

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-8

Study No.: 230513

Title: Evaluation of returns of salmonids to weirs in Michigan's waters of the Great Lakes.

Period Covered: October 1, 2006 to September 30, 2007

Study Objectives: (1) To annually monitor and record returns of Chinook salmon, coho salmon, and steelhead trout to Michigan weir operation facilities. (2) To mark Chinook salmon, coho salmon, and steelhead trout at index sites and provide annual estimates of size at age. (3) To collect data and report on contracted salmon harvest operations. (4) To provide annual data summaries of weir returns to be used in Management Unit reports, GLFC reports, MDNR web site updates, and for distribution to interested researchers and the public.

Summary: Data were collected during 2006 on Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* returning to six MDNR harvest weir facilities. Returns of Chinook salmon and coho salmon were (in most cases) higher than in 2005 and above the long-term average. The audit report for 2006 operations was completed as scheduled, and is available electronically. Marking and stocking of Chinook salmon at three weir index sites was completed in spring of 2007, as scheduled. Collection of data on 2007 salmon weir returns is ongoing.

Findings: Jobs 1 through 4 and 6 were scheduled for 2006-07, and progress is reported below.

Job 1. Title: Monitor and record data at weir operation facilities.—In coordination with management unit personnel, data were collected during fall 2006 on Chinook and coho salmon returning to six MDNR harvest weir facilities. Returns of Chinook salmon to Lake Michigan harvest facilities (44,574) were above the long-term average (Appendix A). Lake Huron returns of Chinook salmon to the Swan River weir in 2006 (2,482 fish) were substantially lower than the long-term average of 21,540 fish. Returns of coho salmon to Lake Michigan weirs (10,479 fish) were the lowest recorded in the 1983–2006 time series (Appendix A). Data collection for 2007 weir returns is ongoing; this information will be presented in future reports, along with information collected on steelhead and other (non-harvested) trout at facilities throughout the state. Biological data are collected on steelhead in the Boardman and Platte rivers in the fall and on the Little Manistee River in both the spring and fall. Additionally, historical information regarding the number of fish observed and passed through the weir facilities is available and efforts are currently underway to compile information regarding run size for inclusion in annual weir reports. Databases have been created to archive biological data collected from steelhead and brown trout. Charlevoix staff are updating the databases with current information and checking the accuracy of past information. Steelhead and brown trout scales from Lake Michigan and Huron weir collections are being archived at the Charlevoix Fisheries Research Station.

Job 2. Title: Mark salmon and trout.—Marking of Chinook salmon stocked in the Little Manistee River, Medusa Creek, and the Swan River was completed in spring of 2007. Coded wire tag marking was conducted in coordination with Study 230464, “Coded wire tag marking of salmonines in the Great Lakes.” Marked fish stocked in 2001–07 are collected at weir facilities, and will be used in the future to provide us with a standard index of size-at-age for Lake

Michigan and Lake Huron Chinook salmon. A long-term plan for marking steelhead at index sites is being developed, for implementation in spring 2008.

Job 3. Title: Report on contracted salmon harvest operations.—The report for 2006 weir operations (Clevenger 2007) – detailing harvest by species, weir facility, and date of collection – was completed as scheduled, and is available electronically. Collection of data on 2007 contract weir harvest operations is not yet complete. At the end of the weir harvest season (approximately December 1) this data will be compiled for the 2007 audit report. This report will be used to reconcile financial arrangements between the MDNR and the harvest contractor.

Job 4. Title: Produce annual data summaries and write report.—Charlevoix staff are continuing to develop data summary formats appropriate for web distribution. For example, weekly updates of 2007 harvest operations are currently available on the division's Intranet page. Additional multi-year data summaries have also been added to the annual audit report for weir operations, e.g., Clevenger (2007).

Job 6. Title: Publish report for 2001–05.—In lieu of a published document, findings for 2000–06 are reported in Appendix A. Additional data and description (fall 2000, 2006) are included to provide a more complete picture of sample years and stocked year classes of fish that are artificially divided by fiscal year in the reporting process.

