Advisory Visit

River Lagan, Dromore, Co. Down

July 2011

1.0 Introduction

This report is the output of a site visit undertaken by Tim Jacklin and Paul Gaskell of the Wild Trout Trust to the River Lagan, Co. Down, Northern Ireland on 30th June, 2011. Comments in this report are based on observations on the day of the site visit and discussions with Michael Shanks and Donald McClearn of Dromore and District Angling Club (DADAC) and subsequent discussion with Dr. Robert Rosell of the Agri-Food and Biosciences Institute (AFBI).

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 source of the Lagan is on Slieve Croob, the tallest of a group of peaks in central County Down, between Dromara and Castlewellan. The river's course takes it from Slieve Croob , through Dromara, Dromore, Lisburn and Belfast where it enters Belfast Lough, an inlet of the Irish Sea. The river's salmon population became extinct in the early C19th and a restoration project for the species has been carried out over the last 30 years (Robert Rosell, pers. comm.).

Dromore and District Angling Club control the angling on the river in the vicinity of the town of Dromore and look after the upper reaches and tributaries of the river where trout and occasionally salmon spawn. DADAC is a trout angling club and has around 80 – 100 members. The club employs the services of a hatchery to catch up trout broodstock in the upper river and stock fed fry back into the river. Salmon fry are also stocked into the river and tributaries as part of the restoration scheme.

Trout stocks within the DADAC waters on the Lagan are reported to be good and reasonable numbers were seen rising (and caught during an evening's angling). The club is however concerned about other changes observed within the river, namely a large reduction in the amount of water crowfoot (*Ranunculus* sp.) and reduced fly hatches. In addition, the formerly clean river bed is now regularly covered with a veneer of very fine sediment.

3.0 Habitat Assessment

The upper reaches of the river were inspected briefly from the road bridge (Grid Reference NW 39314 02822). The river here was very open with overgrazed banks and little cover from riparian vegetation. Fencing and /or a reduction in grazing pressure is needed to improve the riparian zone. Some fencing had recently been completed just upstream of the road bridge (Photos 1, 2).

At the next road bridge downstream (NW 38703 03794) there was a recently constructed fish pass just downstream of the bridge culvert. The pass was constructed to improve fish access across a known obstruction and also included works to shore up the left bank downstream of the bridge which was becoming undermined, threatening a property. The works were part-funded by DADAC and carried out by the Rivers Agency with design input by Robert Rosell (pers. comm.). The pass is a baffled, Denil-type and the downstream water levels have been raised by the installation of a rock weir (Photo 3).

Upstream of the Denil pass there remain some challenges for fish passage and some opportunities for improvement. At the time of the visit (low flow) there was a lip at the upstream end of the Denil (Photo 4) which is not ideal; this will be drowned out at higher flows but removing it would increase the window of opportunity for fish migration. Upstream of this point, mass concrete studded with rocks was present, up to the base of the bridge culvert; a low-flow channel was present within the mass concrete, but it was quite shallow and a lip was present at the downstream end, again limiting the range of flows when fish passage is possible (Photos 4, 5).

The bridge culvert (Photo 5) remains an obstruction to fish passage because of the shallow skim of water over smooth concrete. High flows are necessary to achieve the depth at which fish could pass, at which point the water velocities over the smooth concrete are likely to become an impediment. It is understood that this problem was not tackled during the fish pass construction project because of the issue of liability for the integrity of the bridge structure if the culvert base was altered. This is a pity, because a very simple solution is possible which would pose minimal risk to the bridge structure. Low baffles bolted (or cast) onto the concrete base to concentrate and slow flows would solve the problem (see Recommendations section).

Photo 1

Photo 2

Photo 3

Photo 4 Lip at the upstream end of the Denil pass and at the edge of the mass concrete.

Photo 5 The bridge culvert remains a challenge for migrating fish

A large number of salmonid fry were observed in the pools downstream of the fish pass. These could be the result of salmon fry stocking (Robert Rosell, pers. comm.).

