




Arthropod communities and drivers of their species diversity and composition in caves







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LOOKING INTO THE PAST TO SEE THE FUTURE OF BIOSPEOLOGY

100 YEARS OF SPELEOLOGY IN ROMANIA 1920-2020
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Why is needed to study subterranean arthropod communities and drivers of their diversity and composition?

Arthropods represent most of the world's biodiversity

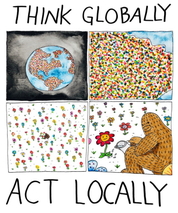
In caves previous studies relied on:

➢ higher taxon surrogates instead complete inventories of species diversity

➢ one or few taxonomic groups ☛ inhibit a holistic view on a coexisting community

➢ mainly qualitative inventories of species and descriptions of spatial distribution patterns

➢ single cave ☛ findings are difficult to extrapolate to other cave environments or geographic areas



The contribution of local-scale ecological factors in explaining patterns of arthropod diversity is largely unknown for caves!

Subterranean arthropod communities and drivers of their species diversity and composition

AIM

➢ assess the abundance, richness, diversity and composition of arthropod communities from caves

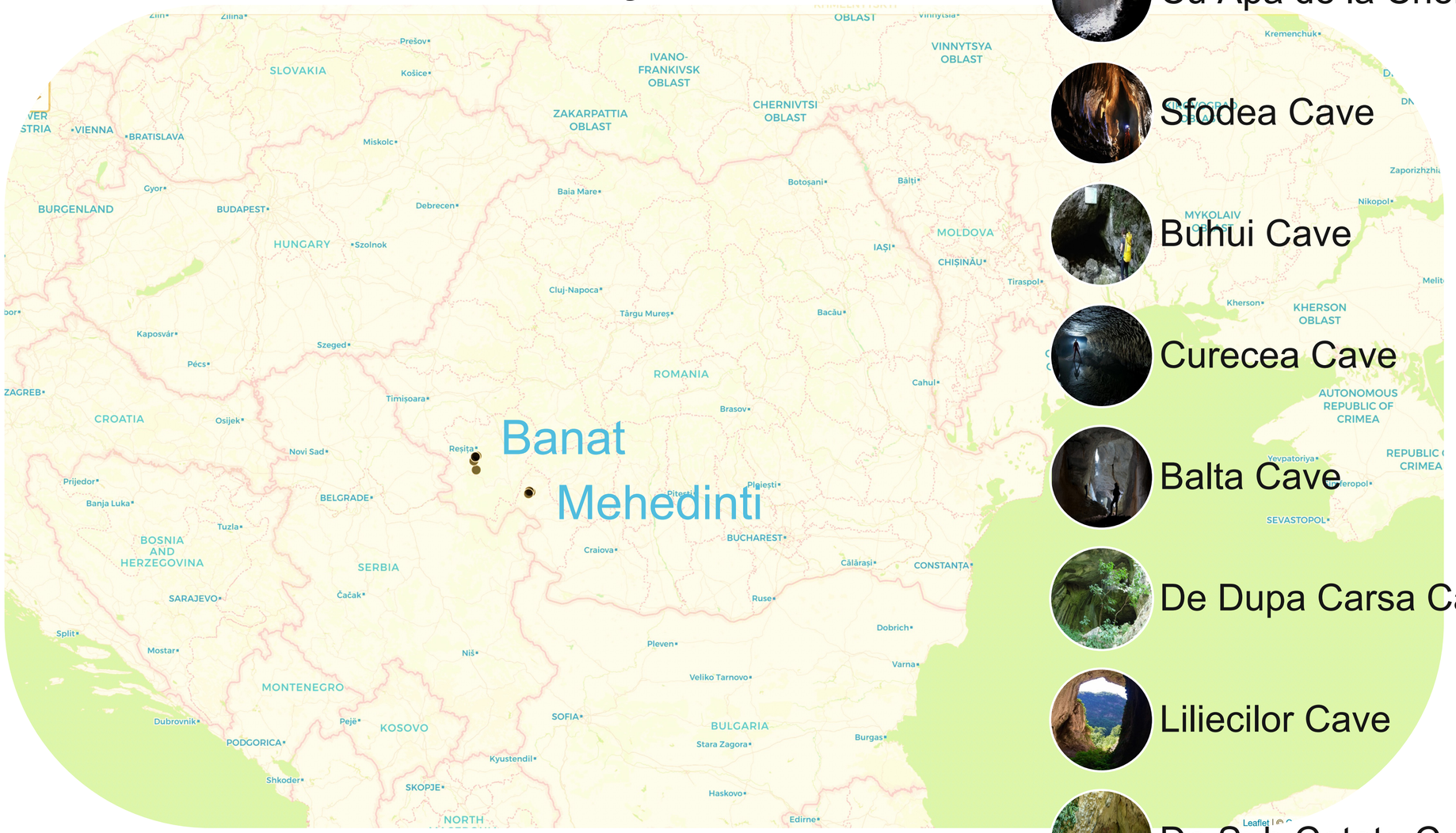
➢ determine whether cave physical characteristics and features influence cave arthropod communities along the development of the cave





Material and methods

Study area



● caves


Cu Apa de la Cheile Garlistei Cave

Sfodea Cave

Buhui Cave

Curecea Cave

Balta Cave

De Dupa Carsa Cave

Liliecilor Cave


De Sub Cetate Cave

Material and methods

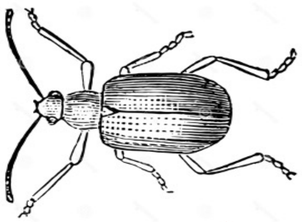
Sampling	• Linear transects of 100 m • 10 sectors of 10 m per transect
Cave features	• Temperature (T) (C^0) • Relative humidity (Rh) (%) • Width (m) • Height (m) • Light intensity (lux) • Heterogeneity
Techniques	• quadrate sampling • timed searches • opportunistic searches

Material and methods

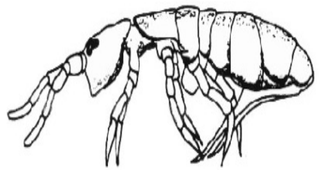
Species-level identification



Araneae



Coleoptera



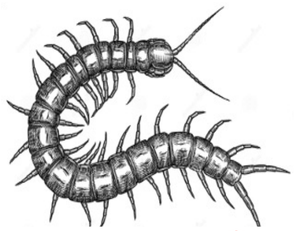
Collembola



Izopoda



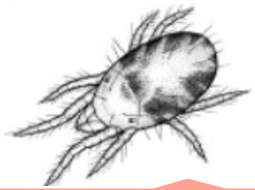
Diplopoda



Chilopoda



Opiliones



Acari



Lepidoptera

Material and methods

Data analysis

- ➢ Species accumulation curves (SAC)
- ➢ Rank abundance curves (RAC)
- ➢ Abundance and Species Richness (S)
- ➢ Diversity indices: Shannon-Wiener (H′), Simpson (D) and Pielou (J)
- ➢ Non-metric multidimensional scaling (NMDS) ordination with a Bray-Curtis similarity
- ➢ Redundancy Analysis (RDA)

