**Supplemental Information 1**

A picture containing screenshot, diagram, text, line

Description automatically generated

Supplemental Figure S1. Bayesian *p*-values (left) and c-hat values (right) across different numbers of trout counts from each 15-minute video (e.g., we extracted counts at different time intervals) of trout from 15 UAC sites within six thermal refuges within the Housatonic River, Connecticut, USA. We assumed model convergence when the Bayesian *p*-value was near 0.50 (MacKenzie & Bailey, 2004) and the c-hatvalue was less than 1.1 (Gelman et al., 1996; appr. blue shaded regions).

A group of graphs showing different types of data

Description automatically generated

Supplemental Figure S2. Posterior predictive check of goodness of fit (based on Chi-square discrepancy tests) outputs for our simulated data using a zero-inflated Poisson, year-stratified, *N*-mixture model in a Bayesian framework. The top row shows the marginal posterior distributions for the test statistic for the actual (top left) and simulated (top right) data, and for their ratio (c-hat). The bottom row shows the joint posterior distribution of the fit statistic, where the Bayesian *p*-value (bpv) is the proportion of the posterior mass above a 1:1 line.