STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-4

Study No.: 486 **Title:** Assessment of lake trout populations in Michigan's waters of Lake Michigan.

Period Covered: October 1, 2002 to September 30, 2003

Study Objectives: To determine the population structure, health, and reproductive success of lake trout in Michigan's waters of eastern Lake Michigan. To determine if spawning adults are present at the three stocked spawning reefs within the northern refuge and at traditional spawning reefs that lie within (Big Reef) and outside (Fisherman's Island and Dahlia Shoals) the boundaries of the northern refuge.

Summary: During the 2003 field season, lake trout sampling efforts focused on assessments of populations in eastern Lake Michigan from April to August. A total of 899 lake trout were captured throughout Lake Michigan during the 2003 field season. Aging and bio-data entry remain to be completed. The age of lake trout in 2002 May-July assessments ranged from 2 to 11 years. The majority of these fish fell into the 4- to 8-year old age groups. Because of low observed rates of the incidence of bacterial kidney disease (BKD) in Lake Michigan lake trout, evaluation efforts were discontinued in 2002. Monitoring of more vulnerable salmonids (i.e., chinook or coho salmon) is continuing. As in the past, we did not observe any indications of feral lake trout in Lake Michigan.

Findings: Jobs 2 through 10 were scheduled for 2002-03, and progress is reported below.

Job 2. Title: Search for feral lake trout.–Our sampling provided no evidence of natural reproduction by lake trout in Lake Michigan. All lake trout stocked in Lake Michigan are marked, and the number of unmarked fish collected from each statistical district is within the range expected for clipping or tagging error for all years sampled (2002-2003).

Investigators are collaborating on a project funded through the Great Lakes Fishery Commission and the Great Lakes Fishery Trust entitled, "Effects of egg and fry predators on lake trout recruitment in Lake Michigan." A large component of the project is to identify potential lake trout spawning habitats in northern Lake Michigan and determine egg deposition rates of existing lake trout populations. Comparisons will then be made among lake trout populations observed in Lake Huron, Lake Ontario and Lake Champlain. The project will provide a better indication of our potential for detecting feral lake trout in Lake Michigan, as well as identify potential bottlenecks to production and survival of early life stages of naturally-produced lake trout.

Job 3. Title: Coordinate with other studies, process and analyze data; write reports.–We initiated a new lake-wide spring/early summer monitoring program in 1998. All agencies on Lake Michigan have agreed to follow standardized protocols that will enable us to better compare data and will help provide a lake-wide perspective on fishery population assessments. We have also coordinated closely with other agencies to develop age-structured lake trout population models for northern Lake Michigan and have compiled past and present assessment data to contribute to this effort. For the last 6 years, we have played a major role in producing a report submitted to the Great Lakes Fishery Commission on behalf of the Lake Michigan Technical Committee (Claramunt et al. 2001). The report presents a summary of all collaborative Lake Michigan sampling efforts directed at lake trout.

Job 4. Title: Evaluate relevant literature on lake trout.–Literature on lake trout physiology, behavior, and habitats are being collected and catalogued in an Endnote bibliographic software file. Twice monthly, we evaluate Current Contents (a literature search program) search results from fisheries journals. Relevant articles and publications are obtained and integrated into the database.

Job 5. Title: Establish the distribution pattern, relative abundance, and origin of lake trout collected throughout eastern Lake Michigan from May through August.–We collected lake trout in the spring/summer period through targeted bottom gill nets set as part of the lake-wide lake trout assessment plan agreed to by all agencies on Lake Michigan. Assessment nets are composed of 100 ft panels of graded stretch mesh ranging from 2.5 to 6.0 in with 0.5 in increments. During April and May of 1999, six bottom gill nets were set at each of three Lake Michigan sites (Manistique, Arcadia, and Northern Refuge) and in 2000, six nets were set at each of two sites (Saugatuck and Arcadia). Information was collected in 2001 from bottom gill net surveys at three Lake Michigan sites (Leland, Arcadia, and Saugatuck). The number of sampling locations expanded considerably in 2002 as we incorporated surveys for yellow perch, lake whitefish, and lake trout into one survey (Table 1). We also processed biological data on lake trout captured in surface, bottom, and suspended gill nets set as part of the chinook salmon monitoring protocol (Table 2).

