A study of the hypogean fauna in England and Wales

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Introduction

- Background & aims of the project
- Groundwater as a habitat
- Groundwater fauna in England & Wales
- Distribution - our hypotheses
- Wider context & implications

Background – why are we interested?

- Many aquifers contain unique assemblages of groundwater organisms – a habitat.
- WFD requires a more integrated approach to environmental management.
- The new EU Groundwater Directive encourages member states to undertake research on groundwater ecosystems.

Aims

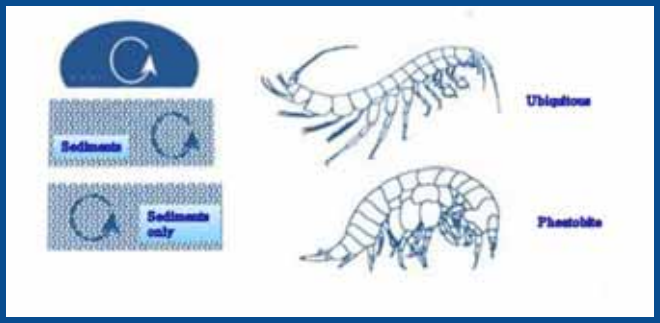
- Establish diversity and distribution of hypogean invertebrates across England & Wales.
- Identify areas where these fauna are likely to be found, based on geological and geomorphological properties. Identify any differences in the type of fauna.
- Identify knowledge gaps and provide supporting evidence for discussions on groundwater ecological conditions.

The groundwater habitat

- Habitat opportunities provided by:
  - Strata with wide pore throats and, or fracture apertures (i.e. karstic, fissured and coarse clastic rocks)
  - At groundwater / surface water interfaces in streambeds (the hyporheic zone) and springs.
- Characterised by:
  - permanent darkness, stable environment, space restrictions and lack of resources – supporting a lower diversity than surface water environment.
  - Low energy inputs, food resources mainly organic matter from external sources, short simple food webs

What are groundwater fauna

- Stygoxens
- Stygophile
- Stygobite



Gibert et al (1994)

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Stygobites

- Globally there a large number of stygobite species (7,700 known stygobite species in 2000). Many are endemic and rare.
- Disperse slowly, have low population densities and slow rates of reproduction (ref. surface water species).
- Faunas of aquifers affected by natural or anthropogenic events are very slow to recover - local extinctions might be irreversible.
- Exhibit morphological convergence (different species resemble one another)

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Stygobites

Niphargus aquilex

Niphargus kochianus kochianus

Niphargus glenniei

Proasellus cavaticus

Crangonyx subterraneous

Copepod

Photographs – by kind permission of Lee Knight and Chris Proctor

Groundwater fauna in Britain

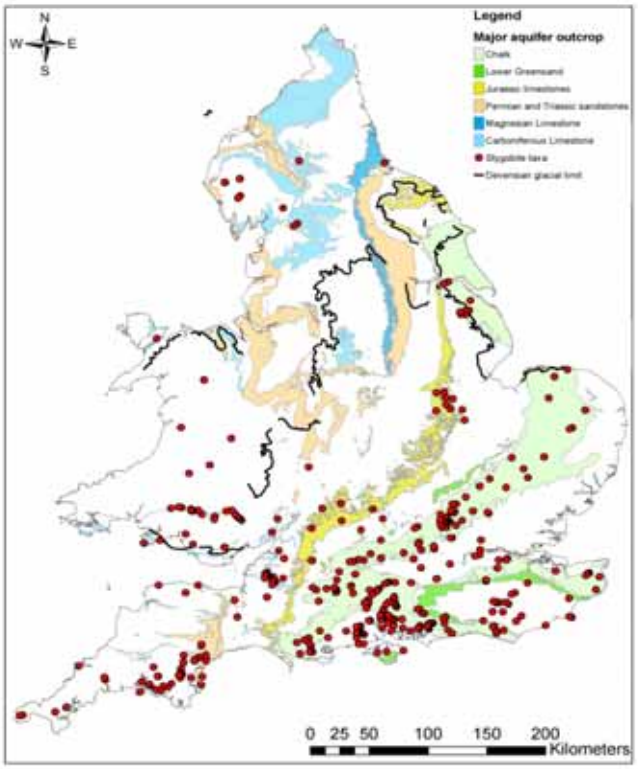
- Examined existing records of stygobites in the groundwater and hyporheic zone in the British Isles
- Records were collated from the Biological Records Centre, the Environment Agency BIOSYS, caving records, peer reviewed literature and personal communications.
- Stygobites recorded in a total of 513 samples.
- Investigated distribution of assemblages and relationships with environmental variables (geology/glacial controls).
- ArcGIS mapping against geology and Devensian glacial limit.

