Specialist site visit - headwater streams running off the South Downs

Tuesday 2 June 2015

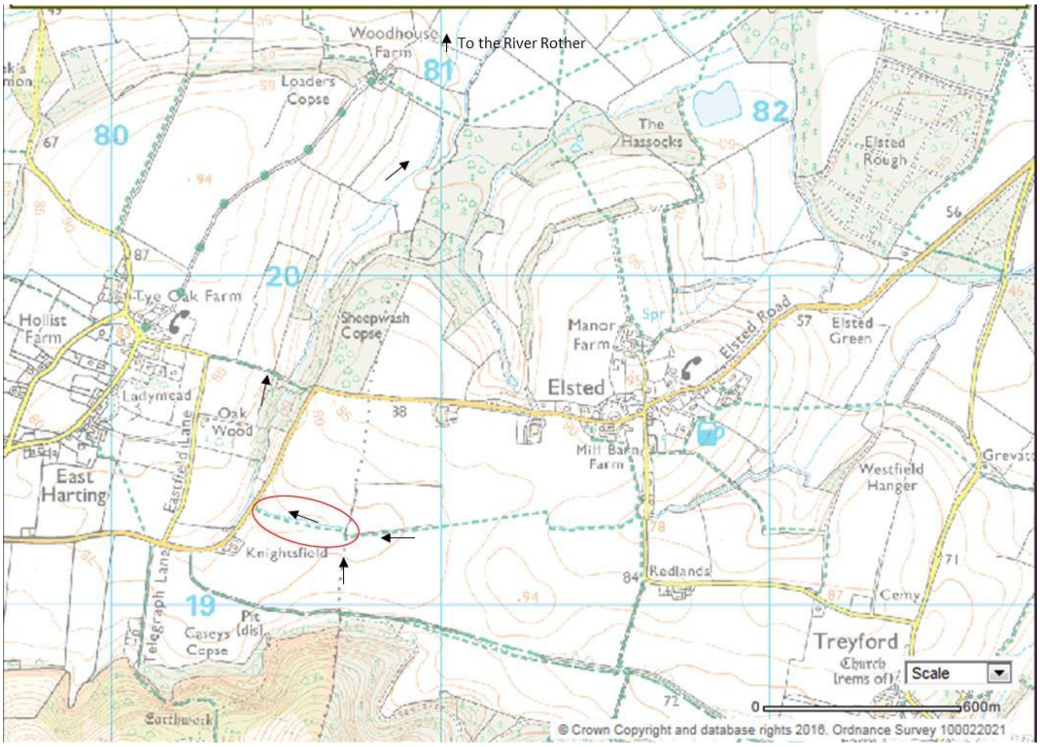
In attendance at various points in the day: Chris Mainstone, Louise Bardsley, Nigel Hiscoke

We visited as many sites as possible from the list of highly natural headwater chalkstreams provided by Nigel Holmes (Holmes 2010) and suggestions from Fran Southgate (Sussex Wildlife Trust). See map below.

1. **Harting Stream**

In attendance: Chris Mainstone, Louise Bardsley, Nigel Hiscoke

This stream is labelled as Harting Number 4 in Nigel Holmes' headwater survey report (Holmes 2010). It rises from a series of springs at the base of the northern fringe of the South Downs, running over greensand and then flowing north for some kilometres before discharging into the Rother (an east-flowing tributary of the Arun). See map below. We walked along the streambed adjacent to the public footpath at the upstream end of the watercourse, from the Elsted to East Harting Road at SU 804 192. The stream was dry at the time of the visit.



The main stream is hidden within an incised channel covered in a dense canopy from a thin zone of riparian trees. The channel is very geomorphologically active, with a bed of greensand cobbles and a very sinuous planform (Figures 1.1 and 1.2). The stream clearly experiences high flows and considerable hydraulic forces in the winter and early spring.

Figure 1.1 Greensand cobble bed of the Harting Stream.

Figure 1.2 Highly accentuated meander loop.

There is a good level of interaction between the channel and riparian trees, in terms of both root systems and woody debris (Figures 1.3 and 1.4). This contributes considerably to habitat heterogeneity of the channel and banks.

Figure 1.3 Extreme channel meandering and a major debris dam generating a scour pool downstream.

Figure 1.4. Debris dam.

The main channel is fed by three headwater channels which converge at a point some 100 metres upstream from the Elsted to East Harting Road. We walked a short distance up one of these channels, which flows southwards taking drainage waters from the wooded scarp slope and intervening arable land (on greensand). The channel has been heavily ditched and is devoid of natural habitat (Figure 1.5).

Figure 1.5. Ditched headwater channel flowing south from the base of the Downs into Harting Stream.

We did not walk to the heads of any of the dry headwater channels feeding the stream. Only the channel draining the woodland at the base of the Downs is likely to have any associated mire habitat. The other two channels seem to rise in arable fields and must have been drained all the way up.

