River Mimram, Tewin, near Welwyn Garden City, Hertfordshire

An Advisory Visit by the Wild Trout Trust October 2015

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Introduction

This report is the output of a visit undertaken by Mike Blackmore of the Wild Trout Trust on approximately 1 kilometre of the River Mimram at Tewin near Welwyn Garden City, Hertfordshire (national grid reference (NGR) TL 27294 13678 to TL 28232 13311). A walk-over of the site was requested by George Horne of the Environment Agency (EA), and was accompanied by Mr Chris Mungovan, Secretary of the Tewin Fly Fishing Club (TFFC), as well as Tony Langford, TFFC Chairman and club member Steve McSweeney. The visit was primarily focussed on assessing habitat for wild trout (*Salmo trutta*) and general biodiversity, with an objective of improving the river as a productive wild trout fishery.

Comments in this report are based on observations on the day of the site visit and conversations with George Horne and Chris Mungovan. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

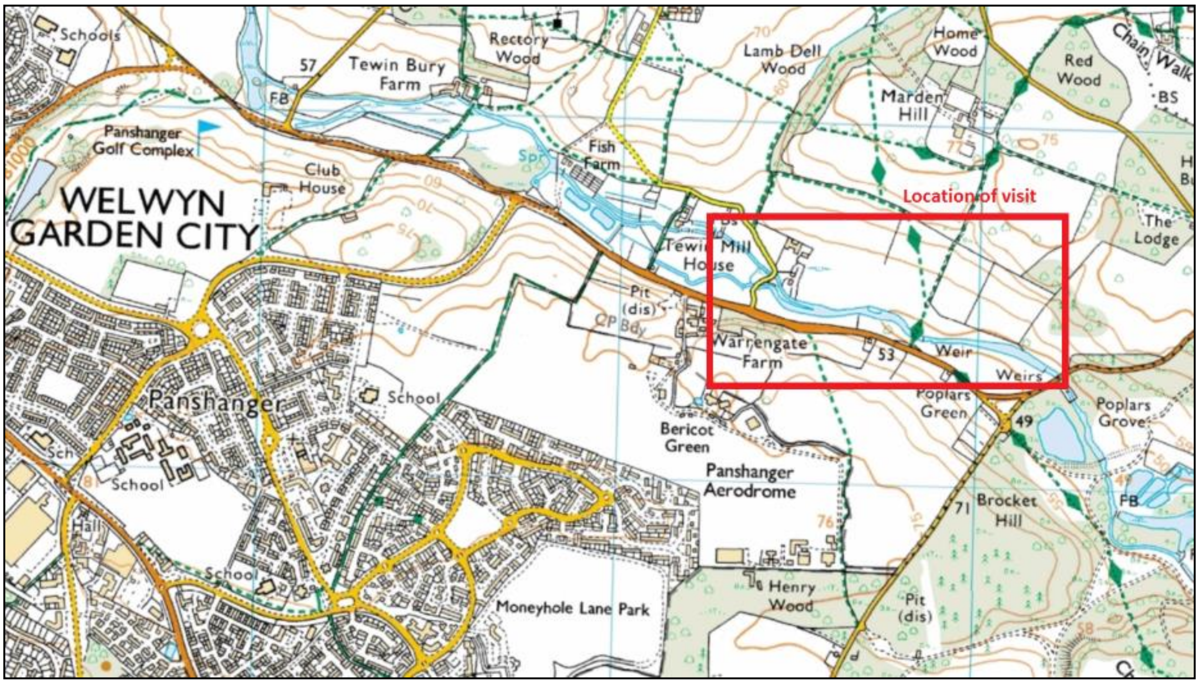

Figure 1: Map showing the location of the water visited

Catchment and Fishery Overview

The Mimram is a small (approximately 19-km long) Chilterns chalk stream with a reputation for gin-clear flows and excellent fishing. The Mimram catchment has a chalk geology overlain with deposits of clay, sand and flint gravel, and the catchment is predominantly used for intensive arable farmland. Land use changes significantly in the lower reaches, becoming urbanised as the river flows through Welwyn and the outskirts of Welwyn Garden City, before joining the River Lea at Hertford.

Historically, the Mimram's wild fishery enjoyed a standing to rival the Test and Itchen. Over the last half-century, its status has declined – but still supports a thriving wild trout population.

As with many of the chalk streams in the region, over-abstraction for public water supply has had a significant impact on flows. The Mimram has been modified by humans for centuries, with records of milling within the catchment in the Domesday Book. However, in the 1950s, the rate of water abstraction increased significantly to supply the rapid growth of Welwyn Garden City. The majority of water abstracted from the Mimram is not returned to the river and is instead returned to the River Lea as treated effluent.

Years of campaigning by a number of organisations including the Friends of the River Mimram (FoRM) have contributed to a decision to reduce abstraction from the river, and the Fulling Mill pumping station is due to halt operations in 2018. However, the region still has, and is highly likely to continue to have, some of the highest water demands and lowest availability of water per capita in the country.

Partnership projects such as the Chilterns Chalk Streams Project, individual initiatives by the Environment Agency, Herts and Middlesex Wildlife Trust and Countryside Management Service, helped in part by Wild Trout Trust training days, are helping to restore the struggling Hertfordshire chalk streams. The establishment and development of the South East Rivers Trust and improved collaboration through initiatives such as the Catchment Based Approach (www.catchmentbasedapproach.org) are providing new opportunities for river restoration. Nonetheless, a great many chalk streams, continue to fail their ecological quality targets under the European Water Framework Directive (WFD), and the Mimram is no exception; see Table 1.

Table 1: WFD information for the section of the River Mimram visited.

