Linking hydrology and geomorphology on the Middle Rio Grande with habitat conditions for the Rio Grande Silvery Minnow

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Middle Rio Grande

**Hydrology**
- Reduced magnitude, duration, and frequency of peak flows
- Increased duration and frequency of low flows

**Geomorphology**
- Reduced width – channel narrowing
- Reduced sediment supply
- Bed degradation – channel incision

**Rio Grande Silvery Minnow Habitat**
- Increased velocities
- Increased depths
- Reduced floodplain connectivity
Estimated Density of RGSM (fish per 100 m$^2$) vs. Discharge (cubic feet per second) from 1983 to 2018.

Dudley et al., 2019
Project Overview

Morpho-dynamics

Hydrology

Geomorphology

Habitat Conditions

Rio Grande Silvery Minnow Population

Bio-habitat interactions

Monitoring, Research, and Management

Middle Rio Grande ecosystem

UNM-ASIR

CSU

USBR
Project Objectives

1. Provide current understanding of bio-habitat conditions needed for the RGSM during primary life-stages (RGSM Bio-Habitat Syntheses).

2. Improve understanding of the morpho-dynamic processes (geomorphic, hydrologic, hydraulic, sediment, and vegetation) on the Middle Rio Grande through an analysis of collected information (Reach Reports).

3. Improve understanding of the specific morpho-dynamic processes that influence bio-habitat conditions for RGSM (Reach and Linkage Reports).

4. Delineate and understand the linkages between fluvial morpho-dynamics, bio-habitat conditions, and the RGSM population (Linkage Reports).

5. Provide recommendations for data collection efforts that may help to inform notable data gaps in the linkages between the morpho-dynamics and biological-habitat conditions for the RGSM (Linkage Reports).

6. Provide recommendations for innovative river management practices that may be viable given linkages made between the morpho-dynamics and biological-habitat conditions for the RGSM (Linkage Reports).
RGSM Bio-Hab Syntheses – Life History Model

- **Captive Propagation Program**: Adults (Broodstock), Juveniles, Larvae, Eggs

- **Augmentation**: (6) Winter, (7) Spring [Experimental]

- **(5) Juvenile Mortality**: Desiccation, Starvation, Stress, Predation

- **(4) Larval Mortality**: Drift into reservoir, Entrainment/diversion, Desiccation, Starvation, Stress, Predation

- **Salvage and Rescue**: Occurs only during river drying events

- **Systemwide Monitoring Activities**:
  - * Population Monitoring
  - + Reproductive Monitoring
  - # Repeated Sampling (Population Monitoring)
  - ^ Genetic Monitoring

- **(1) Adult Mortality**: Post-spawn, Desiccation, Starvation, Stress, Predation, Winter mortality

- **(2) Egg Mortality**: Unviable or infertile, Drift into reservoir, Egg mortality, Settling and suffocation, Water quality, Desiccation, Predation

- **(3) Eggs collected for captive propagation**: July, June

- **Non-Irrigation Season**
  - Winter Baseflow
  - Floodplain Inundation

- **Irrigation**
  - Spring Runoff
  - Monsoons

- **Intermittency**

- **Flood Recession**

- **MRG**

- **Salvage and Rescue**: Occurs during river drying events
Angostura Reach
Alameda Gage
USGS 08329918
2005–2018

Egg viability reduced below 15°C and above 30°C

Floodplain?
Data and Methods

Data:
Channel surveys (USBR)  
agg/deg lines  

Stream gaging stations (USGS)  
Discharge, sediment

RGSM Research and Monitoring (UNM-ASIR)  
Habitat use studies  
Pop. Monitoring 1993–2018

Methods:
Geomorphic characteristics
Subreach delineation
Hydraulic modeling (HEC-RAS)
RGSM habitat criteria by life-stages
Habitat mapping
Flow-habitat relationships
Time-integrated habitat metrics
Data and Methods

**Data:**
- Channel surveys (USBR)
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**Methods:**
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- Subreach delineation
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Preliminary Results – 2012 San Acacia Subreach

San Acacia Diversion Dam to Escondida Bridge

Adult RGSM habitat by subreach

Didge and Julien, 2019
Preliminary Results – 2012 San Acacia Subreach

San Acacia Diversion Dam to Escondida Bridge
RGSM habitat by life-stage

Doidge and Julien, 2019
Preliminary Results – 2012 San Acacia Subreach

San Acacia Diversion Dam to Escondida Bridge

Velocity and Depth

Area (m$^2$) vs. Discharge (cubic feet per second)

Doidge and Julien, 2019
Linkage Report – Conceptual Approach

Geomorphology – Habitat conditions

Habitat conditions – RGSM population
Anticipated Project Outcomes

1. Identify and understand key process-linkages between morpho-dynamics and habitat conditions: Floodplain connectivity, instream habitat complexity, geomorphic controls on RGSM habitats

2. Develop integrated channel-habitat evolution model: Describe past, present, and future habitat responses to observed fluvial morpho-dynamics in the Middle Rio Grande

3. Provide recommendations for data collection to fill data gaps and improve characterization of key process-linkages

4. Inform river management practices that have potential to create and maintain suitable habitat for RGSM
Discussion

Thank you!
Works Cited


