ZERO-INFLATED REGRESSION FOR MODELING SPECIES ABUNDANCE IN RELATION TO HABITAT: A BAYESIAN APPROACH

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Ecological data often have clustered or nested structure, in which observations are made on units grouped at different hierarchical levels. We examined the variation in counts of the slimy sculpin, a fish species commonly found in North American streams, in relation to habitat descriptors from sites nested hierarchically within a river basin. The distribution of counts was highly over-dispersed and had excess zeros, with nearly 10% of the sampled sites having zero counts. Zero-inflated Poisson (ZIP) and negative binomial (ZINB) regressions, as well as extensions of these models incorporating random effects at one or two levels, were used to account for overdispersion and potential intra-group correlations arising from the nested sampling. Comparisons between models (ZIP vs. ZINB, with vs. without random effects) were based on DIC. The zero-inflated regressions were useful in distinguishing structural from sampling zeros and identifying the main environmental determinants of incidence (presence/absence) separately from those of abundance (number of individuals), two key objectives in many ecological studies.