Hydrology, physics, and oocytes: Observations on Rio Grande Silvery Minnow reproductive life history

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US Army Corps of Engineers
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Foundational Studies

Reproductive strategies of seven Rio Grande Basin cyprinids.

- Semi-buoyant eggs
- Downstream Egg drift
- Upstream migration

Specific gravity of semi-buoyant eggs

Four species extirpated from Rio Grande persist in the Pecos River

- *Machybopsis aestivalis*
- *Notropis jemezanus*
- *N. simus simus*
- *N. orca*

Analogies are not observations

"Hybognathus amarus is the only member of the semibuoyant egg reproductive guild to persist in the Middle Rio Grande, New Mexico."

Platania SP, Altenbach CS. 1998. Reproductive strategies and egg types of seven Rio Grande Basin cyprinids.
Altenbach CS, Dudley RK, Platania SP. 2000. A new device for collecting drifting semi-buoyant fish eggs.

Egg Monitoring and Salvage

- Egg collection efforts in 2001 were highly successful
- 2001 Biological Opinion – RPM B) Between April 15 and June 15 of each year, provide a one-time increase in flows (spawning spike) to cue spawning, if necessary.
- The 1999 report documented earliest spawn in late March

While spawning spikes produced lots of eggs, the population index continued to decline

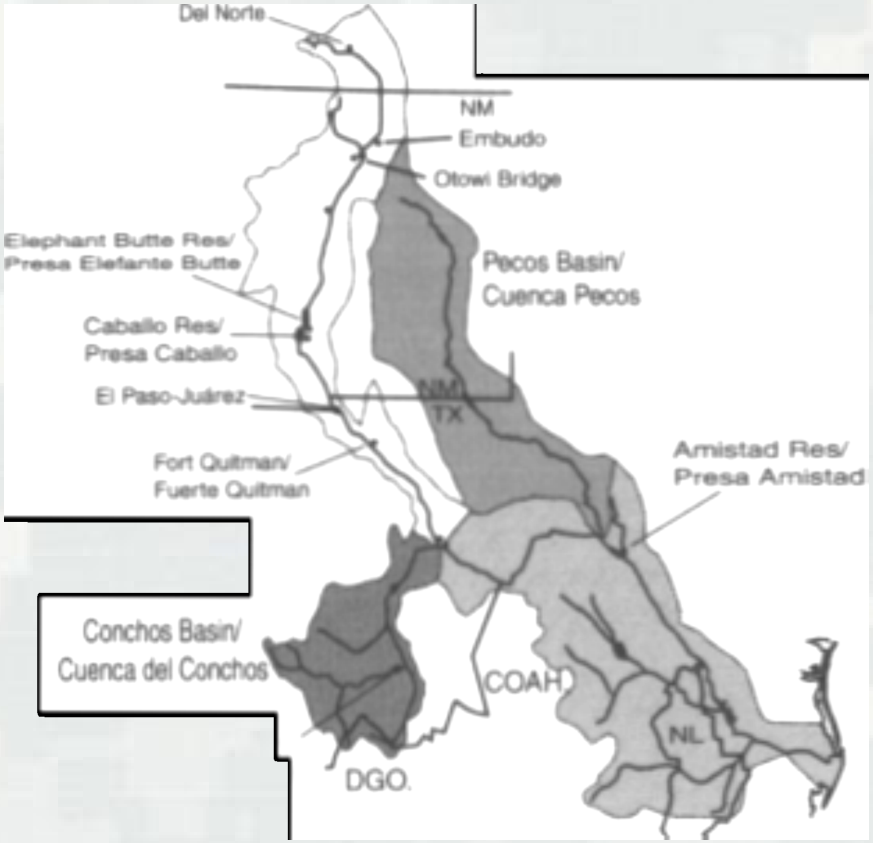
Spawning spikes were repackaged as the 'jiggle' for egg salvage

Egg dispersal during higher flows re-populate downstream reaches

Platania SP, Dudley RK. 1999. Spatial Spawning Periodicity of Rio Grande Silvery Minnow During 1999.

