Desert Fishes Council

Consejo de los Peces del Desierto

Dedicated to the Conservation of North America's Arid Land Ecosystems

51st Annual Meeting
Long Program

20-24 November 2019
Sul Ross State University,
Alpine, Texas, USA

SUL ROSS
The FRONTIER University of Texas

CAMPUS MAP

1. President's Home
2. Wildenthal Memorial Library
3. Morgan University Center
4. Briscoe Administration Building
5. Morelock Academic Building
6. Academic and Computer Resource Building
7. Lawrence Hall
8. Museum of the Big Bend
9. Francois Fine Arts Building
10. Warnock Science Building
11. Ferguson Hall
12. Fletcher Hall
13. Industrial Technology Building
14. Art Annex
15. Physical Plant
16. Lobo Village Housing Complex
17. Residential Living Office
18. Graves-Pierce Gym
19. Pete P. Gallego Center
20. Tennis Courts
21. Swimming Pool
22. Outdoor Amphitheater
23. Range Animal Science Center
24. Mountainside Hall

P **PARKING**

E **ENTRANCE**

For more information contact the
University Operator: 432-837-8011

Overview and Event Locations

Date & Time	Event	Location
Wednesday, 20 November 2019		
16:00-17:30	Registration and Presentation Loading	Espino Conference Center in Morgan Univ. Center
18:00-20:30	Social Mixer	Espino Conference Center in Morgan Univ. Center
Thursday, 21 November 2019		
08:00-18:00	Registration and Presentation Loading	Espino Conference Center in Morgan Univ. Center
08:30-08:45	Welcome	Espino Conference Center in Morgan Univ. Center
08:45-11:30	General Session I	Espino Conference Center in Morgan Univ. Center
11:30-13:30	Lunch	On your own
13:30-17:00	General Session II	Espino Conference Center in Morgan Univ. Center
17:15-19:15	Poster Session	Espino Conference Center in Morgan Univ. Center
19:15-21:15	Student Networking Session	Espino Conference Center in Morgan Univ. Center
Friday, 22 November 2019		
08:30-10:30	General Session III	Espino Conference Center in Morgan Univ. Center
10:30-11:30	Plenary Session	Espino Conference Center in Morgan Univ. Center
11:30-13:15	Lunch	On your own
13:15-16:45	Symposium – Changing Landscapes	Espino Conference Center in Morgan Univ. Center
16:45-17:00	Awards	Espino Conference Center in Morgan Univ. Center
17:15-18:45	Business Meeting	Espino Conference Center in Morgan Univ. Center
19:00-21:00	Banquet	Espino Conference Center in Morgan Univ. Center
Saturday 23 November 2019		
08:30-11:00	General Session IV	Espino Conference Center in Morgan Univ. Center
11:00-12:15	Hidden Rivers Video	Espino Conference Center in Morgan Univ. Center
Sunday 24 November 2019		
07:00-19:00	Field Trip	Mount Livermore hike, Davis Mountains Preserve

We thank our generous hosts:

Cover artwork by Alice Best, River Horse Studio (https://riverhorsestudio.com/)

Events are in Espino Conference Center within the Morgan University Center Building unless otherwise specified.

Presenters, please load your presentation by 6:00 pm the day before your presentation.

Presenters have an asterisk next to their name.

Student award presentations have superscripts next to times.

Long Program Detail

Wednesday, November 20th

16:00-17:30 Registration and Presentation Loading

18:00-20:30 Social Mixer

Thursday, November 21th

08:00-18:00 Registration and Presentation Loading

08:30-08:45 Welcome (Chairs: Phil Pister, Krissy Wilson, Megan Bean)

08:45-11:30 General Session I (Chair: Brandon Senger)

08:45 Undescribed Mexican trout diversity: an update and conservation status assessments

Dean Hendrickson*[1], Tim Lyons[2] (1-University of Texas at Austin, Biodiversity Collections, United States; 2-New Mexico BioPark Society, United States)

Two Mexican trout taxa are formally described (*Oncorhynchus chrysogaster*, and *O. mykiss nelsoni*), but many other congeners have long been informally recognized as likely distinct. For more than two decades, the binational Truchas Mexicanas team searched for and collected trout broadly throughout the Sierra Madre Occidental of Sonora, Chihuahua, Sinaloa and Durango. That fieldwork documented that the native range of the genus extends to the Tropic of Cancer, or ~1000 km S of El Paso, Texas, and indicates that most of Mexico's trout exist as small, isolated populations with very restricted ranges. Genetic studies of Truchas Mexicana's specimens demonstrated that the many distinctive lineages found in Mexico are at least as divergent from one another as are their much more thoroughly-studied relatives in the *O. mykiss* complex in the Western U.S.A. When an opportunity presented itself to list the many still undescribed Mexican forms in the IUCN Red List, as part of a large project to assess the conservation status of the entire Mexican freshwater fish fauna, the authors rapidly compiled the necessary documentation and submitted the required proposal. Once the proposal was accepted, we then worked with IUCN staff to finalize formal conservation assessments that should be published in the Red List about 1 month after this presentation is given at the 2019 meeting. We hope that this official listing of these 12 mostly undescribed Mexican endemic species, with 3 determined to be Critically Endangered (CR), 5 Endangered (EN), 3 Near Threatened (NT), and one Data Deficient (DD), will call attention to this important biodiversity asset and open doors for much-needed financial support for the conservation actions that are so desperately needed. Meanwhile, work continues on the morphologically difficult diagnoses of the new species and their descriptions.

09:00 Environmental DNA sampling of desert fishes: performance relative to location, species, and traditional sampling

Anthony Robinson*[1], Yvette Paroz[2] , Matthew Clement[1] , Thomas Franklin[2] , Joseph Dysthe[2] , Michael Young[2], Kevin McKelvey[2] , Kellie Carim[2] (1-Arizona Game and Fish Department, United States; U.S. Department of Agriculture, Forest Service, United States)

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 more sensitive than traditional methods for detecting rare minnows in desert streams. With the sensitivity to detect even a single desert fish in a 100 m reach, managers will be able to more effectively identify habitat occupied by threatened or endangered desert fish, even if a population is in decline.

09:15 Critical swim speeds of two suckers and their hybrids

David Rogowski*[1] , Cory Nielson[1] , Pilar Wolters[1] (1-Arizona Game and Fish Department, United States)

The Razorback Sucker, *Xyrauchen texanus*, and Flannelmouth Sucker, *Castostomus latipinnis*, are two fish native to the Colorado River basin. Currently within the Grand Canyon, Flannelmouth Suckers are abundant while Razorbacks remain extremely rare. Flannelmouth Suckers are found in abundance throughout the flowing waters of the Colorado River, while Razorback Suckers are generally found in the still or slow moving waters of Lake Powell, Lake Mead, and their inflows. Hybridization between these species occurs in the wild, however little is known concerning physiological differences between them and their hybrids. We investigated the differences in critical swim speed of purebred and hybrids of these species. A fish's critical swimming velocity is a measure of its sustained swimming ability, not its maximum sprint speed. Determining the critical swimming speed of these species may illuminate how water velocity affect habitat constraints of these species, and increase our understanding of future repatriation challenges for the Razorback Sucker. Flannelmouth Suckers had a higher critical swim speed than Razorback Suckers, with hybrids intermediate. The critical swim speed results of these purebred catastomid species are consistent with general flow conditions of these habitat types where they are commonly found. The slower critical swim speed of Razorback Suckers could indicate challenges to repatriation throughout the Colorado River basin. Disparities in critical swim speed may be linked to physiological differences of the two species. Wolters (2017) did not see significant differences in body shape of Razorback and Flannelmouth Suckers and their hybrids up to 140 mm in length, but differences in behavioral and/ or metabolic performance have not been explored. Both hybrid types resulted in critical swim speeds between those of

their parental stocks. The parental combination had significant effects, with swimming ability most consistent with their paternal species.

09:30 Utilizing the Endangered Species Act to protect desert fishes: 3 cases

Patrick Donnelly* (Center for Biological Diversity, United States)

The Endangered Species Act (ESA) has been a critical tool to protect desert fishes since its passage in 1973, providing badly needed protections not only for fishes' habitats but also for the water sources those habitats rely on.

The threats to desert fishes from habitat degradation and groundwater overdraft persist, and the Center for Biological Diversity is currently using the ESA to pursue protections for numerous species. Three will be highlighted here.

The Moapa Dace, *Moapa coriacea*, is threatened by groundwater overdraft in the Upper Muddy River spring complex in Clark County, Nevada. A complex legal battle over water use in the area which has played out administratively and in the courts for decades may be coming to a denouement. Unlike the Devils Hole Pupfish, the dace does not have senior water rights, so this is a test case for the power of the ESA to protect these species on its own. The White River Springfish, *Crenichthys baileyi baileyi*, is threatened with overuse by bathers in the thermal spring in Lincoln County, Nevada that it calls home. The protections it has under the Endangered Species Act should guard against this sort of degradation of its habitat. Finally, the Amargosa Canyon population of Nevada Speckled Dace, *Rhinichthys osculus nevadensis*, in Inyo and San Bernardino Counties, California, is threatened by groundwater overdraft in the regional carbonate aquifer which feeds the springs that form its habitat. Distinct Population Segment (DPS) status under the Endangered Species Act will be sought to protect the water that this species relies upon.

Each case poses significant questions about the reach and power of the ESA to protect desert fishes, and in each case, the fate of a species may hang in the balance.

09:45 Hot, cold, and hungry suckers

Pilar Wolters*[1], David Rogowski[1], Corwin Nielson[1] (1-Arizona Game and Fish Department, United States)

The Razorback Sucker, *Xyrauchen texanus*, is an endangered endemic fish of the Colorado River basin. Recovery efforts include nonnative fish removals, habitat improvements, and population augmentation. All populations are still augmented by stocking except for the Lake Mead population on the Arizona-Nevada border and the Colorado River in Grand Canyon, Arizona. Adult and larval Razorback Suckers have

been detected in the Colorado River within the Grand Canyon, however recruitment has yet to be documented. The Colorado River in Grand Canyon is largely dominated by the Flannelmouth Sucker, *Catostomus latipinnis*, another native sucker species. We hypothesized that Razorback Sucker recruitment may be negatively affected by competition with Flannelmouth Sucker. To test this hypothesis, we conducted a competition experiment with young of year fish at different temperatures and feed levels. We had four replicates of six different treatments: Flannelmouths at high and low feed, Razorbacks at high and low feed, and both Flannelmouths and Razorbacks at high and low feed. The experiment was conducted in two phases, each eight weeks in length. The cold phase (15 °C) was first followed by the warm phase (20 °C) with a one week acclimation period between phases. In the experimental treatment (Flannelmouths and Razorbacks together at low food) the Razorbacks gained weight at 15 °C while the Flannelmouths lost weight. We did not see this pattern at 20 °C. This preliminary result suggests that the presence of Flannelmouth Sucker may not be negatively affecting Razorback Sucker recruitment (at 15 °C), or that limitations on Razorback recruitment within the Grand Canyon are occurring before they reach 30mm total length in the wild.

10:00 Fish assemblage restoration in the lower Blue River, Arizona

Brian Hickerson*[1], Anthony Robinson[1] , Kent Mosher[2] (1-Arizona Game and Fish Department, United States; 2-U.S. Bureau of Reclamation, United States)

Opportunities for multi-species native fish restoration efforts are sparse in the desert southwest and such efforts are not always successful. Native fish restoration efforts are often impeded by biotic factors that can potentially be controlled (e.g., presence of nonnative fishes), but equally important are the abiotic factors that cannot be controlled (e.g., annual discharge and flow regime). 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 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. The fish community 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 2018. Nonnative piscivore removal efforts were successful as Channel Catfish, *Ictalurus punctatus*, were last captured in 2013 and Green Sunfish, *Lepomis cyanellus*, in 2016. We evaluated whether relative abundance of native fish was related to a number of factors including: time since stocking, relative abundance of nonnative fishes, and several discharge metrics using generalized linear modeling. Time since stocking best explained 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 2018 and Roundtail Chub were detected several miles upstream in a major tributary in 2019. A comprehensive approach to native fish restoration resulted in the eradication of nonnative fishes and the establishment of robust populations of sensitive native species in the lower Blue River. 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.

10:15 Invasive crayfish eradication - a complicated species requires complicated conservation efforts

Tyler Goodearly* (Center for Natural Lands Management, United States)

Red Swamp Crayfish, *Procrambus clarkii*, invaded the Simone Pond of the Thousand Palms Oasis Preserve in the Coachella Valley, California in the 1950s; subsequently, their destructive habits have led to the extirpation of the endangered Desert Pupfish *Cyprinodon macularius*. Scientific literature has demonstrated that eradicating *P. clarkii* is extremely difficult (Hyatt 2004). The only successful attempts have come from plans that combine multiple techniques that work synergistically (Girardet et al. 2012). Therefore, a multi-faceted eradication plan was developed and implemented to eradicate *P. clarkii* from the Simone Pond. This plan included physical (draining the pond, implementing vigorous trapping, and erecting barriers), electrical (utilizing an electrofishing backpack), and chemical (applying pyrethroids, a synthetic version of pyrethrin that degrades swiftly and does not bioaccumulate) to achieve complete eradication of *P. clarkii*. These combined efforts proved effective in eradicating this invasive species from the Simone Pond—no crayfish have been observed or captured in traps since June 26, 2019. Currently, biotic data (benthic macroinvertebrate sampling, planktonic macroinvertebrate sampling, and submerged aquatic vegetation assessment) and abiotic data (water quality measurements, water level measurements, and pesticide concentration measurements) are being collected to ensure the pond meets environmental standards for the Desert Pupfish. Desert Pupfish are projected to be reintroduced into Simone Pond in June 2020.

10:30 How many off-channel habitats are needed to sustain genetic diversity in 'big-river' fishes?

Thomas Turner*[1], Megan Osborne[1], Thomas Dowling[2] (1-University of New Mexico, United States; 2-Wayne State University, United States)

Fishes of the Colorado River Basin have suffered declines in abundance and genetic

diversity attributable to large-scale river flow regulation that began in the early 1900s. Subsequent proliferation of non-native predators led to system-wide recruitment failures of Razorback Sucker, *Xyrauchen texanus*, and Bonytail, *Gila elegans*. A conservation plan to rear fishes in predator-free backwater habitats was proposed to facilitate recruitment. Genetic factors were considered, but uncertainties remained regarding sources of variance in reproductive success (VRS) that spoke to generality and efficacy of the backwater rearing strategy. In this study we used parent-offspring genotyping to evaluate VRS in Razorback Sucker and Bonytail. Individual VRS was higher in Razorback Sucker than Bonytail in a manner consistent with species-specific differences in life history, but neither species exhibited VRS in excess of Poisson expectation when parental contribution was greater than 50% in a given backwater. However, we observed 'all or nothing' recruitment events across backwaters that were presumably tied to local differences in water quality and predator regimes. Thus, as mean quality and stability of selected backwaters increases and variance in quality among backwaters decreases, fewer backwaters will be required to implement the conservation plan at proscribed levels of genetic diversity.

