

Groundwater influence on the ecological integrity of hyporheic invertebrate communities in upland streams

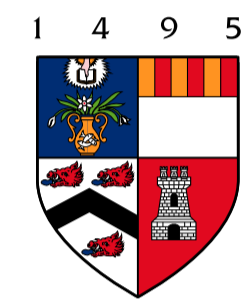
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Figure 1: The Girnock Burn



1. INTRODUCTION

- Very few studies in the British Isles have attempted to look at the hyporheic ecotone, and very little is known about the nature and community structure of the hyporheic denizens of Scottish head water streams.
- Hard to characterise because of (1) difficulties associated with sampling beneath streambed and (2) the dynamic nature of groundwater surface water interactions and associated hyporheic physiochemistry.
- Despite the above this study aims to produce a preliminary investigation into the relationship between hyporheic invertebrate community structure and the dynamic influence of groundwater-surface water interactions on hyporheic water quality in the Girnock Burn, Cairngorm Mountains, Scotland. (Figure 1)

2. STUDY SITE

Girnock Burn is a 30km² tributary of the Dee river system, Aberdeenshire. (Figure 2)

- Altitudinal range between 230 and 862m
- Solid geology, primarily granites and schists
- Solid geology overlain by various glacial and fluvio-glacial sediments
- Rainfall ca. 1200mm
- Flashy hydrological regime



Figure 2: Location of Girnock Burn

3. METHODOLOGY

- Based on previous studies carried out by our hydrology group two contrasting reach types were selected: groundwater dominated and surface water dominated.
- At each of the two sites 9 hyporheic chambers were inserted (in a 3 x 3 grid spaced at 1.5m intervals spanning the width of the channel) into the stream bed. (Figure 3) Each chamber extended 45cm into the bed and comprised of 3 stacked, 15cm long, gravel filled sub-chambers which were open to invertebrate colonisation and also contained water quality sampling devices. (Figure 4)
- From Nov 2005 – July 2006 water quality samples were taken at fortnightly intervals.
- Water samples were analysed for dissolved oxygen (DO), Gran alkalinity, chloride and temperature.
- Time series of hyporheic chemistry were analysed for the different chambers, depths and reach types.
- Seasonally (Winter, Spring and Summer) colonisation chambers were removed from the stream bed and their invertebrates collected for later identification.
- Microscopy techniques are currently being used to identify individual invertebrates down to species level where possible.