	2009 Cycle 1	2014 Cycle 2	Objectives
Overall Water Body	**Poor**	**Poor**	**(Cycle 2) good**
Ecological	Poor	Poor	(Cycle 2) good
Biological quality elements	Poor	Poor	(Cycle 2) good
Fish	<u>Poor</u>	<u>Poor</u>	(Cycle 2) good
Invertebrates	<u>Moderate</u>	<u>High</u>	(Cycle 2) high
Macrophytes	-	-	-
Macrophytes and Phytobenthos Combined	-	Good	(Cycle 2) good
Hydromorphological Supporting Elements	Not-high	Not-high	(Cycle 2) not high
Physico-chemical quality elements	Good	-	(Cycle 2) good
Ammonia (Phys-Chem)	High	-	(Cycle 2) high
Dissolved oxygen	High	-	(Cycle 2) high
pH	High	-	(Cycle 2) high
Phosphate	<u>Good</u>	-	(Cycle 2) good
Temperature	High	-	(Cycle 2) high
Specific pollutants	High	Moderate	(Cycle 2) good
Ammonia (Annex 8)	Good	-	-
Arsenic	High	-	-
Copper	High	High	(Cycle 2) high
Iron	High	-	-
Triclosan	-	Moderate	(Cycle 2) high
Zinc	High	High	(Cycle 2) high
Chemical	Good	Good	(Cycle 2) good
Other Pollutants	Does-not-require-assessment	Does-not-require-assessment	-
Priority hazardous substances	Does-not-require-assessment	Good	(Cycle 2) good
Priority substances	Good	Good	(Cycle 2) not assessed

Note: Anything classified as less than 'good' is failing quality targets

TFFC is a relatively small club with only 35 members. The club was established in the 1950s and until 2015 has been managed as a stocked fishery. The club has recently taken the commendable decision to cease stocking and trial managing the water as a wild fishery. However, concerns have been raised within the membership regarding falling wild trout numbers in club catch returns and EA electrofishing surveys over the past few years.

The club's waters have been a routine site for EA fish surveys for a number of years. However, budgetary constraints mean that this site has now been dropped from the EA's monitoring programme. This unfortunately coincides with the club's decision to trial 'going wild', and precludes the gathering of electrofishing data on the outcome of the trial. Nonetheless, there is increasing evidence from across the UK, Europe and North America to suggest that ceasing stocking and focussing on habitat improvements is highly likely to result in a larger trout population than stocking with farmed fish or those derived from wild broodstock schemes. The Wild Trout Trust was contacted to help identify any potential habitat bottlenecks and make recommendations to improve habitat and help TFFC manage its water to achieve its full potential as a wild trout fishery.

Habitat Assessment

For the purposes of this report, the river is separated into three reaches and described from the upstream to the downstream extent of the water visited.

Upper reach

At the upstream extent of the visit, the Mimram flows out from a residential property which was formally a corn mill. Upstream of the mill the river was once impounded into a large ornamental lake but later converted to watercress beds and finally to a fish farm (now closed).

At the top of the TFFC controlled water, the Mimram flows through an artificially straightened channel with a relatively steep gradient. The riparian land is not grazed and a rich and diverse community of marginal plants have established along both banks. A fallen hawthorn limb, secured to the bed by the fishing club, provides some excellent cover for fish and pinches the channel, promoting scour which has facilitated the formation of a small pool (Figure 2). Gravel scoured out from the pool is in good condition and relatively free from fine sediment (Figure 3). Clean, well-sorted gravel at the tail of a pool provides excellent spawning habitat for wild trout.


Figure 2: A hawthorn limb secured to the bed provides excellent cover and deflects flow


Figure 3: Gravel scoured out from the pool is well-sorted and relatively free from fine sediment

Apart from the hawthorn limb and a pinch-point created by a pair of flow deflectors constructed from wooden planks and stakes (Figure 4), the channel is overly uniform in width throughout the upper reach. The pinch point could be improved by replacing the planks with logs (sourced from nearby trees) set well below water level towards the centre of the channel, sloping up to above water level at the banks. In addition to the accelerated flow through the pinch point, this technique ensures a portion of the flow is forced over the submerged logs in all flow conditions, maximising the scouring effect. The introduction of untreated dead wood would also make the pinch a valuable habitat feature in itself, providing food and habitat for freshwater invertebrates, whilst retaining the beneficial flow deflection produced by the present arrangement.

Figure 4: Opposing flow deflectors create a pinch in the channel.

Despite the straightness and uniform width of the channel, a good diversity of depths was observed in the upper reach. This is largely due to the relatively steep gradient which maintains a good overall flow speed through the reach, retaining a fairly active morphology. The variation in depth is also maintained, in part, by a number of low-level cobble and block stone structures which have been installed by the club (Figure 5). Under the flow conditions observed on the day of the visit, the low level structures interacted with the flow in a similar fashion to a pair of log deflectors positioned in an 'upstream V' (see Figure 6). Flows deflected over the structure collide immediately downstream creating a pocket of intense scour. Whilst these structures are causing a localised increase in flow and depth diversity, and do not pose a fish passage problem under normal flow conditions, the structures fall short of best practice. Any structure reaching across the full width of the channel at bed level impedes the natural transport of bed load. This actually causes a net reduction of natural channel morphology and essentially impedes the river's ability to create and maintain a sequence of natural habitat features. Such interruptions to bedload transport can cause an accumulation of sediment upstream, leading to a reduction in habitat diversity. Under low flow conditions, the structures may also have an impounding effect on flow, reducing habitat quality upstream and possibly impeding fish passage. Replacing each structure with paired or alternating log deflectors would retain, and probably improve, the downstream pool habitat without supressing overall channel morphology. The existing cobbles and block stones could be used to reinforce the banks at the sides of the log deflectors or distributed in the channel as habitat for bullhead (*Cottus gobio*) and invertebrates.

Figure 5: One of the low-level stonework structures

Figure 6: An example of a pair of log deflectors installed in an 'upstream V' formation (with an approximately 1m gap between them) to replace a blockstone summer weir. This arrangement has helped to scour down the bed and retain depth during low flows without impounding the river.

Whilst the margins of the channel were providing excellent cover during the time of the visit, many marginal plant species die back during winter months, potentially reducing the abundance of marginal cover habitat. A greater abundance of coarse woody material (brushwood) within the channel margins could boost valuable winter cover. Brushwood installed to create wedge or D-shaped berms would also introduce a greater diversity of flow speeds. Several such features alternated along each bank could help promote a more pronounced and sinuous thalweg (Figure 7). The thalweg is the lowest part of the river bed which, in an un-altered channel, should also be the lowest part of the river valley. In many straightened or overly-uniform rivers, the channel cross-section can be relatively flat, making the river particularly vulnerable to uniformly low flows during prolonged periods of dry weather (as water levels drop, the depth is reduced uniformly across the bed). Even in rivers with a relatively good abundance of pools, an overly-flat channel cross section can reduce connectivity between pool habitats, making it difficult for fish to access pools and potentially leading to over-crowding, reduced water quality and increased risks from predation and stress of fish with attendant issues from opportunistic pathogens. A river with a pronounced thalweg is able to self-narrow as water levels drop, retaining not only depth, but also a good speed of flow. Such rivers are often referred to as having a 'two-stage' channel.

