Hydrological extremes in riverine epikarst: response of the invertebrate fauna

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Presentation overview

- Study site: headwaters of the River Lathkill
  - Hydrogeological character
  - Instream habitats
- Hydrological extremes during summer 2007
- Sampling techniques
- Results & Discussion
  - Invertebrate survival during hydrological extremes

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The River Lathkill: a karst river

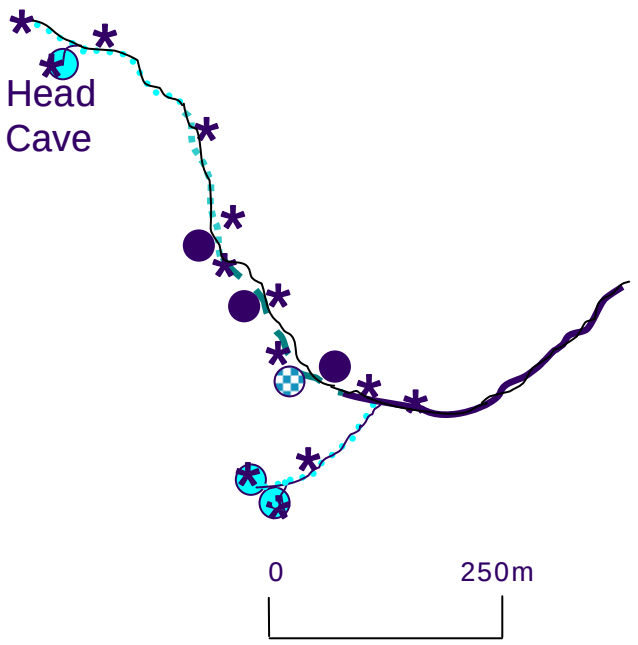
- Lathkill headwaters: ~800m
- Geology of the catchment
  - Carboniferous limestone
  - Karst landscape
- Hydrology of karst rivers
  - Very responsive to inputs
  - Hydrological extremes
    - Streambed drying
    - Spates

Gradient of Intermittency

- Upper reaches, Cales Dale
  = EPHEMERAL
- Downstream
  = INTERMITTENT
- Downstream spring inputs
  = NEAR-PERMANENT
- Downstream further springs & Cales Dale
  = PERENNIAL

○ = spring

* = sampling site



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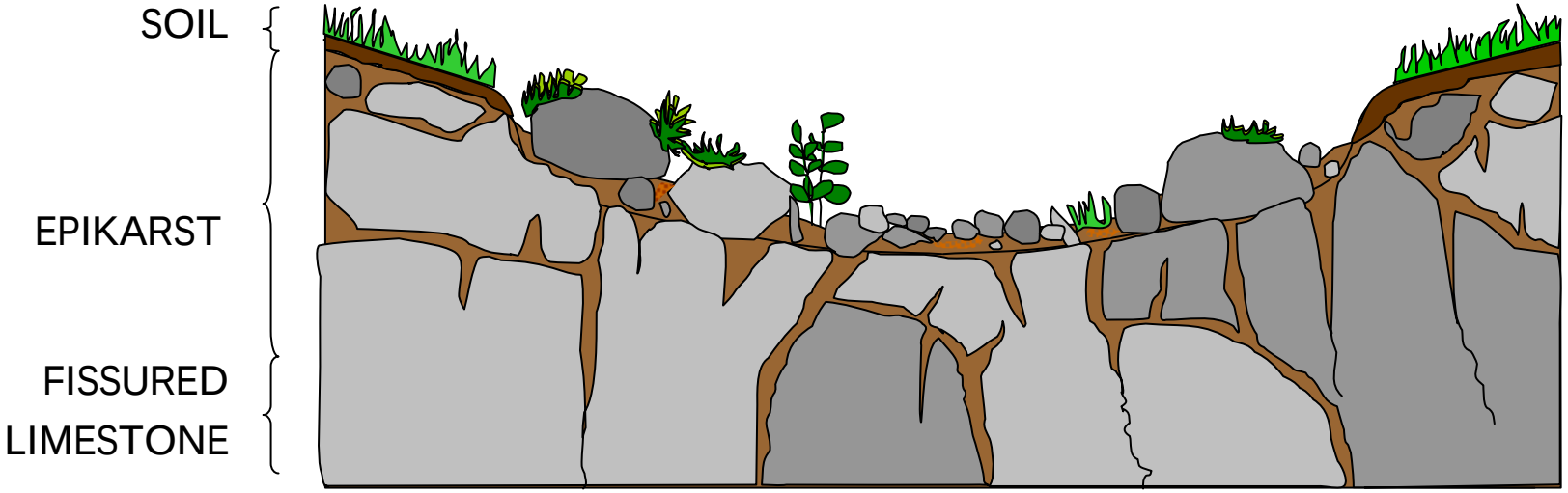
The Epikarst