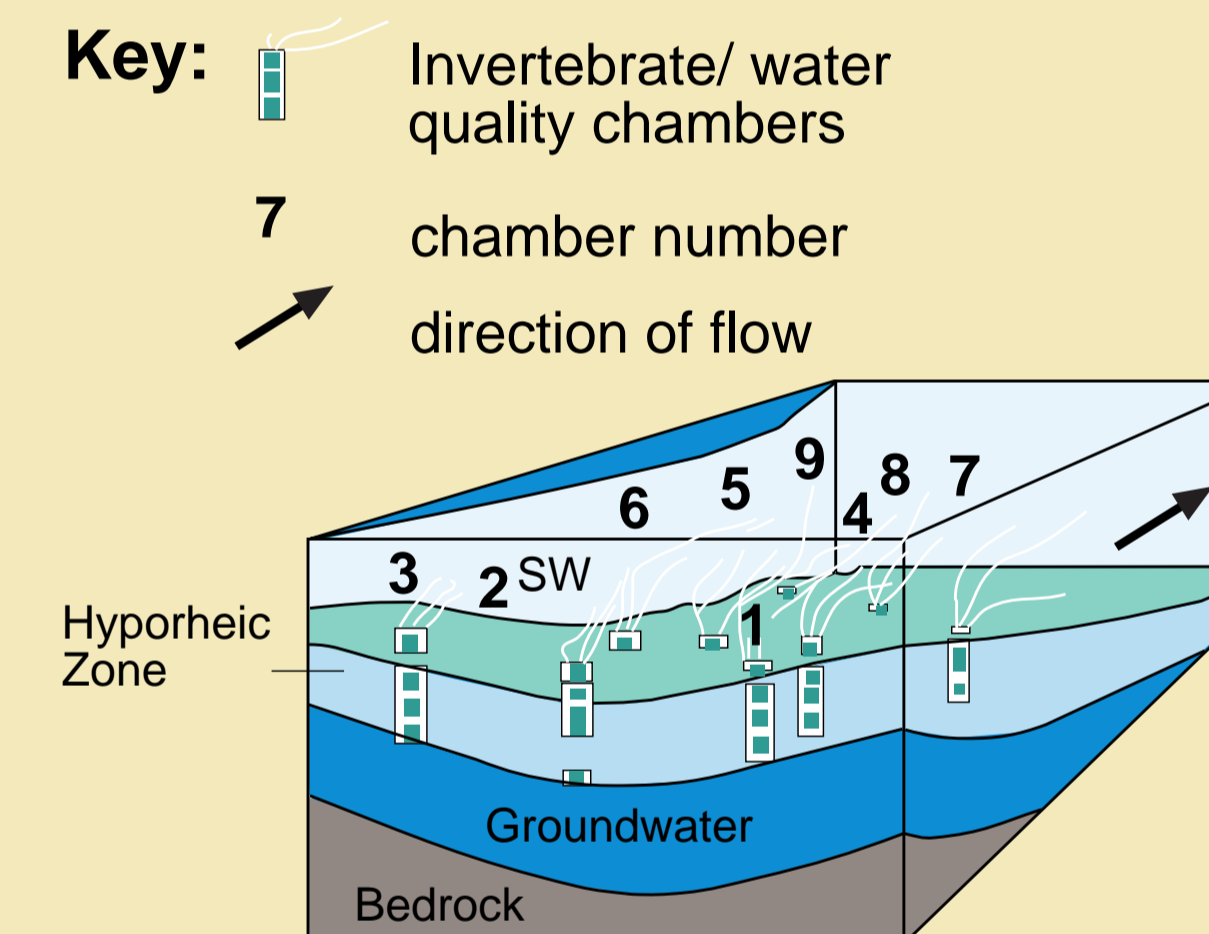


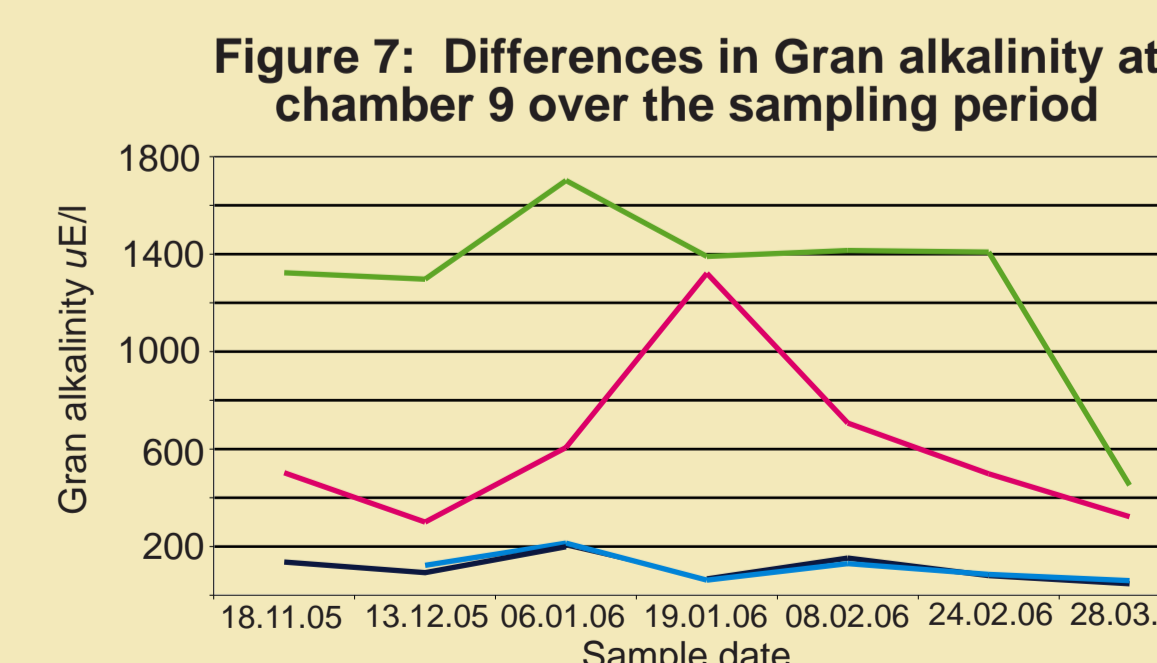
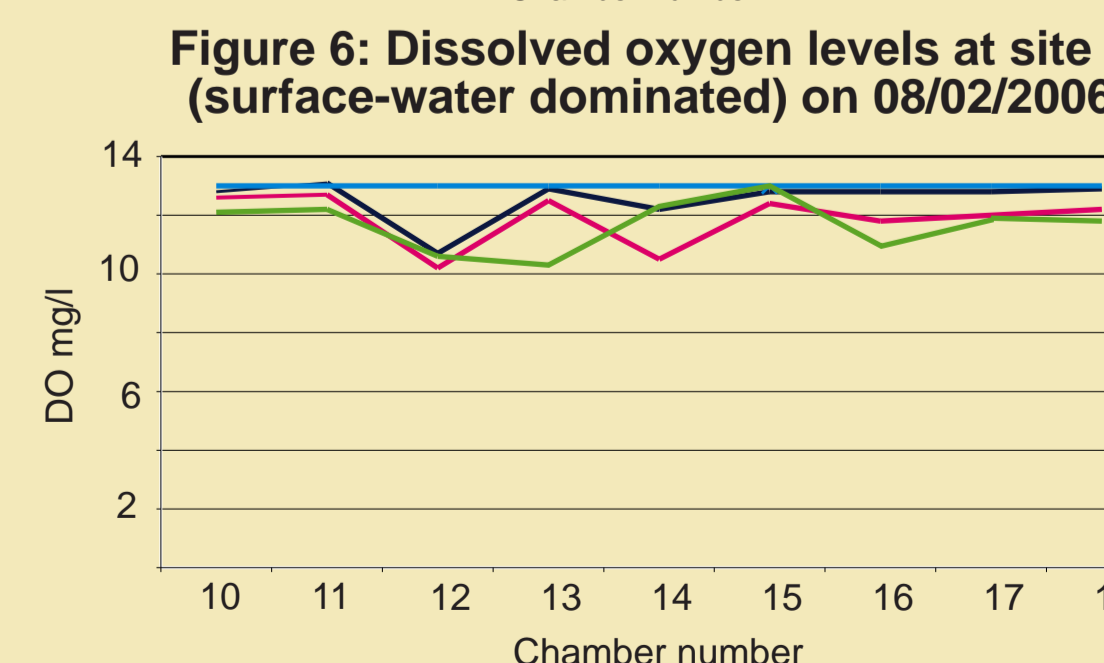
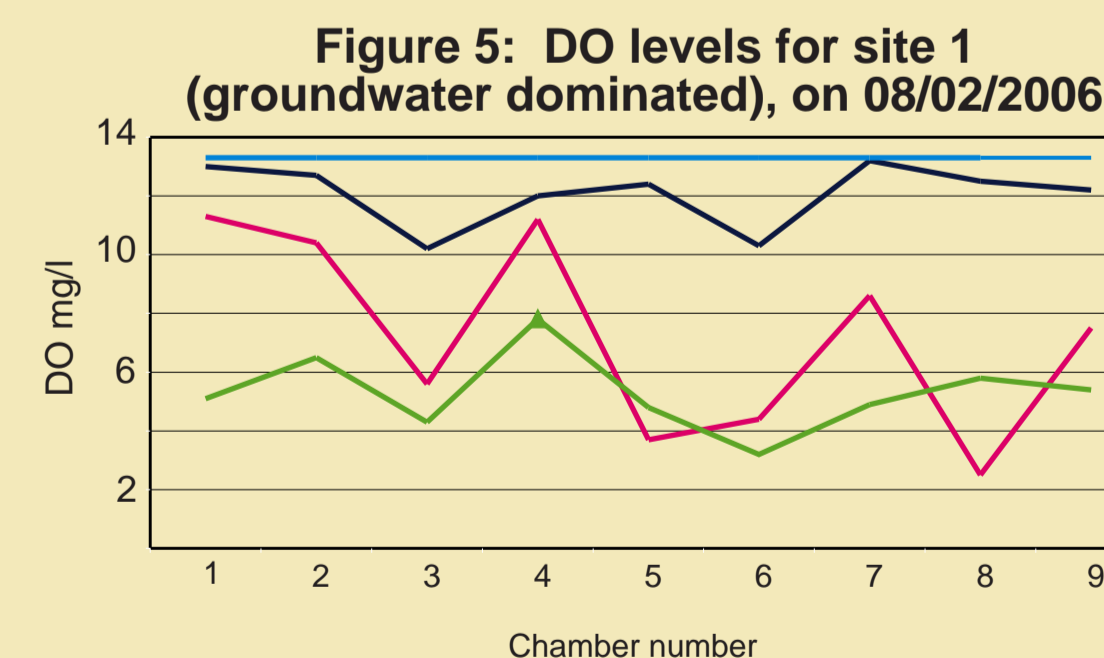
Figure 4: Diagram of the hyporheic chamber sampling grid



Figure 3: Hyporheic chambers containing water quality devices

4. RESULTS

- There were distinct spatial (lateral and vertical) and temporal differences in levels of DO, Gran alkalinity and temperature recorded in the upwelling groundwater sites. (Figure 5)
- These differences were less marked at the surface water dominated site (Figure 6), however during certain hydrological events vertical stratification of water quality DO and alkalinity became more pronounced. (Figure 7)
- At present preliminary results for the hyporheic community structure shows that there is a distinct seasonal intra and inter-site variation in population numbers present in the interstitial sediments of the hyporheic chambers.
- At present ongoing identification of invertebrates means that all the data will not be analysed until late this year.



5. CONCLUSIONS SO FAR

- The hyporheic zones of Scottish upland streams are complex physiochemical environments. Differences in groundwater-surface water exchange can significantly influence the hydrochemistry of hyporheic zone on the meter to centimetre scale.
- Upwelling reaches exert different hyporheic chemical conditions on the invertebrate assemblages and thus may have very different hyporheic community structures than downwelling reaches.
- This preliminary insight into the hyporheic zone of upland streams provides the basis for ongoing work that will provide useful information to aid the management of riverine habitats and their associated biodiversity.