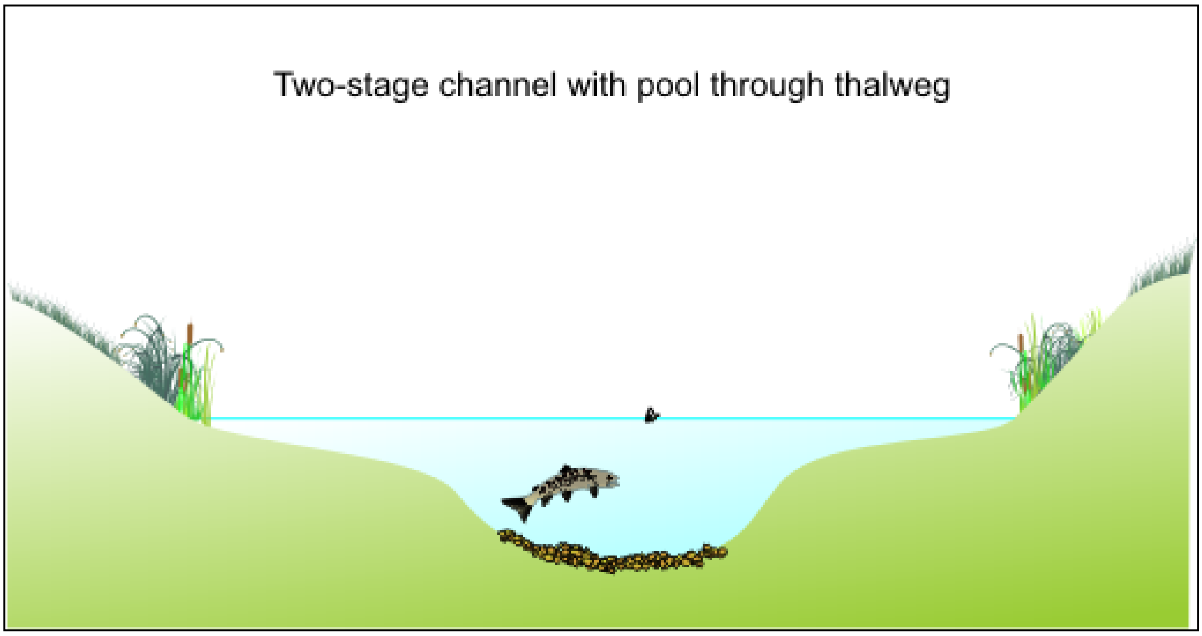

Figure 7: An illustration showing a two-stage channel cross section

An increase in flow diversity in the upper reach could help to better distribute fine sandy sediment. Water flowing through a brushwood berm is slowed, allowing fine sediment to drop out of suspension. Conversely, water flowing around the structure is accelerated, scouring away fine sediment. Thoughtful positioning of such features could help to manage sections where fine sediment is uniformly deposited over the bed (Figure 8).

The upper reach receives a good balance of light and shade and most trees are low-growing shrubby species. These provide good overhead cover and have a reduced maintenance requirement compared to some faster-growing, taller species. Where trees are multi-stemmed, individual limbs could probably be hinged (cut partially through and folded down into the river) or felled and secured to provide good refuge habitat, flow deflection and sediment management without reducing the overall amount of shade.


Figure 8: A thick deposit of fine, sandy sediment blankets the bed in a section of the upper reach

Middle Reach

At top of the middle reach the channel is relatively narrow and free-flowing (un-impounded), allowing for a good diversity of habitat (Figure 9). However, habitat quality degrades as the flow becomes more laminar and sluggish upstream of another cobble and block stone structure (Figure 10). The impounding effect of this feature is more pronounced than the structures in the upper reach and it is essentially acting as a 'summer weir'. Many such structures have been installed in rivers throughout the UK by fishery managers attempting to mitigate against low water levels. Whilst this may seem like an intuitive solution, the act of holding up water levels actually reduces a river's resilience to low flow events by impeding the morphological processes that would otherwise contribute to the development a more natural and drought-resilient channel profile.

Impoundments also cause uniform slowing of flows upstream, causing deposition of sediment over the bed. Over time, this will cause an evening out of the channel topography above the weir, resulting in reduced habitat diversity. Many clubs are reluctant to remove summer weirs, expressing concerns over the loss of water depth or favoured fishing spots. However, it is often the weir pool below the structure that provides the good fishing and replacing the weir with flow deflectors that retain scour through the existing pool should ensure that favoured fishing spots continue to provide good angling without impounding flow.

Figure 9: At the top of the Middle Reach the channel is narrow and the river flows freely.

Figure 10: Flow is impounded by another stone structure. Whilst there is good scouring flow below the structure, this is at the expense of flow diversity upstream (note the uniform laminar flows upstream of the structure).

Downstream, the river becomes uniformly over-wide and over-shaded. A project was undertaken in 1996 to narrow this over-wide channel (Figure 11). Whilst the project appears to have been relatively successful, the dense tree cover over the reach is putting the long-term integrity of the project at risk.

The works consist of large marginal berms created from hazel faggots and brushwood (branches) sourced from bankside tree works, secured to the bed with wooden fencing stakes. Marginal plants have been translocated into the structures and these have since spread across most of the structures to form a dense sedge bed. This sort of technique is tried and tested and works particularly well on rivers, such as chalk streams, that have relatively stable and benign flows. Brushwood structures steadily collect and consolidate fine sediment, providing a good medium for wetland plant species to grow. Submerged brushwood also provides excellent refuge habitat for juvenile trout and other small fish. Unfortunately, many of these structures do not last more than a few years when situated in particularly shady sections of river. In order to endure as a long-term feature, a dense bed of marginal plants must be fully established so that plant roots replace the brushwood as it naturally degrades over time. This can only occur where light levels are sufficient to encourage the vigorous growth of marginal plants. Ideally, such structures should support as diverse a range of marginal plants as possible to provide additional benefits (such as increased abundance and diversity of invertebrates) to the river ecosystem, and ultimately, to the diets of resident fish.

