Efficacy of a Low-Dose EarthTec QZ® Treatment for the Control of New Zealand Mud Snails in a Hatchery Setting

Lorraine D. Avenetti, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086; lavenetti@azgfd.gov

Devon C. Oliver, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086; doliver@azgfd.gov

Alex Loubere, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086; aloubere@azgfd.gov

Jeff Sorensen, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086; jsorensen@azgfd.gov

Poster Presentation

The New Zealand Mud Snail (NZMS) *Potamopyrgus antipodarum*, Gray, 1843 is an invasive species of freshwater snail that has become established on several continents, including North America. Where they establish, NZMSs can achieve very high densities (>500,000 snails/m^2), alter food webs by sequestering large amounts of primary production, and out compete native grazers. In Arizona, NZMSs have been present in the Arizona portion of the Colorado River drainage since 1995 but were not known to be in any other Arizona waterbody until they were discovered in two raceways at Page Springs Hatchery (PSH) in 2019. QZ (EarthTec, Rogers, AR) is a copper based molluscicide currently approved for treating infestations of Dreissenid Mussels, but may prove useful in controlling NZMSs. However, concentrations used to achieve 100 percent mortality of target species in previous studies (> 1 ppm) would also prove lethal to trout. This study used a Cu^{+2} concentration of 60 µg/L (ppb) delivered via QZ, approximately 25% of 240 ppb lethality threshold for Rainbow Trout *Oncorhynchus mykiss*. In addition to NZMSs, survivorship of two native species of snail (Page Springsnail *Pyrgulopsis morrisoni* and Pond Snail *Physella virgata*) with established populations at PSH were evaluated. Snail survivorship was evaluated every 72-hours following initiation of treatment and was terminated after 30-days. There was no statistical difference in survivorship until the 15^{th} day of treatment ($p < 0.05$). Survivorship for NZMSs and Page Springsnail did not decline blow 50% until 18 days of treatment.

Gila Trout Egg Stocking as a Successful Repatriation Tool

Zachary S. Beard, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, Arizona 85086; zbeard@azgfd.gov

Brett J. Montgomery, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, Arizona 85086; bmontgomery@azgfd.gov

Poster Presentation

Gila Trout, *Oncorhynchus gilae* is endemic to streams above 1524 m in the Gila River basin of Arizona and New Mexico. Gila Trout were originally listed as endangered under the Endangered Species Act in 1973 and were down listed to threatened in 2006. One of the actions required to recover and delist Gila Trout is their repatriation into streams throughout their historic range. Currently, the most common way to repatriate Gila Trout is to stock Gila Trout that are 6-8 months old. This method is largely successful, but it has its disadvantages. Many Gila Trout recovery streams are remote and are difficult to access. As a result, a large amount of effort is required to carry 250 to 500 Gila Trout in to stock in a stream. One alternative to fish stocking may be the stocking of fertilized eggs into artificial redds built in the stream.

We tried this approach on two Arizona Gila Trout recovery streams, Grapevine and Frye Creeks. We stocked 19,000 Gila Trout eggs at Grapevine Creek and 24,000 Gila Trout eggs at Frye Creek. Visual surveys one month and four months after stocking found good survival of Gila Trout at Grapevine Creek, but no survival at Frye Creek. Stocking eggs may provide a method for repatriating Gila Trout eggs that requires less manpower and reduces the cost of raising fish.

Hydropower limits on aquatic invertebrates in the Grand Canyon affect fish biomass

Jan K. Boyer, David L. Rogowski, Arizona Game and Fish Department, 506 N Grant St. Suite L, Flagstaff, AZ, 86001, USA jboyer@azgfd.gov

Theodore A. Kennedy, USGS Grand Canyon Monitoring and Research Center, 2255 N Gemini Rd, Flagstaff, AZ 86001

Jeffrey D. Muehlbauer, USGS Grand Canyon Monitoring and Research Center, 2255 N Gemini Rd, Flagstaff, AZ 86001

