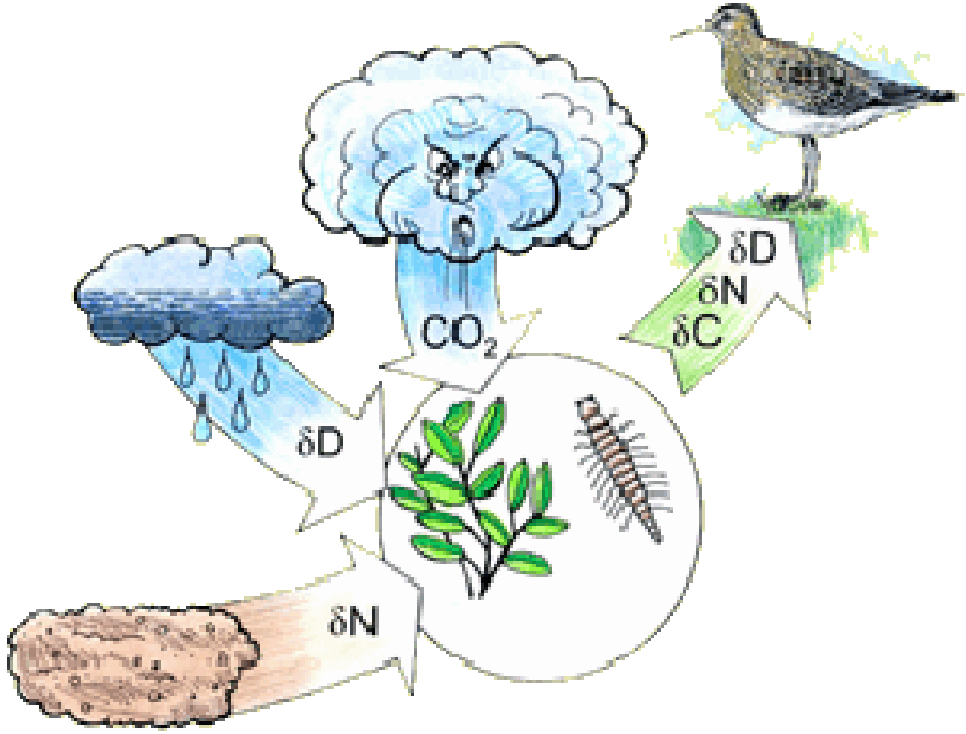
Super Stable Isotopes

Using isotope chemistry to study animal behaviour

Association for the study of animal behaviour

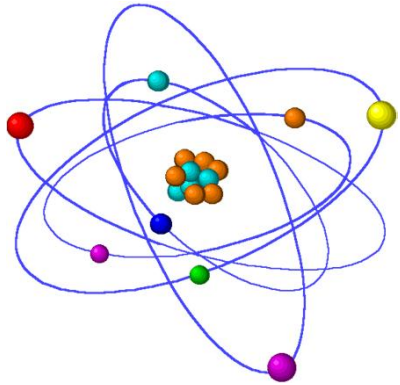


Andrew Robertson

UNIVERSITY OF EXETER

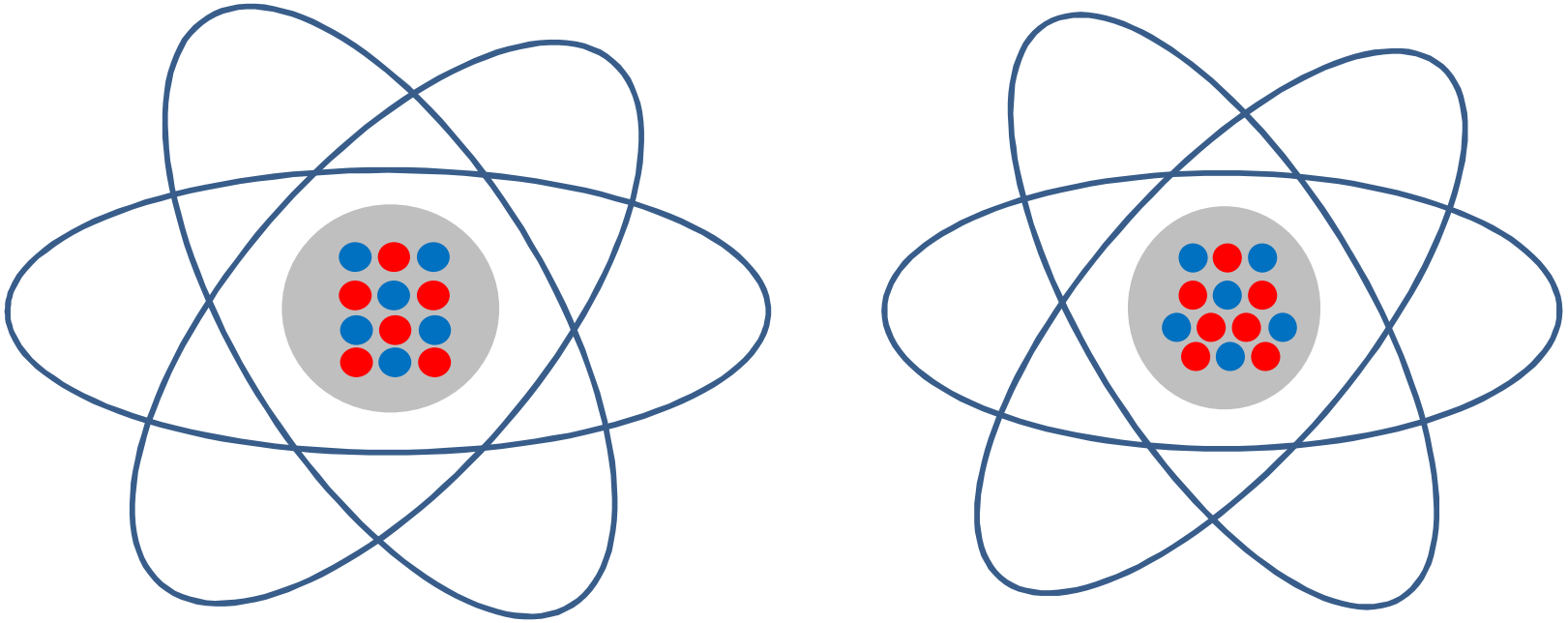
TALK OUTLINE

Part 1 – Stable isotope analysis



Part 2 – Foraging behaviour in badgers

STABLE ISOTOPES

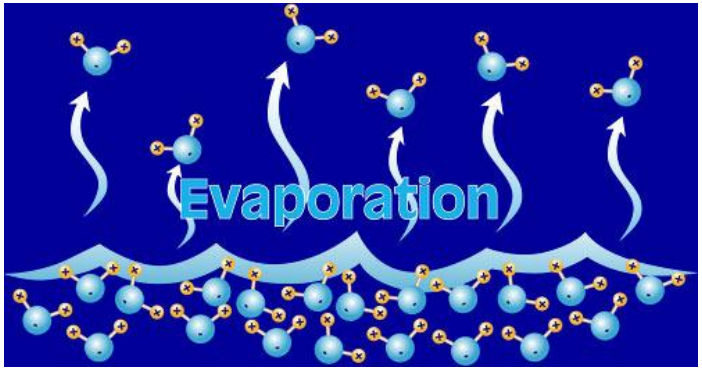


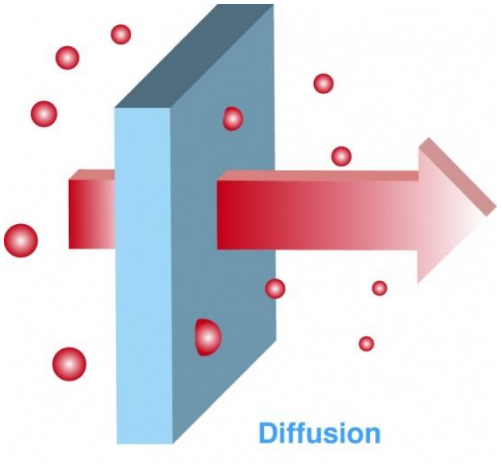
Carbon 12 Carbon 13

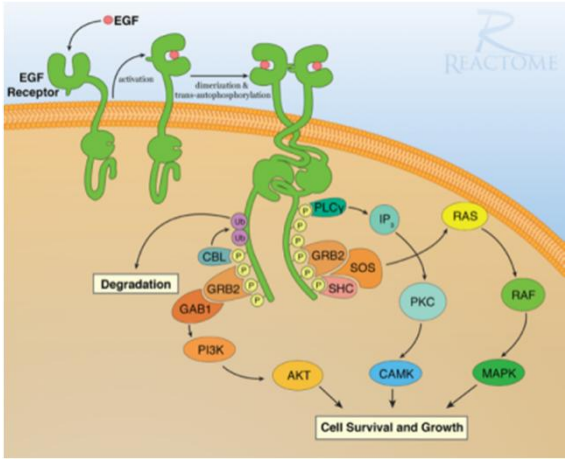
Proton

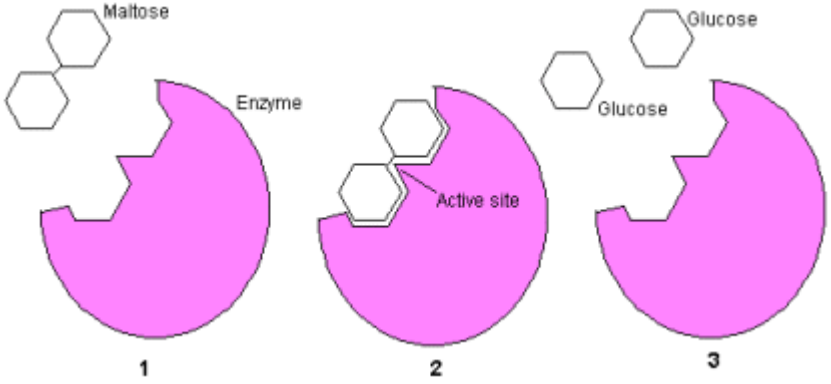
Neutron

Different mass = different behaviour

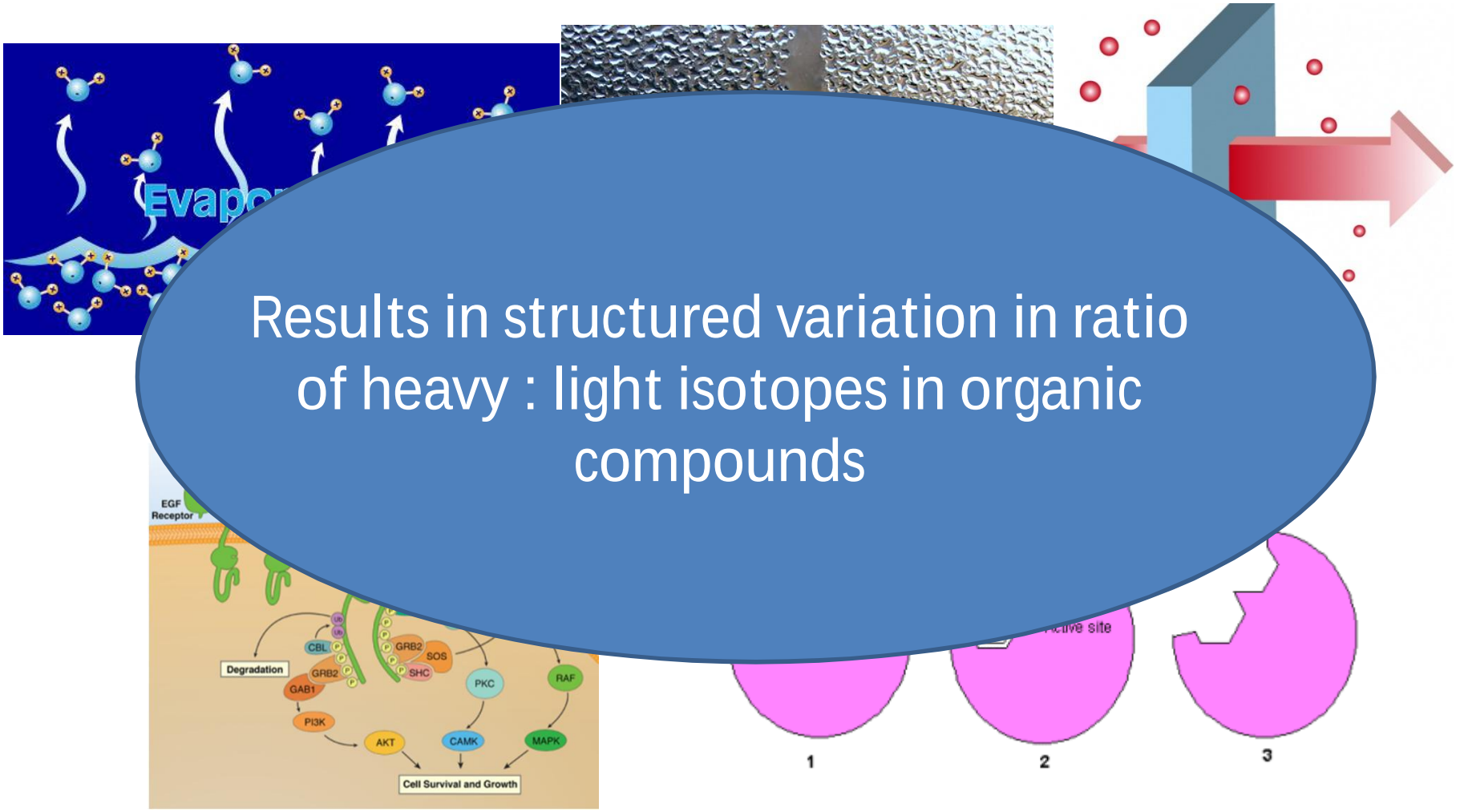






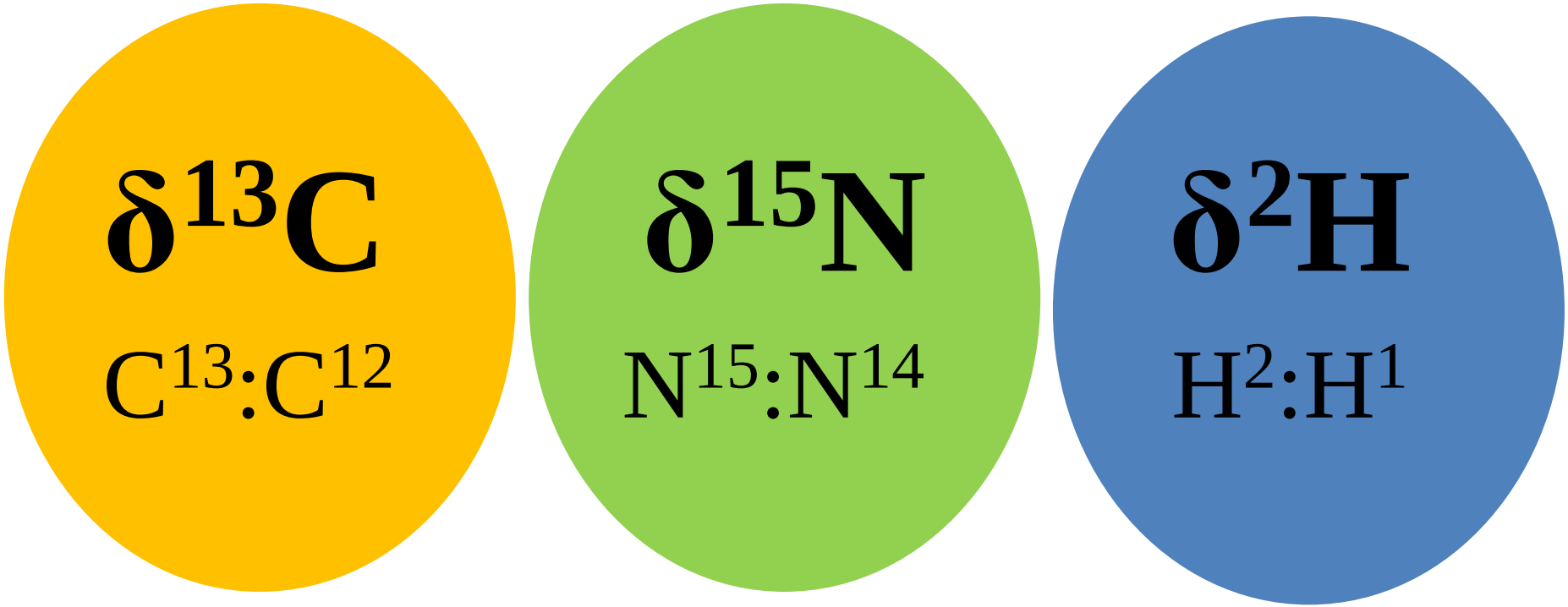


Different mass = different behaviour



Results in structured variation in ratio of heavy : light isotopes in organic compounds

