Rio Grande Silvery Minnow Biology, Monitoring, Geomorphology and Habitat Needs/Restoration

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Reclamation River Restoration
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Sacramento, CA

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Rio Grande S & T Research Projects

- Arroyo de los Piños Research Station
  - Low confidence in estimating sediment delivery from ephemeral streams to mainstem rivers (Rio Grande and others)
  - Construct and operate total sediment load (bed and suspended load) gaging station near Socorro, NM
  - 10 U.S. and International partners
  - 5 storms during 2018 monsoon season
    - Multiple suspended sediment, bedload, depth and velocity and automated recorded measurements
- Principle Investigator: David Varyu, SRH Group TSC

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Rio Grande S & T Research Projects

- **Field Deployment of a Continuous Sediment Load Surrogate**
  - **Deploy instruments in lieu of physical measurements. Reduced cost for determining suspended sediment load.**
  - **USGS-Partner**
- **Principle Investigator Ari Posner, Albq. Area Office**

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Rio Grande S & T Research Projects

- **Stochastic Hydraulic Simulations using HEC-RAS**
  - **Develop software tool for performing Monte Carlo simulation on input parameters for HEC-RAS**
  - **Uncertainty estimation important due to large uncertainties with input parameters**
  - **Stochastic simulations provide probabilities associated with input parameters.**
- **Principle Investigator: Ari Posner, Albq. Area Office**

Albq. Area Office Funded Projects

- **Linking Morpho-dynamics with Biology**
  - **Colorado State University**
    - **Civil and Env. Engineering Department, Pierre Julien**
  - **University of New Mexico**
    - **Division of Fishes, Museum of Southwest Biology, Robert Dudley, Steve Platania, Thomas Turner**
    - **American Southwest Ichthyological Researchers, L.L.C. Jacob Mortensen**
  - **Objectives:**
    - **Overall: Improve understanding of changing morpho-dynamics of the MRG between Bernalillo NM and Elephant Butte Reservoir regarding habitat for Rio Grande Silvery Minnow (RGSM).**
    - **Develop on sub-reach scale (a few miles)**
    - **Overcome challenge with spatial scale of transect data and fish habitat**

Albq. Area Office Funded Projects

Linking Morpho-dynamics with Biology

- **Planned Actions:**
  - **Compile morphological data on a decadal scale 1962-2012 ~200 miles.**
  - **Develop and compare changes in channel hydraulics**
  - **Determine changes through time in floodplain connectivity**
  - **Document what is known or unknown about RGSM biology**
  - **Develop relationships between channel conditions, and habitat**
  - **Evaluate various strategies to overcome challenge with spatial scale of transect data and fish habitat**

Albq. Area Office Funded Projects

- RGSM Minnow Population Monitoring 1993 to Present
  - University of Mexico Division of Fishes, Museum of Southwest Biology
  - Reclamation Technical Service Center (Mike Horn's group)
  - Objectives:
    - Long-term systematic monitoring of MRG fish community
    - Assessment of RGSM recruitment over short periods
    - Comparing changes in recruitment among years,
    - Status of species conservation, vital during periods of reduced abundance
    - Sites based on spatial distribution, site accessibility, relative permanence of flow and presence of realtively diverse habitat
    - Correlation between spring runoff flow rate, overbank flows and fall population

Albq. Area Office Funded Projects

- **Post project morphological changes (Reclamation's Technical Service Center, Nathan Holste Team Leader)**
  - **Utilize 2012-13 LiDAR and 2017 high flow and low flow LiDAR to determine depositional patterns in habitat restoration features**
  - **Field review (preliminary take aways)**
    - **Placing excavated material in the river seems effective method**
    - **Restoration features with multiple elevation surfaces has best change of longer term success.**
    - **Woody vegetation growth, increased resistance to flow increases suspended sediment deposition.**

Photographs by Nathan Holste and Joel Sholtes

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Rio Grande Silvery Minnow (RGSM)

- **Historical Range**
- **Current Range (Red)**

Mortenson, J.G, Dudley, R.K., Platania, S.P., and Turner, T.F, final draft report for U.S. Bureau of Reclamation, 2019 (UNM)

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RGSM

*Ant*ropogenic Effects

- Dispersal Interruption (3 Diversion Dams and Cochiti)
- Lateral Confinement (levee and channelization)
- Desiccation
- Reduction in Geomorphic Drivers (peak flow and sediment supply)
  - Disconnection of historical floodplain- channel bed lowering
  - Uniform velocity and depth (narrowing)

