

Analysing the isotopic life history of the alpine ungulates *Capra ibex* and *Rupicapra rupicapra* through their horns

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## ABSTRACT

The horn of ungulate grazers offers a potentially valuable isotopic record of the animals' diet and environment. As yet, however, spatio-temporal variation of the isotopic composition of horns has not been analyzed. We investigated isotopic patterns of carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) along and perpendicular to the horn axis in *Capra ibex* and *Rupicapra rupicapra* to determine effects of animal age, seasonal and inter-annual variation, natural contamination and sampling position on horn isotope composition. Horns of male *C. ibex* ( $n = 24$ ) and *R. r. rupicapra* (one) were sampled longitudinally on front (only *R. r. rupicapra*) and back sides and surface and sub-surface. *R. r. rupicapra* horn sides did not differ in  $\delta^{13}\text{C}$ . In both species, the horn surface had a 0.15‰ lower  $\delta^{13}\text{C}$  and a higher carbon to nitrogen ratio (C/N) than the sub-surface. Washing with water and organic solvents removed these differences. The  $\delta^{15}\text{N}$  of *C. ibex* horns increased with age (+0.1‰ year<sup>-1</sup>), as did the C/N ratio and  $^{13}\text{C}$  discrimination relative to atmospheric  $\text{CO}_2$  ( $^{13}\Delta$ ) (+0.03‰ year<sup>-1</sup>). Geostatistical analysis of one *C. ibex* horn revealed systematic patterns of inter-annual and seasonal  $^{13}\text{C}$  changes, but  $^{15}\text{N}$  changed only seasonally. The work demonstrates that isotopic signals in horns are influenced by natural contamination ( $\delta^{13}\text{C}$ ), animal age ( $^{13}\Delta$  and  $\delta^{15}\text{N}$ ), and seasonal ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) and inter-annual variation ( $\delta^{13}\text{C}$ ). The methods presented allow distinguishing between these effects.

## KEYWORDS

Isotopic archives, behavioural ecology, ontogenetic changes, alpine chamois, alpine ibex.