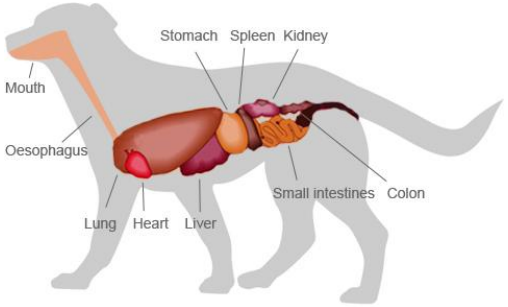
Commonly used isotopes

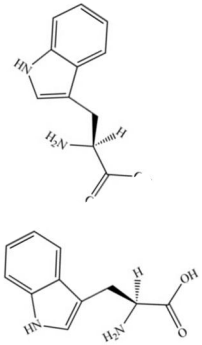


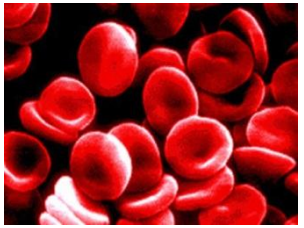
‘You are what you eat’

‘You are what you eat’

Animals tissues are constructed from components in their diet







‘You are what you eat’

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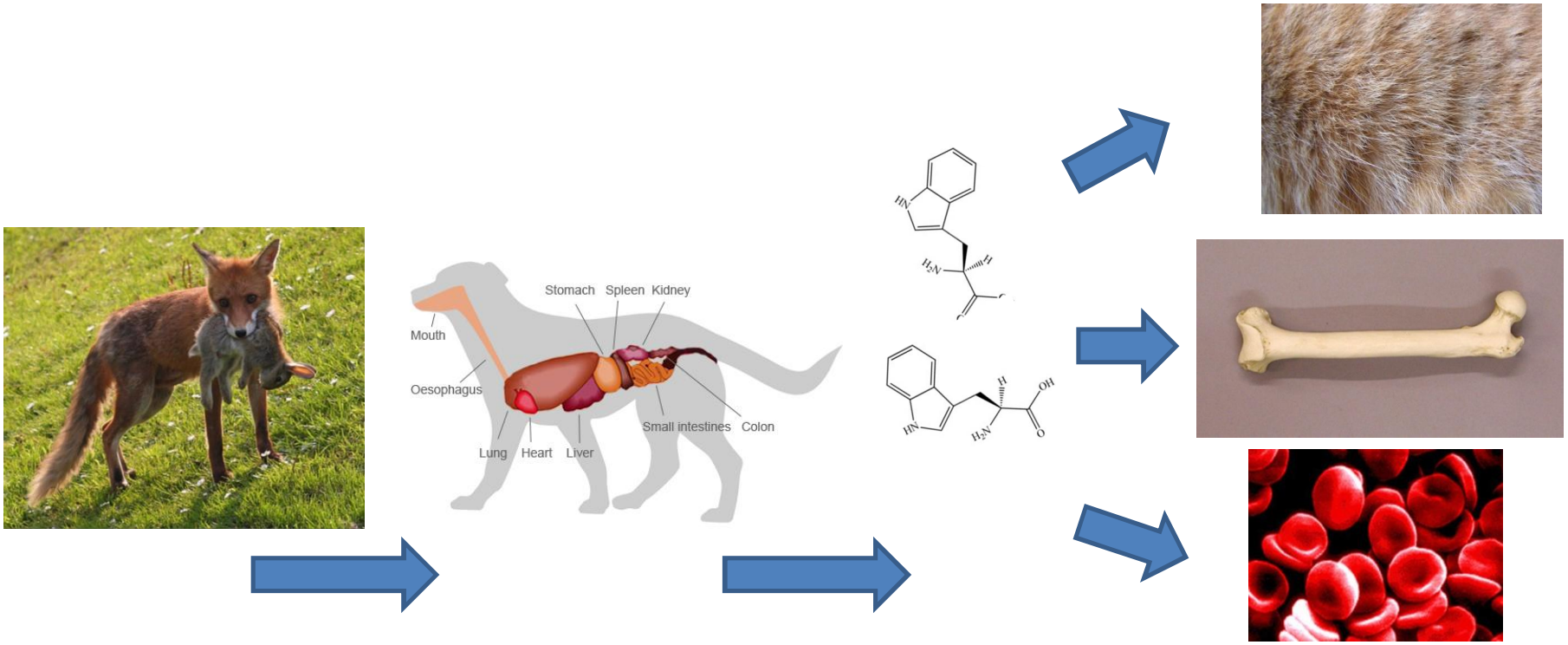
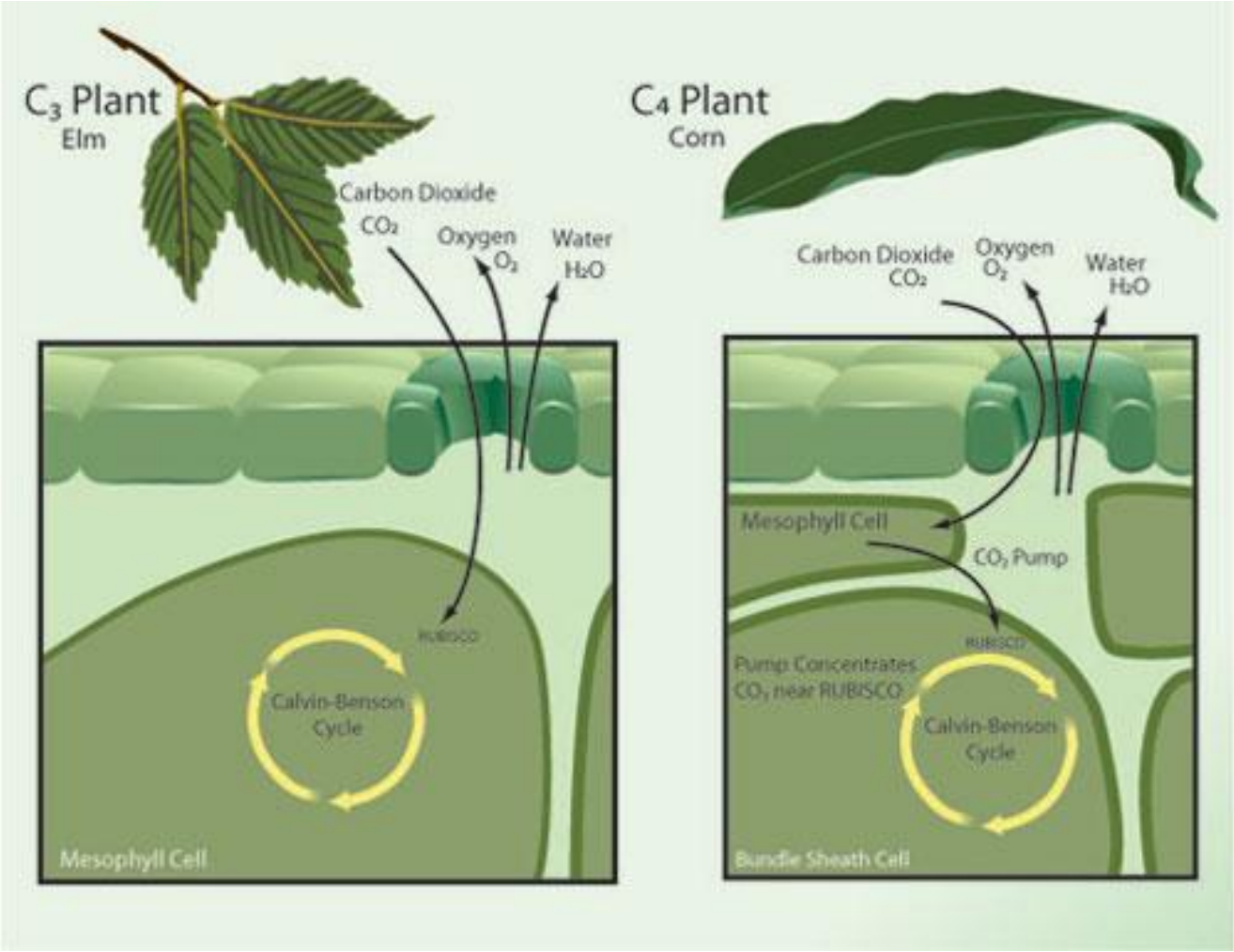


<u>Isotopic composition of animals protein tissues reflect that of their diet over period of tissue growth</u>

