Fisheries Session 1 – Friday, January 31st, 2020 1:00-3:00 PM

Fisheries Student Paper Competition

Fish Abundance and Population Structure Pre- and Post- High Magnitude Flooding Event in an Arizona River.

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Oral Presentation:

The Verde River native fish assemblage has experienced significant declines, due in part to nonnative species introductions and an altered flow regime. Streamflow reductions of 25% are projected by the end of the century and droughts are expected to be of increased severity, duration, and frequency, further stressing native fish populations. However, high magnitude spring floods may favor native fishes of arid-land systems. These species have adapted to survive flood events as regular occurrences, while high magnitude flows have been shown to reduce nonnative fish populations. On February 16, 2019, the Verde River experienced its 5th largest flood in recorded history. We hypothesized that following this flow event, we would see an increase in the density of native fishes and a reduction in the density of nonnative fishes. To investigate, we sampled the fish community within the "Scenic" section of the Verde River with the use of prepositioned areal electrofishing devices (PAEDs). Data from this study was compared to data collected at the same locations, using this same method, in 2017. Our research revealed a significant increase in the density of native fishes with the greatest increase observed in Roundtail Chub, *Gila robusta*, and Sonora Sucker, *Catostomus insignis*. Most native fish were year-of-young, suggesting that a successful spawning event occurred following the late-winter/early-spring flood. There was no observed change in the density of nonnative species, nor in the density of adult fish between the 2017 and 2019 sampling seasons. These results demonstrate the importance and limitations of large spring-floods to the persistence and recovery of Verde River native fishes.

Effects of estradiol-17β on the survival, growth, and sex reversal of Red Shiner.

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Oral Presentation:

Estradiol-17β (E2) is an effective hormone for male to female sex reversal of gonochoristic fishes. The development of fish sex reversal methods benefits research in sex determination, allows production of monosex populations for aquaculture, and is used to produce Trojan sex chromosome carriers for population control. We investigated sex reversal methods of Red Shiner (*Cyprinella lutrensis*) through the administration of E2 treated feeds during their larval and juvenile development. We assessed the survival, growth, and sex ratios of Red Shiner fed 50 mg E2 kg^{-1} diet and 100 mg E2 /kg^{-1} diet for 60 days. We saw a significant reduction in the survival of the 100 mg E2 treatment group compared to the control and 50 mg E2 treatment group ($P < 0.05$). E2 treatment groups had a higher growth rate ($P < 0.05$) than the control and E2 treatment groups had a significantly higher proportion (81.1% - 93.5%) of phenotypic females ($P < 0.05$) upon maturation. Histological analysis of gonads in developing Red Shiner showed that the treatments ended when the fish were still too young for all males in the treatment groups to have undergone sex reversal. Our study found that Red Shiner sex reversal treatments should begin by 20 days post hatch (DPH) and extend to at least 100 DPH for maximum effectiveness.

Using native fish in Arizona high schools to teach Earth's carrying capacity and limiting factors.

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Oral Presentation:

Four Arizona high schools have ponds built on their campus stocked with Gila topminnow or desert pupfish, both native species. Current science teachers rarely use the ponds due to a lack of aquatic knowledge. We designed a curriculum that meets Arizona's new science standards (Next Generation Science Standards) and helps teachers use the ponds. Students will collect and access pond data to create graphs, observe variations, make predictions and use statistics to describe the small aquatic world at their school. Our curriculum allows students to create their own experiments based on observations with an emphasis on the importance of natural resources. Ponds emphasize that resources are limited, just like our larger world. Students will complete a population estimate for the pond and discuss how limiting factors can change the population number and the carrying capacity. In order to determine the effectiveness of the pond, only half of the students will visit the pond in person. The other students will use videos and pictures of the pond during the lesson. The lesson ends with comparing and contrasting the fishpond and planet Earth and discussing limiting resources of Earth. The use of pre and posttests will determine the difference between the two groups of students and the knowledge they gain.

Microplastic Pollution in the Effluent-dependent Santa Cruz River.