Our hypotheses

1. Stygobites would be found south of the limit of the Devensian glaciation, and less frequently north of that line
2. Stygobites would be present in karstic, fractured and coarse intergranular deposits and in coarse superficial deposits, but absent where the pore spaces are smaller or less well connected
3. Stygobites would be restricted to calcareous aquifers where groundwater is dominated by bicarbonate-type waters

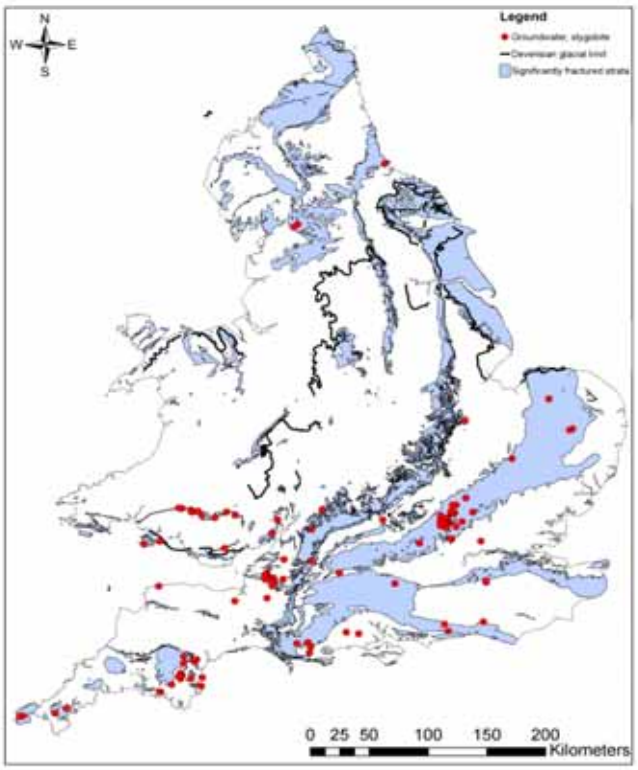
Hypothesis 1:

Stygobite distribution in relation to glacial history



Hypothesis 2:

Distribution in karstic, fractured strata and coarse intergranular deposits and coarse superficial deposits



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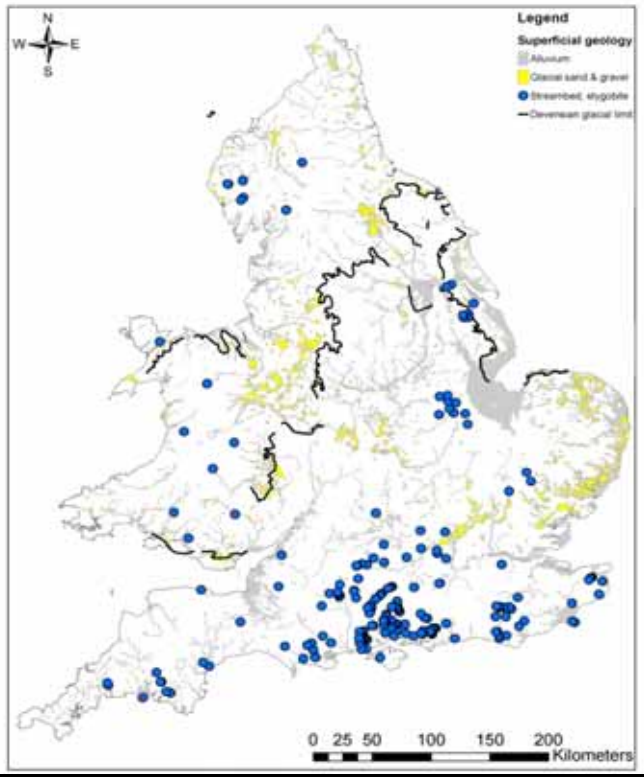
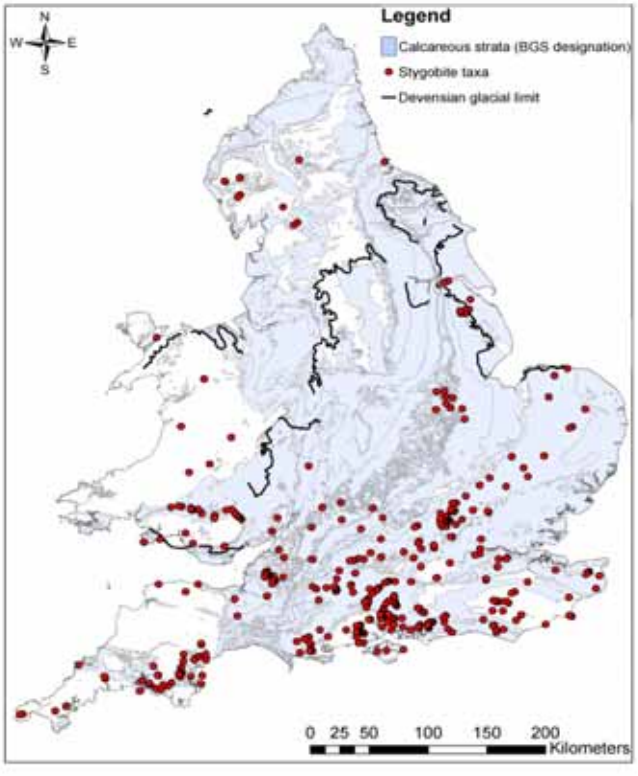