Carbon isotopes



$\delta^{13}C$ varies with habitat

C3 plants

C4 plants

Low

$\delta^{13}C$

High

$\delta^{13}C$ varies with habitat

Terrestrial

Marine

Low

$\delta^{13}C$

High

$\delta^{13}C$ varies with habitat

Intertidal

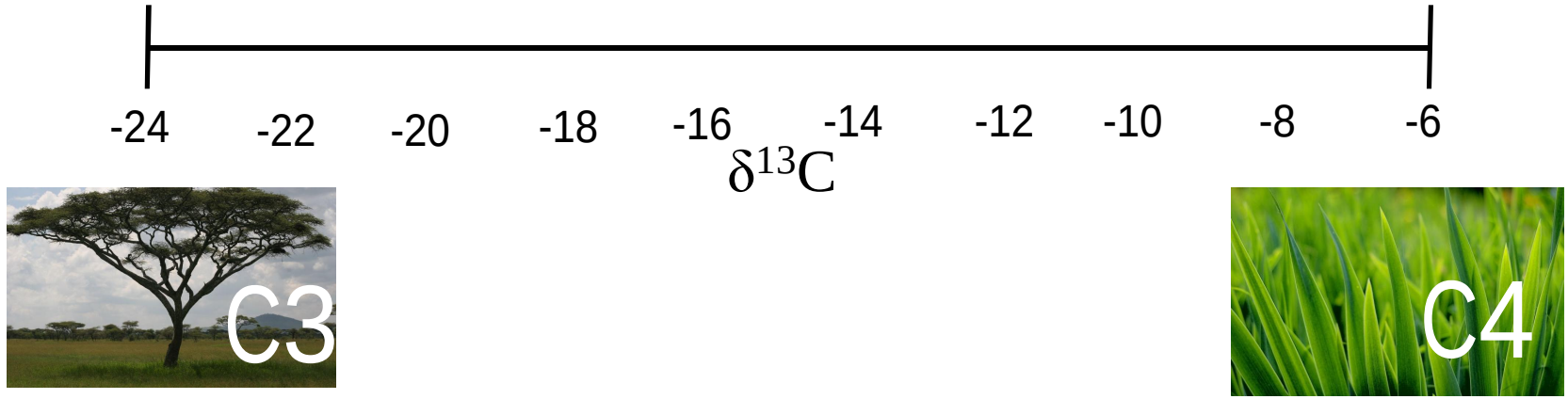
Pelagic

Low

$\delta^{13}C$

High

$\delta^{13}C$ varies with habitat

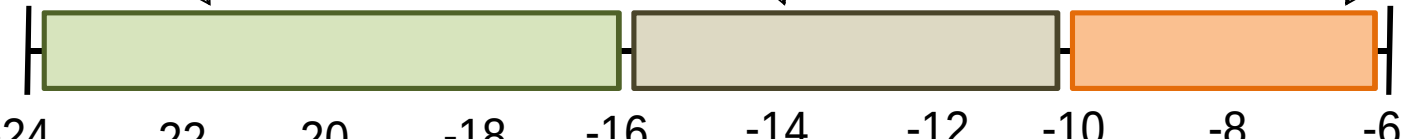


$\delta^{13}C$ varies with habitat

Browsers

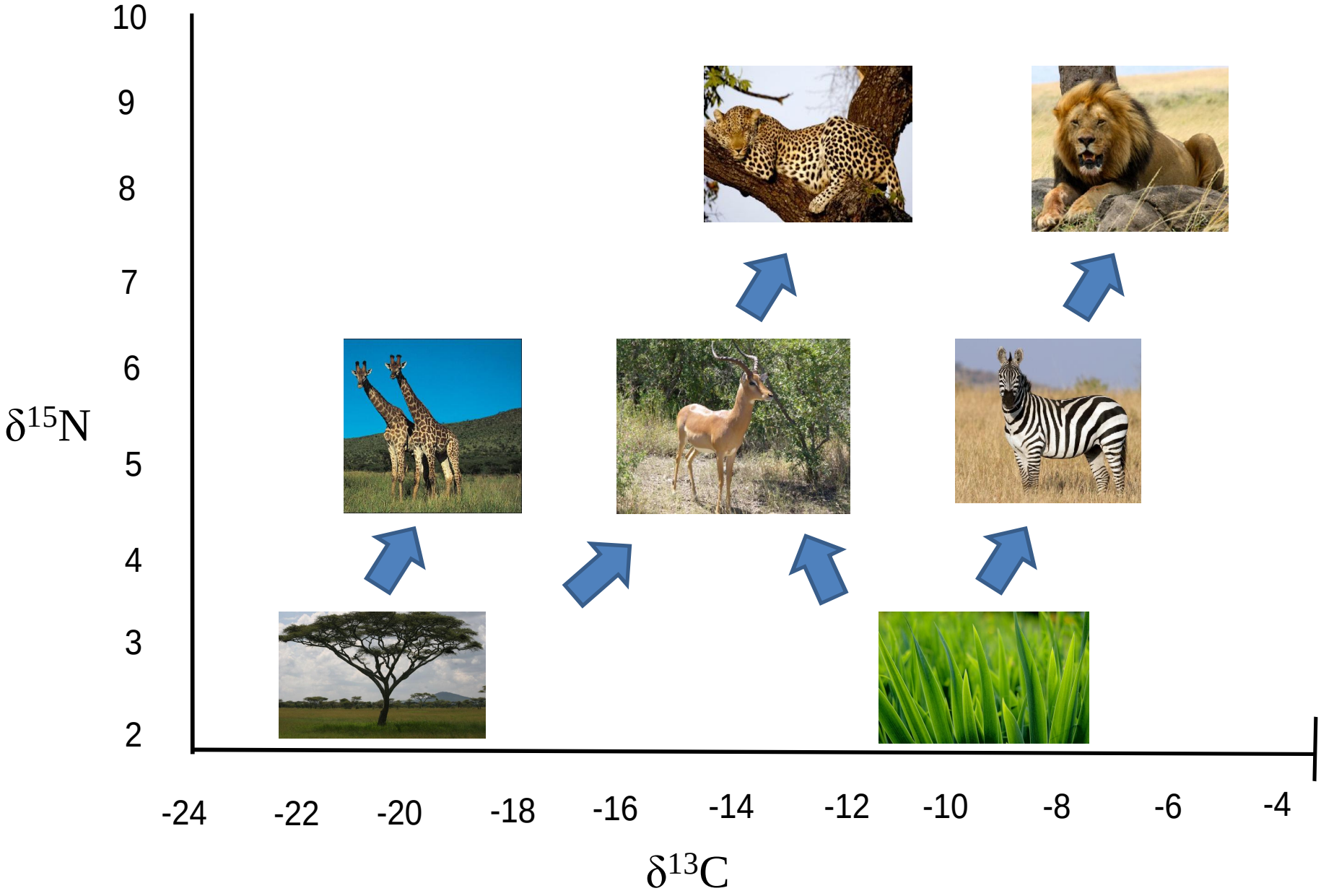
Mixed feeders

Grazers

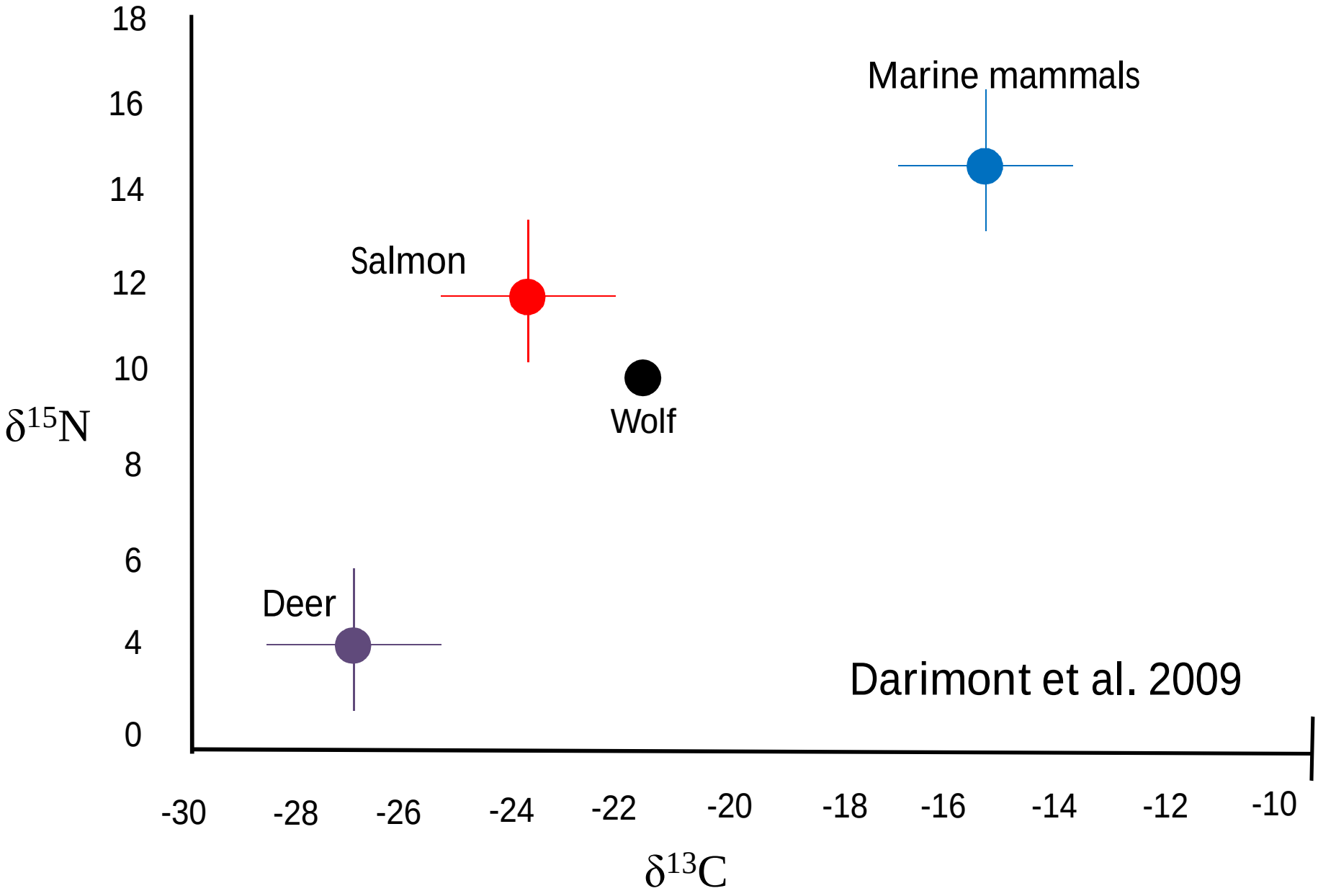


$\delta^{13}C$

$\delta^{15}N$ varies with trophic level



Mixing models



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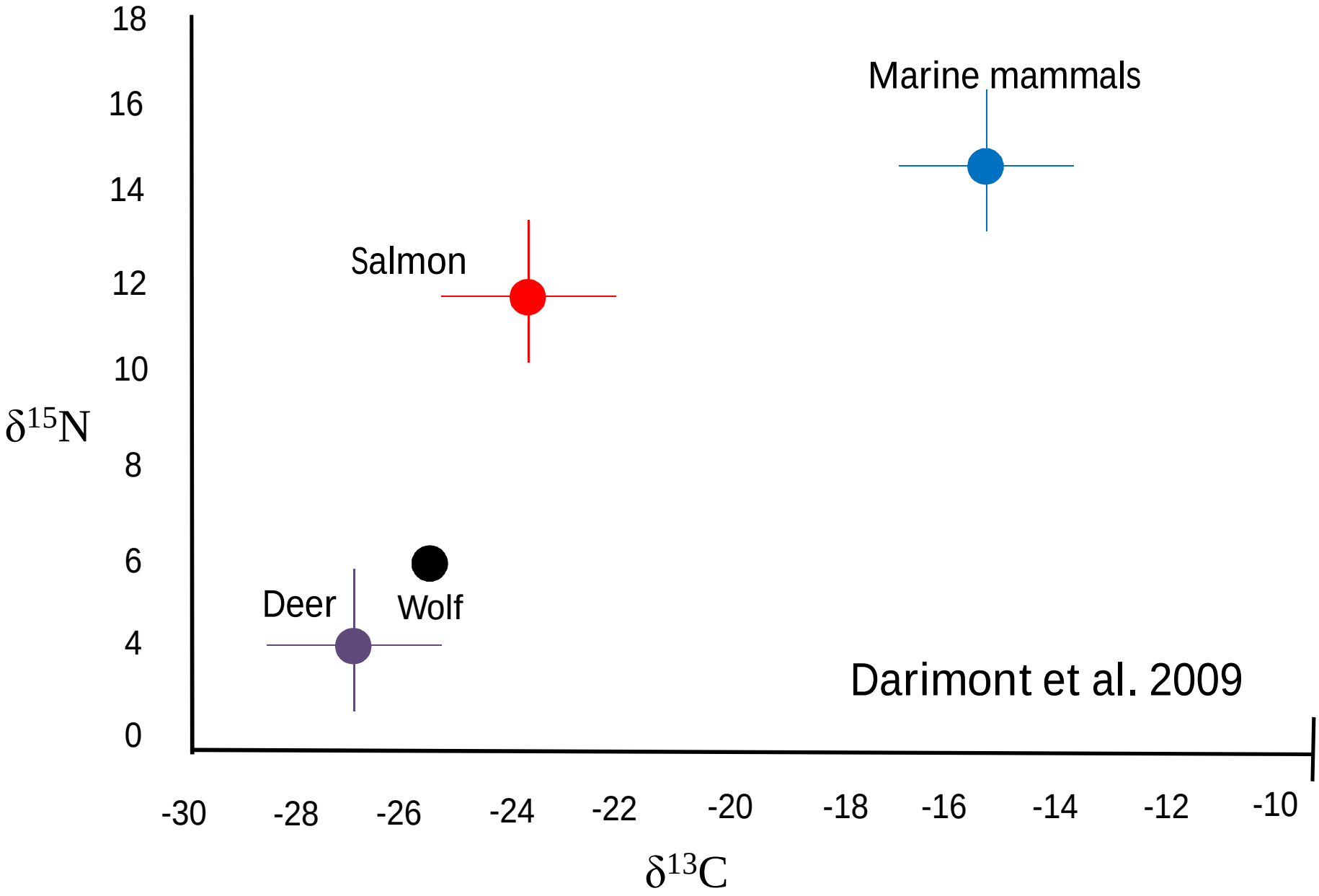

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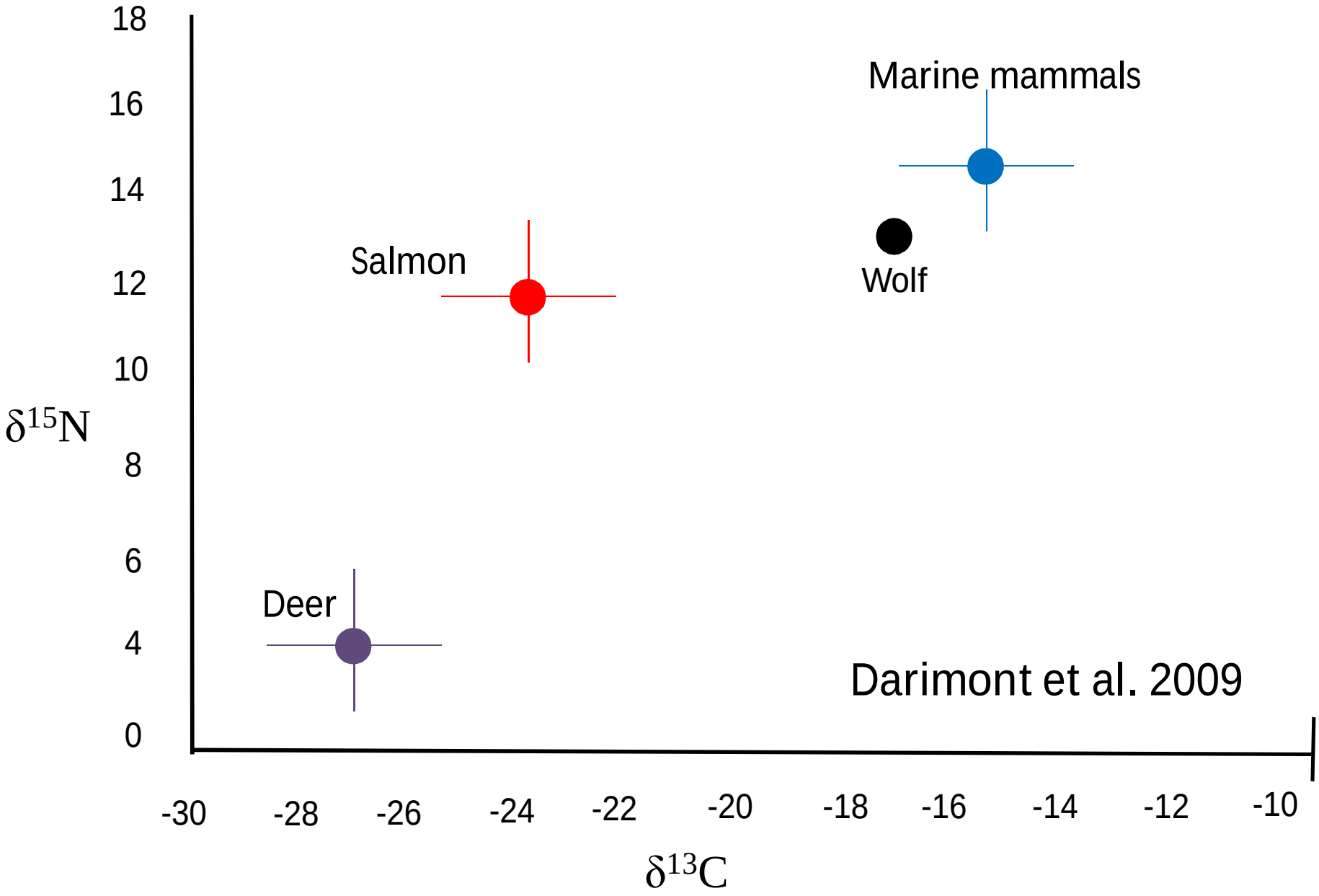
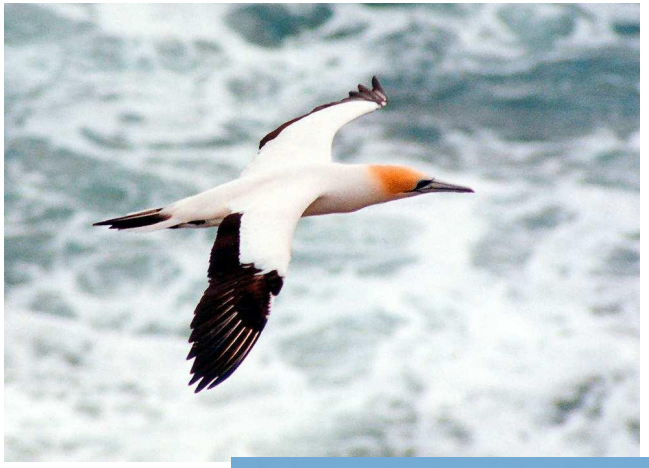
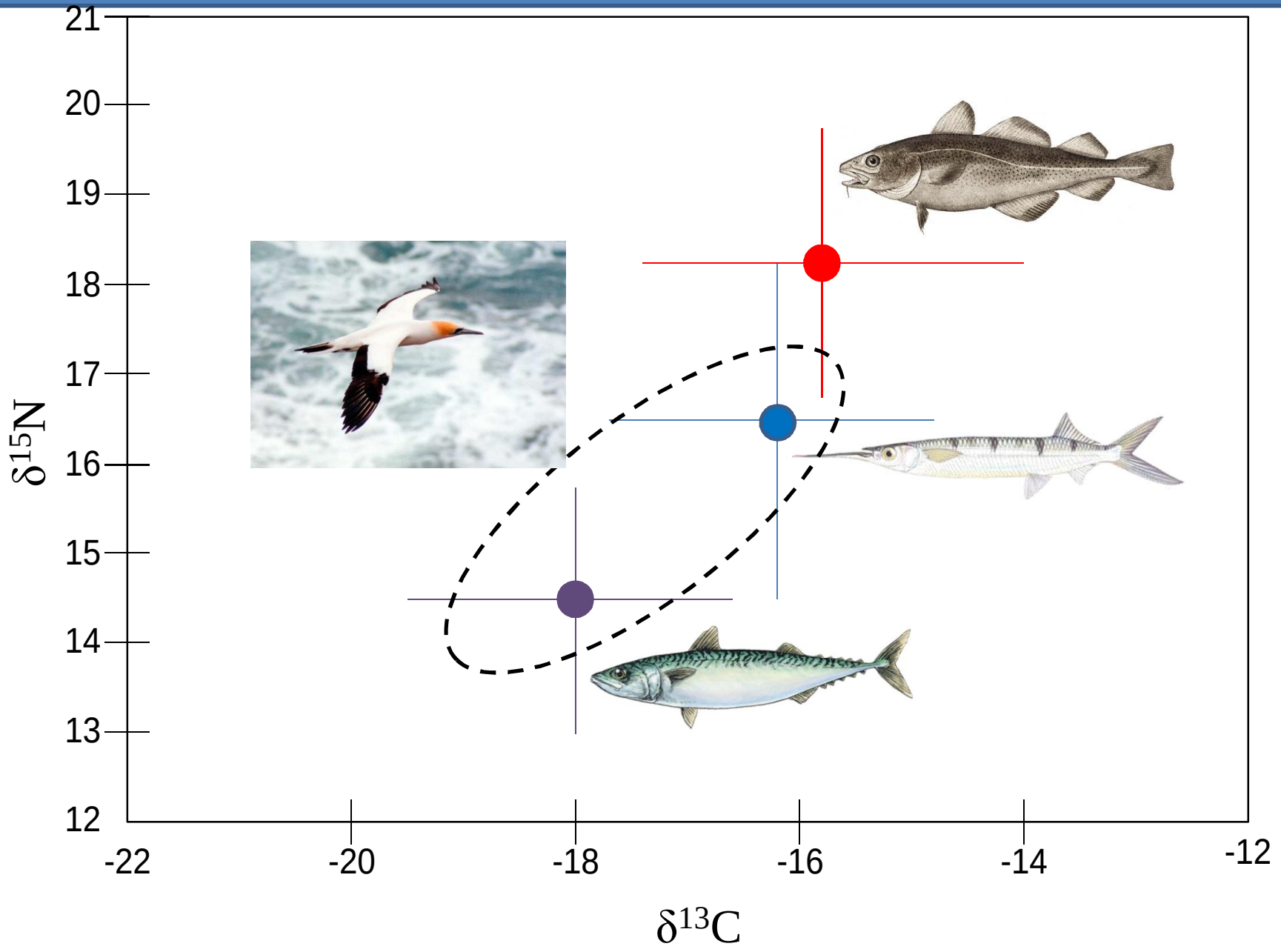