Geomorphology Studies

Hydrology and Geomorphology of the Rio Grande and Implications for River Rehabilitation.

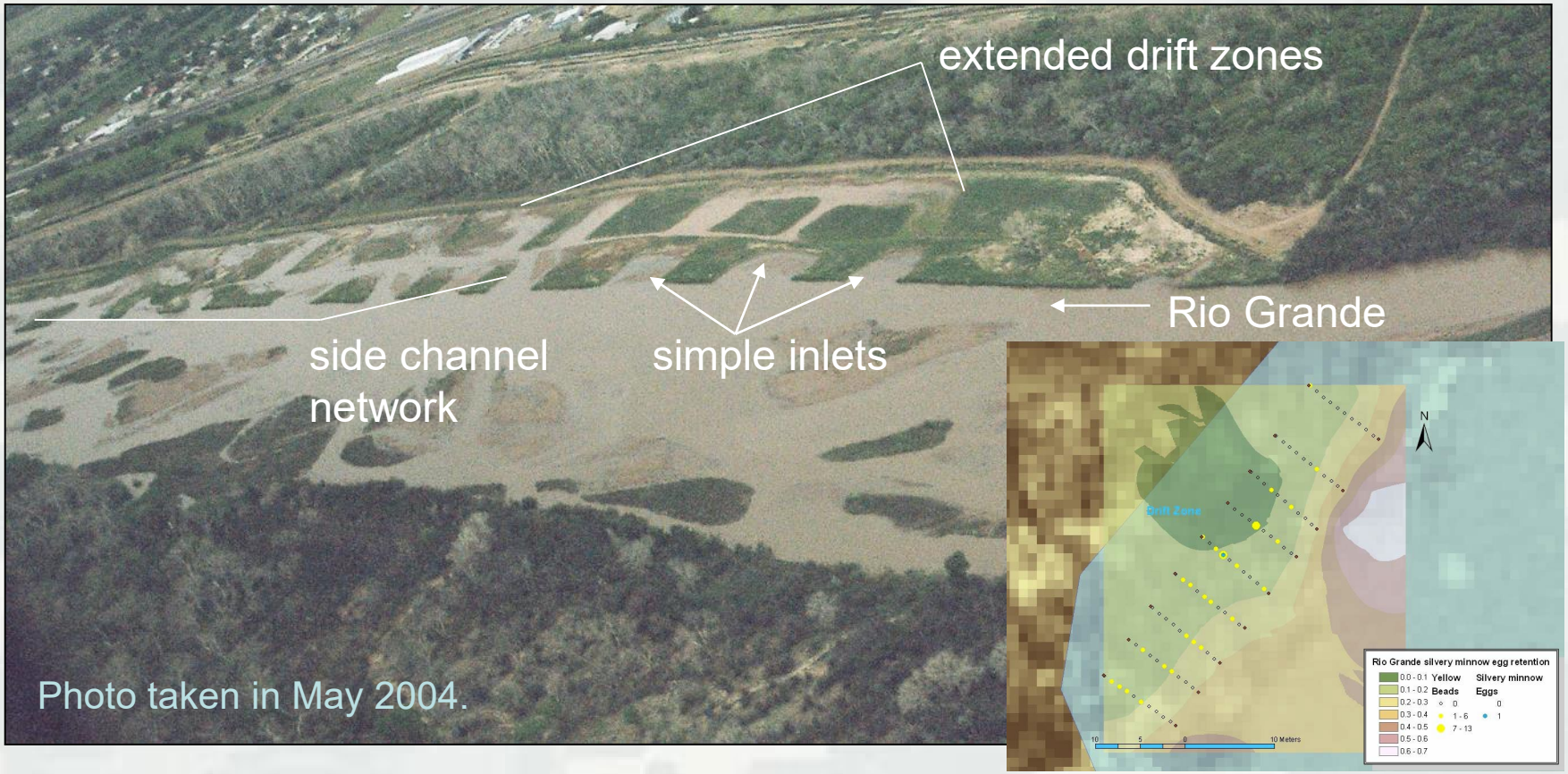


- Trends from Dam building
- Downstream channel incision
- Loss of floodplain connectivity
- Riverine time scales

The concepts of geomorphology and floodplain connectivity would form the foundation for nursery habitat

Schmidt JC, Everitt BL, Richard GA. 2003. Hydrology and Geomorphology of the Rio Grande and Implications for River Rehabilitation.