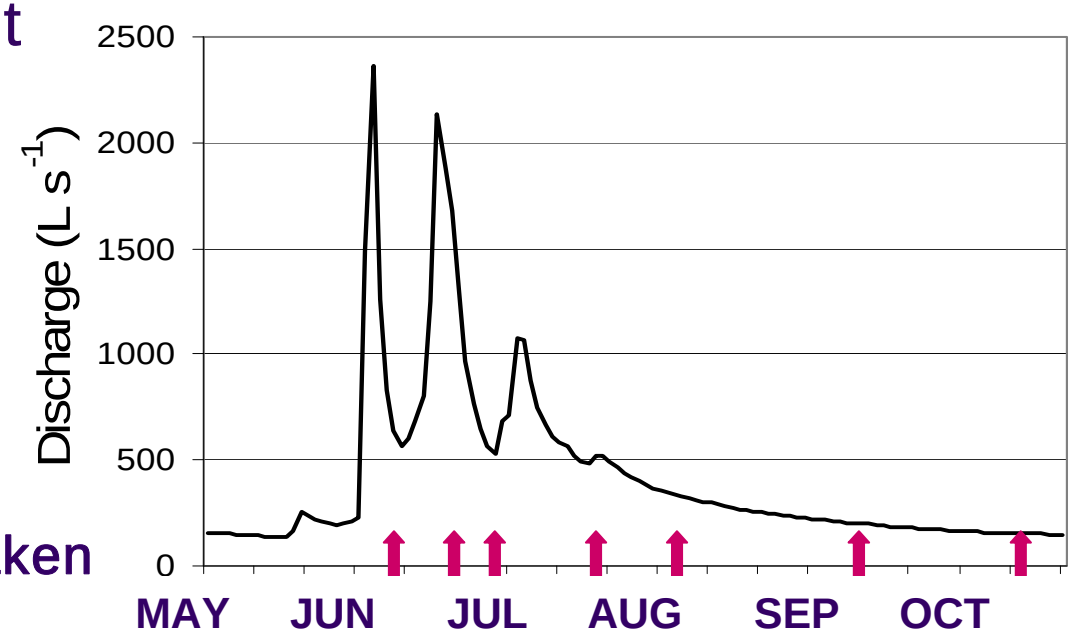
- Surface layer of the underlying karst
- Includes soil, sediment & limestone
- Exposed in the river channel
- New term in ecology

The Epikarst in the Lathkill headwaters:



Hydrological Extremes: Summer ´07

- April: seasonal drying of ephemeral & intermittent reaches
- Wet May – July > flow resumes
- Two spates
- Gradual decline in discharge
- Ephemeral & intermittent reaches dry 9th August

