Duration of Floodplain Inundation Necessary for Larval Rio Grande Silvery Minnow

Richard A. Valdez, Ph.D.
SWCA Environmental Consultants

Grace M. Haggerty
New Mexico Interstate Stream Commission

Stephen A. Zipper
SWCA Environmental Consultants

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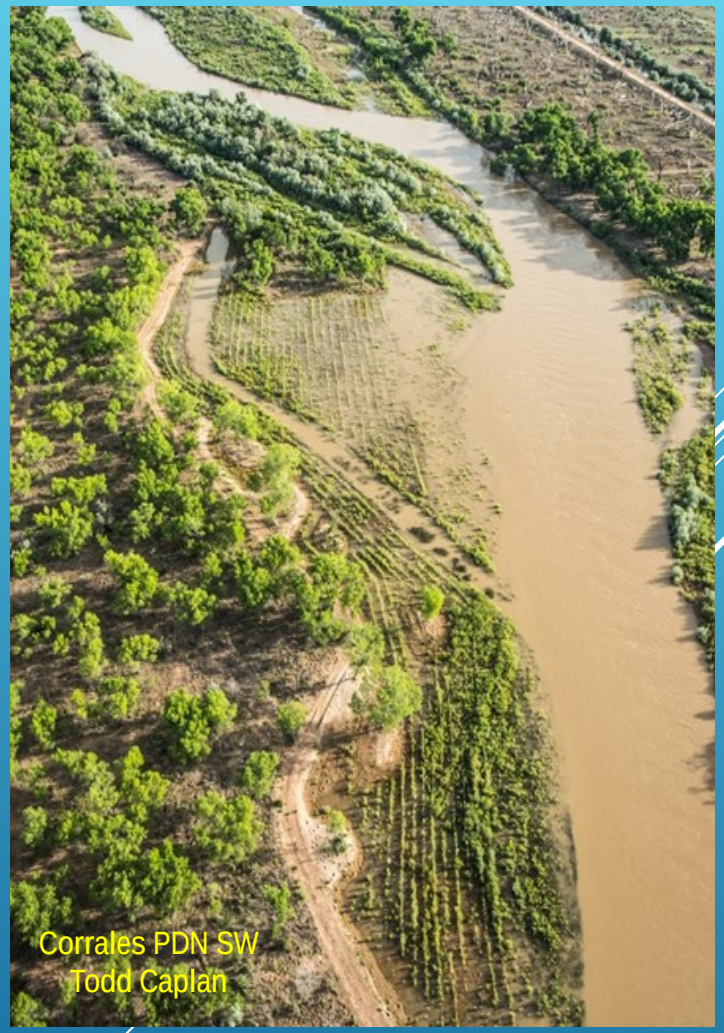
Prelude:

