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The good things come in larger packages: size matters in Neotropical fruit-feeding butterfly dispersal

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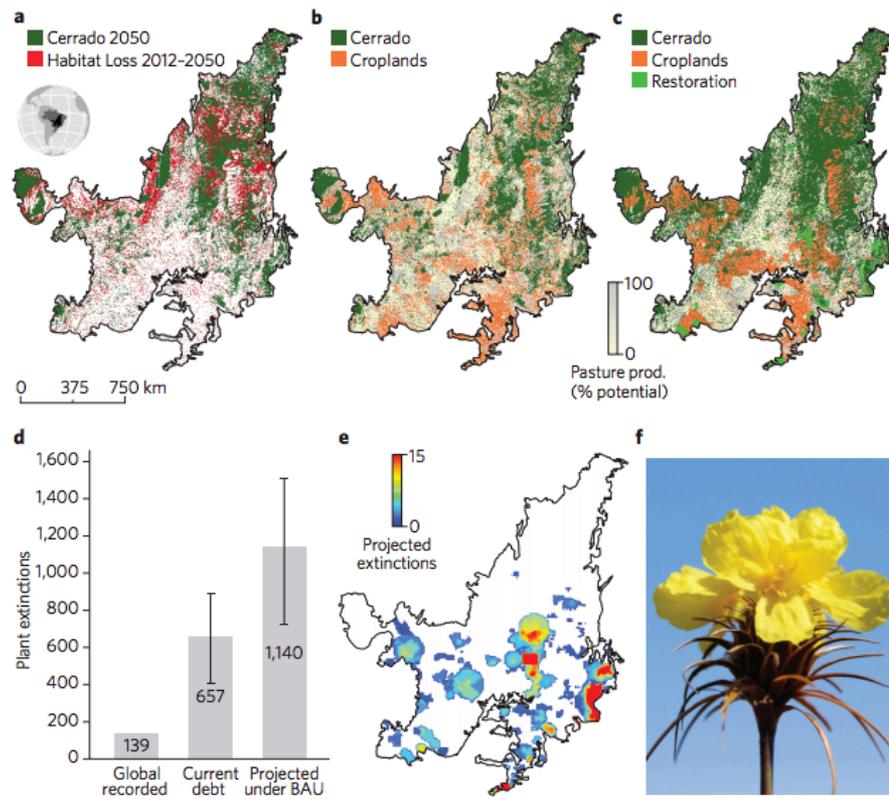
Abstract: Body size relates to many aspects of a species' natural history, such as life span, abundance, and dispersal capacity. However, contrasting trends have been reported for the relationship between body size and these ecological traits. We marked and recaptured 539 individuals from 27 species of fruit-feeding butterflies to study how body size affect species abundances, dispersal, and detectability in a Neotropical savanna (Cerrado). Body size has shown to be an efficient predictor of abundance, however this association was not significant after phylogeny was taken into account. Moreover, body size has positively influenced the dispersal rate, distance, and individual detectability, indicating that larger butterflies have a greater proportion of dispersing individuals over longer distances, and were detected through longer periods, than their smaller relatives. Large butterflies demand more resources which may forcing them to disperse in search of better habitats. On the other hand, smaller species may be better able to survive in small patches, reflected in their lower dispersal capacity. Nevertheless, their lower dispersal ability, if not compensated by large population sizes, may threaten the small-bodied species inhabiting environments with intense deforestation rates, such as the Cerrado. Finally, our study highlights the importance to consider species evolutionary history in order to study complex trait-environment relationships.

Keywords: Cerrado; Nymphalidae; Phylogeny; Species traits

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Background

- ✓ Dispersal is a key process to maintain gene flow among meta-populations
- ✓ Identifying which life-history traits that co-vary with dispersal, enable us to make predictions about species responses in the face of changes
- ✓ This is particularly relevant for species inhabiting environments with high deforestation rates, such as the Brazilian Savannah (Cerrado).