Figure 11: The 1996 narrowing project has been relatively successful but is at risk from over-shading from bankside trees

Patches of the berm are no longer vegetated and, in some places, new faggots have been added by the club in attempt to patch up sections where the original brushwood has rotted away. One berm, on the RB towards the downstream extent of the shaded reach is barely vegetated (Figure 12). Additional brushwood or planting here will have limited success unless tree works are undertaken to allow more sunlight onto the bed and bank.

Whilst the 1996 project has helped to narrow the channel, the habitat remains relatively uniform. This is owing, in places, to the edge of the vegetated brushwood berm being overly-straight (Figure 13), resulting in relatively uniform channel width and flow conditions.


Figure 12: A berm on the LB (right of picture) is particularly over-shaded and barely vegetated


Figure 13: In places, the existing berm presents an overly-straight bank edge, reducing channel diversity

Tree works to allow a greater diversity of light into the channel would greatly enhance this section of the club's water. Woody material arising from tree works should be used to patch up the berms where required and also to introduce greater variation in flow speeds and channel widths. From a fishery perspective, this would increase the number of good holding lies and feeding runs, making for a more interesting, and potentially more productive angling experience. From a biodiversity perspective a greater diversity of physical characteristics (flows, depths etc.) will provide a greater diversity of habitat niches, which should result in improved populations of freshwater plants and invertebrates.

Increased flow deflection and bed scour would also help develop a more pronounced thalweg and make the channel a more resilient habitat better able to support resident fish populations over a wider range of flow conditions.

Woody material can be used in a variety of different ways to improve channel complexity and flow deflection. Options are explored in the *Recommendations* section of this report.

At the downstream extent of the middle reach, bankside tree cover becomes sparser, allowing a greater abundance and diversity of wetland plants to occupy the river margins. In 2000, a project was undertaken at this location by the Environment Agency in partnership with TFFC. Alternating marginal berms were installed to narrow the channel from an average width of 18m down to approximately 7m and increase channel sinuosity. Flint gravel was imported to increase the diversity of depth conditions (the section being uniformly over 1-m deep and covered by thick silt deposits).

Figure 14: A downstream view from the top of the reach restored in 2000

The channel was not uniformly narrowed and a good diversity of channel widths is present. The imported gravel appears to have remained relatively free from fine sediment infiltration (Figure 15) and redds have been observed most winters. The dense and 'shaggy' marginal vegetation also provides good refuge habitat for juvenile trout.

Figure 15: Chris Mungovan demonstrates the relatively good condition of the gravel imported as part of the 2000 restoration project

Although this reach has benefitted from the 2000 project, overall habitat quality remains limited by the impounding effect of a weir a short distance downstream. This structure, although partially lowered as part of the project, uniformly slows flow through the reach and prevents a full range of flow conditions from being exhibited. Under all but the highest flows, this results in a reduced rate of morphological change within the channel and puts the restored habitat at risk from degradation. Removal of the impoundment combined with a slight increase in submerged woody habitat features would fully restore natural processes to the reach and provide a greater diversity of habitat, benefitting fish and anglers alike.

The weir (Figure 16) was originally installed to hold up a head of water which was pumped to a nearby mill. This purpose is now redundant but the weir arguably also helps to protect the footings of an ornamental bridge situated at the downstream extent of the restored reach (Figure 17). However, a number of ecologically appropriate and cost-effective soft-engineering solutions are available to protect the bridge footings in the absence of the impoundment. These options are explored further in the *Recommendations* section.

Figure 16: The weir at the top of the bottom of the middle reach limits habitat quality upstream

Figure 17: A view of the ornamental bridge from upstream

Although the weir is not necessarily a barrier to trout migration, it remains a significant obstacle for juvenile trout and smaller fish species. Whilst it is commonly believed such structures help to protect fish during low flow events by retaining sufficient depth, it is often during low flow events that weirs are at their most damaging. During low flows, obstacles that may be perfectly passable under other flow conditions can become barriers to fish passage. This can prevent fish from easily moving out of low flow environments and accessing deeper pool habitat. The slowing of flow during such events can also lead to spikes in temperature, putting undue stress on fish and other temperature-sensitive organisms. During higher flows, when the river should be at its most morphologically active, weirs can inhibit natural processes, preventing new pool habitats from forming and inhibiting the development of a natural two-stage channel. A WTT information paper, referencing scientific literature relating to impoundments and barriers to fish passage, is available on the WTT website: http://www.wildtrout.org/sites/default/files/library/Obstructions%20information%20paper%2020082013.pdf

