STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-6

Study No.: 230665 **Title:** Investigation of causes of declines in Au Sable River brown trout populations.

Period Covered: October 1, 2004 to September 30, 2005

Study Objective: To continue to conduct annual trout population surveys at index stations on the Au Sable River. These data will be used to determine effects of changes in channel habitats and water quality on the abundance of larger trout in the river. They will also be used to evaluate the effectiveness of instream structure rehabilitation efforts in the Mainstem and North Branch Au Sable River.

Summary: A draft final report for this study has been written and is currently in the review/publication process.

Findings: As amended for 2005-06, Job 4 was scheduled, and progress is reported below.

Job 4. Title: Write final report.–The draft final report for this study focused on two scales of resolution; a detailed analysis of factors influencing brown trout and brook trout density, growth, and survival in three branches of the Au Sable River in the northcentral Lower Peninsula, and a statewide analysis of correlations among streams in regards to spring flow conditions and trout densities. The findings of our detailed analyses for the Au Sable River highlighted the strong influence of year class strength on abundance of older age classes of brown trout and brook trout (Table 1). We found spring flow conditions and spawner abundance (egg deposition) to have significant influences on young of year trout densities in the Au Sable River, though our models accounted for less than half of the variation in trout densities. A subjective index characterizing the quantity and quality of large woody debris (LWD) in the Au Sable River was significantly related to density, growth, and survival of several age classes of brown trout and brook trout, suggesting its importance to these species. Differences in total phosphorus levels among sites and through time had significant positive influences on density and growth of several age classes of trout. Such findings suggested that LWD and nutrient levels should be included in monitoring programs where testing hypotheses behind trends is an objective.

From our broad-scale analysis of correlations in spring flow conditions and density of age-0 to age-2 trout among streams scattered throughout Michigan, we found regions where flow conditions and fish densities among streams were highly correlated through time. The patterns we observed existed among sites as much as 140 km apart in rivers that drained into different Great Lakes (Figure 1), a much greater distance compared to a previous study (Lobón-Cerviá 2004) in which sites were less than 30 km apart. These findings support the hypothesis that population dynamics of some stream fishes (e.g., trout) may be temporally synchronous across large regions of Michigan. The final report for this study, tentatively entitled “Regional and local influences on brown trout and brook trout population dynamics in Michigan rivers” has been drafted and is in the review/publication process.

Literature Cited:

Lobón-Cerviá, J. 2004. Discharge-dependent covariation patterns in the population dynamics of brown trout (*Salmo trutta*) within a Cantabrian river drainage. Canadian Journal of Fisheries and Aquatic Sciences 61:1929-1939.

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Date: September 30, 2005

Table 1.–Summary of multiple linear regression models developed for brown trout and brook trout density (fish per hectare) in the Au Sable River system. A significant model could not be developed for age-3 brook trout. Variable descriptions occur in Table 2.

Species	Total df	Adj.R^2	SE	Variables	Standardized coefficients	Significance
Age-0 brown	204	0.18	490	BRNEGGS	0.39	0.000
				A10M10QD	-0.20	0.002
Age-1 brown	169	0.75	79	LWD	0.48	0.000
				BNAGE0P	0.42	0.000
				TOTAL_P	0.32	0.000
				MINUS10	-0.09	0.015
Age-2 brown	169	0.71	53	BNAGE1P	0.74	0.000
				LWD	0.22	0.000
				TOTAL_P	-0.12	0.016
Age-3 brown	216	0.64	30	BNAGE2P	0.80	0.000
				MINUS20	-0.14	0.001
Age-4 brown	216	0.25	7.4	BNAGE3P	0.38	0.000
				BNTSIZE	0.24	0.000
				MINUS15	-0.21	0.001
Age-5 brown	253	0.19	3.9	BNAGE4P	0.44	0.000
Age-0 brook	207	0.39	672	BKEGGYR-1	0.52	0.000
				PREDATORS	-0.21	0.000
Age-1 brook	170	0.54	109	BKAGE0P	0.64	0.000
				PREDATORS	-0.29	0.000
				LWD	0.25	0.000
Age-2 brook	170	0.47	20	BKAGE1P	0.69	0.000
				LWD	0.16	0.005

Table 2.–Description of variables used in multiple linear regression models for brook trout and brown trout density. Model results occur in Table 1.

