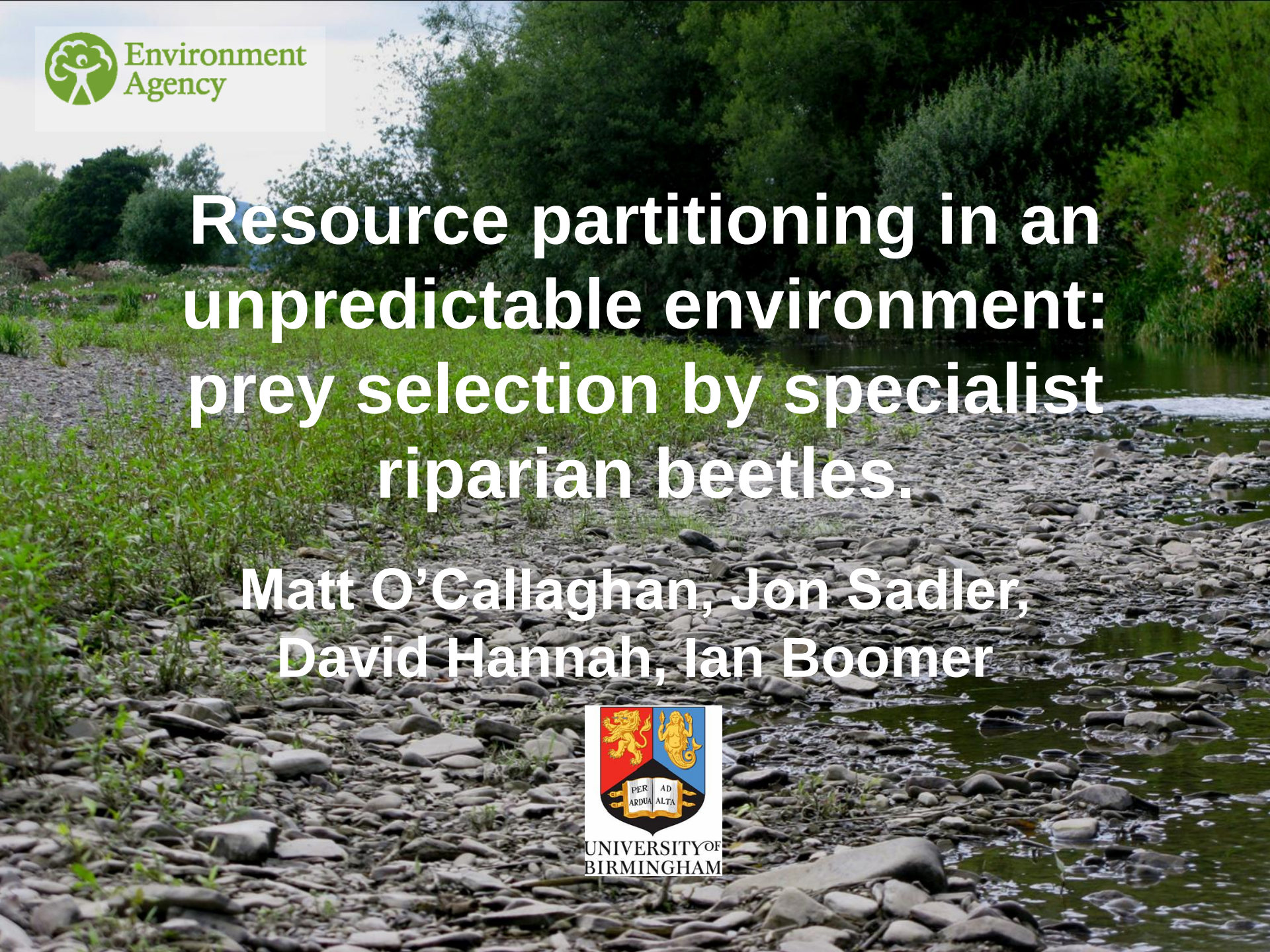

Environment Agency
Resource partitioning in an unpredictable environment: prey selection by specialist riparian beetles.
Matt O'Callaghan, Jon Sadler, David Hannah, Ian Boomer
PER ARDUA AD ALTA
UNIVERSITY OF BIRMINGHAM

Abiotic extremes

Inundation tolerance

Aquatic food sources

Morphology

Behaviour

Specialist invertebrates

4 April 2009 – 54cm

27 July 2009 – 128cm

Existing research

- Sadler & Bates 2008

  ERS is utilised by a large number of high affinity species, often with high levels of rarity.

- Paetzold et al 2005

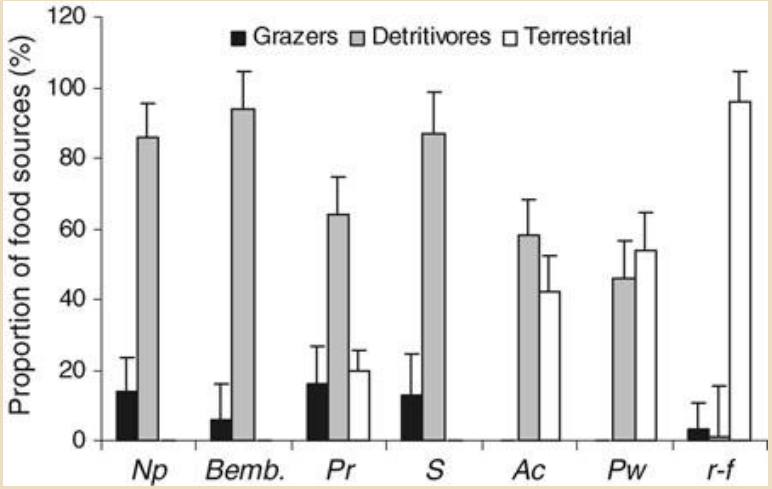
  On a large, braided river (Tagliamento), aquatic prey accounted for > 80% of prey items.