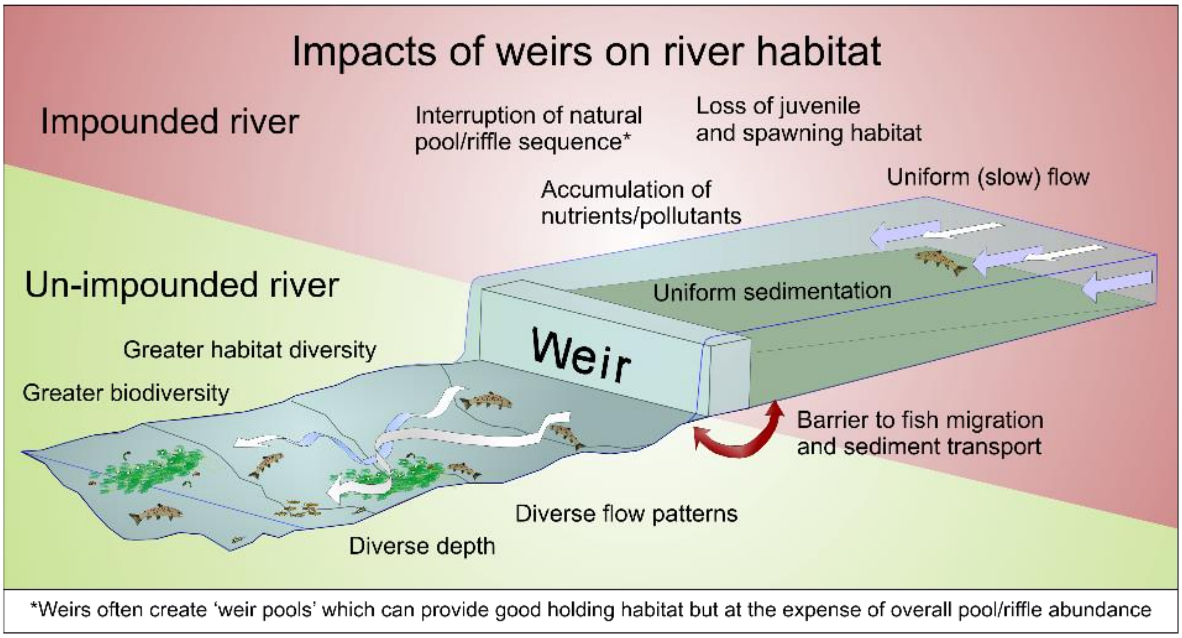

Figure 18: An illustration highlighting the impacts of weirs on river habitat

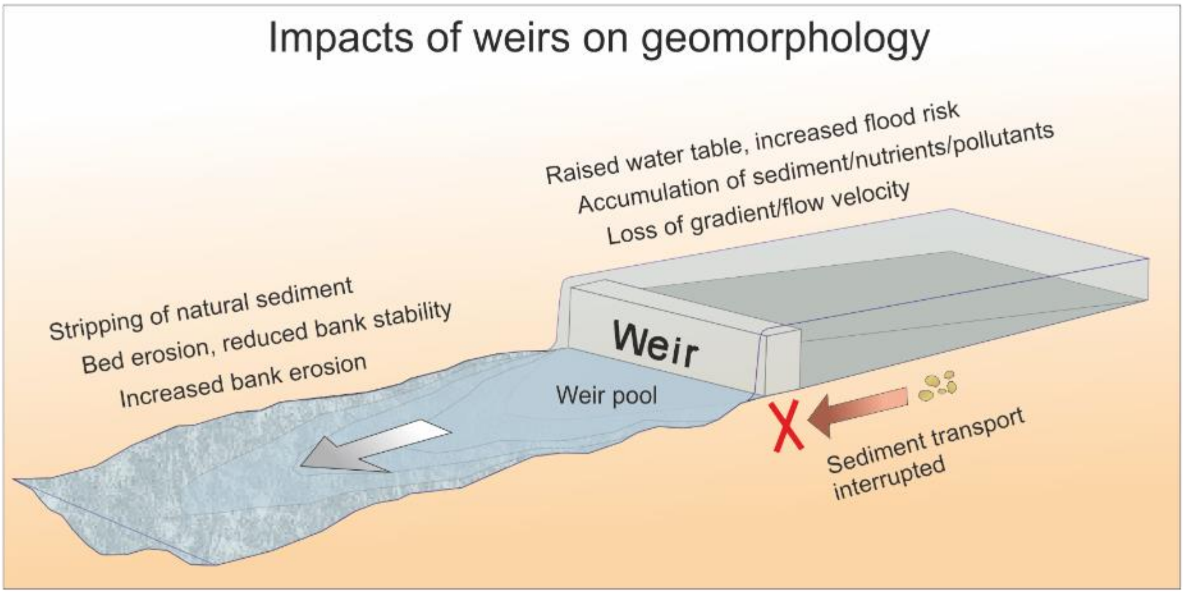

Figure 19: An illustration highlighting the impacts of weirs on river morphology

The weir is a key limiting factor presently preventing this reach from reaching its full potential as a healthy chalk stream ecosystem capable of supporting a vibrant wild trout population. Therefore, removing the weir or at least lowering a significant portion of it to bed level should be considered a priority action for the middle reach. With the impoundment removed, or its effect significantly reduced, a more natural morphology could be reinstated via the installation of some occasional woody habitat features in the form of secured log deflectors or tree limbs.

Lower reach

From the weir downstream, tree cover is significantly reduced compared to the middle reach. Sunlight plays a vital role in chalk stream ecology as the often gin-clear water means that the rich and diverse macrophyte (river plant) community is particularly adapted to abundant light levels. However, too much sunlight, particularly during periods of hot and dry weather and low flows, can cause spikes in temperature and/or encroachment of marginal vegetation. With growing concerns over the potential impacts of climate change and over-abstraction, the Environment currently recommends an approximately 70:30 ratio of direct sunlight to dappled shade for chalk rivers.
(www.asfb.org.uk/wp-content/uploads/2012/09/Keeping-Rivers-Cool_Guidance-Manual_v1.-23.08.12.pdf)
The lower reach appears to be about right in terms of shade. However, an increase of low trailing branches would provide more overhead cover for trout. This habitat feature is in particularly short supply along the entirety of the water visited. Rivers managed for fly fishing can sometimes suffer from a lack of low cover if trailing branches are removed in order to facilitate casting. Sometimes these limbs are removed simply in an attempt to let more light into the river when more substantial tree works are deemed too expensive or otherwise unfeasible. However, this is one of the most valuable habitat features for a productive trout fishery. Trout tend to favour lies underneath trailing branches where they are naturally more protected from predators such as piscivorous birds. Such spots also provide a reliable and rewarding challenge for wild trout anglers and are increasingly favourite features in established wild trout fisheries.

The lower reach was, until a few years ago, heavily grazed by cattle. This resulted in heavy bank poaching, causing a widening of the channel and depletion of marginal habitat (Pers comm. Chris Mungovan). Since the grazing ceased, a wide and biodiverse margin has recovered, naturally narrowing the channel and providing excellent habitat for invertebrates and juvenile fish as well as waterfowl and mammals (Figure 20).

Figure 20: Marginal vegetation has recovered since the cessation of grazing in the adjacent fields.

Whilst the majority of the riverbanks provide good habitat, examples of historic, less appropriate bank stabilisation works were observed in places (Figures 21 and 22). Balancing good habitat with safe, easy and cost-effective angler access is a common challenge facing many wild trout fisheries. However, there are a range of techniques available that will provide good angler access whilst also having a degree of habitat value (see *Recommendations*).

