River Holme: Advisory Visit

Paul Gaskell Wild Trout Trust (WTT) 25/08/2016

	River 2015, Holmfirth
River	Holme
Waterbody Name	Holme from source to New Mill Dike
Waterbody ID	GB104027057600
Management Catchment	Aire and Calder
River Basin District	Humber
Current Ecological Quality	Moderate
U/S Grid Ref inspected	SE1392108006
D/S Grid Ref inspected	SE1439208481
Length of river inspected	1km

1 Introduction

A site visit and habitat appraisal was carried out by Paul Gaskell at the request of Kim Warren, Project Officer for the River 2015 group to explore the potential for habitat improvement on the River Holme, Holmfirth. The Water Framework Directive (WFD) identifies this within the single Waterbody "Holme from source to New Mill Dike" which has the Waterbody ID code GB104027057600.

The 2015 classification for the full waterbody cites "moderate" ecological potential for this waterbody. The classification appears to be driven mainly by "moderate" status for fish ("good" in 2009 assessment), "moderate" status for invertebrates ("moderate" in 2009) and "moderate" status for phosphate ("good" in 2009 assessment). Measurements that rely on "snapshots" are subject to fluctuations that may, or may not, be a highly robust reflection of trends in the ecological potential or status of a waterbody. However, it is important to note the existence of phosphate concentrations that have the potential to impact the biological health of the waterbody. With the phosphate measurements in mind, the fact that the invertebrate and fish surveys also showed reduced quality should not be overlooked. In particular, the potential for water quality to override structural habitat conditions means that habitat and water quality need to be protected and/or improved if genuine ecological improvements are to be achieved.

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

2 Habitat assessment notes

It is important to note that the approach to habitat assessment used by the WTT references, but is not solely confined to, a single species (the UK's native trout species *Salmo trutta*). Instead it uses the trout as a functional indicator of a range of conditions that are important for river corridor health as a whole. Meeting the needs of this iconic species in river systems that should naturally support wild trout is a simple but reliable means of protecting or improving conditions for a wide range of other species. The presence of structurally-variable habitat, a good supply of clean (and well-oxygenated) water and the opportunity to move freely between different patches of good habitat are all essential for healthy surface watercourse ecosystems.

This includes the riparian (river-side) flora, fauna and land-use too – since aquatic foodwebs are inextricably linked to riparian foodwebs (and land-use fundamentally determines surface runoff to watercourses). With this in mind, it is useful to examine habitat requirements for the full life-cycle of brown trout and explore the consequences of particular limiting factors (where crucial habitat features are absent):

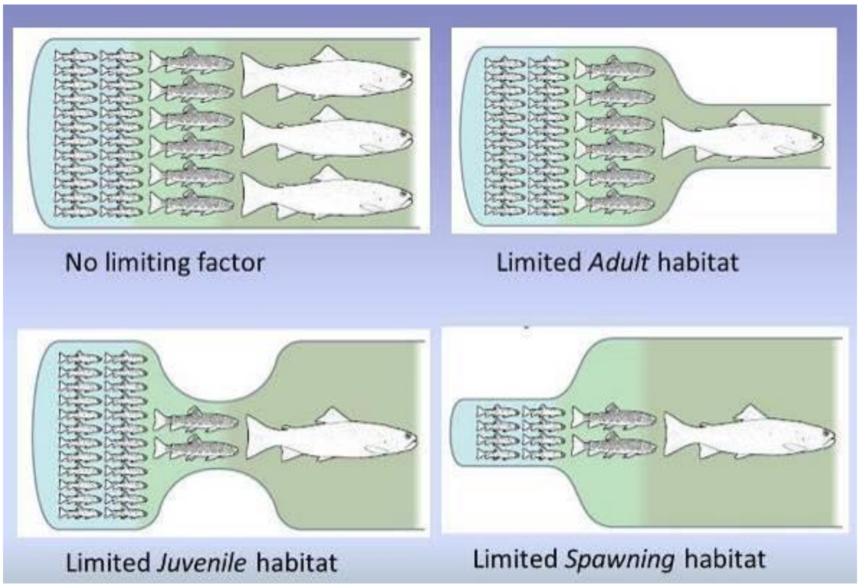

Figure 1: The impacts on trout populations lacking adequate habitat for key lifecycle stages. Spawning trout require loose mounds of gravel with a good flow of oxygenated water between gravel grains. Juvenile trout need shallow water with plenty of dense submerged/tangled structure for protection against predators and wash-out during spates. Adult trout need deeper pools (usually > 30cm depth) with nearby structural cover such as undercut boulders, sunken trees/tree limbs and/or low overhanging cover (ideally within 30cm of the water's surface. Excellent quality in one or two out of the three crucial habitats cannot make up for a "weak link" in the remaining critical habitat.

