Advisory Visit

R. Wharfe, Otley Angling Club

July 2019

Key Findings:

- The majority of the Wharfe at Otley has been realigned and canalised, and is severely negatively impacted by weirs at either end of the Otley AC waters (and near to the confluence of the one major tributary in between). Its flow regime is also strongly influenced by modifications to the river upstream and insensitive land management throughout the catchment. Hence, without much prospect for in-river migration to more favourable habitat to spawn for example, or reduced ability to recolonise fragmented areas following displacement downstream by spates etc, the sustainability of wild fish populations appears limited currently.

- However, most of the Club waters are downstream of the town and any works to improve habitat will be less likely to be viewed negatively from a perceived flood risk perspective. Also, there is ample natural and diverse riparian vegetation providing good quality buffer strips which: a) should be protected at all costs (noting the invasive non-native species reported; and b) can be managed and used to good effect to enhance instream features for the benefit of the fishery and wider ecology.

- Simple and cost-effective techniques using material won from the relatively dense stands of mature riparian trees could extend better quality habitat along considerable reaches of the Club waters. It is likely that this could be carried out under exemption, ie at very little expense to the Club, and WTT could undertake a workshop with club members to demonstrate those techniques.

Index links

Click the relevant section name to link to the content:

1.0 Introduction

This report is the output of a site visit undertaken by Jonny Grey of the Wild Trout Trust to the River Wharfe at Otley at the request of Karl Ridley of Otley Angling Club, who attended the walkover. The rationale was to assess in-river and riparian habitat quality, and identify any remedial actions that might be implemented to improve the fishery for all species.

Normal convention is applied with respect to bank identification, i.e. left bank (LB) or right bank (RB) whilst looking downstream. Upstream and downstream references are often abbreviated to u/s and d/s, respectively, for convenience. The Ordnance Survey National Grid Reference system is used for identifying locations.

	Otley AC	
River	River Wharfe	
Waterbody Name	Wharfe from Hundwith Beck to River Washburn	Wharfe from R Washburn to Collingham Beck
Waterbody ID	GB104027064258	GB104027064254
Management Catchment	Wharfe and Lower Ouse	
River Basin District	Humber	
Current Ecological Quality	Overall, **Moderate** ecological *potential* based upon an ecological potential of **Moderate** and chemical potential of **Good**	Overall, **Moderate** ecological status based upon an ecological status of **Moderate** and chemical status of **Good**
U/S Grid Ref inspected	SE 20130 45866	SE 22943 46105
D/S Grid Ref inspected	SE 22943 46105	SE 22959 45550
Length of river inspected	~3060m	~650m

Table 1. Overview of the waterbody. Information sourced from: https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027064254

Under the Water Framework Directive, the Environment Agency consider the Wharfe from Hundwith Beck to River Washburn (ie the majority of the Otley waters) as a heavily modified waterbody (HMWB). Through two cycles of assessment, it has achieved *Moderate Ecological Potential* overall. It is important to note that five ecological classes are used for WFD Water Bodies: high, good, moderate, poor, and bad. These are assessed against 'ecological status' (or 'ecological potential' in the case of HMWBs), and that anything ranked below good is classified as a failure.

The status (or potential) of a waterbody is derived through classification of several parameters: water quality, physical condition and barriers, invasive non-native species, fish, and flows and levels. The overall status is then dictated by the lowest score amongst those parameters. However, it is important to note that, in the case of HMWBs, the status of fish (and benthic invertebrates) are often discounted as the HMWB designation already highlights a potential impact on those biological indicators, but as these are of the greatest immediate importance to angling clubs, they should not be overlooked.

In 2016, the classification of *Moderate Ecological Potential* was based upon an ecological quality of moderate, and a chemical quality of good. Chemical quality has improved from fail in 2014.

The lower ~650m of Otley waters fall into the next waterbody downstream which is not classified as heavily modified but effectively exhibits the same status of '*Moderate*'.