Poster Presentation

In the Colorado River in Grand Canyon, hydropeaking at Glen Canyon Dam constrains aquatic invertebrate abundance and diversity via egg desiccation, resulting in some reaches of river with a diminished aquatic foodbase. Do hydropeaking induced patterns in invertebrate abundance affect higher trophic levels? We used long-term (2012-2019) fisheries monitoring data to investigate whether condition, relative biomass, and growth of Flannelmouth Sucker Catostomus latipinnis, Humpback Chub Gila cypha, and Rainbow Trout Oncorhynchus mykiss were correlated with midge abundance, which is negatively correlated with discharge at dusk. Fish were sampled using boat electrofishing and hoop netting at randomly selected reaches throughout 478 kilometers of the Colorado River. We calculated Le Cren's relative condition factor for each fish weighed, monthly growth rates for recaptured fish, and relative biomass (g fish/hour) for each site sampled. There we no relationships between fish condition or growth and midge abundance, but relative biomass of all species and Flannelmouth Sucker peaked near river kilometer 275, a reach with low water at dusk and high midge abundance. This suggests that hydropeaking constraints on aquatic invertebrates in the Grand Canyon affect organisms at higher trophic levels, such as insectivorous and omnivorous fish.

Mapping the Extent of Effluent Flow and Observing the Impacts of River Drying on Fish in the Santa Cruz River (Agua Nueva Reach)

**Anton E. Ebenal, University of Arizona, School of Natural Resources and The Environment, 1064 E Lowell St, Tucson, Arizona 85721; antonebenal@email.arizona.edu

Poster Presentation

The Santa Cruz River (SCR) prior to the 1930s was connected to groundwater year-round and served as invaluable habitat for native fish species such as longfin dace (*Agosia chrysogaster*) and Gila topminnow (*Poeciliopsis occidentalis*). Due to extensive groundwater pumping, the SCR is no longer connected to the groundwater table. Surface flows are highly variable and confined to select sections of the river as a result of effluent discharge. The SCR experiences partial drying multiple times a day. The objective of this study is to map effluent flow patterns in the Agua Nueva reach (32.28450000N, 111.02944444W)

(32.32808333N, 111.07250000W) of the SCR to assess potential impacts on fish, more specifically endangered Gila Topminnow. Three camera traps were initially placed (9/8/2019 – present) along the reach roughly 250 m apart with the purpose of capturing stream flow conditions (dry or wet) every half hour. An Additional two cameras were set on opposite ends of the reach in order to define the sections of the reach that is always wet and that is always dry. Once a week, we conducted an observational survey (10/25/2019 - present) looking for dead fish and fish isolated to drying pools. Surveys began at the furthest upstream point characterized by no flow (varied weekly). The study is still ongoing but thus far data indicates that fish mortality is greatest where initial drying and wetting begins and mortality declines the further downstream you move from that initial point. Gila topminnow fatality has not been observed at this point in the study.

Geomorphology affects desert fish assemblages in a restored travertine-depositing stream ecosystem in Central Arizona

**Nicolas Katz, University of Arizona, Department of Ecology and Evolutionary Biology, nkatz@email.arizona.edu
Dr. Scott Bonar, University of Arizona, USGS Arizona Cooperative Fish and Wildlife Research Unit, 1064 E. Lowell St. Tucson, AZ 85721, sbonar@ag.arizona.edu
Christopher Jenney, University of Arizona, USGS Arizona Cooperative Fish and Wildlife Research Unit, 1064 E. Lowell St. Tucson, AZ 85721, chrisjenney@email.arizona.edu

Poster Presentation

Stream geomorphology varies widely, and the general impact of the spatial and temporal variation of travertine deposition on fish habitat selection is not yet well known. Our research sought to examine the impact of variation in travertine deposition on native desert-adapted fishes in Fossil Creek, a restored stream ecosystem in Central Arizona. Herein, travertine deposition occurs as a result of high concentrations of dissolved calcium from its originating springs. Due to recent removal efforts, introduced and invasive species are no longer found in the upper portions of Fossil Creek. Subsequently, the communities in these regions serve as important modeling systems for understanding native desert fish ecology. Travertine deposition was visually estimated and compared with fish densities (taken by snorkel survey) in 7 sites throughout the creek. Variation in travertine deposition was found to significantly explain fluctuation in total fish density (p-val: 0.000323, F-statistic: 22.375), as well as individual species densities for 4 native species: *Castostomus clarkii* (p-val: 0.016, r^2= 0.146), *Gila robusta* (p-val: 0.035, r^2= 0.675), *Castostomus insignis* (p-val: 0.001, r^2= 0.631), and *Rhinichthys osculus* (p-val: 0.006, r^2= 0.362). Subsequently, we argue that the impact of travertine deposition on stream geomorphology may have significant implications for habitat selection by desert fishes, and therefore should be considered in the construction of habitat suitability criteria in stream ecosystems. Additionally, the maintenance of specific geomorphological mechanisms like travertine deposition is implicated in the success of desert fishes, and should therefore be considered when informing management and restoration efforts of stream ecosystems.