10:45 Red Tank Draw drainage nonnative fish mechanical removal

Elizabeth Grube*[1], Brian Hickerson[1], Anthony Robinson[1] (1-The Arizona Game and Fish Department, United States)

Restoration efforts to benefit the conservation of native fish through securing native fish from nonnatives and increasing distribution of native fish in the desert southwest has had limited success due to the establishment of nonnative and piscivorous species. During 2016, the Arizona Game and Fish Department began a project in the Red Tank Draw Drainage to remove nonnative piscivorous fish and to expand the range of native species within the drainage. Red Tank Draw is a tributary to Wet Beaver Creek on the Coconino National Forest that supports an assemblage of native fish species including Roundtail Chub, *Gila robusta*, Longfin Dace, *Agosia chrysogaster*, Desert Sucker, *Catostomus clarki*, and Sonora Sucker, *Catostomus insignis*. Red Tank Draw also supports a compliment of nonnative fishes including Green Sunfish, *Lepomis cyanellus*, Black Bullhead, *Ameiurus melas*, and Fathead Minnow, *Pimephales promelas*. In 2016 the Department began mechanical removal efforts of nonnative fish in Red Tank Draw. After limited initial success a comprehensive survey of the drainage (including two tributaries, Rarick Canyon and Mullican Canyon) and several stock tanks within the drainage was completed in 2017. Green Sunfish and Black Bullhead were detected in Mullican Place Tank and in downstream tinajas in the Mullican Canyon drainage. Fathead Minnow were detected in two tanks and downstream tinajas in the Rarick Canyon drainage in 2017 and Black Bullhead were detected in downstream tinajas in 2018. Mechanical removal of Black Bullhead in Rarick Canyon began in April, 2019 with

eradication achieved by August, 2019 after the removal of 14 Bullhead. Removal efforts in Red Tank Draw have been ongoing since the project began in 2016. The size class structure of Green Sunfish has shifted to mostly smaller fish, and fewer Black Bullhead have been detected. A comprehensive approach to the Red Tank Draw drainage allowed for the suppression or eradication of nonnative fishes and will hopefully allow for an increase in distribution of native species. Considering the importance of upstream sources of nonnative fishes and opportunities for creating refugia for native species resulted in a successful approach for native fish conservation and will help inform future efforts.

11:00 Passive detection data aid estimation of Razorback Sucker *Xyrauchen texanus* survival rates

Koreen Zelasko*[1], Kevin Bestgen[1], Gary White[2] (1-Larval Fish Laboratory, Department of Fish, Wildlife, & Conservation Biology, Colorado State University, United States; 2-Department of Fish, Wildlife, & Conservation Biology, Colorado State University, United States)

Low probabilities of capture (<0.05), based only on physical recaptures of tagged fish, have hindered the precise estimation of survival rates for endangered Razorback Sucker, *Xyrauchen texanus*, in the upper Colorado River basin (UCRB). Because those populations are maintained by stocking of hatchery-reared individuals (N = 416,004 cumulatively through 2017), reliable evaluations of survival are essential to the species' management. Since 2008, PIT tag detection antennas and ultrasonic receivers have been deployed throughout the UCRB, San Juan River Basin, and Colorado and San Juan river arms of Lake Powell to passively document tagged fish. Increased detections, along with physical captures from more intensive sampling, were used to determine if more robust estimates of survival were possible. Encounter records of 395,488 stocked Razorback Suckers from 1995 through 2017 were analyzed with the Barker model, in which passively-collected data are incorporated as "resight" events outside the physical sampling occasions. Annual capture probabilities remained low (mean: 0.05, range: 0.01–0.09), as in previous studies. Since antenna deployment began, resight probabilities increased from 0 to a high of 0.13 in 2017. Importantly, the empirical rate of physical recaptures for the entire 23-year study period was 3.9%, while rate of detections from antennas was nearly half that (1.8%) but almost entirely from just the most recent five years of antenna use, < 25% of the study period. Analyses supported previous findings that survival through the first year post-stocking was lower than subsequent years, first-year survival for fish stocked during summer (mean: 0.06, range: <0.01–0.12) was lower than other seasons (mean: 0.20, range: 0.01–0.39), and first-year survival of fish stocked in the Green River subbasin (mean: 0.27, range: 0.02–0.80) was higher than the Colorado River subbasin (mean: 0.12, range: <0.01–0.59).

Both seasonal and subbasin survival rate estimates through the first year were higher and more precise than those from our previous studies using only records from 1995–2006 and 2004–2008. This analysis showed survival after the first year post-stocking increased to 0.83 (CV < 1%) and was higher and more precise than in 1995–2006 (0.75, CV = 4%). Incorporating passive detection data with physical recaptures provided more robust survival rate estimates, which are useful to evaluate hatchery stocking practices and recovery status of populations. Passive detections may also improve estimation of population parameters for other PIT-tagged fishes in large river systems where capture probabilities are low.

11:15 Captive breeding of the Devils Hole Pupfish

Jennifer Gumm*[1], Mitchell Stanton[2], Olin Feuerbacher[1] (1-USFWS, United States; 2-Great Basin Institute, United States)

Captive propagation is vital to recovery and management of many imperiled fishes. With fewer than 200 fish restricted to a single pool in the Mojave Desert, the federally endangered Devils Hole Pupfish, *Cyprinodon diabolis*, seems a prime candidate for captive propagation. However, despite decades of attempts, propagation in aquaria has never been fully successful. While refuge populations had some success, ultimately all ended in failure. Since 2013, the Ash Meadows Fish Conservation Facility (AMFCF) has maintained a backup population of Devils Hole Pupfish. To establish the population, eggs were recovered from Devils Hole and brought to the lab at AMFCF for rearing and culturing. Herein, we discuss recent advances in captive breeding of the Devils Hole pupfish. Specifically, we highlight advances that resulted in fertilized eggs being collected from the refuge population and breeding trials in aquaria that produced fertilized eggs. Finally, we present results of a comparative analysis of eggs collected from the three sources (wild, refuge tank and lab aquaria) comparing egg production, hatching success and survival to adulthood. Understanding differences in reproduction between wild and captive fish is critical for recovery of the Devils Hole Pupfish and will help inform management of this and other species.

11:30-13:30 Lunch Break

13:30-17:00 General Session II (Chair: Kate Boersma)

13:30 Landscape modeling of threatened Yaqui Catfish in a data limited environment

Thomas Hafen*[1], Andrew Taylor[2], James Long[1], David Stewart[3], Dean Hendrickson[4] (1-Oklahoma State University, United States; 2-University of Central Oklahoma, United States; 3-U.S. Fish and Wildlife Service, Southwest Region,

United States; 4-Department of Integrative Biology and Biodiversity Collections, University of Texas, United States)

Yaqui Catfish, *Ictalurus pricei*, is an understudied species with limited data on their distribution, environment, or habitat use. Native to southwest United States, and northwest Mexico, Yaqui Catfish populations are declining, causing the species to be listed as threatened in the United States, and specially protected in Mexico. Water over-allocation, habitat degradation, invasive species introductions, and hybridization with non-native Channel Catfish, *Ictalurus punctatus*, have caused the declining populations in Mexico. To help better focus conservation efforts, as well as define important habitat for Yaqui Catfish we modeled the potential distribution using species distribution model MaxEnt, a machine learning program, in the Yaqui River Basin, a basin found in both the US and Mexico. Limited biologically relevant geospatial environmental data in Mexico caused us to model at a landscape scale, allowing us to determine factors that may affect the entire population. Some variables we used were elevation, landcover, temperature, precipitation, and stream order. Response curves from the model indicated relationships with stream order, riparian shrub and slope. Model results also estimated habitat suitability for Yaqui Catfish in 78% of the Yaqui Basin. Evaluations of the model suggest it was predictive as well as discriminative.

13:45 Born to be rewilded; the Pahrump Poolfish and Relict Leopard Frog find a new home in Las Vegas, Nevada

Aaron Ambos*[1], Raymond Saumure[1], Thomas O'Toole[2], Zane Marshall[1] (1-Southern Nevada Water Authority, United States; 2-Las Vegas Springs Preserve, United States)

In May 2018, 290 adult Pahrump Poolfish, *Empetrichthys latos*, and 100 juvenile Relict Leopard Frogs, *Rana onca*, were released into two constructed ponds at the Las Vegas Springs Preserve in Las Vegas, Nevada. These introductions mark the first time in over sixty years that native fish and frogs have occupied the site of the historic Las Vegas springs. Once a lush oasis within an arid Mojave Desert landscape, the Las Vegas spring complex ceased flowing prior to 1962 due to increasing groundwater usage. The loss of this spring complex led to the extinction of the endemic Las Vegas Dace, *Rhinichthys deaconi*, around 1957. Reduced spring flows along with habitat alteration also led to the extirpation of the Vegas Valley Leopard Frog, *Rana fisheri*, within the Las Vegas Valley by the late 1940's. In the following decades, the site of the Las Vegas spring complex existed solely as a well field, providing water for the growing Las Vegas community. In 1997, however, the Las Vegas Valley Water District Board of Directors approved a plan to develop a

180-acre preserve to protect and manage the natural, cultural, and water resources of the site. The Springs Preserve opened in June 2007, and by 2010 plans were made to restore some surface water habitat within the original spring complex channels. The imperiled Relict Leopard Frog and the federally endangered Pahrump Poolfish were identified as candidates to inhabit these ponds. Both species are native to Nevada and need additional refuge populations and would fill the niches of the extirpated species. The initial two ponds were completed in early 2018 and by late May, Pahrump Poolfish from an existing refuge population and captive reared Relict Leopard Frogs representing two natural populations were introduced. Surveys in October 2018 documented 4 large adult Relict Leopard Frogs (1 male and 3 females) and provided a population estimate of 386 (95% CI 278-605) Pahrump Poolfish. Several cases of Fall/Winter mortality of the Pahrump Poolfish were documented. In Spring 2019, 101 large Relict Leopard Frog tadpoles and 111 juvenile frogs were released in the ponds. A nocturnal survey in March 2019 documented 2 large adult frogs including a calling male. Numerous small Relict Leopard Frog tadpoles were observed in late April 2019, which demonstrated natural recruitment. Larval Pahrump Poolfish were observed in May 2019, and a mark-recapture survey in June provided an estimate of 173 (95% CI 131-232) adult Poolfish between the two ponds. A visual encounter survey of Relict Leopard Frogs in August 2019 documented 195 juveniles and 4 small adults. In September 2019, a survey of Pahrump Poolfish documented 130 individuals including fish under 35 mm in length, which represented new recruitment. An additional eight ponds at the Springs Preserve may eventually hold Pahrump Poolfish and Relict Leopard Frogs.

14:00 Lower Colorado River area report

Ronald Rogers*[1], Brandon Albrecht[1], Ronald Kegerries[1] (1-BIO-WEST Inc, United States)

The lower Colorado River Basin encompasses an area that spans from Lee's Ferry, Arizona, approximately 15 river miles below Glen Canyon Dam (Lake Powell), to the Gulf of California (Sea of Cortez), Mexico. Historically, the dynamic nature of river would have meandered across large flood plains, creating isolated pools, oxbow lakes, and backwater habitats, that were broken in small areas by when not bound by narrow canyons and high gradient reaches. This ecosystem was home to numerous species of fish, reptiles, plants, and invertebrates. However, in less than 100 years, a system of dams, diversions, levees, and canals has left this region as one of the most managed rivers in the world. Many scientists are currently working within the basin to better understand, conserve, and enhance endangered, threatened, and native fish populations. This report highlights some of the research,

monitoring, and recovery efforts for fishes within the lower Colorado River Basin.

14:15[RRM] **Advances on the genetic characterization of the reproductive stock of Yaqui Catfish, *Ictalurus pricei* (Rutter, 1896) of the Bavispe River sub-basin, Sonora**

Alexsandre Gutiérrez-Barragán*[1], Alejandro Varela-Romero[2], Carlos Alonso Ballesteros-Córdova[2], José Manuel Grijalva-Chon[2], Enrique De la Re-Vega[2], Francisco Javier García-De León[2] (1-Maestría en Biociencias de la Universidad de Sonora, Mexico; 2-DICTUS Universidad de Sonora, Mexico)

The Yaqui Catfish, *Ictalurus pricei*, is an endangered species (SEMARNAT, IUCN) due to the decline and loss of its populations in more than half of its historical distribution in Mexico and the United States. The main threat is the competition and hybridization with the Channel Catfish, *I. punctatus*. As part of the efforts for the conservation of the species, in 2019 began the creation of a reproductive stock in Rancho San Bernardino, Sonora, with 18 individuals morphologically similar to Yaqui Catfish collected in Arroyo Cajón Bonito, sub-basin of the Bavispe River to start the recovery of the species in Mexico. In this work, the specific identity of the catfishes captured, is being analyzed by means of the DNA barcode from the mitochondrial gene COXI, and the phylogenetic analysis of all individuals was performed with the COXI gene and the nuclear genes RAG1 and RAG2, with the objective of characterizing genetically the stock to ensure purity and reproductive success. So far 13 pure Yaqui Catfish, three Channel Catfish and two *Ictalurus punctatus X pricei* hybrids of the 18 initiators of the Arroyo Cajón Bonito in Sonora have been detected. This is the first genetic evidence of hybridization between these two species found in the wild in Sonora. We recommend including this information in the management of individuals in the reproductive stock in facilities of the Instituto de Acuacultura del Estado de Sonora and increase the evidence by using microsatellites to rule out possible genetic introgression.

14:30 Ongoing restoration projects for the endangered Moapa Dace, *Moapa coriacea*, at the Warm Springs Natural Area, Clark County, Nevada.

David Syzdek* (Southern Nevada Water Authority, United States)

The Moapa Warm Springs in Southern Nevada is a regional spring complex that forms the headwaters of the Muddy River. These thermal springs, and associated streams, are habitat for an endemic suite of thermophilic aquatic species that includes the federally-endangered Moapa Dace, *Moapa coriacea*. Currently, the Southern Nevada Water Authority (SNWA) and other stakeholders are undertaking recovery actions for the Moapa dace and its habitat. These include construction of fish barriers, reduction in or removal of non-native and invasive species, riparian

and aquatic habitat restoration, and development of an ecological model for the Moapa Dace. To facilitate recovery of the dace and other native species, SNWA purchased the 1,218-acre Warm Springs Ranch in September 2007 and designated it the Warm Springs Natural Area for conservation and environmental stewardship purposes.

In 2008, Moapa Dace numbers suddenly declined to a record low of 459 individuals. Working with the US Fish and Wildlife Service, Nevada Department of Wildlife (NDOW), and other stakeholders and researchers, SNWA is conducting stream restoration work and intensive habitat improvements to reverse the population's decline. Following the February 2008 nadir, dace numbers improved somewhat but have yet to reach recovery levels of 6000 fish. Latest snorkel counts recorded 1317 Moapa Dace in August 2019. Since 2008, NDOW and SNWA have successfully treated the Upper Muddy River with rotenone to control the invasive and predatory Blue Tilapia, *Oreochromis aureus*. Furthermore, stream restoration and clearing of dense stands of invasive Tamarisk, *Tamarix spp*., and California Fan Palms, *Washingtonia filifera*, are facilitating the re-establishment of native riparian vegetation, providing prevention of future wildfires and continued improvement in Moapa Dace numbers.

In 2015, a removable fish barrier was opened that allows the dace access to its entire historical range. In 2018, additional habitat was acquired on the North Fork with a property purchase and that stream is currently being restored. In 2019, 59 Moapa Dace were translocated into the South Fork and those fish have successfully reproduced. Moapa Dace numbers are currently stable and work continues to improve dace habitat, improve stream connectivity, and to monitor for invasive species.