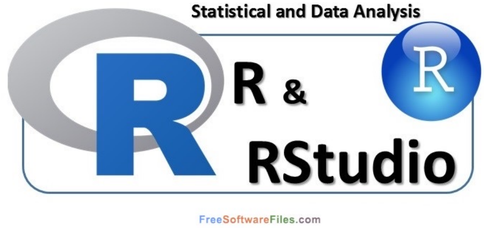
Generalized mixed models (GLMM)

- if significant effects of cave physical characteristics and features

Multiple comparisons

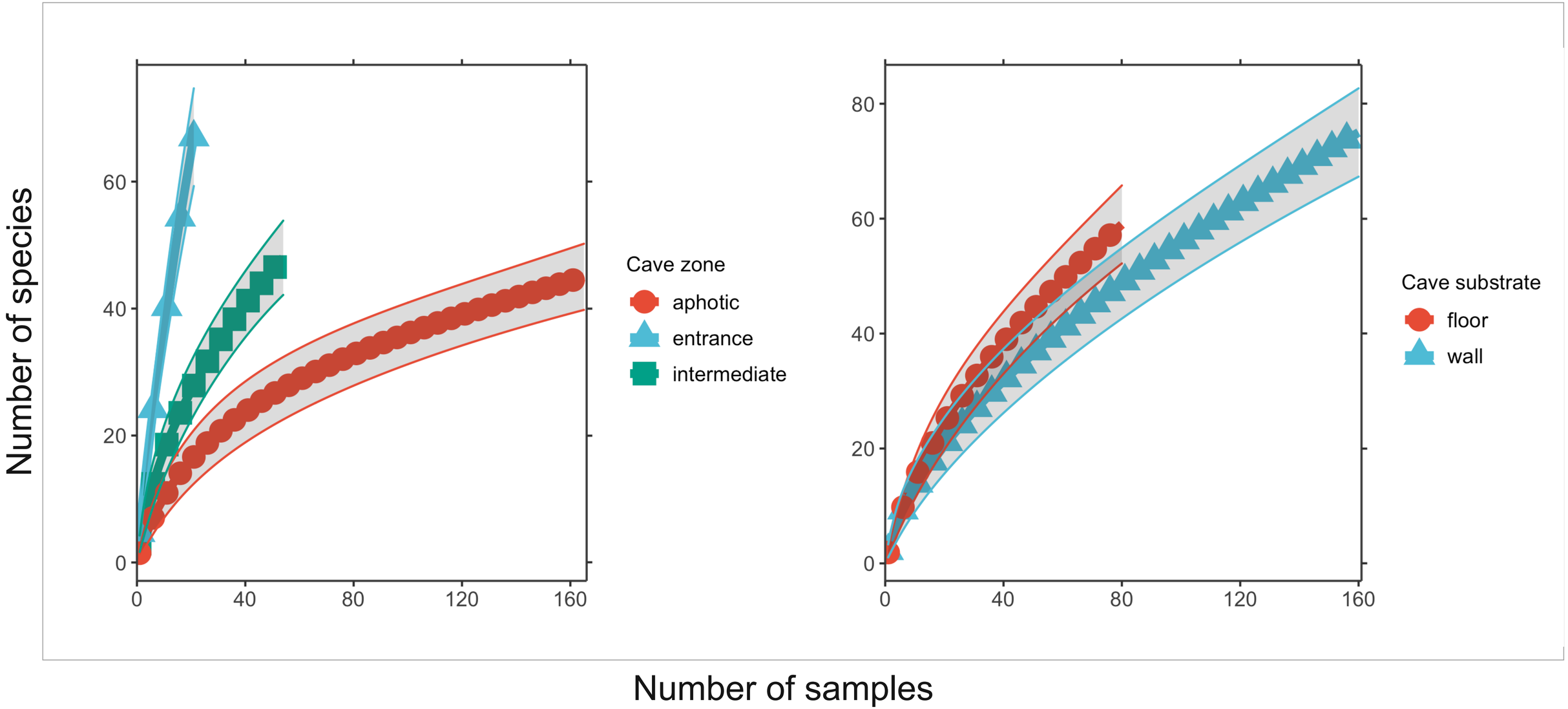
ADONIS

- if species composition differ between cave zones and substrate



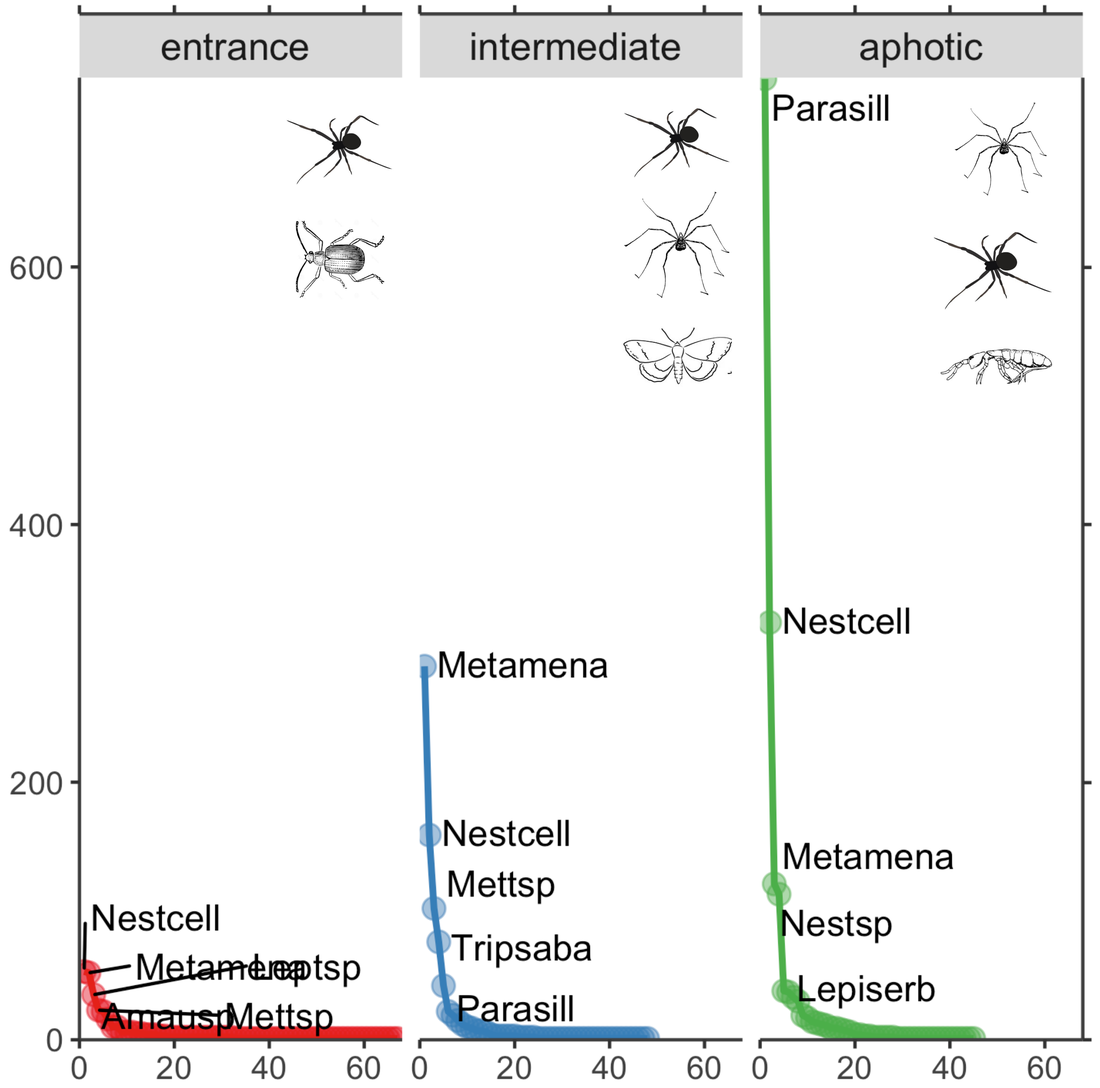
Results

SAC


Number of species
Number of samples
0
20
40
60
0
40
80
120
160
Cave zone
aphotic
entrance
intermediate
80
Cave substrate
floor
wall

Results

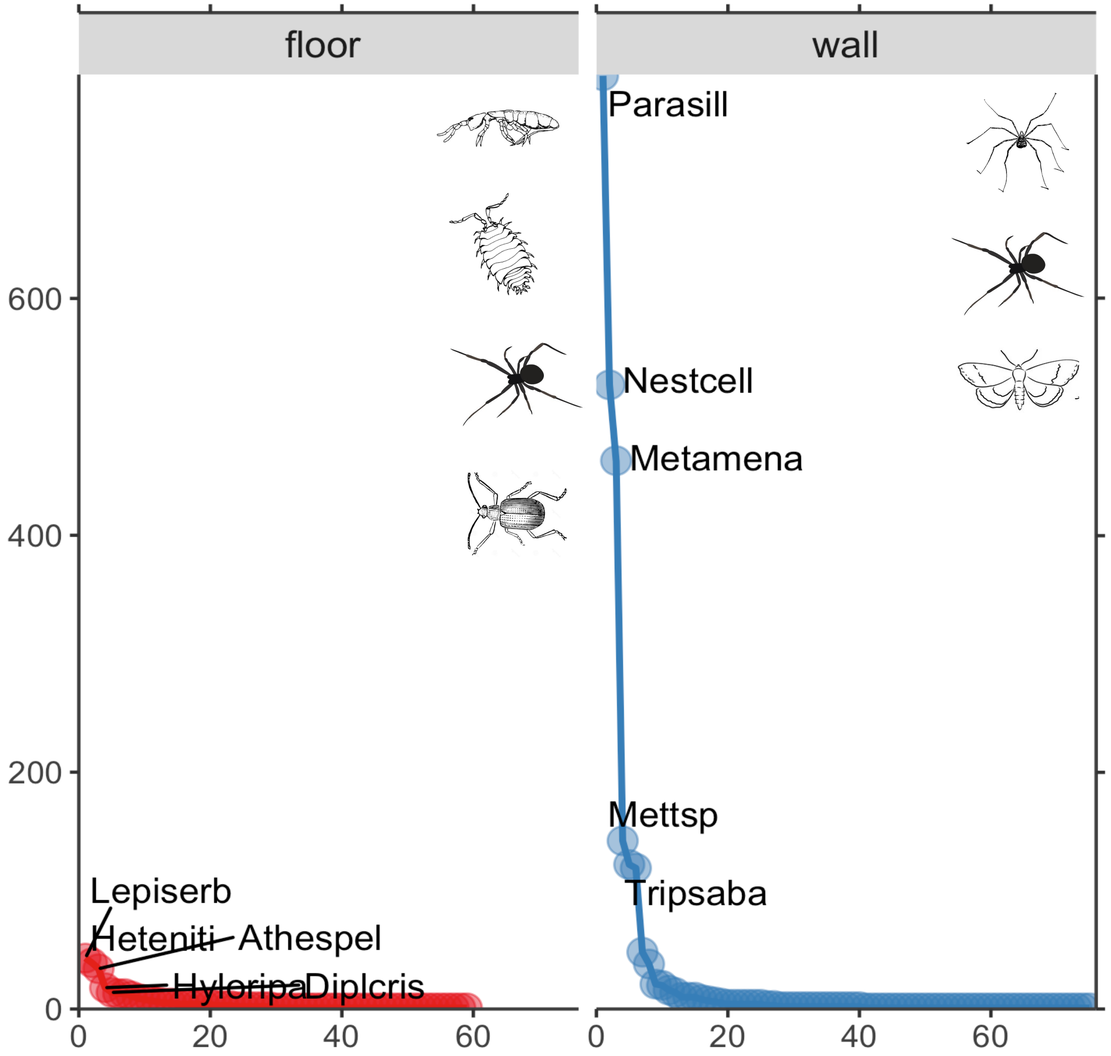
RAC cave zone



Amausp - ***Amaurobius sp***
Lepiserb - ***Lepidocyrtus serbicus***
Leptsp - ***Leptusa sp***
Metamena - ***Meta menardi***
Mettsp - ***Mettelina sp***