Bolesbrook Farm is the upstream end of DADAC fishing. The farmer here is conservation-minded and this has been recognised with awards for the way the farm is managed. This is reflected in the river upstream of the road bridge where a buffer strip between the fields and river is present along the right bank (Photo 6). As a result, a healthy riparian zone has developed with emergent vegetation (long grasses, rushes and reeds) and low, bushy sallow trees providing superb low cover over the water – excellent for holding fish. The condition of the right bank is a great example of good marginal habitat and its current state is “just right” – some light maintenance of the trees may be required (such as an annual rotational coppice of about 1 in 8 trees to maintain a mixed height and healthy understory vegetation).

Unfortunately, the good margin is not complemented by the in-stream conditions because this section of river is very slow flowing and not great trout habitat. The reason for the slow flow appears to be a naturally low

gradient on this section because the flow velocity has not increased despite the removal of an impoundment downstream (see below).

The left bank upstream of the bridge, in contrast to the right bank, is grazed pasture and has a poor quality riparian zone (Photo 6). The banks are steep, possibly because of previous land drainage works, and there is little vegetation present other than grass. The grazed banks do however provide easy access for angling. Some temporary (electric) fencing could be utilised here to reduce grazing pressure on a marginal strip and encourage better riparian habitat; allowing grazing for short periods would keep vegetation in check and maintain angling access.

At the upstream end of the Bolesbrook Farm section is the confluence of the Lagan and its tributary the Little Lagan. A sewage treatment works discharge enters the river here from a recently upgraded works. The river below the discharge appeared clean and no water quality problems have been noted here by club members. The Little Lagan has been engineered and straightened and has poor in-stream habitat (Photo 7); there are the remnants of a low weir here – maybe a previous attempt at habitat enhancement? A large fish kill occurred on the Little Lagan about 8 years ago as a result of a pollution incident from a farm; DADAC were awarded compensation which was spent on the fish pass described above.

The Lagan upstream of the Little Lagan has a steeper gradient than downstream and is noted as being a prolific area for the production of juvenile trout. Land use alongside the river here was silage production and slurry spreading following the first cut was taking place (Photo 8).

Downstream of Black Bog Road bridge the river occupies what appears to be an engineered channel with a trapezoidal cross-section, a large spoil bank on the left bank and the water level low in the channel (Photo 9). These appear to be the remnants of an impoundment and old mill race (behind the LHB spoil bank). The impounding weir has recently been bypassed; a meander has been cut off and the river diverted into a short section of new channel (Photo 10). This was done in order to reduce flooding of land adjacent to the now dry meander and has effectively removed the impounding effect of the weir.

On the right bank of the river here (NW 35469 08014) there was a discharge to the river from a quarry. The discharge was discoloured and carrying

suspended solids which were visibly affecting the watercourse for approximately 40 metres downstream (Photo 11). The input of sediment from quarry drainage and also from the washing down of roads (which sluices fine sediment into surface drains and hence the river) in the vicinity of the quarry continues to be a cause for concern to DADAC. Fine sediment clogs gravels and impacts upon the survival of trout and salmon eggs and upon invertebrate communities.

Turning over stones in this area revealed olive nymphs (Baetidae), hog louse (*Asellus aquaticus*), shrimp (*Gammarus pulex*), blackfly larvae (Simulidae) and leeches. These invertebrate taxa are moderately tolerant of organic enrichment and no groups sensitive to organic pollution were observed, indicating organic enrichment of the watercourse.

Photo 6 Contrast between the grazed and ungrazed banks upstream of Black Bog Road

Photo 7 Little Lagan

Photo 8 Land use at the Lagan / Little Lagan confluence

Photo 9 Downstream of Black Bog Road. Lowered water levels following bypassing of the weir (below).

Photo 10 Former weir. Flow previously spilled over the concrete sill and away to the left of the picture, following a meander which rejoined the river in the background. The visible (wet) channel is the new cut.

