Instream Structures

Issues

England's chalkstreams have been heavily modified in the past. Milling, water meadow operation, the need for efficient land drainage, navigation and fishery interests have all been responsible for degradation of riverine habitat. For instance, dredging for land drainage has reduced the variation in bed and bank profile in many chalkstreams, whilst the removal of riparian trees and fallen timber from rivers by fishery managers has cut the supply of Large Woody Debris so important for creating good habitat for numerous species of animals and plants.

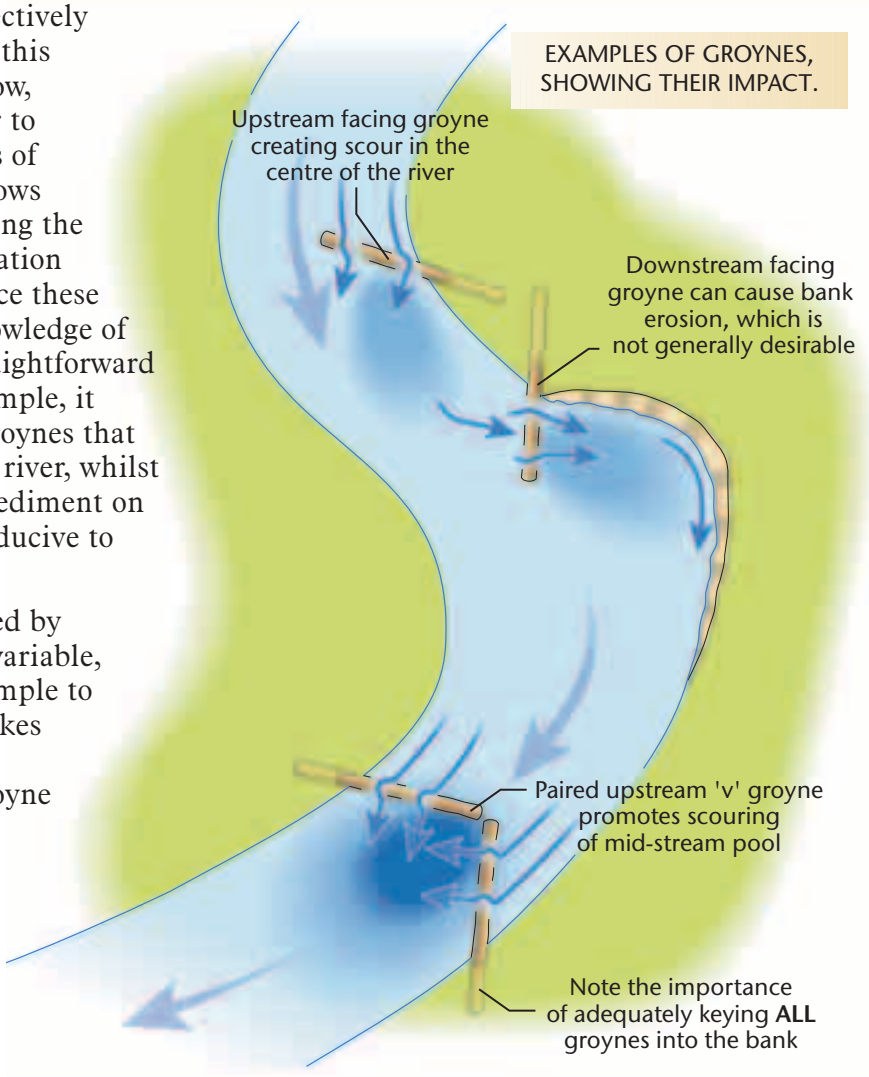
As a consequence, there is often a requirement to install features within a river that mimic natural processes, and increase habitat diversity, both for trout, and other chalkstream flora and fauna. Increasing habitat diversity can be a particularly useful tool in increasing the abundance of brown trout, particularly during their juvenile phase.

Potential restoration options

Groynes and deflectors

Groynes and deflectors (referred to collectively as groynes throughout the remainder of this document) function by concentrating flow, either vertically or horizontally, in order to increase velocity locally and create areas of differential scour and deposition. It follows that the most important factor in planning the installation of groynes is the desired location of the areas of scour and deposition. Once these have been agreed, and armed with a knowledge of how groynes function, it is relatively straightforward to achieve the desired outcome. For example, it would be counterproductive to install groynes that encouraged lateral scour in an overwide river, whilst designing a groyne that deposited fine sediment on gravel spawning areas would not be conducive to improving trout stocks.

Although the disturbance patterns caused by water flowing over groynes can be very variable, their general functioning is relatively simple to understand. In essence, when water strikes a submerged groyne, it is deflected at approximately right angles. Hence, a groyne installed pointing downstream will tend to deflect flow into the bank, causing erosion, whilst an upstream facing groyne will tend to deflect water into the centre of the channel, eroding a small pool here.