Nestcell - ***Nesticus cellulanus***
Nestsp - ***Nesticus sp***
Parasill - ***Paranemastoma silli***
Tripsaba - ***Triphosa sabaudiata***

Results

RAC cave substrate



Athespel - ***Atheta spelaea***
Diplcris - ***Diplocephalus cristatus***
Heteniti - ***Heteromurus nitidus***
Hyloripa - ***Hyloniscus riparius***
Lepiserb - ***Lepidocyrtu serbicus***
Metamena - ***Meta menardi***
Mettsp - ***Mettelina sp***
Nestcell - ***Nesticus cellulanu***
Parasill - ***Paranemastoma silli***
Tripsaba - ***Triphosa sabaudiata***

Results

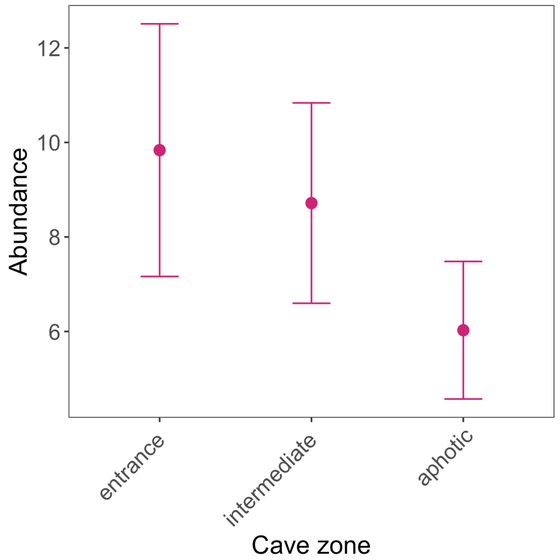
Effect of cave zone, substrate, physical characteristics and features on arthropod communities diversity patterns

