Habitat Diversity in Alluvial Rivers

Final Innovative Project Presentation

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45-minute presentation + 15 minutes for questions

Remote-sensing data from LIDAR (high-resolution and highly accurate elevation data) and aerial thermal sensors provides an extremely powerful combination for assessing geomorphic influences on river hydrology and water temperature in alluvial rivers. However, the data are difficult to manipulate. Successful application of these data requires substantial experience working with spatial data sets, image processing software, and geographic information systems. At moderate resolutions (e.g., pixel sizes ranging from 30 meters (m) to 60m), remote sensing data derived from satellites are of limited utility on rivers the size of the Umatilla. However, fine resolution (1m to 10m) remote sensing data, fully processed, provides an exceptional source for mapping floodplain topographic and thermal variability. Further investigation of spectral unmixing and image sharpening, using thermal and optical data, could overcome present limitations of moderate resolution data sets. An integrated model of surface- and ground-water hydrology that can adequately represent geomorphic complexity and can simulate water fluxes in three dimensions is a valuable tool for understanding patterns of hyporheic flux. Agent-based modeling may be an especially fruitful avenue for development of more sophisticated models in the future. Like many rivers, the Umatilla becomes warmer as water flows from the headwaters downstream. However, areas where hydrologic modeling predicts high rates of hyporheic flux tend to be the same areas where the downstream warming trend is reduced or even reversed. Thus, high rates of hyporheic exchange are associated with cooler stream temperatures. Channel engineering results in substantially simplified channel and flood-plain morphology. Where major channel engineering projects have occurred, modeled rates of hyporheic exchange are noticeably reduced from similar areas where dredging and diking have not occurred. Therefore, reduced hyporheic exchange associated with channel engineering provides a likely mechanism to explain the tendency for the river to warm rapidly as it flows through engineered reaches. This research has resulted in substantial new understanding of the interactions between geomorphology, hydrology, and river temperature in the Umatilla River – especially in the intensive study sites and, to a lesser degree, on the Upper Umatilla River flood plain. The technique and findings outlined here are likely applicable to alluvial rivers in adjacent river basins and perhaps throughout the Columbia River Basin, yet additional work is required to understand whether these processes and dynamics are specific to the Umatilla, or represent widespread phenomena. Further, these research results suggest that geomorphic restoration of flood plains could play a vital role in the management of river temperatures and pilot projects that are carefully and cautiously planned, executed, and monitored should be implemented to test their effectiveness.