Photo 11 Discolouration resulting from the discharge of quarry drainage to the river

The section of river known as Blacks' between grid references NW 33102 09480 and NW 33387 09301 has some good habitat, with a pool and riffle sequence, good river-floodplain connection and a gravel bed. There are reasonable numbers of trout in this section but there is very little water crowfoot (*Ranunculus* sp.) compared with the past. DADAC have tried re-planting *Ranunculus* in this section of river with limited success. Methods of planting were discussed (see Recommendations for more details)

The river bed is covered with a film of algae which has trapped very fine sediment which is released in clouds, discolouring the water when disturbed (Photo 12). Stone turning revealed olive nymphs (Baetidae), blackfly larvae (*Simulium* sp.), shrimp (*Gammarus pulex*) and freshwater limpet – all moderately tolerant of organic enrichment. The presence of algae and the composition of the invertebrate fauna strongly suggest that nutrient enrichment is a problem in this catchment, probably originating from agriculture and domestic effluents. It is recommended that a detailed analysis of nutrients and sediments is carried out to determine which sources are the major contributors, so efforts to tackle them can be effectively targeted.

The lower end of this section of river is grazed by horses which have access to the river and there is a poor riparian zone (Photo 13). By contrast,

further upstream, electric fencing is present and the margins are well-vegetated with long grass, meadowsweet and some low willow trees (Photo 14). Some low stone weirs have been installed and at the head of the section some in river works have been completed by DADAC to relieve overgrazing and protect the banks; an island has been created and some very nice habitat has resulted with a good variety of depth, flow velocity and well-sorted bed substrate.

Upstream of Blacks' to the next road bridge the river is very slow flowing (almost imperceptible flow) for a long section. This appears to be because of a naturally low gradient (possibly exacerbated by historic land drainage works?). At the downstream limit of the slow section there is a bedrock bed level check which is used as stock drinking / crossing point. Upstream of the slow section there is some good in-stream habitat although it was noted that there was little buffering between agricultural fields and the river in places (Photo). At the road bridge is a flow gauging weir; there is no provision for fish passage here and if the weir is repaired or replaced in the future, the design should provide for fish passage. Ideally it should be an open channel design, but there are now International (ISO) and British Standards (BS) for compound flow gauging and fish pass structures (ISO 26906:2009).

Downstream of Blacks' a visit was made to an impounding structure across the river that supplied water to a flax mill museum. Fish have been observed struggling to ascend the the weir and sluice in the autumn, getting stuck below the lip along the crest of the weir. Advice was provided to the weir owner on how to construct a simple easement to allow fish to cross the weir (Photo 15).

Photo 12 Diatomaceous algae and fine sediment coating the river bed

Photo 13 Grazed section of river

Photo 14 Better riparian vegetation behind the electric fence

Photo 15 Flax mill weir. Install a baulk (of similar dimensions to the lip on the weir crest) along the line indicated to concentrate flows on the weir face. Notch the crest of the weir at the head of the baulk.

In Dromore the river flows through a public park where it is impounded by a large weir with a head difference of approximately 2 metres (NW 30421 09959). The weir is a redundant structure with the former leat upstream now blocked off. This is a substantial barrier to fish migration, although it is reported that bigger fish (including salmon) have been observed crossing the structure in high water by swimming over the right hand side of the weir which has a rough, rocky surface.

The deep, slow section upstream of the weir extends upstream into Dromore. There are substantial stands of Japanese knotweed here, particularly along the right bank. This is an invasive non-native plant and gives cause for concern because of its proximity to buildings and a car park. The plant is extremely persistent and has the ability to spread underground via runners then grow up through hard surfaces like tarmac and concrete. Further information on the plant and appropriate control methods can be found at www.doeni.gov.uk/niea/japanese_knotweed-commonly_asked_questions__2_.pdf.

In the town the river channel is widened for flood capacity and has concrete and stone walled banks. The wide channel means the river is very shallow and just downstream of the road bridge, DADAC have installed a crescent-shaped boulder weir to hold up water levels. Weirs impound water upstream encouraging sediments (cobbles, gravel, sand) to settle out and making their intended purpose of deepening the water only short-lived. The town location may restrict what is possible, but it would be better to replace the weir with low, D-shaped groynes or berms on alternate banks to create some low water, in-channel habitat variation. These could be designed to cause no more flood risk than the current weir. A vegetated berm has already developed naturally on the right bank just below the weir; this is a nice feature which softens the hard channel sides and it should be retained if possible.

