Gloucestershire headwater streams – site visits, May 2015

Bubblewell and Shard streams

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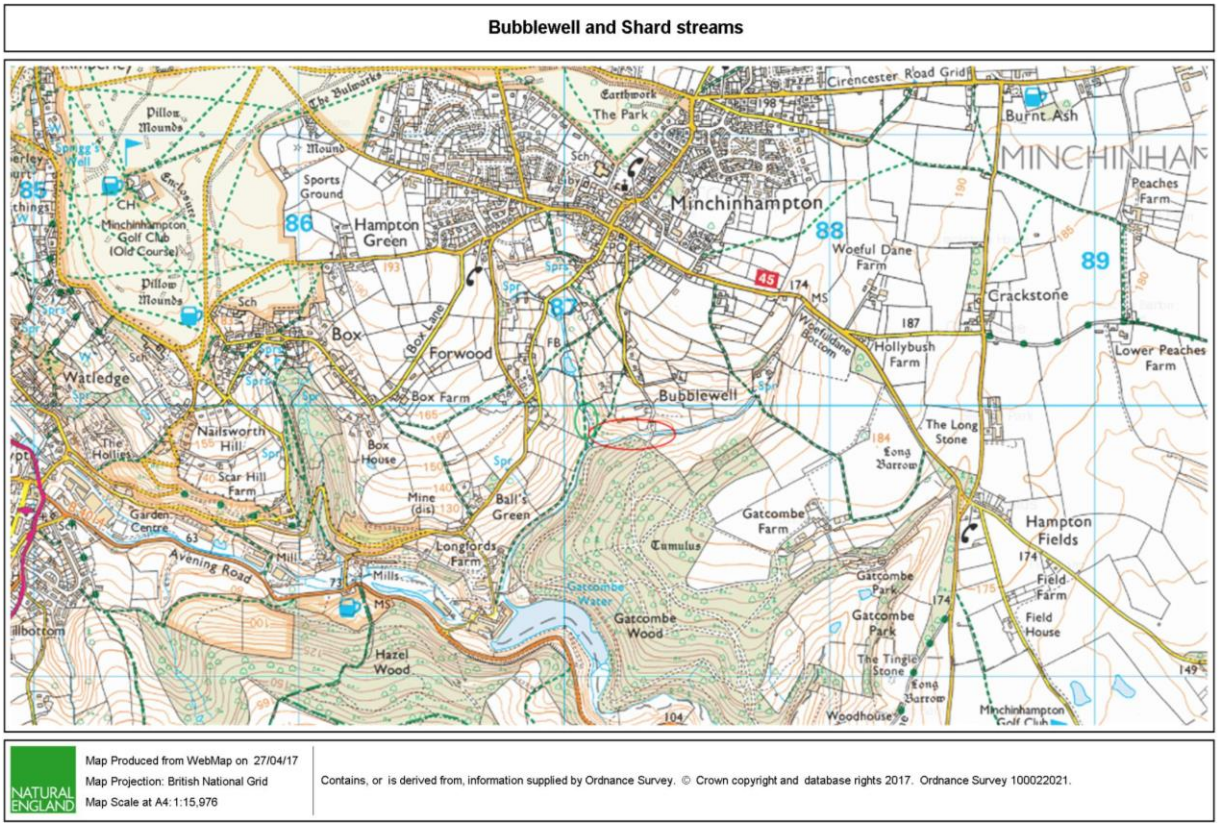
The streams visited form part of the headwater system of the Nailsworth Stream, which flows into the Frome around Stroud. We walked along the Bubblewell stream at the northern perimeter of Gatcombe Wood (ST 872 999), going upstream until in open fields. Then we walked downstream to the confluence with the Shard stream (ST 871 999), and up that stream towards Minchinhampton for 100 metres.



Map showing the area inspected. Red circle shows the Bubblewell stream section, green circle shows the Shard stream section.

