STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-1

Study No.: 469 **Title:** Investigations into causes of, and solutions for, recent declines in survival of trout stocked in Lake Huron

Period Covered: October 1, 1999 to September 30, 2000

Study Objective: (1) to explore methods of documenting the lacustrine early life history of stocked salmonids, with emphasis on understanding factors influencing mortality during their first year at large; (2) to determine whether there are genetically-based differences in early life-history characteristics that affect return to the creel, by comparing performance of a lacustrine strain of brown trout with that of one of the standard domesticated strains; and (3) to define methods that can be employed to improve survival and extend average longevity of brown trout used for stocking, such that return to the creel in lakes can be improved to 10% of the number stocked.

Summary: During 1999-2000, most activity was devoted to data scrubbing and organization and to data analysis. This annual report therefore gives progress to date on data analysis and progress in preparing the final report. In 1990, two strains of brown trout were selected for study, Wild Rose and Seeforellen. The stocking phase of this evaluation was completed in 1995. Returns of the two strains were monitored in 1992-99. In 1996 and 1997, two stocking methods were compared; one lot of brown trout was stocked offshore by boat in Thunder Bay, and a second lot was stocked off the beach by truck using conventional techniques. In 1996 Wild Rose strain was used for both stocking method comparisons; in 1997, Seeforellen strain was used. Relative survival was measured using creel census. The stocking phase of this stocking-method study was completed in 1997 and the evaluation phase was completed in 2000. The 1991-95 year classes of brown trout were much more successful than those of previous years. Estimated sport harvest of brown trout increased from 500 in 1991 to 2,284 in 1992 and 3,908 in 1993. Harvest steadily declined thereafter, however, and brown trout harvest in Thunder Bay was estimated to be only 158 fish in 1999. Both Wild Rose and Seeforellen strains produced significantly better harvests than Plymouth Rock strain, principally because of the shorter longevity of Plymouth Rock brown trout. Differences between Seeforellen and Wild Rose brown trout were inconsistent. Significantly more Seeforellen-strain trout were observed in the creel than Wild Rose in half of cohort/age-group combinations, but not in the other combinations. A similar study was conducted on Lake Charlevoix. Creel census was conducted there from 1993-96 to assess the performance of three strains: Seeforellen, Wild Rose, and Plymouth Rock. The catch rates (fish per 100 angler hours) were similar for Seeforellen and Wild Rose strains of the same age. However, in 1993 and 1994, catch rates of both Seeforellen and Wild Rose strains were at least 5 times those for Plymouth Rock strain of the same age. Paired Seeforellen and Wild Rose stocked in 1994 and 1995 survived poorly and fishing success for brown trout in Lake Charlevoix sharply declined in 1995 and 1996. Causes of the recent declines in brown trout catches at Thunder Bay and Lake Charlevoix have not been identified, but declining numbers of alewives in the spawning run may have contributed to the relapse. Thus far, returns from offshore (vessel) stocking and shore stocking in Thunder Bay have been too few to provide for a meaningful evaluation. Neither group appears to have contributed significantly to the recreational fishery.

Job 1. Title: Identify and import to the Michigan hatchery system strains of trout for experimental purposes.

Findings: There was no activity under this job in 1999 because it was completed in earlier segments.

Job 2. Title: Culture the selected experimental strains, mark, and stock them as yearlings in May.

Findings: There was no activity under this job in 1999 because it was completed in earlier segments. The numbers of brown trout stocked by strain or stocking method during the study period are given in tables 1 and 2.

Job 3. Title: Summarize fish health data from the source hatcheries to document size, condition, and health of the study fish at time of stocking.

Findings: There was no field activity under this job in 1999 because it was completed in earlier segments. Quality control data are being organized into a single database for the study period.

Job 4. Title: Assess conditions of the receiving water and early life history characteristics of the stocked fish in Thunder Bay.

Findings: The work on early life history characteristics and post-stocking behavior and distribution of stocked brown trout was completed in earlier segments.