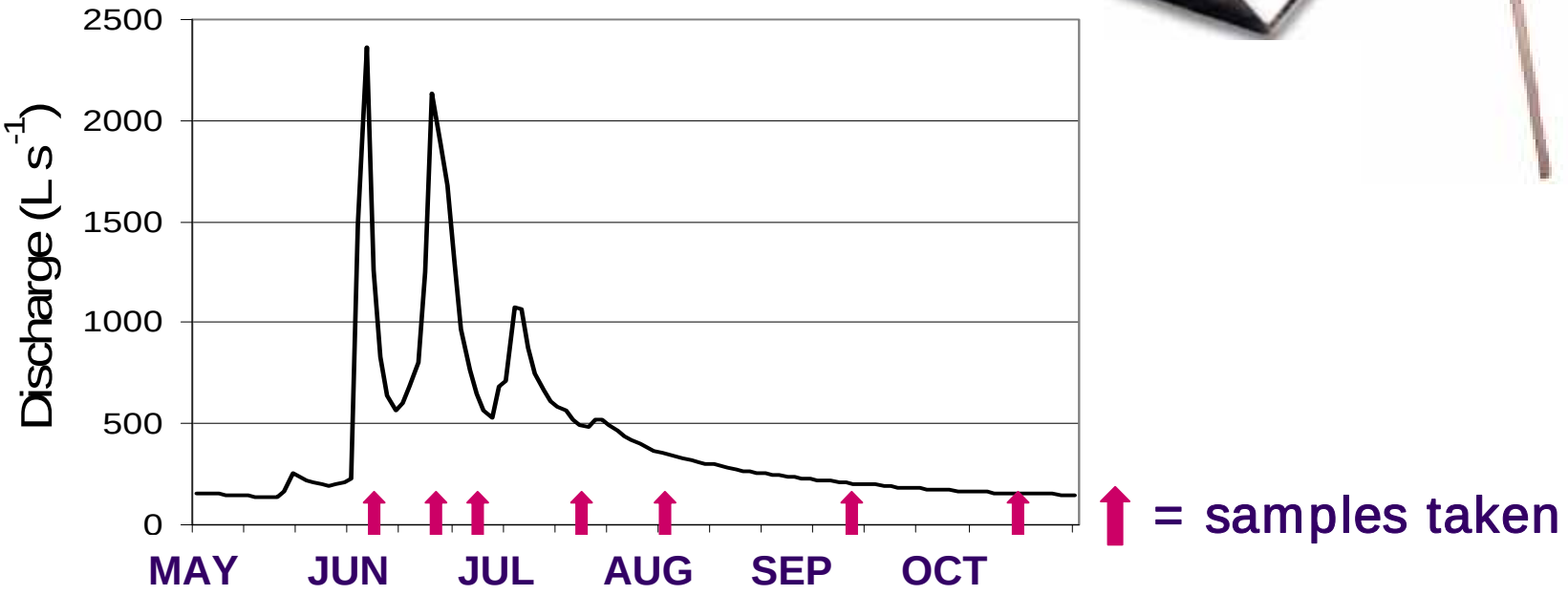


⬆ = samples taken

Sampling techniques

Response to spate & declining flow (Surface flow present):

