STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-6

Study No.: 230485 **Title:** Assessment of Chinook and coho salmon populations and their prey in eastern Lake Michigan

Period Covered: October 1, 2004 to September 30, 2005

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 2005, Chinook salmon (N=124 fish) and were collected in Statistical Districts MM-6 and MM-8. However, coho salmon were not captured in the survey in 2005.

Average (±1 SE) catch rates for Chinook salmon in east-central (across units) Lake Michigan were 3.3±0.7 fish per standard gill net set in 2005. Mean Catch rates by unit were 2.1±1.1 for MM-6 and 5.5±0.6 for MM-8. Preliminary analysis of the survey CPEs suggests that the relative abundance of Chinook salmon is down slightly in MM-6, but up substantially in MM-8 from the previous year (2.9±0.9 and 1.3±0.3 for MM-6 and MM-8 in 2004, respectively). Complete biological data were recorded for Chinook salmon as well as for the other salmonines collected (e.g., brown trout); these data, including samples for bacterial kidney disease (BKD) detection, are currently being evaluated. Forage fishes were sampled using hydroacoustics and midwater trawls according to a lake-wide protocol (Fleischer et al. 2001); detailed forage fish results were reported to the Lake Michigan Committee in March 2005 (Warner et al. 2005).

Findings: Jobs 1, 3, 4, 5, 6, 7, and 8 were scheduled for 2004-2005, 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 (Schneeberger et al. 2001). 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. In 2005, however, we had to reduce our sampling effort (Table 1) and did not conduct the seasonal component of the survey. Also, catches of coho salmon have been very low in recent years (only 12 coho were collected in the 33 net sets during 2004; Table 2) and no coho were caught in 21 net sets in 2005 (Table 2).

A total of 11 and 10 net sets were made in statistical districts MM-6 and MM-8, respectively (Table 1). Sampling was conducted between May 16 – June 21, 2005, and both surface and suspended gill nets were used for the 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. Average (±1 SE) catch rates for Chinook salmon in east-central Lake Michigan (all units combined) were 3.3±0.7 in 2005. By unit, mean CPEs were 2.1±1.1 for MM-6 and 5.5±0.6 for MM-8. Preliminary comparison of the 2005 survey CPEs to previous years suggests that the relative abundance of Chinook salmon is down slightly in MM-6, but up substantially in MM-8 from the previous year (2.9±0.9 and 1.3±0.3 for MM-6 and MM-8 in 2004, respectively). Similarly, CPEs were slightly below the long-term average (1990-2004) in MM-6 and higher than the average in MM-8 (3.4±0.8 and 5.1±1.3 for MM-6 and MM-8, respectively).

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 unit of the Partnership for Ecosystem Research and Management - PERM, principal investigators) as well as providing input on developing a Decision Model for Chinook salmon. The results from our survey were combined with lake-wide data and included in a report from the Salmonid Working Group to the Lake Michigan Committee and Lake Huron Committee at the Upper Lakes Meeting of the Great Lakes Fishery Commission (Claramunt et al. 2005). 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. *In Review*).

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 2005 samples.

Job 5. Title: Determine survival rates of Chinook and coho salmon in eastern Lake Michigan.– Evaluation of Chinook salmon survival rates using statistical catch-at-age (SCAA) analyses is ongoing. Preliminary analyses indicate that total mortality rates estimated from SCAA are highly variable through the time series based on recreational harvest data and weir returns. Survey information is currently being evaluated to determine if it can be used to improve the stock assessment model developed for Lake Michigan (Benjamin and Bence 2003) and provide better estimates of abundance and survival of Chinook salmon.

Job 6. Title: Obtain data on diet of Chinook and coho salmon.–A total of 124 Chinook stomach samples were collected in 2005. Stomachs were frozen at time of collection and are stored at the Charlevoix Station for analysis. The 1998-2004 Chinook salmon diet samples were processed and the results are reported in Claramunt et al. (2005). However, several years of coho salmon stomach samples remain to be processed. The 2005 Chinook salmon diet samples are currently being analyzed. The Chinook salmon diet data from 1990-2005 will be evaluated with

bioenergetics models and the results presented in final reports and peer-reviewed publications. Diet data from 1990-2004 has been used by managers during the decision process for determining appropriate stocking levels for 2006 in Lake Michigan.

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 ELISA (enzyme-linked immunosorbant assay) techniques (KwiK-Dtect–; DiagXotics, Inc., Wilton, CT) and include both a modified rapid test for the field (FELISA) as well as quantified test (QELISA). The rapid test is developed specifically for use in the laboratory or field, but the results are highly variable. Both FELISA and QELISA will be used to test for BKD for each individual fish from the 2005 samples.

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 have not been collected using vertical gill nets since 2001; instead, forage fishes were sampled using hydroacoustics and midwater trawls according to a lake-wide protocol (Fleischer et al. 2001). Forage fish results were reported to the Lake Michigan Committee in March 2005 (Warner et al. 2005), and will be reported in peer-reviewed publications.

References:

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Table 1.–Total number of net sets for the salmonine survey, 1990-2005.

	Lake Michigan Statistical District							
Year	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
2005						11		10

Table 2.–Species composition of the catch (number of fish) from salmonine assessment netting in eastern Lake Michigan, 1990-2005.

Year	Salmonine species sampled				
	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	1,072	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
2005	1	124	0	22	0