

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-53-R-15

Study No.: 485

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

Period Covered: April 1, 1998 to September 30, 1999

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. Michigan Department of Natural Resources 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.

Chinook salmon and coho salmon were sampled during May-August, 1998-1999 between St. Joseph and Naubinway. As in previous years, monthly catches were higher for chinook salmon (N=479, 186) than for coho salmon (N=42, 181); however, catch of chinook salmon was lower in 1999 than in any year since lakewide (eastern shoreline) sampling began in 1994.

Complete biological data were recorded for all salmonines collected. This data included information on age and growth of salmonines, incidence of bacterial kidney disease (BKD), diet, and lamprey wounding. In 1998, age 0.2 and 0.3 chinook salmon made up 72% of the assessment catch, and percent of age 0.4 chinook salmon increased significantly (22%). Chinook salmon average total length at age remained relatively constant from 1994-1997, but declined dramatically in 1998, especially for age 0.2 and 0.3 salmon. Scales were also collected from coho salmon captured in 1998 assessment netting, but age determinations have not been completed. Average lakewide incidence of BKD for both chinook and coho salmon declined significantly in 1998 as compared to 1997.

Processing of diet samples has been completed only through 1996. Chinook salmon collected in 1995 ate primarily alewife, while coho salmon ate primarily insects and amphipods. More chinook salmon (43%) than coho salmon (8%) had empty stomachs. The revised design of our netting program implemented in 1997 included forage fish assessments to enable us to determine selectivity by salmonine predators for piscine prey items. Forage fish catch in 1997 was comprised primarily of alewife (94%); other fish collected included several not previously recorded in MDNR assessments of salmonine diets. Analysis of forage fish data collected in 1998-99 is ongoing.

Job 1. Title: Establish the distribution pattern, relative abundance, and origin of chinook and coho salmon in eastern Lake Michigan.

Findings: *Distribution and Relative Abundance.*—Chinook salmon and coho salmon were sampled during May-August, 1998-1999 between St. Joseph and Naubinway. As in previous years, monthly catches were higher for chinook salmon (N=479, 186) than for coho salmon (N=42, 181); however, catch of chinook salmon was lower in 1999 than in any year since lakewide (eastern shoreline) sampling began in 1994 (Table 1).

Sampling during the 1994-96 seasons was conducted in one sweep of the lake, moving from south to north beginning in the spring. This design was based on the assumption that distribution of salmonine species in Lake Michigan remained constant throughout the sampling period. A revised sampling protocol was implemented in 1997 to better define the spatial and temporal variation in fish distribution. By sampling thermal bars and thermal clines, and by covering the entire lake in two south to north sweeps during the spring and summer, we hoped to be able to better define the distribution of salmonine populations in Lake Michigan.

Based on 1998-99 results from the revised assessment design, chinook salmon along the eastern shoreline of Lake Michigan moved north during the summer months. Percentage of catch in northern and central districts increased during summer sampling (80-85% in districts MM-3 and MM-6) as compared to spring sampling (20-30%, Table 2). Additionally, chinook salmon moved offshore as summer progressed and were more likely to suspend than in spring. Catch of chinook salmon in offshore nets (water depth 150' and greater) accounted for 55% of the total in summer and only 9% of the total in spring 1998 (Table 3). A higher percentage of chinook salmon were captured in suspended nets in summer (60%) when compared to spring assessment netting (11%, Table 3).

The majority (>99%) of coho salmon captured during spring sampling were taken in the southern portion of the lake (MM-8). Like chinook salmon, coho moved north during the summer; 95-97% of coho salmon collected in July-August were taken in statistical district MM-6.

Job 3. Title: Coordination with other studies, process and analyze data; write report.

Findings: This performance report was completed on schedule. The information presented was also used in preparing the MDNR-Charlevoix Great Lakes Station annual report to the Great Lakes Fishery Commission. Presentations were also made at the following meetings: American Fisheries Society Annual Meeting (poster presentation), Michigan State University Extension Fisheries Workshops in Benzonia and Bridgman, and the Lake Michigan Task Force (Advisors) Meeting.

Job 4. Title: Determine growth rates of chinook and coho salmon in eastern Lake Michigan.