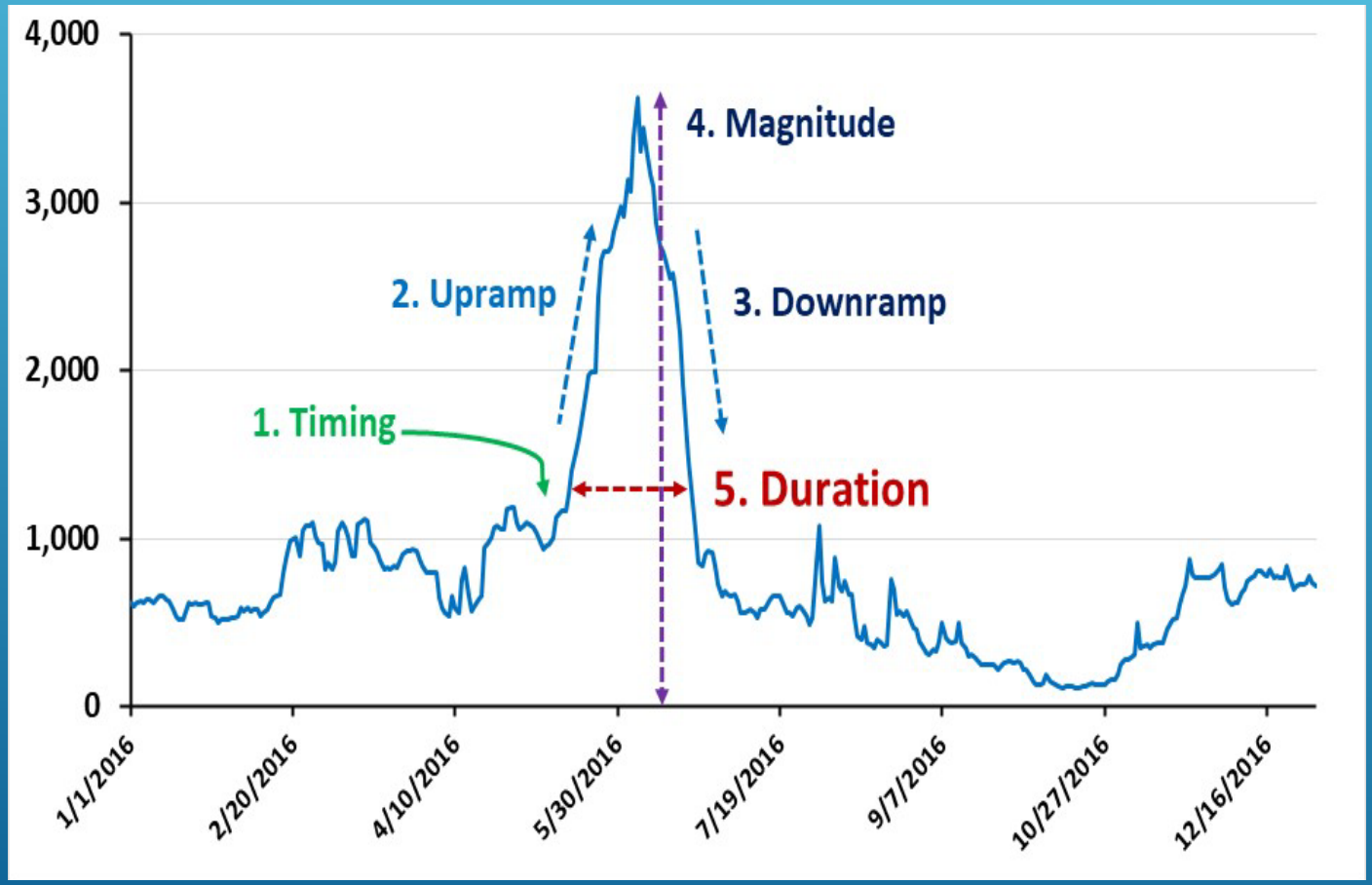
- Perhaps the most critical question for self-sustainability of RGSM is the duration of floodplain inundation necessary for larval survival.

- Direct field measure of residence by larvae may not be feasible, and resolution requires lines of evidence using available field data and laboratory studies.



Restoration Sites (2016-2017)

Aspects of Spring Runoff



1. **Timing** – The start of runoff should correspond with RGSM spawn/hatch.
2. **Upramp** – Rate of flow increase will affect habitat persistence.
3. **Downramp** – Rate of flow decrease may strand fish.
4. **Magnitude** – Flow level will determine floodplain area.
5. **Duration** – Length of time with floodplains is critical to larval survival.