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Oral Presentation:

Microplastics are an emerging contaminant in waterbodies across the world. One important source of microplastic pollution is treated wastewater, which is often discharged directly into streams. In southern Arizona, effluent discharge supports perennial flow and riparian habitat in the Santa Cruz River but also brings microplastic pollution and its potential ecological challenges. In this project, we quantified microplastic concentrations in the water column, benthic sediment, and in western mosquitofish (*Gambusia affinis*) stomachs at 10 sites along the lower Santa Cruz River in Tucson, Arizona before and during the monsoon season. We found four types of microplastics in the river: fibers, fragments, film, and beads. Across all sites, microplastic concentration in the water column was ~33% higher during monsoon, with the majority of pieces (≥80%) being fibers in both seasons. In benthic sediment, microplastic concentration was nearly twice as high before the monsoon season (340 ± 54 No./Kg) than during the monsoon season (153 ± 21), with fibers and fragments being the most common types of plastic found in sediment. Before the monsoon season, only three of the 200 mosquitofish sampled had ingested microplastics. In contrast, microplastics were found in 20 of 200 fish sampled during the monsoon season. This project provides the first evidence that microplastics are common in the water column and sediment of the Santa Cruz River, and that mosquitofish are more likely to ingest microplastics during the monsoon season. Future studies should assess the long-term impacts of these microplastics on the health and populations of aquatic species.

Shrinkage of Rio Grande silvery minnow after preservation in formalin and storage in ethanol.

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Oral Presentation:

Preserving fish in museum collections allow researchers to use them as voucher specimens of the time and location they were collected. However, the ability to get morphological data from preserved fish at any time after preservation that accurately represents the morphology of the live fish is necessary for this method to be viable. Understanding how the preservation process affects fish morphology is important due to the fact that fixation and preservation can cause shrinkage to happen in most animal tissues. Failure to account for changes in body shape after fixation could confound analyses of changes of morphology over time. To test this, sixty-nine Rio Grande silvery minnow (standard lengths 32.14-81.65 mm) were observed over 545 days during formalin to water to ethanol preservation procedure. Standard length decreased by the end of each preservation step; formalin 97.8% of live length, water 96.5%, 35%-EtOH 96.1%, 50%-EtOH 95.8%, and 75%-EtOh 95.1%. Peak shrinkage occurred at 365-d with an average 92.6% of live length (SL 29.57-75.98mm). After 545-d Rio Grande Slivery Minnows began to increase in length and reached 96.1% of live length (34.62-79.72mm) at the final measurement.

New ammonia-based piscicdes: Getting from science to useable management tools.

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Oral Presentation:

Management and removal of invasive aquatic species is often difficult because the problems are typically large in scale with few effective tools available. Ammonia has many qualities that make it an effective candidate piscicide, such as its specific toxicity to gill breathing organisms, its high solubility, and its natural ability to detoxify via the nitrification cycle. Several studies have demonstrated the effectiveness of ammonia as a fisheries management tool in small-scale experimental settings but transitioning from small-scale experiments to large-scale eradication efforts on wild fish populations has been challenging. Large-scale management efforts to demonstrate effectiveness are hindered by regulatory requirements because ammonia is generally considered an aquatic contaminant with extensive laws preventing its discharge into natural environments. These regulations, while justified in terms of limiting detrimental effects of treated wastewater, impede the ability of scientists to gather the data that is required for licensing and registration of new ammonia-based piscicides. We are currently pursuing an experimental use permit from the US Environmental Protection agency to allow additional data to be gathered on effectiveness at larger scales. Getting from science to useable management tools is challenging and will require regulatory support.

