

## Using stable isotopes to track origins at multiple scales

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A variety of exogenous markers, including rings, tags, transmitters and, more recently, geolocators, have and will continue to provide invaluable information on migratory routes and connections involving migratory animals. However, implicit in all such approaches is the need to initially mark an animal and then recapture it at a later time. For highly aggregated species, this is not typically a problem, but for widely distributed animals the initial capture sample is biased toward more easily accessible or spatially clumped aggregations. This initial capture or marking bias can be eliminated through the use of endogenous markers that allow inference of origin with a single capture. The measurement of stable isotopes of the common light elements C, N, H, O and S in the tissues of migratory animals is being used more and more to infer spatial origin or the use of specific biomes. The basis of the approach is that naturally occurring stable isotope ratios in foodwebs are transferred to tissues of animals in equilibrium with them and that stable isotope values show patterns related to a number of biogeochemical processes that are understood. Of most interest are spatial isotopic patterns or *isoscapes* that can be used to infer previous location. This presentation will introduce the concept of isotopic tracking of migrant animals with particular emphasis on  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ,  $\delta^{34}\text{S}$ ,  $\delta\text{D}$  and  $\delta^{18}\text{O}$  measurements. Emphasis will be placed on isotopic tracing at various scales from nutrient allocations within individuals to global movements. Finally, consideration of the use of heavier isotope measurements such as  $\delta^{87}\text{Sr}$  and  $\delta^{210}\text{Pb}$  as well as trace element analyses will be discussed. The stable isotope approach is not a “silver bullet” able to consistently inform questions of animal origins. However, when used correctly and in combination with other techniques, stable isotope analyses can be a powerful addition to the tool box of those interested in tracking migrants.



*Biological and Water Samples*

H																	He																												
Li	Be											B	C	N	O	F	Ne																												
Na	Mg											Al	Si	P	S	Cl	Ar																												
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																												
Rb	Sr	Y	Zr	Nb	Mo	Te	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																												
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																												
Fr	Ra	Ac																																											
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