Figure 21: A bank revetment constructed using recycled car tyres has no habitat value and detracts from the overall aesthetics of the club's water

Figure 22: A revetment of untreated wooden stakes is less incongruous but inhibits the growth of marginal plants and ultimately fails as a long term solution

One of the reasons wild trout fishing is growing in popularity is the connection to nature that anglers experience whilst enjoying their favourite past-time. Providing as natural an angling experience as possible will be key to the long-term success of the club 'going wild'. It is therefore important to consider the aesthetics of the river as well as its quality and performance as a wild trout habitat.

The plan-form of the channel throughout the lower reach is notably more sinuous compared to upstream. The lower reach also presents a greater range of natural chalkstream characteristics including a good abundance of water crowfoot (*Ranunculus* spp.) and other aquatic plants associated with chalk streams such as starwort (*Callitriche* spp.) water parsnip (*Berula erecta*), brooklime (*Veronica beccabunga*), water forget-me-not (*Myosotis scorpiodes*) and cress (*Nasturtium officinale*). Water crowfoot is a particularly important species in chalk stream ecology. It not only provides excellent cover for trout, but also supports a high abundance and diversity of freshwater invertebrates, helps to naturally elevate summer water levels without impounding flow and helps to focus available flow and promote scouring of gravels.

Water crowfoot communities have a tendency to boom-and-bust and despite a great deal of scientific research, the reasons for this are not fully understood. However, what is known is that water crowfoot is reliant on both sufficient sunlight and flow and it often fails in impounded and/or heavily-shaded sections of river. Ensuring that the river is as free-flowing as possible, by removing all artificial impoundments, is highly likely to result in a more abundant and stable water crowfoot population. This will in turn help to raise water levels during summer months, mitigating against low flows without sacrificing habitat quality or connectivity.

At the bottom of the reach, the remains of an old grid work 'fish stop' structure, previously used to retain stocked fish during the fishing season, is redundant and marked for complete removal by the club. This structure impounds flow and is a potential obstacle to free fish passage (especially if a significant volume of weed becomes trapped against the grid work). The removal of this structure will be an important step towards a more natural wild fishery.

Figure 23: Chris Mungovan points out the remains of the old fish stop towards the bottom of the lower reach

Between the old fish stop and the B1000 road bridge downstream, the channel becomes abruptly wide and shallow (Figure 24).

Figure 24: Some additional light and structure could make this shallow and wide section more resilient to low flow events

Whilst sections of wide and shallow river can be valuable, and often rare habitats in themselves, the lack of any in-stream structure and paucity of weed could potentially make this section impassable to fish during periods of low flow. Allowing a little more light into the river here and adding one or two flow-deflecting woody habitat features could help make this section more physically diverse and resilient to low flow events.

A short distance below the B1000 road bridge is a crump style EA flow gauging weir which was not observed during the advisory visit. This structure is reportedly not a complete barrier to fish passage but could nonetheless be a significant obstacle under certain flow conditions (Pers. Comm. George Horne). Ensuring that fish are able to migrate up into the TFFC waters from downstream will be of the utmost importance for safeguarding the wild trout population for the future. Some EA gauging weirs have been successfully altered with low cost baffles to make them more passable for fish and exploring the feasibility of such a modification on this weir is recommended.

Figure 25: An example timber baulk easement fixed to a crump weir

The visit was undertaken during wet weather and this was reflected by a significant colouration of the water for approximately one hour. This is reportedly an increasingly common phenomenon on the club's waters and is often accompanied by a sudden, but short-lived, rise in water level (Pers comm. Chris Mungovan). This is an uncharacteristic (if increasingly common) scenario for many chalk streams which should be typified by clear and stable flows. The spate flows are probably due to urban drainage upstream at Welwyn Garden City, and poor land management in the wider catchment. Whilst water quality and the input of excess fine sediment associated with such events is a cause for concern, occasional spates of higher flow could provide an opportunity for habitat improvement.

Whilst many chalk streams, particular those suffering from the effects of over-abstraction, can lack the flow energy required to drive significant morphological changes, occasional spate flows in the Mimram at Tewin could be harnessed to further diversify channel topography. Ensuring that an abundance of flow-deflecting woody habitat features is present will make the most out of occasional spate flows, helping to scour new pools and promote the more resilient two-stage channel profile described above.

Conclusions

The section of the River Mimram visited has clearly undergone some significant habitat improvements whilst under the management of Tewin Fly Fishing Club. Engagement with land owners regarding grazing livestock has helped restore and protect the river margins and work with the Environment Agency (and previously, the National Rivers Authority) has resulted in two restoration projects. The river displays a surprisingly good diversity of depth conditions along its length and, where light levels allow, a relatively good abundance of in-stream and marginal plants.

Despite the good variation in depth along the long-section profile of the river, much of the channel is relatively flat across its cross section and river thalweg is not particularly pronounced. Flows are relatively uniform and impounded to the point of becoming laminar in places. Light conditions are well-balanced in the upper and lower reaches but the river is over-shaded throughout the middle reach. In the middle and lower reaches there is also a paucity of low overhead cover (low branches).

Despite relatively good redd counts, fish survey data suggests that recruitment is not as good as it could be and this may indicate that egg/alevin survival is less than optimal.

The river would benefit both as a wild trout habitat and fishery from the removal of existing impoundments and the introduction of more submerged structure in the form of flow deflectors and complex woody structures. These would provide a greater abundance of habitat features for wild trout and also help promote the scouring of new pools and runs and help a more pronounced thalweg to develop.

Recommendations:

In order for the River Mimram at Tewin to achieve its full potential as a biodiverse and good quality wild trout fishery, capable of supporting healthy, self-sustaining populations of wild brown trout, the following actions are recommended:

1. All impounding structures should be removed in order to allow natural river morphology to resume. Reinforcing the bank around the footings of the ornamental bridge is likely to make the partial or complete removal of the weir downstream a more feasible option. A number of contractors specialise in soft engineering techniques such as composite geotextile revetments that act like reinforced grow bags – creating a nature-like, vegetated, yet extremely erosion resistant bank. Such a technique is a much more ecologically and aesthetically appropriate, and significantly a more cost-effective alternative to traditional hard-engineering techniques such as sheet piling or gabion baskets. Such a project would not necessarily require heavy plant machinery and could quite easily be installed by supervised volunteers. The most cost-effective and ecologically appropriate solution would be the installation of a densely-packed brushwood wedge either side of each bridge footing. Such a structure could be filled and topped with soil and planted with marginal species upon completion, kick-starting the formation of a naturally reinforced bank.