Photographs by UNM

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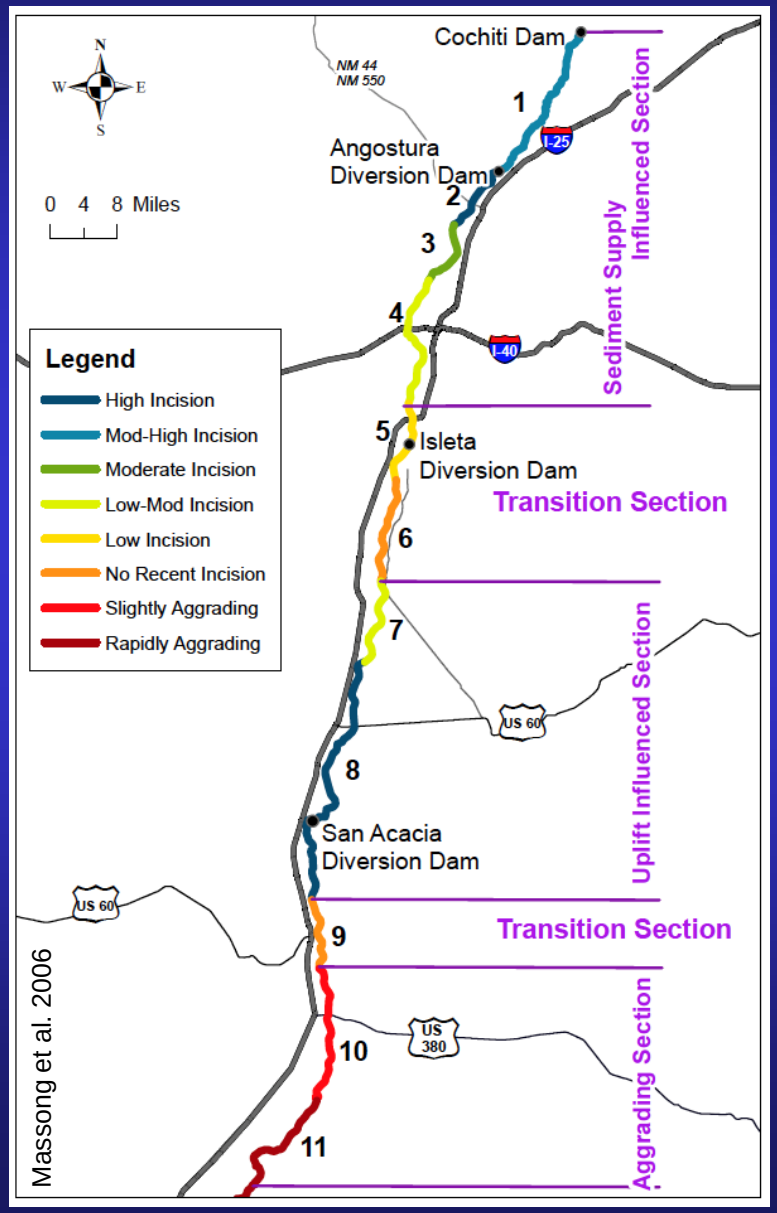
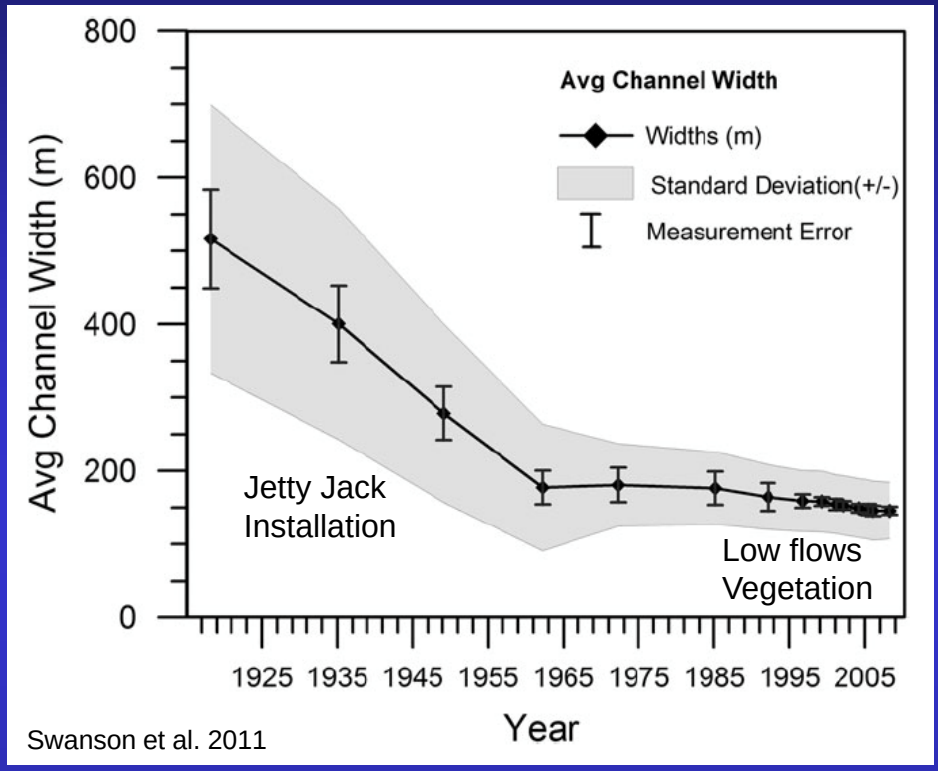
MRG Habitat Degradation and Connectivity (UNM)

