Advisory Visit

River Colne, Uxbridge Moor

January 2018

Key findings

- The River Colne has much potential for habitat enhancement through the management of its existing tree stock to provide materials for features such as flow deflectors and brushwood ledges.

- The invasive non-native floating penny wort should be controlled and not spread from the site.

- The invasive non-native demon shrimp is present in the Sluice and should not be moved to other sites.

- The Sluice lacks flow diversity and cover.

- The River Colne is shaded which is restricting plant growth (both marginal and aquatic).

- There are barriers to fish migration at the former mill on the Sluice and the weir on the Colne.

1.0 Introduction

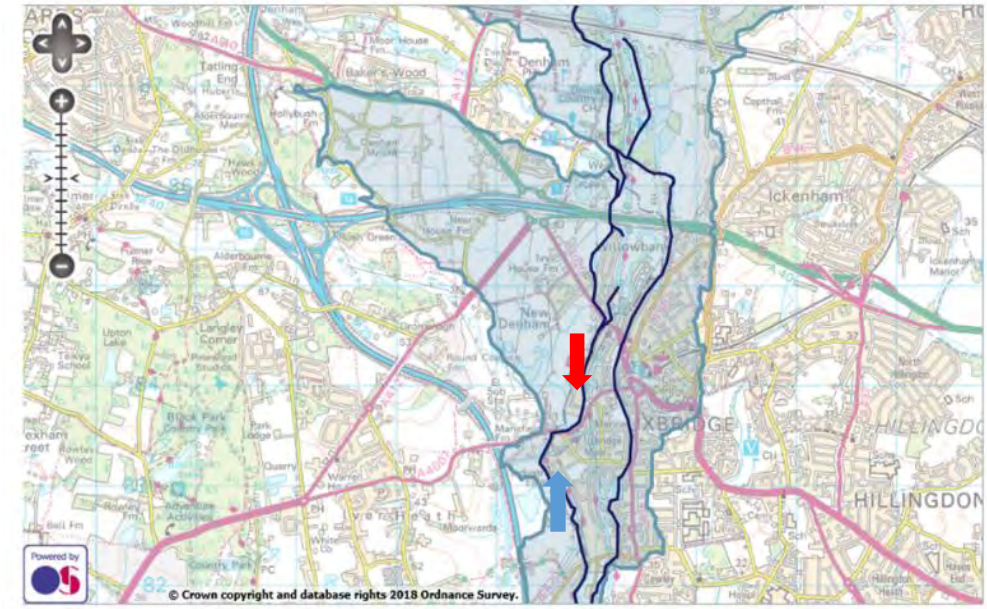
This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the River Colne on 6th February 2018. The visit was requested by Mr Derek Turton of Gerrard's Cross and Uxbridge Angling Society in order to assess reasons for a perceived decline of the fishery, and to consider habitat enhancement. The visit was also attended by Lewis Thomas (Environment Agency Fisheries Officer, Colne Valley).

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left hand bank (LHB) or right hand bank (RHB) whilst looking downstream.

2.0 Catchment / Fishery Overview

The Colne rises above Colney Heath and flows in a south westerly direction through the urban areas of Watford, Rickmansworth and Denham. It is met by major tributary rivers (the Ver, Gade, Chess, and Misbourne) before reaching Uxbridge Moor. All of the tributaries listed above are known to hold wild brown trout and it is possible that fish from those rivers could drift downstream (subject to water quality barriers) to naturally colonise the Colne. After Uxbridge Moor, the Colne flows in a southerly direction taking it past Heathrow airport to join the Thames at Staines-upon-Thames.

The River Colne at Uxbridge sits at the edge of the urban/rural interface. To the east of the river is the built-up area of Uxbridge with business parks, main roads and a legacy of light industry, and to the west is the rural setting of Uxbridge Moor and disused gravel workings. There are extensive gravel workings throughout the Colne valley with naturalised water-filled quarries providing complementary habitat to the river. The river has clearly been diverted to facilitate gravel extraction, road building and historically for milling.



Map 1 – the River Colne catchment. Red arrow marks the upper limit of the visit and blue the lower. Data from www.environment.data.gov.uk/catchment-planning/WaterBody/GB106039023090

Map 2 – River Colne and Sluice. Red arrow marks the upper limit of the visit and blue the lower

River	Colne
Waterbody Name	River Colne (confluence with Chess to River Thames)
Waterbody ID	GB106039023090
Management Catchment	Colne
River Basin District	Thames
Current Ecological Quality	Overall status of Moderate ecological potential sustained through two assessment cycles from 2009 - 2016
U/S Grid Ref inspected	TQ 0491184234
D/S Grid Ref inspected	TQ 0457183521
Length of river inspected	1.95km (1.03km of River Colne and 0.92km of Sluice)

Table 1 - Data from www.environment.data.gov.uk/catchment-planning/WaterBody/GB106039023090

The Colne is naturally a groundwater-fed river and can be described as a chalk river. However, in recent decades the aquifer has been reduced through abstraction, resulting in less base flow from springs and ground water seepage. There is now a greater reliance on flow from treated effluent and urban run-off. Water entering the river can now be assumed to be warmer than its natural base flow and will have higher turbidity. The high nutrient loading of phosphates originating from agricultural fertilisers, detergents and human effluent is given as a reason for the river failing the 2016 Water Framework Directive (WFD) assessment cycle. The urbanisation of the catchment will be having a negative effect on the river with regard to water quantity and quality, geomorphology and floodplain connectivity. All of the above result in the river now being classified as a Heavily Modified Water Body.

Although the catchment is urbanised, the WFD assessment for the reach is encouraging with the main reason for failure being phosphate loading (see table 2). It is also interesting to note the Colne is classed as "high" for its invertebrates and "good" for fish. This latter classification is at odds with the observations of the Angling Society who perceive fish populations in both the Colne and Sluice to be depleted from what they once were.