Case study: Gannets and Fisheries



Votier et al. 2010

Case study: Gannets and Fisheries



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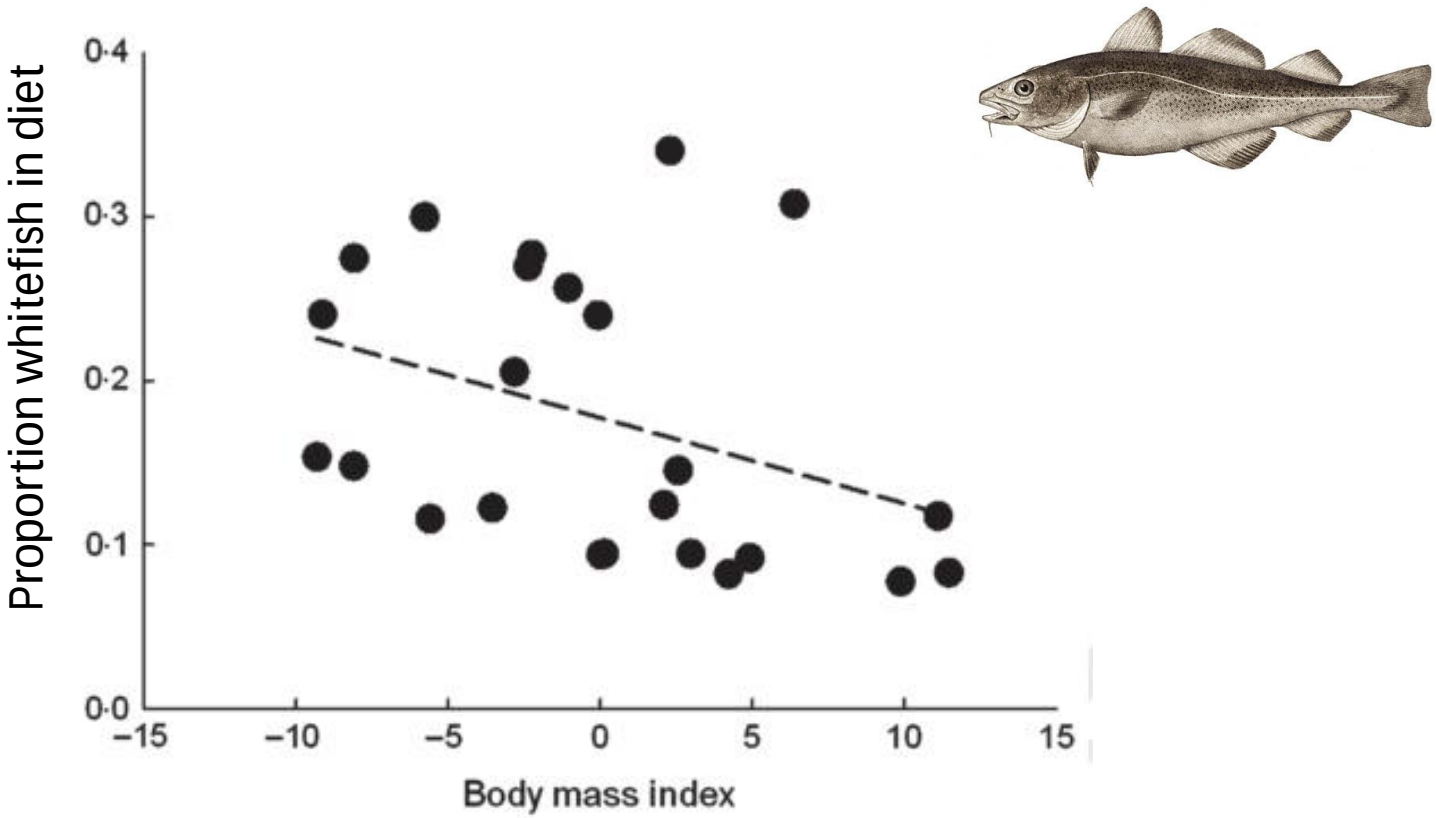
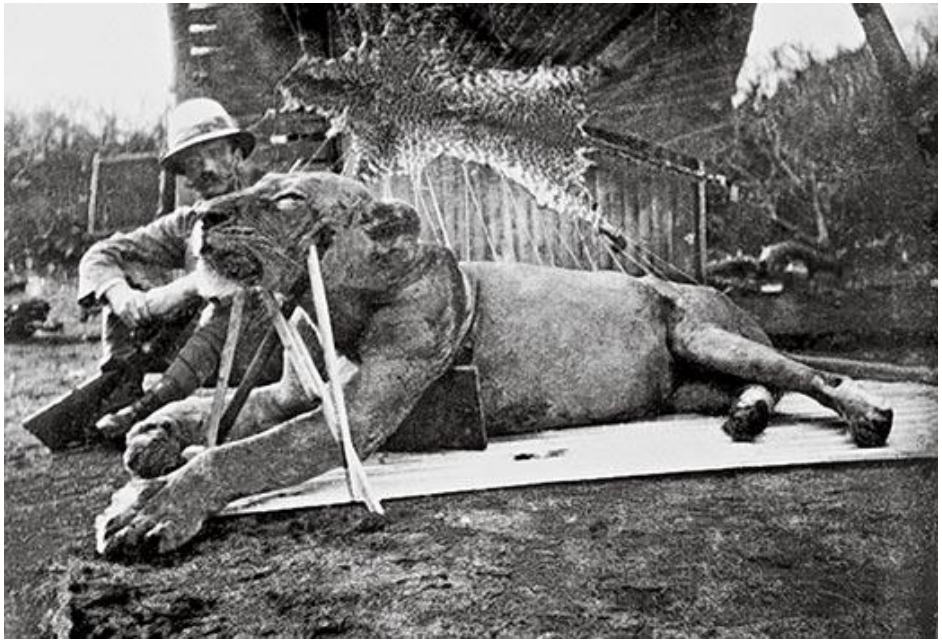
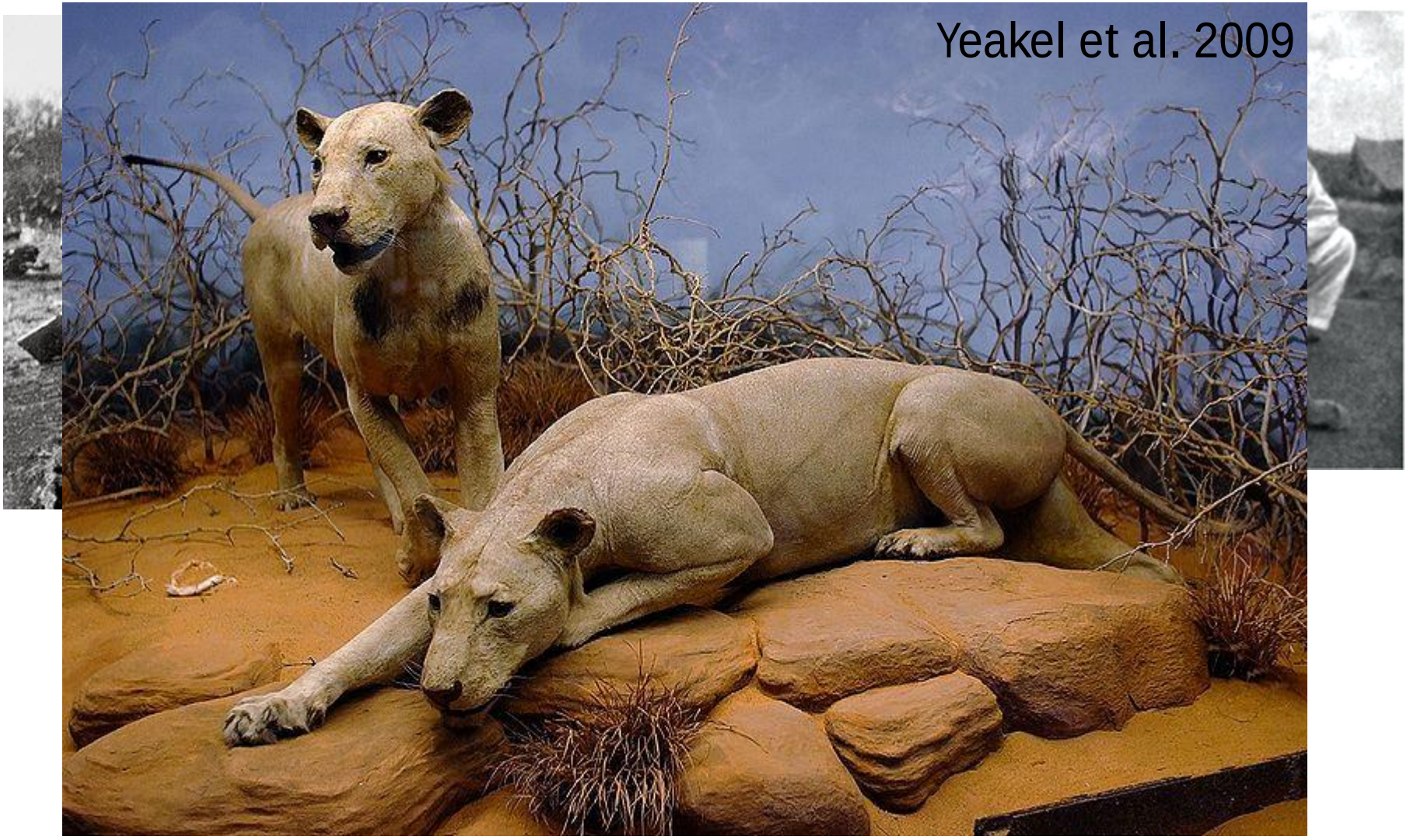


The man eaters of Tsavo



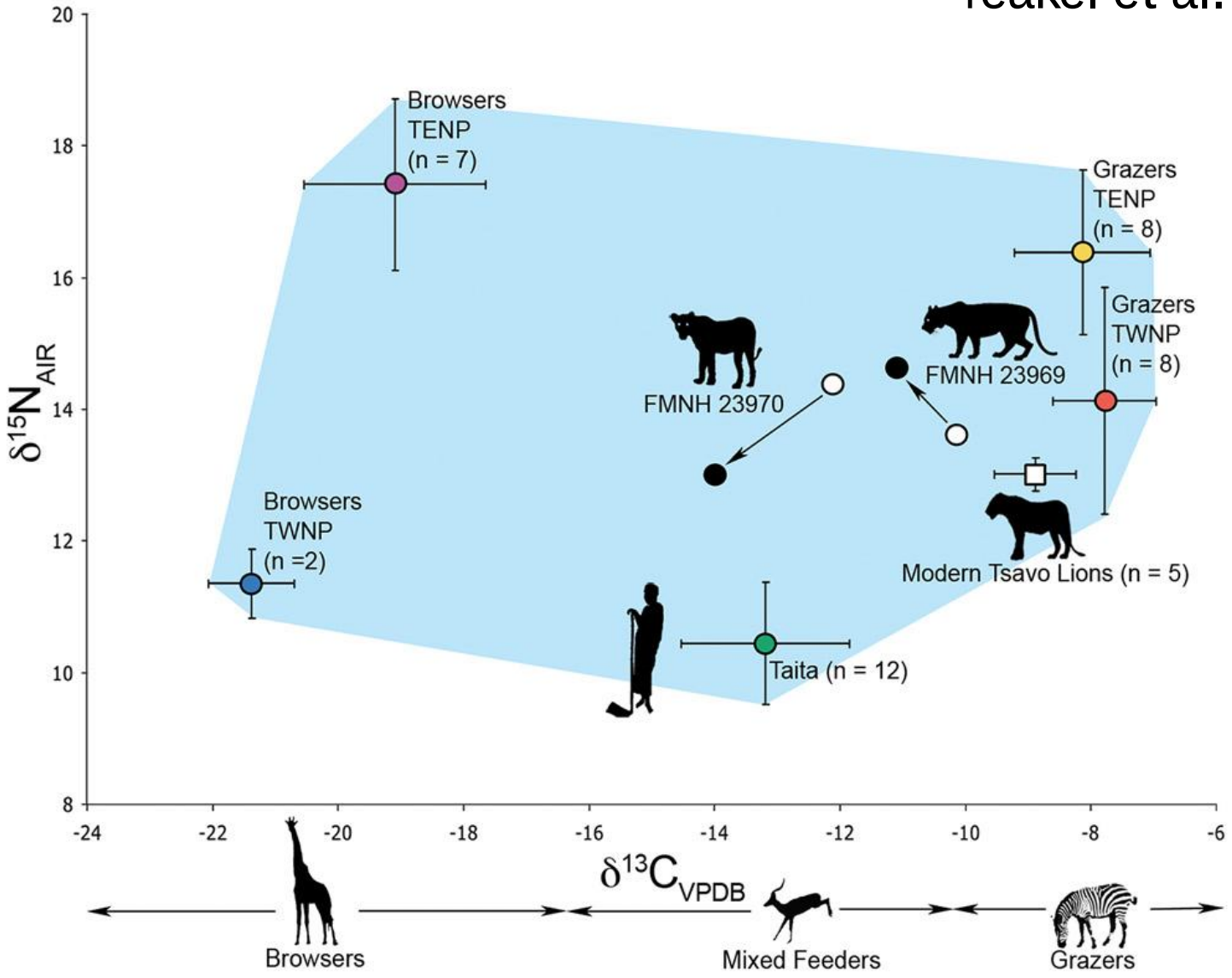
Two man eating lions killed 135 people

The man eaters of Tsavo



The man eaters of Tsavo

Yeakel et al. 2009



Using isotopes to infer movement

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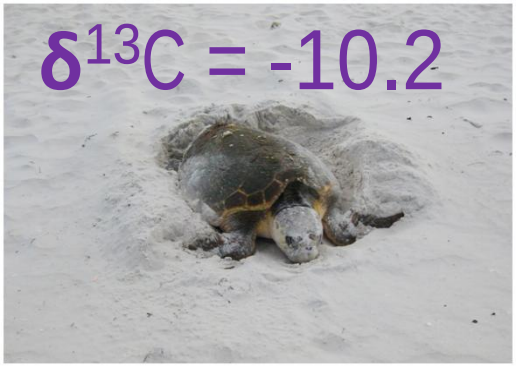
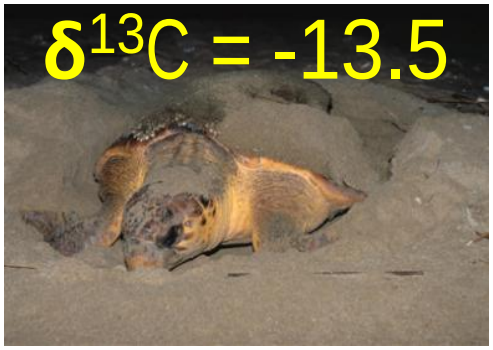
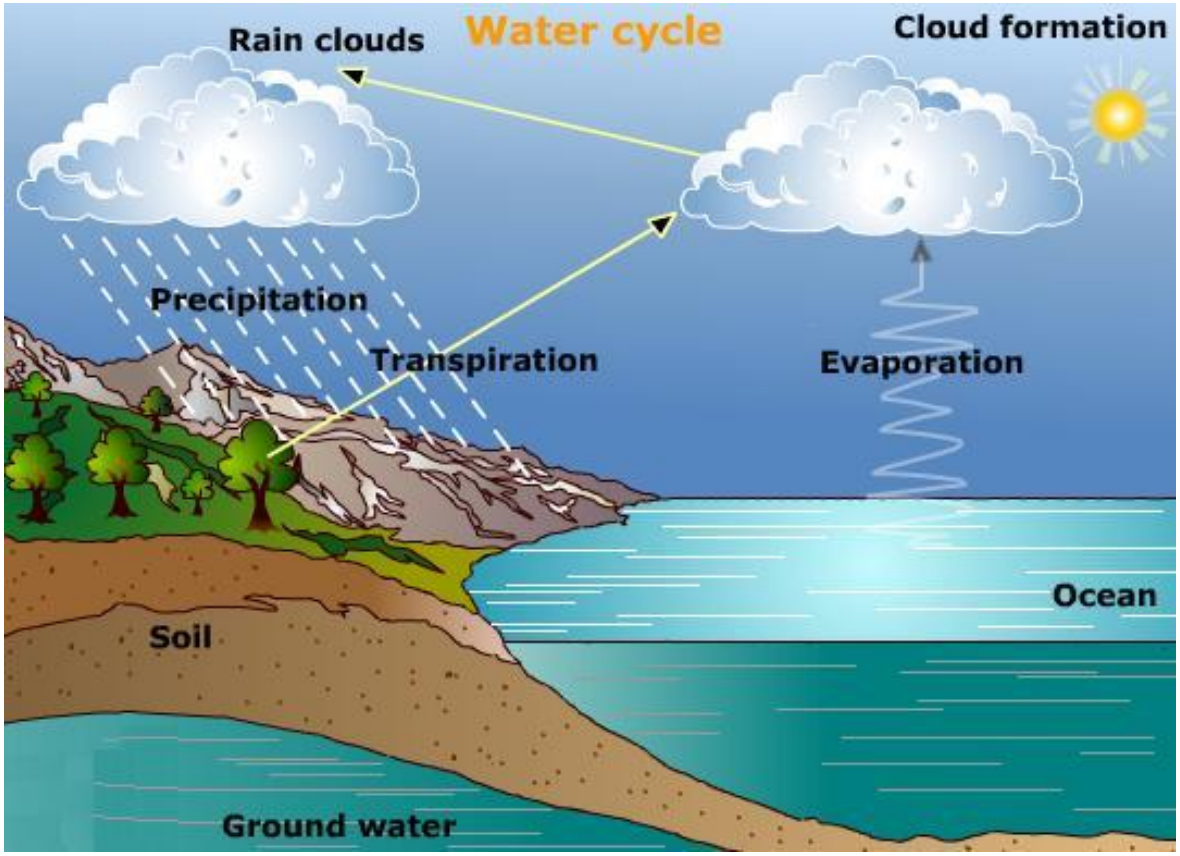
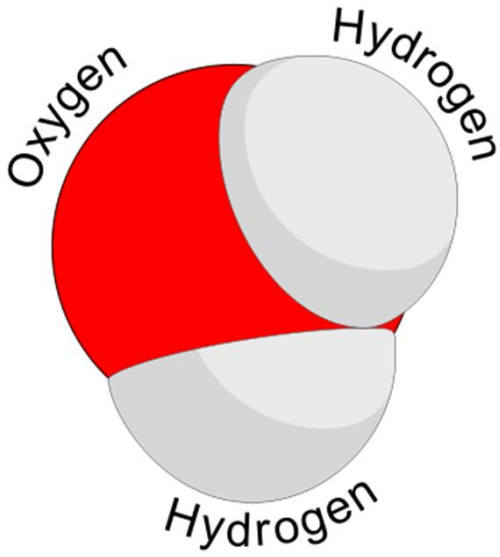