The Bubblewell stream through Gatcombe wood, is highly natural, with abundant woody debris forming debris dams and capturing leaf litter, creating a good habitat mosaic with coarse and finer substrates and depth variation (Figure 1). This habitat mosaic provides the diversity of niches needed to satisfy the needs of characteristic invertebrate species including their different life stages. The abundant leaf litter

provides the foundation for the characteristic food web of such streams, based on shredding invertebrates providing access to the nutrients tied up in the leaves.

Figure 1. Bubblewell stream in Gatcombe Wood, showing the effect of woody debris in habitat formation in the channel.

Upstream of Gatcombe Wood, the stream runs through semi-improved grassland (Figure 2), providing contrasting open conditions more suited to the development of a higher plant assemblage within the stream channel and its banks. The shallow channel cross-section is indicative of a lack of significant drainage operations, and allows marginal species such as brooklime and fool's water-cress to encroach into the channel through the summer flow recession. The open character of the stream is repeated below Gatcombe Wood around the confluence with the Shard stream.

Figure 2. Bubblewell stream upstream of Gatcombe Wood.

Brief kick-sampling of the macroinvertebrate community was undertaken at points within Gatcombe Wood, and downstream of the wood prior to the confluence with the Shard stream. This revealed a diverse assemblage for headwater streams (which are generally relatively species-poor compared to stream and river sections further downstream), reflecting the good water quality and natural habitat mosaic within the channel and banks. The sample included stoneflies, caseless and cased caddis-flies, mayflies, freshwater shrimps, molluscs and tipulids.

The influence of leaf-litter on the food web was very apparent, with leaf-shredding freshwater shrimps (*Gammarus* sp.) featuring heavily and a range of species present that progressively break down the leaf fragments into finer and finer detritus particles. Like *Gammarus* the stonefly *Nemoura cambrica* is a leaf-shredder and detritivore. Net-spinning caseless caddis-fly larvae in the Hydropsychidae family are omnivores but the majority of their diet (in England) is detritus and fresh plant fragments. The common *H. siltalai* was found in the sample taken, but of more note is the presence of the less commonly recorded *H. fulvipes* which is localised to headwater streams - it was until recently a Nationally Notable species but its status has been removed in this year's review due to increasing numbers of records (Wallace 2016). *Philopotamus montanus* is another net-spinning caseless caddis-fly that specialises in headwater streams; species of this family spin fine-mesh tubular nets in fast water (most often in upland areas) and feed on very small detrital particles.

Species feeding on live plant material include Baetid mayflies (*Baetis* sp.), which were present in large numbers – species of this genus feed on higher plants, mosses

and algae and would favour the open vegetated parts of the stream. A freshwater limpet (*Ancylus fluviatilis*) was also recorded – this species grazes algae attached to cobbles and larger rocks (i.e. periphyton). Cased caddis-fly larvae from the families Glossosomatidae, Lepidostomatidae and Limnephilidae were also recorded but not speciated - these are also periphyton grazers, moving across the algal biofilm on cobbles and pebbles.

Moving up the food web, the caseless caddis-fly *Plectrocnemia geniculata* spins snare-like nets in parts of the habitat mosaic with slower flows, with which it catches live prey such as midge larvae, mayflies and small stoneflies. *Plectrocnemia* species are headwater specialists, giving way to other species in the Polycentropid family further downstream. Also picked up by kick-sampling was the predatory stonefly *Isoperla grammatica*, which inhabits faster-flowing 'riffle' areas within the stream habitat mosaic.

The Shard stream provides very different habitat, being strongly tufa-forming with a higher stream gradient and greater channel incision (Figure 3). It has extensive canopy coverage from a zone of riparian trees, which have generated large amounts of large woody debris. This has created a more diverse planform and associated channel morphology, with fallen trees and debris dams generating scour pools and riffles with their associated bed substrates (Figure 3). Flushes enter the incised channel through the steep banks, creating a humid zone exploited by mosses and liverworts.