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UPSTREAM FACING WOODEN GROYNE CREATING AN AREA OF SCOUR IN THE CENTRE OF THE CHANNEL.

Gradually reducing the height of a groyne from the bank to the centre of the channel minimises the risk of bank erosion, whilst maximising the benefits of desirable mid-channel bed scour.

Given these properties, it is generally best to install upstream facing groynes whose outer limits are submerged over the normal range of flows experienced in the river. Paired upstream facing groynes are very useful in creating mid-channel scour. This not only increases the heterogeneity of the bed profile, but also creates small holding pools and areas of clean scoured gravel suitable for spawning immediately downstream of the structure.

Groynes can be constructed from a variety of materials including naturally derived timber (*see* **Tree Management** section), faggot bundles, and stone. Where possible, it is always best to utilise local materials, on aesthetic, nature conservation and cost grounds.

Weirs

The construction of weirs in chalkstreams is generally to be avoided. They have several potential disadvantages, including creating obstructions to migrating fish, degrading upstream habitat by slowing water velocity and depositing excess silt over the whole width of the channel, and impacting adversely on other geomorphological processes. The small benefits that accrue from increased water velocity and scour downstream of weirs can be easily attained without detrimental impact by judicious placement of groynes.

Erosion protection

Erosion is a natural process that is essential to the functioning of chalkstreams. However, often as a result of the impact of poor management such as overgrazing or excessive bankside cutting, rapid and damaging erosion can occur locally. Where possible, the cause of the erosion should be addressed at source; for instance, the erection of stock proof fencing can be effective in preventing overgrazing. However, in some circumstances rapid rates of erosion can continue to present a management problem. There are a number of techniques that can be utilised to help address this problem. They include the installation of tree kickers on the outside of bends, the installation of faggots bundles and the use of willow spiling (*see* **Large Woody Debris** and **Erosion Control** sections).

Spiling is a very robust technique, differentiated from faggot installation by its utilisation of live willow, rather than the dead wood used in faggot construction.

Freshly cut willow stakes (diameter >50mm) are driven vertically at centres of <600mm close to the eroded bank, along the affected length, taking care to return the line of stakes into the bank at the upstream and downstream ends. Fine 'wands' of freshly cut willow are then tightly woven between the uprights to form a densely packed 'hedge'. It is again essential to key the ends of the wands into the bank at each end of the spiling.

Willow roots will grow into the bank behind the spiling, further strengthening it. In subsequent years, the spiling can be trimmed, or coppiced in order to restrict its height and promote dense growth.

Failures of installed spiling can be common. These generally result from either:

- Failure to use freshly cut willow. Any material older than a fortnight from cutting should be ruthlessly discarded.
- Wrong timing of installation. Provided the spiling is installed in the period March-June (inclusive), then strong and rapid growth of the vertical and horizontal elements will result in good establishment prior to the high flows of winter. Installation can be undertaken outside this period, but success cannot be guaranteed.

FAGGOT BUNDLES (*ABOVE*), AND WILLOW SPILING (*LEFT*), REDUCING EROSION ON THE OUTSIDE OF BENDS.

- Failure to ensure adequate keying in of the structure at upstream and downstream limits can lead to damaging erosion behind the spiling.

- Attempting to retain too high a bank behind the spiling. Where the height of the eroded bank exceeds 1m, the spiling should be undertaken in a number of lifts, creating a 'terraced' effect. This will ensure the structural integrity of the spiling, and maximise the chances of successful establishment.

- Failure to back-fill adequately with soil, brushwood, or a mixture of the two.

Summary

Technique	Advantages	Disadvantages
Groynes	Can be relatively quick and cheap to install, particularly if using LWD. Much of the construction work can often be undertaken by hand. Can make use of materials available on site.	Can cause severe erosion if poorly located and wrongly installed.
Spiling	Utilises live willow to create strong, living bank protection, which dissipates energy reducing erosion elsewhere.	Relatively labour intensive. High volume of material required per linear metre of bank treatment. Potential need for maintenance of willow growth.
Faggots	Utilises any dead wood arising from coppicing or pollarding. Can easily be installed by volunteers.	Large amount of material required per linear metre of bank treatment. Requires accumulation of sediment and subsequent growth of emergent plants to attain full benefit.

