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Sedimentation and salmon: Salmon-mediated floc formation and biofilm sediment trapping ability can drive lotic primary productivity

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Each year, as millions of Pacific salmon (*Oncorhynchus spp.*) return to their natal streams to spawn and die, their decaying bodies release significant amounts of marine-derived nutrients (MDN), fertilizing surrounding aquatic ecosystems. This nutrient release tends to stimulate an increase in productivity. Spatial patterns of MDN-driven productivity increases, however, remain poorly understood. This is partially because the interaction between in-stream spawning activity and benthic biofilms remains unclear. An in-stream floc delivery mechanism driven partially by salmon-mediated sediment resuspension has been previously identified and post-spawning biofilm abundance increases are well documented. Delivery mechanisms of MDN and biofilm organic matter processing, however, have not been sufficiently examined in concert. Our objectives were to quantify, over the course of a salmon spawning cycle, (*i*) changes in biofilm abundance, (*ii*) patterns of sediment trapping by biofilms and (*iii*) in-stream particle size changes within a spawning channel.

An opportunity to utilize the Horsefly River spawning channel (HFC) in the summer and fall of 2009 allowed for characterization of both marine derived nutrients (MDN) and fine sediment trapped by benthic biofilms during both the active-spawn and post-spawn periods of salmon. The HFC is located in the Central interior region of British Columbia and is part of the larger Fraser River basin. The HFC represents a unique research tool that spans the manipulability of an artificial stream with the realism of a natural habitat. This type of ecological realism has been previously highlighted as vitally important for making consistent observations.

Using the HFC, the role of biofilm in trapping fine sediment was evaluated as a mechanism of nutrient processing and retention. In the active spawn period, biofilm was reduced in abundance while the streambed sediment infiltration was at its highest level. During the post-spawn period, downstream biofilm abundance recovered to pre-spawn values indicating a nutrient pulse over a small downstream scale. With the re-established biofilm layer, sediment was increasingly trapped at the streambed surface by biofilms driving biofilm abundance increases. Biofilms transfer increases in abundance to higher trophic levels. This transfer has a positive effect on the next generation of juvenile salmon growth and survivorship. This work identifies the importance to stream ecosystems of both the nutrient delivery and physical reworking of the gravel bed by salmon and may have consequences for both salmon and river management goals.