2.0 Catchment / Fishery Overview

The River Wharfe is a gravel bed river in a glacial valley, rising on Camm Fell in the Yorkshire Dales National Park and flowing for ~115km to join the Yorkshire Ouse near Cawood. The physical characteristics of the Wharfe and hence the potential of the fishery, by the time it reaches Otley AC waters, are influenced strongly by processes and interventions occurring upstream. Most Yorkshire Dales' rivers have been affected by drainage and intensive stock grazing in both the catchments and floodplains, resulting in rapid transit of water and flashy hydrographs with narrow, high peaks and troughs of flow, excessive erosion, and a scarcity of wetland features. There is typically over-supply of cobble and gravel resulting in pools filling in to become uniformly shallow, especially where natural geomorphology is constrained by bank revetment and channel realignment / straightening (see scale of this in Fig 1), or interrupted behind weirs. Weirs are especially pertinent for Otley AC as their waters fall between two major structures, not only affecting geomorphological process, but introducing many issues for fish passage both u/s and d/s.

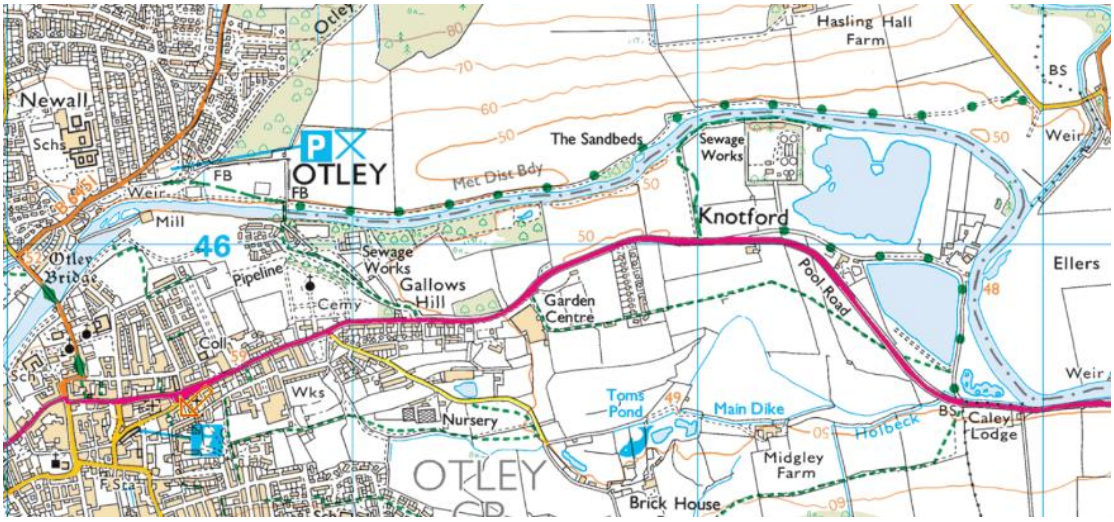

Fig 1. Map showing extent of Otley AC waters on the R Wharfe, between Otley Bridge and Caley Lodge.

3.0 Habitat Assessment

The walk effectively commenced at Otley weir; the heavily impounded section extending u/s to Otley Bridge is overly wide and featureless. The weir was recently refurbished to accommodate a hydro-power scheme to the RB and has two fishways installed: a technical 'Larinier' fish pass co-located next to the hydro output, and a simple baulk pass to the LB (Fig 2).

Fig 2. The weir below Otley Bridge presents a major barrier to sediment and fish passage. It has two fishways installed (baulk pass in the foreground), neither of which are monitored. Islands of various sizes have established immediately downstream of the weir from deposition bars being stabilised by vegetation, and these introduce much needed heterogeneity into the habitat. These features should be retained.

