Gloucestershire headwater streams – site visits, May 2015

Cranham Woods

Chris Mainstone (Senior Freshwater Habitat Specialist) Iain Diack (Senior Wetland Specialist) Natural England

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In attendance: Chris Mainstone (Natural England), Chris Uttley (Stroud District Council), Ann Skinner (Environment Agency), Iain Diack (Natural England), Richard Spyvee and Pete Bradshaw (Gloucestershire Wildlife Trust).

The stream we inspected is the most upstream section of the Painswick Stream, which has its source in Cranham Wood. We walked from Cranham village upstream to the tufa springs at the stream head (Figure 1).

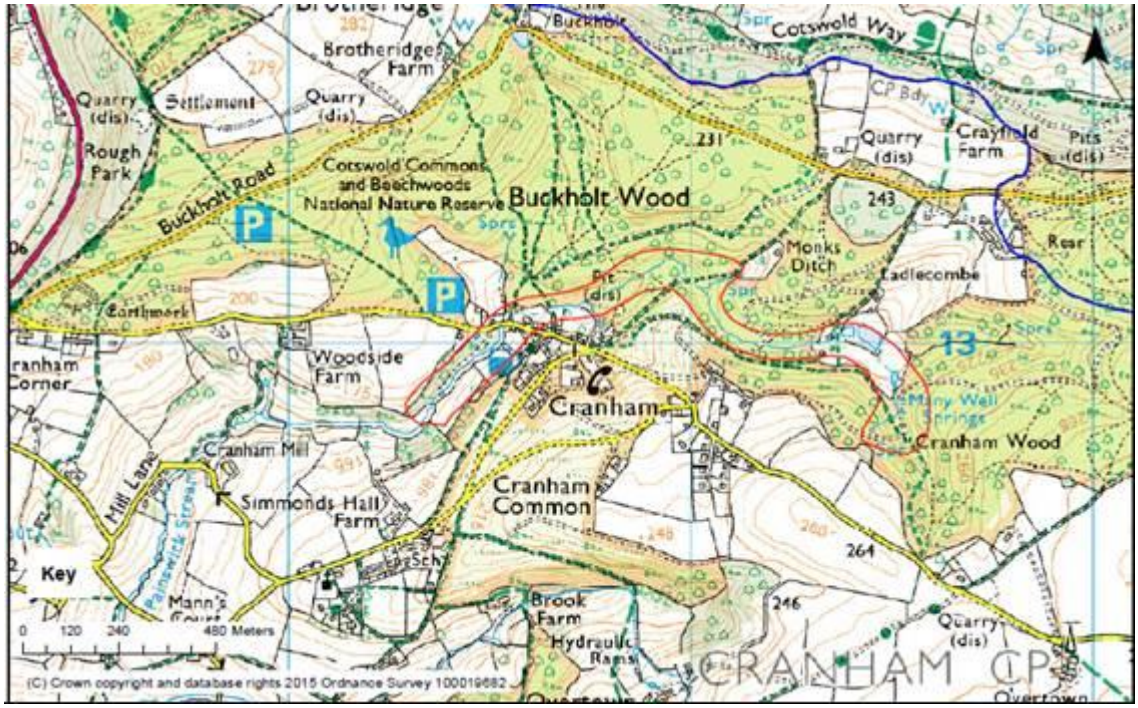

Figure 1. The top end of the Painswick Stream. We walked along most of the section shown in red, to the east of Cranham village.

This is a managed beechwood, but relatively low intensity. The stream bed has abundant coarse substrates with plenty of leaf litter (Figure 2), providing habitat suitable for a good invertebrate assemblage. There is a considerable amount of woody debris around the stream, but much of it is not actively interacting with the channel (e.g. Figure 3).

Springs and seepages emerge from the valley slopes along much of the stream course, creating very wet conditions in places, particularly towards the foot of slope. These areas tend to support alder trees and can be assigned to W7 alder-ash woods of the National Vegetation Classification.

Figure 2. Coarse substrates and leaf litter in the stream channel.

Figure 3. Woody debris on the stream bank.

Woody material (tee root systems of bankside trees, fallen trees, debris dams) is fundamental in shaping stream habitat through modifying flow patterns and creating variation in hydraulic scour. This generates characteristic habitat mosaics of scour pools, riffles, substrates of different coarseness, slack waters with fine silts and leaf litter, all within a sinuous channel planform that adds more variation. All of these different biotopes are habitat niches for different species, and life stages of the same species. However, if the woody

material is not creating partial obstacles to flow then the characteristic habitat mosaic will not develop.

