

Introduction

• UKCP09 projections predict that average summer air temperatures will warm by between 2°C and 4°C by the 2050s compared to the long-term 1961-90 average temperature₁.

• River temperatures are sensitive to changes in climate and water temperatures are expected to rise by a similar amount. Even small changes like this can have an impact on the health of wildlife living in freshwaters₂.

• Brown trout and salmon are particularly vulnerable to predicted climate change. A rise in water temperature above 22°C for more than seven consecutive days can be lethal for brown trout₃.

• The Environment Agency is looking at ways of keeping rivers cool and taking action now to prevent, where possible, rivers in England and Wales becoming inhospitable for our freshwater wildlife over the next 60-70 years.



Keeping rivers cool – creating riparian shade

• Historically natural rivers, streams and their floodplains across the UK were more densely wooded, and woody debris would have been a common feature in river channels₄.

• Much of this tree cover has been lost and many rivers now lack shade. Riparian trees and shrubs can help reduce local stream temperatures on hot summer days. Summer mean and maximum water temperatures are on average 2-3°C lower in shaded than in open rivers₅.

• In certain circumstances other interventions for cooling rivers for example, river restoration, heated effluent control, modified abstraction regimes and water meadow management may also be beneficial and we will be exploring these in the future. • In the mean time we aim to help create riparian shade (Figure 1.)

where we think it will have the greatest benefits for river ecology.

Project Overview

DRIVER

Climate Change Act (2008) and the EA's Corporate Strategy

OBJECTIVE

To benefit salmon and trout by reducing river temperatures through tree planting/fencing

♦ PROGRAMME

2 years: April 2012 to March 2014 (+)

\$ FUNDING

EA, \sim £1.5 million

PILOTS (4 CATCHMENTS) Ribble, Wye, Tyne, and Hampshire Avon

PROJECT MANAGEMENT

Partnership Project managed nationally, but the pilots delivered locally by EA Area/Partner Leads



Figure 3. LIDAR First and Last returns

KEEPING RIVERS COOL creating riparian shade

Additional benefits of creating riparian shade

•More bank side trees means a natural source of large woody debris which benefits fish by providing shelter, feeding, spawning and nursery sites, and refuges from predators.

• Woody debris from bank side trees also provides a range of surfaces for algae, microbes and invertebrates can colonise, forming the base of the food chain.

• More bank side trees in catchments can reduce the amount of sediment flowing into the rivers from surface runoff and decrease bank side erosion (Figures 2 & 6).

• The shading effect of trees can be a very cost effective way of reducing eutrophication by decreasing filamentous algal growth as well as the spread of invasive weeds⁸.



Figure 2. Example of cattle poaching, over grazing and bank erosion on an unfenced tributary of the River Ithon, Wye (photo by Rachel Lenane).

Supporting tools

LIDAR data and shade maps

• Remote sensing LIDAR (light detection and ranging) data makes it possible to look at the distribution of riparian trees with a much greater degree of accuracy than in the past (Figure 3).

• We have collected LIDAR data for the majority of England and Wales over several years used this to produce an accurate map of riparian tree distribution (Figure 5).

• We have also used the data to calculate the relative amount of shading reaching a river channel. This is not a direct measure of water temperature but an indication of how effectively the local area provides shading compared to a neighbouring reach

 The measure of incoming solar radiation indicates the likely amount of shade created by the landscape e.g. hill and valley effects as well as shading caused by existing vegetation.

• 'Shade maps' have been produced for 19 catchments (Figure 4)

• The shade maps are being used to support the identification of key areas to target to increase riparian shade.

• The maps are guidelines only and decisions made using these are supported by local site information or survey





Figure 5. A JPEG image of LIDAR derived vegetation object map showing vegetation over 2.5m

Guidance manual

•A guidance manual has been produced to support the creation of shade over rivers using riparian trees and vegetation (riparian shade).

 As we gather more information on best practice ways of creating riparian shade we will add to and develop this guide, making it more widely available to land owners and other interested organisations in the second year of the project.

Taking Action

Pilot projects in four catchments

•We are taking a catchment approach to tree planting and fencing to encourage the re-growth of vegetation in four pilot catchments over the next four years.

• We will firstly try to ameliorate impacts where they are already happening, supporting natural adaptive responses in southern lowland rivers (Wye and Hampshire Avon), and secondly, building capacity to protect against future change, in two northern catchments (Tyne and Ribble) (Figure 7).

expertise.

Targeting planting and fencing

•An important consideration will be the availability of land and support of landowners. Other catchment objectives such as the reduction of flood risk and the impacts of diffuse pollution will influence choice of species, planting design and site selection.

•The width of the riparian zone that needs to be planted to provide optimum shade is not yet clear. To gain more evidence it will be beneficial to plant a range of widths within the 'Keeping Rivers Cool' pilot catchments.

Planting and fencing on streams of less than 5m width Planting belts of riparian trees between 2 – 5m wide (although greater widths than this are preferable, with land owner support, for other measures such as reducing diffuse pollution₁₀).

Shading 50% of the water surface with dappled shade11, unless working on chalk streams where Natural England have recommended shading of about 30% where in-channel macrophytes need to be considered.



• We will be working with the local Rivers Trusts and Woodland Trust to deliver the tree planting and fencing work with the help of their local

•Specific local issues will influence site selection for tree planting or

We are initially recommending: Selecting headwaters (low order streams)

Fencing on both banks for effective stock proofing (Figure 8) and finding solutions to stock watering (Figure 9).

Natural regeneration where possible, or planting where it is more appropriate (but not in designated sites)

Planting stands of riparian trees, rather than blocks of contiguous woodland

Planting native broadleaf trees, of local provenance where possible

Ensuring that planting does not conflict with macrophyte growth

S Working with angling community and other interested parties to establish suitable planting sites

Consulting with local EA flood guidance teams on proposed sites Avoiding other priority habitats and species (taking local advice) S Working to include control of non-native species such as Himalayan balsam

Next steps...

• We are in the process of developing partnership agreements to start planting and fencing in pilot catchments to begin in November • We are developing a monitoring plan to capture the long term benefits of this project, including water temperature change and potential wider benefits.

 To support the business case for this project we are also trying to identify the whole life cost benefits of this project and are open to advice. • We have funding for two years, until 2014 and will be looking for external funding for years 3 & 4.

Figure 6. A. Clywedog, tributary of the Wye 2012: stream narrowing and full riparian shade created by natural regeneration



Figure 8. A. Clywedog, tributary of the Wye 2012, showing the benefits of fencing both banks to prevent over grazing and aid natural regeneration



References 1. Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008) 2. Webb, B.W. & Nobilis, F. (1997) 3. Elliott, J. M. & Elliott and J. A. (2010) 4. Peterken, G.F., Hughes, F.M.R. (1995) 5. Bowler, D.E., et al.(2012) & Caissie, D. (2006) 6. (Mott, 2005) 7. Braccia & Batzer, 1999 8. Hutchins et al. 2010 9. Correll, D.L. (2005) 10. Forestry Commission (2011). 11. Broadmeadow, S. & Nisbet, T. (2002)





Figure 7. The 'keeping rivers cool' four pilot catchments



Figure 9. Sheep operated pasture pump providing water from a fenced off tributary of the River Ithon in the Wye (photo by Rachel Lenane)

Contact Rachel Lenane at .uk if you would like: - to be sent quarterly newsletter updates on the keeping rivers cool project, - access to the shade maps or, - to receive a copy of the guidance manual.