It was not possible to sample the macroinvertebrate fauna because the stream was not flowing at the time of the visit.

Reflections

Overall, whilst the short section immediately above the Elsted to East Harting Road is physically highly natural, as a headwater stream system it is highly physically impacted by arable management. There is a good case for adding the short section of natural stream to the priority river habitat map as part of on-going local refinements. This might help promote physical restoration of the headwater feeder channels, which could be added to the associated restoration priorities map.

Abstraction might be having a significant effect on the natural flow regime. It is unclear whether it is a natural winterbourne – the channel is of a reasonable size and winter flows are clearly strong, but the aquifer feeding the stream is apparently over-abstracted. If the hydrological impact is not severe then this would not preclude the stream from the priority habitat map. If it is severe then the stream should be included on the associated restoration priorities map.

It is possible that the highly natural channel form may continue downstream of the road. The land use (pasture and woodland) seems to be amenable to this but there was no time to inspect further. If it is similarly natural then it should be added to the priority habitat map (or associated restoration priorities map). The work of Holmes (2010) can inform this judgement.

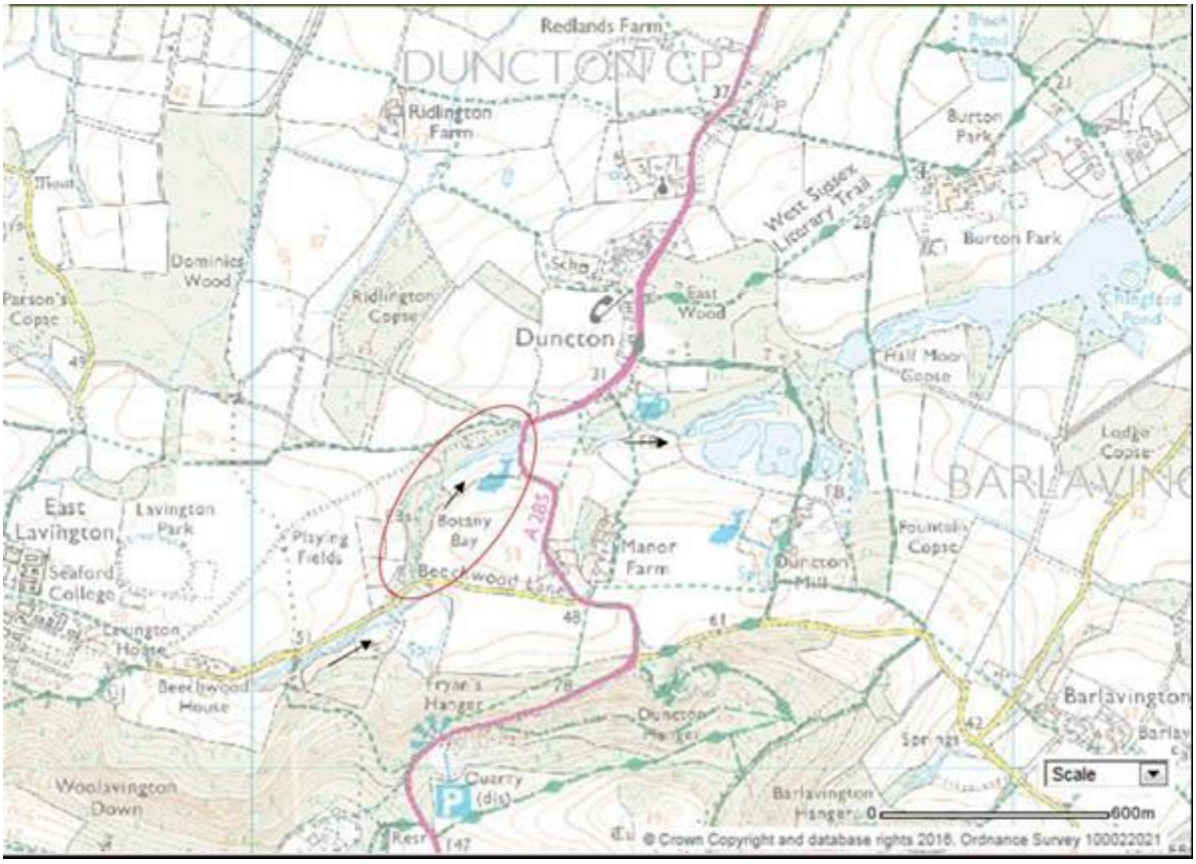
The degraded state of the headwater channels feeding into the main stream affects its suitability as a candidate for notifying as a headwater-only river habitat SSSI. Streams with connectivity to intact stream/mire transitions would be favoured for notification, although it may be that no such sites remain in the area and this is the most natural example that remains. The headwater channels could be restored through the arable fields, which would greatly improve the case for notification.