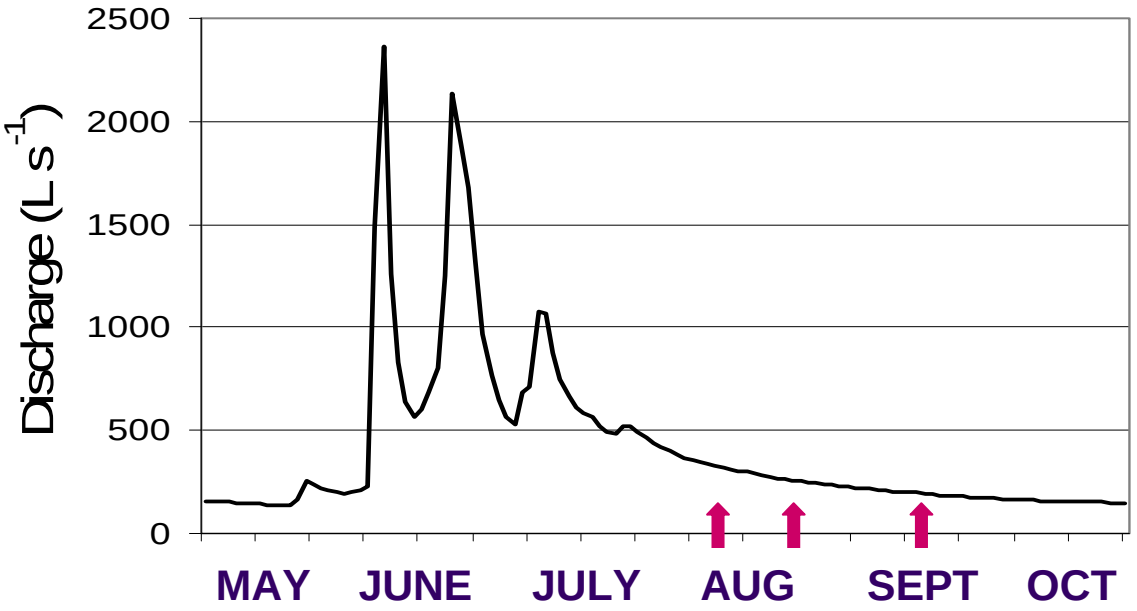
- Surber sampling
- Kick sampling



Sampling techniques

Response to streambed drying (Surface water lost):

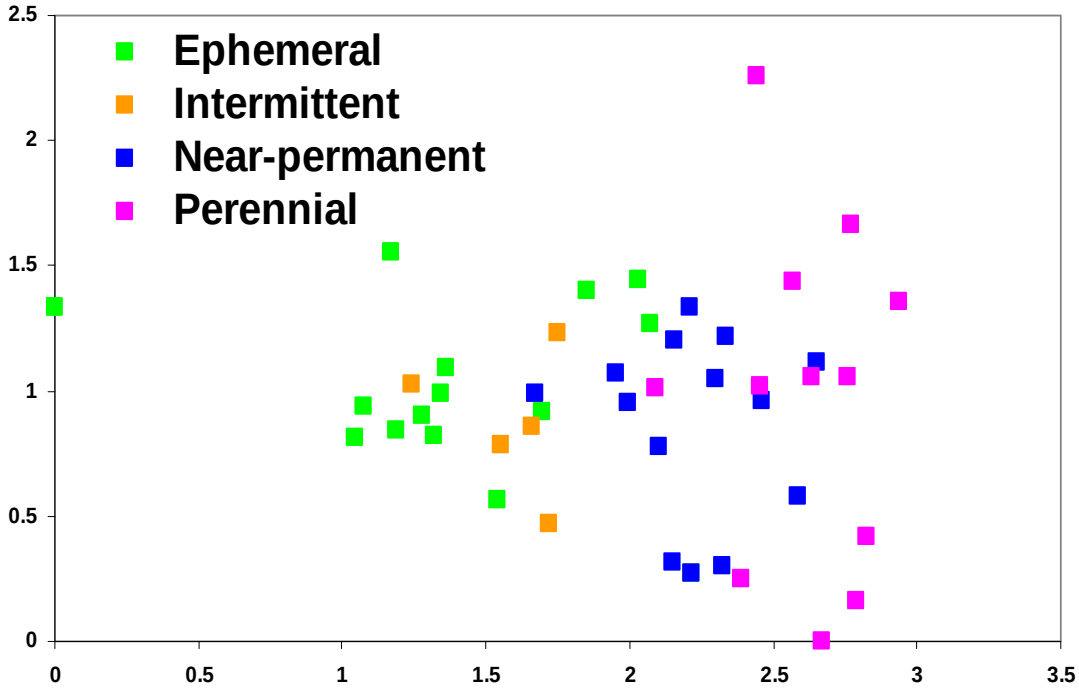
- Excavation of dry sediments
  - Half preserved
  - Half rehydrated (28d)



= samples taken

Results: Gradient of Intermittency

- DCA
- ANOVAs:
- Flow permanence
  + association with:
    - Species richness
    - Total abundance
- Flow permanence
  - association with:
    - Simpson's diversity