Three species commonly captured in spring assessment sampling efforts included lake trout, burbot, and lake whitefish. We also collect information on lake herring, which are less abundant (Table 1). In bottom gill nets set in 1999, overall average lake trout catch rates (number per net night per 1,600 ft of net) were lowest in Manistique (1), and highest in the Northern Refuge (15). We also captured the greatest number of burbot in the Northern Refuge area, whereas lake whitefish were more prevalent at Arcadia. In 2000, the highest catch rates for lake whitefish were observed at Saugatuck. Lake trout catch rates were approximately equal at both the Arcadia and Saugatuck locations sampled in 2000 (Table 1). In 2000, lake trout catch rates at Arcadia were higher than in 1999 (Table 1). In 2001, lake trout catch rates at Arcadia nearly doubled from the 2000 values. Arcadia had the highest catch rates of lake trout among locations sampled in 2001, and was second highest, behind Leland, in 2002. We did not observe lake herring in 1999, 2000 or 2001. We captured a single lake herring at Leland in 2002.

The age composition of lake trout collected in May-July, 1999 assessments ranged from 2 to 9 years. The majority of fish were in the 5- to 7-year old age groups (Table 3). In 2000, the proportion of age-4 lake trout represented in the sample increased (Table 3). In 2001 and 2002 a larger proportion of young fish were present in the samples collected from Arcadia and the range of dominant ages appeared to be expanding with the majority of lake trout from the 4- to 10- year old age groups. Lake trout collected in the year 2000 from Saugatuck ranged in age from 2 to 12 years. The majority of the Saugatuck fish in both 2000 and 2001 were in the 3-6 year old age groups (Table 3). In 2002, a greater proportion of 7- and 8-year old lake trout were observed in the catch.

Job 6. Title: Determine the timing of spawning, distribution patterns, relative abundance, and origin of lake trout collected on traditional spawning reefs from October through November.–In 1999, the Great Lakes Fishery Trust (Trust) approved a proposal to sample multiple reefs in northern Lake Michigan. Six tribal agencies, two federal agencies, and the state are collaborating on this project. This Trust-funded project has provided the opportunity to collaborate and combine data from each of the agencies involved and has greatly increased the number of sites evaluated in northern Lake Michigan. The goal of this project is to evaluate the abundance of spawning lake trout at a given location by deploying a minimum of three nets in each of two years. We evaluated four sites from 1999 to 2001.

Catch rates at both near-shore and offshore stocked and non-stocked sites were evaluated to determine whether stocked lake trout are using historically important spawning sites or staying

near the locations where planted. In all three years (1999 to 2001), catch rates at non-stocked offshore sites were near zero. When comparing our catch rates with data collected by other collaborators, it is evident that lake trout in northern Lake Michigan are most abundant on stocked sites and prefer near-shore zones (Claramunt et al. 2001). A paper is being developed for publication of the results of these efforts.

Job 7. Title: Obtain information on diets of lake trout in surface vs. bottom nets, throughout the spring and summer and during spawning, and from different spatial locations in eastern Lake Michigan.–We are participating in a collaborative lake-wide effort to consolidate information and publish a paper describing the diets and foraging relationships of lake trout collected throughout Lake Michigan in 1994 and 1995. A draft of this paper was submitted to the co-authors for review in the summer of 2001. The laboratory evaluation of stomach contents collected from 1996 to 2001 is now complete, and a paper will be written in the near future comparing the diets from burbot and lake trout collected in the same nets. After conferring with the Lake Michigan Technical Committee, it was decided that diet collections would be discontinued for lake trout for a few years, beginning in 2002.