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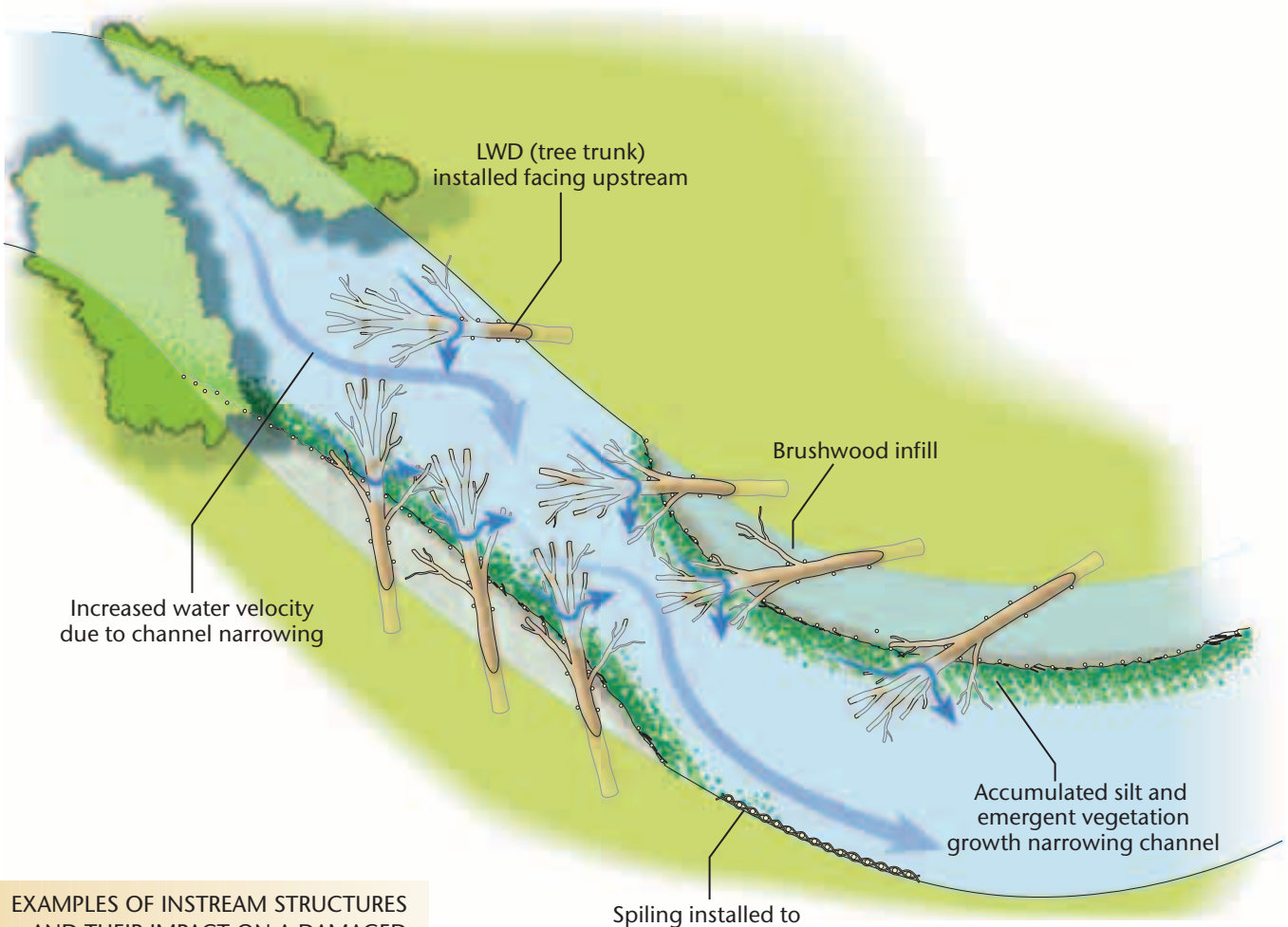

EXAMPLES OF INSTREAM STRUCTURES AND THEIR IMPACT ON A DAMAGED CHALKSTREAM

Case Study

River Wylye at Seven Hatches, Wilton, Wiltshire.

A section of over-wide channel was narrowed using timber and brushwood, partially derived from the felling of mature poplar trees adjacent to the river. Not only did these provide an abundant supply of woody material, but their removal also reduced over-shading of the left bank of the river.

Large sections of tree trunk were fixed in place using untreated wooden stakes and wire, to create a number of upstream facing groynes.

The void space between the groynes was infilled with a brushwood and soil mix, and covered with a mattress of coir fibre, pre-planted with emergent aquatic vegetation, to create a low-level marginal berm.

This approach successfully narrowed the channel by approximately twenty five per cent, and created a gently shelving bank profile, ideal for water voles found nearby the site.

LWD IN THE FORM OF TREE TRUNKS HELD IN PLACE USING UNTREATED WOODEN STAKES.

VOID SPACE BETWEEN THE LWD INFILLED WITH BRUSHWOOD AND COVERED WITH PRE-PLANTED COIR FIBRE MATTRESSES.

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