A brief kick-sample was taken from the Shard stream. The invertebrate assemblage inevitably has a lot in common with the main Bubblewell stream, including *Isoperla grammatica*, *Hydropsyche fulvipes*, *Plectrocnemia geniculata*, Limnephilid caddiis-fly larvae, *Gammarus* sp., *Baetis* sp. and tipulids. However, some differences were found that relate to differences in habitat conditions. The horny orb mussel *Sphaerium corneum* was found in abundance – this lives in fine sediments within the habitat mosaic and filters diatoms as well as hoovering up fine organic particles form the sediment surface. Scirtid beetle larvae in the Shard stream are probably there because the adult beetles can thrive in the flush vegetation at the stream sides. Caseless caddis-fly larvae of the Psychomyiidae family build galleries on large stable wood or stone substrates, feeding either off the wood itself or periphyton attached to the substrate surface. In the Shard stream large and stable woody debris is submerged in the channel and may be providing a suitable substrate and food source for these larvae.

Figure 3. The Shard stream - steep gradient and set within an incised gill. Note the scour pool formed by fallen tree and the heavy tufa formation.

We had insufficient time to inspect the springs and flushes at the head of the two streams. However, it seems possible from the surrounding landscape that they are intact. Further headwater streams occur on the eastern margin of Gatcombe Wood which may function equally naturally.

After the confluence of the two streams, the channel runs along the western margin of Gatcombe Wood into Gatcombe Water, an on-line impoundment of all of the headwaters of the Nailsworth Stream.

Key messages

Overall, these streams are excellent examples of highly natural headwater streams, with apparently good continuity with their springs and flushes. They provide a high diversity of habitat conditions characteristic of natural stream function, within each stream and between them.

1. Priority habitat mapping

These streams and their interconnected spring and flush habitat, all the way to the springs and flushes at their stream heads, should be included in the priority river habitat map for England (Mainstone *et al*. 2014, 2015). The Shard stream should probably also be included in an inventory of SAC habitat 7220 (petrifying springs with tufa formation (Cratoneurion).

2. Objectives

Natural ecosystem function is the over-arching objective for stream/spring/flush habitat, as outlined in the freshwater and wetland habitat narrative (Mainstone *et al.* 2016). Management should seek to intervene as little as possible, acting only to restore natural function where needed.

3. Management issues

Trees and woody debris - The importance of the interaction between standing and fallen wood and stream habitat is clear here as it is elsewhere in the headwater stream systems recently visited in Sussex and Kent. Fallen trees across stream and flush habitat should be left in place to generate characteristic habitat mosaics and provide dynamism in the stream/mire system. Debris dams should be allowed to develop and decay naturally.

Although partly running through woodland, bankside trees are relatively uncommon on the Bubblewell stream, within woodland or pasture areas. This means that interaction with tree root systems is relatively infrequent. Bankside tree root systems are important contributors to the full expression of stream habitat mosaics, providing additional biotopes, instigating plan form movement but preventing excessive channel destabilisation, and generating the bulk of woody debris in the stream. Selective planting of appropriate bankside trees along this stream, both within the wood and in the upstream section towards the stream head, would be beneficial. In contrast, the Shard stream is tree-lined for much of its length (at least the section we visited), and there is good interaction between tree roots and the channel.

Nutrient inputs - An increase in external nutrients, from domestic sources or agriculture for instance, destroys the characteristic trophic structure of headwater streams. Leaf litter decomposition becomes less important as easier sources of nutrients are exploited. The role of shredders declines and species may be lost, as species feeding on other nutrient sources (for instance, ‘scrapers’ feeding on algae) out-compete them. Artificial nutrient inputs should be avoided wherever possible.

Impounding structures – It is worth investigating whether the artificial discontinuity associated with the on-line impoundment at Gatcombe Water can be addressed. This eliminates stream habitat immediately upstream of the impoundment and prevents the free movement of species up into the headwater stream system. At

least in the short-term the structure may provide an important barrier to colonisation of the headwater streams by non-native species, which would need to be considered. The structure may also have built heritage value that would need to be considered. Possible remedial options are: 1) complete removal and restoration of natural stream habitat throughout; or 2) by-passing the impoundment (at least in relation to the Bubblewell stream which enters Gatcombe Water close to the impoundment), possibly associated with downsizing the size of the on-line lake; 3) modifying the structure so that the currently drowned stream can act like a stream in the summer and like a temporary lake in the winter (this may have flood storage benefit).