	2009 Cycle 1	2016 Cycle 2	Objectives
Overall Water Body	Moderate	Moderate	Moderate by 2015
Ecological	Moderate	Moderate	Moderate by 2015
Biological quality elements	Moderate	Good	Moderate by 2015
Fish	Moderate	Good	Moderate by 2015
Invertebrates	Moderate	High	Good by 2015
Macrophytes	-	-	-
Macrophytes and Phytobenthos Combined	-	Good	Good by 2015
Phytobenthos	-	-	-
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good by 2015
Other Substances	-	-	-
Physico-chemical quality elements	Moderate	Moderate	Moderate by 2015
Acid Neutralising Capacity	-	High	Good by 2015
Ammonia (Phys-Chem)	High	High	Good by 2015
Biochemical Oxygen Demand (BOD)	-	High	-
Dissolved oxygen	High	High	Good by 2015
pH	High	High	Good by 2015
Phosphate	Poor	Poor	Poor by 2015
Temperature	High	High	Good by 2015
Specific pollutants	High	High	High by 2015
Supporting elements (Surface Water)	Moderate	Moderate	Good by 2027
Chemical	Fail	Good	Good by 2015

Table 2 – WFD Waterbody Classification sourced from www.environment.data.gov.uk/catchment-planning/WaterBody/GB106039023090

The reach of the Colne which was inspected runs in two channels. The most westerly channel is the more natural channel with a sinuous planform. The east channel, the Sluice, is much straighter and has clearly been cut to form a mill leat (with the mill and its sluice still present). The Sluice receives additional flow from an off-take of the Grand Union Canal.

The river (both main Colne and the Sluice) is known locally as the Island water and fished by Gerrard's Cross and Uxbridge Angling Society (~300 members) which has controlled the Island water since 1989. Mr Turton reported that in the last 18 years, 25,000 mixed coarse fish have been stocked into the river in order to mitigate a number of fish kills. No records of trout stocking exist. Trout are not the primary target of the fishery but there is no reason why the club should not aspire to enhance the river for wild brown trout as good brown trout habitat would be beneficial for coarse fish species, especially chub and barbel.

The occurrence of a mill upon the river is an indicator of the river's previous industrial past. On the Ordnance Survey 1852 6-inch map the mill is shown to be a flour mill. In recent decades part of the site has become known as the Iron Foundry.

The river is not subject to any statutory nature conservation designations. However, during the visit it became apparent that the site is partly within the London Wildlife Trust's "Uxbridge Moor" nature reserve. The Wildlife Trust must be involved in any plans to improve the river.

The Colne is reported to contain the invasive American signal crayfish and as such it is very doubtful that any native white-clawed crayfish exist. No signs of water vole were observed but there is certainly habitat potential present for this declining and protected species. No otter spraints were found. Whilst it is doubtful that otters regularly use this part of the Colne, it would not be surprising to encounter otter field signs as they are well established throughout the Thames catchment.

Adjacent riverside trees provide important riparian habitat but it is doubtful that they are providing any bat roosts as the trees do not exhibit rot holes and/or bark fissures. It is possible that as trees become mature they may present roost potential. The London Wildlife Trust should be contacted prior to undertaking any tree work within the nature reserve as they may hold

records of bat roosts within their site. All species of bat and their roost sites are fully protected by both UK and EU law.

Following stone turning to visually assess the invertebrate life of the Sluice, it was found to contain the demon shrimp (*Dikerogammarus haemobaphes*). All anglers and river users should be made aware of the "Check, Clean and Dry" campaign to stop the spread of invasive animals and plants (see Appendix).

The non-native invasive floating penny wort plant (*Hydrocotyle ranunculoides*) was present throughout the visit. Across many waterways, the plant is causing significant problems for river managers due to its rapid growth and habit of choking watercourses. It must not be spread as its control is very expensive and time consuming. Eradication of the plant from sites is extremely hard so its presence creates a very significant management problem.

3.0 Habitat Assessment

The Sluice was viewed from the Riverside Way bridge (south). The land use on the downstream side is amenity grassland with tall riparian trees. Upstream of the bridge, there were new offices and small industrial units. The channel downstream of the bridge was ~8m wide with a depth ranging from ~0.1m to ~0.6m. The bed was predominantly gravel and sand. Whilst the flow appeared quite uniform it was encouraging to see water crowfoot growing. It is an important aquatic plant as it provides shelter (and food) for a wide range of invertebrates and fish. It is also considered an ecosystem engineer: as it grows, it will hold back water and forcing the flow to run at an increased velocity around and between plants, which in turn increases bed scour, helping to cleanse the bed of silt and to keep gravels supplied with clean well-oxygenated water. As water crowfoot raises summer water levels, it can be beneficial for coarse fish species which may spawn upon the weed, with the dense weed then providing cover for juvenile fish.

The occurrence of clean gravel is important to many different invertebrate species. Invertebrates often have very specific niche needs. This can often be governed by an interaction of particle size, organic matter occurrence, flow velocities and oxygen concentration. A more diverse and complex substrate leads to greater availability of niches which in turn may increase

the diversity of the invertebrate communities. A greater abundance and diversity of invertebrates is important within a river for functions like the breakdown of organic matter (leading to nutrient cycling), and as a potential source of food for fish.

Picture 1 – Water crowfoot growing from the bed of the Sluice. This plant can provide important cover for fish and invertebrates whilst increasing water levels as it holds back flow. The growth of the plant should be encouraged through habitat enhancement techniques that increase flow rate and bed scour.

