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Advisory Visit
River Don, Salmon Pastures

Advisory Visit by Paul Gaskell (pgaskell@wildtrout.org)

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River	River Don
Waterbody Name	Don from River Loxley confl to River Don Works
Waterbody ID	**GB104027057412**
Management Catchment	Don and Rother
River Basin District	Humber
Current Ecological Status	Poor
U/S Grid Ref inspected	SK3716888170
D/S Grid Ref inspected	SK3728388341
Length of river inspected	0.25 km

1 Summary

- *Previous alterations to the course of the River Don – and the installation of extensive block stone revetment – have had negative impacts on river ecology*
- *Episodic poor water quality, fine sediment inputs and the existence of multiple weirs beyond the visited reach also impose significant impacts*
- *Invasive, non-native plant species compound these impacts and limit overall biodiversity*
- *Control of invasive plants and the creation of additional structural variety and hydraulic roughness (in the form of small boulder clusters and stable, marginal woody material) would be beneficial*
- *A wider campaign to continue improvements in water quality seen since the 1980s (and avoid deterioration) is necessary to consolidate benefits to habitat structure*
- *Don Catchment Rivers Trust are already engaged in improvements to connectivity, by making weirs passable – along with Environment Agency fish pass and weir-removal projects*
- *The accumulation of gains made in the key areas of habitat quality, water quality, connectivity and control of invasive, competitively dominant species has significant potential to improve the ecological status of the River Don*

2 Introduction

The Wild Trout Trust (WTT) was invited by representatives of Don Catchment Rivers Trust (DCRT) to examine the River Don in the area known as Salmon Pastures and advise on any possible improvements to habitat. Throughout the report, banks are designated as right (RB) and left (LB) while facing downstream and locations are specified using the National Grid Reference system.

2.1 Background

Historic modification of the channel (and the creation of the adjacent canal) has impacted river habitat in this section of the River Don. In addition, water quality is impacted by many aspects of the surrounding industry, transport and domestic development of the city, from the industrial revolution to the present day. By contrast, the naming of this area as Salmon Pastures derives from the previous abundance of Atlantic Salmon in this section of the South Yorkshire River Don.

The WTT was invited by DCRT to assess the reach

3 Habitat Assessment

The reach was walked in a downstream direction with features noted sequentially in this assessment. Two very obvious characteristics of this reach are the mature riparian woodland lining the steep-sided valley and the block stone revetment that defines the artificial course of the channel (Fig.1; SK37168 88170).

Figure 1: Tree lined river valley (the canal runs along the top of the slope in the background). The block stone revetment is just visible at the foot of the far bank.

Bed substrate materials were dominated by sand, though cobble and gravel were also present. The cross-section profile also appeared relatively uniform. The smooth stone-lined channel is generally lacking in structures that would increase hydraulic roughness and promote greater variation in patterns of substrate deposition (both in terms of sorting particle sizes and creating localised variation in depth). Variety in channel depth, flow velocities and substrate particle-sizes are all required in order to support diverse communities of aquatic flora and fauna.

The size and power of the river under spate flows at this point makes the secure placement (and retention) of small-scale, mid-channel features difficult. However, the placement of mid-channel boulder clusters could provide some diversification of substrate deposition (additional detail in Recommendations section).

As well as favouring uniform bed characteristics, the block-stone revetment also significantly reduces the amount of trailing/partially-submerged vegetation cover in the margins (as well as reducing the supply or gravel and cobble material). Note the lack of understorey vegetation between the widely-spaced mature trees – and the resultant separation of riparian vegetation from the river by exposed block stone surfaces (Fig.2).

Figure 2: Note the "sterile strip" of block stone separating the woodland understorey vegetation from the water at SK37141 88140.

Dense matrices of complex, brashy cover are vital resources for juvenile fish to shelter from predators and also from powerful spate flows. Due to the reduced opportunity for such material to arise in the margins of the watercourse, introductions of stable woody material to the margins confer significant potential ecological benefits (see Appendix 1 for the importance of particular habitat features across wild trout lifecycles).