Vander zanden et al. 2010



Spatial variation in isotopes





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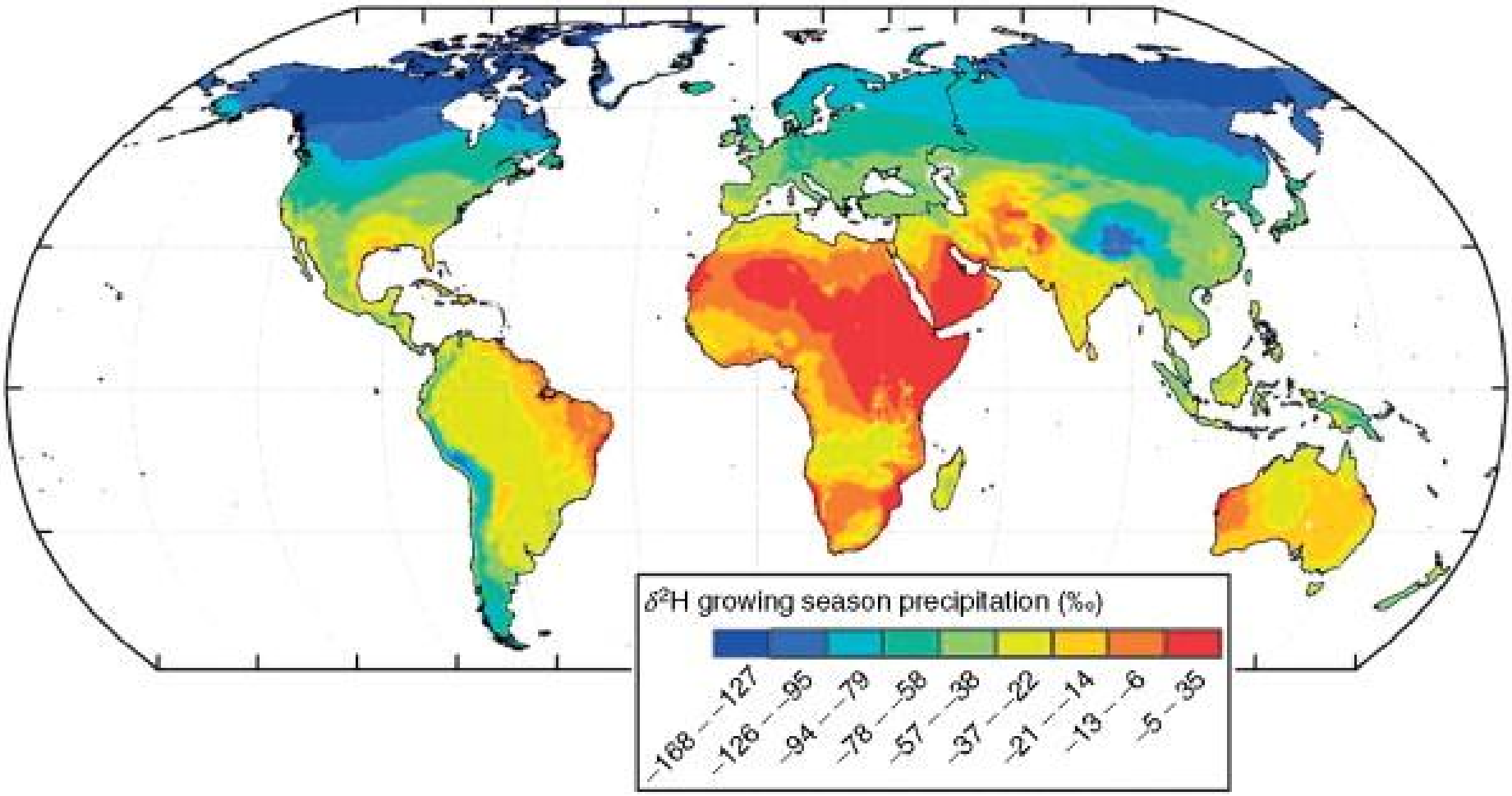

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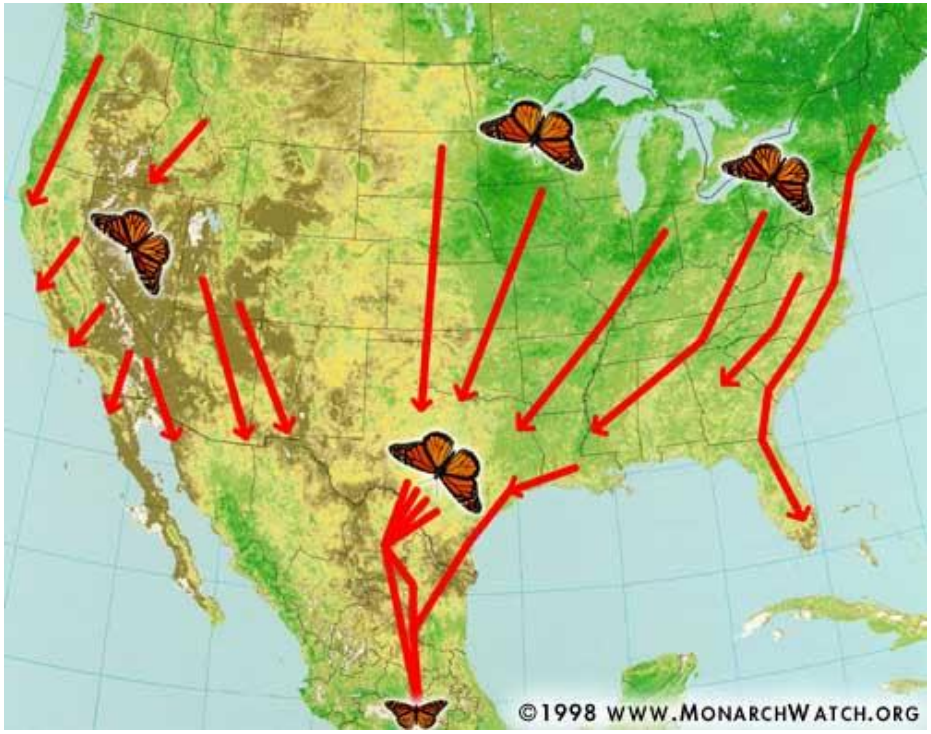
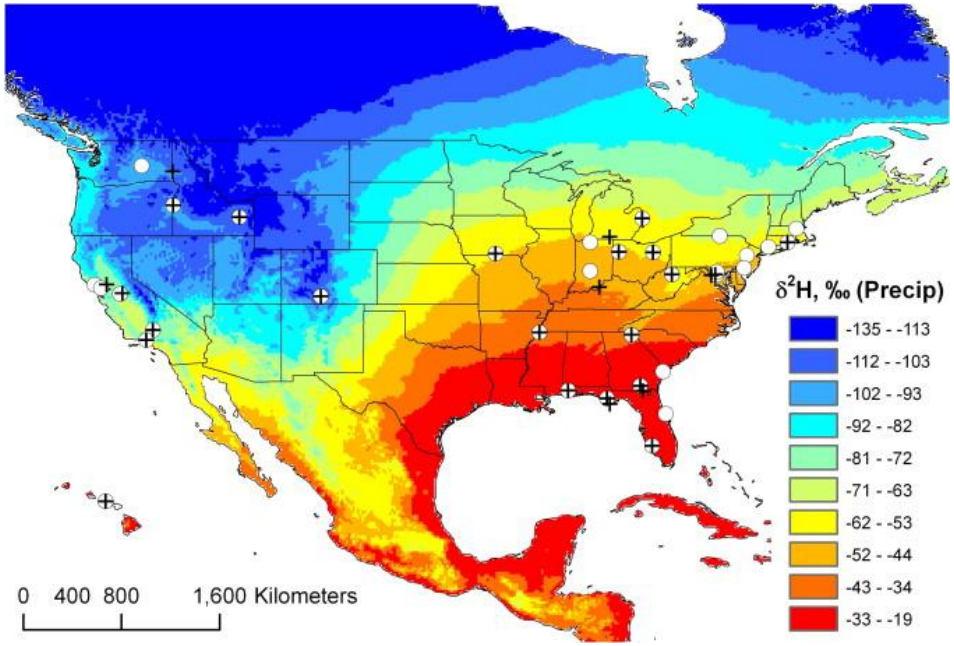
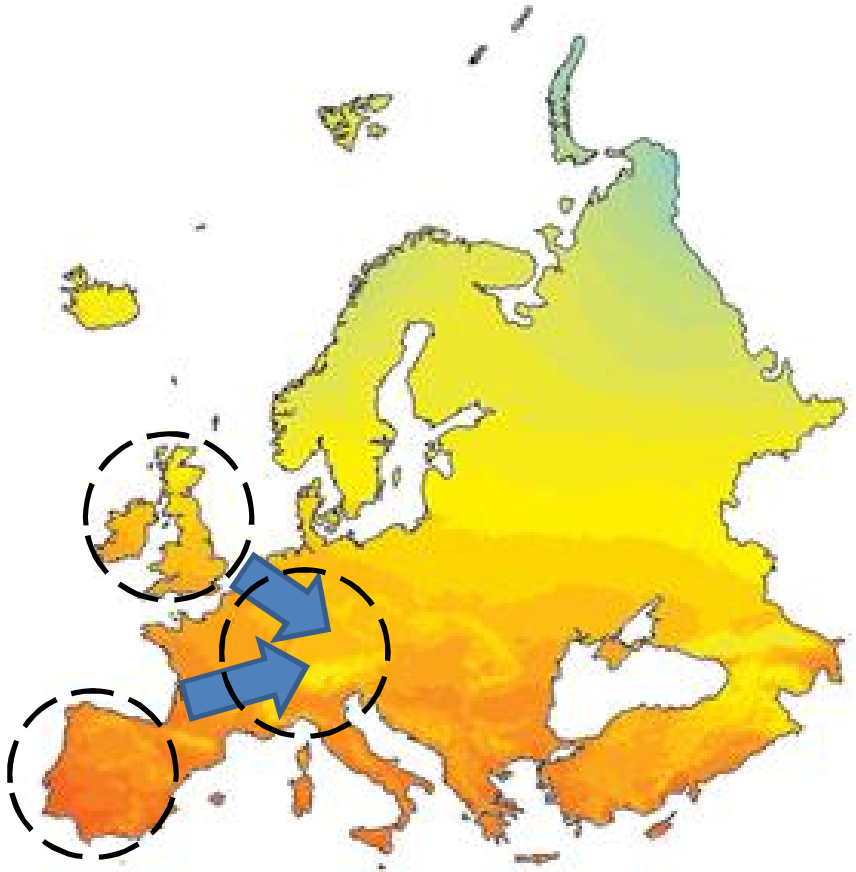




Wassanar and Hobson 1998

Spatial variation in isotopes

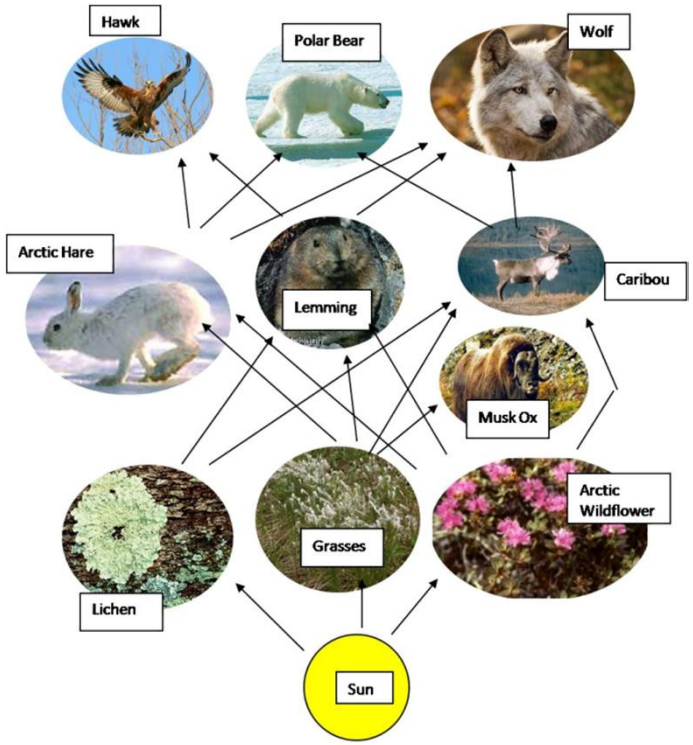


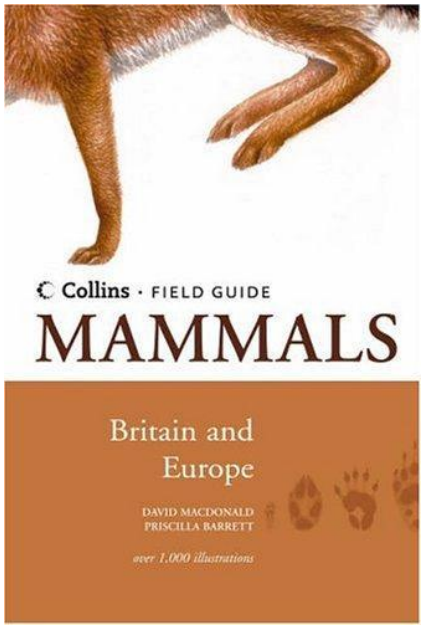
Bearhop et al. 2009

Individual foraging variation in badgers

FORAGING NICHE

Foraging niche – habitats and food sources utilised





Often measured at the population level – within population unimportant?

Why might niche use vary within populations?

Age – ‘Ontogenic niche shifts’

Sex – ‘Resource dimorphism’

Individual – ‘Individual specialisation’

Individual foraging specialisation

Individual foraging specialisation

Potentially important

Often ignored

Poorly understood

Why are badgers a good species to study niche variation?

Why are badgers a good species to study niche variation?