When the Sluice was viewed looking upstream, a number of fishing platforms were apparent. There were also posts that is assumed would have once held coir rolls or some other form of marginal habitat enhancement but that have since degraded to leave nothing of value. The LHB marginal plants had been cut down to water level, presumably to maintain a 'tidy', kept appearance in front of the offices. Consequently no standing marginal habitat was present. Removal of standing dead vegetation would have negative consequences for a range of invertebrates as vegetation provides an important food source and as over-winter cover. A reduced abundance of invertebrates may result in less food for fish. Only a very narrow (~0.3m) fringe had been retained on the side from which angling could take place (the RHB). At the time of the visit, the new owner of the offices approached

Mr Turton and said that he would be interested in improving the setting of the offices; this opportunity should be followed up by the Angling Society.

The river at this location did not look very attractive with few marginal plants, no flow diversity, little bed form variation, and dark silt smothering the bed. Burr reed was growing and it is reasonable to assume that, come July, the plant will dominate the channel thereby impeding the flow, giving an appearance of a choked channel (but with water actually finding a pathway through it).

Picture 2 – The Sluice looking upstream from Riverside Way bridge (south). Note the lack of flow diversity illustrated by a smooth water surface. There is also no cover for fish to take refuge as the marginal vegetation has been 'managed' and the bed form has little variation. This reach of the Sluice does not offer an attractive setting for the adjacent offices.

Improving the setting of the offices using more sensitive land management techniques could be the key to improving further habitat areas of the Sluice. Engagement with the site owners should be attempted to improve aspects of the channel (flow diversity, appearance and biodiversity) as there is evidence accruing that a healthy ecosystem confers healthier, happier people.

Picture 3 – Note the posts (red arrow) that would have held habitat enhancement features such as pre-planted coir rolls. Consideration should be given to replacing this features or to seek permission to replace them with something more durable and beneficial to the river.

A short distance upstream of the offices, the river was fronted by a hard concrete wall which, except for where it was failing and plants had been able to root, offered no habitat value for fish.

Picture 4 – The concrete wall offers little habitat except where vegetation has managed to root and trails into the water.

At this point, the flow emerging from the historic mill (shown as Govt Offs. on map 2) gave an interesting flow contrast and it was reported that this location is a good holding point for fish with the occasional barbel to be found in the deeper water (~1.5m). Depth and flow would appear to be the main draw for fish in this area.

The sluice at the mill is in a poor state of repair (picture 5). The grill preventing debris from washing beneath it is partially damaged and large tree stems were wedged into it. It was not possible to assess the height of the fall. The main flow appears to run around the mill, dropping over a side sluice with a fall of ~0.3m (picture 6) into a narrow channel. The mill and its sluices are considered to present a barrier to the upstream movement of fish.

Above the mill, the channel was clearly wider in the past as the mill pond. However, it appears that in recent times the mill pond has become partially silted leading to the development of berms (picture 7) which in turn have become vegetated with reed canary grass and greater willow herb. These vegetated berms present an important habitat as they are providing a gradual transition from water to dry land. The vegetated margins will be providing juvenile fish cover and a diversity of habitats for invertebrates. The flow in the impounded mill pond is slow and consequently silt has settled upon the bed smothering the gravel (picture 8).

In places, willow trees have fallen into the water. Many trees had been cut back but fortunately trailing branches and roots have been retained (picture 9). Trailing branches further increase habitat for invertebrates and willow root masses provide good cover for freshwater shrimp. Importantly, both these habitats can be used by coarse fish as spawning substrates.

The inflow from the Grand Union Canal enters via a cascade of water (picture 10) which is probably locally important for increasing oxygenation during low flow and/or warm water periods. The canal would not provide habitat for trout so it was not assessed.

Picture 5 – Note the trash (which included tree stems) built-up against the mill intake. The side sluice now takes the majority of the flow.

Picture 6 – The side sluice to the former mill (now Government Offices). This structure is considered impassable to most coarse fish species. It may be passable to trout. A lack of access prevented it from being properly assessed.

Picture 7 – The mill pond which has developed vegetated margins as a result of silt settlement and colonisation by plants. These vegetated berms provide important marginal cover.

Picture 8 – The bed of the mill pond has a covering of silt over gravel.

Picture 9 – Willow tree have been cut back but fortunately cover has been retained in the form of trailing branches and roots. Note the rafts of floating pennywort (red arrows).

Picture 10 – The flow of the Grand Union Canal enters the Sluice by a cascade; whilst this inflow is impassable to fish, it will provide oxygenation of the water received from the canal.

Floating pennywort is particularly prevalent in the mill pond as the flow is not enough to flush it though, and the trailing willow branches catch small fragments as they drift downstream. This enables the plant to continue growing whilst anchored in the margins from which pieces break away to colonise new areas. The Angling Society are actively removing the plant where possible but their actions only manage to keep up with the growth rather than achieve eradication. Advice should be sought from experts in the EA on the best method of control.