- Hering et al 2004

  Local population recovery following major flood events is species specific.

- Greenwood et al 2010

  Low flows suppress specialist abundances.



Paetzold et al 2005

How does this disturbed, nutrient poor resource support so many specialist species at relatively high abundances?

Hypotheses

- Strategies to avoid/survive inundation pressures will cause species-specific variations in prey selection.
- Variations in inundation risk at patch scale will cause within-species switches to alternative food sources.

Stable Isotopes to indicate nutrient sources

- Naturally occurring heavier isotopic forms ($\delta^{13}C$ and $\delta^{15}N$) can be used to trace nutrient pathways (proportions vary spatially, temporally and between ecosystems).

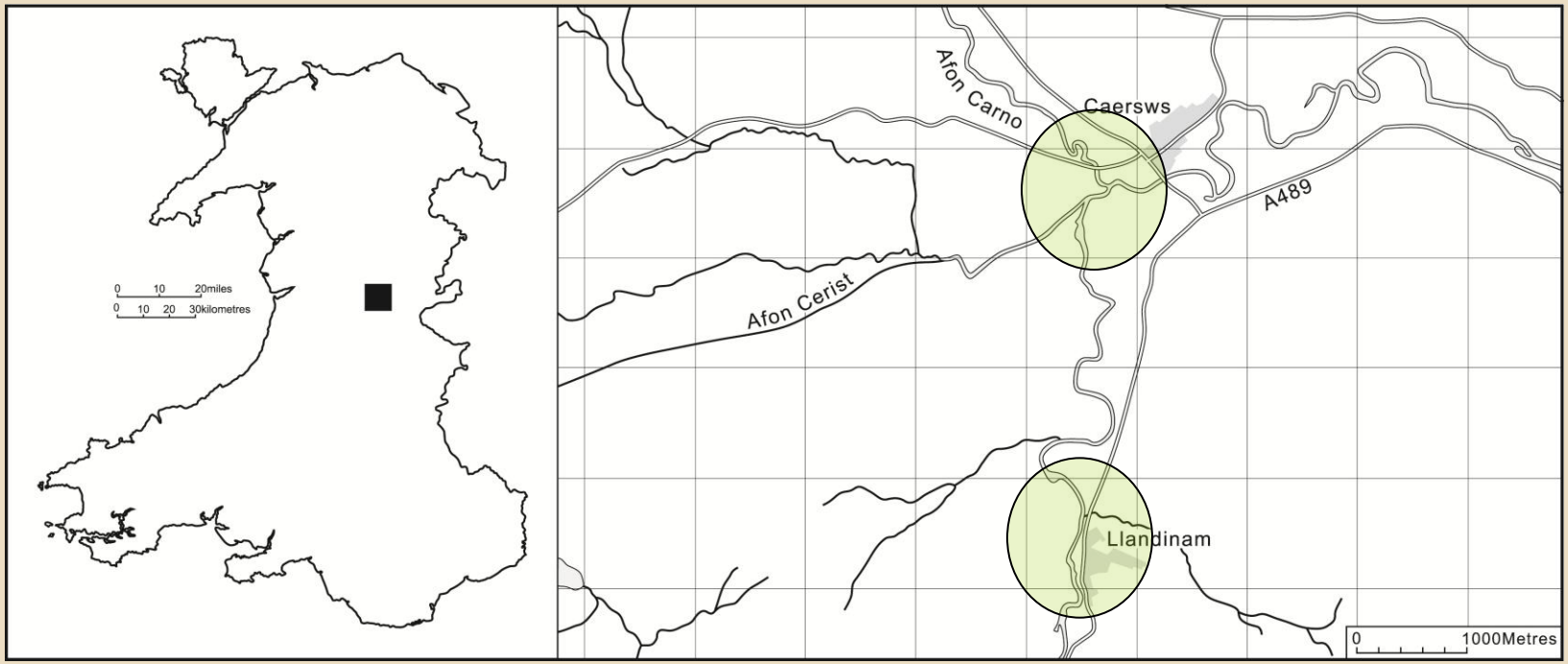
- Lighter, more abundant forms preferentially metabolised and excreted, consumers are more enriched than prey

- Enrichment occurs at a predictable level, the Trophic Enrichment Factor (TEF)