Egg Retention Studies



Reinert TR, Will TA, Jennings CA, Davin WT. 2004. Use of egg surrogates to estimate sampling efficiency of Striped Bass eggs in the Savannah River.
Porter MD, Massong T. 2003, 2004. Progress Report-Contributions to Delisting Rio Grande Silvery Minnow: Egg Habitat Identification.

Egg Drift Model

- Habitat fragmentation
- Constrains egg drift
- Upstream migration

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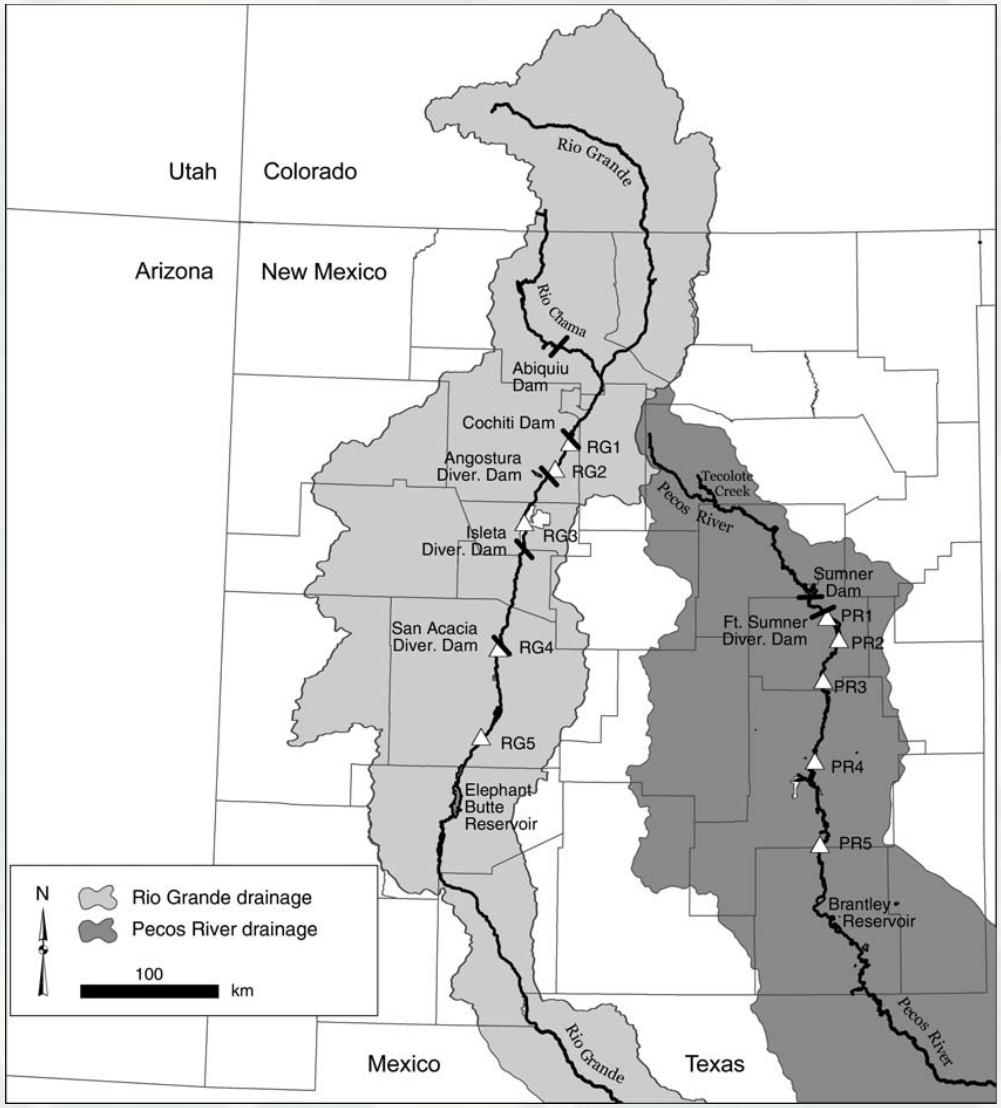
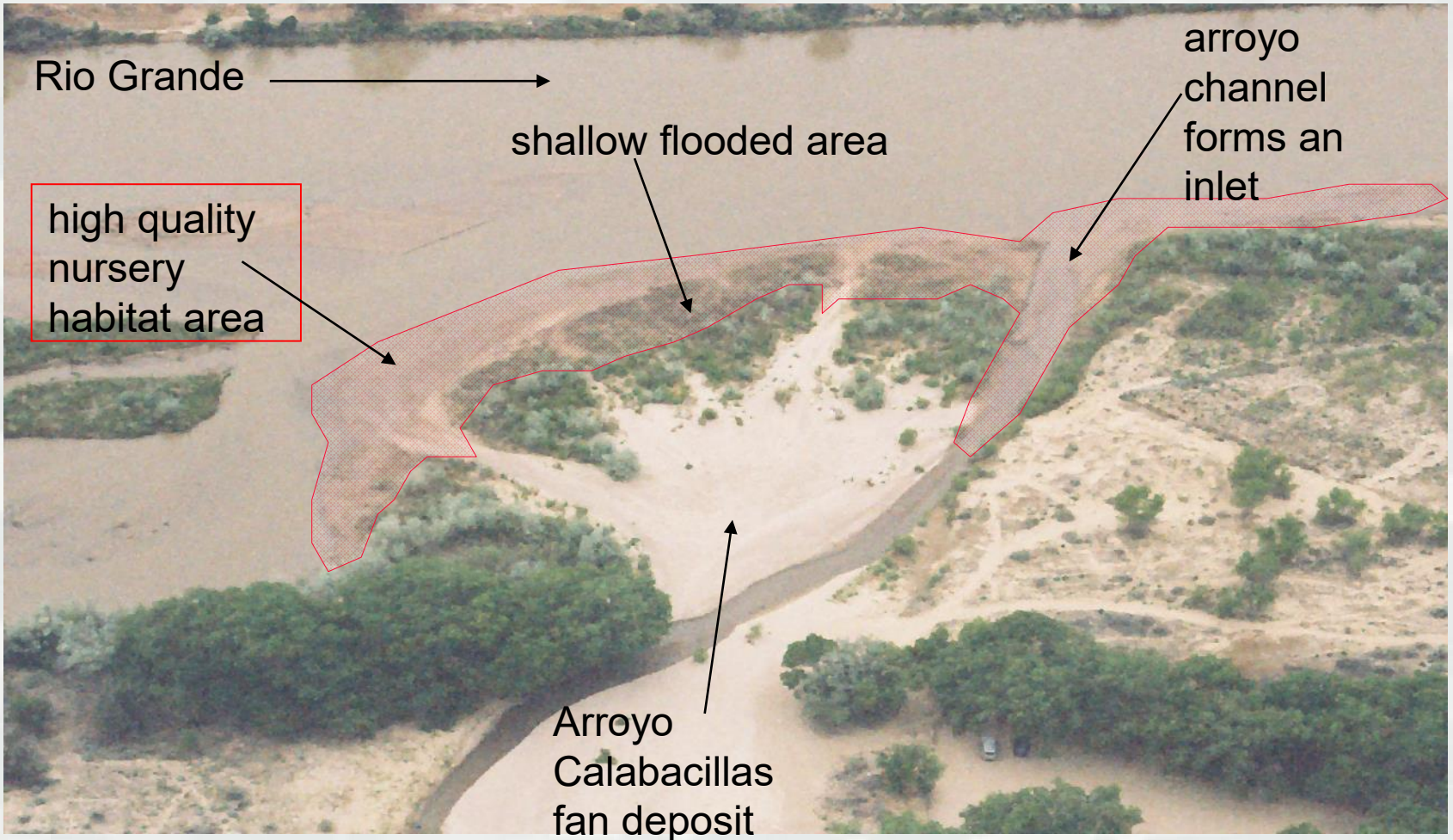