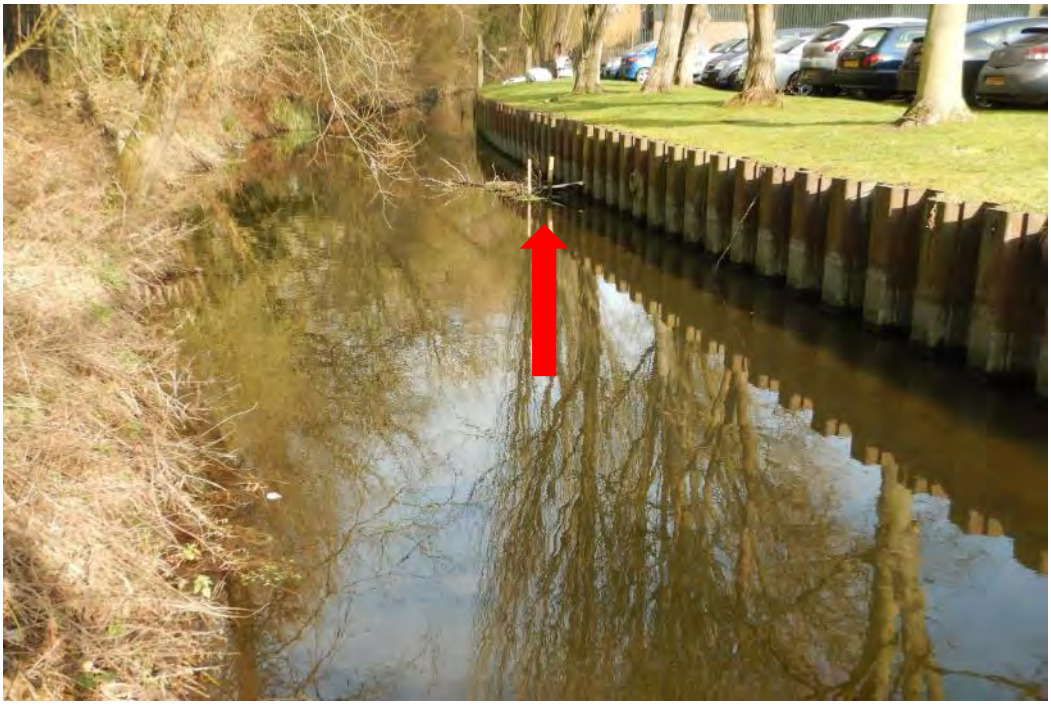
Removal of the pennywort by raking it back is also having a knock-on effect on other marginal plants as they too are being pulled out as a by-catch of the control. The establishment of more strongly rooted plants which grow taller, such as yellow flag iris and lesser pond sedge should be considered in order to retain some native marginal habitat.

Picture 11 – Removal of the floating pennywort is also resulting in the removal of native marginal plants with a negative impact upon both the Sluice and the Colne. A strategy needs to be evolved that sees the removal of the invasive plant but retains the natives. Consideration should be given to planting new native marginal plants such as yellow flag iris and lesser pond sedge both of which are strongly rooted and may not be prone to removal as pennywort is raked to the sides.

Immediately above the Riverside Way bridge (north), there was a stand of common reed which had narrowed the channel by >50%. This is a good example of a naturally narrowed channel pinching the flow to a width where the flow velocity is sufficient to cleanse silt from the bed and to expose gravel.

Picture 12 – Note that this stand of common reed has been allowed to grow out into the channel presumably without any negative impact upon the channel's flood conveyance capacity.

In the locality of the small industrial units, sheet steel piling was present, which presented no habitat opportunities. With the Colne being an urban river, it has largely lost its floodplain connection. This is detrimental to the flow regime of the river and to its ecology. The presence of dark silt upon the river bed suggests that urban run-off is an issue for the river. Without the river having a means to flush silt out of its channel (as might happen in a flood) that silt remains. It could be possible to use habitat enhancement techniques, such as brushwood ledges, to entrain the silt in order to establish vegetated margins.



Picture 13 – Note the hard edge presented by the sheet steel piling which offers no habitat. One low key flow deflector is present (red arrow).

Picture 14 – A close-up view of the flow deflector which is a simple arrangement of vertical posts which collect material drifting downstream. These features should be replaced with structures that are larger in width in order to create a greater scour effect within the channel.

To mitigate the lack of in-channel features within the Sluice, the Angling Society has undertaken some low key interventions in the form of small flow deflectors (pictures 13 and 14). These features generally consist of vertical posts erected to catch material drifting downstream thereby creating a raft. The material creates a small refuge area for fish but has very limited effect on local flow diversity. To have a greater beneficial impact upon the river, all flow deflectors should be increased in size. Flow deflectors are often created up to a size of 50% of a channel width. This local narrowing increases flow velocity to the point where bed scour is created.

At one location (picture 15), a number of fallen tree branches have been retained within the channel. They provide valuable functions: as fish refugia and as flow deflectors. Ideally, they should be kept in their current location with the angling platform relocated in order to retain important habitat and fish refuge.

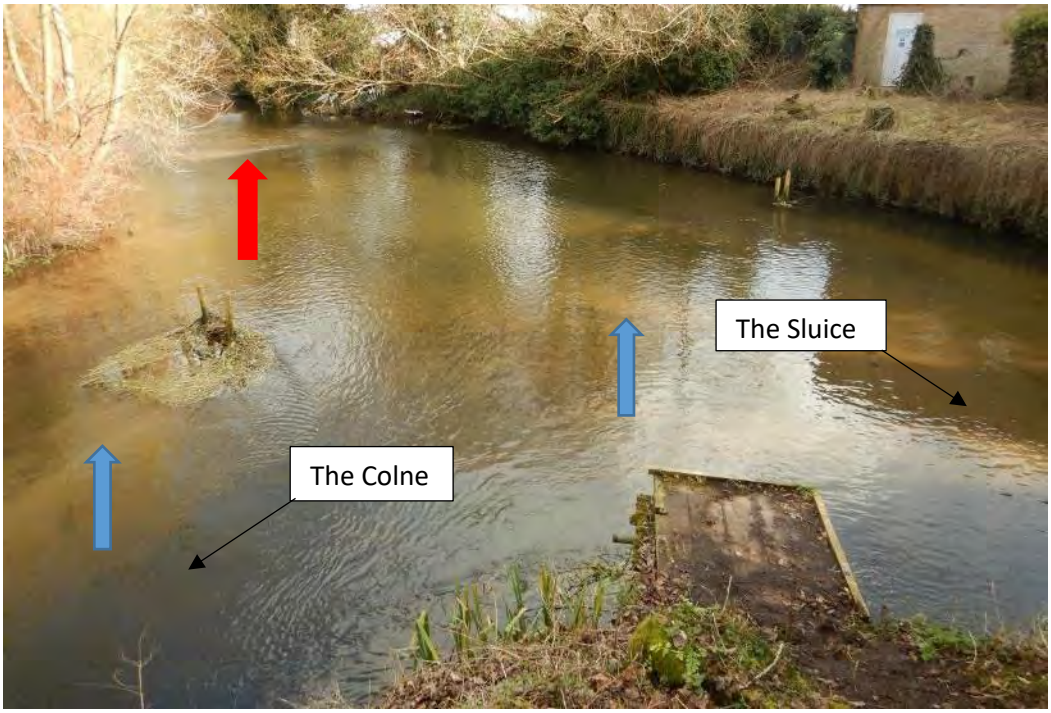
The majority of the Sluice had extremely poor instream and marginal habitat. The highly modified nature of the waterbody means that there is very limited natural bank gradient at the water's edge to enable emergent or marginal plants to become established (picture 16). Fish cover was very limited. A large shoal believed to be of roach (and possibly perch) was observed swimming very tightly and rapidly. The fish appeared unsettled and were probably searching for cover. No other fish were seen in the Sluice.

