



Managing Woody Debris in Rivers, Streams & Floodplains



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This booklet aims to promote best practice to farmers, riparian landowners, site managers, drainage boards, anglers, foresters, local authorities, highways engineers, water policy makers, teachers, students and the general public.

Branches, large limbs, root boles or entire trees that have fallen into rivers are commonly referred to as Large Woody Debris (LWD). Accumulations of smaller branches, twigs and leaf litter are known as Coarse Woody Debris (CWD).

Woody debris is a vital component of our watercourses and its removal can severely degrade their health. The positive ecological contribution of LWD has often been overlooked or downplayed, while impacts on water flow and erosion have been misunderstood or exaggerated. This booklet seeks to dispel some of the myths and summarise the latest thinking.



Large Woody Debris (LWD)



Coarse Woody Debris (CWD)



Distribution of Woody Debris

Watercourses containing large amounts of woody debris, including log jams, are not particularly common in England and Wales (see map). It tends to be extremely localised and restricted to steep-sided headwater woodland streams often referred to as cloughs, pingles, dingles, sprinks, drumbles or dumbles.

Why is it Important?

The rôle of woody debris in the healthy functioning of freshwater ecosystems has become increasingly recognised in research carried out in different parts of the world since the 1980s. LWD is beneficial in some of the following ways...



Stabilises river banks and beds

LWD can be seen as the 'backbone' of the watercourse; its presence can help protect a stream from the erosion of beds and banks by resisting and deflecting flows. It also assists with the trapping and retention of sediments, organic matter and CWD.

Increases floodwater storage

Woody debris helps regulate the energy of running water by decreasing the velocity. Thus the 'travel time' of water across the catchment is increased.

Provides habitat for fish

LWD helps provide shelter from high velocity flows, shade, feeding, spawning and nursery sites, territory markers for migratory fish and refuges from predators. Research in the USA found that pools created by logs and branches provide over 50% of the salmonid spawning and rearing habitats in small streams.



Fish live in trees too!



Helps create river structure

Creates niche habitats

LWD adds complexity to the channel and helps to create new sediment pathways resulting in a range of habitats including chutes, pools, submerged and exposed sediment bars all of which, in turn, influence water temperature and additional micro-habitats for a wide range of aquatic plants and animals.

Provides space and food for colonisation

CWD and LWD provide a prolific range of surfaces including splits and hollows, in which algae, microbes and invertebrates can colonise. These tiny organisms are crucial as they make up the base of the aquatic food chain and provide food -directly and indirectly- for all the creatures associated with the watercourse including mayflies, stoneflies, caddis, crayfish, trout, dippers and otters.



Supports invertebrate life cycles

Research carried out in the UK identified 147 invertebrate species strongly associated with CWD (Godfrey, 2003). These include the UK Biodiversity Action Plan (BAP) cranefly *Lipsothrix nobilis/nigristigma*, the nationally scarce hoverfly *Chalcosyrphus eunotus*, and the rare lowland riffle beetle *Macronychus quadrituberculatus* all of which have a larval stage developing in CWD. Many aquatic invertebrates have a terrestrial adult stage. Woody debris that protrudes out of the water helps dragonflies and "river flies" like mayflies, stoneflies and caddis species to emerge from the larval to the adult stage of their life cycle.



Provides cover and perches

Insects, birds, amphibians, reptiles and mammals all use CWD and LWD as foraging, resting and lookout sites.



Otters use woody debris as secure resting sites

Improves water quality

One of the main functions performed by woody debris is the removal of fine silt from the system by creating silt 'benches' immediately upstream. This allows oxygenation of deposited silts, thus improving water quality. This process also helps to prevent gravels from becoming silted over.

Assists re-colonisation

Scour pools formed by woody debris can be very important for watercourses that are prone to low flows or drying out completely. Animals living in these pools provide a reservoir of species that migrate and colonise the rest of the watercourse when flows increase. CWD also helps to protect species from the adverse effects of freezing or drying out.