Cabling (or lodging) selected, suitable riverside trees securely to their stumps is a good way to provide that marginal cover. Leaving the crown end free allows the trunk to line up with spate flows – offering the least resistance. This enhances the stability of anchored structures and actually promotes deposition of sediment (consolidating banks, rather than accelerating erosion). A similar effect can be achieved by hinging smaller sapling growth into the margins in a comparable manner to hedge laying techniques. An opportunity for this was noted on the LB close to the upstream limit visited for this report (Fig.3).

Figure 3: Young willow growth on the margins of the LB at SK37123 88123 – suitable for laying brashy material into the water while retaining live growth.

It may be possible to identify other, similar, opportunities in nearby locations also. However, it is important to also undertake control of Japanese knotweed (Fig.4) and Himalayan balsam wherever possible in order to remove their suppression of native flora and fauna.

Figure 4: Japanese knotweed and Himalayan balsam photographed adjacent to the willow growth shown in Figure 3.

During the walkover survey, several opportunities on the RB were noted for cabled tree installation (e.g. Figs. 1, 2, 5 and 6).

Figure 5: Three bankside trees at SK37240 88218 whose root plates could be protected by coppicing the main stem and cabling to the stump (or lodging the "v" of a felled tree around a standing tree where possible). Coppice regrowth from stumps would also generate low, bushy cover.

This would act to protect the root plate of these trees and prevent it being ripped out from the stonework as the tree ages (along with the stonework). Bankside trees often have shallow roots due to easy availability of water close to the soil surface. Being at the base of the embankment supporting the canal and other infrastructure, there are win:win opportunities for the ecology of the river and surrounding structural stability. Felling a mature tree and cabling to its stump allows the water to support the weight of the tree – and creates much less leverage compared to high winds acting on a standing tree. At the same time, this creates the range of habitat benefits described already in connection to marginal brash and refuge habitat from spate flows and/or predation. Additional benefits are derived from the cover and tree-canopy diversification created by low, bushy coppice regrowth.

Figure 6: Additional "cabled tree" opportunities at SK37265 88267 on the far bank. Care must be taken to avoid interference with the canal overspill (just out of frame to the left)

The downstream limit of this visit featured generally more varied habitat (Fig.7). While some opportunities for hinging sapling growth exist, probably the most significant action here would be an ongoing programme of invasive plant control.

As with previously-noted stands of Japanese knotweed, this would require intervention from appropriately certified personnel. Stem injection towards the end of the growing season – just before winter dieback – would be the preferred option. This minimises poisoning of non-target species as well as being highly effective and cost-effective for ecological gains.

For stands of Himalayan balsam, hand pulling by volunteers can be extremely effective when carried out with sufficient regularity. Composting the pulled plants on site helps to avoid spreading infestation around, while also being effective in preventing pulled plants from re-rooting and/or dispersing seed.

Compared to rest of the visited reach, the spatial variation in substrate deposition and erosion, flow depth and velocity over the channel's cross-section was probably greatest in this section. Consequently, little structural intervention is proposed for this location.

Figure 7: Downstream limit of the reach visited for this report. Lateral variation in scour and deposition is apparent – along with trailing marginal vegetation and invasive, non-native plants.

Instead, wider campaigns to protect and improve water quality have much greater potential to achieve ecological improvements. While greatly improved compared to the decades of the 1970s and 1980s, intermittent pollution is still evident. Evidence of combined sewer outfall discharges are noted in the presence of rag-waste in the lower limbs of trees. Surface-water drainage also appears to be contributing excess fine sediment to the reach.

Improvements to baseline water quality and reduced frequency of episodic pollution would support a greater diversity of aquatic flora and fauna across the whole food-web. Since simple and low-cost solutions are rare, instigating or joining larger-scale campaigns to avoid regressions and pursue improvements in water quality are necessary to achieve progress.

A summary of recommendations is given in the following section.