14:45[CLH] **Disentangling natural dispersal versus human-mediated introduction of the Longfin Dace across the trans-continental divide**

Alex Cameron*[1], David Camak[1], Megan Osborne[1], Tyler Pilger[2], David Propst[1], Thomas Turner[1] (1-University of New Mexico, United States; 2-FISHBIO, United States)

A long-standing objective of biogeography is to relate patterns of genetic diversity to historical and contemporary processes that influence the distribution of populations across a landscape. For some taxa, the role of human-mediated dispersal can confound the signal from natural processes and obscure our understanding of a species' evolutionary history. The Longfin Dace, *Agosia chrysogaster*, is a small-bodied minnow native to the Upper Gila River basin in New Mexico. Accounts as early as the 1950's proposed that the Longfin Dace was recently introduced into

tributaries of the Mimbres River and the Rio Grande. Human-mediated dispersal was hypothesized as a mechanism for crossing the trans-continental divide, but recent molecular evidence suggests that headwater capture events may have mediated the east to west movement of other fish taxa (e.g., *Pantosteus plebeius*). Therefore, it is plausible that populations of the Longfin Dace found east of the trans- continental divide were established via a similar headwater capture event as *P. plebeius* as opposed to human-mediated dispersal. We sequenced a mitochondrial locus for 294 individuals collected across Arizona and New Mexico to examine range-wide patterns of historic population structure. Additionally, we assayed a panel of 9 microsatellite loci for 165 individuals collected in New Mexico to infer the mechanism of colonization across the trans-continental divide.

15:00 A comprehensive assessment of Mexican freshwater ichthyofauna extinction risk under the IUCN Red List Categories and Criteria

Timothy Lyons* (New Mexico BioPark Society, United States)

Freshwater ecosystems are undervalued and receive insufficient funding, political attention, and protection globally. In order to develop interest and funding for freshwater species conservation, the International Union for Conservation of Nature's (IUCN) Freshwater Biodiversity Unit (FBU) is working to complete a globally comprehensive assessment of freshwater fishes by 2021. As part of this initiative, extinction risk of 536 species of Mexican freshwater fishes were evaluated against the IUCN Red List Categories and Criteria, representing the most comprehensive assessment of freshwater biodiversity in Mexico to date. The results of this highly collaborative assessment process reveal that 40% of all extant species assessed are threatened with extinction, and 18.5% are data deficient. The threats to freshwater biodiversity in Mexico are diverse, and threat is not evenly distributed across Mexico. These results can be used to help support the implementation of multilateral environmental agreements in Mexico, guide conservation planning and priority setting at the local and national levels, and will provide a baseline of conservation success in subsequent assessments of extinction risk. Recommended conservation actions include the promotion and development of an integrated Mexican freshwater fish conservation strategy, including directives to further study data deficient species, the planning and establishment of additional freshwater protected areas and environmental safeguards, establishment of species level conservation plans where necessary, identification of suitable candidate species for ex-situ conservation, and planned reevaluation of conservation status to develop a regional Red List Index.

15:15[CLH] A global review of patterns of aquatic macroinvertebrate dispersal and

functional feeding traits in aridland rock pools

Susan Washko*[1], Michael Bogan[1] (1-School of Natural Resources and the Environment, University of Arizona, Tucson, AZ, United States)

Rock pools are important ecosystems providing rare sources of surface water in arid regions. Hydroperiod is one of the primary limiting factors for aquatic macroinvertebrates living in rock pools. Resident macroinvertebrates must complete their life cycles before pool drying, and may employ active or passive dispersal strategies to survive. Quantifying dispersal and functional feeding traits across rock pool macroinvertebrate communities in multiple regions could provide insight into how rock pool ecosystems will respond to shorter hydroperiods predicted by climate change models. We reviewed taxonomic data (26 species lists) from 24 published studies on rock pools in Africa, North America, and Australia, to assess the dispersal and feeding strategies of macroinvertebrates, and how ecosystem functions may change with shorter hydroperiods. On average, taxa lists were equally comprised of active dispersers and passive dispersers. Most active disperser taxa were predators (60%) and gatherers (33%). In contrast, passive disperser taxa were generally filterers (39%), gatherers (29%), and scrapers (21%). Climate change may reduce rock pool hydroperiods, which could reduce habitat availability for passive dispersers with weak overland dispersal abilities. If passive disperser populations decrease, their associated ecosystem functions, such as fine organic matter processing, could be disrupted. These results provide a foundation for future work investigating changes in rock pool ecosystem function due to altered hydroperiods.

15:30 Restoring Gray Redhorse populations in the Delaware River, New Mexico

Joanna Hatt*[1], Daniel Trujillo[1], John Caldwell[2] (1-New Mexico Department of Game and Fish, United States; 2-Utah Department of Natural Resources, United States)

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 Mexican 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 Endangered Species Committee considers this species to be threatened [Jelks et al., 2008, Fisheries 33(8):372-407]. By 2008, only two populations were known to persist in New Mexico. Fish kills resulting from blooms of toxic golden algae, *Prymnesium parvum*, were largely responsible for this extirpation event. Following an extensive survey effort, 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 in 2012. Multiple years of

habitat restoration of the Delaware River provided suitable conditions for repatriation of this species of conservation concern. Forty-four adult redhorse were captured in the Black River and translocated to the Delaware River between 2012 and 2018. These individuals were introduced to a site containing a translocated population of Texas Hornshell, *Popenaias popeii*. As Gray Redhorse serve as a primary host for the glochidia stage of the mussel, repopulating the Delaware River with this species is equally important to the long-term viability of Texas Hornshell. Annual monitoring of the restoration site has occurred since 2013 and multiple young-of-year Gray Redhorse were detected between 2016 and 2018. The creation of a third population reduces the risk of extirpation of 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 restoration sites in New Mexico.

15:45CLH **Phylogeography of *Notropis stramineus* (Cope, 1865)**

Amanda K. Pinion*[1], Daemin Kim[2], Kevin W. Conway[1] (1-Texas A&M University, United States; 2-Yale University, United States)

Notropis stramineus (Cope, 1865), the Sand Shiner, is a small minnow with an expansive range. It is distributed across much of the North American continent to the east of the Continental Divide, from northern Mexico (Rio San Juan and Rio Salado) to southern Canada (upper St. Lawrence River and Great Lakes drainage to the east and the Red-Assiniboine River system to the west), spanning regions commonly recognized as phylogeographic barriers. Within the southwestern U.S., *N. stramineus* is found in Oklahoma, New Mexico and Texas, where it is distributed in most river systems including the Rio Grande system (Pecos and Devils rivers). Despite early taxonomic work, including the recognition of two subspecies (*N. s. stramineus* and *N. s. missuriensis*), the Sand Shiner continues to be recognized as a single widespread species. To test the hypothesis that the widespread *N. stramineus* represents a single species, we gathered one mitochondrial gene (Cytb) and two nuclear loci (S7 and RAG1) representing the breadth of the range. Preliminary analysis of this data suggests that *N. stramineus* represents several genetically distinct and geographically isolated lineages. Additionally, the current subspecies designations may not accurately represent the true evolutionary history of this species complex.

16:00 Population estimates for Humpback Chub, *Gila cypha*, and Roundtail Chub, *Gila robusta*, in Westwater Canyon, Colorado River, Utah, 2016-2017

Brian Hines* (Utah Division of Wildlife Resources, United States)

Westwater Canyon on the Colorado River contains one of the five remaining

populations of the endangered Humpback Chub, *Gila cypha*, in the Upper Colorado River Basin. Westwater Canyon also contains a large population of Roundtail Chub, *Gila robusta*, which are listed as a species of concern throughout their range. Recovery goals identified by the Upper Colorado Recovery and Implementation Program require maintaining several populations of Humpback Chub within the Upper Colorado River Basin. Monitoring efforts are essential to evaluate the population of Humpback Chub in Westwater Canyon and meet the recovery goals. Trammel nets, electrofishing gear, and submersible antennas were used to sample Humpback and Roundtail Chubs in Westwater Canyon in 2016 and 2017. Important metrics including catch rates, size structure, and population size were calculated for Humpback and Roundtail Chub. Catch rates of Humpback Chub in 2016 and 2017 were 0.3 and 0.5 fish/hr, respectively. Catch rates of Roundtail Chub in 2016 and 2017 were 1.37 and 0.98 fish/hr, respectively. The population size of Humpback Chub in 2016 and 2017 were estimated at 2,002 (95% CI 1118-2886, SE=430, CV=0.23) and 3,656 (95% CI 1,177-6,133, SE=1,097, CV=0.30), respectively. The population size of Roundtail Chub in 2016 and 2017 were estimated at 7,916 (95% CI 6,320-9,512, SE=811, CV=0.10) and 11,300 (95% CI 8,055-14,545, SE=1,645, CV=0.15), respectively. In this presentation, I will describe recent monitoring activities of Humpback and Roundtail Chub in the context of historical data for the Westwater population.

16:15 Spatial structure and survey method influence population estimates for endangered Comanche Springs Pupfish

Matthew Acre*[1], Joshuah Perkin[1], Megan Bean[2] (1-Texas A&M University, United States; 2-Texas Parks and Wildlife Department, United States)

Desert fishes in the American southwest are vulnerable to anthropogenic landscape alterations. Nearly 90% of pupfish (family Cyprinodontidae; 38 of 43 species) are listed as imperiled and many persist within freshwater protected areas (FPA). Pupfish population assessments within FPA are infrequent, in part, because of inconsistencies and few comparisons among methods. We developed density estimates for the Comanche Springs Pupfish, *Cyprinodon elegans*, using mark-recapture and unmarked individuals observed through visual count (VC) and minnow trap (MT) surveys at Balmorhea State Park (BSP), Texas, USA. During Spring 2019, we collected 1,328 *C. elegans* during three repeated VC and MT surveys at 40 locations within BSP. We fit a Schnabel estimator to the mark-recapture data and N-mixture models to VC and MT count data and assess the influence of habitat covariates and spatial autocorrelation using Akaike's information criterion. We found N-mixture model estimates were generally greater than mark-recapture model estimates, though models agreed in some habitats. We also found

differences in density estimates from VC versus MT methods, including higher densities from MT in shallow water and VC in deep water. Best-fit models included habitat covariates such as depth, water temperature, and fine sediments, though spatial autocorrelation variables were the strongest predictors. We conclude that N-mixture models fit to unmarked individuals from VC and MT methods include trade-offs in their performance depending on habitats surveyed, and that spatial contexts matter. Monitoring other fishes inhabiting other FPA using the methods described here could provide consistent and repeatable abundance indices to benefit conservation biology.

16:30 The success of Green Sunfish removals in McGee Wash

Brett Montgomery*[1], William Partridge[1], Matthew Chmiel[1] (1-Arizona Game and Fish Department, United States)

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 cyanellu*s, 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.

16:45[RRM] Population status of the Sonoyta Mud Turtle (*Kinosternon sonoriense longifemorale*) in the Sonoyta River, Sonora, Mexico

Miguel Angel Grageda Garcia*[1], Michael Bogan[1] (1-School of Natural Resources and the Environment. The University of Arizona, United States)

The endangered Sonoyta Mud Turtle, *Kinosternon sonoriense longifemorale*, is a subspecies endemic to a small portion of the Sonoyta River in Sonora, Mexico and

Quitobaquito Springs in Arizona. Human development in the region and economic activities, such as agriculture, livestock production and mining, have caused overdraft of the Sonoyta aquifer and reduced flow in the river. This situation has led to a decrease in the habitat available for the Sonoyta Mud Turtle. Localities with Sonoyta Mud Turtles have been reduced from seven sites in 2003 to three natural and two transplanted sites in 2019, one of which is a sewage treatment lagoon. The largest natural population occurs in the Agua Dulce reach of the Sonoyta River, a roughly 2 km long reach that contracts to only pools during the dry season. From 2017-2019, we estimated the mud turtle population size of the Agua Dulce reach using the capture-recapture sampling method. Additionally, we quantified mud turtle movements based on ten individuals (5 males and 5 females) that were radio-tagged in 2017 and 2018. Thus, we estimated mud turtle seasonal home ranges by calculating the Minimum Convex Polygon (MCP) based on all locations where tagged individuals were recorded. Using the Schumacher-Eschmeyer model, we estimated a population size of 209 turtles, with a 95% confidence interval. Radio-tagged individuals had a mean seasonal home range size of 0.09 ha and travel paths with a mean length of 173 m. Females had larger mean seasonal home ranges than males (0.12 ha vs 0.04 ha) and longer mean travel paths (239 m vs 91 m). Despite their ability to survive in degraded wetlands and tolerate periodic loss of flow in the river, decreasing dry season habitat poses a serious conservation concern. If wetted areas keep decreasing in the study site due to water withdrawals and a change in the precipitation frequency, then the Sonoyta River may not support a healthy turtle population in the future.

17:15-19:15 Poster Session

17:15 Stonefly assemblages vs trout in low-order creeks along the northern Wasatch Front.

Blake Hansen*[1], Amber Bell[1], Jackeline Wilkinson[1] (1-Weber State University, United States)

A previous study in northern Utah suggested there is competition between large predatory Perlid stoneflies and trout (salmonidae). We examined stonefly abundance in two small Wasatch Front creeks, expecting fewer perlids to co-occur with trout. Each creek system had a trout (lower Strongs Creek and Steed Creek) and troutless (upper Strongs Creek and Davis Creek) reach. We sampled 24 pools with trout and 27 troutless pools. We electrofished each pool to confirm the presence or absence of trout and mini-Surber sampled for two common families of stoneflies: Chloroperlidae (*Sweltsa*) and Perlidae (*Hesperolperla, Eccoptura, Neoperla*). Mean number of Perlidae per pool was lower in reaches with trout than without (Strongs Creek: 0.46 ±

0.22 SE with trout, 1.80 ± 0.51 SE troutless; Davis-Steed Creek: 0.00 ± 0.00 SE with trout versus 2.75 ± 1.12 SE troutless). This fit our prediction. The opposite trend was seen with the Chloroperlidae mean numbers (Strongs Creek: 0.85 ± 0.42 with trout versus 0.30 ± 0.15 SE troutless; Davis-Steed Creek: 6.08 ± 2.04 SE with trout versus 2.94 ± 0.77 SE troutless), but their abundance difference was not statistically significant. Competition or predation by trout may limit perlid abundance, whereas chloroperlids might not compete with or be preferred food for trout because they are much smaller than perlids.

