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Oxygen isotope composition of North American bobcat (*Lynx rufus*) and puma (*Puma concolor*) bone phosphate: implications for provenance and climate reconstruction

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Dedicated to Professor Dr Jochen Hoefs on the occasion of his 75th birthday

Feline carnivores are threatened by illegal wildlife trade. Tracing the provenance of unknown felid tissues via stable isotope analysis could provide important information in wildlife crime investigations. The oxygen isotope composition of mammalian skeletal phosphate ($\delta^{18}O_p$) is widely applied to trace the origin of animal remains and to reconstruct migratory patterns in palaeontological, archaeological, ecological and wildlife forensic applications. Teeth and bones of terrestrial mammals form at constant body temperature in isotope equilibrium with body water, which is predominantly controlled by ingested meteoric water ($\delta^{18}O_w$) that varies systematically with latitude, altitude and climate. Here we analysed $\delta^{18}O_p$ of 106 North American puma and bobcat bones of known geographic origin to establish the first $\delta^{18}O_p - \delta^{18}O_w$ regression for feline carnivores: $\delta^{18}O_p = 0.40(\pm 0.04) * \delta^{18}O_w + 20.10(\pm 0.40)$ ($R^2 = 0.46$, $n = 106$). This was compared with those from their respective prey species (deer and rabbit), a canid carnivore (fox) and other placental mammals. Effects of species, sex and relative humidity on the feline $\delta^{18}O_p - \delta^{18}O_w$ correlation were analysed and additional intra-individual tissue comparisons (hair $\delta^{18}O_h$ vs. bone $\delta^{18}O_p$) were performed for some bobcat individuals. Bobcats and pumas exhibited only a moderate $\delta^{18}O_p - \delta^{18}O_w$ correlation, which differed from canid carnivores and other placental mammals. However, feline $\delta^{18}O_p$ values revealed a moderate relation with $\delta^{18}O_w$, which lacks for the $\delta^{18}O_h$ of hair from the same bobcat individuals. This indicates a difference in oxygen isotope routing from body water to bioapatite and hair. Most herbivores and omnivores track $\delta^{18}O_w$ in their bioapatite $\delta^{18}O_p$ values much better, whereas $\delta^{18}O_p$ and especially $\delta^{18}O_h$ values of feline carnivores are less precise proxies for meteoric water $\delta^{18}O_w$ values and thus for provenance determination in wildlife forensics and palaeoclimate reconstructions. Oxygen isotope fingerprinting of bobcat and puma is biased by factors related to their diet, behaviour and metabolism that need to be better understood.

Keywords: bone phosphate; climate; drinking water; feline carnivore; hair; isotope ecology; oxygen-18; wildlife forensics

1. Introduction

Many carnivore species are threatened and hence of major conservation concern [1]. Feline carnivores are particularly affected by illegal wildlife trade [2,3]. Probabilistic provenance

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