Dudley RK, Platania SP. 2007. Flow regulation and fragmentation imperil pelagic-spawning riverine fishes.
Bestgen KR, et al. 2010. Swimming performance and fishway model passage success of Rio Grande silvery minnow.
Chase, NM, et al. 2015. Movement patterns and dispersal potential of Pecos bluntnose shiner (*Notropis simus pecosensis*) revealed using otolith microchemistry.

Nursery Habitat



Pease AA, et al. 2006. Habitat and resource use by larval and juvenile fishes in an arid-land river (Rio Grande, New Mexico).
Fluder J, et al.. 2007. Analyzing floodplain and aquatic nursery habitat of the Rio Grande silvery minnow at different hydrologic flows.
Magaña HA. 2012. Habitat use of the Rio Grande silvery minnow (*Hybognathus amarus*) during a long-term flood pulse in the Middle Rio Grande, New Mexico.

In-channel Egg Retention

- Retention varied by reach, discharge, and hydrograph shape
- Egg retention associated with high habitat heterogeneity and complex channel structure

Medley CN, Shirey PD. 2013. Review and reinterpretation of Rio Grande silvery minnow reproductive ecology using egg biology, life history, hydrology, and geomorphology information.
Widmer AM, et al. 2010. Drift and retention of pelagic spawning minnow eggs in a regulated river.

Floodplain Spawning

Rio Grande Nature Center

- Documented spawning in vegetated channel
- RGSM eggs embedded in the benthic leaf-litter
- Manning's N high relative to water velocity

Spawning Habitat

Medley CN, Shirey PD. 2013. Review and reinterpretation of Rio Grande silvery minnow reproductive ecology using egg biology, life history, hydrology, and geomorphology information.
Gonzales, EJ, Tave D, Haggerty GM. 2014. Endangered Rio Grande silvery minnow use constructed floodplain habitat.

Larval Transport

- Monitoring larval fish on restoration sites
- Back calculate length to hatch date
- Some larvae hatched in early April
- Drift distance unknown
- Appearance at upstream sites consistent with population monitoring

Implications for other processes

- Consistent with egg drift and retention
- Complement floodplain spawning
- Floodplain habitat is essential

Valdez RA, Haggerty GM, Richard K, Klobucar D. Managed spring runoff to improve nursery floodplain habitat for endangered Rio Grande silvery minnow.

Silvery Minnow Reproduction

Process	Association
Egg Monitoring	Negative correlation with October CPUE
Egg Drift	Egg salvage / Jiggle flow and dispersal
Geomorphology	Floodplain connectivity is important
Nursery Habitat	Associated with October CPUE / Good data
Habitat fragmentation	One factor. Important for extirpated species
Floodplain Egg Retention	Very low rate (<1%)
In-channel Egg Retention	Viable process (20+%)
Floodplain Spawning	Adult movement, patchy egg distribution
Larval Transport	Preliminary data

Which concepts contribute to effective management?

Thanks to

US Army Corps of Engineers

US Bureau of Reclamation

US Fish and Wildlife Service

Middle Rio Grande Conservancy District

Middle Rio Grande Endangered Species Collaborative Program

New Mexico Interstate Stream Commission

American Southwest Ichthyological Researchers

SWCA Environmental Consultants

TetraTech

Questions?

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