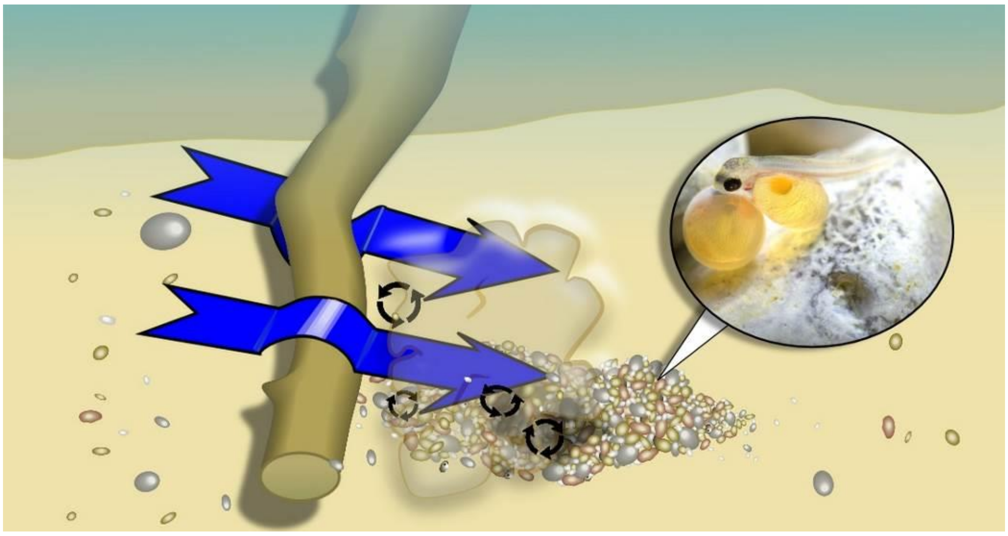

Figure 2: Features associated with successful trout spawning habitat include the presence of silt-free gravels. Here the action of fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of river-bed that results in silt being blown out from between gravel grains. A small mound of gravel is deposited just below the hollow dug by focused flows. In these silt-free gaps between the grains of gravel it is possible for sufficient oxygen-rich water to flow over the developing eggs and newly-hatched "alevins" to keep them alive as they hide within the gravel mound (inset) until emerging in spring.

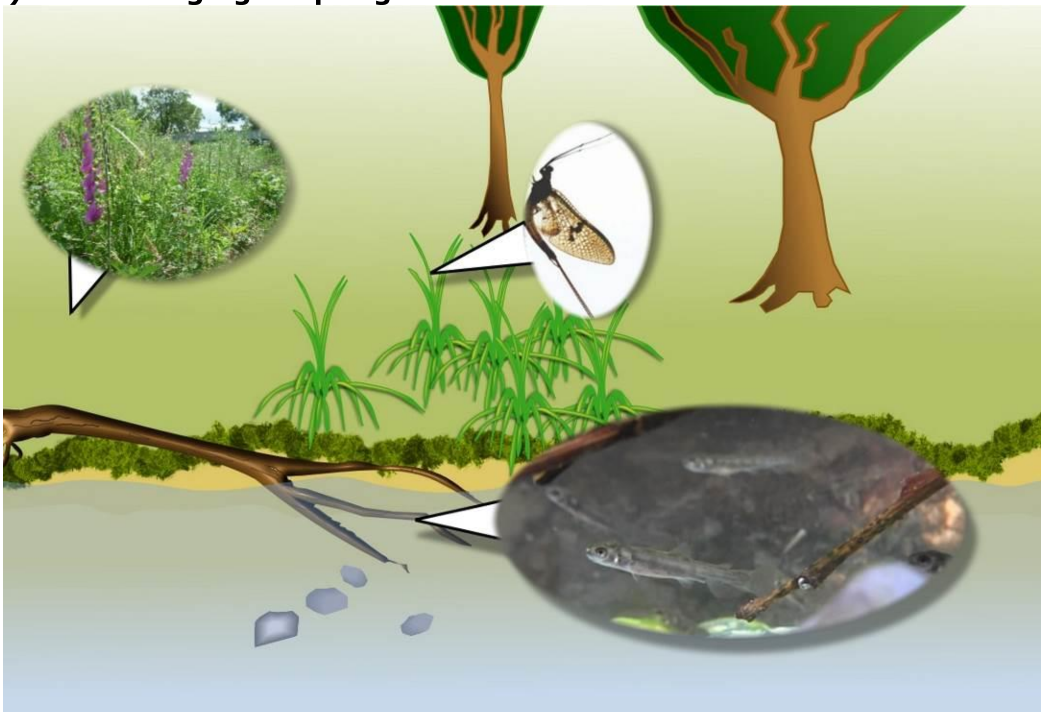

Figure 3: Larger cobbles and submerged "brashy" cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows to tiny juvenile fish in shallower water (<30cm deep). Trailing overhanging vegetation also provides a similar function and diverse bank-side vegetation has many benefits for invertebrate populations (some of which will provide a ready food supply for the juvenile fish).

Figure 4: The availability of deeper water bolt holes (>30cm to several metres), low overhanging cover and larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle in this case) are all strong components of adult trout habitat requirements.