References:

Clevenger, J. A., Jr. 2007. Summary of the Chinook and coho salmon harvest from Michigan weirs on tributaries of Lakes Michigan and Huron, 2006. Michigan Department of Natural Resources internal report.

Prepared by: Randall M. Claramunt, David F. Clapp, John Clevenger, and Jory L. Jonas.

Dated: September 30, 2007

Appendix A

Federal Aid in Sport Fish Restoration—Study 230513, Project F-81-R-8 Evaluation of returns of salmonids to weirs in Michigan’s waters of the Great Lakes October 1, 2000 to September 30, 2006

Study Objectives: (1) To annually monitor and record returns of Chinook salmon, coho salmon, and steelhead trout to Michigan weir operation facilities. (2) To mark Chinook salmon, coho salmon, and steelhead trout at index sites and provide annual estimates of size at age. (3) To collect data and report on contracted salmon harvest operations. (4) To provide annual data summaries of weir returns to be used in Management Unit reports, GLFC reports, MDNR web site updates, and for distribution to interested researchers and the public.

Summary: In coordination with management unit personnel, data were collected during fall 2000–06 on Chinook and coho salmon returning to six MDNR harvest weir facilities (Boardman, Little Manistee, Medusa, Platte, Swan, Thompson). Returns of Chinook salmon to Lake Michigan harvest facilities during 2000–06 averaged 38,044 fish, and returns on Lake Huron (Swan River weir) averaged 8,039 Chinook salmon per year. Lake Michigan returns during the study period were above the 1986–2006 average; returns to the Swan River have declined significantly since the late 1990s, and are currently at the lowest levels observed. Returns of coho salmon to Lake Michigan harvest facilities during 2000–06 averaged 54,835 fish, slightly greater than the long-term (1987–2006) average of 53,617 fish.

Marking of Chinook salmon stocked in the Little Manistee River, Medusa Creek, and the Swan River was completed in spring of 2001–06. Coded-wire tag marking was conducted in coordination with Study 230464, “Coded wire tag marking of salmonines in the Great Lakes.” Marked fish stocked in 2001–06 were collected at weir facilities, and provided data to estimate size-at-age and percent return for Lake Michigan and Lake Huron Chinook salmon. Weight of Chinook and coho salmon has generally declined since 2000, although a slight increase was observed in 2006. Percent return of coded-wire tagged Chinook salmon to harvest weirs ranged from less than 0.1% to almost 6% during 2000–06. The 2001 year class of Chinook salmon exhibited the greatest survival (based on returns to weirs) of those year classes sampled during the study period.

Annual audit reports for 2000–06 weir operations – detailing harvest by species, weir facility, and date of collection – were completed as scheduled. During 2000–06, weir return and size-at-age data were provided to numerous Great Lakes researchers and managers for use in current management efforts and development of new models of the Great Lakes pelagic ecosystem. Uses of weir data during this period included examination of and improvements to salmonid assessment methods, Chinook salmon stocking decisions, Lake Michigan and Lake Huron predator population models, and Chinook salmon movement analysis. Data collected and compiled as part of Study 230513 are available to researchers and managers in three primary database tables; table structures are provided.

Findings: Progress towards completion of all study jobs for 2000–06 is reported below.

Job 1. Title: Monitor and record data on returns of Chinook salmon, coho salmon, and steelhead trout to Michigan weir operation facilities.—In coordination with management unit personnel, data were collected during fall 2000–06 on Chinook and coho salmon returning to six

MDNR harvest weir facilities. Returns of Chinook salmon to Lake Michigan harvest facilities during 2000–06 averaged 38,044 fish, and returns on Lake Huron (Swan River weir) averaged 8,039 Chinook salmon per year. Lake Michigan returns during the study period were above the 1986–2006 average (Table A.1); the Little Manistee River weir had the most returning Chinook salmon, followed by the Medusa Creek weir, the Boardman River weir, and the Platte River weir. A single weir is currently operated on Lake Huron (Swan River weir); returns to the Swan River have declined significantly since the late 1990s, and are currently at the lowest levels observed.