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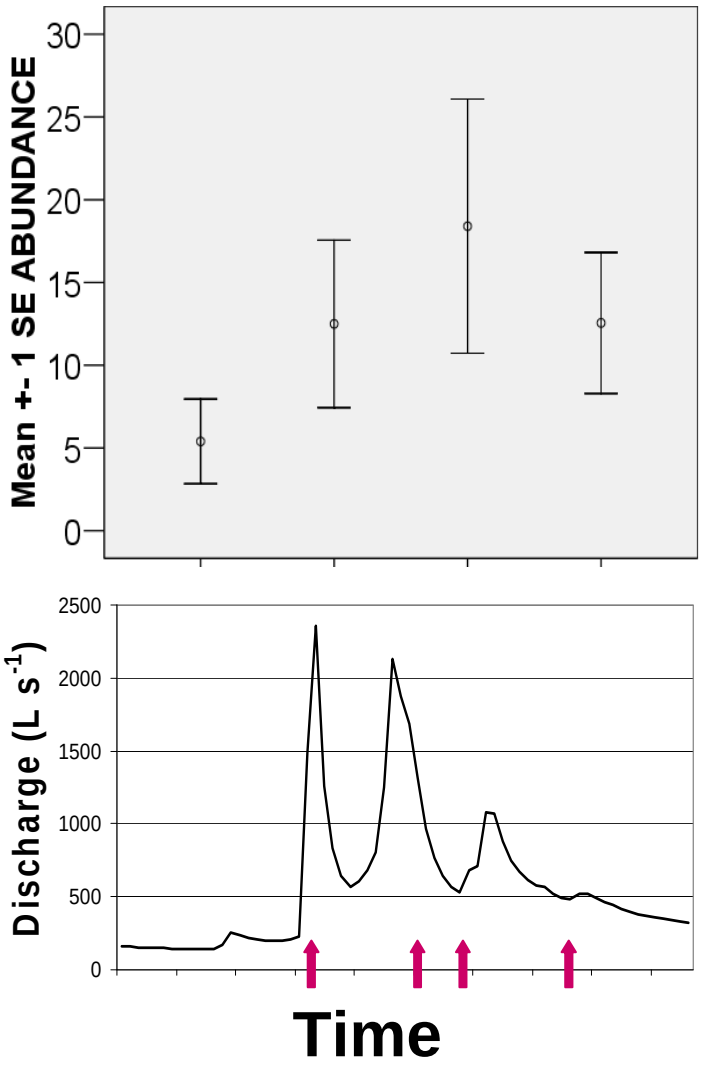
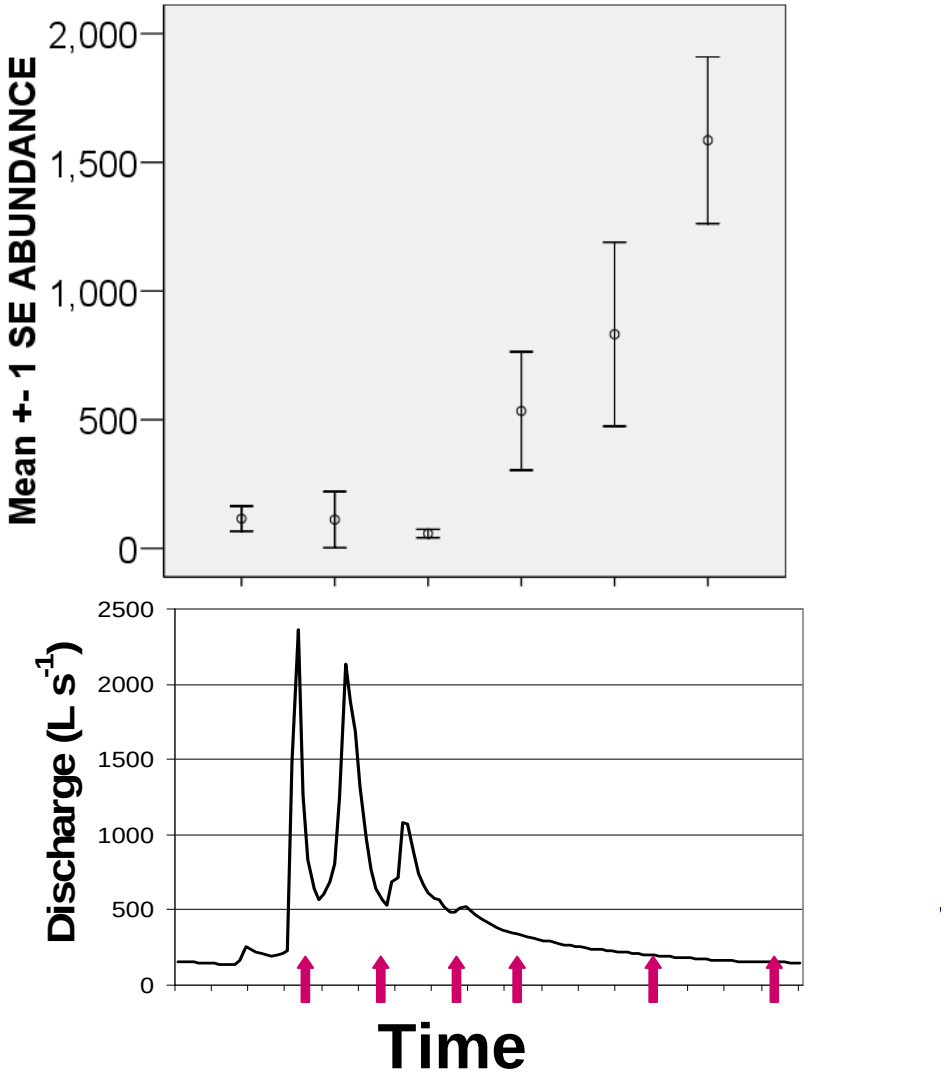
Response to the spate & declining flow: Invertebrate abundance

