River ecosystem theory: Putting concepts into action for defining reference conditions for Great Rivers

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Great rivers have been an integral part of the development of human civilization, where they have functioned as a source of water, food, transport, and waste removal for millennia. A considerable drawback from this intimate relationship is that great rivers are among the most altered ecosystems in the world. These changes have been a major impediment to the recent trend to rehabilitate rivers to something approaching their prior condition because of the difficulty in ascertaining a target condition for rehabilitation. We recently proposed the riverine ecosystem synthesis (RES; Thorp, Thoms, and Delong 2006) as a model of lotic biocomplexity across spatiotemporal scales from headwaters to great rivers by integrating ecogeomorphology, hierarchical patch dynamics, and lotic ecosystem theory from the last 25 years. The RES provides a framework for understanding broad, often discontinuous patterns along longitudinal and lateral dimensions of river networks and local ecological patterns across various temporal and spatial scales. The RES, in contrast to the common view that physical and biological conditions of rivers occur along a continuous, longitudinal gradient, portrays rivers as a patchy array of hydrogeomorphic patches formed by catchment geomorphology and climate. Hydrogeomorphic patches (e.g., constricted, braided floodplain, and anastomosing areas), can reoccur along the longitudinal gradient of a river, reflecting the discontinuous, patchy framework of river networks. Because hydrogeomorphic patches are identifiable using standard geomorphic techniques, it is possible to recognize reference patches through the use of historical climatic or hydrological data as a comparison to existing conditions. Identification of hydrogeomorphic patches is also relevant to ecological metrics as each hydrogeomorphic patch will possess physicochemical attributes that will affect ecosystem structure and function. This presentation will provide an example of how the river ecosystem synthesis can be applied toward identifying hydrogeomorphic patches in the Upper Mississippi River for the identification of reference conditions and how this approach can incorporate the probabilistic sample design of EMAP.

Thorp, J.H., M.C. Thoms, and M.D. Delong. 2006. The riverine ecosystem synthesis: biocomplexity in river networks across space and time. River Research and Applications, *in press*.

Dr. Delong has been at WSU since 1992. He established the Large River Studies Center in 1995. His Interest in rivers came from his M.S. work on the Tennessee River as part of a kraft paper mill biomonitoring project. Research interests have included invertebrate and fish habitat use in large rivers, invertebrate secondary production, and zebra mussel population/community dynamics. Current research focuses on ecosystem processes in large rivers with an emphasis on food-web processes. Bioassessment interests for large rivers today stems from interest in understanding how river ecosystem function responds to potential impacts and the application of functional measures in assessing rehabilitation efforts. He has worked on the Upper and Lower Mississippi, Tennessee, Ohio, Missouri, and Snake Rivers, as well as a number of medium-sized rivers.