Fisheries Session 2 – Friday, January 31st, 2020 1:00-3:00 PM

Environmental DNA and 16S rRNA metabarcoding detects fish and wildlife in the Verde River, Arizona

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Oral Presentation

In this study, the application of the 16S rRNA mitochondrial gene for vertebrate eDNA metabarcoding was explored in the Verde River, Arizona. During June and August 2018, six 250 mL replicate water samples were taken from three sites on the Verde River. In the lab, samples were vacuum filtered to collect eDNA and then amplified using polymerase chain reaction and an existing 16S rRNA primer set. The amplicons were then sequenced on an Illumina MiSeq FGx Forensic Genomics System. Paired-end reads were assembled and quality filtered before clustering into OTUs at 97% sequence similarity resulting in 5.9 million DNA sequences assigned to 85 OTUs. Each OTU was compared to the NCBI nucleotide database using BLAST. A total of 37 vertebrate taxa, classified at the rank of family or lower, were detected via eDNA analysis. This included members of all vertebrate groups, including 19 fishes, three amphibians, two reptiles, two birds, and 11 mammals. Of the 106 total vertebrate detections across all sites and months, 70% of species were detected in only one or two of the six sample replicates. This indicates that multiple replicates are necessary to characterize the vertebrate assemblage at sites. All taxa that were detected corresponded to those known to occur in the Verde River corridor. Species detected at sites included both aquatic species and facultative users of riparian areas. This study demonstrates the utility of eDNA metabarcoding as a tool for monitoring fish and wildlife in aquatic ecosystems.

Environmental DNA sampling of desert fishes: performance relative to location, species, and traditional sampling

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Oral Presentation

We performed experiments in desert streams to evaluate the efficacy of environmental DNA (eDNA) sampling for two rare minnows: Spikedace, Meda fulgida, and Loach Minnow, Rhinichthys cobitis. We compared detection sensitivity of eDNA assays to traditional sampling methods (electrofishing and seining) by using both techniques at 33 sites in 7 streams. We used caged-fish experiments to estimate eDNA production rates, persistence, and travel distances, and to estimate relationships between fish density, biomass and eDNA quantity. Loach Minnow were detected at 22 sites by both eDNA and traditional sampling, were not detected by either technique at 7 sites, and detected only by eDNA at 4 sites. Spikedace were detected with both techniques at 15 sites, not detected by either technique at 8 sites, and were detected only by eDNA at 7 sites. In the Verde River and Wet Beaver Creek, both species' eDNA was detected downstream of caged fish out to our maximum sampling distance of 500 m. Estimated eDNA production rates were greater for Spikedace than for Loach Minnow, although more Spikedace were used. Production rates for both species were greater in the Verde River than in Wet Beaver Creek. Persistence of eDNA did not differ among species, but was greater in Wet Beaver Creek than in the Verde River. In density experiments, the amount of Spikedace eDNA was positively related to the density and biomass of caged Spikedace, but the relationship differed between streams. We conclude that eDNA surveys are better than traditional methods for detecting rare lotic minnows.

Using Environmental DNA to Plan, Implement, and Evaluate Piscicide Treatments in Whitewater Creek

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Oral Presentation

Environmental DNA (eDNA) is an effective tool for determining fish presence and has recently been utilized to both plan and evaluate the success of nonnative fish removal projects. From 2013 to 2019, a large piscicide project has occured in Whitewater Creek to remove nonnative Rainbow Oncorhynchus mykiss and Brook Salvelinus fontinallis trout and restore Gila Trout Oncorhynchus gilae to approximately 39km of native range. Over the course of the project, more than 200 eDNA samples were collected throughout the drainage to assist with planning and evaluating the success of non-native removal. Sample results were used to inform project managers of important target areas and adjust treatment applications accordingly. Post-treatment electrofishing was also utilized to verify eDNA results and showed similar sample results, demonstrating the effectiveness and reliability of eDNA to determine nonnative presence and influence treatment decisions. Environmental DNA will continue to be used in the Whitewater Creek piscicide treatmet and other future piscicide treatments to evaluate removal success and inform treatment decisions.