Findings: Ages of all chinook salmon and coho salmon collected were determined based on scale or coded-wire tag analysis. Since lakewide assessment began in 1994, the age composition of chinook salmon in the survey catch has changed significantly. In 1994-95, the catch was composed primarily (>80%) of age 0.1-0.2 salmon, while in 1996-97, age 0.2 and 0.3 salmon combined made up a higher proportion (84% and 80% in 1996 and 1997, respectively) of the catch (Table 4). In 1998, age 0.2 and 0.3 chinook salmon made up 72% of the assessment catch, and percent of age 0.4 chinook salmon increased significantly (22%, Table 4). Scales were

collected from chinook salmon captured in 1999 assessment netting but age determinations have not been completed.

Chinook salmon average total length at age remained relatively constant from 1994-1997, but declined dramatically in 1998, especially for age 0.2 and 0.3 salmon (Table 5).

Scales were collected from coho salmon captured in 1998 and 1999 assessment netting but age determinations have not been completed.

Job 5. Title: Determine survival rates of chinook and coho salmon in eastern Lake Michigan.

Findings: Preliminary estimates of total annual mortality were calculated for chinook salmon based on catch-at-age data from assessment netting conducted during 1994-95. These estimates were presented in previous reports. We are continuing to collect chinook and coho salmon with (now) standard sampling gear to obtain better estimates of mortality. This information will be presented in future reports.

For chinook and coho salmon collected in 1998, rate of lamprey wounding was extremely low. Wounds were observed on less than 1% of chinook salmon in all districts; none of the coho salmon collected showed any evidence of lamprey attack. Analysis of lamprey wounding data from 1999 assessment netting is ongoing.

Job 6. Title: Obtain data on diet of chinook and coho salmon.

Findings: Stomach contents were collected from assessment-caught chinook and coho salmon in 1997-99. Processing of these samples is not yet complete. During 1998-99, processing was completed for stomach samples from 400 chinook salmon and 15 coho salmon collected during 1996.

Data on chinook salmon diets from 1995 MDNR survey vessel collections was combined with that collected in other jurisdictions according to the lakewide diet assessment protocol; this collaborative effort will continue for the foreseeable future. One use of this information is in ongoing work to revise the SIMPLE model of lakewide predator-prey dynamics.

Job 7. Title: Monitor prevalence of bacterial kidney disease in populations of chinook and coho salmon in eastern Lake Michigan.

Findings: The incidence of bacterial kidney disease (BKD) among populations of chinook salmon and coho salmon was assessed using FELISA procedures. Year-to-year variation in BKD incidence was similar across species. Average lakewide incidence of BKD for both chinook and coho salmon was highest in 1997, and declined significantly in 1998 (Table 6). In 1997, levels of BKD incidence in chinook salmon were over two times higher than levels recorded in any year since the beginning of lakewide assessment.

Incidence of BKD in chinook salmon increased with age of fish (Table 7), but was similar for male and female fish (Table 8). No pattern was apparent with age or sex for coho salmon, probably due to small sample sizes in most years.

Job 8. Title: Measure relative abundance, species composition, and size structure of forage fish in the vicinity of salmonine sampling locations.

Findings: The revised design of our netting program implemented in 1997 included forage fish assessments. Forage fish assessment nets (100' deep, 1-2.5" graded mesh gill nets) were attached to suspended gill nets designed for salmonine assessments. Two samples were collected in each statistical district between May and August, to enable us to determine selectivity by salmonine predators for piscine prey items. Forage fish catch in 1997 was comprised primarily of alewife (94%); other fish collected included spottail shiner, bloater chub, lake whitefish, and yellow perch. Spottail shiner, whitefish, and yellow perch have not been recorded in chinook or coho salmon stomachs collected in MDNR assessments during 1990-1996. Analysis of forage fish data collected in 1998-99 is ongoing.

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Table 1.—Catch (number of fish) of chinook salmon and coho salmon in assessment netting in eastern Lake Michigan, 1994-99.

Sample year	Chinook salmon	Coho salmon
1994	719	4
1995	898	20
1996	1,072	12
1997	409	24
1998	479	42
1999	186	181

Table 2.—Percent of total assessment catch of chinook salmon in spring (May-June) and summer (July-August) by statistical district and net type (surface or suspended gillnet), 1998-99.