2. Botany Bay

In attendance: Chris Mainstone, Louise Bardsley, Nigel Hiscoke

This stream rises in springs on the northern fringe of the South Downs and flows north eastwards until it joins the River Rother (an east-flowing tributary of the River Rother). We walked up the stream from the Duncton entrance to Seaford College, starting at SU 955 168 and reaching the outlet of the on-line pond at Beechwood

Lane (SU 954 164). We then walked back downstream to the on-line pond ending at the A285 at SU 957 169.



Map of Botany Bay showing stretch visited (circled in red)

This stream has suffered from a range of physical modifications along the stretch we visited, which have damaged natural habitat function. The current owner is doing excellent work in trying to restore the stream through removing those modifications as far as possible.

Figure 2.1 shows the remains of an impounding structure associated with an old fish farm, abandoned some time ago. Whilst the impoundment has not been totally removed, it has been partially removed to reduce its effect. Downstream of the structure, in a more open area with plenty of light, characteristic marginal plants such as water-cress and water speedwells show classic encroachment into the channel as seasonal flows recede. This encroachment not only provides an important biotope in its own right, but it maintains current velocities in the centre of the channel and thereby sustains habitat for rheophilic species. This is the type of seasonal habitat evolution that is lost when stream channels are impounded.

Figure 2.1 Partially removed structure associated with an abandoned fish farm.

Further upstream, the channel runs through an incised fern-covered ghyll surprising to find in the South Downs. The flow was extremely strong at the time of the visit, which is apparently normal for the stream. As a result the bed substrates are very coarse – submerged and moss-covered exposed cobbles (Figure 2.3). The moss flora includes two rare species on the exposed cobbles and one (*Mnium stellare*) on the banks (pers comm Tom Ottley).

Figure 2.3 Strong flows, coarse substrates and moss-covered exposed boulders.

An *ad hoc* macroinvertebrate sample taken from this reach contained a good range of taxa, particularly considering the proximity to the stream's source. Freshwater shrimps (*Gammarus pulex*) were abundant, as well as the mayfly *Rithrogena* sp. which is dorso-ventrally flattened to withstand fast flows. Simuliid (blackfly) larvae were also abundant, taking advantage of the fast flows and stable anchorage on cobbles. Caddis-flies were well-represented, including species with cased larvae (Glossosomatidae) and caseless larvae (*Ryacophila dorsalis* and *Hydropsyche* sp.). Ryacophila requires particularly fast water and high oxygen levels, and would be taking advantage of the abundant simuliid prey. Beetle larvae (Droyopidae and Elmidae) were also present, along with ephemerellid mayflies. There was also one stonefly specimen, *Nemoura cambrica* – this is a shredder that would be feeding mainly on the abundant leaf-fall into the stream.

A bullhead (*Cottus gobio*) was caught and returned – this is a European protected species but is common in fast-flowing streams across England. The stream also has a wild brown trout (*Salmo trutta*) population.

In a few places there was significant interaction between the stream channel and riparian trees (Figure 2.4), creating additional instream habitat diversity.

Figure 2.4 Tree trunk generating flow constriction and added habitat diversity.

The upstream point of the walk was an impoundment for an on-line pond (Figure 2.5). This generates a massive discontinuity in the stream, and eliminates stream habitat through the impounded section. The impoundment is deteriorating – a breach has eroded a channel to the right of the main outlet (visible in the right hand side of Figure 2.5).

Figure 2.5 The impoundment at the top end of the walk, showing the breach.

What looks to be the original channel can be seen entering the stream downstream of the impoundment (Figure 2.6). It is possible that the impoundment was originally off-line but that over time the full flow has been diverted through the pond.

Figure 2.6. Dry channel meeting the stream immediately downstream of the impoundment.

Upstream of the impoundment, the stream continues for about 500 metres until the spring source running off the Downs. Although not visible, it is understood that this stretch runs through grassland and is not subject to significant pressure.

Walking back downstream, along the top of the gorge, the depth of the gorge and the abundance of the lower plant flora is more apparent (Figure 2.7).

Figure 2.7 The fern-filled gorge.

Tufa formation was evident in some of the springs seeping down into the channel, and was extensive in some areas (Figure 2.8).

Figure 2.8. Hart's tongue fern and dog's mercury growing on a tufa mound.

Back down at the downstream end of the stream, the old fish farm ponds are still in place alongside the stream channel (e.g. Figure 2.9). These currently provide limited habitat. Alongside these ponds, stream gradient declines and the channel starts to meander and lay down finer marginal sediments. The main channel supports submerged plants (*Callitriche stagnalis* and *Berula erecta*), whilst characteristic encroaching plants invade the channel from the margins (*Veronica beccabunga* and *Rorippa nasturtium-aquaticum*).

Figure 2.9 Abandoned fish farm pond.

At the downstream end of the walk, immediately upstream of the A285, there is a further impoundment for an on-line fishing lake (Figure 2.10). This is long-established but has eliminated chalkstream habitat through a long stretch. The impounding effect is still evident 100 metres upstream (Figure 2.11). Flushes still feed into the lake from the rough pasture on the north bank.