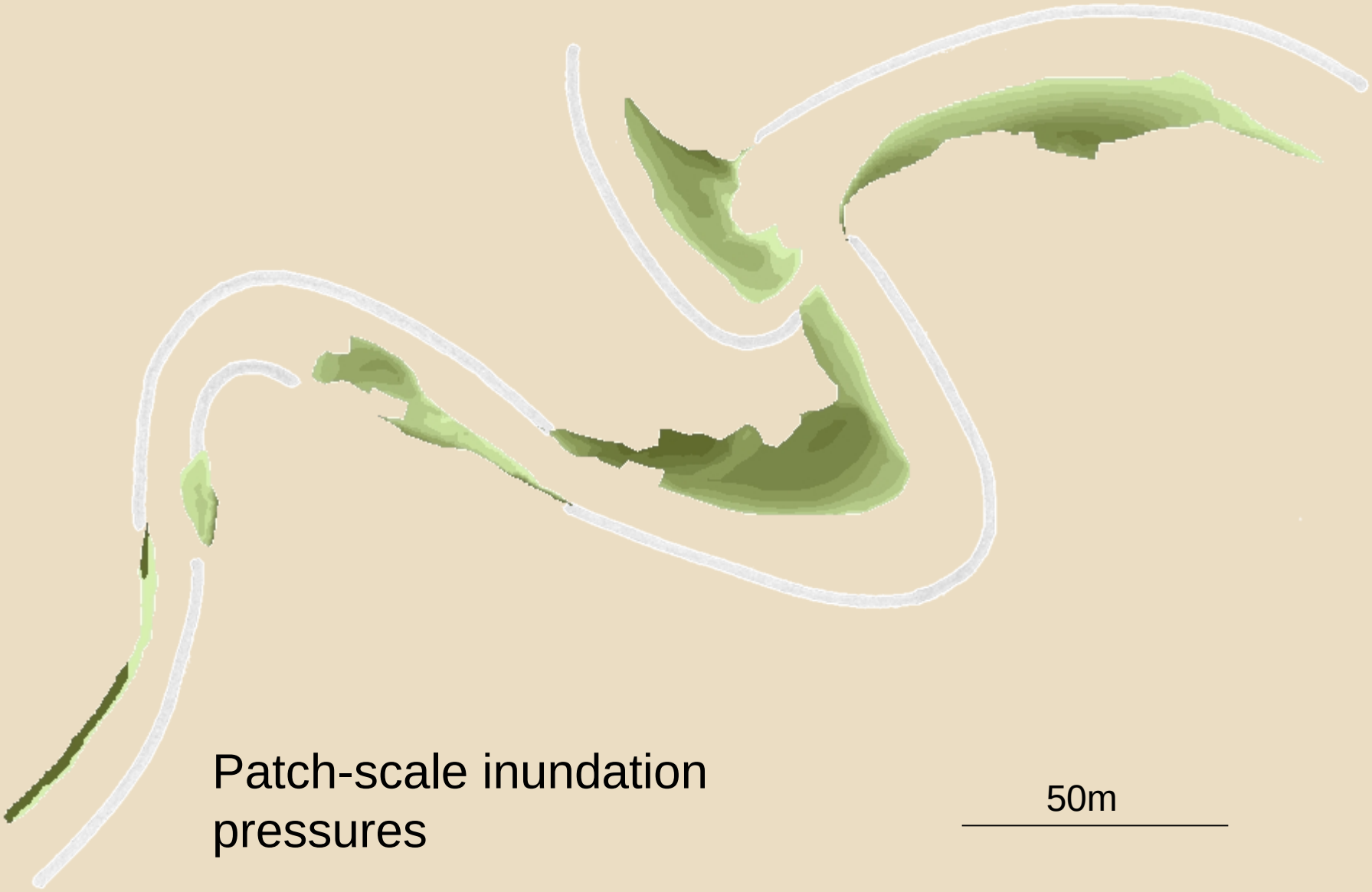
- Arthropods: $\delta^{15}N = 2.3 \pm 0.16$ ‰
  $\delta^{13}C = 0.5 \pm 0.13$ ‰

(McCutchan et al 2003)

