

## STUDY PERFORMANCE REPORT

**State:** Michigan

**Project No.:** F-80-R-1

**Study No.:** 471

**Title:** Chinook salmon population dynamics in Michigan's waters of the Great Lakes

**Period Covered:** October 1, 1999 to September 30, 2000

**Study Objectives:** (1) To assemble the volumes of data collected on all life stages of chinook salmon (*Oncorhynchus tshawytscha*) since the inception of the salmon program in Michigan; (2) to capture these data into computerized databases to allow for a) management and update of such data, b) analysis, c) development of predictive capabilities for future management of chinook salmon, and d) easier dissemination of these data to other interested researchers; (3) to develop information and mathematical models from these data which will allow managers to predict, with some predetermined level of certainty, the outcome of various management strategies for chinook salmon; and (4) to begin the process of a holistic approach to the management of the Great Lakes through the development of mathematical models to predict, with some predetermined level of certainty, the outcome of various management scenarios on the Great Lakes' ecosystem.

**Summary:** Harvest of chinook salmon was monitored at seven state weir facilities in fall of 1999. The number of chinook salmon harvested at weirs located on tributaries to Lake Michigan increased by 131% from 1998 to 1999. This increase was observed at all Lake Michigan weirs. A similar increase in weir harvest (114%) was observed at the Swan River (Lake Huron). Weir sampling was also used to obtain information on disease incidence, trends in percent return, age and sex composition of returning chinook salmon, and average length and weight at age; these data are still being analyzed.

Analyses of spatial patterns in chinook salmon tag returns, survival from holding pens versus direct stream plants, and survival from upstream versus downstream plants were presented in previous performance reports. A final report, technical reports, and research reports are currently being prepared that will address the net pen comparison (statewide), the upstream versus downstream comparison (Grand River), and chinook salmon movement and straying rates.

During 1999, caudal vertebrae from 79 chinook salmon were collected in Michigan Department of Natural Resources (MDNR) assessment netting on Lake Michigan. These vertebrae were examined for oxytetracycline marks at the Charlevoix Fisheries Research Station. From 32% to 35% of the lake population of chinook salmon in a given year were likely produced in Lake Michigan tributaries. These data are not yet corrected for non-marked fish stocked in other states (>10% of fish stocked in last two years of study) and mark retention rates estimated from hatchery quality control checks. Estimates of contribution from natural reproduction increase with increasing chinook salmon age, likely reflecting loss of marks (or increased difficulty of detection) as fish age. Corrected estimates will be presented in subsequent reports.

**Job 2. Title: Analyze data on chinook salmon hatchery culturing techniques.**

**Findings:** Work continued on a review paper examining the effects of size at stocking and rearing density on short- and long-term survival of salmonids as well as other fish. This paper will combine previously published literature with data on current MDNR hatchery practices (Job 1 of this study), and serve as the starting point for a joint Fish Production / Research section study on chinook salmon and steelhead size at stocking and rearing density, to begin in October 2000 (Study 692).

**Job 4. Title: Analyze data on stocking and release techniques of chinook salmon.**

**Findings:** No work was accomplished on this job during 1999-2000.

**Job 5. Title: Make recommendations, and write technical and research reports.**

**Findings:** This progress report was completed as scheduled. Collection, compilation, and analysis of stocking and release data for chinook salmon are in various stages of completion. Results will be presented in the study final report, as well as in technical and research reports.

**Job 7. Title: Analyze weir harvest and biological data.**

**Findings:** Fall harvest of chinook salmon was monitored at seven state weir facilities in 1999. The estimated number of chinook salmon harvested at weirs located on tributaries to Lake Michigan increased by 131% from 1998 to 1999 (Table 1). This increase was observed at all Lake Michigan weirs. A similar increase in weir harvest (114%) was observed at the Swan River (Lake Huron).

In addition to compiling harvest estimates, weir sampling was also used to obtain information on disease incidence (bacterial kidney disease – BKD), trends in percent return, age and sex composition of returning chinook salmon, and average length and weight at age. These data are still being analyzed and will be presented in subsequent reports.

Project documents were completed to continue this job as a new Federal Aid study (Study 513). The proposal reflects the agreement by Management and Research section personnel to implement a joint study with responsibilities solely for continued collection of data from weirs. This will be an ongoing task that will provide managers with the necessary knowledge to make prudent and justifiable management decisions for the long-term benefit of Great Lakes fisheries.

**Job 11. Title: Integrate data from coded-wire tag, assessment, and creel studies of chinook salmon in the Great Lakes.**

**Findings:** Data analysis and reporting on biological data from tagging and oxytetracycline marking has been shifted from Study 464 to this study (471). Objectives of the chinook salmon coded-wire tag program (Study 464) were 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.

Analyses of spatial patterns in chinook salmon tag returns, survival from holding pens versus direct stream plants, and survival from upstream versus downstream plants were presented in previous performance reports. A final report, technical reports, and research reports are currently being prepared that will address the net pen comparison (statewide), the upstream versus downstream comparison (Grand River), and chinook salmon movement and straying rates.