With these broad descriptions of the elements of spawning, juvenile (nursery) and adult trout habitat in mind, measures to address the issues identified during the survey can more easily be described. Additionally, in the case of heavily-modified waterbodies such as the River Holme, it is essential to understand the role of riverbed material transport in the formation and maintenance of high quality habitat. To this end, it is useful to consider two short videos prior to (and alongside) considering the subsequent site-specific observations of habitat features on the River Holme:

The basic principles by which variation in cross-sectional depth (and flow-velocity) emerge from the inherent behaviour of water flowing downhill are introduced in this short WTT video: http://www.wildtrout.org/content/case-study-videos#Emriver

Some specific ways that weirs stifle the formation of high quality habitat both upstream and downstream of their position are demonstrated in this WTT video: http://www.wildtrout.org/content/weirs-culverts-and-barriers#habitat

These processes of periodic redistribution of riverbed material by erosion and deposition are described by the field of study called "fluvial geomorphology". The potential for healthy stream and river ecosystems to exist is strongly influenced and, in fact, limited by the action of geomorphology.

2.1 Site specific habitat observations

The downstream limit of the watercourse inspection for this report was at National Grid Reference (NGR) SE14392 08481 (Fig. 5). The beneficial existence of a relatively steep longitudinal gradient (increased potential for riverbed redistribution) and the presence of mature riparian woodland (provision of shade and support for foodweb interactions spanning aquatic/terrestrial boundary) are evident.

Figure 5: Mature woodland and beneficial impacts of relatively steep gradient. These contribute some mitigation for the realignment of the channel and armouring of the banks. Examples of dressed stonework that the river has washed out and repositioned can be seen.

While there is always a balance to be struck (you can always have too much of a good thing), the importance to rivers of areas of tree-canopy shade must be noted. This is particularly important for rivers that are dark in colour – such as ones like the River Holme that have a bed of gritstone and peat-stained water. Solar heat-gains are more pronounced in dark coloured rivers that absorb more solar radiation than light-coloured rivers.

Although common in the catchment, the presence of the invasive plant Himalayan balsam (*Impatiens glandulifera*) was notably reduced in this lower section of the surveyed reach. It is likely that this is due to previous and ongoing diligent efforts by the River 2015 group to control this problem species. A short introduction to some of the problems posed by Himalayan balsam is given in this video: https://youtu.be/VijmRm-qd4Y and a handy summary of facts and figures has been published by Commonwealth Agricultural Bureau International (CABI) https://himalayanbalsamdotcabidotorg1.files.wordpress.com/2013/06/himalayan-balsam-infographic.pdf.

The presence of diverse understory vegetation in the riparian zone is, therefore, important for both terrestrial and aquatic foodwebs. It will be useful to return to this concept later in this report when considering the following:

- Appropriate balance of light/shade regime
- Riparian vegetation management (broadly)
- Grazing by waterfowl (specifically)

Walking the footpath upstream (on the LB), a few metres along the path from the photographed point in Fig. 5, a line of young saplings (Fig. 6) may be good future candidates for light, rotational coppicing (so as to introduce a more staggered height/age structure to the canopy).