Effects of Flooding on Fish Populations in the Verde River

**Jenna Livingston, University of Arizona, School of Natural Resources and the Environment. 1064 E Lowell St, Tucson, AZ 85719; jennalivingston@email.arizona.edu
Nicolas Katz, University of Arizona, School of Natural Resources and the Environment. 1064 E Lowell St, Tucson, AZ 85719; nkatz@email.arizona.edu
Chris Jenney, University of Arizona, School of Natural Resources and the Environment. 1064 E Lowell St, Tucson, AZ 85719; chrisjenney@email.arizona.edu

Scott Bonar, University of Arizona, School of Natural Resources and the Environment. 1064 E Lowell St, Tucson, AZ 85719; sbonar@ag.arizona.edu

Poster Presentation

Abstract:
Flooding is a vital abiotic factor that determines how fish populations migrate and repopulate. Throughout the past decade, Arizona has faced a decline in flooding over its various rivers and streams which can cause a change in water depth, temperature, and flow velocity. In this study, we wanted to see if there was a specific environmental factor modified by flooding that induced a response, such as increased spawning, from fish populations in the Verde River. We conducted our research in 382 sampling units between May and July of 2019, which was after a 50,000 CFS flood in February. We took measurements of the vegetation density, temperature, velocity, depth, substrate, aquatic vegetation, and woody debris in each site. In order to capture the fish, we used electro grids and noted their species and measured the length of each individual. This data was then compared to data taken in 2017 before flooding had occurred to see if any changes in fish population or abiotic factors are the result of flooding, not the time of year or location. Post flooding, we found 452 native and 417 nonnative fish compared to 2017, where only 15 native and 230 nonnative fish were measured. We also found an increase in the water depth and available substrate. This research will help to see if there is a response from fish in the Verde River as a result of the flooding that occurred briefly before we gathered our data.

Water Quality in Acequias used by the Pueblo of Sandia

**Jason Montoya Bosque School. 4000 Bosque School Rd NW, Albuquerque, NM 87120 (505)227-0080 andre.montoya@bosquestudents.org

Poster Presentation

Water quality has been a highly talked about topic for indigenous communities along the Rio Grande. The Rio Grande is the main and most important river to New Mexico. It runs through the middle of the state and has a significant impact on the ecosystem. Different indigenous communities along the Rio Grande use the water for ceremonial and agricultural purposes which means the water quality is very important. The purpose of this project was to see how water quality in pueblo acequias are affected by run off and how fish and macroinvertebrate populations reflect the health and quality of the water. This was done by using various methods of water quality testing, and data collection through dip nets and seine nets. Through the results found, the data indicated that there was a higher population of pollution intolerant fish and macro species found further downstream vs the headwaters in Bernalillo. This meant that the health and quality of the water was better further into the pueblo. With the data that has been collected, it can be seen that the upstream waters in Bernalillo affect the water quality in the Pueblo of Sandia because this water is important for irrigation and cultural practices.

Can native Colorado River fish utilize New Zealand mudsnails as a food source?

**Haile Nelson, Basis High School, 1700 Gemini Drive Flagstaff, AZ, 86001; hailebnelson@gmail.com

David Ward, U.S. Geological Survey, Southwest Biological Science Center, 2255 N. Gemini Drive, Flagstaff, AZ 86001; dlward@usgs.gov

Laura Tennant, U.S. Geological Survey, Southwest Biological Science Center, 2255 N. Gemini Drive, Flagstaff, AZ 86001; Ltennant@usgs.gov

Poster Presentation

Invasive New Zealand mudsnail (Potamopyrgus antipodarumis) was first found in Arizona in 2002 in the Colorado River at Lees Ferry. It has since spread downstream within the Colorado River and has recently been discovered in Oak Creek. It can reach extremely high densities and alter aquatic food webs. With its protective shell, the New Zealand mudsnail commonly passes through the intestine of trout alive providing no nutritional value. Flannelmouth sucker (Catostomus latipinnis) and humpback chub (Gila cypha) which are native to the Colorado River possess pharyngeal teeth and may be able to crush mudsnails allowing them to be utilized as a food source. We evaluated this question in two-week, replicated laboratory trials using cobble collected from Lees Ferry. One hundred New Zealand mudsnails were placed in each of 9 tanks (three replicates of each treatment) at 20°C with either four flannemouth suckers, 4 humpback chub, or no fish (control). Flannelmouth sucker and humpback chub were both able to find and consume New Zealand mudsnail and crush them sufficiently to utilize them as a food source. This may be one reason for recent increases in these native fish species within the Colorado River in Grand Canyon.