Significant returns of coho salmon are only observed at Lake Michigan weirs, and most of the Lake Michigan returns are to the Platte River weirs (upper and lower – data combined in this report). Returns of coho salmon to Lake Michigan harvest facilities during 2000–06 averaged 54,835 fish, slightly greater than the long-term (1987–2006) average of 53,617 fish (Table A.2). Returns of coho salmon to the Boardman River weir during 2000–06 were 57% greater than the long-term average returns to this weir. During the same period, returns to the Little Manistee River weir were reduced by 83%, compared to the 1987–2006 average.

Job 2. Title: Mark Chinook salmon, coho salmon, and steelhead trout at index sites, and provide annual estimates of size at age and percent return.—Returns of known-age (tagged) fish at weirs provide managers and researchers with an annual index of salmon growth – a critical variable in assessing ecosystem health. Marking of Chinook salmon stocked in the Little Manistee River, Medusa Creek, and the Swan River was completed in spring of 2001–06 (Table A.3). Coded-wire tag marking was conducted in coordination with Study 230464, “Coded wire tag marking of salmonines in the Great Lakes.”

Marked fish stocked in 2001–06 were collected at weir facilities (Table A.4), and provided data to estimate size-at-age and percent return for Lake Michigan and Lake Huron Chinook salmon. Weight of age 0.3 Chinook salmon has generally declined since 2000, although a slight increase was observed in 2006 (Table A.5). A similar pattern was observed in weight of age 1.1 coho salmon. Percent return of coded-wire tagged Chinook salmon to harvest weirs ranged from less than 0.1% to almost 6% during 2000–06 (Table A.6). The 2001 year class of Chinook salmon exhibited the greatest survival (based on returns to weirs) of those year classes sampled during the study period.

A long-term plan for marking steelhead at index sites is currently being developed, for implementation in spring 2008.

Job 3. Title: Report on contracted salmon harvest operations.—Salmon harvest operations at MDNR weirs have traditionally been conducted by private contractors. It is critical to have a mechanism in place to monitor and report on these harvest operations. One of the objectives of Study 230513 is to consolidate data collection and reporting for the weir harvest audit report, which serves to reconcile payments to contractors related to surplus salmon harvest. Annual Fisheries Division audit reports for 2000–06 weir operations – detailing harvest by species, weir facility, and date of collection – were completed as scheduled, and an example is included with this report. The most recent report is:

Clevenger, J. A., Jr. 2007. Summary of the Chinook and coho salmon harvest from Michigan weirs on tributaries of Lakes Michigan and Huron, 2006. Michigan Department of Natural Resources internal report.

Job 4. Title: Produce annual data summaries of weir returns for use in Management Unit reports, GLFC reports, MDNR web site updates, and for distribution to interested researchers and the public.—Collection of long-term, consistent, fishery-independent data is an

essential component of fisheries stock assessment and management (Kline 1996). This type of data on Great Lakes salmonids is sought by researchers and managers throughout the Great Lakes region for use in ecosystem modeling efforts (see, for example; Benjamin and Bence 2003, Jones et al. 1993, Stewart and Ibarra 1991, Kitchell and Crowder 1986) that strongly influence salmonid management in the Great Lakes. Data on weir returns of salmonids is an important input to many of these models. During 2000–06, weir return and size-at-age data were provided to numerous Great Lakes researchers and managers for use in current management efforts and development of new models of the Great Lakes pelagic ecosystem. Uses of weir data during this period included examination of and improvements to salmonid assessment methods (R. M. Claramunt, MDNR, unpublished), Chinook salmon stocking decisions (Claramunt et al. 2006, M. L. Jones, MSU, unpublished), Lake Michigan and Lake Huron predator population models (Dobiesz et al. 2005, Benjamin and Bence 2003) and Chinook salmon movement analysis (Adlerstein et al. 2007a,b). Data collected and compiled as part of Study 230513 are available to researchers and managers in three primary database tables; a coded-wire tag table, a fish bio-data table, and a harvest summary table. Database table structures for the weir database are shown in Tables A.7–A.9.