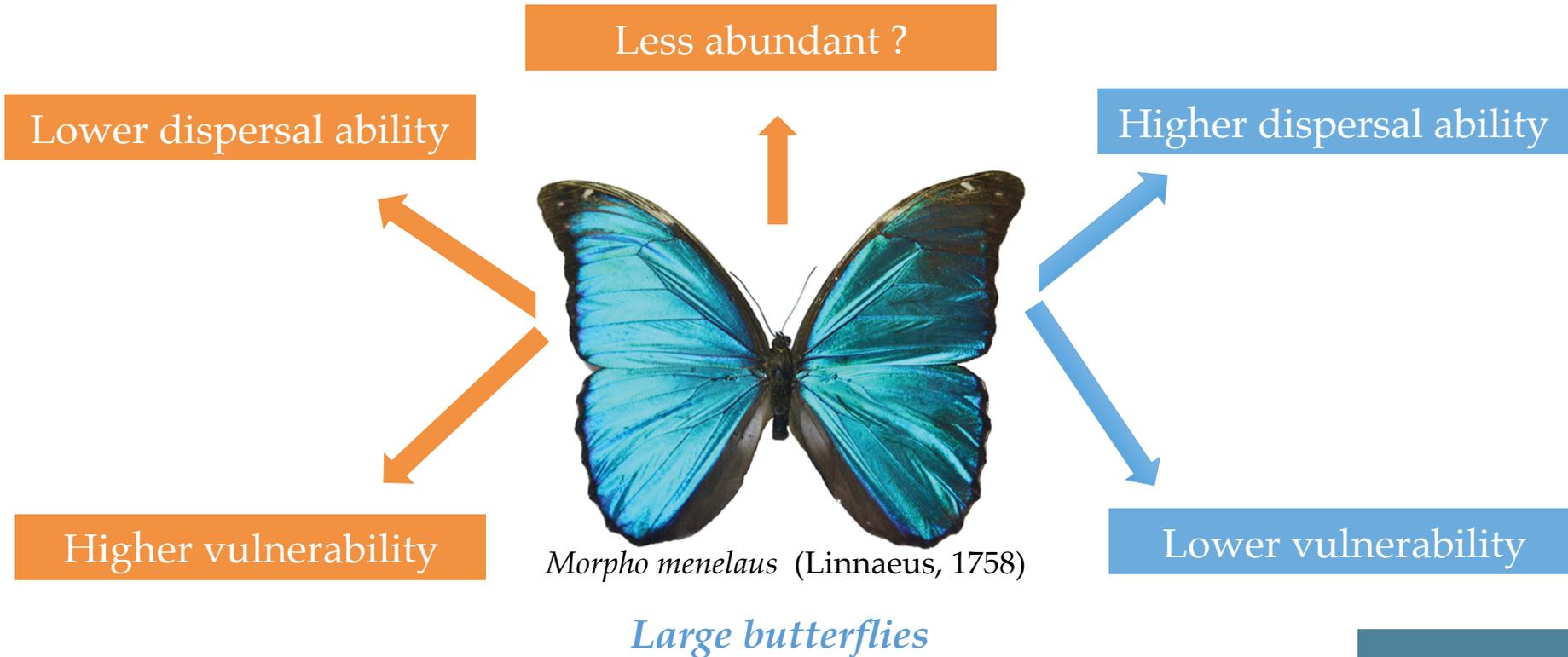
Strassburg et al. 2017. Moment of truth for the Cerrado hotspot. Nature Ecology & Evolution.

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Background

- ✓ Body size is related to many aspects of species life-history such as:

Life span; Metabolism; Reproduction; Dispersal



Background

- ✓ Fruit-feeding butterflies comprises 50-75% of Nymphalidae richness
- ✓ Great diversity of colors, behaviors, and body-sizes
- ✓ They respond to environmental changes in space and time
- ✓ Suited for quantitative studies of dispersal



Smyrna blomfieldia (Fabricius, 1781)

Morpho menelaus (Linnaeus, 1758)



Prepona clauina (Godart, [1824])



Hamadryas amphinome (Linnaeus, 1767)



Caligo brasiliensis (C. Felder, 1862)

Material and Methods

- ✓ 24 “bait-traps” (30m apart) installed in four linear transects (40m apart) at Fazenda Água Limpa, Brasília-DF, Brazil