Statistical district	Season			
	Spring		Summer	
	Surface	Suspended	Surface	Suspended
	<u>1998</u>			
MM-3	0	<1	0	6
MM-6	10	9	37	37
MM-8	79	2	2	18
	<u>1999</u>			
MM-3	0	1	0	16
MM-6	20	9	26	43
MM-8	51	18	1	13

Table 3.—Percent of total assessment catch of chinook salmon in spring (May-June) and summer (July-August) by depth strata and net type (surface or suspended gillnet), 1998-99.

Depth strata	Season			
	Spring		Summer	
	Surface	Suspended	Surface	Suspended
<u>1998</u>				
Inshore	82	8	32	12
Offshore	6	3	7	48
<u>1999</u>				
Inshore	40	---	29	---
Offshore	32	28	3	67

Table 4.—Age frequency (percent) of chinook and coho salmon collected in Michigan Department of Natural Resources survey vessel assessment netting, 1994-98. NA = Age determinations not completed.

Sample year	Age			
	0.1	0.2	0.3	0.4
<u>Chinook salmon</u>				
1994	25	57	17	1
1995	24	66	10	<1
1996	12	39	45	3
1997	17	47	33	3
1998	5	20	52	22
<u>Coho salmon</u>				
1994	NA	NA	---	---
1995	5	95	---	---
1996	13	87	---	---
1997	62	38	---	---
1998	NA	NA	---	---

Table 5.—Average length at age (mm) of chinook and coho salmon collected in Michigan Department of Natural Resources survey vessel assessment netting, 1994-98.

Sample year	Age		
	0.1	0.2	0.3
<u>Chinook salmon</u>			
1994	445	607	792
1995	408	604	783
1996	404	603	720
1997	434	612	776
1998	396	504	620
<u>Coho salmon</u>			
1994	NA	NA	---
1995	---	501	---
1996	414	483	---
1997	483	562	---
1998	NA	NA	---

Table 6.—Incidence of bacterial kidney disease (BKD) in chinook and coho salmon sampled in Lake Michigan during 1994-98. Values are percent of fish testing positive for BKD in each year. N is the number of individuals tested. BKD results are determined from FELISA tests of kidney tissue.

Year	Chinook salmon		Coho salmon	
	N	%	N	%
1994	116	21.6	0	---
1995	855	22.9	19	15.8
1996	1,043	17.6	12	0.0
1997	412	54.4	24	20.8
1998	484	14.0	42	0.0

Table 7.—Incidence of bacterial kidney disease (BKD) by age in chinook and coho salmon sampled in Lake Michigan during 1996-98. Values are percent of fish of each age class testing positive for BKD in each year. BKD results are determined from FELISA tests of kidney tissue.

Year	Age				All ages
	1	2	3	4	
<u>Chinook salmon</u>					
1994	5.0	23.2	38.1	---	22.7
1995	15.0	26.0	22.1	0.0	22.9
1996	7.6	18.1	20.0	13.9	17.6
1997	20.3	58.9	66.9	77.8	55.3
1998	0.0	5.9	15.3	22.4	14.1
<u>Coho salmon</u>					
1994	---	---	---	---	---
1995	0.0	16.7	---	---	15.8
1996	0.0	0.0	---	---	0.0
1997	26.7	11.1	---	---	20.8
1998	0.0	0.0	---	---	0.0

Table 8.—Incidence of bacterial kidney disease (BKD) by sex in chinook and coho salmon sampled in Lake Michigan during 1996-98. Values are percent of male and female fish testing positive for BKD in each year. BKD results are determined from FELISA tests of kidney tissue.

Year	Sex		All fish
	Male	Female	
<u>Chinook salmon</u>			
1994	24.6	20.8	22.7
1995	24.3	21.6	22.9
1996	18.3	16.8	17.5
1997	52.6	57.1	55.0
1998	12.2	16.3	14.0
<u>Coho salmon</u>			
1994	---	---	---
1995	18.2	12.5	15.8
1996	0.0	0.0	0.0
1997	36.4	16.7	29.0
1998	0.0	0.0	0.0