Using Hydraulic Modeling and Particle Tracking to Assess Restoration Impact on Egg and Larval Refuge

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Recent geomorphic changes observed along the Pecos River in east-central New Mexico have prompted concern that quality egg and larval fish retention habitat for the federally listed Pecos bluntnose shiner (Notropis simus pecocensis, hereafter shiner) is declining. As part of a three-phase project, the U.S. Fish and Wildlife Service and Tetra Tech conducted cross-section surveys, evaluated current habitat conditions, and conducted a comprehensive hydrologic and fluvial geomorphic study of the Pecos River between Santa Rosa Dam and Dexter, NM. Through these investigations, several disconnected meander bends were identified as potential restoration sites.

To evaluate the potential of meander bend reconnection to act as a refuge for shiner eggs and larvae during block flows and summer monsoons, a two-dimensional (2D) HEC-RAS model was developed. A particle tracking method that simulates movement of semi-buoyant objects was applied to track the paths an egg would take. Travel paths and times for existing and restored conditions were compared to evaluate if restoration led to increased egg retention and if eggs would exit the meander as flows receded. Additionally, large woody debris were simulated in the main channel to evaluate their potential for creating refugia. Results showed there is potential to retain eggs and larvae during block flows without trapping eggs/larvae. During monsoons, the meander was not an effective means of improving egg/larvae retention. Modeling showed localized slower velocities at large woody debris, which indicated some potential for creating refugia during block flows and monsoon flows.

While this specific meander bend may not have the desired potential for improved habitat if reconnected, the study provides insight to identify characteristics of meanders that have higher potential for reconnection. Additionally, this approach, which combines 2D hydraulic modeling with semi-buoyant particle tracking, can be used to explore similar riparian habitat changes in almost any river system.

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