EPHEMERAL & INTERMITTENT

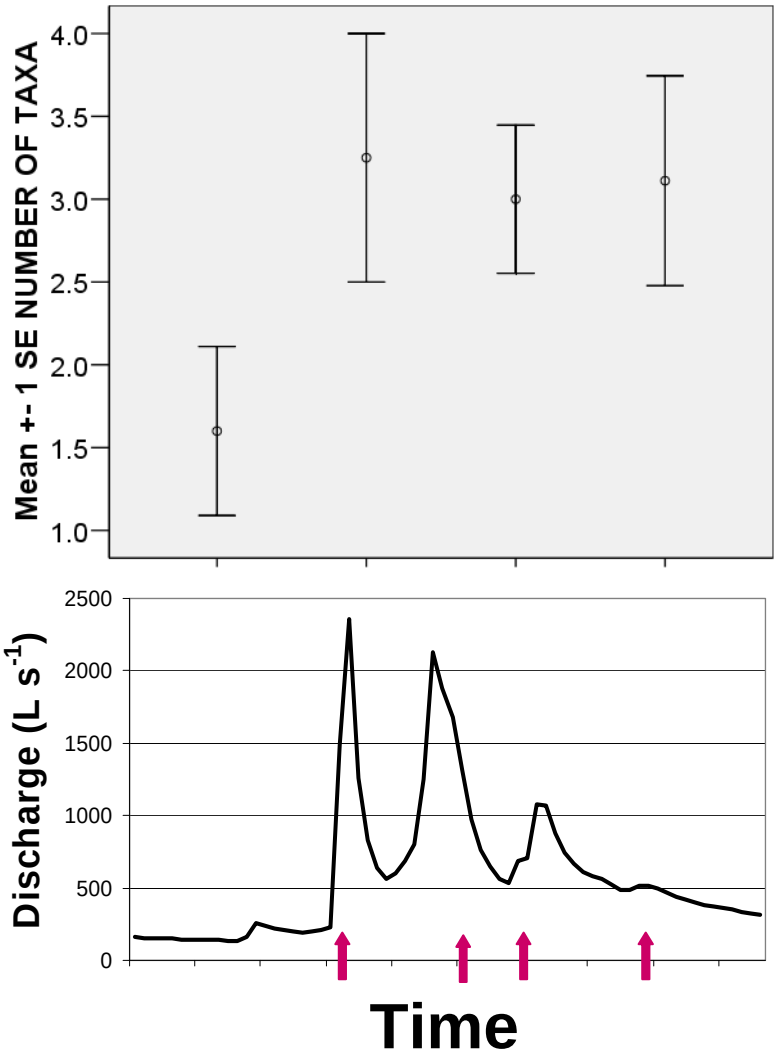


PERENNIAL & NEAR-PERMANENT

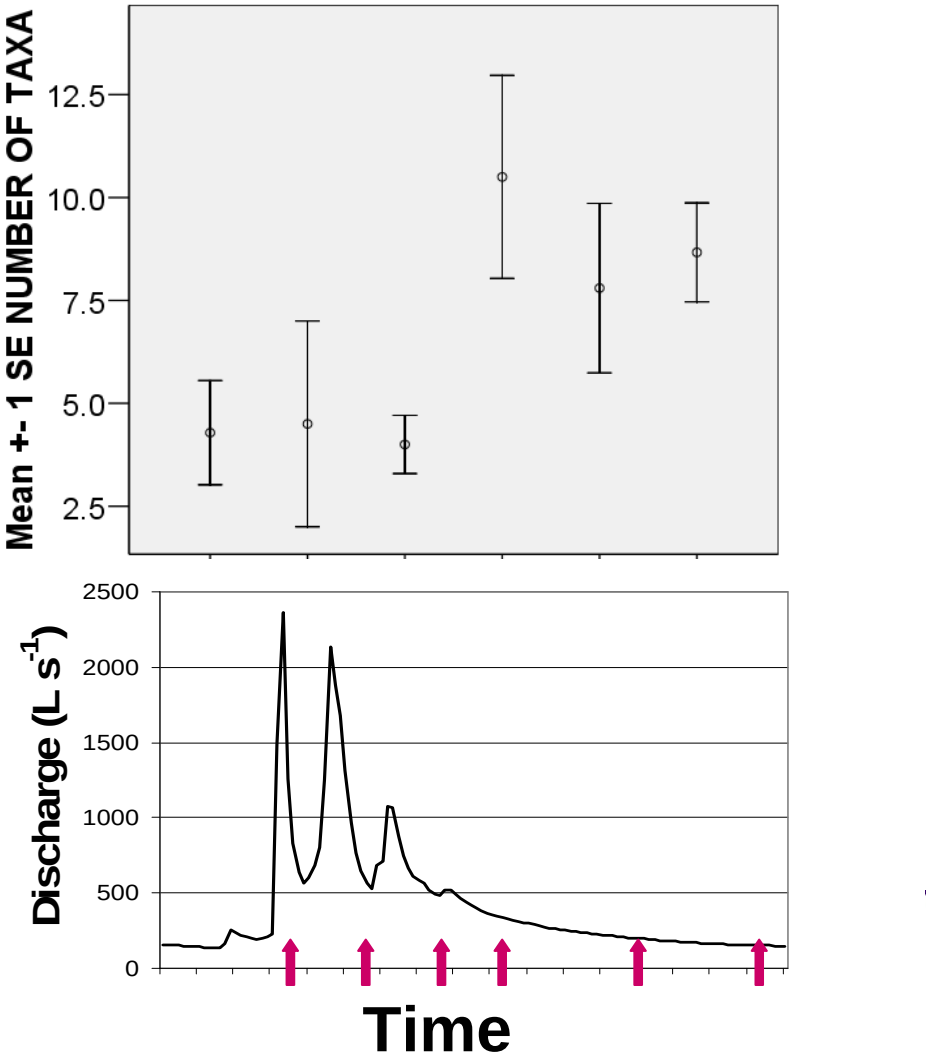


Response to the spate & declining flow: species richness

EPHEMERAL & INTERMITTENT

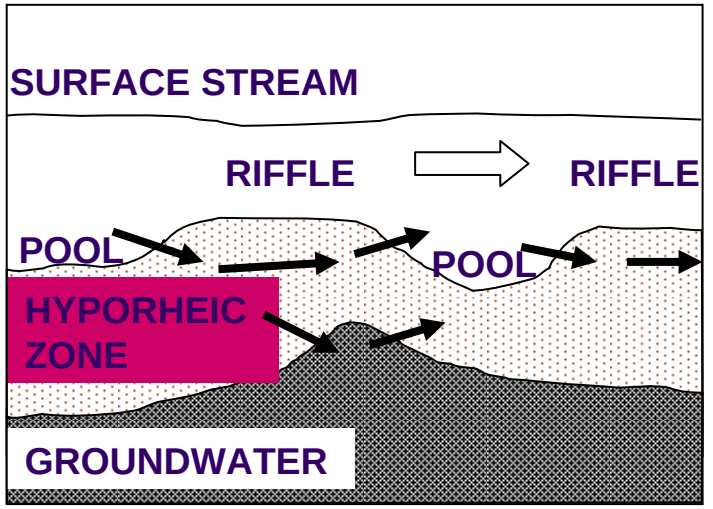


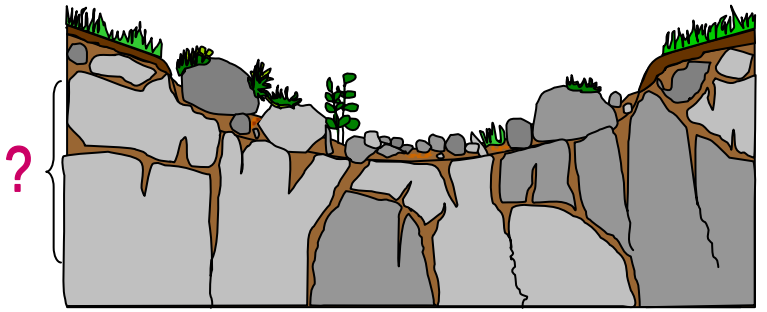
PERENNIAL & NEAR-PERMANENT



Survival of invertebrates following streambed drying: effects of hydrogeology on refugia

- Refugia promote survival during streambed drying
- Drying refugia retain free water or moisture
- Previous work: hyporheic zone can be a refugium
- But not all systems have a hyporheic zone
- Can the epikarst also act as a refugium?





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Recolonisation following flow resumption