Job 8. Title: Monitor prevalence of bacterial kidney disease in populations of lake trout in eastern Lake Michigan.–We tested lake trout for the presence of BKD with the enzyme-linked immunosorbant assay technique (Kwik Dtect, Diagnostics, Inc., Wilton, CT) for laboratory and field use. Incidence of BKD was high in 1997 (31%, N=723), decreased in 1998 (1%, N=499), and remained low in 1999 (0%, N=306), 2000 (0%, N=182), and 2001 (1.5%, N=206; Table 4). We have not analyzed samples from fish collected in 2002 assessment efforts, and have discontinued BKD monitoring for lake trout in 2003.

Job 9. Title: Analyze Data; Write annual report.–Data analyses are ongoing. We produced this annual progress report as scheduled.

Job 10. Title: Publish report through the Fisheries Division's editing and finishing process for Research and Technical reports.–Results of this study are included in the following completed reports:

Bronte, C., J. Jonas, R, Claramunt, M. Holey, E. Olson, et al. 2003. Success of current strategies to recolonize lake trout spawning reefs in northern Lake Michigan. Final Report, Great Lakes Fishery Trust, Lansing, Michigan.

Bronte, C. R., J. Jonas, M. E. Holey, R. L. Eshenroder, M. L. Toneys, et al. 2003. Possible impediments to lake trout restoration in Lake Michigan. Great Lakes Fishery Commission, Lake Michigan Lak Trout Task Group Report, Ann Arbor, Michigan.

Claramunt, R., J. Jonas, P. McKee, M. Toneys. 2001. Status of lake trout rehabilitation in Lake Michigan. Lake Michigan Committee 2001 annual meeting. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Claramunt, R., J. Jonas, P. McKee, M. Toneys. 2000. Status of lake trout rehabilitation in Lake Michigan. Lake Michigan Committee 2000 annual meeting. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Jonas, J., et al. 2001. Status of lake trout populations: Lake Michigan. Pages 40-55 *in* J. R. Bence and M. P. Ebener, editors. Summary Status of Lake Trout and Lake Whitefish Populations in the 1836 Treaty-Ceded Waters of Lakes Superior, Huron and Michigan in 2001, with recommended yield and effort levels for 2002. Technical Fisheries Review Committee, Modeling Subcommittee Report.

Jonas, J., et al. 2000. Status of lake trout populations: Lake Michigan. Pages 42-56 *in* J. R. Bence and M. P. Ebener, editors. Summary Status of Lake Trout and Lake Whitefish Populations in the 1836 Treaty-Ceded Waters of Lakes Superior, Huron and Michigan in 2000, with recommended yield and effort levels for 2001. Technical Fisheries Review Committee, Modeling Subcommittee Report.

Jonas, J. L., P. J. Schneeberger, D. F. Clapp, M. Wolgamood, G. Wright, and B. Lasee. 2002. Presence of the BKD-causing bacterium Renibacterium salmoninarum in lake whitefish and bloaters in the Laurentian Great Lakes. Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 57: 447-452.

Schneeberger, P., M. Toneys, R. Elliott, J. Jonas, D. Clapp, et al. 1998. Lakewide assessment plan for Lake Michigan fish communities. Great Lakes Fisheries Commission, Task Group Report, Ann Arbor, Michigan.

Toneys, M., P. McKee, R. Hess, E. Olsen, J. Jonas. 1999. Status of lake trout rehabilitation in Lake Michigan. Lake Michigan Committee 1999 annual meeting. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Toneys, M., P. McKee, R. Hess, E. Olsen, J. Jonas. 1998. Status of lake trout rehabilitation in Lake Michigan. Lake Michigan Committee 1998 annual meeting. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Toneys, M., P. McKee, R. Hess, E. Olsen, J. Jonas. 1997. Status of lake trout rehabilitation in Lake Michigan. Lake Michigan Committee 1997 annual meeting. Great Lakes Fishery Commission, Ann Arbor, Michigan.

Additional study findings are included in the following manuscripts in preparation for journal publication:

Diana, C. M., J. L. Jonas, D. F. Clapp, and S. L. Hart. Draft prepared. Regional variation in characteristics of burbot in eastern Lake Michigan. Draft manuscript prepared for Journal of Great Lakes Research.