Downstream of the park there have recently been some major improvements to the town's sewerage system including an upgraded pumping station (at a site where previously a pollution and fish kill had occurred) and a new sewage treatment works incorporating two large storm tanks.

Photo 16 Weir in the park in Dromore

Photo 17 Impounded section upstream of the weir with stands of Japanese knotweed

Photo 18 Boulder weir installed by DADAC to maintain water depths

Photo 19 Vegetated berm

Downstream, at Dromore Community Centre, there is a carp fishery on the left bank at the site of a former rainbow trout hatchery. The bank here is protected with gabions and rip-rap stone. The non-native invasive plant species floating pennywort (*Hydrocotyle ranunculoides*) was released into the river at this location in late 2010 and DADAC assisted the Northern Ireland Environment Agency (NIEA) and AFBI in removing five to six tonnes of the plant from the river (www.doeni.gov.uk/news_Details.htm?newsRef=1351). This is a highly invasive and undesirable plant species and club members should keep a look out for it and report it immediately if found.

Poor water quality has also been a problem at this site, the most recent event being reports of stressed fish near the surface and pea-green water following a heavy downpour in May. The incident was unrelated to the new sewage works and probably originated from surface water drains. A close eye should be kept on culverts and pipes discharging to the river, especially during wet weather, and the origin of each drain established.

Just downstream of the bridge to the Angling First site, a large gravel shoal had been recently removed from the river by the Rivers Agency for flood defence purposes (Photo 20). The rationale for its removal is debatable given the control on flow at this point exerted by the aperture of the bridge culvert itself.

Just downstream the right bank is experiencing accelerated rates of erosion because of grazing pressure on the adjacent land (Photo 22). Two stone flow deflectors have been placed against the right bank here and these are pointing downstream; as such they will overtop and exacerbate erosion on the left bank in this location (Photo 21). It is recommended that these are removed and soft revetment and a wide fenced margin is installed.

The furthest downstream section visited was at NW 28975 10253. There was some good in-stream habitat on this river section which gradually gave way to a deep, slow-flowing glide habitat. A tree had been removed from the river at the site of the redundant sewage discharge pipe. If possible, large woody debris such as this should be retained within the river channel because it has many benefits including cover for fish, retention of organic debris which supports various invertebrate species and localised scouring effects which clean gravels.

Photo 20 Site of gravel shoal removal

Photo 21 Downstream-pointing flow deflectors tend to cause adjacent bank erosion in high flows

Photo 22 Accelerated rates of bank erosion

4.0 Recommendations

4.1 Water quality

The main issue currently facing the Lagan appears to be one of water quality. The limited observations of aquatic invertebrates and the condition of the river during this visit suggest that nutrient enrichment is a problem. Whilst the discharge from the quarry as observed is unacceptable (and should be followed up with NIEA), the ubiquity of the algae / fine sediment suggests this is not solely the source. The problem with the quarry discharge (and road washing practices) needs to be addressed, but this should not distract from looking into the issue of nutrient enrichment which appears to be equally problematic. The reduction in the abundance of water crowfoot (*Ranunculus* sp.) and fly hatches noted by DADAC may be linked, and water quality and water quantity (flows) are likely to be important factors.

It is recommended that the relationship between water quality and quantity and the abundance of aquatic flora and fauna (particularly water crowfoot *Ranunculus* sp. and invertebrates) is investigated in more detail. Dr. Nick Everall of Aquascience (www.aquascience.co.uk) has recently completed invertebrate surveys with identification to species level on behalf of Trent Rivers Trust and partners. The analysis of these data has shed light on the nature of the impacts affecting the watercourse studied, their likely source and their relative importance (e.g. sediment, nutrient enrichment, low flows, pesticides). The cost of such investigations are justified because they allow more effective targeting of improvement efforts.