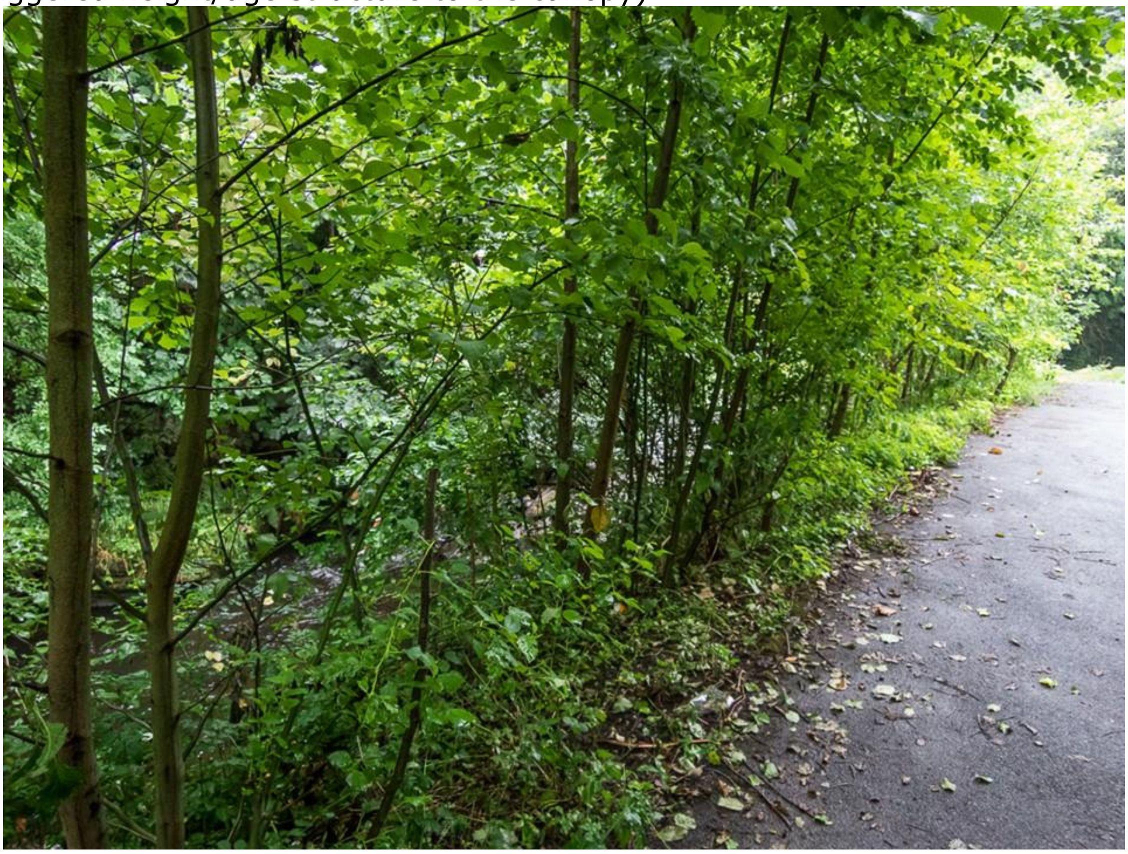

Figure 6: Row of young saplings that, as they grow, could become a means of introducing and maintaining some diversity in canopy structure. If these were closer to the water level, they would also be excellent candidates for "hinging" or "laying" (as in hedge-laying) into the river margins to generate living "cover" habitat.

Of course, in order to properly achieve that increased variety in canopy structure, the much larger (mature) trees on both LB and RB in this section will also need to be included in a light-touch coppicing regime. A broad guideline could be to coppice one in ten trees (in scattered locations) each year for a period of 10 years. This would be a standard 10-year rotational coppicing regime and will provide both ecological – but also public safety – benefits. Little and often management of this kind will help to identify and manage any trees that could develop into a danger to the public – while creating that increased structural variety that drives the greatest biological variety.

Good structural variety within the channel is certainly evident at SE 14389 08446 (Fig. 7).

Figure 7: Gradient and a variety of sizes of rocky substrate are coupled with some important trailing/overhanging vegetation cover to produce some high quality habitat features within this modified channel. There is a nice mixture of shade, dappled light and open water here also.

However, the presence (at this point and throughout the visited reaches) of artificial retaining walls have the effect of cutting off the natural supply of gravel to the system. One of the vital functions of the dynamic, lateral shifting of a river across its natural floodplain is the inputs of gravels and other substrates. When the channel is locked in place, that process is cut off. Supplies of finer particles (i.e. those within the sand/silt fraction) tend to continue to be delivered due to the drainage of tarmacked surfaces and associated particulate runoff in the surrounding, urbanised, catchment. Overall, then, the gravel component of the riverbed will tend to become under-represented over time. That condition is compounded by the presence of weirs that intercept bed material as it is transported downstream – which is problematic for gravel-spawning species such as trout.

Currently, the presence of wild trout in these reaches suggests that there are enough opportunities for successful spawning to at least sustain some kind of breeding population. However, that does not indicate whether that population is close to its full potential. More significantly, it does not indicate how close the system is to simply meeting the minimum requirements for spawning gravel needed to support populations in future years. A preferable status would be to ensure sufficient spawning resources (along with nursery and adult habitat) to support robust and resilient populations.

Although re-establishing natural regimes of bank erosion is probably not practical within the most heavily urbanised reaches, some "seeding" with locally-appropriate gravel may be appropriate in future (by way of mitigation for the bank armouring). Coupled with tackling the impounding structures, that could be an excellent way of building in resilience to climatic and other environmental changes for self-sustaining populations within the Holme. Figure 8, at SE1437808416, displays some excellent nursery and adult fish habitat, but the combination of a straightened channel (reducing the ability of the channel to retain deposits of gravels) and reduced gravel inputs puts this habitat at risk of a spawning bottleneck.

Figure 8: Good examples of deep scour pool habitat, boulders and cobble "point-bar" deposition. However, the restricted supply of gravel due to armouring of banks against erosion and the "straighter than natural" channel combine to produce a relative lack of spawning substrate. Note the valuable woodland canopy on the RB (left of frame).

Outside impounded reaches, where rivers have appreciable gradient and mobile substrate, the formation of depositional features such as "point bars" is evident (e.g. Fig. 8). These are shingle, cobble or (in the most powerful rivers) boulder "beaches" that form on the inside of bends. In Figure 8 there is an obvious point bar above and to the left of the ducks – with another one in the background towards the top right of the frame. One, probably unexpected, benefit of armoured banks is that (while they remain intact) their resistance to erosion compels the river to dig downwards on the outside of bends. This process of point bar deposition (inside of bends) and downwards scour (outside of bends) in combination is known as "lateral scour". It is the driving force behind the ecologically-valuable variation in depth, substrate particle-size and current velocity throughout the cross-section of a river channel. That physical diversity maps directly onto the variety of niches available for biological communities to exploit (and hence is a key determinant of overall biodiversity). When rivers are robbed of the ability to create lateral-scour features, it dramatically limits their potential to support biodiverse communities.

The most common causes of the lack of that vital cross-sectional structural diversity are dredging and straightening of channels and the impoundment of water by weirs. The first two impacts remove the channel-features necessary for lateral scour (bends and a suitable range of mobile substrate) while the third takes away the energy from the flow that is necessary to redistribute the bed material. Consequently, the presence of free-flowing sections of river pictured in Figs. 5 – 8 are extremely valuable patches of habitat.