We have continued to periodically monitor alewife abundance during and after stocking. Large numbers of adult alewives appear to buffer brown trout from predation by other piscivores. No netting for alewives was done in 1999. In June of 2000 we made 12 graded-mesh gillnet sets, principally to measure alewife abundance in the 1.5- and 2-inch-mesh panels. The data will be summarized in the 2001 final report. Alewife abundance had been exceptionally low, which probably contributed to the lower than usual survival rates of stocked brown trout since 1994.

Job 5. Title: Determine return to creel of stocked trout.

Findings: *Thunder Bay.*–Creel census harvest and biological data for the entire study period were organized, scrubbed, and summarized during this segment. The following are results of that analysis.

From 1985 through 1990, an average of 100,000 yearling brown trout was stocked annually in Thunder Bay. But in 1991, the estimated harvest was only 500 brown trout (Study 427). This was the lowest estimated harvest since the creel census began. Clearly, the brown trout fishery had failed in Thunder Bay.

After the stocking date was changed to mid-June to coincide with peak abundance of spawning alewives, brown trout harvest increased to 2,284 in 1992 and rose again in 1993 to 3,908 fish. A reversal occurred from 1994 to present, however, and only 158 brown trout were harvested from Thunder Bay in 1999 (Table 3). The rise and fall of brown trout harvest appears to parallel trends in adult alewife abundance (see Job 4).

Creel census clerks at each of the major ports on Lake Huron (Study 427) measured incidence of test fish in the recreational catch. Fin clips were recorded and scales were taken from creeled fish for age determination. Observed fish were assigned to their respective study groups based on fin clips and ages. Observed returns were corrected for slight differences in stocking rates (tables 4 and 5). Binomial tests were used to compare differences in return rates. The expected return ratio for each paired comparison was the ratio of the numbers stocked of each test group (Table 6).

Study brown trout did not move far from the Thunder Bay study area. Of combined test strain returns, 94% were observed at Alpena, and 97% were observed at Alpena and its adjacent ports of Harrisville and Rockport (Table 7).

Returns per 60,000 stocked were 8.9 times higher during the study of three test strains, which were stocked from 1991-95 (Table 4), than during the study of stocking methods (boat vs. shore) (Table 5). The latter test was conducted from 1996-99, during the period of low alewife abundance.

In the one comparison of Seeforellen and Plymouth Rock strains, both strains produced similar returns at age-2, but Seeforellen-strain brown trout produced significantly better returns at age-3 and older than Plymouth Rock ($p<0.001$) (Table 6).

Seeforellen-strain brown trout also tended to return at higher rates than Wild Rose but return rate differences varied between cohorts and age groups (Table 6). For example, more Seeforellen than Wild Rose brown trout from the 1992 stocking were observed in the creel, both at age-2 and as older fish ($p=0.008$), but there were no significant differences between returns of either strain stocked in 1993 ($p>0.05$). The 1994 paired cohorts produced almost identical returns at age-2, but Seeforellen strain returned better at age-3 ($p=0.026$). The opposite of this age-specific pattern of return was observed for the 1995 paired comparison. The Seeforellen strain produced significantly better returns than Wild Rose in 4 of 8 cohort-age group combinations ($p<=0.026$). In no case did Wild Rose strain return significantly better than Seeforellen brown trout ($p>0.05$).

A concerted effort was made to collect a significant amount of biological data from creeled brown trout during a discrete time period for the purpose of comparing biological parameters of the test strains. The Alpena Brown Trout Festival was held annually during July, thus July was the best opportunity to collect these data because of the large number of sport-harvested fish available for measurement. To further increase sample sizes, we heightened effort dedicated to measuring biological data from creeled brown trout during each Brown Trout Festival from 1993-2000. The creel census biological data from all Lake Huron ports from 1992-99 were combined into a single database and we have nearly completed the error checking of the various fields.

Preliminary analysis suggested that, among those fish observed in the Alpena area creel, there were differences between lengths and weights at age between the three test strains. Plymouth Rock-strain brown trout appeared to be smaller at age-2 than the other strains. Seeforellen strain appeared to be larger at age than Wild Rose or Plymouth Rock (Table 8). Only four age-3 and no age-4 or older Plymouth Rock-strain brown trout were observed in the Thunder Bay creel. Age- and cohort-specific tests of these differences will be prepared for the final report.

