STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-7

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

Period Covered: October 1, 2005 to September 30, 2006

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 salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* populations are important to the fish community as a control of exotic forage fishes (Krueger et al. 1995) and their populations support a 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 in 1990 and this study is a continuation of that sampling program. During 2006, Chinook salmon (N=81 fish; Table 1) were collected in Statistical Districts MM-6 and MM-8. However, only one coho salmon was sampled in the survey in 2006.

Average (± 1 SE) catch rate (CPE) for Chinook salmon in east-central Lake Michigan (across districts) was 3.1 ± 0.7 in 2006. Mean catch rates by unit were 1.0 ± 0.5 for MM-6 and 4.5 ± 0.9 for MM-8. Preliminary analysis of the survey CPE suggests that the relative abundance of Chinook salmon is down in MM-6 and MM-8 from the previous year (2.1 ± 1.1 and 5.5 ± 0.6 for MM-6 and MM-8 in 2005, respectively); however, survey effort was very low in 2006 (N=18 lifts; Table 2). Biological data (length, weight, sex, maturity, tags, clips, age, diet, and observable diseases) were recorded for Chinook salmon as well as for the other salmonines collected (e.g., coho salmon, lake trout *Salvelinus namaycush*, and steelhead *O. mykiss*); these data, including samples to be screened for the presence of bacterial kidney disease (BKD), 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 2006 (Warner et al. 2006).

Findings: Jobs 1, 3, 4, 5, 6, 7, and 8 were scheduled for 2005-06, and progress is reported below.

Job 1. Title: Establish distribution of fish.–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 2006, however, we had to reduce our sampling effort (Table 2) and did not conduct the seasonal component of the survey. Also, catches of coho salmon have been very low in recent years as only 12 coho were collected in the 33 net sets during 2004, no coho were caught in 21 net sets in 2005, and only one coho was caught in 18 net sets in 2006 (Table 1).

In 2006, a total of 7 and 11 net sets were made in statistical districts MM-6 and MM-8, respectively (Table 2). Sampling was conducted between May 22 and June 14, 2006, and both surface and suspended gill nets were used for the spatial comparisons. 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 3.1 ± 0.7 in 2006. By unit, mean CPEs were 1.0 ± 0.5 for MM-6 and 4.5 ± 0.9 for MM-8. Preliminary comparison of the 2006 survey CPEs to the previous year suggests that the relative abundance of Chinook salmon is down slightly compared to 2.1 ± 1.1 and 5.5 ± 0.6 for MM-6 and MM-8 in 2005, respectively. The long-term average of relative abundance by statistical district is 3.4 ± 0.8 and 4.1 ± 0.5 for MM-6 and MM-8, respectively.

Job 3. Title: Analyze data, write performance 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 and the Planktivore Working Group to the Lake Michigan Committee at the Upper Lakes Meeting of the Great Lakes Fishery Commission (Claramunt et al. 2006; Warner et al. 2006). 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*; Bunnell et al. *In press*).

Job 4. Title: Determine growth rates.–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 2006 samples.

Job 5. Title: Determine survival rates.–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, based on recreational harvest data and weir returns, are highly variable through the time series. 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 diet data.–A total of 81 Chinook stomach samples were collected in 2006. Stomachs were frozen at time of collection and are stored at the Charlevoix Station for analysis. The 1994–2005 Chinook salmon diet samples were processed and the results are reported in Claramunt et al. (2006). The 2006 Chinook salmon diet samples are currently being analyzed. The Chinook salmon diet data from 1990–2006 will be evaluated with bioenergetics models and the results presented in final reports and peer-reviewed publications. Diet data from 1990–2005 has been used by managers during the decision process for determining appropriate 2006 stocking levels for Lake Michigan.

Job 7. Title: Monitor BKD prevalence.–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 2006 samples.

Job 8. Title: Monitor forage fish.–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 2006 (Warner et al. 2006), and will be reported in additional 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, 1990–2006.

Year	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	19
2003	0	76	0	28	4
2004	5	120	12	22	6
2005	1	124	0	22	0
2006	0	81	1	20	1
Survey total (1990–2006)	154	6,162	395	2,975	683
Annual average (1990–2006)	9	362	23	175	40

Table 2.–Annual total number of gill net sets for the Lake Michigan salmonine assessment by statistical district, 1990–2006.

	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
2006						7		11