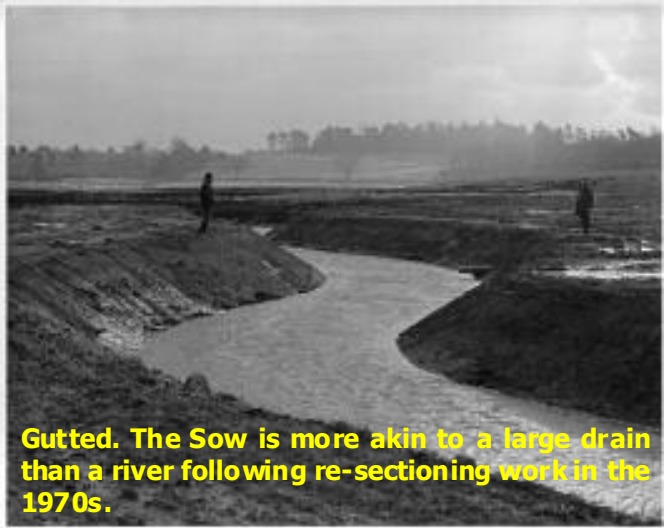
Stores carbon

Woody debris helps to store carbon in the long-term, thus mitigating the effects of climate change.



Nature of the Challenge

Over 85% of lowland rivers in England have been modified, deepened and straightened to provide defence for settlements and farmland established on the floodplain. LWD has traditionally been seen as a nuisance and is still referred to as a "blockage" or "snag". A great deal of taxpayers' money has been spent on removing LWD and CWD dams. Large-scale removal of woody debris and the "pioneer clearance" of tributary streams can take literally hundreds of years to recover.



Gutted. The Sow is more akin to a large drain than a river following re-sectioning work in the 1970s.



The Upper Trent in Staffordshire. A heavily engineered river with a "fossilised channel". Notice the uniform width of the channel and the almost complete absence of physical features or trees.



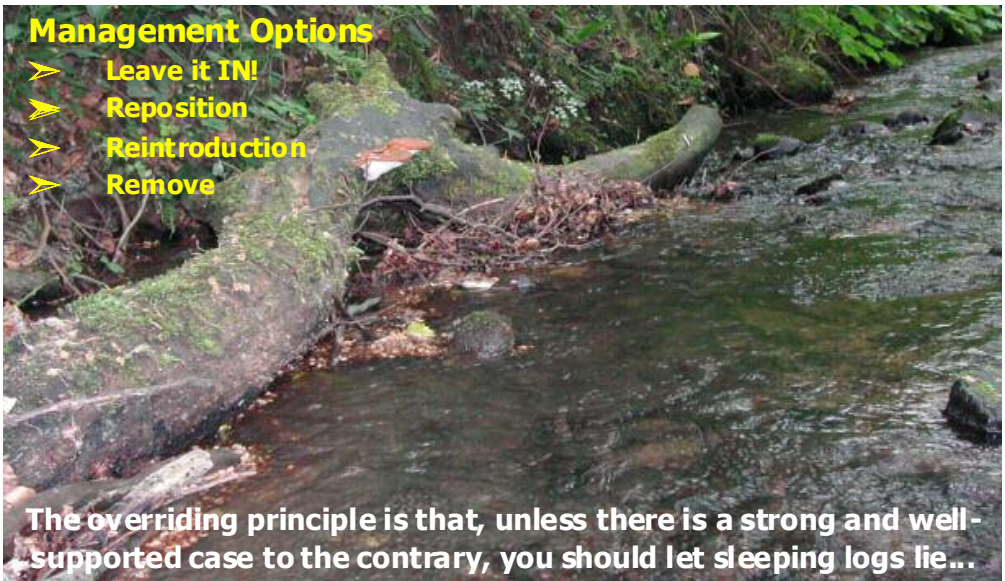
Upper Severn at Welshpool. A river of similar size to the Trent which has suffered fewer modifications in recent times and retains meanders, riffles and backwaters. In the past vast quantities of CWD accumulated in these backwaters.