Hypothesis 3

Distribution in calcareous aquifers



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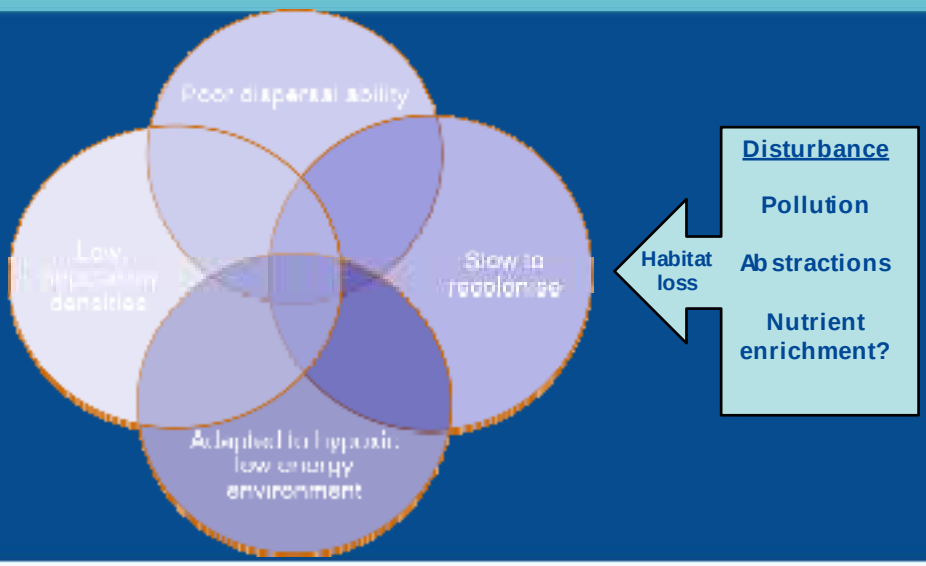
The wider context - vulnerability



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The wider context – functional role

- Physical impact on porosity of material (burrowing)
- Nutrient availability (grazing)
- Transfer of materials and energy (movement)
- Provide biodiversity

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Summary

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Suggested research priorities

- Assess the distribution and composition of GW fauna assemblages in England and Wales - i.e. a systematic sampling programme.
- How do GW fauna respond to pollution &/or abstraction pressures? Quantify ecological role of GW fauna; implications for harming them.
- Are the methods developed to monitor the 'health' of epigean assemblages good proxies for hyporheic and GW habitats?
- How best to deal with endemic species and a spatially variable species distribution when considering a ecological quality of GW?

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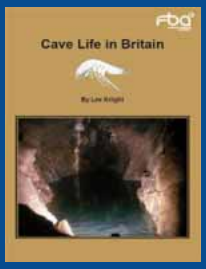
Publications



ENTER PASCALIS

http://publications.environment-agency.gov.uk/pdf/SCHO0408BNYC-e-e.pdf

http://www.fba.org.uk/recorders

http://serv-umr5023.univ-lyon1.fr/~pascalis/index.html

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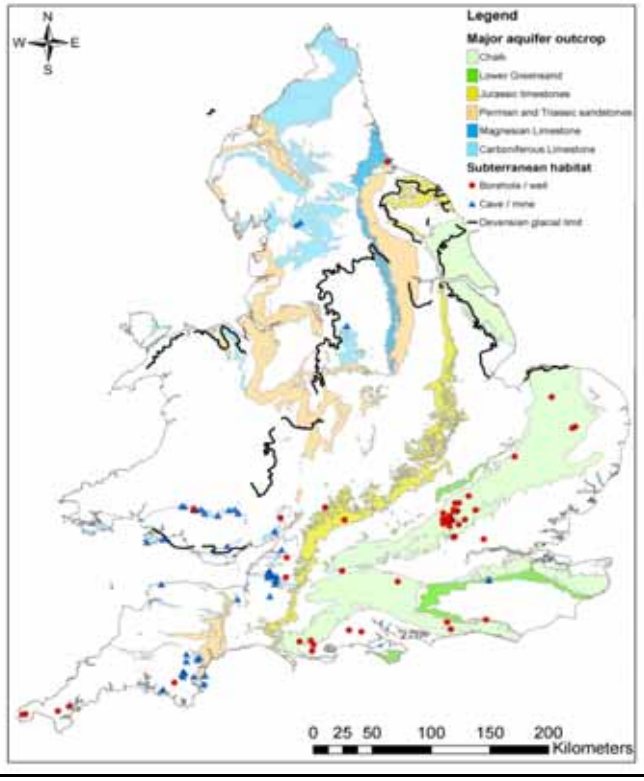
Distribution in major aquifer outcrops



Stygobites in Britain

Amphipoda

Niphargidae

Niphargus aquilex
Niphargus fontanus
Niphargus glenniei
Niphargus kochianus kochianus
Niphargus kochianus irlandicus
Niphargus wexfordensis

Crangonyctidae

Crangonyx subterraneus

Isopoda

Proasellus cavaticus

Syncarida

Antrobathynella stammeri

Copepoda

Cyclopoida

Acanthocyclops sensitivus

Ostracoda

Pseudocandona eremita

Arachnida

Hydrachnellae

18 species