Status of an Iconic Gila Trout Population Five Years after the Whitewater Baldy Wildfire

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Oral Presentation

For cold-water fishes with diverse life history traits, such as salmonids, the direct effects of wildfire can reduce, isolate, and eliminate populations. The indirect effects can increase risk of extirpation by reducing suitable habitat and connectivity to the habitats required to complete their life cycle. Since the 2012 Whitewater-Baldy Fire, the ponderosa pine, pinyon-juniper, and Madrean encinal woodland that compose the Gila River watershed have yet to recover. One stream system, Willow Creek, experienced a range of fire effects (from none to severe). This provided an opportunity to characterize the distribution of Gila Trout with respect to the availability and complexity of habitat post-fire, estimate abundance, and model survival. We conducted seasonal habitat and fish surveys from October 2017 to October 2018 and estimated apparent survival of Gila Trout throughout Willow Creek and across three seasons. There was no movement of fish among sites over the course of the study. The most highly supported model included the covariates of time for survival and site and time for capture probability (φ(~time)+p(~site+time)). Apparent survival between fall 2017 and spring 2018 (i.e., winter) was high (φ = 0.7506; 146 days). In contrast, apparent survival declined between spring 2018 and summer 2018 prior to monsoon rains when stream temperatures were rising (φ = 0.1717; 133 days). Habitat and elevated stream temperatures throughout spring and summer are not supporting a stable population of Gila Trout. Further investigation into the limiting habitat factors is warranted to ensure persistence of this Southwest coldwater fish.

Gila Trout Management and Recovery Efforts in Arizona.

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Oral Presentation

Gila Trout *Oncorhynchus gilae* are native only to the streams of the Mogollon Plateau of New Mexico and Arizona. Gila Trout were first listed as endangered in 1973 and were later downlisted to threatened in 2006. In 2017, the Frye and Goodwin Fires extirpated Gila Trout recovery populations from three streams in Arizona (i.e., Ash, Frye, and Grapevine Creeks) leaving only one recovery population of Gila Trout in Arizona (i.e., Dude Creek). Since 2017, Gila Trout have been reintroduced into four streams (Chase Creek, Frye Creek, Grapevine Creek, and Raspberry Creek) for recovery purposes in Arizona. These recovery efforts have consisted of stream evaluations, habitat surveys, stocking of 6 month old Gila Trout, and stocking Gila Trout eggs. As a result of these efforts Gila Trout are now present in 5 recovery streams in Arizona and monitoring surveys have documented natural reproduction of Gila Trout in two streams (i.e., Dude and Chase Creeks). In addition to the recovery efforts, the Arizona Game and Fish Department is also expanding recreational stockings of Gila Trout throughout the species historic range, creating unique recreational opportunities and increasing public support for Gila Trout recovery efforts.

Rio Grande Cutthroat Trout Stocking in the Rio Grande Gorge: the History and Growth of a Public Outreach Event.

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Oral Presentation

The New Mexico Department of Game and Fish (NMDGF) has coordinated stocking a difficult to access reach of the Rio Grande within the Rio Grande del Norte National Monument since the 1960's. More recently, this stocking effort has shifted from an agency task to a public oriented outreach event that promotes native Rio Grande Cutthroat Trout *Oncorhynchus clarkii virginalis*. While many aspects of the stocking have changed over time, one thing has remained the same: NMDGF personnel and volunteers strap packs filled with trout fry to their backs and hike them into the Gorge. In the beginning, Brown Trout *Salmo trutta* and Rainbow Trout *Oncorhynchus mykiss* were stocked primarily by NMDGF personnel to provide opportunity for anglers in this hard-to-stock location. In 2009, NMDGF switched to stocking Rio Grande Cutthroat Trout to promote conservation and public awareness for New Mexico's state fish. Fast forward to 2019 and the stocking event has grown to over 100 public volunteers, garnered community support, and provided a unique hands-on event for educational outreach

Fisheries Session 3 – Friday, January 31st, 2020 3:20-5:20 PM

Restoring Gray Redhorse populations in the Delaware River, New Mexico.

