Ecohydrology of Surface and Groundwater Dependent Systems: Concepts, Methods and Recent Developments
(Proc. of JS.1 at the Joint IAHS & IAH Convention, Hyderabad, India, September 2009). IAHS Publ. 328, 2009, 34-41.

Modelling the spatial variations of stream temperature and its impacts on habitat suitability in small lowland streams

EVA BOEGH, MARTIN OLSEN, JOHN CONALLIN & ESBERN HOLMES
Dept. of Environmental, Social and Spatial Change, Roskilde University, PO Box 260, 4000 Roskilde, Denmark
eboegh@ruc.dk

Abstract Water temperature strongly impacts stream ecosystem and function. On Sjælland, the main island of Denmark, low summer stream discharge rates are very sensitive to groundwater abstraction, which is therefore also partly responsible for the poor ecological conditions of most streams. However, the combined impacts of water depth, velocity and water temperature on habitat suitability during low-flow conditions are not known. The aim of this study is to measure and model spatio-temporal stream temperature variations as a function of stream surface shade from near stream land cover and to quantify such impacts on stream habitat suitability during low flows. Brown trout is chosen as a bio-indicator of stream ecological conditions because of its well-known preferences for physical habitat conditions such as temperature. A spatially distributed physically-based stream temperature model (Heat Source model) is set up for a 2.4 km reach of Helligrenden stream for a 10-day period in August 2008 at which time low flows are prevailing. Hourly water temperature measurements are obtained from five stream segments representative of meadows and forest stream reaches, and a temperature suitability index representing the fulfilment of temperature requirement of brown trout is calculated for the sites. Water temperatures are found to increase downstream by up to 2°C per km in open meadow reaches, thereby leading to temperature levels which are unsuitable for brown trout. In contrast, cooling rates of as much as –2.4°C per km are simulated for the forest reach. This suggests that planting of trees in riparian zones of downstream stream reaches can significantly improve stream habitat conditions during low flow conditions at Sjælland.

Key words stream temperature; low flow; physical stream habitat suitability; Denmark