Middle Rio Grande Endangered Species Collaborative Program

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2020 Science Symposium Q&A – Day 2

December 2, 2020

Virtual Field Tour: Southwestern Native Aquatic Resources and Recovery Center (ARRC), Wade Wilson, U.S. Fish & Wildlife Service, Southwestern Native ARRC

Q. **From Catherine Murphy, Program Support Team:** Looks like you all do most of your own maintenance—is the facility self-sufficient?

A. **Answered live by Wade Wilson and Southwestern Native ARRC staff.**

Q. **From Casey Ish, Middle Rio Grande Conservancy District:** Why is this facility in Dexter, NM? Is there spring water that is unique to that area?

A. **Answered live by Wade Wilson and Southwestern Native ARRC staff.**

Q. **From Grace Haggerty, New Mexico Interstate Stream Commission:** How much water do you use at the facility during the year, and what is the source of the water? Do you have any water quality issues? Also, what have you been using the eDNA lab for so far?

A. **Answered live by Wade Wilson and Southwestern Native ARRC staff.**

Rio Grande Silvery Minnow Reproductive Monitoring (2003–2020), Robert Dudley, American Southwest Ichthyological Researchers, L.L.C. & Museum of Southwestern Biology, University of New Mexico

Q. **From Thomas Archdeacon, U.S. Fish & Wildlife Service:** A lot of this looks fairly consistent with your 2007 paper on particle drift, can you elaborate on anything you've learned since then?

A. **Answered through email by Robert Dudley:** Yes, in the original 2007 paper (Dudley, R.K., and S.P. Platania. 2007. Flow regulation and fragmentation imperil pelagic-spawning riverine fishes. Ecological Applications 17: 2074–2086.), we focused on the downstream transport of eggs/larvae (using passively drifting particles) across multiple river systems. We found that eggs/larvae were dispersed widely throughout the rivers, with some being retained near the release point and others being transported long distances downstream. Thus, this doesn't require upstream migration for population persistence (e.g., as in salmon) but rather just the dispersal of fish and access to upstream reaches (Platania, S.P., J.G. Mortensen, M.A. Farrington, W. Howard Brandenburg, and R.K. Dudley. 2019. Dispersal of stocked Rio Grande Silvery Minnow (RGSM; Hybognathus amarus) in the Middle Rio Grande, New Mexico. Southwestern Naturalist 64:31–42.). Our current work reinforces those earlier findings (i.e., eggs/larvae dispersed widely near/far following spawning). However, our recent work (and that of others) has highlighted the crucial importance of floodplain inundation in both the retention and recruitment of RGSM. It is important to note that even during the best conditions (i.e., extensive overbank flooding), we still find that eggs/larvae are widely dispersed and some are still transported into irrigation networks or into downstream reservoirs. This has been a consistent finding over time,

and it reinforces the importance of ongoing efforts to restore dynamic river flows, reconnect fragmented reaches, and reestablish a functional floodplain.

Q. **From Grace Haggerty:** Glad we now are now all on board with this. On board meaning we need to do habitat restoration. We got eggs in San Acacia this year, so why do you say there wasn't spawning in 2020?

A. **Answered through email by Robert Dudley:** Yes, we've long acknowledged the importance of flow/habitat in affecting the downstream dispersal/transport of RGSM eggs/larvae. What has become even more apparent over time (based on our studies and others) is the crucial importance of floodplain inundation (e.g., habitat restoration) to help ensure the successful retention/recruitment of RGSM on an annual basis.

We collected large numbers of eggs in the Angostura/Isleta reaches, but very few in the San Acacia reach. For example, we did find large numbers of eggs just upstream of San Acacia Diversion Dam near Sevilleta National Wildlife Refuge (NWR). Our sampling site in the San Acacia reach, however, is just upstream of Elephant Butte Reservoir (i.e., downstream of where drying/pumping occur). I would guess that there would have been eggs present this year farther up in the San Acacia Reach (upstream of Bosque del Apache NWR).

Q. **From Thomas Turner, University of New Mexico:** Does sampling efficiency vary with flow rate, and could this affect egg passage and occurrence values?

A. **Answered through email by Robert Dudley:** Sampling efficiency seems to be relatively constant across flows/velocities, particularly as we use methods to ensure that our sampling screens are kept clean and water can flow freely through them at a wide variety of flows. I would not expect large differences in the occurrence or egg-passage estimates, because the eggs remain in suspension even when subjected to minute flow velocities. We have examined that question on a small scale (e.g., multiple measured environmental concentrations (MECs) within 5 m of the shore), with vastly different velocities, but haven't noted any large differences in either occurrence/egg-passage values. However, it might be interesting to set multiple MECs across the full river channel (i.e., different flow rates), when that is feasible, to see if there are differences in either occurrence/egg-passage values as a function of spatial location or flow rate. My suspicion is that the eggs are so fully mixed into the water column and across the river channel that it wouldn't have a major effect on those metrics. One caveat to all of this, however, is that we're not capturing all the detailed spatial information on RGSM occurrence/passage-rate values, as we're limited to a few sampling sites (e.g., data collected at the upper/middle/lower portions of each reach could be somewhat different). As with any ecological study, more sites/sampling is always better! Ultimately, I think we're getting solid data across reaches and years, using consistent/stable methods, which allows us to make robust inferences about RGSM reproductive ecology over time.