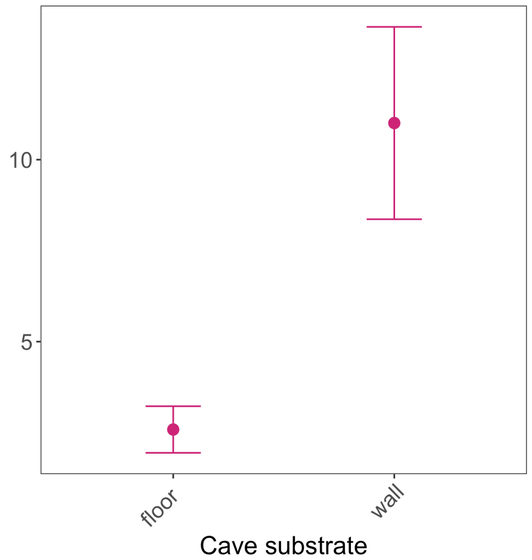
Covariates	Abundance	SR	H′	D	J
Cave zone	***	***	***	*	NS
Cave substrate	***	NS	NS	NS	NS
Cave extension (m)	*	*	NS	NS	NS
Width (m)	NS	NS	NS	NS	NS
Height (m)	NS	NS	NS	NS	NS
Heterogeneity	NS	NS	NS	*	NS
Rh (%)	***	NS	NS	*	**
T (C^0)	NS	NS	NS	NS	NS
Light intensity (lux)	**	NS	NS	NS	NS

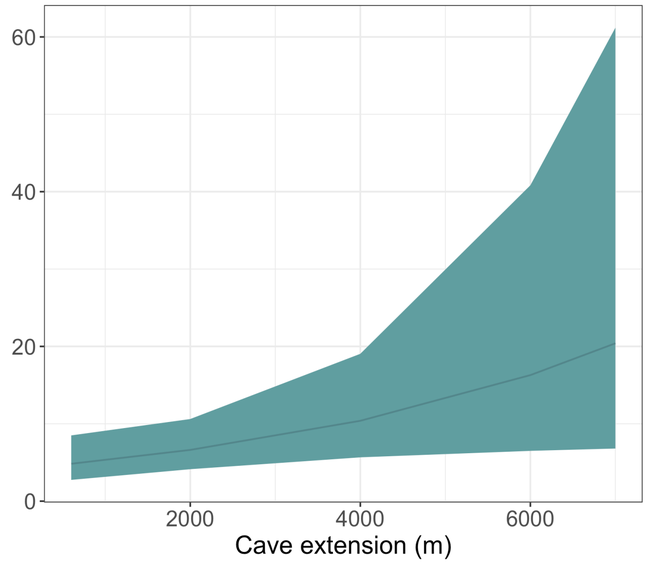
NS $p > 0.05$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

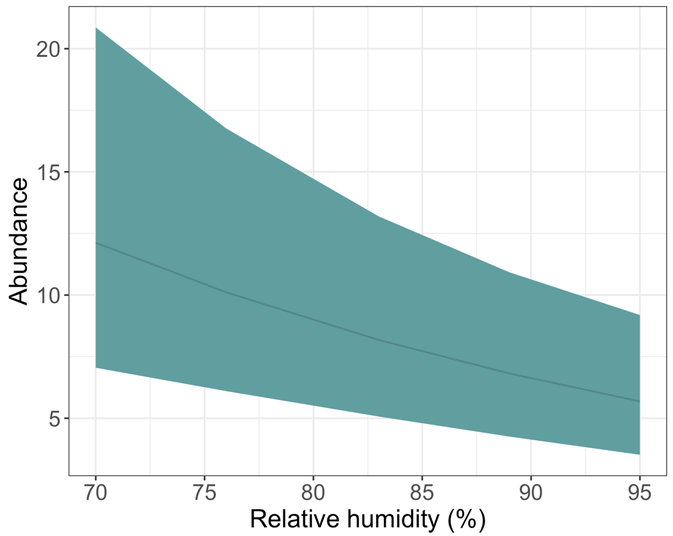
Results

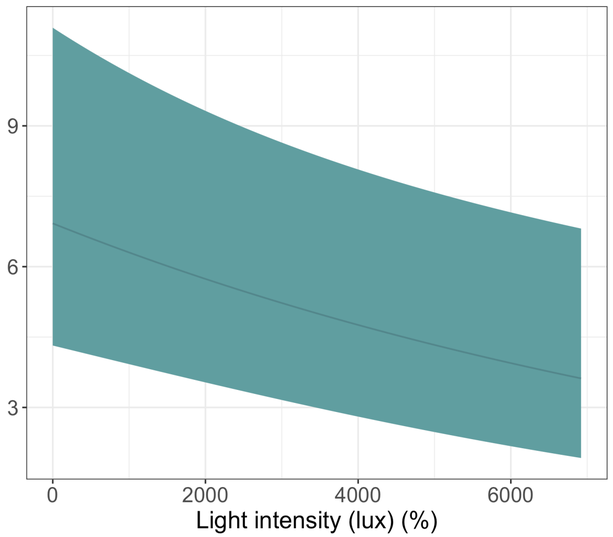
Effect of cave zone, substrate, extension, relative humidity and light intensity on arthropod abundance