When faced with an obstruction such as a natural cascade or man-made barrier, fish will typically seek the path with the greatest flow ('attraction flow') as this is where the majority of the water will be passing the obstruction. A weir presents a very confusing situation because the flow of water is generally dissipated equally across the breadth of the crest without any focus. With a hydro-scheme in place, requiring a considerable volume of water to be focused through the turbine, the attraction flow essentially draws fish to the outflow of the turbine. Hence, the idea of co-locating the outflow of the technical fish pass in the hope that at least some fish will find the pass and be able to move u/s (Fig 3). At higher flows, the likelihood of fish finding the fish pass decreases and if they swim to the bottom of the weir, they are likely to head to the most u/s point which on Otley weir is to the LB. Then, the baulk pass comes into play but fish have to exert considerable power in a 'burst' to be able to swim up the chute constrained by the baulk.

Fishways are not very efficient and are typically species and life-stage specific in how passable they are. Stronger swimming species capable of leaping are clearly favoured eg the salmonids. Even then, not all individuals make passage and hence the presence of the weir / fishway begins to exert a selection pressure on the population by screening out certain individuals. Most fish passage issues are viewed from an u/s movement perspective but of course individuals and progeny spawned u/s are likely to move d/s at some point. The impounded section on the u/s side of a weir is again a confusing environment as there is typically a lack of focal flow, and the greater depth and lack of cover increases opportunities for predators.

To restore full ecological functionality to a river, weirs should be removed which from a fishery perspective would allow all species and life-stages to move freely u/s and d/s whenever they need to. It must be remembered that all fish species undertake in-river migrations to find food, spawning habitat, or relocate after displacement during spates or pollution events. Clearly the weirs at the top and bottom of the fishery are not going to be removed in the foreseeable future. However, it is important to appreciate the subtle direct and indirect impacts that those weirs will have had on the fish populations within the Otley waters since their establishment.

Weir pools are often viewed by anglers as good habitat for fish, but again it is critical to consider that the fish are to a certain extent

Fig 3. Upper panel: from the LB looking across to the exit of the hydro-scheme and co-located technical fish pass, and some deposition bars indicating varied depth profiles and sediment sorting. Lower panel: Looking d/s, habitat diversity immediately gave way to uniformity with almost uniform depth and little discernible flow along the very straightened channel.

'trapped' against the weir (fish passage issues outlined above) *and* the short stretch of perceived good habitat below the weir is at the expense of a much greater loss of habitat under the impounded

section u/s. Impounded water robs the river of the flow required to sculpt the varied habitat needed by fish and other aquatic wildlife to complete their lifecycles, and essentially creates a sediment trap hence the increasingly shallow water and uniform bed characteristics found u/s.

WTT has an excellent, all-encompassing blog on weirs available at: https://www.wildtrout.org/wttblog/why-presume-remove-weirs-river-dove-case-study

The angle of Otley weir has led to the deposition of a plethora of gravel and cobble bars (visible on Ordnance Survey maps >150y old), and colonisation by plants and trees has stabilised these into 'islands' thereby maintaining some diversity and cover in between the walling on both banks (Figs 2-3). They provide considerable habitat diversity in what would otherwise be a very uniform reach, a form the river assumed rapidly d/s (Fig 3). Below the weir pool, the channel was heavily straightened and maintained on course with boulder revetment under an avenue of mature trees, mostly sycamore but including some very large poplars. A straight channel is consequently steeper, inducing accelerated flows and thereby transporting finer sediments (sand / gravel) leaving larger fractions (cobble / boulder) to dominate the substrate in an unsorted matrix. Physical diversity begets biological diversity, so a simpler substrate tends to have fewer available niches to be exploited by invertebrates that might end up as the diet of fish.

Fig 4. A naturally fallen poplar, which was still rooted and hence living, and has been there for many years. Angled downstream, it has clearly been unaffected by recent high spate flow, and provides multiple ecosystem benefits such as flow and predator refugia, shade and substrate. Any attempt to 'tidy up' such features should be resisted.

