Within-catchment variation in stream invertebrate growth patterns: influence of riparian cover and stream temperatures on *Baetis rhodani* (Ephemeroptera)

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2. Objectives

- Assess whether intra-catchment variations in riparian cover result in differences in stream temperature
- Assess whether differences in the thermal regime relate to variations in growth or life cycles patterns of *Baetis* (Figure 1)

Figure 1: Habitus of Baetis sp. ; Left: Larva in freshwater; Right:: Adult

3. Methodology

- The study catchment was the Girnock Burn in the North-East of Scotland
- Temperatures were collected over a period of 12 month at 5 different sites with different riparian cover (Figure 2)
- Sites differed mainly in riparian cover with: Open moorland (Hampshire Bridge (HB), Open Water (OW)); Single/Double tree line (Forest Water (FW)); Semi natural broadleaved woodland (Littlemill (LM), Forest Automatic Weather Station (FAWS))
- Monthly invertebrate samples (kick sampling) were taken to evaluate the differences in mean length and size frequency distribution in relation to the observed thermal regime

1. Introduction

- Thermal habitat has been shown to play a vital role in the biology of aquatic organisms
- Rivers with dense riparian cover are characterised by a damped thermal regime, with lower mean temperature and restricted diurnal fluctuation
- Few empirical studies have assessed the ecological implication of thermal regimes altered in these ways
- Not only are such studies useful for assessing the importance of riparian management for stream ecosystems, but they may provide insights into its role in helping to mitigate the effects of predicted warmer climate

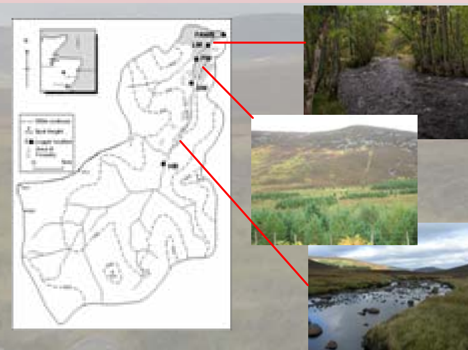

Figure 2: Girnock Burn catchment and the location of the study sites.

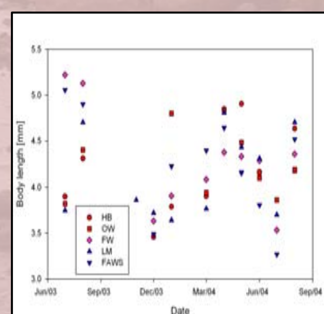

Figure 5: Sizes of *B. rhodani* at study sites during sampling period. In missing month not enough individuals were caught

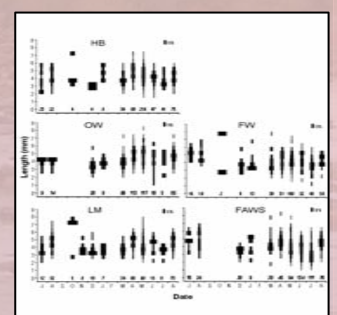

Figure 6: Frequency distribution of the body length and individual numbers of *B. rhodani* for all sites. In missing month not enough individuals were caught

4. Results

Thermal regime

- Inter-site difference became most prominent at maximum temperatures during the summer with a convergence during cooler periods (Figure 3)
- Mean daily temperatures varied up to 2.4°C and maximum daily temperatures up to 8°C between sites
- Sites with forest and moorland riparian vegetation could be differentiated according to the degree of attenuation observed at higher temperatures during the summer month (Figure 4):

Coolest to warmest: FAWS/LM (woodland) > FW (intermediate) > HB/OW (moorland)

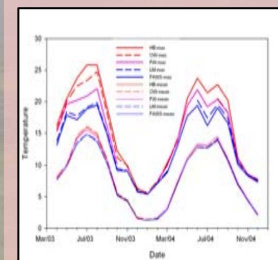

Figure 3: Monthly maximum temperatures (°C) for all study sites in the Girnock Burn from 04/03 – 12/04

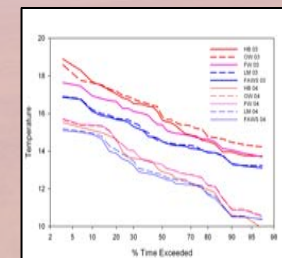

Figure 4: Mean daily temperature (°C) duration curve for July 2003 and July 2004 for all study sites in the Girnock Burn

Invertebrates

- Observed significant differences in mean body length did not reflect the site-grouping on the basis of the thermal differences
- All significant inter-site differences for *B. rhodani* length occurred during the summer (Figure 5)
- FAWS (broadleaved) and OW (open moorland) being the two sites most consistently different from each other in *B. rhodani* length
- Adult emergence patterns occurred during May-July (Figure 6)
- Size frequency distributions varied significantly (Kolmogorov-Smirnov; $p<0.005$) between sites in May, July and August; HB and FAWS being consistently different from each other
- Frequency distribution differed between FAWS/LM and HB/OW but never between FAWS and LM

5. Conclusions and Implications

- The presence of an extensive broadleaved tree canopy in the alluvial forest section of the Girnock Burn strongly influences the net radiation which dominates stream energy inputs during the summer months resulting in a moderated thermal regime. Evidently, riparian planting offers great potential for mitigating higher temperatures and protecting stream habitat conditions (Malcolm et al., 2008)
- Although lower/ moderated temperature means less time for development, site specific factors such as food availability and quality, population density and response to predation can overrule effect of subtle thermal differences
- Most inter-site differences, especially in size frequency distribution, occurred at times of adult emergence, which suggests that emergence patterns could be more directly influenced by the apparent thermal regime. This will be investigated at various spatial scales in future studies in the Girnock Burn

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References
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