Study area
River Severn, mid-Wales, UK



Base flow



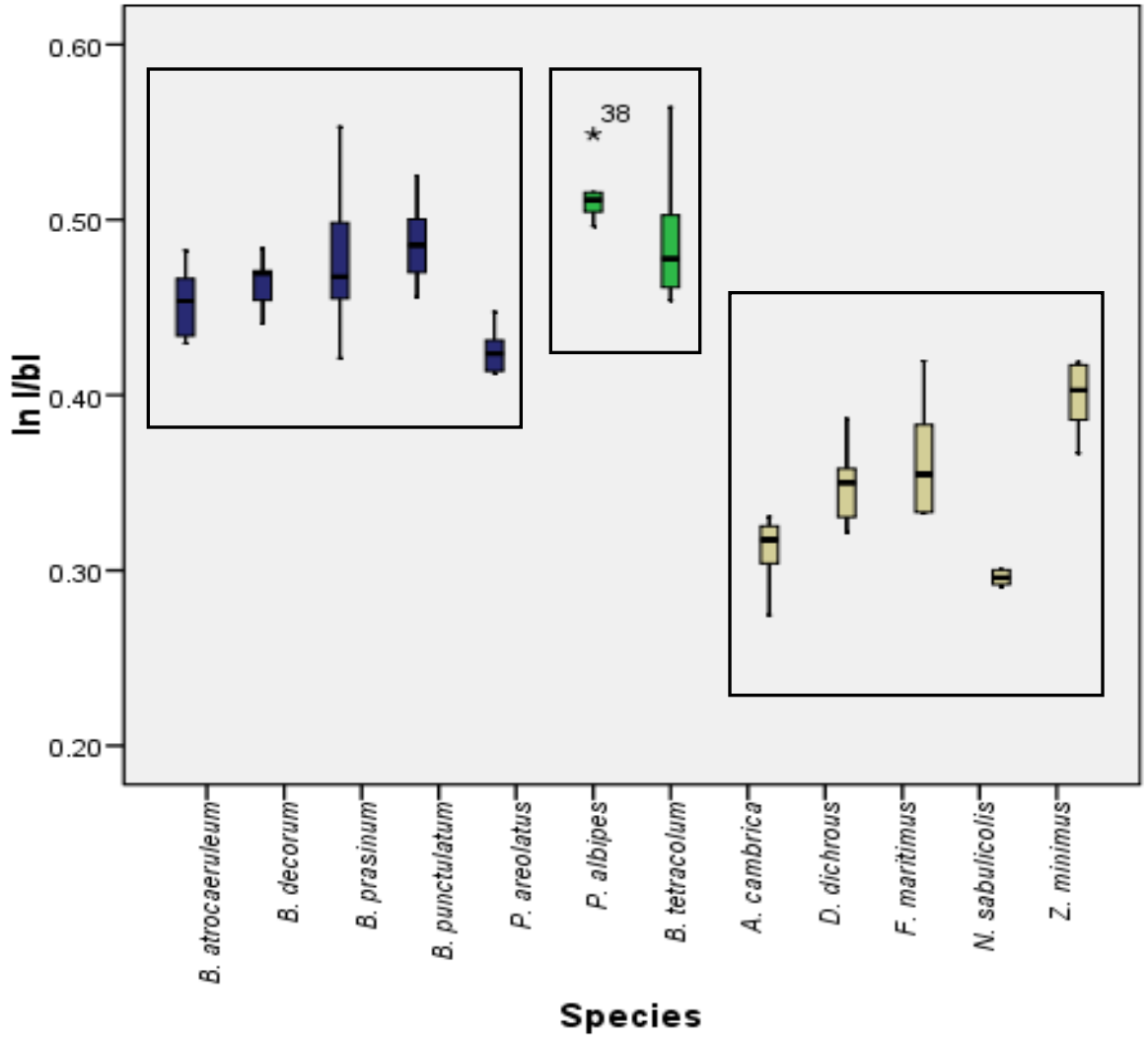
Patch-scale inundation pressures

50m

40cm
50m

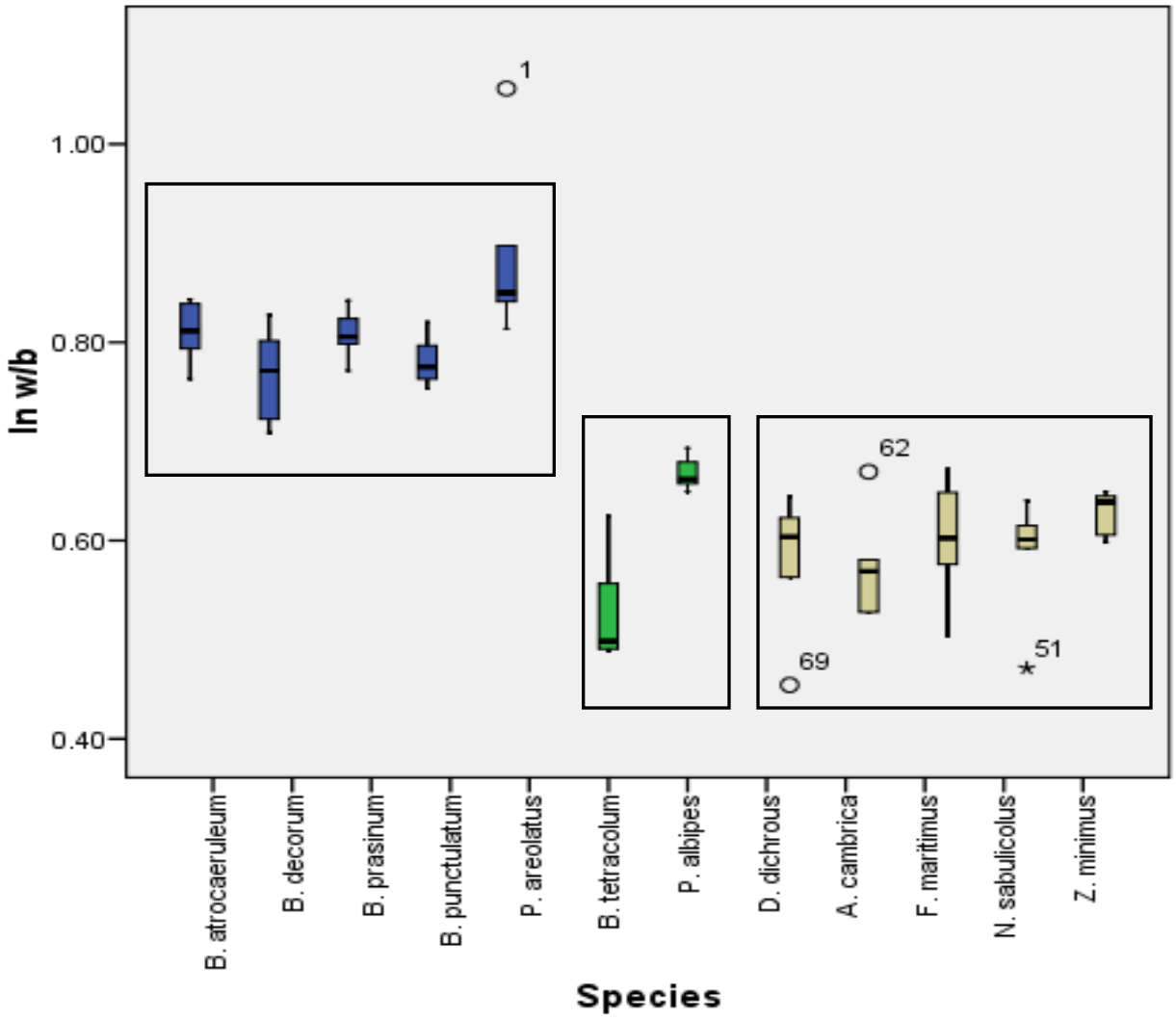
1m
50m

Identifying functionality by morphology.



Leg:body

P < 0.01



Wing:body

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Combining morphology, GLM and correlations

