

## STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-5

Study No.: 230485

Title: Assessment of Chinook and coho salmon populations and their prey in eastern Lake Michigan

Period Covered: October 1, 2003 to September 30, 2004

**Study Objectives:** To assess the health of Chinook and coho salmon stocks in Lake Michigan through continuous monitoring of distribution, relative abundance, growth, mortality, diet composition, and clinical indicators of disease.

**Summary:** Data collection through fishery-independent sampling programs is an essential component of fisheries stock assessment and management. Chinook and coho salmon populations are important to the fish community as a control of exotic forage fishes (Krueger et al. 1995) and their populations support a highly valuable recreational fishery (Bence and Smith 1999).

Michigan Department of Natural Resources (MDNR) experimental sampling of Pacific salmon in Michigan waters of Lake Michigan began only in 1990, and we were not routinely successful in collecting these fish until 1994. This study is a continuation of the sampling program initiated in 1990. During 2004, Chinook salmon (N=120 fish) and coho salmon (N=12 fish) were collected in Statistical Districts MM-6 and MM-8. Complete biological data were recorded for Chinook and coho salmon as well as for the other salmonines collected (e.g., brown trout and steelhead); these data, including samples for bacterial kidney disease (BKD) detection, are currently being evaluated.

**Findings:** Jobs 1, 3, 4, 5, 6, 7, and 8 were scheduled for 2003-2004, and progress is reported below.

**Job 1. Title: Establish the distribution pattern, relative abundance, and origin of Chinook and coho salmon in eastern Lake Michigan.**-A revised sampling protocol was implemented in 1997 to better define the spatial and temporal variation in fish distribution. The sample design is a stratified-random design that targets both inshore and offshore thermal habitats using surface and suspended graded-mesh gill nets. By covering at least two statistical districts in the lake, and by sampling one unit in both the spring and summer, we were able to better define the relative abundance of Chinook salmon populations in Lake Michigan. Catches of coho salmon have been very low in recent years, and only 12 coho were collected in the 33 net sets during 2004 (Table 1).

Based on analysis of the catch and biological data from this survey, catch rates in east-central Lake Michigan (MM-6) were found to be closest to the long-term average and more representative of Chinook and coho stocks in Lake Michigan compared to the catch rates in other management units. Therefore, seasonal sampling (spring and summer comparison) was focused in statistical district MM-6 starting in 2003. In this district in 2004, a total of 12 net sets were conducted in the spring (June 10 -29) and 12 net sets were conducted in summer (July 20 – August 3; Table 2).

In addition to the seasonal component of the survey, a spatial comparison was made between statistical districts MM-6 and MM-8. For this comparison, an additional 9 net sets were

conducted between May 5 – June 8 in MM-8. Surface and suspended gill nets were set for both the seasonal and spatial comparisons. Complete biological data, including information on age and growth, incidence of bacterial kidney disease (BKD), diet, and lamprey wounding were recorded for all salmonines collected. Processing of these data and samples is ongoing.

Chinook salmon catch-per-effort (CPE) was calculated as the number of Chinook salmon per 1,000 ft of graded-mesh monofilament gill net set for four hours. In 2004, CPEs were compared to the long-term average to provide an index of change in the relative abundance of salmon. Mean CPEs ( $\pm 1$  SE) were  $2.9 \pm 0.9$  for MM-6 and  $1.3 \pm 0.3$  for MM-8. The long-term average CPE for these two units are  $3.4 \pm 0.8$  and  $5.1 \pm 1.3$  for MM-6 and MM-8, respectively. Preliminary analysis of the survey CPEs suggests that the relative abundance of Chinook salmon is up from the previous year (2003) but slightly below the long-term average.

Catch rates from the survey also tend to be higher in the spring compared to catches in the summer assessment cruises. During 2004, Chinook salmon were sampled in the spring and summer in MM-6. Catch rates were higher in the summer period; CPEs were  $1.5 \pm 0.5$  and  $4.3 \pm 1.6$  for the spring and summer periods, respectively. Also, Chinook salmon were the dominant species captured in the survey; this pattern was similar to that observed in previous years (Table 1).