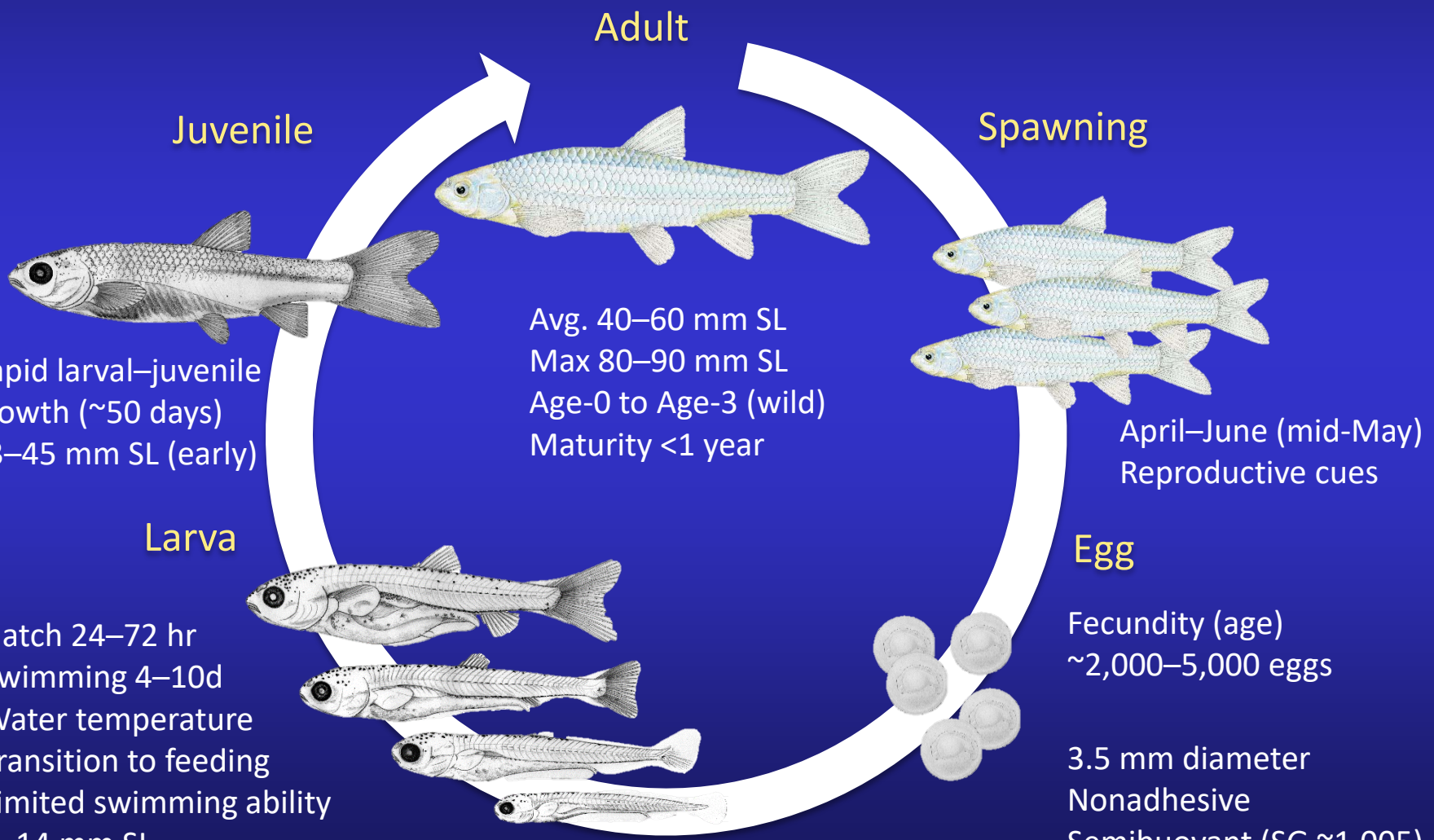




Habitat implications of channelization and incision:

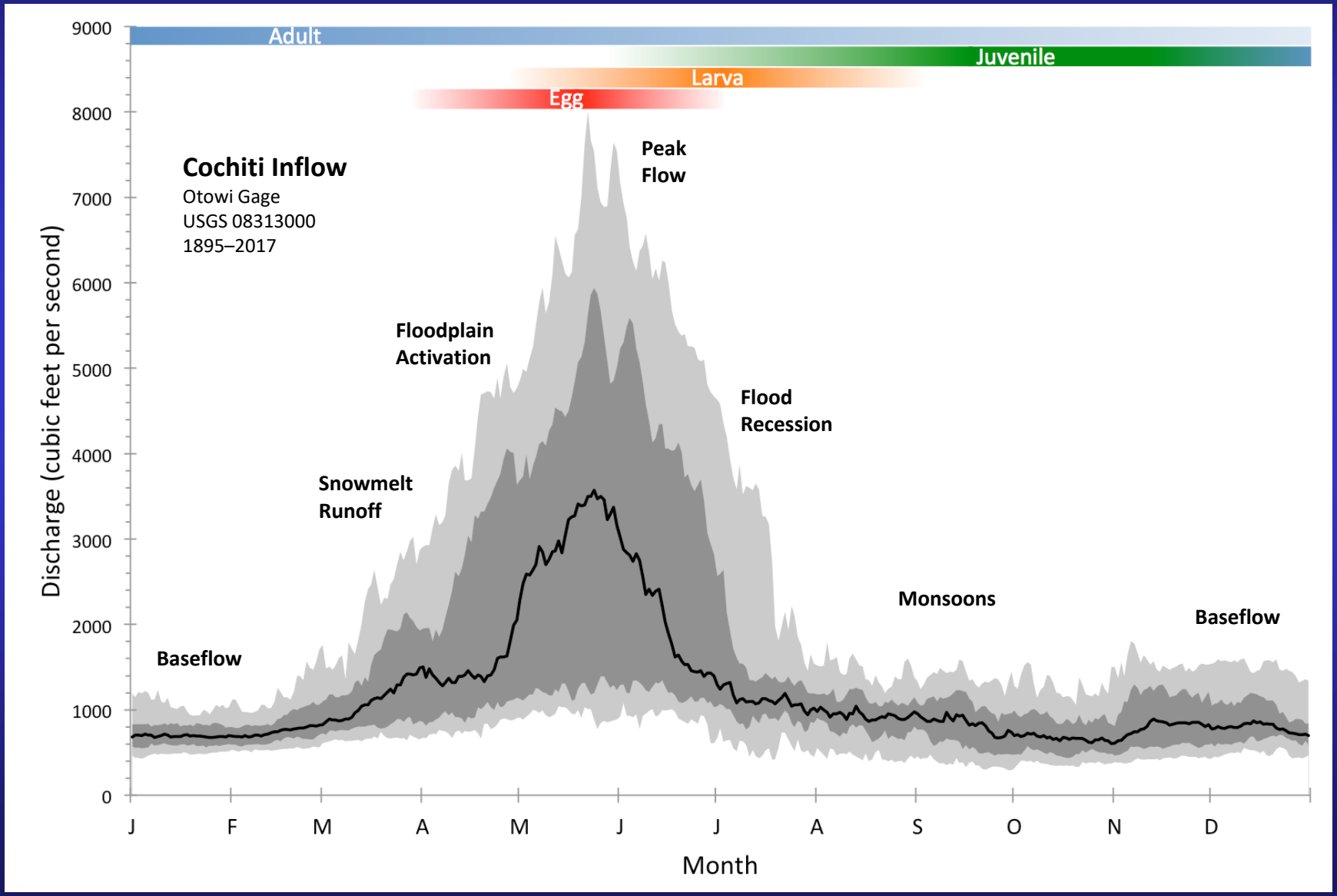
+ depth
+ velocity
– channel complexity
– floodplain connectivity