Through 1997, brown trout harvest sampling produced adequate sample sizes for comparisons of performance (Tables 2 and 4). In 1998 and 1999, however, too few brown trout from the 1996

and 1997 paired comparisons were observed in the creel to adequately test the effects of boat and shore stocking methods (tables 5 and 6). Similarly, in 2000, few brown trout were observed during the Brown Trout Festival. The 2000 data will be entered and analyzed this winter. Based on the low returns from both test groups, apparently neither strategy (boat nor shore stocking) produced an adequate return to the sportfishery.

Sampling during 1999 completed the strain evaluation phase of this study. Evaluation of the stocking methods phase was completed at the end of the 2000 field season.

Job 7. Title: Analyze data, and prepare performance and final reports and technical publications.

Findings: This job was completed as scheduled. The annual progress report was prepared. Graphics were prepared and presentations made to various public interest groups and the Division's Lake Huron Basin Committee. Databases from each job have been compiled and verified in preparation for the final report. Progress was made in data analysis for the final report (see Job 5) and for a presentation at the Midwest Fish and Wildlife Conference in Minneapolis this December.

Prepared by: James E. Johnson
Date: September 30, 2000

Table 1.–Number of brown trout by strain stocked in Thunder Bay, 1990-95.

Year	Seeforellen	Wild Rose	Plymouth Rock	Total
1990	–	–	95,032	95,032
1991	59,288	–	58,914	118,202
1992	54,917	55,051	–	109,968
1993	56,133	57,000	–	113,133
1994	62,932	62,932	–	125,864
1995	58,098	56,390	–	114,488

Table 2.–Number of brown trout stocked in boat-shore stocking site comparison, 1996-97.

Year	Offshore	Beach	Total
1996	42,268	47,564	89,832
1997	61,601	58,669	120,270

Table 3.–Brown trout harvest, 1991-99, Thunder Bay, Lake Huron.

Year	Brown trout harvest
1991	500
1992	2,284
1993	3,908
1994	3,322
1995	3,167
1996	1,899
1997	1,198
1998	589
1999	158

Table 4.–Brown trout observed in creel (not expanded to recreational fishing effort), Michigan waters of Lake Huron, by strain and year class, 1991-95.

Stocking year	Age	Count by strain			Observed return per 60,000 stocked		
		Seeforelle n	Wild Rose	Plymouth Rock	Seeforelle n	Wild Rose	Plymouth Rock
1991	1	0	–	0	0.0	–	0.0
	2	126	–	111	127.5	–	113.0
	3	58	–	21	58.7	–	21.4
	4	1	–	0	1.0	–	0.0
	5	1	–	0	1.0	–	0.0
	6	0	–	0	0.0	–	0.0
	7	0	–	0	0.0	–	0.0
Total		186	–	132			
1992	1	8	3	–	8.7	3.3	–
	2	218	166	–	238.2	180.9	–
	3	35	25	–	38.2	27.2	–
	4	17	3	–	18.6	3.3	–
	5	1	0	–	1.1	0.0	–
	6	0	0	–	0.0	0.0	–
	7	0	0	–	0.0	0.0	–
Total		279	197				
1993	1	2	4	–	2.1	4.2	–
	2	91	98	–	97.3	103.2	–
	3	49	61	–	52.4	64.2	–
	4	20	2	–	21.4	2.1	–
	5	2	4	–	2.1	4.2	–
	6	0	0	–	0.0	0.0	–
	7	0	1	–	0.0	1.1	–
Total		164	170				
1994	1	0	4	–	0.0	3.8	–
	2	115	114	–	109.6	108.7	–
	3	42	20	–	40.0	19.1	–
	4	21	17	–	20.0	16.2	–
	5	2	4	–	1.9	3.8	–
	6	0	0	–	0.0	0.0	–
Total		180	159				
1995	1	1	0	–	1.0	0.0	–
	2	156	56	–	161.1	59.6	–
	3	54	45	–	55.8	47.9	–
	4	4	9	–	4.1	9.6	–
	5	2	0	–	2.1	0.0	–
Total		217	110				

Table 5.–Brown trout observed in creel (not expanded to recreational fishing effort), Michigan waters of Lake Huron, by stocking method and year class, 1996-97.