- Omnivores – very adaptable
- Diet varies between social groups
- Live in groups – forage alone
- Variable individual diets?
- Potentially important ecologically





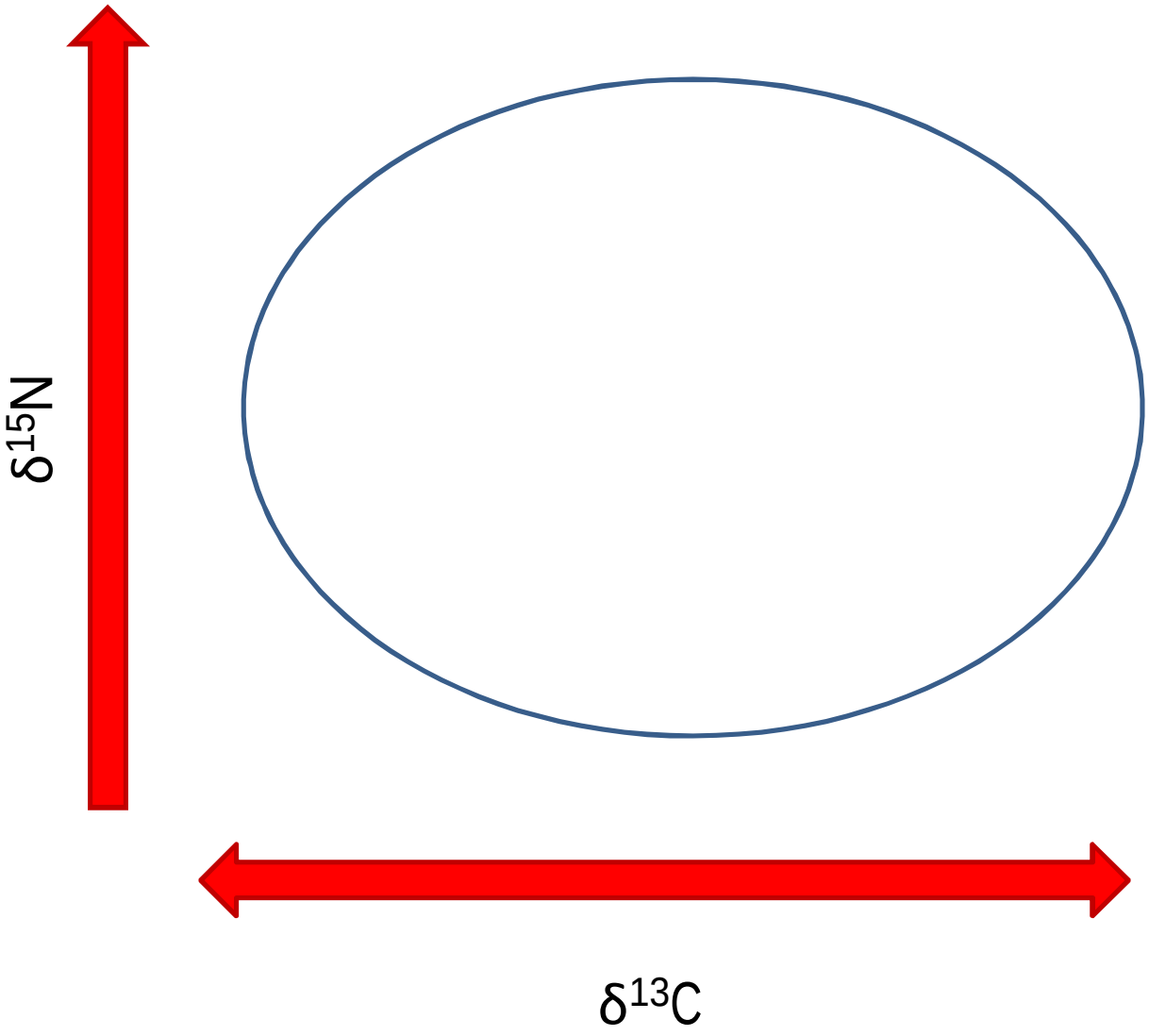




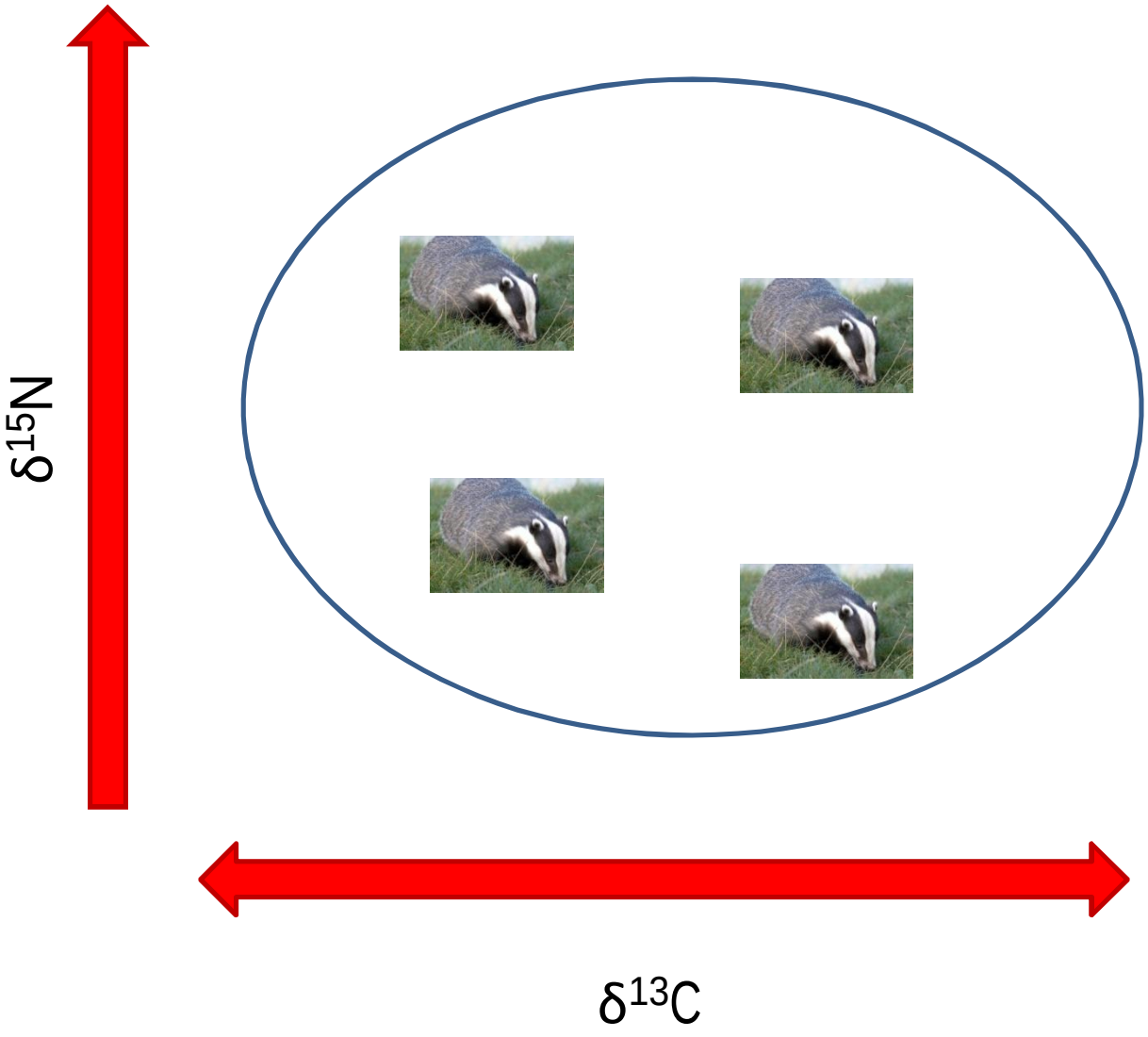
Why are badgers a good species to study niche variation?

- Omnivores – very adaptable
- Live in groups – forage alone
- Varies between social groups
- Variable individual diets?
- Potentially important ecologically
- Majority of studies at population level - Long term individual variation unexplored

The ‘isotopic niche’



The ‘isotopic niche’



Study site : Woodchester park, Gloucestershire, UK

Longterm study population

- ~200 individuals
- 20 social groups
- Territories mapped annually
- Trapped each season
- Individual life history data

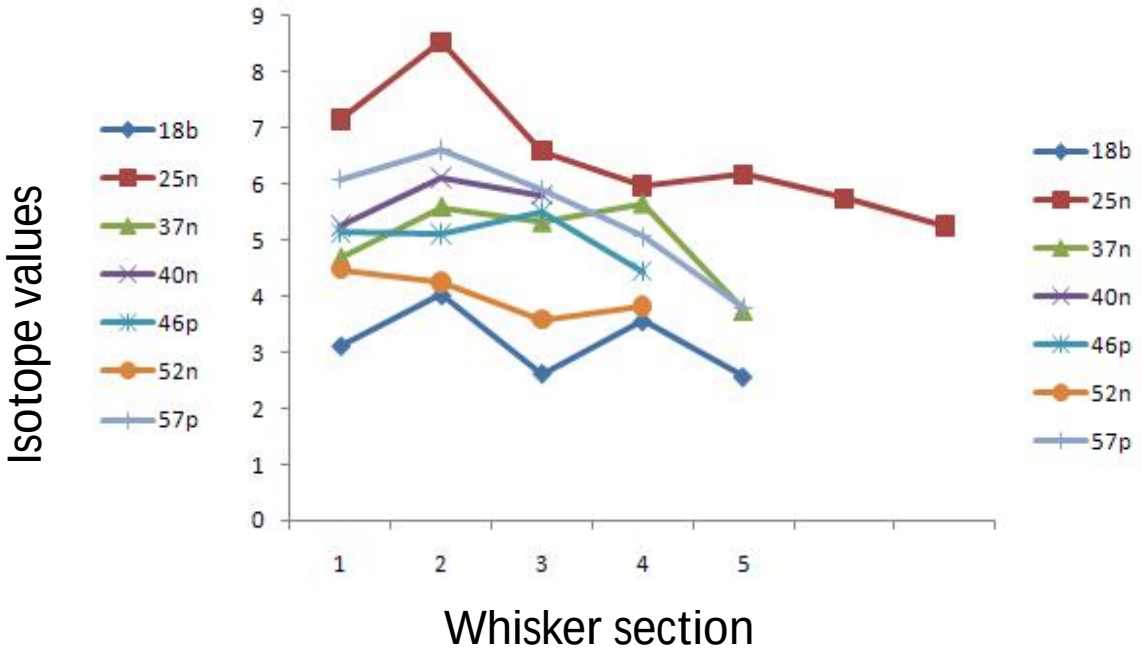
fera

The Food and Environment Research Agency

Whiskers – a long term diet tracer

Whisker sample

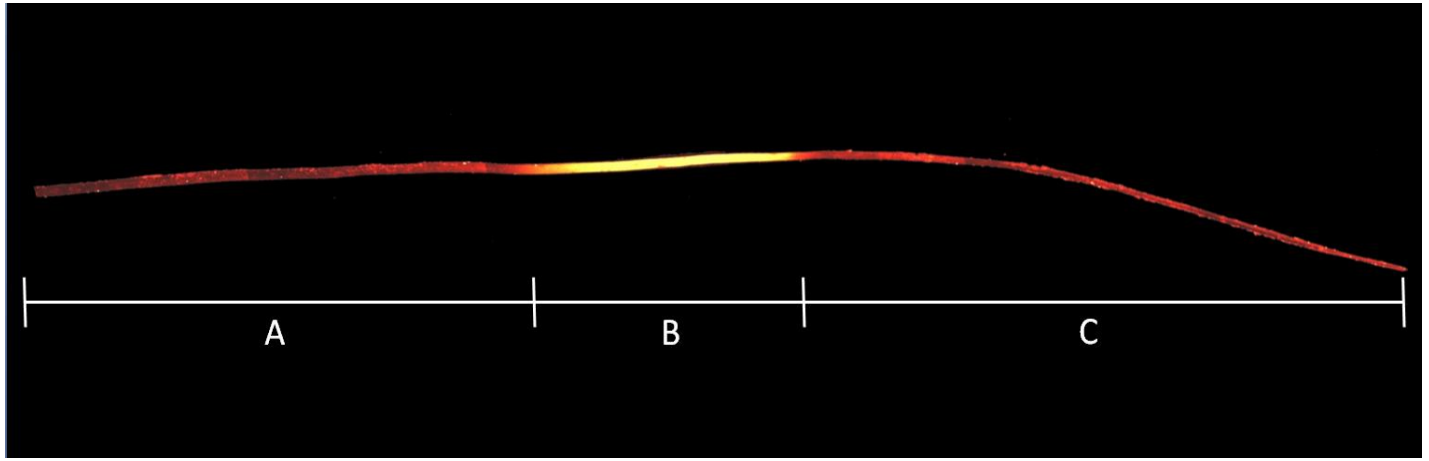
Mass spectrometry



Whiskers – a long term diet tracer

Whisker sample

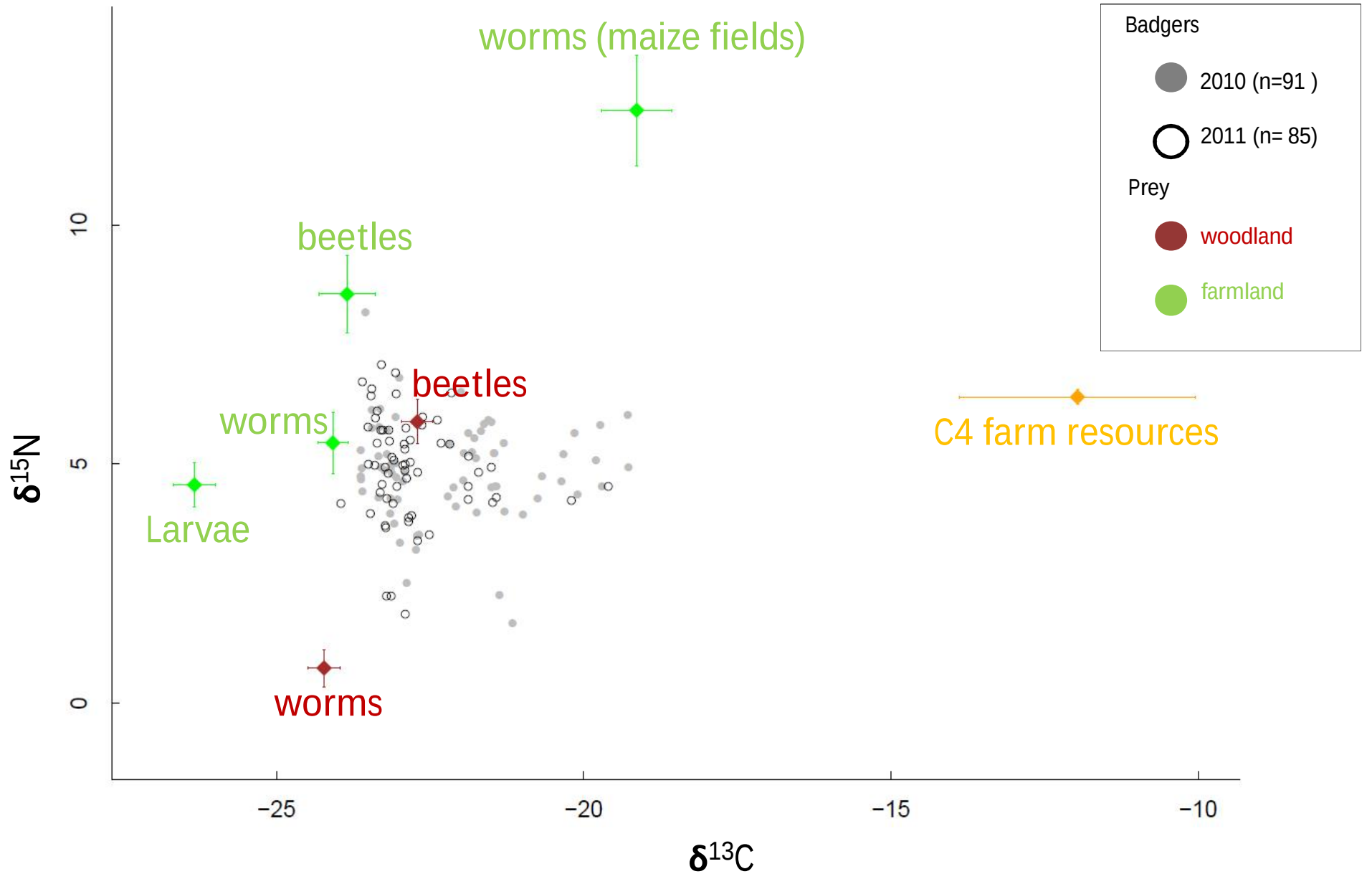
Mass spectrometry



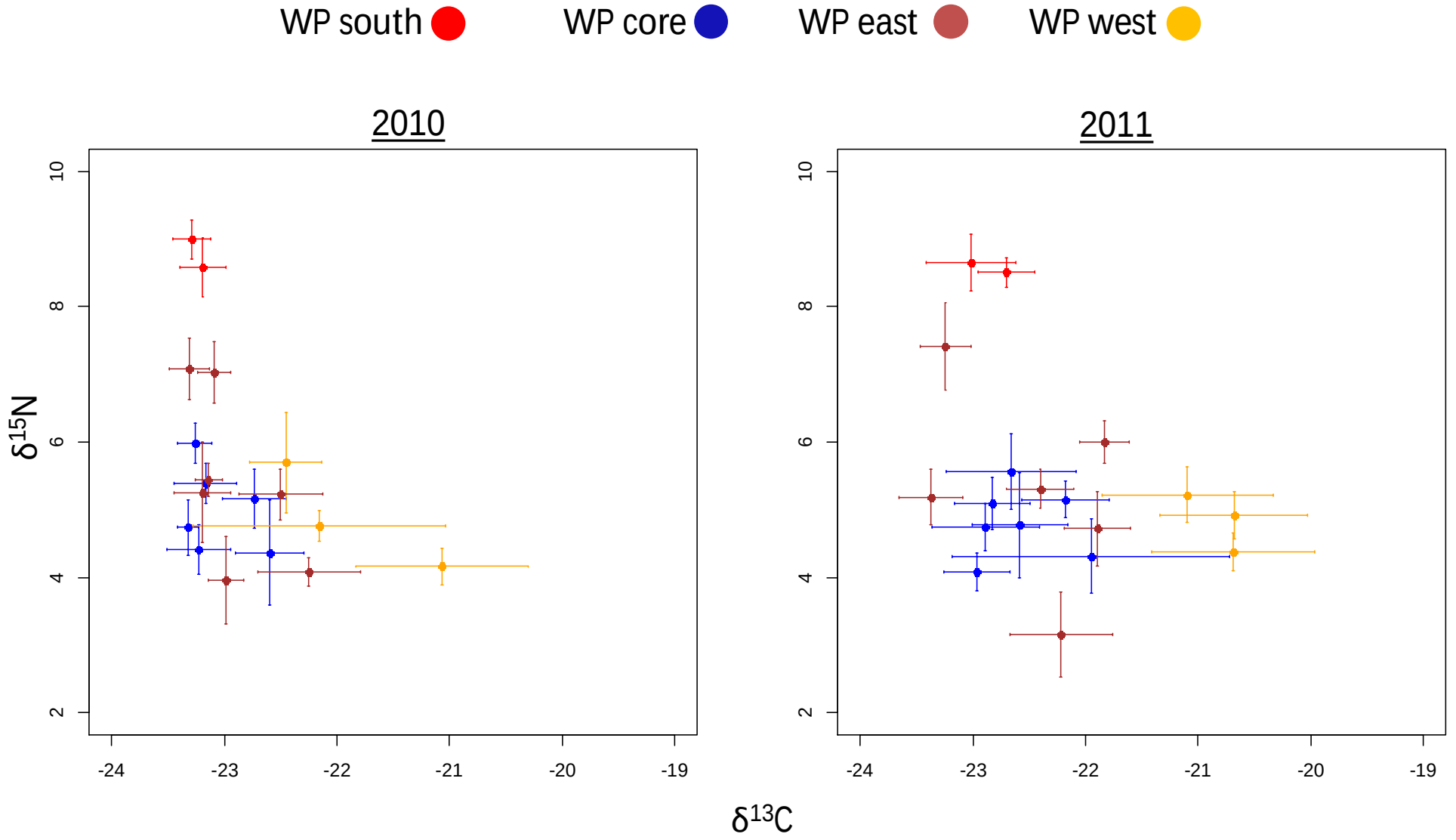
Time scale – on average ~100 days +

Q1 -Do individual badgers within social groups differ in their foraging niches?