2. Submerged woody structures should be introduced into the channel to increase the abundance and diversity of trout habitat and maximise morphology. With flows un-impounded and woody features carefully positioned and secured, winter flows should help scour new pools and allow the river to develop a natural two-stage cross section over time. This will provide the best long-term resilience against future low-flow events as well as providing more resting habitat during higher flows.


Figure 26: An example of a simple log deflector diversifying flow on the River Wylye, Wiltshire


Figure 27: An example of a scour pool created by a tree limb secured to the river bed (arrow indicates direction of flow)

Figure 28: A mid-channel pair of log deflectors in an 'upstream V' formation and adjacent live willow berm

Figure 29: The effect of a log deflector is amplified by the installation of a small live willow limb on the opposite bank

3. Undertake initial tree works to open occasional 'skylights' in the tree canopy through the middle reach. Particular effort should be made to allow as much direct sunlight onto areas where the marginal brushwood structures are no longer fully vegetated. Brash (branches and brushwood) arising from these tree works should be used to patch up the marginal structures where required. Large tree limbs should be retained and used to create a variety of flow-deflecting habitat features. Logs cut from the trunks of felled trees should be used to create simple flow deflectors to help kick flow laterally across the channel to

accentuate any existing subtle meanders and to focus scour on the bed. These should ideally be positioned protruding out from the bank at a 45^{O} upstream. The bankside end of the log should be slightly higher than the riverside end, which should be submerged so that water is just over-topping it during average summer flows.

Simple straight, cylinder-shaped logs make for the most predictable flow deflectors as water over-topping these will be deflected perpendicular to the angle of the log (as shown in Figure 26). However, the more complex the shape of the log, the more diverse the flow conditions it will create. Complex-shaped logs usually provide excellent cover for fish (Figure 30).

Figure 30: An example of a more complex-shaped log defector secured to the bed of a chalk stream.

4. Wherever feasible, small trees or large limbs should be felled or 'hinged' (cut part-way through and kneeled over) into the river with the branched ends pointing downstream to pinch the channel. This will provide good cover habitat and deflect flow around the tree/limb, scouring the bed, whilst slowing flow within the branches, which will encourage sediment to deposit in the margins. Engaging with the club's membership should ensure that opportunities can be identified to undertake such works without impeding angling activity. In fact, if judiciously positioned, new features should actually provide a greater abundance of angling prospects.

Figure 31: An example of a small bankside alder (*Alnus glutinosa*) hinged into the river to deflect flow and provide refuge habitat and a new angling opportunity

5. The recycled car tyre revetment should be removed and replaced by a more appropriate structure. For example, logs secured to the bed and back-filled with flint gravel rejects. If the cost and/or logistics of importing gravel make this option unfeasible, another option could be to backfill with brushwood until dense-enough to walk on and secure with cross-braces cut from straight branches. Translocated marginal turfs could be planted over the structure and within a season it should be established enough to withstand being walked on (Figure 32).

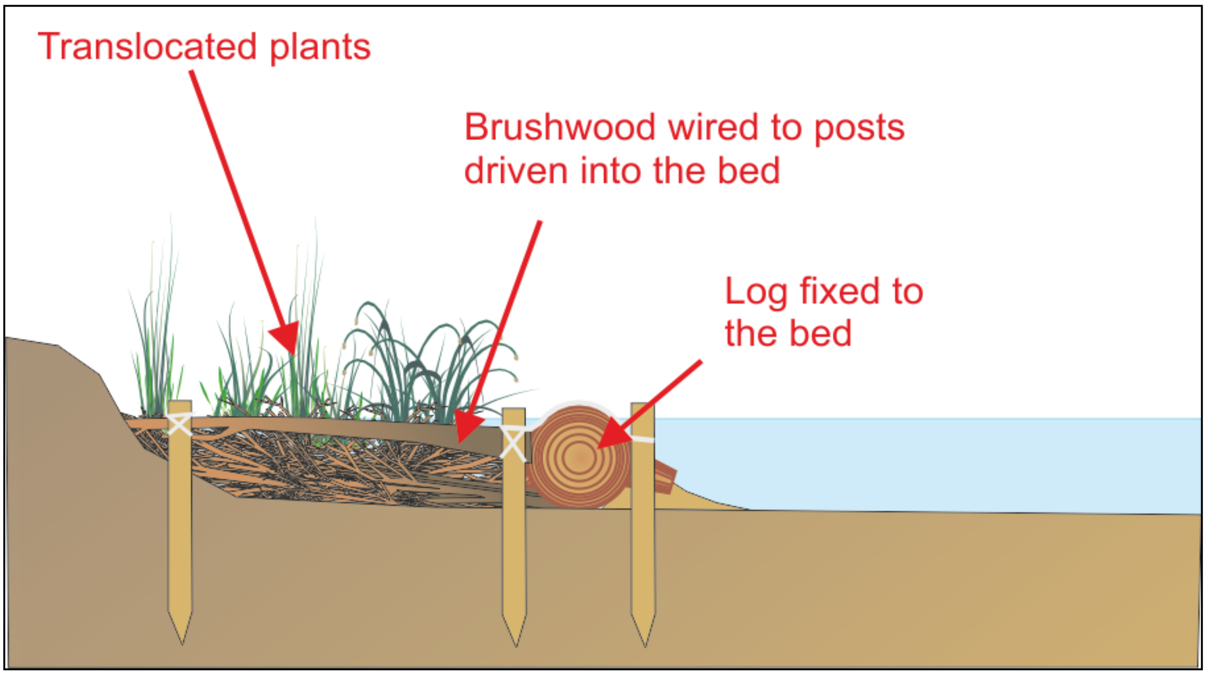

Figure 32: A drawing showing a cross section of a log and brushwood marginal berm. If densely filled and covered with local marginal turfs, such a structure makes for good angler access once fully establsihed.

6. Opportunities should be taken to secure funding to undertake further tree works throughout the middle reach to create an approximately 70:30 ratio of direct sunlight to dappled shade. Once this initial light balance has been achieved, future tree works should be scheduled in a 10-year rotation so that a good diversity of light conditions is maintained.
   www.wildtrout.org/content/how-videos#tree
   These works would give rise to an abundance of woody material that could be used to further increase habitat diversity throughout the clubs waters.