17:15 Rainbow versus Cutthroat Trout effects on predatory invertebrate assemblages

Amber Bell* (Weber State University, United States)

Input and output subsides link aquatic and terrestrial ecosystems. Non-native trout occur at higher densities in streams where they replace native trout and can disrupt key ecosystem functions that cross ecosystem boundaries, such as aquatic-insect emergence. The increased biomass and behavioral differences of non-native trout can influence other aquatic predators such as predatory stoneflies (Perlidae) and water striders (Gerridae), as well as riparian predators such as spiders (Tetragnathidae). Our study sites were in six streams along the northern Wasatch Front, Utah. We hypothesized three streams with non-native Rainbow Trout, *Oncorhynchus mykiss*, would have fewer aquatic and riparian predators than three others with native Bonneville Cutthroat Trout, *Oncorhynchus clarkii utah*. We found mean rainbow trout biomass (598.96 ± 277.2 SE mm/m^3) was higher than cutthroat trout biomass (202.09 ± 87.5 SE mm/m^3). Water strider densities were higher in cutthroat streams than in rainbow streams (1.07 ± 1.02 SE m^3, 0.18 ± 0.13 SE m^3, respectively), as were perlid stonefly densities (0.25 ± 0.14 SE m^3, 0.12 ± 0.05 SE m^3, respectively). In contrast, tetragnathid spider horizontal-web density was lower in cutthroat streams than in rainbow streams (1.53 ± 1.20 SE m^3, 3.07 ± 1.30 SE m^3, respectively). Differences in habitat could account for some of our findings. Rainbow streams were wider with higher aerial-wood and submerged-wood biomass. Aerial wood could provide web-building sites for tetragnathid spiders and submerged wood could elevate in-stream productivity. On the other hand, cutthroat streams were deeper and had larger substrates, possibly better habitat for perlid stoneflies. In any case, evidence suggests non-native rainbow trout do interact differently with other predators compared to native Bonneville cutthroat trout.

17:15[PA] Predatory interrelations in Weber & Davis County streams

Jackeline Bedoya-Wilkinson*[1], Blake Hansen[1], Brennen Slagowski[1], Desiree Peck[1], Crystal Price[1], Mckenna Merrill[1] (1-Weber State University, United States)

Studies of aquatic-riparian ecosystems suggest that trout (Salmonidae) can impact associated invertebrate predators, like aquatic larvae of perlid stoneflies, water-surface dwelling water striders (Gerridae), and riparian tetragnathid spiders. We studied 100 m reaches in seven small streams along the northern Wasatch Front (Weber and Davis counties, Utah). In each stream, we counted water striders, horizontal spider webs (characteristic of tetragnathids), and used kick nets to sample perlid larvae along 10 evenly spaced transects. We also measured wetted width and water depth. We made pebble counts every 0.2 m across transects and measured all submerged and aerial branches (stem width). We sampled trout through each reach with a backpack electrofisher and calculated habitat volume as median width x median depth x reach length to calculate biomass based on trout total length. We used Pearson correlations to explore potential relationships of depth, width, substrate, submerged branch, aerial branch, and trout biomass with the densities of water striders, spider webs, and perlid larvae. We found most significantly that water-strider and spider-web density were inversely correlated with depth and spider-web density was positively correlated with median width and with submerged-branch density. Interestingly, perlid density correlated positively with trout biomass. Overall, this suggests trout abundance is not necessarily the primary driver of abundance in other aquatic or riparian predatory invertebrates and that habitat features can be important. For instance, in streams with higher productivity, multiple predator populations might increase. Also, streams with greater width may have a higher diversity of habitats, with more opportunities for different predators.

17:15 Freshwater Fishes of North America, Volume 2

M. L. Warren[1], B. M. Burr[2], A. A. Echelle[3], B. R. Kuhajda[4], S. T. Ross*[5] (1-Forest Service, Forest Hydrology Lab 1000 Front Street Oxford, MS 38655, United States; 2-Department of Zoology, Southern Illinois University (retired), United States; 3-Oklahoma State University (retired), United States; 4-Tennessee Aquarium Conservation Institute, United States; 5-Museum of Southwestern Biology, Division of Fishes, University of New Mexico, United States)

Over 1,200 native freshwater fish species occur on the North American continent, composing the largest temperate, freshwater fish fauna on Earth. The importance of freshwater fishes in North American ecosystem function, their direct value economically and as providers of ecological services, and the increasing need to conserve this fauna cannot be over emphasized. In the last 30 years, major scientific advances have been made for these fishes across disciplines of systematics, genetics, physiology, behavior, ecology, and conservation. These advances, however, are marked by increased specialization and resulting fragmentation of knowledge about the diverse North American fish fauna. Our three-volume series is

the first-ever published, fully-illustrated work synthesizing the diversity, natural history, ecology, and biology of 52 families of North American freshwater fishes (including several marine families with species occurring in fresh water). The coverage includes all of Canada, the coterminous United States, and Mexico (south to about the Isthmus of Tehuantepec). Chapter authors are synthesizing information on a set of standard topic areas for each family and our emphasis is on near-comprehensive synthesis of existing information on freshwater fishes in North America. The book also covers non-taxonomic topics including evolution and ecology of fish assemblages, mating behavior, foreign fishes, fishes as models for scientific studies, and conservation overviews. Johns Hopkins University Press is the publisher, with volume 1 published in 2014 and volume 2 scheduled for publication in the spring of 2020. Volume 2 will cover 19 families (Characidae to Poeciliidae), with contributions from 38 different authors. The volume includes families of major interest to those concerned about desert fishes, including Poeciliidae, Cyprinodontidae, Fundulidae, Goodeidae, and Profundulidae.

17:15 Potential for Gila Trout egg stocking as a successful repatriation tool

Zachary Beard* (Arizona Game and Fish Department, United States)

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 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.

17:15 Advancing technology: the PIT tag problem in the lower Colorado River

Tiffany Love-Chezem*[1] , Chase Ehlo[1] (1-Arizona Fish and Wildlife Conservation Office, United States)

Passive integrated transponder (PIT) tag technology is commonly used as a tool to track native fish stocking survival, movement, and provide population estimates in the Colorado River. As any technology, PIT tagging has changed and advanced over time. The long life span of native fish in the Colorado River Basin present an interesting problem for managers using PIT tags, as fish have survived several iterations of this technology. This study focuses on our ability to use current and past technology to detect two types of PIT tags. We tested the read range and capabilities of the three most commonly used readers (Destron/IDI, Cheeseblock (BioMark 2001F), and HPRLite) on 400 kHz and 134.2 kHz tags, and when of both types of tags were present. We found that many factors affect read range including interactions between tags, orientation of tags, model of reader, and batch number of PIT tags. The Destron/IDI had the longest read range and was able to read all 400 kHz tags, even in the presence of a 134.2 kHz tag. The other two readers had a more limited read range and were unable to pick up 400 kHz tags if a 134.2 kHz tag was present.

17:15 Advances in the study and recovery of a reproductive stock of the Yaqui Catfish, *Ictalurus pricei*, in Arroyo Cajón Bonito, Sonora

Alejandro Varela-Romero*[1], Chuck Minckley[2], Anna Valer A. Clark[2], Francisco Javier Villegas-Cota[3], Alexsandre Gutiérrez-Barragán[4] (1-Universidad de Sonora, Mexico; 2-Cuenca Los Ojos, United States; 3-Instituto de Acuacultura del Estado de Sonora, Mexico; 4-Maestría en Biociencias del la Universidad de Sonora, Mexico)

Recent collections of Yaqui Catfish, *Ictalurus pricei*, in northwest Mexico record their existence only for the Arroyo Cajón Bonito in Sonora, and the Tutuaca River in Chihuahua. Following the recent conservation interest of the species by NGOs and government agencies on both sides of the border, due to the imminent risk of extinction in which it is found, it began with the capture of Yaqui Catfish from the Cajón Bonito Stream in order to initiate a reproductive stock, between other initiatives of knowledge of the species. Twenty individuals of Yaqui Catfish were captured during 2018 and 2019, of which 16 were initially kept alive in a pond of the Area Voluntarily Dedicated to the Conservation of Cuenca Los Ojos in Rancho San Bernardino, Sonora. In the first attempt to transport these live specimens to facilities of the Centro Acuícola del Estado de Sonora (CAES) near Obregón City (Instituto de Acuacultura del Estado de Sonora, IAES), five specimens were transferred, and are currently under the technical care of the staff of the CAES. These specimens receive commercial food for catfish normally and show no signs of stress so far. The genetic identity of the 18 specimens of the reproductive stock has been analyzed using mitochondrial and nuclear genes. Two hybrids have been detected between Yaqui and Channel Catfish, *Ictalurus punctatus*, and are excluded from captive stock. In

addition, the Oklahoma State University (OSU) has begun the study of environmental DNA (eDNA) in selected localities throughout the Yaqui River basin in order to detect potential sites of occurrence of the species not yet reported. The project has a collection license granted by the Dirección de Vida Silvestre (DVS) of the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) and has exercised shared funding from the University of Sonora, Desert Fishes Council, IAES, Cuenca los Ojos and OSU. The project raises the need for financing to develop all the activities, which include the use of specific microsatellites for the analysis of hybridization between these catfish, the reproduction and cultivation of Yaqui Catfish, the training for pilot cultivation of species with management and conservation purposes in Sonora.

17:15 Genetic variability and Inbreeding of the Sonoyta Pupfish *Cyprinodon eremus* Miller and Fuiman, 1987, in artificial refuges and wild populations of Sonora, Mexico

Román Rodríguez-Ramírez[1], Alejandro Varela-Romero*[2], Nohelia Pacheco-Hoyos[3], José Manuel Grijalva-Chon[3],Marco Antonio López-Torres[3], Anthony Echelle[4] (1-Maestría en Biociencias de la Universidad de Sonora, Mexico; 2-Universidad de Sonora, Mexico; 3-DICTUS Universidad de Sonora, Mexico; 4-Oklahoma State University, United States)

The Sonoyta Pupfish, *Cyprinodon eremus*, is an endemic species of the Sonoyta River basin (Sonora) and the Quitobaquito spring (Arizona). Its current distribution is restricted by anthropogenic impacts and does not have an official conservation status. As an immediate conservation strategy in response to the imminent removal of its population in Mexico, four artificial refuges was built in Sonora, however, its establishment was without considering genetic indicators of the population of origin. The hypothesis states indicators of genetic variability changes and inbreeding in artificial refuges were caused by isolation and genetic differentiation due to bottlenecks and founder effect. The objective is to evaluate their genetic variability and inbreeding level in three artificial refuges and the wild population in Sonora, by means of ten microsatelite loci and determine parameters of genetic variability, genetic equilibrium, fixation index (Rst and Fis) and presence of bottlenecks. The results indicate that there is a high genetic variability in all populations; the population of the Centro de Estudios de Desiertos y Océanos (CEDO) has the greatest genetic diversity. All refuge and wild populations have a genetic disequilibrium caused by heterozygous deficits. Fixation indices show little genetic differentiation (Rst = 0.007) and a high inbreeding coefficient (Fis = 0.26) indicating that there is divergence among all populations due to isolation. Presence of bottleneck was detected in the artificial refuge of the Centro Ecologico de Sonora (CES). In conclusion, only the population of the CEDO is potentially useful to increase the genetic variability of the

rest of the refuges, since the indicators of genetic variability agree with those of the wild population, this population could be subject of source individuals for their reintroduction in the Sonoyta River in case it is required.

17:15 Spatial dispersion of soldier flies (Stratiomyidae, Diptera) between non-perennial water bodies in El Pinacate y Gran Desierto de Altar Biosphere Reserve, Sonora, México

Germán Salazar Cabral*[1], Alejandro Varela-Romero[2], Michael Thomas Bogan[3], José Manuel Grijalva Chon[4], Francisco Molina Freaner[5] (1-Maestría en Biociencias de la Universidad de Sonora, Mexico; 2-Universidad de Sonora, Mexico; 3-University of Arizona, School of Natural Resources and the Environment, United States; 4-DICTUS Universidad de Sonora, Mexico; 5-Departamento de Ecología de la Biodiversidad UNAM, Mexico)

Flight capability in insects is important for microhabitat colonization, this dispersion is of great reproductive importance since this maintains the genetic flow between populations, and nevertheless, the high energetic cost of flight is an impediment for insects that cross great distances looking for these habitats. In drylands non-perennial water bodies are important temporal niches and their colonization is vital for the aquatic community that lives in them, that is why the study of gene flow between these populations is critical to know the various effects that can occur in them. The El Pinacate y Gran Desierto de Altar Biosphere Reserve has many non-perennial water bodies with variable hidroperiods and are separated between arid lands, inhabitants of this water bodies include soldier flies (*Stratiomys sp.*) which colonization mechanisms and actual status of the population are unknown. The gene flow between populations permit to have a high degree of heterozygosity and therefore to have a great genetic variability to survive to changing conditions, in regions like El Pinacate where water scarcity is high is of great importance to know the state of populations of aquatic insects like soldier flies that depend on the essential resource. The objective of this work is to determine the gene flow of *Stratiomys sp* between various water bodies in the volcanic plate of the El Pinacate Biosphere Reserve. We will use at least 10 microsatellites loci from DNA extracted from larvae collected during the rainy season, to evaluate potential dispersion between populations. This study will allow us to make inferences of the population status and extrapolate the information for the study of the aquatic communities.

17:15 Study for the recognition of the specific identity of the remaining population of the Long-finned Carp *Agosia chrysogaster* Girard, 1856 of the Sonoyta River from the variation of its mitochondrial genes

Marisol Andrea Paredes Gallardo*[1], Alejandro Varela-Romero[2], José Manuel

Grijalva-Chon[2], Enrique de la Re-Vega[2] (1-Maestría en Biociencias de la Universidad de Sonora, Mexico; 2-DICTUS Universidad de Sonora, Mexico)

The Longfin Dace, *Agosia chrysogaster*, is one of the endemic species that inhabits the Gila River basin (Santa Cruz and San Pedro rivers), the Colorado River in the southwestern United States of America (USA) and the Sonoyta and de la Concepcion rivers in the northwest of Sonora. Currently, the population of the Sonoyta River is virtually extirpated from its natural environment, and the remaining population of few individuals is in a refuge in the Centro de Estudios de Desiertos y Océanos (CEDO) in Puerto Peñasco, Sonora. Its current conservation status of threatened with extinction according to NOM-059-2010 also includes the historical distribution of the Mexican Longfin Dace (*Agosia sp*), which makes it inoperative. Thus, it is necessary to confirm the specific identity of the population of the Longfin Dace remaining in the Sonoyta River by means of genetic criteria to recognize their specific identity, their genetic variability and phylogenetic affinity with the rest of the populations in their natural distribution. Therefore, through molecular analyzes based on the variation of mitochondrial and nuclear genes, specific identity studies (COXI) will be carried out using the DNA Barcoding technique, genetic variability (ND2) and inbreeding degree of the population in refuge, as well as phylogenetic affinity within the species (Cyt-b). The information generated in this project will serve as a basis for the recovery and management of a species in the Sonoyta River basin.

17:15[PA] Morphological investigation of the Sand Shiner *Notropis stramineus* (Cope, 1865)

Amanda K. Pinion*[1], Daemin Kim[2], Kevin W. Conway[1] (1-Texas A&M University, United States; 2-Yale University, United States)

In recent years, investigations of widespread North American freshwater fishes have revealed significant levels of cryptic diversity, especially in minnows and shiners of the family Cyprinidae. The Sand Shiner, *Notropis stramineus* (Cope, 1865) is a small North American minnow with an expansive distribution east of the Continental Divide present abundantly in a portion of the southwestern U.S. to northern Mexico. Though *N. stramineus* is currently regarded as a single species, previous taxonomic authorities recognized two subspecies (*N. s. stramineus* and *N. s. missuriensis*) still recognized as valid by some authors. This two subspecies classification is based largely on minor differences in scale-row counts between individuals inhabiting tributaries to the Great Lakes, upper Mississippi and Texas gulf coast river systems (*N. s. stramineus*) and those inhabiting the Missouri and Arkansas River systems (*N. s. missuriensis*). Analysis of an unpublished, multi-locus genetic data set has revealed the presence of multiple genetically distinct lineages geographically

incompatible with the aforementioned subspecies designations. These results instead suggest that *N. stramineus* may represent a super-species-complex, comprising multiple (4+) similar looking, yet genetically distinct species, the majority of which have yet to be formally recognized and diagnosed with phenotypic characters. To uncover morphological traits useful for distinguishing between putative members of this super-species-complex, we have analyzed geometric morphometric landmark-derived characters to investigate whether consistent phenotypic variation exists across the range of *N. stramineus sensu lato* and whether patterns of phenotypic variation are congruent with geography and genetic lineage membership.