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Oral Presentation:

The Gray Redhorse (Moxostoma congestum) is a species native to the Gulf Coastal drainages of central and west Texas, the Rio Grande and Pecos River in Texas and New Mexico, and tributaries to the Rio Grande downstream of the Big Bend region. Gray Redhorse are listed in New Mexico as endangered and the American Fisheries Society considers this species to be threatened. By 2008, only two populations were known to persist in New Mexico. Fish kills resulting from golden algae (Prymnesium parvum) blooms were largely responsible for this extirpation. In 2012, the New Mexico Department of Game and Fish, in cooperation with the Bureau of Land Management, initiated a reintroduction of Gray Redhorse to the Delaware River. Habitat restoration of the Delaware River provided suitable conditions for repatriation. Forty-four redhorse were captured in the Black River and translocated between 2012 and 2017. Individuals were introduced to a site containing a translocated population of Texas Hornshell

(Popenaias popeii). As Gray Redhorse are as a primary host for the glochidia stage of the mussel, repopulating the Delaware River with redhorse also serves to ensure the long-term viability of Texas Hornshell. Multiple young-of-year Gray Redhorse were detected between 2016 and 2018 during annual monitoring of the restoration site. The creation of a third population reduces the risk of extirpation of both Gray Redhorse and Texas Hornshell in New Mexico. Future priorities for this recovery effort include improving fish passage on the Delaware River and identifying additional reintroduction sites in New Mexico.

Fish Assemblage Restoration in the lower Blue River, Arizona

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Oral Presentation

Opportunities for multi-species native fish restoration efforts are sparse in the desert southwest and such efforts are not always successful. The Blue River native fish restoration project began in 2009 with the goal of increasing the abundance of existing Loach Minnow, *Rhinichthys cobitis*, and establishing populations of Spikedace, *Meda fulgida*, and Roundtail Chub, *Gila robusta*. The project involved several steps including the completion of a fish barrier to exclude nonnative fish, removal of nonnative piscivores in the lower portion of the river above the barrier, stocking of native fishes, and annual monitoring. Mechanical removal efforts resulted in the successful eradication of nonnative fishes from the Blue River by 2017. Similarly, the fish community composition of the Blue River experienced a significant shift from roughly equal proportions of native and nonnative fish in 2012 to an exclusively native fish community dominated by the three focal species in 2019. Time since stocking best explained patterns in the relative abundance of the three focal species, but discharge may also play a role. Relative abundance of pre-existing native fishes was most influenced by relative abundance of nonnative predators. The distribution of the three focal species within the mainstem increased rapidly from 2012 to 2019 and Spikedace and Roundtail Chub are now dispersing and colonizing tributary streams. By evaluating factors that contributed to successful establishment of focal species, we can implement future restoration efforts with a more informed approach, ultimately resulting in additional successful restoration efforts.

Red Tank Draw Drainage Nonnative Fish Mechanical Removal

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Oral Presentation

Restoration efforts to benefit the conservation of native fish in the desert southwest often require control of nonnative species. The Arizona Game and Fish Department has been working to protect and restore Roundtail Chub *Gila robusta* (previously classified as *G. intermedia*), within the Red Tank Draw Drainage through eradication and suppression of nonnative fishes, and expansion of native fish

distribution within the drainage. This project included mechanical removal of nonnative piscivorous fishes including Green Sunfish *Lepomis cyanellus* and Black Bullhead *Ameiurus melas* in Red Tank Draw from 2016 through 2019. Over time there was a shift in size structure of Green Sunfish, reduction in Black Bullhead relative abundance, and an increase in abundance and CPUE of native species. The Department completed a comprehensive survey of the drainage in 2017 to determine the distribution of nonnative fish in the drainage. In Rarick Canyon waterfall barriers to upstream movement of fish were detected, and only Fathead Minnow were detected upstream, thus presenting an opportunity to expand the range of native fish upstream into Rarick Canyon. Unfortunately, in 2018 one Black Bullhead was visually observed above the waterfalls. Mechanical removal of Black Bullhead in Rarick Canyon began in April, 2019 with eradication achieved by August, 2019 after the removal of 14 bullhead in 6,201 trap hours. Subsequently, 319 Roundtail Chub were translocated above the falls in October 2019 to start a refuge population. By expanding this project to the entire Red Tank Draw drainage, additional opportunities for conservation were realized.