Opportunities to maximise the potential value of that habitat can depend, in part, on factors already mentioned (increasing variety in tree canopy structure, potential seeding with gravels in the upper reaches of the system). However, other opportunities also exist. For example, there is a general lack of high quality "overwintering" habitat for trout and other species. This typically takes the form of submerged, relatively dense "cover" or "shelter" that fish can hole up inside and go into a more dormant state while remaining at relatively low risk of predation or wash-out due to spate flows. Excellent examples include submerged masses of tree roots, the submerged crowns of fallen trees (or natural coarse woody material log-jams), root masses of emergent herbaceous vegetation or undercut banks, fringed with ample trailing riparian vegetation. In the surveyed reaches of the Holme, the predominance of stone retaining walls means there is a significant lack of that sort of habitat. Section 3 "Recommendations" contains some suggestions on methods to tackle that shortfall.

A further problematic factor (for both aesthetic amenity and as a pathway for sediment runoff) is the denuding of previously vegetated areas due to waterfowl grazing and associated footfall (Figs. 9 and 10).

Figure 9: Bare earth exposed due to feeding waterfowl (note orange dye mark on tree – presumably identifying it as suitable for removal by the local council)

Figure 10: Further destruction of herbaceous vegetation due to waterfowl grazing and associated pedestrian access. The popularity of feeding the ducks from the bridge is demonstrated in the background.

This activity and associated impacts are greatest between grid references SE 14363 08389 and the footbridge at SE14328 08346. It may be possible to reduce the potential for this area to act as a sediment runoff pathway by excluding wildfowl and undertaking planting of appropriate species. However, this requires sufficient "buy in" and understanding by the local community. Again, suggestions are given in Section 3 "Recommendations".

A very prominent effect of variation in tree canopy structure was evident at SE14328 08346 (Figs. 11 and 12). The Figure 11 photograph shows a much more vigorous growth of understory vegetation compared to the more densely-shading high tree canopy of Figure 12. Now, it is important to recognise the value of areas of dense shade (particularly for the cooling effects noted earlier in this report). However, the response of the understory vegetation to patches of increased daylight shows that there will be value in creating a patchwork of similar openings in the canopy.

The key consideration is to avoid being too heavy-handed and too uniform with the canopy-management interventions. The previously-suggested 10-year rotational coppice should give the desired results here – and some of the arising material from those tree works may be used to enhance overwintering habitat within the channel (Section 3: "Recommendations").

Figure 11: Relatively lush and varied understory vegetation associated with an opening in the tree canopy (N.B. grass clippings dumped at the top of this slope were noted to be a source of pollution and should be challenged informally and then, if necessary, under the Control of Pollution Act 1974.

Figure 12: Sparser ground cover in densely-shaded areas

The presence of several substantial road bridges (and even the construction of buildings over the river for short sections) means that there are some areas of complete shade within the surveyed reach. Consequently, as long as the trees are allowed to re-grow (and to continue to provide leaf-litter inputs to support food webs), there will be benefits to extending the rotational coppicing throughout the visited reaches. For instance, the very uniform shading directly upstream of the footbridge at SE14328 08346 would benefit from the creation of a more staggered age-structure to the trees.

Figure 13: Uniform and extensive shading. While retaining some patches of shade, there will be benefits from light rotational coppicing to produce more variation in canopy height and density.

In contrast, the examples of extremely valuable low, overhanging cover at SE14264 08306 (Fig. 14) should be diligently protected (and certainly excluded from any trimming/coppicing works undertaken to manage the high canopy). It is also noteworthy that the collapse of a weir that previously impounded this section (at SE 14284 8307) has now allowed the formation of a point bar and the regeneration of some cross-sectional variation in depth and flow velocity in the reach (also Fig. 14).

In contrast, the historic channel modifications have left an overwide and over-shallow/uniform channel directly upstream of the footbridge at SE14264 08306 (Fig. 15). This was also the first noted example of a small stand of Japanese knotweed (*Fallopia japonica*), an invasive plant species that is more difficult to control than Himalayan balsam. It can also cause significant damage to buildings due to its extensive rhizome (root) system and ability to find, exploit and expand small fissures in rocks or stonework. In its native range, it has evolved to grow through volcanic rock and any single plant can have rhizomes that extend anywhere within a circumference of seven metres. This quite commonly leads to structural problems with walls and foundations of buildings. Not only that, but it is not unusual for plants that start their lives as a stand outside a building to break through and start growing out of the floors of rooms inside that building.

Figure 14: Lateral scour/point-bar deposition and excellent low, overhanging cover that should be protected during any vegetation-management works.

Figure 15: Overwide, over-shallow and uniform. If the whole reach was dominated by this type of habitat - it would represent a significantly degraded system. However, when present as a short section such as this, it may provide a specialised habitat for species adapted to periodically dry channel conditions.

Note Japanese knotweed lower right of frame and complete shade provided by building spanning the river channel in the background.

The Japanese knotweed foliage was more discoloured than would usually be expected for the time of year (Fig. 16) – a possible indication that some chemical control has been attempted. In this, and all subsequent mentions of knotweed infestations of structures with identifiable owners, contacting owner(s) to ensure they understand the implications of the presence of knotweed is essential.

Figure 16: Brown discolouration on Japanese knotweed foliage growing just upstream of footbridge a SE14264 08306. Possibly due to relatively challenging growing conditions for what is, as yet, a young plant – but maybe an indication that some chemical control measures have been attempted.