It was encouraging to see a large poplar that had fallen naturally into the water but had maintained a living 'hinge' had been left *in situ* for several years (Fig 4). Any attempt to 'tidy up' such a feature should be resisted. Indeed, it would be extremely beneficial to replicate such a feature (a 'tree-kicker') along all the straightened reaches d/s. The ecological benefits of such woody material include flow and predator refugia for fish and invertebrates, egg-laying substrate, a surface for biofilm colonisation (bug food), leaf-litter and shade. Furthermore, water moving around the trunk and branches introduces flow diversity, creating a slightly faster run on the outside edge and deposition in the slacker water in the lee of the structure, thereby 'pinching' the channel and kicking the flow away from the bank.

Fig 5. From the White Bridge at SE 20812 46092, it was easy to visualise the straightening of the channel by boulder revetment to both banks. The majority of bank length was covered by trees, dominated by sycamore but with occasional crack willow, poplar, and scrubbier species like goat willow at the bank toe.

The very straightened nature of the channel was evident from the White Bridge (Fig 5), as was the typically mature avenue of trees. Unlike many other Dales' rivers, the tree cover was more than 'one tree deep' along the majority of reaches and there were plenty of self-set saplings generating, albeit struggling to compete for light with the mature canopy. Elsewhere, young trees are generally in short supply because they are browsed by livestock. Make no mistake, the presence of these trees is good, but the uniformity of age structure could be improved by encouraging some gaps (replicating Fig 4) and allowing some of the new growth to come through. Some greater diversity could also be introduced. Sycamore and crack willow tended to dominate. Alder and hazel or hawthorn would be useful to introduce, especially as the former produces extremely nutritious leaf litter that is preferentially fed upon by macroinvertebrates.

Similarly, where low growing, scrubby species like goat willow were lining the toe of the bank (eg Fig 5), one or two trunks of the multiple-stemmed trees could be forced over into the channel in a d/s direction to further roughen the 'edge' of the vegetation.

Deposition bars of finer sediments were evident, predominantly downstream from such low-lying willow. Emergent and pioneer (early colonising) plant species were consolidating fine sediment bars, providing good spawning habitat for coarse fish species and nursery habitat for fry. The silt substrate also provides a different habitat for colonisation by burrowing invertebrates like chironomid (non-biting midges) and true mayflies (*Ephemera danica*). Subtle changes to bankside trees (even through modest pruning) can have knock-on effects to these deposition bars, so any planned riparian management should be reviewed carefully to consider the wider environmental ramifications u/s and d/s. However, as already noted, trees can be managed to create and emphasise such features too. There were several examples of leaning limbs of crack willow which could be encouraged to 'lay' in the river to maximise ecological benefits (Fig 6; see Recommendations).

Fig 6. A couple of examples where previously coppiced crack willows (indicated by multiple trunks) would be ideal for laying of at least one trunk into the water to simulate that seen in Fig 4, pinching the flow and thereby locally accrue the ecosystem benefits.

Every 400m or so, there were deposits of sediment that interrupted the relatively featureless long glides and created a more dynamic riffle habitat (Fig 7) and some slight focussing of flow to one side or the other. It would be worth investing some time to improve and thereby extend the habitat mosaic in these areas, capitalising upon the slight revitalisation of flow.

Fig 7. Eventually, the long, straight glides are interrupted (at ~400m) by deposition causing a shallow riffle, and a slight pinch to the flow as depicted above at SE 21193 46079. These are essentially little oases of habitat mosaic interspersed far too infrequently along the modified, relatively barren channel.

Seemingly dead branches and trunks on the banks, and any material arising from peg management should be retained wherever possible as they still perform vital functions. Such material is an important component of the detrital food chain (food for many terrestrial beetle larvae), as well as nesting and/or roosting sites for species of conservation interest (eg bats).