17:15 Oregon / Northern California area report to the Desert Fishes Council, November 2019

Alan Mauer*[1], Brian Sidlauskas[2], Marci Schreder[3], Justin Miles[4], Fred Monzyk[4], Richard Pyzik[5], Benjamin Nicholas[2] (1-US Fish and Wildlife Service, Bend Field Office, United States; 2-Oregon State University, United States; 3-Lake County Umbrella Watershed Council, United States; 4-Oregon Dept. of Fish and Wildlife, United States; 5-Fremont-Winema National Forest Paisley Ranger District, United States)

The Oregon/Northern California Area Report includes activities to report to the council from the northwestern extreme of the desert region which includes several endorheic or terminal lake basins in Oregon, northeastern California, and northwestern Nevada (Fort Rock, Chewaucan, Goose, Warner, Catlow, Alvord, Malheur, Coyote lakes, and Quinn River basins). This region supports remnant fish faunas that once inhabited extensive pluvial Pleistocene lakes. In 2019, OSU and other investigators are re-evaluating the taxonomy of the Torrent Sculpin, *Cottus rhotheus*, across the Pacific Northwest, including parts of Oregon's desert. There are three genetically, geographically and morphologically distinct entities within the current concept of this species, meaning the species may be split taxonomically. The lab is testing whether *Cottus gulosus* and *Cottus perplexus* are distinct species in Oregon. That means that the range of the "true" Torrent Sculpin in Oregon is less extensive than currently conceived. Lake County Umbrella Watershed Council (LCUWC) along with several partner organizations and agencies have formed the Warner Basin Aquatic Habitat Partnership to develop fish passage solutions for Warner Suckers, *Catostonus wasrnerensis*, Redband Trout, *Oncorhynchus mykiss*, and other aquatic life. The LCUWC designed, planned, and implemented projects benefiting Warner Sucker and Redband Trout. Oregon Department of Fish and Wildlife (ODFW) Lakeview District provided updated information on Redband Trout surveys conducted in the Warner and Abert lakes basins. ODFW also conducted a population estimate of Foskett Speckled Dace, *Rhinichthys osculus ssp.*, in 2019 and observed an estimated

population change from 4,279 (95% CI 3,878 to 4,782) in 2017 to 9,493 (95% CI 9,265 to 9,740) in 2019. The Fremont-Winema National Forest, Eastside Fish Program reported completion of several aquatic habitat restoration projects on the upper Sycan, and North Fork Sprague Rivers as well as several smaller tributary streams. The Fish and Wildlife Service (FWS) proposed to remove the Borax Lake Chub, *Siphateles boraxobius*, from the ESA list February 26, 2019. Comments were received from peer reviewers and the public. The final decision will publish in the Federal Register approximately one year from the proposal. The FWS also finalized a rule to remove the Foskett Speckled Dace from the list on September 13, 2019.

17:15 Morphometric and meristic variation within populations of the Mexican Roundtail Chub *Gila minacae* (Teleostei: Cyprinidae) in Northwest México

Carlos Ballesteros*[1], Gorgonio Ruiz-Campos[2], Alejandro Varela-Romero[3], Sergio Sánchez Gonzáles[4] (1-Universidad de Sonora, Mexico; 2-Universidad Autónoma de Baja California, United States; 3-Universidad de Sonora, DICTUS, Mexico; 4-Universidad Autónoma de Sinaloa, Mexico)

The Mexican Roundtail Chub, *Gila minacae*, possess a widespread distribution in the Yaqui River basin and other adjacent southward drainages at the Sierra Madre Occidental in northwest México. However, the formal description of *G. minacae* was based exclusively on specimens taken from the type locality on the Papigochic River at Miñaca, in the Yaqui River basin. Therefore, all the populations currently considered part of the *G. minacae* lineage and inhabiting the drainages beyond the south of the Yaqui River basin have not been formally characterized in terms of their meristic and morphometric variation. We performed a morphological characterization of populations of the *G. minacae* lineage inhabiting the Yaqui River basin, and the southern populations from the Fuerte, Sinaloa, and Culiacán River basins, plus other congeneric species from the Sierra Madre Occidental, Mexico. Discriminant function analysis based on 33 morphometric and six meristic characters applied to 209 Gila spp. specimens revealed 15 body characters to be significantly different ($p < 0.01$) among the taxa compared. Canonical variables 1 and 2 explained 76.8% of the total variation among the populations analyzed. Morphologically, the southern Gila sp. populations inhabiting the Fuerte, Sinaloa and Culiacán River basins are divergent from both the *G. minacae* found in the Yaqui River basin and the other species analyzed. The southern populations of *Gila sp*. have a deeper body and lower numbers of gill rakers, dorsal fin rays, and lateral line scales than *G. minacae* from the Yaqui River basin. The morphological differences detected here among populations of *G. minacae* from the Yaqui River basin and the southern populations suggest the presence of at least two significant evolutionary units within the *G.*

minacae lineage.

17:15 Learning about how pupfish live

Harlan Bean* (Starkey Elementary School, Kerrville, TX, United States)

I will examine how Comanche Springs Pupfish, *Cyprinodon elegans*, at Balmorhea State Park live. I will watch pupfish videos to see what they do. My hypothesis is that they will be moving, playing, and eating. I will record my observations and make some graphs.

17:15 Importance of drainage-specific growth curves for back-calculating spawning periodicity of federally endangered Colorado Pikeminnow and Razorback Sucker

Martinique Chavez*[1], Stephani Clark Barkalow[1], Steven Platania[1] (1-American Southwest Ichthyological Researchers, United States)

San Juan River larval fish surveys have occurred annually since 1998 to monitor reproduction by federally endangered Colorado Pikeminnow, *Ptychocheilus lucius*, and Razorback Sucker, *Xyrauchen texanus*. As part of this monitoring effort, spawning periodicity of both species was back-calculated annually using growth equations developed in the Upper Colorado River basin. While back-calculated spawning dates generated from these models were assumed to be approximations, use of the equations was limited, particularly for Razorback Sucker, because older age-0 fishes produced unfeasible spawning dates. In 2017, San Juan River basin-specific growth curves were developed for Colorado Pikeminnow and Razorback Sucker, using larvae collected in the San Juan River from 2009 to 2017. These growth curves were used to estimate age in days from standard length of age-0 fish. Back-calculated age was used to calculate spawning periodicity and was compared against spawning periodicity calculated with the upper Colorado River basin equation and daily otolith ages for both species. Initial results indicated that spawning periodicity produced by San Juan River basin growth curves was significantly different from those produced by the Upper Colorado River basin growth curves but not from spawning dates calculated from otolith ages. We then used species-specific San Juan drainage growth curve equations to back-calculate spawning dates of all larval Colorado Pikeminnows and Razorback Suckers collected in the San Juan River between 2000 and 2018. Spawning periodicity from the San Juan River equations was compared against that of the Colorado basin equations using ANOVA. The San Juan River is largely a dam-regulated system with water release from Navajo Dam managed to mimic a natural flow regime. Inaccurate back-calculation of spawning dates could result in missed opportunities for water release from dams or

inadvertently harm larval fishes.

19:15-21:15 General Student Networking Session

Friday, November 22nd

08:30-10:30 General Session III (Chair: Tiffany Love-Chezem)

08:30 A status and conservation update for the Desert Pupfish

Doug Duncan*[1], Sharon Keeney[2], Martha Roman[3] (1-U.S. Fish and Wildlife Service, United States; 2-California Department of Fish and Wildlife, United States; 3-Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora, Mexico)

The Desert Pupfish, *Cyprinodon macularius*, was listed as endangered in 1986 due to the well-known and extensively documented threats of habitat loss and the spread of exotic and nonnative fishes. Even though the Desert Pupfish was split into three species by Echelle et al. in 2000 (*C. eremus*) and Minckley et al. in 2002 (*C. arcuatus*), under the U.S. Endangered Species Act it is still considered one species.

The 1993 Recovery Plan was recently amended to add criteria for delisting the species, through drought, climate change, border activities, and increasing human populations still threaten streams and springs and nonnative and exotic species are still introduced and distributed across the landscape. The status of the species continues to improve in Arizona due to the actions of the Arizona Game and Fish Department and its partners. However, the natural population inhabiting the Salton Sink in California continues to experience declines. The populations in Mexico appear to be mostly static, except for Rio Sonoyta

08:45 Structural analysis in gonopodium of the genus *Poecilia* (Cyprinodontiformes: Poeciliidae) on selected species and its implication on taxonomy

Mario Alberto Lucio-Alvarez* (Universidad Autonoma de Nuevo Leon, Mexico)

The poecilid family is formed by a group of viviparous fishes, where the male's anal fin is modified into a reproductive system called gonopodium. This modification makes rays 3 to 5 enlarged and formed segments in each ray that may present structures like spines, hooks, claws, serrated areas and more. The gonopodium has been proven useful to identify species like *Xiphophorus* or *Gambusia* and therefore it could be useful in the *Poecilia* genus. The present study will focus on the taxonomical differences within the species of the genus *Poecilia* mainly *P. latipinna*, *P. velifera, P. petenensis*, *P. mexicana* (sulfur and non-sulfur*), P. butleri,* and *P. sphenops*; this study may be used as an extra tool for the inexperienced on the

taxonomy of *Poecilia spp*. Each gonopodium was cut and processed for a better description of it. Each species has their traits like the number of spines in the serrated area, the number of internal spines, the presence or absence of a membranous hook in ray 3. The number of spines in ray 4p, the spines in ray 5a and the shape of the claw in ray 5p may serve as a useful taxonomic complement.

09:00[CLH] **Spatial and temporal variation in benthic macroinvertebrate assemblages at tributary confluences of the Pecos River**

Kelbi Delaune*[1], Connor Brown[1], Allison Pease[1] (1-Department of Natural Resources Management, Texas Tech University, Lubbock, Texas 79409, United States)

Tributary streams offer basal resources for aquatic food webs and unique habitats to taxa that differ from the main stem of the river. Because of this, many stream tributaries are known to be biological “hot spots” for species diversity, making them important for river conservation strategies. The Pecos River flows from New Mexico through Texas and offers an ideal study system to investigate diversity in stream tributary junctions across both natural and impacted conditions. In this study, we explored seasonal (summer 2016, fall 2016, and spring 2017) effects of tributary confluences in the Middle and Lower Pecos on the diversity of benthic macroinvertebrate assemblages across sites that encompass a range of habitat conditions. Longitudinally, specific conductivity, substrate, and discharge varied, and sites were significantly different when comparing macroinvertebrate density, Shannon- Weiner diversity, and species evenness. Post-hoc analyses revealed that the Middle Pecos confluence sites of Taiban Creek and Rio Hondo had lower benthic macroinvertebrate density than the Permian Basin site of Delaware River. Additionally, the Taiban Creek and Independence Creek, the most northern and southern sites, were significantly different when comparing Shannon-Weiner diversity. Seasonal differences also existed in the density of macroinvertebrates and the functional feeding groups present across sites. Nonmetric multidimensional scaling analysis revealed that confluences within the same region had similar community structure, and indicator species analysis showed that some taxa were strongly associated with particular regions (e.g., Psephenidae and Naucoridae in the Edwards Plateau). Taken together, these findings indicate that tributary confluences are important sites for benthic macroinvertebrate production in the highly altered Pecos River, and ecoregion-scale physiographic variation strongly influences local confluence community structure.

09:15 Changes in fish diversity at La Silla River, Nuevo León, Mexico: biological collections as witness of the ecosystems quality

Erick Cristóbal Oñate González*[1], María Elena García Ramírez[1], Deborah Esther Veloz Barocio[1] (1-Universidad Autónoma de Nuevo León, Mexico)

Mexico is considered a megadiverse country because its geographical position into the Neotropical and Nearctic biogeographic regions, due to the variety of climates, the great orographic diversity, being surrounded by two different oceans, presenting different types of soil, inland waters and different types of vegetation, generating high fauna richness. However, biodiversity has been diminished due to anthropogenic activities, as well as environmental changes that have affected populations. To mitigate the effects of these factors, it is necessary to be aware on how this diversity has changed over time, making biological and ecological comparisons at different time and geographic scales. The aquatic systems in Mexico are used for the disposal of wastewater, which generates ecological disturbances in the rivers and the surrounding ecosystem. La Silla River, in Nuevo León, Mexico, is considered one of the aquatic ecosystems with the highest ecological priority in North America, due to its biodiversity, as well as the different environmental services it offers as a system, in addition to the potential risk due the human settlements around. It is at this point that the importance of Biological Collections arises, considered as libraries of specimens that are stored in special conditions to guarantee their integrity over time, and providing biological information at historical, geographical, genetic, ecological, anatomical and morphological levels. Fish species lists of Nuevo León have demonstrated the presence of several national or international protected species, and some of these species are distributed in La Silla River. However, for many of them there is not enough information about their biology and ecology to assess their vulnerability to adverse ecosystem conditions. The current conditions of the La Silla River allow us to infer that the fish populations will present unfavorable ecological, demographic and genetic conditions that will increase the need for their protection. At the Ichthyological Collection of the Biological Sciences Faculty from the Autonomous University of Nuevo León, specimens from almost all the States of Mexico and from other countries of the world are present. From La Silla River, there are records dating since 1966, with the Catostomidae, Centrarchidae, Cyprinidae, Characidae, Cichlidae, Poecilidae and Ictaluridae families being the oldest recorded for the area. In this way, for different locations of La Silla River, there are records from 1966, 1969, 1981, 1982, 1988, 1995, 1996, 1998 and 2011, where, in addition, the families Clupeidae, Percidae and Cyprinodontidae are included. During the second half of 2019, a weekly monitoring is carried out in different locations of La Silla River, to analyze the current diversity of species, with the main goal of temporary comparisons and assessing how diversity has changed, both in richness of species as functional, in order to understand how anthropogenic changes, affect the health of the freshwater ecosystem. So far, it a tendency in the decrease of the specific richness is observed, produced, possibly, by

the contamination of the river, as well as the decrease of the tributaries and the quality of the water.