Diffuse pollution from agriculture is often a major source of nutrients in watercourses. Fertilisers and slurries applied to land can leach nutrients which are washed into rivers over land, via drains and ditches and from farm yards and standing areas. Tackling diffuse agricultural pollution is not quick and requires hard work building relationships and trust with land managers. There are government schemes available to farmers which provide funding to encourage environmentally sensitive farming (www.dardni.gov.uk/ruralni/index/environment/countrysidemanagement/schemes.htm) and interested local groups can make a difference by applying their local knowledge, influencing landowners and highlighting the issue amongst the local community. Groups like rivers trusts have tackled these issues successfully and a local example is Ballinderry River Enhancement Association (www.ballinderryriver.org).

Farmers in receipt of the Single Farm Payment agricultural subsidy are subject to cross-compliance which means they need to comply with a set of standards for environmental protection, food safety, animal welfare, etc. The environmental standards include updated regulations relating to nitrates and phosphates. (www.dardni.gov.uk/ruralni/index/environment/countrysidemanagement/nap2011-2014.htm)

Photo 23 Agriculture on a slope immediately adjacent to the Lagan with little to buffer the river from effects of fertilisers or sprays.

Practical measures which reduce the impacts of diffuse pollution from agriculture include the establishment of a vegetated buffer strip (as wide as possible – at least 3 metres and better if 5 - 10 metres) alongside watercourses. This will help to slow the rate at which dissolved nutrients enter the stream over fields, as long as the buffers are not bypassed by ditches or drains. Including access gates for seasonal grazing by livestock is ideal for achieving a diversity of plants and animals within the buffer strip and maintaining access.

Vegetated buffer strips will also reduce inputs of sediments washed off the land and provide some resistance of the banks to rapid erosion. To support the process of reducing erosive inputs of sediment, the headwater flow regime would benefit from close inspection. If extensive drainage systems exist in the upland bogs, the ideal solution would be to block drainage channels to promote the re-establishment of bog habitat. There are huge biodiversity benefits to such a practice and the rivers that have their source there will benefit from a slower release of stored rainwater. The smoothed

and prolonged release of rainstorm water reduces flooding risks downstream by reducing the incidence of short very high intensity spates. In turn, the reduction in highly erosive spates will also minimise the rate of bank erosion (and consequently sediment inputs).

In conjunction with the above, the potential for establishment of deciduous vegetation "shelter belts" for livestock would also be an extremely beneficial measure for the river. These narrow bands of deciduous shrubs and trees (planted at 90 degrees to the field slope) greatly increase the amount of rainfall that penetrates into the ground before reaching the river. Naturally, the livestock also should benefit from access to shelter during harsh weather.

Further information on diffuse water pollution from agriculture and practical actions for addressing it can be found here:
www.associationofriverstrusts.org.uk/pinpoint/dwp.html

The Riverfly Partnership (www.riverflies.org) runs the Anglers' Monitoring Initiative which provides training and support to voluntary groups willing to undertake regular invertebrate sampling on their rivers. The sampling provides a regular check on water quality and flags up any deterioration. The methodology is recognised by government agencies as providing more eyes and ears on the bank for detecting pollution incidents.

4.2 Fish passage improvements

The site of the Denil fish pass described above could be improved further by removing the lip at the exit of the Denil pass and improving the low-flow channel through the mass concrete (Photo 4). The main improvement however would be to modify the road bridge culvert by fitting low baffles to the concrete surface. These could be made of a variety of materials, but wooden or pre-cast concrete posts thru-bolted to the culvert base would suffice.

The aim should be to concentrate low to medium flows through one arch of the bridge by constructing a low fillet across the entrance to the other arch; this would overtop in flood flows. The fillet could be wedge-shaped (pointing upstream) to allow trash to wash over the top in high water. Photo 24

illustrates the concept; Figure 1 gives an example of a design for baffle arrangement;

Photo 24 Concept for fish easement. A = wedge-shaped fillet to divert low/medium flows through other arch; B = low fillet similar to existing concrete one on left of picture.

