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Patterns of surface water/groundwater Exchange and aquatic habitat Diversity in contrasting braided River Floodplains

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Exchange between surface water and ground water is a fundamental feature of alluvial floodplain rivers. Aquatic habitats on floodplain surfaces (e.g. ponds, oxbows, springbrooks, etc.) demonstrate a high degree of heterogeneity in nutrients and temperature due to their differential hydrologic exchange with the ground water, and thereby have a controlling affect on biodiversity distributions. However, our identification and understanding of these differential exchange patterns as a result of dynamic fluviogeomorphic processes (e.g. channel scouring, cut-and-fill alluviation, channel avulsion) functioning on various spatial and temporal scales is still very limited. In order to gain an understanding of the naturally existing exchange patterns a detailed analysis of the historical floodplain development and measurement of the surface water budget of the Nyack Floodplain of the Flathead River in northwestern Montana, USA was conducted. Surface water samples for each discharge location and at specific upwelling locations within gravel bars were taken to measure the signals emitted by the radioactive isotope Rn-222 to calculate local residence times of upwelling groundwater. Mean residence times along preferential flowpaths of high hydraulic conductivity were measured by inserting piezometers across gravelbars. A high degree of variance in the residence times of upwelling ground water was detected at the meso-scales of the floodplain and less variance at the floodplain scale, which is reflected in the high heterogeneity of aquatic habitats on the meso-scale. Fluvial processes of cut-and-fill alluviation and channel avulsion that form floodplains with complex gravel bars re-

sult in a high degree of variable flow path lengths that are thought to exert significant control on the residence time of ground water flowing through the floodplain and associated gravel bars.

A comparative study is being conducted on the Tagliamento River, Italy, which receives a much higher sediment load and has a “flashy” discharge regime, resulting in frequent floods throughout the year. In this system residence times show low variability, and are dominated by the small scale, short-term geomorphic features. The system can be viewed as being “leaky”, with a rather low diversity of upwelling habitats, extremely low abundances of organisms, but as being highly connected to the groundwater both hydrologically as well as biologically. These findings have important implications for the goals and strategies of river restoration projects and how their success should be assessed.