Developmental Phases of Larvae

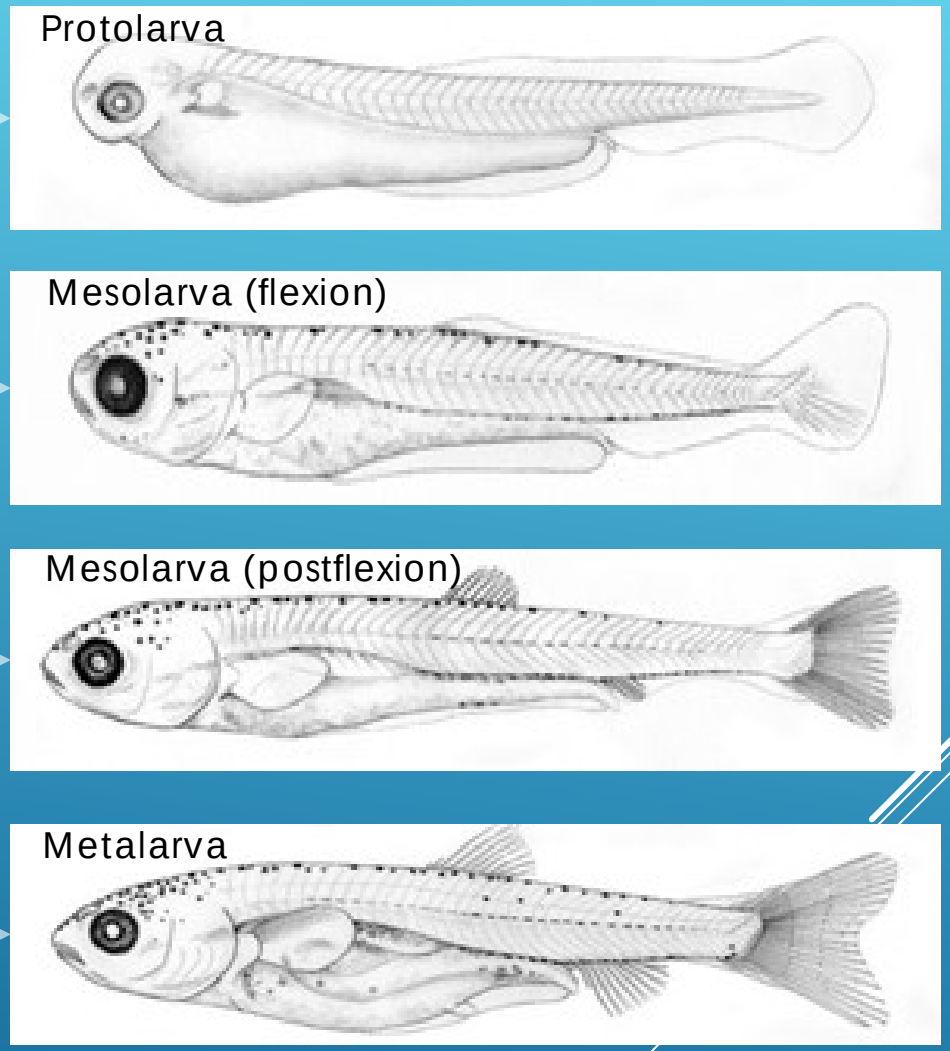
Protolarva
1-day, 4 mm SL
(yolk sac, no fins)
"C-start" movement

Mesolarva (flexion)
~7-days, 5-6 mm SL
(yolk sac absorbed, caudal fins rays)
Coordinated "C-start"

Mesolarva (postflexion)
~14-days, 6-8 mm SL
(dorsal, caudal, anal fin rays)
Coordinated Swimming

Metalarva
~22-days, 9-10 mm SL
(fins fully formed)
Increased Swimming Efficiency

Rio Grande silvery minnow (*Hybognathus amarus*)