Figure 2.10. On-line fishing lake.

Figure 2.11 Signs of impoundment in the stream 100 metres upstream on the fishing lake impoundment.

Reflections

Although the stream is degraded in places, it retains many excellent aspects of natural habitat function, particularly in the section running through the ghyll where it is highly natural. The stream is under sympathetic management and restoration is taking place. The stream through the ghyll just needs to be left to behave naturally. Suggestions for further restoration of damaged sections are given below.

- It seems possible to address the effects of the most upstream impoundment on Beechwood Lane by restoring flow to what appears to be the original channel. A proper investigation would be required, but it seems possible to divert the majority of flow away from the on-line pond into the channel. This would not affect the quality of the pond but would restore the natural function and therefore habitats of the stream.

- The impoundment associated with the fishing lake, upstream of the A285 seems more problematic because of its on-going use and the existing goodwill of the angling club who fish there. In practical terms, there seems no reason why sediment could not be pumped out of the lake and the impoundment removed, which would restore around 100 metres of stream to high quality chalkstream habitat. Alternatively, it may be possible to take the lake off-line, if the topography of the land permits. Given the high flow on the stream and the shallower gradient of this stretch, it is quite possible that this sort of restoration would create classic chalkstream habitat that would be highly desirable to native brown trout. It is worth investigating the practical options and views of those involved. The stream section immediately upstream of the impounded reach, with its meanders, submerged and encroaching marginal vegetation, and diversity of water depths and substrates, gives an indication of the habitat that could be restored.

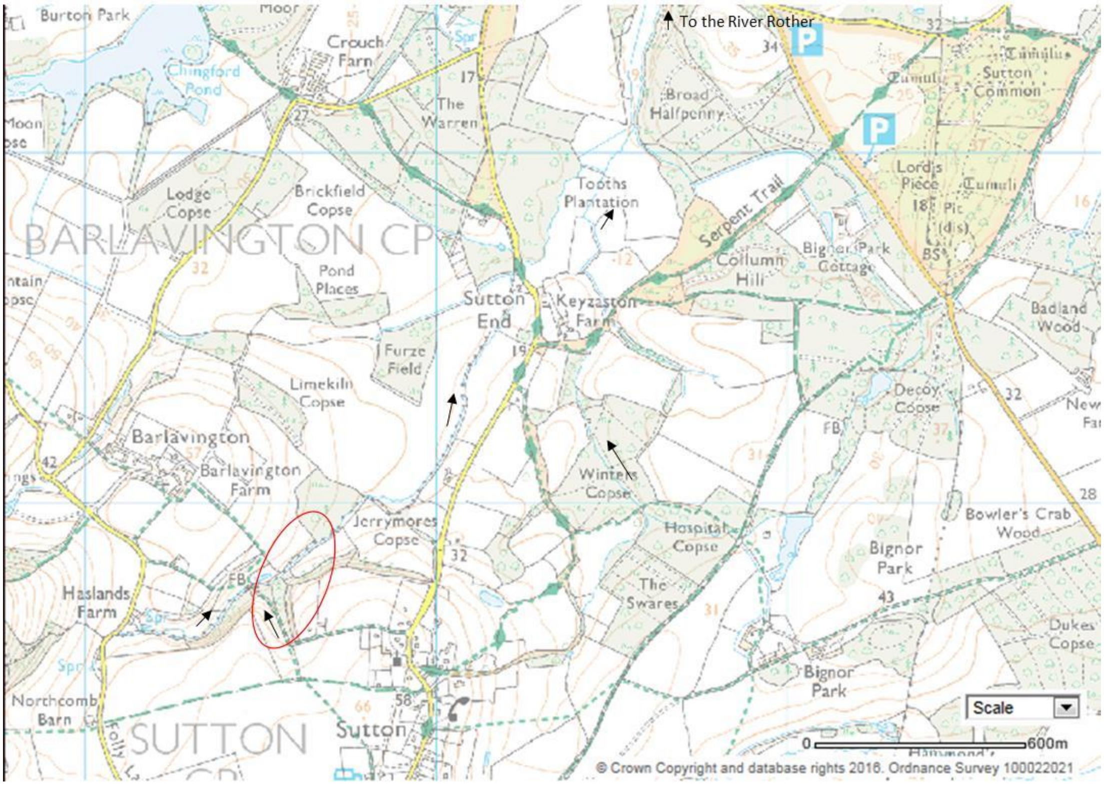
- The abandoned fish farm ponds could be improved by shallowing the bank profile and allowing encroaching marginal plants species characteristic of chalk streams (such as watercress, fool’s watercress and brooklime) to colonise. Some submerged plants characteristic of chalkstream habitat will grow happily in these ponds, such as water starwort and lesser water-parsnip, and can be harvested directly from the stream, so no import of plant species is necessary.

