

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-8

Study No.: 230485

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

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

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 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 2007, Chinook salmon (N=56 fish; Table 1) were collected in Statistical Districts MM-6 and MM-8. However, only two coho salmon was sampled in the survey in 2007. Average (± 1 SE) catch rates for Chinook salmon in east-central Lake Michigan (across districts) were 2.2 ± 0.5 in 2007. Mean catch rates by unit were 1.2 ± 0.4 for MM-6 and 2.9 ± 0.3 for MM-8. Preliminary analysis of the survey CPEs suggests that the relative abundance of Chinook salmon is relatively unchanged in MM-6 and reduced in MM-8 from the previous year (1.0 ± 0.5 and 4.5 ± 0.9 for MM-6 and MM-8 in 2006, respectively); however, survey effort was very low in 2007 (N=9 lifts; Table 2). Complete biological data were recorded for Chinook salmon as well as for the other salmonines collected (e.g., lake trout and steelhead); 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 for 2006 surveys were reported to the Lake Michigan Committee in March 2007.

Findings: Jobs 1, 3, 4, 5, 6, 7, and 8 were scheduled for 2006-07, and progress is reported below.

Job 1. Title: Establish distribution of salmon.—A revised sampling protocol was implemented in 1997 to better define the spatial and temporal variation in Chinook and coho salmon 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. Since 2005, however, we have had to reduce our sampling effort (Table 2) and did not conduct the seasonal component of the survey in 2005–07. Also, catches of coho salmon have been very low in recent years as only 12 coho salmon were collected in the 33 net sets during 2004, none were caught in 21 net sets in 2005, only one coho salmon was caught in 18 net sets in 2006, and two coho salmon were caught in 9 net sets in 2007 (Table 1).

A total of five and three net sets were made in statistical districts MM-6 and MM-8, respectively, in 2007 (Table 2). Also, an exploratory net was set in MM-3 on July 27, 2007, but no Chinook or

coho salmon were captured. The beginning of the survey was substantially delayed because of budgetary constraints and conflicts with other surveys. We conducted sampling between May 22 and June 14, 2006, but in 2007, the survey period was June 5–July 23. Both surface (N=7) and suspended (N=1) 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 2.2 ± 0.5 in 2007, down from 3.1 ± 0.7 in 2006. By unit, mean CPEs were 1.2 ± 0.4 for MM-6 and 2.9 ± 0.3 for MM-8. Preliminary comparison of the 2007 survey CPEs to the previous year suggests that the relative abundance of Chinook salmon is unchanged or down slightly compared to 2006 (1.0 ± 0.5 and 4.5 ± 0.9 for MM-6 and MM-8, respectively). Similarly, CPEs were well below the long-term averages by statistical district (3.3 ± 0.8 and 4.1 ± 0.5 for MM-6 and MM-8, respectively).

Job 3. Title: Process 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 grant-funded studies as well as collaborative research with universities and other governmental agencies. The results from our survey were combined with lake-wide data and included in the following reports 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 (the following publications are complete and included with this performance report):

Claramunt, R. M., and eight co-authors. 2007. Status of Chinook salmon in Lake Michigan, 1985–2006. Lake Michigan Committee Report, Great Lakes Fishery Commission, Ypsilanti, Michigan.

Warner, D. M., R. M. Claramunt, and C. Faul. 2007. Status of pelagic prey fish in Lake Michigan, 1995–2006. Lake Michigan Committee Report, Great Lakes Fishery Commission, Ypsilanti, Michigan.

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. “Importance of early-life interactions between alewife and Chinook salmon in Lake Michigan” is in review at *Transactions of the American Fisheries Society*. The following publication is complete and included with this report:

Bunnell, D. B., C. P. Madenjian, and R. M. Claramunt. 2006. Long-term changes of the Lake Michigan fish community following the reduction of exotic alewife (*Alosa pseudoharengus*). Canadian Journal of Fisheries and Aquatic Sciences 63: 2434–2446.

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 following protocols described in 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 samples collected in 2007.

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 56 Chinook stomach samples were collected in 2007. Stomachs were frozen at time of collection and are stored at the Charlevoix Station for analysis. The 1994–2006 Chinook salmon diet samples were processed and the results are reported in Claramunt et al. (2007; see Job 3). The 2007 Chinook salmon diet samples are currently being analyzed, along with several years of coho salmon stomach samples. The Chinook salmon diet data from 1990–2007 will be evaluated 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 stocking levels for 2006 in Lake Michigan (Jones et al., in review).

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 QELISA (enzyme-linked immunosorbant assay) techniques (KwiK-Dtect[®] DiagXotics, Inc., Wilton, CT). The QELISA will be used to test for BKD for each individual fish from the 2007 samples. Chinook salmon samples (N=56) were also collected for ongoing MDNR monitoring of VHS incidence in Lake Michigan fish populations.

Job 8. Title: Monitor forage fish.—Vertical gill nets were 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 from 2006 sampling were reported to the Lake Michigan Committee in March 2007 (Warner et al. 2007; see Job 3), and will also be reported in peer-reviewed publications.

References:

- Bence, J. R., and K. D. Smith. 1999. An overview of recreational fisheries of the Great Lakes. Pages 259–306 in W. W. Taylor and C. P. Ferreri, editors. Great Lakes fisheries and policy management: a binational perspective. Michigan State University Press, East Lansing.
- Benjamin, D. M., and J. R. Bence. 2003. Statistical catch-at-age framework for Chinook salmon in Lake Michigan, 1985–1996. Michigan Department of Natural Resources, Fisheries Research Report 2066, Ann Arbor.
- Fleischer, G. W., J. Dettmers, and R. M. Claramunt. 2001. Acoustics lake-wide assessment plan for Lake Michigan. Lake Michigan Technical Committee, Great Lakes Fisheries Commission.
- Jones, M. L., J. R. Bence, E. B. Szalai, and W. Dai. In review. Assessing stocking policies for Lake Michigan salmonine fisheries using decision analysis. In Clapp, D.F., and W. Horns, editors. The state of Lake Michigan in 2005. Great Lakes Fishery Commission Special Publication, Ann Arbor, Michigan.
- Krueger, C. C., D. L. Perkins, E. L. Mills, and J. E. Marsden. 1995. Predation by alewives on lake trout fry in Lake Ontario: role of an exotic species in preventing restoration of a native species. *Journal of Great Lakes Research* 21 (Supplement 1):458–469.

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Schneeberger, P., M. Toneys, R. Elliott, J. Jonas, D. Clapp, R. Hess, and D. Passino-Reader. 2001. Lakewide assessment plan for Lake Michigan fish communities. Lake Michigan Technical Committee Report. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Prepared by: Randall M. Claramunt and David F. Clapp
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Table 1.—Species composition of the catch (number of fish) from salmonine assessment netting in eastern Lake Michigan, 1990–2007.

| 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 |
| 2007 | 2 | 56 | 2 | 35 | 6 |
| Survey total | 156 | 6,218 | 397 | 3,010 | 689 |
| Annual average | 9 | 345 | 22 | 167 | 38 |

Table 2.—Annual total number of gill net sets for the Lake Michigan salmonine assessment by statistical district, 1990–2007.

| Year | Statistical district | | | | | | | |
|------|----------------------|------|------|------|------|------|------|------|
| | MM-1 | MM-2 | MM-3 | MM-4 | MM-5 | MM-6 | MM-7 | MM-8 |
| 1990 | 2 | | | | | 54 | | |
| 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 |
| 2007 | | | 1 | | | 5 | | 3 |