Results Individual variation

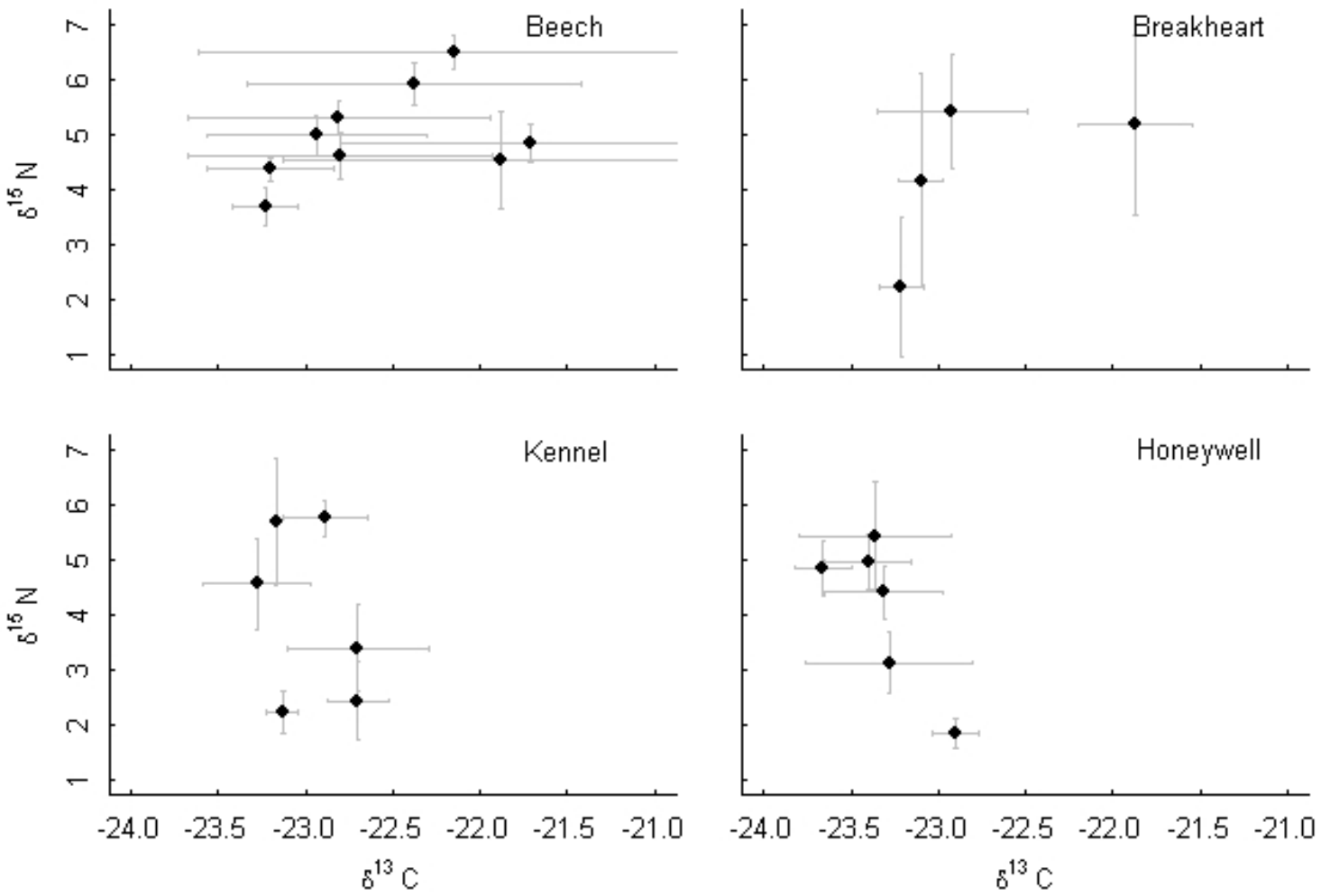


Social group variation



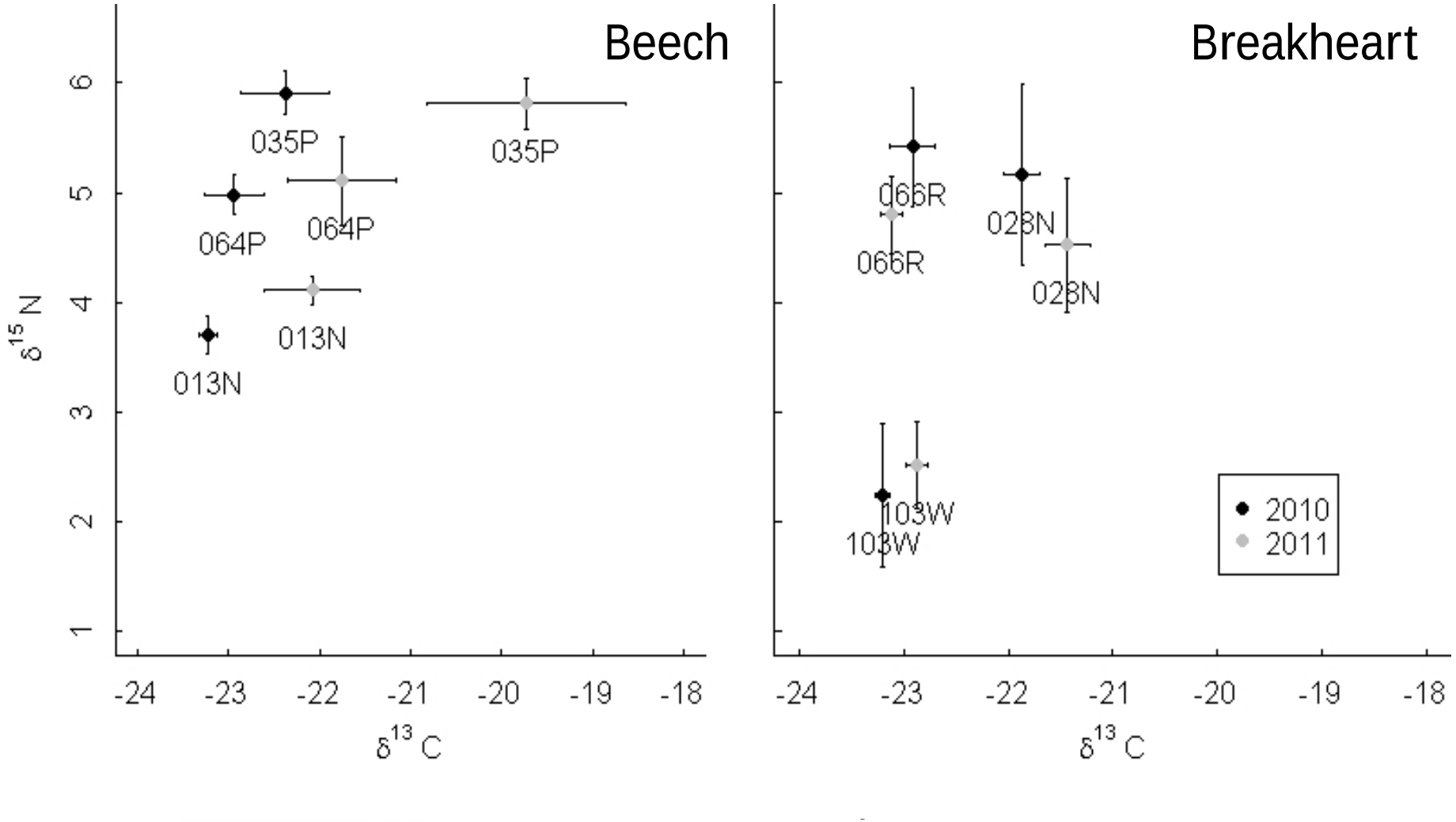
Social group mean $\delta^{15}N$ and $\delta^{13}C$ ± 95CI