Life Stages of Rio Grande Silvery Minnow (UNM)

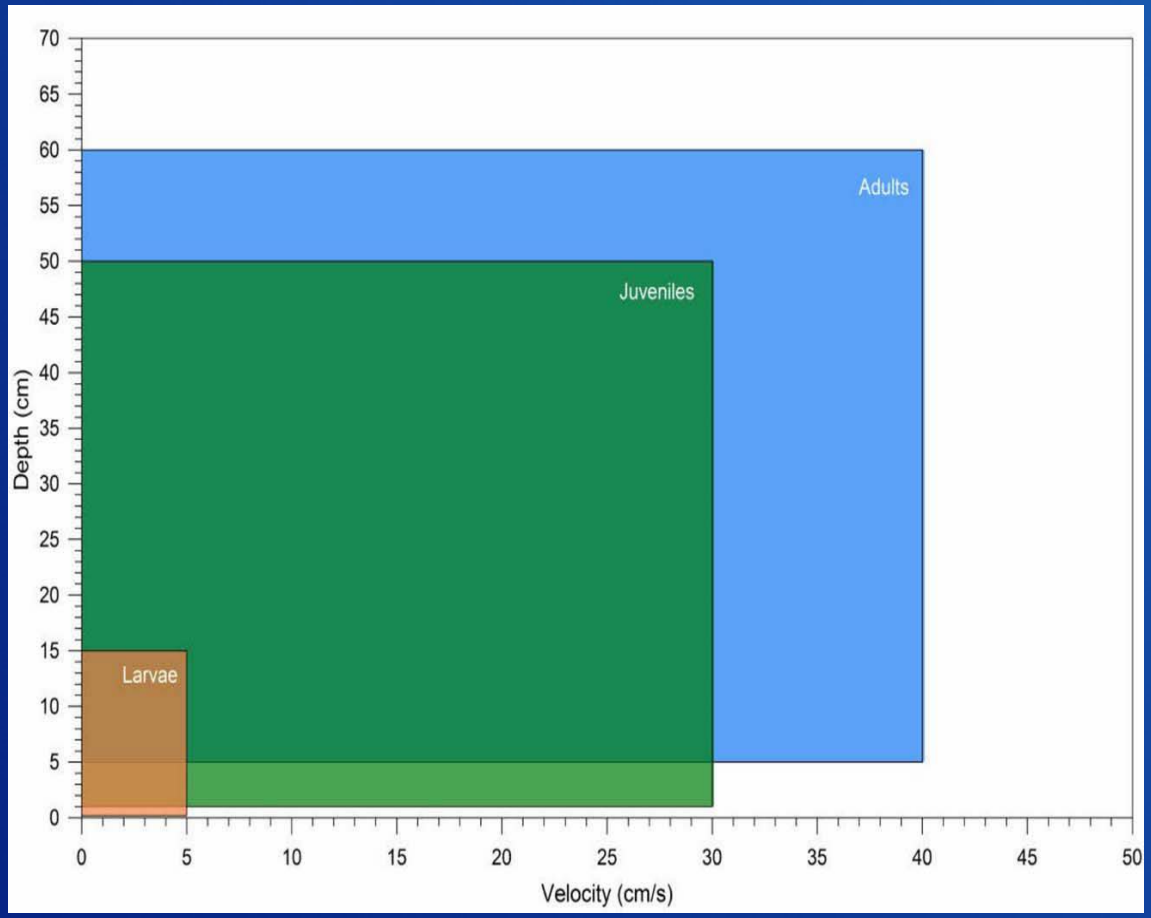


Illustrations by JP Sherrod, WH Brandenburg

Life History of Rio Grande Silvery Minnow (UNM)



RGSM Velocity and Depth Habitat Preference by Life Stage



Spawning generally occurs at moderate depths (~20 cm or a little larger) and "seemingly imperceptible flow velocity"

(UNM)