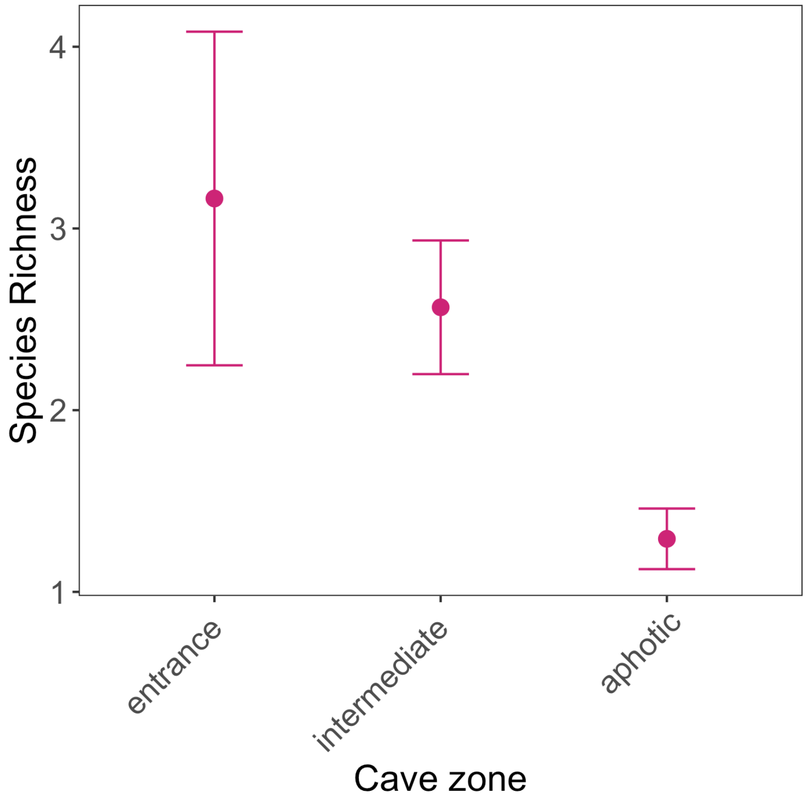


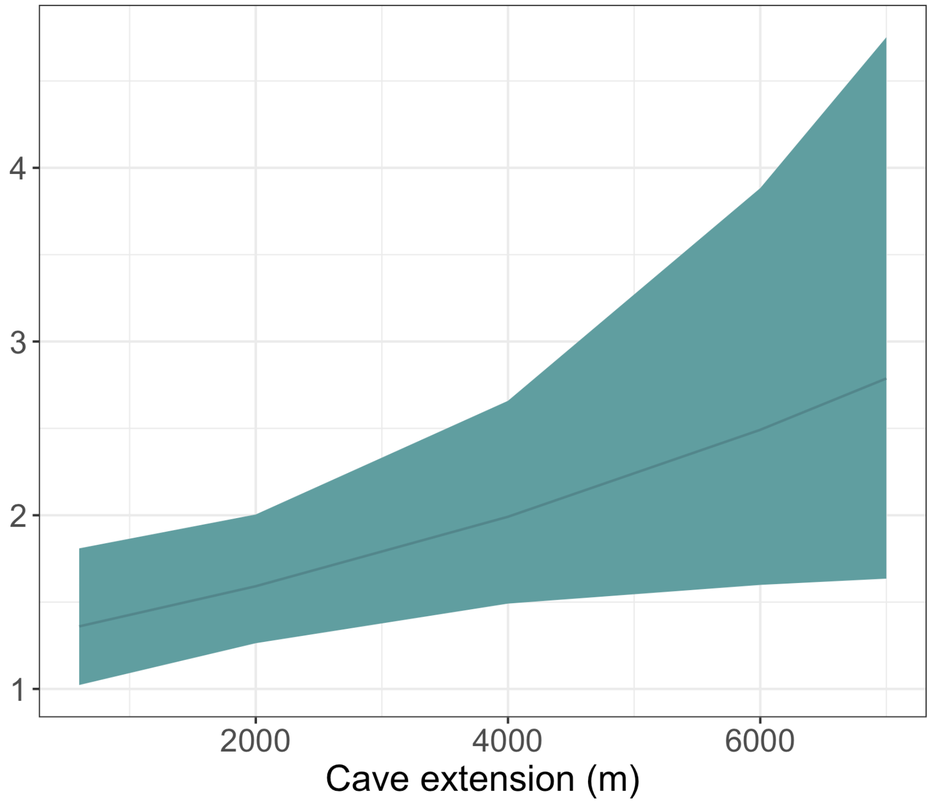




Results

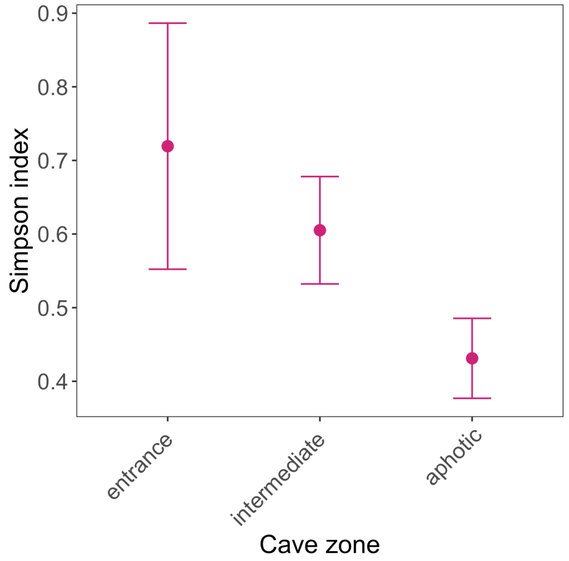
Effect of cave zone and extension on arthropod communities species richness patterns