4 Recommendations

Assuming that all legal requirements have been met for relevant activities, a summary of the recommended actions are:

- Undertake and support regular "balsam bashing" to hand-pull and compost Himalayan balsam on-site prior to plants setting seed

- Undertake Japanese knotweed control using appropriately-certified personnel – if a fishery benefit can be identified, potential funding is available via https://anglingtrust.net/funding/aif/
- Consider establishing routine stream invertebrate monitoring as a means of tackling episodic and chronic pollution (e.g. via involvement with the Riverfly Partnership's recording schemes: https://www.riverflies.org/recording-schemes
- Undertake "outfall safari" assessments of combined sewer outfalls (and other point-sources of pollution) – guidance and resources available on https://catchmentbasedapproach.org/learn/outfall-safari-guide/
- Undertake some hinging of bankside sapling growth to increase marginal cover
- Pursue the secure introduction of marginal tree-crown/large woody material via felling and cabling or lodging suitable mature trees to their own stumps (see below and Figs. 8 & 9)
- Consider introduction of mid-channel boulder clusters in the most uniform reaches to promote greater structural variety in substrate deposition (Fig.10)

4.1 Marginal Tree Cover Creation

For the creation of marginal/submerged cover using tree crowns, the ideal situation is to avoid the use of extraneous materials (such as cables and cable crimps). Instead, lodging a felled tree by slotting the "V" shape formed by the main stem and a significant limb around a stable, standing tree is the ideal way to mimic naturally-arising woody material. As long as the point of the "V" is facing upstream, it will always be pressed into the standing-tree anchor point by strong currents.

It is important to note that a standing "anchor" tree needs to be tall enough to avoid the lodged tree floating over the top during spate flows. A potential risk, given the extreme height of spate flows at this site, is that trees may need to be pollarded (rather than coppiced) in order to provide a suitable anchor.

Lodging the arising crown around the standing trunk should be successful in the short term. However, the response to pollarding is likely be accelerated growth in the canopy – at the expense of the roots. For shallow-rooted trees growing through stonework, this could increase the risk of the tree blowing over in high winds. Consequently, subject to a case-by-case assessment, it may be necessary to deploy cables for at least some of the installations suggested in this report.

There is more guidance on using cables (where they are necessary) to anchor trees in the "Secure Tree Kicker Installation" video on this link: https://www.wildtrout.org/content/how-videos#:~:text=This%20video%20illustrates

Figure 8: One example of securely-lodged tree crown material – the same principle is scaled up for larger trees.

Figure 9: Cabled tree creating cover habitat as well as providing bank protection as a side-effect.

4.2 Boulder Cluster Installation

For the installation of boulders, there obviously needs to be a feasible route and method to getting the stone into the channel. Assuming that this challenge can be overcome, a common way to arrange clusters of boulders is in a diamond formation (e.g. Fig.10).

Figure 10: An example of one placement pattern of introduced boulders - where each rock represents a point making up a "diamond" shape. One of the corners of the diamond is pointing into the flow. The stream is flowing from the top right to bottom left corner of this picture.

Grouping rocks in this way aims to create some diversity in the patterns of localised scour and accumulation of cobbles and gravel. Introducing a rough gridwork pattern of such clusters throughout an area of channel will increase the hydraulic roughness within that "grid".

Assuming sufficient cobble and gravel materials are transported into that reach during spate flows, there should be an increase in accumulation of that material around the boulders. Over time, the boulders shown in Fig.10 have been almost completely buried by accumulated cobble material.

This has formed a riffle in a steep section of stream, subjected to strong spate flows (Fig.11) and shows the potential changes that are possible as a result of increased roughness within the channel.

Figure 11: The same cluster of boulders shown in Fig.10 (circled) have caused a cobble and gravel riffle to deposit around and among that cluster in a walled section of steep, fast-flowing spate river.

5 Further information

The WTT may be able to offer further assistance such as:

- WTT presentation/Q&A session
    - Where recipients are unsure about the issues raised in the AV report, it is possible that your local conservation officer may be able to attend a meeting to explain the concepts in more detail.

In these examples, the recipient would be asked to contribute to the reasonable travel and subsistence costs of the WTT Officer.