Once the top of the Sluice had been reached the main river Colne was met. The Colne exhibits many features important to gravel (rheophilic) spawning fish. Where the river's velocity was high, mid-channel gravel bars were present with abundant clean and well-sorted gravel. The bed depth also had variation which created flow variation. There were also sand bars forming which provide a complementary habitat to the dominant gravel bed.

As a chalk river, the Colne could be expected to consist mainly of glides, well-vegetated riffles and the occasional pool habitat. However, chalk rivers have a long legacy of having been harnessed for human needs with a consequential modification of the natural planform and morphology and often end up with many impoundments as weir and mills hold back water as a source of power. The Colne is no different in this regard with a complex network of mills, weirs and connections to the nearby Grand Union Canal.

Picture 15 – Fallen branches are providing important cover in an otherwise open channel

Picture 16 – Note the complete absence of cover for fish and the even smothering of silt upon the bed. The sheet steel piling offers no habitat.



Picture 17 – The point at which the main Colne splits to supply the Sluice. Note the gravel bar (red arrow) and sand bars (blue arrows).

Picture 18 – A riffle within the Colne, an important area for fish spawning and juvenile habitat. Riffles should receive good amounts of sun light in order for good plant growth. Plant growth upon riffles increases the available niches for fish and invertebrates.

The Colne offered significantly better habitat than the Sluice for wild brown trout and many other fish species. The Colne exhibited the key habitat features that trout require, namely:

- Spawning habitat – there was clean and well-sorted gravel into which adult fish could cut redds. There were 2 main riffles.
- Fry habitat – although limited in its extent, there was brash and vegetation in some margins which could be utilised as cover. Fry are relatively weak swimmers and require protection from the river's main flow.
- Parr habitat – juvenile trout (or parr) typically occupy shallow riffles which keep them separate from adult trout. Plants growing upon the riffles will increase the number of lies for juvenile trout whilst reducing competition.
- Adult trout – the deeper pools and glides would provide depth cover for mature fish with fallen trees and branches offering cover from predators.

See figure 1 for an illustration of the life cycle of the brown trout.

The Colne is lined with mature trees, mainly willow but with some alder and ash also present. The trees cast dense shade over the river. Even though this visit took place in winter, the presence or absence of plants largely corresponded with the tree cover. Shade cast by riparian trees is limiting the extent of both aquatic and marginal plant growth. Consideration should be given to a management strategy to create a mixed age structure of riparian trees. However, due to the site being part of a nature reserve, any such action must discussed with the London Wildlife Trust.

