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Riparian Response to Hydrologic Flux in the Downstream Reach of an Impounded 2nd Order Stream

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RIPARIAN RESPONSE TO HYDROLOGIC FLUX IN THE DOWNSTREAM REACH OF AN IMPOUNDED 2nd ORDER STREAM

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Current river restoration policies have focused on dam removal in order to establish pre-dam river functions of flooding and biological dispersal, and reduce risk in the case of catastrophic dam failure (Hart and Poff 2002). The push for dam decommissioning is based on numerous studies of the negative impact of large-scale dams (Nilsson and Berggren 2000), yet the vast majority of dams removed to date have been small-scale dams (Doyle et al. 2003). Furthermore small-scale dams and their associated riparian zones have been relatively neglected by river management researchers (Moore and Richardson 2003). This is a serious oversight as the ecological effects of small-scale dams may be vastly different than large dams due to dissimilarities in the geomorphology of large and small channels. In order to better evaluate the effects of existing dams as well as predict future project successes both economically and ecologically, a better understanding of the broad range of dam alterations on river hydrology is needed. In particular, small-scale dams need to be further characterized to determine their unique ecological significance.

This paper examines the relationships between hydrologic fluxes in stream, groundwater, unsaturated zone and riparian response in the downstream reach of a small, impounded stream. In headwater streams a close coupling between stream and hillslope processes creates large temporal and spatial variation at the aquatic/terrestrial interface. The construction of a dam along one of these small, intermittent streams will alter downstream hydrologic flux and influence the balance between stream water and adjacent soils. A three-year site specific study was conducted along a 2nd order stream to examine the interrelationship that exists between stream and riparian zone 300 m downstream of the dam. The long-term influence of increased water availability in the stream channel on downwelling in the hyporheic zone was examined. We then analyzed riparian response in the adjacent parafluvial zone and compared the three-year trends. The close proximity of stream to hillside vegetation benefits the adjacent riparian zone which then through a positive feedback mechanism plays a significant role in stream/groundwater exchange.

We found canopy transpiration to be closely coupled with stream and groundwater fluctuations in which the riparian zone was benefiting from increased stream water availability. During periods of low groundwater availability, the correlation between stream water fluctuations and canopy transpiration increased, showing the dependence of riparian vegetation on seepage from the hyporheic zone. Canopy productivity is assumed to be enhanced via increased transpirative ability along the stream under such conditions. Via the slow release of stream flow and groundwater seepage, the dam was providing an extended supplemental water source to the downstream vegetation in an otherwise intermittent channel. The implication is that in addition to the economic use for which small dams were intended (flooding and sedimentation mitigation), they also provide an ecological benefit of reduced fragmentation and

even increased development of the riparian zone. The significance of this study provides a better understanding of the influences of small dams on mechanistic processes within riparian corridors. This will enable environmental planners to make informed decisions about the value of these structures for watershed function and resource management.

Literature Cited

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