Problems can be exacerbated by a lack of ongoing input of both LWD and CWD into streams. Overgrazing, especially by sheep, and bankside poaching can mean that trees in the riparian zone are failing to regenerate. Over time this could result in a reduction and, ultimately, a cessation of woody debris input.

Over-zealous coppicing programmes, i.e. too much, too quickly, can also disrupt stream ecosystems adversely and reduce woody debris input for many years. River managers, fishery, forestry and agri-environment scheme staff are encouraged to consult more widely before embarking on large-scale projects. Surveys should be commissioned and a monitoring scheme incorporated to assess any changes.



Managing Woody Debris



Leave it IN!

Woody debris should be left in a watercourse unless there is a very strong and well-supported case for its removal or repositioning. If reduced local water levels and flood duration is the primary rationale for LWD removal, the case should be supported by a hydraulic analysis.

Reposition

If a case for repositioning LWD is successfully made, a management proposal should be drawn up and circulated to all interested parties and relevant agencies for consultation. LWD needs to be pegged in at 20°-40°. This should improve the capacity of the channel to carry peak flows, while retaining a reasonable variety of low velocity habitats.

Reintroduction

The addition of LWD improves physical habitat and counteracts stream incision. 'Re-snagging' is now a common river rehabilitation technique in many parts of the world, in particular the USA, Australia and Canada. Introduced material should form the key pieces of stable debris accumulation:

- *Length: at least as long as the channel width*
- *Diameter: at least 0.1 metre or 5% of channel width (whichever is largest)*
- *LWD often needs to be securely keyed into the bed of the watercourse*



Possible Cases for Selective Removal

- *Debris accumulating on bridges and culverts, potentially resulting in localised flooding*
- *Navigation*
- *Urban Areas: Sewage litter and rubbish*
- *Confirmed long-term barrier to salmonids (BUT see page 14)*



Catchment Strategies

Attitudes towards woody debris are changing in the UK. In many areas agencies are reducing their watercourse maintenance programmes. Interested parties are now in a position to develop strategies for the management of woody debris in river catchments. This can be carried out as a mapping exercise to identify both potential constraints and opportunities.



Riverine Woodland

Information gathering

- River Habitat Surveys (RHS), River Corridor Surveys and aerial photos provide data on the degree of bankside tree cover, LWD, debris dams, braided channels, islands and wet woodland.
- Local Environmental Records Centres maintain data on species, designated sites, nature reserves and County Wildlife Sites.
- UK and Local BAP partnerships have agreed targets for habitats like wet woodland and for flagship species such as *Lipsothrix* craneflies, white-dawed crayfish and Atlantic salmon.
- Agencies and local authorities have information on listed structures (bridges, weirs, water mills), bridges and culverts with poor capacity to handle peak flows, settlements in major flood zones, commercial forestry areas and community forests.

Promoting woody debris

- Do not disturb naturally occurring LWD unless it is vital for safety reasons or to protect investments (e.g. from flooding).
- Protect riparian corridors and floodplains to ensure that there will be a future source of woody debris. Influence agri-environment schemes in riparian areas and floodplains: promote the reduction, rotation or exclusion of livestock grazing, selective fencing of watercourses, buffer strips, planting schemes and natural regeneration areas. Avoid the uniform pollarding of willows and encourage a higher percentage to mature and collapse.
- When building, maintaining or improving roads and railways ensure that culverts and bridges have the capacity to allow flood flows and for LWD to pass through them.
- In the UK it will be many decades before the majority of watercourses once again begin to build up a resource of woody debris. Catchment strategies should help to identify suitable areas to reintroduce LWD in the short and medium term.



A benchmark lowland RHS site

Barrier or Boon for Fish?

