Painswick Stream, Cranham, Gloucestershire

An Advisory Visit by the Wild Trout Trust, December 2012

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Introduction

This report is the output of a Wild Trout Trust visit undertaken on the headwaters of Painswick Stream upstream of Cranham, Gloucestershire – national grid reference (NGR) SO903130. The visit was requested by Mr Richard Tyson, who is the land owner. The visit was primarily focussed on options to enhance the river habitat for the benefit of local wildlife including wild brown trout *(Salmo trutta)*.

This section of river (Painswick Stream – Source to confluence with Slade Brook) is classified as being in Moderate Ecological Condition under the Water Framework Directive and is identified in the Environment Agency's River Basin District Plan as water body ID no. GB109054032460.

According to Annex B of the Environment Agency's River Basin Management Plan for the Severn River Basin District, Painswick Stream has been assigned a target of achieving 'Good Ecological Status' by 2027. The listed justification for this target not being achieved by 2015 is that the actions required are disproportionately expensive and technically infeasible.

The current 'Moderate Ecological Status' designation is attributable to the stream failing for fish. This may be owing to a number of barriers to fish passage at different locations along the river.

Comments in this report are based on observations on the day of the site visit and discussions with Mr Tyson and Sam Chapman of the Environment Agency.

Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank or Right Bank whilst looking downstream.

Painswick Str - source to conf Slad Bk	
Waterbody ID	GB109054032460
Waterbody Name	Painswick Str - source to conf Slad Bk
Management Catchment	Severn Vale
River Basin District	Severn
Typology Description	Low, Small, Calcareous
Hydromorphological Status	Not Designated A/HMWB
Current Ecological Quality	Moderate Status
Current Chemical Quality	Good
2015 Predicted Ecological Quality	Moderate Status
2015 Predicted Chemical Quality	Good
Overall Risk	Probably At Risk
Protected Area	No
Number of Measures Listed (waterbody level only)	-

Water Framework Directive (WFD) information for Painswick Stream

Catchment and Fishery Overview

Painswick Stream drains an area of Birdlip Limestone – a pale coloured sandy limestone that often forms into ooids (small rounded grains formed of concentric layers). This 'oolitic' material forms the limestone gravel of the riverbed. The limestone geology also accounts for relatively high levels of calcium carbonate in the stream. The stream rises from springs at NGR SO907130 and flows roughly southwest cutting a steep v-shaped valley through Cranham Woods before flowing through the villages of Cranham and Painswick and turning south through Pitchcombe and eventually confluencing with the River Frome via the Stroudwater Canal in Stroud.