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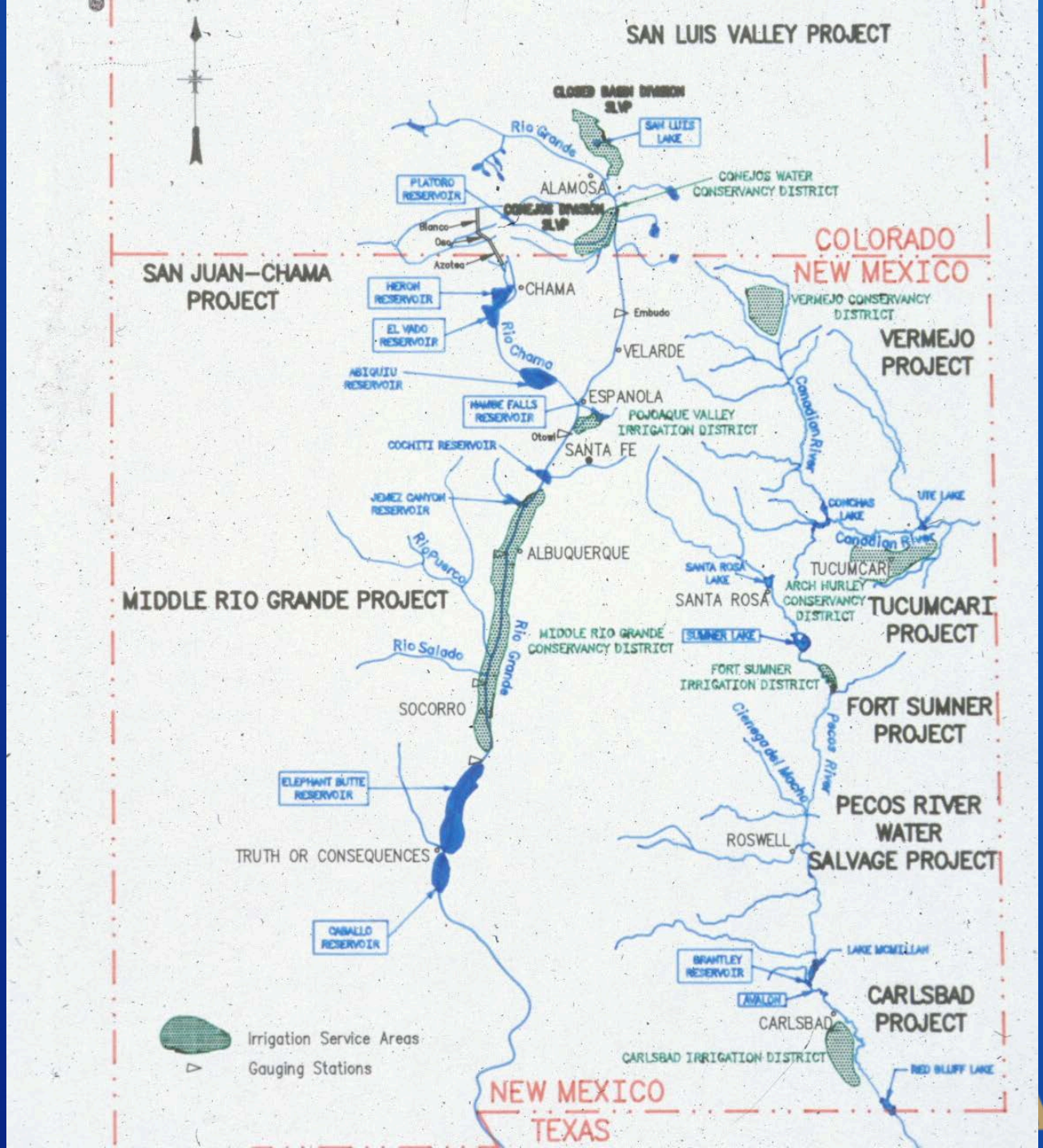
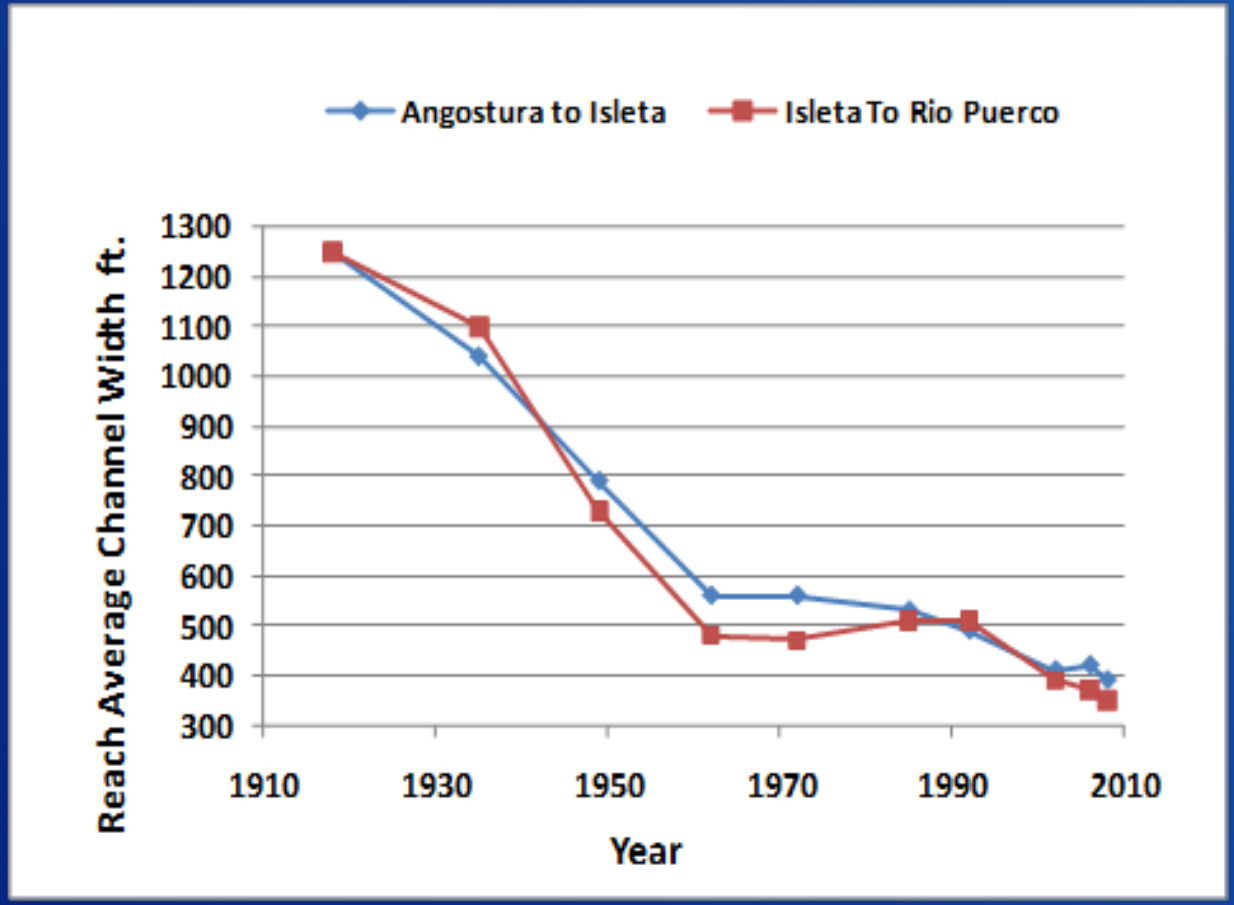