Log jams that span a stream are often thought to create barriers to fish passage. As a result, many concerned woodland and fisheries managers have removed them. The irony is that, out of a desire to increase access for fish to habitat upstream, many efforts



to remove perceived 'blockages' are in fact detrimental to fish (and other wildlife) habitats downstream. Removing 'key pieces' of LWD can destabilise the remaining debris resulting in increased sedimentation of pools and gravels downstream. These pools may be reduced in size or lost altogether and gravels become unsuitable for fish spawning. Spawning gravels, previously held in place by stable LWD, can also be flushed downstream and dispersed.

Debris dams are generally observed and removed during normal flows. They are rarely observed during high flows when salmon and sea trout migration to spawning areas occurs. During high flows, debris dams can become submerged as water passes over the top or they can 'raft' upwards as water pushes from beneath. Fish are very adept at finding spaces above, below, around or within log jams. They have been doing it unaided for millennia!



Nevertheless, there are extreme instances where log jams become 'sealed' (perhaps by

forestry operations upstream or high silt burdens as a result of diffuse pollution) and prevent fish passage. Selective removal rather than complete removal is recommended. Ongoing monitoring of fish, other key species (eg otter and *Lipsothrix*), geomorphology (gravels, sediments and organic matter) and hydrology is important. Generally the removal of log jams to promote fish access needs to be carefully considered and weighed against the benefits summarised on pages 4-7.

Large Floodplain Rivers

LWD also has an important rôle to play in large floodplain rivers. Downed trees and living pieces of sprouting driftwood dramatically accelerate the process of island formation. If deposited 'living wood' (usually willows and poplars) is able to sprout and anchor to river sediments through the growth of adventitious roots, then the process of creating a pioneer island can begin. Sediments and gravel accumulate in the protected lee of the deposited LWD. These are good sites for willow regeneration and, in time, could help to produce a braided river channel.



River islands or braided channels are rare due to past land drainage works and a lack of naturally occurring LWD. Islands and their associated habitats support a range of biodiversity and it is time to identify areas where large rivers can be restored to their former character.



'Living LWD' enters a large river channel



Bridge abutments mimic the rôle of LWD in a river channel. Sediments accumulate downstream to form the beginnings of an island

Case Studies

1. Black Water, New Forest National Park

Background The New Forest has the highest recorded density of debris dams in Britain. It contains some of the most important and rare wetlands in Europe including spectacular stands of riverine woodland, bog woodland and valley mires. However, many watercourses were re-sectioned and large areas drained for timber growing and livestock grazing.



A newly created log jam

Objectives To restore 600 hectares of wetland habitat, in part, by re-connecting watercourses with their former channels. To restore ten kilometres of damaged watercourse.



LWD introduced to the channel

Project Description Log jams have been introduced at strategic locations to help re-wet old stream courses.

Assessment The Black Water scheme is part of a completed Life3 Project. Monitoring has been carried out by PhD students. Results indicate that: (i) flood 'travel time' has been increased. Water now takes 35% longer to travel the length of the catchment due to storage on the restored wooded floodplains; (ii) there is an increase in channel diversity characterised by more woody debris and more pools.

Project Partners Forestry Commission, Environment Agency, English Nature, RSPB, Hampshire County Council, National Trust and the University of Southampton.

Cost Part of £2.9 million project

More info

www.newforestlife.org.uk/life3

www.geog.soton.ac.uk



One of the restored former channels

2. Tittesworth, Peak District National Park

Background Tittesworth Reservoir is owned and managed by Severn Trent Water. There are several fine examples of log jams and debris dams on the feeder streams that drain into the reservoir. However, one tributary in particular was identified as having been heavily modified in the past. This stream corridor became the focus of a habitat rehabilitation project.



Log weirs were installed at strategic locations and designed to create some ponded reaches upstream (but still allow fish passage). Raised water levels helped to re-wet approximately ten hectares of floodplain and a number of scrapes, ephemeral 'dragonfly' pools, 'ridge and furrow' reedbed shells and several more permanent ponds.