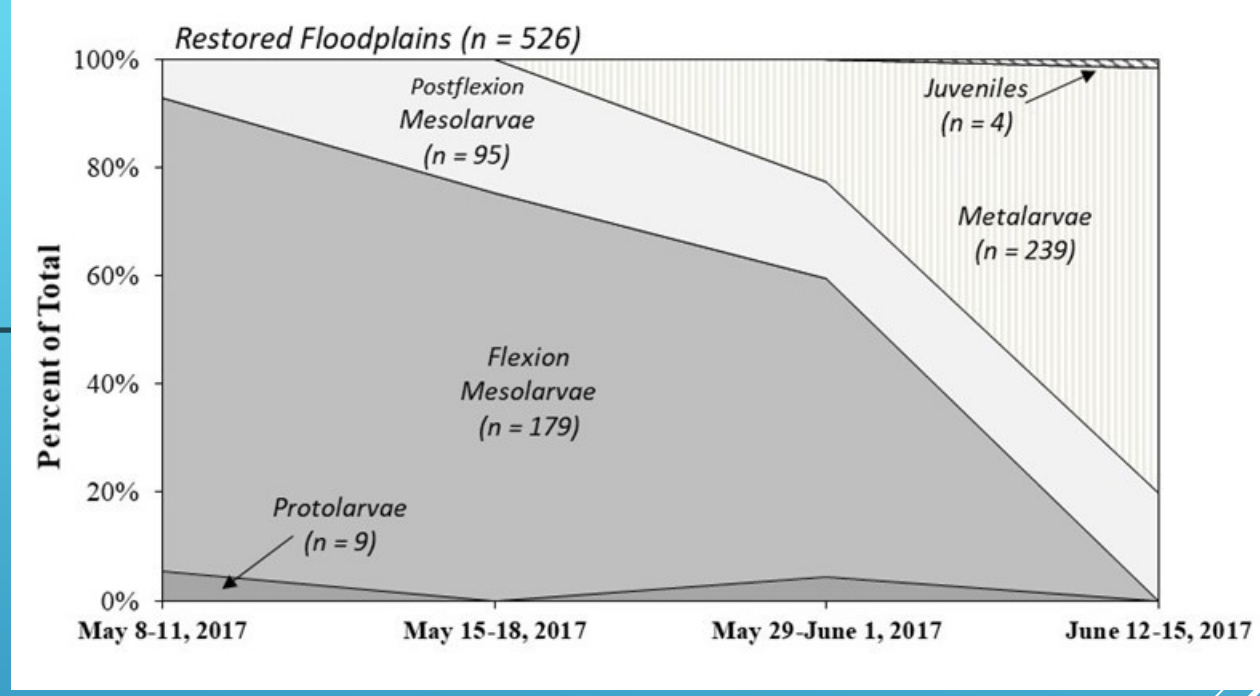


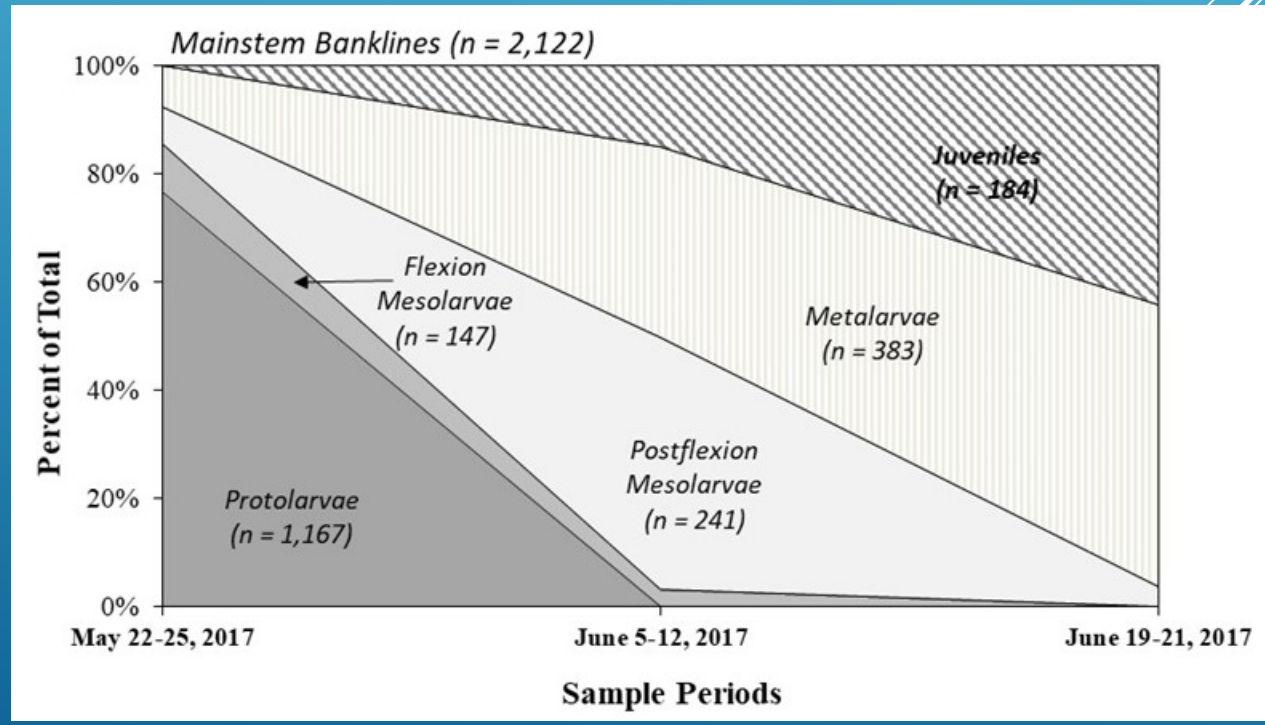
Swimming Performance of PF Mesolarva and Metalarva is significantly greater (at 14-22 dph)

Illustrations from: Brandenburg, W. H. 2018. Species account—*Hybognathus amarus*, Rio Grande silvery minnow. American Southwest Ichthyological Researchers, Albuquerque, NM.