It is vital to note that, while chemical control is an essential step, it is also covered by strict licensing by the Environment Agency (designed to minimize harm to non-target species and systems). Some additional, general, information on herbicide application alongside watercourses is available here: https://www.gov.uk/government/publications/application-to-use-herbicides-in-or-near-water. However, there are further, extremely serious considerations when dealing with Japanese knotweed. Specifically, Schedule 9, Section 14 of the Wildlife and Countryside Act 1981, states that it is an offence to plant or otherwise cause the species to grow in the wild. Additionally, section 14(2) of the Wildlife and Countryside Act 1981 states that "if any person plants or otherwise causes to grow in the wild any plant which is included in Part 2 of Schedule 9, he shall be guilty of an offence"; Japanese knotweed is a Schedule 9 listed plant.

Japanese Knotweed is classed as 'controlled waste' and as such must be disposed of safely at a licensed landfill site according to the Environmental Protection Act (Duty of Care) Regulations 1991. Soil containing rhizome material can be regarded as contaminated and, if taken off a site, must be disposed of at a suitably licensed landfill site and buried to a depth of at least 5 metres.

Due to the capacity of Japanese knotweed to produce entire new stands from small fragments (approximately the size of the first joint of your thumb) and the potential extent of rhizomes (root-masses) from each individual plant over a radius of seven metres, the effective control of this plant is skilled work. Either employing reputable contractors (e.g. sourced via the certified trade body INNSA; http://www.innsa.org/) or investing in training and certification of members of River 2015 is recommended. While the number and size of Japanese knotweed stands remain relatively small, there is a golden opportunity to achieve control without immense expenditure.

That window of opportunity will not remain open for long, and the potential for exponential growth as stands become more established and vigorous is ever-present. At the same time it is important to understand the difference between "control" and "eradication". The latter is almost certain to require specialist, professional input, while the former can be possible through in-house training in the use of stem injection kit (and the purchase of same). Depending on the situation at each site (for instance threat to current or future building developments – versus mitigating ecological impact), the requirement for "eradication" over "control" will vary.

Another example of important choices of options for tree canopy management was noted at SE14244 08270 (Fig. 17). Here, a riverside tree is providing a patch of extremely valuable overhead cover and shade.

Figure 17: Valuable shade and cover close to the surface of the river. If there is pressure to manage the shade or impact that this tree is having on the riverside properties – it is essential to explore ways of achieving that while preserving the cover it is providing to the channel via its lower/overhanging limbs.

There may be current or future pressures to remove this tree due to its influence on the riverside properties. In such a case, it would be important to consider the significant beneficial effect that the low, overhanging limbs are providing to the river ecosystem. Interventions that could retain this benefit at the same time as managing any potential impact on buildings or infrastructure should be fully explored and implemented.

Another stand of Japanese knotweed was observed at “Y’s Bar and Snap” (Fig. 18). Naturally, given the previously-highlighted potential for the plant to break through structural walls, floors and foundations, the treatment of this will be essential for the business-owner in question. The excellent engagement and involvement of local stakeholders (including riparian businesses) that River 2015 has already achieved will be extremely useful in this respect.

Figure 18: Knotweed at base of wall of Y's Bar & Snap at SE14244 08261; a significant concern to the business ownership.

The channel at this location may be a good candidate area for the introduction of some stable, in-stream cover. Previous modifications to the channel include gabion baskets that are now degrading and there is a general lack of good submerged cover for young fish and invertebrates (Fig. 19). At the same time, the presence of multi-stemmed trees that form part of a berm on the LB (Fig. 20) could provide both raw material and a suitable anchor-point for a “tree kicker” type habitat feature. A detailed guide to tree kickers, their installation and performance is given in this short WTT video: http://www.wildtrout.org/content/how-videos#tree kicker

One vital element to note for tree kickers is that their size can be tuned to ensure that they are appropriate to the channel into which they are installed. There is not a single “set size” for these features.

Figure 19: Degrading gabion structure and opportunity to increase submerged cover habitat a few metres upstream from SE14244 08261