Gloucestershire headwater streams as a network

The headwater streams of the south Cotswolds in Gloucestershire, including their associated spring and flush habitat, constitute a highly important habitat resource. There are many fine naturally functioning examples of stream habitat, most of which are still connected to intact flush and spring habitat. These streams have retained much of their natural function because of the steep topography of the area, which has resulted in the retention of semi-natural woodland and relatively unimproved grassland.

Their association with broadleaved woodland (some ancient), adds to the biodiversity importance of the landscape. Whilst these streams have high conservation value in their own right, they are also critical to the health of downstream river systems, and when functioning naturally they provide a range of ecosystem services that are too often taken for granted (Mainstone *et al.* 2016). These services include nutrient processing, water cooling (in association with woodland or riparian trees) and flow regulation, the latter in relation to moderating peak flows and supporting base flows in dry weather.

Damaged streams and stream sections can and should be restored to higher levels of natural habitat function, with all of the biodiversity and societal benefits that brings. Headwater streams are too easily forgotten by the decision-making processes that govern water management (including the Water Framework Directive) and so greater reliance needs to be placed on biodiversity drivers (protected sites and priority habitat) to make sure they receive the attention they deserve (Mainstone *et al*. 2016).

The Bubblewell/Minchinhampton stream/spring/flush system should be seen as part of a network of headwater systems of high conservation value running off the south Cotswolds that should be conserved in an integrated way based on natural ecosystem functioning. Key management messages to include:

- Maintain or restore continuity of natural water-related habitat from valley mires, through springs to stream channels.

- Minimise physical interventions to the channel and its margins.
- Maintain tree cover (and increase to patchy cover where needed) and retain fallen trees and woody debris unless there is a significant safety risk – woody material is an essential element of natural stream/mire function.
- Be aware of water resource and water quality pressures in the catchment and raise awareness of the need to control these pressures to protect natural ecosystem function.

In addition, a local initiative to find or develop definitive names for all of the streams in the area would be a positive step for headwater stream conservation. The lack of names (or at least well-known names) seems symptomatic of a lack of societal value assigned to headwater streams. A naming initiative would help focus greater attention on them and their conservation importance, encourage greater care over activities affecting them, and foster public engagement.

Potential SSSI notifications for stream habitat in this area, including associated flushes and springs, should be considered within a wider perspective on SSSI notifications, which includes terrestrial habitats (particularly ancient broadleaved woodland) and rare species such as bryophytes. An integrated approach to notifications is necessary to ensure that the links between these features, and the dependency of characteristic species on natural ecosystem function, is properly captured.

Use of the SSSI mechanism needs to be supported by appropriate use of priority habitat mapping, to ensure that valuable sites not selected for SSSI notification receive the recognition (and the drive for restoration where necessary) that they deserve. A new initiative is being set up to allow stakeholders to contribute to our collective knowledge of the naturalness of headwater streams and help refine the English priority river habitat map. A webpage and data portal is being developed by the Freshwater Biological Association which should be operational this summer.

References and further reading

Mainstone, C.P., Hall R., Diack, I. (2016) A narrative for conserving freshwater and wetland habitats in England. Natural England Research Reports, Number 064.

Mainstone, C.P., Skinner, A., Peters, S. and Rogers, M. (2015) Refining the priority river habitat map for England: a report on recent revisions and proposals for on-going refinement. Natural England joint publication JP012.

Mainstone, C.P., Laize, C., Webb, G. and Skinner, A. (2014) Priority river habitat in England – mapping and targeting measures. Natural England joint publication JP006.

Wallace, I.D. (2016) A review of *the caddis flies (Trichoptera) of Great Britain - Species Status No.27*. Natural England Commissioned Reports, Number191.