Biological data from steelhead have been consistently collected from the Boardman, Little Manistee and Platte River weirs. Data collected include length, weight, fin clip, sex, and scales (for determining fish age). Scales were examined to determine years in the river, years in the lake, number of previous spawns, time between spawns, and the ratio 2:3 (Seelbach and Whelan 1988) to distinguish naturally reproduced fish from hatchery-reared fish. Collections at the Boardman River weir facility have occurred annually during the fall since 1987. Sample sizes were relatively small at this facility ranging from 10 to 50 scale samples per season. At the Platte River weir facility, samples have been collected each fall from 1986 to the present. Scale samples at the Little Manistee River weir have been collected from 1979 to the present during each of two seasons (spring and fall). All scale samples have been aged and bio-data entered into a standard Access database format. The database and scales are organized and archived at the Charlevoix Fisheries Research Station. Future efforts to develop management plans for Great Lakes salmonids will include a re-evaluation of bio-data collection at weir facilities, to better facilitate information needs associated with proposed management actions.

Job 5. Title: Write report for 2001–05.—This report was completed and submitted with the 2006-07 annual report. Additional data and description (fall 2000, 2006) are included to provide a more complete picture of sample years and stocked year classes of fish that are artificially divided by fiscal year in the reporting process.

References:

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Table A.1.—Estimated total number of Chinook salmon harvested from weirs on tributaries to Lakes Michigan and Huron each fall from 1986-2006.

Sample year	Lake Michigan weirs					Lake Huron weirs			
	Boardman	Little Manistee	Medusa	Platte	Thompson ^{a,b}	Total	Swan	Van Ettan ^b	Total
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	19,771	1,218	20,989
1995	4,547	13,079	4,714	3,943		26,283	30,320	–	30,320
1996	5,705	17,120	6,548	4,145		33,518	25,615	–	25,615
1997	3,040	15,443	4,036	1,659		24,178	17,219	–	17,219
1998	2,665	7,326	1,277	2,380		13,648	11,654	–	11,654
1999	6,004	18,773	3,551	3,242		31,570	24,884	–	24,884
2000	4,549	13,030	3,904	2,345	624	24,452	11,552	–	11,552
2001	5,231	18,289	8,068	4,511	–	36,099	12,282	–	12,282
2002	5,489	19,392	10,417	6,053	–	41,351	9,645	–	9,645
2003	6,211	14,367	12,792	7,988	–	41,358	10,979	–	10,979
2004	7,795	15,615	15,465	7,169	–	46,044	6,193	–	6,193
2005	7,875	11,064	9,936	3,557	–	32,432	3,143	–	3,143
2006	12,663	12,731	16,340	2,840	–	44,574	2,482	–	2,482
Average	5,184	16,294	6,306	3,878	624	31,692	21,540	7,241	24,298

^a Data compilation on harvest from Thompson Creek (Lake Michigan) is incomplete; harvest at this facility in most years did not exceed 1,000 fish.

^b The harvest weir at Van Ettan Creek has not been operated since 1994; the harvest weir at Thompson Creek has not been operated regularly since 2000.

Table A.2.—Estimated total number of coho salmon harvested from weirs on tributaries to Lake Michigan each fall from 1983–2006.

Sample year	Weir					Total
	Boardman	Little Manistee	Medusa ^a	Platte	Thompson ^{a,b}	
1983	–	24,264		154,179		178,443
1984	–	33,764		131,692		165,456
1985	–	15,177		74,532		89,709
1986	–	16,724		45,266		61,990
1987	306	15,101		50,300		65,707
1988	477	4,467		28,310		33,254
1989	288	14,023		44,612		58,923
1990	141	10,030		22,516		32,687
1991	64	12,300		25,730		38,094
1992	25	13,400		33,072		46,497
1993	182	18,096		38,911		57,189
1994	1,530	562		29,491		31,583
1995	147	355		51,997		52,499
1996	209	2,584		49,816		52,609
1997	3,804	781		85,556		90,141
1998	1,127	1,471		83,059		85,657
1999	101	526		43,017		43,644
2000	5,934	590	10	102,682	735	109,951
2001	599	926	0	82,024	–	83,549
2002	1,344	530	2	119,276	–	121,152
2003	163	618	1	22,947	–	23,729
2004	1,407	1,106	0	16,061	–	18,574
2005	3	2,094	0	14,317	–	16,414
2006	824	129	0	9,526	–	10,479
Average (1987–2006)	934	4,984	2	47,661	735	53,617

^a Data compilation on harvest from Thompson Creek and Medusa Creek is incomplete; harvest at these facilities in most years did not exceed 1,000 fish.