*Contribution of natural reproduction.* - During 1999, caudal vertebrae from 79 chinook salmon were collected in MDNR assessment netting on Lake Michigan. These vertebrae were examined for marks at the Charlevoix Great Lakes Station. From 32% to 35% of the lake population of chinook salmon in a given year are likely produced in Lake Michigan tributaries (Table 2, 1994-96 collection years; Table 3, 1993-94 year classes). These data are not yet corrected for non-marked fish stocked in other states (>10% of fish stocked in last two years of study) and mark retention rates estimated from hatchery quality control checks. Estimates of contribution from natural reproduction increase with increasing chinook salmon age (Table 3), likely reflecting loss of marks (or increased difficulty of detection) as fish age. Corrected estimates will be presented in subsequent reports.

**Job 13. Title: Write Final Report.**

**Findings:** This progress report was prepared on schedule. The final report has been rescheduled for 2001.

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**Dated:** September 30, 2000

Table 1.—Estimated total number of chinook salmon harvested from weirs on tributaries to lakes Michigan and Huron each fall from 1986-99. Harvest from Thompson Creek (Lake Michigan) is not included; harvest at this facility in most years does not exceed 1,000 fish. The harvest weir at Van Ettan Creek has not been operated since 1994.

Sample year	Weir							Total (Lake Huron)
	Boardman	Little Manistee	Medusa	Platte	Total (Lake Michigan)	Swan	Van Ettan	
1986	0	22,131	0	2,678	24,809	38,781	12,733	51,514
1987	4,902	31,841	11,230	7,787	55,760	51,447	12,472	63,919
1988	6,129	12,519	2,353	4,649	25,650	30,830	9,081	39,911
1989	5,809	18,338	3,040	1,899	29,086	30,119	3,891	34,010
1990	6,236	19,499	6,533	1,761	34,029	19,521		19,521
1991	5,556	21,062	2,127	4,398	33,143	23,048	8,319	31,367
1992	3,139	15,747	4,038	4,171	27,095	37,862	7,913	45,775
1993	2,299	12,911	3,021	3,109	21,340	34,994	2,300	37,294
1994	3,025	11,888	3,030	1,162	19,105	16,925	1,218	18,143
1995	4,547	13,079	4,714	3,943	26,283	29,719	0	29,719
1996	5,705	17,120	6,548	4,145	33,518	25,615	0	25,615
1997	3,040	15,443	4,036	1,659	24,178	17,219	0	17,219
1998	2,665	7,326	1,277	2,380	13,648	11,654	0	11,654
1999	6,004	18,773	3,551	3,242	31,570	24,884	0	24,884

Table 2.—Number and percent of chinook salmon from hatchery and wild sources collected by MDNR assessment netting in eastern Lake Michigan, 1994-99. Fish were considered to be from hatchery sources if they displayed a fin clip, coded-wire tag, or oxytetracycline (OTC) mark. Eight fish could not be classified as hatchery or wild fish (“Other”). Note small (<50) sample sizes for some age and year combinations. Data are not corrected for non-marked fish stocked in other states and mark retention rates estimated from hatchery quality control checks.

Year	Source	Age				Total	%
		1	2	3	4		
1994	Hatchery	152	262	79	0	493	67.6
	Wild	33	150	47	4	234	32.1
	Other	0	1	0	1	2	0.3
1995	Hatchery	161	368	51	2	582	64.7
	Wild	47	231	38	0	316	35.1
	Other	1	1	0	0	2	0.2
1996	Hatchery	63	291	311	19	684	65.7
	Wild	56	112	171	17	356	34.2
	Other	1	0	0	0	1	0.1
1997	Hatchery	---	90	77	4	171	51.2
	Wild	---	103	54	5	162	48.5
	Other	--- <sup>1</sup>	1	0	0	1	0.3
1998	Hatchery	---	---	22	25	47	29.9
	Wild	---	---	46	62	108	68.8
	Other	--- <sup>1</sup>	--- <sup>1</sup>	1	1	2	1.3
1999	Hatchery	---	---	---	0	0	0.0
	Wild	---	---	---	1	1	100.0
	Other	--- <sup>1</sup>	--- <sup>1</sup>	--- <sup>1</sup>	0	0	0.0

<sup>1</sup> OTC marking was discontinued in 1995; age 1 fish collected in 1997, age 1-2 fish collected in 1998, and age 1-3 fish collected in 1999 would not be expected to have an oxytetracycline mark.

Table 3.—Percent of wild chinook salmon from three year classes (1993-95). Fish were collected by MDNR assessment netting in eastern Lake Michigan. N is the number of fish examined for oxytetracycline (OTC) marks in each age and year class. Data are not corrected for non-marked fish stocked in other states and mark retention rates estimated from hatchery quality control checks.

Year class	Age								Total N	average Weighted %
	1		2		3		4			
	N	Percent wild	N	Percent wild	N	Percent wild	N	Percent wild		
1993	185	17.8	600	38.5	482	35.5	9	55.6	1,276	34.5
1994	209	22.5	403	27.8	131	41.2	88	70.5	831	33.1
1995	120	46.7	194	53.1	69	66.7	1	100.0	384	53.6
Total N	514		1,197		682		98			
Average		29.0		39.8		47.8		75.3		