**Job 3. Title: Coordination with other studies, process and analyze data; write report.**-This performance report was completed on schedule. The information presented was also used in preparing MDNR research summaries to the Great Lakes Fishery Commission and Lake Michigan Technical Committee. Coordination activities included study design assistance and fish collection for a Great Lakes Fishery Trust-funded study investigating disease incidence and energy dynamics in Lake Michigan Chinook salmon (Mike Jones and Jim Bence, Michigan State University Partnership for Ecosystem Research and Management - PERM, principal investigators). The results from this survey were combined with lake-wide data and included in a report from the Salmonid Working Group to the Lake Michigan Committee at the Upper Lakes Meeting of the Great Lakes Fishery Commission (Claramunt et al. 2004). Survey results were also combined with data from other Great Lakes to evaluate the role of salmonines as top-down predators in the Great Lakes (Bence et al. 2004).

**Job 4. Title: Determine growth rates of Chinook and coho salmon in eastern Lake Michigan.**-Biological data (length, weight, sex, maturity, tags, clips, age, diet, and observable diseases) were recorded for each of the Chinook salmon collected (Schneeberger et al. 2001). Biological data were also recorded for the bycatch of all other salmonines. Growth will be evaluated as age-, sex-, and species-specific total length and weight. Both actual and back-calculated growth rates will be determined. These analyses are currently being completed for 2004 samples.

**Job 5. Title: Determine survival rates of Chinook and coho salmon in eastern Lake Michigan.** - Evaluation of Chinook salmon survival rates using cohort and catch-curve analyses is ongoing. Preliminary analyses indicate that total mortality as estimated from catch-curves is highly variable and the data from the survey do not meet the assumptions for catch-curve analyses. Survey information is currently being evaluated to determine if it can be used in recent stock assessment models that predict mortality by source (Benjamin and Bence 2003).

**Job 6. Title: Obtain data on diet of Chinook and coho salmon.**-A total of 120 Chinook stomach samples were collected in 2004. Stomachs were frozen at time of collection and are stored at the Charlevoix Station for analysis. The 1998-2003 Chinook salmon diet samples were processed and the results are reported in Claramunt et al. (2004). However, several years of coho salmon stomach samples remain to be processed. The 2004 Chinook salmon diet samples are currently

being analyzed. The Chinook salmon diet data from 1990-2004 will be evaluated with bioenergetics models and the results presented in final reports and peer-reviewed publications.

**Job 7. Title: Monitor prevalence of bacterial kidney disease in populations of Chinook and coho salmon in eastern Lake Michigan.**-We examined Chinook and coho salmon for visible symptoms of disease and collected swabs that we will analyze using laboratory tests for BKD. These tests use a modified rapid ELISA (enzyme-linked immunosorbant assay) technique (KwiK-Dtect<sup>2</sup>-DiagXotics, Inc., Wilton, CT) developed specifically for use in the laboratory or field.

**Job 8. Title: Measure relative abundance, species composition, and size structure of forage.**-Vertical gill nets have been used (1997 – 2001) to assess forage fishes during the same time that Chinook and coho salmon were being sampled. Forage samples were not collected using vertical gill nets in 2004; instead, forage fishes were sampled using hydroacoustics and midwater trawls according to a lake-wide protocol (Fleischer et al. 2001). Forage fish data will be reported to the Lake Michigan Committee in March 2005, and in final reports and peer-reviewed publications.

#### **References:**

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Table 1.—Species composition of the catch (number of fish) from salmonine assessment netting in eastern Lake Michigan, 1990-2004.

Year	Brown trout	Chinook salmon	Coho salmon	Lake trout	Steelhead
1990	35	373	34	296	14
1991	1	402	1	41	5
1992	0	253	4	39	1
1993	0	557	0	17	0
1994	7	719	4	405	42
1995	5	898	20	449	105
1996	20	1072	12	661	411
1997	33	409	24	428	15
1998	8	479	42	262	17
1999	25	186	181	131	19
2000	6	188	35	50	5
2001	8	149	22	52	19
2002	0	76	3	52	10
2003	0	76	0	28	4
2004	5	120	12	22	6

Table 2.—Total number of net sets for the salmonine survey, 1990-2004.

Year	Lake Michigan Statistical District							
	MM-1	MM-2	MM-3	MM-4	MM-5	MM-6	MM-7	MM-8
1990	2					54		4
1991						27		
1992						48		
1993						81		
1994		1	9		3	11	3	6
1995			4		5	10	7	12
1996			4		7	6	6	9
1997			14	4	14	20	16	16
1998			12	8		23		22
1999			10			19		19
2000			6			9		10
2001			4			17		25
2002						16		
2003						20		10
2004						24		9