NM WRRI Student Water Research Grant Progress Report Form
Final Report

1. Student Researcher: Richard M. Raymondi
   Faculty Advisor: Jesse E. Filbrun, Ph.D.

2. Project title: Investigating the effects of flow on growth and survival of larval pelagic-spawning minnows of the Pecos River, NM

3. Description of research problem and research objectives.

   There is a significant knowledge gap regarding the early life histories of pelagic-spawning minnows and other native fishes pertaining to current water resource management strategies in the Pecos River, NM. Due to agricultural and human demands, the Pecos River has numerous impoundments that store and divert water for consumption. Current strategies involve periods of extended reservoir storage followed by prolonged and intense reservoir releases. As a result, the Pecos River no longer resembles historical conditions and is unable to provide basic ecosystem services to native ichthyofauna. The ecological issues arising from the intense management style of the Pecos River, characterized by prolonged periods of reservoir storage and short but high intensity reservoir releases, has been exacerbated through prolonged drought, rising temperatures, and reduced precipitation. Accelerating climate change has further compounded these effects. The objective of this research project is to test the effects of streamflow on early life using an artificial stream tank.

4. Description of methodology employed.

   Target species of fish (Plains Minnow, Red Shiner, Sand Shiner, Speckled Chub), including pelagic-spawning minnows and other native minnows, were collected via backpack electrofishers from the Pecos River near Fort Sumner, NM and transported back to our wet lab at ENMU. In the lab, specimens were sexed through phenotypic characteristics and level of sexual maturity. Females that were most gravid were observed to release eggs when abdominal pressure was applied or characterized as having distended abdomens, an indication that eggs were present. Males freely emitted milt due to abdominal pressure and lacked distended abdomens. Individuals that were spawning ready were injected with Ovaprim®, a commercial spawning agent used to induce and synchronize reproductive behaviors, and then placed inside of aquaria with different environmental variables.

   We experimented with two different injection sites, intramuscular (IM) injection administered behind the dorsal fin and intraperitoneal (IP) injection near the anal vent. Ovaprim® doses were also manipulated; fish received either a single dose, multiple doses, or split doses. Male to female ratios were either 1:3 or 2:3, fluctuating based on available mature fish stock. Injected fish were subjected to one of three environmental conditions: no flow, low flow, and medium flow controlled via powerheads. Various substrate media were presented to injected fish which composed of no media, gravel, and stacked tile.

5. Description of results; include findings, conclusions, and recommendations for further research.

   During June through August, 438 fish were injected with Ovaprim®, which consisted of: 159 Plains Minnow, 152 Red Shiner, 80 Sand Shiner, and 47 Speckled Chub. Unfortunately, only four unique spawning events occurred of which one was the release of unfertilized eggs. Plains Minnow were responsible for the single unfertilized egg event with Red Shiner being the only species with successful egg hatching. Since laboratory spawning proved unsuccessful, the ultimate goal of testing flow on fish larvae was unable to proceed.

   Regarding successful spawning events, eggs released after the Plains Minnow injection were the result of the IP injection with no flow or substrate present. The Red Shiner fertilization event was due to injection at the DO site with low flow and tile substrate. We are uncertain if any one of our treatments were responsible for spawning as not enough replications were performed to be confident in a conclusion. The overall goal of this project was not to establish injection methodology in a clinical fashion as we relied on previous reports of the efficacy of Ovaprim® for inducing spawning in minnows. A literature search yielded publications on the successful use of Ovaprim® in inducing spawning of species belonging in the same family and genus as our target species, but not for our target species. Failure of our specimens to respond positively to Ovaprim® may be due to a physiological and/or environmental conditions. Although we were unable to induce large enough numbers of synchronous spawning events to complete our planned stream tank trials, we did collect over 4,000 drifting eggs in the river. By identifying those eggs, we will still be able to test our hypothesis that reservoir block releases impair reproductive efforts of native minnows. We will also use our dataset on adult assemblages in the river to test how flows impact spawning movements.

   We believe that Ovaprim® will aid in the laboratory induced spawning of Pecos River minnows but water chemistry, flow, and substrate play a critical role. Future trials should mimic Pecos River water chemistry in the lab as river chemistry changes pre- and post-reservoir release. Creating variable flow in aquaria may play a vital role in initiating reproductive behaviors in conjunction with Ovaprim® as decreasing flows after a “pulse” serves as a reproductive signal for some Pecos River minnows. Lastly, providing substrate specific to spawning requirements of the desired species may prove fruitful when trying to artificially induce spawning of wild fish. Moving forward, we will complete habitat improvements in our wet lab and to our outdoor stream tank, as budgeted.