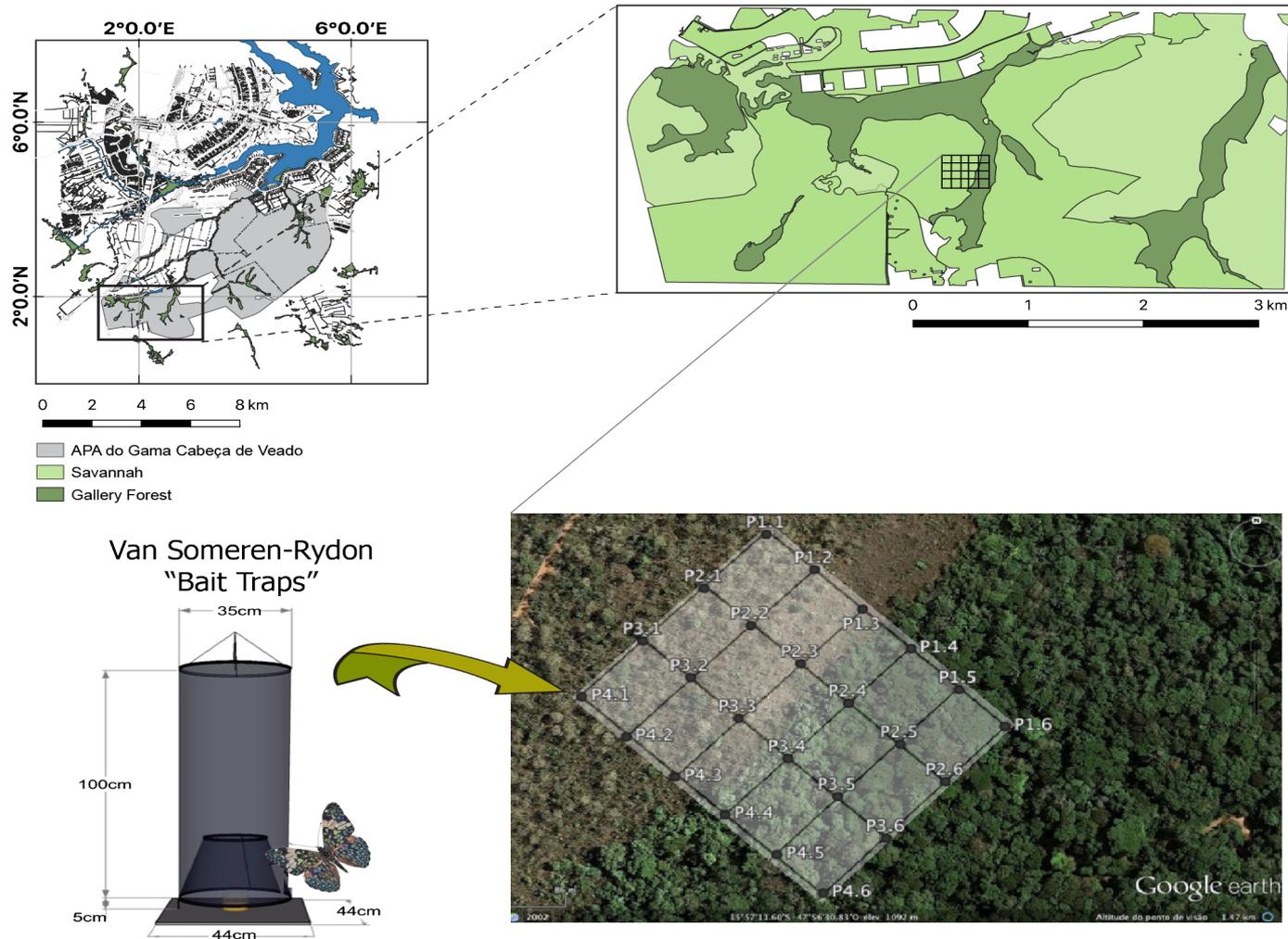


Fig.1. Experimental grid of 1.8 ha installed in Fazenda Água Limpa located at “APA Gama Cabeça de Veado” a 10,000 ha of protected area near Brasília-DF, Brazil.

Results and Discussion

- ✓ 539 individuals from 27 species were marked-recaptured-released (MRR)



Siderone galanthis (Cramer, 1775)

Source: Geraldo Freire personal archives



Hamadryas feronia (Linnaeus, 1758)

Results and Discussion

- ✓ Phylogenetic signal was found only in body size (K: 1.1; P = 0.001)

Table 1: Test of phylogenetic signal (Blomberg's K and P-value) of species-traits in fruit feeding butterflies

Traits	Blomberg's K	P value
Body size	1.1	0.001
Dispersal rate	0.76	0.07
Dispersal distance	0.53	0.53
Detectability (days)	0.39	0.78
Abundance	0.47	0.72

Results and Discussion

- ✓ Body size has negatively influenced the abundance ($\beta = -1.7$; $p = 0.02$);
- ✓ Nevertheless, size-abundance relationship was non-significant while phylogeny was taken into account ($\beta = -0.09$; $p = 0.76$)

Table 2: Phylogenetic independent contrasts between body size and dispersal traits in fruit feeding butterflies

Traits	Beta	P value
Dispersal rate	1.07	0.01
Dispersal distance	4.25	0.005
Detectability (days)	0.13	0.04
Abundance	-0.09	0.76

