

Putting multi-dimensionality back into niche: diel vs. day-only niche breadth separation in stream fishes

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With 2 figures and 2 tables

Abstract: Since its original description, the niche concept has undergone a variety of interpretations. In large majority, subsequent applications of the niche concept began to simplify, or were selective of, the various components used to assess 'fundamental' and/or 'realised' niche. As a result, the term 'niche' is being used (and misused) increasingly in univariate and single-species investigations of species resource use, which deal mostly (if not solely) with microhabitat or diet. And in some cases, the ill-conceived concept of 'filling an empty niche' is perpetuated. To re-introduce multi-dimensionality to the applications of the niche concept, and to test the hypothesis that niche breadth is influenced by the time of day samples are collected, published data on the diel microhabitat use and diet of ten species/age classes of fish (barbel *Barbus barbus*, chub *Leuciscus cephalus*, minnow *Phoxinus phoxinus*, gudgeon *Gobio gobio*, bullhead *Cottus gobio*, stone loach *Barbatula barbatula*) collected from the River Lee (Hertfordshire, England) during three diel cycles over a 10-day period in 1997 were used to construct and separate the niches for specimens collected during daytime only and for those collected over the entire diel cycle. Niche breadth was found to be significantly greater for specimens from the entire diel cycle compared with those from daytime-only sampling, indicating that estimates of niche breadth based solely on resource use during a restricted period of the day are potentially mis-leading. As demonstrated here, niche should not be used as a catch-all for simple investigations of microhabitat or of diet.

Key words: Canonical correspondence analysis, replicated point abundance sampling, observational niche construction, dietary diversity.

Introduction

Since its original description (Grinnell 1917, Elton 1927), the niche concept has undergone a variety of interpretations and developments, including the emergence of 'niche construction' as an evolutionary agent in natural selection (Odling-Smee et al. 2003) and a unified niche-neutral theory model (Gewin 2006). One of most revolutionary of early developments for field biologists was that of Hutchinson (1944), which inspired Green's (1971) seminal exploration of n -dimensional hypervolume. Green's work paved the way

for subsequent field studies of the multi-dimensional nature of species "doing niche construction" (Odling-Smee et al. 2003), though 'construction' in these investigations were more about identifying and understanding how species interacted with each other and their environment (i.e. 'observational niche construction') than it was about the evolutionary consequences of the interactions. In large majority, subsequent applications of the niche concept in the field began to simplify, or were selective of, the various components used to assess 'fundamental' and/or 'realised' niche (*sensu* Hutchinson 1944). Indeed, many (if not most)

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