Despite the presence of Himalayan balsam, the riparian buffer strips on either bank were, for the most part, quite rich and diverse in herbaceous vegetation (Fig 8) which imparts multiple ecosystem benefits:-

- The plants introduce 'hydraulic roughness' – under higher flows, the water has to flow around and through the vegetation, thereby slowing the flow and trapping debris.
- Trailing vegetation on the water surface provides low cover and refugia for fish and invertebrates from predators and spate flow, some shading, egg-laying substrate for river fly species (and some coarse fish), as well as structure to help insects emerge from the water.
- A diverse assemblage of plants will also impart greater physical stability to bank soils and resilience to erosion during spates via a diverse root matrix 'knitting' the soils together. Hence, it is important to continue to control Himalayan balsam which, as an invasive annual plant, outcompetes native vegetation, develops a

monoculture and leaves banks bare during the winter. Giant hogweed and Japanese knotweed create similar issues but must be treated differently – see Recommendations.

- A rich riparian fringe provides diverse opportunities for feeding, sites for reproduction, and shelter for a host of insect and other invertebrate life which may ultimately contribute to the diet of fish and birds, and contribute important ecosystem services such as pollination and decomposition. Leaf litter deposited directly into the river provides sustenance for many shredding and filtering species such as shrimp and caddis flies.

Fig 8. Where tree cover was missing, or the canopy thinner, the herbaceous community was reasonably diverse with meadowsweet, cranesbill and comfrey all good for pollinators and will provide refuge for emergent 'riverfly' species. Unfortunately, Himalayan balsam was present throughout, and there were 7 or 8 individual giant hogweed plants (RH-panel) noted along the length.

A slight (enforced) bend to the river to circumnavigate the Water Treatment Works and former gravel pit sites has allowed a degree of geomorphological process to alter the otherwise uniform channel dimensions (Fig 9). Deposition on the inside of the bend has been stabilised by vegetation and pinched the channel into a narrower, deeper run, with plenty of low and trailing vegetation; it culminates in a few more natural repeating sequences of pool-riffle-glide (instead of the long glide-short riffle found u/s and d/s). The diversity of habitat in this reach encapsulated many features that would benefit multiple species and life-stages and replicating that 'mosaic' elsewhere in the straightened sections should be an aspiration to improve the fishery.

Fig 9. At one of the few (slight) bends in the river, looking u/s and d/s in upper and lower panels, respectively. The channel was naturally pinched by deposition to the LB which has been stabilised over time by encroaching vegetation, and initiated a more habitat diverse reach of ~400m as the river was diverted around the WTW and (now) Knotford lagoons.

The only sections of bank exhibiting any serious erosion, aside from very focussed points of entry and exit primarily by dogs, was found at SE 22749 46332 (Fig 10). One field on the LB was used for pasture,

and the impact of livestock was immediately evident. Trampling, poaching and grazing by sheep, cattle and horses denudes ground cover, reduces the root matrix which binds soil together (because the grass is continually having to replace cropped shoots), compacts the soil and causes guttering of overland flow (rainfall), thereby contributing to diffuse agricultural pollution via soil running into the river. Weakened banks are more susceptible to spate flow, so while it is the river 'doing' the eroding, it is the activities of livestock which initiates the process. Fines entering the watercourse contribute to the clogging of interstices within the gravel, degrading that microhabitat for invertebrates and also its suitability as fish spawning substrate.

Fig 10. One of the few stretches of bank exposed to livestock was immediately evident from the erosion scars and input of diffuse pollution from bare soil, clearly demonstrating the combined effects of trampling and grazing. LB at SE 22749 46332.