^b The harvest weir at Thompson Creek has not been operated regularly since 2000.

Table A.3.—Number of spring fingerling Chinook salmon marked with coded-wire tags for stocking in 2001–06 at weir index stocking sites. Number tagged is not corrected for tag retention or fin clip rates.

Stocking site	Study number	Stocking date	Net pen (Y/N)	Number tagged	Tag retention (%)
Medusa Creek, Charlevoix	513/692	06-05-01	Yes	203,506	88.8
		05-30-02	Yes	206,843	96.4
		05-28-03	Yes	204,498	96.8
		06-03-04	Yes	199,012	93.2
		06-01-05	Yes	201,924	93.9
		06-01-06	Yes	202,483	84.3
Swan River, Rogers City	482/513/692	05-15-01	No	203,839	94.5
		05-07-02	No	198,209	94.1
	513/692	05-06-03	No	203,805	97.1
		05-13-04	No	203,580	88.0
		05-11-05	No	202,238	93.7
		05-17-06	No	200,055	79.6
Little Manistee River	513/692	05-14-01	No	203,946	92.7
		05-09-02	No	203,599	92.9
		05-05-03	No	202,255	96.8
		05-12-04	No	202,896	91.4
		05-10-05	No	202,241	89.6
		05-12-06	No	200,869	79.6

Table A.4.—Number of coded-wire tagged fish recovered at Michigan harvest weirs, 2000–06.

Year	Lake Michigan weirs					Lake Huron weir	
	Boardman	Little Manistee	Medusa	Platte	Thompson	Swan	Total
2000	0	0	1	9	39	157	206
2001	18	39	84	72	9	126	348
2002	34	165	385	146	7	156	893
2003	51	385	916	37	14	176	1,579
2004	29	541	1,056	18	3	151	1,798
2005	35	372	783	87	14	50	1,341
2006	56	515	1,445	32	0	33	2,081
Average	32	288	667	57	12	121	1,178
Total	223	2,017	4,670	401	86	849	8,246

Table A.5.—Size-at-age (weight, kg) of Chinook salmon and coho salmon sampled at Michigan DNR harvest weirs, 2000-2006. Data are average weight of Age 0.3 female Chinook salmon (CHS) from Little Manistee River, Medusa Creek, and Swan River weirs, and Age 1.1 female coho salmon (COS) from the Upper Platte River weir.

Sample year	Weir			
	Little Manistee (age 0.3, F, CHS)	Medusa (age 0.3, F, CHS)	Swan (age 0.3, F, CHS)	Upper Platte (age 1.1, F, COS)
2000	7.0	7.0	10.4	2.7
2001	9.1	6.2	8.8	2.9
2002	6.2	4.6	8.7	1.4
2003	6.1	6.7	6.4	2.5
2004	5.4	5.8	5.8	2.2
2005	4.7	5.3	3.8	1.9
2006	4.9	6.1	5.8	2.4

Appendix A

Table A.6.—Percent return of coded-wire tagged (CWT) Chinook salmon (CHS) to Little Manistee River, Medusa Creek, and Swan River weirs. Number of CHS stocked with CWT is the initial number of tagged fish stocked, corrected for tag loss and fin clip quality. Data are shown for 2000–03 year classes; data for more recent year classes are not complete (all ages have not returned to weirs - NS). Data are not corrected for straying; generally, less than 3% of the total numbers of salmon returning to a harvest weir are from other weirs.

