

Macroinvertebrate use of the hyporheos during a supra-seasonal drought

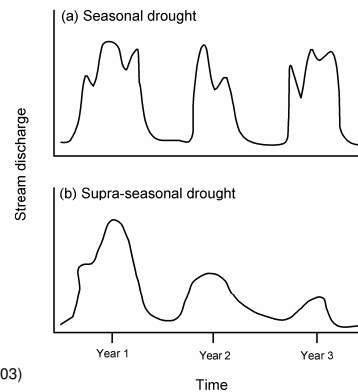
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Seasonal and Supra-seasonal Drought



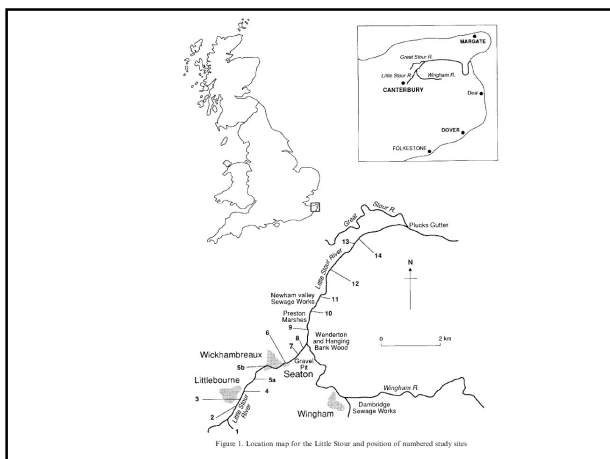
After Lake (2003)

Supra-seasonal droughts in the UK

- Since 1854 there have been 10 supra-seasonal droughts that have impacted England and Wales.
- Since 1970 there have been 4 national supra-seasonal drought events (1975-1976; 1990-1992; 1995-1997 and 2004-2006).
- Supra-seasonal events have significant impacts on groundwater aquifers (chalk and limestone), drinking water provision and surface flows in riverine ecosystems.

Supra-seasonal Drought - Little Stour (Kent)

- Little Stour River (Kent) - perennial chalk stream.
- Parts of the perennial river have become dry in previous supra-seasonal droughts (1947-1949; 1990-1992 and 1996-1997).
- Benthic macroinvertebrate community of the Little Stour River (Kent) has been studied to examine the influence of low flow variability since 1992.



Little Stour (supra-seasonal drought - 1992)



Little Stour ('normal' - 1994)



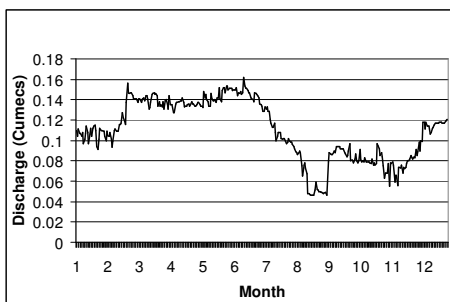
Hyporheic refuge

- Hyporheic refuge hypothesis – Palmer et al. (1992).
 "... recovery is facilitated by behavioural migrations during **floods** down into the hyporheic zone (the interstitial spaces of the stream bed) to seek temporary refuge" p182.

Hypothesised refugia for a range of disturbances – flood, drought and a range of pollution types.

However evidence is patchy for droughts – contradictory data for naturally intermittent systems, largely untested within perennial lotic ecosystems.

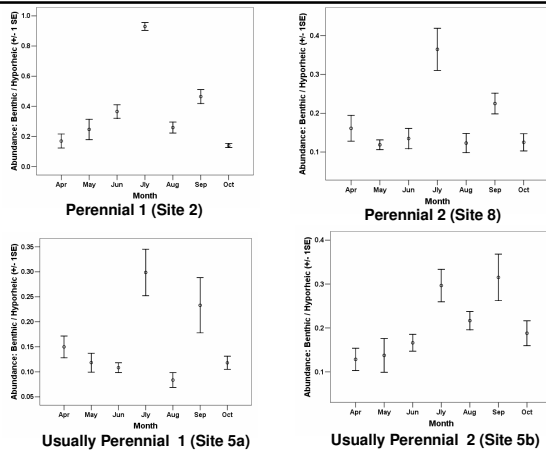
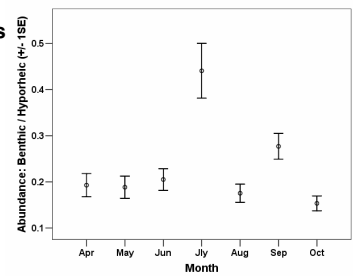
River Discharge – Little Stour (Littlebourne) 2006



Hyporheic Refuge?

Marked increase in the proportion of individuals within the Hyporheos in July and September