09:30 Time for rescue: genetic conservation of imperiled fishes: Arkansas River Shiner (*Notropis girardi*), Peppered Chub (*Macrhybopsis tetranema*) and Plains Minnow (*Hybognathus placitus*)

Megan Osborne*[1], Joanna Hatt[2], Stephen Davenport[3], Eliza Gilbert[3], Thomas Turner[1] (1-University of New Mexico, United States; 2-New Mexico Department of Game and Fish, United States; 3-U.S. Fish and Wildlife Service, United States)

The prairie rivers of the Great Plains have been altered significantly over the past century and these changes have disproportionately impacted the pelagic broadcast spawning guild of minnows. We used genetic monitoring time series data from microsatellites and mtDNA for Arkansas River Shiner, *Notropis girardi*, (2009-2019), Peppered Chub, *Macrhybopsis tetranema*, (2015-2018) and Plains Minnow, *Hybognathus placitus*, (2013-2015) to evaluate genetic status and trajectory of genetic change in these taxa. Genetic data was considered with reference to stream flow data and metrics of species density. Results indicate that the Canadian River harbors genetically diverse populations of these species despite losses of populations elsewhere. Metrics of genetic diversity were also stable across the time series for all taxa. Despite clear differences in contemporary abundance, all species have high values of haplotype diversity, consistently low values of nucleotide diversity and an excess of rare haplotypes. These results are indicative of populations that have experienced bottlenecks in the past but that have subsequently expanded rapidly. Despite all taxa having considerable standing stocks of genetic diversity, their persistence is not guaranteed. Populations that experience large fluctuations in abundance and have a narrow geographical distribution, face higher extinction risks than larger and more broadly distributed species. The presence of genetically diverse populations of all species in the Canadian River does however present an opportunity to establish captive populations using the Canadian River as a source. Captive populations of Peppered Chub and Arkansas River Shiner could serve as both an insurance policy for these taxa when drought conditions return to the southwest, and as a source of individuals for future reintroduction efforts.

09:45[CLH] Seasonal and longitudinal water quality dynamics in three effluent-dependent rivers in Arizona

Hamdhani*[1], Drew Eppehimer[1], David Quanrud[1], Michael Bogan[1] (1-University of Arizona, United States)

In the past 100 years, many rivers in the southwest USA have dried up, but some reaches in these rivers have remained perennial due to the continuous input of effluent discharged by wastewater treatment facilities. The re-establishment of perennial reaches has brought back habitat for numerous aquatic and riparian taxa. However, because these reaches are artificially supported by effluent, flow regimes and water quality gradients may differ from former natural conditions and water quality below effluent outfalls may be a limiting factor in supporting native fish populations. The objective of this study was to quantify spatial and temporal changes in basic physical and chemical water quality parameters below the outfalls of three effluent-dependent rivers in Arizona: Santa Cruz (Tucson), Salt (Phoenix) and Rio de Flag (Flagstaff). Six reaches were studied; three reaches were short (~3-5 km), one was intermediate (~9 km), and two were long (>24 km). In 2018, we measured dissolved oxygen, temperature, pH, specific conductance, and nutrients at 26 river sites. In the long reaches, dissolved oxygen increased with distance from effluent outfalls, whereas temperature and ammonia concentration decreased; most other water quality variables did not exhibit clear longitudinal trends. No trends were apparent in the short reaches studied. In all reaches, most variables exhibited at least some seasonal variation; for example, in summer, dissolved oxygen and pH tended to decrease, whereas temperature increased. In all seasons, water quality conditions in most reaches were within ranges tolerated by native desert fishes. These findings help us understand the potential for managing effluent to augment perennial river habitats in arid regions.

10:00[CLH] **Assessing genetic diversity among lineages of Gila Trout based on neutral and adaptive single nucleotide polymorphic loci**

David Camak*[1]; Megan Osborne[1]; David Propst[2], Thomas Turner[1] (1-Department of Biology and Museum of Southwestern Biology, University of New Mexico, United States; 2-Museum of Southwestern Biology, University of New Mexico, United States)

Gila Trout, *Oncorhynchus gilae*, is a federally protected species that inhabits headwater streams of the Gila and San Francisco rivers in New Mexico and Arizona. Gila Trout occupy habitats that test the limits of their physiological tolerances. Severe droughts, floods, and wildfires present risks of local extirpation. Gila Trout is actively managed and past focus has been on preserving 'purity' of individual lineages. Now, genetic rescue and restoration of metapopulation dynamics are planned. Therefore, it is imperative to understand sources of genetic variation available to effectively conserve genetic diversity and existing population structure within Gila Trout. Using a dataset of 961 high-quality single nucleotide polymorphisms (SNPs), we characterized genetic diversity among all known

lineages of Gila Trout. Gila Trout lineages are highly structured. Individual lineages contain low, yet unique, genetic diversity and low effective population sizes. Spruce Creek lineage had the lowest diversity with an expected heterozygosity estimate of 0.02 and 75% of loci monomorphic. Iron Creek lineage had the highest observed heterozygosity (0.30). All lineages were significantly differentiated from one another, but Iron Creek, Main Diamond Creek, and South Diamond Creek lineages showed the least differentiation relative to other lineages. A set of SNPs associated with genes related to immunity, ion homeostasis, growth, and thermal tolerances were also characterized and analyzed. Our data indicate evidence for local adaptation despite low genetically effective population sizes. The data suggest a management strategy focused on increasing genetic diversity while retaining the unique diversity within each lineage.

10:15 Collaborative research, conservation, and management strategies for the endangered Devils Hole Pupfish

Michael Schwemm*[1], Ambre Chaudoin[2], Jeffrey Goldstein[2], Kevin Wilson[2], John Wullschleger[2], Olin Feuerbacher[1], Jennifer Gumm[1], Alex Jones[1], Corey Lee[1], Javier Linares-Casenave[1], Brandon Senger[3] (1-U.S. Fish and Wildlife Service, United States; 2-National Park Service, United States; 3-Nevada Department of Wildlife, United States)

The endangered Devils Hole Pupfish, *Cyprinodon diabolis*, has persisted as a single population in Devils Hole, Nevada for an estimated ≥10,000 years. Twice on the brink of extinction during the past 15 years, adaptive conservation strategies have proven essential to its survival. The first population decline to under 40 fish in 2006 prompted the reconvening of the Devils Hole Recovery Team, a task force comprised of managers, researchers, and subject matter experts. This paved the way for the subsequent formation of the Devils Hole Incident Command and Management Oversight Teams (ICT/MOT). The ICT structure facilitates biologists and managers from the US National Park Service, US Fish and Wildlife Service, and Nevada Department of Wildlife who work directly with the species to formulate and execute management efforts in real time, with the MOT ultimately providing higher-level oversight. ICT members regularly communicate to guide minimal impact recovery planning for research, monitoring, and habitat restoration projects; public outreach; and partnerships with outside researchers to investigate underlying factors in past population declines and current trends. Recent successes include the largest population estimates since 2003 (187, 136, and 170 during fall 2018, spring 2019, and fall 2019, respective), record larval pupfish estimates, and new milestones in captive propagation, offering renewed hope of a positive trajectory for this unique

desert fish.

10:30-11:30 Symposium Plenary Session (Speaker: Timothy Birdsong)

11:30-13:15 Lunch Break

13:15-16:45 Symposium - Changing Landscapes: The Shift of the Chihuahuan Desert to a Groundwater Dependent Ecosystem (Chair: Megan Bean)

13:15 The role of climate in establishing goals and expectations for rangeland restoration projects in Far West Texas

Lynn Loomis* (USDA-Natural Resources Conservation Service, United States)

Rangeland restoration in Far West Texas is a risky venture; failure lurks around every corner. Practitioners can increase the likelihood of success 1) by establishing reasonable goals and expectations, 2) by choosing sites with potential to respond, 3) when appropriate, by selecting species adapted to the site, and 4) by adopting management practices that promote the germination, establishment, and reproduction of the selected species.

13:30 West Texas springs: leaking into an uncertain future

Chad Norris* (Texas Parks and Wildlife Department, United States)

The Trans-Pecos region of Texas is a region of extremes where mountain ranges interrupt the Chihuahuan Desert, which is recognized as both the largest desert in North America and the most biologically diverse in the Western Hemisphere. With an average annual rainfall of only twelve inches, perennial water is derived primarily from freshwater springs sourced in local and regional aquifers. Freshwater springs, such as San Solomon, San Felipe, Caroline, Dolan, Giffin, and East Sandia springs, contribute substantially to the region's water quantity and quality. In addition, these springs are ecologically important as they provide habitat for numerous rare and federally listed endemic species and are a vital water source that keeps regional and migratory fish and wildlife species common. The loss and decline of springs in the region has been well-documented and concern exists regarding the potential impacts associated with recent oil and gas discoveries and related activities in the region. The many challenges facing West Texas Springs and groundwater management will be discussed along with efforts to protect and conserve these vital resources.

13:45 The Rio Grande Wild and Scenic River

Kevin Urbanczyk*[1], Jeffery Bennett[2] (1-Rio Grande Research Center, Sul Ross State

University, United States; 2-Rio Grande Joint Venture, United States)

The Rio Grande Wild and Scenic River (RIGR) starts in Big Bend National Park (BBNP) and extends 315 km to the Terrell/Val Verde county line. This segment of the Rio Grande benefits from a base flow increase provided by the Edwards Trinity Plateau Aquifer (ETPA), which is part of a binational aquifer system. The base flow increases start in BBNP, and continue through the Lower Canyons and on to Amistad reservoir. We initiated monitoring of this system in 2005 and continue to conduct annual monitoring trips to assess water quality, flow, geomorphology and aquatic habitat. Comprehensive seepage runs completed in 2006 and 2011 suggest a flow increase of ~8 and ~9 m^3/s for the entire segment. All of this can be attributed to ground water input as there are no perennial tributaries and the field work was completed during low flow conditions with no local atmospheric input to the river. We have also analyzed existing stream gage data between Johnson Ranch and Foster Ranch using only data from low flow conditions for a similar groundwater inflow assessment. This 1962 to 2011 estimate yielded an increase of 6.4 m^3/s. This estimate is lower than the seepage run data because it includes a shorter segment and excluded some of the downstream springs.

For comparison, a 1944 water treaty between the US and Mexico stipulates 13.7 m3/s (350,000 ac-ft/yr) in the Rio Grande. The ETPA in the RIGR contributes an additional ~8.5 m3/s (217,000 ac-ft/yr; an average of the two seepage runs). The water quality in the segment improves as a result of the groundwater inflows. The specific conductivity (SC) of the springs varies from ~350 uS/cm up to a maximum of 1000 uS/cm while the SC of the Rio Grande above the segment is rarely lower than 1000 uS/cm. The groundwater inflows result in a dilution effect with an overall increase in water quality. This increase in flow and water quality support the conclusion made in the Upper Rio Grande Basin and Bay Expert Science Team report that the area represents a Sound Ecological Environment with a functioning aquatic habitat.

14:00 Resource use and ecological interactions of invertebrate communities in springs of central and west Texas

Weston Nowlin*[1], Parvathi Nair[2], Nina Noreika[3], Pete Diaz[4], Chad Norris[5] (1-Department of Biology, Texas State University, United States; 2-University of Texas Marine Science Institute, United States; 3-Czech Technical University in Prague, Czechia; 4-United States Fish and Wildlife Service, United States; 5-Texas Parks and Wildlife Department, United States)

Spring ecosystems serve as ecotones (i.e., transition zones between adjacent ecosystem types) between surface and subterranean as well as terrestrial and aquatic habitats. As ecotones, spring ecosystems often contain complex assemblages from

multiple habitat and ecosystem types including spring obligate (crenic) taxa, subterranean taxa (hypogean), and more widespread surface water associated (epigean) species. This study examines patterns of resource and habitat use in the invertebrate communities at spring ecosystems in semi-arid and arid areas of central and west Texas, USA. We examined invertebrate food web structure and function at Comal Springs (central Texas), Finegan Springs (Devils River in west Texas) using stable isotopes of carbon (d13C), nitrogen (d15N) in organisms and their potential food sources. In the Comal and Finegan spring systems, endemic crenic and hypogean invertebrate species generally relied upon inputs of terrestrial organic matter (leaves and woody material) as their primary organic matter source, but more cosmopolitan epigean taxa relied upon algal-derived resources. We also found that the ecological niche (as determined by stable isotope values) of endemic crenic and hypogean species were narrow and exhibited little overlap with other species. We conducted a comparable study in several spring systems in the Davis Mountains region of west Texas (i.e., San Solomon systems) and similarly found that endemic and endangered spring obligate snail and amphipod fauna exhibit narrow ecological niches with little overlap with non-native invertebrates. Overall, our results indicate that invertebrate food webs found in spring ecotones exhibit a substantial trophic complexity and endemic fauna are finely partitioning food resources and exhibit narrow feeding niches. Results also highlight the importance of lateral connections to riparian zones as a source of organic matter for the macroinvertebrate communities in spring systems.

14:15 A semi-arid river in distress: contributing factors and recovery solutions for three imperiled freshwater mussels (Family Unionidae) endemic to the Rio Grande basin in North America

Charles Randklev*[1], Michael Hart[1], Jennifer Khan[1], Clint Robertson[2] (1-Texas A&M University, United States; 2-Texas Parks and Wildlife Department, United States)

Freshwater resources in arid and semi-arid regions are in extreme demand, which creates conflicts between needs of humans and aquatic ecosystems. The Rio Grande basin in the southwestern United States and northern Mexico exemplifies this issue, as much of its aquatic biodiversity is currently in peril as a result of human activities. Unionid mussels have been disproportionately impacted, though the specific factors responsible for their decline remain largely enigmatic. This is problematic because the Rio Grande basin harbors three unionid mussel species (*Potamilus metnecktayi*, Salina Mucket; *Popenaias popeii*, Texas Hornshell; and *Truncilla cognata*, Mexican Fawnsfoot), which are being considered for listing under the U.S. Endangered Species Act. To date, surveys for these species have not corrected for variability in detection; thus, current range estimates may be inaccurate. Using single occupancy-modeling to estimate detection and occupancy at 115 sites along ~ 800 river kilometers of the Rio

Grande in Texas, we found that detection probabilities were relatively high, indicating that our survey design was efficient. In contrast, the estimated occupancy was low, indicating that our focal species were likely rare within the Rio Grande drainage. In general, the predicted occupancy of our focal species was reduced throughout their respective ranges, indicating possible range declines. A comparison of currently occupied ranges to presumptive ranges underscores this point. The best-approximating models indicated that occupancy was influenced by habitat, water quantity, and quality and proximity to large-scale human activities, such as dams and major urban centers. Our study provides important empirical evidence on the ecological implications of hydrologic alterations and land use on rare endemic mussel species and highlights the need for better management of semi-arid rivers. We also provide recommendations on conservation activities that may not only improve the long-term prognosis of our focal species but also other aquatic taxa within this basin.

14:30 Assessing salinity toxicity of *Popenaias popeii* (Texas Hornshell) from the Rio Grande, Texas

Michael Hart[1], Charles Randklev[1] (1-Texas A&M University, Agrilife, United States)

Popenaias popeii (Texas Hornshell) is endemic to the Rio Grande drainage, in Texas and New Mexico, and to Mexico in select coastal streams. Currently, only four populations persist in the United States and its status within Mexico remains unknown. In 2018, USFWS listed Texas Hornshell as Endangered under the ESA. A number of factors have been implicated in the decline of this species including degraded water quality due to changes in land use, river impoundment, and ground water pumping, but none of these stressors have been explicitly tested. In particular, salinization of the Rio Grande and its tributaries has long been a concern due to the underlying geology, the effects of which have been exacerbated by agricultural practices, natural gas extraction, and river impoundments. In general, unionid mussels are considered sensitive to even low levels of salinity so increased salinization could be a major contributing factor to the decline of Texas Hornshell in the Rio Grande. The objective of this study was to determine the effects of various concentrations of salinity on survival of adult mussels of Texas Hornshell. We performed acute and chronic toxicity tests at various salinity concentrations for up to 10 days. We found that mussels exposed to concentrations above 4 ppt showed significant mortality, while concentrations below this showed no mortality. Our results demonstrate that Texas Hornshell is tolerant of salinization compared to other unionid mussel species. However, large segments of the Pecos and parts of the Rio Grande are near or exceed 4 ppt, which indicates that these reaches are becoming unsuitable and populations within them at risk.