Larval Phases in Floodplains

- All four phases are present in floodplains, but few juveniles.
- All phases are present in mainstem, but increasing numbers of juveniles.
- Larvae appear to leave floodplains as postflexion mesolarvae (14 dph) and metalarvae (22 dph).





Estimated Spawning Dates

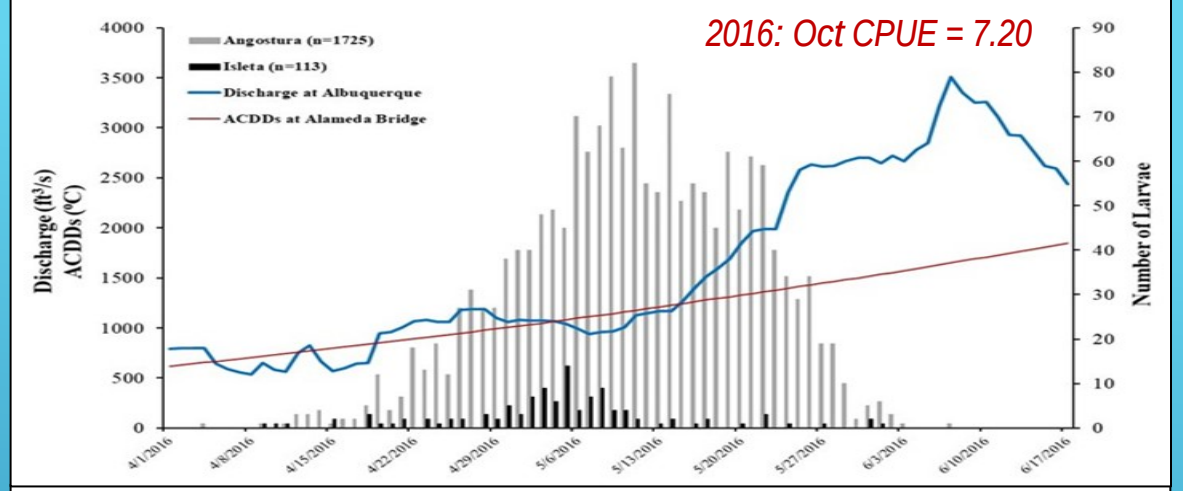
Spawning Spanned
~40-50 days

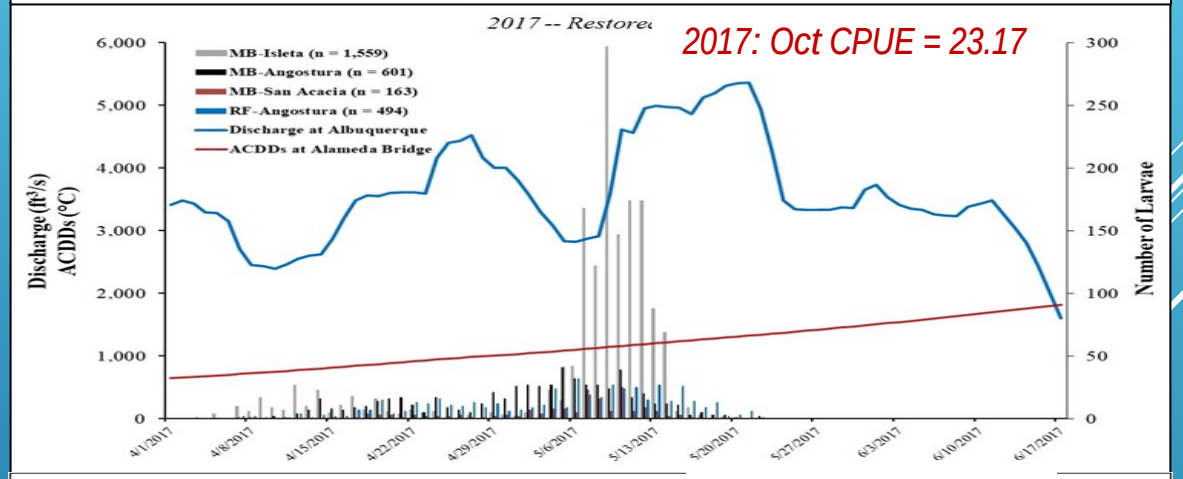
Year	No. Larvae	~ Earliest	~ Latest	~ Peak	Earliest Temp	Earliest ACDD*
2016	1,838	4/10/2016	6/1/2016	5/11/2016	12.5°C	692-717
2017	2,817	4/12/2017	5/20/2017	5/10/2017	12.9-14.1°C	777-931
2019	4,931	4/7/2019	5/15/2019	4/29/2019	12.2°C	604

