COMPARISON OF PREDICTED HABITAT CHANGE AND BROOK TROUT POPULATION RESPONSE TO A SIMULATED IRRIGATION WITHDRAWAL IN HUNT CREEK, MICHIGAN

ABSTRACT

We withdrew approximately 50% of the summer stream flow from Hunt Creek, MI from 1 June-31 August, 1991-94 to simulate the impacts of a water withdrawal for irrigation on the brook trout *Salvelinus fontinalis* population and to evaluate the Physical Habitat Simulation System (PHABSIM) under controlled conditions. We modeled brook trout diurnal foraging habitat using habitat suitability criteria developed from frequency of use data (use-HSC) and from bioenergetic models (bioenergetic-HSC) based on data collected in Hunt Creek. We also modeled nocturnal resting habitat by application of use-HSC developed from data collected in Hunt Creek. We formulated hypotheses concerning the impact of the withdrawal on the brook trout population based on the PHABSIM model output and tested these hypotheses using Before-After-Control-Impact (BACI) analysis. The PHABSIM model indicated that young of the year diurnal and nocturnal Weighted Usable Area (WUA) increased as a result of the reduced summer stream flow and that yearling and older nocturnal WUA was increased as a result of the reduced stream flow and that yearling and older diurnal foraging habitat decreased only slightly under reduced flow conditions. The PHABSIM model predicted no reduction in density of young of the year or yearling and older brook trout as a result of the reduced flow and these predictions were supported by the BACI analysis. Biannual estimates of brook trout population density in the treatment section of Hunt Creek and in the downstream control sections were very similar in the ten years preceding the withdrawal and during the withdrawal period. The PHABSIM model also predicted that a

summer withdrawal equal to approximately 88% of summer baseflow would be needed to produce a statistically detectable reduction in brook trout density in the treatment section of Hunt Creek and that yearling and older brook trout habitat would be reduced more than young of the year habitat at that level of flow reduction.

Introduction

Changes in stream flow regime can influence the ecology of stream fishes in a variety of ways (Orth 1987). Stream fish ecology can be impacted by changes in stream flow because flows are important in determining reproductive success (Starrett 1951), fish community structure and habitat use (Bain et al. 1988), and habitat availability (Kraft 1972). In midwestern trout streams the input of groundwater is recognized as an important abiotic factor influencing trout populations. For example, Latta (1965) found a significant positive relationship between young of the year brook trout *Salvelinus fontinalis* numbers and groundwater levels during a nine year study on the Pigeon River, Michigan. Similarly, White et al. (1976) determined that trout streams in Michigan and Wisconsin that had the most stable flow regime also had the greatest trout abundance and standing crop. Clearly, protecting flows in midwestern trout streams is important for the maintenance of healthy trout populations.

The Physical Habitat Simulation System (PHABSIM) is the computer based habitat modeling component of the Instream Flow Incremental Methodology (IFIM) that predicts stream habitat quality and quantity as a function of discharge (Milhous et al. 1989). PHABSIM was developed in the western U.S. with the purpose of evaluating the impacts of changes in streamflow on stream habitat. The PHABSIM system is widely used in the