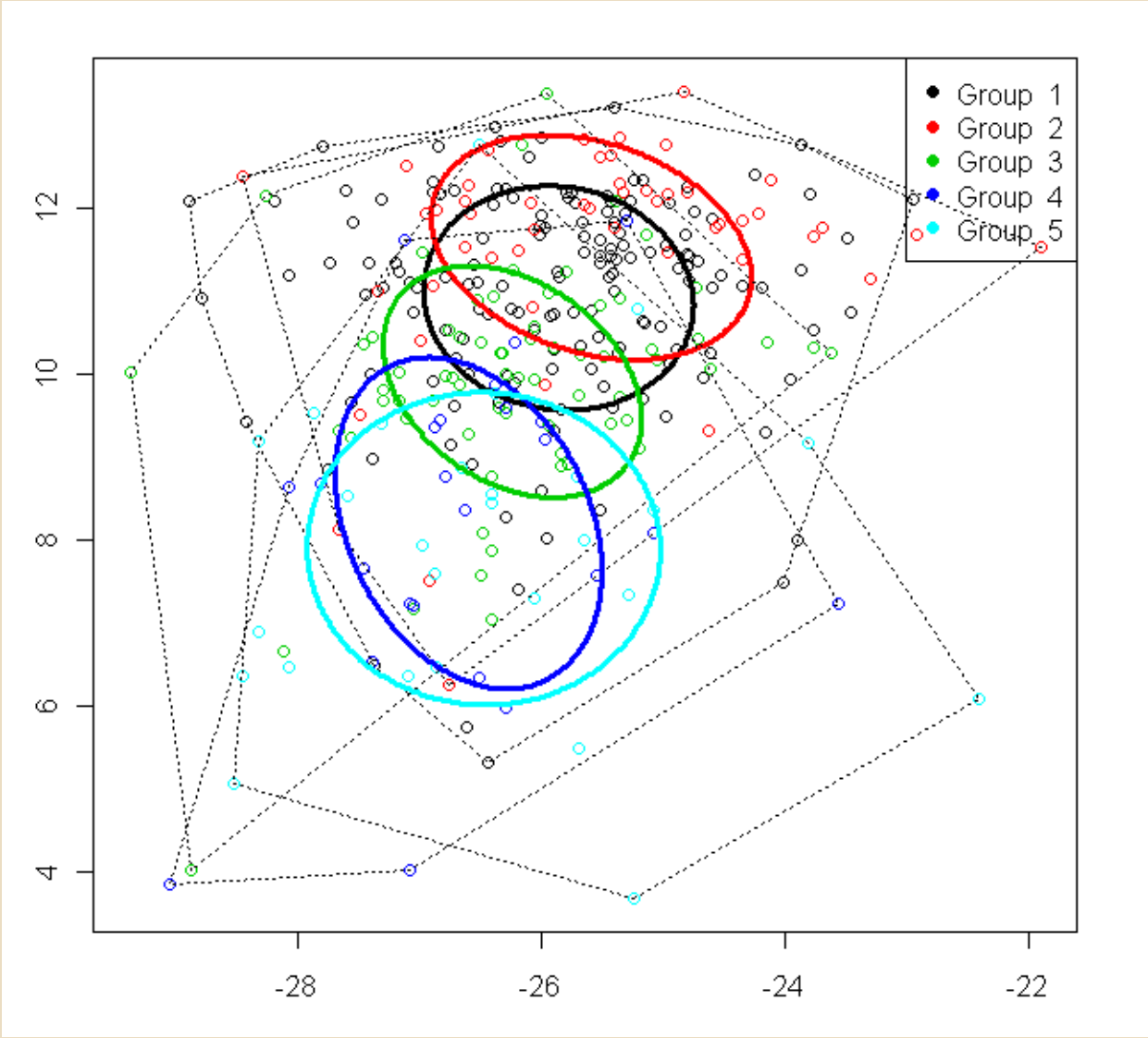
	Summary	Species
Group1	Specialist ground beetles, headwater	*Bembidion atrocaeruleum, Bembidion decorum*
Group 2	Specialist ground beetles, floodplain	*Bembidion punctulatum*
Group 3	Low affinity ground beetles	*Bembidion tetracolum* *Paranchus albipes*
Group 4	In-land ground beetles	All other species
Group 5	Specialist non-ground beetles	*Stenus* sp *Coccinella 5-punctata*

Isotope data: Consumers & prey

	$\delta^{13}C$	St Dev	$\delta^{15}N$	St Dev
Group 1	-26.03	1.34	10.93	1.35
Group 2	-25.60	1.31	11.43	1.35
Group 3	-26.23	1.07	9.95	1.36
Group 4	-26.59	1.09	8.20	2.00
Group 5	-26.47	1.45	7.89	1.88
Aquatic	-25.76	1.60	10.52	1.44
Terrestrial	-25.72	1.23	4.86	2.11

n = 398

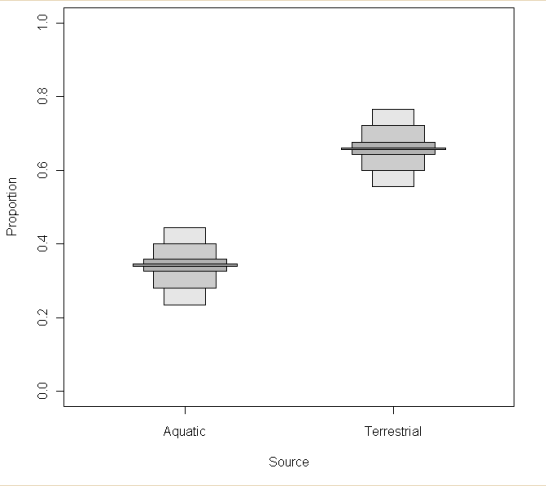
Isotopic niche



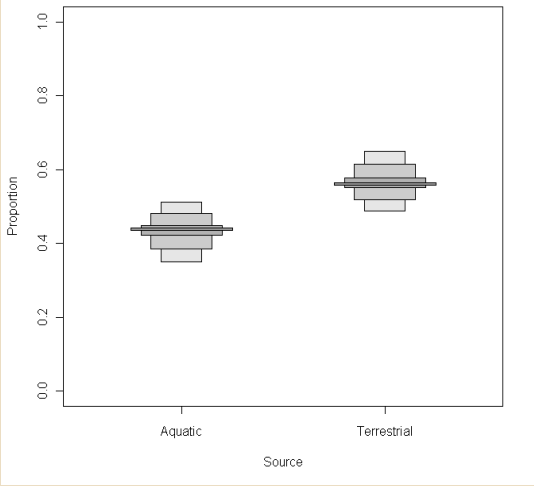
How does inundation risk impact prey selection?