Rapid recolonisation of surface channel

Taxa present after 5 days:

Epikarst ✓

Epikarst ✓

Epikarst X

Epikarst X

and after 11 days:

Epikarst ✓

Epikarst ✓

Epikarst ✓

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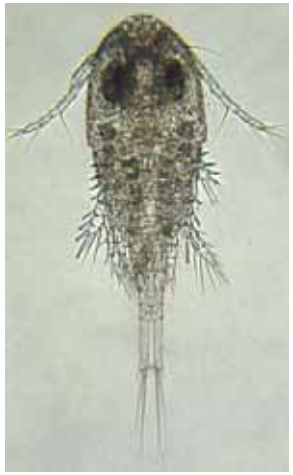
The Epikarst as a Refugium

Invertebrate abundance & diversity in ~38kg dry sediment:

- >3000 individuals
  - Oligochaeta & Nematoda dominated (>64% of all individuals)
  - Sphaeriidae & Cyclopoida also abundant
- 38 taxa from 23 families
  - Chironomidae the most diverse: 13 taxa
- Some survived for at least one month:




Survival in the Epikarst Refugium

- Taxa in preserved sediments must have survived as the observed life stage
  - Various beetle larvae & fly larvae
- Other taxa restricted to rehydrated samples:




- Rehydration may have broken dormancy for these taxa
- Particularly likely for the Chironomidae: larvae,



pupae,
exuviae
& adults present

Summary

- Hydrogeology influences the invertebrate community in karst rivers
- In particular, hydrological extremes shape the invertebrate community
- Hydrogeological character influences the refugia present
- Epikarst can act as a refugium during streambed drying
- Hydrogeology should be central to ecological studies in karst rivers

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Thank you for listening

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