The Success of Green Sunfish Removals in McGee Wash.

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Oral Presentation

The threat that invasive fish species pose to native aquatic species is substantial. In McGee Wash, a tributary to Trout Creek in the Bill Williams River drainage, Green Sunfish *Lepomis cyanellus* pose a threat to the native aquatic species present. In 2017, the Arizona Game and Fish Department began a project to remove non-native Green Sunfish from McGee Wash to eliminate the threat to native aquatic species. McGee Wash has a 1.5 km stretch of perennial water that hosts an assemblage of native aquatic species including Roundtail Chub *Gila robusta*, Desert Sucker *Catostomus clarkii*, Sonora Sucker *Catostomus insignis*, Lowland Leopard Frogs *Lithobates yavapaiensis*, and Sonora Mud Turtles *Kinosternon sonoriense*. Removal efforts have consisted of monthly single pass backpack electrofishing and minnow traps to collect and remove all Green Sunfish. Initially Green Sunfish inhabited the entire perennial reach, and various age classes were found throughout the reach. After 33 mechanical removal trips the fish assemblage in McGee Wash has changed from a non-native dominated fish assemblage to a native fish dominated assemblage and few Green Sunfish have been detected. Mechanical removals will continue until Green Sunfish are eradicated from the reach. However, suppression of Green Sunfish has allowed the native aquatic species to repopulate the stream and distribute throughout the perennial reach.

Trout and Char of the World: A New Book on the Status and Conservation of trout and char across the globe

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Oral Presentation

This is the first comprehensive look at the taxonomy, life history, and conservation status of the world's inland trout and char. These are fascinating and beautiful fish that rate high for the angler as well as for tourist and recreational economies. Trout and char also play key roles in the ecology of many river and lake systems around the world. This book will be a resource for trout biologists, conservationists, and anglers in the many countries where trout are native or have been introduced.

This project assembles some of the most renowned trout biologists and conservationists from across the globe to contribute their knowledge and passion about trout and char. Much of this book documents new information about species diversity and distributions that has not been widely available before. Summary chapters explore significant conservation and management challenges posed by these fishes that should be of broad interest to scientists, resource managers, anglers, and interested public from around the globe. Trout and char are abundant in many regions but most native species are on the decline. Some are classified as vulnerable, threatened, or endangered. Because of their widespread stocking in regions where they are not native, some trout and char also are the cause for threats to other native species. Regardless of whether they are native or introduced in origin, rapid climate change is challenging their future as streams warm and waters become more variable in their flows. This book examines trout and char from all these perspectives.

The 100-watt method: Electrofishing for salmonids in small streams

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Oral Presentation

Since 2005, fisheries personnel with the Idaho Department of Fish and Game (IDFG) have successfully used a 100-W protocol for backpack electrofishing to capture salmonids in small streams. The protocol requires voltage adjustment to achieve 95-100 W average (continuous) power output in pools and riffles. Average power is not affected by pulsed DC frequency if duty cycle is kept constant. In 2017-2018, IDFG obtained data on electrical output, habitat features and capture efficiency for 18 small streams (1-6 m average width) in southern Idaho using the 100-W method. In each stream, two reaches (one for 30 Hz, the other for 60 Hz; both 24% duty cycle) were sampled for Cutthroat Trout *Oncorhynchus clarkii*, Rainbow Trout *O. mykiss*, and Brook Trout *Salvelinus fontinalis*. Among reaches, ambient water conductivity was 41-357 µS/cm and fish length (TL) was 9-29 cm. Average power output for all reaches was 99 W, close to the 100-W goal. Within all reaches, average power was 72-116 W in riffles and 89-136 W in pools. As expected, voltage decreased and current increased, with increasing conductivity. Capture efficiency among all reaches for both frequencies was 0.54-1.0 and was not dependent on

average power. Thus, the 100-W method served as a reliable standard even though frequency and fish size affected capture efficiency. The 100-W method is effective for salmonids in small streams, despite variation in frequency, fish size and conductivity, because salmonids are vulnerable to electrofishing, especially in small streams where boundary effects concentrate the electric field.

