	49.96	12.09
	0.2	63.85	79.33	17.82	68.59	67.15	79.76	59.08	18.68
	0.3								
	0.4								
	Total	82.77	103.57	27.57	89.45	95.64	118.56	109.04	30.77

¹ See Table 4 for breakdown of return rates from the different plants on the Little Manistee River.² See Table 5 for breakdown of return rates from the different plants on the Grand River.³ See Table 6 for breakdown of return rates from the different plants on the Au Sable River.

Table 3.—Number of sport-caught CWT chinook salmon harvested in lake fisheries per 100,000 fish planted in the Little Manistee River by hatchery of origin.

Year class	Ages	Hatchery	
		Platte River	Wolf Lake
1990 ¹	0.0	0.00	0.00
	0.1	9.77	7.74
	0.2	9.25	12.58
	0.3	6.17	3.87
	0.4	1.03	0.00
	Total	26.22	24.19
1991 ¹	0.0	0.53	0.00
	0.1	18.95	36.70
	0.2	12.10	6.12
	0.3	10.53	4.08
	0.4	2.63	0.00
	Total	44.21	46.90
1992	0.0	0.00	2.16
	0.1	18.35	24.80
	0.2	22.42	18.33
	0.3	10.19	11.86
	0.4	0.51	0.00
	Total	51.47	54.99
1993	0.0	0.00	0.00
	0.1	4.76	14.97
	0.2	4.76	16.04
	0.3	1.59	2.14
	0.4		
	Total	11.11	33.15
1994	0.0	0.00	0.00
	0.1	9.10	10.41
	0.2	13.65	21.98
	0.3		
	0.4		
	Total	22.75	32.39

¹ See table 1 for differences in egg origin for 1990 and 1991.

Table 4.—Chinook salmon sport catch per 100,000 fish planted in Michigan's waters of the Great Lakes and tributary rivers from different planting sites and modes in the Grand River.

Year class	Ages	Grand Haven net pen	Grand Haven direct river plant	Grand Rapids direct river plant ¹
1990	0.0	0.00	0.00	-
	0.1	12.27	6.14	-
	0.2	25.66	7.16	-
	0.3	10.04	20.50	-
	0.4	0.00	0.00	-
	Total		47.97	33.80
1991	0.0	0.00	0.00	0.00
	0.1	10.30	7.21	12.08
	0.2	14.42	4.12	7.05
	0.3	5.15	1.03	2.01
	0.4	0.00	0.00	0.00
	Total		29.87	12.36
1992	0.0	1.19	1.05	0.00
	0.1	27.39	27.40	20.18
	0.2	15.48	22.13	11.10
	0.3	22.62	9.48	3.03
	0.4	0.00	2.11	1.01
	Total		66.68	62.17
1993	0.0	0.00	0.00	0.00
	0.1	29.23	14.66	14.58
	0.2	49.79	23.04	19.79
	0.3	34.64	23.04	19.79
	0.4			
	Total		113.66	60.74
1994	0.0	0.00	0.00	0.00
	0.1	36.73	15.91	9.92
	0.2	110.08	67.05	28.65
	0.3			
	0.4			
	Total		146.81	82.96

¹ In 1990, no coded-wire tagged chinook were released near Grand Rapids.

Table 5.–Number of sport-caught coded wire tagged chinook salmon returns per 100,000 fish planted in the Au Sable River.

Year class	Ages	Net-pen plant ^{1,2}	Direct river plant
1991	0.0	0.00	0.00
	0.1	10.23	10.45
	0.2	47.42	38.97
	0.3	79.04	69.38
	0.4	12.09	8.55
	Total	148.78	127.35
1992	0.0	0.00	0.00
	0.1	0.00	25.96
	0.2	8.40	93.47
	0.3	8.40	79.97
	0.4	0.00	4.15
	Total	16.80	203.55
1993	0.0	0.00	0.00
	0.1	55.43	28.68
	0.2	116.90	63.50
	0.3	76.59	45.06
	0.4		
	Total	248.92	137.24
1994	0.0	1.17	0.00
	0.1	79.39	20.52
	0.2	92.24	25.92
	0.3		
	0.4		
	Total	172.80	46.44

¹ 1993 and 1994 net pens were located in Van Etten Creek.

² 1994 net pen fish were trucked to the river mouth at release.

Table 6.—Chinook salmon returns to the rivers with harvest weirs during 1996. Percent from planting site of returning CWT chinook salmon to each river during 1996.

Harvest weir	Harvest weir summary			Percent of CWT chinook salmon by plant site							
	Number of CWT found	Number of chinook sampled	Total CHS harvested	Kids Creek	Medusa Creek	Little Manistee River	Swan River	Au Sable River	Other MI rivers	Wisconsin rivers	Ontario rivers
Boardman River	71	720	5,706	90.14	5.63	2.82	0.00	0.00	1.41	0.00	0.00
Little Manistee River	201	2,087	17,013	0.50	0.00	98.51	0.50	0.50	0.00	0.00	0.00
Medusa Creek	89	944	6,547	2.25	96.63	1.12	0.00	0.00	0.00	0.00	0.00
Platte River	165	913	4,341	13.94	63.64	5.45	9.70	1.21	2.42	3.03	0.61
Swan River	405	3,721	25,617	0.49	0.00	0.00	98.77	0.25	0.00	0.00	0.49
Au Sable River ¹	153	438	438	0.00	0.00	0.00	13.73	84.97	0.65	0.65	0.00
TOTAL	1,084	8,823	59,662	8.49	17.99	19.37	40.41	12.36	0.55	0.55	0.32

¹ No harvest weir was operated on the Au Sable River during 1996. The Au Sable River fish were collected by electro-fishing.