Restoring river systems by wood addition to the channel – practical examples

Restauration des systèmes fluviaux par l'ajout de gros bois dans les rivières – exemples practiques

Susie Kinghan, Nick Mott

susannah.m.kinghan@cyfoethnaturiolcymru.gov.uk Natural Resources Wales
n.mott@staffs-wildlife.org.uk Staffordshire Wildlife Trust

RÉSUMÉ

Le retrait du bois dans les cours d'eau au cours du temps et le dragage ont contribuer à créer des rivières encaissées, à fil unique, déconnectées de leur plaine d'inondation. La technique de restauration des rivières basée sur la nature, qui consiste à introduire du gros bois dans les chenaux fluviaux, présente de multiples avantages et peut être auto-restauratrice. Elle permet notamment d'améliorer la diversité des habitats, de rehausser le niveau du lit de la rivière, de créer de nouvelles caractéristiques à l'intérieur du canal, de reconnecter les plaines d'inondation, de gérer les inondations de manière naturelle, de développer des canaux fluviaux à fils multiples et d'améliorer la qualité de l'eau. Cette technique reproduit les effets naturels des tempêtes et de l'activité des castors. Si les avantages du bois dans les canaux sont bien connus, on dispose de moins d'informations sur la manière de mettre en œuvre cette technique peu coûteuse dans des contextes relativement contraignants. La méthode décrite ici utilise un treuil de tracteur pour tirer des arbres riverains entiers dans le canal de la rivière, et l'abattage à la tronçonneuse pour ajouter du bois dans le canal afin qu'il s'accumule sur les structures. Les sites idéaux disposent d'une couverture boisée établie qui peut servir de source de matériaux à ajouter à la rivière ainsi que d'espace pour la reconnexion entre la rivière et la plaine d'inondation. La taille des arbres doit au moins couvrir la largeur de la rivière afin d'être raisonnablement stable et d'éviter d'endommager les infrastructures en aval. Deux exemples issus du Royaume-Unis sont présentés ci-dessous.

ABSTRACT

Historic removal of wood and dredging have contributed to incised single-thread rivers disconnected from their floodplain. The nature-based river restoration technique of introducing large wood to river channels has multiple benefits and can be self-restorative. These include improving habitat diversity, river-bed level raising, the formation of new in-channel features, floodplain reconnection, natural flood management, development of multithread river channels and improvement to water quality. This technique mimics the natural impacts of storm events and beaver activity. While the benefits of in-channel wood are well known, less information is available of how to implement this low-cost technique in relatively constrained contexts. The method described here uses a tractor winch to pull entire riparian trees into the river channel, and chainsaw felling to add more wood into the channel to accumulate on the structures. Ideal sites have some established woodland cover which can serve as a source of material to add to the river as well as space for river-floodplain reconnection. The size of trees should at least span the width of the river in order to be reasonably stable to avoid damage to downstream infrastructure. Two examples from the UK are presented below.

KEYWORDS

Floodplains, large wood, process-based, river restoration, winch.

Approche axé sur les processus, gros bois, restauration de cours d'eau plein inondable, treuil.

1 LARGE WOOD IN UK RIVERS

1.1 Introduction

1.1.1 Background

One of the most widespread issues with river habitats in the United Kingdom is that they have been altered to reduce their natural dynamism and keep them confined to their channels in efforts to maximise land area and reduce localised flood risk. Naturally functioning rivers should regularly inundate their floodplains, increasing wetland habitat locally and reducing overall flood risk downstream.

A key element of river dynamics is the amount of in-stream wood (fallen trees, branches), which would have been historically abundant in most rivers but has become increasingly rare due to woodland clearance and management practices. There is also a widespread practice of removing in-stream wood due to perceived flood risk, concerns about fish migration, and perhaps most pervasive, an effort to 'keep things tidy'. Public perception generally views rivers as a single thread channel with closely cut bankside vegetation and many bemoan the loss of dredging as a common river management technique to keep the river in the channel.

In-channel wood plays a wide range of important functional roles in river ecosystems, and is increasingly recognised as a fundamental component of a healthy river system (Gurnell et al. 2005). Accumulations of wood create localised patches of erosion and deposition, increasing habitat diversity. Features lead to quantities of gravel being deposited and acts as a brake on flood water, increasing river levels relative to their floodplains. The interaction of the in-channel wood with flows and the riverbed 'works' the gravels, reducing fine sediment content and improving their suitability for fish spawning. Wood also provides food for aquatic invertebrates and provides cover and habitat for fishes and other organisms, slowing flows and creating new depositional areas.

1.1.2 Benefits of using large wood as a river restoration technique

River restoration professionals are increasing looking to restore process rather than arrive at a defined restored scenario outcome. This philosophy promotes the idea of looking forward to a new dynamic river equilibrium, where low-intervention techniques act as a catalyst to kick-start self-restoration of the river, rather than trying to restore the river to a perceived historic state prior to anthropogenic intervention. Large wood addition can be a key tool to this technique, by retaining gravels and increasing riverbed levels over time, restoring previously incised channels. Further, the in-channel wood raises water levels, leading to more frequent out-of-bank flow. These combined outcomes promote the re-connection of the river to its floodplain, providing a range of benefits such as dropping of sediment and nutrients onto the floodplain with improved water quality results, as well as creation of new wetland habitats. Further, the in-channel wood encourages new flow paths for the river, re-connecting paleo channels and creating new ones.