The stretch through the gorge should be added to the new priority river habitat map, and the upstream and downstream sections degraded by artificial impoundments should be added to the associated restoration priorities map.

3. **Sutton Stream**

In attendance: Chris Mainstone, Louise Bardsley, Nigel Hiscoke

This stream rises on the northern fringe of the South Downs and flows north-eastwards through grassland and woodland until it reaches the River Rother. It is labelled as Sutton Number 6 in Nigel Holmes' headwater survey report. We walked from Sutton church along the public footpath, and down the tributary into the main stream at SU 976 157. We walked downstream for a few hundred yards then retraced our steps. See the map below.



Map of Sutton Stream showing stretch visited (circled in red).

The small tributary had a steep gradient and incised channel, with abundant woody debris. The main stream along the section we walked had abundant gravel substrate but relatively limited habitat diversity (Figure 3.1). This was possibly due to the limited amount of woody debris in the channel. However, areas of exposed gravel substrate were evident (Figure 3.2), which is a rare biotope in chalk streams generally.

Figure 3.1 Limited habitat diversity in Sutton stream.

Figure 3.2. Exposed gravels on Sutton stream.

The general lack of woody material in the main stream did not appear to be related to active removal – there was a fallen tree across the channel at the lower end of the reach (Figure 3.3), which presumably would have been removed if there were on-going management.

The water was turbid at the time of the visit, probably due to recent rain. It may also be a feature of many of the South Downs streams whose waters are derived from the chalk but which flow over greensand substrates.

The riparian zone of the main stream was high quality though patches of woodland, with a diverse ground flora.

Figure 3.3. Fallen tree across Sutton stream, collecting woody debris upstream and forming a scourpool downstream.

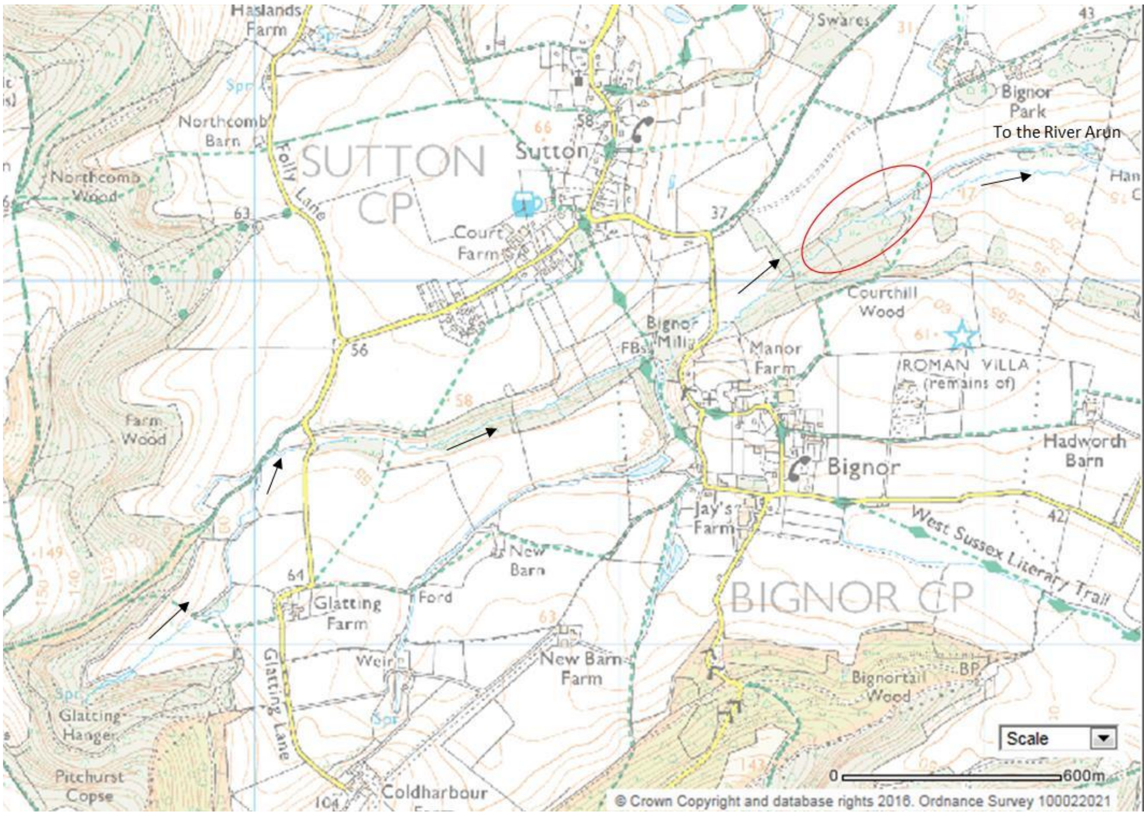
Reflections

There is a case for adding the stream to the new priority river habitat map, although the upper and lower limits of the addition would need further consideration.