Stocking year	Age	Count by strain		Observed return per 60,000 stocked	
		Boat	Shore	Boat	Shore
1996	1	1	0	1.42	0.00
	2	9	6	12.78	7.57
	3	5	9	7.10	11.35
	4	1	4	1.42	5.05
Total		16	19		
1997	1	0	0	0.00	0.00
	2	13	14	12.66	14.32
	3	1	4	0.97	4.09
Total		14	18		

Table 6.–Binomial tests of age-specific returns observed by creel census clerks from paired stockings to compare strains and stocking method, Michigan ports on Lake Huron, 1991-99.

Test group	Stocking year	Age	Number observed	Observed proportions	Expected proportions	2-tailed significance (Z approx.)
Seeforellen	1991	2	126	0.502	0.532	
Plymouth Rock			111	0.498	0.468	0.396
Seeforellen	1991	3+	60	0.741	0.532	
Plymouth Rock			21	0.259	0.468	0.001[1]
Seeforellen	1992	2	218	0.568	0.499	
Wild Rose			166	0.432	0.501	0.008[1]
Seeforellen	1992	3+	53	0.654	0.499	
Wild Rose			28	0.346	0.501	0.008[1]
Seeforellen	1993	2	91	0.481	0.496	
Wild Rose			98	0.519	0.504	0.744
Seeforellen		3+	71	0.511	0.496	
Wild Rose			68	0.489	0.504	0.792
Seeforellen	1994	2	115	0.502	0.500	
Wild Rose			114	0.498	0.500	1.000
Seeforellen	1994	3+	65	0.613	0.500	
Wild Rose			41	0.387	0.500	0.026[1]
Seeforellen	1995	2	156	0.736	0.507	
Wild Rose			56	0.264	0.493	<0.001[1]
Seeforellen	1995	3+	60	0.526	0.507	
Wild Rose			54	0.474	0.493	0.750
Boat	1996 &	2+	29	0.433	0.494	
Shore	1997		38	0.567	0.506	0.28

[1] Significant difference ($p<=0.05$) between test groups.

Table 7.–Number of each test group observed, per 60,000 stocked, by creel census clerks at 10 Lake Huron sites, 1991-99.

	Test group				
	Seeforellen	Wild Rose	Plymouth Rock	Boat	Shore
Rogers City	0.618	0.000	0.000	0.000	0.000
Rockport	3.913	1.297	1.018	2.311	0.565
Alpena	195.835	160.001	131.378	17.907	12.990
Harrisville	4.530	0.519	0.000	0.578	1.694
Oscoda	3.501	1.556	1.018	1.155	1.694
Tawas	1.441	0.259	1.018	0.000	0.000
Pt. Austin	0.206	0.000	0.000	0.000	0.000
Harbor Beach	0.412	0.519	0.000	0.000	0.000
Pt. Sanilac	0.412	0.259	0.000	0.000	0.000
Lexington	0.412	0.864	0.000	0.000	0.000
Total observed	211.279	165.274	134.433	21.951	16.944

Table 8.–Preliminary summary of length (mm) and weight (gm) at age for test strains observed in creel at Thunder Bay (site=Alpena). (Standard deviation shown in parentheses)

	Strain								
	Seeforellen			Wild Rose			Plymouth Rock		
Age	Length	Weight	N	Length	Weight	N	Length	Weight	N
2	525 (51)	2,183 (659)	189	507 (36)	2,114 (488)	150	444 (26)	1,358 (501)	26
3	687 (64)	5,240 (1,340)	96	607 (56)	3,562 (1,023)	78	627 (4)	3,870 (233)	4
4	729 (57)	5,771 (1,284)	30	620 (92)	3,829 (1,597)	23			0
5	743 (34)	5,605 (682)	4	642 (88)	4,063 (1,200)	6			0