The WTT website library has a wide range of free materials in video and PDF format on habitat management and improvement:

www.wildtrout.org/content/wtt-publications

A print-on-demand book "*The Urban River Toolkit*" distils our most important, practical advice on caring for urban rivers and is available via Amazon:

https://www.amazon.co.uk/Trout-Town-Urban-River-Toolkit/dp/1688496130/

We have also produced a 70-minute DVD called 'Rivers: Working for Wild Trout' which graphically illustrates the challenges of managing river habitat for wild trout, with examples of good and poor habitat and practical demonstrations of habitat improvement. Additional sections of film cover key topics in greater depth, such as woody material, enhancing fish populations and managing invasive species.

The DVD is available to buy for £10.00 from our website shop www.wildtrout.org/shop/products/rivers-working-for-wild-trout-dvd or by calling the WTT office on 02392 570985.

6 Acknowledgements

Wild Trout Trust would like to thank the Environment Agency for their continued support of the advisory visit service, in part funded through monies from rod licence sales. The advice and recommendations in this report are based solely on the expert and impartial view of WTT's conservation team.

7 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.

Legal permissions must be sought before commencing work on site. These are not limited to landowner permissions but will also involve regulatory authorities and any other relevant bodies or stakeholders. Alongside permissions, risk assessment and adhering to health and safety legislation and guidance is also an essential component of any interventions or activities in and around your fishery.

N.B. See Appendix 1, over.

Appendix 1: Key trout lifecycle stages and associated habitat

There are three main types of habitat that are needed in order for wild trout to complete each one of three key lifecycle stages (spawning, juvenile and adult; Fig. A1). The consequences to trout populations of a lack of each specific habitat-type are also illustrated in Fig. A1.

The basic process by which the Wild Trout Trust's advice is derived is to examine whether each of the key habitats are represented within a visited reach. Where those habitats do exist, there is then an assessment of whether trout can access those habitats to make use of them and successfully complete self-sustaining lifecycles. In this way, both habitat quality and habitat connectivity are assessed in order to judge whether wild trout populations could survive and thrive.

Because the habitats which support complete trout lifecycles meet a wide range of varied requirements, they are physically diverse (Figs. A2-A4). That structural variety is, in turn, vital for supporting a wide variety of species.

In this way, assessing habitat for a trout provides a means of identifying how to improve and/or protect wider river-corridor biodiversity

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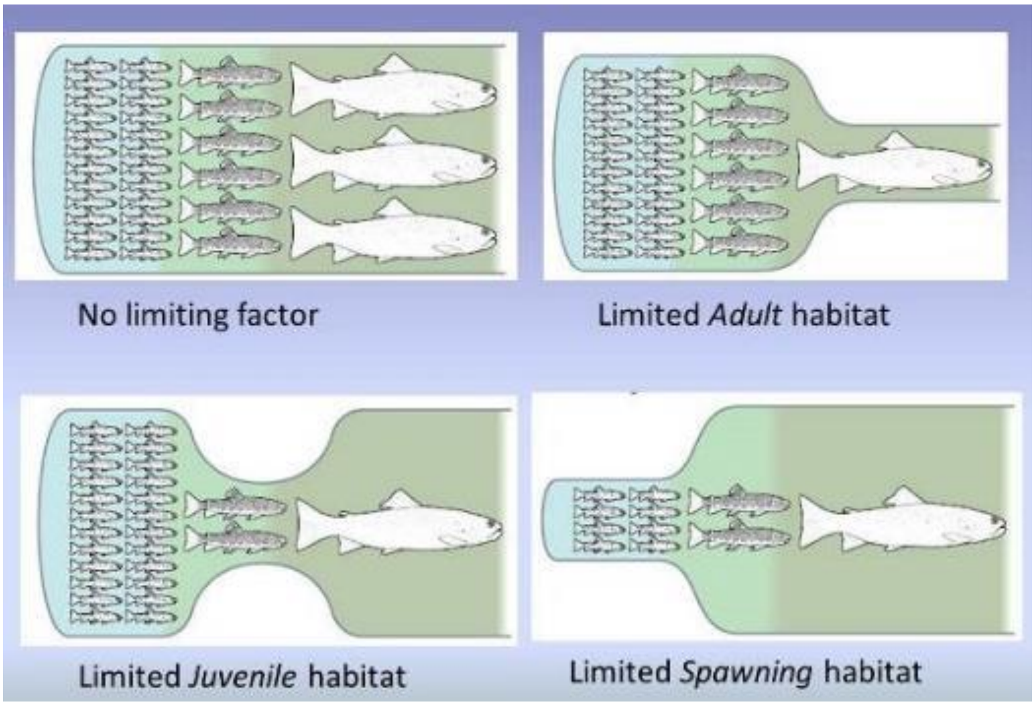