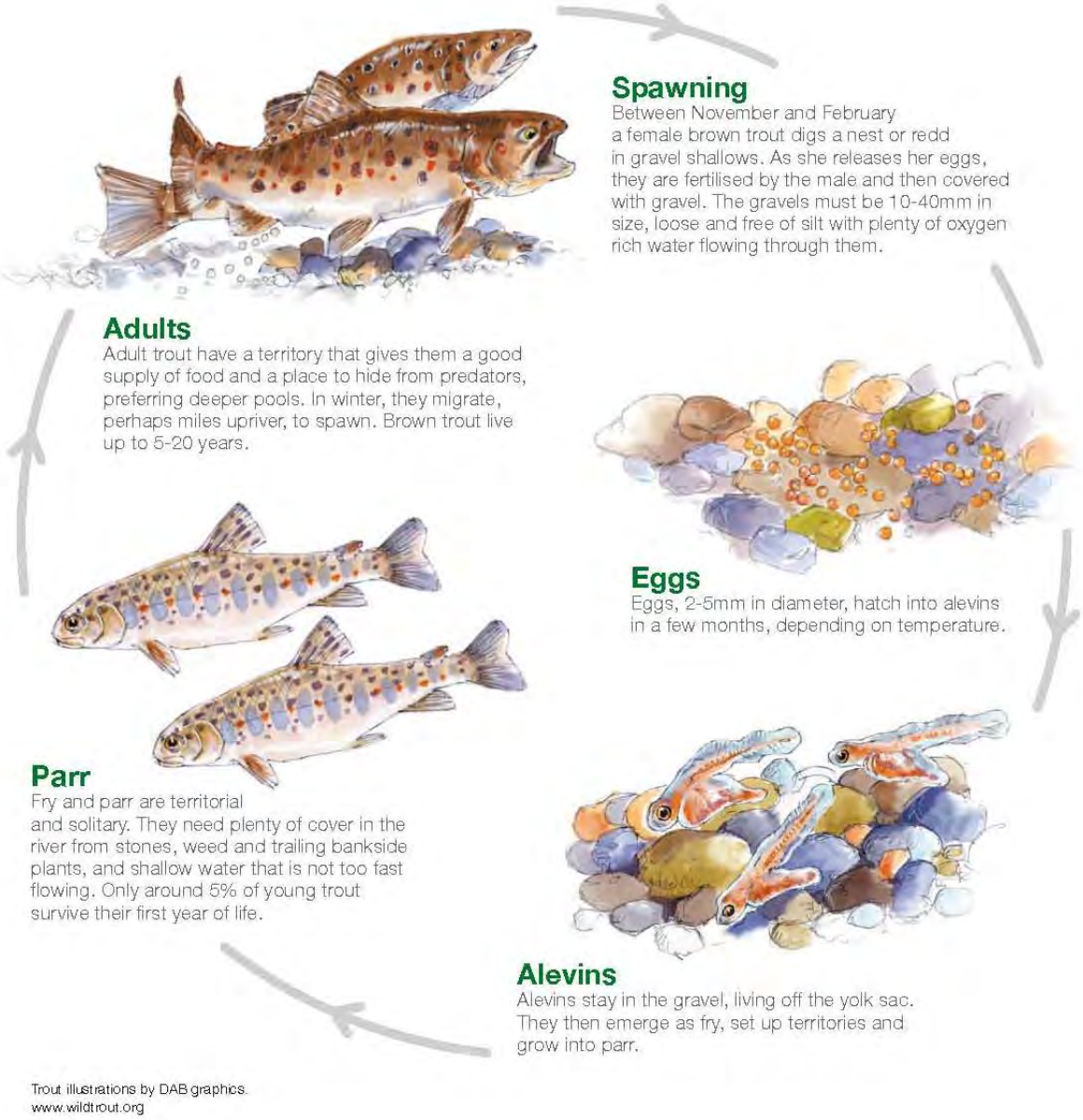


Figure 1 – an illustration of the life cycle of the brown trout.

Picture 19 – The Colne was shaded mainly by willow trees, many of which were a similar age. Tree management could create a better balance of light and shade upon the channel and create age and structural diversity within the tree stock.

Tree management could start with the pollarding of willows as that would retain high cover and allow light to reach the river. However, pollarding trees, by its very nature, will remove the occurrence of collapsed limbs that could provide beneficial habitat. It is possible that a balance could be found where trees are pollarded to sustain their growth and a number of tree limbs or stems are tethered in the water to increase cover.

Tree management should be combined with habitat enhancement works. This approach could see trees hinge-cut (a technique similar to hedge laying) to create large woody material (LWM) as cover at water level and to provide flow deflection. By creating cover at water level the fish-holding capacity of the river (of a range of species) would be increased.

Tree management would also create woody material, such as logs and brash, which could be used to create flow deflectors and brushwood ledges.

Due to the effect of shade, many parts of the Colne are over-wide. One of the consequences of the river being over-wide is that large sand bars

smother the gravel bed. With a degree of channel narrowing and/or the creation of brushwood margins, the increased flow velocity would transport, sort and deposit the sand in the margins to provide a suitable substrate for marginal plants to colonise and stabilise (provided plants have enough light).

Picture 20 – The Colne was densely shaded (even in winter). Sand was dominant where flow diversity was lacking and it was able to smother the bed.

By increasing bed scour, it will be possible to energise the deeper pool areas. At present, these have dark matter deposited within them which may be organic in nature or result from road run-off. Whatever its origin, the ability to direct scouring flow into deeper pools would be of benefit to many fish species especially if it is able to mobilise and sort material that is otherwise degrading the river.

The presence of many fallen trees within the Colne should not be seen as a problem. Trout and chub are commonly associated with such features because they provide food and shelter. Trees also initiate geomorphic processes, such as bed scour, sediment transport and deposition.

Picture 21 – Fallen trees provide important overhead cover for many fish species. Additionally, roach and perch will spawn upon trailing branches.

The occurrence of fallen trees within the channel can be managed if necessary by winching stems into different positions to lessen an impounding effect upstream, or to enhance a scouring flow. The management of fallen trees does not require EA permission if it is done in a manner that reduces flood risk (such as pulling back protruding limbs and securing them so that they cannot break free and increase flood risk).

Picture 22 – Fallen trees can be winched and fixed to provide overhead cover at the margins if their adjustment is necessary. Where trees have been in position for many years they may already be providing important habitat features for a wide range of birds and mammals in addition to fish. Note the small flow deflector (red arrow) which is not having any great effect.

Picture 23 – Note the dense line of willows which are all of the same age having been coppiced in the past. The tree have now grown out over the channel. These trees should be managed to create a varied age structure. Floating pennywort is prevalent on the far bank where it cannot be raked out.

The presence of the weir at grid ref. TQ04718 83899 is having a negative effect upon the river. The pool below it may be attracive to anglers, but the negative impacts in terms of fragmentation of populations and loss of varied habitat due to impoundment upstream outweigh the perceived benefits.

The weir is holding a head of water ~40cm. There was limited depth immediately below the weir due to bed lining, and immediately above it the depth was ~0.1m deep as it ran swiftly over a lined bed for ~1m. Thus it is unlikely that any fish species could easily traverse the weir except in higher flows when the weir is drowned out. But in those conditions the flow may increase too much so as to prevent some species from attempting to traverse the strucure.

The weir is creating a barrier to the natural movement of fish: all fish species need to migrate within a river, for feeding, breeding or to escape a pollution event.

Picture 24 – The weir on the River Colne does not appear to serve any purpose and consideration should be given to its removal in order to restore impounded habitat above it and to allow coarse sediment transfer downstream.

Below the weir, the river ran deep (>1.2m) at the rear of gardens. The flow had little diversity and was considered to be less favourable to trout when

compared to the reach above the weir. It is likely that the weir has trapped coarse sediment and prevented it from being transported downstream. The greater depth downstream is due either to sediment transfer out of the reach or dredging, and the weir has prevented resupply.