Q. **From Yasmeen Najmi, Middle Rio Grande Conservancy District:** I believe you mentioned in your presentation that 2020 was the first year you analyzed floodplain inundation as a separate factor. Do you have data on floodplain inundation prior to this year, i.e. when the floodplain actually inundated on a large scale.

Q. **From Grace Haggerty:** Eggs are quite difficult to detect on floodplain though we find some eggs and larvae do drift onto the floodplain. We think most eggs are spawned on the floodplain though and with the number of larvae that is the best explanation.

Q. **From Mick Porter, U.S. Army Corps of Engineers:** Eggs are very challenging to find on the floodplain. Most eggs on the floodplain were probably spawned there. The percent spawning in river versus floodplain impossible to estimate with current methods.

A. **Answered through email by Robert Dudley:** Yes, we included a floodplain inundation metric in our RGSM reproductive-ecology models this year. We used floodplain estimates from 2003 to 2020 for that analysis, and these estimates were based on data/model/equations derived from this study (USACE [U.S. Army Corps of Engineers]. 2010. Historic inundation analysis along the Middle Rio Grande for the period 1990 to 2009.). There are several ongoing modeling efforts to come up with even more robust estimates of floodplain inundation over time, so we'll include those estimates (e.g., USACE/USBR) when they are available across all reaches over time.

Interestingly, those years with very high inundation (e.g., 2017/2019) resulted in lower egg passage rates, which would be quite beneficial for RGSM. In other words, flooding seems to result in reduced downstream transport of eggs past diversion structures, into irrigation networks, or into Elephant Butte Reservoir. It seems that RGSM spawns primarily along the margins (very low velocity areas) of the river and, when available, the very slow flowing areas of floodplain habitats (these areas seem ideal for RGSM recruitment). Although there aren't robust estimates of the percentage of eggs spawned in the river vs. floodplain, we can surmise (based on long-term reproductive/population monitoring) the important mechanisms that are driving both egg retention/transport, along with fish recruitment, so that we can come up with informed management actions (within an AM framework) that should help to support resilient and self-sustaining populations of RGSM. So, reconnecting these potential floodplain habitats to the river, across a range of flows, is extremely important, not just for upstream egg retention but also for the successful recruitment of larval and juvenile RGSM. I think continuing long-term ecological research in both the river and floodplain will continue to elucidate key factors that regulate this complex ecosystem, which will be essential for achieving recovery of the Rio Grande Silvery Minnow.

Surface Flow Intermittency Results in Ecological Traps for a Fish Assemblage: Implications for Conservation, Thomas Archdeacon, U.S. Fish and Wildlife Service

Q. **From Grace Haggerty:** Can you translate the number of pumps into cfs at SB and downstream?

A. **From Thomas Archdeacon:** Yes, it's included on one of the slides earlier.

A. **From Ashlee Rudolph, U.S. Bureau of Reclamation:** Each pump contributes about 11 cfs.

Q. **From Mick Porter:** When will the report be available?

A. **From Ashlee Rudolph:** Report should be available before the end of the month.

Q. **From Ari Posner, U.S. Bureau of Reclamation:** Do we know if the short trips would become longer if given more time? Does this have implications for the need for fish passage?

A. **From Thomas Archdeacon:** It's not evident from a decade of examining spatial trends in pools. Rate of drying did not affect numbers of adults trapped, and did have a small effect on young-of-year (YOY), which is a hard discrepancy to explain. See the Archdeacon & Reale 2020 publication cited within.

I have a second answer for Ari that will be included in the report. We looked at the spatial distribution of silvery minnow collected from isolated pools in 2018 and 2020. Fish were given about 3 days to move in 2018 and 4 weeks to move in 2020, yet the distributions were similar. My speculation is that cue to actually move comes far too late and the fish are either unwilling or unable to move between pool habitats.

Response. **From Ari Posner:** These findings seem to support a natural history model that describes a species that relies on large numbers of eggs to maximize long-term survivability, and not so much a response to changing ecological variables. Does this suggest that a focus should be put on the most upstream locations, as they are most likely to have the highest flows that have the longest duration? And that large upstream larvae recruitment will eventually work its way downstream.

Environmental Flow Analysis for Rio Grande Silvery Minnow Recruitment, Mick Porter, U.S. Army Corps of Engineers

Q. **From Thomas Archdeacon:** Your top AIC scores are all pretty similar, indicating model ambivalence. Have you thought about model-averaging? I'm not sure how that would work with each model having a single, unique term though. Also, did you try to normalize or standardize any of the predictor variables, as I imagine some span orders of magnitude. Without seeing the actual data, it's hard to judge a model by just the R^2, will you be able to present that actual scatterplots in a report?