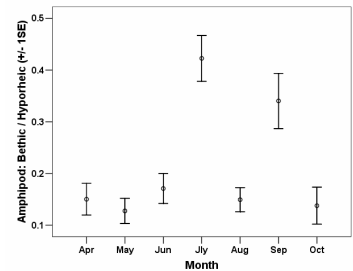
Kruskal-Wallis $P > 0.001$

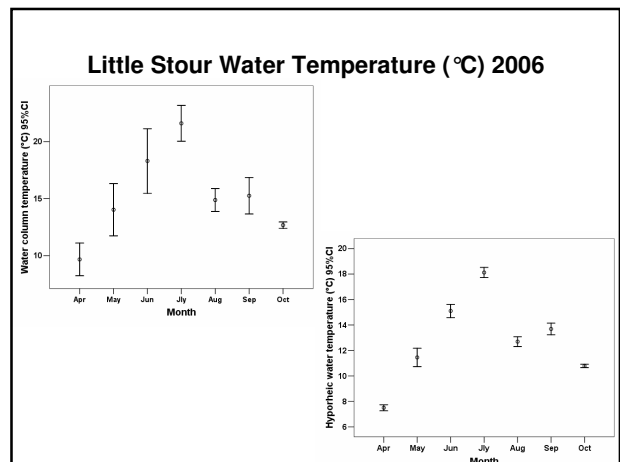
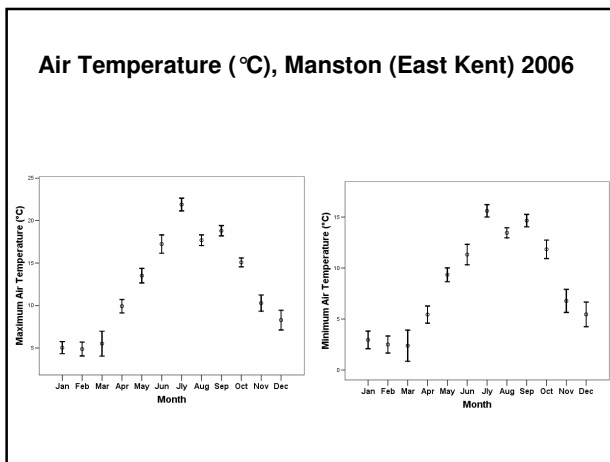
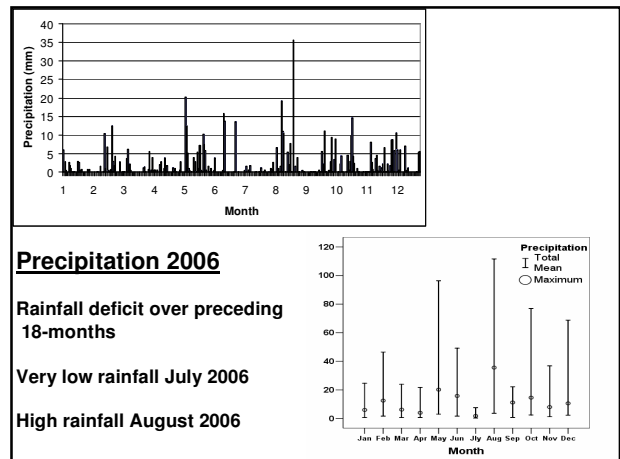
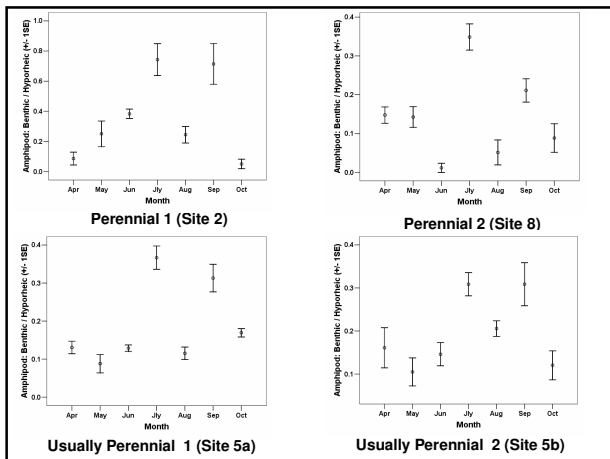


Amphipods (*Gammarus pulex*)

Gammarus pulex abundant in benthos and most common benthic taxa within the hyporheos

Kruskal-Wallis $P > 0.001$





- ### Summary
1. Benthic macroinvertebrates utilised the hyporheos as a refuge at several points during the drought.
 2. River flow (discharge) does not appear to be the only factor influencing benthos use of the hyporheos as a refuge.
 3. Temperature (air and water) appears to be a trigger for increased benthos utilisation of the hyporheic refuge.
 4. Some taxa, such as *Gammarus pulex*, constitute a significant proportion of the benthic individuals within the hyporheos and may be particularly sensitive to changes in water temperature.

- ### Acknowledgements
- Natural Environment Research Council (NE/E001769/1) – ‘The response of aquatic invertebrate fauna to supra-seasonal drought and drying in a largely perennial chalk stream’.
 - British Atmospheric Data Centre for provision of meteorological data.
 - Environment Agency (Shelagh Wilson, Ian Humpheryes and Kevin Grimmett).
 - Terry Gledhill - Freshwater Biological Association.

Groundwater/Hyporheic Ecology in the UK

- **Historic – Primarily within Caves 1938-1978**
 - Biological Recorded of British Cave Research Group (Mary Hazelton). Published in 15 Volumes
- **Terry Gledhill – Hyporheic research (1970's)**
Waterston water cress beds (1969-1974)
- **Widely assumed UK fauna is known, poor compared to mainland Europe, and of little wider ecological interest**

Little Stour – Obligate hyporheic taxa

Macroinvertebrates

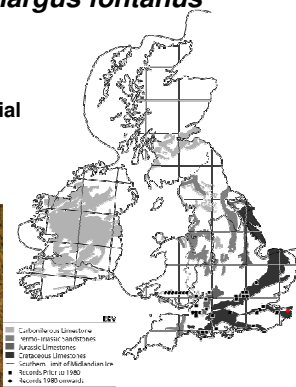
Crustacea – *Niphargus aquilex*,
N. fontanus
N. kochianus kochianus
Crangonyx subterraneus
Proasellus cavaticus
Others???

Meiofauna ??

Copepoda, Ostracoda,
Hydracarina

Niphargus fontanus

62 Sites
23 Lotic / interstitial
39 Caves



Niphargus aquilex

137 Sites
123 Lotic / interstitial
14 Cave