Headwater species

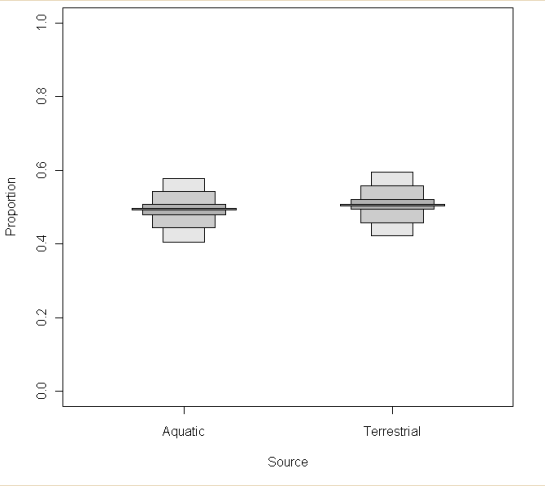
B. atrocaeruleum



Low risk



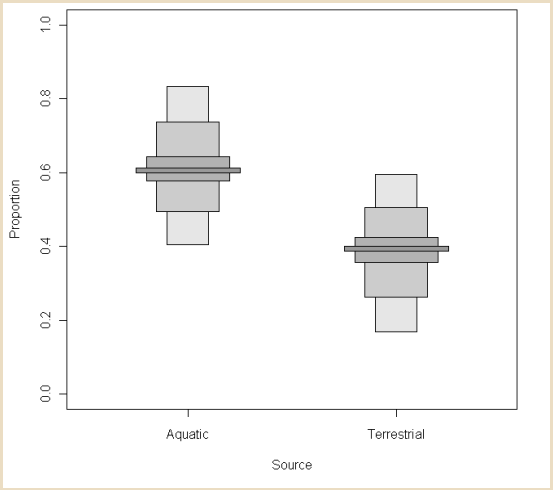
Medium risk



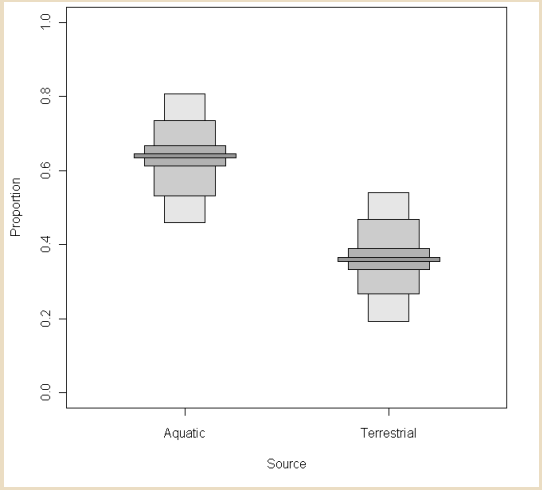
High risk

Floodplain species

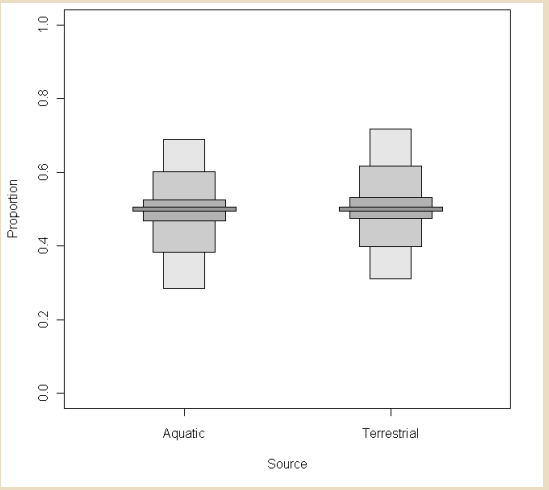
B. punctulatum



Low risk



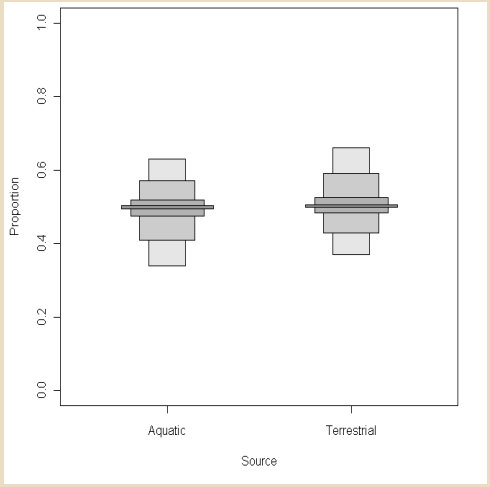
Medium risk



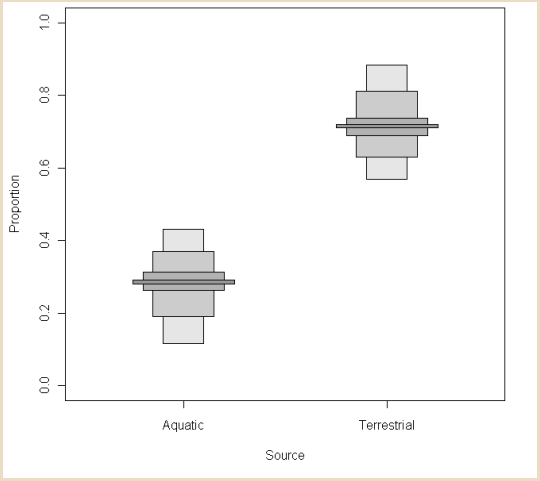
High risk

Low affinity species

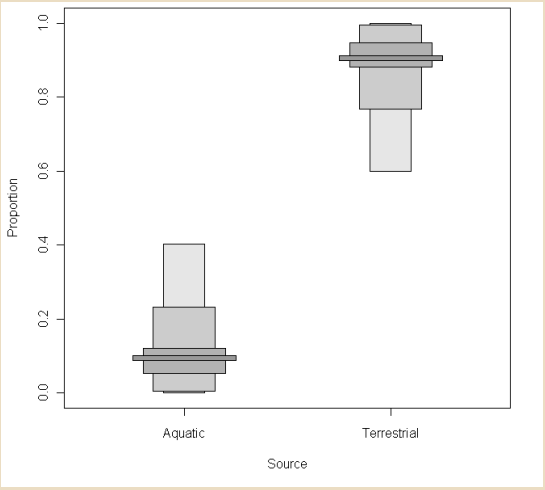