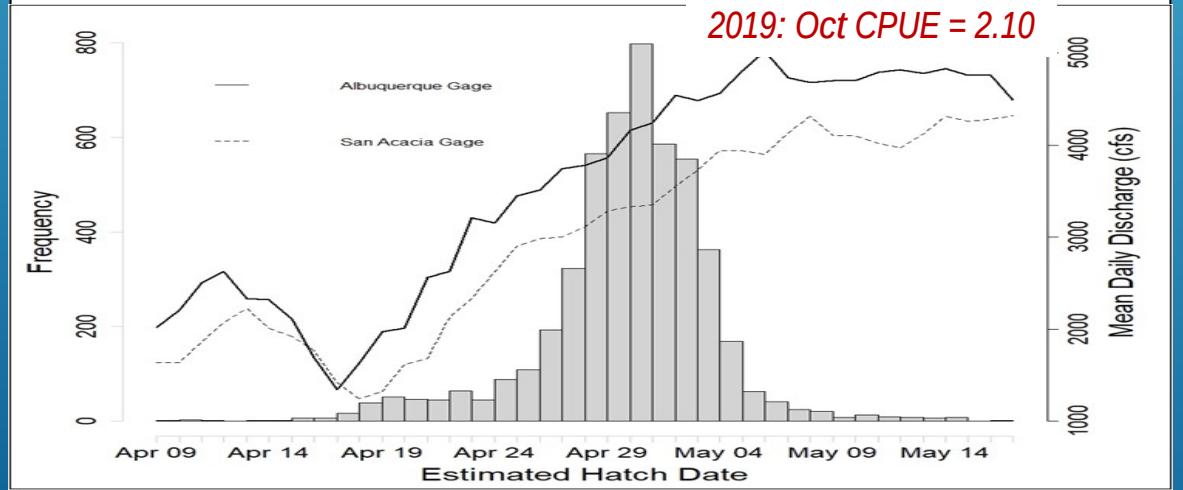
* ACDD = annual cumulative degree-days at Alameda starting Jan 1

Valdez, R. A., S.A. Zipper, S.J. Kline, and G.M. Haggerty. 2020. Use of restored floodplains by fishes of the Middle Rio Grande, New Mexico, USA. Ecohydrology (In Press).

Zipper, S.A., S.J. Kline, and R.A. Valdez. 2020. Spring 2019 study of Rio Grande silvery minnow spawning and nursery habitat of restored and natural floodplain sites of the Middle Rio Grande. Final Project Completion Report by SWCA to New Mexico Interstate Stream Commission, Albuquerque, NM.







Conclusion: A single RGSM larva needs 14-22 days of floodplain inundation

PF Mesolarvae (~14 dph, 6-8 mm)

Metalarvae (~22 dph, 9-10 mm)