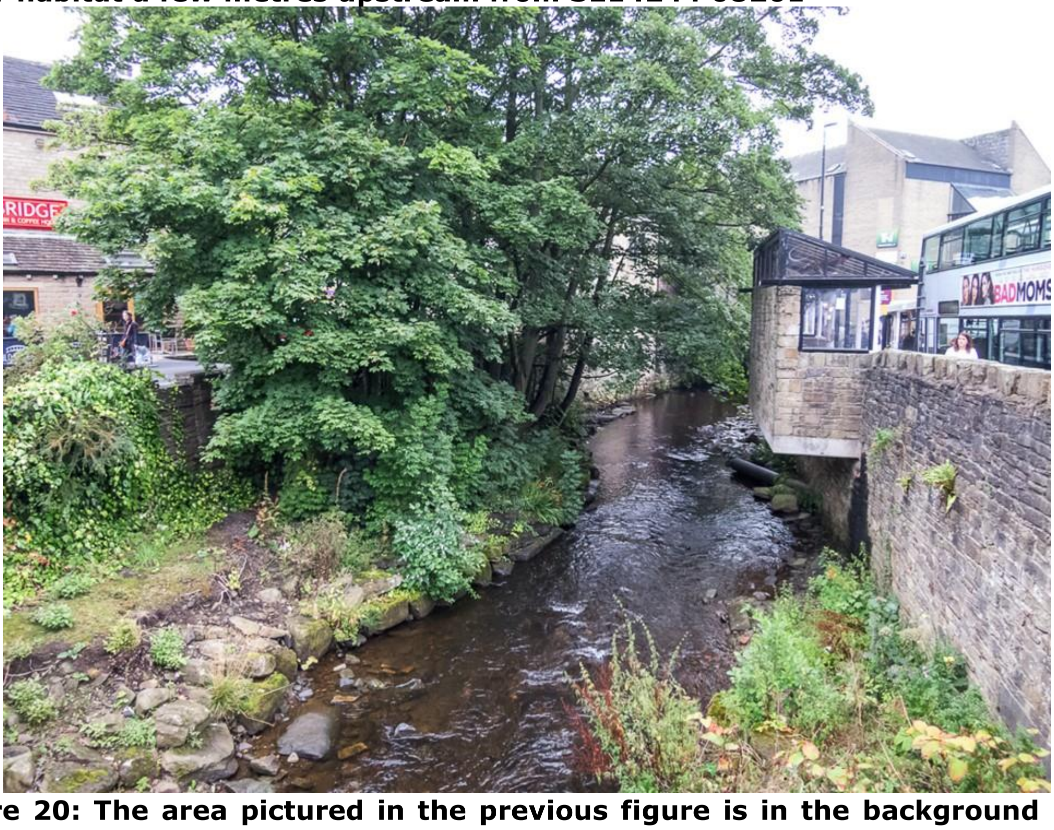

Figure 20: The area pictured in the previous figure is in the background here. The degrading gabions are visible on the RB (right of frame, background) and the multi-stemmed trees on the LB-berm are readily visible.

A collapsing weir was noted and photographed from SE14248 08226 (facing upstream; Fig. 21). With reference to the previously-highlighted importance of geomorphological processes (as well as access to habitat), the gradual and ongoing degradation of this structure is having a very positive benefit to the ecological status of the river Holme.

Figure 21: Collapsing weir - which will continue to improve both the habitat and also connectivity (i.e. ability for species that migrate between different areas of river systems in order to complete their lifecycles) of the River Holme and wider catchment.

For this reason, enacting suggestions from local stakeholders to build weirs higher for various visual amenity values would have extremely negative ecological consequences.

Although some Himalayan balsam is beginning to reappear in this section, there is still a visible benefit to previous clearances at this site – with native vegetation growing on the deposited cobble bars at the margins of the channel at this point. An excellent way to protect and increase biodiversity – while also enhancing visual amenity value – would be to continue regular balsam control and supplement with appropriate native-seed planting.

Even without supportive planting, the efforts to control invasive plant species will reap significant benefits for – not only native flora – but the range of fauna associated with diverse riparian vegetation. This is true even with the ongoing existence of upstream sources of recolonization by invasive plant species. Of course, the ideal scenario would be to sequentially eradicate those species from their upstream limits down throughout the system. However, the cost associated with that can paralyse any efforts at control – and this has been demonstrated to be extremely significant for biodiversity at the landscape scale. A blog post that gives both an individual, anecdotal case-study as well as linking out to a specific scientific publication on the mechanism behind this surprising situation, is available on this link: http://urbantrout.blogspot.co.uk/2014/07/volunteer-action-on-urban-river.html

The individual link to the paper that examines the effect of local-scale control of invasive species on the overall biodiversity at the landscape scale is: http://www.sciencecodex.com/global_plant_diversity_hinges_on_local_battles_against_invasive_species-105553

In other words, by creating a patchwork of areas in which invasive species are excluded, the summed effect of native species flourishing within those patches adds up to greater native biodiversity at the landscape scale. Looking after your own small patches can be vital in this respect.

One of the reasons behind suggestions to re-instate, increase the height of or build new weirs is the suggestion to "drown out" the visible service pipes that cross the river just upstream from the bridge at SE14220 08153 (Fig. 22).

Figure 22: Exposed pipes and varied low-level vegetation at SE14220 08153

As well as the previously-highlighted (substantially-negative) aquatic ecological impacts of doing this, there is also a significant consideration of the new height of the water which would drown out the currently varied and attractive riparian vegetation. The loss of that riparian vegetation not only impacts on the visual amenity, but also the potential for valuable ecosystem processes such as photosynthesis and interception/absorption of pollutants (both waterborne and airborne). An impoundment of that height would also have potentially highly significant implications to flood risk for the properties upstream of a new weir of that size.

A better compromise (assuming that the pipes cannot be de-commissioned and removed) would be to explore the potential to paint in a more muted colour and also establish native climbing plant growth; possibly ivy (*Hedera helix*). The evergreen status of ivy would maintain a year-round pleasant appearance as well as providing additional ecological niche opportunities for invertebrates.

More knotweed was noted at SE14134 08121 at "The Pattern Principle" (Fig. 23) and also nearby in the footings of Holmfirth Mills (Fig. 24). In both cases, the same considerations as previously raised in this report apply. With the generally more widespread presence of Himalayan balsam (currently), there is a danger of overlooking the opportunity to reduce the amount of funding required to achieve control of the (much more technically difficult to control) Japanese knotweed infestation.