Picture 25 – Below the weir, the river ran deep with sand and black silt covering the bed. The presence of trailing LWM offered habitat cover at the margins and should be retained.

The Colne and the Sluice joined at the approach to the Slough Road bridge. The lower reach of the Sluice was then inspected which was wide at ~11m with a depth of ~0.2m. The river ran slowly over a gravel bed with many stones covered in fine silt and algae. The bed form was largely uniform except for one shoal of exposed gravel. It was most probably present as a result of a tree having fallen into the river which concentrated the flow to a point where bed scour was initiated. This is an important observation as it illustrates the potential of the channel to respond to flow deflection and bed scour as a means of enhancing the channel.

The riparian trees were providing LWM to the channel but it appeared that much of it had been removed as small piles were present on the banks. A similar approach to tree management to that proposed for the Colne could be adopted, i.e. to create a varied age structure.

Picture 26 – The Sluice below Riverside Way bridge (south). The adjacent riverside trees are casting shade over the channel limiting marginal growth. Note the LWM that appears to have been removed from the channel (red arrow). Its retention would have increased cover for fish and habitat for invertebrates.

Picture 27 – The trees on the RHB are suitable for hinge-cutting (red arrow) in order to provide flow deflection and over-head cover. They offer a relatively simple and low cost means of diversifying habitat within the Sluice.

It should be noted that many trees are suitable for hinging. In a shallow river, tree hinging would be a very simple and cost effective means of diversifying the flow characteristics and for providing cover.

The presence of extensive deposits of gravel and a reasonable gradient would enable the technique of "dig and dump" to be undertaken. This technique sees existing bed material, usually of a high gravel content, excavated (the dig) and placed to create exposed gravel bars (the dump) funnelling water into the newly created pool.

Picture 28 – Note the gravel bar formed as a result of scour. The position of the gravel bar forces water into the middle of the channel where it is gaining velocity and starting to form a new riffle. These types of features are to be expected in a dynamic river and should be retained. The exposed gravel bar will be providing a habitat for invertebrates which was not observed elsewhere during the visit.

An example of the dig and dump technique taken from the River Misbourne at Denham Country Park

Picture 29 – An excavator is positioned in the river and starts to dig a pool.

Picture 30 – The excavator places the excavated material at the sides of the newly dug pool in order to enhance flow into it.

Picture 31 – The excavator places further material either side of the new pool in order to correctly align the flow into it.

Picture 32 – The bed form is now diverse with a pool created after a shallow riffle thus mimicking the natural pool and riffle sequence that is expected within gravel-rich rivers. LWM can be placed to create instant cover.

The Sluice was shallow enough to make a visual assessment of invertebrates by stone turning. The technique showed a lack of the native freshwater shrimp and mayfly species (note that this was a very *ad-hoc* approach) but did reveal the presence of the invasive non-native demon shrimp (*Dikerogammarus haemobaphes*; confirmed by Lewis Thomas, EA). The reduced species diversity contrasts with the WFD assessment of "high" for the Colne. It is possible that the demon shrimp is currenly having a local effect on the Sluice but has not impacted upon the wider Colne yet.

Encouragingly, the lower Sluice did have water crowfoot growing within the shallower streamy areas and it is possible that the plant's growth may get to the extent where it could hold back the flow, leading to a greater water depth and enhanced flow diversity. However, there is the risk that the plants' growth could be affected by low flows and/or grazing by birds (such as swans or Canada geese).

Inspection of the gravel showed it to be compacted and also accreted with calcium deposits. Bed scour is only likely to occur in these areas if the amouring crust can be broken. Gravel rehabilitation can be achieved through water jetting with a high pressure water pump using a lance to direct water into the gravel. The water pressure is able to blast accreted material and fine particles out of the gravel where the water flow carries it downstream. The result is loosened gravel with a significantly reduced content of fine particles (sand and silt). The interstices between the gravel particles can then provide a habitat for invertebrates, and the cleaned and loosened gravel can be used by rheophilic fish species to spawn upon.

Picture 33 – The gravel bed is well compacted and bound by calcium deposits. This gravel could not be moved by fish, such as brown trout, that require loose gravel in order to form a redd (the resting place for fertilised eggs).

4.0 Recommendations

- There would appear to be an interest from the offices with respect to improving the appearance of the Sluice. This opportunity should be discussed in further detail to understand what their vision for the site is. Habitat enhancement measures should be integrated to any overall site improvement works. It would worth establishing the detail of what works were previously delivered to see if it is appropriate to repeat them or to undertake a different approach.

- If routine maintenance work for flood defence purposes are undertaken to either the Colne or Sluice (with both being classed as Main River), the Angling Society should seek to influence the works to gain a better balance between flood risk management and the retention of habitat features (such as fallen wood and aquatic weed). The EA have documentation for working with natural processes to mitigate flood risk.

- Due to the removal of the floating pennywort, in places there was very little marginal cover. The Angling Society should undertake the

planting of tall-growing and strongly-rooted native marginal plants such as yellow flag iris and lesser pond sedge. These plants may also offer a degree of competition to the floating pennywort.

- A programme of tree management should be initiated to create a mixed age structure of trees. This would have the benefit of extending the life of some trees, by allowing more light to parts of the channels and creating woody material, such as logs and brash, which could be used to create flow deflectors and brushwood ledges.

- The Sluice is lacking in flow diversity and cover. This could be addressed through the installation of flow deflectors and brushwood ledges. The flow deflectors would create areas of local scour which would be beneficial to the gravel bed and in turn to invertebrates. Flow deflectors would also provide cover for fish and increase the fish-holding capacity of the river. The creation of brushwood ledges would encourage the entrainment of silt whilst assisting the development of vegetated margins, and also deliver a degree of channel narrowing. Vegetated margins would provide further cover for both fish and invertebrates, and if planted up with attractive marginal plants, could bring colour to the setting of the offices.