14:45 Thermal tolerance of *Popenais popeii* (Texas Hornshell), an endangered

freshwater mussel endemic to the Rio Grande basin

Jennifer Khan[1], Amanda Goldsmith*[1], Michael Hart[1], Charles Randklev[1] (1-Texas A&M Natural Resources Institute, United States)

Freshwater mussels are among the most imperiled groups of aquatic organisms in North America largely due to anthropogenic impacts, such as altered temperature regimes. Detailed knowledge on lethal temperatures for freshwater mussels has been limited to only 22 species, which is less than 10% of the species known to occur in North America, and relatively little is known about the thermal tolerance of mussel species inhabiting arid or semi-arid river systems. This lack of information is problematic because climate change coupled with increasing human water demand is expected to increase the frequency and intensity of droughts in these regions, which may negatively impact threatened mussel populations. To determine the effects of elevated water temperature on vulnerable mussel populations, we tested the upper thermal tolerances of the larval (glochidia) and juvenile life stages of *Popenaias popeii* (Texas Hornshell) from the Devils River, a species recently listed as Endangered under the U.S. Endangered Species Act. Mussels were acclimated to 27°C across a range of experimental temperatures (30 – 38 °C) in standard acute laboratory tests. The median lethal temperature (LT50) among populations in 24-h tests with glochidia averaged 32.0 °C and ranged from 31.1 to 32.7 °C. The LT50 in 96-h juvenile trials was 32.7 °C. Ongoing thermal trials will test *P. popeii* throughout its range in the Rio Grande basin.

15:00 Controls on native fish diversity in the Big Bend and Forgotten Reach of the Rio Grande and implications for management

Brian Laub*[1], Demitra Blythe[2], Jack Schmidt[3], Phaedra Budy (1-The University of Texas at San Antonio, United States; 2-Idaho Fish and Game, United States; 3-Utah State University, United States)

Flow alteration impacts native river biota through multiple stressors, including altered disturbance regimes, water quality, and physical habitat. To understand the relative impacts of these different stressors on native fish communities in the Rio Grande, we examined how native fish richness responded to variation in flow, water quality, physical habitat, and non-native fish relative abundance in two reaches of the Rio Grande that differed in their degree of flow alteration. Flows in the Forgotten Reach (FR) have been completely altered from historic conditions, the historic channel has narrowed by 90%, and water quality is severely degraded. In the Big Bend, flows from the Rio Conchos provide higher base flows than in the Forgotten Reach and periodic channel reset floods that temporarily widen the channel. In each reach, we identified all available fish sampling records at several common sampling points, and for each fish sample compiled information on flow levels, specific conductivity, water temperature,

channel width, and nonnative fish relative abundance. We then developed and parameterized a structural equation model for each reach relating fish richness to hydrology, water quality, habitat, and non-native abundance variables. Comparison of the models between the two reaches revealed that width variation is a major factor driving native fish richness in Big Bend, where channel-widening floods occur, and where water quality is less impaired. In the Forgotten Reach, where channel-widening floods do not occur, small flow spikes and water quality are equally as important as habitat changes for native richness. Though additional research is needed, results suggest flow management to maintain channel width in the Big Bend is warranted if water quality is protected, whereas in the Forgotten Reach, habitat management may be ineffective without improvements in water quality.

15:15 Meeting in the middle: biogeography of Pecos drainage Cyprinodon

Christopher Hoagstrom* (Weber State University, United States)

The Pecos River drainage hosts three endemic species within Cyprinodon. Although their biogeography is fundamentally understood [Echelle & Echelle 1978, Copeia 1978(4):569-582; Echelle et al. 2005, Copeia 2005(2):320-339], this study provides an updated synthesis of essential details. The three species ultimately descend from the same widespread coastal ancestor, but directly descend from two separate geographic lineages of Pliocene age: (1) *C. elegans* from a lower Rio Grande branch, (2) *C. pecosensis-bovinus* from a Red River branch. The Rio Grande taxa evolved in a karst-dominated watershed and *C. elegans* eventually colonized springs, similar to relatives elsewhere. In the ancestral Pecos River drainage, these occurred in Cretaceous limestones cropping out across the slope northeast of the Davis and Glass mountains. In contrast, the Red River taxa evolved in sediment-laden plains rivers, within a region with widespread salt dissolution and high rates of evaporation. There, saline habitats (backwaters, wetlands, springs) were widespread and are still occupied by members of the Red River clade. The most recent common ancestor of *C. pecosensis* and *C. bovinus* (sister species) colonized the incipient Pecos River via stream capture. Although secondary contact between pupfishes of Rio Grande and Red River descent resulted in mtDNA introgression, the lineages remained distinct [Echelle et al. 2005, op. cit.]. Based on recent secondary contact of *C. elegans* with *C. variegatus* (an invasive species), habitat segregation was likely an important isolating mechanism, restricting hybridization to ecotones [Stevenson & Buchanan 1973, Copeia 1973(4):682-692; Echelle & Echelle 1994, Copeia 1994(3):590-597]. Captive breeding experiments indicate mate selectivity and hybrid sterility/inviability could have also been involved [Tech 2006, J. Evol. Biol. 19:1830-1837]. In contrast, representatives of the Red River clade lack reproductive isolation from *C. variegatus* [Wilde & Echelle 1992, Trans. Amer. Fish. Soc. 121(3):277-286; Echelle & Echelle 1997, Conserv. Biol. 11(1):153-

161], consistent with a heritage of similar habitat use. Both endemic species require strict protection from introgression with the nonnative invader. Speciation of *C. bovinus* versus *C. pecosensis* reflects isolation of Leon Creek on a horst where *C. bovinus* is endemic. The horst became elevated above an otherwise subsiding, surrounding landscape. Ephemeral stream reaches between the horst and the Pecos River, possible dispersal barriers (i.e. vertical drops) at the horst boundary, and spring adaptation presumably explain interspecific reproductive isolation. Today, only residual habitats remain available to each of the three endemic species. All require conservation management, are severely imperiled, and—history suggests—could quickly disappear.

15:30 Conservation status of Chihuahuan Desert fishes in the United States: a spatial perspective

Joshuah Perkin*[1], Matthew Troia[2] (1-Texas A&M University, United States; 2-University of Texas at San Antonio, United States)

Native fishes in the American Southwest are threatened by anthropogenic landscape alterations involving habitat destruction and dewatering. Consequently, many species are in need of conservation and status assessments are necessary for conservation planning. However, many conservation assessments are based on expert opinions or data available only to the researchers that develop status assessments. There is a need for repeatable, empirically-driven assessment frameworks that can be applied by multiple conservation entities and repeated as new data become available. We present a status assessment framework based on publically available geospatial data and apply this framework to native stream fishes occupying the Chihuahuan Desert region of the United States. Criteria included in the assessing were: (1) area occupied based on open access digital data from the Global Biodiversity Information facility; (2) abundance inferred from probability of occurrence modeled using landscape data and environmental niche modelling (ENM); (3) dependence on humans for persistence based on the percent of occurrences that fall within freshwater protected areas; (4) tolerance to environmental alteration based on cumulative habitat alterations at locations where species occur; (5) genetic risk based on the percent of habitat that is co-occupied by an non-native congener; (6) vulnerability to climate change based on expected climatic shifts where species occur; and (7) anthropogenic causes of declined based on ENM and geospatial data. Scores ranging 1-5 for each of these criteria were averaged to give a quantitative conservation status (1 = endangered; 5 = least concern) for 55 native species occupying the Chihuahuan Desert region of the United States. We present species status ranks and the major factors contributing to current conservation status and hope that Desert Fishes Council members with expert knowledge can provide their opinions.

15:45 Conservation of aquatic SGCN wildlife in the Trans-Pecos Ecoregion of Texas

Russell Martin* (Texas Parks & Wildlife Department, United States)

The Texas Conservation Action Plan's (TCAP) purpose is to provide a statewide "roadmap" for research, restoration, management, and recovery projects addressing Species of Greatest Conservation Need (SGCN) and important habitats (TPWD 2012). There are 6 herps, 27 freshwater fishes, 30 invertebrates, and 27 plants SGCN's in the Chihuahuan Desert Ecoregion that are aquatic-obligate or associated and another 5 mammals, 11 birds, 1 herp, and 1 invertebrate that are riparian-associated. Many of these species are dependent on groundwater-fed springs along the Rio Grande or it's tributaries. Significant cross-taxa conservation threats and opportunities exist where multiple SGCN species occupy overlapping aquatic habitats such as the Lower Canyons of the Rio Grande or Dolan Falls on the Devil's River.

16:00 Managing uplands to support riparian health

Robert Potts* (The Dixon Water Foundation, United States)

The hydrologic health of uplands directly affects the health of riparian systems. The predominate land use in most arid uplands is livestock ranching. Planned grazing can improve the ecological health of uplands watersheds and the downstream riparian areas.

16:15 The Nature Conservancy's history and current role in fish conservation in the Chihuahuan Desert

Ryan Smith[1], John Karges[1] (1-The Nature Conservancy, United States)

The Nature Conservancy has a deep history in conservation of aquatic ecosystems in the Chihuahuan Desert. This began with investment as a landowner and/or stakeholder in Texas, New Mexico, and several states of Mexico. In Texas, the Conservancy manages six major desert preserves, which protect habitat for at least nine endemic and endangered fishes as well as numerous invertebrates and plants. Development of science has also been a major goal, from an initial focus on natural heritage inventory, to ecoregional and local conservation planning, to targeted studies at preserves and watershed projects. Recently, in Texas this has taken on a focus on understanding ecosystem needs and balancing human needs with those of nature. In the Chihuahuan Desert we are collaborating with partners to better understand the groundwater-surface water interactions sustaining desert aquatic ecosystems to enable sustainable water management, even as Texas grows. The Conservancy is using this science to inform several conservation efforts that move beyond land protection to groundwater and surface water protection and restoration at scale. Developing understanding of

springflow needs and underlying hydrogeology is informing groundwater policy and management. We also hope to help encourage sustainable approaches to energy development, including water use for hydraulic fracturing. Instream flow needs are also serving as targets for development of environmental water transactions and irrigation efficiency strategies.

16:30 Conservation of Chihuahuan Desert fishes – past and present

Gary Garrett*[1], Megan Bean[2] (1-The University of Texas at Austin, United States; 2-Texas Parks and Wildlife Department, United States)

With 95% of the land in Texas privately owned, conservation of the aquatic resources is particularly daunting and is exemplified by the fact that 48% of the 191 native freshwater fishes in Texas are now of conservation concern. Partnerships with private landowners is not only sensible, but often the only way to achieve long-term conservation goals. In the Chihuahuan Desert region of Texas, 55% of the native fishes are of conservation concern or already lost to extirpation or extinction. Although there are numerous contributing factors, habitat degradation and loss are the primary culprits. For decades, research and restoration have focused on some of the more imperiled species and their habitats. From reestablishing ciénegas, to landowner partnerships, to Conservation Agreements, much has been accomplished. Unfortunately, the challenges increase faster than our accomplishments. Our latest, and most promising, approach has been to develop six Native Fish Conservation Areas in the Chihuahuan Desert. These NFCAs represent an ecologically-focused conservation prioritization of watershed segments that serve as native fish “strongholds” and they function as priority areas for conservation investments to promote integrated, holistic conservation strategies that enable the long-term persistence of freshwater biodiversity. Current and future conservation of aquatic resources in Texas emphasizes a landscape-scale approach, working primarily with private landowners to provide conservation best management practices and support on-the-ground projects to maintain or restore habitats to sustain functional ecosystems.

16:45-17:00 Awards (Chair: Brandon Albrecht)

17:15-18:45 Business Meeting (Chair: Krissy Wilson)

19:00-21:00 Banquet

Saturday, November 23rd

08:30-11:00 General Session IV (Chair: Jennifer Gumm)

08:30 Conservation biogeography of Headwater Catfish (*Ictalurus lupus*) in the United States

Stephanie George[1], Joshuah Perkin*[1], Megan Bean[2], Dijar Lutz-Carrillo[3] (1-Department of Wildlife and Fisheries Sciences, Texas A&M University, United States; 2-Inland Fisheries, Texas Parks and Wildlife Department, United States; 3-Analytical Services Laboratory, Inland Fisheries, Texas Parks and Wildlife Department, United States)

Our aim was to review the conservation status of Headwater Catfish, *Ictalurus lupus*, in the United States with emphasis on Texas populations. Our status assessment included evaluating change in geographic distribution over time and measuring introgression and hybridization with Channel Catfish, *Ictalurus punctatus*, to inform conservation prioritization. We used machine learning methods (random forest and boosted regression tree) to construct species distribution models based on historical and contemporary presence-absence data using 13 environmental predictors based on remotely sensed stream network data. We measured introgression and hybridization with the widely introduced Channel Catfish using external morphology and molecular markers. The sub-basin (8-digit hydrologic unit code) from which collections were made was the most important predictor variable across all models. Species distribution models illustrated temporal shifts in Headwater Catfish occurrence. Historically, Headwater Catfish occurrence was higher among streams with steeper slopes, greater distances from spring outflows, broader ranges of annual precipitation, and with greater portions of the network catchment classified as water. These shifts are likely related to both range contraction of the species and temporal variation in sampling locations. Morphological and molecular data revealed four genetically pure and isolated locations where conservation of Headwater Catfish phenotypes and genotypes are likely to be most successful. Species distribution models provide critical assessments of where a species might persist, but they require careful validation and cannot account for genetic introgression. Combining targeted sampling efforts with locations highlighted by SDMs and genetic analyses can be used to promote systematic conservation planning for rare and threatened species.

08:45 2019 Bonneville Basin coordinator update

Drew Dittmer* (Utah Division of Wildlife Resources, United States)

The 2019 Bonneville Basin Update will focus on the following three projects:

1) Snake Valley hydrologic monitoring.

Wetlands in Snake Valley serve as critical habitat for at least five of Utah's Species of Greatest Conservation Need, including four species threatened by groundwater

withdrawal. Utah Geologic Survey has developed a network of shallow wells to document baseline hydrologic conditions in these wetlands. Utah Geologic Survey and Utah Division of Wildlife Resources are uploading and processing the 10th year of pressure transducer data and producing a final report with a summary of existing data and recommendations for the future of the monitoring network.

2) Soda ash control of Green Sunfish*, Lepomis cyanellus*, and restocking Least Chub, *Iotichthys phlegethontis*.

At the Desert Fishes Council meeting in 2018 the United States Geologic Survey reported on the use sodium carbonate to manipulate pH levels in aquatic habitats and kill unwanted Green Sunfish (*L. cyanellus*). It was reported that pH returned to normal levels within 4 days. In the late summer of 2019 Utah Division of Wildlife Resources trialed this method to remove invasive Green Sunfish from a pond in Box Elder County. Following a successful treatment, this pond will be stocked with native Least Chub. The potential and primary benefit of this method vs more traditional chemical eradication is that the pond can be restocked sooner after a sodium carbonate treatment.

3) Springsnails (Pyrgulopsis) conservation agreement and strategy and the 3 *Pyrgulopsis spp*. status assessment.