Fisheries Session 4 – Friday, January 31st, 2020 3:20-5:20 PM

Varying recruitment success of two endangered fishes in historically wet and dry years in the San Juan River.

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Oral Presentation

Recovering endangered fishes is intrinsically a difficult task, but the challenge of managing an arid river for the benefit of native fishes, including two federally endangered fishes, can be confounding. Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* are two big river fishes that coevolved in the Colorado River Basin and were both historically abundant in the San Juan River. Recovery efforts in the San Juan River have led to adult populations of both species that consistently spawn and produce offspring but examples of either species recruiting to post-larval stages are limited. However, in recent years (2016–2019) post-larval Colorado Pikeminnows and Razorback Suckers were detected. Vexingly, Colorado Pikeminnows were documented only during years with high flows (2016, 2017, 2019), while large numbers of post larval Razorback Suckers were documented during a historically low flow year (2018). Given the varied recruitment successes of both endangered fishes during drastically different hydrologic conditions, what are the best management actions to further the recovery of both species?

Innovative Approaches to Reduce Predation Risk on Hatchery-Reared Endangered Bonytail and Razorback Sucker

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Oral Presentation

Bonytail *Gila elegans* and Razorback sucker *Xyrauchen texanus* are two endangered fishes endemic to the Colorado River Basin. Population declines of both species are attributed to the introduction of non-native fishes and alteration to flow regimes. As part of the Lower Colorado Multi-Species Conservation Program, each year hatchery reared Bonytail and Razorback Sucker are reintroduced back into the wild. Goals include stocking over 600,000 individuals of both species over the life of the program. However, post-stocking survival is often poor as offspring are naïve to predation. Therefore novel strategies are needed to increase the post-stocking survival of these critically imperiled fishes. This study evaluated two potential strategies to reduce predation on Razorback Sucker and Bonytail: the use of artificial structures and predator recognition conditioning. Using Largemouth Bass *Micropterus salmoides* as a model

predator, subadult Razorback Sucker and Bonytail were used in three separate repeated-measures experiments to evaluate these strategies (each factor alone and the interaction between factors). Preliminary results indicate that artificial structure alone may effectively reduce the predation of naïve Bonytail, while a combination of both structure and predator recognition conditioning may be effective for Razorback Sucker.

Falling water, rising temperatures, growing fish?

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Oral Presentation:

In recent years, native fish have increased in abundance in the Colorado River in Grand Canyon, particularly in downstream reaches. Water temperature rises with increasing downstream distance from Glen Canyon Dam; one hypothesis for this recovery is that warm temperatures have increased spawning success, growth, and recruitment. We calculated growth rates from recapture data, recorded capture locations of ripe females, and calculated CPUE of juvenile fish for three native species. We determined temperature throughout the year at locations where growth and juvenile CPUE increased, or where ripe females were detected. We compared these temperatures with minimum and optimum temperatures for growth from a literature search. For Flannelmouth Sucker *Catostomus latipinnus*, we observed aggregations of ripe fish and a dramatic increase in juvenile CPUE near river mile 160, whereas for Bluehead Sucker *Catostomus discobolus* and Humpback Chub *Gila cypha*, we did not see increases in juvenile abundance until approximately river mile 200. Water temperatures in these reaches are above minimum thresholds, but still lower than optimum growth temperatures for these native fish species. Most habitats with high abundance of juvenile Humpback Chub and Bluehead Sucker was previously inundated under Lake Mead (River Miles 237-281); the shrinking of Lake Mead has contributed to native fish recovery by increasing the amount of warm lotic habitat that can support juvenile growth and recruitment.

Is Pearce Ferry rapid a barrier to native and a non-native fish in the Colorado River?