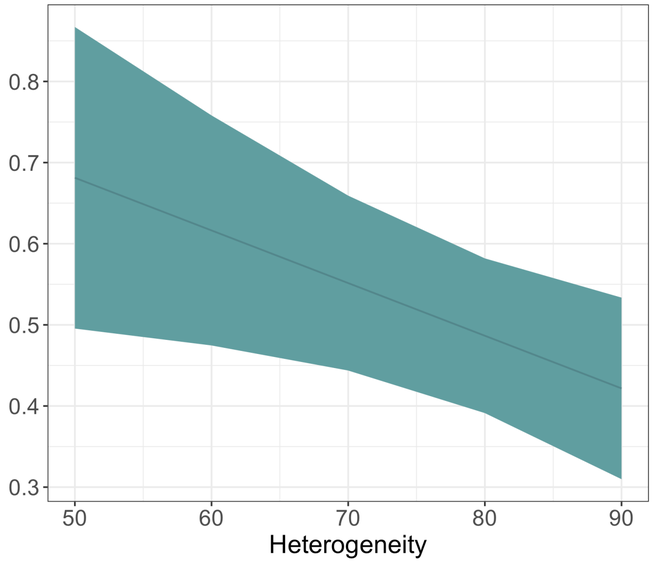


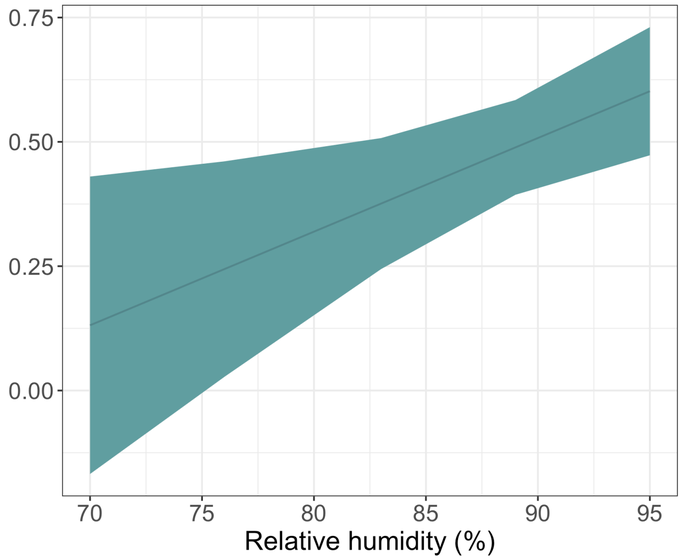


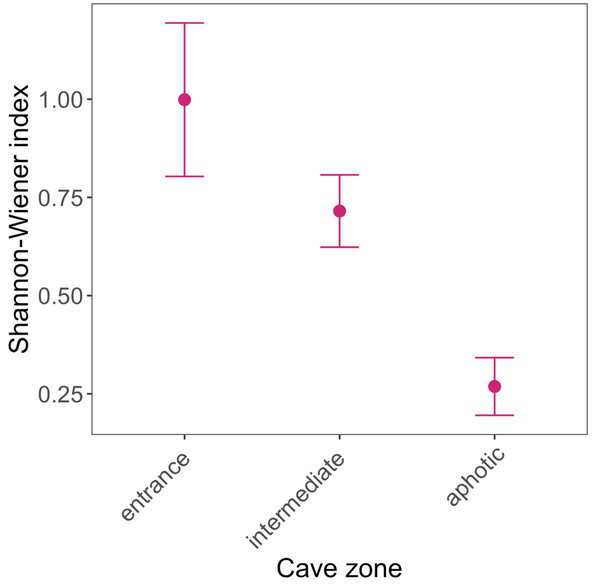
Results

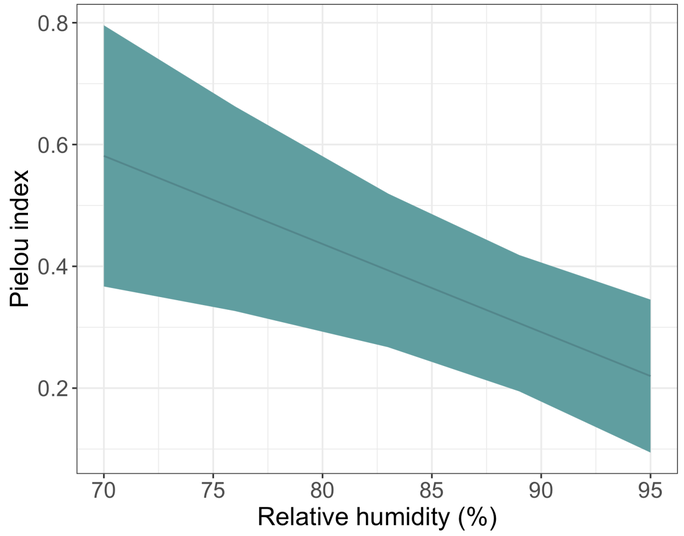
Effect of cave zone, heterogeneity, relative humidity on arthropod communities diversity patterns