4. Bignor

In attendance: Chris Mainstone, Louise Bardsley, Nigel Hiscoke

The stream rises in scarp woodland at Glatting Hangar and flows north-eastwards through Bignor Mill before turning eastwards for a further 3 km to meet the River Arun north of Amberley. We walked from Bignor Park estate buildings to meet the stream at the bottom of Courthill Wood, around SU 988 152, and proceeded upstream for about 300 metres. See the map below.



Map of Bignor Stream showing stretch visited (circled in red).

This is a naturally functioning stream running through a mixture of ancient broadleaved woodland and organic grassland, with good levels of woody material and habitat diversity (Figure 4.1). It is relatively low energy through the reach we walked, with considerable amounts of finer sediments. This is a function of relatively low stream gradient and does not prevent the evolution of a varied biotope mosaic (Figure 4.2). Further upstream stream gradient and therefore hydraulic energy is higher, but we did not walk that far upstream.

Figure 4.1 Bignor stream.

Figure 4.2 Woody material creating a diverse natural biotope mosaic in Bignor stream.

Tufa springs are evident feeding into the stream (Figure 4.3), which are generating a significant proportion of the coarser substrate in the channel.

Figure 4.3 Tufa spring entering the stream.

Higher plants are largely absent from the stream in the wooded reach we walked along, as might be expected from a small woodland stream. The principal biological interest in such conditions are lower plants and invertebrates, as well as (for at least some species) fish. An *ad hoc* composite sample of aquatic macroinvertebrates was taken as we walked up the stream. Freshwater shrimps (*Gammarus pulex*) and baetid mayflies were abundant. A Leuctrid stonefly (probably *L. hippopus*) was also present – this is another leaf-shredder suited to this environment. Blackfly (simuliid) larve and hydrobid snails were also present, along with a cased caddisfly larvae (Sericostomatidae).

The only significant physical modification encountered on the stream is a short section engineered into a uniform channel with a square cross-section and a series of small regular cascades forming a 'ladder' (no photo). This seems to be a Victorian feature, although the purpose is obscure. This feature supports five rare moss species, so is valued by lower plant specialists (pers comm Tom Ottley). A bryophyte survey of the stream has been undertaken to confirm its conservation importance (Ottley 2015). All of these rare mosses are associated with natural stream habitat, either within this stream or in other streams flowing off the South Downs. However, the added stability of the walls of the Victorian structure allow them to grow in greater abundance than in their local natural habitat niches.

Reflections

The stream should be added to the new priority habitat map, unless there is a serious impact on the natural flow regime causes by abstraction from the aquifer (if this is the case it should be added to the associated restoration priorities map). The upstream and downstream limits of the priority habitat should be taken from the work of Holmes (2010).

The stream would appear to be a good candidate for notifying as a headwater-only river habitat SSSI. The land use of the catchment and the sympathetic management of the stream are highly compatible with notification.

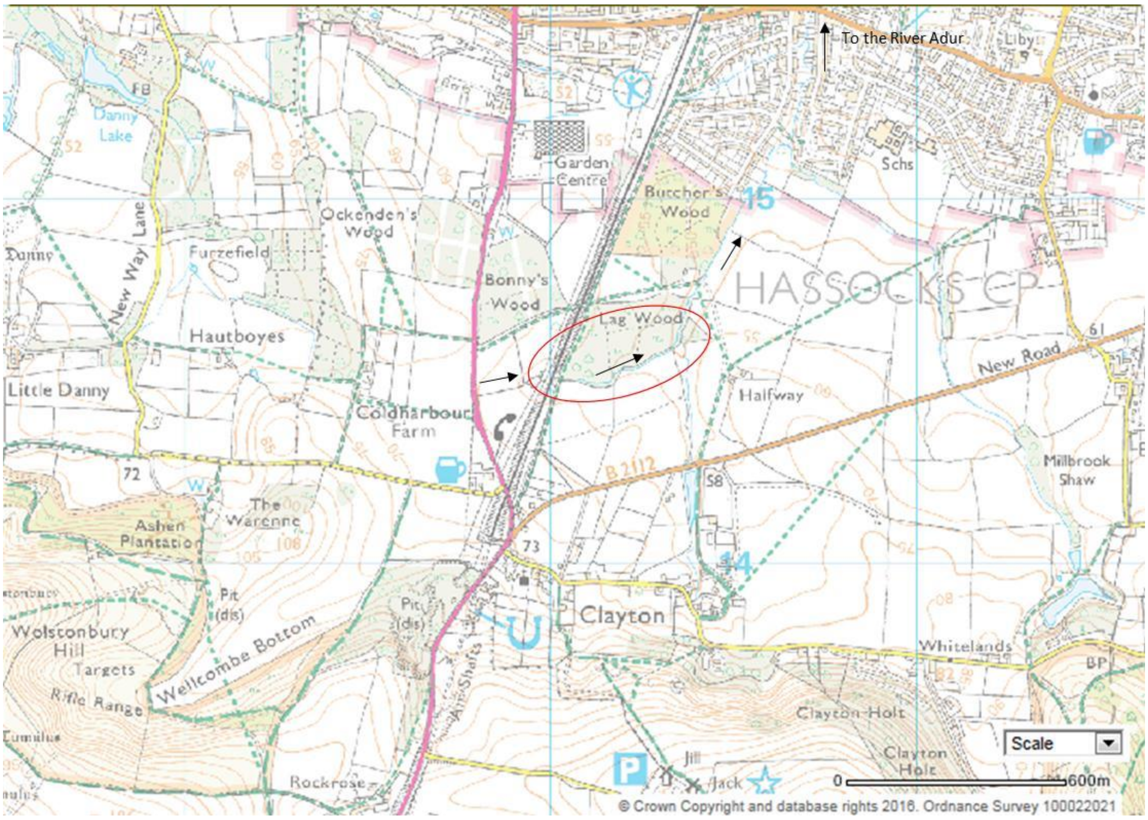
There are no obvious significant management issues along the wooded reach we walked. Whilst light levels in this section precluded the development of a submerged and marginal higher plant community, the woodland flora and stream bryophytes are characteristic of the habitat and other more open stream sections (not visited) should provide opportunities for other characteristic elements of the plant community (e.g. encroaching marginals).