B. tetracolum



Low risk

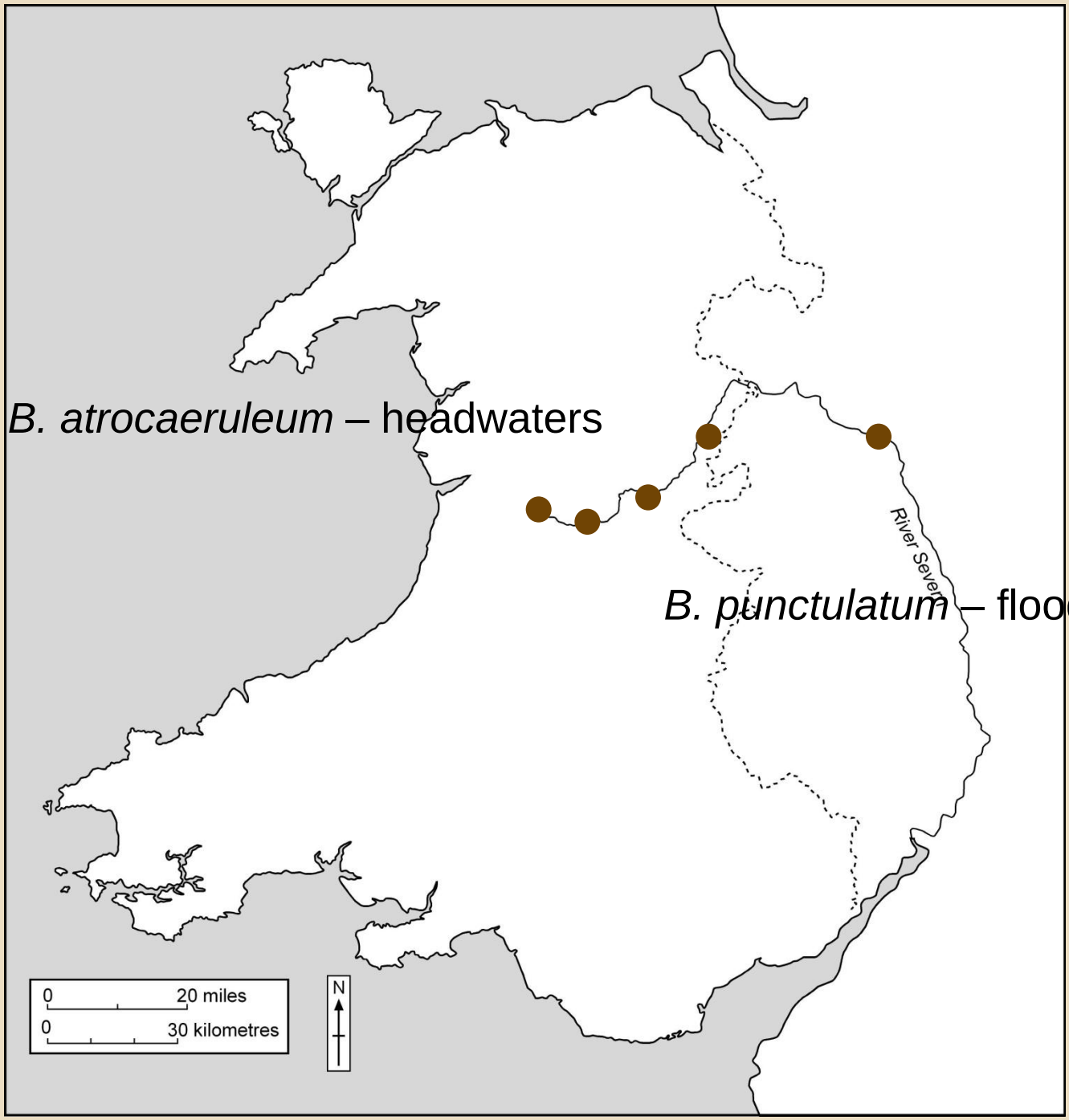


Medium risk



High risk

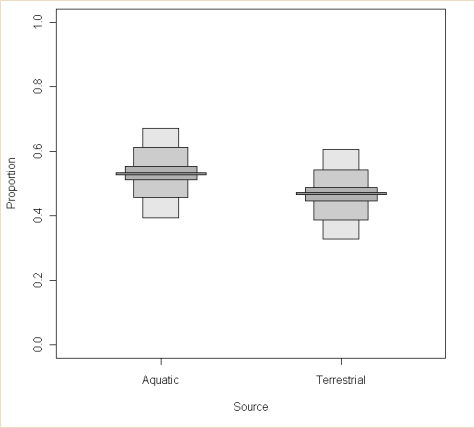
- Specialist ground beetles show variations in local positioning and regional abundances.
- They also show variations in dietary composition according to inundation pressure
- Are these variations an indication of different functions? i.e. is prey selection and positioning inherent?



