Geophysical Research Abstracts, Vol. 9, 11422, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11422

Interstitial flow rates in simulated Atlantic salmon nests

A.F. Youngson (1), C. Imholt (2), I.A. Malcolm (1), E. I. Meyer (2) and C. Soulsby (3)

(1) FRS Freshwater Laboratory, Faskally, Pitlochry, UK (a.youngson@marlab.ac.uk / Fax: +44 (0)1796 473523 / Phone: +44 (0)1224 294448) (2) Institute for Evolution and Biodiversity, University of Muenster, Germany (3) Department of Geography and Environment, School of Geosciences, University of Aberdeen, UK

Atlantic salmon lay their eggs in nests created in early winter in streambed gravels of the hyporheic zone and the eggs remain there until hatching in spring. Developing embryos are dependent on interstitial water flow for the delivery of oxygen. Egg mortality rates during the incubation period are frequently high and sub-lethal impairment of embryo performance is also common. These effects are usually attributed to the occlusion of the initially open matrix of the nest by infiltration of bedload, consequent reduction of surface water downwelling, reduced interstitial flow and inadequate oxygen delivery. At some study sites, however, infiltration of upwelling groundwater of low oxygen content is the principal determinant of the interstitial oxygen levels to which embryos are exposed. Considered at the fine spatial scales appropriate to salmon nests, ambient hyporheic oxygen values are reduced locally by in situ oxygen consumption by embryos and other organisms. This effect will be especially pronounced at low interstitial flow rates. In addition, low interstitial flow rates are likely to affect the diffusive uptake of oxygen by embryos due to the effect of velocity on the conformation of the boundary layer on the surface membrane of the egg. Few estimates of interstitial flow rates have been reported at the fine spatial scales associated with salmonid nests. This study determined volume exchange rates for interstitial water at intra-nest scales. Estimates of interstitial velocity were derived from these. Volume exchange rates were determined by measuring dilution rates of an applied conservative tracer (1% NaCL). Measurements were made in simulated salmon nests in proven spawning locations in the Girnock Burn, UK. Repeat measurements were made over the egg incubation period, using 300mm vertical arrays of 12 inter-locking units to impart permanent spatial structuring to data acquisition. Supporting data for dissolved oxygen,

temperature and conductivity were obtained from within the array and from surface water. Stream stage was recorded continuously. Temporal and spatial variations in interstitial flows are considered in the context of the dominant hydrological processes. The vertical arrays contained salmon eggs, which were recovered near hatch time, and embryo performance is considered in the context of the quality of the interstitial hyporheic environment.