The Victorian 'ladder' would ideally be removed to restore the naturalness of the stream ecosystem. The moss species it supports are present in natural habitat niches in this and nearby streams, even though in lower abundances. However, it does not generate much of an impact, and it could be left to provide an artificial stronghold for the species if there is strong feeling about the retention of the structure. In this case it could potentially be by-passed by creating a natural channel adjacent to it, allowing full restoration of the river habitat mosaic whilst leaving a residual flow in the ladder to provide the humidity required by the mosses.

5. Lag Stream

In attendance: Chris Mainstone

This stream rises off the northern scarp slope of the South Downs, flowing northwards through grassland and woodland to Hassocks, then north-westwards to join up with Pook Bourne and on to the upper Adur. I walked from the Jack and Jill pub car part up the public footpath into the top of Lag Wood at TQ 303 147. We then walked upstream through Lag Wood to the railway line, which forms the existing upstream point of the flowing natural stream. We briefly looked at the ditched watercourse on the other side of the railway line, although there is some uncertainty about the current hydrological relationship between this and the Lag Stream. See the map below.



Map of Lag stream, showing stretch visited (circled in red).

The stream through this section is naturally functioning and very close to its source running off the Downs. The channel has high levels of interaction with tree root systems and fallen wood, creating a physically diverse channel (Figure 5.1 and 5.2).

Figure 5.1 Strong morphology of the Lag Stream.

Figure 5.2 Exposed tree root systems adding biotope diversity.

The stream is fed by tufa forming springs, and the tufa contributes strongly to the coarser bed substrates in the channel (Figure 5.3). This provides habitat for a range of invertebrate species dependent on open-structured sediments.

Figure 5.3 Tufaceous deposits on the streambed.

The bed substrates also include extensive flint cobble in some areas (Figure 5.4), drawn from the clay/flint deposits on the Downs. It is these deposits that generate the finer gravel base of classic chalkstreams.

Figure 5.4 Flint cobbles in the stream bed.

An *ad hoc* composite sample of aquatic macroinvertebrates was taken as we walked up the stream. The sample was dominated by freshwater shrimps (*Gammarus pulex*), spire-shell snails (Hydrobidae) and caddis-fly larvae. The caddis-fly assemblage is particularly diverse and impressive for a stream so close to its source. Species with cased larvae dominate (families Glossosomatidae, Limnephilidae, Odontoceridae, Bereidae, Sericostomatidae, and Leptoceridae) but caseless larvae are also present (Hydropsychidae). Baetid and ephemerellid mayflies were also present, as well as pea mussels (*Pisidium* sp). Bullhead (*Cottus gobio*) were also found – this is a common British species of fast-flowing streams and rivers, but is listed under the European Habitats Directive because of its European status.

The water quality of the stream is known to be affected by pollution from the railway line, caused by a transistor leak. This is being addressed, but is a long-term water quality issue that is likely to affect the invertebrate assemblage of the stream.

The lack of bankside vegetation in some areas of the wood may be caused by footfall, as the wood is well-used by locals. This is likely to be linked to the long periods of riparian inundation during the winter months, which would favour wetland vegetation that is more sensitive to trampling. It is not clear whether any high levels of human activity extend into the channel, but the invertebrate fauna does not indicate a major problem. However, the lack of marginal vegetation precludes certain plant-dwelling species.