Year class	# CHS stocked with CWT (corrected)	Chinook salmon age				Total (%)
		0.1	0.2	0.3	0.4	
<u>Little Manistee River</u>						
2000	77,664	0.3	0.3	0.6	0.0	1.2
2001	178,697	0.4	0.9	1.4	0.2	2.9
2002	186,795	0.1	0.2	0.3	0.0	0.6
2003	192,341	0.1	0.2	0.0	NS	0.3
<u>Medusa Creek</u>						
2000	82,301	0.6	0.5	0.6	0.0	1.7
2001	169,810	1.0	2.2	2.5	0.2	5.9
2002	196,949	0.3	0.3	0.3	0.0	0.9
2003	195,239	0.9	1.3	0.0	NS	2.2
<u>Swan River</u>						
2001	187,452	0.4	0.6	0.4	0.0	1.4
2002	179,693	0.0	0.0	0.0	0.0	0.0
2003	194,737	0.0	0.1	0.0	NS	0.1

Table A.7.–Table description for weir harvest database, coded-wire tag table (“WRYYYYYTAGS”).

Variable name	Variable description
WEIR	Harvest weir where fish was collected BOR = Boardman River LMR = Little Manistee River LPR = Lower Platte River MEC = Medusa Creek SWR = Swan River UPR = Upper Platte River
SPECIES	Species of fish harvested CHS = Chinook salmon COS = Coho salmon
HAR_DATE	Date of harvest (MM/DD/YYYY)
PAGE	Original data sheet page number
SAMPLE	Original data sheet sample number
FIN_CLIP	Observed fin clip (corresponding to standard MDNR clip abbreviations) ADLOST = Tag detected but not recovered ADNONE = No tag detected
CWT_NUM	Number recovered from CWT (##-##-##; where first two digits describe marking agency, and remaining digits correspond to specific stocked lots of fish.
CWT_AGE	Fish age (N.N), based on year class determination from CWT_NUM

Table A.8.–Table description for weir harvest database, fish bio-data table (“WRDTYYYY”).

Variable name	Variable description
WEIR	Harvest weir where fish was collected BOR = Boardman River LMR = Little Manistee River LPR = Lower Platte River MEC = Medusa Creek SWR = Swan River UPR = Upper Platte River
SPECIES	Species of fish harvested CHS = Chinook salmon COS = Coho salmon
HAR_DATE	Date of harvest (MM/DD/YYYY)
PAGE	Original data sheet page number
SAMPLE	Original data sheet sample number
AGE	Fish age, based on CWT, or age/length key (age generator) for non-tagged fish
OBS_WGT	Weight of fish, as sampled (pounds)
WEIGHT	Weight of fish (pounds), reconstructed for fish from which eggs have been stripped
LENGTH	Length of fish, as sampled (pounds)
FIN_CLIP	Observed fin clip (corresponding to standard MDNR clip abbreviations) ADLOST = Tag detected but not recovered ADNONE = No tag detected
LAM_WOUN	Number of lamprey wounds observed on sampled fish
SEX	Gender of sampled fish (M/F/U)
FUL_SPEN	Condition of fish, with respect to egg content (F/S/U)
BKD	Condition of fish, with respect to disease incidence (N/U/Y)

Table A.9.–Table description for weir harvest database, harvest summary table (“WRSTYYYY”).

Variable name	Variable description
WEIR	Harvest weir where fish was collected BOR = Boardman River LMR = Little Manistee River LPR = Lower Platte River MEC = Medusa Creek SWR = Swan River UPR = Upper Platte River
SPECIES	Species of fish harvested CHS = Chinook salmon COS = Coho salmon
HAR_DATE	Date of harvest (MM/DD/YYYY)
OSAM_PER	Observed (target) percentage of total harvest sampled for harvest date
CSAM_PER	Calculated (actual) percentage of total harvest sampled for harvest date
TOT_PAGE	Record of data collection (number of pages of data recorded)
TOT_TOTE	Number of totes of fish harvested
HAR_MORT	Number of mortalities in harvest
HAR_JACK	Number of “jacks” (immature salmon) in harvest
HAR_ADUL	Number of mixed adult salmon in harvest
PAS_FISH	Number of fish passed upstream of harvest facility
STRIP_F	Number of stripped females (salmon from which eggs have been collected for hatchery operations) harvested
RND_MAL	Number of round (uncut) male salmon in harvest
RND_FEM	Number of round (uncut) female salmon in harvest
TOT_FISH	Total number of fish harvested