Figure A1: The impacts on trout populations lacking adequate habitat for key lifecycle stages. Spawning trout require loose mounds of gravel with a good flow of oxygenated water between gravel grains. Juvenile trout need shallow water with plenty of dense submerged/tangled structure for protection against 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 trailing on, or at least 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.

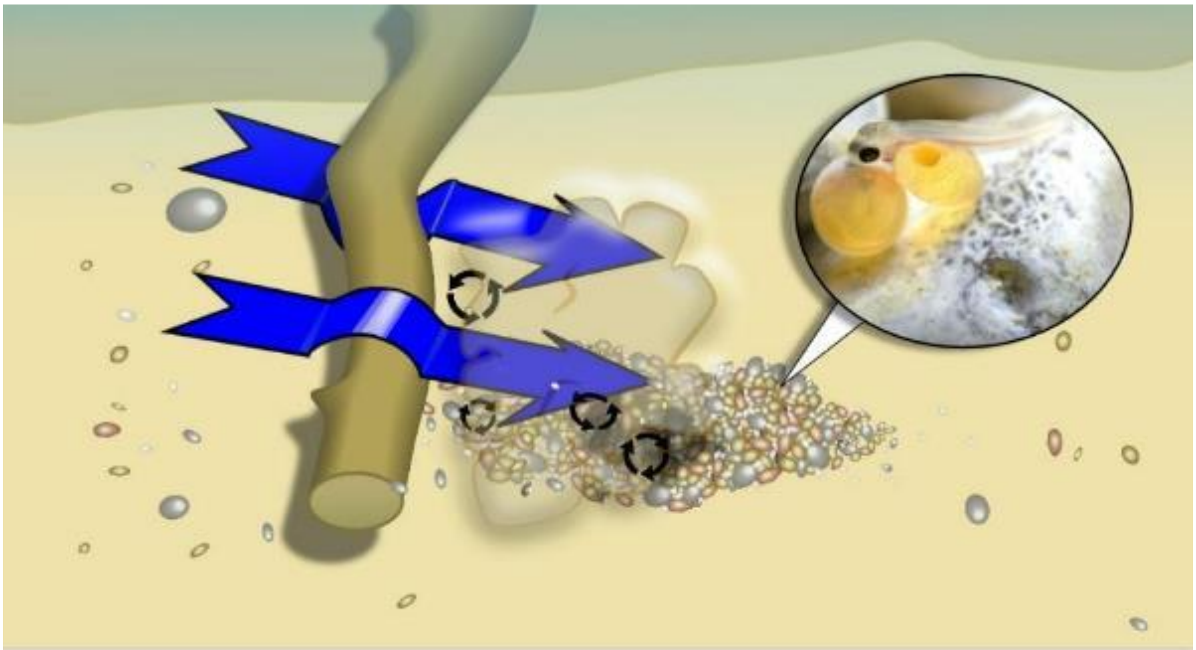

Figure A2: Features associated with successful trout spawning habitat include the presence of silt-free gravels. Here the action of fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of river-bed that results in silt being mobilised from between gravel grains. A small mound of gravel is deposited just downstream of 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 within the gravel mound (inset) until emerging in spring.

Figure A3: 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 A4: The availability of deeper water bolt holes (>30cm to several metres), low overhanging cover and/or larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle and with prey likely to fall from overhanging tree canopy in this case) are all strong components of adult trout habitat requirements.