Making It Happen

The installation of any structures within most rivers or within 8m of the channel boundary (which may be the top of the flood-plain in some cases) will usually require formal Flood Defence Consent (FDC) from the Environment Agency. This enables the EA to assess possible flood risk, and also any possible ecological impacts. The headwaters of many rivers are not designated as 'Main River', in which case they are classed as an 'ordinary watercourse' and the body responsible for issuing consent will be the Local Authority. In any case, contacting the EA early and informally discussing any proposed works is recommended as a means of efficiently processing an application.

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

The Wild Trout Trust has 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.

There is also the possibility that the WTT could help via a Practical Visit (PV). PV's typically comprise a 1-3 day visit where WTT Conservation Officers will complete a demonstration plot on the site to be restored.

This enables recipients to obtain on the ground training regarding the appropriate use of conservation techniques and materials, including Health & Safety, equipment and requirements. This will then give projects the strongest possible start leading to successful completion of aims and objectives.

Recipients will be expected to cover travel and accommodation (if required) expenses of the WTT attendees.

There is currently a big demand for practical assistance and the WTT has to prioritise exactly where it can deploy its limited resources. The Trust is always available to provide free advice and help to organisations and landowners through guidance and linking them up with others that have had experience in improving river habitat.

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.

Appendix I – Good Practice Code for Coppicing

Coppicing of riparian trees during the winter is a traditional method of management. This can benefit the river, the farm and the whole catchment area. One of the aims is to increase the amount of light falling on the banks and bed of the river to promote the growth of bankside grasses and aquatic macrophytes and algae. Coppicing should be planned on a minimum of a five to nine year cycle.

1. Before carrying out any coppicing a plan should be drawn up. For this the presence of protected species (including bats and otters) should be determined (see below), and their habitat requirements taken into account.

2. In heavily shaded sections, coppicing should be concentrated in fast flowing shallow 'riffle' areas with lighter work around the glides and pools.

3. Try to leave most of the remaining shading on the south bank along glides.

4. Coppice trees only from October to March and, in any case, well before they come into leaf in the spring.

5. Avoid cutting right back to old growth. Aim to cut to knee height, retaining at least 200mm of new growth. This helps promote good re-growth of the coppice stool.

6. Preferentially leave ivy covered trunks.

7. Leave old and dead trees unless dangerous. Very old or "veteran" trees provide valuable habitat for a variety of wildlife and can contain a rich lichen flora. Some bat species are known to roost under loose bark and in tree holes.

8. Do not take mature timber. It does not coppice well. Any trees with good holes, cavities, splits, or loose bark should be retained.

9. Do not use machinery in the river. There are risks of pollution from fuel, oils and silt associated with use of machinery, which could result in prosecution.

10. Do not damage riverbanks or tree roots with machinery as this may lead to additional erosion. Avoid the use of machinery within 3m of the bank edge or tree stems.

11. Do not work **in** the river between 1 October and 31 March to prevent disturbance to spawning trout, trout eggs and newly hatched fry.

12. Coppiced timber and brash can form valuable habitat for a wide variety of wildlife. Where possible, it should be used to create LWD in the channel, or stacked and secured in such a way as to avoid it washing away and either

endangering fences downstream or accumulating on obstructions (bridges etc) and causing a flood risk. If material cannot be securely stacked then it should be removed from the flood plain completely. Should any material be burnt then this should be done no nearer than 50m to any other tree. In no circumstance should burning take place in the river channel. Ash must not be allowed to enter the watercourse.

13. Leave the stumps in the bank as they help to protect the bank from erosion and provide valuable habitat for fish. Tree roots also provide lying up sites for otters and nest sites for riverine birds such as grey wagtail and dippers.

14. Coppicing should be fenced to prevent damage to new growth from browsing stock.

15. Before working in areas with wildlife designations - Natura 2000 sites, Sites of Special Scientific Interest, National and Local Nature Reserves – you must first consult the relevant authorities, to avoid breaching wildlife legislation.

PROTECTED SPECIES

Many of the animals associated with river corridors (including bats, otters and dormice) are protected under Schedule 5 of the Wildlife and Countryside Act (1981), as amended by the Countryside and Rights of Way Act (2000) (CROW 2000) and The Conservation (Natural Habitats, &c.) Regulations 1994. This now extends the offence in section 9(4) of the 1981 Act to 'subject to the provisions of this Part, if any person intentionally or recklessly kills, injures or takes any wild animal included in Schedule 5, he shall be guilty of an offence.

BATS

All work that may affect bats should be discussed in advance with Natural England as a bat licence is required to survey (licensed consultant/bat worker) or carry out work on roost sites (DEFRA license). Under the Bonn Convention (Agreement on the Conservation of Bats in Europe) the UK is also required to protect their habitats, requiring the identification and protection from damage or disturbance of important feeding areas.

Bank side trees form important habitats for bats, as certain species are dependent on trees. Check trees for signs of bat roosts:

- obvious holes, cavities and splits in trunks and limbs
- dark staining on the tree below a hole

- staining around a hole caused by the natural oils in bats' fur
- tiny scratch marks around the hole from bats' claws
- droppings below a hole - they look similar to those of rodents but crumble to a powder of insect fragments
- noise (squeaking or chittering) coming from a hole
- check holes by inserting a mirror and watching the hole at dawn or dusk
- bats will also roost behind loose bark, which should be checked similarly.

If a roost is identified or suspected a more detailed inspection must be undertaken by someone with the relevant experience and correct license to assess, obtain and implement a DEFRA license where tree roosts will be damaged or lost. Whether bats are found or not, any trees with good holes, cavities, splits, or loose bark should be retained. An assessment should be made of the impact the work will have on bat roosts, feeding habitats and commuting routes before determining the final coppice plan, which may require alteration to accommodate the requirements of the bats.

OTTERS

Otter holts are found in cavities in large tree root systems, so any work on trees should be preceded by a root inspection. If a holt or lying-up place is *identified or suspected* a more detailed inspection must be undertaken by someone with relevant experience to ascertain whether otters are present. Coppicing should be carried out so that the coppice cut is taken some height above the stool, to allow for the protection of the cavity. Otter holts are protected by law and a licence may be required if disturbance is likely. All such works should be discussed and agreed with Natural England before proceeding.