SAN LUIS VALLEY PROJECT
CLOSED BASIN DIVISION SLVP
SAN LUIS LAKE
Rio Grande
PLATORO RESERVOIR
ALAMOSA
CONEJOS WATER CONSERVANCY DISTRICT
CONEJOS DIVISION SLVP
Blanco
Oso
Azotea
COLORADO
NEW MEXICO
SAN JUAN–CHAMA PROJECT
HERON RESERVOIR
CHAMA
EL VADO RESERVOIR
Embudo
VERMEJO CONSERVANCY DISTRICT
VERMEJO PROJECT
Rio Chama
VELARDE
ABIQUIU RESERVOIR
ESPANOLA
NAMBE FALLS RESERVOIR
POJOAQUE VALLEY IRRIGATION DISTRICT
Otowi
COCHITI RESERVOIR
SANTA FE
Canadian River
JEMEZ CANYON RESERVOIR
CONCHAS LAKE
UTE LAKE
Canadian River
Rio Puerco
ALBUQUERQUE
SANTA ROSA LAKE
TUCUMCARI
ARCH HURLEY CONSERVANCY DISTRICT
SANTA ROSA
MIDDLE RIO GRANDE PROJECT
TUCUMCARI PROJECT
Rio Salado
Rio Grande
MIDDLE RIO GRANDE CONSERVANCY DISTRICT
SUMNER LAKE
FORT SUMNER IRRIGATION DISTRICT
SOCORRO
FORT SUMNER PROJECT
Cienega del Macho
Pecos River
ELEPHANT BUTTE RESERVOIR
PECOS RIVER WATER SALVAGE PROJECT
ROSWELL
TRUTH OR CONSEQUENCES
CABALLO RESERVOIR
LAKE MCMILLAN
BRANTLEY RESERVOIR
AVALON
CARLSBAD PROJECT
CARLSBAD
CARLSBAD IRRIGATION DISTRICT
RED BLUFF LAKE
Irrigation Service Areas
Gauging Stations
NEW MEXICO
TEXAS

Reach Average Channel Width 1918 to 2010



1935 Aerial Photographs show evidence of MRGCD levees and drains.

After 1949 width changes attributed to:

- Reclamation Channelization
- Upstream Sediment and Flood Control Dams (reduced sediment loads and peak flows).
- Trans-mountain diversions can encourage channel narrowing (vegetation growth).

The most recent width reduction is also related to drought conditions

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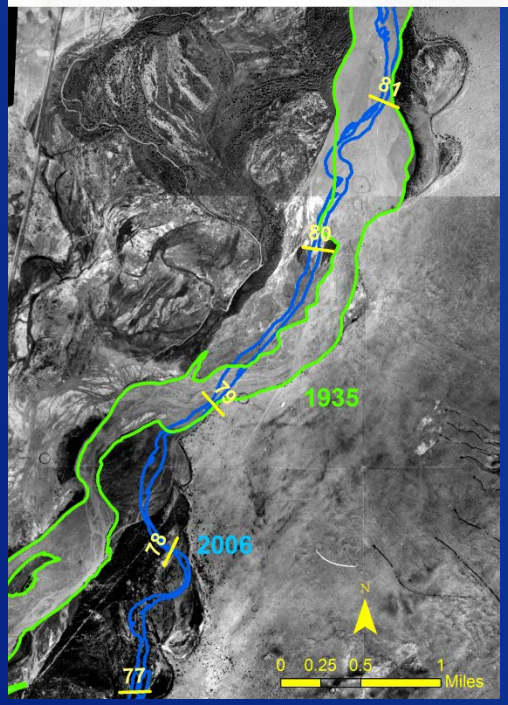

Planform Change

Historically: wide, low flow braided channel that frequently shifted position, aggrading, low bank height, high floodplain connectivity, shallow variable depth and velocity. Lateral migration avulsion.

Currently: narrow, single thread channel with relatively fixed position (Fossilized), high bank height, very low floodplain connectivity, essentially uniform deep depth and higher velocity. Lateral migration process, low sinuosity bend migration.