Results and Discussion

✓ Body size has positively influenced (Phylogenetic Independent Contrasts):

a) The dispersal rates ($\beta = 1.7$; $p = 0.01$)

b) Dispersal distances ($\beta = 4.2$; $p < 0.01$)

c) Individual detectability ($\beta = 0.13$; $p = 0.04$)

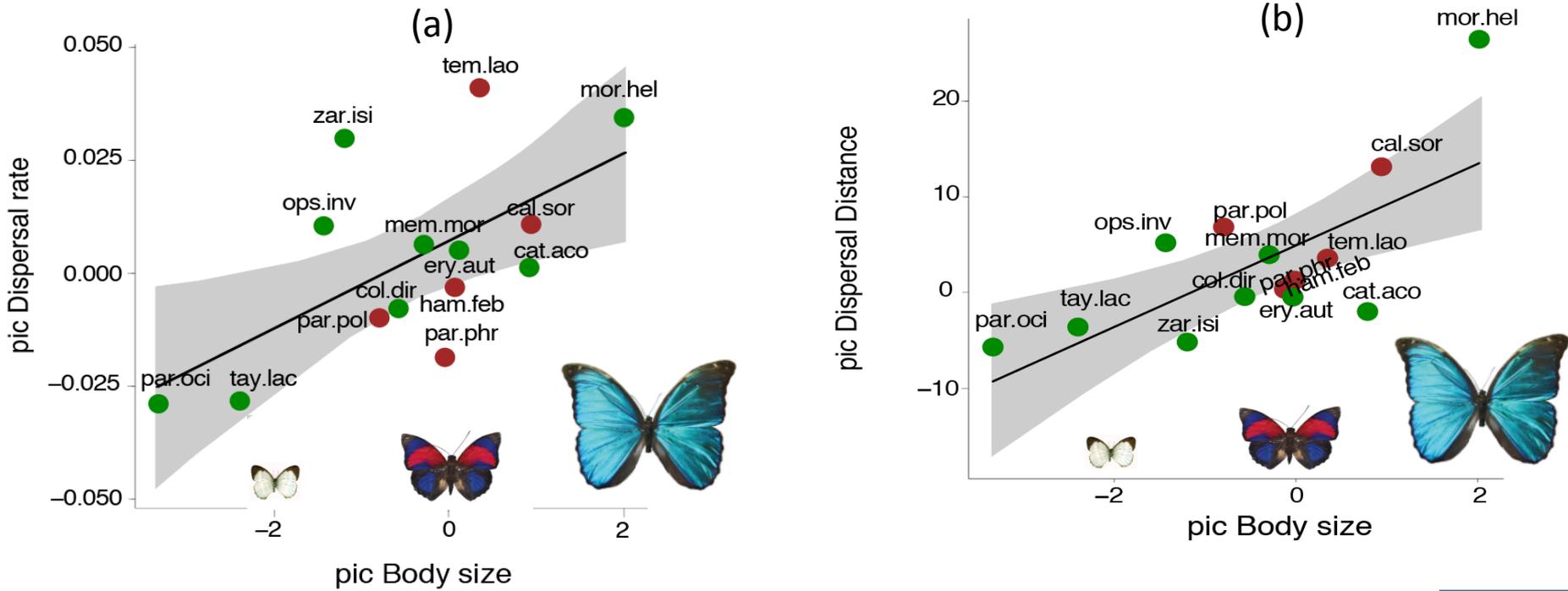


Fig.2. Phylogenetic Independent Contrasts between body size and a) dispersal rate; b) dispersal distance and; c) detectability. Green/Brown circles = forest/savannah specialists