On the other side of the railway line, the stream has been ditched and then ponded. The degraded nature of this section is a shame as it destroys continuity of natural stream function up to the top of the springline, so that the natural section through Lag Wood is isolated from the wider landscape. It is thought that there is a significant spring directly underneath the railway line, because the flow through Lag Wood is much greater than the flow in the ditch on the other side of the line. Chalkiness is also observed in waters of the Lag Stream following rainfall, when none is apparent in the ditch. From a map of 1823 showing the planned line of the railway (Figure 5.5, it is clear that the ditch and amenity grassland of the green cemetery replace woodland and naturally functioning stream and flush habitat, which would presumably have been similar to the existing section through Lag Wood.

Figure 5.5 1823 map showing the proposed line of the railway (shaded red) and the woodland upstream of the present-day Lag Wood.

The owners have a wonderful enthusiasm for the site and its history, which adds to the interest of the site.

Reflections

Management through Lag Wood is highly sympathetic to the natural function of the stream – continued non-intervention is recommended, including leaving fallen wood *in situ*. Not much can be done about the public use of the stream sides without restricting access to the wood. A sign advising of the importance of the stream and its banks and encouraging responsible behaviour may help.

Upstream of Lag Wood, restoration of the stream/flush habitat mosaic is needed to restore natural function. A vision for the stream should be explored with the relevant landowners, and options for restoration considered. The pond has poor water quality and is of limited aesthetic appeal. In-filling the ditch to restore flush habitat, allowing a natural channel to form if there is sufficient flow, would provide a wetland area of flower-rich grassland and a more attractive landscape for visitors. This would however require restricting access to this small area, particularly in the winter, depending on ground conditions.

Downstream of Lag Wood, the stream is impounded to form a pond, eliminating the natural stream habitat mosaic and interfering with the free movement of species. It would be worth exploring the views of the landowner of this stretch on the possibility of restoring natural chalkstream habitat by removing the impoundment. Again, a vision of the restored channel could be explained, along with the aesthetic and ecological benefits.

There is a good case for adding the stretch through Lag Wood to the new priority river habitat map, and the upstream and downstream sections degraded by ditching and artificial impoundments to the restoration priorities map.

The upstream and downstream modifications affect the suitability of the stream as a candidate for notifying as a headwater-only river habitat SSSI. Streams with connectivity to intact stream/mire transitions would be favoured for notification, although it may be that no such sites remain in the area and this is the most natural example that remains. However, if the restoration works above were undertaken so that the stream were naturally functioning from spring to downstream of Lag Wood, this would greatly strengthen the case for notification.

Reflections across all of the South Downs streams visited

The headwater streams of the South Downs, including their associated spring and flush habitat, constitute a highly important habitat resource. There are still some fine naturally functioning examples of stream habitat, some of which are still connected to intact flush and spring habitat. Their association with ancient woodland, and rare species such as mosses, 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. These services include nutrient processing, water cooling (in association woodland or riparian trees) and flow regulation, the latter in relation to moderating peak flows and supporting base flows in dry weather.

In the highly permeable landscape of the South Downs the density of the headwater stream network is comparatively low compared to other landscapes, so each individual stream becomes more precious. 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.* in press).

All the streams running off the South Downs (both natural and impacted ones) should be treated as a network, and a set of common key messages should be provided to landowners to promote their management as naturally functioning headwater stream systems. Messages to include:

- Maintain or restore continuity of natural water-related habitat from valley mires, through flushes and springs to stream channels. This may involve selective in-filling of ditches to restore water retention in defined land areas, which are likely to be small given the incised topography of the downland fringes.
- Minimise physical interventions to stream channels and their 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 particular, spring heads and their associated flushes, and the natural winterbournes they feed, are destroyed by over-abstraction.

In addition, a local initiative to find or develop definitive names for all of the streams, building on the headwater condition mapping work of the Sussex Wildlife Trust, would be a positive step for stream conservation in the Downs. The lack of names (or at least well-known names) seems symptomatic of a lack of societal value assigned to the streams. It would help focus greater attention on them and their conservation importance, encourage greater care over activities affecting them, and foster public engagement. There is scope for engaging with suburban communities in the many areas where chalkstreams run through housing estates near the foot of the downs, often forgotten or neglected between gardens.

There is potential within this network for SSSI notifications for stream habitat, to include associated flushes and springs. This constitutes one facet of a wider perspective on SSSI notifications in this landscape, 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.

Finally, as Nigel Holmes' original survey work highlights, these streams call into question our understanding of what a chalk stream is. Our previous definition has been limited in scope because it failed to characterise the most upstream, high gradient examples of streams running off chalk. An additional complexity is the belts of greensand over which chalk source waters run, which adds an even wider diversity of conditions that might be embraced by the term chalkstream or chalk river. The main message is, however these streams are classified, the principle characteristics by which we judge their conservation value relate to their naturalness and natural function. The UK priority habitat definition for river habitat was rightly extended in 2008 to include a much wider range of river types than just chalk rivers. As a consequence, it is no longer possible to base judgements of conservation importance on river type, and so the issue of river classification has become less of an issue. See Mainstone *et al*. (2014) for further explanation.

References and further reading

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