Seeing the landscape for the trees: the development of simple metrics to inform riparian zone management

Matt Johnson and Rob Wilby
M.Johnson@nottingham.ac.uk
www.mattjohnson.org.uk
Introduction

- Rising temperatures due to climate and environmental change will have major consequences for river biota.
- Riparian tree planting to shade rivers is a popular management strategy.
- But, in many places planting is currently unfocused.
The Loughborough University TEmpature Network (LUTEN) provides detailed measurements of air and water temperature in the Rivers Dove and Manifold, Peak District, UK. The project aims to provide simple landscape metrics that can be used to determine the vulnerability of rivers or river reaches to temperature change and to inform monitoring protocols.
Thermal regime

Water temperature is spatially patchy and temporally variable.

Potentially harmful to trout

Maximum 15 minute Tw (°C)
However, shade is not of equal magnitude.

Not all river reaches will benefit from shade to the same degree.
To provide simple metrics to inform where riparian shading will have maximum benefit in mitigating against rising water temperature

Using existing and routinely-collected data.
Heat capacity and shade length

4181 J required to heat 1 kg of water by 1 °C

Know volume (and therefore weight) of water at a gauge

Predict how long it takes to attain sufficient solar energy to reach heat capacity
Heat capacity and shade length

Which is the length of continuous shade required
Shade requirement

A river that is 6 m wide, 0.4 m deep and velocity is 0.5 m s\(^{-1}\) requires 1 km of continuous shade
- at midday on hottest day
- At 52°N latitude
Sensitivity to shade

Landscape

Where shade is lacking

Where is sensitive to riparian shade
Groundwater refuge

Dovedale is an important thermal refuge

- Robust Mayfly phenology maintained in this reach
- Substantial changes upstream to a more vulnerable structure
Conclusions

Sensitivity to shading will vary greatly between and along rivers

Riparian planting is likely to be successful on:
• Relatively limited regions of catchments
• But impacts will be propagated downstream
• And there are numerous mutual benefits!

Important to identify and maintain existing thermal refuge, particularly those associated with cool groundwater inputs.
• Protect such areas from other adverse pressures.