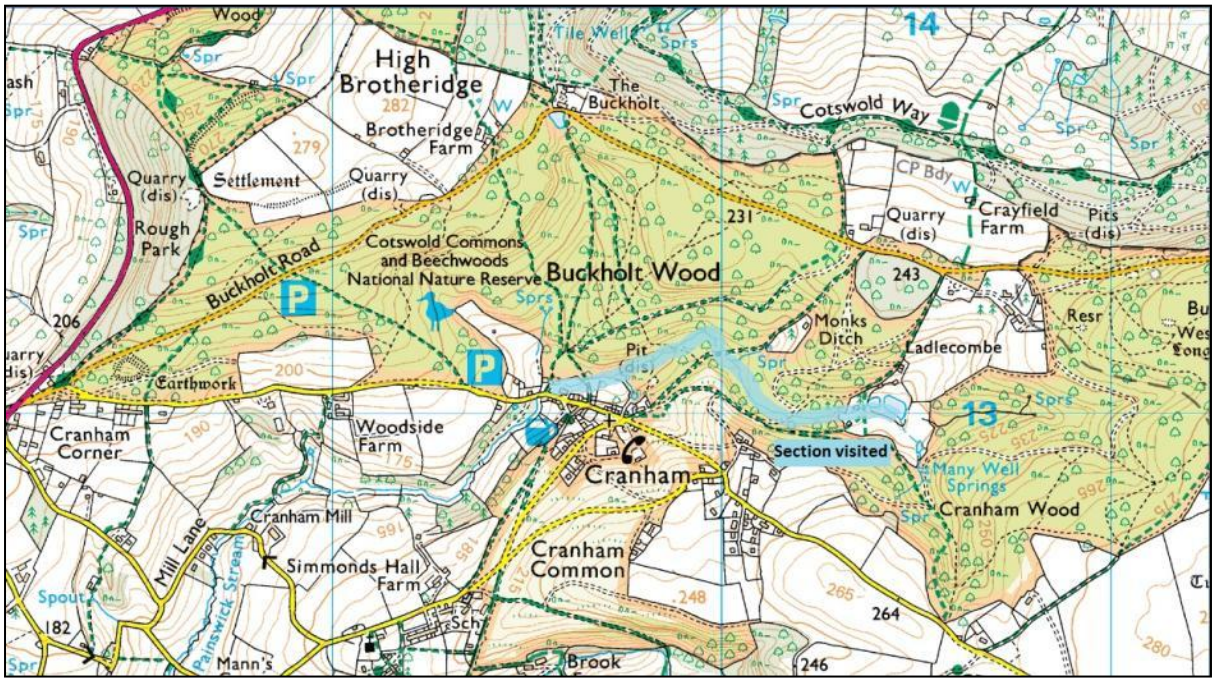

Figure 1: Map showing the section of Painswick Stream visited

The steep gradient and reliable springs feeding the stream have historically made it an ideal watercourse for powering water mills. According to an article published by Gloucestershire Society for Industrial Archaeology in 1985, water mills have been recorded on the Painswick Stream and its tributaries as far back as the 15th century. Of the 31 mills of which there is historical documentary evidence, 27 were in the cloth trade. Painswick Stream was known as the *Never Failing Stream* for its reliable water-power. [1]

The legacy of centuries of milling mean that a number of barriers to fish passage, most likely the remnants of mill weirs, have fragmented the stream

habitat. Wild brown trout *(Salmo trutta)* are often unable to pass upstream over such barriers and this can mean that resident populations are unable to recover from mortality events such as pollution incidents or droughts.

According to Sam Chapman (Environment Agency Fisheries Officer), there are at least four known barriers to fish passage between Cranham and Painswick. Additionally, a Water Framework Directive Waterbody Investigation undertaken in November/December 2011 identified over 20 potential barriers to fish passage between the confluence and Tocknell Court north of Painswick. It is highly likely that these barriers are preventing the Painswick Stream from performing as well as it could in terms of fish numbers. It is not known if wild trout occupy the headwaters of Painswick Stream but considering the known barriers to fish passage on the river, if a small population does persist in the headwaters the population will be entirely resident with no additional recruitment from fish migrating from downstream to spawn.

Whilst these barriers are a significant issue limiting populations of trout, salmon *(Salmo salar)* and European eels *(Anguilla anguilla),* the barriers may be helping to protect a known population of white-clawed crayfish *(Austropotamobius pallipes)* in and around Cranham. White-clawed crayfish are the only native species of crayfish in the UK and our largest freshwater crustacean. Populations have declined sharply over recent decades with many disappearing altogether from some parts of the country.

Changes to habitat and water quality have taken their toll but the most devastating impact on white-clawed crayfish has been the introduction of non-native crayfish, in particular the American signal crayfish *(Pacifastacus leniusculus)*. Signal crayfish are not only larger, more aggressive and more prolific than native white-claws, but also carry a fungal disease known as 'crayfish plague', against which white-clawed crayfish have no immune defence. At present, there is no recognised method of eradicating signal crayfish populations and once a signal crayfish population has established in a river, the entire native population downstream is potentially exposed to the disease. Signal crayfish can also migrate upstream to fully occupy a watercourse.

Barriers to upstream migration can therefore protect native species by halting or at least slowing the spread of signal crayfish. As signal crayfish have been

reported in the River Frome, the barriers on the Painswick Stream may be performing a function in protecting the white-clawed population.

Habitat Assessment

A short distance down from the spring at the source of the stream, at NGR SO903130, an online impoundment holds water in two ponds. On the day of the visit the impoundment, over which a footpath crosses, was overtopped by water flowing out of the smaller, lower pond. The structure may require inspection by a structural engineer to assess its condition as were the structure to breach and fail, the sudden input of fine sediment into the stream below could have a significant impact on habitat quality.

Figure 2: Water normally flows out from the pond through pipes but on the day of the visit water was flowing out over the path.

Near the head of the stream below the outfall of the pond, a small outfall structure appeared to be a drainage (and possibly a sewerage) outfall from a nearby property. Within a small watercourse such as Painswick Stream, with known isolated populations of sensitive endangered species, water quality is of the utmost concern. Misconnected sewerage could have damaging impacts on water quality in the stream. No obvious signs of enrichment were observed but further investigations may need to be carried out to ascertain the quality of water discharging from the outfall.

Figure 3: An outfall coming from a nearby property may need further investigation

As the stream flows down from the pond and through the surrounding beech *(Fagus sylvatica)* forest woodland, it becomes apparent that the habitat is heavily shaded during summer months. Shade loving species such as hart's-tongue fern *(Asplenium scolopendrium)* are prevalent on the steep banks and leafy plants are relatively sparse throughout the forest understory.

In addition to providing shade, the forest also provides an abundance of woody debris and leaf litter to the stream. Woody debris is an important component of the river ecosystem. It is an important food source for invertebrates, provides refuge for fish and crayfish, and diversifies flow patterns which in turn invigorate the geomorphology of the stream by scouring new pool and riffle features and increasing habitat diversity.

