Exploring the Potential for Meander Bend Reconnection for the Pecos Bluntnose Shiner (Notropis simus pecocensis) Egg and Larval Retention on the Pecos River, Chaves County, New Mexico, USA

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Introduction

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) is declining.

The U.S. Fish and Wildlife Service and Tetra Tech conduced a three-phase project to evaluate current habitat conditions by conducting a comprehensive and in-depth geomorphic and hydrologic study of the Pecos River between Sumner and Brantley Reservoir. The hydrology of the Pecos River through the study reach is regulated by Sumner Dam. Water is released from Sumner Dam in block flows that average approximately 1,400 cfs for up to 15 days.

2018

Phase I:

Literature review regarding
- Shiner habitat
- Geomorphology
- Hydrology,
- Existing hydraulic models

2019

Phase II:
- Assessment of geomorphology and hydrology of Pecos between Sumner and Brantley Reservoirs.
- Selection of potential restoration sites.

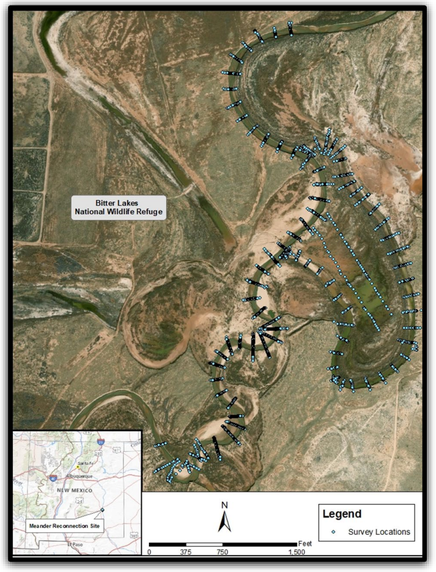
2020

Phase III:
- Topographic and bathymetric surveys of meander site.
- Develop 2D hydraulic model.
- Evaluate potential for shiner habitat and in-channel habitat features.

Phase III Study Area

The study reach was a relic meander bend located on Bitter Lakes National Wildlife Refuge in an area designated as critical shiner habitat.

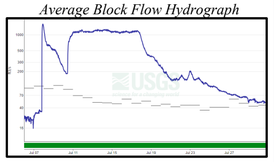
Apex of relic meander bend



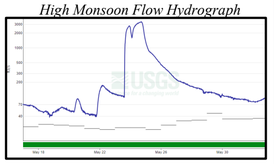
Methods

1. **Detailed topographic/bathymetric survey of meander site**
2. **Developed 2D HEC-RAS model**
   - **Three model geometries**
   - ➢ Geometry A – Baseline, current conditions
   - ➢ Geometry B – Future condition – grading at meander inlet and outlet; large woody debris (LWD) in main channel
   - ➢ Geometry C – Alternate future condition – to evaluate additional LWD in main channel
   - **Hydrology**
   - ➢ Average block flow and duration
   - ➢ High monsoon flow with low duration
   - **Grading**
   - ➢ 700 feet of grading at the inlet and the outlet
   - ➢ The inlet and outlet slopes were 0.0002 feet/foot to match the simulated water-surface elevations (the energy gradient)
   - ➢ Inlet was graded to allow 2 feet of the water column to enter the meander channel at 1,100 cfs, the average block flow in the study reach
3. **Particle Tracking Method**
   - Estimate egg retention times and flow paths
   - Used 14 different particle starting locations

Average Block Flow Hydrograph



High Monsoon Flow Hydrograph



Matrix of Model Geometries, Flows and Results for Each Model Run

Model Run	Model Geometry	Flows (Q) used	Particle Tracking used?	Results
1	A – Existing conditions/baseline	I – average block flow Q, average duration	Yes	1. *Flow in main channel**, with particle/egg retention
				2. *Flow in meander**, with particle/egg retention
2		II – High monsoon Q, low duration	Yes	3. *Flow in main channel**, with particle/egg retention
				4. *Flow in meander**, with particle/egg retention
3	B – Future conditions • grading at inlet/outlet • LWD structures in the main channel along the outside of the bend between the meander inlet and outlet	I – average block flow Q, average duration	Yes	5. *Flow in main channel**, with particle/egg retention
				6. *Flow in meander**, with particle/egg retention
4		II – High monsoon Q, low duration	Yes	7. *Flow in main channel**, with particle/egg retention
				8. *Flow in meander**, with particle/egg retention
5	C – Future conditions 2 • Same as Geometry B with: • additional LWD structures in the main channel along the inside of the bend between the meander inlet and outlet	I – average block flow Q, average duration	Yes	9. *Flow in main channel**, with particle/egg retention
				10. *Flow in meander**, with particle/egg retention
6		II – High monsoon Q, low duration	Yes	11. *Flow in main channel**, with particle/egg retention
				12. *Flow in meander**, with particle/egg retention

* in addition to flow, results include .tiff files of the hydraulic parameters (including depth and velocity), and shapefiles of maximum inundation extents

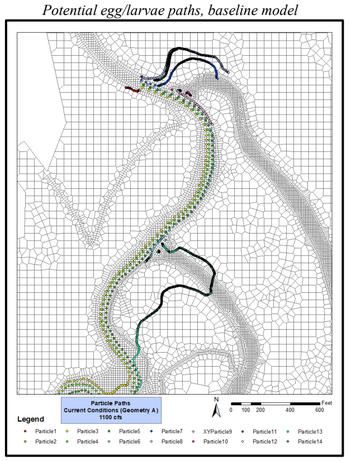
Key Findings During Block Flows

Particle tracking showed:
- That eggs do re-enter the main channel, below the meander outlet
- Eggs travel across the left overbank through high flow channels.
- Eggs that traveled through the meander and exited to the main channel took 3 to 6 hours versus 10 to 15 minutes to pass directly through the project reach.
- LWD structures in the main channel result in localized areas of slower velocity and may provide some refuge for eggs and larvae.
- Grading at the inlet and outlet allowed more water to flow into each location which resulted in slower velocities in the main channel outside the inlet and downstream of the outlet compared to current conditions.

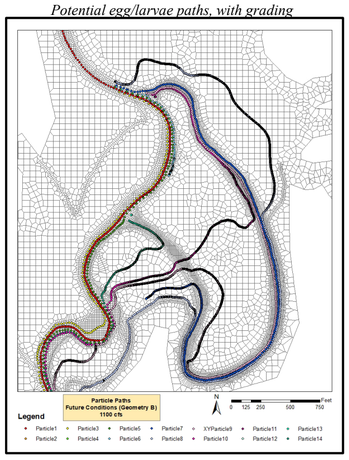
Key Findings During Monsoon Events

- Grading the meander has little to no impact on the amount of water that flows through the meander during a high flow monsoon event.
- Particle tracking confirmed that grading did not result in more paths in the meander or on the floodplain.
- LWD structures still provide some localized areas where velocities are lower and might be the best option for egg and larvae retention during a high flow monsoon-driven event.

Potential egg/larvae paths, baseline model



Potential egg/larvae paths, with grading



Future Work

- Develop construction plans for the meander bend
- Similar Phase III work for additional meander bend reconnection
- Long-term monitoring

Funding for this study was provided by the US Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, NM.