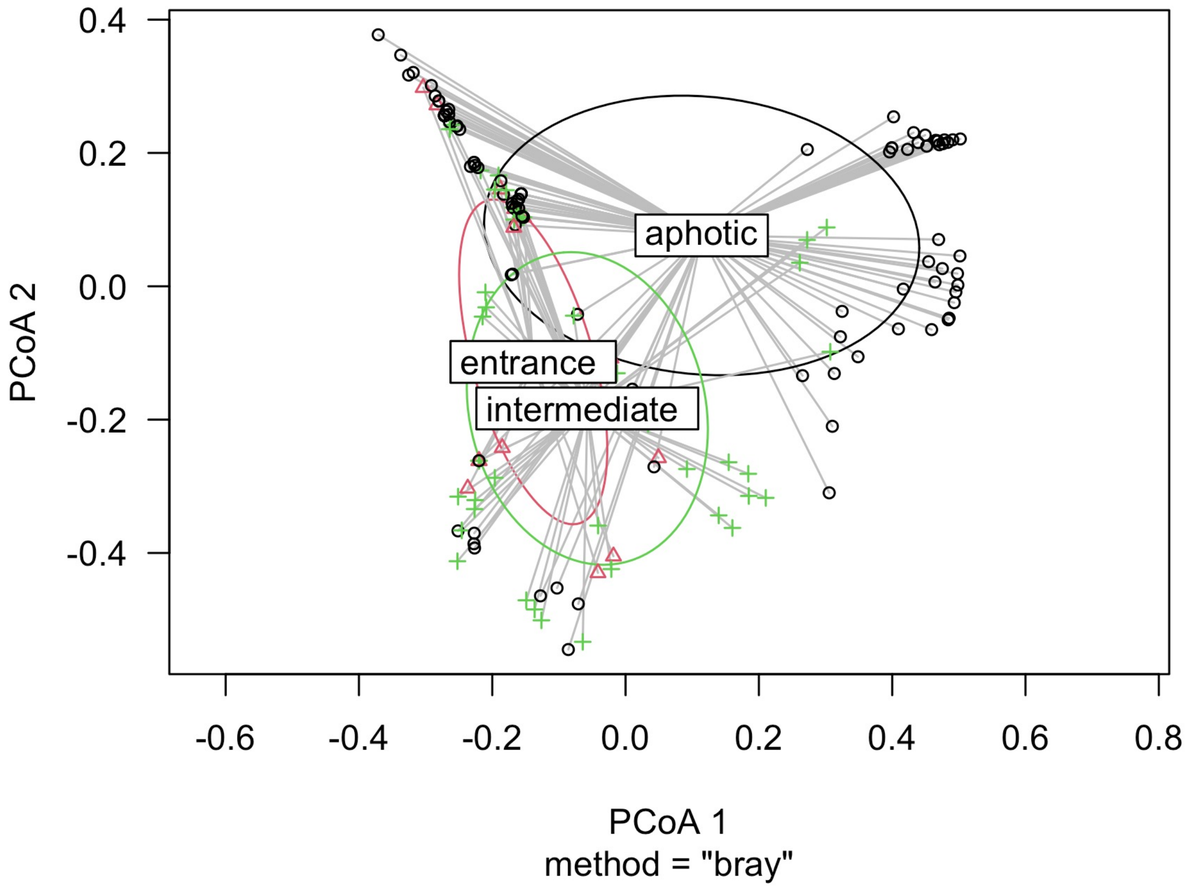


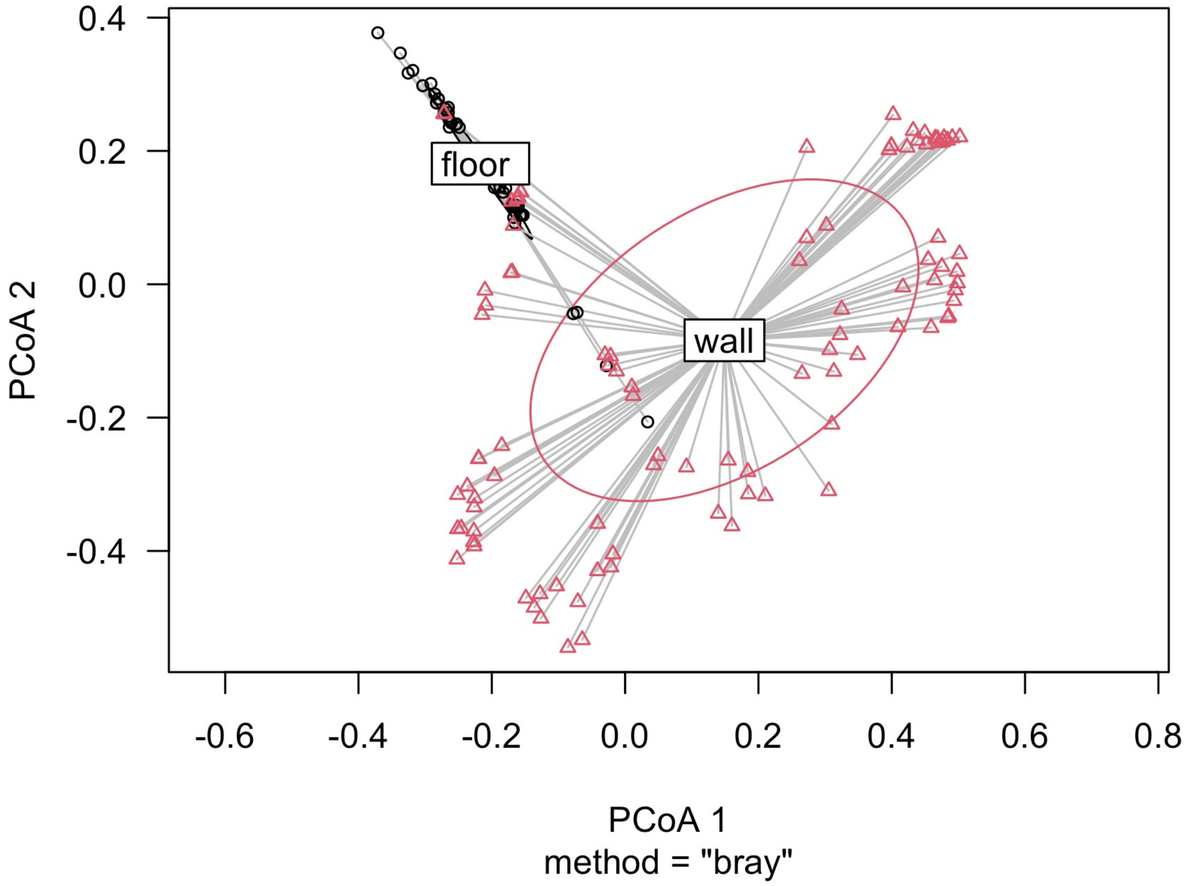




Results

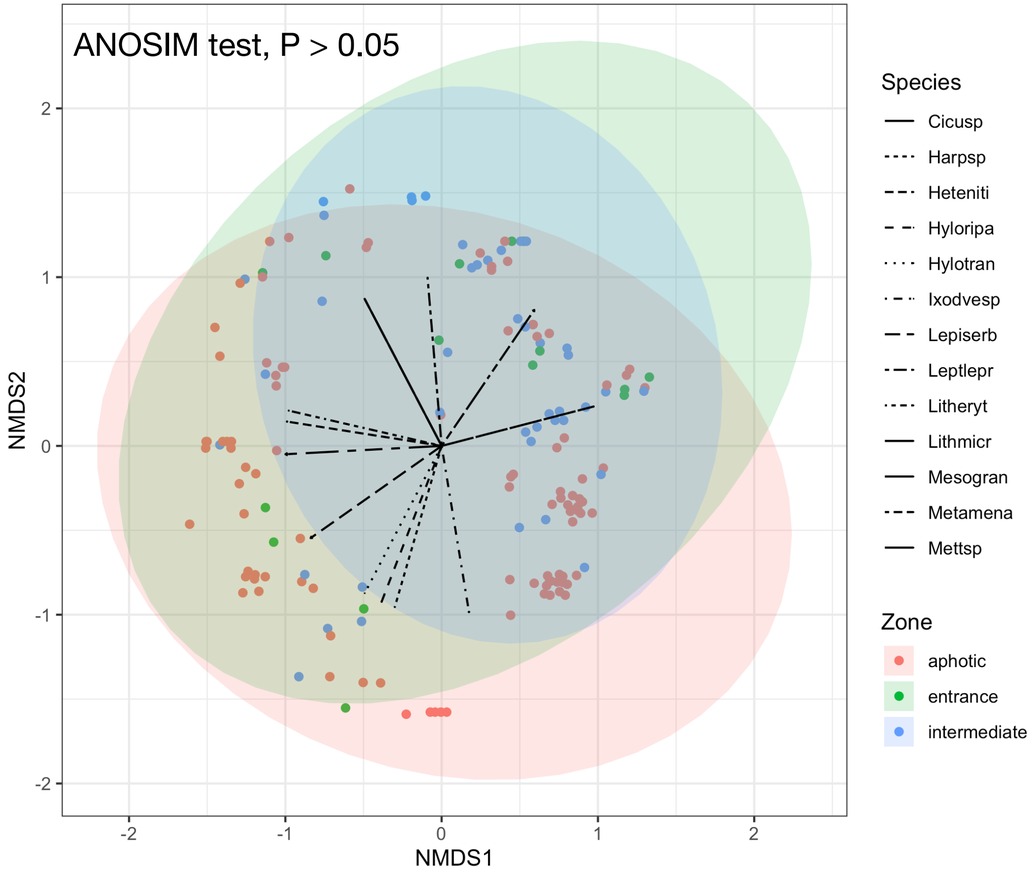
Multivariate dispersion - variability in species composition among cave zones and between substrates