Analysis of single nucleotide polymorphisms confirm the presence of Coosa Bass *Micropterus coosae* in the Upper Verde River, Arizona.

Matthew J. Valente, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; valentm9@erau.edu

Matthew R. Lewis, School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University, AL 36849; mrl0004@auburn.edu

Catherine E. Benson, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; bensonc5@erau.edu

Matthew Chmiel, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, Arizona 85086; mchmiel@azgfd.gov

Eric Peatman, School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University, AL 36849; peatmer@auburn.edu

Hillary L. Eaton, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; eatonh@erau.edu

Poster Presentation

Following finding mitochondrial DNA and morphological evidence for the presence of a Redeye Bass species in the Verde River, we analyzed nuclear DNA using a diagnostic single nucleotide polymorphism (SNP) panel. DNA from 5 individuals were genotyped at 64 nuclear SNP loci for comparison with reference populations of six species of black bass. Population genetic analysis using STRUCTURE showed that the 5 individuals tested aligned with Coosa Bass *Micropterus coosae* reference genotypes. The analysis of SNP nuclear DNA markers from the Upper Verde River support a hypothesis that these fish are Coosa Bass with no evidence of hybridization or introgression of Smallmouth Bass *Micropterus dolomieu* genes. When compared to other black bass species, excluding members of the Redeye Bass complex, all individuals from the Verde River were assigned to Coosa Bass with Q values >0.90 with no

other species exceeding 0.05. These results support the hypothesis that at least one of the historical introductions of black bass in the Verde River was an introduction of Coosa Bass. Further work is needed to determine the extent of the Coosa Bass presence in Arizona and if hybridization of Coosa Bass and other black basses has occurred elsewhere in the Verde River system.

Fish hatchery effluent affects the results of vertebrate eDNA metabarcoding studies in Oak Creek, Arizona

**Anna R. Wockenfuss, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; wockenfa@my.erau.edu

**Courtney S. Turner-Rathbone, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; turnerrc@my.erau.edu

Hillary L. Eaton, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; eatonh@erau.edu

Catherine E. Benson, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; bensonc5@erau.edu

Matthew J. Valente, Department of Biology and Chemistry, Embry-Riddle Aeronautical University, 3700 Willow Creek Rd., Prescott, AZ 86301; valentm9@erau.edu

Matthew W. O'Neill, Coconino National Forest, US Forest Service, 1824 S. Thompson St., Flagstaff AZ 86001; matthewoneill@fs.fed.us

Poster Presentation

Environmental DNA (eDNA) metabarcoding is a genetic tool that can be used to detect multiple species' barcodes in environmental samples. In this study, we conducted eDNA metabarcoding at the Bubbling Ponds and Page Springs Fish Hatcheries in Arizona. Study objectives included determining whether 16S rRNA vertebrate metabarcoding could detect threatened/endangered species, determining how fish hatchery effluent impacts the results of metabarcoding studies, and to characterize the distance that the eDNA from hatchery fish travels from its source. Triplicate water samples were collected in 250 mL volumes from eight sites. Water samples collected in the field were vacuum filtered in the lab, eDNA was then extracted, and polymerase chain reaction was used to amplify the 16S rRNA gene. Amplicons were sequenced using an Illumina MiSeq and clustered in operational taxonomic units (OTUs) at 97% sequence similarity. OTUs were compared to the GenBank database using BLAST. Samples taken from the sump at the Aquatic Research and Conservation Center resulted in detections of all threatened/endangered species on-site, including Spikedace *Meda fulgida*, Colorado Pikeminnow *Ptychocheilus lucius*, and Loach Minnow *Tiaroga cobitis*. Water samples taken downstream from Page Springs indicated that eDNA from fishes on station (Rainbow Trout *Oncorhynchus mykiss* and Brown Trout *Salmo trutta*) dominated metabarcoding data <400 m of the hatchery. However, no eDNA from hatchery fishes was detected at samples >2.5 km downstream from the hatchery. These results suggest that eDNA in hatchery effluent has the potential to mask metabarcoding results from fishes *in situ*, but that these effects are spatially isolated.