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Oral Presentation

Water elevation levels in Lake Mead have been declining since 1998. This decline in reservoir water levels has resulted in the reemergence of approximately 50 river miles of Colorado River habitat that was previously a lake. Additionally, over the last few years a new rapid, Pearce Ferry rapid has developed and grown in size. During this same time period the Arizona Game and Fish Department's long term monitoring of the Colorado River (Grand Canyon reach) has documented a decline in relative abundance of Common Carp and Channel Catfish. Results from electrofishing reveal that Common Carp have significantly declined, from a high of 5.05 [4.16, 5.95] fish/hour in 2003 to a low of 0.21 [0.0750, 0.340] fish/hour in 2019. More recent monitoring this autumn (2019) below Pearce Ferry rapid revealed that catch per unit effort of Channel Catfish was significantly less above the rapid (0.00 fish/hr) compared to below (1.99 fish/hr). These results suggest that the rapid is acting as a barrier to nonnative fish, and potentially native fish.

Assessment of Stocked Rainbow Trout Persistence at Lees Ferry, Colorado River AZ.

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Oral Presentation

Catch rates remain below management goals for the Lees Ferry Rainbow Trout fishery, particularly at the 'walk-in' area, Arizona Game & Fish has considered management actions in order to address angler concerns. Stocking is an active management tool that provides fish directly to anglers and can in part address concerns over low catch rates and small average sizes as the fishery recovers. Although stocking is recognized as an effective management tool for addressing low catch rates, stocked trout represents a considerable investment by AZGFD in the form of the cost to purchase, raise, and distribute this resource to the public. As such, understanding what happens to fish following stocking is important to understanding what impact stocking will have on the system. We investigated persistence of stocked trout within Lees Ferry, and monitored any downstream movement out of the management area using acoustic telemetry. Quantifying downstream movement allowed us to evaluate the potential for negative impacts to native fish residing in warmer water areas downstream in the Grand Canyon, but also quantify the number of stocked fish that remain accessible to anglers within the walk-in area. Results from the study will inform management decisions on Rainbow Trout stocking of Lees Ferry.

Estimating Persistence and Movement Probability of Hatchery Gila Trout in an Arizona Stream.

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Oral Presentation

The Gila Trout (*Oncorhynchus gilae*), is one of two species of Salmonid native to Arizona. While recovery efforts are ongoing in several streams throughout the state, there are currently no streams in Arizona where Gila Trout are stocked as a species available for recreational fishing. Furthermore, it is unknown whether in-stream persistence and movement patterns of hatchery reared Gila Trout make them a suitable candidate species for a put-and-take style recreational fishery. To address these management questions, 30 catchable size Gila Trout implanted with radio tags were stocked in three locations on the

East Verde River (EVR) near Payson in August of 2019. Tracking was conducted on foot using ATS© hand-held receivers coupled with portable Yagi antennae. A stationary Lotek Wireless© receiver was used to estimate emigration out of the study area. Trout were tracked daily for the first 10 days post stocking, weekly for 6 weeks, then bi-monthly until the end of November. Trout locations were approximated in stream and location was recorded in UTM via handheld GPS unit along with macro habitat (e.g. riffle, run, pool). Fates of radio tagged trout were assessed using a multi-state model in order to quantify persistence. The same model assessed probability of detection and probability of transition between distinct regions of the river. These data will help shape management of the put-and-take trout fishery in the EVR.

Improving the Bartlett Lake Fishery.

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Oral Presentation

The Arizona Game and Fish Department Aquatic Habitat Program and Region VI Fisheries Program teamed up to conduct two fish habitat improvement projects at Bartlett Lake from Jan. 2019 to Jan. 2020. The projects involved removing old decomposed and dilapidated habitats from the shoreline, building and installing 500 Georgia Cubes, and acquiring about 1700 donated Christmas trees and placing them in the lake with the assistance of volunteers. The 2 projects will benefit anglers by attracting crappie, bluegill, largemouth bass and catfish populations.