DEVELOPMENT AND EVALUATION OF ALTERNATIVE HABITAT SUITABILITY CRITERIA FOR BROOK TROUT *SALVELINUS FONTINALIS*

ABSTRACT

We used bioenergetic modeling to derive diurnal foraging habitat suitability criteria (bioenergetic-HSC) for mean column velocity and depth for brook trout *Salvelinus fontinalis*. We compared these to diurnal foraging habitat suitability criteria (HSC) derived from frequency-of-use data (use-HSC) for brook trout in Hunt Creek, MI. We also constructed nocturnal use-HSC from frequency-of-use data collected in Hunt Creek. Bioenergetic benefits were estimated by use of an empirical invertebrate drift density x current velocity model that adjusted fish foraging area as a function of fish size, depth, and current velocity. Metabolic costs were modeled from published swimming energetics equations for brook trout. Size-specific net benefit curves were constructed for the range of observed current velocities and bioenergetic-HSC were constructed by standardizing these curves. We constructed use-HSC from Hunt Creek frequency-of-use data using nonparametric tolerance limits. Bioenergetic-HSC were more restrictive in predictions of optimal velocity: a single velocity was optimal and depended on fish size, as opposed to a range of optimal velocities predicted from frequency-of-use data. Also, the optimal velocities predicted for yearling and older fish from bioenergetic-HSC were greater than the highest optimal velocity predicted by use-HSC. Young of the year optimal velocities predicted from bioenergetic-HSC were within the range of optimal velocities predicted from use-HSC but were at the upper end of the range. Also, the predicted range of usable velocities was

narrower for bioenergetic-HSC than for use-HSC. Nocturnal use-HSC indicated young of the year and yearling and older brook trout selected microhabitats with lower mean column velocities at night. Yearling and older brook trout used microhabitats with higher mean column velocities and greater depths than young of the year fish during both the diurnal and nocturnal periods. Bioenergetic-HSC provided a more conservative assessment of microhabitat suitability for drift feeding brook trout. A comparison of bioenergetic and use-HSC suitability scores for an independent data set of habitat use observations in Hunt Creek indicated that use-HSC predicted suitability values greater than bioenergetic-HSC. We suggest this is because use-HSC are too general and do not represent the actual suitability of foraging microhabitats in Hunt Creek.

Introduction

The construction and use of habitat suitability criteria (HSC) is an important step in the evaluation of stream fish habitat, particularly in conjunction with the use of the Physical Habitat Simulation System (PHABSIM). HSC are quantitative models which represent the suitability of particular habitat parameters for stream fish. Habitat suitability ranges between zero and one, with zero meaning the habitat parameter is unsuitable and a value of one indicating the habitat is optimally suitable (Thomas and Bovee 1993, Bovee 1986). The four habitat parameters typically used in a PHABSIM evaluation of stream habitat are water depth, water velocity, substrate and cover (Milhous et al. 1989). Previous stream habitat evaluations have been based on HSC for the species and life stage of interest constructed using one of three methods as suggested by Bovee (1986): 1)the construction of HSC from expert opinion, 2)collection of frequency-of-use data in the stream