Just u/s from the confluence of the R Washburn entering on the LB, the mainstem Wharfe became notably sluggish as the impounding effects of the weir ~km d/s were detected (Fig 11). The bed of the channel was much siltier and deposition bars comprised finer materials, leading to more emergent vegetation occurring on the inside of the bend (RB). The Washburn could not be viewed from the RB. The confluence appeared to present good access but scrutiny of an Ordnance Survey map since has revealed the presence of a weir <200m u/s. A tributary of that size should be an important nursery for fish migrating from the Wharfe where spawning habitat is in short

supply so the presence of the weir should be investigated further, especially as the Washburn is the only tributary of note between the two weirs effectively demarking the limits of Otley AC.

Fig 11. The confluence of the R Washburn (upper panel) and immediately d/s (lower panel) is within a very sluggish section of the Wharfe, probably impounded from the weir at SE 23251 45591, ~1km d/s. Access to the Washburn appeared good from deeper water on the outside of the bend.

The lowest reach was even broader and sluggish to the extent that one or two whole trees had been deposited mid-channel in the past (Fig 12). While these flow characteristics favour various species of coarse fish, the restriction of cover to the trailing branches along the banks meant precious little refuge from potential predators. Better protection of those fish stocks and more opportunities for spawning substrate would be afforded by dropping some of the bankside trees into the river as 'tree-kickers'.

Fig 12. A broader, sluggish reach with the effects of the impounding weir at SE 23251 45591 evident as deposition and retention of trees within the main channel.

It was disheartening but not unexpected to see large stands of Japanese knotweed on the bank next to a layby / access point where garden waste and other refuse had been fly-tipped (Fig 13).

Fig 13. Of note was a large stand of Japanese knotweed at SE 22796 45946, Knotford Nook Gravel Workings. The right-hand panel depicts fly-tipped garden waste at the end of a short layby, again with knotweed at the bank edge.

4.0 Recommendations

The factors affecting the abundance of coarse and game fish in this section of the river operate at a spatial (and temporal) scale beyond the boundaries of Otley AC but the club is in a fortunate position to have plenty of raw materials *in situ* to work with to improve the local situation. At the wider catchment scale and thinking over the longer term to tackle climate change and improve catchment resilience, it is important that support for organisations like the Yorkshire Dales Rivers Trust (YDRT) is maintained. They are working with multiple landowners especially in the headwaters and the tributaries to 'slow the flow' and reduce the impact of warmer, wetter winters and warmer, drier summers. Reducing the 'flashiness' of the water delivery (lower, flatter peaks in winter) and creating more sustainable storage and release of water to improve summer low flow conditions will have knock-on effects to gravel and water weed retention for example.

At the more local scale, fragmentation of the fish assemblage and populations by the weirs is of concern, so it is especially important to consider the needs of all life-stages for all fish species when considering river habitat improvements. One of the greatest assets the Club has is the condition of the riparian fringe for the majority of its waters. It is paramount that this is maintained, protected, and well managed to maximise the potential of the fishery.

4.1 Riparian Management

As the straightened sections are relatively devoid of instream features, trees and their low-lying or submerged branches provide the majority of fish holding features. They are also crucially responsible for some of the deposition features. Pruning or 'tidying up' of such material should be resisted. While there may be occasional lost tackle, and the requirement to remove that from public view, far better to have a feature to cast to that holds fish than no feature with few fish.

Conversely, some of the more exposed sections of bank that are currently without any trees would benefit from some planting, particularly to diversify the current assemblage with smaller species such as alder, hazel, hawthorn, bird cherry and other native broadleaves. Without any pressure from livestock, and accepting the odd loss due to rabbits (low risk because of the amount of dog traffic), these will not require stakes and guards. The simplest, quickest and