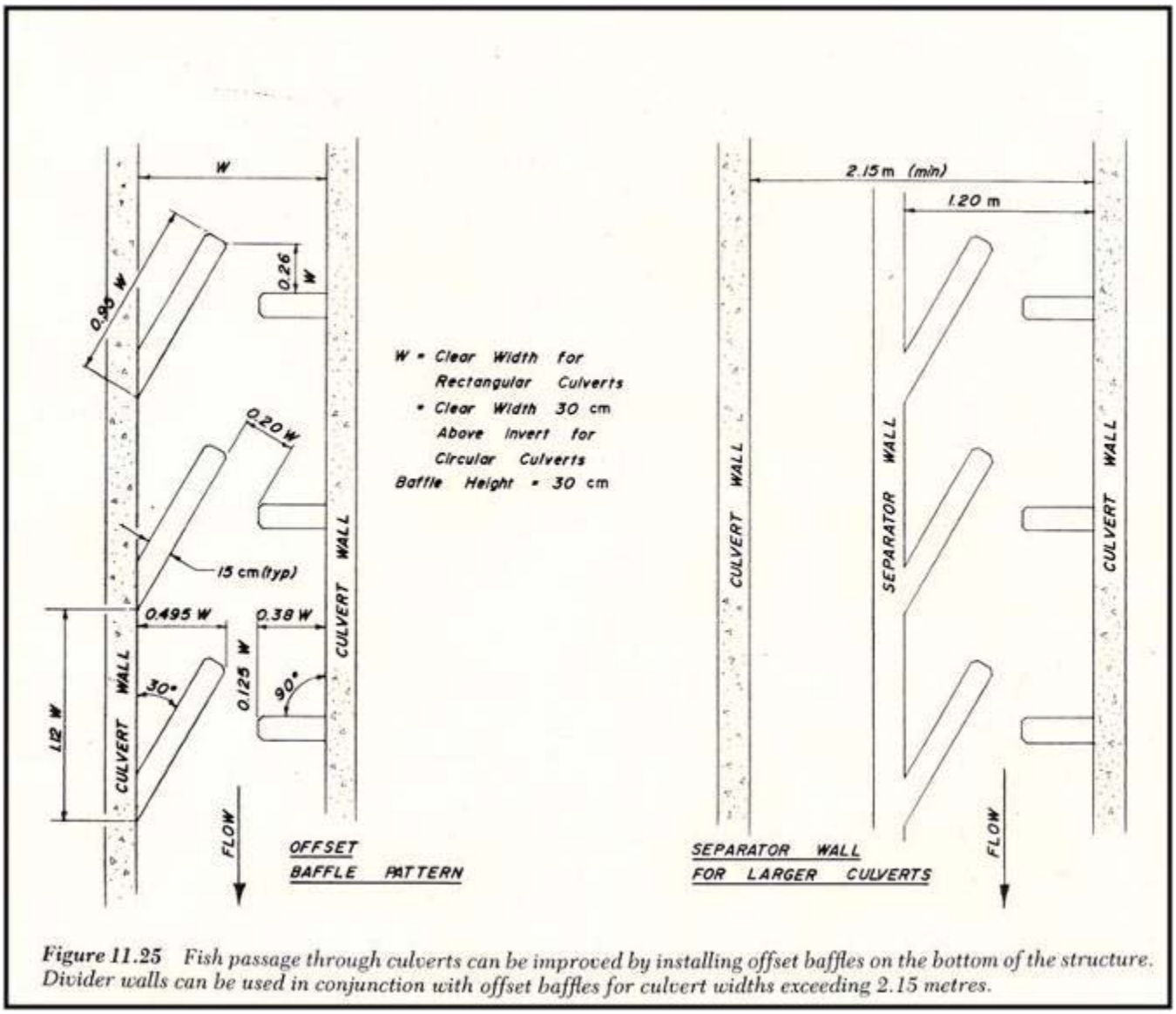

Figure 11.25 Fish passage through culverts can be improved by installing offset baffles on the bottom of the structure. Divider walls can be used in conjunction with offset baffles for culvert widths exceeding 2.15 metres.