While in no way under-estimating the extent, severity and significance of the widespread balsam infestation, there is at least a simple hand-pulling option to achieve control of that species. The same certainly cannot be said of Japanese knotweed.

Figure 23: Japanese knotweed (left of frame) as well as Himalayan balsam (centre frame) at The Pattern Principle.

Figure 24: A (currently small) infestation of Japanese knotweed at Holmfirth Mills.

Although constrained by high, vertical walls, some of the impacts of channel modification have been naturally mitigated by combined effects of geomorphology and natural succession. An example of where gradient, channel width and the opportunistic colonisation of channel stonework have combined to produce more valuable habitat was noted at SE 14060 08089 (Fig. 25)

Figure 25: Some diversity in flow depth and velocity (as well as more varied trailing and overhanging riparian vegetation) has naturally emerged and provided a little mitigation for the historic channel modification.

In contrast a large, and vigorously growing, knotweed stand was noted at SE14039 08069 (outside houses number 4 and 5 on what is thought to be Lower Mill Lane; Fig. 26).

Figure 26: Large stand of lush Japanese knotweed growth. The houses in the background are conceivably within reach of the extending rhizome system from this stand.

Similarly, at the upstream limit of the surveyed reach at SE13921 08006, another huge stand of knotweed was noted (Fig. 27).

Figure 27: Japanese knotweed infestation spanning both banks at the upstream limit of the surveyed reach.

While both of these stands of knotweed are clearly much larger than the other, developing, infestations downstream, they are still feasible to tackle via stem-injection. Although this will not guarantee eradication, it is a cost-effective way of achieving control. Until the development of specific stem-injection technology, the alternative cutting, spraying and control/disposal of biohazardous waste (and the need for multiple repeat treatments) methodology was far, far more expensive.

3 Recommendations

A summary of recommended actions include:

- Explore, with the Environment Agency, the potential sources of Phosphate pollution and seek measures to control same
- Create more staggered canopy within the densely-wooded river corridor areas (a 10-year rotational coppice is likely to be appropriate in this case). N.B. Coppiced trees must be allowed to regrow under this regime to achieve the desired improvements
- Seek opportunities to install tree kickers using material arising from canopy works – particularly in the region of SE14244 08261 (Fig. 28 shows a sizeable example, but refer to guidance video link given after this figure).
- Seek opportunities to hinge (lay) saplings into margins to produce refuge habitat (e.g. Fig. 29)
- Coupled with a diversification of light/shade via tree-canopy management in the region of SE14328 08346, it may be possible to plant and then protect (via waterfowl-grazing exclusion) appropriate riparian vegetation (e.g. Fig. 30)
- Tackle nitrogenous/general organic enrichment pollution arising from grass clippings (e.g. Fig. 31)
- Explore opportunities to "seed" the upper reaches of the watercourse with locally-appropriate gravels to mitigate historic channel armouring
- Encourage the continuation of natural degradation of previously-impounding structures (weirs) and avoid re-instating or increasing the height of impoundments in future
- Explore the potential for interpretive signage around the sites of degrading weirs to document historic state, construction techniques and notable features – along with explanation of recovering geomorphological processes/attendant biodiversity benefits
- Continue and extend the efforts to control Himalayan balsam infestations
- Supplement removal of Himalayan balsam with planting of appropriate seed mix (particularly in the area of the Picture House to provide dual ecological and visual amenity values. One potentially-suitable species mix is: http://www.bostonseeds.com/advice/2/Wildflowers/63/Wildflower-Mixtures-BS6-Wetland-and-Pond-Mixture/)
- Explore the purchase of stem-injection kit for the control of Japanese knotweed (with attendant training and certification of appropriate and willing River 2015 personnel and volunteers)
- Enter into consultation with local stakeholders via the River 2015 network to facilitate discussion and understanding of proposed measures highlighted in this report (WTT happy to contribute to this process)
- Establish and obtain any and all permissions necessary to undertake any of the proposed actions in this report (these extend to all relevant regulatory authorities and landowners

Figure 28: Newly-installed tree "kicker" (attached to a secure anchor point using braided steel cable; circled).

A guide to installation and the typical effects of a tree kicker can be seen in this video: http://www.wildtrout.org/content/how-videos#tree kicker.

Figure 29: Hinging or laying of saplings to create marginal cover (in this case using hazel).

Figure 30: Successful establishment of waterside flora by the South East Rivers Trust, River Wandle – including exclusion of waterfowl grazing (more extensive measures may be required in Holmfirth, and there is a risk of vandalism with initiatives such as this).

Figure 31: Grass clippings dumped at the top of slope draining directly into the river - a source of organic pollution.

4 Next Steps

Following the circulation of this report to relevant stakeholders (and subsequent arising discussions), it may be appropriate to draw up a more specific project proposal in partnership with River 2015. The WTT is happy to contribute to that process. The WTT is also happy to offer an evening, slideshow presentation and discussion of the outputs from this report with stakeholders at a mutually agreed time.

5 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and project proposal work associated with this project – including a portion of funds arising from rod licence sales.

6 Disclaimer

This report is produced for guidance; no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon guidance made in this report.