cheapest way to achieve some low cover is to introduce willow 'whips' or stakes (sourced from the bankside of existing goat willow u/s or d/s). This can be undertaken at any time of the year, but will have the greatest success within the dormant season, shortly before spring growth begins (ideally late Jan-March). Whips should be inserted into soft, wet earth/sediment at the toe of the bank so that there is a greater length within the ground than out of it, *and at a low angle,* to minimise the distance that water has to be transported up the stem; 30-40cm of whip protruding from the ground is sufficient, providing that it receives light past the other bankside vegetation. Live willow stakes can be hammered deep into the bank and may provide greater structural stability under spate conditions. Willow takes readily and may require some future management to keep in check by either laying it over the water (hinging) or coppicing it. Insert whips in bunches to (hopefully) form clumps of young trees, especially on bare banks immediately adjacent to where there is sufficient water depth to potentially hold fish. Staggering clumps of willows on alternate banks creates more lies and refugia from predators. Further advice can be found in the WTT video on tree management:

http://www.wildtrout.org/content/how-videos#tree

Striking a balance between access for coarse anglers and maintaining the vegetation in as natural a state as possible is key. Any repeated use of a 'peg' will cause compaction of the bank soils and trampling of the vegetation, ultimately exposing the soils of the steep banks to erosion. It may seem beneficial to create or install peg platforms to minimise the impact upon vegetation or bank integrity but any 'hard' structure introduced will affect the flow of water during spates and potentially cause erosion; this can be minimised if pegs are created in depositional areas or taking advantage of existing structures such as tree trunks.

Non-native vegetation such as Himalayan balsam can and should be removed simply by pulling prior to seed-set, making sure to remove certainly to the first node on the stem. The few individual giant hogweed plants and the Japanese knotweed stands were reported via the Yorkshire Invasive Species Forum to inform future management strategies. Giant hogweed requires care when handling as the sap can cause considerable damage to people upon exposure. Plants are typically sprayed early season prior to flower heads forming. If flower heads do form, they can be cut and should be bagged, removed and burnt. Japanese knotweed is treated by stem injection, late summer when the plant is withdrawing nutrients down into the rhizome to

sustain it over winter; it should never be pulled or cut as the smallest fragments can regenerate. More information is available at:

http://www.nonnativespecies.org/home/index.cfm

It would be useful to have several designated monitors within the Club, trained in the ID and control of Invasive Non-Native Species. If problematic, help should be sought from Yorkshire Dales Rivers Trust and the EA.

4.2 Instream habitat diversification

In conjunction with riparian management above, existing trees can be used to diversify instream habitat and replicate what was seen in Fig 4. Laying or hinging of appropriate pliant species such as goat or crack willow at a downstream angle <30° to the bank retains a living attachment point and reduces undue stress on the hinge during spate flows.

A larger scale solution is to use a tree-kicker, to increase flow diversity by creating narrower pinch points where bed scouring and sorting will occur and create areas of slack water immediately d/s to encourage more deposition. A tree kicker secured within a river margin (Fig 14) has accumulated sediment within the crown and in its lee d/s, providing beneficial channel narrowing.

Fig 14. A tree-kicker tethered to its own stump to the left of image causes flow to be focussed away from the near bank resulting in deposition along the protected, nearside margin.

A tree kicker is created by felling a tree to lay in the margins almost parallel to the bank and preferably already in an area of modest deposition to encourage stability of the ensuing structure. However, it must be cabled securely to an appropriate anchor point (usually its own living stump or another living trunk) to prevent any risk of future mobilisation and transport d/s. Installation of tree kickers requires consent under the EA environmental permitting regulations. WTT has produced a video on secure tree kicker installation:

http://www.wildtrout.org/content/how-videos#tree%20kicker

As the Wharfe naturally contains boulders, the judicious relocation of some of the larger boulders that have collapsed out of the bank revetment will create some localised scour and sorting of sediments immediately d/s. These relatively small 'pockets' of deeper water are valuable holding features.

Note: the most diverse instream reach was immediately d/s of Otley weir amongst the 'islands', and there have been proposals to remove gravel and vegetation to allegedly reduce flooding. The bars were mapped in the 1850s and the Fisheries, Biodiversity & Geomorphology team of the EA have recently fought against bar removal and advised against vegetation removal. However, there are plans to 'manage' the vegetation so it is worth the Club contributing to these discussions as a stakeholder and arguing for retention of the valuable habitat.