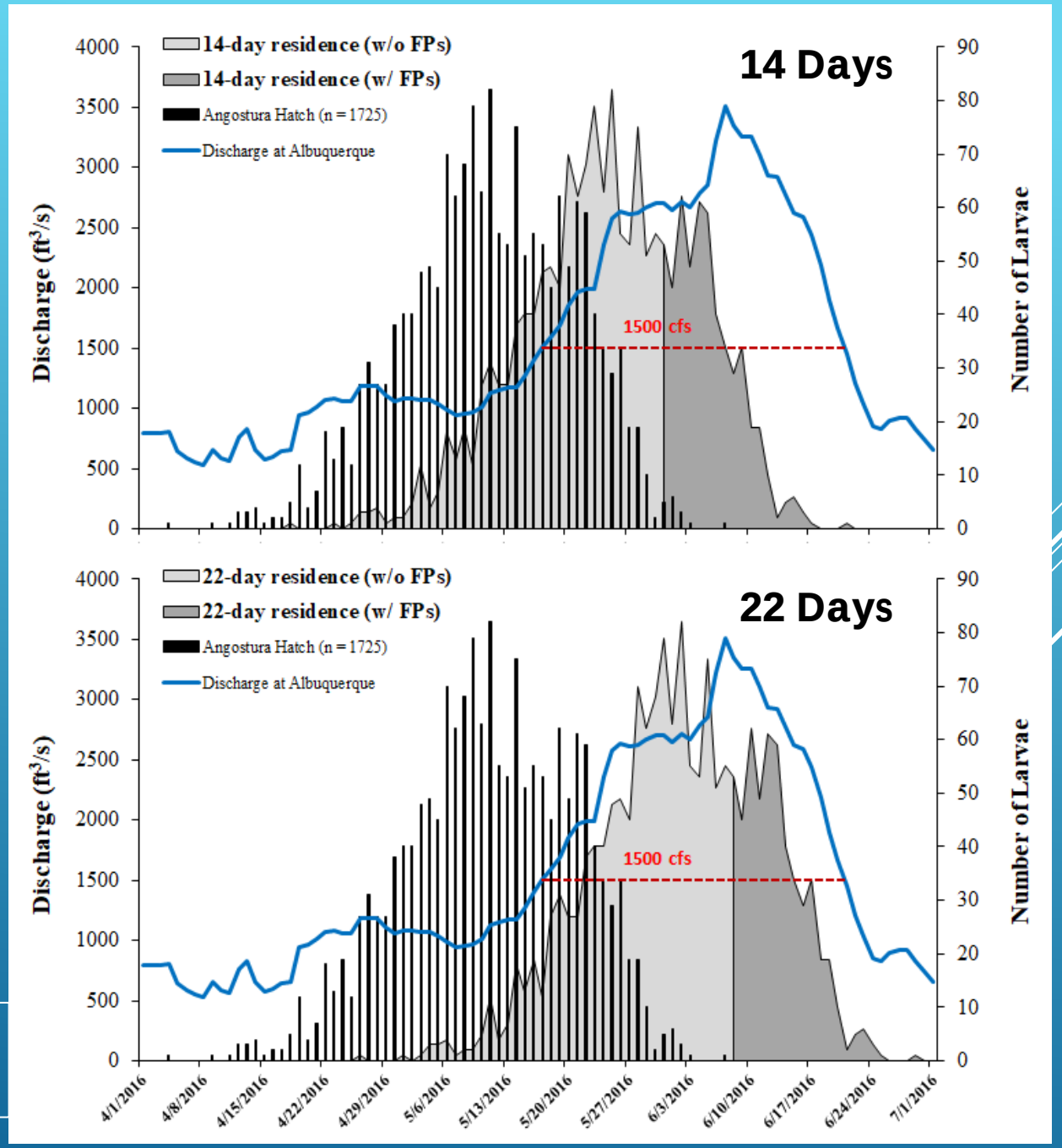
Lines of Evidence:

1. Proportions of larval phases in floodplains—fewer metalarvae, no juveniles.
2. Consistent with outdoor aquaculture facility (Tave & Hutson, 2012).
3. In literature, tests show increased swimming performance of PF mesolarvae (14 dph) and metalarvae (22 dph) (see Valdez et al., 2019).

Valdez, R. A., G. M. Haggerty, K. Richard, and D. Klobucar. 2019. Managed spring runoff to improve nursery floodplain habitat for endangered Rio Grande silvery minnow. Ecohydrology 12(7). https://doi.org/10.1002/eco.2134.

Inundation for Entire Hatch

- **Ideally, 40-50 days of inundation.**
- In 2016, only about 30% of hatch occurred during floodplain inundation, and Oct CPUE increased from 0.16 in 2015 to 7.2 in 2016.
- In 2017, entire hatch with inundation, and CPUE was third highest at 23.17.
- Synchrony of hatching and floodplain inundation—as well as DURATION– are vital to RGSM larval survival.



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