Individual variation – within groups

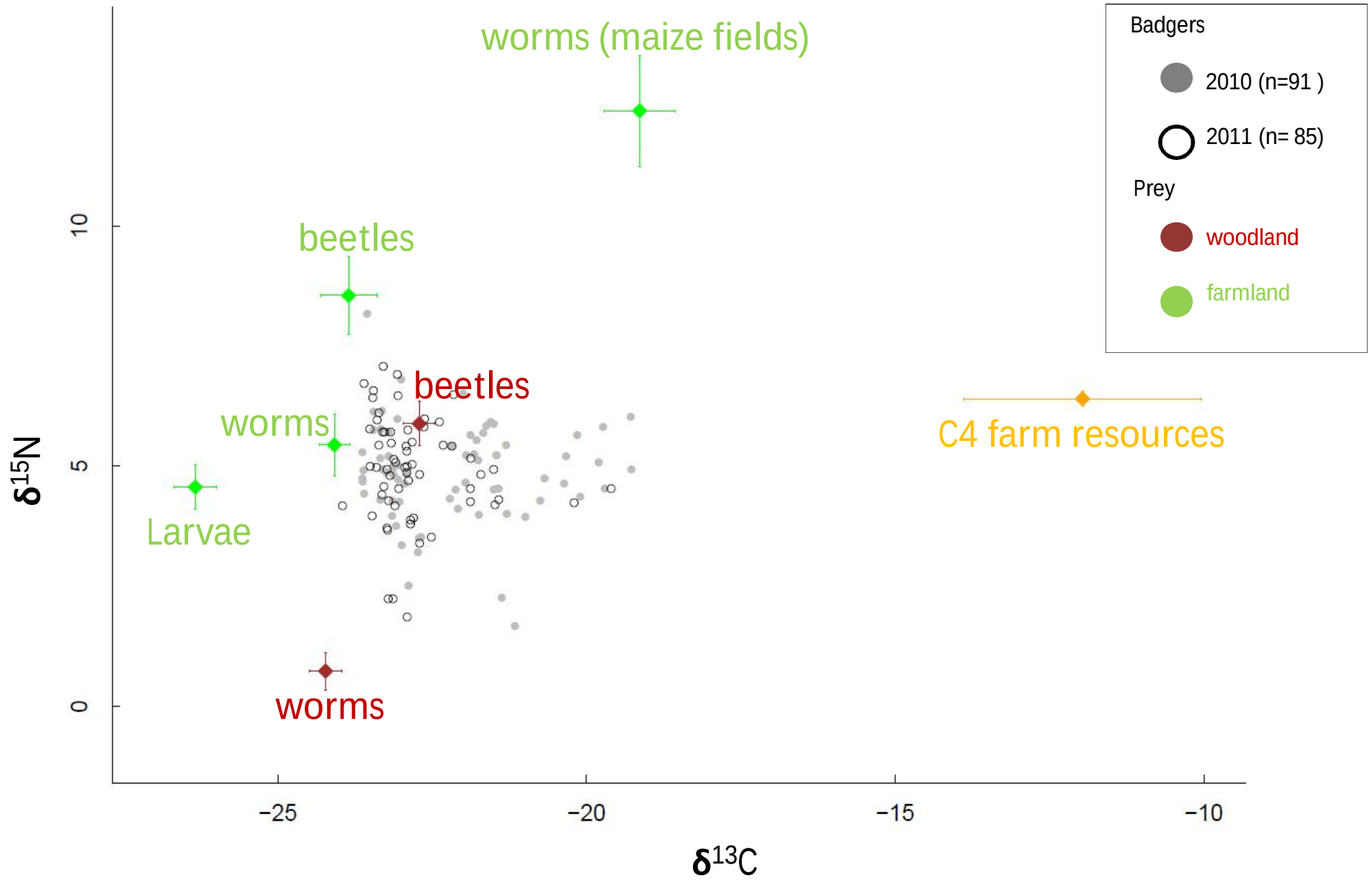


Social group mean $\delta^{15}N$ and $\delta^{13}C$ ± 95CI

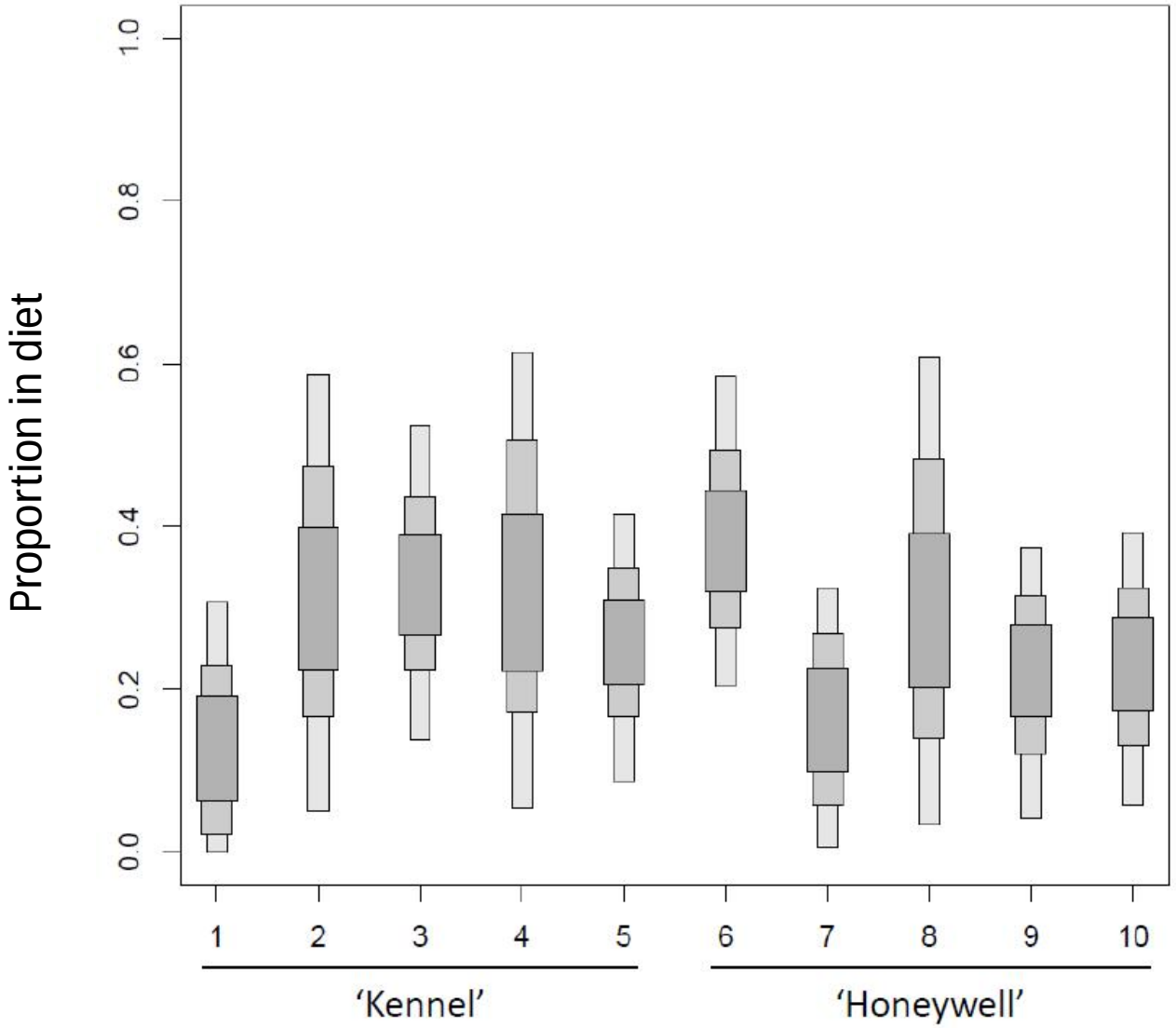
Consistent differences



What do these isotopic differences mean



Turning isotopic data into dietary data



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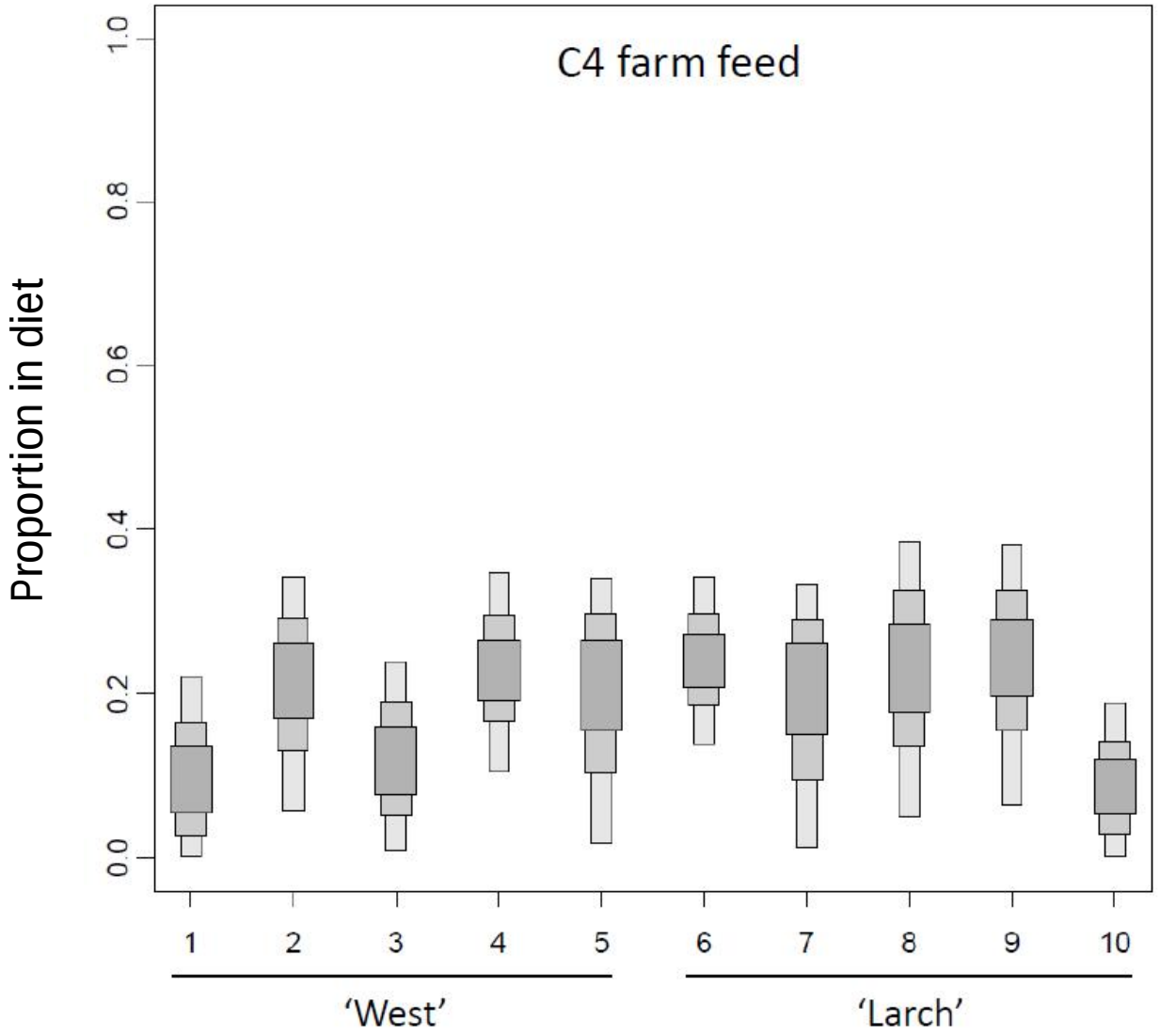
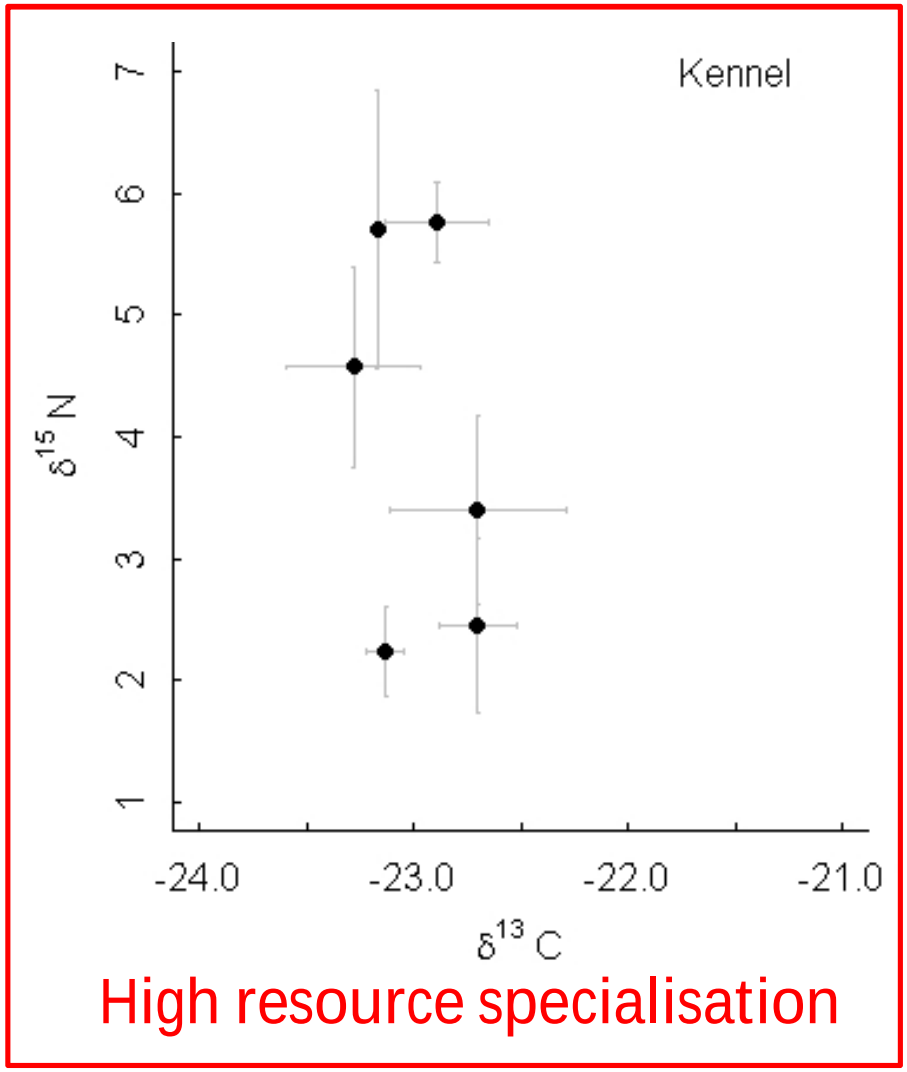
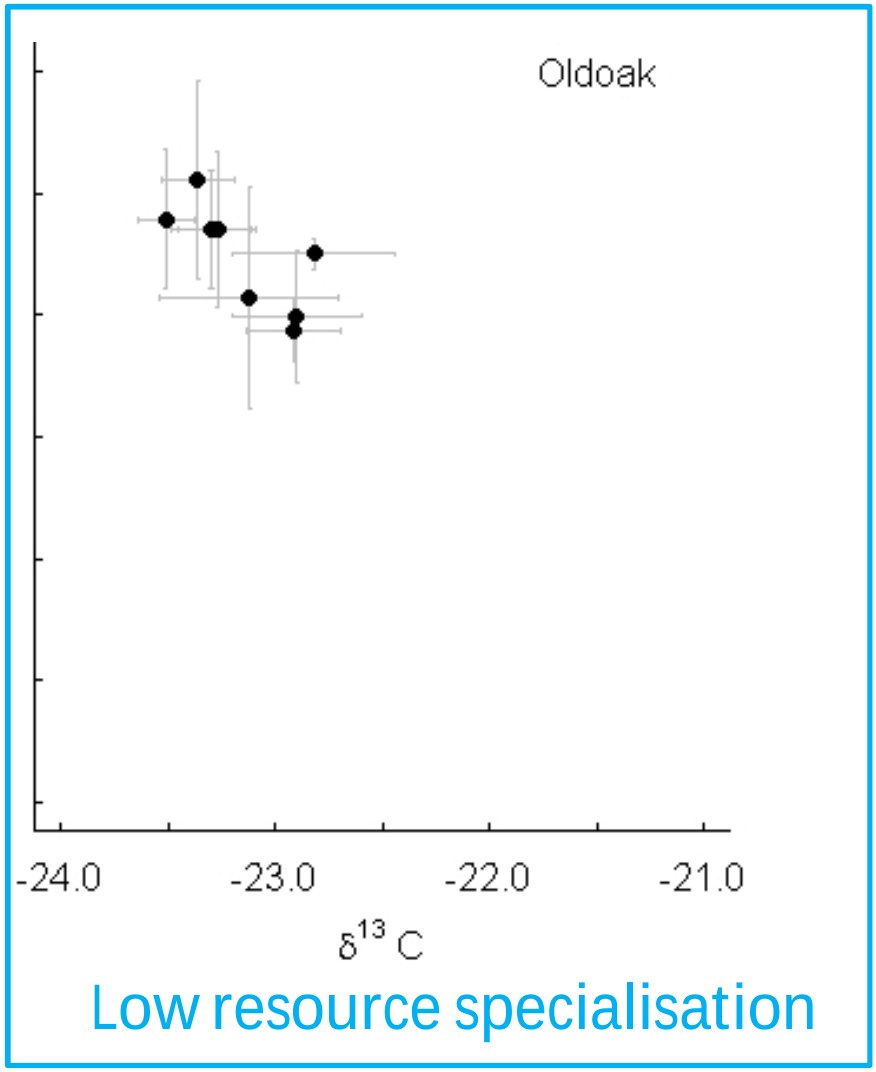


Q2 – Why do individuals use different resources?

Why specialise



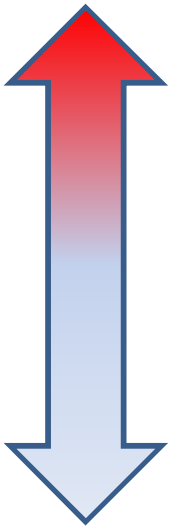
High resource specialisation



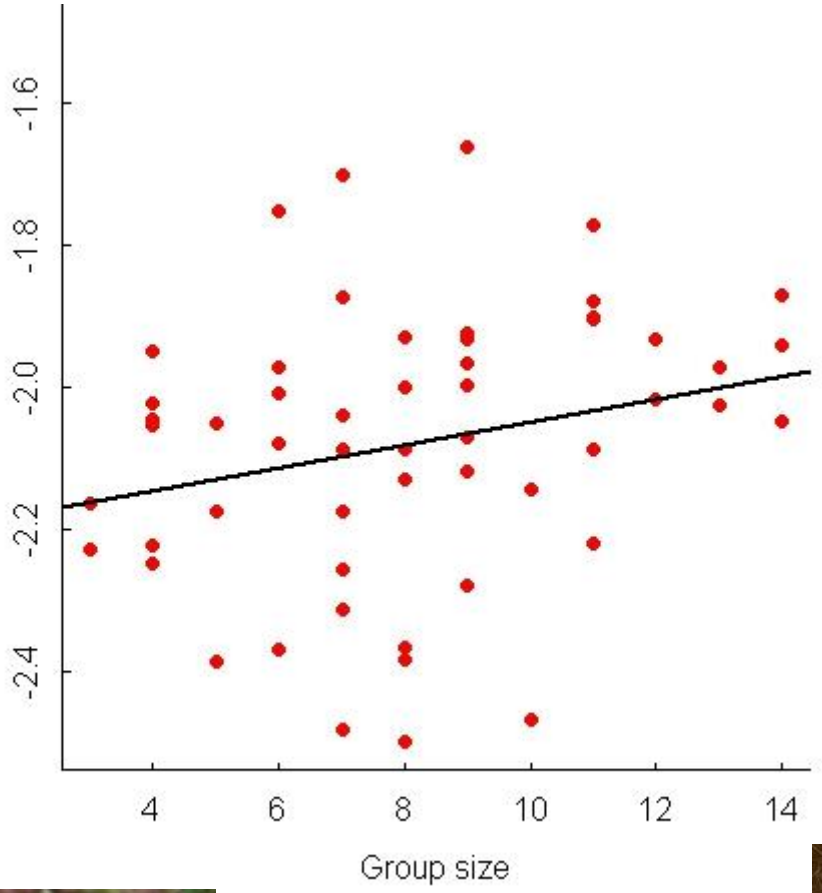
Low resource specialisation

Why specialise

High resource specialisation

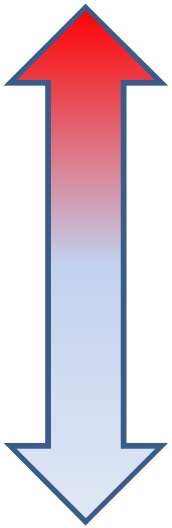


Low resource specialisation



Why specialise

High resource specialisation



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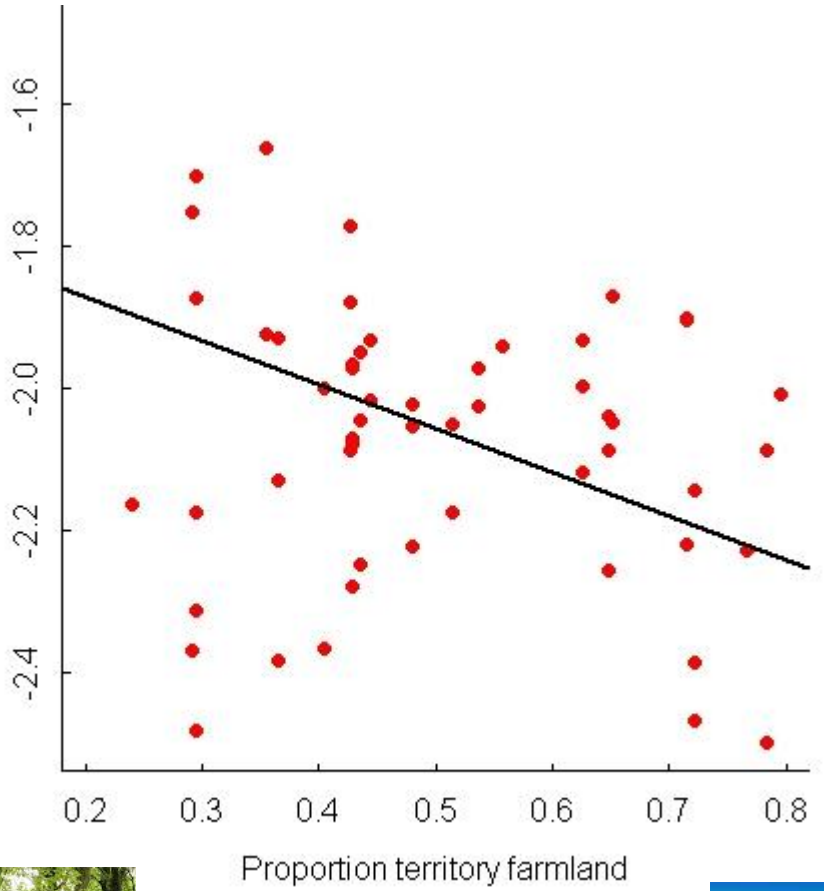

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