   In order to fulfill the requirements for a Masters of Science, I shifted my focus onto DNA barcoding fish eggs and assessing adult body condition of fishes in the Pecos River, NM. The objectives of this new project were similar to those of the initial research project, I aimed to quantify the effects of flow on the early life histories of pelagic-spawning minnows by investigating the effects of reservoir releases on the downstream fish assemblage. I analyzed the drifting fish egg assemblage and adult body conditions of target species in relation to the single June 2020 reservoir release by Sumner dam near Fort Sumner, NM with emphasis on pelagic-spawning minnows. Both spawning and adult (length and weight) data recorded for my initial project were critical components in my new research.

6. Provide a paragraph on who will benefit from your research results. Include any water agency that could use your results.

   Any wildlife or water management agencies involved in the middle reach of the Pecos River, especially those that adhere to policies regarding management actions and their effects on wildlife, will benefit from this research. Specifically, the United State Bureau of Reclamation, United States Army Corps of Engineers, United States Fish and Wildlife Service, and the New Mexico Department of Game and Fish. Alteration of the Pecos River has already led to the extirpation of three species of fishes, with another nine listed as Species of Greatest Conservation Need and two more under consideration for increased protection by the NMDGF. Without timely management intervention based on scientific investigation, native fish populations will continue to collapse. Our data on artificial spawning trials can be used to inform captive propagation efforts of imperiled native minnows.

7. Describe how you have spent your grant funds. Also provide your budget balance and how you will use any remaining funds. If you anticipate any funds remaining after May 31, 2021, please contact Carolina Mijares immediately. (575-646-7991; mijares@nmsu.edu)

   In general, grant monies have been spent on procuring all the necessary agents and equipment necessary for the laboratory induced spawning of minnows and nutritional maintenance. We have spent further monies on the necessary items to monitor and maintain water chemistry in the wet lab as well as obtaining the powerheads for environmental manipulation. Recently, a new artificial stream tank pump was purchased to increase stream tank water velocity. We have spent $2,822.59 of the total awarded $4809.00 in grant money, leaving $1,986.41 for the rest of our project. The remaining balance will be spent on purchasing all the necessary equipment for the recirculating tank system that will maintain optimal water chemistry and installing the new stream tank pump for future experimental trials.

8. List presentations you have made related to the project.

   Raymondi, R.M. & Filbrun, J.E. (2020) *Establishing methods to artificially spawn Pecos River minnows*. New Mexico Water Resources Research Institute Water Conference, virtual conference.

   Raymondi, R.M. & Filbrun, J.E. (2020) *Measuring survival of drifting fish eggs and larvae in the Pecos River, NM*. Southern Division of the American Fisheries Society, Little Rock, AR.

9. List publications or reports, if any, that you are preparing. For all publications/reports and posters resulting from this award, please attribute the funding to NM WRRI and the New Mexico State Legislature by including the account number: NMWRRI-SG-2020.

   None at this moment.

10. List any other students or faculty members who have assisted you with your project.

    Jesse E. Filbrun, Ph.D., Sara Ricklefs, MS

11. Provide special recognition awards or notable achievements as a result of the research including any publicity such as newspaper articles, or similar.

    I received recognition for the NM WRRI award through the Eastern New Mexico University academic news department. An interview was conducted and distributed to faculty and students through email and other forms of social media. The interview was also made available in the Green & Silver Magazine, a joint Alumni Affairs and ENMU Foundation publication.

12. Provide information on degree completion and future career plans. Funding for student grants comes from the New Mexico Legislature and legislators are interested in whether recipients of these grants go on to complete academic degrees and work in a water-related field in New Mexico or elsewhere.

    Recently, I successfully defended my thesis and will be receiving my MS in Biology. Planning for my future career involves seeking employment in the management of natural resources in the western United States, specifically, in the SW or NW ecoregion. Pursuing an education at ENMU has not only allowed me to pursue fisheries, but advance my understanding of ecology, evolution, genetics, and fisheries management. The NM WRRI grant has been an outstanding experience, the first for me, and will undoubtedly help me propel my career in the sciences.