

# Riparian Forest can help mitigate climate warming effects in lowland temperate streams

## Synthesis

- ✓ Stream water temperature is predicted to increase with climate change, and will affect stream biotic assemblages and ecosystem functioning, threatening the implementation of the EU Water Framework Directive and Biodiversity Strategy 2020.
- ✓ Results from the REFRESH project conducted in five lowland temperate streams show that the presence of riparian forest has a cooling effect ranging from 1°C to 3 °C, depending on the reach length and canopy cover.
- ✓ River restoration by planting riparian trees, combined with open reaches allowing the presence of aquatic plants, can be a useful adaptation measure to combat the negative effects of future warmer temperatures on freshwater life.

## Riparian forests and stream temperature

Riparian forests provide shade for river ecosystems and thereby contribute to the regulation of stream temperature. Temperature is known to exert direct and indirect effects on freshwater organisms and in stream processes and functions. For instance, it influences the amount of dissolved oxygen and metabolic activity and thereby the distribution of species, but also determines primary productivity and decomposition. Previous studies have demonstrated that the loss of riparian canopy cover has led to increases in-stream water temperatures due to greater exposure to solar radiation, mostly during summer. Under climate change, either protecting or restoring riparian areas may play an important role in buffering higher water temperatures and in mitigating their potential negative effects on stream ecosystems.

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*“Relatively short stretches of forest alongside streams may combat the negative effects of heating of stream water”.*

*(Kristensen et al., 2013)*

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## How much Riparian Forest is needed to reduce stream temperature?

By analysing five lowland temperate streams in Denmark and comparing open and forested reaches, researchers from the REFRESH project have investigated the effects of riparian shading relative to reach length and canopy cover needed to obtain a significant decrease in water temperature. The experiment was conducted during July, August and September, the period of maximum air temperature and canopy cover. The study shows that 100 m of riparian forest reduced stream water temperature by up to 1°C compared to the temperature of an open reach. Moreover, the range in daily temperature variation also decreased. If the length of riparian forest is extended up to 500 m and canopy cover is between 75 and 90 % the shading effect increases and temperature can be reduced by 2–3°C. Therefore, increasing canopy cover over relatively short lengths can be a useful adaptation measure in the face of climate warming.

## What is the best management strategy considering other stream habitat elements?

Differences between the forested and the open reaches have also been observed in terms of channel morphology and cover of aquatic vegetation. Importantly, reduced macrophyte coverage is found in forested reaches due to the riparian shading effect. Because macrophytes provide structural habitat for many fish and macroinvertebrates, REFRESH researchers suggest combining riparian forestation with open reaches to reduce stream temperature and also enable the presence of aquatic plants to enhance habitat diversity.

## What are the implications of global change for EU biodiversity and water related policies?

The results from REFRESH provide evidence for the major benefits of riparian forests as a potential response option for climate change adaptation within the context of EU biodiversity and water related policies. Shading has multiple benefits for ecosystem condition services. Riparian forests provide numerous physical, hydrological and ecological functions, enhancing hydromorphological and ecological quality of streams and thereby contributing to the implementation of the EU Water Framework Directive and to the integration of climate change into the River Basin Management Plans. Furthermore, conservation and restoration strategies of the riparian zone could contribute to combat biodiversity loss and meet targets of the Biodiversity Strategy 2020, in particular Target 1 that aims *to halt the deterioration in the status of all species and habitats covered by EU nature legislation*, and Target 2 which requires that *ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems*.

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*“A riparian cover to reduce temperature could co-exist with open reaches ensuring both a temperature decrease and presence of macrophyte assemblages”*  
(Kristensen et al., 2013)

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### Additional scientific information

*Kristensen, P. B., Kristensen, E. A., Riis, T., Baisner, A. J., Larsen, S. E., Verdonschot, P. F. M., Baattrup-Pedersen, A. 2013. Riparian forest as a management tool for moderating future thermal conditions of lowland temperate streams. *Hydrol. Earth Syst. Sci. Discuss.*, 10, 6081–6106*

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<http://www.refresh.ucl.ac.uk/>