Variable name	Description
BKEGGYR-1	Estimated brook trout eggs/hectare laid in previous fall
BKAGE0P	Age1 brook trout/hectare in previous fall
BKAGE1P	Age0 brook trout/hectare in previous fall
PREDATORS	Age 3 and older brown trout/hectare
BNAGE0P	Age0 brown trout/hectare in previous fall
BNAGE1P	Age1 brown trout/hectare in previous fall
BNAGE2P	Age2 brown trout/hectare in previous fall
BNAGE3P	Age3 brown trout/hectare in previous fall
BNAGE4P	Age4 brown trout/hectare in previous fall
BNTSIZE	Mininimum BNT size limit for harvest. Lower end of slot was used during period of slot limits. For no-kill regulations, a 51 cm minimum size was used.
A10M10QD	Average flow from April 10 to May 10 divided by the mean April 10 to May 10 discharge the period of record for period (which consists of measured and predicted daily flow values).
MINUS10	Number of days in previous winter having a minimum temperature less than 10C.
MINUS15	Number of days in previous winter having a minimum temperature less than 15C.
MINUS20	Number of days in previous winter having a minimum temperature less than 20C.
LWD	Large woody debris quality and quantity rating; scale: 0-10, with 10 being best.
TOTAL_P	Hypothesized total phosphorus concentration (mg/L)

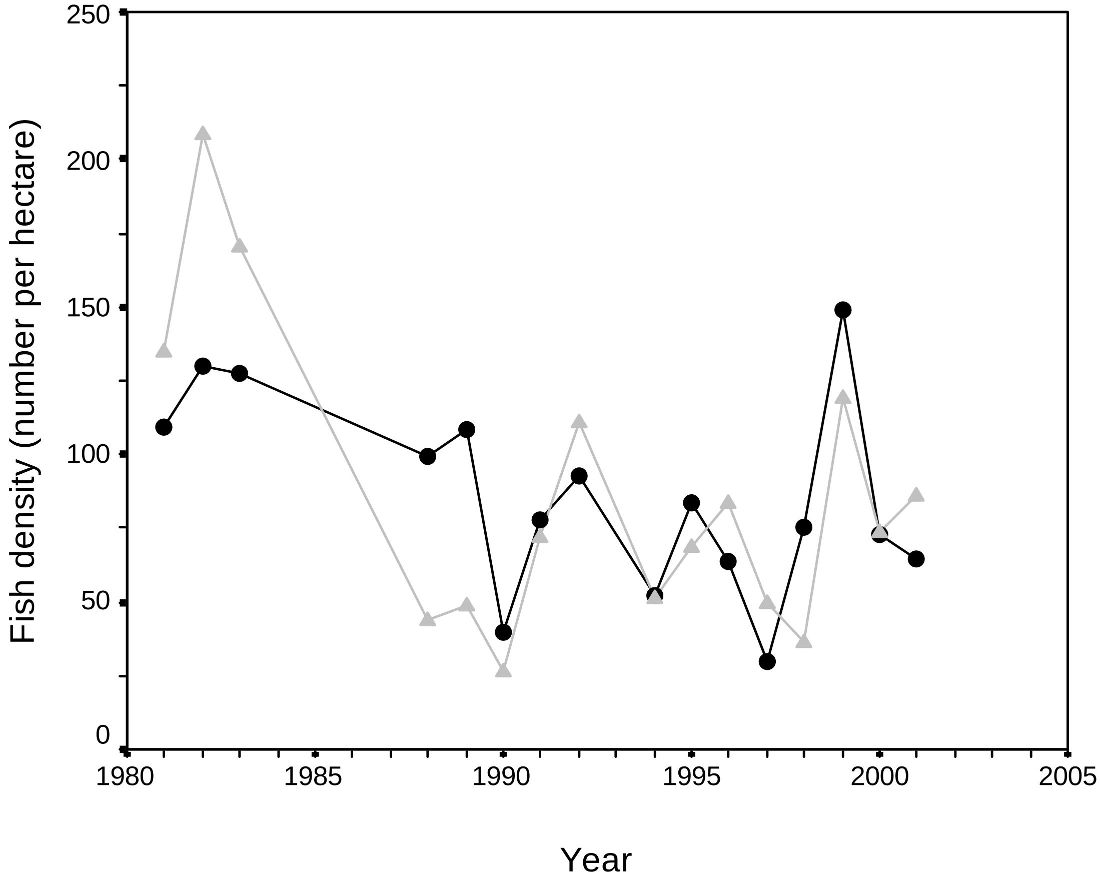

Figure 1.–Age-2 brown trout density at sites 140 km apart on two Michigan rivers, the mainstem Au Sable (black circles) and Pere Marquette (gray triangles), from 1980-2003.