A. **From Mick Porter:** The fish and environmental metrics are auto-correlated, which may contribute to model ambivalence. I didn't normalize the predictor variables. Yes, they vary considerably. In this case, the variability is what we are trying to tease out from the noisy data.

Response. **From Thomas Archdeacon:** If you are using an annual time-step, the fish data shouldn't be auto-correlated very strongly, at least not in October surveys.

Response. **From Mick Porter:** Correct, auto-correlated within a year. Initially used 5 fish metrics for model.

Response. **From Thomas Archdeacon:** But you did not account for that auto-correlation in your models? Do you think that is artificially underestimating your variances?

Response. **From Mick Porter:** Each model is fish ~ environment.

Response. **From Thomas Archdeacon:** That's what I understood from your presentation. So the fish data probably isn't too auto-correlated at the annual time step. You just have a bunch of predictor variables that are all telling you the same thing. Given no model clearly floated to the top, you should probably consider model-averaging, though again I'm not sure how that might work with only a single predictor per model.

Response. **From Mick Porter:** Thanks Thomas. I will follow up.

The Next Generation of Rio Grande Silvery Minnow Genetic Monitoring, Guilherme Dias, Department of Biology & Museum of Southwestern Biology, University of New Mexico

Q. **From Grace Haggerty:** I'm wondering the age of the fish that were used as broodstock and was there genetic information on them?

A. **From Guilherme Dias:** I think the age of the fish were essentially young of the year (Megan Osborne can give a more clear answer), and we have samples from broodstock but only for microsatellites. Actually would be nice to have rad-seq data for these samples too. It would help to clarify some details of genetic variation as the inbreeding question.

A. **From Megan Osborne, University of New Mexico:** There were no captive stocks included in the dataset that Gui presented. We have collected genetic data (microsatellites and mitochondrial DNA) for representative captive stocks from all facilities released to the river each year— these are YOYs. More recently, we have also collected genetic data from broodstocks held at each facility.

Once we have the GTseq panel we will be able to go back to the captive stocks and genotype them using the new markers.

Response. **From Guilherme Dias:** Yes. RADseq was the way to identify these genetic markers but GTseq will guarantee the replicability.

Q. **From Dana Price, U.S. Army Corps of Engineers:** Some of the important things we wanted to use the markers for (going back to the genetics peer review panel recommendations) include optimizing group spawning; identifying paternity/family relationships so family size can be equalized in augmentation, and identifying adaptive variation. This goes beyond the genetic monitoring that's been done in the past. Considering the Program's high hopes for these new markers, what considerations should be taken into account when deciding which markers to focus on for future work?

A. **From Guilherme Dias:** This is an important question. There are several aspects to take into account to choose the markers, depending on the goals. For example, for parentage analysis, markers with higher heterozygosity are more useful. But for monitoring genomic diversity, using only these markers will inflate the diversity estimated. So it may be challenging, considering the limiting number of markers that we can use.

As far as I know, the augmentation program does not optimize family sizes and does not currently use orchestrated family crosses. This may be difficult to do considering the high number of fish the facilities have to deal with.

A. **From Thomas Turner:** Guilherme's presentation was an important step in developing the markers and marker selection for future studies. A critical step is to understand how the new approach links to previous approaches used for monitoring. We have been simultaneously working on selecting markers (from the thousands that Gui presented) for high-throughput analysis that can be broadly employed for the other analyses you identified in your comment. We could not fit this into this presentation. Stay tuned for future presentations and reports!

Response. **From Guilherme Dias:** We are trying to achieve a set of markers that mimic the variation detected with the full dataset.

Keynote Speaker: Laura Paskus, NM PBS

Q. **From Grace Haggerty:** Do you think the Covid news has prepped the public to be more in tune to science information and so perhaps we should take advantage of that interest?

A. **Answered live by Laura Paskus.**

Q. **From Catherine Murphy:** What do you think is the biggest obstacle to effective science communication with the public?

A. **Answered live by Laura Paskus.**

Q. **From Grace Haggerty:** What do you think the public is most interested in hearing when it comes to the Rio Grande?

A. **Answered live by Laura Paskus.**

Q. **From Becky Bixby, University of New Mexico:** There is a real push in the social science realm to have more bi-directional outreach (termed public engagement in science) rather than one-directional outreach....so it's scientists talking with, not talking to...the public. Can you give your thoughts?

A. **Answered live by Laura Paskus.**

Response. From Laura Paskus: Hit me up with any questions, laura.paskus@gmail.com. I thought of one other thing: (post COVID), invite a state legislator (or a member of your congressional delegation) to visit your field site.

Linking Hydrology and Geomorphology on the Middle Rio Grande with Habitat Conditions for the Rio Grande Silvery Minnow, Jake Mortensen, American Southwest Ichthyological Researchers, L.L.C.

Note. Email jake_mortensen@asirllc.com with any comments or questions.