Park Authority, RSPB, Middlemarch Environmental, Landscape Matters.

Cost Approximately £25K for stream corridor work (part of £95K scheme)

More info n.mott@staffs-wildlife.org.uk

Objectives To increase habitat and species diversity at the site in line with Severn Trent Water's and the Peak Park's Biodiversity Action Plans. Use the scheme to inspire similar work at other sites as appropriate.

Description

700m of stream course were re-



Assessment

This imaginative and inspiring project has benefited a number of BAP target species. Monitoring has identified increases in breeding wildfowl and waders. Evidence of water voles was also detected for the first time.

Project Partners Severn Trent Water, Defra, Staffordshire Wildlife Trust, Environment Agency, Peak District National

3. River Trent at Wolsley Bridge, Staffordshire



Background Staffordshire Wildlife Trust (SWT) owns and manages the site. The River Trent had been engineered into a deep trapezoidal channel and effectively disconnected from its floodplain.

Objective To re-profile 340 metres of the River Trent along the inside of a large meander to help kickstart natural geomorphological processes including erosion and deposition and promote re-

alignment with its floodplain. To use the scheme as a demonstration of best practice to inspire similar work elsewhere.

Description The river re-profiling has been very successful. Shortly after completing the works a 'happy accident' involved the input of a mature beech tree which formed LWD in the restored channel. Liaison with the Environment Agency ensured that the LWD could be left in and monitored.



Assessment Monitoring of the LWD over a three year period has shown that (i) a short-term erosion pocket was created shortly after the beech tree entered the channel. The volume of the erosion pocket was approximately one and half times the volume of the submerged timber when the river was bank-full. It has since stabilised; (ii) No part of the LWD has moved more

than twenty metres downstream; (iii) The LWD has gradually accumulated smaller pieces of woody debris and has become surprisingly stable; (iv) common sandpiper, grey wagtail, kingfisher, homet and otter are among the species recorded using the LWD as a foraging, perching or spraint site.

Project Partners SWT, Environment Agency, Middlemarch Environmental

Cost Part of £21K project

More info n.mott@staffs-wildlife.org.uk



Reading

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* These free publications can be ordered from Natural England's enquiry service enquiries@naturalengland.org.uk Tel. 0845 600 3078

Websites

Key Word Search: Large Woody Debris/Coarse Woody Debris/Large Wood/Snags/Re-snagging

- <http://www.sbes.stir.ac.uk/riversconference/>
- <http://panda.org/downloads/forests/deadwoodwithnotes.pdf>
- [http://www.forestresearch.gov.uk/pdf/FCGL002.pdf/\\$FILE/FCGL002.pdf](http://www.forestresearch.gov.uk/pdf/FCGL002.pdf/$FILE/FCGL002.pdf)
- <http://www.rivers.gov.au/acrobat/facts07.pdf>
- http://www.rivers.gov.au/acrobat/techguidelines/tech_guide_vol2_chapb.pdf
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- <http://www.ontariostreams.on.ca/OSRM/Tech6.pdf>
- <http://www.associationofrivertrusts.org.uk>

Credits

Author: Nick Mott; Design: Martin Adams

Photography: Nick Mott / Staffordshire Wildlife Trust

Additional Photography: p1 GCSlawson (debris dam), Sue Scott (Salmon), Darin Smith (Otter); p5 Sue Scott (Salmon); p6 Stuart Ball / JNCC (Mayfly), Steve Hewitt (Cranefly), David Iliff (Hoverfly); p8 Martin Cooper (R.Sow), Andrew Crawford, Environment Agency (R.Trent), Alan Jones, Environment Agency (R.Severn)

Map: Environment Agency / RHS

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***Please report all pollution incidents and fish kills immediately to
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Water UK The water industry is divided into twelve regional water and sewerage companies, with twelve smaller water-only companies. The companies are all members of Water UK, the organisation that represents the industry at national and European level. www.water.org.uk for more details.

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