Patterns of Niche Partitioning in Temperate Ecosystems of Ohio

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Introduction

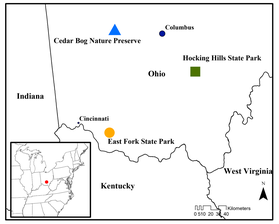
Terrestrial gastropods are threatened globally, comprising ~25% of recorded modern animal extinctions[1]. However, with upwards of 30 sympatric species living in any given ecosystem[2], it is unclear if multiple coexisting species may overlap ecological niches, potentially reducing the risk to ecosystem services posed by the loss of individual species.

Recent geochemical investigations of dietary niche partitioning among sympatric land snails have varying degrees of niche partitioning within communities living in different temperate woodlands[3,4]. However, much of this work has been conducted in temperate deciduous forests, and little data is available for other ecosystems.

This research uses carbon and nitrogen stable isotope analyses to investigate the diets of 14 gastropod species from a deciduous forest, a deciduous wetland, and a conifer-dominated forest, to determine if species in these three ecosystems partition resources in a predictable fashion. We tested the hypothesis that species in each ecosystem partition food resources to reduce competition.

Methods

- ◇ Field sites: Cedar Bog, Urbana, OH (40.0579, -83.7957); East Fork State Park, Batavia, OH (39.0118, -84.0507); Hocking Hills State Park, Laurelville, OH (39.4936, -82.6136)
- ◇ Specimen collection
  - Gastropods: 238 samples across 14 gastropod species (6 species from Cedar Bog, 9 from East Fork, 3 from Hocking Hills)
  - Food sources: 112 samples across 6 types (fresh vascular plants, leaf litter, fungi, moss, lichen, soil)
- ◇ Specimen preparation
  - Decarbonation (of soil and gastropod soft tissues)
  - Freeze drying
- ◇ Stable Isotope Analyses
  - Carbon and nitrogen analyses of soft body tissue and food resources



Results

Five to nine species were collected from each forest, and species composition showed some taxonomic overlap across sites. Deroceras laeve was present across all sampling localities whereas Mesodon thyroidus was found at Cedar Bog and East Fork Lake State Park. The isotope values of gastropod species indicate analyzed specimens followed a mixed diet that incorporated variable amounts of vascular plants, leaf litter, fungi, moss, lichen, and soil. Statistical analysis of the carbon and nitrogen isotope values within each community suggests significant dietary differences across coexisting gastropod species (Kruskal-Wallis, $P < 0.01$) in all three studied sites.

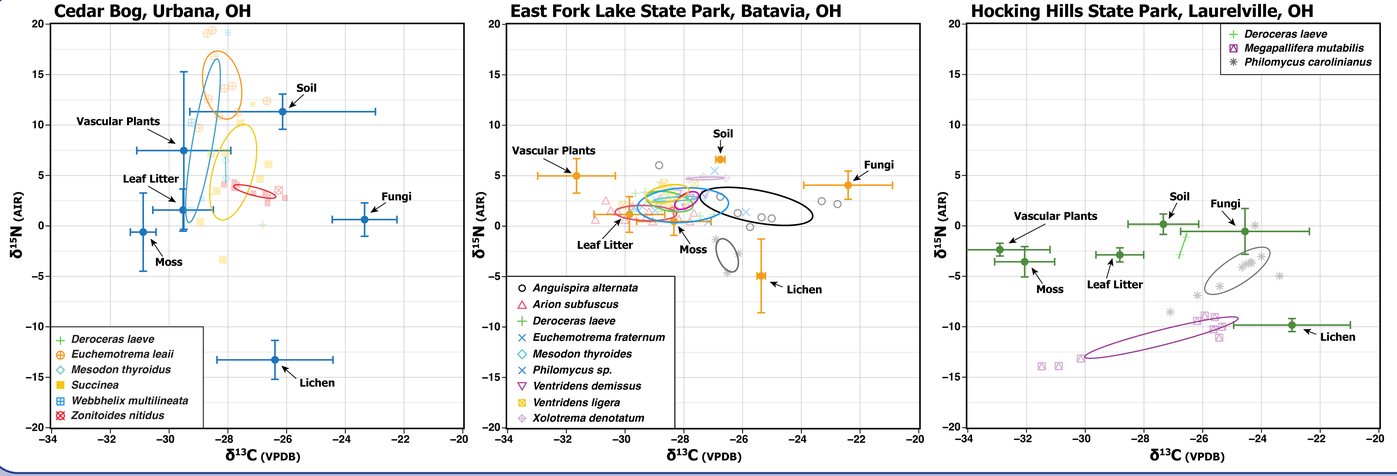


Figure 1. Carbon and nitrogen stable isotope values of bulk body tissues and potential food resources of gastropod species per study site. Gastropod values have been corrected for carbon (1‰) and nitrogen (3.4‰) isotopic fractionation[5-7]. Food sources include fresh vascular plants, leaf litter, fungi, moss, and soil organics. The mean values are plotted with crosshairs indicating 1σ. The values of all analyzed gastropods are plotted with ellipses indicating isotopic niche of each species.

Discussion/Conclusions

Sympatric gastropod species in each community showed some degree of resource partitioning, possibly to decrease direct competition with one another. Even at the Hocking Hills site, which has the lowest species abundance, gastropods still appear to partition food resources.

The isotopic variance was different across species, with some taxa like *Mesodon thyroidus*, *Ventridens demissus*, and *Zonitoides nitidus* showing a narrower range of isotope values (suggesting a more constrained diet), whereas others like *Anguispira alternata* and *Webbhelix multilineata*, exhibited greater isotopic dispersion (suggesting a more varied diet).

While the isotopic niches of many species overlapped somewhat, there seems to be some degree of partitioning of food resources despite the apparently unlimited abundance of potential food resources.

This study suggests that the ecological interactions among sympatric species are complex and signifies the need for additional research to improve our understanding of the mechanisms and effects of interspecific competition in structuring the trophic organization within gastropod communities.

This research also emphasizes that in most temperate environments, gastropod species exhibit complex diets, often incorporating significant proportions of non-plant foods like fungi and lichen. This finding is also particularly relevant for paleontologists who use carbon isotope values of fossil gastropod shells to infer past vegetation.

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