The stream channel is quite heavily incised through clay in places, presumably not through active channel works because there would be no significant drainage benefit of artificially deepening the bed in such a steep v-shaped valley. However, in the sections the incision may be a consequence of insufficient large woody debris in the channel, which in headwater streams does exercise considerable control over bed levels. Partial dams formed by large or small woody debris catches coarse sediments delivered by the upstream catchment, raising the bed level and maintaining a shallow cross-section.

Invertebrate sampling revealed an abundance of freshwater shrimps (*Gammarus*), typical of woodland alkaline streams, as well as a range of insect taxa reflecting swift-flowing water and coarse substrates. The stonefly *Isoperla grammatica* is a predatory species typical of these conditions. Mayflies were represented by *Ecdyonurus* sp, *Rithrogena* sp., *Ephemera* sp. and *Baetis* sp.. A range of caseless (*Ryacophila* sp., *Hydropsyche* sp.) and cased (Goeridae and Limnephilidae) caddis-fly larvae were also present. Bullhead were also found – a fish species common in England but listed under the European Habitats and Species Directive.

Further upstream, tufa springs emerge from the valley sides and run down to the main stream (Figure 4). These areas are covered in mosses and liverworts, including the moss *Palustriella commutata*. One spring has created a large tufa mound (Figure 5).

Figure 4. Tufa spring emerging from the valleyside, supporting an abundant moss and liverwort flora.

Figure 5. Tufa mound covered in mosses including abundant *Palustriella commutata*.

The stream and banks adjacent to the tufa spring in Figure 4 have been subjected to heavy disturbance, associated with drainage and a stream crossing. The stream has been culverted in a pipe under the crossing. The spring head in Figure 4 has been historically exploited for water supply (the remains of the pump and pipework are still in place). The pipework has been damaged in recent earth-moving operations, and it is not clear if the supply is still used.

Walking back downstream, we passed through an area of open fen. Whilst this has clearly been of high conservation value in the past, and there is still a large colony of marsh orchids along with abundant cuckoo flower and other species, the fen has been invaded by giant horsetail and also Himalayan balsam, and is now in a highly neglected state. If not controlled the balsam will spread to all downstream areas of the stream network.

Key messages

Overall, this stream has potential to exhibit high levels of natural function and thereby provide high quality stream habitat. However, some refinements to management are needed to realise this potential.

1. Priority habitat mapping

This stream and its interconnected spring and flush habitat is probably acting sufficiently naturally in its present state to be included in the priority river habitat map for England (Mainstone *et al.* 2014, 2015).. Refinements to management can be promoted as part of work to restore favourable condition of the stream habitat.

The site should also be included in an inventory of SAC habitat 7220 (petrifying springs with tufa formation (Cratoneurion vegetation).

2. Objectives

Natural ecosystem function is the over-arching objective for stream habitat including associated flush and springs, 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 (particularly relating to the role of bankside trees and wood debris).

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 mire and stream 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 running through woodland, bankside trees are relatively uncommon in the site. 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, 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 at this site would be beneficial. Beech trees are not typical of stream riparian zones and do not provide suitable root zone structure – alder and willow are more characteristic.

Works affecting channel integrity – Woodland management operations should try and avoid damage to the stream channel and its banks, and springs/flushes. Depending on the nature and frequency of use, widespan bridges or fords should be used instead of culvert pipes.

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 other species feeding on other nutrient sources (for instance, 'scrapers' feeding on algae) out-compete them. Artificial nutrient inputs should be avoided wherever possible.

Abstraction – If the off-take on the upstream spring head is no longer in use it would be beneficial to block the pipework to ensure there is no unnecessary continuing hydrological impact.

Fen management and balsam control – A management plan for the neglected fen is urgently needed before the interest is lost completely. Wider action needs to be taken on the balsam outbreak to ensure that there is no spread to other areas.

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 Cranham Woods 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. This network has retained much of its natural function because of the steep topography of the area, which has resulted in the retention of semi-natural woodland and relatively unimproved grassland. 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. This 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 and Hall (2016) A narrative for conserving open freshwater and wetland habitats in England. Natural England Research Report NERR064. Natural England.

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.