Mollusks (including gastropods and bivalves) are one of the most imperiled group of organisms in North America. Their taxonomy, historical and current locations, and life history traits are not well understood. Prioritizing the monitoring and conservation of the 154 species of native mollusks in Utah has become a priority in preserving and gaining knowledge of these rare and sensitive species to preclude future Endangered Species Act listings.

09:00 Assessment of age-0 Colorado Pikeminnow survival in backwater nursery habitats of the middle Green River, Utah

Matthew Breen*[1], Tildon Jones[2] (1-Utah Division of Wildlife Resources, United States; 2-U.S. Fish and Wildlife Service, United States)

Despite consistent Colorado Pikeminnow, *Ptychocheilus lucius*, reproductive success, first year survival of larval fish remains poor in the middle Green River, Utah. In 2012, we examined potential factors impeding age-0 Colorado Pikeminnow survival in nursery backwater habitats. Presence and arrival of larval Colorado Pikeminnow was verified by drift net sampling conducted near the Split Mountain boat ramp (river mile [RM] 310) in Dinosaur National Monument and larval seining that took place in downstream backwaters. Twelve randomly selected backwaters (RM 305–273.5) were blocked off and depleted of nonnative fishes with a beach seine (≥ 90% depletion), then assigned one of three possible treatments: (1) four backwaters that were not blocked after initial

depletions, (2) four backwaters blocked by 1/4" mesh block nets, and (3) four backwaters blocked by 1/2" mesh block nets. Experimental backwaters were revisited every other week on six separate occasions (10 July–25 September 2012) to monitor fish community response over time; changes in fish community composition were analyzed using a Repeated Measures ANOVA. Given that environmental conditions (i.e., dry hydrology) and deteriorating habitat quality were not conducive to Colorado Pikeminnow larval drift, arrival in nursery areas, or age-0 recruitment in 2012, other age-0 native fishes (mainly Flannelmouth Sucker, *Catostomus latipinnis*) provided helpful insights on the effects of our experimental design. Abundance of both native and nonnative fish (mainly small-bodied cyprinids) was greatest in 1/2" mesh blocking treatments. Moreover, native fish were completely absent from unblocked backwaters before the fourth sample period (20–22 August 2012) and nearly eliminated from 1/4" mesh blocking treatments before the fifth sample period (4–5 September 2012). Additionally, unblocked backwaters contained the lowest abundance of all species, suggesting that predation by nonnative piscivores (e.g., Smallmouth Bass, *Micropterus dolomieu*) coming from riverine habitats may be a significant threat to small-bodied fishes and blocking treatments can positively influence survival in nursery areas. By blocking backwater nursery areas, we created predator free habitats that benefited most species of small-bodied fishes. Despite higher abundance of small-bodied nonnatives in 1/4” and 1/2” mesh blocking treatments throughout our experiment, age-0 native fishes were also more abundant (1/2” mesh treatments containing the highest abundance). We do not discount that competition between age-0 native fishes and nonnative cyprinids can be intense in backwaters, but if we can control for predation by blocking backwaters, survival can be positively influenced despite ongoing competition for resources in nursery habitats.

09:15 Leave your hat in the office: Informal working groups as a conservation tool

Stewart Reid* (Western Fishes, United States)

Collaborative groups are often successful for developing and implementing conservation programs. However, sometimes... in official settings, efforts are influenced by the conflicting priorities, constraints and relationships of the participants' various institutions - to the detriment of the species we strive to protect. Informal working groups composed of individuals focused on common conservation interests can often explore and cultivate the synergy of individuals who bring together their shared interests, varied experience and the potential resources of their respective organizations. They may focus on species that are not currently priorities for management agencies. They can also facilitate the inclusion of diverse members of the community who may not typically have seats at the discussion. With gatherings outside the formal settings that many of us find ourselves in, the informal working group

develops comradery and promotes intellectual exchange within a diverse conservation community. Examples are drawn from conservation efforts on Pacific Lamprey, *Entosphenus tridentatus*, pike minnows, *Ptychocheilus spp*., and Modoc Sucker, *Catostomus microps*.

09:30 Microplastic pollution in the effluent-dependent Santa Cruz River

Kelsey Hollien*[1], Drew Eppehimer[1], Hamdhani Hamdhani[1], David Quanrud[1], Michael Bogan[2] (1-University of Arizona, United States; 2-Desert Fishes Council, United States)

Microplastics are an emerging contaminant of potential ecological concern in waterbodies across the world. One important point source of microplastic pollution is treated wastewater- after treatment this effluent is often discharged directly into streams. In southern Arizona, USA, 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. We also compared microplastic concentrations before and during the monsoon season. We found four types of microplastics in the Santa Cruz River: fibers, fragments, film, and beads. Across all sites, microplastic concentration in the water column was ~33% higher during the 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 (100% fiber). In contrast, microplastics were found in 20 of 200 fish sampled during the monsoon season (85% fiber, 10% film, 5% fragment). 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.

09:45 Spawning periodicity and growth of larval Colorado Pikeminnow and Razorback Sucker in the San Juan River, in response to abiotic and temporal variables

Stephani Clark Barkalow[1], Martinique Chavez[1], Steven Platania[1] (1-American Southwest Ichthyological Researchers, United States)

Colorado Pikeminnow, *Ptychocheilus lucius*, and Razorback Sucker, *Xyrauchen texanus*, federally endangered species, spawn annually in the San Juan River, yet a recruitment bottleneck persists between larval and juvenile life phases. The larval

ontogenetic phase, though temporally short, is a period of high natural mortality and vulnerability to predation and starvation. Match/mismatch of spawning activities with larval abiotic requirements influence recruitment and survival. Age and growth of larval Colorado Pikeminnows (n = 514) and Razorback Suckers (n = 522) collected in the San Juan River from 2009 through 2017 were determined from otoliths. Daily ages of larval fish were used to calculate spawning dates and growth rates. Annual differences in adult spawning periodicity and larval fish growth rates were analyzed using ANOVA. Multiple linear regression was used to examine the relationship between abiotic variables (growing degree days (GDD), river mile, day length, and multiple parameterizations of discharge (Q) and temperature) on spawning dates and growth rates; multicollinearity was assessed for each model using variance inflation factors (VIF) and any variable with VIF>5 was removed. Colorado Pikeminnow growth rates and spawn dates were both significantly different across years ($P < 0.0001$). Length (SL) was predicted by age, mean July Q, river mile, water temperature on collection date, and GDD ($R2= 0.72$). Spawning periodicity was predicted by GDD, 7-day change in water temperature, 7-day change in discharge, and day length ($R2 = 0.90$). Adult Razorback Sucker spawn dates and larval fish growth rates were both significantly different across years ($P < 0.0001$). Length (SL) was predicted by age, mean April Q, river mile, and temperature ($R2 = 0.76$). Spawning periodicity was predicted by GDD, discharge, 7-day change in discharge, and day length ($R2 = 0.99$). Variation in Colorado Pikeminnow spawning periodicity was most impacted day length (53% of variation), whereas Razorback Sucker spawning periodicity was most impacted by GDD (76% of variation). Knowledge of spawning periodicity and growth rates, as well as the factors influencing them increases understanding of the needs of larval endangered Colorado Pikeminnow and Razorback Sucker and can help improve timing of management activities to benefit the species.

10:00 Ecosystem simulation as an intermediate step to establishing Devils Hole Pupfish in captivity

Olin Feuerbacher*[1], Jennifer Gumm[1], Corey Lee[1], Michael Schwemm[1], Kevin Wilson[2], Jeffrey Goldstein[2], Ambre Chaudoin[2], Brandon Senger[3], John Wullschleger[2], Mitchell Stanton[4], Javier Linares-Casenave[1], Alex Jones[1] (1-U.S. Fish and Wildlife Service, United States; 2-National Park Service, United States; 3-Nevada Department of Wildlife, United States; 4-Great Basin Institute, United States)

The Devils Hole Pupfish, *Cyprinodon diabolis*, has twice in recent years teetered at the edge of extinction with fewer than 40 animals observed during annual surveys. Establishing a captive population of these fish has proved an elusive goal for decades. Laboratory propagation in aquaria and refuge attempts in large outdoor tanks showed promise, but ultimately failed. Endeavoring to establish a lifeboat population, the Ash

Meadows Fish Conservation Facility built upon earlier efforts by utilizing a two-fold approach to population establishment: laboratory rearing of wild-collected eggs through hatch and grow-out until adults were released into a 100,000-gallon refuge tank designed to mimic the challenging habitat and ecosystem of Devils Hole. Adults reared from wild-collected eggs failed to produce viable offspring in aquaria. However, adults stocked into the refuge tank began reproducing, producing successive generations within the refuge tank. Unlike wild-collected eggs, captive-produced eggs subsequently collected from the refuge tank population produced fish which spawned in aquaria and have produced entirely laboratory-reared offspring. Though successful, this approach met significant challenges in the technology required to simulate Devils Hole and to monitor the progression of a complex quasi-ecosystem, and necessitated novel approaches to pathogen and predator control and monitoring of fish and ecosystem health.

10:15 Demographics of Bonytail and Razorback Sucker in isolated ponds

Brian Kesner*[1], Kurt Shollenberger[1], Paul Marsh[1] (1-Marsh & Associates, United States)

Bonytail *Gila elegans* and Razorback Sucker *Xyrauchen texanus* are two critically endangered fishes that have no known self-sustaining populations in the Colorado River. Both species have been stocked extensively throughout the basin and for Razorback Sucker this has resulted in thousands of adults persisting near several stocking centers. However, their presence is reliant on the release of tens of thousands of fish per year. For Bonytail, persistence beyond a year post-release has rarely been recorded despite large scale stocking similar in scope and numbers to Razorback Sucker. A major factor of both species failure to achieve recruitment levels that match mortality is a suite of predatory non-native fishes that have been introduced and established throughout the basin. These introduced species consume nearly all larval production by Bonytail and Razorback Sucker. They also increase post-stocking and adult mortality of both species by consuming stocked fish. Many of the introduced species are sport fish, and their wide-scale removal is not considered as a management option because states rely on revenue from anglers to support their programs. Bonytail and Razorback Sucker recovery in the Colorado River therefore depends on dramatic changes in wildlife management strategies or the discovery of novel approaches that allow large scale recruitment within the system in the presence of non-native sport fish. In the meantime, the only viable solution may be creation of aquatic environments that exclude piscivorous non-native fishes. For the last 15 years proponents of the “backwater concept” in the lower Colorado River basin have worked to develop and test the idea that naturally recruiting populations of Bonytail and Razorback Sucker can be maintained in isolated, predator free off-channel habitat.

Initial estimates of important demographic parameters have been calculated from monitoring data available through the online component of the lower Colorado River Native Fishes Database (ncreased.net). Monitoring in these backwaters includes continuous PIT scanning to track tagged individuals and annual netting efforts to capture and tag new recruits as well as recapture adults for health and growth studies. Annual adult survival of Razorback Sucker within monitored backwaters is consistently over 90%. Natural recruitment of Razorback Sucker in one backwater (Yuma Cove backwater) has resulted in a sustained population of more than 300 fish since 2013. Bonytail annual survival in backwaters typically has been less than 50%, but large recruitment events appear to maintain a relatively young population in at least one backwater (Imperial Ponds, Imperial National Wildlife Refuge). PIT scanning thus far has been less effective at tracking Bonytail populations due to the high turnover rate of these populations; most of the population is made up of untagged young fish. Results thus far are encouraging and support continued investigation toward eventual large-scale implementation of the backwater program.

10:30 Comparative mitochondrial genetic investigation of three lower Rio Grande endemic species of freshwater fishes

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The arid southwestern United States is home to many endemic freshwater fishes. The majority of these species are patchily distributed across this desert landscape and are experiencing range-wide declines due to habitat degradation, aridification through ground water depletion, and the introduction of non-native species. Though several of these desert fishes are already offered protection under the US Endangered Species Act and are relatively well-studied, many desert fishes are not yet protected at State or Federal levels and basic information that would aid conservation assessment (e.g., estimate of genetic diversity) is not currently available. This is the case for three species of freshwater fishes endemic to the lower Rio Grande drainage of south central Texas and northern Mexico: *Cyprinella proserpina*, *Notropis megalops* (Cyprinidae), and *Etheostoma grahami* (Percidae). We investigated levels of mitochondrial DNA diversity (multiple loci) within and between multiple TX populations (ranging from 4-6) of the three aforementioned species to provide baseline genetic data for future conservation assessment and management. Haplotype diversity (h) was generally low at sample locations for each of the three species (0-0.6786 for *C. proserpina*, 0.2-0.8333 for *N. megalops* and 0-0.6667 for *E. grahami*). A suite of standard conservation genetic statistics (including Pairwise Fst and AMOVA) support that idea that each of the three species comprises multiple populations that appear to be isolated from each other (though there is a lack of precise in some estimates due to small sample sizes). Low

levels of genetic diversity and isolation are a bad combination but appear to be the norm for freshwater fishes of the Trans-Pecos. Additional work with nuclear markers and larger sample sizes will be needed to estimate effective population size and inbreeding coefficients for populations of each of the three species. These basic data will be important for the future conservation management of these relatively poorly studied lower Rio Grande endemic fishes.

10:45 Ichthyofauna of the Bustamante River, Nuevo Leon, Mexico. Priority Land Region for the State

Maria De Lourdes Lozano-Vilano[1], Jorge Contreras-Lozano[1], Armando Contreras-Balderas[2] (1-Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Nuevo León, Mexico; 2-Private Consultant, and Retired Professor of the Universidad Autónoma de Nuevo León, Mexico)

The state of Nuevo Leon is in northern Mexico, and the Bustamante River is in the northwestern portion of this state. The area has limited rainfall and water is a vital resource for anthropocentric activities. The preservation of the rivers is very important, and the fish communities are override in this region. The study was conducted in a Priority Terrestrial Region, bordering Coahuila. This was the first study on fishes in this river, that the most of time is a close flood, is a tributary of the Salado River, for this reason, the objective was to determine the ichthyofauna, as well as conduct a zoogeographical and ecological analysis, and determine the presence of exotic and/or invasive species. Individuals were collected using seine net and electrofishing equipment. Species were identified and stored in the Scientific Collection of FCB-UANL. We reported the presence of 8 native species, representing 6 families and 8 genera. There are 2 species under a status of protection laws of the country, *Cyprinella cf. rutilla* (Threatened) probably a new species and spotted minnow, *Dionda melanops* (Endangered). Zoogeographical affinity presents 4 Nearctic species and 4 Neotropical species, and two, Smallmouth Bass, *Micropterus dolomieu* and Tilapia probably *Oreochromis sp*. Indet., as exotic species were collected. It is important to continue surveys to detect species that are important for conservation.

11:00–12:15 Special Showing of Hidden Rivers. Sponsored by Freshwaters Illustrated.

12:15 Meeting Ends

Recommended Self-Guided Trips for Saturday Afternoon:

Chihuahuan Desert Research Institute (http://www.cdri.org/)
Davis Mountains State Park (https://tpwd.texas.gov/state-parks/davis-mountains)
Fort Davis National Historic Site (https://www.nps.gov/foda/index.htm)

The Desk Hike on Hancock Hill (walking distance from Sul Ross)
(https://www.sulross.edu/page/1077/desk)

Sunday, November 24th

07:00-19:00 Field Trip: Mount Livermore Hike at the Davis Mountains Preserve (led by Megan Bean)