Figure 4: An abundance of woody debris helps to create a diverse and dynamic habitat

As flows are forced under pieces of large woody debris (LWD), gravels are scoured out from the bed to form a pool. Deeper pools are a holding habitat for trout and crayfish alike and can be vital refuges for a variety of species during low-flows. Gravel and fine sediment scoured out from pools is transported a short distance downstream. The finer material is transported the farthest whilst the largest stones settle closer to the pool. This 'sorting' of bed material is an essential process that ensures the gravel bed does not become overly compacted with fine sediment and makes it easier for gravel spawning fish species (such as trout) to shape the gravel to their individual spawning requirements.

Brown trout cut nests or 'redds' and spawn in 10-50mm diameter gravels at the tail end of pools in fast flowing, well oxygenated flows. Spawning gravels need to remain relatively free from fine sediment to prevent fertilised eggs from becoming smothered and suffocating.

Figure 5: LWD causing localised scour in the bed and diversifying the in-channel habitat

Although overall there is an abundance of woody debris in the stream, some sections of the river are deficient in larger woody debris and the bed is relatively flat and uniform. Sections of stream with a relatively uniform and flat bed can become desperately shallow during drought conditions, providing no deep pool refuges for aquatic fauna. Without pockets of localised scour, the bed substrate remains poorly sorted and can become compacted with fine sediment and precipitations of calcium carbonate.

Elevated levels of calcium carbonate leached from the limestone aquifer can be beneficial to the ecosystem as some invertebrates (such as crayfish) use the calcium to build their tough exoskeletons. However, the calcium carbonate can also precipitate out of the water and bind to river sediments. This build-up of calcium carbonate, known as 'tufa' can essentially glue pieces of gravel together and exacerbate the compaction of the bed.

Figure 6: Some sections of flat and compacted bed may become desperately shallow during low flows

In addition to LWD, coarse woody debris (CWD) consisting of branches and brushwood can be equally as important to the health of the ecosystem. In upland rivers where in-stream macrophytes (river weeds) are less common, CWD and leaf litter provide the main source of nutrition for detritivores and shredding invertebrates and the main input of energy into the stream food-web. CWD can also become trapped at pinch points within the channel and form 'debris dams'. These accumulations of woody material locally impound flows and create small areas of deeper water upstream. The localised slowing of flows allows fine sediment to drop out of suspension and accumulate on the bed.

In small upland streams with a steep gradient, fine sediment is readily washed downstream and without debris dams, deposits of fine sediment can be relatively scarce. Depositional features such as this can be a habitat for brook lamprey *(Lampetra planeri)* and burrowing invertebrates.

Pools surrounded by CWD can be prize territories for white-clawed crayfish which are omnivorous and can feed on detritus (as well as other invertebrates and even juvenile fish).

Figure 7: CWD debris dams provide small areas of deeper water and depositional habitat

Debris dams are a naturally occurring phenomenon common in heavily wooded areas that have a number of benefits to the stream ecosystem. However, large dams can be a barrier to fish passage and potentially prevent trout from accessing spawning gravels upstream.

An occasional sympathetic prodding of the woody material to ensure a solid flume of water is flowing through could help to keep the structures passable to trout. However, considering the reported presence of white-clawed crayfish and the apparent absence of brown trout, the debris dams may be best left undisturbed.

At NGR SO901129, the stream flows through two small culverts under a forest track. This is a barrier to fish passage that essentially cuts-off the upper reaches of the stream to any fish downstream. The track over the culverts was also heavily eroded at the time of the visit suggesting that the pipes are too narrow to convey a sufficient discharge during high flows and the track has over-topped and been partially washed away.

The culverts should be replaced with a larger conduit or perhaps a culvert with a natural bed or a clear span bridge in order to improve habitat connectivity and control erosion.

Figure 8: Narrow pipes used as a culvert under a forest track are fragmenting the stream habitat

Figure 9: Erosion around the culvert suggest that conveyance is inadequate during high flows

Occasionally on the banks of the stream and elsewhere within the woodland where small clearings allow direct sunlight onto the forest floor, less shade-tolerant species such as sedges *(Carex spp.)* have established. This

demonstrates the potential for a greater abundance of marginal plants to colonise the banks if and when light conditions allow.

Overhanging vegetation trailing into the stream provides an important interface between the aquatic and terrestrial habitat for invertebrate species have life-stages both in and out of the water. In addition, overhanging vegetation can provide cover for wild trout.

Figure 10: Sedges growing in a clearing demonstrate the potential for marginal species to develop where sunlight reaches the forest floor and stream banks

Selective tree works to allow more light onto the river banks and bed would greatly benefit the biodiversity of the stream ecosystem. However, it is important to ensure that such works be planned with the objective of creating a diverse range of light conditions over the stream.

