STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-2

Study No.: 655 **Title:** The effects of severe water withdrawal on the population and habitat of brook trout.

Period Covered: October 1, 2000 to September 30, 2001

Study Objective: To determine the impact of severe water withdrawal during the summer on a brook trout population, and to test the validity and accuracy of an existing PHABSIM model.

Job 5. Title: Compare PHABSIM predictions to population response and write final report.

Findings: We diverted water around a 602-m treatment zone (TZ) of Hunt Creek between 1-June and 31-August each year of the study between 1991-98. During 1991-94, 50% of streamflow was diverted, in 1995-96, 75% was diverted, and during 1997-98, flow in the TZ was reduced by 90%. Methods used to collect diurnal and nocturnal brook trout habitat use data and construct use-habitat suitability criteria are fully described in Baker and Coon (1995). We calculated microhabitat suitability scores by multiplying depth and velocity suitability values, as in a PHABSIM analysis (Milhouse et al. 1989). We estimated Weighted Usable Area (WUA) for yearling-and-older (YAO) and young-of-the-year (YOY) brook trout at each discharge level tested. Populations of brook trout were estimated each year before and after water diversions. Abundance of YOA and YOY were regressed against WUA predicted by PHABSIM modeling for each level of summer discharge tested. A brief summary of findings is reported below. Detailed findings will be presented in a 2000 research report.

Fall abundance of YAO brook trout was not positively related to WUA estimates derived from diurnal use-HSC. The predicted decline of 12% in diurnal WUA for YAO (compared to baseflow) when discharge was reduced by 75% was associated with a 58% increase in mean YAO abundance. Fall abundance of YAO brook trout in the TZ was significantly higher in 1995-96 following summer flows of 4 cfs (25% of normal) than after summer flows of 16, 8, or 1.5 cfs. Similarly, the predicted decline of 36% in WUA for YAO (compared to baseflow) when discharge was reduced by 90% was associated with a 21% increase in mean YAO abundance (compared to abundance at baseflow). Nocturnal WUA was significantly and positively related to fall abundance of YAO. However, there was considerable scatter around the linear regression line and the coefficient of determination was not large ($R^2 = 0.30$).

Fall abundance of YOY brook trout was not significantly related to either diurnal or nocturnal WUA projected by PHABSIM modeling for the discharge levels tested. PHABSIM model projections of diurnal WUA for YOY indicated that habitat in the TZ would increase by 17% when discharge was cut in half, and by 15% when discharge was reduced by 75% as compared to baseflow. A decline of 13% in diurnal WUA for YOY was projected for a 90% dewatering level. However, nocturnal WUA for YOY was projected to be higher at all reduced flow levels as compared to baseflow. Mean YOY abundance in the TZ was similar between the baseflow period and periods when discharge was reduced by half or by 90%. Mean fall abundance of

young-of-the-year (YOY) brook trout in the TZ was significantly higher when 75% of water was diverted than during the pretreatment period or when summer discharge was cut in half.

A final report has been drafted as the following manuscript, which has been submitted to the Fisheries Division's Editing and Finishing Process for Publication of Research and Technical reports:

Nuhfer, A. J., and E. A. Baker. 2002. A field validation test of the instream flow incremental methodology (IFIM) in a Michigan brook trout stream. Michigan Department of Natural Resources, Fisheries Research Report Draft, Ann Arbor.

This manuscript will be published as a Fisheries Research Report during 2001-02, and submitted as a final report December 2002.

Literature Cited:

Baker, E. A. and T. G. Coon. 1995. Development and evaluation of alternative habitat suitability criteria for brook trout *Salvelinus fontinalis* Michigan Department of Natural Resources Fisheries Research Report 2017, Lansing.

Milhous, R. T., M. A. Updike, and D. M. Schneider. 1989. Physical habitat simulation system reference manual-version II. Instream flow information paper 26. U.S. Fish and Wildlife Service Biological Report 89(16).

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Date: September 30, 2001