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BOOK OF ABSTRACT



O3. Multidimensional isotopic niches inform coexistence mechanisms in an Alpine ungulate community

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Niche differentiation; Large herbivores; Realised resource use

Understanding functional community structure and the niche-based mechanisms that enable coexistence among sympatric species is essential for explaining how biodiversity is maintained in natural systems, and for anticipating how ecological communities will respond to ongoing environmental change. Stable isotope analysis provides a process-oriented perspective on resource use by integrating information across time and space, thereby allowing reconstruction of realised isotopic niches that reflect multiple dimensions of ecological differentiation. We applied this framework to a community of ungulates in the Central-Eastern Italian Alps, including red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and Alpine chamois (*Rupicapra rupicapra*). Using stable isotope ratios in summer-grown hair segments ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$, $\delta^{18}\text{O}$, $\delta^2\text{H}$), we quantified species-specific five-dimensional niche hypervolumes within a Bayesian framework and estimated niche regions, overlap probabilities, univariate differentiation and multivariate structure. Despite broad dietary overlap typically observed among these ungulates, we found clear isotopic niche segregation, with mean pairwise overlap consistently remaining below 40%. Three dimensions emerged as primary drivers of differentiation: water sourcing ($\delta^{18}\text{O}$), diet quality ($\delta^{15}\text{N}$), and habitat openness ($\delta^{13}\text{C}$). Specifically, chamois appeared to derive more water from plants in their diet rather than from drinking, and to consume a higher-quality diet compared to Cervids. Red deer relied more heavily on forested habitats for resource use compared to roe deer and chamois, and additional isotopic differences between red deer and roe deer may stem from fine-scale abiotic conditions like microclimate and topography. We found no isotopic evidence for differential niche breadth among the three ungulate species. Together, these patterns highlight functional differentiation across multiple ecological axes, offering mechanistic insight into how these ungulates segregate realised niche space despite substantial potential for resource overlap. This multi-element isotope perspective underscores the value of integrative, process-based approaches for understanding current coexistence as well as improving predictions of how mammal communities may reorganise under accelerating environmental change.