- The occurrence of fallen trees within either channel should be seen as a habitat enhancement opportunity. Fallen trees should be made secure and be positioned to benefit the fishery by retaining overhead cover, fish refuges and/or flow deflection.

- The weir is creating a barrier to the natural movement of fish. Its purpose in the river no long appears necessary. Its removal would enable the channel upstream of it to establish a pattern of natural sediment transfer, which in turn would lead to the development of riverine features such as riffles and mid-channel bars. The supply of coarse sediment to the reach downstream of the weir would be beneficial to the long, dark, deep glides present in that reach. Furthermore, the removal of the weir would enable fish to move naturally through the entire reach. This is very important when spawning migrations are considered, or when fish need to escape pollution events or to re-populate a reach after a pollution or flood

event. The ability of fish to naturally re-populate areas of the river would reduce the Angling Society's dependence on fish stocking.

- The presence of extensive deposits of gravel and a reasonable gradient means that the technique of "dig and dump" could be used to enhance parts of the Sluice. This approach could be worked up into a project proposal in partnership with the WTT and EA (subject to funding and the securement of an environmental permit).

- The use of in-channel structures such as flow deflectors, brushwood ledges, tethered LWM and gravel rehabilitation could bring notable benefits to the Sluice for relatively little cost. Such measures could be the basis of a partnership project with the WTT and EA (subject to funding and the securement of an environmental permit).

- A means of assessing the impact of demon shrimp upon the fishery could be achieved through the application of the Riverfly Partnership's *Angler's Monitoring Initiative* (AMI). By monitoring groups of invertebrates and taking an estimate of their abundance over a period of time trends or even declines in invertebrate numbers may be observed. Dialogue should be had on this matter with the EA initially to see if they hold any data. More information about AMI can be found at www.riverflies.org/

5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the River Colne and the Sluice require written EA consent prior to their implementation, either in-channel or within 8 metres of the bank.

The Wild Trout Trust can provide further assistance in the following ways:

- Assisting with the preparation and submission of an Environmental Permit to the EA (formerly referred to as Land Drainage or Flood Defence consents).

- Running a training /demonstration day to demonstrate the techniques described in this proposal.

We have 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 stocks and managing invasive species.

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

The WTT website library has a wide range of materials in video and PDF format on habitat management and improvement: www.wildtrout.org/content/library

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; 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. Accordingly, 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 comments made in this report.

8.0 Appendix


STOP
THE SPREAD
STOP THE SPREAD
INVASIVE AQUATIC SPECIES
CHECK-CLEAN-DRY
Are you unknowingly spreading invasive species on your water sports equipment and clothing?
Invasive species can affect fish and other wildlife, restrict navigation, clog up propellers and be costly to manage. You can help protect the water sports you love by following three simple steps when you leave the water.
CHECK
Check your equipment and clothing for live organisms - particular in areas that are damp or hard to inspect.
CLEAN
Clean and wash all equipment, footwear and clothes thoroughly. Use hot water where possible.
If you do come across any organisms, leave them at the water body where you found them.
DRY
Dry all equipment and clothing - some species can live for many days in moist conditions.
Make sure you don't transfer water elsewhere.
For more information go to www.nonnativespecies.org/checkcleandry
Department for Environment Food & Rural Affairs
natural scotland
NNSS
RYA
BRITISH ROWING
ANGLING TRUST
SFCA
angling cymru

NNSS
GB non-native species secretariat

www.nonnativespecies.org

Produced by Olaf Booy, Max Wade and Vicky White of RPS

Floating Pennywort

Species Description

Scientific name: *Hydrocotyle ranunculoides*
AKA: Dail-ceiniog amofiol (Welsh), *Hydrocotyle nova zealandiae*
Native to: North America
Habitat: Emergent or floating on the surface of still or slowly moving freshwater

Free-floating or rooted. The characteristic leaves and growth form help to make this plant easy to identify. It is found mostly in the south-east of England and occasionally in the north-west of England and Wales. Spreading rapidly.

First naturalised in 1990 as a result of discarded plants from garden ponds. Can grow up to 20cm per day and may quickly dominate a waterbody forming thick mats and impeding water flow and amenity use. May out-compete native species by blocking out light, causing deoxygenation, obstructing air breathing insects from reaching the water surface and reducing water temperatures.

Floating pennywort is listed under Schedule 9 to the Wildlife and Countryside Act 1981 with respect to England, Wales and Scotland. As such, it is an offence to plant or otherwise cause this species to grow in the wild.

For details of legislation go to www.nonnativespecies.org/legislation.

Picture 34 – The demon shrimp (*Dikerogammarus haemobaphes*) Picture sourced from www.envirotecmagazine.com/2017/01/24/demon-shrimp-threatens-uk-river-life/ (Picture credit EA, CC, BY)

The demon shrimp originates from the Ponto-Caspian region of Eastern Europe around Black Sea, and has invaded Western Europe largely as a result of a canal link created between the Danube and the Maine, a tributary of the Rhine, in 1992.

It is up to 18mm long, similar in size to our native freshwater shrimp. It may have striped or spotted markings, with two distinctive humps on the tail. It prefers to live in zebra mussel beds, but will also use a range of other freshwater habitats for cover, including aquatic weeds, mud and gravel.

Dikerogammarus haemobaphes is the less aggressive relative of *Dikerogammarus villosus,* the 'killer shrimp'. It is a rapid breeder, producing three generations per year, with each female laying 100 or more eggs. In Europe *Dikerogammarus haemobaphes* kills and competes with a range of native species, such as freshwater invertebrates, and particularly native shrimps. It also scavenges and eats plant matter. This alters the ecology of the habitats it invades.

Text taken from Angling Trust News October 2012.