Photographs Holste 2016

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Average Bed Elevation, Decreased Floodplain Connectivity

Angostura to Bernalillo Reach

1971-1995 lowered 7.3 Ft.

Bernalillo to Corralles Reach

1972-1992 lowered 3.5 Ft.

Rio Puerco to San Acacia Reach

1962-1992 lowered 3 Ft.

San Acacia to Escondida Reach

1962-1999 lowered 9.6 Ft.

Habitat Restoration Objectives

- Increase floodplain connectivity
- Provide heterogeneity of velocity and depth
- Improve bankline complexity

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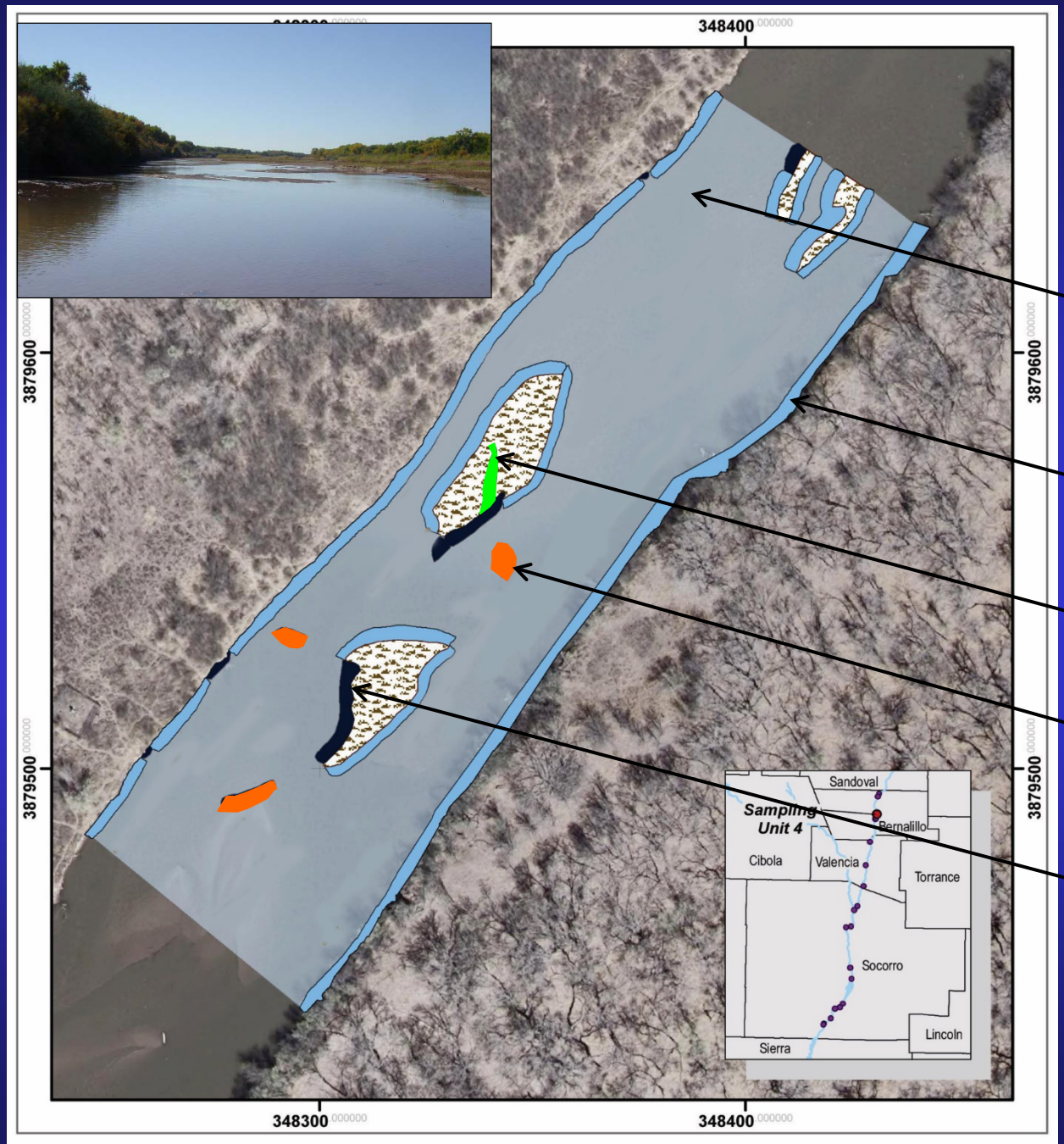
Field Monitoring

Mesohabitats (UNM)