Figure 1 (From *Stream Enhancement Guide, (1980). Province of British Columbia, Ministry of Environment, Vancouver, Canada*).

Photo 25 Example of wooden baffles and flow deflector (arrow) fitted to a bridge culvert in Wales.

Advice has already been provided separately for improving fish passage at the weir near the flax mill downstream of Blacks (Photo 15). Either a baulk or low-cost baffle easement were suggested and details can be found in the Environment Agency (England and Wales) Fish Pass Manual (pages 144 and 151).

4.3 Water crowfoot planting

Re-establishment of water crowfoot (*Ranunculus* sp.) was discussed. This has been carried out on the Lagan further downstream by Iveagh Angling Club and it would be worth contacting Gary Houston to compare notes. There are different species of water crowfoot, for example the river water crowfoot (*Ranunculus fluitans*) and the stream water crowfoot (*R. penicillatus*). *R. fluitans* has a restricted distribution in Ireland, occurring only in one stretch of the Six Mile Water, Co. Antrim and is protected under Schedule 8 of the *Wildlife (Northern Ireland) Order 1985*, which makes it an

offence to pick, uproot, or destroy this plant (www.doeni.gov.uk/niea/riverwatercrowfoot.pdf).

R. penicillatus is much more common and a study into the factors influencing its distribution in selected rivers in Northern Ireland can be found here: www.doeni.gov.uk/niea/print/atec.pdf . Siltation, nutrient enrichment, channel engineering and cattle grazing are cited as factors causing declines in water crowfoot abundance. Limiting factors such as these need to be addressed before re-introduction will be successful.

A method of establishing water crowfoot which has been found to be effective in rivers similar to the Lagan is to wrap up the stems / roots of the crowfoot in hessian or old tights with holes punched in and tie off to make tennis-sized balls. These are then buried in the river bed (use a crow bar to make a hole) and a rock placed on top. This is best done in spring and the resulting first year's growth should be cut back in autumn to prevent winter floods pulling out the roots. Site selection is important for success and the plants should be sourced from the same watercourse as close as possible to the site for introduction. The above study found that *R. penicillatus* was associated with run, glide and pool habitat with a gravel / pebble substrate and it was less common where the channel was shaded and areas of rapids and bedrock.

4.4 Physical enhancements

A number of areas along the river have structures made of block stone, including low weirs (Photo 14), flow deflectors (Photo 21) and bank re-inforcement (Photo 26). Whilst stone is the right choice in some circumstances, the use of softer materials such as brushwood, Christmas trees and root wads can achieve similar aims and also provide much better in-stream habitat. The WTT's Upland Rivers Habitat Manual provides detailed guidance on these techniques and can be downloaded from the publications section at www.wildtrout.org.

There are opportunities for further in-stream enhancements on the Little Lagan (vortex weirs and gravel introduction), and on the section of the Lagan downstream of Black Bog Road where water levels have been lowered by the weir bypass; large woody debris introduction could take place here (Photo 28).

Please note that written consent may be required from the Rivers Agency before any in-stream works are carried out.

Photo 26 Stone bank revetment

Photo 27 Brushwood revetment along a formerly rapidly eroding bank on the River Manifold, Staffordshire. This technique (combined with fencing) has greatly slowed the rate of erosion, provided excellent in-stream cover for trout and locally increased the diversity and abundance of fly life.

Photo 28 Tree anchored to its stump providing good in-stream habitat

5.0 Making it Happen

The WTT can provide further assistance to help implement the above recommendations. This includes help in preparing a project proposal with more detailed information on design, costs and information required for obtaining consents to carry out the works. If required, a practical visit can be arranged to demonstrate habitat improvement techniques. Demand for these services is currently high but WTT is able to provide further advice and information as required. Please contact projects@wildtrout.org for more information.

6.0 Acknowledgement

The Wild Trout Trust would like to thank its members and fund-raising supporters for providing the resources which made this visit possible.

7.0 Disclaimer