B. atrocaeruleum – headwaters

B. punctulatum – floodplains

B. atrocaeruleum



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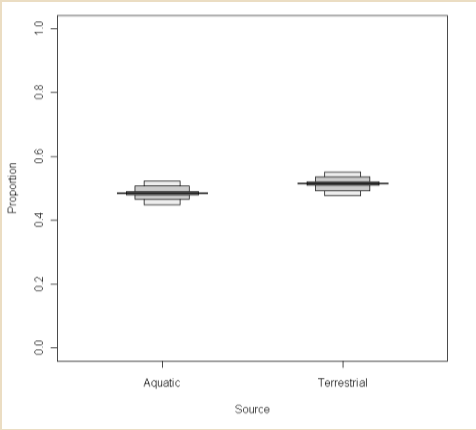

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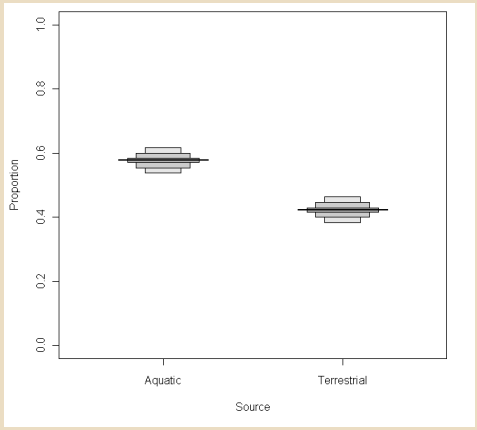

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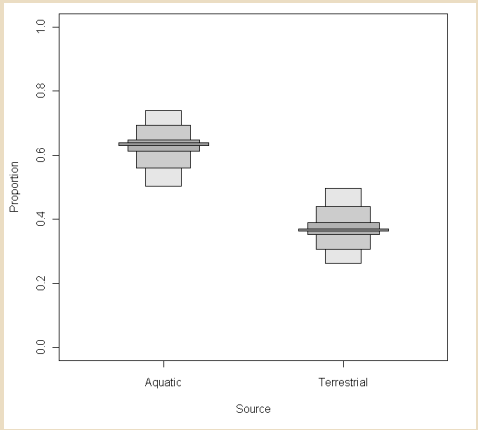

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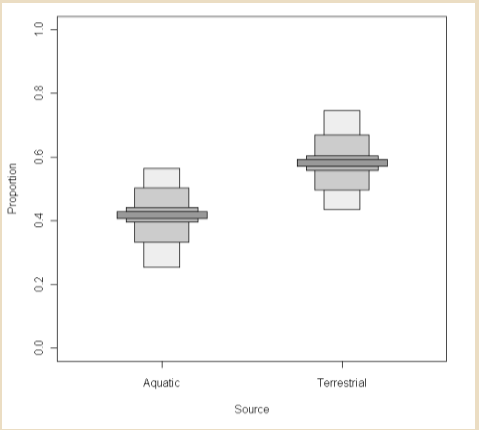
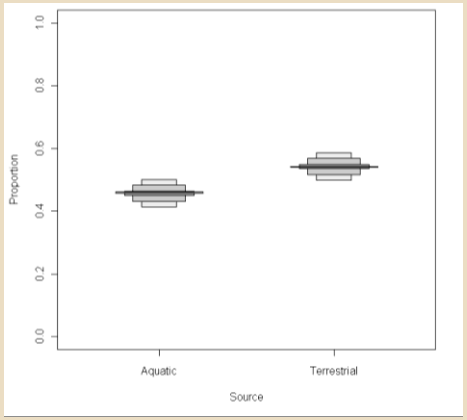


5

B. punctulatum



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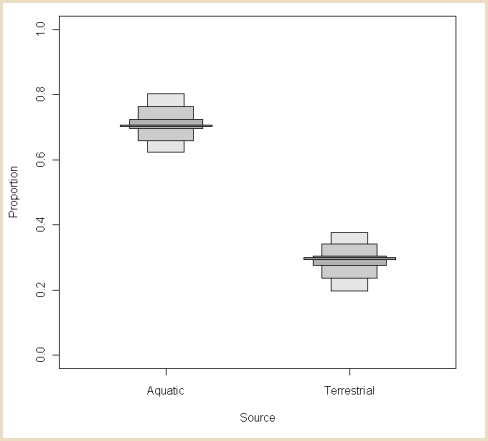

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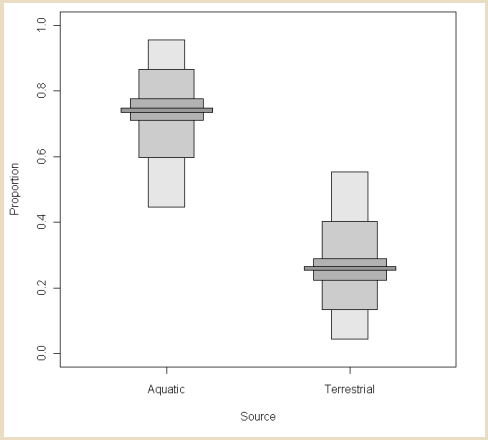

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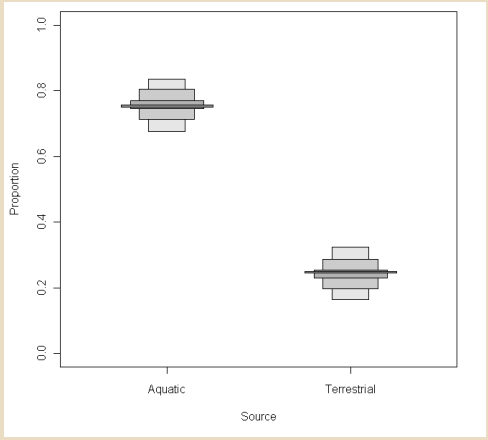

5

Conclusions

- Specialist ERS ground beetles are highly adapted to the demands of their optimum habitat, such that inundation has minor impact on feeding strategies.
- Small differences in adaptations alter assemblage structure at a regional scale and the level of aquatic nutrient uptake.
- Less well adapted ground beetles exhibit a strong aversion to flooding risk.
- Non-ground beetle specialists have a dependency on the habitat, but not aquatic subsidy. They are also poorly morphological adapted.
- The resource contains multiple niches – overlapping and requiring differing specialisations that define the optimum habitat.

Thanks to:
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Questions?

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