A study of the hypogean fauna in England and Wales

- Tim Johns  Environment Agency
- Anne Robertson  Roehampton University
- Jonathan Smith  Environment Agency

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)
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)

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
Hypothesis 2:
Distribution in karstic, fractured and coarse intergranular deposits and coarse superficial deposits

Hypothesis 3
Distribution in calcareous aquifers
The wider context - vulnerability

- Disturbance
- Pollution
- Abstractions
- Nutrient enrichment?

The wider context – functional role

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

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?
Publications

http://www.fba.org.uk/recorders
http://serv-umr5023.univ-lyon1.fr/~pascalis/index.html

Acknowledgements

- Dr Anne Robertson, Roehampton University.
- Thanks to Lee Knight (Subterranean Crustacean recorder) and Graham Proudlove for access to BRC data
- Thanks to Dr C Extence, Dr B Brierley (EA), Dr P Wood (Loughborough University), Terry Gledhill (FBA), Dave Horne (QML) and colleagues in the NERC Hyporheic Network for helpful discussions (www.hyporheic.net)
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