Riparian shade plays an important role in regulating river temperature. Concerns over the potential effects of climate change on river temperatures and the subsequent impact on temperature sensitive species such as salmon and trout have instigated the development of the Environment Agency's 'Keeping Rivers Cool' (KRC) guidance manual. The manual advises on the use of riparian shade to help protect rivers from overheating during hot and dry weather. Summer mean and maximum water temperatures are on average 2-3ºC lower in shaded

than in open rivers.[2] The cooling effect of shade over stream headwaters such as Painswick Stream through Cranham Wood, is particularly important for regulating temperatures downstream.

Getting the correct balance between direct sunlight for plant growth, and shade for regulating water temperature is an important part of river habitat management. At present, the KRC manual recommends a roughly 50:50 ratio dappled shade to direct sunlight. Considering the nature of the woodland visited by WTT on this occasion and the importance of shade over stream headwaters, retaining a higher ratio shade to sunlight might be more practical and of greater benefit to the stream and woodland. Tree works should be planned with an objective of opening a number of 'skylights' in the tree cover to allow occasional patches of direct sunlight onto the stream banks. Trees with branches that trail low over or into the stream should be preserved where possible.

Dense populations of coniferous trees within 20m of the stream bank can cast heavy shade all year round which can restrict growth of the understory and lead to bare stream banks and increased rates of sedimentation from surface run-off. Removal of non-native and coniferous tree species would benefit the broadleaf woodland species which in turn support a greater diversity and abundance of terrestrial invertebrates and provide high quality of leaf litter, which is beneficial to the aquatic ecosystem.

Conclusions

The Painswick Stream through Cranham Woods has a good mixture of the habitat features required to support a high quality spawning and nursery habitat for wild trout. Some sympathetic management of the surrounding woodland and the introduction of some LWD to the more uniform and compacted sections of the stream could further enhance the habitat by increasing the number of pools and patches of direct sunlight.

Despite the fact that a number of barriers to fish passage downstream may be preventing the stream from being populated by wild trout, improving the habitat for trout will benefit the biodiversity of the stream as a whole.

Under the European Water Framework Directive, the Environment Agency has a target of returning Painswick Stream to 'Good Ecological Status'. This will involve the reconnection of fish passage through the stream to establish a healthy population of wild salmon, trout and eels. At present the cost and practicability of fish passage improvements on the stream mean that these works are not a major priority within the wider Severn River basin. The potential importance of the barriers in protecting the stream as an 'ark site' for white-clawed crayfish must also be considered. Nonetheless, ensuring the stream is maintained as a high quality habitat for wild brown trout as well as crayfish and other invertebrates is important for the future of the river and will maximise the chances of wild brown trout one day using the headwaters through Cranham Woods as a spawning and nursery habitat for the Painswick Stream.

Recommendations

In order for the Painswick Stream through Cranham Woods to achieve its full potential as a healthy and biodiverse stream habitat, the following actions are recommended:

- The pond impoundment at NGR SO903130 should be monitored for signs of water seepage and if necessary may need to be assessed by a structural engineer.

- The outfall downstream of the impoundment could be a potential water quality issue. It is recommended that the owner of the outfall be engaged to discuss the quality of the discharged effluent and if necessary advice may need to be sought as to what alternatives may be available to ensure the water quality of the stream is protected.

- The culvert at NGR SO901129 should be replaced with a more fish friendly culvert to improve conveyance and habitat connectivity.

- Tree works should be undertaken within the woodland to replace coniferous trees with native deciduous species and to create occasional pockets of direct sunlight over the banks.

- Pieces of LWD should be introduced to the more uniform and compacted sections of the stream in order to create more pools and loosen and sort compacted gravels. Where possible, small bankside trees should be hinged into the channel to provide anchored woody debris.

Making it Happen

The WTT has a range of information available that can help land owners to sensitively manage rivers and streams. Online 'how to' videos and publications such as habitat manuals and The Wild Trout Survival Guide are available from the WTT website.

A conversation with Sam Chapman at the Environment Agency in Tewkesbury regarding the EA's aspirations for Painswick Stream and what actions might be undertaken to complement these plans, could help to direct the future management of the stream (sam.chapman@environment-agency.gov.uk).

Normally, the installation of any structures in-stream or within 8 metres of the banks of main river channels will require Flood Defence Consent from the EA. This allows the proposed installation to be assessed for fisheries and biodiversity impacts as well as flood risk.

For water bodies not designated as 'Main River', consent will need to be issued by the local council. The Painswick Stream at Cranham Woods is not designated as Main River.

WTT Officers are always available to offer free help and advice on FDC and river management.

Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programmes.

Disclaimer

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