Runs

Shoreline runs

Backwaters

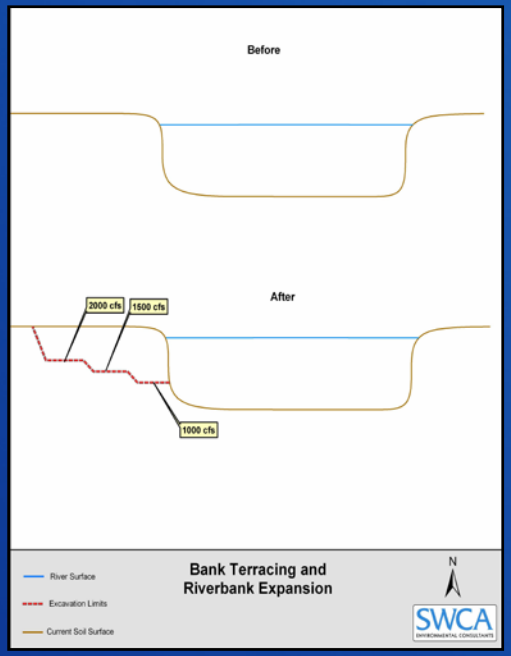
Pools

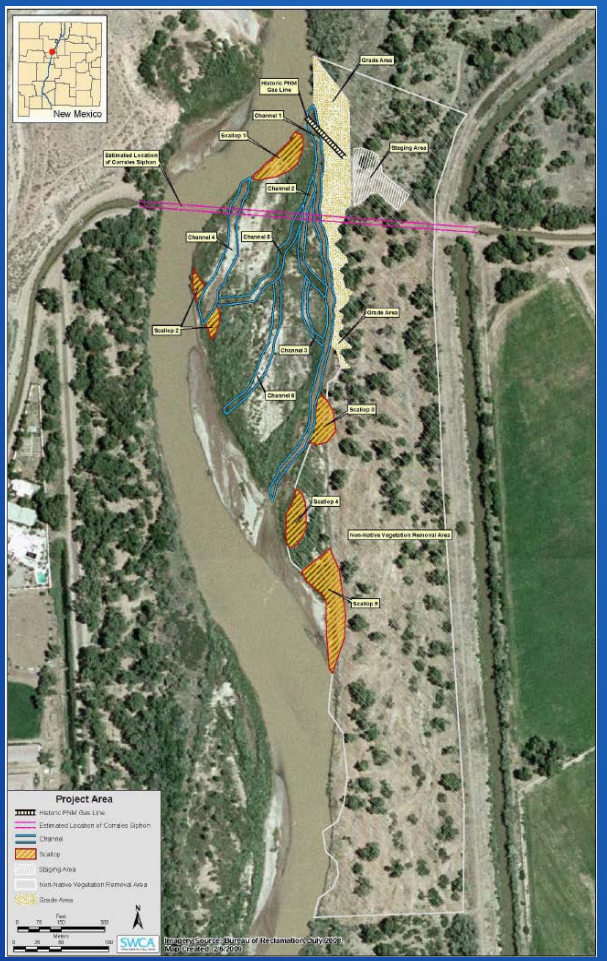
Shoreline pools

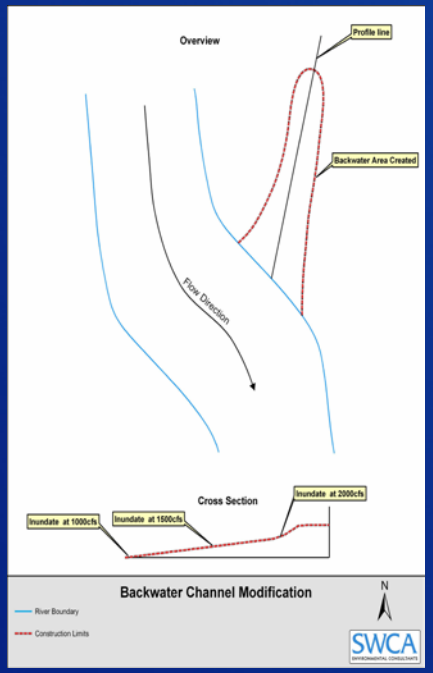
Availability and quality varies with discharge

Habitat Restoration

- Lower banks for floodplain connectivity
- Create backwaters







Deposition of suspended sediment reduces sustainability

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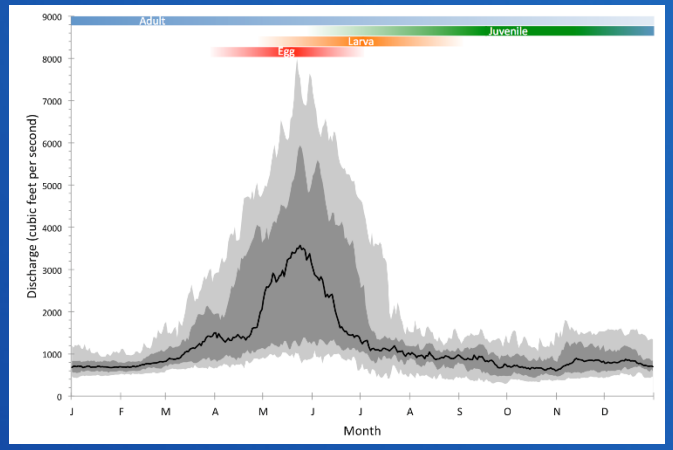
Research Questions

1. **Understanding Flow-Habitat Relationships (UNM)**
   - How does habitat availability vary with discharge in the MRG (instream and floodplain habitats), and how do flow-habitat relationships influence the recruitment of RGSM?
   - How have flow-habitat relationships changed relative to historical conditions?
2. **Improving Longitudinal Connectivity (UNM)**
   - How does longitudinal dis-connectivity (i.e., diversion dams) affect the distribution, abundance, and genetic viability of RGSM?



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Habitat Restoration Project Research Questions

3. **Sediment**
   - How does restoration projects effect sediment dynamics of the system?
4. **Sustainability (embracing periodic sediment removal or new sites-life cycle):**
   - What is the interaction between lowered channel surfaces (variable elevations) between vegetation recruitment sediment dynamics and eventual sediment deposition?

Photograph Joel Sholtes

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Habitat Restoration Project Research Questions

4. Sustainability (cont.)

- What features, geometries, and topography should be included in floodplain projects to improve sustainability?

5. Habitat Restoration Site Usage

- What is the RGSM usage of created habitat?
- What life stages use created habitat?
- Is there a correlation between RGSM use of created habitat and the numbers of fish at the population monitoring sites.

Illustration by W.H. Brandenburg

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