4.3 Spawning habitat provision

For substrate spawning fish, lack of appropriate spawning substrate is inherently limiting and a lack of access to suitable spawning habitat will lead to population collapse. Specific spawning habitat can be created or enhanced as a means of mitigating or offsetting the harmful effects of barriers like the weirs.

The addition of tree-kickers mentioned above will focus flows and sort and maintain clean gravel in the seam or crease between faster and slacker water, thereby providing for species like trout, salmon, grayling, barbel, chub and dace. Coarse species like roach, perch, pike and bream require vegetation for spawning substrate for which the laid branches of shrubby species like goat willow may suffice. Alternatively, but requiring more time and effort each year, brash bundles can easily and cheaply be created using willow or sycamore branches sourced locally and tied with jute string or other

biodegradable material. Bundles up to 1.5m in length and 0.5m in diameter (of varying density – tie some loose and some tightly packed to give fish options) should be anchored to a suitable sized stone or existing tree branch in slack flow areas, or pinned into the shallow margins against the outskirts of the emergent vegetation. These can be made and installed immediately prior to the spawning season and only need last for 2-3 months. Brash substrates have been successfully used to promote fish populations in otherwise habitat poor water bodies like the Salford Quays (Nash et al 1999). Used in conjunction with other habitat improvements to protect the fry stages (above), these simple approaches can help reinstate a sustainable population of, for example, roach or perch.

4.4 Connectivity

The magnitude and location of the weirs, plus the substantial investment around hydro-infrastructure especially at Otley weir means that it is highly unlikely they will ever be removed (the ideal situation to reinstate connectivity for both fish and geomorphology). However, with improvements elsewhere in the Wharfe catchment, the Environment Agency should be looking into assessing the efficacy of the fish passes currently *in situ,* expanding the network of passes or removing other defunct weirs, especially to cater for coarse fish and species of conservation concern (i.e. eel and lamprey). It is worthwhile maintaining a dialogue with the local EA Fisheries Officer (as well as the Yorks Dales RT) to keep abreast of developments and raise awareness of interests from the Club to improve fish passage.

4.5 Pollution

There were no obvious point sources of sewage pollution seen, and little evidence of excess nutrient influxes aside from livestock erosion in one field which could easily be rectified with flood specification fencing. Extensive poaching of the bank by livestock is an offence under the Farming Rules for Water (2018). Any discoloured or malodorous water should immediately be reported via the EA hotline (0800 807060).

There is an already established site monitored regularly for the Riverfly Partnership's Anglers Riverfly Monitoring Initiative, and this could be usefully extended to below the WTW (http://www.riverflies.org/rp-riverfly-monitoring-initiative).

5.0 Making it Happen

The WTT may be able to offer further assistance:

- WTT Project Proposal
  - Further to this report, the WTT can devise a more detailed project proposal report. This would usually detail the next steps to take and highlight specific areas for work, with the report forming part of an Environmental Permitting Regulations application.
- WTT Practical Visit
  - Where recipients are in need of assistance to carry out the kind of improvements highlighted in an advisory visit report, there is the possibility of WTT staff conducting a practical visit. This would consist of 1-3 days work, with a WTT Conservation Officer teaming up with interested parties to demonstrate the habitat enhancement methods described above. The recipient would be asked to contribute only to reasonable travel and subsistence costs of the WTT Officer. This service is in high demand and so may not always be possible.
- WTT Fundraising advice
  - Help and advice on how to raise funds for habitat improvement work can be found on the WTT website - www.wildtrout.org/content/project-funding

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

http://www.wildtrout.org/content/index

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 debris, enhancing fish stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop http://www.wildtrout.org/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

6.0 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England, through a partnership funded using rod licence income.

7.0 Disclaimer

This report is produced for guidance only; 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.