Results and Discussion

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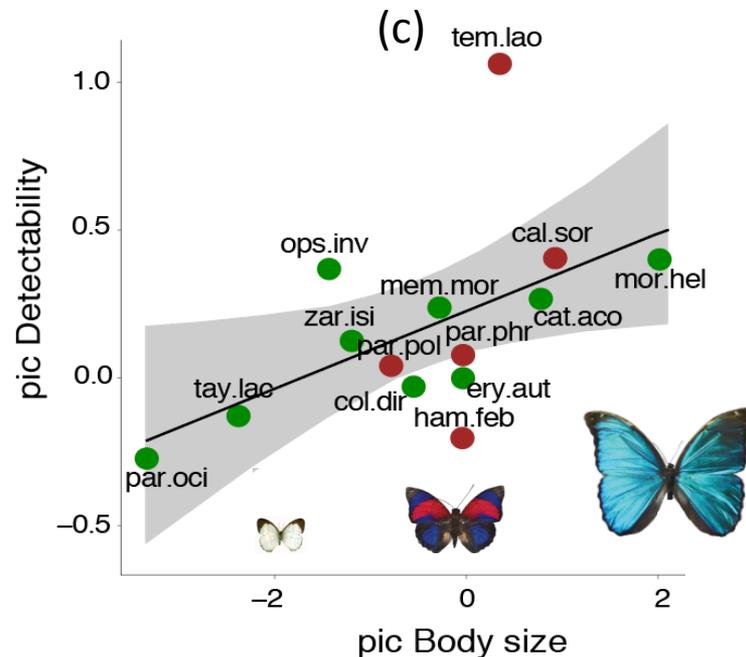
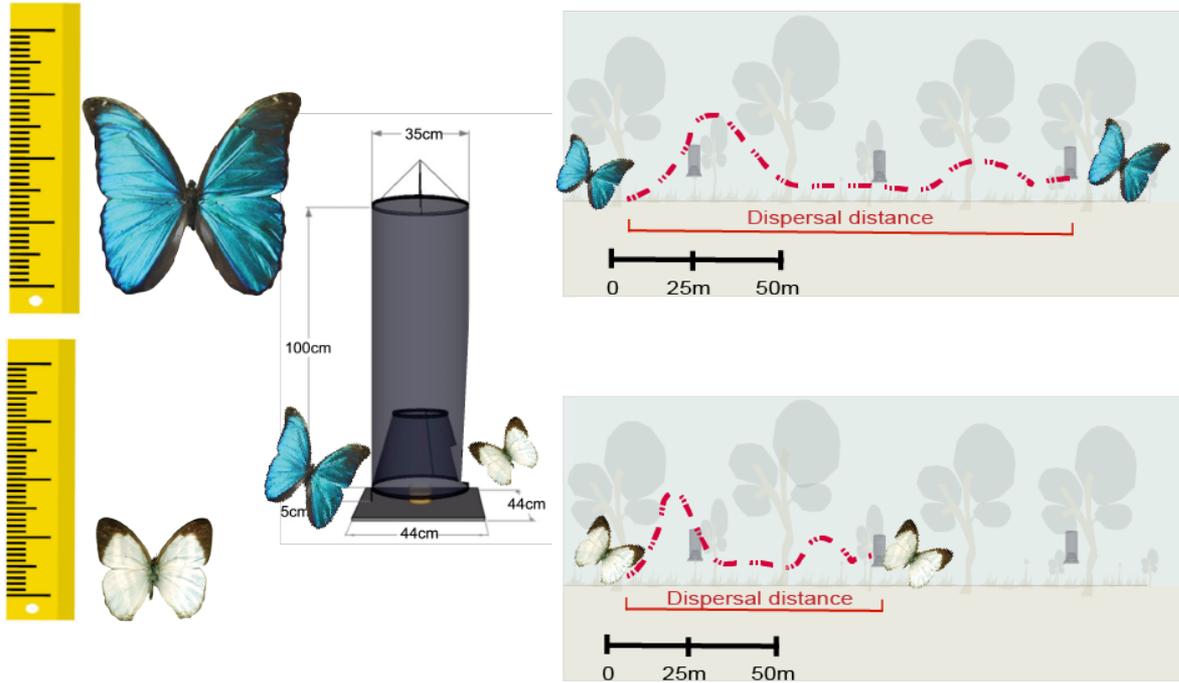


Fig.2. Phylogenetic Independent Contrasts between body size and a) dispersal rate; b) dispersal distance and; c) detectability. Green/Brown circles = forest/savannah specialists

Results and Discussion



Large-bodied butterflies

- Higher demand for resource may act as selective pressure to greater dispersal
- Most large-bodied species with lower population size.

Small-bodied species

- Lower dispersal & Lower demand for resources = Better ability to survive in small patches
- For some species, it were observed a trade-off between dispersal and population size
- Small-bodied species with reduced population sizes deserves particular focus from conservation efforts

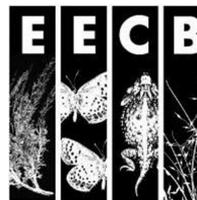
Conclusions

- ✓ Larger species have a greater proportion of dispersing individuals over longer distances, and were detected through longer periods than their smaller relatives.
- ✓ Our study highlight the importance to consider the species evolutionary history in order to study complex trait-environment relationships.

Acknowledgments



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