All of these outcomes can be achieved by adding large wood to the river channel, mimicking the natural process of trees falling into the river during storm events, or the actions of beavers. This is a process-led approach since the river and sediment dynamics will find their own new paths and dynamic equilibrium, rather than excavating a new channel or historic paleo channel.

2 ADDING LARGE WOOD TO THE CHANNEL – PRACTICAL EXAMPLES

2.1 Winching and felling

A low-cost and low-tech method to achieve the above results is to winch whole trees into the river channel to mimic the impacts of a hurricane. This is particularly appropriate in headwater and tributary streams or smaller rivers, typically below 10m in width. Since the UK is generally densely populated and few rivers are free from local infrastructure such as bridges and buildings, concerns over mobilising whole trees are mitigated by ensuring that the most downstream woody structure is a "catch all" designed in such a way that it will accumulate and retain any wood mobilised from upstream.

Another technique, 'Chop and Drop' is simply the felling of riparian trees into rivers and tributary streams. It is important to ensure that the length of some of the trees exceeds the channel width in order to promote the formation of accumulations. These 'key pieces' are the building blocks of the log jams. The jams can be augmented through the coppicing, pleaching and ring-barking of multi-stemmed trees (like alder, willow, poplar, hazel and birch) to increase biocomplexity and also to 'punch' holes in the riparian woodland canopy. This mimics the impacts of beaver activity and storms and increases the overall amount of light reaching the watercourse resulting in the growth of macrophytes.

2.2 Examples from Staffordshire, England

Staffordshire Wildlife Trust based in central England have been applying this technique for over 2 decades with some very encouraging results.

The upper reaches of the mainstem of the River Manifold in Staffordshire (Peak District National Park, UK) have been modified in the past to create a uniform width channel with reinforced, stone banks. In 2020 an experimental 400 metre section of the river was 're-snagged' by winching over large bankside Ash, Sycamore and Alders to create a dense, chaotic jumble of log jams in the river channel. This method involved the use of a tractor-mounted ex-military 12-tonne hydraulic winch (designed to extract tanks from mires) to pull mature trees and their root plates into rivers. Arborists were used to attach the winch to the target trees via a series of strops, shackles, cables and pulleys. We found that this approach works best where the tractor can access both sides of the river. The width of the River Manifold is approximately 12 metres which is probably at the upper limit of the width of naturally occurring stable wood jams that span the entire channel. Total costs were around £2,000.

Fig. 1: Tractor winch used in tree winching

Fig. 2: Wood accumulation following winching

Electric fishing surveys were carried out at the Manifold Leys in September 2020, September 2021 and September 2022. No Atlantic Salmon were recorded in 2020. In 2021, thirty-two Atlantic Salmon parr (young-of-the-year [YOY]) were caught, the first record of this species in the River Manifold and furthest upstream record for the Dove River catchment. In 2022, seventeen Atlantic Salmon parr (1+ age group) were caught. These are the same year-class of fish caught in 2021 which have grown on from a mean fork length of 84 mm (2021) to 129 mm (2022). No YOY salmon (0+ age class) were caught, suggesting adult salmon did not reach this site in winter 2021/22 or spawning/recruitment was unsuccessful.

2.3 Examples from south Wales

In 2024 the UK's River Restoration Centre designed a restoration plan on a tributary of the river Usk in south Wales which was delivered by Natural Resources Wales' "4 Rivers for LIFE project". Fourteen large wood accumulations were created along a 600m reach using bankside trees. Using a tractor-winch, selected trees were winched into the channel with their root plates attached. Where possible, trees were pulled at an angle to wedge them against live bankside trees to minimise the risk of becoming displaced in high flows. While it would have been preferable to allow a more mobile state, downstream infrastructure such as bridges constrained this. However, "chop and drop" was used upstream to provide some smaller and more mobile material. No tethering or artificial materials were used. Equipment: 15 tonne excavator with appropriate safety screen, bucket and rock grapple; 12 tonne hydraulic winch plus; 25m MEWP; 12 tonne tracked dumper; chainsaws.

Trees were strategically positioned to encourage floodplain inundation and augment in-channel habitat. The accumulations are designed to be permeable to fish passage. Where possible, we used ash with dieback to reduce impacts on the riparian woodland. Using an excavator, "cuts" were also excavated in the riverbank to encourage out-of-channel flow and new flow paths. Total costs were around £14,000. The felling will be accompanied by a tree planting scheme of 25,000 native broadleaf trees to encourage woodland recovery across the site.

We have already observed out of bank flows during wet weather events in areas where it would not have occurred before. With continued inundation, more natural floodplain habitat communities will develop. There are small areas of clean gravel deposition already apparent, after only one significant rain event. This is an example of how relatively minor interventions can kick start natural processes and promote ecosystem recovery.

Fig. 3: Area view of large wood accumulation achieved through winching and chainsaw felling

Fig. 4: Floodplain inundation using large wood and “notching”

Fig. 5: New gravel bar created by large wood

Fig. 6: Newly inundation floodplain

3 SUMMARY

The above schemes promote large wood addition to the river channel use winching and “chop and drop” techniques for low-cost process based river restoration. Costs ranged from around £2,500 (in 2020) to £12,000 (in 2024) per 500 metres of restoration. Key constraints are finding willing landowners and appropriate sites with riparian tree cover and where the river has space to re-connection to its floodplain. Education, culture and public perception remain key constraints and we hope that creating demonstration sites we are able to show the positive outcomes of more wood into the river channel, changing current perceptions.

REFERENCES

Gurnell, A. *et al.* (2014); Effects of deposited wood on biocomplexity of river corridors; Frontiers in Ecology and the Environment. 3(7): 377–382.