



Groundwater influence in hyporheic zones: a key control on site selection for Atlantic salmon spawning in a braided river system?

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Abstract

During the last 30 years numbers of Atlantic salmon, *Salmo salar* L., returning to spawn in Scottish rivers have declined. Measures to conserve these populations have focused on protecting the ecological integrity of their upland spawning sites. Discrepancies exist between predicted available spawning habitat derived from suites of hydraulic and sedimentary variables, and actual sites used by salmon. These differences may be due to physiochemical characteristics of the hyporheic zone in spawning gravels. The impact of groundwater-surface water interactions on redd site selection are well documented for some salmon species such as the Bull trout (*Salvelinus confluentus*) and the Chinook salmon (*Oncorhynchus tshawytscha*) but are poorly understood for Atlantic salmon. This study investigates the influence of the physiochemical characteristics used in redd site selection for Atlantic salmon. The study is located in the river Feshie, Cairngom Mountains, Scotland; a complex braided river system where groundwater-surface water interactions are particularly marked, creating a highly variable hyporheic environment. The site is known to provide important spawning habitat for Atlantic salmon and a preliminary study of the braided system indicated that, spawning habitat suitability was high. Intensive hydrochemical surveys of the braided channels - and associated groundwater-surface water interactions - were carried out during 2005-2006. Results indicated a spectrum of different channel types, each with contrasting levels of surface and ground water quality: these encompassed main-river channels, side channels, hillslope tributary streams, mixed channels and groundwa-

ter spring-fed channels. During the spawning period, every channel was walked daily and a total of 220 redds were counted and their positions recorded using GPS. Despite widespread availability of suitable habitat, spawning was mainly concentrated in two main channel types: hillside tributaries with major groundwater contributions and alluvial/groundwater fed channels. Within individual reaches clustering and superimposition of redds occurred in areas of known groundwater up-welling. Results obtained during this preliminary redd count and ongoing hydrochemical surveys suggest that Atlantic salmon selectively choose reaches which display strong groundwater signatures. This may have the advantage of providing stable hyporheic thermal regimes to facilitate embryo development in cold mountain rivers. However, the potential deleterious impact of low dissolved oxygen levels associated with such groundwater up-welling is well documented and ongoing work is assessing the implications of spawning selection of groundwater sites on embryo/egg survival.