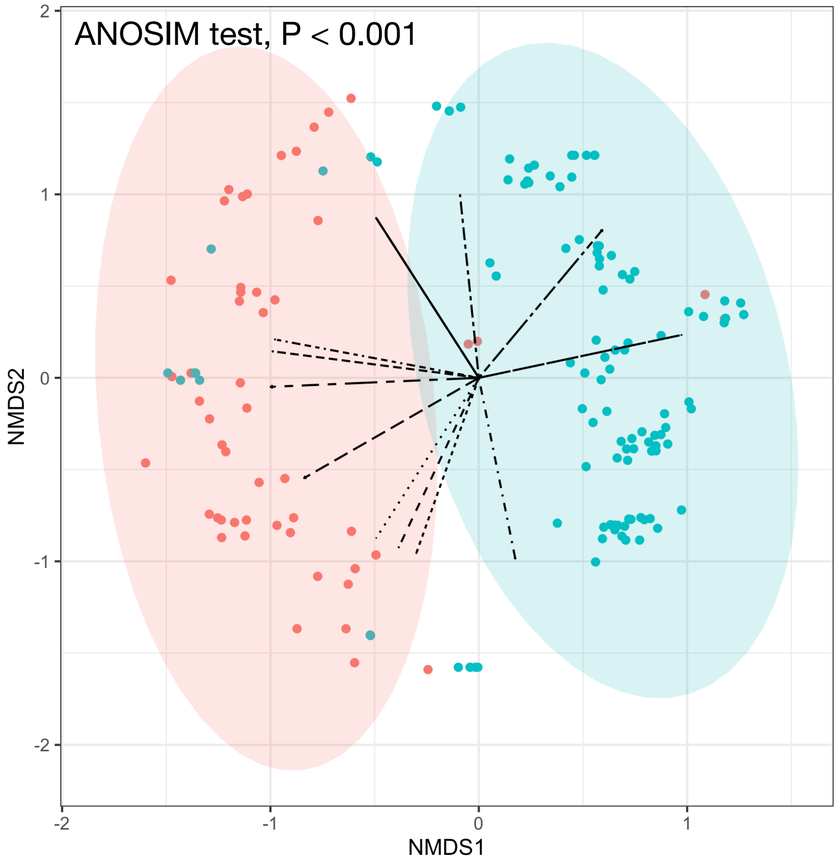




Results

Differences in species composition among cave zones and between substrates

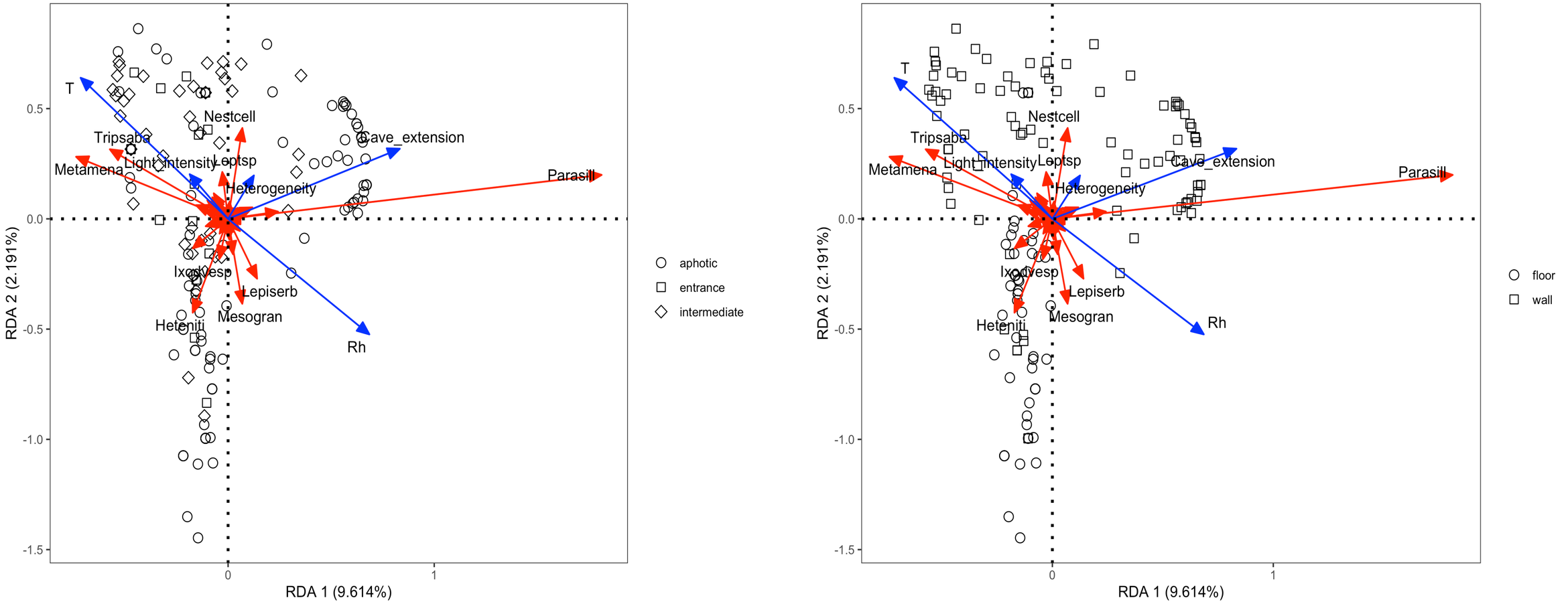




Cicusp – *Cicurina sp*
Harpsp – *Harpactea sp*
Heteniti – *Heteromurus nitidus*
Hyloripa – *Hyloniscus riparius*
Hylotran – *Hyloniscus transsylvanicus*
Ixocvesp – Ixodes vespertiliones
Lepiserb – *Lepidocyrtu serbicus*
Lethlepr – *Lepthyphantes leprosus*
Litheryh – *Lithobius erythrocephalus*
Lithmicr – *Lithobius microps*
Mesogran – *Mesoniscus graniger*
Metamena – *Meta menardi*
Mettsp – *Mettelina sp*

Results

Effect of environmental variables on arthropod species composition



Tripdubi - *Triphosa sabaudiata*
Metamena - *Meta menardi*
Leptsp - *Leptusa sp*
Nestcell - *Nesticus cellulanus*

Heteniti - *Heteromurus nitidus*
Ixocvesp – Ixodes vespertiliones
Parasill - *Paranemastoma silli*

Lepiserb – *Lepidocrytus serbicus*
Mesogran – *Mesoniscus graniger*

Conclusions and take home message

➢ Abiotic factors explain the diversity and composition of cave arthropods communities.

! Understating of spatial beta-diversity changes and their drivers could provide a sensitive indicator of arthropods community changes in caves.

➢ Cave-dwelling arthropods form different communities.

! This highlights the importance of using a multi-community approach to support the design of effective conservation and management actions for cave fauna.

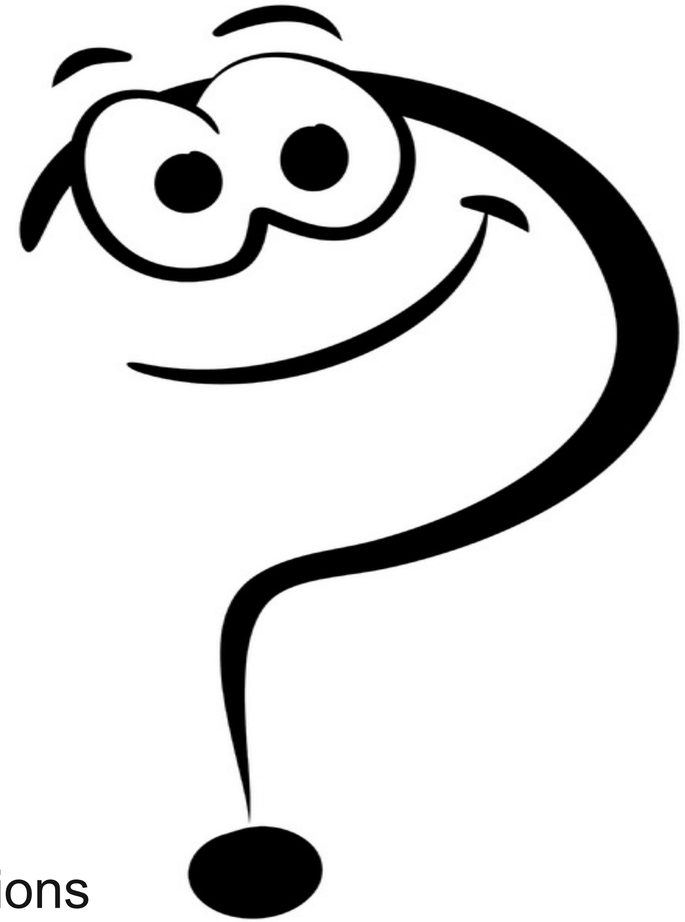
PUTTE & ALIEN



seppo.net

* PUTTE = DEFICIENTLY KNOWN AND THREATEND CAVE SPECEIS

Thank you!



Questions