Jonas, J. L., R. M. Claramunt, J. D. Fitzsimons, J. E. Marsden, and B. J. Ellrott. In preparation. Estimates of egg deposition and the effects of lake trout egg predators in northern Lake Michigan, Parry Sound (Lake Huron), and Lake Champlain. For submission to the Canadian Journal of Fisheries and Aquatic Sciences Special Symposia.

Citations:

Claramunt, R., M. Toneys, P. McKee, R. Hess, E. Olsen, and J. Jonas. 2001. Status of lake trout rehabilitation in Lake Michigan. Great Lakes Fishery Commission, Lake Michigan Committee Report.

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Table 1.–Average catch of the three most commonly captured species and lake herring per overnight set of 1,600-foot graded-mesh bottom gill nets during April-July. From 1999 to 2001 six nets were set per site and eight nets were set per site in 2002.

Site Name	Year	Lake trout	Burbot	Lake herring	Lake whitefish
Manistique	1999	1.0	2.7	0.0	0.8
Northern refuge	1999	15.0	10.0	0.0	0.3
Arcadia	1999	12.3	3.7	0.0	2.2
	2000	20.7	8.8	0.0	3.3
	2001	41.8	1.3	0.0	13.0
	2002	18.6	3.4	0.0	7.8
Saugatuck	2000	14.7	0.3	0.0	16.5
	2001	11.5	0.0	0.0	9.5
	2002	8.3	0.4	0.0	12.6
Leland	2001	21.0	7.3	0.0	5.0
	2002	24.9	2.0	0.1	1.9
St. Joseph	2002	10.4	0.0	0.0	18.3
South Haven	2002	7.0	0.1	0.0	11.4
Grand Haven	2002	14.3	0.3	0.0	19.9
Charlevoix	2002	17.4	0.4	0.0	0.7

Table 2.–Number of lake trout captured annually in bottom, suspended, and surface gill nets set in Michigan's waters of Lake Michigan.

Year	Bottom gill net	Suspended gill net	Surface gill net
1994-1997 (mean)	427	52	439
1998	145	51	211
1999	214	72	59
2000	331	21	31
2001	499	42	10
2002	771	20	32
2003	871	13	15

Table 3.–Age composition of lake trout collected in April-July bottom gill net surveys expressed as a percent of the total number of fish sampled (N).

			Age										
Site name	Year	N	2	3	4	5	6	7	8	9	10	11	12
Arcadia	1999	74	3	9	9	11	51	15	1	0	0	0	0
	2000	124	1	2	31	44	14	5	1	1	0	2	0
	2001	185	3	14	14	36	17	8	6	1	1	1	0
	2002	115	0	1	10	30	15	21	11	15	3	0	3
Saugatuck	2000	88	1	24	31	20	11	3	5	1	1	1	1
	2001	69	0	25	30	25	10	3	6	0	1	0	0
	2002	43	0	9	5	40	9	12	16	7	0	2	0
Leland	2001	126	5	40	13	14	13	9	3	0	1	1	0
	2002	120	0	3	30	25	18	5	10	7	4	0	0
St. Joseph	2002	56	2	4	5	20	16	16	23	5	5	4	0
South Haven	2002	34	0	9	18	41	3	15	6	9	0	0	0
Grand Haven	2002	60	0	2	18	40	8	5	15	10	2	0	0
Charlevoix	2002	50	0	8	8	14	16	22	10	10	8	4	0
Manistique	1999	6	0	0	0	33	33	33	0	0	0	0	0
N. Refuge	1999	89	4	7	8	20	37	16	4	3	0	0	0

Table 4.–Prevalence of bacterial kidney disease (BKD) in lake trout from Michigan waters of Lake Michigan, 1995-2002.

Year	Percent testing positive	95% confidence limits
1995	11.9	2.4
1996	1.4	1.6
1997	31.4	3.4
1998	0.6	0.7
1999	0.0	0.0
2000	0.0	0.0
2001	1.5	1.6
2002	pending analyses	pending analyses